

Species: Flypoison Borer Moth (*Papaipema* sp. 1)

Global Rank: G2G3

State Rank: S2

State Wildlife Action Plan: Immediate Concern Species - Responsibility Species

Climate Change Vulnerability: Moderately Vulnerable

Confidence: Very High

Habitat:

The flypoison borer moth can utilize a range of woodland and forest habitats supporting good populations of the food plant. Habitats are wooded to forested situations on acid soils where the caterpillar food plant, fly-poison (*Amianthium muscaetoxicum*), is abundant. Most sites are oak dominated forests on acidic soils; some sites are or include pitch pine scrub-oak barrens; some are mostly mixed northern hardwoods (NatureServe 2008).

The host plant, fly-poison, is found mostly in the eastern half of the state with concentrated populations in northeastern Pennsylvania (Rhoads and Klein 1993). The plant is frequent in woods and barrens, especially in the mountains (Rhoads and Block 2000). Distribution of the flypoison borer moth is limited to habitats that support good populations of the food plant, however, not every good population of fly-poison has been found to support the flypoison borer moth. There appear to be other factors that affect the distribution of the moth, but those factors are currently unknown. This species is currently known from nine counties in Pennsylvania and has not been documented in any surrounding states. For reasons of endemism, rarity, and use of a single host plant for larval development, the flypoison borer moth is a responsibility species (Rawlins 2007).

Current Threats:

The most serious threats are habitat loss and fragmentation (usually from development), fires (especially September through May), and spraying for gypsy moth control (especially April-May) (NatureServe 2008). Fires are most problematic during the dormant season from September through early May when flypoison borer moth eggs are exposed on the host plant. Survivorship of fire later in the summer greatly increases after the caterpillars bore into the bulb of the host plant. Severe deer browsing has been an ecological problem rangewide for a decade or two, but this species has apparently not been negatively impacted and may have even benefited. Deer conspicuously avoid the new growth of fly-poison in April and early May making it sometimes virtually the only herbaceous growth present (observations by D. Schweitzer in the 1980s).

Gypsy moth control is used to protect timber resources in habitats occupied by *Papaipema* sp. 1. The level of mortality in flypoison borer moth caterpillars from gypsy moth control is related to the timing and number of applications and the type of spray. Regardless of the treatment used, spraying for gypsy moth should be a concern if a large extent of the population is scheduled to be sprayed, since it is not known exactly when or

for how long the first instar larvae would be exposed before burrowing into the host plant bulb.

Bacillus thuringiensis var. *kurstaki* (Btk) is commonly used in Pennsylvania to control gypsy moths because it targets butterfly and moth caterpillars and is not toxic to a wider spectrum of arthropods outside of the Order Lepidoptera. Also, Btk does not persist in the environment since it breaks down within ten days (Butler 1998). It is not currently known if flypoison borer moth larvae are susceptible to Btk. Peacock et al. (1998) showed that among 42 tested species of native butterflies and moths, all first and second instar caterpillars had a 90-100% mortality regardless of species. Older caterpillars in the third or later instar varied in susceptibility, even within one genus. Flypoison borer moth eggs hibernate (typical of the genus), and the larvae probably hatch in May when the potential for Btk exposure is greatest since spraying typically also occurs at this time. The tree canopy may offer some protection by intercepting the spray and preventing much of the Btk from reaching the base of the host plant where the newly hatched flypoison borer moth caterpillars are located.

Diflubenzuron (trade name Dimilin) is a broad-spectrum insecticide universally toxic to several types of arthropods including butterfly and moth caterpillars. Diflubenzuron could be more problematic to *Papaipema* larvae because it persists on treated foliage until leaf drop in the fall. When leaves fall to the forest floor, the chemical becomes a part of the leaf litter layer and may enter into forest streams via runoff (Butler 1998).

Main factors Contributing to Vulnerability:

The main factors contributing to climate change vulnerability are large scale changes in the amount and seasonality of soil moisture, the flypoison borer's endemism to Pennsylvania, its association with cooler and higher altitude sites in the commonwealth, and its dependence upon one host plant during the larval stage. Mitigating factors include the ability of adults to disperse relatively easily through suitable habitat; the species is not restricted to particularly specialized habitats.

The regions of Pennsylvania where flypoison borer moth occurs have experienced slightly lower than average precipitation variation in the past 50 years, making populations somewhat more vulnerable to future changes in precipitation. Increased summer soil droughts are predicted by climate models, and could lead to an increase in the amount and severity of forest fires (Shortle et al. 2009). Forest fires could maintain some barrens habitats that support fly-poison. However many sites are woodlands that do not require disturbance to remain suitable for fly-poison. The widespread burning of habitats at the wrong time of year (September through May) could be devastating to local populations. Fire-related mortality at this time of year would be expected to be near 100% because the eggs are above the soil surface and on the outside of the fly-poison lily plant, making them very vulnerable to fire (NatureServe 2008).

The impacts of development of alternative energy sources are expected to be important especially as it relates to population dynamics and the health of populations of its food plant. Right-of-way infrastructure supporting alternate energy sources such as wind

energy and natural gas are expected to further fragment many acres of land in forested habitats. Flypoison borer moth occurs in fairly undisturbed habitats that support good populations of the food plant.

Dispersal and movements: A few adults have been captured up to several miles from known habitat indicating that this species is to some extent dispersive, as are most borers in the genus *Papaipema* (NatureServe 2008).

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