

SALT LAKE CITY MOSQUITO ABATEMENT DISTRICT

Executive Director's Report

June 2026

1. Personnel:

Personnel	
Staff	Seasonal
11	41

Type of Work	2026	3 - Year Average
Adulticiding	0.00	17.83
Wetlands / Rural	1,184.25	1,064.67
Fish Culture	349.75	248.92
Watch Basins / Gutters	753.00	576.00
Tree Holes	208.00	298.67
Prison	7.00	57.58
Service Request	52.50	48.83
Traps	538.75	497.00
Aerial Operations	0.00	0.00
Laboratory	1,391.75	979.67
Office / Administration	861.75	868.67
Equipment Maintenance	392.50	328.08
Facility Maintenance	318.50	364.58
Training	110.50	143.83
Education	456.75	229.33
Unmanned Aerial System	505.00	335.67
CSU Grant	4.00	425.92
Other / Errands	51.75	160.67
Comp. Time Used	85.75	87.50
Vacation	153.75	71.17
Central Life Science Trials	237.75	0.00
Holidays	84.00	192.00
Sick Leave	39.75	25.08
Total	7,786.75	7,021.67

2. Office/Lab/Shop Activities:

Ary Faraji, Executive Director

- The District hosted Dr. Sammie Tian from Central Life Sciences in the dormitories for field trials with DuoVex on 2-5 June 2026.
- Attended weekly Owner/Architect/Consultant meetings on 3, 10, 17, 24 June 2026.
- Attended a virtual PhD Committee meeting for Mikena Smith at Colorado State University on 3 June 2026.
- Attended a virtual Editors Meeting for the Journal of Medical Entomology on 8 June 2026.
- Conducted an interview with Slate Magazine on mosquitoes and mosquito-borne diseases on 9 June 2026.
- The District hosted Dr. Lindsay Keegan and Dr. Hillary Topazian from the University of Utah for a site and field visit on 9 June 2026.
- Attended the monthly manager's meeting of the Utah Mosquito Abatement Association on 10 June 2026.
- Attended quarterly board meeting of the Davis-Salt Lake Aerial Spray Authority on 11 June 2026.
- Attended a virtual meeting with Dr. JR McMillan regarding 2025 aerial adulticide trials on 15 June 2026.
- Thad Allen, PhD student from Utah State University stayed in the dorms on 22-24 and 29-30 June 2026 and accompanied field crews.
- Dr. Steven Su from EcoZone visited the district for insecticide resistance work and stayed in the dormitories on 29-30 June 2026.

Aleta Fairbanks, CFO

- 16 June 2026 – Attended the virtual cybersecurity brief provided by Utah Local Governments Trust: The Modern Threat & CIS On-Ramp.

Chris Bibbs, Laboratory Director

Jun 1	Materials and colony prep for DuoVex trials
Jun 2	Site visit from Dr. Yuexun 'Sammie' Tian from CLS for night trial work; thermal fogger night trials w/ DuoVex
Jun 3	Site visit from Craig Wallentine on Cliff swallow project; mist blower night trials w/ DuoVex
Jun 4	Data debrief from Emily Calhoun blood meal analysis and hybrid zone work; ULV backpack night trials w/ DuoVex
Jun 5	Alina Moreno (USU, RaHP Vec intern) site visit and training on enzyme bioassays; Safety Meeting; visit conclusion and departure for Sammie Tian; project debrief and exits w/ Nadia Greeding-Leithead
Jun 8	GIS training and project start w/ Natalee Boone; live trap route development for IRM program
Jun 9	Epidemiology visitors from 3i program (5 from University of Utah), shadowing and training with laboratory/surveillance; JME review; Wing Beats article drafting w/ Amy Jamison
Jun 12	Receipt of GLP research materials from Eurofins
Jun 15	Stats call w/ JR McMillan
Jun 17	GIS mapping project updates w/ nee Boone & Iris McCulloch
Jun 18	Review for J Med Ent
Jun 22	Meeting w/ Dr. Steven Su; Meeting w/ Saarman lab

Jun 23	Meeting w/ Epi faculty and students from University of Utah; quality control testing for camera system; J Med Ent Review
Jun 24	Toxicology training w/ Amy Jamison; Night trial (Duovex) [cancelled, wind]
Jun 25	Toxicology training w/ Amy Jamison; Sasha Alfaro orientation and training; Night trial (Duovex) [cancelled, rain/hail]; paper drafting and GIS maps w/ Iris McCulloch; teaching gut dissections
Jun 26	J Med Ent Review; Toxicology training w/ Amy Jamison
Jun 29	Night trial (Duovex); GLP training organization; Larvicide resistance monitoring call w/ Andrew Partin, Jackson Co MCD (Oregon)
Jun 30	Dr. Steven Su visit, toxicology training for lab staff, and review of IRM program proposals

Michele Rehbein, Education Specialist

- Dr. Rehbein attended a ULGT Prime Time Safety webinar on 1 June.
- Dr. Rehbein attended the ULGT Legal Briefs Series webinar (car accidents) on 2 June.
- Dr. Rehbein attended Partners in the Park tabling event at Jordan Park with Evelyn Acosta, Hannah Brennan, and Mitch Pruitt on 2 June.
- Dr. Rehbein held a safety meeting on 5 June on heat safety & heat illness.
- Dr. Rehbein, Hannah Brennan, Evelyn Acosta, and Mitch Pruitt held an education program at the Hartland Partnership Center on 10 June.
- Dr. Rehbein completed and published the SLCMAD biweekly newsletter issue 10 on 12 June.
- Dr. Rehbein, Evelyn Acosta, Kaitlyn Purrington, Keith Lawrence, Mike Packard, and Gizelle (DWR seasonal tech) conducted a least chub fish transfer from the Salt Lake County jail pond to the USCF on 15 June.
- A SLCC environmental science class with Professor Laura Harris came for a tour conducted by Dr. Rehbein on 16 June.
- Evelyn Acosta and Hannah Brennan conducted an education program at the Hartland Partnership Center on 17 June.
- Dr. Rehbein worked on additional information/edits for the website redesign and submitted to Third Sun on 18 June.
- Dr. Rehbein, Evelyn Acosta, Mitch Pruitt, and Hannah Brennan went to the Hartland Partnership Center for an education program on 23 June.
- Dr. Rehbein, Evelyn Acosta, Mitch Pruitt, and Hannah Brennan conducted education programs for the Guadalupe Center on 22, 23, and 24 June for 4th-6th grades, 2nd-3rd grades, and kindergarten to first grades.
- Dr. Rehbein completed and published the SLCMAD biweekly newsletter issue 11 on 26 June.
- Dr. Rehbein reviewed Amy Jamison's tree hole manuscript on 29 June.
- Dr. Rehbein spoke with Raegan Edelman from KSL for a phone interview about the mosquito season and what SLCMAD does on 1 June.
- Dr. Rehbein was interviewed by Alexandra Bonilla from KSL News Radio on 2 June.
- Dr. Rehbein attended the UMAA Board of Director's meeting on 10 June.
- Dr. Rehbein met with Zac Dixon from Cintas to talk about their safety equipment/services on 18 June.
- Dr. Rehbein Evelyn Acosta, Mitch Pruitt, and Hannah Brennan attended Utah STEM Action Center's STEM Best Practices Conference on 30 June.

Nate Byers, Molecular Biologist

Resumed virus testing earlier than usual which yielded an unprecedentedly early West Nile virus positive *Cx. tarsalis* samples.

Maintained smooth operations of the surveillance and laboratory teams by dealing with issues that arose including delayed Airgas deliveries, insufficient primers stocks, and coordinating autoclave installation with Brad and Eckman.

Ran one CLS night trial on 29 June. Completed 2 replicates of Stihl backpack testing on caged mosquitoes. Participated in one trial on 4 June and prepared for trials on 24 and 25 June that were cancelled by wind.

Hosted RaHPVec interns from USU/Saarman lab to assist in their research – Thad and Alina.

Met with Dr. Steven Su virtually to discuss larvicide resistance testing. 22, 29, & 30 June

Met with and provided wetland tours for Dr. Lindsay Keegan, Dr. Hillary Topazian and other epidemiologists from the University of Utah. 9 & 23 June

Met with Dr. Karla Savadraa-Rodriguez and the Saarman Lab about *Cqm1* results from SLCMAD-assayed mosquitoes. 24 June

Attended Dr. Price's seminar (State Veterinarian) on New World Screwworm. 25 June

Assisted Dr. Ivy Hurwitz with arbovirus testing parameters. 26 June

Brad Sorensen, Aerial Operations Supervisor

Continued training UAS staff

Attending Construction Meetings and working through issues

Working on purchases of equipment for hangar

Worked on getting videos and pictures of operations

Treated 1154 Acres using the UAS

6/2 – Discussion of LD's

6/3 – OAC Meeting

6/9 – Commissioning agent meeting

6/10 – OAC Meeting

6/11 – Commissioning agent meeting

6/17 – OAC Meeting

6/17 – Garsite fuel tank issue meeting

6/24 – OAC Meeting

6/30 – AMCA Aviation Subcommittee Meeting

6/30 – Hangar Door Issue Meeting with OAC Team

Jason Hardman, Rural Field Supervisor

Fixing equipment issues, calibration ATV W, field work, and seasonal employee training

Help with trial

Quinten Salt, Urban Field Supervisor

Bike team $\frac{3}{4}$ way through second round of catch basin treatments (similarv this time)

Complete 20ft plus treeholes with treehole team

Meeting with Jim Webster about Miller Bird Refuge trail renovations 6/18

School kids visit and facility tour 6/22-6/26

3. **Field Data:**

Control:

ACRES TREATED

	Adulticide		Larvicide		Total
	Ground	Aerial	Ground	Aerial	
June's Total	0.00	20,480.00	1,346.35	2,675.00	24,501.35
June's 3 Year Avg.	439.33	34,474.67	1,322.67	2,238.00	38,474.67

Service Requests:

MOSQUITO SERVICE OPPORTUNITIES RECEIVED BY MONTH

	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
2026	5	8	24	19						56
3-Year Avg.	3.67	14.00	35.00	42.67	34.00	19.00	13.33	3.33	0.67	165.67

Inspection and Surveillance:

Larval Collections		
Species	June	5-Year Average
<i>Ae. campestris</i>	0	0.0
<i>Ae. dorsalis</i>	71	99.6
<i>Ae. fitchii</i>	0	0.0
<i>Ae. increpitus</i>	0	0.4
<i>Ae. nigromaculis</i>	1	0.0
<i>Ae. niphadopsis</i>	0	0.0
<i>Ae. sierrensis</i>	0	0.2
<i>Ae. melanimon</i>	0	0.0
<i>Ae. varipalpus</i>	0	0.0
<i>Ae. vexans</i>	4	1.2
<i>Cx. erythrothorax</i>	2	1.2
<i>Cx. pipiens</i>	73	57.8
<i>Cx. tarsalis</i>	233	197.8
<i>Cx. salinarius</i>	0	0.0

<i>Cx. impatiens</i>	0	0.0
<i>Cs. incidens</i>	81	32.8
<i>Cs. inornata</i>	43	26.0
<i>An. freeborni</i>	2	0.4
Total	510	417.4

4. Weather:

June's weather was warmer (by 1.8°) and drier (by 0.78") than normal.

Temperature:

	Monthly Avg.	Normal	High	Low
May	64.0°	61.5°	93°	39 °
June	73.4°	71.6°	99°	45 °

<https://www.weather.gov/wrh/Climate?wfo=slc>

Precipitation:

	Total for Month	Normal	Most in 24 hours	
May	0.66"	1.82"	0.29"	on 30 th
June	0.17"	0.95"	0.29"	on 30 th

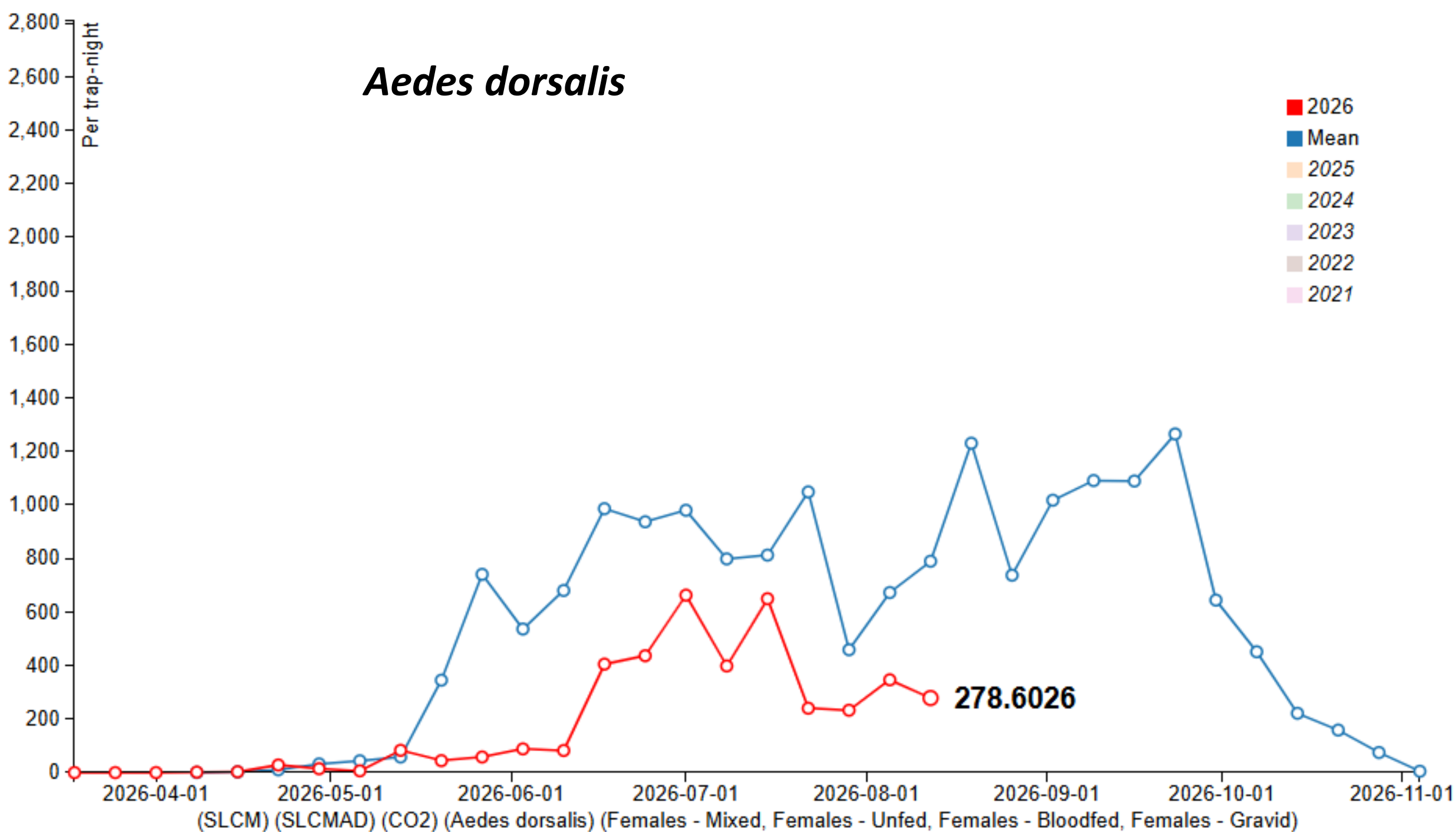
<https://www.weather.gov/wrh/Climate?wfo=slc>

Great Salt Lake (elevation in feet above sea level):

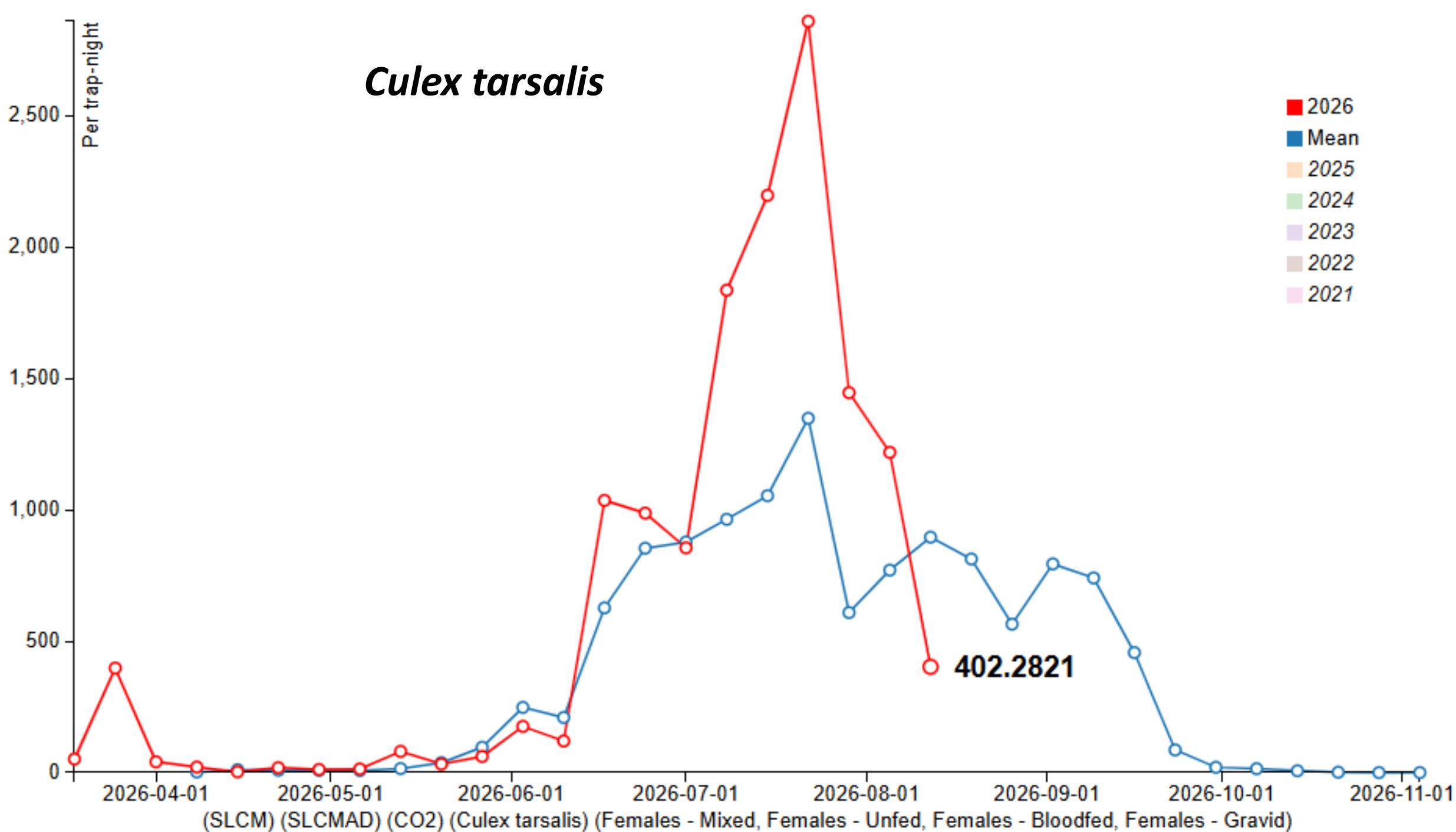
	May 1	Jun 1	Jul 1
2025	4,193.4	4,193.2	4,192.7
2026	4,192.2	4,191.8	4,191.1

<https://waterdata.usgs.gov/monitoring-location/USGS-10010000/>

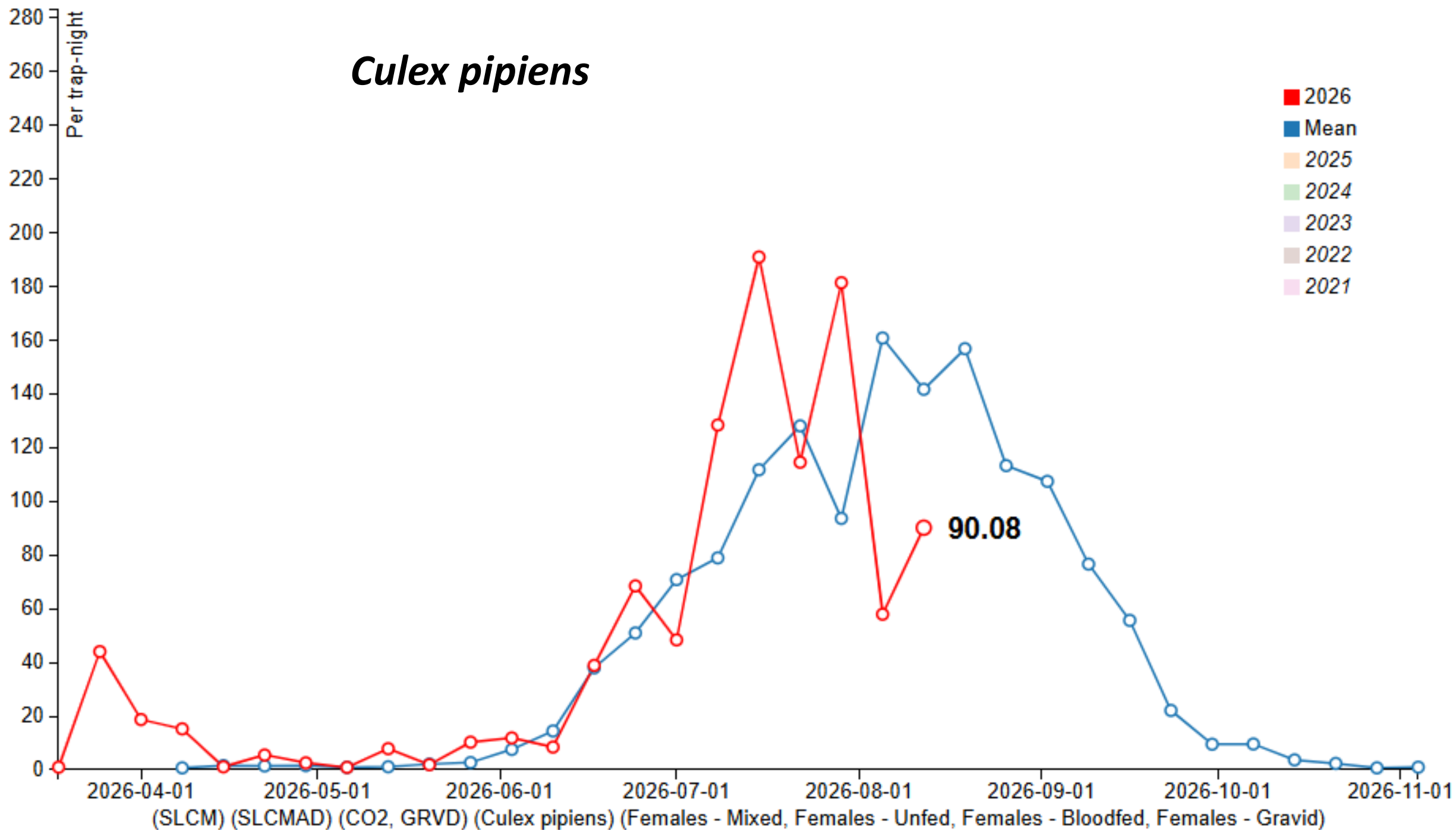
Aedes dorsalis



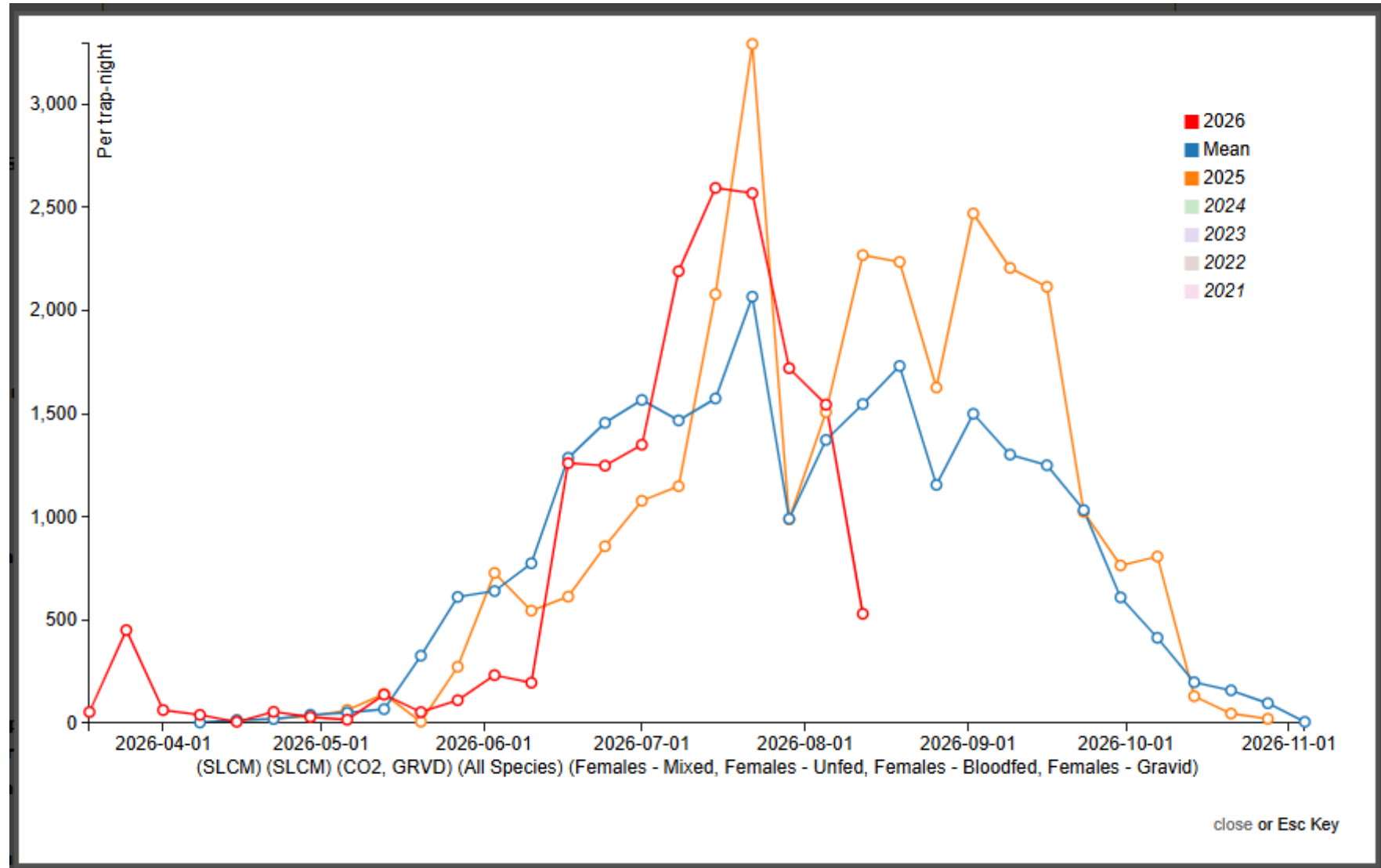
Culex tarsalis



Culex pipiens



All mosquitoes – all traps SLCMAD

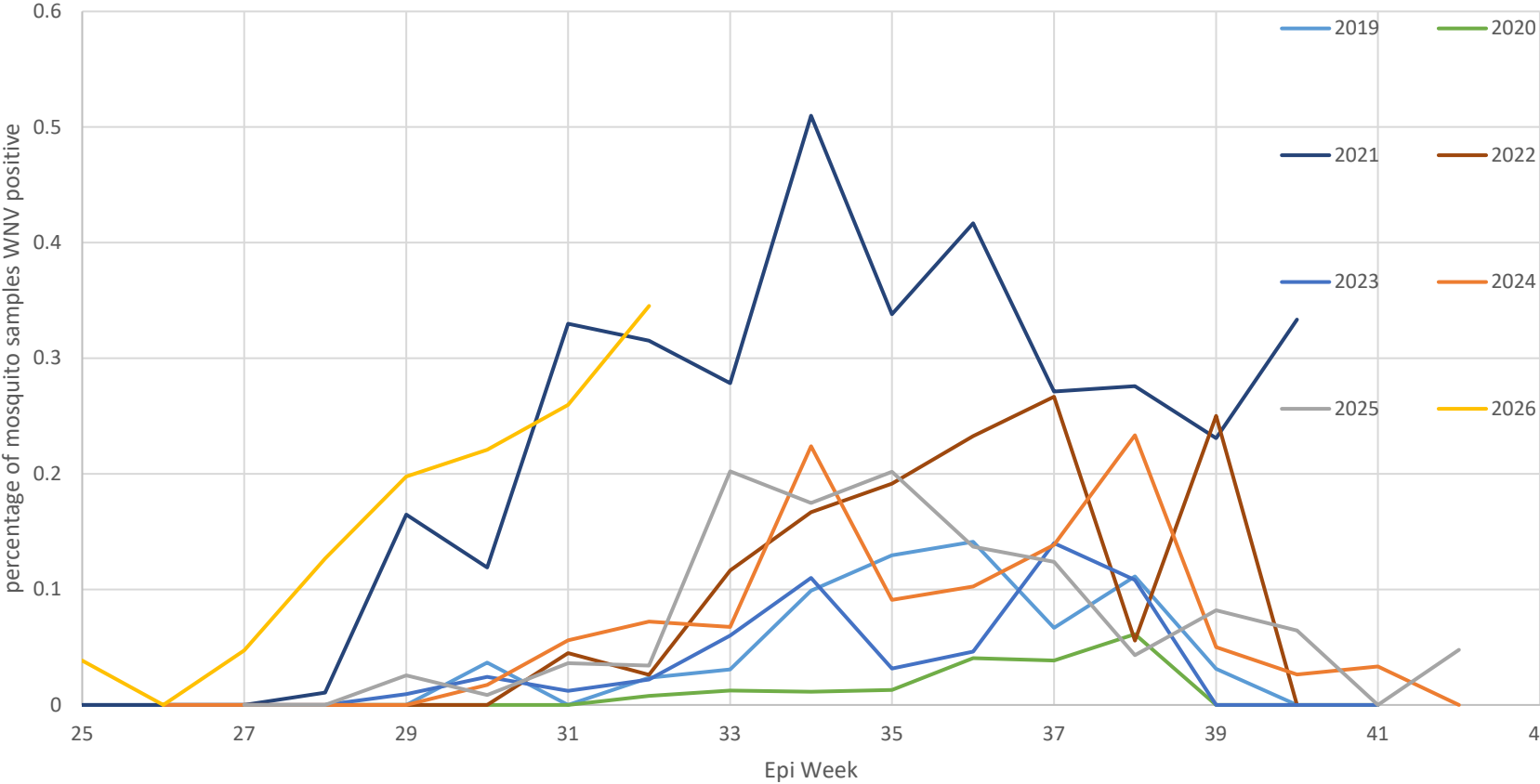


West Nile virus surveillance

Table 3. 10-year WNV season comparison, Utah 2015-2025

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Human	8	13	62	11	21	2	28	5	8	14	49
Horse	4	7	35	6	8	3	12	7	16	16	21
Mosquito pools	281	244	443	180	272	44	654	158	300	319	557
Positivity rate for pools	4.15%	4.24%	8.25%	3.58%	4.19%	1.24%	7.07%	1.76%	2.5%	3.23%	6.36%
Bird	•	•	3	4	1	•	•	•	1	0	0
Chicke*	5	•	•	•	•	•	•	•	1	2	•
Counties with detection	8	8	17	16	20	8	11	9	15	9	15

Percent mosq pools positive SLCMAD

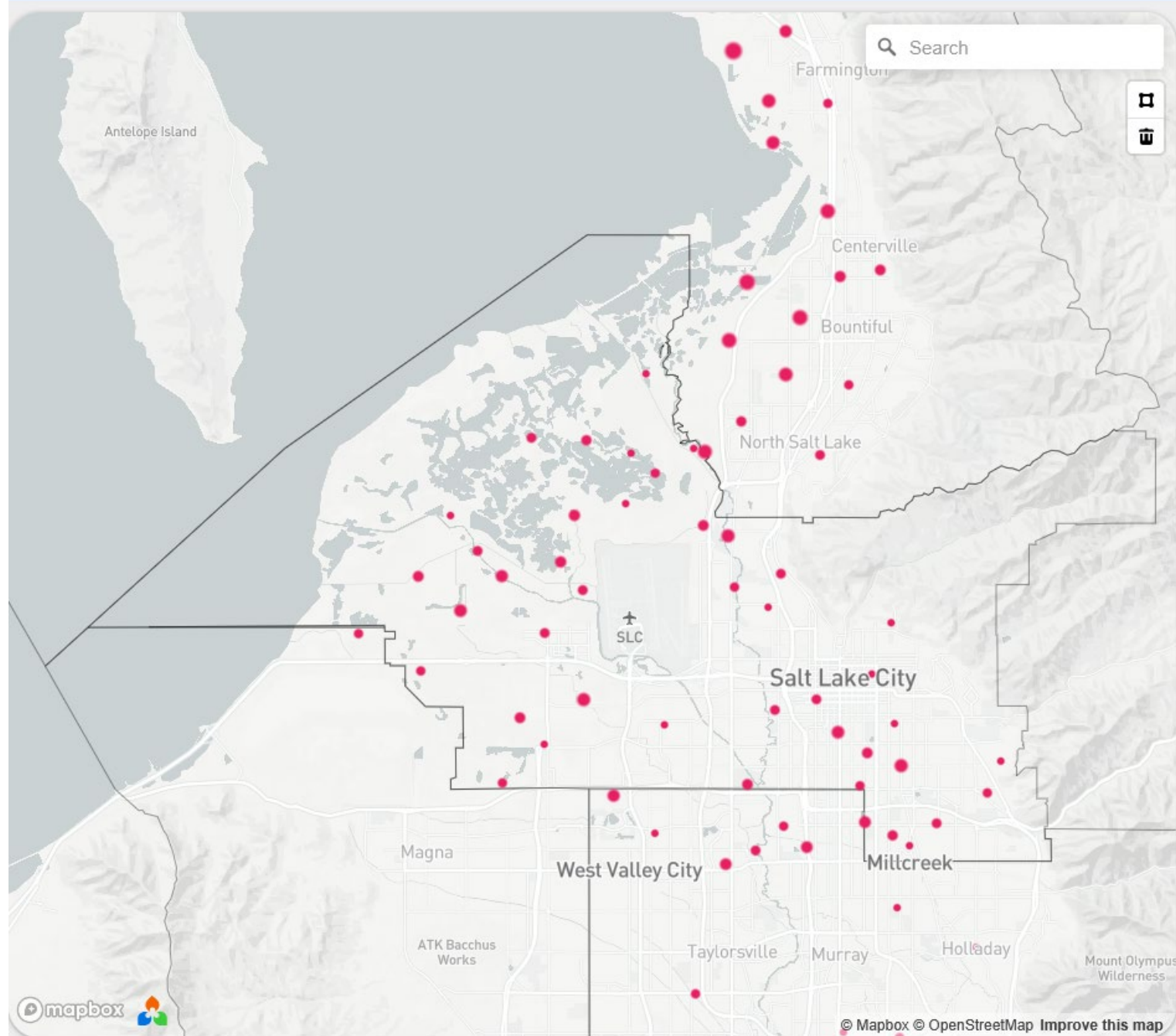


2021 had 28 human cases across Utah. Last year had 49.

West Nile virus surveillance - 2026

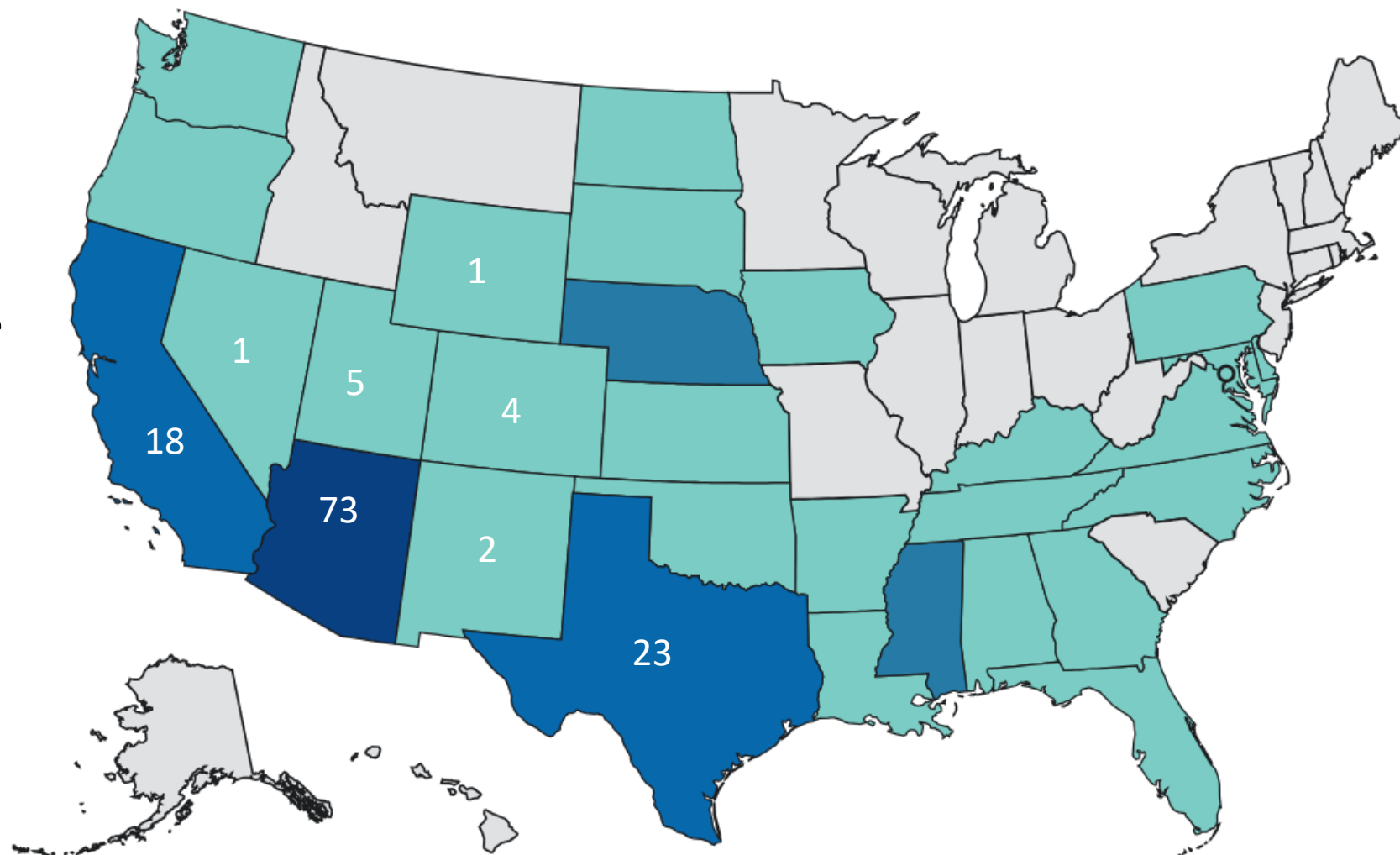
Current Date: 14Aug2026	Location	# of Human WNV Cases	# of Equine WNV Cases	# of Mosquito WNV Samples
	SLCMAD	1	0	165
	Utah	5	5	715
	USA	181	18	5,235
Top Five States with WNV Activity	Arizona	73	1	195
	Texas	23	0	146
	California	18	5	1,320
	Mississippi	7	0	0
	Nebraska	6	0	27

- 3 out of 5 UT human cases were neuroinvasive
- No deaths reported
- 709 positive WNV mosquito pools have been reported across Utah
- SLCMAD: 165 positive WNV mosquito samples



West Nile virus human disease cases reported by state of residence, 2026

Total human
cases: 181
Neuroinvasive
cases: 129
*as of 8/11/26



1 to 5 6 to 8 9 to 25 >25



Utah's Tiny Titans

Utah's Facilities Supporting the Insects That are Essential to Utah's Unique Ecosystems

Kelly Loverso, Writer

Bugs are all around us. From the ants crawling on a picnic blanket to the flies buzzing around a trash can, to the butterfly in the garden and the bee buzzing past an ear. Maybe you already knew that jumping spiders, under a centimeter in size, are the most intelligent of any arachnid and can recognize human faces. Or maybe you're just learning that moths can use their wings to deter bats by disrupting their echolocation, and that in the Arctic, mosquitoes are responsible for a large majority of all pollination.



Coming in all shapes and sizes, big and small, hairy and slimy, bugs have an incredible variety and skillset that fills every corner of every ecosystem in the world. They were here before us, will be here long after us, and while small, they play a huge role in the environment, especially right here in Utah. Whether you love bugs, don't mind them or completely fear them, here are three places in Utah where bugs are being studied, shared and waiting to be discovered.

Community Protection is All the Buzz

The Salt Lake City Mosquito Abatement District (SLCMAD) is a special service district that provides surveillance and control of mosquitoes and mosquito-borne diseases, according to Ary Faraji, Ph.D., executive director of SLCMAD. Faraji says that Utah was the

third state to pass legislation for mosquito abatement, and when laws were passed in 1923, and the SLCMAD became operational in 1924. Their facility, which Faraji says they moved into in 2019, includes much more than mosquitoes such as pollinator plants, a community garden, laboratories, dormitories, a helicopter hangar and a fish hatchery.

Faraji, also an adjunct professor at the University of Utah, says he got into the field for his love of entomology but didn't know there was a field specifically for mosquito control. He found out about working with mosquitoes in college and realized he could love what he does and it didn't have to feel like work. He grew up in California and began his master's in entomology at Rutgers University, where he says mosquito control was founded. Faraji says that many people wonder why Utah has mosquitoes if it is such a hot and dry place. He says the answer lies in Utah's famous snow melt and an antiquated water system that creates a constant flooding and drying effect that produces mosquitoes.

"When I was in New Jersey, if we set a trap out and we collected 5,000 mosquitoes, that was a lot of mosquitoes. Like, something had gone wrong, somebody didn't do their job. It was just shocking to see those numbers. My first week here in Salt Lake in July of 2014, we collected 30,000 mosquitoes. In a single trap," says Faraji.

Faraji says SLCMAD are global leaders when it comes to mosquito surveillance and control. He says he sits on PhD committees both locally and globally, helps drone pilots receive their certifications and that he and his team are working toward training the next generation of specialists. Faraji says they also innovate surveillance technology by creating their own traps, new products and new formulations, all while making sure methods are safe and not impacting non-target organisms.

"We're making mosquito control safer, more economic and more efficacious at the end of the day for the residents that we serve in Salt Lake City," says Faraji.

In order to understand mosquitoes, Faraji says SLCMAD starts by finding out where they are, how many there are and what species are present. He says they collect up to 3 million mosquitoes within a two-month period, with a team of 10 to 15 people dedicated to surveillance. Faraji says they run 40 3D-printed mosquito traps twice a week during active season. Because it would not be possible to speciate every mosquito, he says they have developed software that can identify species from a sample. Faraji says a small vial is then taken to their molecular laboratory where they can amplify RNA and DNA to test for three pathogens routinely found in the Salt Lake Valley.

He says these are arthropod-borne viruses such as West Nile virus and Western Equine Encephalitis. Faraji also points out that using the same insecticide on pests repeatedly will eventually lead them to build up resistance, similar to how humans can build antibiotic resistance. He says using their own colony in comparison to mosquitoes from the field allows them to see if they need to rotate products or back off until resistance has worn off.

Faraji says their primary method for treating mosquitoes is larvicide, not spraying adult mosquitoes. He says they achieve this using BTI, a bacteria specific to mosquitoes that doesn't harm any other beneficial insects. In addition, Faraji says their fish hatchery uses Gambusia fish to eat larvae naturally in enclosed pools. He says the SLCMAD is also currently working with a state prison to hatch the native, endangered least chub fish as a biological control alternative. For Faraji, the work goes beyond just mosquito control.



"This is part of the importance of having an actual entomologist run a mosquito control business ... we want to make sure that we're not killing all the bugs," says Faraji. "We're just suppressing the bad ones to tolerable levels."

A Picture-Perfect Way to Face Fears

Located just south of the hustle and bustle of Salt Lake City is a more family-friendly introduction to bugs at Thanksgiving Point. From the snap of a photo, the Butterfly Biosphere is an incredible gateway bug according to Stephen Ashton and Marissa Harrison from Thanksgiving Point. The conservatory includes over 10,000 square feet of designated space designed to replicate a real rainforest, and there are opportunities for all ages to learn about and interact with insects.



Stephen Ashton, Ph.D., Senior Director of Butterfly Biosphere and Curiosity Farms at Thanksgiving Point, comes from a family deeply rooted in the organization. His parents, Alan and Karen Ashton, are the founders of Thanksgiving Point. Before becoming director, Ashton says he began by studying exhibit design and assisting with the development and evaluation of the biosphere from the beginning. He says the biosphere was not originally part of the plan for Thanksgiving Point, but after being approached by for-profit butterfly experience organizations, they thought it could be a great addition to their nonprofit mission. He calls the biosphere's addition "very successful" and says guests have really enjoyed the experience.

For Thanksgiving Point, their mission remains the same across all of their facilities: to "ignite curiosity and build confidence in children from all backgrounds through hands-on STEM experiences," according to Ashton. Otherwise known as the three C's: curiosity, confidence and compassion.

"We're not only talking about bugs, which are super cool, but helping kids learn that process of what it means to be a scientist. What does it mean to exercise your curiosity, to ask questions, to observe," says Ashton.

He notes a meaningful cycle of growth that has come from that mission and describes the biosphere as another powerful way to talk about science and STEM.

"A lot of new people that come to work here at Thanksgiving Point grew up coming here ... they grew up with this kind of excitement, and now they get to come back and help push that forward. It's just another way that we're able to talk about science and STEM in really fascinating ways," says Ashton.

Marissa Harrison, chief entomologist at the biosphere, says that working with butterflies gives her the opportunity and privilege to work with all kinds of bugs. Before coming to Thanksgiving Point, Harrison worked at Disney's Animal Kingdom caring for their invertebrate collection and specifically moved from Florida to Utah just to help open the facility. She and Ashton describe butterflies as a great "gateway" bug since it is easier for people to get comfortable with.

"That was the only thing that could have gotten me to leave. There aren't a lot of insectariums around the country. This was a really unique, rare opportunity," says Harrison.

Harrison notes the biosphere has created a ripple effect even internally, saying that many of her colleagues at Thanksgiving Point were afraid of bugs when she first arrived and have since come to accept or even love them.

"A lot of my partners were afraid of bugs when I first arrived at Thanksgiving Point, and they've come to either accept or love some of our bugs," says Harrison.



According to Harrison, about 80% of the butterflies in the conservatory come from Costa Rica. The butterflies are mailed in cocoons, and between 100 and 200 butterflies are hatched live every day, giving visitors a chance to witness their first flight and the metamorphosis process. Harrison says that the biggest emergence day and the best day to attend the biosphere is on Mondays, where up to 250 butterflies can be released at once.

Through their emphasis on biodiversity and bugs of all kinds, from pretty butterflies to stick bugs and decomposers, they also encourage visitors to contribute to their community insect collection through a trading post program. Ashton describes it as an opportunity for kids to go out, collect bugs local to their environment and think like

scientists. Harrison also states that they participate in a network of science museums that trade bugs with each other to avoid pulling bugs out of their natural habitat and contributing to pet trades. Pest management for things like aphids in the conservatory is also done completely by hand to avoid the use of pesticides.

"If we're [going to] have them out of the wild, not in their natural habitat, we want to give them as many opportunities as possible to engage in natural behaviors, to live the long lifespan that they should have ... we want to be very responsible stewards of their lives," says Harrison.

Ashton also encourages a chance for readers to step into the world of the biosphere by attending their upcoming Pollinator Power event on May 16, described as a "Super STEM Saturday" with partner organizations, stations, a pollinator parade and a native butterfly release into the garden.

Crawl Into the World of Bugs

Dr. Jason Cryan, the Sarah B. George Executive Director for the Natural History Museum of Utah, began his entrance to the world of bugs through Earth Day. Originally from Vermont and born in the same year that Earth Day began, Dr. Cryan says he enjoyed discovering and being in nature as a young child. He had a professor in undergraduate that sparked his interest in bugs, Dr. Ross Bell, an entomologist at the University of Vermont. Cryan says he began doing his undergraduate research with Bell and found himself intrigued at the idea of hiking up and down Vermont's biggest mountains to see ground beetle biodiversity.



"I found myself asking, 'Oh, my God, can you get paid to, like, do this as a career?'" said Cryan.

His favorite bug started out as beetles, but he says he had an aspiration to study the most wild and weirdest bugs he could find, which led him to becoming a tropical entomologist, working with crazy looking bugs like tree hoppers and plant hoppers, all wild colors and related to the cicada family. He says that they are unbelievable, as if they are little aliens. While he may be an administrator of a museum now, he used to travel the world for science research, his favorite places being Borneo and southern Peru.

Cryan also emphasizes the importance of bugs in a historical context, saying there is no aspect of human culture, biology or history that is not affected by insects. Affecting everything we do from the food we eat to the medicine we make and how we live in our homes. He says that entomology is interesting since it is not just one science but covers a broad number of careers from agricultural to medical. He says that invertebrates are most essential to Utah's unique ecosystems.

"So any ecosystem, whether it's a desert, low desert, high desert, mountain, alpine, here in Utah, for rainforest or a temperate forest in the east. Invertebrates really do all kinds of things that are essential to those ecosystems — nutrients cycling, decay and removal of organic materials, pollination absolutely. When you have a healthy biodiversity, including invertebrates, that's an indicator of a healthy environment," says Cryan.

Cryan also highlights Utah's unique variety of ecosystems and the bugs that come with them. "Utah is interesting in that it has some very unique and extreme habitats, and we've got a whole suite of animals, including insects, that are adapted to them," says Cryan.

The Natural History Museum also offers Bug Fest, one of four signature festivals presented by the museum and their summer festival. Cryan says it's all about understanding something in order to love it and do something for it. Bug Fest brings together invertebrate experts and enthusiasts with lectures, showcases, insect interactions and a bug bar, all with the hope of making those with a fear of bugs more aware of the world of insects. A highlight and fan favorite of the festival according to Cryan is a food experience where guests have a chance to try food made with insects and vote for their favorite.

"I partnered with a professional chef who's also a scientist, and she puts together four high cuisine recipes using insect ingredients. We invite hundreds of people who come and we give them a taste of everything, and then they vote for which one they like best. It has attracted a huge following. People come year after year and say, 'I'll go there for that. This is great,'" says Cryan.

As a treat to hold those over until Bug Fest, the Natural History Museum presents Bug World, an exhibit created by the Museum of New Zealand Te Papa Tongarewa and built by Wētā Workshop, the five-time Academy Award-winning special effects masters behind The Lord of the Rings and Avatar. Cryan says this totally immersive experience tells the story of floral ambush predators, beetles that can create boiling water, mind controlling wasps and a hive that works together. He says it features a more immersive and experiential exhibit than their usual scientifically labeled exhibits, continuing through Bug Fest and into the first week of September.



Make Mini Friends

For all three experts, it starts with understanding. Ashton says that any negative interaction with a bug can color your impression of all bugs, and Harrison says that fear largely comes from not knowing.

"They're very different from us, and a lot of times we fear things that we don't understand. Part of why we're here is to give people more exposure, desensitization, help them understand what all those legs and mouth parts are doing, and it makes them a little bit less mysterious and less scary," says Harrison.

Faraji agrees, and says that while the fear is sometimes justified, it doesn't have to stay that way. "I wish they weren't afraid ... bugs are so fascinating, and even mosquitoes, people just have such a negative reaction towards mosquitoes, but when you really start to look at mosquitoes, you'll notice how wonderful they actually are," says Faraji.

Cryan puts it simply: "Bugs aren't gross. They can be really exciting." He says that once you begin to understand something, you can begin to appreciate it, and from there, even small actions make a difference. For homeowners, he says the biggest thing is to try to plant native plants when possible and encourage pollinators by planting pollinator-friendly flowers. Something as simple as what is growing in a backyard can make a real difference.

"There are studies from around the world that show that not only are species declining, but biomass is declining, which means we have fewer species and many, many fewer individuals of those species in our lives. Bird biodiversity is declining because of that. It's not a good story to tell, but it's a concerning one," says Cryan.

Harrison agrees, that if all bugs disappeared, “We would see a decline in bird populations, reptiles, amphibians ... plants rely on pollinators for pollination ... you'll start to see a decline in plant diversity. Maybe in a year you'll just see small impacts, but by the next year it'd be catastrophic,” says Harrison.

Whether it is a butterfly landing on a shoulder at the biosphere, a mosquito trap being set out at dawn, or a giant cockroach being held for the first time at the Natural History Museum, the bugs are out there doing their thing. As Cryan puts it, “The vast majority of insects are either completely uninterested in what we do as humans, or they're beneficial to us.”

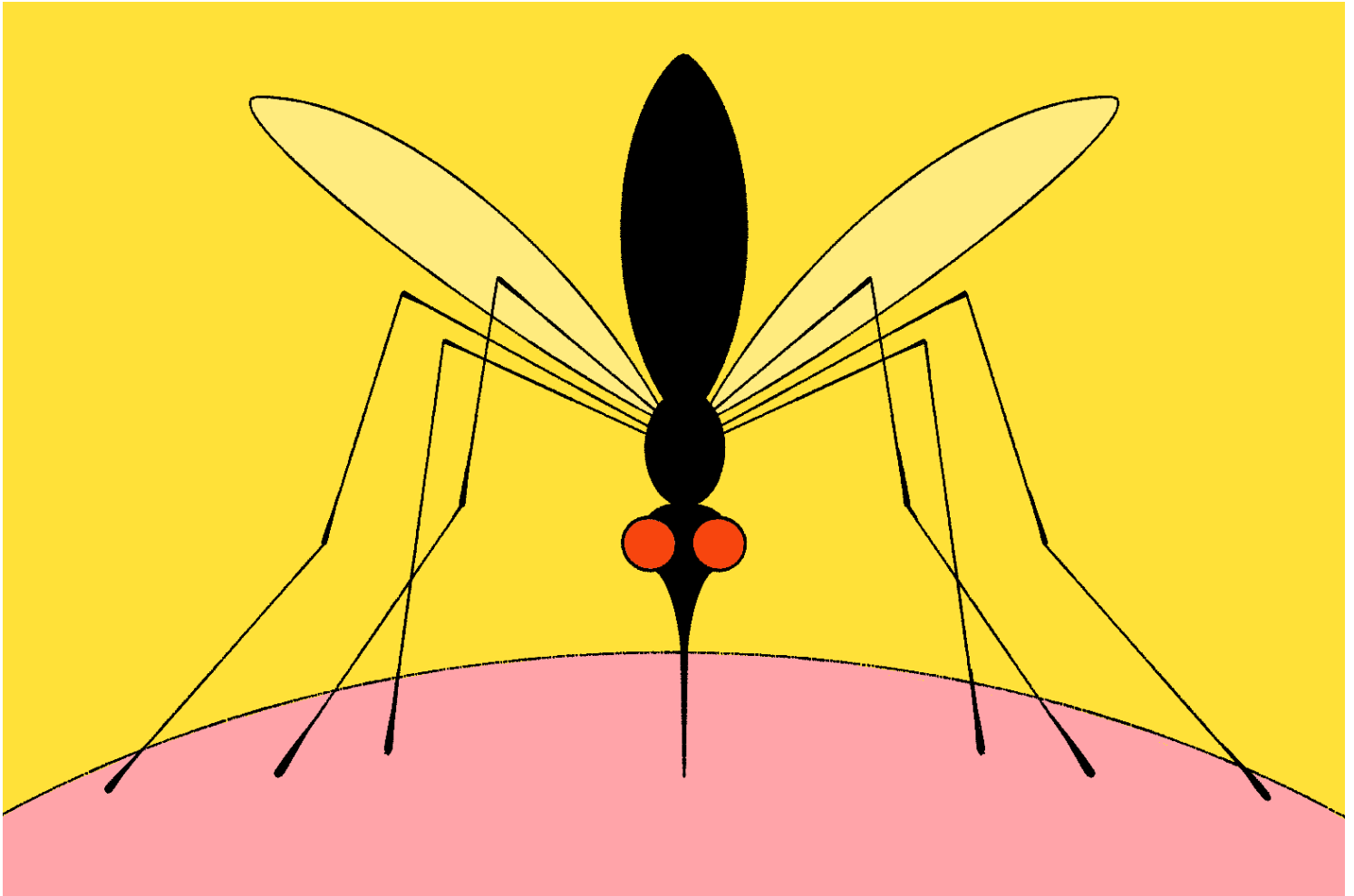


Illustration by [Tolga Akdoğan](#)

SCIENCE

How the Mosquito Is Conquering America

The deadliest species of the world's deadliest animal used to find it hard to survive in the United States. Now they're here—and they're thriving.

BY MARIANNE DHENIN

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On an overcast Wednesday morning in Salt Lake City this summer, four bicyclists gathered in an industrial area not far from the city's airport before fanning out across town. They were on a mission to kill. Almost anyone in America would have supported them.

The riders work for the Salt Lake City Mosquito Abatement District, the first mosquito-control program in the nation to launch a bicycle brigade, according to Ary Faraji, the district's executive director. One rider stopped to kneel alongside the road, another at the edge of a park, to spritz stormwater catch basins with larvicide, a chemical designed to kill mosquito larvae before they develop into adults and begin feasting on people. Each of the riders covers upward of 30 miles a day to treat every catch basin in the city's urban and suburban areas, about 75,000 total, over the course of a month. Then, they start all over again.

Faraji is an entomologist who sometimes calls the insects he studies "skeeters" and who sent me a photo of his desk piled high with mosquito-related history books when I asked him for reading recommendations. He and his team take what's known as an integrated mosquito management approach to protect Salt Lake City residents from the incessant itch that the pests bring. "Really, that means understanding the pest that you're trying to control, understanding its biology and its ecology, and intervening with appropriate control measures that take into consideration larval control, adult control, disease surveillance, adult surveillance—it's really a holistic approach," he told me.

The Salt Lake City Mosquito Abatement District even has its own fish hatchery, where it rears the aptly named Western mosquitofish. The tiny fish have a voracious appetite and work wonders as natural mosquito-control agents in abandoned swimming pools, small residential ponds, and other confined aquatic habitats. Residents need only call the abatement district to get a special delivery of mosquito-eating fish for their backyard at no cost.

These might sound like extreme measures just to prevent a common nuisance. But it's not only annoying pink welts that Faraji's team is concerned about. The threat of mosquito-borne disease is increasing in the U.S. as invasive mosquito species expand their range across the country and their seasonal populations last longer and grow larger during global warming. Studies have also found that warmer temperatures push some species to bite more, develop into adults faster, and serve as better virus incubators.

Already, mosquito-borne diseases kill more than 1 million people and infect about 700 million worldwide each year. Cases in the U.S. comprise only the smallest fraction of those numbers, with annual deaths usually in the low hundreds and diagnosed cases in the thousands. (Cases are much more common in Puerto Rico and other U.S. territories than they are in the 50 states and D.C.) But that could soon change as two particular mosquito species, *Aedes aegypti* and *Aedes albopictus*, make their way deeper and deeper into the country.

These species are worth worrying about—and they are increasingly around us. Since its arrival in the Americas centuries ago, *Aedes aegypti* has conquered the Southern states, swaths of the Midwest, and much of California, and has begun to advance up the East Coast. The insects were found for the first time in Oregon in 2024 and in Idaho in 2025, and they have now established themselves across parts of mountainous Colorado, where conditions have historically been far too harsh for them to survive. *Aedes albopictus*, a much more recent arrival, now has a range that stretches well into New England and the lower Great Lakes and has even been found to overwinter in the Midwest.

Aedes mosquitoes are vectors for some of the most serious and widespread mosquito-borne diseases. Four in particular cause the most human suffering worldwide: chikungunya, Zika, dengue, and yellow fever. Each of these viruses comes with a raft of symptoms ranging from unpleasant to, in some cases, fatal—fever, headache, muscle and joint pain, shock, organ failure. Zika can spread from a birthing parent to their child in the womb and cause congenital disabilities, which notoriously led to panic after an outbreak erupted in Brazil in 2015. Of the four diseases, dengue is the most prevalent, with more than 3.9 billion people in over 132 countries at risk of contracting it, an estimated 96 million symptomatic cases annually, and about 40,000 deaths per year as a result.

As populations of *Aedes* mosquitoes grow and spread across the U.S., researchers expect we'll see more mosquito-borne disease outbreaks. Warmer states where the mosquitoes are already prevalent are at the greatest risk. "Florida is on the front lines," John-Paul Mutebi, director of Miami-Dade County's Mosquito Control division, told me. The list of locations where mosquitoes are only a nuisance—and not a serious public health threat—is shrinking.

Preventing mosquito-borne diseases from taking root here will require more than just covering ourselves in bug spray (though that's always a good idea too). To grasp what we're facing, we should look to the past to understand how these insects have spread so far, why they are so at home in our cities—and what it will really take to stop them.

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Some 400 years ago, a six-legged invader disembarked on the coast of Spanish Florida and began making its way across North America. Capable of flying only about the length of a football field, it relied on humans for transport—and sustenance. As the *Aedes aegypti* mosquito expanded its range across more of the Americas, it brought with it the delirium, jaundice, and aching joints of yellow fever. Researchers later used the archival record of yellow fever outbreaks, paired with genome analyses of modern mosquitoes, to piece together the insect's travels. Though *Aedes aegypti* is native to the forests of Africa, it evolved long ago to live in human settlements.

“These mosquitoes really like living with us,” Douglas Norris, a vector biologist at Johns Hopkins Bloomberg School of Public Health, told me. That’s because they don’t have a large flight range and have evolved to breed in just about anything that holds water—from a bottle cap or the plant boxes on your patio to parts of the stormwater management infrastructure in our nation’s cities. And because *Aedes aegypti* feeds almost exclusively on humans, the insects are great at transmitting disease from one person to the next. In fact, in a crowded field of more than 3,500 mosquito species, *Aedes aegypti* has been the vector for almost all major epidemics of some of the world’s worst mosquito-borne diseases.

The subspecies of *Aedes aegypti* now established across large swaths of the U.S. began its evolutionary journey in sub-Saharan Africa. Ancestral populations can still be found in wooded areas there, depositing their eggs in tree holes and other natural pockets of water and feeding on wildlife, including a variety of mammals and occasional birds or reptiles. But when humans began living in villages and towns on the outskirts of those forests, some mosquitoes found the water stored in containers in human settlements a more attractive breeding ground. (Unlike forest nooks, stored water tended to last through seasonal droughts.) The mosquitoes that bred in settlements eventually evolved a preference for blood meals from their human neighbors, who were now the most available food source.

The insect's first trips west came soon after, as the transatlantic slave trade brought ships packed with enslaved Africans to the New World. Those ships also carried supplies of fresh water for the monthslong voyage, stored in barrels fit for mosquito breeding. The yellow fever virus, also indigenous to Africa, must have stowed away too. Tracing *Aedes aegypti*'s colonization of the Americas using records of yellow fever epidemics places it in Atlantic port cities in the British colonies in the 1690s and limited parts of the American South in the mid-1700s. By the 1850s, the new arrival had spread to much of the south-central U.S.

Aedes albopictus, a mosquito native to Asia that can transmit the same diseases as *Aedes aegypti*, conquered the country even faster thanks to developments in human infrastructure. Researchers believe that it first arrived with military equipment and tires shipped back from the continent following World War II. Tires make excellent mosquito incubators. They collect heat and organic matter, which mosquitoes feed on during their larval stage, and are almost impossible to empty once water pools inside. Turn a tire upside down or on its side, and the water will flow within it to whatever section is now at the bottom. Roll or shake the tire, and you are likely to succeed only in sloshing out some of the water.

Additional *Aedes albopictus* mosquitoes arrived via the used tire trade. The U.S. imported millions of used tires in the 1970s and '80s, largely from countries where the mosquito is indigenous. By the end of the '80s, the mosquito had established itself in at least 15 states.

Once the invasive *Aedes* mosquitoes arrived on U.S. soil, they found American cities comfortable places to live. Our urban centers tend to be low in mosquito predators (like frogs, fish, and birds), offer a buffet of options for blood meals (humans, mostly), and provide plenty of habitat where mosquitoes can breed, as well as places for the insects to shelter from scorching or freezing temperatures that would otherwise kill them.

Many wealthy neighborhoods feature environments that support *Aedes* mosquitoes, but the situation tends to be worse in lower-income areas. One study of mosquito prevalence in Baltimore and D.C., in which researchers tested for mosquitoes in water-holding containers in public alleyways and residents' backyards, found that *Aedes albopictus* pupae (a stage the mosquito passes through after the larval stage but before it emerges as an adult) were more common in neighborhoods with below-median incomes. More than half of the *Aedes albopictus* pupae recorded in Baltimore were in a single low-income neighborhood.

Shannon LaDeau, a disease ecologist at the Cary Institute of Ecosystem Studies, worked on that study. She told me that mosquito populations spiked in areas with more human-made mosquito habitat, such as abandoned buildings, unkempt vacant lots, and piles of discarded bulky items. Rain can gather in those areas and attract mosquitoes, but the spaces do not tend to attract many natural mosquito predators.

“The garbage that had been dumped and collected around abandoned spaces, like toilets and tires and big Tupperware containers, created semipermanent water bodies that were in some cases just under an overhang, so they had a little bit of environmental protection, and there was also vegetation growing over the whole thing—so it was like the perfect mix of habitat for mosquitoes with no mosquito predators,” LaDeau explained.

The type of vegetation in a neighborhood also affects mosquito populations. Wealthier neighborhoods tend to have better-managed green space, with the leafy parts of trees growing far above lawns or planted flowers. That leaves fewer shaded, humid spaces for water to pool and mosquitoes to hide, as well as more access for mosquito predators such as birds and larger insects. But mosquitoes thrive in the denser and less well-managed vegetation often found in lower-income neighborhoods.

The push to green our cities amid warming temperatures due to climate change has also created new mosquito habitats. “When we create a modern suburbia with fragmented parks and green space, we do a pretty good job at creating mosquito habitat,” Norris said.

That doesn't mean cities should avoid urban greening projects. But, Norris said, public administrators should recognize that “you're not going to be able to beat biology, so if you create this green space, you should also have the infrastructure to keep those places safe.” The infrastructure Norris has in mind is control and surveillance programs that monitor both mosquitoes and mosquito-borne diseases and are prepared to respond when disease is detected in the mosquito population, like the program in Salt Lake City. But some experts fear we could be underprepared for what's to come.

The fact that *Aedes* mosquitoes keep showing up in new locales does not necessarily mean those places will go on to experience disease outbreaks. But it does mean that the risk is growing.

Female mosquitoes need the proteins and iron in blood to produce viable eggs, so a blood meal is a vital part of the insect's reproductive cycle. When a female mosquito bites, it uses specialized mouthparts to pierce through the skin of its chosen host and into the blood vessels. It also injects a bit of saliva, which contains anticoagulants to prevent the host's blood from clotting as the mosquito feeds. It's that saliva that triggers an immune response in humans—and makes us itch long after the mosquito has gone.

When a mosquito takes a blood meal, it also swallows any viruses or parasites living in its host's blood. Those pathogens can then be transferred to the next creature the insect feeds on when it deposits saliva into that creature's bloodstream.

The diseases that *Aedes aegypti* and *Aedes albopictus* are known to carry—chikungunya, Zika, dengue, and yellow fever—as well as most other mosquito-borne diseases, are most common in tropical and subtropical climates. Almost all cases diagnosed in the continental U.S. and Hawai'i are travel-associated rather than locally acquired, meaning that an infected mosquito bit the person while they were out of the country and they brought the virus home. Several states are seeing sharp increases in mosquito-borne diseases among travelers, as case numbers abroad are already climbing due to climate change.

But a case brought home from vacation can spark a local outbreak since the mosquitoes that transmit the diseases are well established in much of the country. Cases of dengue exploded in Little Havana and Hialeah in Miami-Dade County in 2023, an outbreak that ended after close to 200 locally acquired cases were recorded. Mutebi told me that, based on his research, he suspects that travelers returning from Cuba had carried it home.

When it comes to spreading one of these viruses, *Aedes aegypti* is the most prolific vector because it bites human after human after human, and each meal is a chance for it to deposit a pathogen in its host. *Aedes albopictus*, on the other hand, is less effective because it is a promiscuous biter. It might dine on someone enjoying a backyard barbecue one time, then on the neighbor's dog, then maybe a squirrel or a deer if you happen to live near wildlife. Some diseases can be spread from animals to humans by certain mosquito species (that's how West Nile virus moves from birds to people). But chikungunya, Zika, dengue, and yellow

fever are human diseases, and the chain of transmission can sputter out as *Aedes albopictus* feasts on other creatures between its human blood meals.

Still, both *Aedes aegypti* and *Aedes albopictus* are aggressive biters capable of transmitting the same diseases. Plus, during the summer months, when mosquito populations across the U.S. peak, *Aedes albopictus* is more ubiquitous. It is also quick to adapt and capable of extending its range far beyond that of *Aedes aegypti*—and it is doing just that, fast.

“We thought *Aedes albopictus*, because it came from a tropical climate in Asia, would never get very far north,” Norris said. But in the decades since it arrived in the U.S., he said, “the mosquito actually has adapted to those newer climates, so the ones we find in Texas or Florida have slightly different adaptations than the ones we find in Long Island. They figure out ways to get to where they want to be.”

It was those Long Island *Aedes albopictus* mosquitoes that public health authorities blamed for a locally acquired case of chikungunya last year. That was the nation’s first locally acquired case ever recorded outside the South.

LaDeau told me that *Aedes albopictus*’ capacity to adapt is one of the things that most concerns her about the future of mosquito-borne disease in the U.S. “It is adapting to these urban spaces, and as it does that, it will increasingly bite the animal that is the densest-population animal in these habitats, which is humans,” she said. “It’s likely that mosquito-borne diseases are only going to increase, both because it [the climate] is warming and because they’re adapting to the environments we build very quickly.”

* * *

When it comes to mosquito management, the program in Salt Lake City is among the best in the nation. Faraji, its director, told me that besides the program’s bicycle brigade and backyard fish program, which help keep mosquito populations down, his team also sets hundreds of mosquito traps across the city. The traps are laid in the afternoon and picked up the following morning, allowing them to collect mosquitoes at dusk and dawn, when the insects are most active. They lure mosquitoes with carbon dioxide—all vertebrates release the gas with each exhale, so to mosquitoes, it usually signals a meal. Once a mosquito nears a trap, a small fan forces it into a baglike net, where it is held for pickup.

Workers regularly collect the trapped mosquitoes and, after sticking them in a fridge for a while to knock them out, sort them by species and count them. A lab tests the mosquitoes

for parasites and viruses. When infected mosquitoes are found, workers treat the area where they were collected with adulticide and conduct “source reduction,” a sophisticated way of describing what usually amounts to emptying containers of standing water.

But Faraji added that mosquito management requires constant vigilance and a willingness to adapt and improve. “We make changes on an almost weekly basis,” he said. His team is always learning about new developments and technologies in the field, conducting research, and juggling resources to ensure they are allocated to treat the mosquito species and habitats that pose the greatest risk to residents.

Not all cities are as well equipped. Some areas where new mosquitoes are arriving lack control and surveillance programs altogether. LaDeau, the disease ecologist, told me that part of the problem is that local governments tend to focus only on mosquito-borne disease when an outbreak erupts and, even then, usually only on that specific disease; they also relax surveillance and control programs in between. The federal government’s programs and research funding agenda take a similar approach. “Because we focus so much on the kind of retroactive or reactionary human caseload, we miss the opportunity to control the vector and to understand more about the vector,” LaDeau said.

Salt Lake City’s program also has the benefit of being a mosquito abatement district, a governmental agency with its own budget funded by property taxes. Elsewhere, mosquito control efforts carried out by city and county public health or environmental services departments risk having their budgets commandeered for other needs and, often, their attention diverted to other tasks. Instead of having time to mount a bicycle brigade to treat the local stormwater infrastructure for mosquito larvae, a city’s public health department might have to juggle mosquito control alongside restaurant inspections, vaccine programs, and more.

The mosquito abatement district model has its roots in the early 20th century, and Utah was the third state to pass legislation authorizing the agencies. Woodrow Wilson, who would go on to become president in 1913, signed the first such state legislation in 1912, as then governor of New Jersey. California followed in 1915, and Utah in 1923. What these early adopters had in common was that they were home to more than their fair share of nuisance mosquitoes, which bred in huge numbers in the Jersey Shore’s salt marshes, in floodwaters from California’s agricultural irrigation, and in snowmelt from Utah’s mountains. With residents already scratching and swatting, it took only a couple of charismatic entomologists to win over the right politicians to move legislation forward.

That on-the-ground mosquito control work, which has been carried out in a growing number of states and municipalities across the country over the past century, is vital. But it is still just one piece of a much larger puzzle we'll need to solve to survive as mosquitoes spread and their populations boom—and, unfortunately, some of the other pieces are in bad shape.

Recent cuts at the National Institutes of Health, the Centers for Disease Control and Prevention, and the Department of Agriculture are expected to result in the loss of important institutional knowledge and to hobble research efforts vital to tracking mosquito spread and understanding mosquito-borne disease. Increasingly, too, the attention of the press and global health organizations—and, in turn, funding opportunities—is being pulled toward projects promising higher-tech solutions. Many mosquito experts seem to agree that there is room in the arsenal for something like mosquitoes that have been infected with a bacterium that leaves them sterile or genetically modified such that their female offspring cannot survive to adulthood, when they would begin to bite people. But developing those solutions should not come at the cost of more mundane but effective interventions.

Mutebi, the director in Miami-Dade County, warns that we might not even see the next mosquito-borne problem on the horizon if research and surveillance programs receive too little support. Mosquitoes “are always going to find a way to outwit us; it is amazing how variable they are, and because they’re so adaptable, they are unpredictable,” he said. “To deal with them, we have to be vigilant, we have to continue doing surveillance, and we have to continue doing research.”

It is not just the mosquito experts who have a role to play in preventing mosquito-borne disease outbreaks as the climate warms and the insects spread across more of the U.S. On the contrary, Faraji told me, “mosquito control is really a job for everybody.” If you have old tires sitting around, take them to a recycling center. Store your wheelbarrow inside your shed so rainwater can’t collect. Or if you happen to have a small pond or an abandoned swimming pool in your backyard, look online for a local mosquito control agency that can help prevent it from becoming a mosquito breeding ground.

The insects have made our towns and cities their homes. But we can do more than sit back and get bitten. It’s in everyone’s interest to stop them. 🟡

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