THE BUZZ

UNIVERSITY OF CALIFORNIA RIVERSIDE
DEPARTMENT OF ENTOMOLOGY
NEWSLETTER

WINTER 2000

BUGS, CHICKENS AND COWS

By Brad Mullens, Professor of Entomology

As many of you know, our laboratory is involved in research on veterinary pests, and most of our work revolves around two principal areas. The first is the ecology and control of blood-feeding midges (*Culicoides* spp.) that transmit bluetongue virus, and lately we have begun to examine the pathogen as well in some comprehensive field epidemiology studies. In the process we have gotten pretty good at removing blood samples from cows that generally would rather be left alone. The second is nuisance Diptera, such as little house flies (*Fannia canicularis*) and *Musca domestica*. When it gets right down to it, however much we may desire it, keeping livestock without their manure is pretty tough to do. The juxtaposition of an increasingly urbanized population and animal agriculture creates many problems, and this means designing pest management strategies that will mitigate the problem and still allow the producers to stay in business. Besides those two areas, we have begun to study *Ornithonyssus sylviarum*, the nastiest ectoparasite of poultry in the U.S. It is a blood-feeding mite found around the vent region of the birds. One of these days I really must get creative and study something in a beautiful, exotic, and sweet-smelling location.

The "Bluetongues" Alec Gerry, Kathryn Luhring, Brad Mullens, Mark Breidenbaugh, Teresa Chin, Rob Velten, Corki Szijj.

The recently completed *Culicoides* -bluetongue work involved primarily Alec Gerry (former quite excellent Ph.D. student) and a sizable supporting cast, including Rob Velten, Corki Szijj, Teresa Chin and Katherine Luhring. Over 3 years we characterized the components of vector capacity (biting rates, survivorship, pathogen extrinsic incubation period and vector competence, all of which are influenced by temperature) on the test dairy. The components were related separately and in combination to observed bluetongue seroconversion patterns in sentinel calves bled every 2-4 weeks. While we didn't demonstrate year-round transmission to our sentinel animals, virus was present much longer in the insects. The results suggested a low-level virus transmission pattern, enhanced by excellent vector survival, in winter. Our next step, I hope, will be to look specifically for virus in winter-collected insects and to study low temperature influences on the virus-vector relationship in the laboratory. I am also helping out with a study in the School of Veterinary Medicine at UC Davis looking at the virus at the molecular level as it is transmitted among vertebrate and insect hosts.

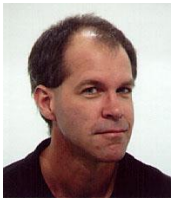
Elsewhere on the *Culicoides* front, Mark Breidenbaugh (former quite excellent M.S. student) described the immature stages of the main species found in desert bighorn sheep habitats, plus a couple of new species to boot. These things are SMALL, especially when one gets down to the level of describing and drawing structures inside the larval head capsule. Amazingly, Mark is none the worse for wear and, best of all, can still see without glasses. Thanks to this, we now can recognize the immatures when we find them in the field. The studies were done by rearing immatures from identified, field-collected adult females. For some species, then, even though we know what the immatures look like, we don't yet know where they are found in nature. The *Culicoides* -transmitted hemorrhagic disease viruses (such as bluetongue) are not considered to be as important in desert sheep mortality as they once were, but they are still bad to have, if you're a sheep. Besides, it is very likely that different species are transmitting viruses in these wild regions, whereas a single species (*C. sonorensis*) accomplishes the dirty deed on dairies. The opportunity to implicate new vector species is one of those things that thrills medical/veterinary entomologists, and we plan to explore this further by feeding virus to some of these potential desert vectors next spring. If a species can be infected by the virus orally, it paves the way for further work.

The manure-fly work is buzzing right along. After demonstrating that alternate row manure cleanout patterns offer little advantage for fly control (the key beetle and mite predators didn't disperse well from older to newer manure deposits across a 1 m-wide concrete aisle), it also turns out that one almost cannot get poultry manure dry enough in the poultry houses to prevent *Fannia* from developing. This is in stark contrast with *Musca*, which requires moist manure for development. Tolerance of dry conditions helps explain why producers with good in-house manure management nevertheless have problems in cool weather with *Fannia* at times. Neither of these findings is particularly good news for poultrymen, but it's still progress. Corki Szijj is our main chicken person; like several

of us, she is very resistant to fowl odors (habituation can be a good thing). A new and soon-to-be quite excellent M.S. student, Jon Darbro, is set to examine *Musca* resistance to toxic fly baits, which are used heavily for house fly control and are ubiquitous on dairy and poultry operations here. One byproduct of incessant fly complaints by neighbors is that many more poultrymen clean their manure out frequently now and dry it in the sun. This pretty well solves the fly problem in many cases, but then the odor can be worse. It's always something. Then there is the dairy fly problem, which is harder to manage, since the fly "developmental substrates" are seldom under cover.

Finally, the past few years we have been getting into work with the blood-sucking northern fowl mite, in conjunction with Nancy Hinkle,Doug Kuney (UC Extension Poultry Advisor), and Mike Brewer (former quite excellent UCR Ph.D. student with John Trumble and now a Univ. of Wyoming sampling guru). It takes a lot to creep me out after all these years, but handling a hen with over 50,000 mites (a fair number of which end up crawling up your arms and then having a party in your eyebrow hairs) will do it. It's one of those things you don't discuss much at the dinner table or with your significant other. Just take a really HOT shower as quickly as possible. Fortunately, in contrast with some of the literature, they haven't yet bitten us. Producers usually spray for these mites whenever the mites become abundant on the eggs and the workers complain, and large mite numbers probably impact production or feed conversion efficiency. We are working toward an egg-based sampling plan to help producers localize and treat at least moderate level infestations. It is less sensitive than examining the hens directly, but producers don't seem to want to do that any more than we do. Besides, at least in the open style houses, a flock without mites is a very rare event. We now have a new and soon-to-be quite excellent M.S. student, Jeb Owen, who will be working on mite behavior, with an emphasis on potential host cues used by the mites for orientation. Corki Szijj and Randy Stumpp are helping out with the field sampling, and Rob Velten is the main guy in screening for mite resistance to acaricides in the laboratory. This summer I will be going to Denmark again for a month or so to work on host cue responses of another chicken mite, *Dermanyssus gallinae*. Animal welfare concerns in Europe are forcing cage modifications and to some extent a return to floor-type operations, as opposed to the confinement cages used here. Parasites like *Dermanyssus*, *Argas*, and some serious pathogens, which require harborage near the host or host-manure contact, should increase in prevalence and/or return to key pest status in many places where typical confinement cage systems are abandoned.

FACULTY CORNER



Peter W. Atkinson is an Associate Professor of Entomology & Associate Entomologist. He obtained his Ph.D. in 1986 from the University of Melbourne, Australia and joined UCR in 1997.

The research in our laboratory focuses on developing technologies that will permit the introduction of genes into insect species of medical and agricultural importance. We have spent several years developing one member of a family of transposable elements as a gene vector in insects. This element, called *Hermes*, can now transform a range of insect species. At Riverside we are particularly interested in using *Hermes*, and other transposable elements that now, too, can transform insects, to examine strategically important molecular pathways in the yellow fever mosquito, *Aedes aegypti*, the southern house mosquito, *Culex quinquefasciatus*, and the Mediterranean fruit fly, *Ceratitis capitata*. These pathways are those that are involved in pathogen transmission, sex determination, and the development of autogeny. In addition, given that these transposable elements are seen as one possible mechanism with which to drive genes into insect populations, we are devoting a considerable amount of time to discovering and understanding both the molecular and environmental parameters that influence the mobility of the *Hermes* element in vinegar fly and mosquito populations.

It has been three years since we established our laboratory in the Entomology Department at Riverside. During that time we have been able to make some progress towards some of our goals:

Rob Hice has developed baculovirus and *E. coli* based expression systems that enable him to express high levels of *Hermes* transposase. Rob is now using the *Hermes* transposase to determine where in the *Hermes* element (and flanking sequences) it binds and will also determine the physical properties of the *Hermes* transposase. **Dennis Bedishi**, a new member of our group, is determining whether or not the *Hermes* transposase is actually biologically active in *E. coli*. If so, this will enable Dennis to undertake a detailed structure:function analysis of the *Hermes* transposase and should result in the generation of hyperactive *Hermes* elements that can transform insects at even higher efficiencies. Dennis is also constructing some autonomous *Hermes* elements that contain the green fluorescent protein (GFP) gene. With **Alex Pinkerton's** help, Dennis will introduce these into caged populations of *Drosophila* and *Aedes* and, for the first time, we will be able to determine if transposable elements can actually invade wild-type populations of mosquitoes. **Alex Pinkerton** is generating site specific mutants in the *Hermes* element to examine how this element moves in mosquitoes and higher diptera. A surprise to us is that *Hermes* appears to integrate differently into nematoceran and cyclorrhaphan genomes and Alex is attempting to find out how. Besides maintaining sanity in the lab, Alex's work on showing that the GFP gene can be used as a genetic marker in mosquitoes will appear on the cover of all six editions of the 2000 volume of *Insect Molecular Biology*. **Kristin Michel** is using a yeast expression system to determine how single molecules of the *Hermes* transposase interact with each other and with other transposases that are related to the *Hermes* transposase. She is also interested in examining any interactions between the *Hermes* transposase and any host-encoded proteins. Her work is important since determining the interactions that occur between the *Hermes* transposase and other proteins will help to predict the behavior of this transposable element in insects into which it is introduced. Kristin has also characterized, at the molecular level, the several independent *Hermes*-mediated transformations we have generated in *C. capitata*. A manuscript describing this work, with Kristin as first author, will be submitted for publication during the winter quarter. **Yu Jung Kim** is working on a transposable element that is related to the *Hermes* element. This element, called *hobo*, can also transform insects although it is not as effective as *Hermes*. Nevertheless a comparative study between these two related elements helps with understanding how structural differences between them relate to functional differences as gene vectors in insects. Yu Jung is genetically mapping sequences in *hobo* that are important for transposition and is also looking at the role that a *Drosophila* protein called inverted binding repeat protein might play in the mobility of the *hobo* element. **Meg Allen** has used the *Hermes* element to genetically transform a second medically important mosquito species – *Culex quinquefascistus*. This, coming so soon after the initial *Aedes* transformation breakthrough, has been a surprise to everyone but Meg, who never lost confidence. With the help of **Cynthia LeVesque**, Meg is now determining the molecular basis of *Hermes* transposition in *Culex*. Soon Meg may even be looking at some *Culex* salivary gland promoters to see if any of these can be used to express sufficient

quantities of desired protein in *Culex* salivary glands. **Mark Robertson** has been examining a key sex determination gene, called *transformer-2*, that he cloned from *C. capitata*. The exact molecular basis of sex determination in *C. capitata* is unknown; however, by analogy with *Drosophila*, we know that *transformer-2*, should play a key role. Manipulation of *transformer-2* in transgenic *C. capitata* may lead to development of new genetic sexing strains that could be used in existing sterile insect technique programs. In addition, *transformer-2* provides us with one further step back to the key male determining gene in this species. **Amy Chin** and **Suzy Zaghloul** have been testing some observations that were originally made on the *mariner* transposable by **Dr. Yves Bigot**, a recent visitor to the **Federici** laboratory. More specifically they are determining whether the left hand and right hand inverted terminal repeated sequences of *mariner* are functionally identical by examining their behavior in developing *Drosophila* embryos. **Daryl Martinez** is also looking at the *mariner* transposable element but, in this case, the mariner element comes not from Drosophila but from distantly related insect species. Daryl is anxious to determine if this particular mariner element is mobile. If so, it would be only the second natural form of this element that could be directly used as a gene vector.

We continue to have a strong collaboration with Dr. David O'Brochta's laboratory at the Center for Agricultural Biotechnology at the University of Maryland. In addition, we have ongoing or new collaborations with the Entomology Unit at the International Atomic Energy Agency Laboratories in Seibersdorf, Austria, with Dr. Anthony James at the University of California, Irvine, with Dr. Jose Ribierio at the National Institutes of Health, and with Dr. Giuliano Gasperi at the University of Pavia, Italy.

For a complete listing of Entomology faculty, staff, postdocs, graduate students and access to all of the latest news in the department, check out our website: http://cnas.ucr.edu/~ento/index.html

ALUMNI FEATURE

In this issue we are proud to feature one of our distinguished alumni – Dr. Raymond E. Frisbie. Dr. Frisbie is Professor and Head, Department of Entomology, Texas A & M University.

Dr. Frisbie attended the University of California, Riverside and received his B.A. in Zoology in 1967; his M.S. in Entomology in 1969 and his Ph.D. in Entomology in 1972. He has a national and international reputation for the development and delivery of Integrated Pest Management (IPM) systems. His special area of expertise is cotton IPM.

Dr. Frisbie has been with The Texas A&M University since 1972. He co- ordinated 22 Extension IPM programs across 60 major agricultural producing counties involving 10 commodities in Texas. These efforts to transfer IPM technology to the key agricultural industries provided significant economic and environmental benefits to the state. He led in the formation of the Texas Pest Management Association, the largest farmer operated, non-profit IPM association in the U.S. Dr. Frisbie was a primary organizer of the National Coalition on IPM, a producer, food processor, environmentalist and consumer coalition formed to support greater implementation of IPM in the U.S. He also led in the organization of the National Foundation for IPM. He was a founder and served as Director (1991-1993) of the Center for Biologically Intensive IPM at Texas A&M. Dr. Frisbie was Director of the Consortium for Integrated Pest Management (1979-1985), a 17 university, 250 scientist, interdisciplinary research program. He is a member of the ESA Committee on Policy Issues Oversight and the Council of Entomology Department Administrators (CEDA).

Dr. Frisbie has given invitational addresses at National Academy of Sciences special symposia, UNDP/FAO in Rome, International Congresses of Entomology, and numerous national professional societies. He has served as a special IPM consultant in Egypt, Sudan, Colombia and Brazil and to the UNDP/FAO Panel of Experts on IPM. Dr. Frisbie has an extensive publication record with over 100 publications in scientific journals, books and conference proceedings, and has served as the lead editor on three books.

On a personal note Dr. Frisbie enjoys fishing, especially wading the crystal clear salt water flats near Corpus Christi in search of red fish and speckled trout. He finds fly fishing in Texas to be an uplifting experience. He is the proud father of a teenage girl, Katelan, "who offers all the challenges of a normal, healthy teenager." His wife Renee is a leader in the community focusing primarily on improving the College Station school system.

Dr. Frisbie can be contacted at rfris@tamu.edu .

CHAIR'S MESSAGE

By Tim Paine, Department Chair

The Entomology Department has undergone several significant changes since July 1999 and enters the new century with exciting opportunities. Members of the entomology faculty who were also part of the Environmental Toxicology Graduate Program (Drs. Eastmond, Gill, Grosovsky, Mehra, and Sladek), as well as several members of the biology faculty, transferred their departmental affiliations to the Department of Neuroscience. The newly expanded unit is in the process of changing its name to the Department of Neuroscience and Cell Biology. These changes have occurred at a time of unprecedented growth in the undergraduate student population on campus. The increase in student numbers has brought new faculty positions to the campus and the Entomology Department. The prospect of obtaining new positions has provided an opportunity for the department to assess the future directions for research and teaching. We are in the process of conducting open searches for two new faculty positions this year. The first position is in the area of molecular population genetics, with particular emphasis on the genetics of small populations and introduced species. We expect that the successful candidate will be able to develop strong interactive links with our existing research strengths in both the department and in the college in the areas of exotic/ invasive species, biological control, and conservation biology. The second position is in the area of the molecular basis of perception. The department maintains a long-standing reputation for excellence in the area of insect behavior and chemical ecology. The individual filling this position will provide a vital synergistic complement to our existing research strengths at the organism and population levels. In addition to these two new faculty positions, we hope to be able to recruit for two or three more new faculty members during the next two academic years. We are in a very fortunate position, relative to many other entomology departments elsewhere in the country, in having the opportunity to add new faculty as well as having two new buildings under construction. The prospects for the future are as bright as they have ever been.

BUILDING UPDATE

By Dan Hare, Department Vice Chair

The official groundbreaking ceremony for the new Entomology Building occurred on September 13, 1999 just outside of Chapman Hall, at the southwest corner of the site. Speakers from UCR at that function included the Chancellor, Dr. Raymond L. Orbach, Associate Dean Philip A. Roberts, and Entomology Department Chair, Timothy D. Paine. Also speaking were members of the agriculture community including Mr. John C. Veysey, Mr. Robert Perkins, and Mr. John Moramarco.

The building will be comprised of three floors and will total approximately 67,000 square feet in size. Research laboratories and offices will take up almost 39,000 square feet of the total. The building was designed to house 20 research groups as well as the Department of Entomology's administrative offices. The new building will replace the old Main Entmology Building, Annex I, Annex II, and the Insectary, all of which have been found to be seismically unsafe.

Prior to the ceremony, the building site was cleared by demolishing the old University Club and the old "Temp" lab. Annex II was also demolished subsequently. The bid for construction was awarded to Skidmore Construction Co. of Rancho Cucamonga, and their first day of work was October 18, 1999. Since then, the contractor has been busy erecting fences for safety around the construction site and opening trenches around the site to lay new utility lines.

A major challenge in constructing this new building is to continue to provide all utility services to the surrounding buildings during construction. In order to do this, new utility lines need to be installed on the periphery of the building site in order to continue to serve all of the buildings surrounding the site, in addition to the utility lines that are needed for the new building itself. This work has gone more slowly than anticipated because a number of utility lines have been found by the contractor that do not appear on any plans. Some of these are old, abandoned lines that have been removed, while others are active lines whose locations were poorly documented when they were installed. Most of these problems were addressed during the first two months of construction, and the project is now well under way. After the peripheral utility work is completed in late February or March, 2000, the next phase will be the excavation of the site for the building's foundations. We anticipate moving into the new building around the start of classes in the Fall of 2001.

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ADDRESS CORRECTION REQUESTED

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