

## **Walter Reed Biosystematics Unit**

*(Written for Clinical RM Newsletter. Clinical RM is a government contractor that staffs military research facilities. I wrote staff bios and features on various programs such as this one over a three year period)*

Last December, when the mosquito-borne disease Chikungunya jumped the Atlantic and began spreading rapidly through the Caribbean, David Pecor was able to walk down the hall from his office and put his hands on the culprit.

Out of a collection of 1.5 million mosquito specimens, David found what he was looking for; *Aedes aegypti* and *Aedes albopictus* collected in the western hemisphere. Both are vector species for “Chik,” and the data from past collections will help develop risk models for the spread of the disease in the Americas.

David is a CRM employee who works at Walter Reed Biosystematics Unit (WRBU) located in the Smithsonian Institution’s museum support center in Suitland, MD. Home to the largest collection of museum research objects in the world, the center houses the National Entomology Collection where WRBU manages the vector species division (USDA manages agricultural pest species, and Smithsonian scientists manage the rest).

With such a large and diverse mosquito collection at their fingertips, WRBU is in a unique position for conducting research on the systematics of medically important insects. Their work enhances the study of disease ecology and helps the military develop control strategies for vector species and vector-borne illnesses. To that end, their many duties include collecting new specimens throughout the world, developing morphological identification keys and DNA coding tools, training military field staff to identify vector species, and developing risk assessment tools for soldiers on deployment and at home.

“We’re translating the vast expertise of WRAIR and Smithsonian researchers into risk models and tools that can be used in the field for the benefit of military personnel,” said David. He’s one of the three employees CRM provides to the unit.

The first, Judy Stoffer has been with CRM the longest. She creates all of the images for WRAIR’s morphological identification keys that help people in the field to correctly identify and report vector species. Since she began, she’s photographed 2,500 mosquito specimens alone and provided images and graphics for 115 mosquito keys and numerous keys for other vectors. Each specimen must be delicately handled and expertly manipulated to obtain the multiple images necessary to convey the morphological characteristics of such challenging subjects as a translucent wing or a leg no thicker than a strand of hair. She’s also employed her broad artistic expertise in the creation of original posters and brochures of the malarial lifecycle, vector-borne

infections, device prototypes and other related subjects. “I basically do most of the graphics for WRAIR’s entomology branch” she says. “That adds value to what I can do for them, and it keeps it interesting for me.”

When Judy began her first short-term contract at WRBU, photo microscopy was completely new to her. She had a master’s degree in medical illustration from The Johns Hopkins University and was running her own freelance business. Her projects had included illustrating a cell biology book for NIH and a book for pediatric orthopedic surgeons. She had expected to return to full time freelance, but shortly after she began photographing mosquitoes, a fascination took hold. She’s found herself behind the microscopes at WRBU for ten years now. “I had no idea just how beautiful they are,” she said, referencing a small poster showing close-up photographs of five different mosquito “backs”. One is a downy grey, another bears markings resembling a leopard’s pelt, and still another looks from a distance like a loofa.

Her appreciation for the beauty of mosquitoes combined with the talent she brings to the paintings and sketches she incorporated into her posters are reflections of an earlier life. Before pursuing her degree in medical illustration, Judy had enjoyed a 20-year career as a fine artist. Today, she spends her free time mountain biking and bicycle touring. She’ll be heading out to Mount Rushmore soon with her bike at her side.

The other two CRM staff members, David Pecor and Dr. Desmond Foley are responsible for VectorMap, an online GIS program used to build risk assessment models for the transmission of arthropod vector-borne diseases. Desmond authored the program along with WRBU staff Dr. Pollie Rueda and Dr. Richard Wilkerson.

Containing searchable collections records, the program allows users to zoom in on any location on the globe and display geo-referenced collection data. A user can view the distribution of a given vector species for instance and overlay a wide variety of data revealing prevalence of disease, host species/reservoirs, habitat suitability for the vector species and more.

New collections are continually being added to the VectorMap database, which numbers close to half a million records, so it serves as a clearinghouse and reporting platform for data for a variety of arthropod vectors; mosquitoes, ticks, sand flies, mites, and fleas.

Desmond is a research entomologist and the technical lead for Vector Map which he began to develop in 2006 when he was an NRC research fellow under Dr. Wilkerson. With a PhD in Medical Entomology from University of Queensland, Desmond was originally interested in studying *Anopheles punctulatus*, the major vector of malaria in the South Pacific and New Guinea. During his fellowship, he began to recognize the huge resource in geo-referenced mosquito collections records that weren’t being stored and made available in any consistent or systematic way.

“We have this vast repository of information about where and when mosquitoes have been collected over the last 100 years or so,” he says, “and I began to think that it would be a good idea to have a system for looking at the data to see what we can learn about vector-borne diseases. I saw that this could be used to develop models based on where they’re collected, and where they should occur based on topography and climate.” Some of the collections and records were stored in obsolete formats such as reel-to-reel computer tapes. Others may only exist on paper in scientific literature, or in the files of scientists who did the collecting. Many of them are at risk of disappearing altogether.

When his fellowship ended, Desmond became a CRM employee in 2007 and stayed on at WRBU, continuing to build a program to “rescue”, standardize and manage this vast pool of “orphaned” data. Much of the data had to be cleaned up and manually entered into the newly designed system, which was then called MosquitoMap. The project has since grown to include the other arthropod vectors. It’s become a valuable tool for developing risk assessment models that help military personnel plan deployment activities, such as where to establish camps and hospitals and where preventative measures are needed to keep their personnel healthy.

His broad goal is to create community within the small circle of people working on vector surveillance globally. He would like to see a collaborative effort to incorporate the dramatically disparate forms of data available into a standardized system for delivery to the general public, researchers and health workers.

It’s a challenging task, but the maps offer him a tangible reward to his hard work. “I enjoy seeing data come to life that’s been sitting on a shelf and been forgotten,” he says. “And to think of the effort that people have gone to, under some pretty hostile conditions, to get these data.” He knows about those efforts first hand, having spent time collecting in the Philippines, the DMZ in Korea, Papua New Guinea and Panama.

After six years as a CRM employee, Desmond finally returned to his native Australia in March 2013. He is now a consultant to the project and makes frequent visits back to the office at WRBU. For now, he’s taking advantage of his Brisbane location to indulge his passion for swimming—having just completed the Byron Bay 2.5 kilometer ocean swim with his local club.

As Desmond was managing VectorMap from Australia, David Pecor was being brought in to fill the newly created position of VectorMap Technical Assistant, and a position for VectorMap project manager has recently been filled. David has been adding to the VectorMap database and developing reporting forms for users to input their own data.

“Having access to the Smithsonian collections is a critical part of being able to do this work,” he says. By mid-May, more than 13,000 specimens had already been barcoded in an effort to create a complete, searchable digital record for the entire collection. David also mines the scientific

literature for other collections data sets and searches gaps in the existing database. For example, a given location may show records of host reservoirs and potential ecological niches, but no records of the presence of vector species. In those instances, he'll search the literature for collections records that can fill in the gaps. "Without this work, a lot of this data would just go away," he says. "I like knowing that we're preserving a digital record that eventually trickles out into public health."

David also works with other groups involved in vector surveys to bring their datasets into VectorMap. Part of that effort involves developing a comprehensive reporting platform that answers the needs of many stakeholders and allows researchers and military personnel with a wide range of training to efficiently submit collection data. He says he's most interested in the reporting side of the platform. He enjoys bringing complex information into clear focus, paying attention to the details and working with data contributors to help them understand the importance of collection protocol. It's a more precise process than it may seem on the surface. For example, specific information on where the larvae are collected has helped scientists to determine that the Asian tiger mosquito breeds primarily in man-made vessels, obviously helpful information for anyone trying to minimize risk.

David's interest in entomology was surely learned from his father, James Pecor, a research entomologist and collections manager who has been with WRBU for 30 years. David earned a BS in environmental studies from the University of Montana, but then returned to the DC area and began volunteering for Desmond. After two successive internships, he was the perfect person to step into the new position.

When he gets the chance, David likes to do a little collecting of his own, sometimes bringing his collection equipment with him on his hiking and camping trips through Maryland and West Virginia.

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While the staff at WRBU are geographically separated from the rest of the CRM team at WRAIR and Frederick, Desmond says he feels their contribution plays an integral role in the work being done in support of the health and wellness of military staff and the public. "I feel like we're connected," he says, "and there's a good environment at CRM. Some of the things they do for recognition are things I've never had anywhere else." David and Desmond also welcome the opportunity to host WRAIR and Frederick staff for a visit and tour of the WRBU collection at the museum support center.