

COSEWIC Assessment and Status Report

on the

Hoptree Borer *Prays atomocella*

in Canada



ENDANGERED
2015

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada



COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: 819-938-4125

Fax: 819-938-3984

E-mail: ec.cosepac-cosewic.ec@canada.ca
<http://www.cosewic.gc.ca>

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Hoptree Borer — Photo provided by author.

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COSEWIC Assessment Summary

Assessment Summary – November 2015

Common name

Hoptree Borer

Scientific name

Prays atomocella

Status

Endangered

Reason for designation

This species is dependent on its sole larval host plant, Common Hoptree, which is confined to a narrow swath of southwestern Ontario and currently assessed as Special Concern. This moth has an even more limited range than that of its host – it is known only from the western shore of Point Pelee, and from Pelee Island. Very few individuals have been detected. The most imminent threats include loss of shoreline habitat through erosion, vegetation succession, and invasive plant species.

Occurrence

Ontario

Status history

Designated Endangered in November 2015.



COSEWIC Executive Summary

Hoptree Borer *Prays atomocella*

Wildlife Species Description and Significance

The Hoptree Borer is a small moth (i.e., 17-20 mm wingspan), and the only species of the family Praydidae native to Canada. Despite its small size, the pattern and colour are distinctive, with a black-spotted, pure white forewing and a pinkish rust-brown hindwing and abdomen. Larvae are up to 20 mm long and pale green to yellowish with indistinct lateral lines.

The Hoptree Borer is one of three known insect herbivores that specialize on Common Hoptree, which is currently ranked as Special Concern at the provincial (Ontario) and federal level.

Distribution

Hoptree Borer occurs from the southern Great Lakes region through the Midwestern United States to south-central Texas. Its distribution is more restricted than that of its larval host plant, Common Hoptree. Hoptree Borer is apparently absent from a large portion of the range of Common Hoptree, which extends from the south Atlantic Coastal Plain to the Gulf coast in the southeastern US. In Canada, Hoptree Borer is known only from Point Pelee. It is also suspected to occur on Pelee Island based on the presence of distinctive larval feeding damage. This species ranges over an area of 148 km².

Habitat

Hoptree Borer is dependent on its sole larval host plant, Common Hoptree, which occurs on shoreline habitats of Lake Erie. Common Hoptree often forms the outermost shoreline vegetation with an active natural disturbance regime, primarily wind and wave erosion. Hoptree Borer has been documented only in the largest subpopulations of Common Hoptree, and has not been found in the smaller, more isolated Common Hoptree subpopulations along Lake Erie northeast of Point Pelee.

Biology

The life cycle of the Hoptree Borer is incompletely known. In Ontario there is one generation per year and adults are active from mid- to late June, during which time eggs are laid on the leaves or shoots of Common Hoptree. Only current-year shoots appear to be suitable for larval feeding. The duration of the egg, larval and adult stage are not precisely known, nor has the egg and egg-laying behaviour been described.

Larval development probably starts in the summer months after egg hatch. The larva bores into a young shoot and creates a diagnostic cavity in the woody stem below the shoot. The excavated material is incorporated into a silken cover for the cavity, forming a short tube that probably serves as a shelter to avoid predators and parasites. Larvae probably overwinter in bored-out stems, as in other species of *Prays*. Larval feeding continues the following spring after initiation of plant growth. Larvae leave the stem for pupation, which occurs in a distinctive mesh-like cocoon, often among the host plant flower clusters. Adult feeding has not been documented.

Population Sizes and Trends

Population size is unknown for Hoptree Borer. In 2010, feeding evidence consisted of 84 damaged Common Hoptree shoots, 62 at Point Pelee and 22 at Pelee Island. Previous collection records consist of single individuals collected or observed between 1927 and 2013.

Population trends for Hoptree Borer are not known. There may have been an increasing population trend mirroring the increase in the number of Common Hoptrees at Point Pelee and Pelee Island between 2002 and 2014, as a result of comprehensive surveys, in contrast to apparent declines of this plant between 1982 and 2002. The increase in Common Hoptrees, is suspected to be offset by ongoing and future habitat loss. Common Hoptree is abundant on Point Pelee with over 10,000 mature individuals, constituting 80-90% of the total number of mature individuals known in Canada. Pelee Island is the second largest subpopulation of Common Hoptree, estimated at 1,000 individuals.

Threats and Limiting Factors

Threats to Hoptree Borer include most of those identified for Common Hoptree. The potential threat impact is, however, higher for Hoptree Borer because it does not occur in all Common Hoptree subpopulations. The most imminent threats include shoreline erosion, vegetation succession, shoreline development, recreational activities and invasive plant species. Other potential threats include population outbreaks of the Hoptree Leaf-roller Moth, which can result in nearly complete defoliation of Common Hoptree and may adversely affect Hoptree Borer populations through direct competition and leaf and shoot dieback. Pesticide application for control of Gypsy Moth outbreaks is also known to adversely affect other moth species.

Protection, Status, and Ranks

Hoptree Borer is not legally protected or ranked in any of the jurisdictions where it occurs. Hoptree Borer habitat within Point Pelee National Park is protected under the *National Parks Act*. On Pelee Island, one suspected Hoptree Borer occurrence was on a shoreline next to a road right-of-way, under the jurisdiction of the Municipality of Pelee Island. Other Pelee Island occurrences were in Fish Point Nature Reserve, where habitat is protected under the *Provincial Parks and Conservation Reserves Act*.

Common Hoptree is a species of Special Concern in Canada and Ontario and the species and its habitat are protected by the *Species at Risk Act* and *Endangered Species Act* respectively. Common Hoptree is given a global rank of Secure (G5) by NatureServe, with subnational ranks ranging from Critically Imperilled (S1) to Vulnerable (S3) for New Jersey, New York, and Maryland, but Hoptree Borer has not been documented in these states. It is likely of conservation concern in Wisconsin, where Common Hoptree is ranked Imperilled (S2), with at least one historical occurrence of Hoptree Borer.

TECHNICAL SUMMARY

Prays atomocella

Hoptree Borer

Perceur du ptéléa

Range of occurrence in Canada (province/territory/ocean): Ontario

Demographic Information

Generation time	Probably 1yr
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Unknown
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown; possible increase since 1982 associated with increase in Common Hoptree (COSEWIC 2015).
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. Unknown b. Unknown c. Unknown
Are there extreme fluctuations in number of mature individuals?	Unknown

Extent and Occupancy Information

Estimated extent of occurrence	148 km ²
Index of area of occupancy (IAO) (Always report 2x2 grid value).	28 km ²
Is the population "severely fragmented" i.e., is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	No.
Number of "locations"* (use plausible range to reflect uncertainty if appropriate)	2
Is there an [observed, inferred, or projected] decline in extent of occurrence?	Unknown
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	Unknown
Is there an [observed, inferred, or projected] decline in number of subpopulations?	Not applicable

* See Definitions and Abbreviations on [COSEWIC website](#) and [IUCN](#) (Feb 2014) for more information on this term

Is there an [observed, inferred, or projected] decline in number of "locations"?*	No
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat? <i>Inferred decline in area because there is an observed decline in Common Hoptree habitat</i>	Yes, inferred decline in area.
Are there extreme fluctuations in number of subpopulations?	Unknown
Are there extreme fluctuations in number of "locations"?	Unknown but unlikely
Are there extreme fluctuations in extent of occurrence?	Unknown but unlikely
Are there extreme fluctuations in index of area of occupancy?	Unknown

Number of Mature Individuals (in each subpopulation)

Subpopulations (give plausible ranges)	N Mature Individuals
Point Pelee	Unknown
Pelee Island	Unknown
Total	Unknown

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Not applicable
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Threats (actual or imminent, to populations or habitats, from highest impact to least)

<ul style="list-style-type: none"> i. 7.2 Dams & water management /use ii. 11.1 Habitat shifting & alteration iii. 8.1 Invasive non-native species iv. 8.2 Problematic native species v. 9.3 Agricultural and forestry effluents
Was a threats calculator completed for this species and if so, by whom?
Yes, J. Heron, C. Schmidt, A. Foster, C. Jones

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	Unknown
Is immigration known or possible? <i>Nearest populations are in Michigan, >200 km distant.</i>	Not known but unlikely
Would immigrants be adapted to survive in Canada?	Likely
Is there sufficient habitat for immigrants in Canada?	Unknown
Are conditions deteriorating in Canada?*	Yes
Are conditions for the source population deteriorating?*	Unknown.

* See [Table 3](#) (Guidelines for modifying status assessment based on rescue effect)

Is the Canadian population considered to be a sink? ⁺	Unlikely.
Is rescue from outside populations likely?	No.

Data Sensitive Species

Is this a data sensitive species? No.

Status History

COSEWIC: Designated Endangered in November 2015.
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Status and Reasons for Designation:

Status: Endangered	Alpha-numeric codes: B1ab(iii)+2ab(iii)
Reasons for designation: This species is dependent on its sole larval host plant, Common Hoptree, which is confined to a narrow swath of southwestern Ontario and currently assessed as Special Concern. This moth has an even more limited range than that of its host – it is known only from the western shore of Point Pelee, and from Pelee Island. Very few individuals have been detected. The most imminent threats include loss of shoreline habitat through erosion, vegetation succession, and invasive plant species.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Populations trends unknown.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Endangered B1ab(iii)+2ab(iii) because both the EOO (148 km ²) and IAO (28 km ²) are well below the thresholds for Endangered; meets sub-criterion “a” since there are fewer than 5 locations (2) and meets sub-criterion “b” because there is an inferred, continuing decline (iii) area, extent of habitat based on a projected decline of 126 ha of the species over the next 50 years.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Number of mature individuals is unknown.
Criterion D (Very Small or Restricted Population): Not applicable. Number of mature individuals is unknown.
Criterion E (Quantitative Analysis): Not Applicable. Insufficient data on this species exists to make population projections.

⁺ See [Table 3](#) (Guidelines for modifying status assessment based on rescue effect)



COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2015)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.



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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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2015

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Phylum: Arthropoda

Class: Insecta - insects

Subclass: Pterygota - winged insects

Order: Lepidoptera - butterflies and moths

Superfamily: Yponomeutoidea

Family: Praydidae

Genus: *Prays*

Species: *Prays atomocella* (Dyar, 1902)

Taxonomic synonyms: *Yponomeuta atomocella* Dyar, 1902;
Yponomeuta atomosella Meyrick, 1914 (unjustified emendation);
Hyponomeuta diaphorus Walsingham, 1907

Preferred English Name: Hoptree Borer

Other English Names: Hoptree Ermine, Brown-bordered Ermine

French name: perceur du ptéléa

Prays atomocella (Dyar 1902), the Hoptree Borer, is the only species of Praydidae native to Canada. A second species, the Ash Bud Moth (*Prays fraxinella*) is an alien species native to Eurasia that has been detected in British Columbia and Newfoundland (Dewaard *et al.* 2009). The family Praydidae contains about 47 species in three genera globally (van Nieukerken *et al.* 2011).

Most of the older literature places the Hoptree Borer in the genus *Yponomeuta* Latr. (e.g., Hodges 1983) because of wing pattern similarities, but *atomocella* is not closely related to species of *Yponomeuta* and it has subsequently been transferred to the genus *Prays* Hbn. (Forbes 1923; Lewis and Sohn 2015). The genus *Prays* and two other related genera are now placed in the Praydidae, as a family separate from the Yponomeutidae (van Nieukerken *et al.* 2011). The family Yponomeutidae is commonly known as the ermine moths, and other English common names of the Hoptree Borer include Hoptree Ermine and Brown-bordered Ermine. Because *P. atomocella* is not an ermine moth, the common name Hoptree Borer is used here to avoid confusion.

Morphological Description

Adults:

The Hoptree Borer is a small moth with a wingspan of 17 to 20 mm (Figure 1). Despite its small size, this is a striking moth with a pure white, black spotted forewing. The thorax has a similar pattern of black spots on a white background; the head and antennal base is white. The hind wings and abdomen are pinkish rusty brown, described as “dull salmon” by Forbes (1923). In eastern Canada, several species of the genus *Ethmia* and *Yponomeuta* are similar in overall size, shape, and forewing pattern; however, no other Canadian species has the distinctive combination of black-spotted white forewing with a rusty-pink (versus pale grey) hindwing and abdomen.



Figure 1. Hoptree Borer collected at Point Pelee on June 11, 1981 by D.H. Pengelly (DEBU) (photo by Steve Marshall).

Larvae:

Larvae are pale-green to yellowish with marbled pale lateral lines and a pale green head. Total length is up to about 20 mm long (Microleps 2011). Although relatively nondescript, the habit of boring in Common Hoptree shoots is highly distinctive (**see Life Cycle**).

Pupa:

The pupa is approximately 15 mm long and pale-green to tan, and pupation occurs inside a distinctive mesh-like cocoon among the foliage or flower clusters of the host plant (Microleps 2011).

Eggs:

The eggs have not been described or illustrated.

Population Spatial Structure and Variability

No population structure, genetic, or other studies have been conducted on Hoptree Borer in Canada or elsewhere in the species' range. Variation of the mtDNA barcode fragment has been assessed only for Illinois and Ontario specimens, which shows that these two populations are very similar but with distinctive haplotypes (Schmidt pers. obs. January 2015).

Canadian populations are over 200 km from the nearest known U.S. population in Michigan and may be genetically isolated. Although the host plant appears to be more continuously distributed south and west of the Canadian range, Hoptree Borer has not been detected at sites between Point Pelee and southwestern Michigan. Similarly, a large distribution gap exists between Point Pelee occurrences and southern Ohio records of Hoptree Borer, despite a broader distribution of Common Hoptree (Figure 2). In contrast to most of the Great Lakes region, sampling effort for Lepidoptera in Ohio is very good (Metzler pers. comm. 2014), and this large distribution gap is not likely a sampling artefact.

Climatic effects may account for the spotty distribution at the northern range edge of Hoptree Borer, where a warmer, drier microclimate of dunes and beaches is required. Similar habitat preference patterns occur in other Lepidoptera, where only dunes or barrens are suitable at the northern range edge, while broader habitats are used further south. Nevertheless, healthy populations of Common Hoptree in southern Michigan and northern Ohio could be surveyed for Hoptree Borer to further establish the geographic isolation of Canadian and other northern populations.

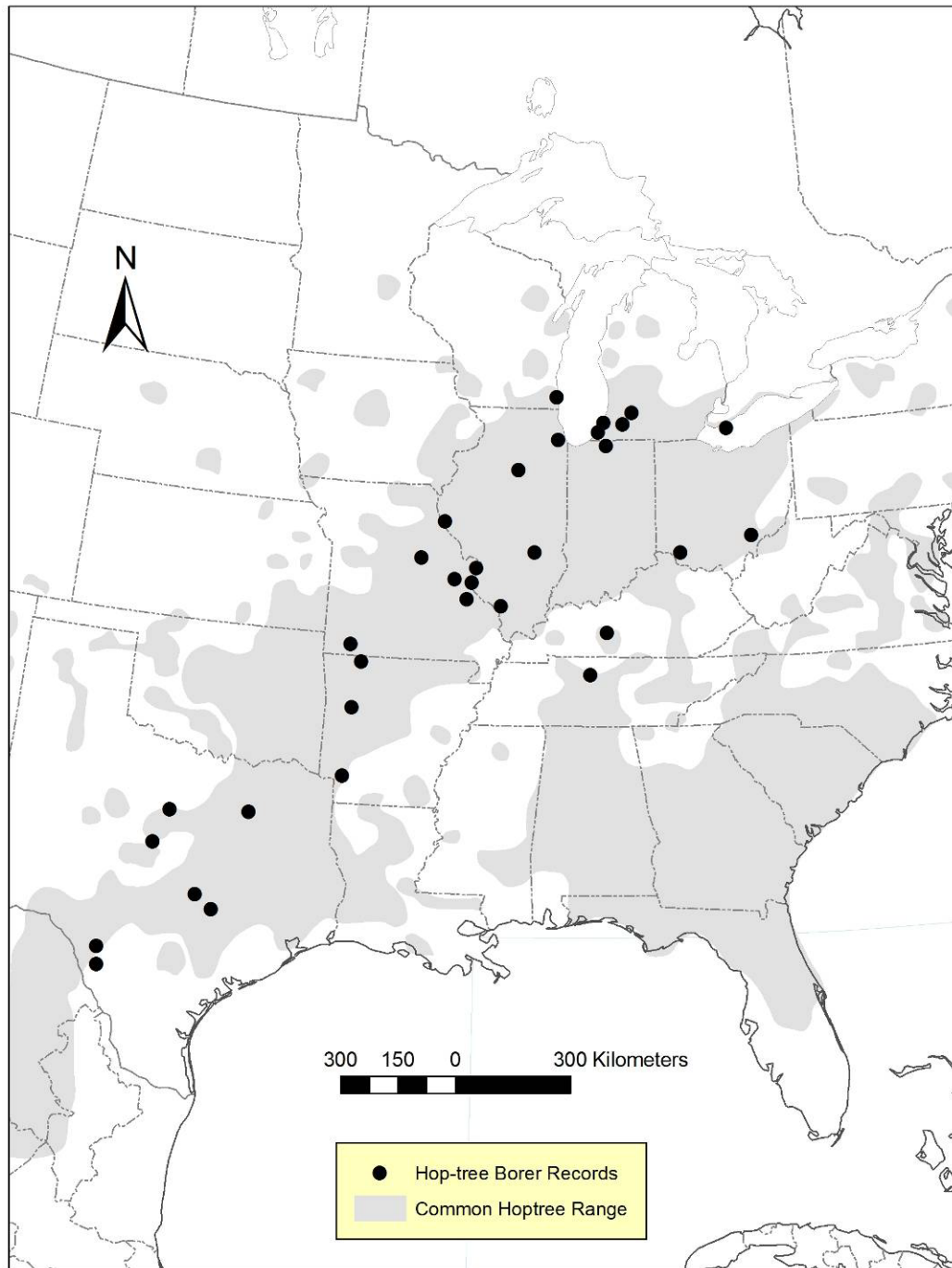


Figure 2. Map showing all known North American records of Hoptree Borer. The range of the host plant, Common Hoptree (*Ptelea trifoliata*) is also shown (Common Hoptree range source: Sibley 2009; Soper and Heimburger 1982).

Designatable Units

Hoptree Borer has one designatable unit in Canada. There are no data on discreteness, genetic structure, or evolutionary significance among populations and no subspecies are recognized. The species occurs within the Great Lakes Plains Ecological Area (COSEWIC 2010).

Special Significance

Hoptree Borer is one of only two Lepidoptera species known to be specialist herbivores on Common Hoptree, which is assessed as Special Concern (COSEWIC 2015) but currently listed as Threatened under the federal *Species at Risk Act* (SARA). Hoptree Borer is the only native species of the family Praydidae in Canada. Canadian subpopulations mark the northeastern extent of the range, and are isolated from the nearest U.S. populations by over 200 km.

DISTRIBUTION

Global Range

Hoptree Borer occurs in Ontario and U.S. states from Ohio to Texas (Table 1, Figure 2). All records are within the range of the host plant, Common Hoptree. Hoptree Borer occurs mostly west of the Appalachian Mountains but east of the Great Plains. Its range may extend into Mexico given its proximity to the U.S. - Mexican border in Texas and that Common Hoptree occurs in northern Mexico.

Table 1. United States collection records of Hoptree Borer (*Prays atomocella*).

State	Source
Arkansas	Three records from 3 counties including Logan Co. and Johnson Co. (Brown pers. comm. 2009; Osborne pers. comm. 2009)
Illinois	Three records from Adams, Cook, Putnam Counties (Illinois State Museum 2011); Coles Co. (CNC)
Indiana	One record from St. Joseph Co. 1995 (Vargo pers. comm. 2009)
Kentucky	One record from Woodford Co. (Covell 1999; Covell pers. comm. 2009; Laudermilk pers. comm. 2009)
Michigan	Four records from Van Buren, Kalamazoo, Berrien and Barry Counties. 1963 - 2000 (Nielsen 1998; Nielsen pers. comm. 2009; Lepidopterists Society 2011)
Missouri	Nine records from 6 counties 1906 -1981 (Fantz pers. comm. 2009).
Ohio	Eleven records from Athens and Clermont Counties between 1913 and 1931 (Horn pers. comm. 2009); Butler Co. (BugGuide 2015)
Tennessee	One record near Lebanon TN (Brown pers. comm. 2009)
Texas	Records from 7 counties (Gottfried pers. comm. 2009; Knudson and Bordelon 2001; 2004; Knudson pers. comm. 2009; Quinn pers. comm. 2009)
Wisconsin	One record from Milwaukee 1924 (Nielsen pers. comm. 2009)

In order to determine its range, conservation data centres within the range of Common Hoptree were contacted. Resulting records are shown in Figure 2. The species is poorly known, but generally considered to be rare throughout its range (Knudson pers. comm. 2009). However, little survey effort has been devoted to microlepidoptera in most jurisdictions.

The total global range for Hoptree Borer as measured by minimum convex polygon is approximately 883,000 km². As the Canadian population is relatively isolated and marks the northeastern-most extent of the global range, loss of the Canadian populations would reduce the global range by about 62,500 km², or 7%.

Canadian Range

In Canada, confirmed occurrences of Hoptree Borer are restricted to Point Pelee National Park (Table 2, Figure 3 and 4) on the north shore of Lake Erie. Precise collection sites within the park are unknown, but likely originate from the western shore along a nine-kilometre stretch of shoreline vegetation where Common Hoptree is most abundant and easily accessible. In 2009 and 2010, probable evidence of the species (distinctive shoot damage on Common Hoptree) was also found on Pelee Island (Figure 5). The proximity of Middle Island 5 km south of Pelee Island, and its large subpopulation of Common Hoptree (> 500 individuals; COSEWIC 2015), make it likely that Hoptree Borer is present. Most of the Common Hoptree sites northwest of Point Pelee and in Essex County contain fewer than 10 mature shrubs (COSEWIC 2015), and the probability that Hoptree Borer could persist there is minimal.

Table 2. Canadian Hoptree Borer (*Prays atomocella*) collections.

Date	Location	Life stage	Collector	Depository*
27.Jun.1927	Point Pelee, ON	Adult, male	F.P. Ide	CNC
29.Jun.1927	Point Pelee, ON	Adult, male	F.P. Ide	CNC
23.Jun.1931	Point Pelee, ON	Adult, female	W.J. Brown	CNC
11.Jun.1981**	Point Pelee, ON	Adult	D.H. Pengelly	DEBU
8.Jun.2008	Point Pelee N.P., ON	Adult, DNA barcode voucher # 08MZPP-142	M. Zhang	BIO
6.Jun.2010	Point Pelee N.P., West Beach, ON 41.934 N 82.517 W	Larva [dead], DNA barcode voucher # CNCLEP00076535	A. Harris & R. Foster	CNC

Date	Location	Life stage	Collector	Depository*
21.Jun.2013	Point Pelee N.P., West Beach trail	Adult	J. Cossey	photograph

* CNC = Canadian National Collection Ottawa; BIO = Biodiversity Institute of Ontario, Guelph; DEBU = Dept of Environmental Biology University of Guelph

** label is unclear; could be 1961 (Marshall 2010 pers. comm.)

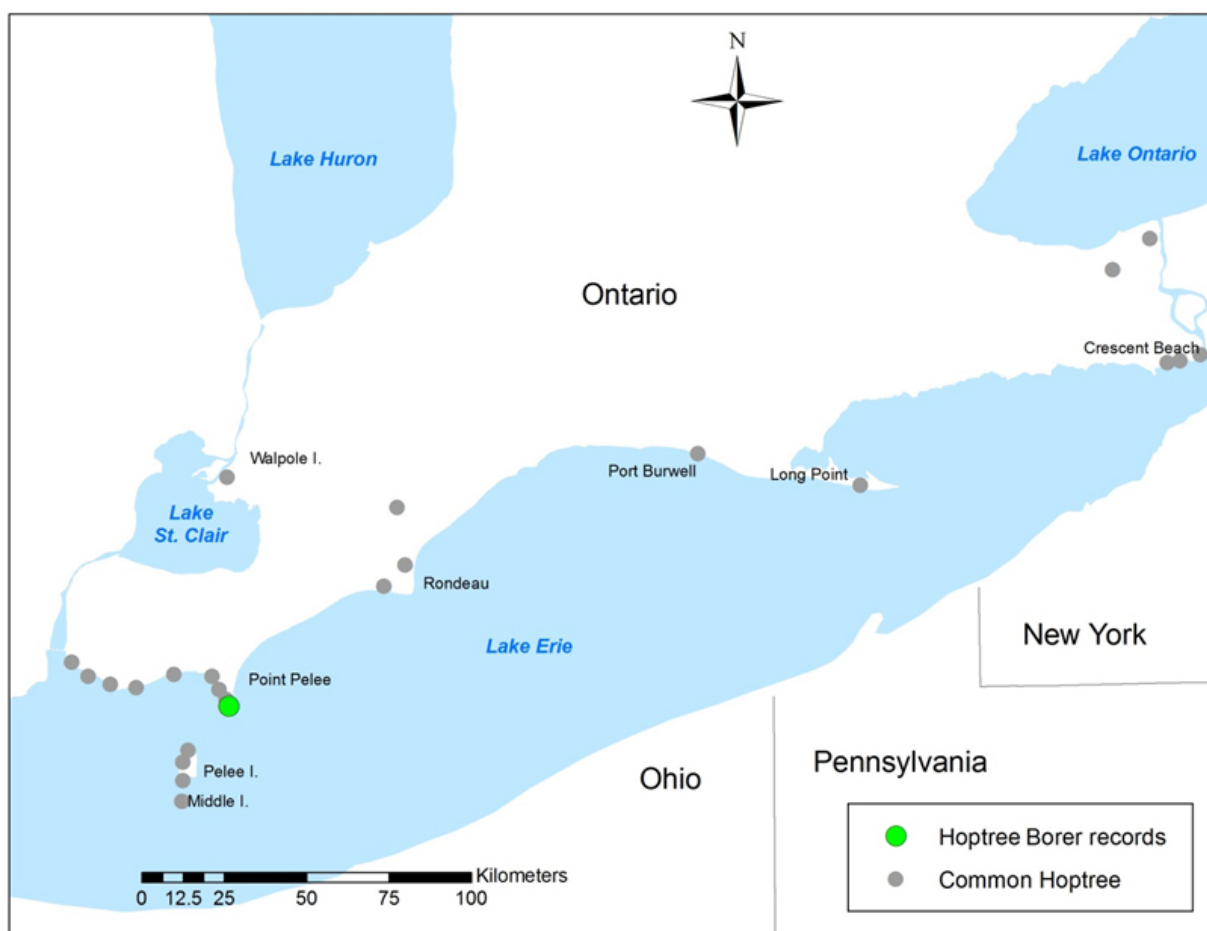


Figure 3. Map of southwestern Ontario showing distribution of Common Hoptree (COSEWIC 2002) and confirmed records of Hoptree Borer.

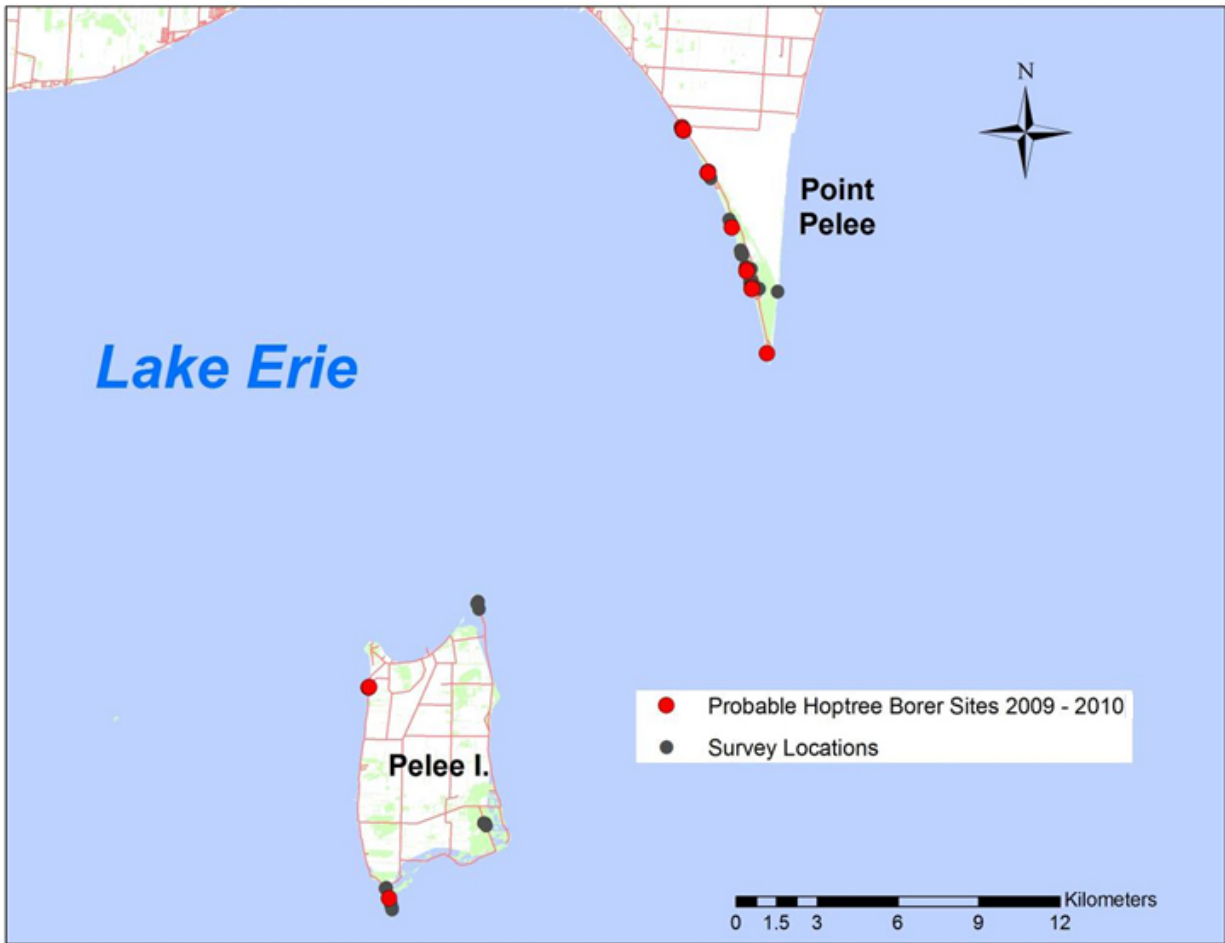


Figure 4. Map showing probable Hoptree Borer records based on the distribution and abundance of Common Hoptree and historical collection information.

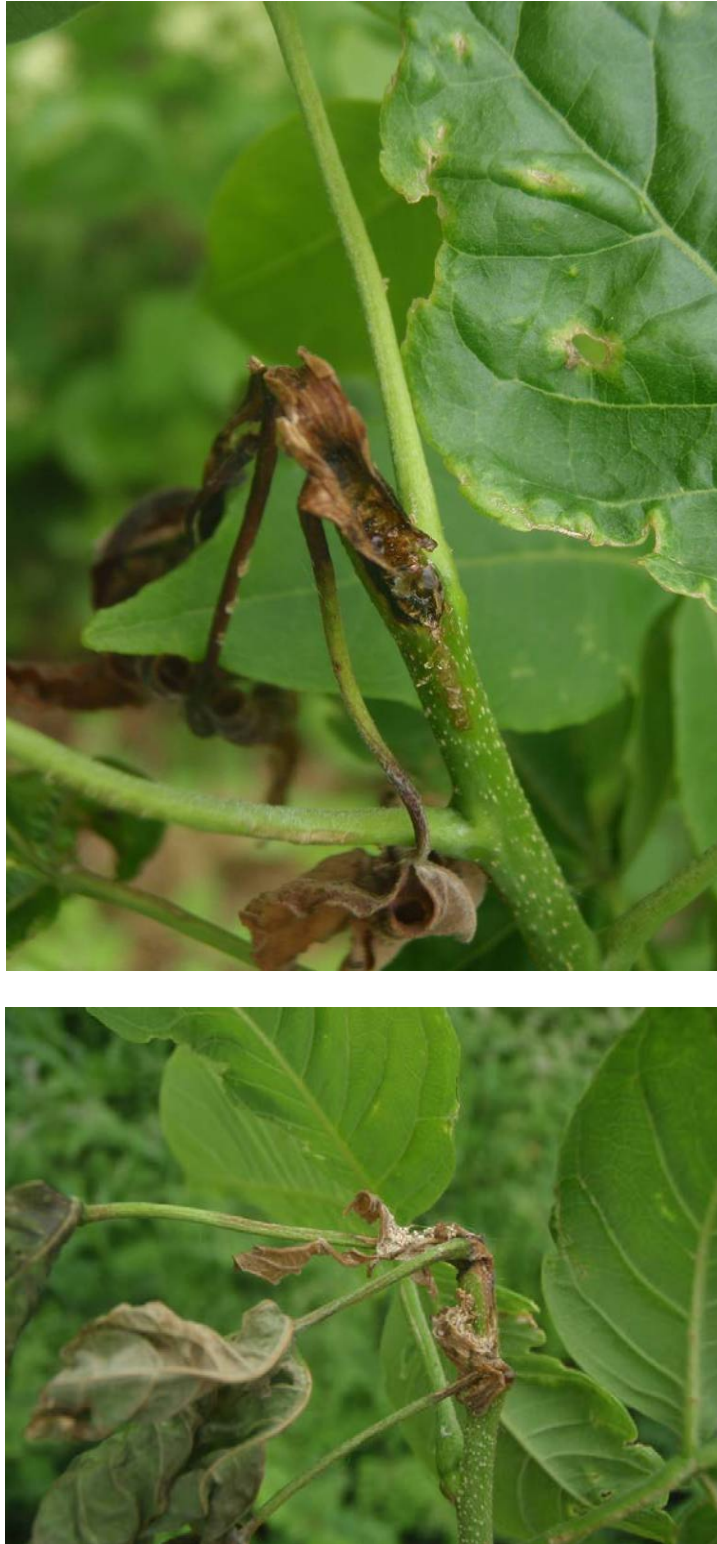


Figure 5. Hoptree Borer cavity in Common Hoptree twig. Note remains of web in the lower photo. Point Pelee, June 2010 (photos by A.G. Harris).

Common Hoptree is distributed along the west side of Point Pelee from the tip north to the park boundary. Its preferred habitat makes up about 46 ha of the park (Dougan and Associates 2007). It is also common on Pelee Island and Middle Island in Lake Erie. Elsewhere in Ontario, Common Hoptree occurs in ten additional subpopulations, mostly scattered along the Lake Erie shoreline (COSEWIC 2015). These subpopulations contain from 2 to ~200 mature shrubs, but the largest subpopulations (Rondeau Provincial Park, Port Burwell Provincial Park, and Niagara region) are isolated from each other and from Point Pelee by 60 - 125 km. Surveys carried out in 2014 at the Rondeau and Niagara subpopulations indicate that Hoptree Borer is absent, possibly because of insufficient Common Hoptree densities, geographic isolation, adverse climatic effects, or a combination of these factors.

The extent of occurrence (EOO) of Hoptree Borer in Canada (including the potential sites recorded in 2009 and 2010) is 148 km² as measured by convex polygon (Figure 6). Of this area, about 112 km² is over Lake Erie. The index of area of occupancy (IAO) of Hoptree Borer in Canada is 28 km² (as measured with a 2 X 2 km grid) (Figure 6).

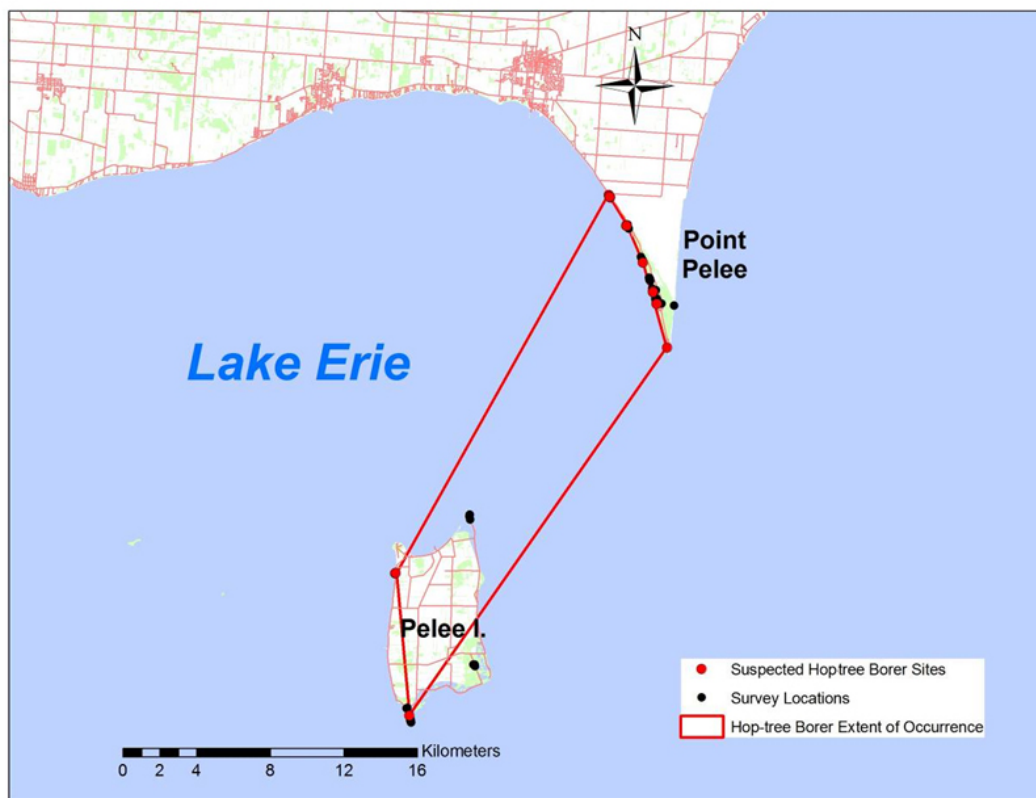


Figure 6. Extent of occurrence map for Hoptree Borer in Canada using convex polygon (red line). The extent of occurrence of Hoptree Borer in Canada (including the potential sites recorded in 2009 and 2010) is 148 km². Of this area, about 112 km² is over Lake Erie. The area of occupancy of Hoptree Borer in Canada is 28 km² (as measured with a 2 X 2 km grid).

Search Effort

Hoptree Borer has been collected or observed 7 times between 1927 - 2014 (Table 1). The southernmost portion of Ontario, and in particular the Point Pelee and surrounding areas of the Lake Erie shoreline are well inventoried for insects. The University of Guelph has 30,000 insect specimen records from Point Pelee and the Lake Erie Islands; however, few of these are Lepidoptera. Steve Marshall and others at the University of Guelph have surveyed the insect fauna of Point Pelee, starting with regular collecting trips arranged by D.H. Pengelly in the 1970s (Marshall pers. comm. 2009). Details of earlier search effort by the collectors F.P. Ide in 1927 and W.H. Brown in 1931 are unknown. Other non-targeted surveys using a variety of techniques are occasionally conducted in Point Pelee National Park (e.g., Borisenko pers. comm. 2010) and the surrounding area (Pratt pers. comm. 2009; Wormington pers. comm. 2009).

Surveys during the preparation of this status report were performed in 2009, 2010 and 2014. Surveys in 2014 were completed in early June and coincided with the optimal potential detection of mature larvae. Surveying for larval damage is a reliable survey method since both larvae and plant symptoms are readily distinguishable from other insect damage. The larva lives and feeds as a borer inside a current-year shoot, causing the shoot to wilt and darken. The larva chews a small hole in the woody stem at the base of the mined stem, with the resulting sawdust incorporated into a silken covering of the hole (Microleps 2014). Pupation is in a distinctive mesh-like cocoon that is often found near the larval feeding site.

There was also potential to detect adult moths during the 2014 surveys. Year-to-year phenology differences could result in early June hatches of Hoptree Borer adults (the earliest record is 8 June), and a second yearly generation, if such occurred, could be expected in September.

Point Pelee and Pelee Island:

Targeted surveys for Hoptree Borer were carried out in 2009, 2010 and 2014 primarily through visual searches of Common Hoptree for larvae, pupae and feeding damage (Table 3 and 4, Figure 4). Like most nocturnal moths, Hoptree Borer adults are attracted to incandescent lights (Brown pers. comm. 2009; Covell pers. comm. 2009; Vargo pers. comm. 2009) as well as ultraviolet light. Direct (vouchered specimens) and indirect (diagnostic feeding damage) evidence confirmed the presence of Hoptree Borer at Point Pelee and Pelee Island, but the species appears to be absent at other Ontario sites northeast of Point Pelee. Middle Island and Essex County west of Point Pelee have not been surveyed for Hoptree Borer.

Table 3. Summary of search effort for adult Hoptree Borer using light traps.

Region	Site	Co-ordinates	Date	Search effort	Hoptree Borer detected?
Essex Co.	Point Pelee N.P., West Beach	41.934N 82.517W	9.Sep.2009	~ 2 light-hrs	No
Essex Co.	Point Pelee N.P., Black Willow Beach	41.946N 82.522W	9.Sep.2009	~ 2 light-hrs	No
Essex Co.	Point Pelee N.P., White Pine Beach	41.941N 82.520W	9.Sep.2009	~ 2 light-hrs	No
Essex Co.	Point Pelee N.P., West Beach	41.934N 82.517W	3.Jun.2010	8.5 light-hrs	No
Essex Co.	Point Pelee N.P., White Pine Beach	41.941N 82.520W	3.Jun.2010	8.5 light-hrs	No
Essex Co.	Point Pelee N.P., Black Willow Beach	41.947N 82.522W	4.Jun.2010	~13 light-hrs	No
Niagara	Point Abino, Marcy's Woods property, back of beach dune	42.857N 79.113W	8.Jun.2014	4 trap-nights (= ~36 light- hrs)	No
Rondeau	Rondeau P.P. visitor centre and adjacent beach dunes	42.282N 81.842W	9.Jun.2014	4 trap-nights (= ~36 light- hrs)	No

2014 surveys: No adult Hoptree Borers were observed, despite light-trap sampling during warm, calm evenings. The spring of 2014 was cooler and later than average, and Common Hoptree phenology indicated that larval rather than adult searches were appropriate.

2009 and 2010 surveys: At Point Pelee and Pelee Island, larval and larval feeding (i.e., damage) surveys were completed by meandering transects through suitable habitat. Survey distance covered 2300 m in May 2009, 1600 m in July 2009, and 4025 m in June 2010 at Point Pelee National Park. On Pelee Island, 3270 m of habitat was searched in June 2010 (Figure 4).

Larval feeding damage, and one dead larva, was found through visual searches of Common Hoptree, but only at Point Pelee (shoot damage and dead larva) and Pelee Island (shoot damage). Identity of shoot damage (Figure 5) was assessed by comparison to that pictured by Microleps (2011). DNA barcoding of the dead larva confirmed the species' identity, and further supports the identity of the shoot-boring damage. Bored-out shoot chambers were found at both Point Pelee (n = 62) and Pelee Island (n = 22). No living larvae were found within any of the chambers.

Niagara and Rondeau:

In 2014, approximately 300 individual Common Hoptree shrubs were surveyed over a total of 11 person-hours (Table 4) at the Niagara and Rondeau subpopulations (COSEWIC 2015). These sites were targeted because they represent *a*) two of the largest Common Hoptree subpopulations in the region (COSEWIC 2015), and *b*) are separated from the known Hoptree Borer subpopulation at Point Pelee by distances of 60 km and 250 km. Neither Hoptree Borer nor its signature shoot damage was found at these sites. The plant phenology with vigorous, current-year shoots averaging 8-12 inches in length, and nearly mature flower bud development, indicated that timing of these searches was correct (Microleps 2014).

Table 4. Summary of visual search effort for Hoptree Borer larvae.

Region	Site	Co-ordinates	Date	Search effort	No. of Hoptree plants searched	Hoptree borer detected?
Essex Co.	Tip, Point Pelee	41.913N 82.510W	May 26 2009	1500m; 1.5 hrs	n.a.	1 damaged shoot
Essex Co	East Beach, Point Pelee	41.934N 82.506W	May 26 2009	200m; 0.5 hrs	n.a.	No
Essex Co	Black Willow Beach, Point Pelee	41.946N 82.522W	July 30 2009	520m; 4 hrs	n.a.	No
Essex Co	Sanctuary Beach, Point Pelee	41.973N 82.538W	July 30 2009	100m; 0.5 hrs	n.a.	No
Essex Co	West Beach, Point Pelee	41.934N 82.517W	July 31 2009	1600m; 1.5 hrs	n.a.	No
Essex Co	Chinquapin Oak Trail, Point Pelee	41.941N 82.518W	July 31 2009	800m; 2 hrs.	n.a.	no
Essex Co	Black Willow Beach, Point Pelee	41.947N 82.522W	June 4 2010	200m; 0.5 hrs	n.a.	No
Essex Co	White Pine Beach, Point Pelee	41.941N 82.520W	June 4 2010	650m; 0.5 hrs	n.a.	10 damaged shoots
Essex Co	West Beach, Point Pelee	41.934N 82.517W	June 4 2010	1700m; 0.5 hrs	n.a.	31 damaged shoots; 1 dead larva

Region	Site	Co-ordinates	Date	Search effort	No. of Hoptree plants searched	Hoptree borer detected?
Essex Co	Lighthouse Point, Pelee I.	41.829N 82.637W	June 5 2010	600m; 1.5	n.a.	No
Essex Co	Stone Road Alvar, Pelee I.	41.75N 82.63W	June 5 2010	320m; 0.5 hrs	n.a.	No
Essex Co	Fish Point, Pelee I.	41.727N 82.673W	June 5 2010	2250 m; 2 hrs.	n.a.	No
Essex Co	West shore, Pelee I.	41.801N 82.685W	June 5 2010	100m; 0.5hrs	n.a.	20 damaged shoots
Essex Co	West side near gate, Point Pelee	41.988N 82.550W	June 6 2010	470m; 2 hrs	n.a.	8 damaged shoots
Essex Co	Sanctuary Beach, Point Pelee	41.973N 82.538W	June 6 2010	520m; 0.75 hrs	n.a.	4 damaged shoots
Essex Co	Dunes Beach, Point Pelee	41.956W 82.527W	June 6 2010	700m; 1 hrs	n.a.	No
Niagara	Point Abino, Marcy's Woods property, back of beach dune	42.857307N 79.112747W	8.Jun.2014	3 person-hrs	~60	No
Niagara	Point Abino, Holloway Bay Rd, S end, beach dunes	42.860123N 79.116062W	8.Jun.2014	1 person-hr	~30	No
Port Burwell	Beach dunes	42.644810N 80.823194W	11.Jun.2014	1 person-hrs	None found	No
Rondeau	Rondeau P.P. visitor centre and adjacent beach dunes	42.282184N 81.841943W	9.Jun.2014	4 person-hrs	~40	No
Rondeau	Erieau, Laverne Kelly Memorial Park	42.257517N 81.913043W	10.Jun.2014	2 person-hrs	150-200	No

The lack of detection of Hoptree Borer at Rondeau and Niagara sites, both with robust stands of healthy Common Hoptree plants in a variety of differing microhabitats, appears to indicate a true absence of the Hoptree Borer. This absence may be a combination of geographical isolation, climatic effects, and small population size of Common Hoptrees. The absence of Hoptree Borer is also consistent with the lack of records in the eastern Lake Erie region where Common Hoptree occurs in isolated patches, including New York and Pennsylvania (Forbes 1923; Table 1). Hoptree Borer also has a much more restricted range than Common Hoptree in other regions, being absent from the south Atlantic Coastal Plain and southeastern USA (Figure 2), both regions that have a long history of Lepidoptera study.

Point Burwell Provincial Park:

Excluding Point Pelee, Middle Island and Rondeau Park, the only Common Hoptree subpopulation with more than 50 mature trees is Point Burwell Provincial Park, with about 73 mature individuals (COSEWIC 2015). Port Burwell is geographically intermediate between the Niagara and Rondeau subpopulations, and given the absence of Hoptree Borer at the latter sites, it is very unlikely that Hoptree Borer is present there. Given their proximity to the Point Pelee sites, Common Hoptree stations in western Essex County northwest of Point Pelee National Park should be surveyed, although only one site has more than 10 mature Common Hoptrees.

Middle Island:

This island has a sizable stand of Common Hoptree with about 500 individuals, and Hoptree Borer should be present there given the proximity to Pelee Island (< 10 km).

Historical Lepidoptera sampling has been sporadic, and no targeted surveys for Hoptree Borer were carried out prior to 2009. The paucity of Hoptree Borer records (Table 1) reflects the close association of this species with Common Hoptree in the appropriate shoreline habitat, the cryptic nature of the larvae, and the relatively short flight period of adults. Unless surveys are correctly timed and directed toward the immediate proximity of Common Hoptrees in the appropriate habitat, Hoptree Borer is unlikely to be detected. Historical search effort for Lepidoptera along Lake Erie where Common Hoptree occurs is limited.

HABITAT

Habitat Requirements

Hoptree Borer is dependent on its host plant, Common Hoptree, which occurs as twelve subpopulations scattered along the sandy shores on Pelee Island and Point Pelee, and northeast toward Port Burwell, Crescent Beach and the Niagara region. The Common Hoptree is present as the outer edge of shoreline woody vegetation where wind and wave disturbances are high (COSEWIC 2002). It rarely occurs in deep shade, and Hoptree Borer is not known to utilize Common Hoptree under these deep shade conditions.

Common Hoptree habitat at Point Pelee, consists predominantly of three community types: Hoptree Shrub Sand Dune (SBS1-2), Red Cedar Treed Sand Dune (SBTD1-3), and Dry - Fresh Hackberry Deciduous Woodland (WODM4) (Lee *et al.* 1998; Dougan and Associates 2007). It occasionally occurs in a wide variety of other vegetation types at Point Pelee. Elsewhere in Ontario, Common Hoptree is also found on shallow soils over limestone. Hoptree Borer has been recorded only at sites where Common Hoptree grows abundantly on sandy shorelines.

Similar to the preferred habitat in Ontario, Hoptree Borer occurs on shoreline dunes of Lake Michigan in association with Common Hoptree (Nielsen pers. comm. 2009). In the central part of the range in Tennessee and Arkansas, it occurs in cedar glades (Brown pers. comm. 2009). At the southernmost range edge in central Texas, it is found along stream banks and shaded slopes (Knudson pers. comm. 2009).

Habitat Trends

Despite an apparent increase in number of Common Hoptree individuals in Canada, Common Hoptree habitat is declining (COSEWIC 2015). The Point Pelee sand spit (with approximately 10,000 mature Common Hoptrees, or 86% of the total Canadian population) is eroding faster than it is accreting (Jalava *et al.* 2008). Decrease in disturbance events such as ice scour may further decrease Hoptree Borer habitat through forest succession (COSEWIC 2015). Shoreline development could be another factor that reduces habitat, particularly for sites not protected within Point Pelee National Park. Outside protected areas, cottage development, vegetation removal and beach grooming have caused the extirpation or decline of several Common Hoptree subpopulations (COSEWIC 2002; 2015). On Middle Island in Lake Erie, there is a large nesting population of Double-Crested Cormorants (*Phalacrocorax auritus*) which negatively impact health of Common Hoptrees and alter soil properties (Boutin *et al.* 2011; Koh *et al.* 2012; *et al.* Parks Canada Agency 2012). However, since 2008 cormorant numbers have been managed by Parks Canada, reducing their impact on Common Hoptree. Suitable habitat may also be lost to invasive alien plant species, either through outcompeting Common Hoptree directly, or indirectly through outcompeting other plants that may be required by Hoptree Borer, such as adult nectar sources (see also Threats and Limiting Factors).

BIOLOGY

Life Cycle and Reproduction

There is very little published information on the life cycle of the Hoptree Borer, and even basic information on life history traits are still lacking. The first report of adults reared from larvae in Common Hoptree shoots were from Michigan (Lepidopterists Society 2015) and Illinois (Microleps 2011). The following summary is derived mainly from websites (BugGuide 2011; Moth Photographers Group 2011; Microleps 2011), personal communications, and natural history of related species.

Hoptree Borer probably has only a single annual generation in Ontario, as all adult capture dates are from June. In Illinois, adults emerge a month or more earlier (Microleps 2011), likely reflecting the delayed phenology along the Lake Erie shoreline due to lake effects. The early spring phenology in Illinois is at odds with collection dates of mid-June in the cedar glades of Tennessee (Brown pers. comm. 2009), which may represent a second generation flight. Arkansas records are for mid- to late May. The related Ash Bud Moth has two annual generations in Europe (Emmet 1996).

Eggs would be deposited during the flight period of mid- to late June in Ontario, presumably on the leaves or shoots of Common Hoptree. It is not known if there is a preference for shoot position or exposure within a Common Hoptree shrub, or for shrubs of a particular size or age class. Only current-year shoots appear to be suitable for larval feeding.

Larvae presumably hatch within several weeks of oviposition, to initiate feeding in early to mid-summer. The larva bores into a young shoot and creates a cavity in the woody stem below the shoot. This shoot damage is distinctive and diagnostic of the species. The excavated material is incorporated into a silken cover for the cavity, forming a short tube that probably serves as a shelter to avoid predators and parasites. Infested shoots have a wilted, darkened appearance (Figure 5).

Larvae probably overwinter (possibly in bored-out stems), as in other species of *Prays* such as Ash Bud Moth (Emmet 1996). There is no evidence that adults overwinter, which would be highly unusual for a species of *Praydidae*. Larval feeding appears to commence the following spring, probably mostly in May after initiation of plant growth. Larvae leave the stem for pupation, which occurs in a distinctive mesh-like cocoon, often among the host plant flower clusters. Adult feeding has not been documented, but females of related species (*Yponomeuta malinellus*) require nectar feeding for a week or more before they are sexually mature (Carter 1984).

Physiology and Adaptability

Hoptree Borer has a highly specialized life history. The species is dependent on a single host plant across its global range, which in Ontario is also primarily restricted to sandy shoreline substrates. It has never been documented as feeding on other plant species, nor is it expected to do so, given the host specialization in other members of the superfamily. It is therefore not highly adaptable.

Dispersal and Migration

Dispersal and migration in this and related species have not been documented. Migration is known to occur in some species of Yponomeutidae (Young 1997). Adults could be wind-dispersed along the Lake Erie shore, but combined with the sporadic and isolated nature of Common Hoptree subpopulations in Ontario, colonization of novel host patches would occur with extremely low probability (Schmidt pers. com. 2015) .

Interspecific Interactions

Hoptree Leaf-roller Moth (*Agonopterix pteleae*, Lepidoptera: Depressariidae) is a leaf-feeding moth that is abundant at Point Pelee and can cause extensive defoliation of Common Hoptree (25% to 75% defoliation in 2005 and 2006; Scarr *et al.* 2007 and similar levels in 2009 - 2010; pers. obs.). Such intensive herbivory may reduce Common Hoptree productivity or survivorship and consequently harm Hoptree Borer. Some plants respond to herbivory by increasing levels of defensive chemicals (Young 1997). Although this response has not been demonstrated in Common Hoptree, defoliation by Hoptree Leaf-roller Moth could result in increased defences by the plant with consequences for Hoptree Borer. Hoptree Leaf-roller Moth larvae were common at the Rondeau sites, and rare at Marcy's Woods (2 leaf rolls detected). As this species is also a specialist herbivore on Common Hoptree, assessment of its conservation status is likely warranted.

The larvae of the Giant Swallowtail (*Papilio cresphontes*) and Eastern Tiger Swallowtail (*Papilio glaucus*) (both Lepidoptera: Papilionidae) feed on Common Hoptree in Ontario (Hall *et al.* 2014) but are probably not abundant enough to affect Hoptree Borers. Both swallowtail species also use other larval host plants. Larvae of the Hoptree Barkbeetle (*Phloeotribus scabricollis*, Curculionidae: Scolytinae) also bore into Common Hoptree twigs (COSEWIC 2002; Marshall 2006) and may cause shoot mortality, although they primarily feed on the inner bark of twigs and branches (Cognato *et al.* 2009). The Hoptree Barkbeetle is thought to be a specialist on Common Hoptree.

Point Pelee is a major migratory bird site, with migrants often concentrating along the forest edges along beaches where Common Hoptree occurs. This could result in higher predation pressure on Hoptree Borer larvae during May compared to other occurrences in its range.

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Abundance

No abundance estimates are available for Hoptree Borer. It is known from seven confirmed records in Canada between 1927 and 2013. In 2010, probable evidence consisting of 84 damaged Common Hoptree shoots was observed at Point Pelee (62) and at Pelee Island (22).

Fluctuations and Trends

No information on population trends or fluctuations is available for Hoptree Borer. The Canadian population may have increased between 2002 and 2014, based on an increase in the number of Common Hoptrees at Point Pelee and Pelee Island (COSEWIC 2015). In contrast, the Common Hoptree declined between 1982 and 2002 and several Common Hoptree subpopulations have been extirpated in recent decades (COSEWIC 2002). However, Common Hoptree is abundant on Point Pelee on the western shoreline, road edges, and hydro corridor (McKay pers. comm. 2009) and common in suitable habitat on Pelee Island (Foster pers. comm. 2010; Harris pers. comm. 2010).

Rescue Effect

Rescue is possible, but unlikely. The nearest known extant populations outside Ontario are over 200 km away in southwestern Michigan and southern Ohio (Figure 2). However, undocumented subpopulations of Hoptree Borer may exist in intervening areas. There are some data that suggest northernmost subpopulations rely on favourable effects of lake-moderated climate and dune microclimate. Common Hoptree is distributed along the Lake Erie shore west from Point Pelee to the Michigan border at the Detroit River (Figure 3) and is widely distributed in the contiguous counties in southern Michigan (Voss 1985) and Ohio (Sibley 2009). The Detroit River is about 0.8 km to 1.2 km wide and is less likely to be a dispersal barrier than the wide expanse of Lake Erie.

THREATS AND LIMITING FACTORS

Immediate threats to Hoptree Borer are those identified for the sole larval host plant, Common Hoptree, as they pertain to Point Pelee and Pelee Island. These include shoreline erosion, vegetation succession, shoreline development, recreational activities and invasive alien plant species. Other potential threats include problematic native species. Finally, pesticide application for control of Gypsy Moth (*Lymantria dispar*) outbreaks is also known to adversely affect other Lepidoptera. Urban development and recreational activities have been identified as an additional threat for Common Hoptree, but these factors are minimally relevant to Hoptree Borer since all known sites are in protected federal and provincial lands. Prescribed burning to maintain alvar and savannah habitat is likely only a minor

threat to Hoptree Borer, as shoreline plant communities where Common Hoptree subpopulations are concentrated would only be marginally affected, or not at all. Given there is little known about the Hoptree Borer it is likely that unknown threats exist to this species.

The International Union for Conservation of Nature-Conservation Measures Partnership (2006) (IUCN-CMP) threats calculator was used to classify and list threats to the Hoptree Borer (Salafsky *et al.* 2008; Master *et al.* 2009). A similar exercise was completed for the Common Hoptree. Overall threat impact was considered low.

Natural System Modifications

Other ecosystem modifications (7.3)

The primary threat to Common Hoptree, and in turn Hoptree Borer, is habitat loss through changes in the dynamics of beach sand deposition and erosion, which results in loss of beach and dune habitat. In the next 50 years, up to 126 ha (1.26 km²) of habitat could be lost from Point Pelee National Park (Baird and Associates Coastal Engineers 2010), where more than 86% of Common Hoptree in Canada are located. Common Hoptree depends on colonizing newly created beach habitat, and under current conditions habitat is not being created fast enough to counter losses due to erosion.

Fire & Fire Suppression (7.1)

Common Hoptree thrives in early successional habitats such as sand dunes, savannah and roadside verges, which are maintained by periodic disturbance. Shading by canopy trees including oaks, ashes, and Hackberry appears to limit persistence of the species, suppressing flowering and limiting recruitment.

Decreased disturbance including suppression of fire in savannah and alvar habitats has allowed for successional forests to develop, shading out Common Hoptree (Ambrose 2002). At Point Pelee National Park and Stone Road Alvar on Pelee Island, succession is being actively addressed by prescribed burns and physical removal of encroaching vegetation from savannah and dune habitats. At this time it is unknown whether similar initiatives are occurring at other sites.

Habitat Shifting & Alteration (11.1)

The shoreline habitats of Common Hoptree are characterized by high levels of disturbance, to which Common Hoptree is adapted. Reduced ice-scour along the Lake Erie shores has allowed for plant community succession to more mature, shaded environs, shading out Common Hoptree when light levels become sub-optimal (COSEWIC 2002).

Storms and Flooding (11.4)

Shifts in the timing and severity of storms could have a significant impact on Hoptree Borer adults and larvae. Recent severe ice storms have had an impact on Common Hoptrees and beach habitat; it is therefore plausible that this threat could negatively impact the entire Canadian population in a short time frame.

Invasive Non-native Species (8.1)

Invasive plant species may also pose a threat to Hoptree Borer habitat, either through direct competition with Common Hoptree, or through competition with native flowering plants used as nectar sources by adult moths. Nectar source requirements for Hoptree Borer are unknown, but females of related species (*Yponomeuta malinellus*) require nectar feeding for a week or more before they are sexually mature (Carter 1984). The most invasive plants at Point Pelee include White Mulberry (*Morus alba*), Japanese Knotweed (*Polygonum cuspidatum*), White Poplar (*Populus alba*), Spotted Knapweed (*Centaurea maculosa*), English Ivy (*Hedera helix*), Garlic Mustard (*Alliaria petiolaris*), and Orange Daylily (*Hemerocallis fulva*) (Dougan and Associates 2007).

Problematic Native Species (8.2)

Population outbreaks of the Hoptree Leaf-roller Moth can result in nearly complete defoliation of Common Hoptree. It is abundant at Point Pelee (Scarr *et al.* 2007), and extensive feeding damage was observed on Pelee Island in 2014, where smaller trees were frequently completely defoliated (COSEWIC 2015).

The Hoptree Barkbeetle can cause twig and shoot dieback. This species was observed on several of the Common Hoptree populations in 2000-2002 (COSEWIC 2002), causing losses of major parts of affected trees, including loss of flowering. Both of these insect herbivores may adversely affect Hoptree Borer populations through direct competition and leaf and shoot dieback.

The large colony of Double-crested Cormorants on Middle Island has been identified as a potential threat to Common Hoptree (COSEWIC 2015), but presence of Hoptree Borer there requires confirmation.

Agricultural and forestry effluents (9.3)

All of the Canadian occurrences of Hoptree Borer are within the range of European Gypsy Moth, which is occasionally subject to control measures through ground- and aerial spraying of Btk (*Bacillus thuringiensis kurstaki*). Btk is a component of commercial pesticides used to control defoliating Lepidoptera, although it also affects most non-target butterfly and moth larvae (Schweitzer *et al.* 2011). Btk for Gypsy Moth is typically applied in early April to early May, coinciding with the larval stage of Hoptree Borer. Parks Canada currently does not control Gypsy Moth within Point Pelee National Park, but any pesticide application has the potential to negatively impact this species.

Number of Locations

The Hoptree Borer occurs at 2 locations. The term 'location' defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. The size of the location depends on the area covered by the threatening event and may include part of one or many subpopulations. While the long-term threat to this species is habitat loss, short-term threats such as shifts in the timing and severity of storms could have a significant impact on the Hoptree Borer (Threat 11.4). Timing of severe weather events, including ice storms that could coincide with adult or larval stages, could rapidly affect all individuals. This species occurs at both Point Pelee National Park and Pelee Island, which have separate subpopulations of Common Hoptree and are geographically distinct, and therefore the Hoptree Borer was considered to occur at 2 locations.

PROTECTION, STATUS, AND RANKS

Legal Protection and Status

Hoptree Borer is offered some level of protection within Point Pelee National Park under the *National Parks Act*. The species is not protected under provincial legislation.

Non-Legal Status and Ranks

Hoptree Borer is unranked at the global, national, or provincial / state level (NatureServe 2014).

Habitat Protection and Ownership

Hoptree Borer habitat within Point Pelee National Park is protected under the *National Parks Act*. On Pelee Island, one suspected Hoptree Borer occurrence was on a shoreline next to a road right-of-way, under the jurisdiction of the Municipality of Pelee Island. The others were in Fish Point Nature Reserve, where habitat is protected under the *Provincial Parks and Conservation Reserves Act*.

Common Hoptree is a species of Special Concern in Canada and Ontario, and the species and its habitat are protected by the *Species at Risk Act* and *Endangered Species Act* respectively.

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Abbott, J., Curator of Entomology, University of Texas

Adams, J., Dalton State College

Arbour, T., Ecologist, Ohio Natural Heritage Program

Baker, R., Animal Research Coordinator/Zoologist, Minnesota Natural Heritage & Nongame Research

Bergey, L., Heritage Biologist, Oklahoma Natural Heritage Inventory

Bier, C.W., Senior Director, Conservation Science, Western Pennsylvania Conservancy

Brown, R.L., Director, Mississippi Entomological Museum

Cairns, S., New Hampshire Natural Heritage Bureau

Caldwell, C., Program Administrator, Ohio Division of Wildlife

Corser, J., Zoologist, New York Natural Heritage Program

Covell, C.V., Department of Biology, University of Louisville

Cuthrell, D., Entomologist, Michigan Natural Features Inventory

deMaynadier, P., Zoologist, Department of Inland Fisheries and Wildlife

Desrosiers, N., Zoologist (Invertebrates), Quebec Conservation Data Centre

Dobbie, T., Park Ecologist, Point Pelee National Park

Dombroskie, J.J., University of Alberta

Elliott, M., Georgia Natural Heritage Program

Falin, Z.H., KU Biodiversity Research Center

Fantz, D., Zoologist, Missouri Natural Heritage Program

Ferguson, M., Zoologist, Vermont Nongame & Natural Heritage Program

Fisher, J., Oklahoma State University Museum

Freeman, C., Kansas Natural Heritage Inventory

Fritz, M., Zoologist, Nebraska Natural Heritage Program

Frye, J., Invertebrate Ecologist, Maryland Natural Heritage Program
Gottfried, B., Invertebrate Zoologist, Texas Wildlife Diversity Branch
Gregory, B., Zoologist, Louisiana Natural Heritage Program
Horn, D., Ohio Lepidopterists
Howell, D., Coordinator/Zoologist, Iowa Natural Areas Inventory
Knudson, E., Houston, Texas
Kruse, G., Illinois Division of Natural Heritage
Landry, J.F., Research Scientist, Curator of Lepidoptera, Canadian National Collection
of Insects, Arachnids, and Nematodes, Agriculture and Agri-Food Canada,
Laudermilk, E., Invertebrate Biologist, Kentucky Natural Heritage Program
Lee, Y.M., Conservation Scientist - Zoology, Michigan Natural Features Inventory
Leppo, B., Western Pennsylvania Conservancy
Lord, H., Data Request Specialist New Jersey Natural Heritage Program
Mann, T., Zoologist, Mississippi Natural Heritage Program
Marshall, S.A., Professor, Department of Environmental Biology, University of Guelph
McKay, V., Species at Risk Recovery Specialist, Point Pelee National Park
Mello, M., Lloyd Center for the Environment
Nantel, P., Parks Canada Agency, Ottawa, ON
Nelson, M., Invertebrate Zoologist, Massachusetts Natural Heritage & Endangered
Species Program
Nelson, J., Oklahoma State University Museum
Nielsen, M.C., Adjunct Curator of Lepidoptera, Dept. of Entomology, Michigan State
University
Opler, P., Colorado State University
Osborne, C., Data Manager / Environmental Review Coordinator, Arkansas Natural
Heritage Program
Pitre, J., COSEWIC Secretariat, A/ ATK Coordinator
Pratt, P., Moth Collector, Essex Co.
Roble, S., Zoologist, Virginia Division of Natural Heritage
Schnobb, S., COSEWIC Secretariat
Schuetze, S., HDMS Data Manager, Arizona Heritage Data Management System
Schweitzer, D., NatureServe, Arlington, VA
Scovell, J., Zoology Team Leader / Invertebrate Zoologist, Colorado Natural Heritage
Program

Smith, B., Program Zoologist, Wisconsin Natural Heritage Program
Stauffer, A., Wildlife Biologist Section Chief, Pennsylvania Natural Heritage Program
Sutherland, D., Natural Heritage Information Centre, Ontario Ministry of Natural Resources
Sutter, B., Database Zoologist, Utah Natural Heritage Program
Swartz, B.I., Wildlife Biologist
Tuininga, K., Canadian Wildlife Service, Ontario Region
Vargo, J., Moth Collector, Indiana
Wagner, D., University of Connecticut
Welch, M., West Virginia Natural Heritage Program, Zoologist
Wormington, A., Moth Collector, Essex Co.

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BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Allan Harris is a biologist with over 20 years' experience in northern Ontario. He has a B.Sc. in Wildlife Biology from the University of Guelph and an M.Sc. in Biology from Lakehead University. After spending seven years as a biologist with the Ontario Ministry of Natural Resources, he co-founded Northern Bioscience, an ecological consulting company based in Thunder Bay, Ontario. Al has authored or coauthored dozens of scientific papers, technical reports, and popular articles, including COSEWIC status reports for Crooked-stem Aster, Bogbean Buckmoth, Laura's Clubtail, Rapids Clubtail, Northern Barrens Tiger Beetle, Drooping Trillium, and Small-flowered Lipocarpha. Al also authored the Ontario provincial status report for woodland caribou, and has authored or coauthored national and provincial recovery strategies for vascular plants and birds. He is a member of the Committee on the Status of Species at Risk in Ontario.

Robert Foster is co-founder and principal of Northern Bioscience, an ecological consulting firm offering professional consulting services supporting ecosystem management, planning, and research. Dr. Foster has a B.Sc. in Biology from Lakehead University and a D. Phil in Zoology from the University of Oxford. Rob has worked as an ecologist in Ontario for over 15 years, and has authored or coauthored COSEWIC status reports on the Weidemeyer's Admiral, Bogbean Buckmoth, Laura's Clubtail, Rapids Clubtail, Northern Barrens Tiger Beetle, Crooked-stem Aster and Drooping Trillium, as well as recovery plans for rare plants, lichens, and odonates.

Jason Dombroskie is the manager of the Cornell University Insect Collection and coordinator of the Insect Diagnostic Lab, Ithaca, NY. He specializes in the systematics of New World leafroller moths (Tortricidae), specializing in the tribe Archipini. Jason has done faunal surveys across the US and Canada for many different insect groups, vertebrates, and vascular plants. He has been a member of the Arthropods Specialist Subcommittee of COSEWIC since 2012.

Christian Schmidt is an entomologist with the Canadian Food Inspection Agency, and specializes in the taxonomy, identification, and systematics of North American macro-moths, particularly owlet moths and their relatives (Noctuoidea). Chris has experience in faunal inventories of significant natural areas and conservation status assessments at the provincial and federal levels, including authorship of three COSEWIC reports. He has been a member of the Arthropods Specialist Subcommittee of COSEWIC since 2009. Chris is based at the Canadian National Collection of Insects in Ottawa.

COLLECTIONS EXAMINED

Institutions examined for specimens of Hoptree Borer and taxonomists who reviewed the respective collection:

Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, ON.
Landry, Jean-François pers. comm. 2009.

Cornell University Insect Collection and Insect Diagnostic Lab, Ithaca, NY. J. Dombroskie pers. comm. 2009.

University of Guelph, Guelph, ON. Marshall, S.A. pers. comm. 2009.

Smithsonian Institution, Washington DC, USA. Robert Foster pers. comm. 2010

Michigan State University, A. J. Cook Collection of Arthropods. Nielsen pers. comm. 2009.

Mississippi Entomological Museum. Brown R.L. pers. comm. 2009.

Oklahoma State University Museum. Fisher pers. comm. 2009; Nelson J. pers. comm. 2009.

Appendix 1 – IUCN Threats calculation for Hoptree Borer.

THREATS ASSESSMENT WORKSHEET			
Species or Ecosystem Scientific Name	Hoptree Borer		
Element ID		Elcode	
Date (Ctrl + ";" for today's date):	25/01/2015		
Assessor(s):	Chris Schmidt (Arthropods SSC), Angele Cyr (COSEWIC Secretariat), Jenny Heron, Vivian Brownell, Colin Jones.		
References:	This threats calculator included threats already discussed during the Common Hoptree threats call, which included Bruce Bennett, Vivian Brownell, Tammie Dobbie, Karen Timm, Joyce Gould, Cary Hamel, Tyler Smith, Victoria Nowell, Eric Lamb, Jim Pojar		

Overall Threat Impact Calculation Help:		Level 1 Threat Impact Counts	
Threat Impact		high range	low range
A	Very High	0	0
B	High	0	0
C	Medium	0	0
D	Low	2	2
Calculated Overall Threat Impact:		Low	Low

Assigned Overall Threat Impact:	
Impact Adjustment Reasons:	
Overall Threat Comments	<i>The Hoptree Borer has an annual life cycle. The Common Hoptree has a ten year (or longer) generation time.</i>

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1	Residential & commercial development		Negligible	Negligible (<1%)	Moderate - Slight (1-30%)	High (Continuing)	Threats from development are mostly historical. But severity would be high since tree absence results in moth absence. Species presence is assumed on Pelee Island.
1.1	Housing & urban areas		Negligible	Negligible (<1%)	Moderate - Slight (1-30%)	High (Continuing)	Common Hoptree: may be a factor, however it is not a factor at the only site where Hoptree Borer is known to occur. Occurrences on Pelee Island are in National Park and therefore protected. Common Hoptree occurrences are random and mainly on Pelee Island, Middle Island and Point Pelee. Middle Island hasn't been verified. Common Hoptree presence confirmed outside of Park on Pelee Island. Reduction in potential habitat occurrence results in a decline in population as opposed to moth dispersal. For Point Pelee NP - there is no housing development; for the other two sites where there is potential for the moth, these haven't been considered.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1.2	Commercial & industrial areas		Negligible	Negligible (<1%)	Moderate (11-30%)	High (Continuing)	Common Hoptree: may be a factor, however it is not a factor at the only site where Hoptree Borer is known to occur. Will the Hoptree Borer just jump to the next Common Hoptree if one gets cut down? Can't assume Hoptree Borer will just move if trees disappear. If lose Common Hoptree within core range, abundance of moth will decline.
1.3	Tourism & recreation areas		Negligible	Negligible (<1%)	Moderate - Slight (1-30%)	High (Continuing)	May be applicable within Point Pelee NP, although because the Common Hoptree is obvious to identify, and also a species at risk, it is unlikely development within the park would impact the tree (e.g., development would not likely occur on tree habitat). Unlikely for golf course or other major recreational development.
2	Agriculture & aquaculture						Probably not applicable.
2.1	Annual & perennial non-timber crops						Not applicable.
2.2	Wood & pulp plantations						Not applicable.
2.3	Livestock farming & ranching						Not applicable.
2.4	Marine & freshwater aquaculture						Not applicable.
3	Energy production & mining						Common Hoptree occurs in the albars; protected habitat. Sand Quarrying to Common Hoptree is accounted for under habitat alteration.
3.1	Oil & gas drilling						Not applicable.
3.2	Mining & quarrying						Not applicable.
3.3	Renewable energy						Not applicable.
4	Transportation & service corridors		Negligible	Negligible (<1%)	Negligible (<1%)	Insignificant/Negligible (Past or no direct effect)	Point Pelee is particularly susceptible to development and therefore under protection, very little road development occurs. Herbicide application accounted for under threat category 6.3. Most road development is outside of scope of threat for species since trimming and maintenance gives way for Common Hoptree potential habitat.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
4.1	Roads & railroads		Negligible	Negligible (<1%)	Negligible (<1%)	Insignificant/Negligible (Past or no direct effect)	Negligible. Roads were historic, and there is ongoing maintenance and it isn't an overall loss. Common Hoptree Threats: Point Pelee - significant numbers growing along roadways (more light to grow more vigorously) (if there was no road there would not be this issue). Park policy allows trimming along roadways with SAR authorization. Managed in Park to avoid losses (and collect seeds for replanting) to the extent possible. Hoptree Borer Threats: trimming may impact shoots/leaves where larvae are present.
4.2	Utility & service lines						Not applicable.
4.3	Shipping lanes						Not applicable.
4.4	Flight paths						Not applicable.
5	Biological resource use						Point Pelee Park is currently the most prominent National Park for tourism and therefore subject to human disturbance.
5.1	Hunting & collecting terrestrial animals						Not applicable.
5.2	Gathering terrestrial plants						Not applicable.
5.3	Logging & wood harvesting						Not applicable.
5.4	Fishing & harvesting aquatic resources						Not applicable.
6	Human intrusions & disturbance		Not a Threat	Pervasive (71-100%)	Neutral or Potential Benefit	High (Continuing)	
6.1	Recreational activities		Not a Threat	Pervasive (71-100%)	Neutral or Potential Benefit	High (Continuing)	ATV use was discussed. Effect of recreation is likely large or pervasive on this species and is ongoing, however, severity is likely neutral. Park education and management is likely of great benefit in relation to the potential for impact of this threat. Currently ATVs are restricted from Point Pelee. The impact of ATVs and recreational use outside the park is mixed. The heavy beach grooming at Nickel Beach, and intense use of high dunes at Sherkston are probably detrimental to the subpopulations at those sites. On the other hand, the subpopulation at Rondeau is being encroached upon by planted Scots Pine (<i>Pinus sylvestris</i>), and would benefit from more disturbance, particularly if it reduced tree cover.
6.2	War, civil unrest & military exercises						Not applicable.
6.3	Work & other activities						Not applicable.
7	Natural system modifications	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Erosion and loss of sand dunes is highest threat to Common Hoptree and therefore to Hoptree Borer. Sand quarrying is another major threat.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
7.1	Fire & fire suppression	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	Overall, unknown extent as to which fire suppression has affected habitat for this species. Managed (to maintain savannah habitat) inside Park. Outside the Park, fire suppression is likely having a negative impact.
7.2	Dams & water management/use						Not applicable.
7.3	Other ecosystem modifications		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Hardening of shoreline removes the source of sand but there are other factors that contribute to overall sand budget. Park Ecologist indicates there are many studies show that the Point should be shifting, not shrinking, as is currently happening. Sand sucking (from freighters) historically caused a sand deficit and craters in lake bottom. Building of marinas trap sand (historically dredged and taken away). Effects of historical sand mining are still seen today (even though stopped in 80's). High water levels in Lake Erie 2014 have resulted in some losses of trees close to western shoreline. Some uncertainty on total number of losses. This is the highest threat but how it manifests (over the 10-year timeframe) is difficult to ascertain in terms of probabilities.
8	Invasive & other problematic species & genes		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
8.1	Invasive non-native/alien species		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Hoptree Borer: Invasive plant species may also pose a threat to Hoptree Borer habitat, either through direct competition with Common Hoptree, or through competition with native flowering plants used as nectar sources by adult moths. Nectar source requirements for Hoptree Borer are unknown, but females of related species (<i>Yponomeuta malinellus</i>) require nectar feeding for a week or more before they are sexually mature (Carter 1984). The most invasive plants at Point Pelee include White Mulberry (<i>Morus alba</i>), Japanese Knotweed (<i>Polygonum cuspidatum</i>), White Poplar (<i>Populus alba</i>), Spotted Knapweed (<i>Centaurea maculosa</i>), English Ivy (<i>Hedera helix</i>), Garlic Mustard (<i>Alliaria petiolaris</i>), and Orange Daylily (<i>Hemerocallis fulva</i>) (Dougan and Associates 2009). Common Hoptree Threats: prefer disturbed areas which are also generally the best areas for invasive alien species that could impact this species. Uncertain as to degree of impact however (in terms of mortality). In some areas of Point Pelee, there are negative effects on seedling establishment but it is uncertain as to whether this is a proximate activity or limiting factor..

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.2	Problematic native species		Not a Threat	Small (1-10%)	Neutral or Potential Benefit	High (Continuing)	Hoptree Borer Threats: Population outbreaks of the Hoptree Leaf-roller Moth (<i>Agonopterix pteleae</i> , Lepidoptera: Elachistidae) can result in nearly complete defoliation of Common Hoptree. It is abundant at Point Pelee (Scarr <i>et al.</i> 2007), and extensive feeding damage was observed on Pelee Island in 2014, where smaller trees were frequently completely defoliated (COSEWIC 2015). The Hoptree Barkbeetle (<i>Phloeotribus scabricollis</i>) can cause twig and shoot dieback. This species was observed on several of the Common Hoptree populations in 2000-2002 (COSEWIC 2002), causing losses of major parts of affected trees, including loss of flowering. Both of these insect herbivores may adversely affect Hoptree Borer populations through direct competition and leaf and shoot dieback. The large colony of Double-crested Cormorants on Middle Island has been identified as a potential threat to Common Hoptree (COSEWIC 2015), but presence of Hoptree Borer there requires confirmation. There are no documented decline in population as a result of threat from cormorants where Common Hoptree seems to be resilient to this threat, therefore threat is accounted for as unknown. Common Hoptree Threats: Main threat is on Middle Island where there is a large population of Double-crested Cormorants. However, as long as the population continues to be managed, at current nesting levels, impacts not high (or of a negative affect). Uncertainty points to more research needed to distinguish effects of Hoptree Borer as limiting factor rather than a threat. Bruce - normally cormorants are considered bad for species, however in this case they are creating openings, and in these areas Common Hoptree was doing very well and thus cormorants weren't considered. Cormorants only likely a threat at Middle Island but they are not likely to invade the Pelee Island and Point Pelee sites. Deer populations in park are currently being controlled.
8.3	Introduced genetic material						Not applicable.
9	Pollution		Unknown	Unknown	Extreme (71-100%)	Moderate (Possibly in the short term, < 10 yrs)	
9.1	Household sewage & urban waste water						Not applicable.
9.2	Industrial & military effluents						Not applicable.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
9.3	Agricultural & forestry effluents		Unknown	Unknown	Extreme (71-100%)	Moderate (Possibly in the short term, < 10 yrs)	Hoptree Borer Threats: All of the Canadian occurrences of Hoptree Borer are within the range of European Gypsy Moth (<i>Lymantria dispar</i> L.), which is occasionally subject to control measures through ground- and aerial spraying of Btk (<i>Bacillus thuringiensis kurstaki</i>). Btk is a component of commercial pesticides used to control defoliating Lepidoptera, although it also affects most non-target butterfly and moth larvae (Schweitzer <i>et al.</i> 2011). Btk for gypsy moth is typically applied in early April to early May, coinciding with the larval stage of Hoptree Borer. However, Parks Canada confirmed no spraying in Pelee Island National Park.
9.4	Garbage & solid waste						Not applicable.
9.5	Air-borne pollutants						Not applicable.
9.6	Excess energy						Not applicable.
10	Geological events						
10.1	Volcanoes						Not applicable.
10.2	Earthquakes/tsunamis						Not applicable.
10.3	Avalanches/landslides						Not applicable. Severe weather is accounted for under threat 11.
11	Climate change & severe weather	D	Low	Large - Small (1-70%)	Slight (1-10%)	Moderate (Possibly in the short term, < 10 yrs)	Ice scour reduced which can alter succession. Uncertain. Possible occurrence in the next 10yrs. Climate change article infers definite shoreline habitat loss in the Point Pelee National Park area. Moth is mainly in the dune habitat as opposed to alvars habitat and therefore under higher risk from threat of shoreline alteration.
11.1	Habitat shifting & alteration	D	Low	Large - Small (1-70%)	Slight (1-10%)	Moderate (Possibly in the short term, < 10 yrs)	Reduced ice scour recently compared to historical events is applicable to the Common Hoptree. The shoreline habitats of Common Hoptree are characterized by high levels of disturbance, to which Common Hoptree is adapted. Reduced ice-scour along the Lake Erie shores has allowed for plant community succession to more mature, shaded environments, shading out Common Hoptree when light levels become sub-optimal (COSEWIC 2002).
11.2	Droughts		Unknown	Unknown	Unknown	Unknown	Unknown
11.3	Temperature extremes		Unknown	Unknown	Unknown	Unknown	Unknown.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11.4	Storms & flooding		Unknown	Unknown	Unknown	Moderate (Possibly in the short term, < 10 yrs)	This species likely evolved with storm and flood events, but climate change is impacting the timing and intensity of these events which may impact the species.. Sever ice storms during adult or larval stages could significantly impact this species, which occurs within a very small range. Some storm events at Point Pelee are known to have huge impacts to beach habitats.

Classification of Threats adopted from IUCN-CMP, Salafsky *et al.* (2008).