

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

Global Rank: G2G3

State Rank: S2

State Wildlife Action Plan: Immediate Concern Responsibility Species

Climate Change Vulnerability: Moderately Vulnerable

Confidence: Very High

Habitat:

The Flypoison Borer moth is can utilize a range of woodland and forest habitats supporting good populations of the foodplant. 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 Fly-poison lily is found mostly in the eastern half of the state with concentrated populations in north-eastern Pennsylvania (Rhoads and Klein 1993). The plant is frequent in woods and barrens, especially in the mountains (Rhoads and Block 2000). The overall range of the Fly-poison lily is eastern U.S. as far north as New York (NatureServe 2008). Distribution of *Papaipema* sp. 1 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 *Papaipema* sp. 1. There appear to be other factors that affect the distribution of the moth, but those factors are not currently known. 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 is a responsibility species (Rawlins 2007).

Threats:

The most serious threats are habitat loss and fragmentation (usually from development), fires (especially September through May), and gypsy moth spray (especially April-May) (NatureServe 2008). Fires are most problematic during the dormant season from September through early May when *Papaipema* sp. 1 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 hostplant. High deer populations and resulting severe deer herbivory has been an ecological problem rangewide for a decade or two, but this species has apparently not been negatively impacted and possibly has even benefited. Deer conspicuously avoid the new growth of the Fly-poison lily foodplant 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 degree of threat from gypsy moth control is related to the timing and type of spray. Regardless of the treatment used, gypsy moth spray should be a concern if a large extent of the population is scheduled to be sprayed, since it is not

known exactly when or how for long first instar larvae would be exposed before they are safe inside the plant.

Bacillus thuringiensis (Bt) 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. Bt also does not persist in the environment since it breaks down within ten days (Butler 1998). It is not currently known if *Papaipema* sp. 1 larvae are susceptible to Bt. Peacock et al. 1998 showed that among 42 tested species of native butterflies and moths, all 1st and 2nd instar caterpillars had a 90-100% mortality regardless of species. Older caterpillars in the 3rd or later instar varied in susceptibility, even within one genus. *Papaipema* sp. 1 eggs hibernate (typical of the genus), and the larvae probably hatch in May, though the exact timing is unknown. Therefore it is possible early instars would have exposure to Bt spray (typically applied in May) as they eat their way from the outside of the plant into the bulb. The tree canopy may offer some protection by intercepting the spray and preventing much of the Bt from reaching the base of the hostplant where the newly hatched *Papaipema* caterpillars are located.

Diflubenzuron (e.g. 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 on the forest floor, the chemical moves into the leaf litter layer and into forest streams (Butler 1998).

Main factors Contributing to Vulnerability Rank:

The main factors contributing to climate change vulnerability are large scale changes in the amount and seasonality of soil moisture, the Flypoison Borer's restricted range, and it's dependence upon one hostplant during the larval stage. A mitigating factor is the ability of adults to disperse relatively easily through suitable habitat and the species use of not particularly specialized habitats.

The regions of Pennsylvania where *Papaipema* sp. 1 occurs have experienced slightly lower than average precipitation variation in the past 50 years, making populations somewhat 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 near 100% because the eggs are above the soil surface and on the outside of the fly-poison lily plant, therefore the eggs are 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

foodplant. 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. *Papaipema* sp. 1 occurs in fairly undisturbed habitats that support good populations of the food plant, and not every colony of fly-poison lilies support *Papaipema* sp. 1. There appear to be other factors that affect the distribution of this moth, and metapopulation dynamics are likely a component.

Migration 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).

Literature Cited:

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