MVCAC
MOSQUITO AND VECTOR CONTROL ASSOCIATION OF CALIFORNIA

West Nile and Mosquito-Borne Illness: An Increasing Threat

In 2014 California experienced the greatest incidence in its history of invasive mosquito activity and West Nile virus. By the year's end, the California Department of Public Health (CDPH) confirmed 887 cases total and 29 deaths from the virus. In 2013, there were 433 total human incidences of West Nile virus and 15 deaths statewide, a doubling of West Nile activity in the state in just one year.[i] This dramatic increase in mosquito-borne illness is troubling, since there is no cure or vaccine for West Nile. Those who acquire the disease can only attempt to manage it as best they can. The California legislature can make a difference in stemming the tide of disease by funding key mosquito research programs for a mere $450,000.

Individual efforts to prevent West Nile, such as encouraging people to use insect repellent, wear clothing that covers the skin, and eliminate standing pools of water can be effective locally, but California must develop and improve on population-based, data-driven strategies, which are the best ways to decrease and slow the spread of mosquito-borne illness. Mosquitoes adapt quickly, become resistant to pesticides, alter their feeding and biting patterns, and infest geographic regions in which they have never before been detected. This is hastened by droughts and record high temperatures, which create the perfect environment for an increase in mosquitoes. Additionally, mosquitoes can become resistant to the products applied by mosquito control professionals, making it more difficult to proactively manage growing populations. Staying ahead of the curve in managing mosquito populations through surveillance, data collection and data analysis is the best way to limit mosquito populations before they infect more Californians.

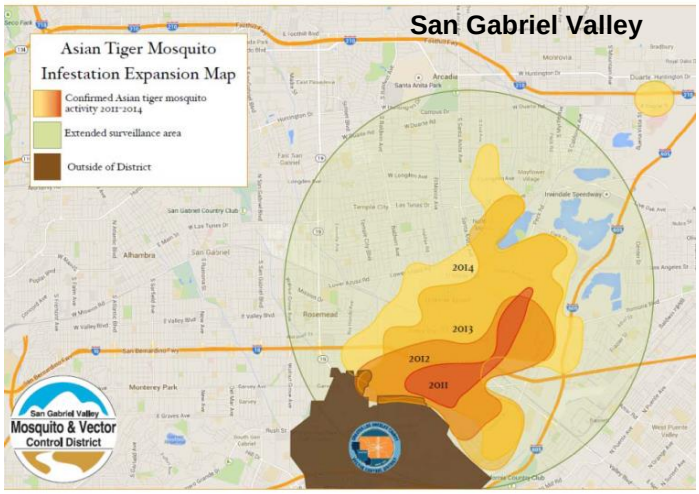
The Changing Environment and Climate Create a Perfect Ecosystem for New Invasive Mosquitoes in California

A 2014 UCLA study that focused on tropical and African climates indicated that higher temperatures and lower precipitation will lead to more West Nile virus infections, and that it will spread to areas that were previously unaffected.[ii] CDPH points to the drought our state is facing as a key reason for the increase in West Nile virus infections. West Nile is transmitted to humans carried by mosquitoes, which acquire it by feeding on infected birds. Horses are also susceptible to West Nile when they are bitten by mosquitoes. With less water due to the historic drought, birds and mosquitoes increasingly share the same water sources, allowing mosquitoes to contract the virus from the birds more readily.[iii] Additionally, stagnant water creates the perfect habitat for mosquitoes to develop. In certain microclimates throughout California, higher temperatures

increase mosquito production and virus activity, leading to higher infection rates. Last year, Los Angeles and Orange counties experienced unprecedented numbers of West Nile virus infections. The state's 66 mosquito and vector control agencies, represented by the Mosquito and Vector Control Association of California (MVCAC), are the local entities that are charged with providing control measures against mosquitoes and are the first line of defense in identifying and managing mosquito populations. Mosquitoes are notoriously opportunistic and adapt quickly to environmental changes with their rapid life and reproductive cycles. MVCAC members must be able to identify new populations that have adapted to traditional mosquito control measures. This is critical in curtailing the spread of diseases. However, with 66 agencies around a state as large and diverse as California, it is difficult to harness surveillance and resistance data in reliable one place.

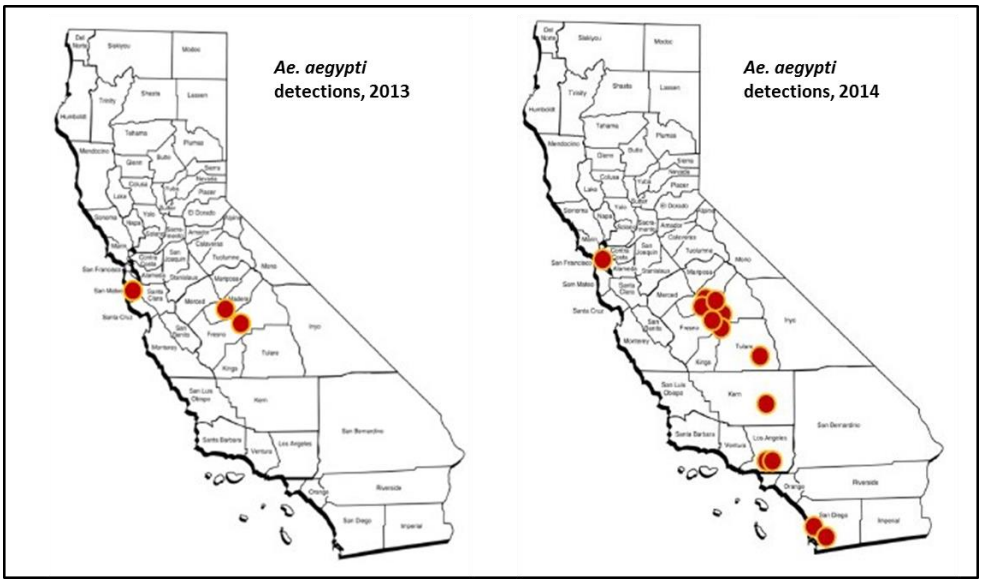
Using Data to Fight Mosquito-Borne Illness

California has historically provided funding for mosquito research, but that eroded in 2008 due to the state's budget crisis. In 1970, the Legislature established the Mosquito Research Program (MRP), directed through the University of California's Office of the President. This provided funding for state-based mosquito research as new species were being identified in California. Significant research was conducted through these grants, which at their highest cost the state less than $500,000 annually. At the height of the state budget crisis, the University absorbed the funding into other research and abandoned a critical public health need.



Enhanced surveillance tools are needed to track hot spots where vectors of West Nile virus and other diseases threaten public health. Technology developed by University of California at Davis Center for Vectorborne Diseases (CVEC) to manage databases and tracking systems for mosquito-borne virus surveillance are currently available and are essential tools in combating vector-borne diseases. These tandem programs are called Gateway and PART (Pesticide Application and Resistance Testing). Together, these two programs comprise a database with a tracking website for growing pesticide resistance in mosquitoes, and a developing structure to make it accessible statewide. In the subsequent years, the surveillance and data monitoring systems that UC Davis CVEC has developed have been at risk of falling fallow as no steady source of funding has become available. As the use of "big data" has emerged in helping businesses shape strategy, local governments adapt traffic patterns; it is time for the state to use big data as a means of improving public health. Without state investment, vector control agencies will not be able to protect the public health as effectively.

The state has also seen the rise of new, invasive mosquito species that seem to becoming established in California despite efforts to eradicate these populations. These new species are especially effective at spreading diseases such as West Nile, dengue, chikungunya, and yellow fever. Prior to 2011, mosquito control professionals had mostly targeted the indigenous *Culex* species. In 2011, *Aedes albopictus* was discovered in Los Angeles, and the *Aedes aegypti* was found in urban parts of Fresno, Madera, and San Mateo counties. *Aedes notoscriptus* is a vetor of dog heartworm and also transmits other viruses that cause human disease. These newly-identified invasive species exhibit different characteristics from indigenous species, and are associated with increased disease transmission. Invasive Aedes are prime disease carriers, have high reproductive rates, short maturity cycles, can adapt to new environments, prefer urban areas, aggressively bite humans, and need very few resources to lay and hatch eggs. Mosquito control professionals need to be able to proactively manage these invasive species, and the enhanced surveillance and planning offered by using statewide data would be the most effective methods of curtailing invasive species. The programming provided through UC Davis CVEC is instrumental in assisting local vector control agencies transition to a West Nile surveillance and control program to an Aedes surveillance and control program, as the surveillance methods, control options, and ecology are significantly different from existing Culex monitoring.



Human and Economic Impacts of Mosquito-Borne Disease

A single mosquito bite can change a life dramatically. In spite of education campaigns and admonitions to wear mosquito repellent, it is extremely difficult to change human behavior and stop mosquitoes from biting. For cases of West Nile that become symptomatic, a mild case involves fever, body aches, fatigue, back pain, and sometimes skin rashes, swollen lymph glands, and eye pain. Those symptoms are on the less acute end of the spectrum. Severe cases may lead to neurological infection, encephalitis, brain and spinal meningitis, and acute flaccid paralysis. Young children, the elderly, and people with compromised immune systems are at the highest risk of becoming symptomatic if they are bitten by an infected mosquito. The American Journal of Tropical Medicine and Hygiene estimates costs due to hospital treatment and lost productivity at $57 million annually throughout the United States.[iv]

Also alarming is the higher prevalence of West Nile in low-income neighborhoods.[v] A 2010 study showed that the most important predictor of finding West Nile mosquitoes was per capita income and that prevalence was consistently associated with low-income areas. High population density combined with abandoned swimming pools that were a result of the housing crisis is just one more example of health disparities being amplified in low-income communities.

California Can Be an International Leader

While these past programs produced reports, plans, tools, and techniques which have helped to curb outbreaks of mosquito-borne illnesses, the dearth of opportunities for new research tools has left the state stagnant when it comes to developing preemptory responses to new mosquito issues. With the spread of diseases like West Nile virus, and the arrival invasive *Aedes* and their potential to transmit West Nile, dengue, chikungunya, and other arbo-viruses, the state needs to be better prepared to protect public health. The current situation regarding measles and the Ebola virus underscores the importance of providing funding for preventive public health programs, as medical staffs did not have the resources they needed to respond and contain those viruses when they first appeared. Similarly, the first incidences of West Nile virus in the United States were also met with unprepared, unstudied reactions, making it difficult to understand and get a coordinated control strategy to combat the outbreak.

The longstanding agreement between the UC and the state provided ongoing funding for grants for research and surveillance of mosquitoes in California. Unfortunately, our state is suffering because the UC's reduced budget forced it to absorb the research funding stream. A modest grant program of $450,000 directed specifically to UC Davis' Gateway and PART programs will greatly assist in managing mosquitoes and curbing vector-borne diseases. Harnessing new research and cutting edge surveillance will not only improve the state's ability to prevent mosquito-borne illness, but can make California an international leader in combatting climate-related public health issues.

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[i] California Department of Public Health. "Reported incidence of West Nile virus illness, California, 2014." Online. Available at www.westnile.ca.gov

[ii] Harrigan, Ryan J. et al. "A Continental Risk Assessment of West Nile Virus Under Climate Change." Global Change Biology. Volume 20, Issue 8. February 27, 2014.

[iii] Dembosky, April. "In California, Less Water Means More West Nile Virus". KQED State of Health blog. Online. Available at: http://www.npr.org/blogs/health/2014/09/22/350636605/in-california-less-water-means-more-west-nile-virus. September 22, 2014.

[iv] Staples, J. Erin et al. "Initial and Long-Term Costs of Patients Hospitalized with West Nile Virus Disease." American Journal of Tropical Medicine. February 10, 2014.

[v] Harrigan, Ryan J. et al. "Economic Conditions Predict Prevalence of West Nile Virus." UCLA Center for Tropical Research. November 12, 2010.