

# First Report of *Halyomorpha halys* (Hemiptera: Pentatomidae) in Montana, USA

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## Abstract

Here, we document the first record for Montana of *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae), a major agricultural and nuisance pest in many parts of the world. The insect was found overwintering in a private residence in January 2021 in Billings (Yellowstone Co.). A preliminary survey of sites in Billings from May to October 2021 confirmed the presence of *H. halys* within a radius of at least 11 km from the January detection. Putatively overwintering *H. halys* and adult bugs found across the city of Billings in the summer suggest the insect may have been present in the area prior to 2021. Surveys conducted in various regions of the state between 2013 and 2020 reported no detections of *H. halys*. Yellowstone Co. was previously surveyed in 2017, indicating the species likely arrived between 2018 and 2020 or was present before 2018 at densities too low to be detected. The summary of presence and absence records we provide herein is valuable for future monitoring and management efforts of this economically important species.

**Key words:** invasive species, pheromone lure, early detection, brown marmorated stink bug

The brown marmorated stink bug, *Halyomorpha halys* (Stål) (Fig. 1A), is native to eastern Asia, including Japan, the Korean peninsula, and eastern China. It has become a globally distributed invasive insect, with the first introduced populations to cause significant agricultural damage occurring in the United States in 2010 (Leskey and Nielsen 2018, Ludwick et al. 2020). In North America, *H. halys* has a broad host range of over 170 plant species, including many horticultural and agricultural crops (Leskey and Nielsen 2018). It can also be a significant nuisance pest due to its propensity to aggregate and overwinter in human structures (Hancock et al. 2019). Prior to 2021, Montana was one of three states (including South Dakota and Wyoming) without confirmed reports of *H. halys* in the United States. Surveys for the insect across the state beginning in 2013 did not detect *H. halys* in Montana.

In January 2021, an adult male *H. halys* was found walking on the ground floor of a private residence in Billings, MT. Specimen identification was determined by Laurie Kerzicnik (Montana State University Extension IPM Program) and confirmed by James Zahniser (U.S. Department of Agriculture Animal Plant Health Inspection Service).

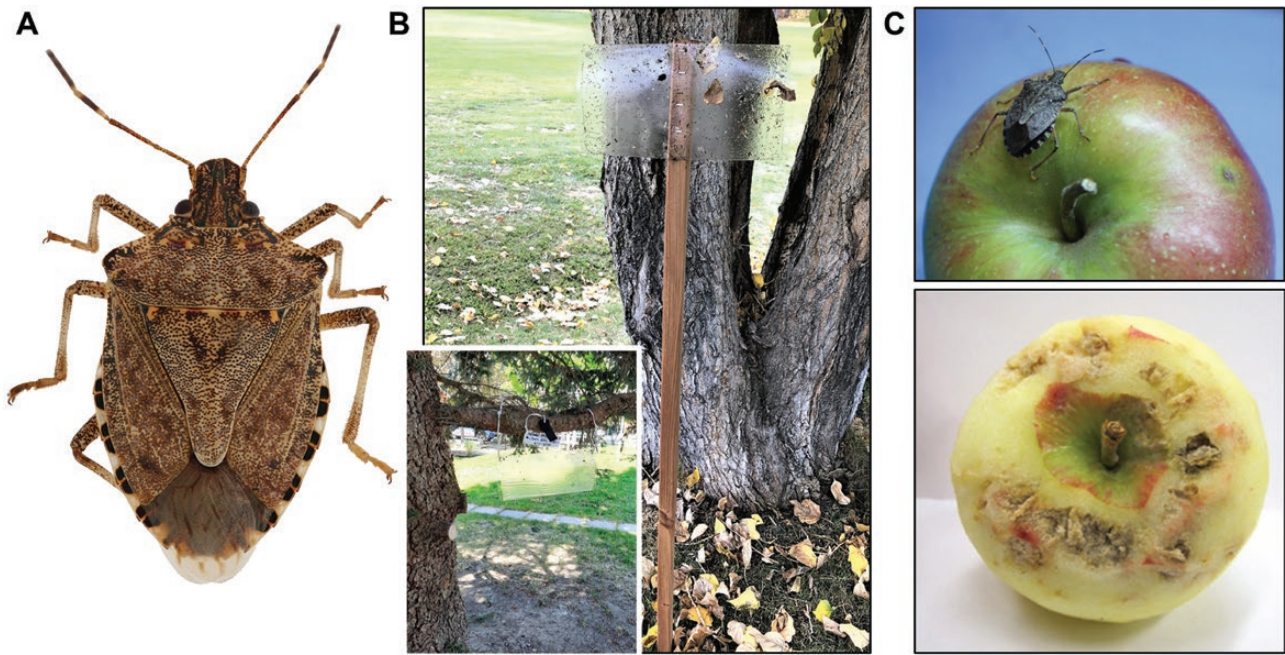
## Surveys and Detections in 2021 and Early 2022

To estimate a preliminary extent of *H. halys* presence within Billings, five pheromone-baited traps (Fig. 1B) were deployed across the city

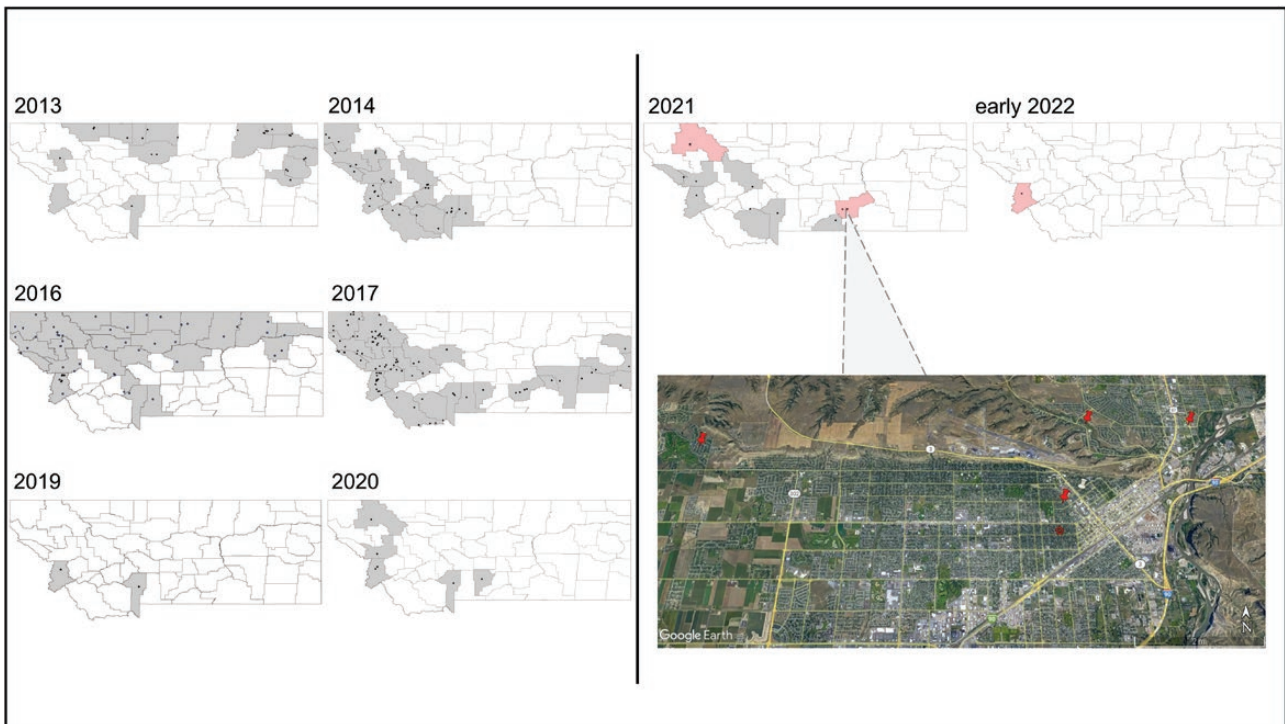
between 14 and 20 May 2021. Four traps were on private residential properties, including the site of the initial detection, and one was on the property of a commercial garden center and nursery (Fig. 2). Trap design and protocol followed the recommendations of Acebes-Doria et al. (2018). In brief, transparent, double-sided sticky cards (PHEROCON stinkbug STKY dual panel adhesive trap, Trécé, Inc.) were secured to a stake or branch that held the card ~1 m above ground. Each card was baited with a dual lure of the two-component *H. halys* aggregation pheromone and the synergist, methyl (*E,E,Z*)-2,4,6-decatrienoate (PHEROCON stinkbug, Trécé, Inc.), a combination known to be attractive to *H. halys* adults and nymphs throughout a growing season. Traps were visually checked approximately weekly and the number of *H. halys* was recorded. Sticky cards were replaced every 4 wk and lures were replaced once after 12 wk. Traps were removed on October 25 after 5 d with minimum temperatures of 0°C recorded for the city (<https://www.ncei.noaa.gov/>).

At least one adult bug was captured at each of the five Billings sites during the trapping period, with the first and last bug caught on 14 May and 5 October, respectively (Fig. 3). No nymphs were reported. The furthest capture from the January detection site was 10.9 km to the west.

Montana State University's Western Agriculture Research Center (WARC) also monitored for *H. halys* in commercial and backyard



**Fig. 1.** Adult *H. halys* are typically 12–17 mm in length, making them larger than most stink bugs native to the United States. They are also distinguished by white bands on their antennae and legs, alternating dark and light bands along the edge of their abdomen, and rounded shoulders (A). Pheromone-baited sticky traps (PHEROCON stinkbug STKY dual panel adhesive trap, Trécé, Inc.) secured ~1 m above ground were used to monitor for the presence of *H. halys* in Montana in 2021 (B). Managers in Montana are particularly concerned with the potential damage *H. halys* might cause to the state's fruit crops, like apples, were the bug to become established. Pictured here is tissue necrosis that can result from *H. halys* feeding on apple (C). Photo credit: (A) Theresa Cira (University of Minnesota), (B) Lauren Kerzicnik (Montana State University) and Bruce Morey (Billings, MT), (C) Hailey Shanovich (University of Minnesota).

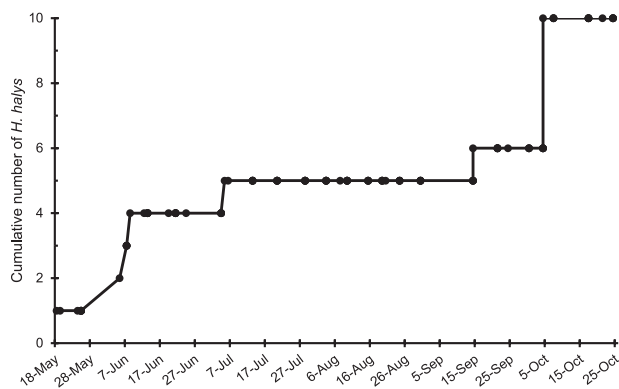


**Fig. 2.** Locations of surveys and detections of *H. halys* in Montana. Dots indicate specific sampling sites within a county and year. Surveyed counties with no *H. halys* detections are shown in grey, whereas counties with at least one *H. halys* confirmed from surveys or public reports in 2021 (Yellowstone and Flathead Co.) or early 2022 (Ravalli Co.; through March) are red. Sites of the 2021 Billings detections, including those from pheromone-baited traps (red pins and star), a confirmed public report (white pin), and the first confirmed *H. halys* (star), are shown in the detailed inset. See also [Supp Table S1 \(online only\)](#) for a list of all georeferenced survey and occurrence data. Maps are unprojected and were produced using ArcGIS Desktop 10.8.2 (Esri ArcMap) and Google Earth Pro (v7.3.4).

orchards in 2021. Following the same trap design as described above (Fig. 1B), sites across seven counties in western Montana (Fig. 2) were sampled approximately weekly, with the first trap deployed on 4 May 2021 (Ravalli Co.) and the last trap removed on 7 November 2021 (Flathead Co.). No *H. halys* were detected by these traps. However, an adult *H. halys* was found inside a car in Flathead Co. on 20 May 2021, highlighting the role of human-mediated spread in the dispersal of this insect (Wallner et al. 2014). Most recent to the time of this publication, a third county (Ravalli Co.) had a positive detection after a live adult *H. halys* was found inside the residence of one of this study's co-authors on 4 March 2022 in the city of Hamilton.

### Surveys and Reports Prior to 2021

Coordinated efforts to look for *H. halys* in Montana have been recorded since 2013 (Fig. 2). Through the U.S. Department of Agriculture Cooperative Agriculture Pest Survey (CAPS) program, the Montana Department of Agriculture surveyed for *H. halys* in Montana in 2013, 2014, 2016, and 2017. Surveys involved visual



**Fig. 3.** Cumulative trap catch of *H. halys* adults across five sites in Billings, MT during 2021. The first trap was placed on 18 May and the last trap was removed on 25 October. The last bugs were caught on 6 October. Each dot indicates when at least one trap was visually checked for the presence of *H. halys*.

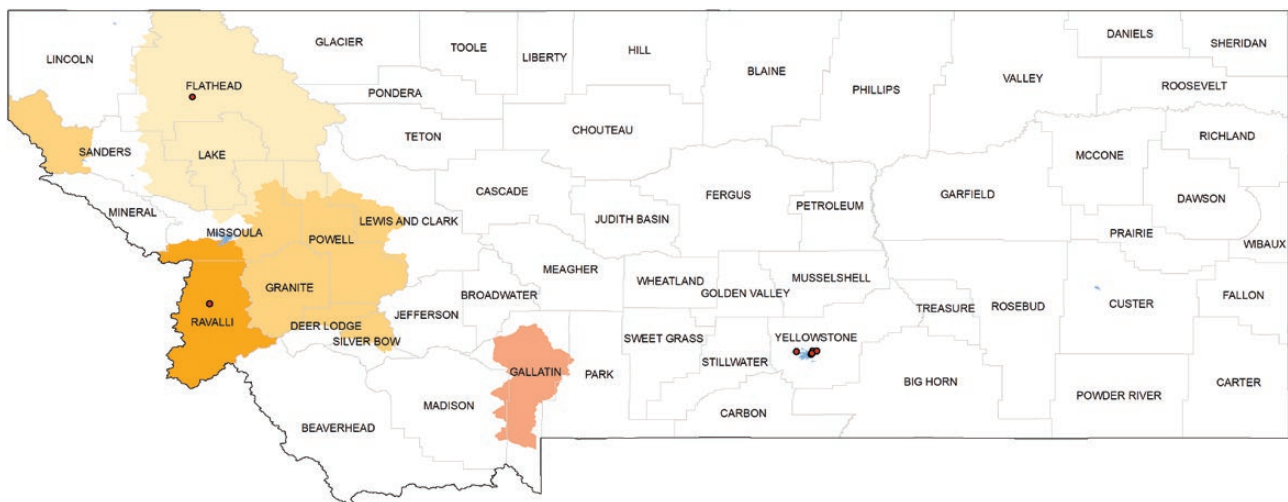
and sweep net sampling in pulse crops and corn, respectively. The number and timing of samples varied across years (Fig. 2 and Supp Table S1 [online only]). In 2016, 2017, 2019, 2020, additional sites and counties were surveyed by Montana State University's Extension IPM Program and the WARC. In 2016–2017, black pyramid *H. halys* traps (Alpha Scents, Inc.) baited with the synergist methyl (*E,E,Z*)-2,4,6-decatrionoate (HALHAL lures, Alpha Scents, Inc.) were placed at six sites in Ravalli Co. and ran from 18 May through 18 November 2016 and from 8 June through 1 November 2017. Traps were checked biweekly. In 2019, monitoring occurred in commercial and backyard orchards in Corvallis and Hamilton (Ravalli Co.) using the aforementioned pyramid traps. Monitoring was expanded in 2020 to include Flathead, Gallatin, Missoula, and Sweet Grass counties, but utilized the clear sticky trap and dual pheromone lure protocol described previously. No *H. halys* were found during any of the above efforts.

A tentative adult *H. halys* in Billings (Yellowstone Co.) was reported by a community member in October 2020. Though the species identification was not confirmed, the same community member submitted a subsequent specimen collected from their residence in May 2021 (approximately 1.5 km from the January 2021 detection; Fig. 2) and noted they had continued to see additional insects of the same appearance in their house since their October report. The May-collected specimen was confirmed to be *H. halys*, suggesting the insects observed in the fall of 2020 were also *H. halys*.

Given the number and extent of bugs caught during the summer of 2021, it is likely *H. halys* has been present in Billings for more than a year prior. Historical monitoring data suggest that the insect was absent from much of the state through at least 2017 or was below a population density detectable by the trapping protocols (Fig. 2). Yellowstone Co. was included in the 2017 CAPS survey, with two sampling locations occurring in Billings near locations with positive captures in 2021 (Supp Table S1 [online only]); however, no bugs were detected in 2017.

### *H. halys* Threat to Montana

Numerous valued plants are potentially at risk were *H. halys* to become established in Montana. Given where *H. halys* has currently



**Fig. 4.** Regions of commercial fruit production in Montana. Each shaded region represents a watershed (shades of orange) or urban area (small regions in blue) within which commercial fruit (cherries, pears, apples, peaches, grapes) production occurs. Small circles depict locations of confirmed *H. halys* detections as of March 2022. Watershed boundaries from the Montana State Library through the USGS ScienceBase Catalog. City boundaries from the Montana Department of Transportation. Map is unprojected and was produced using ArcGIS Desktop 10.8.2 (Esri ArcMap).

been detected (Fig. 2), threats to specialty fruit crops in the state are of particular concern, including apples, pears, grapes, cherries, and peaches (Fig. 1C). Commercial fruit production mostly occurs within river valleys of western Montana (e.g., Bitterroot, Flathead, Clarks Fork, and Gallatin Valleys), with some scattered locations further east (e.g., areas in and around the city of Billings) (Fig. 4). Many of the other major commodity crops known to be damaged by *H. halys* (e.g., soybean, sweet corn, field corn) (Leskey and Nielsen 2018) occur largely in the eastern regions of the state and have comparatively small commercial acreage and value to other areas of the country (USDA-NASS 2022). Though *H. halys* has caused severe damage to fruit and other crops elsewhere, particularly in the eastern United States, the severity and extent of impact in Montana agroecosystems remains uncertain.

Climate may also influence the impact of *H. halys* in the state. Pest risk maps forecasting the potential establishment of *H. halys* in the United States have estimated relatively low levels of climatic suitability in Montana. Though variable, most forecasts do show some suitability in southcentral and/or western areas that roughly include Yellowstone, Ravalli, and Flathead counties where *H. halys* has now been confirmed (Zhu et al. 2012, Haye et al. 2015, Kistner 2017, Kriticos et al. 2017). Forecasts incorporating climate change suggest similar suitability (Kistner 2017). The data presented here and from future monitoring in the state provide a useful opportunity for model validation in a U.S. region generally forecasted to have limited suitability for *H. halys*.

## Supplementary Material

Supplementary data are available at *Journal of Integrated Pest Management* online.

**Supplementary Table S1:** List of survey and detection sites for *H. halys* in Montana from 2013 to March 2022. Site-specific georeferenced coordinates and date of sampling or occurrence are provided where possible. A visual summary of the data is provided in Figure 2 of the main text.

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## References Cited

- Acebes-Doria, C., W. Morrison, B. Short, K. Rice, H. Bush, T. Kuhar, C. Duthie, and T. Leskey. 2018. Monitoring and biosurveillance tools for the brown marmorated stink bug, *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae). *Insects*. 9: 82. doi:10.3390/insects9030082
- Hancock, T. J., D. -H. Lee, J. C. Bergh, W. R. Morrison, and T. C. Leskey. 2019. Presence of the invasive brown marmorated stink bug *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae) on home exteriors during the autumn dispersal period: results generated by citizen scientists. *Agric. For. Entomol.* 21: 99–108. doi:10.1111/afe.12312
- Haye, T., T. Garipey, K. Hoelmer, J. -P. Rossi, J. -C. Streito, X. Tassus, and N. Desneux. 2015. Range expansion of the invasive brown marmorated stinkbug, *Halyomorpha halys*: an increasing threat to field, fruit and vegetable crops worldwide. *J. Pest Sci.* 88: 665–673. doi:10.1007/s10340-015-0670-2
- Kistner, E. J. 2017. Climate change impacts on the potential distribution and abundance of the brown marmorated stink bug (Hemiptera: Pentatomidae) with special reference to North America and Europe. *Environ. Entomol.* 46: 1212–1224. doi:10.1093/ee/nvx157
- Kriticos, D. J., J. M. Kean, C. B. Phillips, S. D. Senay, H. Acosta, and T. Haye. 2017. The potential global distribution of the brown marmorated stink bug, *Halyomorpha halys*, a critical threat to plant biosecurity. *J. Pest Sci.* 90: 1033–1043. doi:10.1007/s10340-017-0869-5
- Leskey, T. C., and A. L. Nielsen. 2018. Impact of the invasive brown marmorated stink bug in North America and Europe: history, biology, ecology, and management. *Annu. Rev. Entomol.* 63: 599–618.
- Ludwick, D., W. R. Morrison, A. L. Acebes-Doria, A. M. Agnello, J. C. Bergh, M. L. Buffington, G. C. Hamilton, J. K. Harper, K. A. Hoelmer, G. Krawczyk, et al. 2020. Invasion of the brown marmorated stink bug (Hemiptera: Pentatomidae) into the United States: developing a national response to an invasive species crisis through collaborative research and outreach efforts. *J. Integr. Pest Manag.* 11: 1–16. doi:10.1093/jipm/pmaa001
- (USDA-NASS) United States Department of Agriculture, National Agriculture Statistics Service. 2022. <https://quickstats.nass.usda.gov/>. USDA, Beltsville, MD.
- Wallner, A. M., G. C. Hamilton, A. L. Nielsen, N. Hahn, E. J. Green, and C. R. Rodriguez-Saona. 2014. Landscape factors facilitating the invasive dynamics and distribution of the brown marmorated stink bug, *Halyomorpha halys* (Hemiptera: Pentatomidae), after arrival in the United States. *PLoS One*. 9: e95691. doi:10.1371/journal.pone.0095691
- Zhu, G., W. Bu, Y. Gao, and G. Liu. 2012. Potential geographic distribution of brown marmorated stink bug invasion (*Halyomorpha halys*). *PLoS One*. 7: e31246.