It’s another busy spring in the museum. This is high season for tours—so many kids, so little time. As you’ll see in the newsletter big changes are coming to the museum. We’ve got some new folks coming in and some leaving. We are also having to reorganize parts of the collection, and how we house staff, students, stored materials and slide-mounted museum specimens.

We had a fun visit from the Chancellor and Dean of the College of Agriculture, and there are plans afoot to raise funds to build a Biodiversity Center/Museum for the campus that would house the major collections including ours. We’re well into spring now and it looks like we’ll have a great buggy summer! More fun to come.

-Lynn Kimsey

CONTENTS

Directors Note 1
Spotlight on a Species 1
Museum News 2
Featured Story 3
More Museum News 5
Ticks and Disease 6
Ask the Bug Doctor 7

SPOTLIGHT ON A SPECIES

Its Big, Bad and Brown

By Lynn S. Kimsey

Some years ago, my graduate student Emily Bzdyk went home over Christmas break to visit her family in Virginia. When she returned she regaled us with a story of finding large numbers of a big brown stink bug in her bedroom closet in her parent’s house. Try as they might her family couldn’t get rid of them. They would clear out all of the stinkbugs they could find, but by the next day they’d be back. When she got back to Davis she was horrified to discover a number of these bugs had hitched a ride in her suitcase. Thus went our first encounter with the brown marmorated stink bug, Halyomorpha halys Stål, otherwise known as the BMSB.

Unlike the stink bugs we’re used to in the United States, this one is larger and tougher in many ways. It is native to East Asia and made its way into the U.S. sometime in the 1990’s as a stowaway in packing crates or machinery (or maybe a suitcase). Ironically, the first one was collected in 1998 in Pennsylvania and not on the West Coast. Given their incredible ability to hitchhike, it’s a bit surprising that it took so long for them to reach the Americas. By the early 2000’s there were 54 reported sightings of these bugs in U.S. shipping ports, but because stink bugs are federally non-reportable organisms, nothing was done. By 2011 the BMSB had spread to 34 U.S. states, and a total of 40 states by the following year.

By the time we realized that this stinkbug was going to be a big problem, it was too late. The U.S. has the ideal conditions for BMSB to thrive. Under optimal conditions these bugs can hatch, develop and begin laying eggs in 35-45 days. Eggs are yellow to reddish and are covered rows of tiny spines. They are laid side by side beneath leaves in masses that usually contain 20 to 30 eggs. A single female can lay up to 400 eggs in her lifetime. In warmer climates, like those found in California and Arizona, BMSB can have as many as six generations a year. An over-wintering population of ten females could produce as many as 4,000 offspring in a season!

Continued on page 4.
MUSEUM NEWS

Oopsie!

This is a major mea culpa. When putting together the donor acknowledgements in the last newsletter I missed including two of our more important donors, Henry Hespenheide and Jeff Smith.

Henry donated more than 1,300 identified specimens last year, and has indicated that there is more to come. He’s sent us a remarkable collection of buprestid jewel beetles, weevils and many other insects.

Jeff, well where do I start. In 2017 he donated 181 glass-topped insect drawers made from scratch, 70 spreading boards for Bio-Boot Club attendees and Entomology Club, 114 identified moths and butterflies, and much more. Plus he donated a really great heavy duty Costco hand truck for Tabatha to use to transport displays etc. to schools.

Chancellor’s Visit to the Museum

In February we had a visit from the UC Davis Chancellor, Gary May and the Dean of the College of Agriculture, Helene Dillard. They were joined by Wildlife Department chair, Nann Fangue, and Entomology/Nematology Chair, Steve Nadler. They spent an hour visiting the Bohart Museum and the Museum of Wildlife and Fish.

Bio Boot Camper Helps Others Become Campers

It is a record-breaking hot day in June in the Central Valley. The campers are hiking at UC Davis Quail Ridge Reserve near Lake Berryessa looking for insects and lizards. The next day we’re in the museum prepping specimens and learning skills to work with both dead invertebrate and vertebrate animals. Then we escape the heat and head to Sagehen Creek Field Station in the mountains. The students set up malaise traps, carried their nets every-where, crossed streams to find new places, and thrilled at sundew plants and basking garter snakes. This was Bio Boot Camp 2017.

One of our campers, Chris McGann, loved the experience so much that he spent the rest of the summer doing extra chores to earn money for scholarships. He said: “Just to let you know that since last year was so fun, afterward I realized that others might have financial problems and would not be able to go. So over the summer, I did chores, so that someone who did not have the money could have such a fun time as I did... I would like to donate the fee for someone else.” That is Chris McGann.

This year Chris applied to BBC 2.0, our summer camp for high schools. Only after he got an acceptance letter did he realize that he’d been saving. He wrote, “I did not tell you earlier, because I did not want to create the appearance of influencing the selection process.” What integrity!

We work hard to keep our camp fees low. The main cost of camps are the stipends for the student instructors, plus renting vans, lodging and food for our overnights. Since these camps began in 2011 the Society has offered need-based scholarships. This year Chris is making sure that 2019 is no different. He is our youngest scholarship donor and the $795 dollars he donated, with approval will be used to offer partial scholarships to several students in both Bio Boot Camp and BBC 2.0. Thank you Chris for being such a caring and thoughtful friend!

BBC 2018!

Poster & T-Shirt Sale

We’re revamping the Bohart Museum t-shirts with new designs including one with a preying mantis, so beginning April 16 and ending April 30. Museum t-shirts will be discounted to $10 a piece, starting with UC Davis’ Picnic Day.
EXOTICS NEWS

Why Not Here?

We never really appreciate the importance of wetlands until they’re gone. In California, extensive wetlands once covered the floor of the Central Valley and coastal regions, like the San Francisco Bay Area. Since the Gold Rush era a variety of human induced changes - placer mining, agriculture and urbanization- have led to a tremendous reduction in these wetlands, from 4.5 million acres in 1850 to fewer than 400,000 today. The remaining wetlands in the San Francisco Bay-Delta still provide home for birds and fish, sequester toxic compounds and protect folks downstream from flooding.

Not much of California’s coastline is protected by wetlands, but it’s another story in the American Gulf Coast.

Wetland vegetation, particularly reeds and canes, hold soil in place and protect coastal areas from storm, boat and tidal erosion. Much of this ocean/dryland interface is covered by large populations of roseau cane (Phragmites australis), which forms large stands in the Mississippi River Delta. Roseau cane has deep roots and traps water-borne sediments thus forming new land, and helping to keep shipping channels open.

In 2015 boaters and researchers began noticing extensive die-offs of roseau cane stands along the coast of Louisiana. Examination of satellite photos from the previous year showed areas of die-off even then. Damage was extensive enough to set off alarms.

Entomologists at Louisiana State University discovered that two species of acleridid scale insects, *Nipponaclerda biwakaensis*, which is exotic, and a native species, *N. holci*, were feeding on the cane. The exotic *N. biwakaensis* is probably the primary culprit in the die-offs. Feeding by these scale insects directly affects stem density and plant vigor, ultimately causing the stems to weaken and die.

By the summer of 2017 the Louisiana Department of Wildlife and Fisheries estimated that the scale insect had damaged or killed more than 100,000 acres of wetland. In some parts of the Louisiana coast Roseau-dominated wetlands have changed to open water in just a few months.

The exotic species of *Nipponaclerda, biwakaensis*, is named after its type location in Lake Biwa, Japan. It has a number of plant hosts including *Phragmites australis*, and species of *Juncus* (rushes) and *Agropyron* (wheat grass). *Phragmites australis* (roseau or common cane) is essentially cosmopolitan in distribution, including California. No one knows how this insect came to be in Louisiana on the opposite side of the globe from China, but researchers think that it may have been introduced in roseau cane contaminated bundles of bamboo poles imported from China. Bamboo poles are commonly used in wetland work in Louisiana.

The importance of wetlands in California is somewhat different. Here wetlands are important habitats for wildlife and provide many other ecosystem services. In central California, the historical wetlands provided protection against flooding and were home to large numbers of waterfowl and fish. Degradation of the natural wetlands and the predators they housed led to large mosquito populations and malaria during the Gold Rush period.

California wetlands are also dominated by roseau cane, eight mostly native species of *Juncus*, and several exotic species of *Agropyron*. This begs the question, why isn’t this scale insect in California, which is much closer to China and has had ships carrying goods from one side of the Pacific to the other for more than two centuries? All of the same host plants are here. The insect may actually be in California, but we don’t notice it because its populations are kept in check by local parasites and predators. And, perhaps just as much to the point, no one has looked...

*Phragmites australis* in winter. Photo courtesy of Wikipedia.

*Nipponaclerda biwakaensis* scale insects in roseau cane. Photo courtesy of Rodrigo Diaz LSU AgCenter.
If half of these are females they could potentially produce a second generation of 800,000 individuals!!! Imagine the numbers if they have up to six generations in a season in a place like California.

The BMSB is a typical looking stink bug, although larger than most, with adults averaging over half an inch (17 mm) in length. Although it is similar in color and shape as some of our native stink bugs, it can be distinguished by the large size, maculate brown coloration and white band on the antenna. In addition, several abdominal segments also have a white band that shows laterally beside the wings.

In addition to their high reproductive output, BMSB feed on a wide variety of host plants, including many different crop plants. In the eastern U.S. they are damaging to apples, apricots, cherries, Asian pears, grapes, beans, peaches, peppers, tomatoes and even corn. In California studies indicate that they will also feed on and damage specialty crops such as olives.

BMSB have the piercing sucking mouthparts typical of true bugs and their feeding removes considerable fluid from their host plants, which damages or destroys growing tips, seeds, flowers and fruits. In addition, the saliva they inject into the plant during feeding can damage the tissue in the vicinity of the feeding site.

The other pestiferous issue with this stink bug is its overwintering behavior. As my graduate student discovered, they really like to overwinter indoors. The last generation of a growing season overwinters as adults, often in huge numbers, and there are reports of homes with literally thousands of BMSB covering the walls in rooms and in closets. Given this behavior you can see how easy it would be for these bugs to stowaway in shipping containers, in or beneath vehicles, and even in commercial jets.

These insects are not easy to control. They are very vagile, and will readily take off and leave if disturbed. When a population has been eliminated in one area, a new population may fly in and replace it in fairly short order. As a result, insecticide spraying essentially pushes them from place to place temporarily. Only a few insecticides have been found to work on BMSB's, and they are already developing resistance to pyrethroid insecticides. Some insecticides have been found to be repellent and can be used to keep the bugs away from crops. The U.S. Department of Agriculture has developed a pheromone trap that may prove to be effective.

It may be that local predators, such as assassin bugs, spiders and even birds will eventually limit BMSB populations, but these populations can be slow to develop. Several parasitoid wasps have been found that attack BMSB eggs. One in particular, the wasp *Trissolcus japonicus* (Scelionidae), is the primary predator of BMSB eggs in China.

The BMSB is a pest. Hopefully the California climate, parasites and predators can prevent it from becoming a damaging agricultural and horticultural pest. We've already seen some BMSB turn up in the Sacramento Region, including Davis, but so far they are few in numbers. If this species follows the typical new species introduction pattern, numbers will stay low for a few years, then start to get huge for a year or so, and then (hopefully) crash. Keep your fingers crossed. Otherwise we need to be creative and develop new stinkbug games and housing partnerships...

The UC IPM Program has an informative webpage on BMSB at: http://ipm.ucanr.edu/pestalert/pabrownmarmorated.html.
More Museum Happenings

Comings and Goings

Tom Nguyen was a UC Davis undergraduate who worked in the museum for several years. He took the lead on the NSF tardigrade grant and developed the technique to remount damaged slide-mounted tardigrade specimens.

Tom got a great job at the Smithsonian, working for Hannah Wood, curator of arachnids. He’s in charge of maintaining and improving the Arachnida, Myriapoda, and Apterygota collections. He’s planning to go to New Zealand this December for a couple of months to collect some unique spiders.

Socrates Letana is an incoming Ph.D. student, who will be working in the museum. He got his M.S. degree from the University of the Philippines. He plans to study the evolutionary relationships in the bot fly family Oestridae. He’s going to be collaborating with Thomas Pape at the University of Copenhagen.

E. L. Smith Estate

We’ve been working on specimens, and library materials from Edward Laidlaw Smith, from San Francisco. He was doing an intensive study of the evolution of the Arthropoda based on anatomy. He accumulated an impressive collection of representatives of nearly every living group of arthropods.

Two students have been going through Smith’s library, manuscripts and specimens. Undergraduate student Brennen Dyer has been sorting and recurating the arthropod specimens. To date, the Smith collection consists of an estimated 15,000 alcohol preserved specimens. Some of these specimens will be pinned and labeled. To help with this Brennen digitized Smith’s five field notebooks, which cover the period between 1953 and 1993; comprising roughly 1,020 pages.

Graduate student Charlotte Herbert has been sorting Smith’s illustrations, manuscripts and literature, organizing them and determining the timeline of his studies.

Changes in the Museum

Several major changes are taking place in the museum in the next 3 months. We will be reorganizing space in the museum to accommodate more people and materials because we have to move out of lab and office space down the hall to make room for the new Schlinger Chair Professor, Jason Bond, who will be arriving July 1. Dr. Bond studies spiders.

This means that we will have to greatly reorganize desk and storage space in the museum to accommodate the bulk of the scale insect collection, including the scale insect library, specimen imaging systems, and some personnel including Tom Zavortink.

We have been offered some lab space in another building. How best to use this space will be part of the planning.

Planning for this move is starting to look a little bit like finding new space on a Rubik’s Cube... But, it will force us to organize things more logically and eliminate duplicate materials. To make it possible for us to do the big reorganization we will be closed to the public most of the month of June.
We had a request from some members for more information about tick-borne diseases in California. So this is probably more than you want to know...but keep in mind these are rare in California.

Ticks, like most blood feeding animals, are the ideal transport system for parasites. Although your chances of being infected by a tick-borne pathogen are low in California, caution is always warranted. In all of the microbe-caused tick-borne diseases discussed below humans are not the normal hosts. The vast majority of the pathogens are normally parasites of rodents, deer, birds and even reptiles. Humans just happen to be at the wrong place at the wrong time, plus we’ve also gotten careless. We’ve lost the habit of regularly checking ourselves and our pets for parasites like ticks when we go outside in places where there might be wild animals.

There are eight diseases associated with ticks in California. One of these, tick paralysis, is caused by the tick itself. Six are caused by bacteria, or bacteria-like microbes (rickettsia/spirochetes), and one by a protozoan. All of the bacterial diseases are treatable with antibiotics. Babesiosis is a protozoal disease and must be treated with drugs similar to those used for malaria.

The principle problem with tick-borne disease in California is correct diagnosis. The vast majority of physicians in California have never seen these diseases, and they are unlikely to correctly diagnose the illness unless they have blood tests done. Even if blood tests are done the results may be misinterpreted or second guessed.

Tick paralysis is an odd condition caused by a tick’s saliva. A chemical in the saliva can stop normal nerve function leading to muscle paralysis. Symptoms begin with weakness in the arms and legs and may lead to breathing problems. It can cause death in 10% of people who go untreated. In humans it is most likely to occur when one or more ticks are attached on the scalp, particularly at the hairline. The paralysis is immediately cured by removing the tick. This syndrome mostly commonly affects children but anyone can be affected, as well as dogs and cats. Species of Dermacentor, as well as Amblyomma and Ixodes can cause tick paralysis.

Anaplasmosis is an infection caused by bacteria transmitted by the western black-legged tick. The bacteria infect white blood cells. Symptoms can be mild to extreme, beginning with flu-like symptoms, fever, headache, nausea, muscle aches and fatigue, though most people have no symptoms. This bacterial infection is normally transmitted among wild rodents. Ticks can transmit the bacteria to dogs, horses and people, but it cannot be transmitted between mammals. Anaplasmosis is rare in California with only 6 confirmed human cases in the past two decades.

Babesiosis is an infection of red blood cells. It is normally a parasite of rodents, but can be transmitted to humans by Ixodes ticks. It causes fever, chills, muscle pain and fatigue, much like anaplasmosis. This tick-borne pathogen is rare in California, and most people that become ill with babesiosis, were infected in the northeastern U.S.

Lyme disease is caused by a spirochete transmitted by soft ticks. These ticks may inhabit rodent infested buildings, particularly in the Sierra. Although uncommon, 1-8 cases of this fever are reported annually in California. Tick-borne relapsing fever symptoms strongly resemble those of malaria, and also include nausea, vomiting, abdominal pain and a rash. The fever comes on suddenly and can go as high as 105°F lasting a couple of days. The fever then recurs a few days later.

Finally, Tularemia is another bacterial disease that can infect people through direct contact with infected animals, particularly rabbits or from the bites of several species of Dermacentor ticks. Symptoms of the disease appear 3-5 days after infection. They include fever, chills, head and body ache and tightness in the chest.

Because of confusion over diagnoses the long-term consequences of the infection may be misdiagnosed. This tick has toxic saliva that commonly causes an immediate rash at the bite site is common. However, longer term secondary rashes that develop along with headaches, muscle and joint pain, and even heart irregularities indicate Lyme disease. Infected ticks must be attached for 48 to 72 hours before transmission can take place.

Spotted fevers, like Rocky Mountain spotted fever, are caused by Rickettsia bacteria and transmitted by the American dog tick (Dermacentor variabilis), the Pacific coast tick (Dermacentor occidentalis) and the brown dog tick (Rhipicephalus sanguineus). The tick must be attached for at least 4 to 6 hours before transmission of the pathogen can occur. Symptoms start with a sudden high fever several days after infection, leading to other symptoms, including weakness, deep muscle pain, chills and a painful abdomen. These are severe diseases and if left untreated can lead to death in up to 25% of cases.

Unlike these other tick-borne diseases, tick-borne relapsing fever is a spirochete transmitted by soft ticks. These ticks may inhabit rodent infested buildings, particularly in the Sierra. Although uncommon, 1-8 cases of this fever are reported annually in California. Tick-borne relapsing fever symptoms strongly resemble those of malaria, and also include nausea, vomiting, abdominal pain and a rash. The fever comes on suddenly and can go as high as 105°F lasting a couple of days. The fever then recurs a few days later.

Finally, Tularemia is another bacterial disease that can infect people through direct contact with infected animals, particularly rabbits or from the bites of several species of Dermacentor ticks. Symptoms of the disease appear 3-5 days after infection. They include fever, chills, head and body ache and tightness in the chest.

Bohart Museum Society Newsletter Spring 2018
**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.

---

**Snailcase Bagworm**

Jim Tassano, of Foothill-Sierra Pest Control, called this unusual insect to our attention when one of his clients in Avery, CA, asked about the peculiar objects on the side of his house (see photo below).

Turns out these are the cases of the snailcase bagworm moth, *Apterona helicoidella*, which is native to Europe, but is now apparently found on the West Coast and other parts of the U.S. This seems to be one of a few observations of this moth in northern California.

The larvae and larva-like females live in helical mud cases and surface feed on leaves. Plant damage seems to be minimal. They feed on *Potentilla* (cinquefoil), *Erodium* (stork’s bill), *Teucrium* (bush germander), *Artemesia vulgaris* (mugwort), *Alyssum* (sweet alyssum) and *Helianthemum* (sunrose). The largest problem with this moth seems to be the unsightly sight of the cases glued on walls and eaves.

There are a number of odd things about this moth. Females are caterpillar-like and remain in the cases. Males are fully winged, but unnecessary, as females can lay eggs without mating. Although the moth has minimal dispersal capabilities on its own, humans can move the larvae and females in their cases incidentally. So control of this moth is complicated.

You can find more information on Jim’s website: https://www.foothillpest.com/technical-pages/photos/snailcase_bagworms/

---

**Listening Midges**

Recent studies by Ximena Bernal at the Smithsonian Tropical Research Institute in Panama found that female biting midges in the family Corethrellidae find their host frogs by hearing the frogs calling during mating season. Male túngara frogs call to attract mates. It turns out that these midges use their antennae to “hear” them. The more elaborate the male frog’s call the more likely it is to attract a mate, but also the more likely it is to be bitten. Being bitten is annoying enough but it turns out that male frogs are also more likely to be infected by trypanosomes transmitted by the midges. Thus, males with the “best” calls are most likely to mate, but are also most likely to become infected, by a sort of air-borne VD.

---

**Apitherapy Gone Bad**

Apitherapy, or the use of honey bee products, including royal jelly, pollen, propolis, honey and stings for their health benefits. Stings from live honey bees or their venom are used to treat arthritis, severe pain and a variety of other symptoms. There is little research on this treatment and most of the supporting evidence is anecdotal. However, on thing is clear, honey bee venom is loaded with things that can cause allergic reactions, particularly with exposure over time.

There are a number of examples of people undergoing sting therapy who have developed severe allergic reactions ending in anaphalaxis, and in at least one case recently, death.

---

**Immortal Cockroaches**

Recent studies of cockroach genomes by Coby Schal (NC State Univ.) and Sheng Li (South China Normal Univ.) have revealed something we should have known already—cockroaches will inherit the world.

Why are cockroaches so successful? These studies found that American and German cockroaches have one of the largest genomes of any insect sequenced, second only to that of locusts. They have an unusually large number of genes related to taste and smell. Plus, these cockroaches also have unusually large suites of genes devoted to metabolizing toxins, including components of many insecticides. These genes allow them to feed on substances that would be toxic to other animals and to detect things they shouldn’t eat, which makes it darned hard to kill them.

All of these adaptations make them ideal human companions, and the ultimate survivors.
Don't miss our special summer programs!

**Moth Night**—Saturday, July 21; 8-10 pm

**Fire & Ice: Extreme California Insects**—
  Sunday, August 19; 1-4 pm

**Crafty Insects**—Saturday, September 8; 1-4 pm