Directors Note

So much has happened this summer it is hard to know what to include in the newsletter and what has to be left out.

The drought is the most significant factor affecting insect populations this year. We’ve had new pests arrive in the state but with the drought it seems like everything is holding its breath.

It’s been a fun-filled eventful summer, with lots of museum activities and student projects. We hope you will be able to stop by and visit us before school starts again!

Lynn Kimsey

SPOTLIGHT ON A SPECIES

Insects and Drought

By Lynn S. Kimsey

The drought in California is having an impact on all parts of the state and insects are no exception. Californians tend to focus on their lawns and the price of water, but the State’s wildlands and animals are also affected. For a number of years rainfall amounts have been dropping, with the least falling in the last four years. The effect on insect populations has been unpredictable, and dependent on the biology of each species. Some insect populations have nearly disappeared, whereas others are exploding. The reasons for one or the other are complicated.

Drought affects our environment in a number of ways. Often times lowered rainfall is accompanied by changes in seasonal temperatures. So depending on the insect species population numbers could be affected either by the lack of rainfall or by warmer than usual temperatures. We had a very mild winter this year and it definitely affected plants and insects. Herbivorous insects are affected by the impact on their host plants. Trees and other woody plants are stressed by lowered water availability. Herbaceous plants might not even germinate. Thus insects that feed on woody plants might do better because the plants cannot mount effective defenses against herbivores. Whereas insects that feed on annual or herbaceous plants would be threatened because their host plants aren’t even present.

In our alpine forests, the steadily decreasing rain and snowfall is leading to extensive tree die-offs. Conifers that are water stressed are vulnerable to attack by bark beetles. The trees are unable to effectively defend themselves with resin because their oleoresin system is “powered” by their water-filled vascular system. This allows the beetles to colonize the trees. If enough beetles attack a tree they will kill it.

Drive through any western conifer forest these days and you’ll see large numbers of dead or dying pines. The culprit is the ponderosa pine or western bark beetle, *Dendroctonus ponderosae*.

Historically pine forests

Kids in the Museum

Some of our favorite visitors are the younger ones whose sense of discovery and wonder keeps us all happy to be here.

Joel Fuerte, 6, of Woodland watches as Roxanne Bell, 7, of Davis reacts to Peaches, a rose-haired tarantula, "tickling" her at the Bohart Museum on April 23. The Bohart Museum was one of the buildings open for Take Our Daughters (And Sons) to Work Day. Peaches is a crowd favorite. (Photo by Kathy Garvey).

A note from one of our young visitors.

Congratulations Jeff!

Our own Jeff Smith is going to be awarded the College Award of Distinction this fall. The celebration will be held on Friday, October 2, 2015 by the College of Agricultural & Environmental Sciences, UC Davis. This will be the 27th annual College Celebration.

No one deserves this award more than Jeff. *The Award of Distinction is presented by the college to individuals whose contributions and achievements enrich the image and reputation of the college and enhance its ability to provide public service.*

If you would like to attend the College Celebration and help Jeff and his wife Cathy celebrate you can sign up at [http://www.caes.ucdavis.edu/connect/events/college-celebration](http://www.caes.ucdavis.edu/connect/events/college-celebration).

Please join us in congratulating Jeff!

Robbin Thorp sharing a male carpenter bee with a Picnic Day visitor. Photo courtesy of Kathy Garvey.
Bug Splats and NASA
by Lynn Kimsey

It turns out that insect splats on jet wings can cause turbulence. Turbulence in turn increases fuel consumption by slowing flight. By cutting down on bug splats it is possible increase fuel efficiency in commercial jets. To address this issue Boeing and NASA teamed up to research different ways to prevent or at least lessen the number of splats.

Now I’m sure at this point you’re wondering what this has to do with the Bohart Museum. Well it turns out that they needed an entomologist to help them find a mid-sized airport in the U.S. that had a large amount of insect activity in April and had a runway that could accommodate a Boeing 757 jet. So last year I traveled with NASA and Boeing engineers to six airports, in California, Florida and Louisiana. We finally decided on Shreveport, Louisiana as the ideal site in April – plenty of bayous, not too windy (or rainy), long enough run way and happy to collaborate. Of course as with all such plans there were delays, and we didn’t go to Shreveport the following year for the test flights until May 2015.

So 2015 arrives and we’re off to Shreveport for two weeks. Boeing flew in their EcoDemonstrator 575 jet for testing wing modifications to repel bug splats. NASA engineers had developed four different surface treatments designed to repel bugs and Boeing had wing modifications to test. The NASA treatment panels ranged from smooth to rough like sandpaper, alternating with four untreated panels installed on the right-hand wing. They first tested the coatings in the laboratory by using a bug gun to shoot Drosophila flies at the panels.

If weather conditions were good the jet did a series of take-offs and landings, going up to an altitude of 5,000 ft. to maximize bug splats. Once the flights were finished for the day the panels were removed, the splats counted, and the insects identified if possible. The panels generally had between 100 and 500 splats each, so counting took a long time. After counting the panels were washed and reinstalled for the next day’s flight.

It turns out that identifying the insects causing the splats wasn’t too difficult. After surveying the insects in the vegetation around the runways in my stylish fluorescent green safety vest (photo above), and making sample splats on paper, a relatively small number of species were found to be causing the bulk of the splats. The most abundant insects we found on the wings and in the airport vicinity were flower flies (family Syrphidae), aphids, thrips, muscid flies, midges, mosquitoes and love bugs (family Bibionidae). Interestingly, the syrphid and muscoid flies had bright red eye pigment that looked almost like a spot of blood in the splat.

Several of the coatings worked well, with 40% fewer splats than found on the other panels. Overall, we had a great time, and ate a lot of fried food, played at the airport and spent hours going over smeared insect bits.

Nirvana!
have long undergone periodic die-offs caused by bark beetles. These die-offs correlate with drought. However, they also serve to feed another outcome of drought – fire. Dead pines provide extra fuel for forest fires and forest fires become commoner during droughts. Ironically, fires are often the very thing needed to bring the bark beetle populations under control. Killing both the beetles and the weakened trees they infest.

Because we really didn’t have a real winter, with cold temperatures and rain, many insects, such as houseflies, began breeding much earlier, giving their populations an early start to build in numbers. Houseflies are doing incredibly well this year. The Sacramento Valley is well known for its housefly populations in late summer and fall, which generally accompany the tomato harvest, but this year we’re already seeing huge numbers of these flies’ months before their usual peak of abundance. An individual female housefly can lay several hundred eggs in her lifetime and half of those result in females in as little as two weeks you can see how the population can get huge quickly.

There have also been a lot of complaints about outdoor flea populations in the region. There may be a number of reasons for this. First, the mild winter may have allowed larger numbers of outdoor fleas (adults and larvae) to survive the winter. Adult fleas need animal blood to survive and lay eggs. The larvae need animal debris, such as shed hair and skin flakes, generally found in nests to survive. Adults are not particularly picky about who they feed on. Cat fleas for example are commonly found on dogs, but they will also feed on rabbits, coyotes, horses, skunks, possums, deer, raccoons, humans and turkeys! Drought brings many of these host animals out of the wildlands into suburban areas in search of water and forage. As a result, their parasites, including fleas are brought into increasing contract with humans. This is one of the reasons why it’s a good idea to keep wildlife away from your home.

Another group of insects showing some odd patterns are the mantids. On the valley floor we’ve seeing adults much earlier in the season than usual. Yet we’ve received a number of calls from folks in the Sierra foothills who are not finding mantids at all even though normally they have large numbers in their yards. The only explanation we can come up with for the discrepancy has to do with the mild winter. It may be that valley mantids got off to an early start like the fleas and houseflies. Those in the foothills may have also emerged early but died because there wasn’t food available. Many of the small insects that the newly emerged mantids rely on for food might not have emerged as early as the mantids did, so the baby mantids starved.

Finally, native black walnut trees are also being badly affected by the drought. These trees were already in decline because of thousand cankers fungus transmitted by the walnut twig weevil. However, they are dying at an accelerated rate due to a combination of water stress and the disease. So for these trees the dry, warm climate is having a devastating effect.

So, each insect group is affected differently by our current weather pattern of heat and drought. Once the rains return these patterns will change yet again and again each insect group will react differently. Increasing rain, with mild winter temperatures, will have a different effect on insects than more rain and cold temperatures. Every year is a new entomological adventure. The more we learn, the less we seem to know about these creatures.

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**Traveling T-shirts**

Have you worn your Bohart t-shirt to some exotic place? Please send us a photo of you, your Bohart t-shirt and wherever you happen to be. We want to see where our members and t-shirts are going.

Tabatha Yang modeling our Xerxes butterfly t-shirt in the Haagen-Dazs Bee Garden
ADVENTURES IN BELIZE

By Fran Keller and Noah Crockette

In June 2014 I traveled with a team of biologists to establish an entomology collection at the Toucan Ridge Ecology and Education Society (TREES) field station in Belize. The project was funded through a crowd funding website, experiment.com (https://experiment.com/projects/cataloging-insect-and-bat-diversity-in-belize). Duplicate specimens were brought back to the Bohart Museum.

Noah Crockette had been volunteering in the museum for about 4 years when I approached him about working on the Belize specimens in 2014. Since Noah had to do a yearlong science project for school, he agreed to pin, label, sort, and photograph Belize insects, ultimately making a web page for them. I also suggested that he pick a group of insects he liked and focus on the taxonomy of the group. Noah chose beetles and I helped him with beetle morphology and how to use a beetle identification key. I worked with Noah on the Belize specimens from 2014 and suggested that in summer 2015 he could go to Belize and do a project. His parents agreed and Noah decided to compare the diversity of carabid and scarab beetles in disturbed and undisturbed habitats for his project.

In Belize we set up sheets and blacklights, light traps, malaise traps, yellow bowls. We spent many hours collecting past midnight at the mercury vapor lamp. Our goal was to bring back as many moths as we could for Jeff Smith to curate for the museum. Noah also participated in reptile and amphibian surveys, trudging through the jungle in the rain at night, which he enjoyed as much as collecting insects. I don’t think I ever saw the smile leave his face during the entire trip, except when he was working on developing a pain index and intentionally got stung by a bullet ant and a paper wasp.

Because of Noah’s experience working in the Bohart Museum he also worked on the TREES collection established the year before. Although working on the collection and cutting out labels were not the most fun part of the trip, Noah worked for hours in the lab on collection curation. His work was exemplary and he even gave several demos to students on how to point mount insects. Noah was a trooper and helped out with all things insect related.

Back in the Bohart Museum, Noah is now sorting his pitfall samples and identifying specimens. He is also sorting the light trap, malaise, and yellow bowl samples. Noah plans to write up his results from his project in Belize. He is a dedicated high school volunteer and with a great work ethic. I am glad that he made the decision to help out with the Belize project, and am glad I was able to act as a mentor in Belize for someone who I think will be an extraordinary future entomologist. Noah plans to go back to Belize to work on another beetle project in 2016.

Noah Crockette preparing to go into the field in Belize. Photo by Fran Keller.

For two weeks this June Fran and I collected insects at TREES. Last year Fran had collected at TREES, so it was interesting to compare what came back last year with this year. So far it appears that we were able to collect far more insects than last year. During the trip we collected over 3,000 moths. We also had the opportunity to collect in two very different environments. The first few days in Belize we stayed at The Tropical Education Center (TEC), which is in a tropical pine savannah located within the limits of Belize City. For the rest of the trip we stayed at TREES, which is located in rainforest in the Maya Mountains. The difference between the two sites was dramatic. TEC was very hot and there were not very many insects, but once we arrived at TREES we were immediately greeted by many insects and found exiting new ones throughout our stay. Even when not collecting, we were finding insects, the dining room had open sides, so insects would fly in attracted to the lights or just randomly fly in. I found my two favorite dung beetles this way. Overall the trip was a great for collecting and we will surely continue to find exciting insects as we sort through the insects that we were unable to curate in the field.—Noah

If you would like to support Noah’s research please make that notation on a donation to the Bohart Museum of Entomology.
Dunes in All the Wrong Places

At the invitation of the U.S. Bureau of Land Management (BLM) a group from the Bohart Museum and the Entomology Club at the University of California, Davis, visited the Monvero Dunes in 2014 and 2015. Mike Powers from the BLM took us through all kinds of locked gates and helped us find the dunes.

It’s not easy to reach the dunes. From Davis you drive south on Interstate 5, exit on an obscure freeway off-ramp that goes nowhere, and go through two locked farm gates. From there it’s a forced march 900 feet up a steep, slippery slope to the top of the ridge.

Once you get to the top you’re suddenly in sand dunes topped by Ephedra “trees”.

The Monvero Dunes are located on the west side of Fresno County, about 2,000 feet elevation in the inner central Coastal Range. Unlike most sand dunes these are not wind deposited, they are hilltop sand accumulations, resulting from erosion of underlying sandstones rich in clay, which gives the dunes an odd slippery texture.

The geological history of the Monvero Dunes is also unusual. The San Joaquin Valley to the east of the dunes formed originally as an inland sea basin in front of the Sierra Nevada Mountains and margined to the west by an arc of islands as early as the end of the Cretaceous. This inland sea was rich in marine life and resulted in extensive fossil and oil deposits. By the late Miocene, some 20 million years ago, the region now occupied by the Monvero Dunes was exposed coastal dunes on the west side of low mountains and east of an island arc. Eventually, subduction of the Pacific Plate elevated mountains to the west of these dunes and beneath the dunes themselves. Subduction and compression formed them into sandstone deposits, which are now in the process of eroding into sand dunes again.

There are several unusual features of this site. First, it is common to find marine fossils in these dunes, such as clams and scallops, and then there are the plants. The vegetation is an odd mixture of Mojave and Colorado Desert species, with those more typical of the Coastal Range. The dunes are home to some of the largest Desert Tea (Ephedra californica) plants I’ve ever seen with trunks up to 7 or 8 inches in diameter! This is one of the northwestern-most locations of the species. Other woody shrubs include several species of Eriogonum, Gutierrizia californica and Atriplex spinifera.

A number of protected species occur on the dunes including the blunt-nosed leopard lizard and the San Joaquin woolly-threads plant, San Joaquin kit fox and the Ciervo aegialian scarab.

The dunes had never been surveyed for insect taxa other than beetles until we visited late last spring. Since then we have been running several malaise traps this spring and summer with the assistance of Mike Powers. The insect diversity has been really surprising given how dry the region is and how isolated. Overall this is a truly remarkable part of California.
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.

Silent But Deadly

African beaded lacewings, *Lomamyia latipennis*, in the family Berothidae, have an unusual way of capturing prey. A recent article in the journal Science by Gwen Pearson examined how their larvae use digestive gas to prey on termites:

“A larva repeatedly approached and retreated until the tip of its abdomen was directed at the termite’s head. The apex of the abdomen was lifted and waved past the termite’s face, without contact. The termite… was not repelled, as it made no obvious effort to escape. One to three minutes later it was incapacitated, lying supine, with its legs moving irregularly.”

Beaded lacewing from Tanzania. Photo courtesy of Patrick Coin/Cotinis.

Poo Defense

Tortoise beetles have come up with a number of novel ways to protect themselves with poo. Adult tortoise beetles are heavily armored and can be quite colorful or cryptically colored, but their larvae are soft-bodied and vulnerable to predators and parasites.

Caroline Chaboo at the University of Kansas studies the behavior of these beetles and their larvae. Female tortoise beetles take care of their larvae but their larvae have their own defense mechanism. Some have an elongate tube at the end of their abdomen, which they use to deposit poo either on their backs or to wield on the end of this tube. When they are threatened the larvae form a circle with their poo tubes pointing outwards. The female moves defensively around the perimeter of this poo shield. Very few predators will feed on poo so this tends to be a fairly successful defense.

Larval tortoise beetle with its poo tube and poo. Photo courtesy of Kenji Nishida; http://www.wired.com/2015/06/absurd-creature-of-the-week-tortoise-beetle/

Yellow Rain

Those of you who are old enough may remember the “Yellow Rain” incident during the Vietnam war. Yellow droplets were found in large amounts on vegetation and the US government announced that this was caused by a Soviet developed biological weapon used to kill thousands of people in Southeast Asia.

Turns out the explanation was much simpler—bee pee! In a paper in the journal Nature, researchers Peter Kevan and Makhdzir Mardan demonstrated that the yellow spots originated from mass flights of giant honey bees (*Apis dorsata*). The bees excreted large amounts of waste during these flights, which consisted of a mixture of water and digested pollen grains, making it appear yellow. These mass excretion events are apparently linked to the bee’s need to cool their colonies.

Panic over yellow rain has also hit in the U.S. It has been blamed on air pollution produced by power plants and refineries. But even in the U.S. the explanation is much the same.

All honey bees excrete digested pollen. Anyone who’s worked around apiaries has seen the residue of this material on and around hives, and we’ve all had it on our cars at one time or another. It resembles discrete yellow globs forming circular spots on your car.

Bee pee spots on a vehicle. Honey bee drinking. Photo courtesy of Kathy Garvey.

Frass

Finally, no discussion of this kind would be complete without an authoritative definition of the word, frass.

According to the Merriam-Webster Dictionary, *frass* is debris or excrement produced by insects.

However, according to the Urban Dictionary, *frass* is used in Jamaica to describe someone who’s high on marijuana…

So, I leave it up to you.