

NATURAL HISTORY AND OBSERVATIONS

Evidence of established brown marmorated stink bug populations in British Columbia, Canada**PAUL K. ABRAM¹, TRACY HUEPPELSHEUSER², SUSANNA ACHEAMPONG³, PEGGY CLARKE¹, HUME DOUGLAS⁴, AND TARA D. GARIEPY⁵**

ABSTRACT— We report four new detections of invasive agricultural pest *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae), the brown marmorated stink bug, in the Lower Mainland and Okanagan Valley regions of British Columbia (BC), Canada, in 2015 and 2016. These finds include two confirmed breeding populations, as well as homeowner collections at the same residence in two consecutive years. Preliminary comparisons of mitochondrial DNA haplotypes from these collections suggest that *H. halys* populations in BC are the result of movement and spread of existing populations in North America, likely from the Pacific Northwest USA.

The brown marmorated stink bug, *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae), native to Asia, is a globally invasive pest with a broad host-plant range. This species often causes economic losses to tree fruit, berries, vegetables, and ornamental plants (reviewed in Rice *et al.* 2014). The stink bug is also a nuisance pest for homeowners when it seeks indoor overwintering sites in the fall and winter months. Since the detection of new invasive populations, beginning more than 20 years ago, *H. halys* has become broadly established in Europe and North America (reviewed in Haye *et al.* 2015), including most of the continental USA. (see <http://www.stopbmsb.org/where-is-bmsb/state-by-state/>) and the Canadian provinces of Ontario (Fogain and Graff 2011; Gariepy *et al.* 2014a) and Quebec (Jacques Brodeur, personal communication). In British Columbia (BC), *H. halys* has been intercepted in shipments from Japan, Korea, and China several times since 1993 (Fogain and Graff 2011; Gariepy *et al.* 2014b), but breeding populations were not detected.

From 2015 to 2016, we detected a total of 487 *H. halys* at four different sites in the Lower Mainland and Okanagan Valley regions of BC (Table 1). Evidence of *H. halys* reproduction (eggs and/or nymphs with adults) was found on host plants at one site in the Lower Mainland (Chilliwack Mountain) and another in the Okanagan Valley. At the Chilliwack (Rosedale) site, where the first detection was made in 2015, an increased number of stink bugs returned to the same residence in the fall of 2016, indicating that a breeding population is established in this area. An *H. halys* nymph and two adults were found by two different residents in the Kitsilano neighborhood of Vancouver, BC.

Possible routes of brown marmorated stink bug invasion into BC include natural spread of already-established populations in the Pacific Northwest of the USA (Oregon,

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Table 1
Brown marmorated stink bug (*Halyomorpha halys*) found in British Columbia in 2015–2016.

Locality (GPS Coordinates) ^a	Collection Dates/ Time period	Initial detection method	Number of specimens and life stage(s)	Location/context of collected <i>H. halys</i>	COI Haplotypes (N individuals) ^b
Chilliwack (Chilliwack Mountain) 49°09'34.5"N 121°59'49.2"W	May–Oct 2016	Homeowner find, followed by weekly beat sheet sampling and traps	176 nymphs, 264 adults	Private garden feeding on Asian pear tree (<i>Pyrus pyrifolia</i>) and aggregating on and inside neighboring house. Homeowner reported infestation had been present since 2014.	H1 (18) H3 (25) Hn (8)
Chilliwack (Rosedale) 49°11'04.2"N 121°47'54.1"W	Oct 2015, Sept–Oct 2016	Homeowner find	2 adults (2015) 30 adults (2016)	Exterior walls and roof of house	H1 (4) H3 (2) Hn (1)
Vancouver (Kitsilano) 49°15'50.9"N 123°10'12.3"W and 49°15'49.4"N 123°09'07.8"W	Oct 2016	Homeowner finds	1 nymph, 2 adults	Backyard strawberry plant (1 nymph, 1 adult), and on public transit (1 adult)	Hn (2)
Penticton 49°28'23.1"N 119°35'23.4"W	May, Aug–Oct 2016	Museum collection fieldwork for other taxonomic research; collected with beating tray	4 adults (May 2016), 6 nymphs and 2 adults (Aug–Oct 2016)	Feeding on chokecherry (<i>Prunus virginiana</i>) bush near waterway; last adult and nymph of season caught in pheromone-baited Pyramid traps ^c .	H1 (2) H3 (1) Hn (2)

^a GPS Coordinates are approximate to protect homeowner privacy.

^b Genbank accession numbers: KP273380 (H1), KP273382 (H3), from Gariepy *et al.* (2014b), KY570297 (Hn).

^c Baited with Stink Bug Xtra Combo Dead-Inn lures (AgBio, USA).

Washington), as well as accidental human-mediated translocation from Asia, Europe, or other Canadian or American localities. To gather preliminary information on possible invasion routes for this species in BC, we used COI haplotyping, which has previously been used to identify possible sources of *H. halys* invasions in Canada, the USA, and Europe (e.g., Garipey *et al.* 2014b; Xu *et al.* 2014; Garipey *et al.* 2015). We amplified and sequenced a 658-base pair (bp) region of the mitochondrial Cytochrome C oxidase subunit 1 (COI) gene from several specimens collected at each site (Table 1) to identify COI haplotypes (see Garipey *et al.* 2014b for primers and methodology). Previous studies concluded that eastern North American *H. halys* populations originated from a single source population in the Beijing area of China. In contrast, European populations are derived from several Asian source populations, including China, Korea, and other currently unidentified locations (Garipey *et al.* 2015). Populations from the western USA (California, Oregon, Washington) include multiple haplotypes, some of which differ from those found in eastern North America (Haye *et al.* 2015). Our genetic analysis of field-collected specimens from BC supports these findings, demonstrating that multiple haplotypes also occur in western Canada. In total, three COI haplotypes were detected among the specimens collected in BC: H1, H3, and a currently undescribed COI haplotype (Hn) (Table 1). COI haplotypes H1 and H3 were described by Garipey *et al.* (2014); H1 is the predominant haplotype in eastern North America and some areas of Europe, whereas H3 is known from several regions in Europe, predominantly in Switzerland (Garipey *et al.* 2015). Concurrent research in the western USA has employed different gene regions for haplotype analysis (COII and 12S), but comparison of representative datasets demonstrates that COI H1 and H3 haplotypes are already known from Washington and Oregon (Marie Claude Bon and Kim Hoelmer, personal communications). The third COI haplotype (Hn) has not previously been described from samples collected in Asia, Canada, or Europe (Garipey *et al.* 2014b; Garipey *et al.* 2015). This haplotype may occur in the Pacific Northwest of the USA; however, additional DNA sequencing will be necessary to determine how it corresponds to the haplotypes for the COII and 12S genes that have been analysed for *H. halys* specimens collected in Washington, Oregon, and California (Marie Claude Bon and Kim Hoelmer, personal communication).

Continuing public outreach will be important for tracking the spread of *H. halys* populations in BC and for gathering specimens to examine population genetics and detect invasion pathways. For example, a citizen discovered the Chilliwack Mountain population following a BC Ministry of Agriculture newspaper advertisement, and the Kitsilano reports were a result of residents seeing news articles reporting on the brown marmorated stink bug. Additionally, just before the submission of this note, two additional citizen reports of individual finds in the Lower Mainland (Langley, BC) and the Interior (Kelowna, BC) were received (Hueppelsheuser and Acheampong, unpublished data). To continue to track the spread and establishment of the brown marmorated stink bug in BC, a citizen science approach is planned, to be complemented by pheromone trapping and grid-based beating sheet sampling of known host plants.

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