Panolis flammea

Scientific Name
Panolis flammea Denis & Schiffermüller

Synonyms:
Bombyx spreta Fabricius
Noctua flammea Denis & Schiffermüller
Noctua piniperda
Panolis griseovariegata
Panolis griseovariegatus
Panolis piniperda
Phalaena griscovariegata Goeze
Phalaena pini Villers
Phalaena piniperda Loschege
Phalaena Noctua telifera Paykull
Trachea piniperda

Common Names
Pine beauty moth

Type of Pest
Moth

Figure 1. Adult female of *P. flammea* (Image courtesy of Stanislaw Kinelski, Bugwood.org)

Taxonomic Position
Class: Insecta, **Order**: Lepidoptera, **Family**: Noctuidae

Reason for Inclusion
CAPS Target: AHP Prioritized Pest List for FY 2012

Pest Description
Egg: "The flattened, circular eggs are centripetally notched, and each has a small declivity in its middle. At first the eggs are whitish but later turn violet-brown. The size of an egg is 0.6 mm x 0.8 mm [0.02 x 0.03 in]" (Novak, 1976).

Larva: "The yellow-green larvae of the 1st instar are 2 to 3 mm [0.08 to 0.11 in] long and have a large conspicuous yellow head (mean width 0.4 mm [0.02 in]). The fully grown caterpillars are 37 to 40 mm [1.06 to 1.57 in] long, dark green with a brown head, and are about 3 mm [0.11 in] wide.

Figure 2. Fifth instar larva of *P. flammea* on *P. sylvestris* (Image courtesy of Hannes Lemme, Bugwood.org)

A broad white band occurs in the middle of the dorsum. On both sides there are narrow white bands and on the underside there are wide orange bands" (Novak, 1976). "It is not until the fifth or final stage (instar) that the caterpillar develops the characteristic bright orange stripe on either side" (Heritage, 1997).

Pupa: "The free shiny brown pupa is 16 to 18 mm [0.63 to 0.71 in] long and ends with two thin spines. On the dorsal side of the abdomen is a characteristic declivity" (Novak, 1976).

Adult: "This night moth has a wing span of 30 to 35 mm [1.18 to 1.38 in]. The basic colour of the thorax and wings changes from red-brown to gray-brown. The bristle-shaped antennae of the males are composed of segments which resemble saw-like points while the antennae of the females are simple. The front edge of the thorax is decorated with a pale coloured band and on both sides there are some light coloured patches. The abdomen is yellow-gray. The end of the male is angularly broad, whereas the end of the female is conical and has a blunt point. The fore-wings are decorated with almost round or kidney-shaped patches. The dark moth has markings consisting of dark, transverse and zigzagging bands. The hind wings are gray. The resting moths sit with their roof-like wings folded. In the pine bark they coalesce in colour with the surroundings (mimicry)" (Novak, 1976).

Biology and Ecology:
Adults swarm after sunset for about one hour (Kolk and Starzyk, 1996). Adults feed on honeydew (a liquid excretion produced by aphids) (Kolk and Starzyk, 1996) and also *Salix* (willow) blossoms (Kimber, 2011). Mating occurs in the tree crown (Kolk and Starzyk, 1996). After mating, females lay 2-25 eggs in a line on host needles and can produce 100-210 throughout their lifetime (Kolk and Starzyk, 1996). Eggs are laid on needles from previous years (Hicks et al., 2001) with dense foliage preferred (Anonymous, 1960). They are usually laid on needles towards the tops of the trees (Heritage, 1997). Although females usually lay eggs on trees at least 25 years of age, "larvae may migrate to younger trees" after hatching (Carter, 1984).

In the United Kingdom, this moth flies from March to April and is found in coniferous forests and plantations (Kimber, 2011). When at rest, adults are hard to see as they are well camouflaged (Kimber, 2011).

Incubation of eggs requires about 14 days (Novak, 1976), although larval hatch can occur anywhere from 9 to 30 days later (Kolk and Starzyk, 1996). In Scotland, larvae emerge from the end of May to early June (Hicks et al., 2001). Afterwards, the larvae climb up into the crown and feed on buds, needles and the bark of young shoots (Kolk and Starzyk, 1996). Larvae "begin to feed on new growth where they consume the internal tissues at the base of developing needle pairs with their heads within the needle and their abdomens exposed" (Hicks et

al., 2001). Older larvae will feed on old host needles (Kolk and Starzyk, 1996). Larvae go through five instars (Novak, 1976). If disturbed, larvae can drop to the ground suspended by a silken thread (Anonymous, 1960).

P. flammea overwinters as a pupa (Kolk and Starzyk, 1996). Pupation occurs in the litter or soil (Kolk and Starzyk, 1996) or in bark crevices in a silken cocoon (Carter, 1984). In Scotland, pupation begins by about mid-July (Hicks et al., 2001).

Symptoms/Signs

This species is considered a severe defoliator of certain *Pinus* spp. throughout many parts of Europe. Larvae can be observed feeding on new growth at the base of developing needle pairs (Hicks et al., 2001).

Larval feeding on young buds can be very damaging to the host trees (Kolk and Starzyk, 1996). Larvae can consume approximately 200 needles throughout this stage (Kolk and Starzyk, 1996). Older larvae can consume entire needles (Novak, 1976). Complete defoliation of host plants can occur in serious outbreaks of this pest. In addition, tree growth may be retarded and trees may die (Carter, 1984).

The most commonly attacked pine stands are aged from 30 to 60 years (Novak, 1976).

Pest Importance

This species is considered a severe pest of certain pine species (*P. sylvestris*) in parts of Europe (Watt, 1988). In Scotland, outbreaks of *P. flammea* occur on *P. contorta* (lodgepole pine) (Watt, 1988). *P. flammea* is considered the most important forest defoliator in the British Isles and *Pinus contorta* monocultures are no longer planted in the area because of the damage caused by *P. flammea* (Watt and Hicks, 2000)."

When outbreaks occur, they usually last from two to three years (Kolk and Starzyk, 1996). Heavy infestations can cause host mortality (Hicks et al., 2001) and two successive attacks can kill a pine forest (Anonymous, 1960).

Known Hosts

Hosts include *Picea abies* (Norway spruce)*, *Pinus* spp. (pines), *P. contorta* (lodgepole pine), *P. pinaster* (maritime pine), *P. sylvestris* (Scots pine), and *Salix caprea* (pussy willow) (food plant for adults) (Kolk and Starzyk, 1996; Watt, 1989; Watt, 1988; Kurir, 1986; Carter, 1984).

Anonymous (1960) states that *P. flammea* will also attack *Abies alba* (silver fir), *Juniperus* spp. (juniper), *Larix decidua* (European larch), *Pseudotsuga* spp. (Douglas-fir), and some broad-leaved trees. Carter (1984) included and *Betula* spp. (birch) as well as *Chamaecyparis* spp. and *Quercus* spp. (oak) as other host

plants. These plants do not seem to be main hosts of this species and damage of these hosts could not be found in the literature.

*Sporadic host (Kolk and Starzyk, 1996).

Pathogens Vectored

This pest is not currently known to vector any pathogens or other associated organisms.

Known Distribution

This species is found throughout Europe and Asia (Novak, 1976). The northern range of *P. flammea* is limited by climate (Novak, 1976).

This species is present in: Andorra, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Channel Island, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Gibraltar, Greece, Hungary, Italy (including Sardinia and Sicily), Japan, Kosovo, Latvia, Lithuania, Luxembourg, Macedonia, Moldova, Montenegro, the Netherlands, Norway, Poland, Romania, Russia (including Kaliningrad Oblast), Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, and the United Kingdom (Fauna Europaea, 2011; Szabóky, 2004; Zolubas, 2003; Johansson et al., 2002; Kolk and Starzyk, 1996; Watt, 1988; Walter and Wawrzyniak, 1986; Slivov, 1984; Austara, 1982; Novak, 1976; Schimitschek, 1932; Saalas, 1929).

Potential Distribution within the United States

This species is most likely to cause damage throughout many parts of the United States if it were to become established. *P. flammea* has caused serious damage to *Pinus contorta* (lodgepole pine) in Scotland (Hicks et al., 2001) which is originally native to parts of North America. *P. contorta* is present in at least 11

Figure 3. Distribution of *Pinus contorta* throughout North America (USDA-NRCS, 2011; accessed 23 March, 2011)

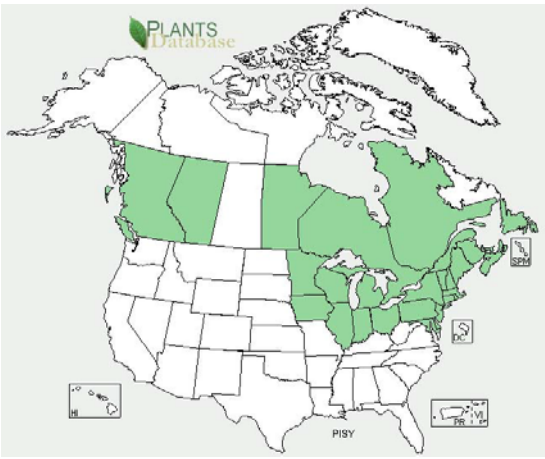

Figure 4. Distribution of *Pinus sylvestris* throughout North America (USDA-NRCS, 2011; accessed 24 March, 2011)

states in the western portion of the country while *P. sylvestris*, another main host, is present in at least 18 states in the northeastern and upper Midwest portion of the United States (USDA-NRCS, 2011).

Pathway

There are no records of this genus being intercepted at any United States ports of entry (AQAS, 2011).

This species may be introduced into the United States through nursery stock. Eggs are laid on pine needles and may be able to survive international trade as they usually take around 14 days to mature before hatch. Pupae may also move through international trade if soil is present on host plants, although this is unlikely as movement of soil is restricted in trade to the United States.

Survey

CAPS-Approved Method*:

Trap and lure. The lure has two components: Z9-14:Ac and Z11-14:Ac loaded into a rubber septum. The trap is the plastic bucket trap (also known as a "Unitrap" or universal moth trap). Refer to the Plastic Bucket Trap Protocol (Brambila et al., 2010) for detailed instructions on how to use the trap.

Literature-Based Methods:

Trapping:

In Scotland from 1993 on, monitoring surveys for *P. flammea* were carried out using pheromone traps (Hicks et al., 2001). "Funnel traps…were baited with a lure containing 25µg Z-9-tetradecenyl acetate + 2.5µg Z-11-tetradecenyl acetate. The traps were placed in the forests during the third or fourth week of March and left until early May" (Hicks et al., 2001). Funnel traps were used to ensure that traps did not become oversaturated with moths (Hicks et al., 2001).

Survey site and selection:

The most commonly attacked pine stands are aged from 30 to 60 years (Novak, 1976). The host *Pinus contorta* is found throughout the western part of the United States, while *Pinus sylvestris* is found throughout the northeastern and upper Midwestern parts of the United States (USDA-NRCS, 2011).

Time of year to survey:

In Scotland, *P. flammea* adults fly from mid-March to May (Heritage, 1997; Hicks et al., 2001). In England, adults fly as early as the end of February (Hicks et al., 2001). The time of year at which the adult stage is found is dependent on temperature (Heritage, 1997).

Trap Placement:

Bradshaw et al. (1983) states that traps should not be obstructed by vegetation and that the height of traps from 1 to 2 m (3.28 to 6.56 feet) caught the most target insects. Traps placed at 0.5 m (1.64 feet) had less total catches, but this

may be because the undergrowth at the site was 0.3 to 0.5 m (0.98 to 1.64 feet) high.

Visual:
In Scotland, *P. flammea* populations were monitored using annual pupal surveys from 1977 to 1993 (Watt and Hicks, 2000). Within sites selected for survey "11 positions were randomly selected within an area of about 0.3 ha [0.74 acre] and a portable frame, 30 cm x 30 cm x 15 cm deep [11.8 in x 11.8 in x 5.91 in deep], was used to sample the forest litter and peat" (Hicks et al., 2001). Today pheromone traps are used to monitor populations in Scotland, although they are augmented by selective pupal surveys (Hicks et al., 2001).

Identification

CAPS-Approved Method*:

Morphological. A brief description of all life stages can be found in Carter (1984). Both South (1961) and USDA (1958) include a description of the adult and larvae. South (1961) also includes a colored plate of the adult male and female. Descriptions of this pest can also be found in Hampson (1905) and Novak (1976).

Adults have hairy eyes (as do all Hadeninae) which can be seen even in sticky trap material. Forward any specimens with hairy eyes to your regional domestic identifier for identification.

Images of male and female can be found at the following links:

Male genitalia: http://www.dissectiongroup.co.uk/page1448.html
Female genitalia: http://www.dissectiongroup.co.uk/page1447.html

*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 Pests

The pupae of *P. flammea* are similar to both *Semiothisa liturata* and *Bupalus piniarius* and can be frequently found in the soil together in the United Kingdom (Bevan and Brown, 1978).

Commonly Encountered Non-targets

When trapping in the United Kingdom, *Orthosia gothica* (Hebrew character [moth]) was the only similar species caught in large numbers. This species is similar in size but is grey in color instead of orangish-brown like *P. flammea* (Bradshaw et al., 1983).

References

Anonymous. 1960. Insects not known to occur in the United States: pine moth (*Panolis flammea* (Denis and Schiffermuller)). Cooperative Economic Insect Report 8:1017-1018.

AQAS. 2011. Interception data on *Panolis* spp. for all time. Accessed 24 March 2011 from: https://mokcs14.aphis.usda.gov/aqas/HomePageInit.do.

Austara, O. 1982. Survey of the pine beauty moth *Panolis flammea* in Norway in 1980 and 1981 using traps with synthetic pheromone analogues [abstract]. Fauna Norvegica, B 29(2): 105-109.

Bevan, D. and R. M. Brown. 1978. Pine looper moth [abstract]. Forest Record 119: 13pp.

Bradshaw, J. W. S., R. Baker, C. Longhurst, J. C. Edwards, and J. C. Lisk. 1983. Optimization of a monitoring system for the pine beauty moth, *Panolis flammea* (Denis & Schiffermüller), using sex attractants. Crop Protection 2(O1): 63-73.

Brambila, J., L. D. Jackson, and R. L. Meagher. 2010. Plastic Bucket Trap Protocol. USDA-APHIS-Cooperative Agricultural Pest Survey Program.

Carter, D. J. 1984. Pest Lepidoptera of Europe with special reference to the British Isles. Dr. W. Junk Publishers. Dordrecht, the Netherlands. 431 pp.

Fibiger, M. and B. Skule. 2011. Fauna Europaea: *Panolis flammea*. In Karsholt, O. and Nieukerken, E. J. van (eds.) Fauna Europaea version 2.4, http://www.faunaeur.org.

Hampson, G. F. 1905. Catalogue of the Lepidoptera Phalaenae in the British Museum, Vol. 5. British Museum of Natural History, London. 634 pp.

Heritage, S. 1997. Pine beauty moth: its biology, monitoring and control. Forestry Commission. Research Information Note 290. Research Division of the Forestry Commission.

Hicks, B. J., D. A. Barbour, H. F. Evans, S. Heritage, S. R. Leather, R. Milne, and A. D. Watt. 2001. The history and control of the pine beauty moth, *Panolis flammea* (D. & S.) (Lepidoptera: Noctuidae), in Scotland from 1976 to 2000. Agricultural and Forest Entomology 3: 161-168.

Johansson, B. G., O. Anderbrant, and A. Sierpinski. 2002. Multispecies trapping of six pests of scots pine in Sweden and Poland. Journal of Applied Entomology 126: 212-216.

Kimber, I. 2011. 2179 Pine Beauty *Panolis flammea*. UK Moths. Accessed on 23 March, 2011 from: http://ukmoths.org.uk/show.php?bf=2179.

Kolk, A. and J. R. Starzyk. 1996. The Atlas of Forest Insect Pests. The Polish Forest Research Institute. Multico Warszawa. 705 pp.

Kurir, A. 1986. List of food plants, visited flowers and natural enemy complex of *Panolis flammea* in Europe [abstract]. Anali za Šumarstvo 12(2): 15-55.

Novak, V. 1976. Atlas of Insects Harmful to Forest Trees. Volume 1. Elsevier Scientific Publishing Company. Amsterdam, The Netherlands. 125 pp.

Saalas, U. 1929. Injurious outbreaks of *P. flammea*, *Myeiophilus piniperda* and *M. minor* in the Valkjarvi District, Finland [abstract]. Annales Botanici Societatis Zoologicae Botanicae Fennicae 8(9):168-180.

Schimitschek, E. 1932. Observations during the occurrence and control of the pine noctuid, P. flammea, in lower Austria [abstract]. Zentralblatt fur das gesamte Forstwesen 57: 321-342; 391-406.

Slivov, A. V. 1984. Species of moths of the family Noctuidae (Lepidoptera) new and little-known to the fauna of Bulgaria [abstract]. Acta Zoologica Bulgarica 25: 56-66.

South, R. 1961. The Moths of the British Isles, Vol. 1. Frederick Warne & Co. Ltd., Great Britain. 427 pp.

Szabóky, C. 2004. Pine beauty moth (*Panolis flammea* Denis and Schiffermüller, 1775), in Hungary [abstract]. Növényvédelem 40(12): 618.

USDA. 1958. Insects not known to occur in the United States. Cooperative Economic Insect Report, Vol. 8. USDA-ARS-Plant Pest Research Service. p. 67-68.

USDA-NRCS. 2011. The PLANTS Database. National Plant Data Center, Baton Rouge, LA 70874-4490 USA. Accessed 23-24 March, 2011 from: http://plants.usda.gov.

Walter, C. and H. Wawrzyniak. 1986. Winter soil sampling for the monitoring and forecasting of population gradations of *Panolis flammea* in central regions of East Germany [abstract]. Beiträge für die Forstwirtschaft 20(3): 116-118.

Watt, A. D. 1988. Effects of stress-induced changes in plant quality and host-plant species on the population dynamics of the pine beauty moth in Scotland: partial life tables of natural and manipulated populations. Journal of Applied Ecology 25: 209-221.

Watt. A. D. 1989. The growth and survival of *Panolis flammea* larvae in the absence of predators on Scots pine and lodgepole pine. Ecological Entomology 14: 225-234.

Watt, A. D. and B. J. Hicks. 2000. A reappraisal of the population dynamics of the pine beauty moth, *Panolis flammea*, on lodgepole pine, *Pinus contorta*, in Scotland. Population Ecology 42: 225-230.

Zolubas, P. 2001. Pine beauty moth outbreak in Lithuania, 1999-2002 [abstract]. Journal of Forest Science 47(2): 46-47.

This datasheet was developed by USDA-APHIS-PPQ-CPHST staff. Cite this document as:

Molet, T. 2011. CPHST Pest Datasheet for *Panolis flammea*. USDA-APHIS-PPQ-CPHST.