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Potential Impact of Btk (*Bacillus thurinigiensis* var. *kurstaki*), Used to Slow the Spread of the Gypsy Moth (*Lymantria dispar* Linnaeus), on Non-target Lepidoptera at Grand Portage National Monument, Cook County, Minnesota

ON THE COVER
Baltimore checkerspot (*Euphydryas phaeton* (Drury)), Source: Ohio Dept. of Natural Resouces.

Potential Impact of Btk (*Bacillus thurinigiensis* var. *kurstaki*), Used to Slow the Spread of the Gypsy Moth (*Lymantria dispar* Linnaeus), on Non-target Lepidoptera at Grand Portage National Monument, Cook County, Minnesota

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Abstract

Twenty one species of butterflies and 170 species of moths were collected at the Grand Portage National Monument (GRPO) in 2008. The most significant butterfly was *Euphydryas phaeton* (Drury), the Baltimore checkerspot, discovered in the wet meadow east of the stockade and maintenance shop. Populations of *E. phaeton* are very local and occur only where its primary larval food plant *Chelone glabra* Linnaeus (turtlehead) grows. The only other known population of *E. phaeton* in Cook County is ca. 56 km (35 mi) from the Monument. Twenty one species of moths captured in 2008 were new Cook County records. Because their larvae feed primarily during June, 17 of the butterfly species and 120 moth species that inhabit GRPO would be at risk if it becomes necessary to use Btk to slow the spread of the gypsy moth, *Lymantria dispar* (Linnaeus). Except for *E. phaeton*, most species are common and widespread and would most likely recolonize the Grand Portage National Monument within several years after Btk application. However, the use of Btk near the meadow, including the stockade and Heritage Center, would endanger and possibly exterminate the population of *E. phaeton*. As it is highly unlikely that *E. phaeton* would ever recolonize the Monument, Btk applications around or near the meadow, stockade, or even The Grand Portage Heritage Center should be avoided.

Acknowledgements

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Introduction

The primary objective of this study was to evaluate the potential impact of Btk on non-target species of butterflies and moths (Lepidoptera) in the event it becomes necessary to slow the spread of the gypsy moth, *Lymantria dispar* Linnaeus at the Grand Portage National Monument (GRPO), Cook County, Minnesota. Egg masses and pupal cases of the gypsy moth, a very serious defoliator of eastern forests, were first reported from Minnesota in 1969 from Duluth, St. Louis County (Minnesota Department of Agriculture 2008). Since then the gypsy moth has been reported from at least 19 southeastern and northeastern counties including St. Louis, Lake and Cook counties (Cremers 2006). The number of gypsy moths reported from Cook County, including the Grand Portage Reservation, has often been the highest in the state. Because of the close proximity of GRPO to the Grand Portage Indian Reservation, it is helpful to review the recent history of the gypsy moth in Cook County and the Grand Portage Reservation.

The gypsy moth in Cook County and on the Grand Portage Reservation

From 2000 to 2003, the number of male moths captured by pheromone traps ranged between 25 and 30, and 193 were captured in 2004. In 2004 Minnesota joined the Slow-the-Spread (STS) program which emphasizes both intensive survey and treatment methods (Minnesota Department of Agriculture 2008a; USDA Forest Service 2008). The number of gypsy moths captured by pheromone traps increased dramatically in 2005 to 1,077 (Cremers 2006). In 2006, approximately 55,094 ha (137,735 ac) were treated in Minnesota for gypsy moth: 135,662 with pheromone flakes (Disparlure), which causes mating disruption, and 829 ha (2,073 ac) with Btk (*Bacillus thurinigiensis* var. *kurstaki*), a non-selective bacterial insecticide that kills not only the larvae of gypsy moths but larvae of non-target Lepidoptera as well.

In 2006, Btk was applied to a 806 ha (2,015 ac) block within the Grand Portage Indian Reservation. The first aerial application occurred on 8 June 2006, followed by a second application on 15 June. Follow-up trapping yielded only one male gypsy moth from 33 pheromone traps (Foray 48B) placed within the treatment block. However, 210 moths were reported from Cook County in 2006, as the number of moths outside the treatment blocks continued to rise (Cremers 2006). No treatments were undertaken in 2007 (Minnesota Department of Agriculture 2008a), but 3,608 gypsy moths were captured throughout southeastern and northeastern Minnesota that year, including 2,584 from Cook County (71.6% of the state-wide total). Of the number from Cook County, 1,175 came from the Grand Portage Reservation (Minnesota Department of Agriculture 2008b).

Because of the large numbers of moths reported from northeastern Minnesota in 2007, six sites totaling 34,015 ha (85,038 ac) in Lake and Cook counties were treated for gypsy moth in 2008. Included were 4,800 ha (12,000 ac) of the Grand Portage Indian Reservation that received the largest operational trial of SPLAT, a waxy carrier of the pheromone Disparlure used to disrupt mating (Minnesota Department of Agriculture 2008b). Three separate environmental evaluations were made in 2008, including Btk and Disparlure treatments used on the Grand Portage Reservation. The number of gypsy moths in Minnesota increased dramatically in 2008. A total of 12,240 adult male gypsy moths were captured in 2008, an increase of 339% from 2007. Included in this total were 3,112 gypsy moths from Cook County, the highest for any Minnesota county. Sixty-seven delta pheromone traps set within a 1,984 ha (4,959 ac) treatment block of the

Reservation caught 15 male gypsy moths. An STS Decision Algorithm calculated the success as 98% and colony presence as 13% (Minnesota Department of Agriculture 2008b).

Grand Portage's place on the ecological landscape

Cook County, Minnesota, lies entirely within the Northern Coniferous Forest (Marschner 1974). Three landscape ecosystems (Albert 1994) that lie within Cook County – the North Shore (Lake Superior) Highlands, the Border Lakes, and the Nashwauk Uplands – provide varied habitats for larval host plants of butterflies and moths. The North Shore Highlands extend inland along the shore of Lake Superior for approximately 15 km (9 mi). The Border Lakes landscape ecosystem within Cook County extends inland to the Canadian border and includes the eastern Boundary Waters Canoe Area Wilderness (BWCAW).

The Grand Portage National Monument, which is bordered by the Grand Portage Indian Reservation, includes both the Northern Highlands and Border Lakes landscape ecosystems. The Monument includes the reconstructed stockade and Great Hall on the shores of Lake Superior, adjacent Mount Rose (276 m/905 ft) and the Grand Portage trail that extends 13.6 km (8.2 mi) from the stockade to the former site of Fort Charlotte on the Pigeon River. Much of the monument consists of mixed conifer-deciduous forest and a beaver-modified wetland dominated by grasses, sedges and willows (Walton 1999). The forest, which is on the Boreal Forest - Northern Hardwoods ecotone, consists primarily of an aspen-birch-fir-spruce association. Also present are well-drained upland stands of white cedar and white and red pine. Red maple, black ash and other species adapted to wet soils occur in poorly drained areas (Walton 1999).

Past Lepidopteran surveys

MacLean (2006) reported 68 species of butterflies and 397 species of moths from Cook County, Minnesota, including 82 species of moths in an initial inventory of GRPO (MacLean 2002). Published inventories from nearby states and provinces are estimates of the number of species of butterflies and moths (excluding the microlepidoptera) that may be present in northeastern Minnesota. Huber (pers. comm.) recorded 169 species of butterflies from Minnesota, including 89 from Wadena County, the only published county inventory of Minnesota butterflies to-date (Oehlenschlager and Huber 2002). Ferge and Balogh (2000) recorded 1,209 species of moths in 13 families from Wisconsin and Rockburne and Lafontaine (1976) documented 603 species of Noctuidae from Ontario and Quebec. Voss (1981, 1983, 1991) reported 531 species from two northern counties of Michigan's Lower Peninsula. For all of Michigan, Nielsen provided preliminary lists of the state's butterflies and skippers (159 species; Nielsen 1999) and macrolepidopteran moths (1,217 species; Nielsen 1998).

Methods

During the summer of 2008, two 22-watt blacklight traps were operated to inventory the moths of the Grand Portage National Monument. One trap (site 2) was placed ca. 1.2 m (4 ft) high on a tree located behind the Heritage Center (UTM, NAD83: N5315442 E299441). The other trap (site 1) was located near the current maintenance shop (UTM, NAD83: N5315848 E299679) along the Grand Portage Creek riparian corridor. Traps were operated by Brandon Seitz and Steven Veit, who placed the trap contents into sealed plastic bags that were then kept in a freezer. A total of 61 collections were made on 37 dates from 8 May 2008 to 25 August 2008. Because of a trap malfunction at the maintenance shop, collections were made only at the Heritage Center after 18 July. All macrolepidoptera specimens were later sorted, pinned, spread and identified by the author. Wet or badly worn specimens that could not be identified were discarded. Ten collecting trips were made throughout the season to collect butterflies at the wet meadow east of the maintenance shop and the intersection of County Rd. 17 (Old Minnesota 61), and along ca. 6.9 km (4.1 miles) of the Grand Portage Trail from the stockade. Voucher specimens were placed in the GRPO insect collection.

Results and Discussion

Twenty-one species of butterflies and skippers were recorded from the GRPO in 2008 (Table 1), which was reportedly a poor year for butterflies in many areas of Minnesota (Ronald L. Huber, Bloomington, MN, pers. comm.), possibly because of a wet cool spring. It was estimated that flight periods of most species were up to three weeks later than average in May and June. Butterfly species that are common in most years and known to occur in Cook County (MacLean 2006), but were not recorded at GRPO in 2008, included *Pieris napae* Scudder, *Colias philodice* Godart, *Colias eurytheme* Boisduval *Colias interior* Scudder, *Enodia anthedon* A. H. Clark, *Polygonia comma* (Harris), *Nymphalis milberti* (Godart), and *Vanessa virginiensis* (Drury). Many butterfly species recorded at GRPO, including *Speyeria cybele* (Fabricius), *Speyeria atlantis* (W. H. Edwards), *Nymphalis vaualbum* (Denis and Schiffermüller), *Limenitis arthemis arthemis* (Drury), and *Danaus plexippus* (Linnaeus) were uncommon in 2008.

Table 1. Species of butterflies and skippers recorded from the Grand Portage National Monument (GRPO), 2008, including location, date, and abundance information.

Family	Genus	Species	Site/Date/No.[1]
Hesperidae	*Thorybes*	*pylades* (Scudder)	Portage Trail and Co. Rd. 17, 06-26-2008. 1(2)
	Erynnis	*icelus* (Scudder and Burgess)	Portage Trail at MN 61, 06-19-2008, 1(2); Meadow, 06-20-2008, 1(2); Portage Trail and Co. Rd. 17, 06-26-2008, 1(2)
	Thymelicus	*lineola* (Oscsenheimer)	Meadow, 07-28-2008, 1(2)
	Poanes	*hobomok* (Harris)	Portage Trail and Co. Rd. 17, 06-19-2008, 2(2); Meadow, 06-19-2008, 1(2)
Papilionidae	*Papilo*	*canadensis* (Rothschild and Jordan)	Portage Trail and Co. Rd. 17, Trail, 06-26-2008, 1(2)
Pieridae	*Pieris*	*rapae* (Linnaeus)	Meadow, 06-19-2008, 1(2); Meadow, 07-14-2008, 1(3); Heritage Center, 07-14-2008, 2(3), 08-26-2008, 2(3), 1(2)
Lycaenidae	*Everes*	*comyntas* (Godart)	Meadow, 06-09-2008, 1(2)
	Celastrina	*ladon* (Cramer)	Portage Trail and Co. Rd. 17, 05-28-2008, 1(2), 1(3); Meadow, 07-03-2008, 1(2)

Table 1. Species of butterflies and skippers recorded from the Grand Portage National Monument (GRPO), 2008, including location, date, and abundance information (continued).

Family	Genus	Species	Site/Date/No.[1]
Lycaenidae	*Plebejus*	*saepiolus* (Bdv.)	Meadow, 07-04-2008, 1(2), 3(3)
Nymphalidae	*Polygonia*	*progne* (Cramer)	Portage Trail and Co. Rd. 17, 05-28-2008, 1(2,3)
	Nymphalis	*vaualbum* (Denis and Schiffermüller)	Heritage Center, 08-26-2008, 1(3)
	Nymphalis	*antiopa* (Linnaeus)	Portage Trail and Co. Rd. 17, 05-23-2008, 1(2), 1(3)
	Vanessa	*cardui* (Linnaeus)	Portage Trail and Co. Rd. 17, 06-26-2008, 1(2)
	Boloria	*bellona* (Fabricius)	Meadow, 06-19-2008, 1(2), 06-21-2008, 1(2)
	Speyeria	*cybele* (Fabricius)	Portage Trail and Co. Rd. 17, 07-28-2008, 1(2); Meadow, 07-28-2008, 1(2)
	Speyeria	*atlantis* (W. H. Edwards)	Portage Trail and Co. Rd. 17, 07-14-2008, 1(3); Meadow, 08-26-2008, 1(2)
	Chlosyne	*nycteis* (Doubleday and Hewitson)	Portage Trail and Co. Rd. 17, 06-26-2008, 2(2); Meadow, 07-03-2008, 1(2), 07-14-2008, 2(3), 07-28-2008, 1(2)
	Phyciodes	*selenis* (Kirby)	Portage Trail and Co. Rd. 17, 06-26-2008, 1(2), 07-14-2008, 2(3), 07-28-2008, 1(2)
Nymphalidae	*Euphydryas*	*phaeton* (Drury)	Meadow, 07-14-2008, 1(3), 07-28-2008, 1(2)
	Limenitis	*arthemis arthemis* (Drury)	Portage Trail and Co. Rd. 17, 07-14-2008, 1(2), 1(3)
Danaidae	*Danaus*	*plexippus* (Linnaeus)	Meadow, 06-26-2008, 3(3)

[1]Numbers in parentheses indicate species was photographed (1), captured (2), or field identified (3).

The most significant butterfly species discovered was the Baltimore checkerspot, *Euphydryas phaeton* (Drury) collected at a small (1.8 ha/4.4 ac) wet meadow located 450 m (1,476 ft) east of the Heritage Center (Table 1). A specimen of *E. phaeton* was also observed at this site (Figure 1) on 14 July 2008.

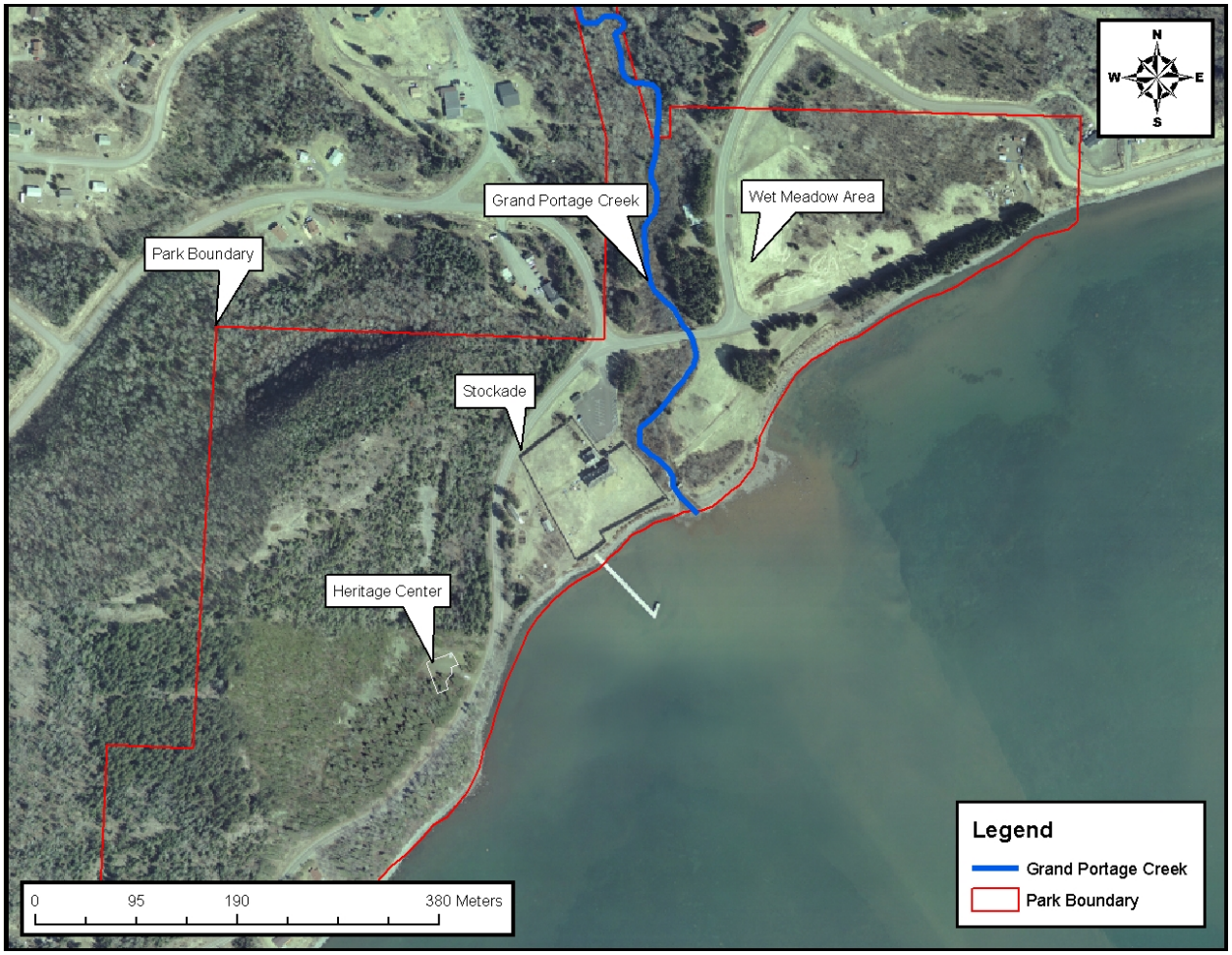

Figure 1. Location of significant project areas.

Populations of *E. phaeton* are very local and occur only where its primary larval food plant *Chelone glabra* Linnaeus (turtlehead) grows. After overwintering, partially grown larvae complete their development by feeding on alternate hosts including black ash, *Fraxinus nigra* Marsh. According to Brandon Seitz (GRPO Resource Assistant, pers. comm.) *C. glabra* and *F. nigra* are common in the riparian zone of Grand Portage Creek. Although it was too late in the season to search for larvae of *E. phaeton*, it is very likely that females oviposit on and larvae feed on *C. glabra* in the riparian zone of Grand Portage Creek. Both *C. glabra* and *F. nigra* should be searched for *E. phaeton* larvae in 2009. The size of the population of *E. phaeton* at GRPO is unknown, but it is likely to be small. The discovery of this butterfly at GRPO is only the second population of *E. phaeton* reported from Cook County (MacLean 2006).

Table 2. Moths identified from the Grand Portage National Monument (GRPO) 2008 Lepidoptera inventory.

Family	Genus	Species	Abundance	Month(s)
Thyatiridae	*Habrosyne*	*scripta* (Gosse)	rare	July
Thyatiridae	*Euthyatira*	*pudens* (Guenée)	common	May
Drepanidae	*Drepana*	*arcuata* (Walker)	uncommon	June, July
Geometridae	*Macaria*	*bitactata*[1] (Walker)	uncommon	August
Geometridae	*Macaria*	*ulsterata* (Pearsall)	rare	July
Geometridae	*Macaria*	*bisignata* (Walker)	rare	June
Geometridae	*Aethalura*	*intertexta* (Walker)	uncommon	May
Geometridae	*Ectropis*	*crepuscularia* (Denis and Schiffermüller)[1]	common	June
Geometridae	*Protoboarmia*	*porcelaria indicataria* (Walker)	uncommon	May
Geometridae	*Melanolophia*	*signataria* (Walker)	uncommon	May, June
Geometridae	*Eufidonia*	*convergaria* (Walker)[1]	rare	June
Geometridae	*Biston*	*Betularia cognataria* (Leach)	uncommon	June, July
Geometridae	*Euchlaena*	*obtusaria* (Hübner)	uncommon	July
Geometridae	*Euchlaena*	*marginaria* (Minot)	uncommon	June
Geometridae	*Euchlaena*	*tigrinaria* (Guenée)	rare	July
Geometridae	*Xanthotype*	*urticaria* Swett	uncommon	July
Geometridae	*Xanthotype*	*sospeta* (Drury)	uncommon	July
Geometridae	*Pero*	*ancetaria* (Hübner)	uncommon	June, July
Geometridae	*Campaea*	*perlata* (Guenée)	uncommon	July, August
Geometridae	*Tacparia*	*detersata* (Guenée)	uncommon	June
Geometridae	*Homochlodes*	*fritillaria* (Guenée)	rare	June
Geometridae	*Selenia*	*kentaria* (Grote and Robinson)	rare	June
Geometridae	*Metanema*	*determinata* (Walker)	rare	July
Geometridae	*Metarranthis*	*duaria* (Guenée)	uncommon	May, June
Geometridae	*Probole*	*alienaria* (Herrich-Schåffer)	rare	June
Geometridae	*Plagodis*	*phlogosaria* (Guenée)	rare	June
Geometridae	*Nepytia*	*canosaria* (Walker)	rare	June
Geometridae	*Sicya*	*macularia* (Harris)	uncommon	August
Geometridae	*Tetracis*	*cachexiata* Guenée	uncommon	June, July
Geometridae	*Eutrapela*	*clemataria* (J.E. Smith)	uncommon	June
Geometridae	*Nematocampa*	*resistaria* (Herrich-Schåffer)	uncommon	July
Geometridae	*Dysstroma*	*citrata* (Linnaeus)	uncommon	July
Geometridae	*Dysstroma*	*hersiliata* (Guenée)	uncommon	July
Geometridae	*Eulithis*	*testata* (Linnaeus)	rare	August
Geometridae	*Eustroma*	*semiatrata* (Hulst)[1]	rare	July, August
Geometridae	*Hydriomena*	*divisaria* (Walker)	common	June, July
Geometridae	*Hydriomena*	*renunciata* (Walker)	uncommon	June
Geometridae	*Rheumaptera*	*undulata* (Linnaeus)	uncommon	July
Geometridae	*Rheumaptera*	*subhastata* (Nolcken)	uncommon	June, July
Geometridae	*Mesoleuca*	*ruficillata* (Guenée)	rare	July

Table 2. Moths identified from the Grand Portage National Monument (GRPO) 2008 Lepidoptera inventory (continued).

Family	Genus	Species	Abundance	Month(s)
Geometridae	*Anticlea*	*vasiliata* (Guenée)	uncommon	May
Geometridae	*Xanthorhoe*	*labradorensis* (Packard)	rare	July, August
Geometridae	*Xanthorhoe*	*lacustrata* (Guenée)	uncommon	August
Geometridae	*Epirrhoe*	*alternata* (Muller)	rare	July
Geometridae	*Euphyia*	*intermediata* (Guenée)	uncommon	June, July
Geometridae	*Acasis*	*viridata* (Packard)	rare	May
Geometridae	*Cladara*	*limitaria* (Walker)	uncommon	May
Geometridae	*Cladara*	*atroliturata* (Walker)	uncommon	May, June
Geometridae	*Lobophora*	*nivigerata* (Walker)	uncommon	May-July
Lasiocampidae	*Phyllodesma*	*americana* (Harris)	uncommon	June, July
Saturniidae	*Antheraea*	*polyphemus* (Cramer)	uncommon	June, July
Saturniidae	*Actias*	*luna* (Linnaeus)	uncommon	June, July
Sphingidae	*Ceratomia*	*undulosa* (Walker)	very common	June, July
Sphingidae	*Sphinx*	*kalmiae* (J.E. Smith)	uncommon	July
Sphingidae	*Smerinthus*	*jamaicensis* (Drury)	abundant	June, July
Sphingidae	*Smerinthus*	*cerisyi* (Kirby)	abundant	May-July
Sphingidae	*Paonias*	*excaecatus* (J.E. Smith)	common	June, July
Sphingidae	*Pachysphinx*	*modesta* (Harris)	common	June-Aug
Notodontidae	*Clostera*	*albosigma* (Fitch)	uncommon	May, June, Aug
Notodontidae	*Clostera*	*strigosa* (Grote)[1]	uncommon	July
Notodontidae	*Clostera*	*apicalis* (Walker)	rare	July
Notodontidae	*Nadata*	*gibbosa* (J.E. Smith)	uncommon	June-Aug
Notodontidae	*Datana*	*ministra* (Drury)	uncommon	July
Notodontidae	*Peridea*	*ferruginea* (Packard)	rare	July
Notodontidae	*Pheosia*	*rimosa* (Packard)	rare	July
Notodontidae	*Gluphisia*	*septentronis* (Walker)	abundant	May-Aug
Notodontidae	*Heterocampa*	*biundata* (Walker)	rare	July
Notodontidae	*Schizura*	*ipomoeae* (Doubleday)	rare	July
Arctiidae	*Eilema*	*bicolor* (Grote)	abundant	July, August
Arctiidae	*Hypoprepia*	*fucosa* (Hübner)	very common	July, August
Arctiidae	*Haploa*	*lecontei* (Guerin-Meneville.)[1]	rare	July
Arctiidae	*Holomelina*	*laeta* (Guerin-Meneville)	rare	July
Arctiidae	*Holomelina*	*aurantiaca* (Hübner)	uncommon	July
Arctiidae	*Spilosoma*	*congrua* (Walker)	rare	July
Arctiidae	*Phragmatobia*	*assimilans* (Walker)	uncommon	June
Arctiidae	*Platacrtia*	*parthenos* (Harris)	rare	July
Arctiidae	*Grammia*	*parthenice* (Kirby)	uncommon	July, August
Arctiidae	*Grammia*	*virgo* (Linnaeus)	rare	July
Arctiidae	*Ctenucha*	*virginica* (Esper)	uncommon	June, July
Lymantriidae	*Lymantria*	*dispar* (Linnaeus)	uncommon	August
Noctuidae	*Idia*	*americalis* (Guenée)	common	July, August

Table 2. Moths identified from the Grand Portage National Monument (GRPO) 2008 Lepidoptera inventory (continued).

Family	Genus	Species	Abundance	Month(s)
Noctuidae	*Idia*	*aemula* (Hübner)	uncommon	July, August
Noctuidae	*Idia*	*lubricalis* (Geyer)	rare	July
Noctuidae	*Zanclognatha*	*jacchusalis* (Walker)	uncommon	July, August
Noctuidae	*Zanclognatha*	*ochreipennis* (Grote)	rare	July
Noctuidae	*Bomolocha*	*abalienalis* (Walker)[1]	rare	June
Noctuidae	*Zale*	*minerea* (Guenée)	uncommon	June
Noctuidae	*Trichoplusia*	*ni* (Hübner)	rare	July
Noctuidae	*Diachrysia*	*aeroides* (Grote)	rare	August
Noctuidae	*Autographa*	*ampla* (Walker)	rare	July
Noctuidae	*Anagrapha*	*falcifera* (Kirby)	uncommon	June, July
Noctuidae	*Syngrapha*	*octoscripta* (Grote)	rare	August
Noctuidae	*Syngrapha*	*viridisigma* (Grote)	rare	August
Noctuidae	*Syngrapha*	*rectangula* (Kirby)	uncommon	July, August
Noctuidae	*Plusia*	*contexta* (Grote)	rare	July
Noctuidae	*Panthea*	*acronyctoides* (Walker)	uncommon	May, June, Aug
Noctuidae	*Charadra*	*deridens* (Guenée)	rare	July
Noctuidae	*Acronicta*	*americana* (Harris)	common	June-August
Noctuidae	*Acronicta*	*lepusculina* (Guenée)	rare	July
Noctuidae	*Acronicta*	*innotata* (Guenée)	rare	July
Noctuidae	*Acronicta*	*grisea* (Walker)	uncommon	July
Noctuidae	*Acronicta*	*fragilis* (Guenée)	rare	July
Noctuidae	*Acronicta*	*noctivaga (*Grote)	rare	July
Noctuidae	*Apamea*	*impulsa* (Guenée)	rare	June
Noctuidae	*Apamea*	*devastator* (Brace)	common	July, August
Noctuidae	*Apamea*	*sordens* (Hufnagel)	uncommon	July
Noctuidae	*Apamea*	*dubitans* (Walker)	rare	June
Noctuidae	*Oligia*	*illocata* (Walker)	rare	August
Noctuidae	*Bellura*	*obliqua* (Walker)	very common	June, July
Noctuidae	*Euplexia*	*benesimilis* (McDunnough)	uncommon	July
Noctuidae	*Phlogophora*	*iris* (Guenée)	uncommon	June-August
Noctuidae	*Phlogophora*	*periculosa* (Guenée)	very common	July, August
Noctuidae	*Enargia*	*infumata* (Grote)	uncommon	July
Noctuidae	*Ipimorpha*	*pleonectusa* (Grote)	rare	July
Noctuidae	*Hyppa*	*xylinoides* (Guenée)	uncommon	June, July
Noctuidae	*Dypterygia*	*rozmani* (Berio)	rare	July
Noctuidae	*Xylena*	*curvimacula* (Morrison)	very common	May
Noctuidae	*Litholomia*	*napaea* (Morrison)	uncommon	May
Noctuidae	*Lithophane*	*innominata* (J. B. Smith)[1]	uncommon	May, June
Noctuidae	*Lithophane*	*petulca* (Grote.)[1]	rare	May
Noctuidae	*Lithophane*	*antennata* (Walker)	rare	May

Table 2. Moths identified from the Grand Portage National Monument (GRPO) 2008 Lepidoptera inventory (continued).

Family	Genus	Species	Abundance	Month(s)
Noctuidae	*Lithophane*	*unimoda* (Lintner)	rare	May
Noctuidae	*Lithophane*	*pexata* (Guenée)	rare	May
Noctuidae	*Eupsilia*	*tristigmata* (Grote)[1]	common	May
Noctuidae	*Feralia*	*comstocki* (Grote)	very common	May, June
Noctuidae	*Cucullia*	*intermedia* (Speyer)[1]	rare	June
Noctuidae	*Sideridis*	*rosea* (Harvey)[1]	rare	June
Noctuidae	*Polia*	*nimbosa* (Guenée)	common	July, August
Noctuidae	*Polia*	*purpurissata* (Grote)	common	August
Noctuidae	*Spirameter*	*grandis* (Guenée)	common	June, July
Noctuidae	*Spirameter*	*lutra* (Guenée) [1]	uncommon	June
Noctuidae	*Lacinipolia*	*renigera* (Stephens)	common	July, August
Noctuidae	*Lacinipolia*	*lorea* (Guenée)	abundant	June, July
Noctuidae	*Lacinipolia*	*olivacea* (Morrison)	very common	July, August
Noctuidae	*Pseudaletia*	*unipuncta* (Haworth)	very common	June, July
Noctuidae	*Leucania*	*multilinea* (Walker)	rare	July
Noctuidae	*Stretchia*	*plusiaeformis* (Hy. Edwards)	uncommon	May
Noctuidae	*Orthosia*	*revicta* (Morrison)	common	May, June
Noctuidae	*Orthosia*	*hibisci* (Guenée)	uncommon	May, June
Noctuidae	*Crocigrapha*	*normani* (Grote)[1]	uncommon	May, June, Aug
Noctuidae	*Egira*	*dolosa* (Grote)	common	May, June
Noctuidae	*Morrisonia*	*latex* (Guenée)	uncommon	July
Noctuidae	*Anhimella*	*contrahens* (Walker)[1]	uncommon	July
Noctuidae	*Pseudorthodes*	*vecors* (Guenée)[1]	common	July
Noctuidae	*Orthodes*	*cynica* Guenée	very common	June, July
Noctuidae	*Orthodes*	*obscura* (J. B. Smith)[1]	common	May-July
Noctuidae	*Agrotis*	*vetusta* (Walker)	very common	August
Noctuidae	*Agrotis*	*mollis* (Walker)[1]	uncommon	July
Noctuidae	*Feltia*	*subgothica* (Haworth)	common	August
Noctuidae	*Feltia*	*herilis* (Grote)	rare	August
Noctuidae	*Euxoa*	*divergens* (Walker)[1]	rare	July
Noctuidae	*Euxoa*	*campestris* (Grote)[1]	rare	July
Noctuidae	*Euxoa*	*comosa ontario* (Smith)	uncommon	August
Noctuidae	*Diarsia*	*jucunda* (Walker)[1]	uncommon	July
Noctuidae	*Diarsia*	*Rosaria* (Grote)	rare	July
Noctuidae	*Eurois*	*occulta* (Linnaeus)	uncommon	August
Noctuidae	*Eurois*	*astricta* (Morrison)	common	July, August
Noctuidae	*Xestia*	*c-nigrum* (Linnaeus)	rare	August
Noctuidae	*Xestia*	*normaniana* (Grote)	uncommon	August

Table 2. Moths identified from the Grand Portage National Monument (GRPO) 2008 Lepidoptera inventory (continued).

Family	Genus	Species	Abundance	Month(s)
Noctuidae	*Xestia*	*smithii* (Snellen)	common	July, August
Noctuidae	*Xestia*	*badicollis* (Grote)	rare	July
Noctuidae	*Paradiarsia*	*littoralis* (Packard)	very common	July
Noctuidae	*Cerastis*	*salicarum* (Walker)	uncommon	May
Noctuidae	*Aplectoides*	*condita* (Guenée)	uncommon	July
Noctuidae	*Anaplectoides*	*prasina* (Denis and Schiffermüller)	rare	August
Noctuidae	*Eueretagrotis*	*perattenta* (Grote)	very common	June-August
Noctuidae	*Lycophotia*	*phyllohora* (Grote)	rare	July
Noctuidae	*Noctua*	*pronuba* (Linnaeus)	uncommon	August
Noctuidae	*Abagrotis*	*alternata* (Grote)	uncommon	August
Noctuidae	*Abagrotis*	*cupida* (Grote)	rare	August

[1] New Cook Co. MN record.

A total of 170 species of moths in 10 families and 118 genera, totaling 1,128 specimens, was recorded from 61 black light collections made on 37 different dates at GRPO in 2008 (Table 2 and Appendix A). Twenty one species were new Cook County records. Thirty-seven species of moths, collected in 2000 and 2001 at GRPO (MacLean 2002), were not reported in 2008. This was no doubt due to collections made into September and the use of four traps in 2000 and 2001 that were operated in a wider range of habitats. Likewise many species collected in 2008 were not collected in 2000 and 2001. The numbers of species for each family were: Thyatiridae (2), Drepanidae (1), Geometridae (46), Lasiocampidae (1), Saturniidae (2), Sphingidae (6), Notodontidae (10), Arctiidae (11), Lymantriidae (1) and Noctuidae (90). Three male specimens of *Lymantria dispar* (Linnaeus), the gypsy moth, were collected on 22 August at the Heritage Center. Many additional species reported by MacLean (2006) from Cook County, Minnesota, and not collected in 2008 likely occur at the Grand Portage Monument.

Sixty-three species of moths (37%) collected in 2008 at GRPO were judged to be rare (one specimen collected), 71 species (42%) were uncommon (2-5 specimens collected), 19 (11%) were common (6-10 specimens collected), 12 (7%) were very common (11-20 specimens collected) and 5 (3%) were abundant (>20 collected) (Table 2). However, the categories used to describe abundance are based on the numbers collected by the two black light traps and may not accurately reflect population size. For example, many species judged to be “rare” or “uncommon” based on the GRPO collections are relatively common in Cook County (MacLean 2006). Many of these species are no doubt relatively common along the Grand Portage trail that extends for 8.5 miles (13.7 km) through dense forest from Minnesota Highway 61 to the former site of Fort Charlotte on the Pigeon River. A literature search found that 14 species of moths at GRPO were uncommon throughout their ranges, but no moth species was rare. The giant silkworm moths *Antheraea polyphemus* (Cramer) and *Actias luna* (Linnaeus) are still common in northern Minnesota. However, *Compsilura concinnata* (Meigen), a tachinid (Diptera) parasitoid introduced to control the gypsy moth also parasitizes the larvae of many other species of Lepidoptera (e.g., *Datana ministra* Drury) (Table 4). This introduced parasitic fly has been

implicated in the drastic decline of *Hyalophora cecropia* (Linnaeus) and other species of giant silkworm moths in the East in the past 30 years (Wagner 2005).

Gluphisia septentronis Walker (276 specimens collected), *Smerinthus cerisyi* Kirby (57 specimens collected), and *Lacinipolia lorea* (Guenée) (49 specimens collected) were the three most abundant species. *Lymantria dispar* was the only major forest defoliator collected in 2008. However, many agricultural pests were collected, including *Trichoplusia ni* (Hübner) (cabbage looper), *Anagrapha falcifera* (Kirby) (celery looper), *Apamea devastator* (Brace) (glassy cutworm), *Pseudaletia unipuncta* (Haworth) (armyworm moth), *Lacinipolia renigera* (Stephens) (bristly cutworm), *Lacinipolia lorea*, *Lacinipolia olivacea* (Morrison), *Feltia subgothica* (Haworth) (dingy cutworm), *Feltia herilis* (Grote), *Agrotis vetusta* Walker, *Xestia c-nigrum* (Linnaeus) (spotted cutworm), *Anaplectoides prasina* (Denis and Schiffermüller), *Abagrotis alternata* (Grote) (mottled gray cutworm) and *Abagrotis cupida* (Grote) (brown cutworm).

Table 3. Species of butterflies and skippers recorded from the Grand Portage National Monument (GRPO) potentially susceptible to Btk treatment used to slow the spread of the gypsy moth, *Lymantria dispar* (Linnaeus).

Family	Genus	Species	Larval hosts, distribution, and abundance[1]
Hesperidae	*Erynnis*	*icelus*	*Betula*(?), *Populus*, *Robinia* and *Salix*. Transition Zone to Canadian Zone. Common, 1 generation, larvae Construct nests of rolled or tied leaves, larva overwinters, present from July-early June.
	Thymelicus	*lineola*	Grasses including *Agrostis* and *Phleum*. Introduced from Europe, widespread across much of n.e. U.S. and southern Canada. Common to very abundant, 1 generation, larvae present June-mid-July.
Papilionidae	*Papilio*	*canadensis*	*Betula*, *Populus* and *Prunus*. Widespread across northern U.S., southern and central Canada to AK. Common most years, 1 generation, larvae mid-June-July.
Pieridae	*Pieris*	*rapae*	Many plants in the Cruciferae, a pest on *Brassica* and others. Introduced from Europe, world wide, all of the U.S. north into Canada and south into Mexico. Common to abundant, 2 or more generations (year around in South), larvae from June-September.
Lycaenidae	*Everes*	*comyntas*	Many genera of Leguminosae including *Astragalus*, *Baptisia*, *Desmodium*, *Galactia*, *Lathyrus*, *LuPinus*, *Medicago*, *Phaseolus*, and *Trifolium*. Eastern U.S. from lower Austral Zone to Canadian Zone. Uncommon to common, 2 generations, larva overwinters, present from May–mid-June, again in July.
	Celastrina	*ladon*	Many families of trees and shrubs including Aceraceae, Asteraceae, Cornaceae, Ericacaceae, Fagaceae, Labiatae, Leguminosae, Ranunculaceae, Rosaceae and Saxifragaceae. Widespread over much of N. America. Generally common, 1 generation, larvae from June-July.
Lycaenidae	*Plebejus*	*saepiolus*	Species of *Trifolium*. Across southern and central Canada and the northern U.S. to AK, south to NM and CA. Common, 1 generation, larva overwinters, present from May-June and again in July.
Nymphalidae	*Polygonia*	*progne*	Mainly *Ribes*. Transition Zone to Hudsonian Zone. Uncommon-common, 2 generations, adult overwinters, larvae present in June and again in August-early September.
	Nymphalis	*vaualbum*	*Betula*, *Malus*, *Populus* and *Salix*. Across southern and central Canada (Canadian Zone to Hudsonian zone) and northern U.S., also e. Europe to Japan. Generally common but locally rare since 2002, 1 generation, adult overwinters, larvae present in June.
	Nymphalis	*antiopa*	Many plants, mostly trees including *Acer*, *Alnus*, *Betula*, *Celtis*, *Populus*, *Pyrus*, *Salix*, *Tilia*, and *Ulmus*. Widespread over all of N. America except arctic Canada and Baja Mexico. Generally common, 2 generations, adult overwinters, larvae present from mid-June to mid-July and mid-July to September.
	Vanessa	*cardui*	Many species of Asteraceae, Cruciferae, Labiatae, Leguminosae, Malvaceae, Rosaceae, Ulmaceae and others. Distributed world wide, immigrates north from Mexico and s.w. U.S., present in northern MN only in certain years. Rare to abundant, 1 (2?) generations, larvae may be present in late June to July.

Table 3. Species of butterflies and skippers recorded from the Grand Portage National Monument (GRPO) potentially susceptible to Btk treatment used to slow the spread of the gypsy moth, Lymantria dispar (Linnaeus) (continued).

Family	Genus	Species	Larval hosts, distribution, and abundance[1]
Nymphalidae	*Boloria*	*bellona*	Many species of *Viola*. Widespread, upper Transition (northern U.S.) to Hudsonian Zone (central and northern Canada). Generally common, probably 2 generations, overwinters as half grown larva, larvae present in May and again late June to July and September through winter.
	Speyeria	*cybele*	Many species of *Viola*. Widespread, upper Austral and Transition Zones (northern U.S.) to Hudsonian Zone (central and northern Canada). Generally common, 1 generation, overwinters as 1st instar larva, larvae from May to June, again from August through winter.
	Speyeria	*atlantis*	Many species of *Viola*. Widespread, upper Transition Zone (northern U.S.) to Hudsonian Zone (central and northern Canada). Generally very common, 1 generation, overwinters as 1st instar larva, larvae from May to June and again from August through winter.
	Euphydryas	*phaeton*	Primary host is *Chelone glabra*, also *Plantago* (eggs and 1st year larvae), after hibernation hosts include *Fraxinus nigra*. Widespread but local in e. U.S. and s. Canada west to ON and e. MB. Populations rare and very local, inhabit wet meadows only where *Chelone glabra* grows, the population discovered at GRPO is only the 2nd known for Cook County, MN, half grown larvae overwinter in a colonial nest at base of host plant, in spring larvae are solitary and search out alternate hosts and resume feeding, larvae present May-early July) and again from August through winter.
	Limenitis	*arthemis arthemis*	Many plants including *Alnus*, *Betula*, *Crataegus*, *Fagus*, *Populus*, *Prunus*, *Salix*, *Tilia*, and *Ulmus*. One of two subspecies, *arthemis* is distributed across the northernmost states in the eastern U.S. and southern and central Canada northwest to AK. Generally common, 1 generation, 3rd instar larvae hibernate, larvae from May to June and again from August through winter.
Danaidae	*Danaus*	*plexippus*	Larvae specialize on *Asclepias* that contains cardiac glycosides that protect the larvae and adults from predation primarily from birds. In spring adults immigrate north from over-wintering sites in Mexico, the next generation reaches the northern U.S., central and western Canada and southeastern AK. Common to abundant most years, scarce others, 5 or more generations in southern FL and CA but only 1 in northern MN, larvae from July-August.

[1] References: Scott 1986; Holmes et al. 1991.

Species potentially vulnerable to the use of Btk to slow the spread of the gypsy moth, *Lymantria dispar*

The primary objective of this investigation was to evaluate which species of macrolepidoptera present at GRPO would be adversely affected if Btk were used to control the gypsy moth. Species whose larval feeding stage coincided with the timing of aerial applications of Btk to control gypsy moth larvae were considered to be the most susceptible. As June is the primary month for Btk application, species of butterflies and moths whose larvae were actively feeding in June were judged to be the most susceptible. However, the residual effect of Btk in July could also place species whose larvae feed in July at risk. Susceptibility of butterflies and moths collected at GRPO to Btk was evaluated by a search of life history data in various references and literature. The primary sources of life history data for butterflies were Holmes et al. (1991) and Scott (1986). The recent field guide on the caterpillars of Eastern North America (Wagner 2005), Wagner et al. (2001), and data from the Canadian Forest Insect Survey (Prentice 1962) provided much of the life history data.

Seventeen species of butterflies observed or collected at GRPO in 2008 were judged to be potentially susceptible to the application of Btk (Table 3), including *E. phaeton*, a rare and local butterfly known to occur at only one other site in Cook County (MacLean 2006). All other "at risk" species, although important members of the butterfly fauna at GRPO, are widespread, common most years and apparently secure (Holmes et. al 1991). Additional butterflies and skippers recorded from Cook County that would be potentially harmed by Btk application include *Carterocephalus palaemon* (Pallas), *Colias interior* Scudder, *Colias philodice* Godart, *Enodia anthedon* A. H. Clark, *Euphyes vestris* (Boisduval), *Nymphalis milberti* (Godart), *Vanessa virginiensis* (Drury), and *Wallengrenia egeremet* (Scudder) (Holmes et al. 1991; MacLean 2006). These species were not collected or observed in 2008 but likely inhabit GRPO.

Table 4. Species of moths recorded from the Grand Portage National Monument (GRPO) potentially susceptible to Btk treatment used to slow the spread of the gypsy moth, *Lymantria dispar* (Linnaeus).

Family	Genus	Species	Larval hosts, distribution, and abundance[1]
Thyatiridae	*Euthyatira*	*pudens*	*Cornus*, widespread southern Canada south to n. FL west to AR, MB and TX, uncommon to locally common, 1 generation with mature larvae from May-June (8).
Drepanidae	*Drepana*	*arcuata*	*Alnus* and *Betula*, southern Canada south to MO and SC (mountains), common, 2 generations with mature larvae from late June–July, August-October (1, 8).
Geometridae	*Acasis*	*viridata*	Northern wild-raisin, common, transcontinental across Canada, widespread in e. U.S., larvae June-July (1).
	Aethalura	*intertexta*	*Alnus* and *Betula* common transcontinental across Canada south to GA, 2 generations mature larvae from June-August (9).
	Anticlea	*vasiliata*	Larvae accept *Rubus*, locally common transcontinental across Canada and northern U.S., 1 generation mature larvae in June-July (9).
	Cladara	*atroliturata*	*Acer*, *Alnus*, *Betula*, *Quercus* and *Salix*, uncommon, transcontinental across Canada south to Ga. and Mo., 1 generation with mature larvae in June (9).
	Cladara	*limitaria*	*Abies*, *Larix*, *Picea*, *Pinus*, and *Tsuga*, very common, transcontinental across Canada south to GA and MO, 1 generation, mature larvae in June (9).
	Dysstroma	*hersiliata*	*Ribes* spp., Canada south to NC (mountains) MN and SD, rare and local, 1 generation with mature larvae from late May-June (9).
	Epirrhoe	*alternata*	*Gallium* spp., locally common northward, transcontinental across Canada south to MN, larvae from June-July (1).
	Eulithis	*testata*	*Populus* and *Salix*, transcontinental across Canada and northern U.S., uncommon, 1 generation, larvae in May-June (2).
	Euphyia	*intermediata*	Related sp. (*E. unangulata* (Haw.)) feeds on *Brassica*, *Impatiens*, *Stellaria*, and *Ulmus*, common, LA to NC west to MB, 2 generations, larvae June-July (1).
	Eustroma	*semiatrata*	*Salix* and herbs, transcontinental across Canada and northern U.S., no abundance data, larvae May-June? (2).
	Eutrapela	*clemataria*	Many plants including *Acer*, *Alnus*, *Betula*, *Cornus*, *Prunus*, *Quercus*, *Ribes*, *Picea*, *Prunus*, *Quercus*, *Salix*, *Tilia*, and *Ulmus*, MN to NF south to FL, common, 1 generation, mature larvae from June-July (9).

Table 4. Species of moths recorded from the Grand Portage National Monument (GRPO) potentially susceptible to Btk treatment used to slow the spread of the gypsy moth, *Lymantria dispar* (Linnaeus) (continued).

Family	Genus	Species	Larval hosts, distribution, and abundance[1]
Geometridae	*Macaria*	*bisignata*	*Pinus strobus* and other pines, common, southern Canada south to AL GA and MO locally common, 2 generations with mature larvae from June-October (1, 8).
	Melanolophia	*signataria*	Many woody trees and shrubs including *Abies*, *Acer*, *Betula*, *Larix*, *Picea*, *Populus*, *Quercus*, and *Ulmus*, common to abundant widespread throughout E. U.S. and Canada, 2 generations, mature larvae from May-June and August (1, 9).
	Mesoleuca	*ruficillata*	*Alnus*, *Betula* and *Rubus*, uncommon, transcontinental across Canada and northern U.S. south to GA (mountains) OH and PA, 1 principal generation with mature larvae in June-July (9).
	Metanema	*determinata*	*Populus* and *Salix*, locally common, transcontinental across Canada south to MA and NE, locally common, 2 generations mature larvae from June-July and August-October (9).
	Nematocampa	*resistaria*	Many plants including *Abies*, *Acer*, *Alnus*, *Betula*, *Cornus*, *Crataegus*, *Fraxinus*, *Prunus*, *Quercus*, *Ribes*, *Salix*, *Tilia*, *Tsuga*, *Ulmus*, and *Vaccinium*, transcontinental across Canada south to FL and TX, common, 1 generation plus a partial 2nd, mature larvae in late May-June again in August (9).
	Nepytia	*canosaria*	*Abies*, *Larix*, *Picea*, *Thuga* and *Tsuga*, eastern Canada south to NC west to MN, common, 1 generation, mature larvae from June-Sept. (9).
	Pero	*ancetaria*	Many woody plants including *Alnus*, *Betula*, and *Salix*, common across southern Canada south to northern FL and TX, 2 generations (1 north?), mature larvae from June-July (8).
	Pero	*morrisonaria*	*Aibes*, *Larix*, *Picea*, and *Pinus*, common, transcontinental across Canada south to GA (mountains) and upper Mid West, I generation north, mature larvae from June-July (9).
	Plagodis	*phlogosaria*	Many hardwoods including *Alnus*, *Populus*, *Prunus*, *Quercus*, and *Salix*, transcontinental across Canada south to GA and KS, uncommon, 2 generations (1 in North), mature larvae from June-July (9).
	Probole	*alienaria*	Many hardwoods including *Acer*, *Betula*, *Cornus*, and *Crataegus*, transcontinental across Canada south to AR, GA and KS, very common, 2 generations with mature larvae from June-July, pupa overwinters (9).
	Protoboarmia	*porcelaria*	Many harwoods conifers and shrubs including *Abies*, *Acer*, *Betula*, *Larix*, *Picea*, *Pinus*, *Populus*, *Prunus*, *Quercus*, *Rubus*, *Salix*, *Tsuga*, *Ulmus*, and *Vaccinium*, common, transcontinental across Canada south 2 generations, mature larvae from May-August (9).

Table 4. Species of moths recorded from the Grand Portage National Monument (GRPO) potentially susceptible to Btk treatment used to slow the spread of the gypsy moth, *Lymantria dispar* (Linnaeus) (continued).

Family	Genus	Species	Larval hosts, distribution, and abundance[1]
Geometridae	*Selenia*	*kentaria*	Many plants including *Acer*, *Betula*, *Quercus*, *Salix*, *Tilia*, and *Ulmus*, transcontinental across Canada south to AL, GA, MS and AR, uncommon, 1-2 generations, mature larvae from June-July and again in August-September (1, 9).
	Sicya	*macularia*	Many plants including *Abies*, *Acer*, *Betula*, *Fraxinus*, *Prunus*, *Quercus*, *Ribes*, *Salix*, *Tilia*, *Tsuga*, and *Ulmus*, transcontinental across Canada south to GA and MO, uncommon, 1 generation, mature larvae from May-July (9).
	Tacparia	*detersata*	*Alnus*, eastern Canada south to WV and the Great Lakes, locally common, 1 generation, mature larvae from June-early August (8).
	Xanthorhoe	*labradorensis*	Many plants including *Alyssum*, *Brassica*, *Raphanus*, and *Tsuga*, common, transcontinental across Canada south to LA, MS and NC, 2 generations northward, larvae June-July (1).
	Xanthorhoe	*lacustrata*	*Betula*, *Crataegus*, *Impatiens*, *Rubus* and *Salix*, Most of eastern U.S., common, 1 (2) generation, larvae apparently June-July (1).
Lasiocampidae	*Phyllodesma*	*americana*	*Alnus*, *Betula*, *Populus*, *Prunus*, *Quercus* and *Salix*, southern Canada to GA and TX, common, 2 generations, with mature larvae from May-September (7).
Saturniidae	*Actias*	*luna*	Many forest trees including *Betula* spp., generally common and widespread across eastern U.S. and southern Canada, 1 (north)3 or more (south) generations, mature larvae from mid June-mid August (5). NOTE: populations of giant silkworm moths are declining throughout much of the East. Results of field experiments indicate that 80% of *Hyalophora cecropia* larvae were parasitized by *Compsilura concinnata* (Meigen) a tachinid (Diptera) parasitoid introduced to control the gypsy moth, *Lymantria dispar* (9).
	Antheraea	*polyphemus*	Many shrubs and trees including *Acer*, *Betula*, *Cornus*, *Fraxinus*, *Populus*, *Prunus*, *Quercus*, and *Salix*, common, occurs across most of Canada and U.S except AZ and NV, 3 generations southward 1 north with mature larvae from June-early August (8).
Sphingidae	*Ceratomia*	*undulosa*	Hosts include *Fraxinus* and *Syringa*, common and widespread from Canada to FL and TX, 1 extended generation northward, mature larvae from late June-August (9).
Notodontidae	*Clostera*	*apicalis*	*Populus* and *Salix*, Canada south to CT, Great Lakes, northern MO, western TX and CA, 2 generations in CT and NY, mature larvae from June-September? (8).
	Clostera	*strigosa*	*Populus* and *Salix*, occurs over much of Canada south, 1 (2?) generations with mature larvae from June-September? (7).

Table 4. Species of moths recorded from the Grand Portage National Monument (GRPO) potentially susceptible to Btk treatment used to slow the spread of the gypsy moth, *Lymantria dispar* (Linnaeus) (continued).

Family	Genus	Species	Larval hosts, distribution, and abundance[1]
Notodontidae	*Clostera*	*albosigma*	*Populus* and *Salix*, from southern Canada south to the Gulf, west across the Mid West, common, 1-2 generations with mature larvae from May-September (8).
	Datana	*ministra*	*Betula*, *Prunus*, *Quercus*, Rosaceae, *Salix*, *Vaccinium*, and other plants, transcontinental across Canada south to FL and TX, 1 generation (north) 2 in south, mature larvae from June-? NOTE: results of field experiments indicate that heavy parasitism (79%) of *D. ministra* larvae by *Compsilura concinnata* (Meigen) a tachinid parasitoid introduced to control the gypsy moth, *L. dispar*, may be responsible for declining populations of *D. ministra* and other *Datana* species in the Northeastern U.S. (8).
	Gluphisia	*septentronis*	*Populus*, southern Canada south to FL and TX, common, 2 generations with mature larvae from May-September (8).
	Heterocampa	*biundata*	Many woody plants including *Acer*, *Betula*, *Carya*, *Fagus*, *Populus*, *Prunus*, *Quercus*, and *Salix*, common, occurs across southern Canada south to FL and TX, 2 generations with mature larvae from late May-June (8).
	Nadata	*gibbosa*	Many woody plants including *Acer*, *Alnus*, *Amelanchier*, *Betula*, *Populus*, *Prunus*, *Quercus*, *Rosa*, and *Salix*, common, occurs across southern Canada southward, 2-3 generations (south), mature larvae from May-September (8).
	Peridea	*ferruginea*	*Betula* spp., common, across Canada, common Northward, 2(?) or more generations, mature larvae from May-? (1, 8).
	Pheosia	*rimosa*	Principally *Populus* also *Salix*, common, occurs from Canada south to NC and n.e. TX, 2 generations mature larvae from late May-September (8).
	Schizura	*ipomoeae*	Many woody plants including *Acer*, *Betula*, *Cornus*, *Crataegus*, *Fagus*, *Populus*, *Prunus*, *Tilia*, *Quercus*, *Rosa*, and *Ulmus*, common, occurs across southern Canada South to FL and TX, 2 generations with mature larvae from June-September (8).
Arctiidae	*Ctenucha*	*virginica*	Mainly grasses, common, occurs across southern Canada to NB and northern PA 1 generation mature larvae from late May-June (8).
	Eilema	*bicolor*	Conifers and lichens growing on conifers, transcontinental across Canada south to SD, common, larvae June-? (1).
	Grammia	*parthenice*	Many low plants including *Carduus*, *Taraxacum*, and *Vernonia*, Canada and eastern U.S., common, 2 generations, larvae June-July (1).

Table 4. Species of moths recorded from the Grand Portage National Monument (GRPO) potentially susceptible to Btk treatment used to slow the spread of the gypsy moth, *Lymantria dispar* (Linnaeus) (continued).

Family	Genus	Species	Larval hosts, distribution, and abundance[1]
Arctiidae	*Grammia*	*virgo*	Many low plants including *Galium*, southern Canada south to FL and KS, common, 1 generation with mature larvae from June-July (8).
	Haploa	*lecontei*	Many herbaceous and woody plants including *Prunus* and *Salix*, across southern Canada south to GA, west to MB and AR, common, 1 generation, mature larvae late May-July (1, 8).
	Holomelina	*aurantiaca*	*Plantago*, *Taraxacum*, and other forbs, Canada south to FL and TX, 2 (?) or more generations with mature larvae from June-late summer (7).
	Hypoprepia	*fucosa*	Lichens and blue green algae growing on tree trunks, fallen logs and rocks, across southern Canada south to FL and TX, common, 1 generation (north) 2-3 southward, mature larvae from May-July (8).
	Spilosoma	*congrua*	*Taraxacum* and other forbs, Canada south to FL and TX, common, 1 generation north (2 southward), mature larvae from June-July (1, 8).
Noctuidae	*Abagrotis*	*cupida*	Larva (brown cutworm) reared on *Salix*, reported from *Prunus* and *Vitus*, transcontinental across southern Canada south to CO, NC, TX and WA, larvae probably from June-July (2, 4).
	Acronicta	*fragilis*	Many woody plants including *Alnus*, *Amelanchier*, *Betula*, *Pyrus*, *Rosa*, and *Salix*, common, Canada south to NC (mountains) and west to Great Lakes, 1 generation mature larvae from Late June-mid October (6, 8).
	Acronicta	*innotata*	*Alnus*, *Betula*, *Carya*, *Populus*, and *Salix*, NF south NC, west to MB and KY, locally common, larvae apparently from June-July (1).
	Acronicta	*lepusculina*	*Populus* and *Salix*, uncommon, Canada south to FL and TX, 2 generations with mature larvae from late June–September (1, 8).
	Acronicta	*superans*	Mostly *Crataegus*, *Prunus*, *Pyrus*, *Sorbus* and other Rosaceae, common, Canada, MB to NF south to NC (mountains) and the Great Lakes States, 2 generations mature larvae from early June – October (8).
	Acronicta	*noctivaga*	*Populus*, occurs across Canada south to FL and TX, common northward, 2 generations with mature larvae from May–September (8).
	Anagrapha	*falcifera*	Larva (celery looper) may be a pest on many herbaceous plants including *Apium*, *Trifolium*, *Vaccinium*, *Viburnum*, and *Zea*, common-abundant, transcontinental across Canada south to northern GA and TX, 2 generations in North 3 or more in South, mature larvae from May-September (1, 8).

Table 4. Species of moths recorded from the Grand Portage National Monument (GRPO) potentially susceptible to Btk treatment used to slow the spread of the gypsy moth, *Lymantria dispar* (Linnaeus) (continued).

Family	Genus	Species	Larval hosts, distribution, and abundance[1]
Noctuidae	*Apamea*	*devastator*	Larva (glassy cutworm) a pest of many grasses, grains and crops including *Brassica*, *Medicargo*, and *Phaseolus*, NF across southern Canada south to MO, common northward, larvae possibly from late June-July (1).
	Apamea	*sordens*	Larvae feed on *Elymus*, *Zea*, *Zizania*, and other grasses and sedges, transcontinental across Canada, south to VA, and MN, fairly common, probably 1 generation, larvae apparently from June-July (1, 7).
	Autographa	*ampla*	*Alnus*, *Betula*, *Populus*, *Salix*, and other plants, NF south to NC (mountains) and KY, west across Canada to s.e. AK, common, larvae from May-July and September (1, 5, 6).
	Cerastis	*salicarum*	Related *Cerastis* sp. reared on *Taraxacum* Vitis and lettuce, widespread and northern, uncommon, 1 generation mature larvae from late May–June (1, 7).
	Charadra	*deridens*	*Acer*, *Betula*, *Fagus*, *Quercus* and *Ulmus*, Canada and eastern U.S., common, 2 (or more) generations, larvae apparently from June-July (1).
	Crocigrapha	*normani*	Many plants including *Acer*, *Betula*, *Ostrya*, *Populus*, *Prunus*, *Quercus*, *Salix*, *Ulmus*, and *Vaccinium*, southern Canada south to MS and SC, common, 1 generation, mature larvae from late May-late August (6, 8).
	Cucullia	*intermedia*	*Lactuca*, occurs from MN to NS south to VA and Great Lakes, 1 generation with mature larvae from late May-late July (6, 8).
	Diachrysia	*aeroides*	*Aster*, *Mentha* and *Spiraea alba*, NS west across Canada south to MI, MN and WI, possibly 1 generation, larvae in June (1, 5).
	Diarsia	*jucunda*	Probably a general feeder, has been reared on grasses (7) and *Taraxacum*, NF and central ON south to n. MI, MN, NC (mountains), OH, PA, and WI, may be locally common, 1 generation, larvae possibly in June (1, 4).
	Egira	*dolosa*	*Populus tremuloides*, occurs across southern Canada south to ?, common, other *Egira* spp. with 1 generation, mature larvae from mid-May-late August (6, 7, 8).
	Enargia	*infumata*	*Populus*, transcontinental across Canada and northern U.S., larvae from mid May-late August (2, 6).
	Euplexia	*benesimilis*	Ferns and many plants including *Alnus*, *Aster*, *Gaylussacia*, *Helianthus*, *Salix*, and *Trillium*, common, occurs across southern Canada south to northern AR, 2 generations, larvae from late May-late September (1, 6).

Table 4. Species of moths recorded from the Grand Portage National Monument (GRPO) potentially susceptible to Btk treatment used to slow the spread of the gypsy moth, *Lymantria dispar* (Linnaeus) (continued).

Family	Genus	Species	Larval hosts, distribution, and abundance[1]
Noctuidae	*Eupsilia*	*tristigmata*	Many plants including *Acer*, *Prunus* (cherry) , and *Quercus*, occurs across southern Canada south to N.C. west to S.D., common, adults overwinter, 1 generation, larvae from late May-late July (1, 6, 8).
	Eurois	*astricta*	Feeds mainly on *Acer*, *Alnus*, *Betula*, *Populus*, *Prunus*, *Salix*, *Spiraea*, and *Viburnum*, range similar to that of E. occulta, except for Greenland and Iceland, common, 1 generation, larva overwinters, in June and August (4, 6. 7).
	Eurois	*occulta*	Reported from many plants including *Acer*, *Betula*, *Delphinium*, *Larix laricina*, *Prunus*, *Spiraea*, *Symphoricarpos*, and *Vaccinium*, in Greenland, may defoliate large areas of all vegetation, NF west across Canada to AK, South to NY, northern OH, southern WI to OR and NM, also Eurasia, common, apparently 1 generation, larvae from late May-late August (2, 4, 6, 7).
	Euxoa	*campestris*	Larval host plants unrecorded, ranges from NF to AK and across northern U.S., no data on abundance, no life history data but larvae probably in June (2, 3).
	Feltia	*herilis*	Larva a cutworm of many plants including *Phaseolus*, *Prunus*, *Trifolium*, and *Zea*, NS west to BC and WA, south to AL, common, 1 generation, larvae apparently in late June-July (1, 2).
	Feralia	*comstocki*	*Abies*, *Picea*, *Pinus*, and *Tsuga*, transcontinental across Canada south to N.C. and MN, common, 1 generation, larvae from mid June-mid-September (1, 6, 8).
	Hyppa	*xylinoides*	Forbs and low woody plants across southern Canada south to northern GA, 2 (?) generations with mature larvae from June-July and September-October (8).
	Idia	*aemula*	Larvae reared on dead *Prunus* and *Quercus* leaves, across Canada south to FL and TX, common, 2 or more generatons, larvae possibly year around (8).
	Idia	*americalis*	Grasses and decayed wood, common from Canada south, common, larvae apparently from June-July (1).
	Idia	*lubricalis*	Fungi and lichens, Canada south to FL and TX, common, 1 generaton (north), larvae overwinter, May-August (8).
	Ipimorpha	*pleonectusa*	*Populus*, NS west to MB, south to KY and MO, uncommon, larvae from mid May-mid August (1, 6).
	Litholomia	*napaea*	*Populus tremuloides*, southern Canada and northern U.S., common, 1 generation, adult overwinters, larvae probably from June-July (2, 6, 7).

Table 4. Species of moths recorded from the Grand Portage National Monument (GRPO) potentially susceptible to Btk treatment used to slow the spread of the gypsy moth, *Lymantria dispar* (Linnaeus) (continued).

Family	Genus	Species	Larval hosts, distribution, and abundance[1]
Noctuidae	*Lithophane*	*innominata*	Many woody plants including *Abies*, *Acer*, *Alnus*, *Betula*, *Picea*, *Pinus*, *Prunus*, *Pyrus*, *Rosa*, *Rubus*, *Salix*, *Tilia*, and *Tsuga*, transcontinental across Canada south to GA and Great Lakes, 1 generation, mature larvae late May-late July (6, 8).
	Lithophane	*petulca*	Hosts include *Alnus*, *Betula*, *Fraxinus*, *Ulmus*, *Populus*, *Salix*, and *Tilia*, southern Canada south to FL west to MN, common, 1 generation, mature larvae from early June-early August (1, 6, 8).
	Lithophane	*pexata*	Possibly *Alnus*, transcontinental across Canada, (and northern U.S.?), 1 generation, larvae from mid May-mid September (2, 6, 7).
	Lithophane	*antennata*	Hosts include *Fraxinus*, *Prunus*, *Pyrus*, *Quercus*, *Ulmus*, *Salix*, *Vaccinium*, and many other plants, occurs across southern Canada south to SC and MS, common, adults overwinter, 1 generation, mature larvae from June-July (1, 6, 8).
	Lithophane	*unimoda*	Mature larvae prefer *Prunus* spp. (cherry and plum) many other hosts reported e.g. *Acer*, *Populus*, *Quercus*, and *Salix* but may include misidentifications, occurs across southern Canada south to Neb. and MO., common, adults Overwinter, 1 generation mature larvae from late May - July. (1, 6, 8).
	Morrisonia	*latex*	Many plants including *Acer*, *Betula*, *Fagus*, *Fraxinus*, *Ostrya*, *Populus*, *Prunus*, *Quercus*, *Salix*, *Tilia*, *Ulmus*, and *Vaccinium*, southern Canada south to GA, common, mature larvae from early June-mid August (6, 8).
	Oligia	*illocata*	Larvae feed on *Alnus*, *Betula* and *Salix*, NS west across southern Canada, south to KY and MO, common, larvae late May-early July (1, 2, 6).
	Orthosia	*hibisci*	Many species of woody shrubs and broadleaf coniferous trees e.g. *Abies*, *Acer*, *Populus*, *Prunus*, *Ribes*, and *Salix*, larva the speckled green fruitworm, common, Canada to FL and TX. 1 generation mature larvae from mid-May-August (6, 8).
	Orthosia	*revicta*	*Betula*, *Populus*, *Prunus*, and other hardwoods southern Canada south to NJ and KY, west to MB, common northward, mid May-late September (1, 6).
	Panthea	*acronyctoides*	*Abies*, *Larix*, *Picea*, *Pinus* and *Tsuga*, common, southern Canada south to the Great Lakes and GA (mountains), 1 generation northward, mature larvae in June. (1, 7).
	Phlogophora	*periculosa*	*Alnus*, *Populus balsamifera*, *Prunus*, and *Vaccinium*, transcontinental across Canada south to SC and AR, locally common, larvae may overwinter, present early June-July (1, 6).

Table 4. Species of moths recorded from the Grand Portage National Monument (GRPO) potentially susceptible to Btk treatment used to slow the spread of the gypsy moth, *Lymantria dispar* (Linnaeus) (continued).

Family	Genus	Species	Larval hosts, distribution, and abundance[1]
Noctuidae	*Plusia*	*contexta*	Grasses, NS west to SK, south to NJ, OH, PA, IL and NE, locally common, 2 generations, larvae apparently from June-July (1, 5).
	Polia	*purpurissata*	*Alnus*, *Betula*, *Vaccinium*, and other woody plants, NS west across southern Canada south to MO and SD, common northward, 1 generation, larvae apparently from June-July (1).
	Pseudaletia	*unipuncta*	Larva (Armyworm) is a serious pest that feeds on various grasses forbs crops garden plants and woody species, common-abundant distributed worldwide, 2-3 generations in the East, year around in the South, mature larvae from late May-August (8).
	Pseudorthodes	*vecors*	*Aster*, *Taraxacum*, grasses, and other low plants; common across southern Canada south to MO and NC 1 generation, larvae possibly in June (1, 2).
	Sideridis	*rosea*	*Elaeagnus*, *Ribes*, *Salix* and *Shepherdia*, southern Canada south to NJ west to MA and MN, 2 generations, larvae possibly June-July (1, 2).
	Syngrapha	*octoscripta*	*Vaccinium*, across Canada and AK, south to n. OH, MN PA and southern WI, 1 generation, larvae apparently from June-July (5).
	Syngrapha	*rectangula*	*Abies*, *Larix*, *Picea*, *Pinus*, *Tsuga* and other conifers, transcontinental across Canada south to MI, MN, PA and northern WI, common, 1 generation, larvae apparently from June-July (1, 5).
	Syngrapha	*viridisigma*	Many coniferous trees, mainly *Abies balsamea* and *Picea glauca*, Canada and the northern U.S., 1 generation, larvae apparently from June-July (5).
	Trichoplusia	*ni*	Larva (cabbage Looper) may be a pest on many herbaceous plants including *Asparagus*, *Brasisca*, *Nicotiana*, *Phaseolus*, and *Zea*, southern Canada south to FL and TX, common-abundant, 1 generation (3 or more in South), Mature larvae June-July (7).
	Xestia	*c-nigrum*	Larva (spotted cutworm) feeds on *Acer*, *Chenopodium* (goosefoot), *Prunus*, *Trifolium*, *Zea*, ranges from NF west to AK south to NC in the East and NM in the West, 2 generations, larvae in late May-June and again in August-September (4, 7).
	Xestia	*normaniana*	Host plants include *Myrica*, *Prunus*, *Spiraea*, and *Vaccinium*, occurs from NS to western AB south to NC and KY west to MI, northern MN and WI, locally common, larvae probably in late June-July (1, 4).
	Xestia	*smithii*	Host plants include *Alnus*, *Betula*, *Fragaria*, *Prunus*, and *Viola*, transatlantic across Canada and much of U.S. including AK, locally common northward, may be a pest on strawberry, (1, 4).

Table 4. Species of moths recorded from the Grand Portage National Monument (GRPO) potentially susceptible to Btk treatment used to slow the spread of the gypsy moth, *Lymantria dispar* (Linnaeus) (continued).

Family	Genus	Species	Larval hosts, distribution, and abundance[1]
Noctuidae	*Xestia*	*badicollis*	*Pinus strobus* less commonly *Abies*, *Larix*, *Picea*, and *Tsuga*, eastern Canada south to WV and west to Great Lakes states, 1 generation with larvae from May-June (8).
	Xylena	*curvimacula*	Hosts include *Alnus*, *Populus*, *Salix*, *Taraxacum*, and others, occurs across Canada south to MN, common northward, 1 generation, adult overwinters larvae mid May-early August (1, 2, 6).
	Zale	*minerea*	Numerous plants including *Acer*, *Betula*, *Fagus*, and *Populus*, widespread throughout eastern U.S., common, 1-2 generations in the upper Midwest, mature larvae from May-August (1, 8).
	Zanclognatha	*jacchusalis*	Probably dead leaves, NS south to FL west to MO and AR, common, larvae possibly year around (1, 8).
	Zanclognatha	*ochreipennis*	Probably dead leaves, ME south to SC west to MO and LA, common, 2 generations, larvae possibly year around (1, 8).

[1] References: 1- Covell (2005), 2- Forbes (1954), 3- Lafontaine (1987), 4- Lafontaine (1998), 5- Lafontaine and Poole (1991), 6- Prentice (1962), 7- Rockburne and Lafontaine (1976), 8- Wagner (2005), 9- Wagner et al. (2001).

An additional 120 species of moths for which life history data are known are potentially susceptible to Btk (Table 4). Species recorded as larvae “probably” feeding in June were based on when adults were collected (Table 4 and Appendix A). With few exceptions, moth species listed in Table 2 are common and widespread across southern Canada, the northern U.S. and the Great Lakes states. Only 14 species collected at GRPO in 2008 are considered uncommon throughout their range.

Some species listed in Table 4 may not be greatly affected by Btk spraying. These would include species of *Idia* and *Zanclognatha* that feed on fungi, lichens, and dead leaves on the forest floor and those that feed on low growing plants and may not come into direct contact with Btk. Some species of cutworms may not be at risk, as they are typically not found in heavily forested habitats. Cutworms that migrate north in late summer would no doubt repopulate the affected area.

Conclusions

Unless the Grand Portage National Monument and the surrounding Grand Portage Indian Reservation is repeatedly sprayed with Btk for many years, I do not believe that its use would have a long-term adverse effect on most species of butterflies and moths that inhabit the Monument. As the majority of the butterflies and moths that occur at GRPO are common and widespread, most would repopulate the Grand Portage National Monument within several years following a one-year treatment with Btk. However, the application of Btk near the riparian zone of Grand Portage Creek, the Heritage Center (approximately 450 m (1,476 ft) from the meadow), or the stockade would likely have a major impact on the Baltimore checkerspot, *E. phaeton*. As stated above, this species is rare and populations are very local. In fact, the only other population of *E. phaeton* known from Cook County, Minnesota, is located ca. 56 km (35 mi) from the monument. Larvae overwinter and complete their development in May and June of the following year. The length of the larval feeding period at GRPO is not known, but apparently extends throughout June and into early July when Btk would be applied. This conclusion was supported in 2008 by the observation of one adult at the meadow site on 14 July and another captured on 28 July. Estimating the length of the pupal stage as 10 days means that larvae of *E. phaeton* feed into late June and early July and would be at great risk to Btk treatment. If the population of *E. phaeton* were eliminated in the riparian zone of Grand Portage Creek (the likely larval habitat), or the meadow, it is highly unlikely that this rare and very local butterfly would ever recolonize the Grand Portage Monument. For this reason, Btk should never be applied around or near the riparian zone of the Grand Portage Creek, wet meadow, stockade, maintenance shop or, because of drift, the Grand Portage Heritage Center.

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Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008.

Site locations are the Maintenance shop (1) and the Heritage Center (2).

Date	Site	Family, Genus species	No.
5/8/2008	1	Noctuidae, *Orthosia revicta*	1
5/8/2008	1	Noctuidae, *Orthosia hibisci*	1
5/14/2008	1	Noctuidae, *Lithophane pexata*	1
5/14/2008	1	Noctuidae, *Cerastis salicarum*	1
5/16/2008	1	Noctuidae, *Panthea acronyctoides*	1
5/16/2008	1	Noctuidae, *Xylena curvimacula*	2
5/16/2008	1	Noctuidae, *Eupsilia tristigmata*	1
5/16/2008	1	Noctuidae, *Orthosia revicta*	1
5/16/2008	1	Noctuidae, *Orthodes obscura*	1
5/16/2008	1	Noctuidae, *Egira dolosa*	2
5/22/2008	1	Thyatiridae, *Euthyatira pudens*	1
5/22/2008	1	Geometridae, *Lobophora nivigerata*	1
5/22/2008	1	Noctuidae, *Xylena curvimacula*	1
5/22/2008	1	Noctuidae, *Feralia comstocki*	1
5/22/2008	1	Geometridae, *Ectropis crepuscularia*	1
5/22/2008	1	Geometridae, *Anticlea vasiliata*	1
5/22/2008	1	Geometridae, *Cladara limitaria*	2
5/22/2008	1	Noctuidae, *Litholomia napaea*	1
5/22/2008	1	Noctuidae, *Orthosia revicta*	2
5/22/2008	1	Noctuidae, *Orthosia hibisci*	1
5/22/2008	1	Noctuidae, *Egira dolosa*	2
5/22/2008	2	Geometridae, *Anticlea vasiliata*	1
5/22/2008	2	Geometridae, *Cladara atroliturata*	1
5/22/2008	2	Noctuidae, *Lithophane unimoda*	1
5/22/2008	2	Noctuidae, *Stretchia plusiaeformis*	1
5/23/2008	1	Thyatiridae, *Euthyatira pudens*	1
5/23/2008	1	Thyatiridae, *Euthyatira pudens*	1
5/23/2008	1	Geometridae, *Aethalura intertexta*	2
5/23/2008	1	Geometridae, *Protoboarmia porcelaria indicataria*	1
5/23/2008	1	Geometridae, *Cladara limitaria*	1
5/23/2008	1	Noctuidae, *Xylena curvimacula*	1
5/23/2008	1	Noctuidae, *Lithophane antennata*	1
5/23/2008	1	Noctuidae, *Litholomia napaea*	1
5/23/2008	1	Noctuidae, *Feralia comstocki*	3
5/23/2008	1	Noctuidae, *Orthosia revicta*	1
5/23/2008	1	Noctuidae, *Orthosia hibisci*	1
5/27/2008	1	Thyatiridae, *Euthyatira pudens*	1

Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008 (continued).

Date	Site	Family, Genus species	No.
5/27/2008	1	Geometridae, *Aethalura intertexta*	3
5/27/2008	1	Geometridae, *Melanolophia signataria*	3
5/27/2008	1	Geometridae, *Metarranthis duaria*	1
5/27/2008	1	Geometridae, *Acasis viridata*	1
5/27/2008	1	Geometridae, *Cladara atroliturata*	2
5/27/2008	1	Noctuidae, *Xylena curvimacula*	5
5/27/2008	1	Noctuidae, *Feralia comstocki*	3
5/27/2008	1	Noctuidae, *Orthosia revicta*	3
5/27/2008	1	Noctuidae, *Cerastis salicarum*	1
5/27/2008	2	Thyatiridae, *Euthyatira pudens*	1
5/27/2008	2	Noctuidae, *Eupsilia tristigmata*	3
5/27/2008	2	Noctuidae, *Xylena curvimacula*	2
5/27/2008	2	Noctuidae, *Feralia comstocki*	5
5/27/2008	2	Noctuidae, *Stretchia plusiaeformis*	1
5/30/2008	1	Thyatiridae, *Euthyatira pudens*	1
5/30/2008	1	Noctuidae, *Litholomia napaea*	2
5/30/2008	1	Noctuidae, *Crocigrapha normani*	1
5/30/2008	1	Noctuidae, *Egira dolosa*	2
5/30/2008	1	Noctuidae, *Cerastis salicarum*	1
5/30/2008	2	Thyatiridae, *Euthyatira pudens*	1
5/30/2008	2	Geometridae, *Cladara limitaria*	1
5/30/2008	2	Sphingidae, *Smerinthus cerisyi*	1
5/30/2008	2	Notodontidae, *Clostera albosigma*	1
5/30/2008	2	Notodontidae, *Gluphisia septentronis*	1
5/30/2008	2	Noctuidae, *Lithophana innominata*	1
5/30/2008	2	Noctuidae, *Lithophana petulca*	1
5/30/2008	2	Noctuidae, *Crocigrapha normani*	1
5/30/2008	2	Noctuidae, *Cerastis salicarum*	1
6/2/2008	1	Sphingidae, *Smerinthus cerisyi*	1
6/2/2008	1	Noctuidae, *Panthea acronyctoides*	1
6/2/2008	1	Noctuidae, *Feralia comstocki*	1
6/2/2008	1	Noctuidae, *Orthosia revicta*	1
6/2/2008	1	Noctuidae, *Egira dolosa*	1
6/2/2008	2	Geometridae, *Cladara atroliturata*	1
6/2/2008	2	Noctuidae, *Zale minerea*	1
6/2/2008	2	Noctuidae, *Feralia comstocki*	1
6/4/2008	1	Geometridae, *Hydriomena divisaria*	2
6/4/2008	1	Geometridae, *Hydriomena renunciata*	1
6/4/2008	1	Geometridae, *Euphyia intermediata*	1
6/4/2008	1	Geometridae, *Cladara atroliturata*	1
6/4/2008	1	Geometridae, *Lobophora nivigerata*	1

Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008 (continued).

Date	Site	Family, Genus species	No.
6/4/2008	1	Noctuidae, *Orthosia revicta*	1
6/4/2008	1	Noctuidae, *Orthosia hibisci*	1
6/4/2008	1	Noctuidae, *Crocigrapha normani*	1
6/4/2008	2	Geometridae, *Ectropis crepuscularia*	1
6/4/2008	2	Geometridae, *Eutrapela clemataria*	1
6/4/2008	2	Geometridae, *Euphyia intermediata*	1
6/4/2008	2	Notodontidae, *Clostera albosigma*	1
6/4/2008	2	Noctuidae, *Lithophana innominata*	2
6/4/2008	2	Noctuidae, *Orthodes cynica*	1
6/10/2008	2	Geometridae, *Eutrapela clemataria*	1
6/16/2008	1	Geometridae, *Ectropis crepuscularia*	1
6/16/2008	1	Geometridae, *Tacparia detersata*	1
6/16/2008	1	Sphingidae, *Smerinthus jamaicensis*	1
6/16/2008	1	Sphingidae, *Smerinthus cerisyi*	1
6/16/2008	1	Notodontidae, *Gluphisia septentronis*	1
6/16/2008	1	Noctuidae, *Pseudaletia unipuncta*	2
6/16/2008	2	Geometridae, *Melanolophia signataria*	1
6/16/2008	2	Geometridae, *Tacparia detersata*	1
6/16/2008	2	Geometridae, *Hydriomena divisaria*	1
6/16/2008	2	Sphingidae, *Smerinthus jamaicensis*	1
6/16/2008	2	Sphingidae *Paonias excaecatus*	1
6/16/2008	2	Notodontidae, *Gluphisia septentronis*	1
6/16/2008	2	Noctuidae, *Bellura obliqua*	1
6/16/2008	2	Noctuidae, *Cucullia intermedia*	1
6/16/2008	2	Noctuidae, *Pseudaletia unipuncta*	1
6/18/2008	1	Geometridae, *Euchlaena marginaria*	1
6/18/2008	1	Geometridae, *Homochlodes fritillaria*	1
6/18/2008	1	Geometridae, *Selenia kentaria*	1
6/18/2008	1	Geometridae, *Probole alienaria*	1
6/18/2008	1	Geometridae, *Nepytia canosaria*	1
6/18/2008	1	Geometridae, *Hydriomena divisaria*	2
6/18/2008	1	Sphingidae, *Smerinthus cerisyi*	1
6/18/2008	1	Sphingidae, *Pachysphinx modesta*	1
6/18/2008	1	Noctuidae, *Pseudaletia unipuncta*	1
6/18/2008	1	Noctuidae, *Orthodes cynica*	1
6/18/2008	1	Noctuidae, *Orthodes obscura*	1
6/18/2008	2	Drepanidae, *Drepana arcuata*	1
6/18/2008	2	Geometridae *Eufidonia convergaria*	1
6/18/2008	2	Lasiocampidae, *Phyllodesma americana*	1
6/18/2008	2	Saturniidae, *Actias luna*	1
6/18/2008	2	Notodontidae, *Gluphisia septentronis*	1

Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008 (continued).

Date	Site	Family, Genus species	No.
6/18/2008	2	Noctuidae, *Anagrapha falcifera*	1
6/18/2008	2	Noctuidae, *Sideridis rosea*	1
6/19/2008	1	Geometridae, *Euchlaena marginaria*	1
6/19/2008	1	Geometridae, *Metarranthis duaria*	1
6/19/2008	1	Notodontidae, *Gluphisia septentronis*	1
6/19/2008	1	Noctuidae, *Spirameter lutra*	1
6/19/2008	1	Noctuidae, *Lacinipolia lorea*	1
6/19/2008	2	Notodontidae, *Gluphisia septentronis*	2
6/19/2008	2	Noctuidae, *Pseudaletia unipuncta*	1
6/19/2008	2	Noctuidae, *Orthodes obscura*	1
6/23/2008	1	Geometridae, *Plagodis phlogosaria*	1
6/23/2008	1	Geometridae, *Hydriomena divisaria*	1
6/23/2008	1	Sphingidae, *Smerinthus cerisyi*	3
6/23/2008	1	Sphingidae, *Ceratomia undulosa*	3
6/23/2008	1	Notodontidae, *Gluphisia septentronis*	5
6/23/2008	1	Noctuidae, *Zale minerea*	1
6/23/2008	1	Noctuidae, *Bellura obliqua*	1
6/23/2008	1	Noctuidae, *Apamea* nr. *dubitans*	1
6/23/2008	1	Noctuidae, *Pseudaletia unipuncta*	1
6/23/2008	2	Drepanidae, *Drepana arcuata*	1
6/23/2008	2	Geometridae, *Macaria bisignata*	1
6/23/2008	2	Geometridae, *Euchlaena marginaria*	1
6/23/2008	2	Saturniidae, *Antheraea polyphemus*	2
6/23/2008	2	Sphingidae, *Smerinthus cerisyi*	2
6/23/2008	2	Sphingidae, *Pachysphinx modesta*	1
6/23/2008	2	Notodontidae, *Nadata gibbosa*	1
6/23/2008	2	Notodontidae, *Gluphisia septentronis*	5
6/23/2008	2	Arctiidae, *Phragmatobia assimilans*	1
6/23/2008	2	Noctuidae, *Bomolocha abalienalis*	1
6/23/2008	2	Noctuidae, *Apamea* nr. *impulsa*	1
6/23/2008	2	Noctuidae, *Bellura obliqua*	1
6/23/2008	2	Noctuidae, *Spirameter grandis*	1
6/23/2008	2	Noctuidae, *Lacinipolia lorea*	1
6/23/2008	2	Noctuidae, *Pseudaletia unipuncta*	1
6/23/2008	2	Noctuidae, *Orthodes cynica*	1
6/25/2008	1	Sphingidae, *Smerinthus cerisyi*	2
6/25/2008	1	Noctuidae, *Anagrapha falcifera*	1
6/25/2008	1	Noctuidae, *Bellura obliqua*	1
6/25/2008	1	Noctuidae, *Hyppa xylinoides*	1
6/25/2008	1	Noctuidae, *Pseudaletia unipuncta*	1
6/25/2008	2	Saturniidae, *Actias luna*	1

Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008 (continued).

Date	Site	Family, Genus species	No.
6/25/2008	2	Sphingidae, *Smerinthus cerisyi*	2
6/25/2008	2	Sphingidae *Paonias excaecatus*	1
6/25/2008	2	Sphingidae, *Pachysphinx modesta*	1
6/25/2008	2	Notodontidae, *Gluphisia septentronis*	2
6/25/2008	2	Noctuidae, *Pseudaletia unipuncta*	1
6/26/2008	4	Geometridae, *Melanolophia signataria*	1
6/26/2008	4	Geometridae, *Rheumaptera subhastata*	1
6/27/2008	1	wet specimens, few identified:	
6/27/2008	1	Noctuidae, *Lacinipolia lorea*	1
6/27/2008	2	wet specimens, few identified:	
6/27/2008	2	Notodontidae, *Gluphisia septentronis*	1
6/30/2008	1	Geometridae, *Pero ancetaria*	1
6/30/2008	1	Geometridae, *Tetracis cachexiata*	2
6/30/2008	1	Geometridae, *Lobophora nivigerata*	1
6/30/2008	1	Sphingidae, *Smerinthus cerisyi*	1
6/30/2008	1	Saturniidae, *Antheraea polyphemus*	1
6/30/2008	1	Sphingidae, *Ceratomia undulosa*	1
6/30/2008	1	Sphingidae, *Smerinthus jamaicensis*	1
6/30/2008	1	Sphingidae, *Smerinthus cerisyi*	2
6/30/2008	1	Notodontidae, *Gluphisia septentronis*	12
6/30/2008	1	Arctiidae, *Ctenucha virginica*	1
6/30/2008	1	Noctuidae, *Eueretagrotis perattenta*	1
6/30/2008	1	Noctuidae, *Bellura obliqua*	1
6/30/2008	1	Noctuidae, *Spirameter grandis*	1
6/30/2008	1	Noctuidae, *Lacinipolia lorea*	3
6/30/2008	1	Noctuidae, *Orthodes cynica*	2
6/30/2008	1	Noctuidae, *Orthodes obscura*	2
6/30/2008	2	Geometridae, *Biston betularia cognataria*	1
6/30/2008	2	Sphingidae, *Smerinthus jamaicensis*	4
6/30/2008	2	Sphingidae, *Smerinthus cerisyi*	5
6/30/2008	2	Sphingidae, *Paonias excaecatus*	1
6/30/2008	2	Sphingidae, *Pachysphinx modesta*	1
6/30/2008	2	Notodontidae, *Gluphisia septentronis*	11
6/30/2008	2	Arctiidae, *Phragmatobia assimilans*	1
6/30/2008	2	Noctuidae, *Acronicta americana*	1
6/30/2008	2	Noctuidae, *Phlogophora iris*	1
6/30/2008	2	Noctuidae, *Hyppa xylinoides*	1
7/2/2008	2	Geometridae, *Tetracis cachexiata*	1
7/2/2008	2	Geometridae, *Dysstroma hersiliata*	1
7/2/2008	2	Saturniidae, *Antheraea polyphemus*	1
7/2/2008	2	Sphingidae, *Smerinthus cerisyi*	5

Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008 (continued).

Date	Site	Family, Genus species	No.
7/2/2008	2	Sphingidae, *Ceratomia undulosa*	1
7/2/2008	2	Notodontidae, *Clostera strigosa*	1
7/2/2008	2	Notodontidae, *Clostera apicalis*	1
7/2/2008	2	Notodontidae, *Pheosia rimosa*	1
7/2/2008	2	Notodontidae, *Gluphisia septentronis*	35
7/2/2008	2	Noctuidae, *Apamea sordens*	1
7/2/2008	2	Noctuidae, *Acronicta lepusculina*	1
7/2/2008	2	Noctuidae, *Acronicta grisea*	3
7/2/2008	2	Noctuidae, *Bellura obliqua*	1
7/2/2008	2	Noctuidae, *Lacinipolia lorea*	2
7/2/2008	2	Noctuidae, *Leucania multilinea*	1
7/2/2008	2	Noctuidae, *Aplectoides condita*	2
7/4/2008	1	Drepanidae, *Drepana arcuata*	1
7/4/2008	1	Geometridae, *Pero ancetaria*	1
7/4/2008	1	Geometridae, *Metanema determinata*	1
7/4/2008	1	Geometridae, *Dysstroma citrata*	1
7/4/2008	1	Geometridae, *Mesoleuca ruficillata*	1
7/4/2008	1	Geometridae, *Xanthorhoe labradorensis*	1
7/4/2008	1	Geometridae, *Epirrhoe alternata*	1
7/4/2008	1	Sphingidae, *Smerinthus cerisyi*	3
7/4/2008	1	Sphingidae, *Ceratomia undulosa*	2
7/4/2008	1	Sphingidae, *Smerinthus jamaicensis*	1
7/4/2008	1	Sphingidae, *Pachysphinx modesta*	1
7/4/2008	1	Notodontidae, *Gluphisia septentronis*	19
7/4/2008	1	Noctuidae, *Anagrapha falcifera*	1
7/4/2008	1	Noctuidae, *Acronicta grisea*	1
7/4/2008	1	Noctuidae, *Acronicta fragilis*	1
7/4/2008	1	Noctuidae, *Acronicta noctivaga*	1
7/4/2008	1	Noctuidae, *Phlogophora iris*	1
7/4/2008	1	Noctuidae, *Lacinipolia renigera*	1
7/4/2008	1	Noctuidae, *Lacinipolia lorea*	3
7/4/2008	1	Noctuidae, *Morrisonia latex*	1
7/4/2008	1	Noctuidae, *Pseudorthodes vecors*	4
7/4/2008	1	Noctuidae, *Orthodes cynica*	4
7/4/2008	1	Noctuidae, *Paradiarsia littoralis*	2
7/4/2008	1	Noctuidae, *Aplectoides condita*	1
7/4/2008	2	Sphingidae, *Smerinthus jamaicensis*	1
7/4/2008	2	Sphingidae, *Smerinthus cerisyi*	2
7/4/2008	2	Notodontidae, *Gluphisia septentronis*	24
7/4/2008	2	Arctiidae, *Spilosoma congrua*	1
7/4/2008	2	Noctuidae, *Acronicta grisea*	1

Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008 (continued).

Date	Site	Family, Genus species	No.
7/4/2008	2	Noctuidae, *Lacinipolia lorea*	4
7/7/2008	1	Geometridae, *Biston betularia cognataria*	1
7/7/2008	1	Geometridae, *Pero* sp.	1
7/7/2008	1	Geometridae, *Rheumaptera subhastata*	1
7/7/2008	1	Geometridae, *Lobophora nivigerata*	2
7/7/2008	1	Sphingidae, *Ceratomia undulosa*	5
7/7/2008	1	Sphingidae, *Sphinx kalmiae*	1
7/7/2008	1	Sphingidae, *Smerinthus jamaicensis*	3
7/7/2008	1	Sphingidae, *Smerinthus cerisyi*	4
7/7/2008	1	Sphingidae, *Paonias excaecatus*	1
7/7/2008	1	Notodontidae, *Nadata gibbosa*	2
7/7/2008	1	Notodontidae, *Peridea ferruginea*	1
7/7/2008	1	Notodontidae, *Gluphisia septentronis*	57
7/7/2008	1	Arctiidae, *Ctenucha virginica*	1
7/7/2008	1	Noctuidae, *Plusia putnami*	1
7/7/2008	1	Noctuidae, Acronicta americana	1
7/7/2008	1	Noctuidae, *Plusia putnami*	1
7/7/2008	1	Noctuidae, *Acronicta superans*	1
7/7/2008	1	Noctuidae, *Bellura obliqua*	1
7/7/2008	1	Noctuidae, *Euplexia benesimilis*	1
7/7/2008	1	Noctuidae, *Phlogophora iris*	1
7/7/2008	1	Noctuidae, *Spirameter grandis*	1
7/7/2008	1	Noctuidae, *Lacinipolia lorea*	9
7/7/2008	1	Noctuidae, *Pseudaletia unipuncta*	2
7/7/2008	1	Noctuidae, *Morrisonia latex*	1
7/7/2008	1	Noctuidae, *Paradiarsia littoralis*	4
7/7/2008	2	Drepanidae, *Drepana arcuata*	1
7/7/2008	2	Geometridae, *Xanthotype urticaria*	1
7/7/2008	2	Geometridae, *Pero ancetaria*	1
7/7/2008	2	Geometridae, *Caripeta divisata*	1
7/7/2008	2	Geometridae, *Euphyia intermediata*	1
7/7/2008	2	Saturniidae, *Actias luna*	1
7/7/2008	2	Lasiocampidae, *Phyllodesma americana*	1
7/7/2008	2	Sphingidae, *Smerinthus cerisyi*	4
7/7/2008	2	Notodontidae, *Clostera strigosa*	1
7/7/2008	2	Notodontidae, *Gluphisia septentronis*	36
7/7/2008	2	Noctuidae, *Plusia contexta*	1
7/7/2008	2	Noctuidae, *Apamea sordens*	1
7/7/2008	2	Noctuidae, *Lacinipolia lorea*	1
7/7/2008	2	Noctuidae, *Orthodes obscura*	1
7/7/2008	2	Noctuidae, nr. *Euxoa divergens*	1

Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008 (continued).

Date	Site	Family, Genus species	No.
7/7/2008	2	Noctuidae, *Paradiarsia littoralis*	1
7/9/2008	1	Geometridae, *Xanthotype urticaria*	1
7/9/2008	1	Geometridae, *Rheumaptera undulata*	1
7/9/2008	1	Lasiocampidae, *Phyllodesma americana*	1
7/9/2008	1	Sphingidae, *Smerinthus jamaicensis*	1
7/9/2008	1	Sphingidae, *Smerinthus cerisyi*	4
7/9/2008	1	Sphingidae, *Paonias excaecatus*	1
7/9/2008	1	Sphingidae, *Ceratomia undulosa*	3
7/9/2008	1	Sphingidae, *Paonias excaecatus*	1
7/9/2008	1	Notodontidae, *Gluphisia septentronis*	40
7/9/2008	1	Noctuidae, *Acronicta americana*	1
7/9/2008	1	Noctuidae, *Lacinipolia lorea*	4
7/9/2008	1	Noctuidae, *Polia nimbosa*	1
7/9/2008	1	Noctuidae, *Pseudorthodes*	4
7/9/2008	1	Noctuidae, *Orthodes cynica*	1
7/9/2008	1	Noctuidae, *Paradiarsia littoralis*	2
7/9/2008	1	Noctuidae, *Eueretagrotis perattenta*	1
7/9/2008	2	Geometridae, *Pero ancetaria*	1
7/9/2008	2	Geometridae, *Hydriomena divisaria*	1
7/9/2008	2	Sphingidae, *Smerinthus jamaicensis*	2
7/9/2008	2	Sphingidae, *Smerinthus cerisyi*	5
7/9/2008	2	Sphingidae, *Pachysphinx modesta*	1
7/9/2008	2	Notodontidae, *Datana ministra*	1
7/9/2008	2	Notodontidae, *Gluphisia septentronis*	40
7/9/2008	2	Arctiidae, *Platacrtia parthenos*	1
7/9/2008	2	Noctuidae, *Charadra deridens*	1
7/9/2008	2	Noctuidae, *Bellura obliqua*	1
7/9/2008	2	Noctuidae, *Spirameter grandis*	1
7/9/2008	2	Noctuidae, *Lacinipolia lorea*	6
7/11/2008	1	Geometridae, *Caripeta divisata*	1
7/11/2008	1	Sphingidae *Paonias excaecatus*	3
7/11/2008	1	Notodontidae, *Gluphisia septentronis*	5
7/11/2008	1	Noctuidae, *Trichoplusia ni*	1
7/11/2008	1	Noctuidae, *Euplexia benesimilis*	1
7/11/2008	1	Noctuidae, *Dypterygia rozmani*	1
7/11/2008	1	Noctuidae, *Pseudorthodes vecors*	1
7/11/2008	1	Noctuidae, *Orthodes cynica*	1
7/11/2008	1	Noctuidae, *Paradiarsia littoralis*	3
7/11/2008	1	Noctuidae, *Pyrrhia exprimens*	1
7/11/2008	2	Sphingidae, *Smerinthus cerisyi*	3
7/11/2008	2	Notodontidae, *Nadata gibbosa*	1

Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008 (continued).

Date	Site	Family, Genus species	No.
7/11/2008	2	Notodontidae, *Gluphisia septentronis*	3
7/11/2008	2	Noctuidae, *Acronicta americana*	1
7/11/2008	2	Noctuidae, *Lacinipolia lorea*	2
7/11/2008	2	Noctuidae, *Xestia badicollis*	1
7/14/2008	1	Specimens wet, unable to identify	
7/14/2008	2	Noctuidae, *Lycophotia phyllohora*	1
7/16/2008	1	Geometridae, *Macaria ulsterata*	1
7/16/2008	1	Geometridae, *Caripeta divisata*	1
7/16/2008	1	Sphingidae, *Smerinthus jamaicensis*	2
7/16/2008	1	Notodontidae, *Gluphisia septentronis*	2
7/16/2008	1	Sphingidae, *Smerinthus jamaicensis*	1
7/16/2008	1	Arctiidae, *Hypoprepia fucosa*	4
7/16/2008	1	Arctiidae, *Holomelina laeta*	1
7/16/2008	1	Noctuidae, *Euxoa campestris*	1
7/16/2008	2	Geometridae, *Xanthotype sospeta*	1
7/16/2008	2	Sphingidae, *Paonias excaecatus*	1
7/16/2008	2	Notodontidae, *Gluphisia septentronis*	5
7/16/2008	2	Noctuidae, *Apamea devastator*	1
7/16/2008	2	Noctuidae, *Bellura obliqua*	2
7/16/2008	2	Noctuidae, *Phlogophora periculosa*	2
7/16/2008	2	Noctuidae, *Polia nimbosa*	2
7/16/2008	2	Noctuidae, *Polia purpurissata*	1
7/18/2008	1	Geometridae, *Hydriomena renunciata*	1
7/18/2008	2	Sphingidae, *Smerinthus jamaicensis*	4
7/18/2008	2	Sphingidae, *Smerinthus cerisyi*	1
7/18/2008	2	Sphingidae, *Pachysphinx modesta*	1
7/18/2008	2	Notodontidae, *Gluphisia septentronis*	3
7/18/2008	2	Noctuidae, *Idia americalis*	1
7/18/2008	2	Noctuidae, *Lacinipolia lorea*	4
7/18/2008	2	Noctuidae, *Xestia smithii*	1
7/21/2008	2	Geometridae, *Ectropis crepuscularia*	1
7/21/2008	2	Sphingidae, *Smerinthus cerisyi*	2
7/21/2008	2	Sphingidae, *Pachysphinx modesta*	1
7/21/2008	2	Notodontidae, *Gluphisia septentronis*	11
7/21/2008	2	Notodontidae, *Heterocampa biundata*	1
7/21/2008	2	Arctiidae, *Holomelina aurantiaca*	2
7/21/2008	2	Arctiidae, *Grammia virgo*	1
7/21/2008	2	Noctuidae, *Zanclognatha ochreipennis*	1
7/21/2008	2	Noctuidae, *Bellura obliqua*	1
7/21/2008	2	Noctuidae, *Lacinipolia lorea*	4
7/21/2008	2	Noctuidae, *Polia nimbosa*	1

Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008 (continued).

Date	Site	Family, Genus species	No.
7/21/2008	2	Noctuidae, *Diarsia rosaria*	1
7/24/2008	2	Geometridae, *Euchlaena obtusaria*	2
7/24/2008	2	Geometridae, *Euchlaena tigrinaria*	1
7/24/2008	2	Geometridae, *Dysstroma hersiliata*	1
7/24/2008	2	Geometridae, *Rheumaptera undulata*	1
7/24/2008	2	Notodontidae, *Gluphisia septentronis*	10
7/24/2008	2	Arctiidae, *Eilema bicolor*	1
7/24/2008	2	Noctuidae, *Idia americalis*	1
7/24/2008	2	Noctuidae, *Acronicta americana*	2
7/24/2008	2	Noctuidae, *Phlogophora periculosa*	1
7/24/2008	2	Noctuidae, *Enargia infumata*	1
7/24/2008	2	Noctuidae, *Lacinipolia lorea*	3
7/24/2008	2	Noctuidae, *Anhimella contrahens*	2
7/24/2008	2	Noctuidae, *Diarsia jucunda*	3
7/25/2008	2	Drepanidae, *Habrosyne scripta*	1
7/25/2008	2	Geometridae, *Ectropis crepuscularia*	1
7/25/2008	2	Geometridae, *Protoboarmia porcelaria indicataria*	1
7/25/2008	2	Geometridae, *Campaea perlata*	1
7/25/2008	2	Geometridae, *Metarranthis duaria*	2
7/25/2008	2	Geometridae, *Caripeta divisata*	1
7/25/2008	2	Saturniidae, *Actias luna*	1
7/25/2008	2	Sphingidae, *Smerinthus jamaicensis*	1
7/25/2008	2	Notodontidae, *Gluphisia septentronis*	5
7/25/2008	2	Arctiidae, *Hypoprepia fucosa*	2
7/25/2008	2	Arctiidae, *Haploa lecontei*	1
7/25/2008	2	Arctiidae, *Platacrtia parthenos*	1
7/25/2008	2	Arctiidae, *Grammia parthenice*	1
7/25/2008	2	Noctuidae, *Autographa ampla*	1
7/25/2008	2	Noctuidae, *Acronicta innotata*	1
7/25/2008	2	Noctuidae, *Apamea sordens*	1
7/25/2008	2	Noctuidae, *Hyppa xylinoides*	1
7/25/2008	2	Noctuidae, *Agrotis mollis*	1
7/25/2008	2	Noctuidae, *Pyrrhia exprimens*	1
7/29/2008	2	Geometridae, *Campaea perlata*	2
7/29/2008	2	Geometridae, *Sicya macularia*	1
7/29/2008	2	Geometridae, *Nematocampa resistaria*	1
7/29/2008	2	Sphingidae, *Sphinx kalmiae*	1
7/29/2008	2	Sphingidae, *Smerinthus jamaicensis*	1
7/29/2008	2	Sphingidae, *Pachysphinx modesta*	1
7/29/2008	2	Notodontidae, *Gluphisia septentronis*	9
7/29/2008	2	Notodontidae, *Schizura ipomoeae*	1

Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008 (continued).

Date	Site	Family, Genus species	No.
7/29/2008	2	Arctiidae, *Eilema bicolor*	7
7/29/2008	2	Noctuidae, *Idia aemula*	1
7/29/2008	2	Noctuidae *Syngrapha rectangula*	2
7/29/2008	2	Noctuidae, *Apamea devastator*	2
7/29/2008	2	Noctuidae, *Phlogophora periculosa*	2
7/29/2008	2	Noctuidae, *Ipimorpha pleunectusa*	1
7/29/2008	2	Noctuidae, *Hyppa xylinoides*	1
7/29/2008	2	Noctuidae, *Polia nimbosa*	1
7/29/2008	2	Noctuidae, *Polia purpurissata*	8
7/29/2008	2	Noctuidae, *Lacinipolia olivacea*	1
7/29/2008	2	Noctuidae, *Agrotis mollis*	1
7/29/2008	2	Noctuidae, *Eurois astricta*	1
7/29/2008	2	Noctuidae, *Xestia smithii*	1
7/31/2008	2	Geometridae, *Ectropis crepuscularia*	1
7/31/2008	2	Notodontidae, *Gluphisia septentronis*	3
7/31/2008	2	Arctiidae, *Eilema bicolor*	4
7/31/2008	2	Arctiidae, *Hypoprepia fucosa*	2
7/31/2008	2	Noctuidae, *Idia aemula*	1
7/31/2008	2	Noctuidae, *Idia lubricalis*	1
7/31/2008	2	Noctuidae, *Zanclognatha jaccusalis*	1
7/31/2008	2	Noctuidae, *Enargia infumata*	1
7/31/2008	2	Noctuidae, *Lacinipolia lorea*	1
8/6/2008	2	Geometridae, *Xanthotype sospeta*	1
8/6/2008	2	Geometridae, *Dysstroma citrata*	1
8/6/2008	2	Geometridae, *Xanthorhoe lacustrata*	2
8/6/2008	2	Sphingidae, *Pachysphinx modesta*	1
8/6/2008	2	Notodontidae, *Nadata gibbosa*	1
8/6/2008	2	Notodontidae, *Gluphisia septentronis*	2
8/6/2008	2	Arctiidae, *Eilema bicolor*	8
8/6/2008	2	Noctuidae, *Acronicta americana*	2
8/6/2008	2	Noctuidae, *Polia nimbosa*	2
8/6/2008	2	Noctuidae, *Polia purpurissata*	4
8/6/2008	2	Noctuidae, *Feltia subgothica*	6
8/6/2008	2	Noctuidae, *Eurois astricta*	3
8/6/2008	2	Noctuidae, *Xestia normaniana*	1
8/6/2008	2	Noctuidae, *Noctua pronuba*	2
8/8/2008	2	Geometridae, *Campaea perlata*	1
8/8/2008	2	Arctiidae, *Eilema bicolor*	9
8/8/2008	2	Noctuidae, *Idia americalis*	2
8/8/2008	2	Noctuidae, *Panthea acronyctoides*	1
8/8/2008	2	Noctuidae, *Phlogophora periculosa*	4

Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008 (continued).

Date	Site	Family, Genus species	No.
8/8/2008	2	Noctuidae, *Polia purpurissata*	1
8/8/2008	2	Noctuidae, *Lacinipolia olivacea*	2
8/8/2008	2	Noctuidae, *Euxoa comosa ontario*	1
8/8/2008	2	Noctuidae, *Eueretagrotis perattenta*	1
8/8/2008	2	Noctuidae, *Abagrotis alternata*	1
8/13/2008	2	Geometridae, *Macaria bitactata*	2
8/13/2008	2	Geometridae, *Sicya macularia*	1
8/13/2008	2	Notodontidae, *Gluphisia septentronis*	1
8/13/2008	2	Arctiidae, *Eilema bicolor*	7
8/13/2008	2	Arctiidae, *Hypoprepia fucosa*	2
8/13/2008	2	Noctuidae, *Diachrysia aeroides*	1
8/13/2008	2	Noctuidae, *Syngrapha octoscripta*	1
8/13/2008	2	Noctuidae *Syngrapha rectangula*	1
8/13/2008	2	Noctuidae, *Acronicta americana*	1
8/13/2008	2	Noctuidae, *Apamea devastator*	5
8/13/2008	2	Noctuidae, *Oligia illocata*	1
8/13/2008	2	Noctuidae, *Phlogophora periculosa*	3
8/13/2008	2	Noctuidae, *Polia purpurissata*	2
8/13/2008	2	Noctuidae, *Lacinipolia renigera*	2
8/13/2008	2	Noctuidae, *Lacinipolia olivacea*	4
8/13/2008	2	Noctuidae, *Feltia subgothica*	1
8/13/2008	2	Noctuidae, *Feltia herilis*	1
8/13/2008	2	Noctuidae, *Eurois occulta*	2
8/13/2008	2	Noctuidae, *Eurois astricta*	1
8/13/2008	2	Noctuidae, *Xestia normaniana*	1
8/13/2008	2	Noctuidae, *Eueretagrotis perattenta*	5
8/15/2008	2	Geometridae, *Macaria bitactata*	1
8/15/2008	2	Geometridae, *Protoboarmia porcelaria indicataria*	1
8/15/2008	2	Geometridae, *Eustroma semiatrata*	1
8/15/2008	2	Notodontidae, *Clostera albosigm*	1
8/15/2008	2	Notodontidae, *Gluphisia septentronis*	1
8/15/2008	2	Noctuidae, *Idia americalis*	1
8/15/2008	2	Noctuidae, *Syngrapha viridisigma*	1
8/15/2008	2	Noctuidae, *Phlogophora periculosa*	2
8/15/2008	2	Noctuidae, *Polia purpurissata*	1
8/15/2008	2	Noctuidae, *Lacinipolia renigera*	1
8/15/2008	2	Noctuidae, *Lacinipolia olivacea*	1
8/15/2008	2	Noctuidae, *Agrotis vetusta*	2
8/15/2008	2	Noctuidae, *Euxoa comosa ontario*	1
8/15/2008	2	Noctuidae, *Eurois astricta*	1
8/15/2008	2	Noctuidae, *Xestia c-nigrum*	1
8/15/2008	2	Noctuidae, *Xestia smithii*	3

Appendix A. Species of moths collected by date and site at the Grand Portage National Monument, Cook County Minnesota, 2008 (continued).

Date	Site	Family, Genus species	No.
8/15/2008	2	Noctuidae, *Eueretagrotis perattenta*	3
8/20/2008	2	Arctiidae, *Eilema bicolor*	3
8/20/2008	2	Arctiidae, *Hypoprepia fucosa*	1
8/20/2008	2	Arctiidae, *Grammia parthenice*	1
8/20/2008	2	Noctuidae, *Apamea devastator*	1
8/20/2008	2	Noctuidae, *Phlogophora iris*	1
8/20/2008	2	Noctuidae, *Phlogophora periculosa*	2
8/20/2008	2	Noctuidae, *Polia purpurissata*	1
8/20/2008	2	Noctuidae, *Lacinipolia renigera*	3
8/20/2008	2	Noctuidae, *Agrotis vetusta*	3
8/20/2008	2	Noctuidae, *Feltia subgothica*	1
8/20/2008	2	Noctuidae, *Euxoa comosa ontario*	1
8/20/2008	2	Noctuidae, *Eurois occulta*	2
8/20/2008	2	Noctuidae, *Eurois astricta*	1
8/20/2008	2	Noctuidae, *Eueretagrotis perattenta*	1
8/20/2008	2	Noctuidae, *Noctua pronuba*	3
8/22/2008	2	Geometridae, *Nematocampa resistaria*	1
8/22/2008	2	Geometridae, *Dysstroma citrata*	1
8/22/2008	2	Arctiidae, *Grammia parthenice*	1
8/22/2008	2	Lymantriidae, *Lymantria dispar*	3
8/22/2008	2	Noctuidae, *Idia aemula*	1
8/22/2008	2	Noctuidae, *Zanclognatha jaccusalis*	1
8/22/2008	2	Noctuidae *Syngrapha rectangula*	2
8/22/2008	2	Noctuidae, *Lacinipolia renigera*	1
8/22/2008	2	Noctuidae, *Crocigrapha normani*	1
8/22/2008	2	Noctuidae, *Agrotis vetusta*	2
8/22/2008	2	Noctuidae, *Xestia smithii*	2
8/22/2008	2	Noctuidae, *Abagrotis alternata*	2
8/22/2008	2	Noctuidae, *Anaplectoides prasina*	1
8/25/2008	2	Geometridae, *Eulithis testata*	1
8/25/2008	2	Arctiidae, *Eilema bicolor*	1
8/25/2008	2	Noctuidae, *Idia americalis*	1
8/25/2008	2	Noctuidae, *Phlogophora periculosa*	1
8/25/2008	2	Noctuidae, *Lacinipolia renigera*	1
8/25/2008	2	Noctuidae, *Lacinipolia olivacea*	7
8/25/2008	2	Noctuidae, *Agrotis vetusta*	12
8/25/2008	2	Noctuidae, *Eueretagrotis perattenta*	1
8/25/2008	2	Noctuidae, *Abagrotis cupida*	1
Total			1128

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National Park Service
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