Bohart Museum Society

Fall 2022 | **Newsletter** | **No. 92**

In This Issue

The beginning of fall quarter here at UC Davis marks the start of many changes in the museum. The most significant of which is a change in the museum's full-time personnel. Steve Heydon will be retiring, marking the end of decades of his collections management.

Our fall members meeting in October will be a major event. Please put it on your calendar—Oct. 29 from 5-8pm. There will be plenty of food and beverages. We will be unveiling awesome new exhibits and you'll be able to meet our new staff members.

-Lynn Kimsey

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SPOTLIGHT ON A SPECIES

What Do Insects See?

by Lynn Kimsey

Mantis showing eye spots. Photo by Kathy Keatley Garvey.

In most animals vision is critical to detect light and movement. For obvious reasons flying animals require highly developed vision. However, the mechanics of how an animal sees can vary widely from group to group, particularly in the insects. Adult insects generally see using their compound eyes and ocelli, which are small single facet "eyes" on top of the head. Larval insects "see" via stemmata, through their integument, or not at all.

Single facet eyes, called stemmata, are found primarily in insect larvae. They are critical to detect light and maybe movement, but not much else. Stemmata are like the ocelli found on the top of adult heads. Both detect changes in light and dark, and day length. In caterpillars there are three to six on the side of the head.

In adult insects the compound eyes are located on either side of the head, or may in some species and particularly in males, occupy nearly the entire head. Compound eyes consist of multiple facets called ommatidia. Each ommatidium functions like tiny telescope and collects light from small part of the insect's visual field. All of these images are merged deep in the eye. In addition, the eye as a whole also collects light.

Mammals and birds have a single lens that projects an image onto a sensory membrane at the back of the eye called the retina. In insects each ommatidium functions in much the same way. Each one has a lens that focuses light on a retina. But in the case of insects the retina is tubular. The resulting image from compound eyes is synthesized from 1000's of these small images.

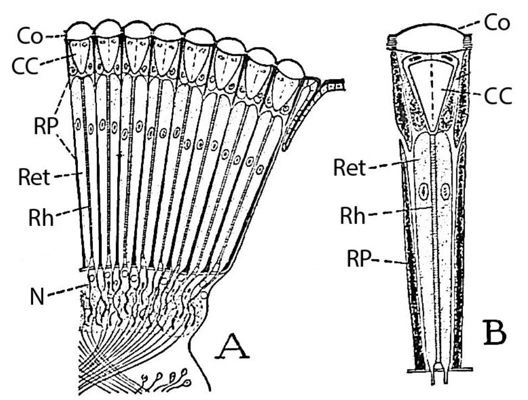

Diagram of an insect eye and ommatidium; CC = crystalline cone; Co = corneal lens; N = nerves; Ret = retina; Rh = rhabdom, and RP = retinal pigment. Image from Snodgrass 1935.

The structural differences between our eyes and insect eyes result in very different views of the world. The very large size of our eye means that we are able to perceive a relatively wide range of wavelengths, ranging from dark red

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Museum News

Thanks to Our Donors in 2022

Many thanks to all of our generous supporters this year.

$500+

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Robert Parks & Priscilla Broadkin
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Gary Ling & Deanna Jackson
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Other Donations

Stevanne Auerbach—892 butterfly designed household objects, books and clothing
Terry Sears collection—8,000 moths
Andrew T. Groover—ichneumon wasp sculpture by Leo Huitt
Alfred Habegger—2,571 butterflies & moths, 24 Cal Academy drawers, 1 24-drawer cabinet and 3 BioQuip display cases
Arnold Menke—more than 3,000 books and scientific articles, and 240 historical photographs of wasp taxonomists since 1800
James R. Mori—1,364 butterflies & moths
Jeff Smith—15,000 butterflies and moths and 100+ drawers and spreading boards in addition to the backing for the new display
Dan Dandri—6 display drawers
Kady Tauber—2 dissecting microscopes

Upcoming Events

September 25, Wasps!, 1-4pm

October 15, Insects, Art and Culture, 1-4pm

October 15, Special talk: Mary Foley Benson's Scientific Illustrations; 11-11:50am, TLC Bldg, room

October 29, members fall meeting, 5-8pm

November 6, Dragonflies!, 1-4pm

January 22, Beetles!, 1-4pm

February Biodiversity Museum Day, date TBD

March 18, Many Legged Wonders (more than six :)

April 15, Picnic Day.

May, Forensics; TBD

June, Ants; TBD

Genetic Control of the Western Encephalitis Mosquito in California

By Richard Meyer

One hopeful mosquito control strategy was to raise and release sterile males to mate with wild females resulting in no viable offspring.

Historically, an attempt to demonstrate and implement a genetic control strategy against the Western Encephalitis Mosquito *(Culex tarsalis)* in California essentially failed as due to preferential mating differences (assortative mating) between laboratory selected (control agent) and wild (field target) populations. When wild populations are reared in the laboratory, a significant selection process occurs whereby "wildness" is largely eliminated. As a result, the colonization process largely selects a subpopulation with mating behaviors taking place in the realm of confined space. However, in the wild, the dominant mating behavior of *Culex tarsalis* necessarily occurs in large swarms. Previously, there was no knowledge that assortative mating existed and would eventually be recognized as a major flaw in this strategy as an environmentally preferred strategy towards vector management of *Cx. tarsalis* in California.

Field and laboratory studies conducted at the Arbovirus Field Station in Bakersfield by the School of Public Health, UC Berkeley in the late 1970s and early 1980s discovered this assortative mating "glich" in an unsuccessful attempt to demonstrate efficacy via this novel approach to vector population management by using a species (*Culex tarsalis)* against itself. As a Research Entomologist, I participated in those studies conducted at an isolated field site at Poso Creek north of Bakersfield, CA in large screened Quonset structures outdoors. The results of those studies were convincing. Field studies demonstrated that Poso wildtype *Cx. tarsalis* mated among themselves while wildtype female matings with lab mass reared *Culex tarsalis* males carrying a genetically lethal translocation gene to be an extremely rare event. Another revelation of the Poso studies indicated that "translocation" males were significantly less dispersive and tended to remain near release points. To the contrary, outdoor Quonset cage studies where laboratory and wild strains were comingled in equal numbers of males and females, the results were significantly biased towards laboratory strains largely mating among themselves with wild females essentially being unreceptive to mating with either laboratory or wild males.

Our overall conclusion from both field and cage studies became obvious. "Laboratory" translocation carrying male *Culex tarsalis* just did not perform to an extent required to be an effective biological control agent in nature. A favorable outcome would have been demonstrated by a natural eurygamous relationship between laboratory males and wild females. Furthermore, one may consider the results as an indication that conspecific laboratory vs. wild strains behaved as if both were a "separate" species. Hence upon encounter, a profound identity paradox must have occurred as if "Who are you stranger"!

MORE MUSEUM NEWS

Museum Staff Changes

All kinds of changes are happening in the museum this year with people coming and going.

Retirement

Big news! Steve Heydon is retiring at the end of October, so our October 29th meeting will be particularly poignant. Steve's been here for three decades as Bohart collection manager. He still plans to work in the museum after he retires. This time focusing on his pteromalid wasps.

More Changes

Brennen Dyer will take over from Steve as collection manager. We had a talented group of undergraduates working in the museum this summer. Solea Wantz, Amberly Hackman, Brittany Kohler and Francisco Basso worked on various projects in the museum, taking care of the petting zoo, curating specimens and databasing. In addition, Brittany and Francisco created the incredible new butterfly display, which will be unveiled at the October 29 members meeting. Sol and Amberly will continue working part-time in the museum in the coming year.

Everyone is shifting positions. Brennen Dyer will be taking Steve's place as collection manager. Brittany will be taking Brennen's place as full-time research associate in the museum. We had hoped Francisco could stay on after graduating, but he had to head home to family after graduating.

Severyn Korneyev, who has been doing a postdoct on tephritid fruit flies in the Bohart for the past year will be taking a full-time position at the California Dept. of Food and Agriculture in Sacramento.

Brittany Kohler and Francisco Basso at Moth Night.

Sol Wantz, with Kaitai Liu.

Amberly Hackman.

Weird Things Caterpillars Do*

1. Hopping caterpillars (*Calindoea trifascialis*) make cases out of leaves and then hop in the case to find a safe place to pupate.
2. Camouflage looper (*Synchlora aerata*) creates a costume out of flower petals and other plant parts that it sticks to its back with silk.
3. Mad hatterpillar—the gum leaf skeletonizer (*Uraba lugens*) glues its old head capsules on top of its head, creating a head tower.
4. Defensive halitosis—tobacco hornworms sequester nicotine from tobacco plants and can release a toxic cloud from their spiracles.
5. Escargot loopers—the Hawaiian *Hyposmocoma molluscivora* caterpillar preys exclusively on snails.
6. Slave-making oakblue butterfly (*Narathura japonica*) caterpillar chemically enslaves ants to protect it from parasites and predators.
7. Trumpapillar—a Peruvian flannel moth (*Megalopyge opercularis*) with an impressive yellow combover that hides venomous spines.

* Taken in part from https://listverse.com/2017/08/30/10-fantastic-and-bizarre-caterpillar-facts/

Fran Keller in front of the British Museum of Natural History in London, wearing a Bohart Museum t-shirt.

Continued from page 1.

to blue. Because of the small telescope shaped ommatidia that make up the insect eye only relatively short wavelength light can be perceived. As a result, compound eyes cannot detect the long wavelength light including red and can generally see from yellow to ultraviolet (UV) (often called bee purple) instead. To insects, red is black. Red colored flowers either have UV coloration (that we can't see) or they are trying to attract birds and not insects.

The best color vision and visual acuity is probably found in bees because they must recognize a wide range of flower colors, patterns and shape to collect pollen and nectar. Many of these bee-visited flowers have special stripes and other UV patterns to guide bees correctly into the flower for pollination services.

There are two basic kinds of compound eyes in insects, apposition and superposition. Both kinds of eyes look pretty much the same externally. Apposition eyes are found in day active insects. In apposition eyes each ommatidium forms a small inverted image and all the images are superimposed to form a single image.

Superposition eyes are probably the most primitive form and are found in nocturnal insects as well as other nocturnal arthropods. They are built to capture as much light as possible. In superposition eyes the ommatidia all together collect light into a single image as opposed to each forming an image that is then merged.

There are many different modifications of insect eyes. Some insects, like mantises, have a pseudopupil, which appears to move as you move, as if the insect was watching you. This is caused by ommatidia that are aligned perpendicular to your field of view, absorbing all light in this view making the area appear black, whereas the adjacent ommatidia reflect the light. Many of the wildest modifications occur in the flies. Other insects have brightly colored or banded eyes, but nothing that rivals the eye coloration of some horseflies. These patterns tend to be more pronounced in females and they tend to be typical of entire genera. In *Tabanus* the eyes have four green stripes. In other genera the colors may be in zigzags or spots. It may be that these colored ommatidia may act as light filters, making vegetation less obvious than potential hosts.

In other flies, males may have hugely elongate heads with the eyes at the end of long stalks. The eyes are very round and they may actually have limited binocular vision. In this case the eye stalks are more for male-male competition and attracting females than for any quality vision.

Male Strepsiptera have eyes that resemble raspberries. They have unusually large ommatidia, with enlarged strongly convex lenses. Strepsipteran eyes are a unique eye type intermediate between a compound eye and image forming single eyes like ours. Their eyes apparently evolved for nocturnal activity and capture as much light as possible, with each ommatidium collecting an image that is then merged with other images.

One of the wildest eye modifications can be seen in male mayflies in the family Baetidae. Their eyes are turbinate and really appear to be four separate eyes not two, as in the photo to the right. The upper half of the eye bulges dorsally with dense, small ommatidia facing upwards, and functions as a superposition eye. The bottom half of the eye is ovoid with ommatidia facing laterally and downward. This part is an apposition eye. The two parts of each eye are separated by a large, clear zone crossed by elongate cells. What kind of image is assembled from these very different structures is unclear.

Interestingly the vertebrate eye probably evolved as early as 200 million years ago. Whereas the insect eye probably evolved in the Carboniferous period, some 500 million years ago.

Female *Tabanus* horsefly. Photo by Alex Wild.

Male striped horsefly. Photo by Thomas Shahan, Wikipedia.

Male baetid (*Callibaetis* sp.) mayfly. Photo by David E. Reed

Achias stalk-eyed fly. Photo by Australian Museum.

Male *Xenos* (Strepsiptera) head. Photo by Mike Hrabar.

Invasion of the Exotics

Clash of the Exotics

Here in North America wherever you have humans you have exotic species. We plant mostly exotic plants in our gardens, and create highly simplified environments around our homes and businesses, with few natural enemies making such environments easy marks for invasive exotic species.

Here in Davis we have a wide variety of exotic insects, including houseflies, several species of butterflies, six species of cockroach, leaf footed bugs, various aphids and plant bugs, a variety of moths, and more. Only some of these insects are considered “pests”.

Some interesting exotic species versus exotic species interactions are taking place in Davis. We now have well established populations of European paper wasps (*Polistes dominula*), in addition to long established populations of exotic species like cabbage white and sulfur butterflies, and house flies.

When you add these to all of the exotic plants we plant in our gardens some interesting interactions can happen.

Gulf fritillary butterflies (*Agraulis vanillae*) only feed on passion vine, species of *Passiflora*, which is exotic in California. It turns out that the European paper wasp happily feeds on gulf fritillary caterpillars.

If there’s a pond nearby there might be flame skimmer dragonflies (*Libellula saturata*), which are the same color as gulf fritillaries. At the same time the butterflies are visiting the passion vine the male flame skimmers may view them as competitors invading their territories. The resulting interactions between butterflies and dragonflies can be very entertaining. Add to this the European paper wasps preying on the gulf fritillary caterpillars and you get exotic versus exotic interactions that have no effect on native insects and plants except perhaps distraction on the part of the male dragonflies.

Frog mouth *Polistes dominula* nest in Davis. Photo by Bruce Hammock.

Gulf fritillary butterfly on passion vine flower. Photo by Kathy Keatly Garvey

Flame skimmer dragonfly. Photo by Tom Roach.

Spotted Lanternfly Update

The spotted lanternfly, *Lycorma delicatula*, is a brightly colored plant hopper with bright pinkish red hind-wings. It is native to China and was first found in Pennsylvania in 2014. This insect feeds on a wide variety of trees and other woody plants and its possible that it was introduced in imported woody plants or wood products.

Since its introduction, it is slowly spreading into adjacent states, including Maryland, New Jersey, New York, Virginia and Delaware.

Although central and coastal California are listed as potential habitats for this invasive species it seems very unlikely that it can establish here because this species is adapted to wet summers. As a consequence it is very unlikely to establish on the West Coast. In a way this is too bad as it would be nice for once to have an invasive pest that’s not brown...

Spotted lanternfly in Brooklyn Botanic Garden. Photo by Rhodeodendrites, Wikipedia.

The Dragonfly

by Bakusui

Dyed he is with the
Color of Autumnal days,
O red dragonfly.

More in the Museum

New Displays

Its time for a change in the Bohart. We plan to have all new exhibits in the museum and in the hallway in time for the October society meeting. There will be three totally new exhibits featuring landscapes and butterflies. Two will be interactive, with large landscapes designed by Allen Chew and Megan Ma printed on metal. They also designed a diversity of animals printed with magnetic backing that kids can arrange on the landscapes.

The new plexiglass display cabinet in the hallway outside the Bohart Museum will house a spectacular butterfly display designed by Brittany Kohler and Francisco Basso. The display will be revealed at our October open house.

These displays were funded in part by the Bess Spiva Foundation. Carpentry for the back of the plexiglass display box to mount it on the wall was made by Jeff Smith.

Metal landscape displays, with magnetic toe biter on the first one.

Chase Fowler and Gregory Mathisen from UC Davis facilities installing a new plexiglass display cabinet in the hallway outside the Bohart Museum.

Moth Night

Moth night in the hallway. Photo by Srdan Tunic.

Moth Night in July was a great success. We had more than 400 visitors come to the museum! Outside of the museum building we ran a black light outside to attract moths and visitors got to create chalk art on the pavement around the tardigrade sculpture. The sculpture got renamed “Teddy”.

Moth Night chalk art. The tardigrade sculpture has a new name. Photo by Srdan Tunic.

ASK THE BUG DOCTOR

If you have an insect question, need advice, want an identification of something you've found, or would like to see an article in the newsletter on a particular topic let us know. Email us at bmuseum@ucdavis.edu.

Oak Galls

Crystalline wasp galls on blue oak. Photo by Diane Martin.

Some spectacular galls have been showing up on blue oaks in our region.

Monarchs

Tagged monarch found in Vacaville. Photo by Kathy Keatley Garvey.

Despite all the bad news about monarchs in the media these days, monarch populations on the West Coast are apparently doing very well according to a study by David James at Washington State University, Pullman. He's reporting large numbers of monarchs in the Pacific Northwest as well as strong reports from Utah, Nevada and eastern California.

Depending on the fall temperatures, monarchs will either migrate to overwintering roosts or establish winter breeding populations in and around coastal California, leading people to assume the population has crashed because they aren't showing up at their traditional over-wintering sites.

Fig Beetles

Cotinus mutabilis on a peach. Photo by Jack Kelly Clark.

Green fig beetles (*Cotinus mutabilis*) have apparently done very well this summer. We have gotten reports from many sites in northern California. This is one of California's more spectacular native beetles. They particularly like compost piles, which may explain their abundance.

Yucca Weevils

Adult yucca weevil. Photo by Margarethe Brummermann, BugGuide. Damaged yucca in Davis. Photo by Lynn Kimsey.

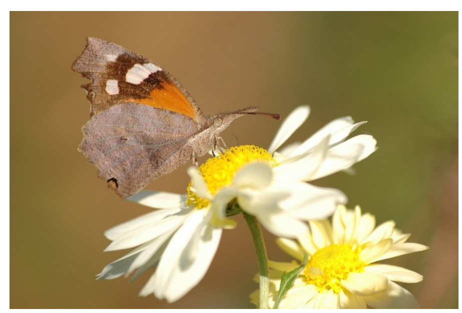
Although yucca weevils in the genus *Sycophorus* are widespread in southern California, they aren't all that common in northern California. They've now shown up in Davis and it turns out that this weevil is increasingly showing up in damaged garden yucca plants. The larvae feed in the root base.

California Oakworm

Oakworm moth. Photo by Gary McDonald, Bugguide. Caterpillars in Monterey. Photo by Daniel Brown.

Periodically the California oakworm moth (*Phyganidia californica*) has local outbreaks. One such outbreak is now occurring in the central coast of California. Although oak trees can be completely defoliated during such outbreaks it apparently doesn't harm the trees unless the tree has another issue, such as a pathogen.

Snout Butterflies



American snout butterfly. Photo by Ospr3yy, Wikipedia.

The American snout butterfly (*Libytheana carinenta*) has annual migrations through central Texas. Although not as spectacular as monarchs, large numbers fly across the state every year much like painted lady butterflies. As we learn more about insect populations we're finding more and more species that migrate in this fashion, sometimes due to the timing of blooms and sometimes climatic conditions that lead to numbers of host plants.

Bohart Museum Society
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Don't miss the annual Halloween Society meeting!

October 29

5-8pm