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About the Cover: The Asian Tiger mosquito, Aedes albopictus, native to Southeast Asia, is an important vector for the transmission of yellow fever, dengue fever and chikungunya. Photo by James Gathany, a biomedical photographer at the US Centers for Disease Control and Prevention, Atlanta, GA.
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The AMCA Young Professionals: In their Own Words
by Kristy Burkhalter

Kristy Burkhalter
Microbiologist
Division of Vector-Borne Diseases
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Fort Collins, CO

One of the things I find particularly attractive about the American Mosquito Control Association (AMCA) is the diversity of its members. Talented people from various disciplines come together to share their depth and breadth of knowledge for the betterment of vector control and public health. The AMCA Young Professional group is no different, and being a part of it will benefit you no matter your subject discipline, experience, or career goals. Get to know the members of our YP committee – the dedicated team of YPs who organize activities for the group – as they offer their unique perspectives on what AMCA and YP membership means to them. They, too, come from different backgrounds in the mosquito world and while they share the common goal of furthering the missions of the YP group, they each bring varied talents, perspectives and experiences to realize these goals. It has been my pleasure to work with such a spirited, committed and fun group.

Kristen Hopperstad
Graduate Research Fellow
North Carolina State University
Raleigh, NC

As chair of the AMCA Young Professionals committee, what I first considered a daunting task has become a joy and incredible opportunity. Within the first few months of joining the committee I grew profoundly, in a professional sense and as a "mosquito person." I’ve been a member of many clubs and organizations in the past, but the enthusiasm and dedication of our committee members is unparalleled. We worked together to organize networking and social events at the annual meeting in New Orleans and launched a monthly webinar series featuring topics relevant to up-and-coming professionals. I’ve led productive discussions, written my first newsletter article, and made meaningful connections with other young professionals around the country.

Mosquito control is truly a collaborative effort, and the perspectives offered by those from different fields have influenced my thinking and research. The ability to share and collaborate with AMCA members from a vast array of fields including, but not limited to, public health, mosquito control, industry, academia, and public relations is an invaluable resource. AMCA fosters these interdisciplinary relationships, and I feel understood and valued as a young professional, rather than considered too new to contribute. The higher ups and "big wigs" I’ve corresponded with are encouraging and accessible. The networking opportunities, online resources like archived webinars and outreach materials, and career development events have helped me become more confident and well-rounded. It is apparent this organization cares about its young people and understands they are the future of mosquito control.

Levy Sun
Public Information Officer
Greater Los Angeles County
Vector Control District
Los Angeles, CA

I joined AMCA’s Young Professionals for reasons that were expected: To meet other people who were new in the industry and to have access to career-development opportunities. What
I got out of the YP group, however, was not expected. Here are three things that I learned as a PR professional that made me appreciate AMCA, the YP group, and its amazing members.

First, you get the “big picture” about mosquito control outside of your state – It’s easy to get caught up with localized and statewide issues, but being in the AMCA network helped me better understand similar issues nationwide. This increased the value of my understanding because I’m able to draw on experiences shared by other people across the nation - and even in other countries! What I’ve learned has helped shape outreach campaigns and strategies that are implemented at my vector control district.

Second, stepping outside your niche challenges you – I’m guilty of networking mostly with PR professionals in and outside of the mosquito control industry. This can result in idea development that stagnates very quickly. When I became active in AMCA and the YP group, I was instantly drawn to the different perspectives that I didn’t normally hear. The different ideas were refreshing and helped elevate my understanding about the increasing importance of mosquito control and AMCA.

And third, you learn to value technology-driven communication tools a lot more – The YP group meets once a month via Skype. This means we need to coordinate over multiple US (plus international) time zones to find a common meeting time. In addition, using tools such as webinar, cloud-based file sharing, and scheduling services have increased our efficiency as an international group. My interactions with AMCA and the YPs have affirmed the idea that digital collaboration is increasingly important and will be common practice in many workplace settings. Being exposed to different tools will also keep me up-to-date on the latest digital communication trends in the industry.

Over the years of attending the annual AMCA meeting, it has always struck me at how the field of mosquito control is so close-knit and interconnected. At my first AMCA meeting in Austin, TX, I participated in the student competition, which is always held on the first day of the meeting. I bonded with several other participants after the anxiety from speaking had passed for each of us. I learned from someone at the event that there was a Young Professionals social outing that night. Over the course of dinner, chatting, bar-hopping and even some dancing in downtown Austin I became fast friends with several people that night.

As a result of my participation in the YPs, I have friends and colleagues that I look forward to seeing each year. The annual meeting is a nice way for us to touch base and find out what is happening in our lives, both professionally and personally. This support network has been critical during the ups and downs of our careers. I have even had the good fortune to establish working relationships and collaborate on research with some of the people that I have met at past annual meetings. As part of the YP Committee and a former President, my goal is to use my years of experience with AMCA and the YPs to help new members take advantage of all the educational and networking opportunities that the YPs have to offer.
When I first started working on mosquito control, I noticed there were numerous entities working on this topic – universities, industries, military forces and public agencies like the CDC. However, I imagined them like a human body without a head, where each body part acts without a direction and without knowing what others are doing. Particularly, I thought there was a long distance between knowledge-driven actions, like “basic” research in academia, and activities focused on mosquito control in the field, like industry research or entomological surveys. Then I joined the AMCA and I had the feeling that the association is like the head, a kind of incubator where many entities are free to contact, interact and exchange ideas and findings, particularly during the annual meeting. This feeling was reinforced when I became a member of the Young Professionals Committee, when we started planning our initiatives; I was really amazed by the fact that “older” members have contact with people from many different sectors and by the fact that these people are ready to interact, help and join our initiatives.

But this was not the unique thing that impressed me; I felt that being part of the YP committee is like a training phase that prepares you to be an active member of the community, a place where you learn how to interact with and involve people. Moreover, this experience is teaching me how to efficiently run group meetings. We usually meet “virtually” once a month and our meetings last for about an hour; they are prepared in advance, focused on a few topics and, in this way, they are always fruitful. Lastly, as I am a postdoctoral fellow in the university, joining AMCA, and particularly the YP group, is opening my mind by comparing my experience and my approaches to those of people that have a different background. For these reasons I am really glad to be part of this group!

Cassie Scott
Biologist
Division of Vector Borne Diseases
US Centers for Disease Control
Fort Collins, CO

The last time the annual AMCA meeting was held in New Orleans was in 2009, which was the year that I first attended. This was to be my first presentation at a meeting and I was quite nervous. Yet I was also thrilled to have the opportunity to attend and meet people from every spectrum of mosquito control.

The Welcome Reception on Sunday night was intimidating, as I didn’t know a soul. Thankfully, my co-workers took me under their wing and introduced me to people along the way. It felt like a family reunion – people were shaking hands and hugging, expressing their joy over seeing an old friend, and catching up over a beer. I knew that I wanted to be a part of this mosquito family. People were very welcoming and over the course of the meeting, I was invited to dinner where I had my first bowl of turtle soup, shared a plate of charbroiled oysters at Drago’s with students from Tulane, and played slots at Harrah’s with people from industry.

I learned an incredible amount from the various talks I attended, and gained insight into many of the components that comprise mosquito control. I was able to connect and trade contact information with people from various areas, and finally met several people in person that I had only previously traded e-mails. Thankfully, my presentation also went well! I enjoyed the experience immensely, but I wish that the Young Professionals group had existed at my first meeting. If it hadn’t been for my co-workers showing me the ropes, I think the experience would have been quite different. The opportunity to have a group of people that can come alongside you when you first enter the mosquito control arena is an invaluable resource. Every year I look forward to attending the annual meeting as I see it as a time to connect with old friends, meet new people, and learn something I didn’t know before.
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As many in our industry already know, tire casings in the outdoor environment can provide an excellent habitat for mosquito larvae to develop from egg to adult. Because of their shape and permanent nature, tires may hold water for long periods of time even during periods of drought, providing a consistent habitat for larval mosquito development. A single tire can produce hundreds, even thousands, of mosquitoes each year. Some of the mosquitoes that develop in tires throughout the northeast, such as *Culex pipiens* and *Ochlerotatus* (*Aedes*) *japonicus*, can transmit West Nile to humans. Work to suppress mosquitoes in tires may consist of weekly visits by technicians to apply larvicides and/or wide scale applications of airborne pesticides to control the adult mosquitoes that have emerged from these habitats. Elimination of tires by recycling cleans the environment from this blight, and permanently eliminates larval habitat and the need for repeated inspections and pesticide applications. This “source reduction” is an important part of an Integrated Mosquito Management (IMM) program.

An Internet search revealed that other mosquito control programs were performing this service, most notably in Florida, Michigan, and New Jersey. After reviewing their success, we began our program with minimal expectations. Earth Day 2010 marked the official start of the Central Massachusetts Mosquito Control Project (CMMCP) waste tire removal program, but work had already begun in late 2009 thanks to the McColgan Grant-in-Aid funding we received from the Northeastern Mosquito Control Association. The program initially consisted of three components:

- Clean-up of large waste tire dumping sites that had been added to our database
- Curb-side residential waste tire removal
- Removal of waste tires discarded on the side of the road

A fourth component was added after this program became popular:

- Coordination with communities during recycling events, hazardous waste collections, river cleanups, etc.

Tires collected in this program were brought to Liberty Tire, a recycling facility located in Littleton, MA. According to the company’s website, http://www.libertytire.com: “As the top tire recycling company in North America, Liberty Tire has a wide network of production facilities. The company collects and recycles about a third of the nation’s scrap tires, saving more than 140 million tires from the waste stream each year.”

Our first large scale project was in the town of Ashland, MA in early 2010. We worked with the local Board of Health and Conservation Commission and removed a tire pile that consisted of over 1200 tires; see Figure 1. Our records show this pile has been an area of concern for us for well over 30 years. A press release was generated on Earth Day 2010, and many media outlets picked up this story. We have worked with the town of Tewksbury during their “Zero Waste Day” event the past...
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few years, collecting over 325 tires from residents. In 2013 we worked with the city of Lowell during the Merrimack River cleanup and brought 113 tires to the recycling center; see Figure 2. For Earth Day 2013 we announced our 10,000th tire recycled; see Figure 3. In the 3+ years we have worked in this program, we have performed over 150 curbside pickups, dozens of roadside pickups, collaborated in over 50 community events, and coordinated over 2 dozen large scale tire cleanups. We have mapped over 565 tires piles through our GIS program, of which over half have already been removed. CMMCP staff is always on the lookout for new piles to be databased – and physically removed at a future date. Several Boards of Health and Highway Departments collaborate with us and depend on this program, calling us when they’ve collected 50 to 100 tires.

Since 2009 we have partnered with the US Environmental Protection Agency’s (EPA) WasteWise program, reporting our tire collection data through their Re-TRAC system. In 2011 we received a Bronze certificate in the Institution and Non-Profit category from MassRecycle, a statewide coalition of individuals, municipalities, businesses, and organizations dedicated to promoting the benefits of waste reduction, reuse, recycling and diversion; see http://massrecycle.org.

In 2014 we received an Environmental Merit Award from the EPA regional office in New England; see Figure 4. EPA recognized our efforts in not only recycling tires, but reducing pesticide use; see http://www.epa.gov/region1/ra/ema/2014recipients.html#Governmental. The award announcement noted the accomplishments of CMMCP: “Through this project, the organization has recycled 11,500 tires, which saved 192 staff hours in monitoring larval habitats, and resulted in usage of 720 pounds less of pesticides.”

Our program was featured in the September 2014 issue of Scrap Tire News magazine, a monthly trade periodical for the tire recycling industry (Deschamps 2014); see Figure 5. Since publication, we have received correspondence from several people about our program. The article has been posted to our website at http://www.cmmcp.org/STN_9-14.pdf.

We have recycled over 14,100 tires from most of our 40 member cities and towns as of November 2014. We are averaging just over 2,700 tires a
year in four full years, with a high of 3,263 in 2012; see Figure 6. Our success has generated interest and creation of similar programs in other mosquito control districts in Massachusetts. With the potential expansion of *Aedes albopictus* in their northernmost fringe here in Massachusetts, this program may become even more necessary as a public health intervention. We have reported our accomplishments at several conferences and public meetings. More information about our program can be found at [http://www.cmmcp.org/tires.htm](http://www.cmmcp.org/tires.htm).

CMMCP was created by the Massachusetts State Legislature in 1973, and currently consists of 40 cities and towns in central Massachusetts, in both Worcester and Middlesex Counties, covering over 725 square miles. Mosquito control districts here are state agencies with unique funding structures; towns vote into the program at annual or special town meetings and cities opt in by City Council vote. More information about our program can be found at [http://www.cmmcp.org](http://www.cmmcp.org).

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The Bean Plataspid: Identifying a new insect invader in Florida

by Aaron Lloyd

For over 60 mosquito control programs in the state of Florida, our mission is straightforward: Get out there and kill mosquitoes. With the daily grind of larviciding, adulticiding, surveillance, etc, it is very easy to maintain a narrow focus and lose sight of the broader goal as public servants. Whether it is a call to the office or a complaint from a constituent in the field, mosquito control personnel often get questions on how to control more than just mosquitoes. In Pasco County it is very common to answer questions about how to control horse and deer flies, no-see-ums and non-biting midges. We will even get questions regarding the control of other insects, such as fruit flies, filth flies, and various urban pests. Our typical response to these questions is to simply explain that the standard mosquito control efforts will not work for that particular pest, give advice on available control options, or we will redirect them to hire an appropriate pest control company. When a question regarding a pest that has not been identified arises, Pasco County Mosquito Control District (PCMCD) offers the expertise of the three entomologists on staff to help the constituents with their pest problem. They have the option to consult with a PCMCD entomologist over the phone or visit the district with a sample for identification and advice for available control options. In rare cases a person will present a pest problem that we have not encountered and it requires attention beyond a 10 minute phone call or a 30 minute visit to the district. The case discussed in this article proved to be interesting, and presented a specimen that was not supposed to be in Pasco County or even in the state of Florida.

In February 2013, PCMCD received a call requesting treatment for “thousands of large green bugs” infesting a property next to a produce stand. We quickly explained the function of MOSQUITO control, but then offered to take a look at the insects and asked the caller to stop by the district with a sample. The sample arrived at the district the same day as the phone call and one by one, our three entomologists attempted to identify the insects and all agreed that they had never seen them before. The next steps in the identification process involved dusting off the general entomology texts and begin scouring dichotomous keys. It was finally determined that the specimen was a member of the true bug order, Hemiptera, in the family Plataspidae, commonly known as the bean plataspid; see Figure 1.

The bean plataspid, *Megacopta cribraria* (Fabricius), commonly known as the kudzu bug, globular stink bug or lablab bug, is 3-5 mm in length. A Florida Department of Agriculture and Consumer Services (FDACS) Pest Alert (Halbert and Eger 2010) listed this insect as “not yet known to occur” in the state. However, in March 2012, *M. cribraria* was first found in a funnel trap in north Florida. It was uncertain if this piercing-sucking insect was established and isolated to north Florida or simply a temporary transplant from Georgia or Alabama where they have become established.

They are a serious pest of soybeans and other legume crops, so when PCMCD notified FDACS of our findings, their Division of Plant Industry (DPI) office in Gainesville, FL quickly requested samples for confirmation. During the confirmation process, PCMCD visited the site where the insects were collected and took pictures of the insects feeding on kudzu, *Pueraria lobata*, Figure 1: The bean plataspid, *Megacopta cribraria*. Photo by Charles Lam
and lead tree, *Leucaena leucocephala*; see Figure 2. Once the insects were confirmed to be *M. cribraria*, DPI requested pictures from the collection site to properly document this insect in Pasco County (Medal et al 2013). After the confirmation and documentation process, DPI noted that lead tree, recognized from the PCMCD photos, was not a known host for the bean plataspid, and that if this weed was being used as a reproductive host plant, there would be no stopping the southern spread of this pest bug to peninsular Florida.

Like all mosquito control programs, PCMCD’s primary mission is to suppress mosquito populations and protect our county residents from nuisance and disease. However, like it or not, there is a fair amount of time spent on public relations. There is a need to facilitate the public desire for mosquito control, and mosquito control personnel should take extra measures to assist their constituents when problems arise. Although it is not advertised, PCMCD has taken extra measures when called upon by assisting residents with various pest problems. As entomologists, we enjoy the challenge to identify unknown insects to help our residents. The vast majority of the time spent on pest problems (other than mosquitoes) involves a quick phone conversation or a short consultation with a district visitor. The situation described in this article is extremely rare, but the time and effort involved helped solve a pest problem for a Pasco County resident, alerted the state of Florida of a southern movement by the bean plataspid and helped document the spread of an important agricultural pest.

**REFERENCES CITED**


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The Central Massachusetts Mosquito Control Project (CMMCP) has conducted bottle bioassays for eight years, beginning in 2005 (excluding 2006), to determine if pesticide resistance has been developing in local mosquito populations. Using procedures recommended by the United States Centers for Disease Control and Prevention (CDC), the results with unexposed mosquitoes were compared to those collected from areas serviced by the CMMCP adulticide program.

With environmental changes, mosquito species have the potential to change their distribution, bringing disease to new areas (Brogdon and McAllister 1998; Simsek 2003). These diseases include malaria, dengue, yellow fever and Rift Valley fever (McAbee et al. 2003; Simsek 2003). Faced with these new threats, vector control personnel must be aware of the dynamics of local mosquito species in order to reduce the risk of human infection.

Insecticide resistance may have a major impact on the ability of public health agencies to effectively control vector-borne disease (Brogdon and McAllister 1998). Studies have correlated agricultural and pest control insecticide application to resistance development in select populations of mosquitoes (Rodriguez et al. 2005). Despite research that has shown resistance in specific mosquito populations, the actual impact of this on vector control is not well known due to several issues. One is the lack of information about the current resistance levels, due in part to the wide variety of surveillance programs and data collection efforts. Another factor is that resistance seems to be localized. In a study in Guatemala, certain mosquito populations only a few kilometers apart varied greatly in the presence and levels of resistance, including the actual mechanism for the resistance (Brogdon and McAllister 1998).

These unknowns about the level of resistance in vector populations have reinforced the need to study pesticide resistance at CMMCP. The goals of this research will be to create baseline data for control efforts, detect early resistance and to observe the current effects of control strategies. If resistance is observed, then a change in application rate or rotation to a different class of insecticide may need to be considered. CMMCP used resmethrin (Scourge® 18% + 54%, EPA Reg. No. 432-667) for ULV applications since 1988, before switching to sumithrin (Anvil® 10+10 ULV, EPA Reg. No. 1021-1688-8329) in 2007. Both products are synthetic pyrethroids that use piperonyl butoxide (PBO) as a synergist. CMMCP had previously used malathion, an organophosphate, a different chemical class of active ingredient (Nauen 2006).

To start, clean 250 ml Wheaton bottles were lined with 1 ml of various concentrations of Anvil 10+10 ULV – 8.868µg/ml, 22.17µg/ml, 44.34µg/ml and 88.68µg/ml (micrograms of active ingredient per milliliter) – which were diluted with pesticide grade acetone obtained from Thermo Fisher Scientific, Inc; see Figure 1. Approximately 10 to 15 field collected mosquitoes were introduced into each bottle by mechanical aspiration. These captured
mosquitoes were primarily *Coquillettidia perturbans* (>90%), with *Anopheles quadrimaculatus* and *An. punctipennis* also observed at lower frequency; see Figure 2. The percentage knockdown was recorded at 5-minute intervals, up to 100% knockdown. Control bottles were lined with acetone only and percentage knockdown was observed at 5-minute intervals, up to an hour. Several trials were conducted at each insecticide concentration until a concentration was found that created a timely mortality curve that reached total knockdown in around 30 minutes. Once the sumithrin baseline concentration was determined, it could be used against the exposed mosquito populations with control bottles running simultaneously.

Mosquitoes collected for the bottle assays were facilitated by the use of several CDC light traps baited with CO₂ at a flow rate of 500 ml per minute. Standard collection nets were used to collect the mosquitoes, which were provided a simple food source until resistance testing took place, usually within a couple of hours. Flashlight aspirators were used to transfer mosquitoes from the collection cages to the assay bottles.

The baseline mosquitoes were collected from an area located near an organic farm. This site has been an official exclusion property since 2006, but even prior to that year, CMMCP has no record of using adulticides in this area. Once the baseline concentration had been determined using these historically unexposed mosquitoes, collections were made at several other sites that had received 2 to 15 adulticide events over the previous couple of years. These potentially resistant mosquitoes were then tested against the baseline concentration for the unexposed population, as well as using control bottles coated with only acetone. Over the past seven seasons of resistance surveillance, several collection sites have been used, with slight modifications from year to year depending on habitat and seasonal population changes. The knockdown percentage was plotted against time interval to determine the presence of resistance in these populations, compared to those historically unexposed. If any specimens survived longer than those of the baseline group, this could represent some degree of resistance has developed.

The baseline component of the bottle assays resulted in an optimal Anvil 10+10 ULV concentration of 22.17µg/ml, which corresponded with data from previous studies (Petersen et al. 2004). Using this concentration, it was found that in 2007 only one assay of eight trial sets had specimens that did not reach 100% knockdown before the 25-minute mark. This particular site, Haskell Street, had an average of 98.9% knockdown by 30 minutes, reaching 100% at 30 minutes. Another site, Otis Street, had a slower curve than the rest, although 100% knockdown occurred at 25 minutes like the baseline population. As one would expect, the control bottles coated with only acetone had zero knockdown effect.

The bottle assay results from the 2013 season were slightly off the baseline averages. Overall, 97% of the specimens were knocked down by 30 minutes, with 93% down by the 25-minute mark. The few remaining individual specimens were knocked down shortly thereafter.

Looking at the yearly totals from the seven seasons of bottle assays, the knockdown rate has been relatively consistent around the baseline average. Two seasons, 2009 and 2013, had knockdown rates that were slightly lower than the baseline average. The acetone-only coated bottles have consistently provided a proper control measure, with negligible knockdown effect, if any; see Figure 3.

The results of the bottle assays continue to indicate that the level of resistance in the populations of the local mosquitoes tested in the CMMCP service area is not significant enough to suggest that a change of pesticide or application protocol is needed. This is not necessarily surprising, considering the nature of the CMMCP adulticide program, which is primarily request-only in localized, targeted areas. The vast size of the CMMCP service area,
encompassing 40 cities and towns, with non-member municipalities having no mosquito control programs scattered in and around them, could be another reason. These factors contribute to local mosquito populations not being consistently exposed to a single class of insecticides, lessening the potential development of resistance. The rapid degradation and low residual nature of the insecticide could also contribute to low resistance development.

Data from 2014 is being compiled and analyzed, and will be posted at http://www.cmmcp.org/research.htm when available. At this link you can also see other research and efficacy projects performed at our program since 2007. In addition, memoranda on bottle bioassay techniques using different formulations and active ingredients have been archived at http://florida mosquito.org/Archive/PHEREC/.

REFERENCES CITED


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ADAPCO Brands

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Sometimes you know what is going to happen even before you do something, but you find yourself doing it anyway. This was the case as I stood in line waiting to check out of a local drug store. As I looked at the products placed alongside the line – the better to encourage impulse purchases – I noticed a box full of yellow plastic bracelets, similar to the ones collected by the girls in the local elementary school. This one was different. It promised 200 hours of protection from mosquito bites. Since it only cost about a dollar, I bought one; see Figure 1.

I did a web search on Superband™ and found out that Revay et al (2013) had evaluated this product against *Aedes albopictus* and *Culex quinquefasciatus* and found it useless and less than useless, respectively, against those species. I knew I had to evaluate its performance against *Ae aegypti*.

I maintain a cage of locally-collected *Ae aegypti* mosquitoes in the Florida Keys Mosquito Control District’s laboratory in Marathon, FL, so I had plenty of test animals with which to work. I placed my left hand in the cage of *Ae aegypti* and with my right hand I activated the stopwatch function on my cell phone. I counted the number of mosquitoes that landed on my hand during a 15 second period. After 15 seconds I shook off any mosquitoes and withdrew my hand from the cage. This procedure was repeated twice more for a total of three trials. Then I made three more counts, but this time I wore the Superband. Upon opening the wrapper I noted the pleasant aroma of “Indonesian Lemongrass” (5%), with undertones of Philippine (sic) geraniol oil (15%) and citronella oil (5%). I put the bracelet on my left wrist and placed my hand in the cage three more times, for 15 seconds each time, counting the number of mosquitoes landing during each trial. Data are presented in Table 1. In this “quick and dirty” test there was apparently no difference in landing rates, as Revay et al (2013) found.

Citronella oil, lemongrass oil, and geraniol are repellent to insects (Müller et al 2009; Patel et al 2012), but wrist bands and bracelets that contain these ingredients and purport to provide protection from mosquito bites are little better than useless (Fradin and Day 2002; Revay et al 2013). Given the low cost of these items and the fact that they probably do not do any harm in and of themselves, the temptation is to ignore them. However, with dengue, chikungunya, and West Nile viruses circulating in Florida, there is the distinct possibility that people could rely on these items and neglect to take correct protective actions. That we cannot ignore.

**REFERENCES CITED**


**Table 1:** 15-second landing rate counts of *Aedes aegypti* with and without Superband wristband.

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<tr>
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<td>12.67</td>
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Mosquito abatement districts are relatively common throughout the US coastal region, but rather sparse in the north central states. Yet, geography, topography and climate combine to create pockets in this region where both nuisance and disease risk have motivated residents to support comprehensive mosquito control (MC) operations. One such area occurs in eastern central Michigan, where a tightly knit community of mosquito control districts with common roots operates.

Four neighboring counties in the Saginaw Valley region of Michigan have dedicated MC districts: Bay, Midland, Saginaw and Tuscola; see Figure 1. Saginaw Valley is the state’s largest drainage basin, formed largely from the action of ice lobes advancing and retreating during glacial periods. This flat, low-lying watershed offers many ideal mosquito habitats.

The history of mosquito-borne disease in Michigan is noteworthy. Prior to 1880, Michigan was known as the “home of malaria,” accounting for an estimated 50 to 75% of illness reported in the state (Kleinschmidt 1941). During the 1940s and 1950s, malaria was brought under control and eventually eradicated. Since that time, however, mosquito-borne encephalitis viruses (encephalitides) have posed the greatest arthropod-borne risk to residents: St Louis Encephalitis (SLE), Eastern Equine Encephalitis (EEE), LaCrosse Encephalitis (LAC) and since 2002, West Nile virus (WNv).

The greatest recorded outbreak of SLE in the United States occurred in 1975 and played a significant role in the establishment of MC districts in Michigan. Chicago was a major outbreak epicenter and shockwaves were felt in neighboring Michigan.
By 1982, interest in county-wide MC service gained traction and that year voters in Midland County approved the establishment of Midland County Mosquito Control (MCMC). Tuscola County Mosquito Abatement (TCMA) was established in 1997, becoming the fourth Michigan county with a MC program. No other counties in the state have programs, though a number of cities and townships contract MC services.

Characteristic of the northern latitudes, endemic mosquito species take full advantage of the shorter warm season and often emerge with great voracity. This requires MC operations to anticipate spring emergence and carefully time and plan control activities. Michigan mosquitoes are classified into four major habitat groups; spring floodwater, summer floodwater, permanent water and container/tree hole species; see Table 1.

\textit{Aedes stimulans}, \textit{Ae excrucians}, \textit{Ae provocans} and \textit{Ae canadensis} are common spring floodwater species in Michigan. Each goes through a single generation per year, hatching from eggs laid the previous year(s) in woodland leaf litter, submerged in pools formed from melting snow and rains the following spring; see Figures 4 \\& 5. Larvae emerge around March and because of the cool temperatures often do not develop to adults until mid-May. Females are long lived and will lay a number of broods of eggs in May-June, and by the end of June most of these mosquitoes have completed their annual cycle. Control of spring floodwater species takes a lot of effort by the Michigan MC organizations each year. An extensive aerial Bti larviciding program is carried out by the counties involving treatment of over 130,000 acres of woodlots. These
are among the largest Bti aerial treatments in the country.

About the time the spring species wane, the summer floodwater species are on the increase. Examples include *Ae vexans*, *Ae trivittatus* and *Ae sticticus*. These mosquitoes go through multiple generations per year and are largely responsive to rainfall events throughout the summer. They are commonly found in flooded fields, roadside ditches, and woodland pools. Rain is carefully tracked and analyzed to guide surveillance and control activities. Efforts to treat the larval stage are a priority to prevent adult emergence. Nevertheless, the vast amount of suitable larval habitat makes complete control with larvicides impossible.

Saginaw Valley is known for a number of natural wetland areas, which produce an abundance of permanent water mosquito species. The cattail mosquito, *Coquillettidia perturbans* and several *Anopheles* species are associated with these habitats. Furthermore, *Cq perturbans* is an important EEE vector and appears in tremendous numbers around July. The method of larval breathing – attaching underwater to aquatic vegetation – makes control particularly difficult with traditional larvicides. Therefore, adulticiding for *Cq perturbans* is often the only viable control method available.

One interesting species that occurs in the area is *Ae sollicitans*, the salt marsh mosquito. Though miles from coastal salt marshes, Saginaw Valley has a significant amount of salt brine. In fact, Dow Chemical, located in Midland County, was established in this region due to the abundance of salt brine used in chemical manufacturing. The brine was deposited from the shallow seas that covered the area during the Mississippian geologic era. A number of salt seeps, along with some brine mining and oil extraction operations, create limited bodies of saline water suitable for *Ae sollicitans* in the area.

<table>
<thead>
<tr>
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<tbody>
<tr>
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<tr>
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<td><em>Ae communis</em></td>
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<td><em>Ae excrucians</em></td>
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<td><em>Ae sticticus</em></td>
<td>WNV, DHW</td>
</tr>
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<td></td>
<td><em>Ae stimulans</em></td>
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<tr>
<td>Summer floodwater</td>
<td><em>Ae cinereus</em></td>
<td>WNV, DHW</td>
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<tr>
<td></td>
<td><em>Ae trivittatus</em></td>
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<tr>
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<td><em>Ae japonicus</em></td>
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<td><em>An walkeri</em></td>
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<td></td>
<td><em>Uranotaenia sapphirina</em></td>
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DHW - Dog heartworm | EEE - Eastern Equine encephalitis  
LAC - La Crosse encephalitis | SLE - St Louis encephalitis | WNV - West Nile virus

Table 1: Common mosquitoes of the Saginaw Valley region in Michigan.
Since the introduction of WNV, surveillance and control of Culex species in environments such as storm drains and catch basins has become increasingly important. All districts have developed extensive mapping of catch basin locations and substantial resources are dedicated to their surveillance and treatment. Saginaw County has a fleet of 10 mopeds that are used to efficiently treat catch basins in the urban areas of Saginaw and neighboring towns.

Primary among container species are the endemic Ae triseriatus and recently introduced Ae japonicus. Aedes japonicus expanded to Michigan about eight years ago and is now firmly established. Though not a disease risk to the extent of Ae albopictus, Ae japonicus has been demonstrated to be a competent vector of WNV. Fortunately, the districts are beyond the present northern limit for Ae albopictus.

Each county’s operations differ slightly due to issues such as budget, expertise and distribution of the rural and urban areas. All, however, emphasize larval control and truck-mounted ULV adulticiding. A unique position at Saginaw County is a source reduction project manager responsible for developing drainage projects that eliminate mosquito larval habitats; see Figure 6. SCMAC also employs an education coordinator for public outreach and education programs focused on a variety of mosquito related topics; see Figure 7. Publications, presentations, and social media are extensively used to inform the public.

One of the challenges for MC in this area is the seasonality of the work, compared with the southern US. Because the mosquito season lasts just through the warm, and not so warm, months of the year, we must hire and quickly train the majority of our staff each spring. There are a few technicians that tend to return from previous seasons, but only being able to offer employment for six months of the year means that individuals often end up leaving after a season or two to find more consistent employment. As a result, each spring involves not only surveying and preparing for upcoming control operations, but we must also devote much effort to screening, hiring, training, certifying and equipping a full contingent of technicians. So if we are a bit slow responding to you in April – you now know why!

Despite the challenges and intense season each year, Michigan’s mosquito control activities enjoy a large amount of popular support. We often hear accounts of residents venturing into other regions of the state that do not enjoy the benefits of comprehensive mosquito control, and how thankful they are for our service. The public has continued to vote for over thirty years for ongoing millage requests, ensuring that the services are funded in the four counties. Each district will continue to focus on quality and responsive service, with the goal of providing expert mosquito control to those we are charged to serve.

ACKNOWLEDGMENTS

We thank Chris Cantrell and Adam Hart of Midland County GIS for assistance with the Michigan map.

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From Where I Sit... One of my most complex and perplexing challenges in my role as an advocate for promoting safe, effective, and environmentally compatible mosquito control practices is debating with activists in their various disguises. This often entails identifying and exploiting flaws in their reasoning which weaken their arguments. Having taken several logic courses during my college days, I'm particularly sensitive to the fallacies on which many unwittingly build their arguments – on both sides of the aisle.

Arguments, as defined in debate, consist of both premises and presuppositions. All humans have presuppositions, sometimes labeled biases, which can significantly impact their choice of premises in an argument. Premises are the basic components of an argument and can be proven or disproven as the argument advances. Thus, it’s important that premises are supported by evidence in order to be proven. Fallacies are defects in these premises that weaken arguments. It’s extremely important that we recognize them, for they expose vulnerabilities in our opponent’s arguments that we can exploit to bolster our own arguments. Remember, though, fallacious arguments are quite common and can be quite plausible, particularly to the casual reader or listener – the kind sometimes drawn to city and county council meetings concerning the use of mosquitocides.

The following are descriptions and examples of only a few of the many recognized material fallacies – but they serve as a start. Be advised that this list is by no means encyclopedic. It’s also extremely important to understand that even if you identify a fallacy associated with an argument in how it’s presented, the person may in fact be correct – it’s just that his/her argument doesn’t make the case for it.

### BEGGING THE QUESTION

**Definition:** An argument that accepts as fact that which has yet to be proven – circular reasoning – or simply ignores an important (but questionable) assumption upon which the argument rests. Aristotle often referred to these as *petitio principii.* The phrase “begs the question,” in the current vernacular, is used to imply that further information to support a conclusion is needed. To “beg the question” in logic arguments, however, does not mean to “raise a question” (i.e., “begs the question”) as if it were an actual question. It simply means that a statement is assumed to be true without evidence other than the claim itself.

**Example:** “The reason there’s such a big demand for ‘natural mosquito control’ is because everyone wants to use it.”

**Tip:** Check to see if any of their premises basically say the same thing as the conclusion (but in different words in this case). Do not let them just assume or use as uncontroversial evidence the very thing they’re trying to prove. In addition, ensure that the premises they assume are incontrovertible in their own sense.

### STRAW MAN

**Definition:** The arguer sets up an exaggerated or caricatured version of your position and tries to score points by knocking it down. This fallacy is extremely common.

**Example:** “Councilman X says we shouldn’t fund the sentinel chicken program. I don’t know why he wants to leave us defenseless like that.” Another example: “You want to kill all insects, which would result in ecological disaster. You want to poison children by introducing toxins into the environment.”

**Tip:** Ensure that your opponent’s version of events reflects reality. To ensure you don’t make the same mistakes, state opponent’s arguments as strongly, accurately, and sympathetically as possible. If you can knock down even the best version of an opponent’s argument, then you’ve really accomplished something.

### RED HERRING

**Definition:** Partway through an argument, the arguer goes off on a tangent, raising a side issue that distracts the audience from what’s really at stake. This fallacy is plausible, but irrelevant.

**Example:** “Natural mosquito controls are the most effective means of controlling mosquitoes. After all, natural controls don’t hurt the environment.”

**Tip:** The original premise is that natural mosquitocides are the most effective. The arguer then introduces an environmental argument that has nothing to do with the original premise. Can they explain how each premise supports the conclusion?

### POST HOC, PROPTER ERGO HOC

**Definition:** Assuming that because B comes after A, A caused B. Correlation isn’t the same thing as causation.

**Examples:** “The local Mosquito Abatement District (MAD) made a ULV application last week and I saw dead bees yesterday. The mosquito control application caused the bee deaths.”
Tip: The bee kill may or may not have been caused by the application, but the argument hasn’t shown us that one caused the other. To avoid the post hoc fallacy, the arguer would need to give us some explanation of the process by which the mosquito control application is supposed to have produced the bee kill, *ie*, exposure.

**AD HOMINEM**

**Definition:** The *ad hominem* ("against the person") fallacy focuses our attention on people rather than on arguments or evidence. In an *ad hominem* argument, the arguer attacks his or her opponent instead of the opponent’s argument. In a *circumstantial ad hominem* argument, the opponent’s association with a circumstance is the target.

**Example:** “Joe Conlon works for the AMCA; therefore his views are tainted by the pesticide industry because they contribute to the AMCA.”

**Tip:** Make sure your opponents stay focused on your reasoning, rather than on your personal character or affiliations. Make them refute your evidence rather than dismiss it offhand because of its source.

**TU QUOQUE**

**Definition:** The *tu quoque* ("you, too!") fallacy also focuses our attention on people rather than on arguments or evidence. In a *tu quoque* argument, the arguer attacks the opponent as a hypocrite instead of the opponent’s argument.

**Example:** “MADs can’t tell us not to use any household chemicals in mosquito control, for they use chemicals too.”

**Tip:** Make sure your opponents stay focused on the evidence supporting your argument, rather than on their accusations of hypocrisy.

**SLIPPERY SLOPE**

**Definition:** The arguer claims that a sort of chain reaction, usually ending in some dire consequence, will take place, but there’s really not enough evidence for that assumption.

**Example:** “Killing adult mosquitoes will reduce the number of mosquito larvae, which will have cascading effects all through our ecosystem, resulting in total collapse of our natural world.”

**Tip:** Since sometimes a chain of events really can be predicted to follow from a certain action, a true Slippery Slope fallacy must be rebutted by analysis of each cause/effect.

**APPEAL TO AUTHORITY**

**Definition:** Often activists attempt to add strength to their arguments by referring to a supposed authority - who really isn’t an expert in the area being discussed.

**Example:** Activists often use Sheldon Krimsky PhD, on the faculty of Tufts School of Medicine, as an authority on the dangers of using mosquito-icides. While it is true that he is on the Tufts Medical School Faculty and possesses a PhD, his doctorate is in Philosophy, not toxicology or entomology. Thus, his academic credentials do not lend any heft to the arguments he makes with regard to mosquito control. In point of fact, his claims may be correct (they aren’t), but his academic credentials have no bearing on their veracity.

**FALSE DICHOTOMY**

**Definition:** In false dichotomy, the arguer sets up the situation so it looks like there are only two choices. The arguer then eliminates one of the choices, so it seems that we are left with only one option: the one the arguer wanted us to pick in the first place.

**Example:** “The mosquito situation here is unacceptable. Either we solve it by using chemical or nonchemical means. Obviously we shouldn’t risk using chemicals, so we must use nonchemical methods of control.”

**Tip:** Examine your opponent’s arguments. If there are other alternatives, don’t just ignore them – explain why they, too, should be ruled out.

I must again emphasize that a fallacious argument is not necessarily false – it’s merely illogical and weak. Nonetheless, talking points based on fallacies should be taken to task for what they are: misconstructions offering significant opportunities to effectively rebut.

“Fallacies do not cease to be fallacies because they become fashions.”

-G K Chesterton

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