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# Parasitoid Wasps of the Invasive Brown Marmorated Stink Bug in Utah

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## Do You Know?

- In 2012, brown marmorated stink bug (BMSB), an invasive insect pest from eastern Asia, was first detected in Utah in Salt Lake City. As of 2017, it is causing agricultural damage in northern Utah.
- There are few natural enemies of BMSB, allowing populations to increase easily.
- Parasitoid wasps that sting and kill stink bug eggs are the most promising control method. While there are native parasitoid wasps in Utah, none have been effective.
- Samurai wasp, a parasitoid native to eastern Asia, has proven to be effective at controlling

The brown marmorated stink bug (BMSB, *Halyomorpha halys* Stål) is an invasive agricultural and nuisance pest native to eastern Asia. It was first confirmed in the U.S. in Allentown, PA, in 1996 and has since spread to 44 U.S. states, many of which have now experienced economic crop damage from this pest (Fig. 1). In Utah, BMSB is now established in five counties (Box Elder, Weber, Davis, Salt Lake and Utah), and has been detected in Cache and Kane counties. While crop damage to peach, apple, squash, and popcorn has been identified, it is currently causing mostly nuisance problems due to overwintering bugs on and inside human structures.

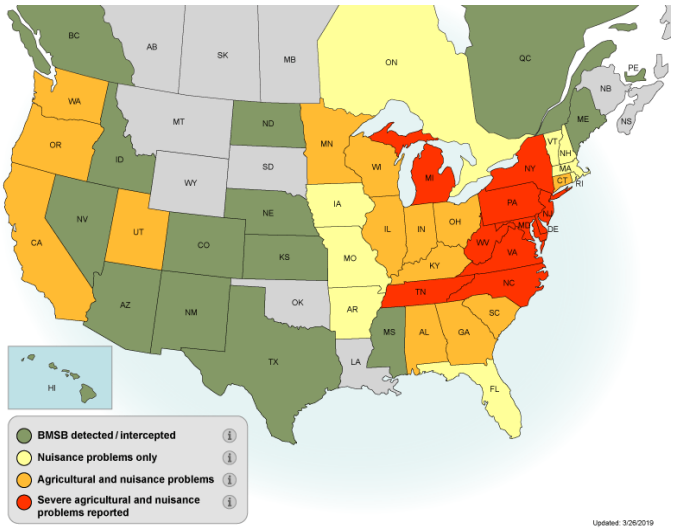


**Fig. 1.** The current distribution and status of BMSB in North America as of April 2019. For updates, see http://www.stopbmsb.org/where-is-bmsb/.

Adult BMSB are marbled brown and black, camouflaging well with woody vegetation. To separate this stink bug from native look-alikes, notice the characteristic white bands on their antennae. Native species do not have this feature. BMSB also has smooth shoulders and a black/white pattern on the edge of the abdomen (Fig. 2).

BMSB is a successful invasive for many reasons: it is polyphagous (feeds on many plant types), highly mobile, has few natural enemies, and adults have a tough

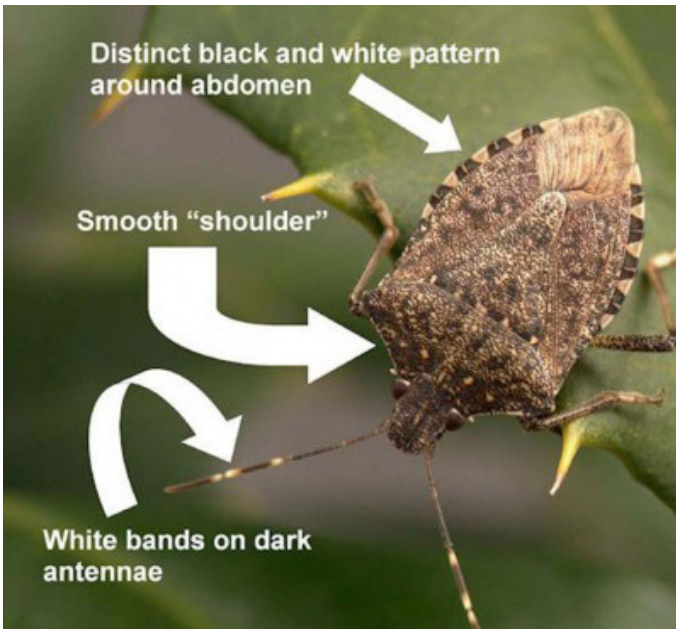


**Fig. 2. A BMSB adult with quick identification characteristics. The white bands on dark antennae is the most helpful feature.**

## GENERAL PARASITOID INFORMATION

exoskeleton that is covered in a waxy, water-repellent cuticle that helps protect them from pesticide applications. Biological control, through the use of egg parasitoids, is the most suitable option for long-term management of BMSB.

There are at least two families of stink bug parasitoids in Utah, Eupelmidae and Scelionidae. These are small, typically black wasps that may be mistaken for small gnats or ants. They will fly in search of stink bug egg

masses. Once they find the eggs, they will sting them, depositing one of their own eggs into the stink bug egg. The wasp egg will hatch, and the larva wasp will feed and develop within the stink bug egg, effectively killing the host. The adult wasp will emerge a couple of weeks later.

The Eupelmids attacking BMSB are all generalist parasitoids, meaning that they sting the eggs of a wide variety of insects. Native parasitoids in this group are moderately successful at stinging and developing inside BMSB eggs, but are unlikely to control BMSB populations due to their generalist nature.

The second family, Scelionidae, includes some stink bug specialists, meaning they only sting stink bug eggs. Specialists are more promising as a control agent for BMSB. Although many of the native Scelionid species will sting BMSB eggs, some will not develop into an adult and emerge. Those that can complete development within BMSB eggs have the potential to be more effective control agents.

**Fig. 3. Left:** An adult BMSB with a freshly laid egg mass; Right top: A parasitoid stings a stink bug egg mass; Right bottom: eggs darken as

Stink bug eggs are usually bright in color (Fig. 3) and take 5 to 7 days to develop and hatch. Eggs will develop a triangular egg "burster" shortly before stink bugs emerge from the egg (Fig. 4). However, if parasitized by a wasp, the eggs will turn dark brown or black after about a week.

**Fig. 4.** A BMSB egg mass with triangular egg bursters. The nymphal stink bugs inside are close to hatching.

## PARASITOID WASP FAMILIES IN UTAH

As the wasps develop, the eggs will continue to darken until the adult wasps emerge about 14 days later (Fig. 3).

There is usually a skewed sex ratio in emerging wasps. In a typical stink bug egg mass that consists of 14-28 eggs, one to three wasps will be male, and the rest will be female. Male wasps will emerge first and wait for the females to emerge. Once mated, the females fly off in search of new egg masses to sting.

Fig 5. An *Anastatus* adult on BMSB eggs. Notice that the wasp is larger than an

### Eupelmidae – Generalist Egg Parasitoids

Eupelmids are small (3-5 mm), slender wasps that are generalist egg parasitoids. One genus, *Anastatus*, will parasitize BMSB, as well as other stink bugs and insects. They

**Fig. 6.** An adult *Anastatus* female. Adults typically measure 3-5 mm in length and resemble ants in appearance.

can resemble ants at first glance. Females often have a white band or white triangles on the wings. There are three species of *Anastatus* known to attack BMSB in Utah (Table 1). When seen on a stink bug egg mass, a general rule is that

**Fig. 7.** An adult *Trissolcus* female. Adults measure 1-2 mm with a robust body form.

**Table 1. Parasitoid wasp species found in Utah as of April 2019 from egg mass and yellow sticky card deployments. *Based on results to-date**

| Species Name | Family | Collection Method | Actual Size | Can Emerge from BMSB? |
|---|---|---|---|---|
| *Anastatus mirabilis* | Eupelmidae | BMSB Eggs | ▬ | Yes* |
| *Anastatus persalli* | Eupelmidae | BMSB Eggs | ▬ | Yes* |
| *Anastatus reduvii* | Eupelmidae | BMSB Eggs | ▬ | Yes* |
| *Telenomus podisi* | Scelionidae | BMSB Eggs / Sticky Cards | - | No* |
| *Trissolcus erugatus* | Scelionidae | BMSB Eggs / Sticky Cards | - | No* |
| *Trissolcus euschisti* | Scelionidae | BMSB Eggs / Sticky Cards | - | Yes* |
| *Trissolcus hullensis* | Scelionidae | BMSB Eggs / Sticky Cards | - | Yes* |
| *Trissolcus parma* | Scelionidae | Sticky Cards | - | Unknown |

these wasps are much larger than an individual egg (Fig. 5).

Females are typically larger than males, and under direct light can exhibit brown, green, or blue iridescence. Males are typically all black, smaller (< 4 mm), and lack wing patterns, making males indistinguishable to species without a microscope.

Fig 8. A *Trissolcus* female on a BMSB egg mass. Notice that the wasp is about the size of an egg.

## Scelionidae – Specialist Egg Parasitoids

Scelionids are very small (1-2 mm), but often robust wasps that are specialists on different insect groups (Fig. 7). One genus within this family, *Trissolcus*, only stings stink bug eggs. The wasps attacking BMSB can only be identified to species by using microscopes, as they are entirely black, small, and lack wing patterns or other characteristics to separate them with the naked eye. However, they can be generally identified in the field to family or genus using the tool that they are as small as or smaller than a stink bug egg (Fig. 8). There are at least two genera of stink bug parsitoids in the family Scelionidae in Utah (*Trissolcus and Telenomus*), with at least eight different species between these two genera (Table 1).

Surveys are ongoing for other species of parasitoid wasps in Utah, particularly *Trissolcus japonicus* (samurai wasp) (Fig. 9). This wasp is native to eastern Asia, the native range of BMSB. In its native range, BMSB causes minimal economic damage, presumably due

**Fig. 9. The samurai wasp (*Trissolcus japonicus)*, a highly effective parasitoid against BMSB. It has been found in 12 U.S. states.**

## SURVEYING FOR PARASITOIDS

to effective biological control by the samurai wasp.

Samurai wasp was collected in China and is undergoing host range-testing in U.S. quarantine facilities to assess non-target effects for release in the U.S. However, samurai wasp has arrived on its own to the U.S. It has been found in 12 states as of January 2019 (Maryland, Pennsylvania, New Jersey, New York, Delaware, Oregon, Ohio, Virginia, West Virginia, Michigan, California, and Washington).

If samurai wasp is found in Utah, it can be reared and redistributed throughout the state to contribute to biological control of BMSB. Until samurai wasp is located in Utah, its release is prohibited.

**Fig. 10. A BMSB egg mass clipped to a corn leaf to attract parasitoid**

Samurai wasp is more likely to be found in areas where BMSB are abundant (urban areas of Salt Lake and Utah valleys). However, it could be found in any location with established BMSB populations, making widespread surveys highly valuable.

Methods used to survey for stink bug parasitoids include

**Fig. 11. An *Anastatus* wasp on naturally-laid eggs.**

physical placement of stink bug egg masses on host plants in the field, finding naturally-laid stink bug egg masses laid directly on host plants, and deployment of yellow sticky cards.

**Physical Egg Mass Placements:**

Lab-reared stink bug eggs are attached to small squares of cardstock paper. These cards are then clipped to the underside of leaves on common hosts of stink bugs in Utah (fruit trees, vegetables, and ornamental trees such as northern catalpa [*Catalpa speciosa*]) (Fig. 10). Cards are left


**Fig. 12. Yellow sticky card hung on a tree to attract parasitoids.**

for 3 to 4 days to attract parasitoids. When collecting cards, parasitoids guarding the eggs are also collected to further assess their efficacy in stinging and developing in eggs.

Finding Naturally-laid Egg Masses:

Stink bug egg masses can be found on the underside of leaves, on the fruiting structures, and occasionally on the stems of host plants (Fig. 11). Just as with deployed egg masses, parasitoids guarding the egg masses are collected to assess efficacy in killing and developing in stink bug eggs.

Yellow Sticky Cards:

Yellow sticky cards attract various insects. Cards are deployed for two weeks on the trunks and branches of ornamental and agricultural host plants, after which the wasps are removed from the card and identified (Fig. 12). When placed in areas with high parasitoid wasp diversity, cards are an effective tool for monitoring wasp diversity and density. While cards are effective at locating parasitoid wasps, information regarding the wasp's behavior on BMSB eggs, or their effectiveness at stinging, killing, and sustaining populations within them cannot be determined.

**Fig. 13. Select native parasitoid wasps stinging BMSB in Utah. From the top left: *Trissolcus erugatus, Trissolcus utahensis, Anastatus reduvii, Telenomus podisi, and Trissolcus euschisti.***

## REPORT PARASITOID WASPS

If You See a Parasitoid Wasp:

If you see a parasitoid on an egg mass, be mindful that it is beneficial for your garden/crops, as the wasps are potentially

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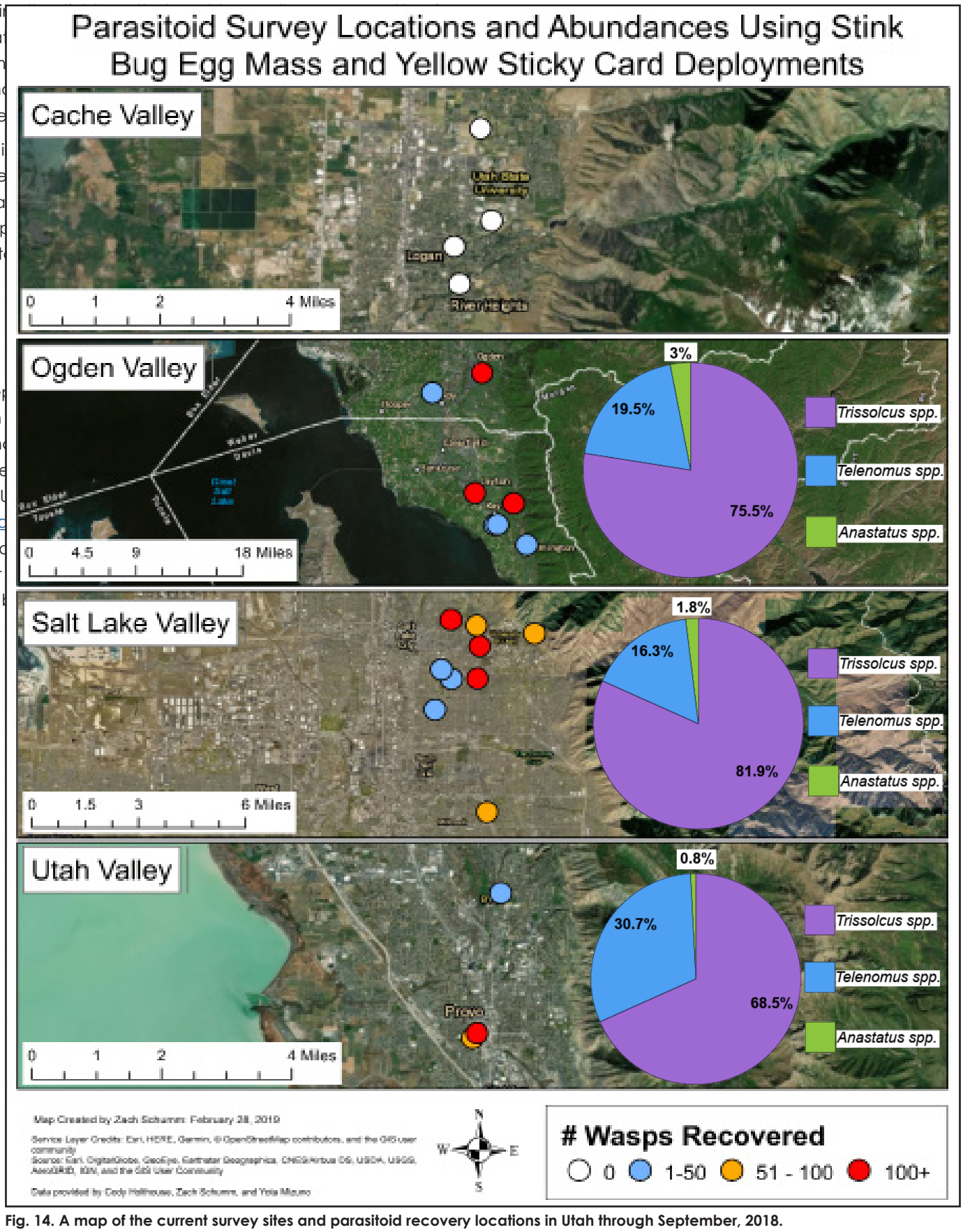


**Fig. 14. A map of the current survey sites and parasitoid recovery locations in Utah through September, 2018.**

## ADDITIONAL RESOURCES


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## PHOTO CREDITS

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