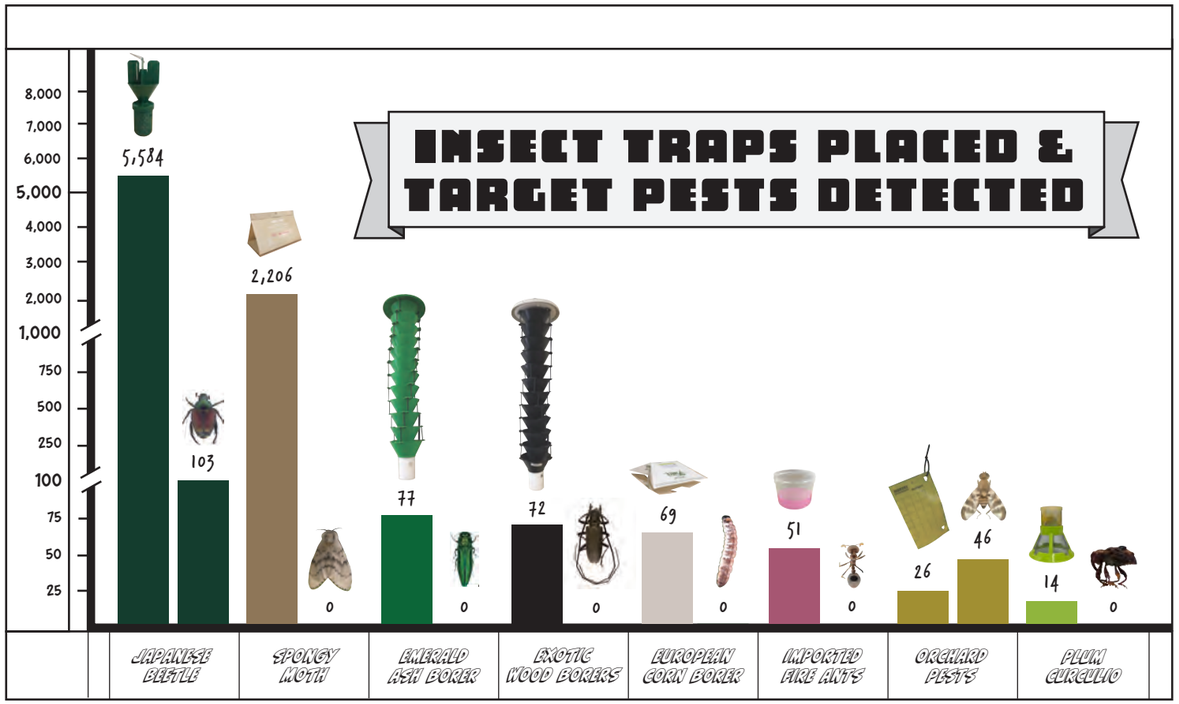
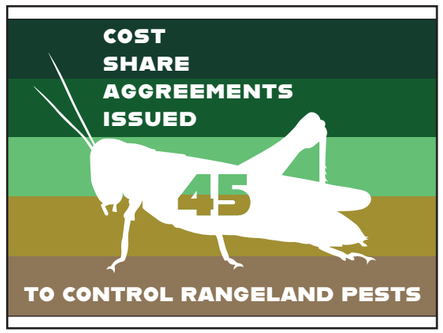
2022 Insect Report

Utah Department of Agriculture & Food
Division of Plant Industry
February 2023

At a Glance Accomplishments





Feature articles

Program Partners

Division Management
Robert L. Hougaard

Contributors
Kristopher Watson
Joey Caputo
Jenna Crowder
Sarah Schulthies

Design and Illustrations
Joey Caputo
Jenna Crowder

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MESSAGE FROM THE MANAGER

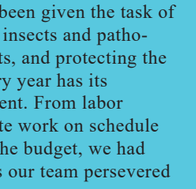
It is with great pride that I present to you the latest edition of the Utah Department of Agriculture and Food's (UDAF) Insect Report. For me and my team, this report is not merely words on paper, but an opportunity to educate others about the incredible work we do. Our program has been given the task of excluding agriculturally important exotic insects and pathogens, suppressing endemic rangeland pests, and protecting the state's managed honey bee colonies. Every year has its challenges and this last one was no different. From labor shortages that made it difficult to complete work on schedule to the rising costs of goods that stressed the budget, we had many obstacles to overcome. Nonetheless our team persevered and excellent work resulted.

In this latest edition you will learn about our ongoing effort to eradicate Japanese beetle (JB) infestations in multiple Wasatch Front counties. Once again, we broke the state's record for the number of JB traps deployed in a single season and conducted multiple turf treatment projects in infested areas. Though JB populations rebounded in Salt Lake County, we continued to make progress in eliminating the beetle from four other counties in the state. With a sustained approach, we are hopeful that the eradication plan will be a success and our state will soon be free of this pest. Our Apiary Program detected a number of American foulbrood disease outbreaks in multiple counties throughout the state. With dedication from our honey bee inspectors and the cooperation of the affected beekeepers, we were able to contain all of these cases. As a result, we expect next year to be a much better environment for colonies all around the state. Finally, rangeland pest problems continue to slowly increase year over year. While we are not seeing the large grasshopper and Mormon cricket outbreaks of two decades ago, an increasing number of producers continue to reach out to us for help.

To all the ranchers, specialty crop growers, nurserymen, apiarists, and residents, I thank you for your continued support of our work. It is my hope that in reading our report, you will feel the passion of the people involved in these projects. For us, this work isn't just a job, but instead a calling to make the great state of Utah even greater.

Respectfully,

Kristopher Watson
State Entomologist



News & Notes

Regulations Update

Out of state ash trees intercepted

The UDAF Nursery Program undertook two regulatory actions to reject the illegal entry of hundreds of ash *Fraxinus* trees from entering the state in February of 2022. The actions were taken because of the newly adopted state rule R68-11 "Quarantine Pertaining to the Emerald Ash Borer" with the goal of preventing the devastating insect pest emerald ash borer (EAB) *Agrilus planipennis* (Fairmore) from being introduced into Utah. This rule creates standards that other states must meet in order to import ash nursery stock, which can serve as a vector for the pest. Thus far, no other states have put forth the effort to meet the important precautionary standards of the quarantine and therefore ash cannot be legally imported into Utah at this time.

The contraband stock was identified by two agricultural compliance specialists on routine nursery inspections. Most of the trees were quickly escorted out of the state and returned to their point of origin, while a small number had to be destroyed. Since the trees were only present in the state for a brief period of time and were rejected well before the EAB's emergence period, there is little risk that the insect was introduced as a result of the incidences. The nurseries were reimbursed the full cost of the orders by the sellers and pledged to not import any ash trees in the future. Inspectors will continue to monitor nurseries throughout the state to check for illegal ash imports, as well as educate the industry and public about the importance of these new rules.

Pine shoot beetle deregulation is contemplated

The UDAF Insect Program is considering the repeal of R68-16 "Quarantine Pertaining to the Pine Shoot Beetle." Pine shoot beetle (PSB) *Tomicus piniperda* (Linnaeus) is an invasive bark beetle, native to Europe, that was first detected in Ohio in 1992. As the insect's name suggests, pine *Pinus* is a preferred host plant. Utah adopted a quarantine the same year the pest was first found in the United States (U.S.) to prevent it from being transported into the state.

Great vigilance was taken by the USDA Animal Plant Health Inspection Service (APHIS) and the State of Utah in the early days of the beetle's introduction, because of its infamous reputation as a pest where it is from. Yet as PSB has spread throughout the Midwest and Northeast, forest disturbances have not materialized as expected. Indeed, USDA APHIS lifted their federal PSB quarantine in late 2020 citing the insect's inconsequential track record as a pest in the U.S.

UDAF is gathering input from stakeholders about deregulating this pest and plans to make an official announcement on the matter in 2023. State entomologist, Kristopher Watson, explained the reasoning for this review in a brief statement:

"UDAF is committed to excluding serious plant pests from our state whenever possible. Like many of our quarantines, R68-16 has done an excellent job in keeping the targeted pest out of Utah. Yet, over the years, it has come to our organization's attention that concern about PSB has greatly waned as predications of this insect's attack on healthy pine trees have not been realized in areas of establishment. Dedicating limited time and funding on pests of minimal agricultural significance drain resources that could be better deployed to exclude more serious pests."

Personnel Changes

Washington County has a new bee inspector. Blaine Nay has been the Iron County inspector for over a decade, and as of April 2022, brings his expertise to Washington County. Blaine is well experienced in working with aggressive bees, which are a known concern in Southern Utah. The department is deeply appreciative of Blaine's meticulous work and his enthusiasm to take on apiary inspection responsibilities in both Washington and Iron counties.

Department Move

After years of preparation and a frantic month of packing, UDAF has officially moved to the Taylorsville State Office Building (TSOB) complex. Compared to the old William Spry building, this new location is more centralized in the Salt Lake Valley and will shorten work-related commute times for many inspectors. This new complex has two buildings–the larger building contains offices for many State of Utah departments, while the southern annex of the complex is dedicated to UDAF and juvenile court offices.

The key design principles guiding this $53 million project are flexibility and longevity. A menagerie of conference rooms, the largest seating over 24 individuals and the smallest perfect for private phone calls, complement the open-office layout. The basement of the TSOB South building houses all the labs that operate under UDAF, including the Entomology Lab (see page 32).

While there is still some ongoing construction in the UDAF annex, the department eagerly awaits the day when visitors can tour a completed facility. The complex is expected to be complete by the end of fiscal year 2023.

Meet an Insect Trapper

Natalie Friesen

2022 was Natalie's first year as an insect trapper, yet she has made a great impression in this short time. Prior to applying at UDAF she worked in a nursery and was fascinated with insects. When Natalie came to the job interview wearing a Japanese beetle necklace, the insect program knew she would be a great fit. Last year, she placed hundreds of insect traps, lent her photography skills to the program (you can find her photos in this insect report), and took an injured monarch butterfly under her wings. Natalie comes to work with enthusiasm for the job and friendliness toward others; we are grateful to have her on the team!

How did you become an Insect Trapper?

I actually interviewed Kristopher Watson, the state entomologist, for a class project I was working on in the spring. I started off interviewing him and he thought I would like the job, and a few weeks later he was interviewing me!

What is your favorite insect?

I have too many to count! I absolutely love jumping spiders and they are definitely up there on my list but I also love moths and beetles. Most specifically I love Rosy Maple, Hawk, and Atlas moths. Pretty much any insect that is fuzzy or iridescent has my heart.

Tell us about your most noteworthy day on the job?

One of the coolest things I got to do was in training when we got to see behind the scenes of the Natural History Museum's insect collection! It was shelves and shelves full of interesting and beautiful insects.

Out in the field, I would have to say it was one of the days I was collecting traps at a campground in Big Cottonwood. It had closed for the season and was completely empty except for me and a Department of Natural Resources employee. I had walked away from my car a pretty good distance to get the moth trap when five deer ran across maybe 10 feet in front of me! I stopped walking and the deer stopped moving. We just stared at each other in silence for maybe a full minute. It was beautiful and so exciting!

If you could summarize your work into a single word, what would it be?

Magical!

Anything else you want to say about insects or yourself?

Insects are the coolest thing you've ever accidentally stepped on. There's an entire tiny world living all around us that we have the good fortune of coexisting alongside. If you're afraid of an insect, take that opportunity to learn about it! Chances are, it's something to be admired far more than feared.

Utah State and County Cooperative Apiary Program

Est. 1892

At the behest of local beekeepers, the Utah territorial legislature created a bee inspection program in 1892. While many things have changed since that time, the program and its original purpose continue to this day: to protect bee health through the appointment of county and state bee inspectors. These inspectors are charged with helping beekeepers to identify and mitigate the many disease and pests that afflict honey bee *Apis mellifera* (Linnaeus) colonies. Today's program is comprised of eight county bee inspectors and two state-wide inspectors. These individuals help protect the state's estimated 31,000 honey bee colonies, which are part of an industry valued at $2.2 million in honey production and $5.9 million in almond *Prunus amygdalus* pollination services.

Inspection Results

2022 was a busy year for the UDAF Apiary Program. State inspectors performed 147 inspections across 132 apiaries, inspecting a total of 669 individual hives across 15 counties. County officials performed another 230 inspections, visiting 188 apiaries and inspecting 1,355 individual hives. The number of hives inspected per county is visualized in Figure 1.

Number of hives inspected per county in 2022

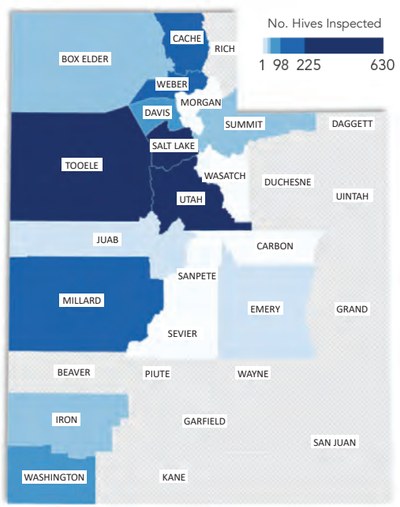


Figure 1. Map of the number of hives inspected in each county in 2022 by state and county apiary inspectors.

Varroa mite *Varroa destructor* (Anderson and Trueman) continues to be the most common and destructive honey bee pest in the state. Varroa is associated with a condition known as parasitic mite syndrome (PMS). This malady is characterized by a complex of symptoms including a spotty brood pattern, shortened worker bee lifespan, the presence of viral disorders in adult bees, and overall poor colony health. In 2022, 9.19% of inspected hives were diagnosed with PMS. However, 42% of those PMS-infected hives originated from a single large commercial apiary. That particular beekeeper is receiving assistance in managing mites from their respective county apiary inspector. If that exceptional case is excluded, the percentage of inspected hives with PMS drops to 5.9%, which is still an increase from last year (Figure 4).

In response to these high Varroa levels throughout the state, program staff published a new fact sheet about PMS and Varroa control (Figure 2). The publication features a handy Varroa monitoring calendar that reminds beekeepers to check for mites at least once a month and record population levels for their own records. Going forward, the program will continue to emphasize the importance of regular mite monitoring and repeated treatments to combat the parasite and its associated poor colony health outcomes.

Figure 2. Parasitic mite syndrome fact sheet.

In keeping with UDAF Apiary Program tradition, a Varroa outbreak alert postcard was mailed to approximately 900 registered Utah beekeepers in August. The purpose of this postcard is to remind beekeepers that Varroa populations are approaching their seasonal peak, and encourages beekeepers to measure - treat - and repeat in order to control the parasites. Due to labor shortages in the state-contracted print shop, the program was unable to send a postcard to every registered beekeeper. But there were some extra postcards from previous years - so recipients located in rural areas of the state were prioritized.

The fungal brood pathogen chalkbrood (CB) *Ascophaera apis* was found in 4.2% of hives inspected (Figure 4). CB is considered one of the less problematic bee maladies, but persistent infections can contribute to colony losses. Colonies most at risk of CB infection are those subject to other stressors such as extreme weather conditions, transportation, poor nutrition, or poor ventilation.

Despite a small population boom of the invasive pest small hive beetle (SHB) *Aethina tumida* (Murray) from 2016 to 2019, there were no detections of SHB in 2022. This finding is similar to last year, when no SHB were found in the state. The pest has previously been confirmed in Davis, Millard, and Washington counties. In response to concerns from beekeepers in Davis county, who had heard rumors that SHB may have been tracked into the state by a migratory beekeeping operation in the county, over 100 SHB in-hive traps and four bottles of beetle oil bait were distributed to beekeepers via Davis County Beekeeping Association officials. Preliminary reports from beekeepers who received these traps indicated no new instances of SHB. Utah's dry climate is thought to be unaccommodating to SHB, which may explain why it has not been found since 2020.

Foulbrood Diseases

2022 has been a remarkable year for American foulbrood (AFB) *Paenibacillus larvae*, which is a fatal and highly contagious bacterial disease of honey bee brood. Thanks to the diagnostic capabilities available through the Entomology Lab (see page 32), inspectors able to positively identify 76 individual hives that were infected with AFB across 18 different apiaries (Figure 3). To put it another way, AFB was found in 3.75% of all hives inspected this year. This is quite a large number, but there's a reason for that. 26 of those AFB-positive hives were from a lot of used beekeeping equipment that had been purchased from an out-of-state beekeeper (see Box 1). An additional 22 AFB-positive hives originated from a different lot of used equipment (see Box 2). If one excludes both of those exceptional cases from the calculation, then AFB was confirmed in just 1.42% of inspected hives - which is still a slight increase from last year (Figure 4). The goal of the UDAF Apiary Program is to keep AFB cases below 1% of inspected hives, and similar to last year, we are close to reaching that goal.

Box 1. Infected Equipment Intercepted

In March of 2022, the UDAF Apiary Program was made aware of a large amount of used equipment that was jointly purchased by two Utah beekeepers from an out-of-state seller in Idaho. Half on a whim, one of those Utah beekeepers decided to have the equipment tested for AFB before installing bees - and good thing too. Of the 10 samples that this beekeeper mailed in, six tested positive for AFB. A follow-up inspection was organized with the other Utah beekeeper to determine the extent of AFB infection in this equipment lot. Upon testing 20 samples from the other beekeeper's lot of equipment, 20 were found positive for AFB. Combined, the whole lot of equipment was found to have an 86.7% AFB positivity rate. This was alarming news for everyone involved - but thankfully, the seller refunded the buyers and returned the equipment back from whence it came. Andrea Thompson, program specialist with the Idaho Department of Agriculture, confirmed that the equipment lot, which included over 250 boxes filled with frames, was put under a stop sale order upon its return to the state. By the end of September 2022, all the equipment was destroyed.

European foulbrood (EFB) *Melissococcus plutonius* disease was found in 2.87% of hives inspected, which is a slight increase from last year (Figure 4). EFB is a less serious brood disease than AFB, but it still can do harm to overall colony health if left unchecked.

Locations of foulbrood cases detected in 2022

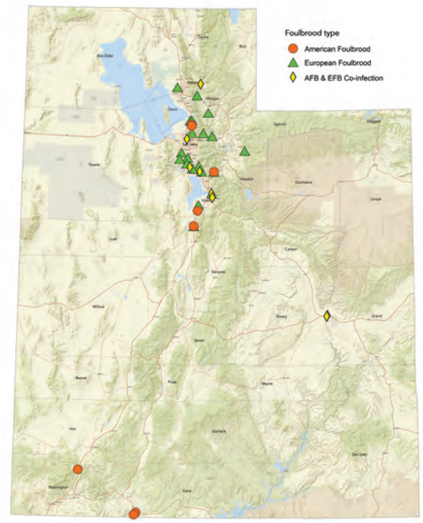


Figure 3. Map of foulbrood cases detected in 2022.

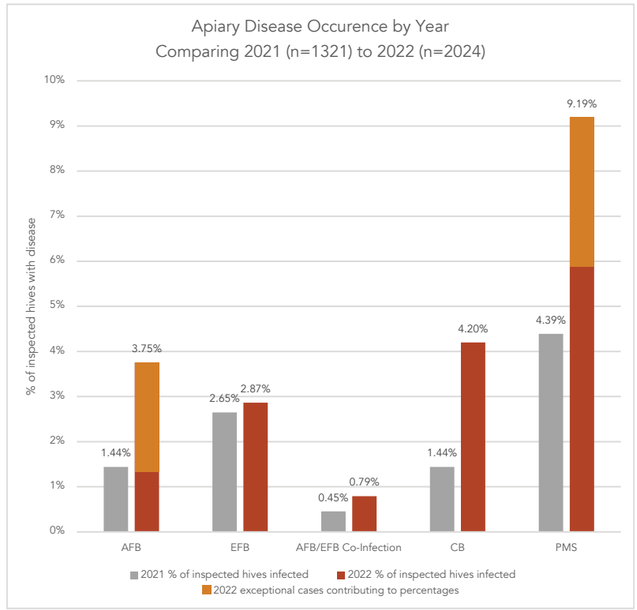


Figure 4. Comparison of apiary disease occurences by year. AFB and EFB cases were confirmed by the UDAF Entomology lab.

Box 2. AFB Mitigation in Utah County

It all started when a beekeeper alerted the program about an apiary that they suspected was abandoned. According to UCA §4-11-107, bee inspectors are authorized to immediately inspect any apiary that is alleged to be abandoned, so the state apiary inspectors were sent to look into the complaint. At the scene, hundreds of bee boxes were stacked to the point of toppling, and wax moths and mice had moved in. In order to determine if AFB was a risk in this apiary, 16 samples were taken from randomly selected brood boxes and subjected to qPCR analysis for foulbrood DNA. All 16 of those samples tested positive for AFB. After some digging into land ownership records and talking to neighbors of the parcel, the apiary owner was identified. In fact, the apiary was not abandoned, but was a staging yard for a commercial beekeeper - who was alarmed to hear the foulbrood news. Thankfully, this beekeeper understood the risk of this infected equipment, and they were exceedingly cooperative in allowing the department to collect and deep-bury over 750 deep boxes filled with AFB-riddled frames.

State of
UTAH

Department of Agriculture and Food
Apiary Program

OLIVER B. HUNTINGTON
Apiary Program Founder

A.J. COOK
Scientific Advisor

Dear Beekeeper,

American foulbrood (AFB) disease can be spread between apiaries when worker bees from a healthy hive scavenge resources such as honey and nectar from infected hives. As an infected hive dies off due to AFB, it becomes more susceptible to these scavengers - aka "robber bees". AFB spores, which can remain viable in honey and beekeeping equipment for decades, may be carried back to a healthy hive via robber bees, which themselves are capable of foraging miles away from their home hive.

This is why, whenever the UDAF Apiary Program detects a case of AFB, a notification letter is mailed to all registered beekeepers within a two-mile radius of the case. This mailer also includes an AFB fact sheet instructing beekeepers on what to look for and how to perform a quick field test for AFB, which allows beekeepers to screen for potential infection themselves.

Inspection requests are prioritized for those beekeepers with hives in a known AFB outbreak area.

133 AFB alert letters were mailed out in 2022.

UDAF Apiary Program

The National Honey Bee Survey

USDA APHIS began the National Honey Bee Survey (NHBS) in 2009 to monitor and address nation-wide honey bee health problems. This survey takes an epidemiological approach to document honey bee diseases, pests, and pathogens. Additionally, NHBS monitors for invasive threats to honey bees, including the parasitic mite *Tropilaelaps clareae* (Delfinado and Baker), the Asian honey bee *Apis cerana* (Fabricus), slow bee paralysis virus, and pesticide residues in secondary hive products (such as pollen and beeswax). Since 2011, the UDAF Apiary Program and beekeepers throughout the state have participated in NHBS and have contributed hundreds of samples to this continually growing body of scientific knowledge.

This federally-funded program allocates funds and specialized supplies to each participating state to cover the costs of labor and ensure the quality of collected samples. Sampling involves the collection of adult bees, immature bees, and pollen samples from apiaries that have eight or more hives. Collected samples are sent to the USDA Bee Research Laboratory in Beltsville, Maryland where they are tested for exotic pests, pathogens, and pesticide residues. Sample processing takes time, so results are not typically available until the following year. The information reported below is from samples collected in 2021.

To date, no exotic pests have been detected in Utah. Both national and Utah data demonstrate that average Varroa mite infestations exceed threshold levels from the months of October through November. 2021 data also show that Utah's beehives have occurrences of deformed wing virus B (DWV-B), chronic bee paralysis virus (CBPV), and Lake Sinai virus 2 (LSV2), among other viruses, at rates higher than the national average (Figure 5). This is likely due to high levels of mite infestations, as all of these viruses are vectored by Varroa mites.

First Recorded Instance of Moku Virus in Utah

2021 marks the first year that Moku virus (MKV) was detected in Utah's beehives. MKV is an RNA virus that was first isolated in 2016 from a population of western yellowjackets *Vespula pensylvanica* (Saussure) in Hawaii. MKV was also found in honey bees and Varroa mites from the same Hawaiian island. The authors of the study hypothesize that MKV jumped from its natural yellowjacket host to honey bees through either predation or shared nectar resources, then the virus jumped again from the honey bees to the Varroa mites. This is likely the same pathway taken by Utah's MKV case, as western yellowjackets robbing beehives are a common sight in many Utah apiaries.

Alarmingly, the MKV strains isolated from Varroa mites had many genetic mutations, indicating that MKV may evolve more rapidly in Varroa hosts than in its natural host - this implies that in the future MKV could develop a pathology that is highly virulent and possibly detrimental to honey bee colony health. Once inside a honey bee colony, MKV may be transmitted from bee to bee via trophallaxis and Varroa mites. MKV will be one to watch as it poses a threat to many Hymenopteran species, and is demonstrably effective at jumping to new hosts.

MKV does not currently have any known symptoms or disease phenotype in honey bees on an individual or colony level. However, this situation demonstrates the danger that RNA viruses pose as they replicate rapidly, are highly mutative, and can easily jump to new host species through a variety of behavioral interactions.

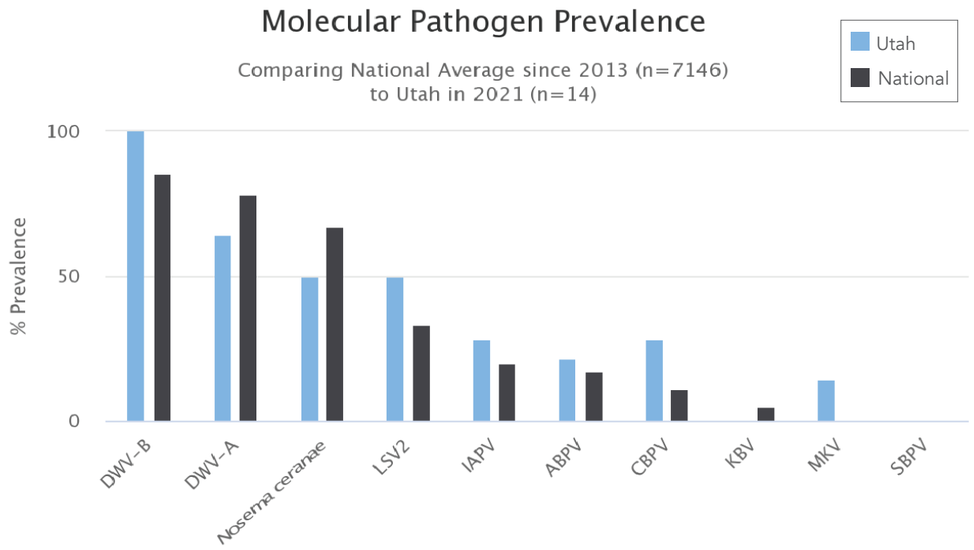


Figure 5. Molecular pathogen prevalence of samples collected in Utah in 2021 as compared to the national average since 2013.

Pesticide Residues

Multiple years of analyzing secondary hive products suggest that pesticide residues in Utah's beehives are frequently below the national average (Figure 6). In 2021 the most commonly appearing pesticide residues were 2,4-DMPF and thymol. Both of these chemicals are associated with Varroa control products, so it's no surprise to find these residues in secondary hive products. 2,4-DMPF is a breakdown product of amitraz, which is the active ingredient in the commonly used the miticide Apivar (amitraz). Thymol is the active ingredient used in multiple different brands of Varroa control products. Program staff have also received reports that some beekeepers use thymol essential oil as a feed additive. When used appropriately and according to the pesticide label, these pesticides are beneficial to colonies because they kill bee parasites. However, beekeepers should use caution when using thymol or any essential oil as a feed additive due to potential deleterious interactions between thymol and common insecticides, and the risk of thymol being leeched into honey or wax.

All of the above information was drawn from 2021 data. In 2022, state apiary inspectors completed 10 NHBS samplings statewide. The results from these surveys will be available in 2023. The most current results of this survey can be viewed at the Bee Informed Partnership website: https://research.beeinformed.org/state_reports/.

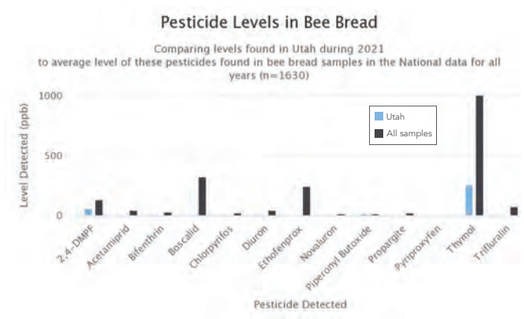


Figure 6. Pesticide levels in bee bread collected in Utah in 2021.

Pollinator Protection Efforts

In response to high-profile concerns about pesticide misuse and the associated negative impacts on bees, UDAF brought together beekeepers, commercial food growers, pesticide applicators, landowners, and the general public to create a Managed Pollinator Protection Plan (MP3) in 2015. The MP3 promotes practices that will reduce pesticide exposure to bees, facilitates communication between stakeholders, and encourages people to plant pollinator-friendly flora. This is accomplished via public presentations, trainings, and the distribution of educational literature. Since the program's implementation, the state has undertaken extensive education and outreach efforts, which continued in 2022.

To start off the year, the UDAF Apiary Program provided an anonymized list of apiary locations to the Grand County weed abatement office and various county mosquito abatement associations across the state. The goal of sharing apiary locations with these officials is to facilitate pesticide applicators' awareness of apiaries that may be at risk of being sprayed.

State apiary inspector and survey entomologist, Joey Caputo, delivered presentations to Harmon & Sons, Thorn Pest Solutions, Summit County Weed Abatement, and Wasatch County Weed Abatement about pollinator-friendly pesticide practices. The first two companies were involved in the state's Japanese beetle eradication effort (see page 16) and were educated about insecticides impact on bees. The latter two organizations are among the many county-based groups that use herbicides to combat the 54 weed species deemed noxious by the State of Utah. While most herbicides are not acutely toxic to bees, and many do not have bee warning labels, recent scientific evidence has shown that certain herbicides can pose a risk to bees due to the sublethal effects of the chemicals. Sublethal effects are those which do not outright kill a bee but may negatively affect a bee's cognition, learning and/or development, and navigational abilities.

At the multiple presentations delivered by Caputo, audiences were given an overview of basic bee biology and the various threats to honey bee health before diving into acute and sublethal effects of pesticide exposure to bees. Practical suggestions for minimizing bee exposure to pesticide were presented, such as not spraying blooming flowers, not allowing these products to drift in the wind, using the least hazardous formulation, and replacing weeds with native and naturalized plants. The presentations concluded by encouraging pesticide applicators and beekeepers to work together, not antagonistically, and to learn more about each other's role in Utah agriculture.

Figure 7. Pesticide pamphlet for consumers.

To increase public awareness about the danger of pesticide misuse, MP3 signs were placed in retail C-A-L Ranch locations across the state. Each sign was strategically placed near the pesticide section in each store and featured tips on how to avoid pesticide drift, along with an accompanying informational pamphlet for shoppers to take home. (Figure 7).

Honey Bees and Antibiotics

As a response to the growing threat of antibiotic-resistant strains of pathogens, the U.S. Food and Drug Administration implemented the Veterinary Feed Directive (VFD) rule in 2017. This rule established new requirements for the use of antibiotics in animal feed. Over the past four years this change has significantly impacted beekeepers by restricting their access to antibiotics and prohibiting prophylactic use in most cases. Perhaps the most substantial requirement of the VFD is that beekeepers are now required to go through a veterinarian to access antibiotics. Previously, beekeepers could purchase these products over-the-counter. This change has likely been a significant contributing factor to Utah's elevated rates of AFB and EFB diseases in recent years.

To lessen the impact of the VFD on beekeepers, the UDAF Apiary

Program has been educating veterinarians about their new responsibilities, facilitating communication between stakeholders, and providing timely pathogen test results. The molecular disease diagnostic capabilities of the UDAF Entomology Lab (see page 32) are crucial to the success of this effort, as rapid diagnostics allow for rapid response to disease outbreaks. In 2022, significant efforts were made to educate veterinarians about honey bee diseases and veterinarian responsibilities in prescribing antibiotics. Most notably, state apiary inspector, Jenna Crowder, gave a talk at the Utah Medical Veterinary Association meeting in June (see page 26, Outreach Corner). The department will continue to reach out to veterinarians across the state, focusing particularly on vet students and those seeking continuing education in the field of honey bee veterinary medicine. Beekeepers seeking a veterinarian are encouraged to visit the Apiary Program website at (see page 39, Contacts and Web Resources) for a contact list of bee-friendly veterinarians.

Africanized Honey Bee

In 2008 an aggressive subspecies of honey bee, the Africanized honey bee (AHB) *Apis mellifera scutellata* (Lepeletier), was first detected in Southern Utah. The UDAF Apiary Program promptly responded by monitoring AHB spread throughout the state. Though AHB can be dangerous, the honey bee subspecies is unfairly sensationalized in the media. In Utah, there have only been a few instances of AHB attacking humans or animals. The UDAF Apiary Program is committed to ensuring that all stakeholders are made aware whenever AHB moves into new areas. The counties with known established AHB populations are:

Africanized honey bee distribution in Utah

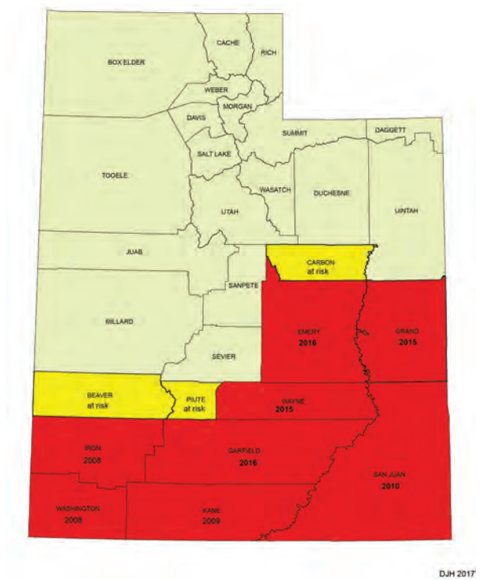


Figure 8. There have not been any new records of AHB movement since 2016. Yellow indicates that a county is at risk for AHB.

Emery, Garfield, Grand, Iron, Kane, San Juan, Washington, and Wayne (Figure 8). State inspectors continue to track AHB movement to new areas by testing feral bees in at-risk counties and aggressive managed colonies regardless of their location. Unfortunately, due to the workload associated with AFB mitigation in 2022, program staff did not collect enough samples to meet the minimum sample requirement from the lab we use for AHB testing. Samples collected in 2022 are being stored until such time that there are enough samples to submit for AHB testing early next year.


UTAH DEPARTMENT OF AGRICULTURE AND FOOD
PLANT INDUSTRY AND CONSERVATION

HONEY BEE HEALTH CERTIFICATE

ORIGINAL CERTIFICATE

NO. UT-2022-01-00A

Figure 9. An example health certificate that is issued to beekeepers to meet import entry requirements of other states and for other purposes.

Health Certification

The UDAF Apiary Program offers health certification services to registered beekeepers in the state for a variety of purposes. For instance, depending on the requirements of other states, certificates may be needed that confirm hives are free of AFB, SHB, or other regulated pests. Health certificates are also available upon request for beekeepers who need documentation to maintain eligibility for federal farm assistance programs, and for beekeepers who sell bees within the state and want to assure their customers that purchased bees are free of disease, although, no health certificates were requested in 2022 for those specific purposes. In 2022, the program's inspectors certified a total 816 hives to meet the import requirements of other states.

The Orchard Pest Sentinel Survey

UDAF Protects the State's Fruit Industry from Invasive Pests

Many states have a strong brand association with the agricultural commodities that are grown there. Florida has its oranges, Georgia has its peaches, and Utah has its tart cherries. Does the last correlation seem out of place? It shouldn't. Utah is consistently the second largest producer of tart cherries in the nation. In 2019, the Utah industry had a bumper crop and produced an astounding 54 million pounds of the tasty fruit. What's more, crop production annually contributes between $7 to $21 million dollars to the state's economy.

Yet, one may understandably ask why being number two in production of a certain fruit would be justification for tying the state's image to it. Why wouldn't the top tart cherry grower (Michigan) get that association? The same question could be asked of Florida and Georgia and their fruit branding. In recent years, Florida's orange production has contracted dramatically and California is poised to take the top spot. Regarding peach production, Georgia hasn't been number one in years. The "Golden State" took the reigns as the nation's top peach grower long ago. In fact, Georgia isn't even number two; those bragging rights belong to South Carolina.

One could justifiably argue that states having an agriculture brand is more about having a strong cultural connection, rather than how much product is actually produced. It is a fair point and one that should undoubtably make Utah the tart cherry capital. Utah's fruit growers are principally responsible for reviving the tart cherry industry by essentially reinventing the fruit. Historically, tart cherries were grown for pies, syrups, and processed foods. While tart cherries are still used in this way today, the market demand for such foods began waning decades ago as consumers searched for more healthy food options. The idea of drying tart cherries so that they could be consumed as a whole food was conceived in the late 1970s. It was presumed that such a development would not only create a new market for the fruit, but would also have superior nutritional qualities compared to processed cherries.

Consequently, Michigan cherry growers began tinkering with oven-drying tart cherries, but the quality of the product was inconsistent and the trial was deemed a failure. A similar venture in Utah fizzled around the same time. Years later, Phillip Rowley, a Santaquin fruit grower, began experimenting with the idea again. After trial and error with a small self-made drier, Rowley was making progress and was finally able to create a consistent, though imperfect (the dried cherries were flat), product. The process needed some refining and had to be scalable. He later obtained a large machine that was used to commercially freeze fruit and reconstructed it as a fruit drier instead. After months of work and further experimentation, the machine eventually churned out plump, delicious, bright red, dried cherries. Rowley was crowned the "Pioneer of the Dried Tart Cherry" and a revolution in the industry began. The fruit would no longer be relegated to the dessert and processed food industry, but instead could be put into granola, trail mixes and other healthy food options. The change facilitated a sustained, multi-decade expansion of the tart cherry industry. So even though Michigan produces a greater quantity of cherries, it is undeniable that Utah growers shaped the business it is today. For that, the "Beehive State" also deserves the reputation as the "Tart Cherry State."

The "Beehive State" also deserves the reputation as the "Tart Cherry State."

Efforts to Protect the Fruit Industry

The UDAF Insect Program celebrates the Utah tart cherry industry's storied history and works to protect its producers, along with the many other tree fruit operations in the state, with the Orchard Pest Sentinel Survey. This annual effort involves placement of traps for four specific fruit pests. In 2022, there were 11 commercial producers and three backyard growers that participated in the program. Although some sites have moved or ended, as a result of urban development over the years, many of the same locations have been trapped for decades. The survey has three principal goals:

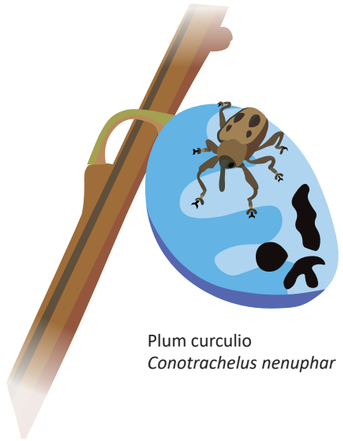
- Provide early detection of invasive fruit pests not known to be in Utah.
- Monitor for pests that are present in certain fruit growing counties in Utah but not others.
- Inform growers of the presence of certain native or established insect pests in their orchards.

Insect pests have the ability to wreak havoc on commercial fruit production; this is especially true of invasive insects. Early detection of non-established invasive insects and reliable data regarding the presence of native or established exotic pests is critical in the management of these insects.

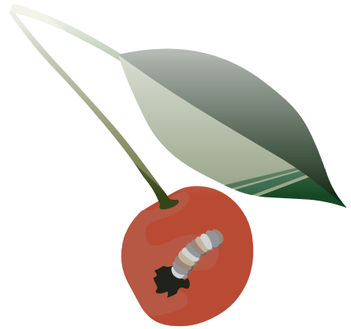
The longest surveyed pest in this survey is the plum curculio *Contrachelus nenuphar* (Herbst), which is a true weevil in the family Curculionidae. While it is native to the Eastern United States (U.S.), it is not indigenous to Utah. In 1985 it was first detected in Box Elder County. Since that time, the UDAF Insect Program has monitored for the pest throughout fruit growing counties in the state. While the pest is established in Box Elder County, it has yet to move anywhere else in Utah. The pest attacks a wide slew of fruit trees including tart and sweet cherries *Prunus cerasus*; *P. avium*, peaches *Prunus persica* apples *Malus domestica*, pears *Pyrus* spp., and—as its name suggests—plums *Prunus domestica*. In 2022, a total of 14 plum curculio traps were placed in Utah, County, and Salt Lake counties. No plum curculio were found at any of these locations.

The survey has also included a trap for two other pests that have been in Utah for some time: apple maggot *Rhagoletis pomonella* (Walsh) and Western cherry fruit fly *Rhagoletis indifferens* (Curran). The former is an invasive pest from the Eastern U.S. that was found in Utah in 1985. The latter is a native pest that began attacking commercial fruit orchards in the early 20th Century. Apple maggot's preferred hosts are apples and hawthorn *Crataegus* spp., however, it will also attack many other stone and pome fruits, as well as some ornamental plants. Western cherry fruit flies attack tart and sweet cherries. In 2022, a total of 13 traps for these pests were placed in Davis, Salt Lake, and Utah counties. No apple maggots were detected, but 46 Western cherry fruit flies were found athree locations.

Finally, 13 traps were also placed for the light brown apple moth (LBAM) *Epiphyas postvittana* (Walker), which is major pest of pome fruits and ornamental plants. LBAM is native to Australia, but it has spread through various parts of the world over the last century. The moth was found in the mainland U.S. in California in 2007. Unfortunately, 13 counties are now infested in that state and a quarantine is in place to prevent its spread. No LBAM have been detected in Utah since it was included in the survey over a decade ago.



Plum curculio
Conotrachelus nenuphar



Cherry fruit fly
Rhagoletis indifferens

Light brown apple moth
Epiphyas postvittana

CARUTO

Utah Pollinator Habitat Improvement Project

House Bill (HB) 224 was passed by the Utah State Legislature in March 2021. It tasked UDAF with the creation of a three-year pilot program to improve pollinator habitat in Utah. UDAF hopes to increase the amount of available pollinator habitat across the state by putting approximately 90,000 resource plants in the ground and distributing native seed mixes to maximize the reach and effort to help local pollinators succeed. Both 'ready-to-plant' habitat kits and seed mixes were made available to qualified projects through an application process and were awarded based on regional needs and potential for project success.

The habitat kits were selectively composed of native plants designed to cover pollinator needs across season and region, primarily in northern Utah. Both wetland and upland kits were developed with about 30 plants in each kit. Applicants could apply for multiple kits based on the size of their property and suitable space. The seed mixes were designed to offer both annual and perennial combinations for specific regions.

A total of 21,000 native plants were grown out in 2022 by three different commercial growers. The plants were ultimately brought to the USU Teaching Greenhouse (Figure 1) where they were organized into the habitat kits (Figure 2). The seed packets were compiled by students at Southern Utah University. The kits and seed packets were then taken to three different distribution centers in northern Utah where they were handed out to the recipients of the awards in the fall of 2022.

Figure 1. Native plants in the USU Teaching Greenhouse.

Figure 2. Various species of native plants are organized into habitat kits ready for distribution to award recipients.

Other aspects of the program development included designing a website (see page 39, Contacts & Web Resources) and brochure (Figure 3) to provide information on the project. A metal garden sign was also created to be posted at project sites to go along with the habitat kits (Figure 4).

Through the online application process, 327 applicants requested a total of 3,478 habitat kits. Of these applicants, 103 were selected based on detailed evaluation criteria and 528 kits were subsequently awarded (15% of the demand) based on availability. Of these kits, 64% went to homeowners with the remaining 36% awarded to larger properties (i.e., schools, cities, open spaces).

The final cost of the project to UDAF was approximately $66,000, with a total of 13,034 reported volunteer hours (counted as 'match' for the program) were spent by the recipients for efforts such as site preparation and installation of the plants. This equates to about $390,000 in matching funds, well over the requested 25% / 75% ratio of state funding vs. matching funds by the property owner (House Bill 224).

Coordination for 2023 efforts for this program is ongoing and includes selection of plant species to include the Southern Utah region, updates of the website, refinement of the applicant form and evaluation criteria, and reporting and follow-up from the 2022 project recipients.

Figure 3. Trifold brochure with information about the pollinator habitat project

Figure 4. Design of the metal garden sign that will be posted at project sites.

ERADICATION AT THE MIDWAY

Japanese beetle populations continue to decline in four counties, but rebound significantly in one.

It has been over a century since the invasive and destructive insect Japanese beetle (JB) *Popillia japonica* (Newman) was first detected in New Jersey. Since that time, the pest has migrated, mostly via human-mediated transport, from its first introduced site to nearly all states east of the Rocky Mountains. While the insect is mostly benign to plant life in its native Japan, it has become a severe pest of turf and hundreds of ornamental, fruit, and vegetable plants in the United States (U.S.). Geographical differences in JB pest status has been attributed to a lack of natural enemies in introduced ranges and plants with better resistance to the insect's feeding in the insect's native home. Infested states are estimated to annually spend nearly half a billion dollars for the purchase of chemical control products and replacement plants.

While JB introduction into the U.S. has become a classic story of how exotic organisms can cause great damage to non-native areas, the full history has also provided a number of examples of how plant protection programs can effectively fight back. Indeed, a number of Western states, including Utah, have taken successful measures to keep their domains free of the pest. These examples demonstrate that invasive insect population radiation is not always inevitable and indeed can be contained to an established range in certain instances.

Life Cycle and Biology

JB belongs to the family Scarabidae, a diverse group that includes the ferocious-looking rhinoceros beetles, ever so charming dung beetles, and occasionally beautiful June beetles. Like all beetles, JB goes through a complete metamorphosis (holometaboly) whereby the immature stage looks substantially different than the adult stage. This is just like butterflies or moths, where a larva emerges from an egg, the larva becomes a pupa and an adult develops in the final phase. For most plant-eating holometabolous insects, the larval stage is the primary period of active feeding; thus, this is usually the time in which most plant damage occurs. For instance, the coddling moth *Cydia pomonella* (Linnaeus) is a severe pest of apple *Malus* and devours fruit innards as a caterpillar (larva), yet it doesn't do any direct feeding as an adult. JB larvae live subterranean and prefer to feed on turf roots. During this active growing stage, they can cause great damage to grass. The grubs pupate underground and emerge from the soil as adults and live the remainder of their lives above ground. However, unlike the food-abstaining adult coddling moth, JB adults that have recently emerged from the ground continue to eat plants. Indeed, over 300 different plant species are known to be hosts for above-ground JB feeding. This is part of the reason why a diversity of agricultural producers, from golf course greenskeepers to commercial fruit growers, are united in their discontentment of JB infestations.

Besides being a pest of many plants, JB are also commonly problematic because their populations can increase rapidly due to the females' impressive reproductive capabilities. Indeed, a solitary female can lay approximately 60 eggs per annum. While not all eggs will come to fruition, the large number laid can result in explosive population growth potential.

JB History in Utah

Utah's history with JB exclusion efforts begins in 1993, when the state enacted a quarantine of articles that are able to transport the pest. This resulted in UDAF beginning to regulate the import of products such as nursery stock, sod, and soil, which originated from areas of known JB infestation. At that time, nearly all states east of the Mississippi River and a few Midwestern states had become infested and Utah was soon to follow the same fate if measures were not taken to reduce risk of introduction. As a result, agricultural inspectors would ensure that products capable of transporting JB were either not allowed entry into Utah or had undergone certain precautionary measures to ensure that these insects would not be "hitch-hiking" aboard.

Just three years later the UDAF Insect Program began the first state-wide survey of JB to monitor for potential introductions. The annual effort would involve placing approximately 600 traps around the state, in areas of high risk for introduction. For a decade, all was quiet on the JB-front. That changed in 2006, when a resident brought to UDAF's attention a JB specimen found in an Orem residential landscape. This finding prompted the placement of an abundant number of traps surrounding the location, which ultimately led to the detection of hundreds of beetles in the first year of survey and thousands in the next.

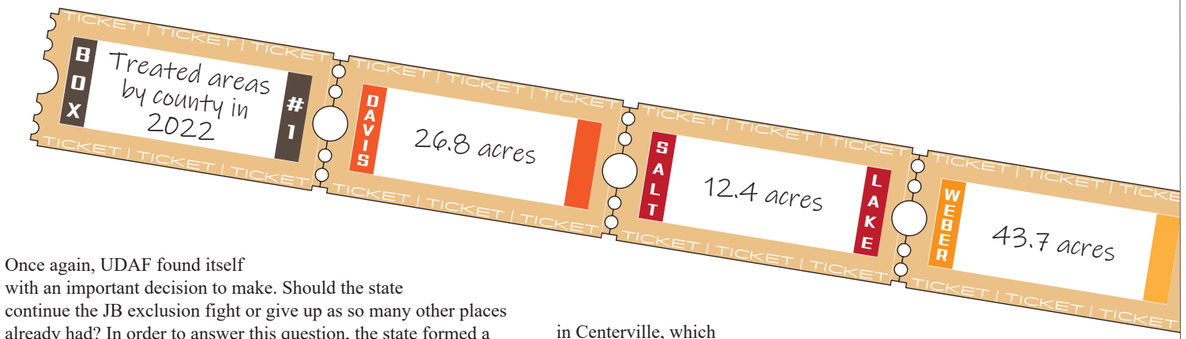
Utah had a critical decision to make at this point: allow JB to establish and cause agricultural destruction across the state or attempt to eradicate the nascent population. With the cooperation of Orem residents and support of various agricultural industries, state officials chose the latter and embarked on, what was at the time, the largest JB eradication attempt in U.S. history. In subsequent years, the state financed the treatment of hundreds of acres of irrigated turf infested with JB. The effort proved effective and by 2014 the infestation was declared eradicated.

Though not all areas of JB infestation experienced reductions in 2022, the eradication effort thus far has elimininated [or suppressed] JB in many parts of the state

For many years Utah continued to be free of JB. Granted there were occasional detections of one or a few beetles in Salt Lake County, but the same high density trapping that took place earlier in Orem—and revealed thousands of beetles—yielded no more captures when deployed in these instances. When this happens, it can be surmised that while JB specimens were introduced, a stable population failed to take hold. For a short period of time, it seemed that Utah was safe from JB.

A New Population is Detected

The state of calm was disrupted in 2018 when three JB were found in Salt Lake City's industrial west-side. While finding a few beetles was not a cause for alarm in that year, subsequent trapping in 2019 would reveal more JB in that same area, as well as specimens in five other separate locations around Salt Lake County and two locations in Davis County. For the first time in over a decade, sizable and potentially stable JB populations had returned to Utah.



Once again, UDAF found itself with an important decision to make. Should the state continue the JB exclusion fight or give up as so many other places already had? In order to answer this question, the state formed a committee of biologists, county extension agents, city parks officials, and local agriculture industry representatives. After presenting this committee with an accounting of the financial and environmental costs that would ensue from inaction and a comprehensive, multi-year plan to vanquish the pest, the group voted unanimously to move forward with eradication.

2020-2021 Eradication & Monitoring Activities*

Between 2020 and 2021, the UDAF Insect Program conducted an extensive trapping survey and bankrolled pesticide treatments for a total of 557 acres of irrigated turf in areas deemed to be infested with JB. The project most heavily relied on soluble chlorantraniliprole as the control agent, though a small amount of soluble and granular imidacloprid was utilized in certain JB hotspots. Treatment areas were diverse in their land-use and included everything from industrial parks to single-family homes.

In 2020, there appeared to be early success in Salt Lake County, with the beetle population dropping about 50% when compared to the previous year. The reductions occurred similarly between the various areas of previous beetle captures in Salt Lake and South Salt Lake cities. At the same time, the JB population swelled in Davis County, especially in Centerville where, alarmingly, nearly 50 beetles were found in a mere three-block area. Kaysville saw a much smaller population increase and the cities of Farmington and West Point yielded single beetle detections for the first time. Also concerning, were new, small populations which began appearing in other counties. In Weber County almost two dozen beetle were found scattered across the southern part of the valley, in Utah County a small number of JB were found in Lehi and Provo cities, and lastly, in Carbon County a single beetle was found in Wellington.

The following year JB populations dropped dramatically in Davis County, with 76% fewer beetles found compared to 2020. Encouragingly, the population declines were extremely noticeable in Centerville, which was the epicenter of the county. Heartening news was likewise found in Carbon and Utah counties where not a single beetle was found in either place. Yet not all the results were encouraging. Weber County saw a modest JB population increase and the Salt Lake County beetle population had rebounded to 2019 levels. By the end of 2021, the statewide overall JB count was falling, but it was clear that there was still work to be done in many areas.

**A more detailed accounting of these activities can be found in the 2020 and 2021 Insect Reports.*

2022 Eradication & Monitoring Activities

In the spring of 2022, the UDAF Insect Program hired two licensed pest control companies to conduct a series of irrigated turf treatments in Davis, Salt Lake, and Weber counties, which totaled approximately 83 acres (see Box 1 above). This was a dramatic reduction in the number of acres treated compared to the previous year. A number of factors were responsible for the reduced amount of pesticide applications, including: fewer beetles found in 2021 compared to 2022, the lack of any beetles found in Utah County in the previous year, and no new areas of JB infestation. In Salt Lake County, nearly all applications were made in industrial areas. Treatment areas in Davis and Weber counties included parks, a golf course, schools, and residential and commercial properties. Granular and soluble concentrations of chlorantraniliprole were used for the project.

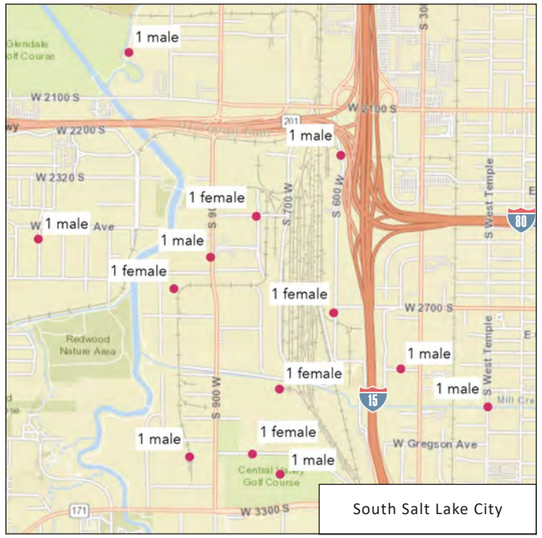
Numerous measures were taken to ensure that applications were safe to the public and the environment (see Box 2). In addition, an extensive outreach campaign was conducted prior to applications to educate the public about this project. First, an informational packet was mailed to residents and business owners in the eradication area, which detailed what parcels were going to be treated, information about the insecticide that would be used, and the importance of eradicating JB. Next, a videoconference Open House with subject matter experts was held, which allowed

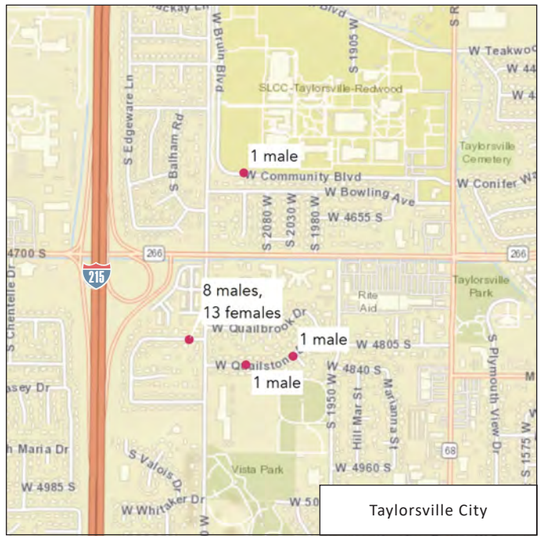
BOX 2. SAFETY & ENVIRONMENTAL PROTECTION

The UDAF Insect Program took many precautions to ensure that eradication activities did not have an adverse effect on the people in the eradication area or the surrounding environment. First, the chemical selected for the project was chlorantraniliprole, which exhibits extremely low acute toxicity to humans, pet animals, birds, bees, and many other beneficial insects. Second, all pesticide applications were supervised by the UDAF Pesticide Program to verify that product was being applied according to label instructions and all federal and state laws. Third, persons with medically verified pesticide sensitivities could elect to apply a non-chemical treatment on their properties. Finally, the UDAF Apiary Program communicated treatment plans to registered beekeepers two days prior to applications; no beekeepers reported adverse effects on their bees as a result of eradication efforts.

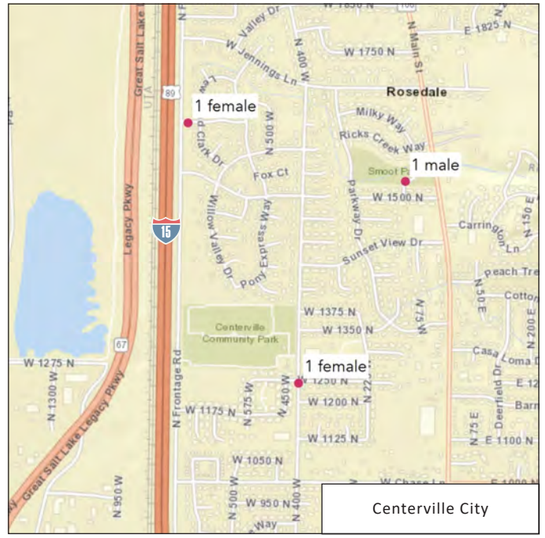
2022 JB DETECTION MAPS

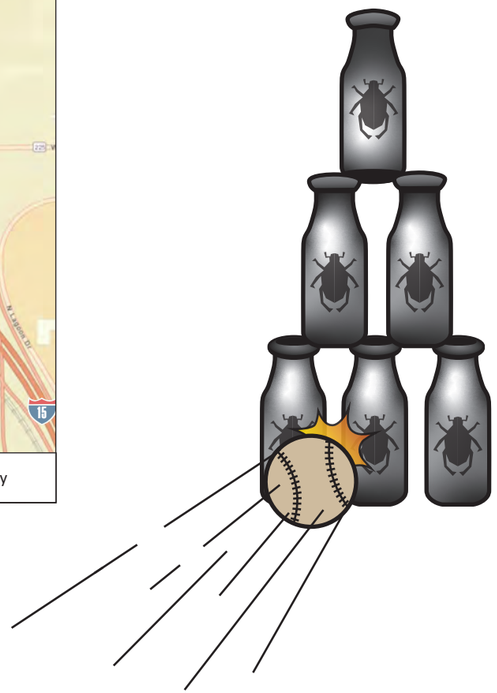
SALT LAKE COUNTY



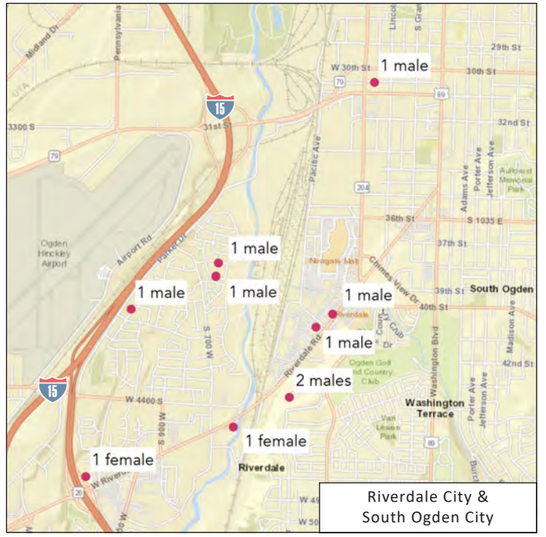


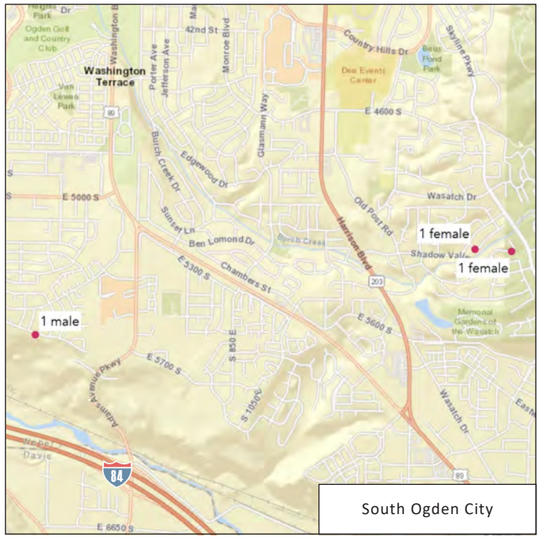
DAVIS COUNTY





WEBER COUNTY





UTAH COUNTY

Eradication in Action

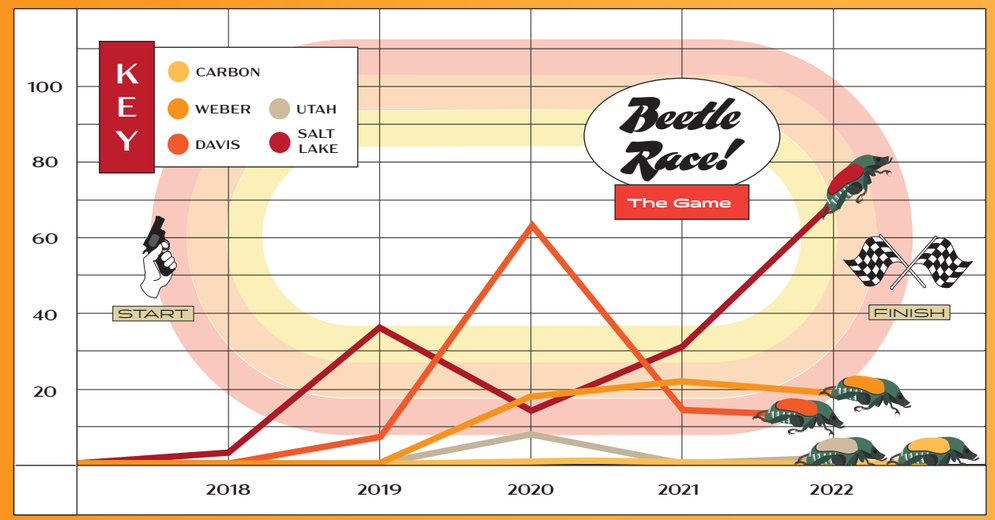
1 Large areas of turf require ride-on spreaders

2 An applicator treats a small commercial turf plot

3 Contracted applicators pulling hoses from spray trucks

4 UDAF staff ensure treatments were compliant with pesticide regulations

Figure 1 - Utah JB Captures by County & Year



affected persons to learn more about the project and opened the floor for questions. Finally, UDAF staff canvased the streets 48 hours prior to the pesticide applications to resolve any final concerns that residents had and prepare them for the arrival of the pest control company.

To determine progress of the eradication project and continue monitoring other areas of the state, the program set a record-breaking 5,584 traps. Of traps placed, 3,617 were set in the areas where JB populations have been in recent years; 1,967 traps were deployed in other areas of the state to monitor for new potential introductions. This surveillance revealed a mixed bag of success and setback, with JB populations continuing to decline in three counties, while increasing substantially in Salt Lake County (see Figure 1).

The greatest progress to report occurred in Davis County. In Centerville, just three beetles were found in 2022, which is a drastic reduction from the 49 beetles found just two years ago. Also, for the first time in two years, no JB were found in eastern Kaysville, though nine were found in western Kaysville and a single beetle was found in Farmington. No beetles were found in West Point for the second consecutive year.

In Utah County, both Lehi and Provo cities have had two years of zero JB captures after yielding eight beetles in 2020. Consequently, these areas are deemed to be JB-free and will no longer require high-density trapping. Unfortunately, a single beetle was found in Orem, about a mile south of the eradication area in the late 2000s. The capture is not thought to be related to the infestation from over a decade ago and is instead likely to be a "hitchhiker" beetle that was artificially transported on a vehicle from an area of current infestation.

Positive developments occurred in Carbon County, where no beetles were found in the high-density trapping grid set in Wellington. Since this is second straight year of no captures, JB is declared absent from this area.

The eradication effort demonstrated modest advancement in Weber County. In Riverdale, just 10 beetles were found which is five fewer than what was found in the previous year. The number of captures in Uintah was seven, which was the same as last year; a small number of new detections were found in South Ogden. Nonetheless, the overall rate of detections for this county declined when compared to the previous year.

Yet, in Salt Lake County, there was little good news. Populations increased in almost all areas where beetles had previously been found, including Salt Lake City's Northwest Quadrant and South Salt Lake's industrial district. Even worse, 24 beetles were detected in a residential area of Taylorsville, which was previously found to be uninfested.

2023 Plans

Though not all areas of JB infestation experienced reductions in 2022, the eradication effort thus far has eliminated JB from many parts of the state and continues to effectively suppress populations in others. The UDAF Insect Program plans to continue eradication activities in Davis, Salt Lake, and Weber counties in 2023. Many acres of irrigated turfgrass are planned to be treated in multiple locations of persistent JB presence, as well as a couple of areas where JB has recently been detected. UDAF will also keep up trapping activities to monitor progress in these areas and continue public education about the importance of this project.

Invasive Moth Watch

Utah continues monitoring for two invasive moths

To most people, moths are merely insects that eat their clothing, fly around light posts in the evening or get splattered on their windshield during road trips. Yet, despite what popular sentiment may suppose, moths are incredibly valuable organisms as a group. As mostly nocturnal animals, they pollinate night-blooming plants that may not get visited by other diurnal insects. Their caterpillar (larval) life stage serves as an important food source for wildlife. The silkworm *Bombyx mori* (Linnaeus) produces silk, a highly sought-after material used to make clothing. One moth might even help to clean up the vast amounts of plastic waste littering the environment. Indeed, one species of wax worm, *Galleria mellonella* (Linnaeus), has the capacity to digest polyethylene; this finding may one day lead to a biotechnical method of destroying unwanted plastic.

Though it cannot be denied that some moths are important plant pests. Two prominent moths that belong in the "bad category" are the spongy moth (formerly Gypsy moth) *Lymantria dispar dispar* (Linnaeus) and the European corn borer (ECB) *Ostrinia nubilalis* (Hübner). While both are rarely problematic in their native European range, they create mass agricultural devastation in North America. As a result, the state of Utah has enacted regulatory quarantines of materials, which may serve to transport either of these pests into the state. The UDAF Insect Program also conducts an annual survey for both pests so that introductions, should they occur, are detected early and can be eliminated before populations become established.

Biology and Host Plant Damage

The spongy moth lifecycle begins after adult mating, sometime in the later part of summer, when females lay small brownish egg masses containing 100-600 individual eggs. These masses become softer as they age, hence the name 'spongy moth'. Most often these egg masses are laid on trees. Yet, sometimes they are put onto other objects, such as buildings, signs, or vehicles—the latter of which creates an opportunity for artificial transmission to other areas. The following spring, the eggs hatch and larvae emerge. The small caterpillars move to host trees and begin feeding on the leaves. After caterpillars have fully grown, pupation occurs sometime in June and July. Adults emerge shortly thereafter, with males flying around in the day to find female mates and females remaining close to the site of emergence, since they are incapable of flight due to their large size.

Spongy moth caterpillars feed on the foliage of trees, primarily hardwood varieties. They are known to attack over 300 different woody plants: aspen *Populus* spp., linden *Tilia* spp., oak *Quercus* spp., and willows *Salix* spp., to name a few. While healthy trees can withstand some feeding by this pest, in severe cases, trees can be entirely defoliated. A single year of stress like this may not cause long-term issues with the host plant, however, if defoliation occurs year to year, trees can become severely stressed and eventually die. It is estimated that spongy moth feeding causes $3.2 billion annually in infested areas of the United States (U.S.) and Canadian provinces.

> Utah has the bragging rights of eradicating spongy moth not once, but twice

Unlike spongy moth with its one generation per season lifecycle (univoltine), ECB can have multiple generations per year (multivoltine). How many generations occur depends on degree day accumulations, with the northern parts of states like Michigan and Maine getting only one generation annually and the southern parts of Georgia and Alabama dealing with up to four. Since ECB has never had established populations in Utah (much less ever been found), it is not certain how many lifecycles would be realized on an annual basis. However, it is supposed that two or three would occur, depending on latitude. These insects winter as fully-grown larvae in corn stalks, stems and other plant debris left behind from a growing season. Pupation occurs when temperatures regularly exceed 50° F and adults emerge in late spring. Females will begin the first new life cycle of the season by laying eggs on hosts, which include corn *Zea mays*, peppers *Capsicum annuum*, and certain ornamental plants. Young larvae hatch out and bore into host plants or their fruit. Pupation and adult emergence occur again and will repeat once more depending on temperature conditions.

Spongy Moth

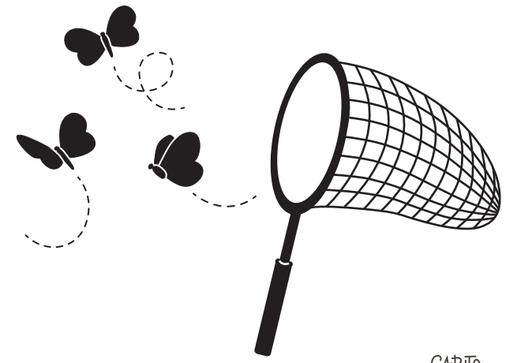
European Corn Borer

ECB can feed on over 200 vegetable and ornamental plants, though corn is the most economically important host. Since the caterpillars eat all above ground parts of host plants, damage varies depending on the time of year and life stage. Feeding can cause stalk breakage, ear/fruit drop, and chewing damage to leaves, tassels, and flowers. Just before the turn of the century, this pest was estimated to cause approximately $1 billion in damages annually to host plants. However, the widespread adoption of *Bacillus thuringiensis* (Bt) corn in recent decades has drastically reduced ECB problems in production of that crop.

U.S. Distribution and Survey Efforts

Spongy moth's distribution is restricted to states in the Northeast, upper Midwest and small parts of the South. USDA APHIS maintains their own quarantine of this pest and has a "Slow the Spread" campaign that is designed to confine spongy moth movement. These efforts have been highly successful in preventing artificial movement of the insect to non-infested areas. That isn't to say that spongy moths haven't made their way to other regions of the country. In fact, over the last 50 years, many Western states have had spongy moth infestations that were then subsequently eradicated. Utah has the bragging rights of eradicating spongy moth not once, but twice: first in the 1980's and again in the 1990's. To prevent new infestations from making their way to Utah once again, state agricultural inspectors annually conduct inspections of imported Christmas trees during the winter season to check for spongy moth egg masses, as well as occasional port interdictions of high-risk commercial cargo. The UDAF Insect Program also coordinates a robust annual trapping survey of each of the state's counties. In 2022, 2,086 traps were deployed around the state as part of the standard detection survey and an additional 120 traps were placed as a high-density grid in West Jordan City, as the result of a single spongy moth capture in that area two years ago. No spongy moths were detected in any of these traps. Because West Jordan has had two consecutive years of high-density trapping with no additional captures, it is declared free of spongy moth and will return to standard detection trapping protocols in 2023.

ECB has a much larger established geographical area than spongy moth—its distribution stretches from Maine to Florida and the Atlantic Ocean to east of the Rocky Mountains. Fortunately, the pest has never been detected in Utah. It should be stressed that finding ECB has not been due to a lack of trying. The UDAF Insect Program conducts an annual trapping survey for this insect as well. In 2022, 69 traps were deployed within Beaver, Box Elder, Cache, Duchesne, Emery, Grand, Juab, Millard, Morgan, Uintah, and Utah counties. The results were welcome: as in years' past, no ECB to see here.



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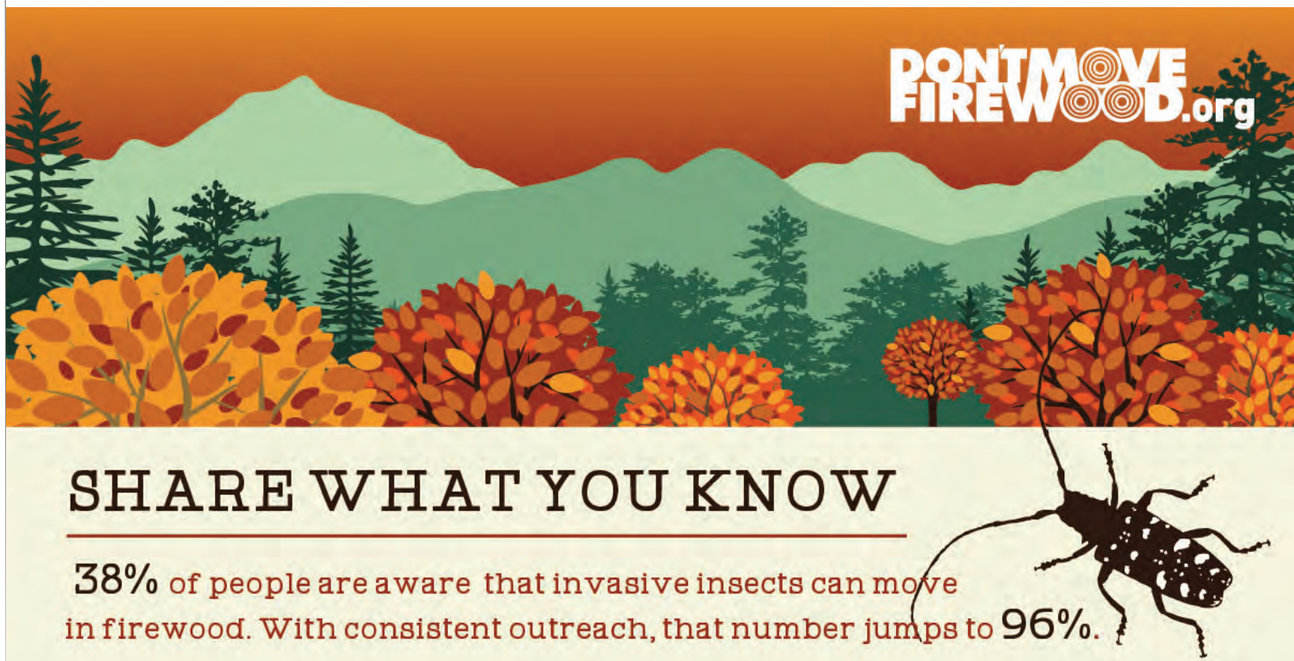


Outreach Corner

In addition to the regular schedule of outreach presentations given by Insect Program staff about honey bee health, pollinator protection, and invasive insect mitigation, this year the team participated in a number of special events that raised awareness about the department and the work we do. Check out some of the highlights below!

Sarah and Jenna tabling at the state capitol building.

Hope on the Hill Veterans Event
25 May 2022
Topic: Beekeeper registration

The insect crew tabled at an event geared towards veteran's suicide prevention at the state capitol building in May. The table consisted of educational material on keeping bees and resources for contacting beekeeping clubs if someone was interested in getting into beekeeping as a hobby.

Sevier County Varroa Workshop
28 April 2022
Topic: Varroa monitoring & control

This workshop was conceptualized and organized by Aaron Dent, the president of the Sevier County Beekeepers Club. The hands-on event gathered nearly a dozen beekeepers from Sevier County and neighboring regions who were eager to get practical experience in testing for and treating Varroa mites. State inspector Jenna Crowder led the group through a mite check demo and answered questions.

Sarah and Natalie tabling at the Natural History Museum of Utah (NHMU).

NHMU BugFest 2022
25 June 2022
Topic: Invasive insect detection & bee biology

Natalie Friesen, Jenna Crowder, and Sarah Schulthies attended the Utah Natural History Museum's (NHMU) annual Bug Fest this summer. UDAF's table focused on the importance of our invasive insect trapping program as well as our Apiary Program. The main draw of our booth was our observation hive with live honey bees in their frames! The event was a huge success and was attended by over 1,500 guests.

Grantsville Honey Harvest Festival
08 October 2022
Topic: Honeybee health & beekeeper registration

For the second year in a row, the UDAF Apiary Program team tabled a booth at the annual Grantsville Honey Harvest Festival. Attendees of this event tend to be honey enjoyers and not necessarily beekeepers. The UDAF table focused on pollinator advocacy, beekeeper registration, and displays about common beekeeping practices (eg. Varroa control) with the aim of fostering attendees' appreciation for the efforts mustered by beekeepers to keep their hives healthy. MP3 pollinator protection signs, which educate viewers on proper home pesticide application techniques, were placed strategically around the event grounds. Joey Caputo also presented to the crowd about state resources that are available for beekeepers in Utah.

Joey Caputo tabling at the Grantsville Honey Harvest Festival.

City Academy, Salt Lake City 8th Grade Class
22 November 2022
Topic: Invasive insect trapping

Jenna and Sarah from the UDAF insect crew, as well as Jan Reinhart, a rangeland biologist with the conservation division, visited City Academy to discuss invasive species with an 8th grade science class. The class had broken into groups and presented on the biology and impact of an assigned invasive insect. Each group even designed a trap specifically targeting their chosen insect. UDAF brought examples of actual insect traps used in the field and it was interesting to compare the similarities of the student designs to the commercially produced traps. Jan, Jenna, and Sarah also shared what it was like working in their respective fields and encouraged the students to pursue careers in natural resources and science.

After graciously giving the UDAF Insect crew a tour of the NHMU, entomology collection manager Christy Bills and her team toured the new UDAF entomology lab in July.

Utah Veterinary Medical Association
10 June 2022
Topic: Apiary diseases & foulbrood treatments

Jenna Crowder gave two back-to-back talks at the annual UVMA conference in Park City. With a rapt audience of veterinarians, the presentation began with a crash course in honey bee biology and reportable bee diseases. The second talk educated vets on how they can facilitate beekeepers' procurement of antibiotics when necessary for foulbrood treatment and the various legal requirements for issuing a VFD or Rx to a beekeeper.

North American forests

have been put under immense ecological strain in the last two decades due to ongoing droughts. Persistent lack of moisture not only increases the chance of wildland fires, but also makes trees more susceptible to pathogens and arthropod pests, both native and introduced. Because of this, it is more important than ever to monitor for exotic insects being introduced to Utah's natural and urban forests so that these landscapes can be enjoyed by current and future generations.

Wood boring beetles are one of many major biotic causes of forest disturbance. People tend to think a single type of beetle is responsible, but there are numerous species that can cause forest decline. Exotic wood boring beetles have few natural enemies where they are introduced, so populations can be poorly regulated and grow at a much faster rate than in their native range. When beetle populations are high, healthy trees are more prone to attack by pests that may otherwise only attack dying trees.

The state administers numerous quarantines (see the last section) which are meant to prevent the importation of exotic wood boring pests. Quarantines are the first line of defense against harmful exotic insects. Trapping programs are another defensive strategy and are essential for monitoring movement of pests into new areas. When trapping detects exotic insects early, their populations can be eradicated. If eradication isn't possible, advanced knowledge of an insect species' presence can give landscape or crop managers time to develop effective suppression strategies. The UDAF Insect Program monitors for several exotic wood boring beetle species, all of which fall into one of three large beetle families.

The bark and ambrosia beetles (family Curculionidae, subfamily Scolytinae) are small beetles that mine the inner bark of woody material in their adult and larval stages. Longhorned beetles (Cerambycidae) and jewel beetles (Buprestidae) can range in size from half a centimeter to upwards of several centimeters, with a great variety of colors and habits. The larval stages of these families feed on the conductive tissues of trees inside trunks and branches. These larvae can continue living and feeding even in cut wood, making them the perfect hitchhikers to new areas through firewood and other tree debris. After a few months or even years, larvae will pupate into adults and emerge by chewing their way out of the tree.

State wood-borer targets

Emerald Ash Borer

Popularly known as "The Green Menace", emerald ash borer (EAB) *Agrilus planipennis* (Fairmaire) has lived up to its nickname by decimating all species of ash trees *Fraxinus* spp. in the United States (U.S.) since its first detection in Michigan in 2002. Although small (½ inch in length), this beetle should not be underestimated. EAB has spread to 30 states and destroyed tens of millions of ash trees in the last two decades. The pest is established in many Eastern, Southern, and Midwestern states. The beetle came even closer to Utah when it was found in the neighboring state of Colorado in 2013. It is now found in four counties east of the Colorado Front Range. Most unfortunately, in June 2022 Oregon detected large numbers of EAB in a stand of ash trees.

In recent years, the UDAF Insect Program has been preparing for EAB introduction by forming a task force of partner agencies and groups, including USDA APHIS, USDA Forest Service, Utah State University (USU) Pest Diagnostics Laboratory, Utah Department of Natural Resources (DNR), Tree Utah, and city arborists. This coalition has embarked on a multifaceted campaign to prevent introduction and facilitate early detection. Efforts include deploying EAB traps statewide, educating the public about the risks of moving firewood, and outreach to local tree care professionals on EAB identification. In areas of the state deemed high-risk for introduction, state, federal, and local officials have been involved in trapping, visual surveys, and caged rearing of ash limbs that are suspected to be infested. The UDAF Insect Program and others have also responded to dozens of EAB infestation claims by homeowners and landscape managers. To date, there have been no confirmed cases of EAB in Utah.

As the pest has continued spreading to other states, there have been considerable strains on federal funding dedicated to containment. In 2017, USDA APHIS announced that it was removing its domestic EAB quarantine. Consequently, federal funds directed toward trapping would be reallocated to biocontrol and research. As a result of this announcement, the Utah task force stepped up efforts to exclude and monitor for this pest. Utah DNR applied for a USDA Forest Service grant to fund increased trapping efforts; some of this money was passed to UDAF for improved surveillance and outreach efforts.

In 2022, the UDAF Insect Program placed a total of 77 EAB traps throughout Cache, Carbon, Davis, Duchesne, Salt Lake, Tooele, Uintah, Utah, and Weber counties. Utah DNR placed an additional 29 traps across Emery, Grand, Iron, Juab, Millard, San Juan, Sevier, Washington, and Wayne counties. National Park Service placed 10 traps in Zion National Park (see Box 1). Trap site placement was prioritized for high-risk areas such as: places that were likely to have out-of-state firewood introduced, vicinities where trees have been reported as potentially infested by arborists or homeowners, and neighborhoods identified as having numerous ash trees in decline. UDAF also hosted a meeting of Western states to coordinate EAB exclusion and mitigation efforts (see Box 2). In 2023 the UDAF Insect Program will continue leading task force efforts such as regulatory measures, survey work, and outreach efforts.

Pine Shoot Beetle

Pine shoot beetle (PSB) *Tomicus piniperda* Linnaeus is an invasive bark beetle with a large native range in Eurasia and North Africa that was first detected in Ohio in 1992. Since its introduction, PSB has spread throughout much of the Northeast and Midwest. Most damage is caused by adults feeding inside young shoots of pine *Pinus* trees. After maintaining a quarantine (see UAC § R68-16) of this pest for four decades, the UDAF Insect Program is considering the deregulation of this insect, due to its relatively benign status in areas where it has been introduced (see Page 3, News & Notes). In 2022, 24 traps were placed in eight



National Park Service staff prepare an emerald ash borer trap and hoist it into the upper canopy of an ash tree at the Watchman Campground at Zion National Park. Traps were deployed in early spring, serviced bi-monthly and retrieved in late summer.

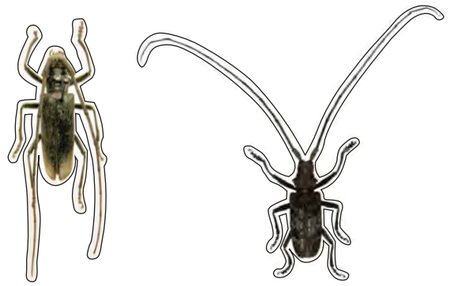
BOX ONE

In 2022, UDAF partnered with National Park Service (NPS) to begin a multi-year EAB survey of Zion National Park. The park had not been surveyed for the pest since 2017. Zion is home to the single leaf ash *F. anamola* and the velvet ash *F. veluntina*, both of which are native. Due to the large number of travelers that visit the area each year, the park is considered to be at high risk for EAB introduction. UDAF met with NPS staff in spring to conduct a trap deployment training and provide the materials necessary to conduct the work. UDAF returned to check the trap captures in the fall. Fortunately, no EAB were found in any of the 10 traps that were deployed throughout the park. UDAF and NPS will continue these joint trapping efforts in the coming years.

Wasatch Front counties, with no detections. PSB has never been detected in Utah.

Cooperative Agricultural Pest Survey

USDA APHIS coordinates the Cooperative Agricultural Pest Survey (CAPS), a science-based federal and state collaborative effort to detect exotic organisms that threaten national agriculture and the environment. Every year the program allocates money to participating states to place traps for high-priority target pests. Utah annually participates in the CAPS woodborer survey and in 2022, 48 traps were placed and 18 visual surveys were conducted within eight Northern Utah counties. There were many changes to the 2022 survey, including the removal of Mediterranean pine engraver *Orthotomicus erosus* (Willaston) and velvet longhorned beetle *Trichoferus campestris* (Faldermann). Due to the minimal impact of these insects on host plants, they were taken off USDA APHIS's National Pest Priority list and are now deregulated. In their place, two new Cerambycid beetles were added: the Asian long-horned beetle *Anoplophora glabripennis* (Motschulsky) and citrus long-horned beetle *Anoplophora chinensis* (Forster). None of the CAPS target pests were detected in Utah via trapping or visual survey in 2022.



Black Fir Pine Sawyer & Japanese Pine Sawyer

Monochamus is a genus of large longhorn beetles that are widely distributed throughout the world, including several native species found in Utah. Most species host primarily on coniferous trees. Black fir sawyer *Monochamus urussovii* (Fischer-Waldheim) is native to spruce *Picea* spp. and fir *Abies* spp. forests from Finland to Japan, and is considered a serious pest in Siberia. Japanese pine sawyer *Monochamus alternatus* (Hope) is indigenous to China, Korea, Laos, and Japan. Both of these beetles can vector pathogenic nematodes to healthy trees which causes large annual losses in forests and plantations in Asian and European counties. Neither species are known to be established in the U.S., though *M. alternatus* was intercepted once in a New York warehouse in the 1990s.

Large Pine Weevil

Hylobius abietis (Linnaeus) is a commercially important pine plantation pest in Europe and Asia and causes millions of dollars in damage annually. The beetle's larval stage does not cause significant damage to living trees, as eggs are laid in recently cut tree stumps. However, adult weevils feed on a large variety of coniferous and some deciduous seedlings. Plantations will often have complete loss of new transplants without implementing pesticide controls. This pest is not established in North America but has been intercepted at ports of entry and in the mail.

European Spruce Bark Beetle & Six-toothed Ips

Ips bark beetles are moderate to large bark beetles (up to 1/3 of an inch) that feed on coniferous trees. European spruce bark beetle *Ips typographus* (Linnaeus) specializes in spruce trees and is native to Europe, where Norway spruce *P. abies* is naturally found. Six-toothed Ips *Ips sexdentatus* (Boerner) has a larger host list of coniferous trees and is native to Eurasia. Both are normally considered secondary pests of dead or weak trees, but stressors such as fire, drought, or windstorms will cause large outbreaks. They also transmit blue-stain fungi (various genera), which are pathogens associated with higher tree mortality. Six-toothed Ips has been intercepted 157 times in the U.S. at various ports, while positive identifications of European spruce bark beetle were made twice in Indiana and Maryland during surveys. Subsequent trapping in both of these areas did not find further specimens.

Asian and Citrus Longhorned Beetles

Asian longhorned beetle (ALB) and citrus longhorned beetle are both large beetles native to east and southeast Asia. ALB has been introduced to several European countries and some eastern U.S. states. Citrus long-horned beetles have also been introduced into Europe but outside of interceptions, it has not been found in the U.S. yet. Both of these beetles have a large range of host trees which make them particularly hazardous. USDA APHIS is working to eradicate ALB from the states where it is currently found. So far ALB has been eradicated from the state of New Jersey, the city of Boston, portions of Ohio, and some of New York state. Both beetle species are a new addition to UDAF's trapping program as of 2022. While no effective trap and lure combination exists for detecting these pests, visual surveys can be done on known host trees that are in decline. Signs of an ALB infestation include large (at least ¼ inch) perfectly round exit holes, numerous oval depressions where a female has chewed the bark to lay her eggs, and frass around the base of a tree or on branches.

Firewood and Nursery Stock Quarantines

Firewood and nursery stock movement are considered the highest risk pathways for wood-boring beetles to enter the state, so regulating their movement is critical in reducing introduction risk. Thus, the State of Utah enforces a number of quarantines.

The Utah Firewood Quarantine (see UAC § R68-23) was enacted in 2017. This rule prohibits the importation of firewood from other states unless the materials are certified to be free of plant pests. Both commercial firewood distributors and members of the general public are subject to these new rules. The UDAF Insect Program has conducted media outreach and distributed literature to educate firewood distributors and the general public about these rules. State agricultural inspectors also regularly visit retail locations that sell firewood, to ensure compliance.

In 2021 an EAB Quarantine (see UAC § R68-11) went into effect which restricts ash nursery stock and other related articles. Nursery inspectors have been informing Utah's greenhouse growers about the new rules. As of this publishing, there are no states that currently meet the quarantine's standards. UDAF is currently in communication with a few neighboring states that are thought to be non-infested and may qualify for such an exemption. However, until an exemption is approved by a qualifying state, the importation of an ash into Utah is currently prohibited.

BOX 2 Western Emerald Ash Borer Cooperator's Meeting

In March of 2022, the UDAF Insect Program hosted the first Western Region EAB Cooperator's Meeting via videoconference. In attendance were representatives from eight Western states, one Canadian province, municipal governments, non-profit organizations, and USDA APHIS. A representative from each state was given time to present to the group about what efforts they are making to prevent and prepare for EAB introduction.

The group was also treated to a presentation by Dr. Joseph Francese, a research entomologist with the Otis Lab in Buzzards Bay, Massachusetts. Dr. Francese was instrumental in developing the EAB trap that is commonly used in pest detection surveys today. He provided a history of how the trap was developed and gave deployment tips for maximizing the trap's effectiveness.

An open discussion ended the event, where states got to discuss their ideas about how best to manage this pest. Attendees found the meeting to be of great value and UDAF plans to organize the event again in 2023.

The Entomology Lab

The UDAF Entomology Lab grew from humble beginnings—both physically and metaphorically. In the mid-2000s, when the lab space was barely larger than a closet, state entomologists sorted and sexed Japanese beetles (JB) *Popillia japonica* (Newman) captured from a historically large outbreak of the pest in Orem. In 2011, the UDAF Insect Program took on a new federally-funded survey—the Exotic Wood Borer (EWB) Survey (see page 28)—and with it, the workload of sorting, pinning, and identifying an enormous number of insects. This sudden influx of new and different target species highlighted the need for a reference insect collection, which would serve as a resource for current and future state employees. The lab continued to grow. But growth can be painful—in 2017, now with three full-time UDAF Insect Program employees sharing a windowless storage room with little to no ventilation, conditions were suboptimal. So, the lab was moved within the William Spry building to occupy the former dairy lab. Compared to how conditions were before, this was a huge upgrade. The cherry on top was the addition of molecular diagnostic capabilities in 2018. A quantitative PCR (qPCR) machine and associated gear were purchased, and now the lab could offer rapid honey bee disease diagnostics to beekeepers with a turnaround time orders of magnitude faster than the out-of-state labs that were previously utilized by the UDAF Apiary Program.

Today, the lab continues to provide essential services to all of UDAF's entomology-related activities. The lab processes trap catches from the European Corn Borer Survey (see page 24), Exotic Wood Borer Survey, Orchard Pest Sentinel Survey (see page 12), and Imported Fire Ant Survey (see page 37). All told, this amounts to thousands of insect specimens that are identified to species each year—many of which are incorporated into the lab's reference insect collection. Additionally, the lab provides essential diagnostic services to the UDAF Apiary Program (see page 4) to facilitate the early detection of and rapid response of regulated honey bee maladies. The lab's phone lines are always open to answer insect-related questions, and walk-in or mail-in identification services are available upon request for potentially harmful invasive agricultural pest species.

Figure 1. Moving boxes packed and ready for transit to the TSOB building.

New Lab Space

After years of anticipation and months of preparation, the UDAF Entomology Lab completed its move to a new space in the Taylorsville State Office Building (TSOB). Packing and moving all the sensitive, heavy, and breakable equipment was stressful—staff packed glassware and instruments carefully (Figure 1), ensuring that nothing could break in transit, and took steps to ensure the existing sample and reagent inventory would be kept frozen while equipment was being moved, but the effort was well worth it.

The new lab boasts an increased square footage of workspace, much of which is purely for storage—this will streamline the process for disinfecting field equipment and reduce cross-contamination risk as field tools will be stored separately from lab tools. A dedicated pre-PCR room and a post-PCR room will further reduce cross-contamination risks and ensure the continued reliability of molecular diagnostic results.

At the time of this report's publication, the UDAF Analytical Seed Laboratory has not yet moved from the old William Spry building into this new space. While this initially caused some confusion, in the end this was a good thing as it allowed UDAF Insect Program staff to identify outstanding construction issues with the lab space that needed to be fixed. This will ensure that the lab is completely constructed and ready for the seed lab team. Once the UDAF Seed Lab team moves into the space, the lab will officially be referred to as the UDAF Plant Industry Lab, though seed and insect staff will largely continue operating as two distinct groups.

The UDAF Insect Program reference collection has also been expanded thanks to this move. Prior to the move, the collection housed over 5,000 individual specimens spanning 150 insect families, and space for expansion was limited. The addition of a new insect collection cabinet increases the theoretical maximum number of specimens to 7,500. With more invasive pests being monitored every year, this storage space is sorely needed, and lab staff is grateful for the allocation of funding to the insect collection.

Apiary Diagnostics

The goal of the diagnostic services offered by the UDAF Entomology Lab is to provide reliable and rapid test results for significant honey bee maladies. For molecular diagnostics, we aim to keep turnaround time shorter than the length of one brood cycle (21 days) from the date the lab receives a sample to the date a diagnostic report is sent to the stakeholder(s). In 2022, the median turnaround time for all types of samples, molecular included, was six days. There were two large batches of samples that were delayed in producing results due to equipment shortages and supply chain issues. In those instances, the longest turnaround time was 22 days, which is only one day longer than a full brood cycle. As is always the case with lab-based diagnostics, one must prioritize good results over fast turnaround times.

As of 2022, the lab offers diagnostic tests for five honey bee maladies using various methodologies as appropriate (Table 1).

Despite the shake-up of a lab move and supply shortages, UDAF Entomology Lab staff were able to perform even more diagnostic tests than last year. Indeed, once in the new lab space, it only took program staff one week to get everything unpacked and re-calibrate the equipment so that the lab could get up and running quickly. In total, 235 honey bee-related samples were submitted for testing, 211 of which were swab samples for molecular testing and 28 of which were adult bee samples for parasite testing.

Figure 2. State apiary inspector Jenna Crowder collecting a swab sample for qPCR testing.

Malady	Causative agent	Test target	Test method	No. tests performed	Percent of test results positive or above threshold levels
American Foulbrood (AFB)	*Paenibacillus larvae*	bacterial DNA	molecular - qPCR	211	36%
European Foulbrood (EFB)	*Melissococcus plutonius*	bacterial DNA	molecular-qPCR	156	37.2%
Nosema disease	*Nosema spp.*	fungal spore	Microscopy	28	21.4%
Tracheal mites	*Acarapis woodi* (Rennie)	parasite	Microscopy	5	0%
Varroa mites	*Varroa destructor* (Anderson & Trueman)	parasite	Alcohol wash	27	59.3%

Table 1. Type and number of apiary diagnostic tests performed by the Entomology Lab in 2022.

New State Record

The Oregon Department of Agriculture (ODA) has several coleopterists (an entomologist that specializes in beetles) on staff that identify beetles and officialize new state records for states that participate in the CAPS survey (see page 28, Exotic Wood Borer Survey). A state record is the first known occurrence of a given insect in any particular state. While 2022 samples are still being processed by ODA, 2021 saw only one new state record.

Xylotrechus insignis (LeConte), or the willow borer (Figure 3), is a West Coast species whose endemic range spans from Oregon down to Baja California. It was first found in Iron County, Utah in September of 2021. While this insect could have just had a poorly understood native range, or it indeed moved here by artificial means, it does not pose a threat to the native fauna in Utah. However, this finding does exemplify how easily exotic pests can move from state to state by human transport.

Figure 3. Willow borer on host plant.

Specimen Showcase

Whirligig beetles (Family Gyrinidae) are one of the most charismatic families of beetles. Many (especially if you fish a lot) would recognize them as the swarms of pinky-nail to dime-sized reflective bugs that dart quickly around the margins of lakes, rivers, and ponds. Whirligig beetles can form large aggregations called "rafts"—which are be composed of hundreds of thousands of individuals (Figure 1)—and can move as a group in sophisticated ways similar to a flock of birds. Scientists have found the antennae of Gyrinids are specialized to detect waves on the surface of the water. This helps the beetles avoid collisions with objects or one another as they swim at speeds up to 144 centimeters a second or 3.2 miles per hour. Gyrinids also use their highly sensitive antennae to detect prey as it falls on the water's surface. Their raptorial front legs are evolved to quickly grab drowning prey, while their paddle-shaped middle and hind legs are specialized for high-frequency swimming strokes. Indeed, the 84% thrust efficiency of these beetles ranks the family as one of the most efficient swimmers in the animal kingdom!

Figure 1. "Body raft" aggregation of gyrinid beetles on the surface of a body of water.

Another common name for these beetles is "apple bugs". When a whirligig beetle is disturbed or handled, it will release a chemical deterrent called gyrinidal which smells like apples. Perhaps the coolest aspect of Gyrinids are their two pairs of compound eyes (Figure 2), making this beetle family an anomaly in the insect world. The arrangement of their four compound eyes is believed to give them simultaneous vision below and above the water. Interestingly, researchers discovered in 2012 that the Gyrinid brain has evolved to use lobes called mushroom bodies–in most insects, the mushroom bodies are used for processing smells–specifically for processing visual signals from the upper pair of compound eyes.

This specimen from UDAF's collection, found in 1990 in Vermont, is in the *Dineutus* genus. Species in this genus are hard to differentiate from one another unless identified by an entomologist that specializes in this beetle family. Since UDAF doesn't have any Gyrinidae experts on hand, we will just leave it at *Dineutus* for now.

Figure 2. Lateral view of Dineutus spp. showing dorsal and ventral compound eyes.

Figure 3. Dorsal view of Dineutus spp.

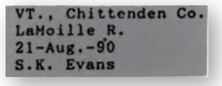
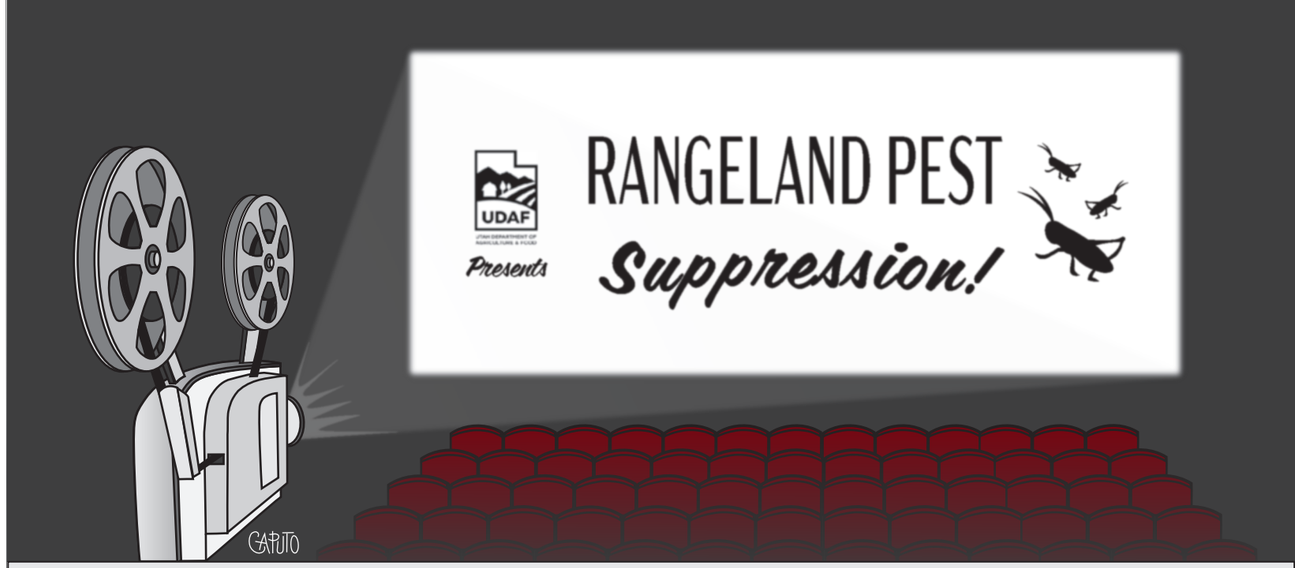


Figure 4. Specimen collection label.



UDAF Assists Agricultural Producers in Grasshopper and Mormon Cricket Control

Grasshoppers, crickets, and katydids are all closely related insects that belong to the taxonomic order Orthoptera. Every so often, the charisma of these organisms captures the imagination of people and their essence become enshrined in culture. Indeed, there are all manner of businesses named after these insects, including restaurants, banks, and even cellular phone service providers. While perhaps not as iconic as butterflies or bees, there is no doubt that these insects can make an impression on people.

Yet, the relationship between humans and Orthopterans is complicated, as not all of our feelings about these insects are positive. Human history is littered with accounts of locust (a group of short-horned grasshopper) outbreaks that plagued agricultural communities. Even Utah has its own fraught history with Orthopterans; chronicles of Mormon crickets *Anabrus simplex* (Haldeman) attacking the farms of early pioneer settlers are entrenched in the collective mind of the state's citizenry.

In short, we have mixed feelings about these creatures. Part of what perpetuates this ambiguity are contemporary challenges that these insects create. Indeed, certain Orthopterans continue to be serious pests of agricultural systems. In Utah, the infamous Mormon cricket and grasshoppers of various genera are known to arise cyclically and cause devastation just as they did a century ago. UDAF has assisted those affected by these pests for about as long as they have been problematic. In recent decades, the department administers cost-share agreements to farmers and ranchers that have economically damaging levels of pests and provides technical assistance when needed. In these arrangements, the state pays for the expense of the chemical controls and the producer covers the cost of the labor and machinery necessary to make applications. This joint effort protects valuable agricultural commodities grown throughout the state, defrays control costs for producers, ensures that food resources for wildlife other than rangeland insects are not depleted, and incentivizes the judicious use of pesticides through program standards.

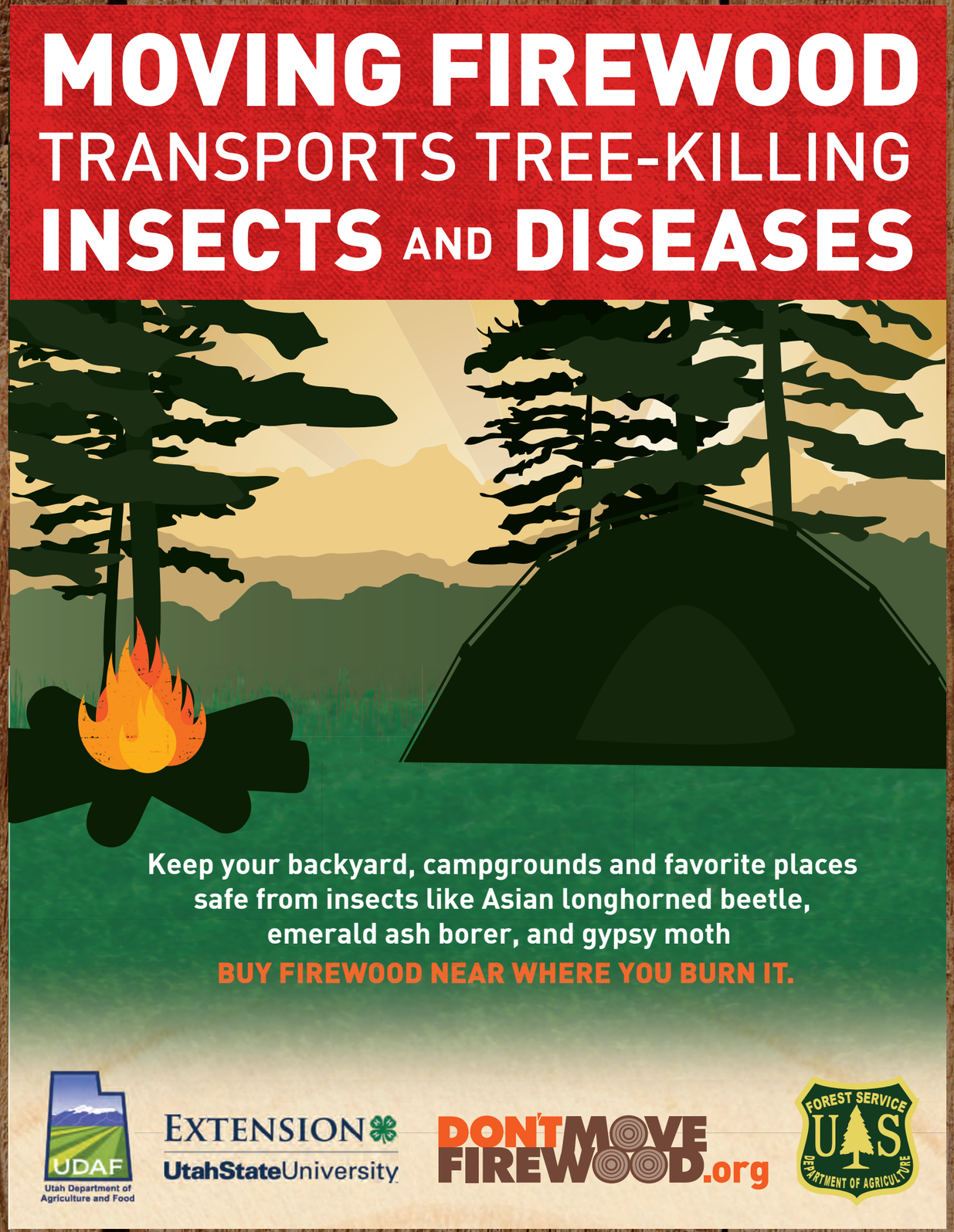
Infestations & Assistance to Producers

It has been some time since the state has experienced a large-scale grasshopper or Mormon cricket outbreak where millions of acres are infested. Yet the number of infested acres and producers seeking help for Orthopteran pest infestations has steadily trended upwards in recent years. This may indicate that large outbreaks are on the horizon. In 2022, the UDAF Insect Program issued 45 cost-share agreements for the control of various rangeland grasshopper species. These agreements benefitted 72 producers throughout the state and resulted in 171,096 acres treated with a liquid formulation and 14,960 acres treated with a bait. Participants were required to conduct reduced agent and area treatment (RAAT) protocol, an integrated pest management (IPM) technique, which drastically reduces the amount of pesticide used to achieve effective control. UDAF insists on producers using the RAAT method so that tax dollars are used efficiently and to ensure that excessive pesticides are not being put into the environment unnecessarily. Box Elder, Sanpete, and Duchesne counties experienced the greatest infestations of any counties in the state.

National Grasshopper Management Board Meeting

The UDAF Insect Program hosted the annual National Grasshopper Management Board (NGMB) Meeting at a Salt Lake City convention center in September of 2022. The event was brought back to Utah after the meeting had been hosted in Colorado for many years prior.

The NGMB is a multi-state, multi-agency organization that is dedicated to promoting the best management practices relating to rangeland pest suppression. Fourteen, mostly Western, states are participants in the group and approximately 50 people representing these areas attended the 2022 event. The meeting gave members an opportunity to discuss challenges, share success stories and plan for future Orthopteran outbreaks. The UDAF Insect Program is hoping to continue bringing the event back to Utah whenever possible.



Imported Fire Ants

UDAF Monitors Southwestern Utah for Two Destructive Exotic Ant Species

The late, esteemed, evolutionary biologist and ant expert, Edward O. Wilson, was once asked in an interview, "What would happen if all ants disappeared from the Earth?" His initial reply was simple and sobering, "Terrible things". Wilson went on to note the important function of ants in soil health, reclamation of dead materials, and complex interactions with other living organisms. He finished by predicting that, in the absence of ants, thousands of animal and plant species would go extinct and that most terrestrial ecosystems would partially collapse. This scenario is not typically on most people's minds when they think of ants. Humans are usually more focused getting them out of their house or brushing them off their shoes when outdoors. People often get so caught up in the problems that ants cause, that they seldom stop to think about what their lives would be like in their absence.

So, before this article devolves into the cliché of discussing all things problematic about ants, the UDAF Insect Program would like to take a brief moment to express that it appreciates ants as a group and all that they do for our planet. That said, not every species of ant needs to be in every part of the world to reap the benefits they provide. Indeed, there are many instances where an ant species leaving its native area turns it from a valuable component of the ecosystem to a purveyor of biological havoc.

Perhaps there is no better example of this exact notion than the accidental, human-facilitated migration of the black imported fire ant (BIFA) *Solenopsis richteri* (Forel) and the red imported fire ant (RIFA) *Soleopsis invicta* (Buren) to the United States (U.S.). BIFA and RIFA would be transported from their native South American range to the U.S. in the early 20th Century, likely in soil that was used as ballast on ships transporting cargo between the two regions. Eventually, BIFA would end up in small areas of just three states: Mississippi, Alabama, and Tennessee. RIFA was successful in colonizing eleven southeastern states, a few areas in Southern California, one county in New Mexico, and all of Puerto Rico.

In the areas where these ants have arrived, damage to plants, animals, and humans has been severe. In fact, a 2006 economic impact study by Texas A&M estimated that imported fire ants cause about $5.6 billion dollars per annum in U.S. states and territories. The burden of these injuries is carried by many. Corn and fruit growers will sometimes find these ants attacking their crops. Golf course superintendents, parks maintenance staff, and sod growers must deal with the large, unsightly mounds that are created by the ants when they invade turfgrass. Even utility companies and airports are forced to cope with the pests, as they chew on cables and move soil into electrical infrastructure. The worst damage of all is perhaps what is done to humans and animals. Because BIFA and RIFA have a ferocious bite, aggressive temperament, and vast distribution, millions of people are attacked by these insects each year; thousands suffer wounds needing medical attention and a small number of these people die as a result of anaphylaxis. Pets, livestock, and wildlife can also suffer the wrath of these ants. Attacks on these animals are not uncommon and can result in injury or even death. Imported fire ants can also compete with other native organisms. For instance, the voracious appetite of the insects has contributed to the population decline of a native, threatened lizard in Texas, by reducing that animal's food sources.

After hearing all of this, a reader may question why ants were so worthy of praise earlier in this article. It must be remembered that in their native range, both BIFA and RIFA are not as problematic because of natural enemies that keep their populations under control. In their introduced range, many of these natural controls are absent and therefore their benefits are less noteworthy. Therefore, it is not their existence that is problematic, but instead their location.

With this notion in mind, USDA APHIS has enacted a quarantine on these insects which is meant to contain their geographical distribution in the U.S. The quarantine regulates the interstate movement of soil, sod, nursery stock, and other materials which are capable of transferring imported fire ants to areas that are uninfested. The agency also provides funding to states that are at risk of BIFA and RIFA introduction and establishment. The UDAF Insect Program has been granted these funds for the last two years and has used them to conduct a biannual trapping survey. The effort is focused on Washington County, which is the area in the state most at risk of imported fire ant establishment, based on suitability modeling. In 2022, 26 traps were placed in spring and another 25 traps were deployed later that fall. Fortunately, no BIFA or RIFA specimens were detected as a result of these efforts. However, the tropical fire anti *S. geminata* (Fabricius) was detected for the first time in Utah last year. It is not nearly as serious of a pest as either BIFA or RIFA, so no actions will be taken as a result of the finding.

In closing, it is worth contemplating once more the paradox of ants as a group being beneficial, but particular species—in certain places—being problematic. Perhaps this contradiction can be best resolved by considering the old adage that a weed is merely "a plant out of place." It could be argued that for imported fire ants, the same logic applies. They are fantastic, as long as they are in the right place.

UDAF Insect Program Staff & Seasonal Crew

Front Row: (left to right) Kristopher Watson – State Entomologist, Jenna Crowder – Diagnostic Entomologist & Honey Bee Inspector

Middle Row: Kole Prestwich – JB/SM Trapper, Alan Lindsay – JB/SM Trapper, Anne Johnson – GIS Administrator, Elizabeth Carroll – JB/SM Trapper, Sharon Gilbert – Lead Trapper, Sarah Schulthies – Lab Technician, – Jeffrey Larson – JB/SM Trapper, Natalie Friesen – JB/SM Trapper

Back Row: Joey Caputo – Survey Entomologist & Honey Bee Inspector, Aaron Oman – JB/SM Trapper

Not pictured: Gabriel Brown – EAB & EWB Trapper

Contacts & Resources

Mail
Utah Department of Agriculture and Food
Insect Program
4315 S 2700 W
TSOB South Bldg, Floor 2
Taylorsville, UT 84129-2128
Web
ag.utah.gov

Insect Program Staff

Kristopher Watson
Program Manager
Office: 801-982-2311
Cell: 801-330-8285
kwatson@utah.gov

Joey Caputo
Survey Entomologist
Office: 801-972-1669
Cell: 801-793-0327
jcaputo@utah.gov

Jenna Crowder
Diagnostic Entomologist
Office: 801-982-2313
Cell: 801-214-5718
jcrowder@utah.gov

Sarah Schulthies
Lab Technician
Lab: 801-982-2313
sschulthies@utah.gov

Compliance Specialists

Brent Ure
Brigham City Office
Office: 435-734-3328
Cell: 385-267-5256
bure@utah.gov

Jake Mayer
Utah County Office
Cell: 385-270-4704
jmayer@utah.gov

Jakeb Barnes
Weber County Office
Cell: 208-316-5414
jakebbarnes@utah.gov

Jason Noble
Salt Lake County Office
Cell: 801-518-0335
jmnoble@utah.gov

Jesse Durrant
Millard County Office
Cell: 435-253-1937
jessedurrant@utah.gov

Joseph May
Box Elder County Office
Cell: 385-368-1689
gmay@utah.gov

Landen Kidd
Weber County Office
Cell: 385-245-4957
lkidd@utah.gov

Mark Hillier
Utah County Office
Cell: 435-230-3584
mhillier@utah.gov

Matt Serfustini
Carbon County Office
Office: 435-636-3216
Cell: 435-452-8650
mserfustini@utah.gov

Mika Roberts
Utah County Office
Cell: 435-592-4007
mroberts@utah.gov

Division Management

Robert Hougaard
Director
Office: 801-982-2305
rhougaard@utah.gov

Apiary Resources

UDAF Apiary Program
ag.utah.gov/farmers/plants-industry/apiary-inspection-and-beekeeping/
UDAF Pollinator Habitat Improvement Project
ag.utah.gov/farmers/conservation-division/pollinator-program/
USDA-ARS Pollinating Insect-Biology, Management, Systematics Research
ars.usda.gov/pacific-west-area/logan-ut/pollinating-insect-biology-management-systematics-research
Project Apis m.
projectapism.org

Invasive Insect Resources

UDAF Invasive Insect Program
ag.utah.gov/farmers/plants-industry/insect-and-pest-program/
Japanese Beetle Eradication
ag.utah.gov/jberadication
USDA-APHIS-PPQ
aphis.usda.gov/aphis/ourfocus/planthealth
Utah Cooperative Agricultural Pest Survey Program
utahpests.usu.edu/caps/utah-caps-program
Utah Plant Pests Diagnostic Laboratory
utahpests.usu.edu/uppdl
National Plant Board
nationalplantboard.org

Trade Associations

Utah Beekeepers Association
uba.wildapricot.org
Utah Horticulture Association
utahhort.org/
Utah Nursery and Landscape Association
utahgreen.org

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The Entomology Lab

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Utah Department of Agriculture & Food
Plant Industry
4315 S 2700 W
TSOB South Bldg, Floor 2
Taylorsville, UT 84129-2128

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