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PUBLIC HEALTH PROTECTORS

Aerial Applicators Are Biting Back Against Mosquitoes

- in Texas, where a deadly West Nile virus epidemic rages
- in Massachusetts, where Eastern equine encephalitis emerged
- and in other localities where mosquito-borne illnesses may strike

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As the United States staggers through the worst drought in half a century—during one scorching stretch, fully two-thirds of the country were pegged as having exceptional or extreme drought conditions—the collateral damage continues to mount in expected and unanticipated ways.

Widespread crop losses and higher food prices that will result as a consequence commanded headlines and have been on the minds of budget-conscious Americans. Water restrictions have been in effect in many towns. Considering the dearth in precipitation, you wouldn't think mosquitoes would be high on the list of repercussions to worry about, but in fact, a surge in mosquito-borne diseases—from Dengue Fever to West Nile virus to Eastern equine encephalitis—has been documented in 2012.

That doesn't surprise mosquito experts such as Dr. Edward Walker, a Michigan State University entomologist and microbiologist who has worked on mosquito-borne diseases since the late 1970s. "West Nile virus is at its riskiest when it's hot and dry and mosquito populations are noticeably absent," he said.

Those hot, dry conditions have spawned the worst outbreak of West Nile virus in the United States since 1999 when it first entered the country. By mid-August 26 people had died from West Nile virus this year, including 10 in Dallas County, Texas, alone. Half of the approximately 700 human infections in the U.S. have been in Texas, and nearly 200 cases of West Nile illness have occurred in Dallas County.

Desperate times call for creative measures. The mayor of Dallas turned to a time-tested solution that had not been used inside the city since 1966: aerial application.

Controlling Public Nemesis No. 1

Aerial applicators take a great deal of pride in the role they play helping farmers produce a safe, affordable and abundant supply of food, fiber and bio-fuel, but applying crop protection products isn't the only vital job they perform. The work they do to protect public health is less well known, but aerial applicators engaged in mosquito control and other efforts to reduce disease and pest infestations get a similar sense of satisfaction knowing they are keeping their communities comfortable and safe.

"I hope that our political leaders will have the political will to allow us to keep our guard up, because if we drop our guard we're going to get punched in the nose or worse by these problems."

—Michigan State University entomologist and microbiologist Edward Walker, on the potential for a deadly mosquito outbreak to take hold in the United States

Mosquito control has two purposes. "One is to manage pest mosquito populations and the other is to manage disease-carrying mosquito populations to hopefully reduce the potential for people and animals to become infected by mosquito-borne pathogens," Walker said.

Mosquitoes transmit a dizzying array of diseases. According to the American Mosquito Control Association, they cause "more human suffering" than any other organism.

The Michigan Mosquito Control Association says mosquitoes are "by far the most dangerous animals on earth."

Thanks to robust mosquito control efforts nationwide that include the use of aerial application, it may be difficult for Americans to comprehend the fact that more than one million people die from mosquito-borne diseases each year. West Nile virus, Eastern equine encephalitis, Japanese encephalitis, La Crosse encephalitis, St. Louis encephalitis, Western equine encephalitis, Dengue Fever, Malaria, Rift Valley Fever and Yellow Fever are some of the deadly diseases mosquitoes spread.

Residents in the United States are much more likely to encounter nuisance mosquitoes, but when cases of West Nile virus or Eastern equine encephalitis (EEE) are reported, it triggers a rapid response that usually involves aerial application. It happened in Massachusetts too this summer when officials declared a state of emergency over EEE.

"When you have a real public health threat, you don't often see a heavy reliance on ground-based equipment. You go to aerial spraying," said Dr. Grayson Brown, director of the Public Health Entomology Laboratory at the University of Kentucky (UK) and this year's president of the Entomological Society of America.

Not all mosquitoes are cut from the same cloth, of course. Today there are more than 200 species of mosquitoes in North America, all with different life spans and different biologies.

"Some would never bite a human. There's even one species that only bites frogs," Walker said. "We have some that would only be pest mosquitoes, even though they can be extremely numerous. We have others that are

carriers of pathogens. Sometimes pest mosquitoes are also disease-carrying, but oftentimes they're not."

The challenge for mosquito control agencies is coming up with the appropriate response because there is no one-size-fits-all approach.

Spring Fever

In Michigan and most of the northern-tier states, spring *Aedes* mosquitoes are a recurring problem. The combination of spring rainfall and snowmelt forms pools of water known as seasonally flooded woodlots. The spring *Aedes* mosquitoes hatch as larvae in the water formed by the melted snow and spring rains starting in February and emerge as adult mosquitoes in May, Walker said.

Walker has worked together with NAAA members Al and Mike Schiffer of Al's Aerial Spraying, LLC, Ovid, Mich., on mosquito abatement research and applications. Al's Aerial Spraying has a contract with the Saginaw County (Mich.) Mosquito Abatement Commission (SCMAC) to make its aerial applications and has been doing so since the late '80s.

Walker has worked with the Schiffer brothers on formulation analysis and research to determine how effective *Bacillus thuringiensis israelensis* (Bti), a naturally occurring bacterium, is at controlling spring *Aedes* mosquitoes. They found that a single aerial application of Bti "completely eliminates the problem," Walker said.

Each year, the Schiffers treat 45,000 acres of flooded woodland habitat in Saginaw County. The application is typically applied in early April when the mosquitoes are still in the larval stage and leaves have yet to grow back on the barren woodland trees. Those conditions are perfect for a well-targeted application of Bti because it



Al Schiffer of Al's Aerial Spraying makes a mosquito adulticiding application in an AT-400. The Ovid., Mich.-based company has six Air Tractor 400s and 502s altogether.

penetrates the non-existent canopy and reaches the targeted seasonally flooded woodlots.

Due to the life cycle of the spring *Aedes* mosquitoes, there's only a small window to make successful control applications. "Aerial application is the only method to achieve coverage for this many acres in such a short time period," SCMAC Director Randy Knepper said. "Any other method would only allow us to larvicide about 10% of the 45,000 acres we currently control."

Eliminating the floodwater mosquitoes early on also means less spraying later because there would be no need to apply an ultra-low volume application of synthetic insecticides since the mosquitoes never reached the adult stage. "It's a very, very good system," Walker said. "We've also monitored to see if the mosquito populations develop resistance to the material and they haven't."

Saginaw County does extensive monitoring to measure the efficacy of its larviciding program and has seen a consistent trend over the last 20-plus years. "We have been averaging 87% reduction in mosquito larvae under very difficult conditions," Knepper said.

Mississippi Flooding Warrants Aerial Response

When the Mississippi River overflowed causing massive amounts of flooding in May 2011, the governor of Kentucky asked the UK's Brown to help coordinate a response to deal with the influx of mosquitoes in western Kentucky. The disaster-response task force collaborated with Clarke Mosquito Control and NAAA member Dynamic Aviation, Bridgewater, Va., and came up with a plan to treat more than 700,000 acres of the flood-ravaged portion of the state with Duet™, a new product marketed by Clarke.

Sumithrin is the principle adulticide applied by air in the United States. Duet combines sumithrin with prallethrin, an irritant that volatilizes quickly. "The insecticides that are used from aircraft are non-residual, so in order to kill a mosquito the droplet has to come in contact with mosquito body in the air. It can't just land on a leaf and have the mosquito walk across it—it has to catch them," Brown said. "Prallethrin is an irritant, and it makes the mosquito get up and fly in the cloud of insecticide, which greatly, greatly improves its effectiveness."

The results were dramatic, Brown said. “We were applying four ounces per acre last year, and depending on the mosquito species we got up to 95% suppression. We were really impressed.”

To put that into perspective, he said mosquito control experts generally consider 80% reduction in measured landing rates in a five-minute period to be acceptable.

Last year in western Kentucky they observed landing rates of about 30 per minute prior to treatment.

“Landing rates are almost equal to bite rates, so we were talking about human biting rates in excess of 25 per minute prior to treatment,” Brown said. “After [applying Duet] there was a lot of twos and less. With just the sumithrin by itself, you would be looking at five [bites per minute] or less. Five or less sounds high, but we generally accept that as being something that can be tolerated with repellents and protective clothing.”

NAAA's Public Health Protectors

Forestry and mosquito spraying work represent a sizable amount of the Schiffers' business, with the rest devoted to agricultural aviation. In addition to larvicide applications in the spring, Al's Aerial Spraying also does adulticide applications, although it has been a few years since they last did so. “Typically we only do that if they have an Equine encephalitis or a West Nile encephalitis outbreak,” Mike Schiffer said.

Al's Aerial Spraying works across the country, not just in Michigan. One such job could be classified as more of a public nuisance than a threat to public health. Three years ago the Schiffers treated 70,000 acres within the city limits of Charlotte, N.C., with BT (*Bacillus thuringiensis*) to combat the Fall Cankerworm, a notorious tree defoliator. “It's an older city that has

If you are an Aerial Applicator, do you make mosquito abatement applications?

Survey Says...

How many aerial applicators engage in mosquito applications? A little less than half, according to an NAAA eNewsletter poll. Although the results are unscientific, the poll results are an indication that mosquito abatement work is available to aerial applicators if they are interested in it.

YES

44.74%
(17 votes)

NO

58.54%
(24 votes)

* Results from a poll question in the Aug. 10, 2012, NAAA eNewsletter. Aerial applicators who have not yet taken part in the poll may do so at <http://news.agaviation.org/naaa/issues/2012-08-10/6.html>.

some gorgeous areas, and they want to keep it that way,” Schiffer said.

Former NAAA President Rick Reed, owner/operator of Reed's Fly-On Farming in Mattoon, Ill., has been spraying adult mosquitoes for various municipalities off and on for 30 years. He works directly with his local municipalities, not a mosquito control district. Several towns get treated on a regular basis and Reed said there are times when he has to make multiple applications over the course of the season.

Whereas a great deal of mosquito spraying across the country is done in large blocks, Reed does the opposite. “We do several small towns. The smallest town I do is only 140 acres,” he said. “So the product we use is a water-soluble product so I can add a little volume to it. Large acreage would allow us to apply an oil-based product at .5 ounces per acre. At that rate, I would have to load over 1,800 acres of product before the pump would even prime. With the water-based product, I apply 10 ounces per acre and still maintain a droplet spectrum of about 50 microns.”

Same Aircraft, Different Setups

Coincidentally, Reed had sprayed mosquitoes the evening before I spoke with him. Earlier that day, his crew had been spraying soybeans. When the

day's work was finished they prepped the Air Tractor for the mosquito mission. Reed says it takes about an hour to convert the aircraft for mosquito spraying. The bulk of that time is spent cleaning the hopper and switching out the booms.

“We clean the inside of the hopper using a hot-water, high-pressure washer. We use a different set of booms with Micronair nozzles, which are designed for creating those small droplets, but it's the same system, the same pump and everything.”

Reed waits until dusk to spray for adulticide mosquitoes because that's when they emerge. Although the aircraft is the same, mosquito spraying is different than making an agricultural application. Ag applications typically occur just a few feet above the crop canopy. Mosquito applications are done 200 to 300 feet above ground level (AGL). Perhaps the biggest difference, though, is that the pilot is expecting a significant swath displacement.

“When you're spraying crops you are very targeted and you are very drift conscious, and you're looking for a specific target area,” Reed said. “When we're doing mosquitoes we're flying higher, and we are manufacturing tiny 50-micron droplets that we want to float down, not drop. It's not coming

down directly under the aircraft. Instead, the air movement will determine the final effective swath width and area treated in the application.”

Despite working for several small, rural towns, ironically Reed has never been able to convince his own town to hire him. “They have full-time people and they’ve got equipment. They prefer to go out with foggers and do sections of the city at a time, because that’s what they’ve done for years. When I tell them I can do the whole town in 40 minutes when it takes them five evenings to treat about 30% of it, you’d think that would be a real boost.

“There’s nothing any more efficient than an airplane in treating mosquitoes. The foggers have to stay on the roads and they’re going up and down essentially through a grid work of roads. Is it going to drift? Is it going to get to the center of the block? Maybe, maybe not. We’re knocking mosquitoes out of the air from 200 AGL clear down to the ground. But they think it’s too expensive to have us.”

Reed doesn’t do mosquito abatement work for the money, though. In fact, he thinks he may be the only ag operator in Illinois who still does mosquito work. There’s more risk for the aerial applicator now thanks to the NPDES pesticide general permit requirements that went into effect earlier this year.

“A lot of applicators just simply don’t want the hassle and potential liability,” he said.

Reed and other aerial applicators engaged in mosquito spraying derive satisfaction from doing their part to protect public health. One time Reed was at a farewell party for a friend. During the course of the evening two of the guests approached him. “He said, ‘You’re the guy who sprays for mosquitoes, aren’t you?’ I said, yeah,

“When you have a real public health threat, you don’t often see a heavy reliance on ground-based equipment. You go to aerial spraying.”

—Dr. Grayson Brown, director of the Public Health Entomology Laboratory at the University of Kentucky

and he said, ‘We really appreciate it. We haven’t noticed any mosquitoes and the kids can play outside.’”

Although a certain segment of the public will never fully embrace aerial applicators, by and large, the public seems more accepting of aerial mosquito applications than they may be of crop-specific applications to treat a plant disease or control insect pressures. Mosquito control is less mysterious to the general populous than the crop protection products and methods used in agricultural applications are. That reality isn’t lost on ag pilots who also engage in mosquito control. The question is whether that goodwill is transferrable in any way. The hope is that it can lead to greater understanding and appreciation of the ways aerial applicators help farmers keep a growing nation and world fed and clothed.

“It’s not necessarily directly [linked in the public’s mind], but it is a great education opportunity,” Schiffer said. “When our Air Tractors are flying over Saginaw County, 99.9% of people are tickled to death they’re there. ... I think it does help the agricultural industry to make sure people understand we do all of that.”

Emerging Threats

Although treating for nuisance mosquitoes is more common than disease-carrying mosquitoes in the United States, Brown and Walker are less concerned about complaints associated with garden-variety pest mosquitoes. What worries them are the emerging threats disease-bearing mosquitoes could introduce.

“We have the ecological conditions in place for these viruses to come in, and once they get going sometimes they’re here to stay,” Walker said. “Certainly, that’s true for West Nile virus—it didn’t invade and then leave, it’s invaded and established.”

“Our biggest concern right now is dengue fever coming up from the Caribbean or the [Florida] Keys,” Brown said. “It wouldn’t be a big public health threat, but it would cause a big public reaction.”

Last year, *Time’s* Bryan Walsh reported on the reemergence of dengue fever in the far southern reaches of the U.S. The first native cases of dengue fever in Florida in more than 70 years began appearing in Key West in 2009. Dengue is considered a threat to public health in Hawaii, south Texas and other Florida counties besides Key West’s Monroe County.

In terms of “actual public health threats,” Brown says he’s more concerned about chikungunya virus entering the United States. “It’s one that would move across the U.S. very quickly. It would be a lot like West Nile virus if it came in. We would be basically powerless to stop it, but unlike West Nile virus it would cause much higher levels of mortality.”

Despite these clear and present dangers, Walker is apprehensive about the chilling effect tighter restrictions and possible lawsuits by citizen’s action groups could have on future response efforts. “Hopefully it won’t interfere with the practices that are currently

in place, which I think are good management practices,” he said.

The new NPDES permits have already raised the cost of mosquito abatement treatments for various municipalities. Meanwhile, some aerial applicators have ended their mosquito contracts and decided to no longer offer mosquito spraying as a service due to the uncertain climate the NPDES PGP has created.

“We have to have a long-term view,” Walker said. “Nobody would ever have predicted that West Nile virus would show up in New York City in 1999, but it did and spread across the continent and reached California by 2004. Don’t we really need to be ready for events like that and have systems and mechanisms in place for the unpredictable?”

It could happen again, Walker cautioned. “Now we have Dengue emerging in South Florida. There’s a lot of concern about chikungunya virus coming in, there’s a lot of concern about Rift Valley fever virus invading North America—all mosquito-borne viruses. So, I hope that our political leaders will have the political will to allow us to keep our guard up, because if we drop our guard we’re going to get punched in the nose or worse by these problems.”

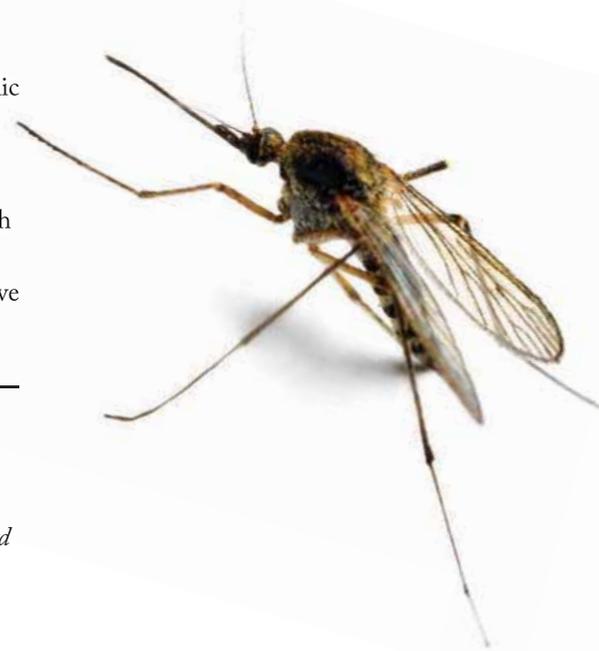
When You Need an Air Force, Not an Army

Aerial application clearly protects the public health and plays an essential role in keeping mosquito-borne diseases at bay. “There are some things we do that aren’t going to happen any other way,” Schiffer said. “We treat 45,000 acres in four to five days in Saginaw County, and it’s little seasonally flooded woodlots scattered over an entire county. You couldn’t come in with an army and treat that many woodlots by hand or by truck or any other way.”

You won’t get an argument from public health officials in Texas about that.

“That’s the only way you can cover that kind of acreage to protect enough people to make it worthwhile,” Schiffer said. “We’re just more effective and faster than any other method.” ■

The entomologists interviewed for this article are members of the Entomological Society of America. Grayson Brown is the ESA’s current president and Edward Walker is vice president of its medical, urban and veterinary section.



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