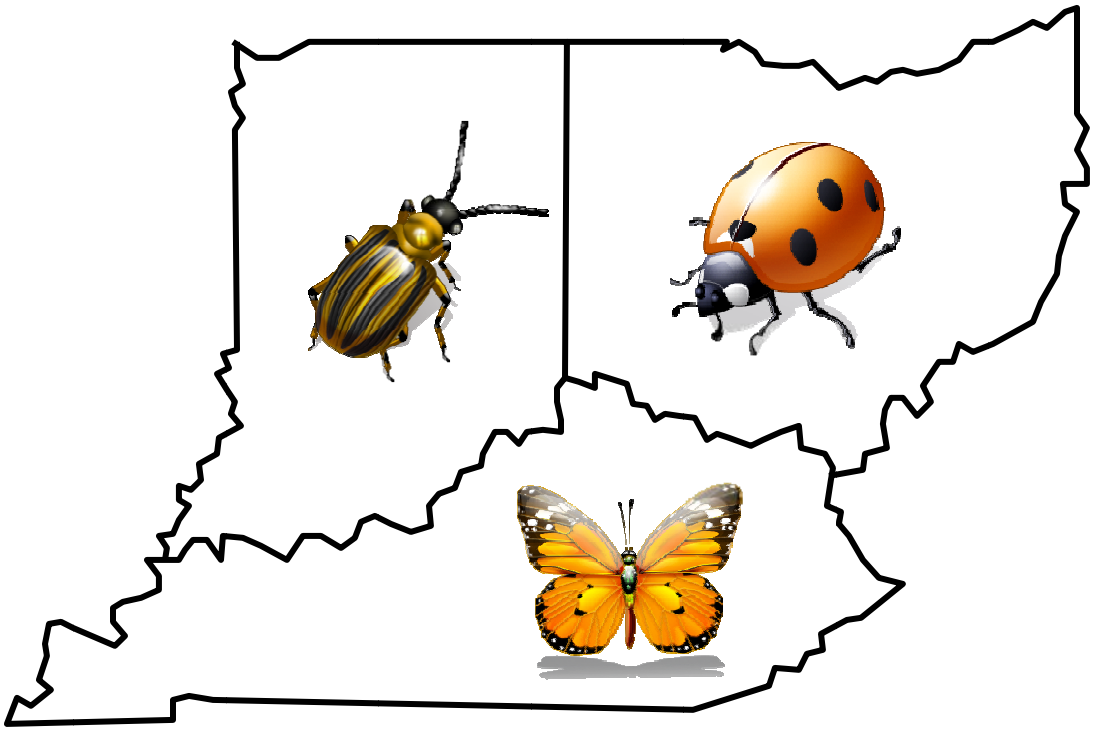
Abstracts of the

22nd Annual Forum

For Student Competition



The Ohio Valley Entomological Association

Cincinnati Museum Center

Cincinnati, OH

November 6, 2009

Special thanks to the event sponsors for their generosity:

Preface

Welcome!

I trust you will enjoy your experience at the Ohio Valley Entomological Association (OVEA) 2009 Annual Student Forum. Please, relax and take some time to enjoy the exhibits at the Cincinnati Museum, or just forge stronger friendships with your fellows . . . if you're not feeling too nervous. Don't worry, you'll do fine! I do hope you are challenged by your peers during this competition, and that OVEA serves as a valuable opportunity to better prepare you for professional meetings and your professional career. I encourage you make an effort to meet many of the outstanding students in the Ohio Valley region. However, please realize that this event would not be possible without the efforts of many of our current and past members, as well as our partners in industry. I invite you to be further involved in the association; to help provide other students with the same opportunity and to promote the legacy left by past officers of our association. Whether you consider becoming an officer, or you prefer to remain a participant, I wish you the best. Good Luck!

Sincerely,

Alexzandra Murphy, President
Ohio Valley Entomological Association

Acknowledgements

The Ohio Valley Entomological Association would like to sincerely thank Dr. Gene Kritsky and the Cincinnati Museum Center for providing us with an ideal setting for our annual meeting. We appreciate the time and effort expended by Dr. Gene Kritsky in securing a reservation and providing valuable advice. We would also like to thank Andrea Howard from Deco Dining for her assistance in making arrangements.

OVEA would also like to recognize Dr. Linda Mason, Dr. Steve Yaninek and Dr. John Sedlacek for their invaluable assistance, guidance and advice. These faculty members tirelessly support our society. Our past presidents, Nicola Gallagher and Walter M. Baldauf, should also be recognized for their past efforts at providing OVEA with a strong foundation. We would also like to extend thanks to Tammy Luck for her assistance and perseverance in maintaining and updating the OVEA website accurately.

Our association would also like to thank the faculty and professional industry members who devote their time to judging and moderating the student competition. OVEA could not exist without your expertise.

Finally, we would like to thank and recognize our continuing and new sponsors, who truly make this event possible. Thank you! We would like to acknowledge contributions from:

Dow AgroSciences

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Indiana Corn Marketing Council

Indiana Soybean Alliance

Purdue University, Department of Entomology

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History and Organization of the Ohio Valley Entomological Association Annual Forum for Student Paper Competition

The Ohio Valley Entomological Association (previously the Ohio Valley Chapter of ARPE) has had a number of successful activities including programs for recertification, exhibits at branch and national Entomological Society of America meetings, occasional newsletters, and a *Forum for Student Paper Presentation*. None of the Chapter activities have been more successful than the Forum, and it became a source of pride with the membership and the envy of other ARPE chapters. Prior to development of the Student Forum, the meetings of the chapter were primarily social gatherings. In November 1984, M.C. Wilson proposed that the Chapter, as an organization, develop a student-related activity.

Students are our future. What better investment could we make with our time and energy than to promote our concepts of professionalism with them? The response was tremendous. Wilson received many letters endorsing the idea, which led to his election as President of the Chapter at the next meeting, and the initiation of a student contest became the Chapter's first project.

Since the program began in 1985 at Earlham College, it has grown steadily. It began in a small way with competition largely between students from the University of Kentucky and Purdue University. This was to be expected because there were significant numbers of faculty from these two institutions who supported and held membership in ARPE. Also, along with Ohio State University, they are the main centers for entomological training in the tri-state area.

With the birth of The Ohio Valley Entomological Association, membership and competition have been opened to all interested parties regardless of demographics or non-affiliation with other organizations. We hope to continue to grow participation beyond the already 300+ contestants who have competed over the years. The constant improvement in the professional quality of the student presentations in recent years is impressive; Ohio Valley entomologists rank these presentations equivalent to the best given at any society meeting.

Objectives of the Contest

The purpose for conducting this competition is multifold:

- To promote an interest in entomology as a career.
- To promote professionalism in our science.

- To recognize student excellence by giving them the opportunity to present a paper before their peers and to have an abstract attesting to this activity in print.
- To foster a dynamic and competitive spirit among young biologists
- To enhance interaction between biology departments in the colleges in the tri-state area and give students the opportunity to meet faculty and discuss opportunities for graduate programs in the various universities.
- To give students the opportunity to interact with professional career entomologists from industry, universities and the public sector.

Format for Competition

The Annual Forum for Student Paper Competition is open to any undergraduate or graduate student who has an interest in entomology. To date participants have come from colleges in the tri-state area of Indiana, Kentucky and Ohio; however, students from other states are encouraged to enter the competition. Students who are enrolled in biology courses, or are majoring in biology or entomology departments at the undergraduate level are particularly encouraged to enter the contest.

- Eligibility is based on enrollment for, or recent completion of, a degree. A student who has graduated is still eligible if enrolled within the past 12 months. Likewise, a student who recently received a Master of Science degree and is newly enrolled for a doctorate may enter competition at the Master of Science level.
- Papers presented may pertain to the area of entomological science.
- Separate competitions are conducted in each of three categories: Undergraduate, Master of Science, and Doctor of Philosophy.
- The paper may present a special problem, MS thesis, Ph.D. dissertation, or be on a topic to popularize entomology.
- A classic abstract of approximately 300 words (statement of problem, objectives, methods, results and conclusions) for research presentations is required. The abstract for popular science presentations should be a summary, 300 words or less, including: 1) an introductory statement, 2) brief discussion of content, and 3) conclusions.
- Ten minutes are allotted for presentation followed by two minutes for questions. Each presentation is timed.
- Presentations are scored by a panel of five judges representing academia, public and private sector.
- Recognition takes the form of certificates and cash awards in each of the three for each student categories: $350 first, $250 second and $200 third prize

Judging Panels

A panel of five judges for each category of competition determines the winners. Each panel is composed of two representatives from either the agricultural or pest control industries and three members from academia, two of whom are usually from biology departments. Professional representatives of both basic and applied science are always included on each panel. Judges may or may not be entomologists. In the event of a tie, the winners will be chosen by a vote of judges.

Emphasis in this student contest is placed on the mechanics of organizing and presenting a scientific paper. The quality of the research is judged only to the extent that the student's objectives and methodology appear appropriate and conclusions are substantiated by data. Judges are expected to write constructive criticism. This is important to the student; score sheets are returned to the students so that they can learn where they need to improve.

A week before the contest each judge receives a copy of the Book of Abstracts to review. Some of the questions that judges should consider are the following. How is the abstract written? Does it have the essentials of a classic abstract? Does it have a statement of the problem, objectives, methodology, results and/or conclusions? Are these conveyed with a reasonable amount of verbiage, using correct English grammar and composition?

In the organization and presentation of the talk, the judges look to see if the student follows through the discussion in a logical manner. Judges expect that the presentations will not specifically target an audience having a general biological background. Finally, it is interesting to note that judges have become more observant of professional appearance and the elements of courtesy.

Coordination of Program

A committee works with industry, which generously supports the contest through prize monies for each of the three categories of competition. In addition, funds from industry provide for continental breakfast at registration, and participating students will be given a lunch voucher. Aside from monetary contributions, personnel from industry have contributed to the success of the contest by serving as judges and working on committees for its promotion.

Mailings announcing the contest and calling for papers are sent to all academic biology departments in the tri-state area, coordinated by staff at Ohio State University, University of Kentucky, and Purdue University. Biology departments serve as hosts,

providing local arrangements as the contest moves from state to state. Provision has to be made for the operation of concurrent sessions when necessary. Finally, a committee provides for projection and timing during the presentations, and tabulation of results.

Following the presentation of the last contest paper, results are tabulated and an Awards ceremony is held during which prizes and certificates are distributed to winners as they are presented with their checks.

The Results

The contest has provided a common interest for Ohio Valley entomologists and is opening the door to greater interaction among the three states. Graduate students, particularly in the large entomology departments, have more interaction between universities, fostering a competitive camaraderie. We have been pleased with our graduate level participation.

The graduate level has been relatively stable, and we have tried for years to increase and encourage undergraduate participation. Getting the interest of undergraduates is difficult, requiring the persistence of instructors.

The most significant achievement of the Student Forum is an increased interaction between entomologists representing industry and the faculties and students of academic biology departments in the three states. Here is the source of students for graduate school and industry. This relationship is developing slowly, but we are encouraged with our progress.

OVEA 2008 Annual Forum Winners

Bachelor of Science Category

Left to right: Megan Meuti (First Place, Ohio State University), Michael Chambers (Second Place, Wittenberg University), and Matt Paschen (Third Place, Purdue University)

Master of Science Category

Left to right: Annie Spikes (First Place, Purdue University), Paul Ayayee (Second Place, University of Kentucky, and Terri Hoctor (Third Place, Purdue University)

Doctor of Philosophy. Category

Left to right: Alexzandra Murphy (First Place, Purdue University), Hua Biah (Second Place, University of Kentucky), and Eunho Suh (Third Place, University of Kentucky)

OVEA Score Sheet

Competitor Name_____ Time: _____

BS MS PhD

Written abstract (10 point total): *Comments* _____

Organization Clarity (5)

English Composition (5)

Organization and Impact (55 points total): *Comments* _____

Introduction, Explanation of problem (10)

Methods & Results (Interpreta- tion of)) (10)

Effective Closing Summary, Conclusions (10)

Originality, Substance, and Impact (15)

Response to questions (10)

Delivery Technique and Skill (20 points total): *Comments* _____

Voice, Grammar, Enunciation (5)
ions

Eye Contact and Enthusiasm (5)

Use of Time *cannot exceed 10 min* (5)

Courtesy and Professionalism (5)

Visual Aids (15 points total): *Comments* _____

Quality and Appropriateness of Visuals (15)

Grand Total Score _____

Undergraduate

Water balance of the bed bug, *Cimex lectularius*: dehydration resistance, heat shock protein (hsp) regulation, and impairment by the addition of alarm pheromones.

Allison A. Barnes, Joshua B. Benoit, Giancarlo Lopez-Martinez, Jay A. Yoder, and David L. Denlinger

Department of Entomology, The Ohio State University, Columbus, OH

Due to the resurgence of the bed bug, *Cimex lectularius*, research focused on the physiology, particularly how this pest survives extremely long periods off-host, is extremely important. One of the most critical factors for determining survival of hematophagous arthropods, particularly those that reside in dry habitats, between bloodmeals is their ability to resist dehydration. This is indeed a challenge for bed bugs that live in human dwellings. In this study, we examined dehydration resistance of *C. lectularius*, and asked whether heat shock proteins are responsive to dehydration and whether alarm pheromones alter bed bug water balance. Bed bug dehydration resistance increased with age: first instar nymphs surviving one day and adults surviving over two weeks when exposed to 0% RH. Desiccation resistance can be greatly improved when individuals form water-conserving clusters. Water stores are only replenished by ingesting blood; no stages are capable of absorbing water vapor from the atmosphere and bed bugs do not ingest free water. Transcripts for Hsp70 and Hsp90 increased in response to dehydration and rehydration. When exposed to alarm pheromone components, E-(2)-hexenal and E-(2)-octenal, individually and in their biological concentrations, water loss rates of the bed bugs increased by nearly 20% for first-instar nymphs and 30% for adult females. When alarm pheromone components were applied as a supplement to Dri-die and diatomaceous earth (DE), these two desiccant dusts were significantly more effective, reducing the survival of first-instar nymphs and adult females by nearly 50%. Overall, the extreme dehydration resistance of bed bugs allows this insect to reside for extended periods in relatively dry off-host harborages. Additionally, alarm pheromones could be combined with previous control methods for bed bugs to improve their effectiveness.

Key words: bed bugs, *Cimex*, water balance, alarm pheromone

Undergraduate

Internal water regulation by the Antarctic midge, *Belgica antarctica*, yields two distinct phases of water loss.

Karina Desai, Joshua B. Benoit, Aiqing Li, Giancarlo Lopez-Martinez, Michael A. Elnitsky, Richard E Lee Jr., and David L. Denlinger

Department of Entomology, The Ohio State University, Columbus, OH

Larvae of the Antarctic midge, *Belgica antarctica*, are capable of losing over 70% of their water content before succumbing to dehydration. During dehydration, water loss rates for *B*. *antarctica* are suppressed as the water pool within the larvae declines. In this study, we examine physiological changes that permit *B*. *antarctica* larvae to alter their water loss rates as dehydration progresses. Based on water loss rates, there are two distinct periods of dehydration resistance for *B*. *antarctica*. The first period of rapid water loss occurred until the midge loses about 50-60% of its water content, while the second period is during the loss of the final 10-25% of the water content. When the amount of water present in the hemolymph and internal organs was assessed, the water content of the hemolymph was significantly reduced during the initial phase of water loss at the expense of maintaining the water content of the internal organs. During the slower phase of water loss, the water content within the internal organs began to decline until death when 30-35% of the water content has been removed. Changes were also noted in osmolality; hemolymph osmolality changed significantly when water loss rates were rapid and increased much more rapidly in the internal organs during the slower period of water loss. Additionally, trehalose and glucose content significantly increased during dehydration, but this is particularly apparent during the slow phase of dehydration. Respiration declined as dehydration progressed with a nearly 70% reduction occurring throughout the slow phase of dehydration. Thus, water loss for *B*. *antarctica* should be treated as two separate periods: the rapid stage of initial water loss that transitions into a period of suppressed water loss that prolongs survival.

Key words: midge, water balance, dehydration, hemolymph

Undergraduate

Dehydration bouts reduce longevity, nutrient reserves, and egg production of the northern house mosquito, *Culex pipiens*

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Department of Entomology, The Ohio State University, Columbus, OH

Many studies have focused on the response of insects to dehydration, but few have assessed physiological changes that result from multiple dehydration exposures. In this study, we examined changes in the physiology of *Culex pipiens* during multiple stints of dehydration and rehydration; particularly we determine if these chronic bouts of dehydration stress reduced the prolonged survival of diapausing *C. pipiens*. After four dehydration/rehydration bouts, mosquitoes provided access to sugar during the rehydration period had considerably higher survival than those allowed to rehydrate without sugar, and survival was similar to mosquitoes of the same age that were not dehydrated. After each bout, there was a reduction in the total dry mass of the mosquitoes that were not provided sugar during the rehydration periods between the bouts of dehydration. This dry mass reduction is likely due to utilization of lipid, glycogen and sugar reserves, and these reductions in metabolic reserves lead to decreased survival after multiple bouts of dehydration/rehydration. Our results show that diapausing mosquitoes experience a continual decline in lipid and glycogen reserves with each bout of dehydration. These reduced metabolic reserves correlate with reduced survival time, indicating that diapausing females may not have adequate fat and glycogen reserves for overwintering if exposed to multiple bouts of dehydration. Egg production of nondiapausing and post-diapause females was reduced following multiple dehydration exposures. Overall, multiple dehydration bouts reduce the metabolic reserves of mosquitoes, likely due to the cost of responding to dehydration stress. This reduced survival can be alleviated by providing mosquitoes access to sugar during rehydration between dehydration bouts.

Key words: dehydration, nutrient reserves, survival, water balance

Undergraduate

Role of Hsp70 during blood feeding in *Aedes aegypti*

Tyler B. Krause, Kevin R. Patrick, Joshua B. Benoit, Giancarlo Lopez-Martinez, and David L. Denlinger

Department of Entomology, The Ohio State University, Columbus, OH

Heat shock proteins (Hsps) play a vital role in stress survival, and recently studies have shown that these genes are upregulated in response to blood feeding. In this study, we provide a detailed description of the upregulation and downregulation of the gene encoding Hsp70 when *Aedes aegypti* is allowed to blood feed. We cloned Hsp70 and found high amino acid homology for the portions of the genes used for northern blot hybridization. The expression of this gene occurs immediately during the onset of blood feeding and remains expressed for nearly 1d, possibly the result of heat, water and oxidative stress from the bloodmeal. Localization of *Hsp70* expression revealed that this gene is significantly increased in the midgut, but not in the ovaries or salivary glands. Utilization of RNA interference (RNAi) to block *Hsp70* resulted in reduced expression of this gene in the midgut. RNAi did not reduce the size of the bloodmeal, adult survival or midgut cell survival, but did reduce egg production. Hemoglobin and protein digestion assays revealed that the digestion rate is reduced by *Hsp70* RNAi, which is likely a result of reduced proteolytic activity. Overall, we have determined that *Hsp70* is essential for digestion in *A*. *aegypti*, likely by preventing injury to the midgut cells.

Key words: blood feeding, mosquito, heat shock proteins, egg production

Undergraduate

RNA interference of Hsp70 and Hsp90 reduces dehydration tolerance of mosquitoes

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The small size of mosquitoes, along with their residence in desiccating environments, indicates that maintaining water balance is extremely crucial to their survival. In this study, we examined the water balance characteristics and the role of two heat shock proteins (Hsp70 ad Hsp90) in response to dehydration stress of three mosquito species, *Aedes aegypti, Anopheles gambiae* and *Culex pipiens*. To do so, water balance characteristics were determined gravimetrically, *hsp* transcript expression was monitored throughout dehydration, and RNA interference (RNAi) was performed on *A. aegypti* by the injection of double stranded RNA (dsRNA) to determine the precise role of Hsps during dehydration. Female mosquitoes of all species displayed percent water content between 72-78% when fully-hydrated, but the rate of water loss differed. The lowest water loss rate was for *A. aegypti* (2.6%/h), followed by *C. pipiens* (3.3%/h), and *A. gambiae* (5.1%/h). All three species can only rehydrate through direct water drinking or blood feeding. *Aedes aegypti* and *C. pipiens* tolerated a loss of 36% of their body water, but *A. gambiae* was able to tolerate a water loss of only 29%. Throughout dehydration, *hsp70* expression was increased in all three species, and *C. pipiens* continued to express this gene during rehydration. *Hsp90* was expressed in fully-hydrated and dehydrated individuals for all three species, but was only expressed in *A. aegypti* and *A. gambiae* during rehydration. Water content and water loss of *A. aegypti* were not altered following RNAi directed toward *hsp70* and *hsp90*, however dehydration tolerance was lower. Females were able to tolerate only a 29% water loss after dsRNA directed against *hsp70* and only a 27% water loss when dsRNA was directed against *hsp90*. Thus, we conclude that Hsps play a critical function in mosquito dehydration tolerance.

Key words: dehydration, mosquito, heat shock proteins, RNAi

Undergraduate

Water balance characteristics of apple maggot pupae under diapausing and nondiapausing conditions

Zachary P. Phillips, Kevin R. Patrick, Joshua B. Benoit, Giancarlo Lopez-Martinez, and David L. Denlinger

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The apple maggot, *Rhagoletis pomonella,* has three different pupal developmental programs: nondiapause, shallow diapause, and deep diapause. In this study, we examine the dehydration tolerance of nondiapausing, shallow diapausing, and deep diapausing pupae. In addition, expression of transcripts for stress-related proteins was compared during dehydration for pupae reared under diapausing and nondiapausing conditions. Differences of size (dry and water mass) and percent water content were minimal between the different groups. The three developmental profiles produced distinct ranges of water loss rates; the nondiapause pupae were the most porous (0.8-1.2%/d), deep diapause pupae retained water the most effectively (0.1-0.3%/h), and shallow diapause pupae lost water at an intermediate rate (0.4-0.65%/h). The critical transition temperature was higher in diapausing than nondiapausing pupae, a consequence of additional hydrocarbons deposited on the puparium of diapausing. Catalase (Cat) expression remained low, while superoxide dismutase (SOD) had high levels of expression during dehydration, but less so during rehydration in nondiapausing pupae. Expression levels of *hsp70* and *hsp90* increased during dehydration and rehydration for nondiapausing pupae. Levels of *hsp70*, *hsp90*, *SOD*, and *Cat* remained constant under control, dehydrated, and rehydrated treatments when pupae were reared under diapausing conditions. Our results identified distinct pupal water balance profiles for nondiapausing and diapausing apple maggots. Additionally, *hsp70*, *hsp90*, *Cat*, and *SOD* expression are only responsive to dehydration when reared under nondiapausing conditions; these four genes are already highly expressed in response to the programming of diapause.

Key words: apple maggot, dehydration, diapause, stress-related proteins

Undergraduate

Chemically-mediated host colonization behavior of the peach bark beetle, *Phloeotribus liminaris* (Coleoptera: Curculionidae: Scolytinae)

Nicole VanDerLaan and Matthew Ginzel

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Black cherry, *Prunus serotina*, is among the most marketable hardwoods in the United States. However, black cherry throughout the central hardwood region is significantly devalued by damage caused by the peach bark beetle, *Phloeotribus liminaris*. The developing larvae feed on nutrient-rich phloem, girdling the tree and preventing water and nutrients from reaching the crown. Moreover, colonizing adult beetles bore underneath the bark where they feed and mate. Trees are not defenseless against these attacks, however. In response to feeding by adults, the tree produces a sticky resinous pitch to expel the beetles, a process called gummosis. This pitch stains the wood, making it unsuitable for high value veneer. The peach bark beetle spends the majority of its life cycle concealed beneath the bark of trees and is difficult to control by conventional sprayed insecticides. Little is known about the host colonization behavior of this and other bark beetles that attack hardwoods. In this study, we test the hypothesis that host colonization behavior of *P. liminaris* is chemically mediated. To determine whether adults are attracted to host compounds, we measured the walking response of males and females to bolts of black cherry in a glass tube olfactometer. As feeding stimulates pheromone production in other bark beetles, we also tested the response of the sexes to bolts of black cherry colonized by either males or females. Males were significantly attracted to female infested bolts of black cherry, suggesting the presence of a female-produced sex pheromone. Information on the colonization behavior of the peach bark beetle will aid in establishing effective management programs, such as improving detection methods and optimizing survey strategies.

Master of Science

Arthropod community structure responds to decreasing frequency of grazing perturbation in a temperate rangeland

Timothy Bankroff and Dr. Alan Cady

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Arthropod community structure in temperate rangelands can be influenced by habitat complexity mediated by ungulate herbivores infrequently grazing small paddocks of pasture. We assessed arthropod community structure and its response to changes in litter cover and vegetation height in a pasture under a rotational high-intensity, low-frequency grazing regime. In this system where herd movements can be traced, we also tested one assumption of Huston's *dynamic equlibrium model,* and we predicted arthropod biomass at lower trophic levels would recover more quickly than at higher trophic levels following grazing perturbations. Spiders (Araneae), parasitoid wasps (Hymenoptera), and predatory Coleoptera largely represented by rove beetles (Staphylinidae) were significantly more abundant in paddocks ungrazed for 32 days, but these taxa declined significantly in the longest undisturbed paddocks (42 days). Numbers of hoppers (Homoptera) significantly increased as time since perturbation increased from 21 to 32 days, and from 32 to 42 days. Vegetation height significantly increased from paddocks undisturbed 1 to 11 days, and from 32 to 42 days, but percent litter cover did not change. Only spider and hopper abundances increased significantly with vegetation height. Our results indicate that predatory and parasitoid arthropod numbers can be maximized using a 32-day grazing cycle, but lower trophic levels may vary in response to other factors.

Master of Science

Development of a novel nematode release system for preventive and curative management of the fungus gnat *Bradysia difformis* in poinsettias

Ronald Batallas

Visiting Scholar, Entomology Department, The Ohio State University/OARDC

The fungus gnats *Bradysia difformis* (Diptera: Sciaridae) is one of the most common insects attacking poinsettias, a very important floricultural crop in Ohio in 2007. Fungus gnat larvae cause direct damage to root and stems, and the adults compromise the plant aesthetics. Insect killing nematodes have been shown to be effective at reducing fungus gnat's infestations. This study evaluated three nematode delivery methods to Oasis (media used to allow plants to root; from Smithers Oasis, a company based in Ohio) to prevent fungus gnat's infestation. Rooted poinsettias cuttings, *cv* Freedom Red, were used for the experiment. Treatments were arranged in a randomized complete block design with six blocks. Fungus gnats larvae were either injected in the propagation media or added directly to the soil after transplant. Two species of insect killing nematodes (*Steinernema feltiae* and *Heterorhabditis bacteriophora*) were delivered via insect cadavers (*Galleria mellonella*), by dipping the rooted cuttings in either nematode solution or by drenching either nematode solution onto the soil after transplant. The use of an insect growth regulator (pyriproxyfen) and rooted cuttings without nematodes were used as controls. To measure the effectiveness of each nematode delivery method fungus gnat adult emergence was recorded by placing sticky cards in the top soil of each plant and immature were collected from the soil using a flotation technique. Low immature recovery was found because it was evaluated by the end of the cycle of the fungus gnat. Adult emergence decreased significantly when plants were treated with the chemical application. Nematode delivered via insect cadaver and drench decreased fungus gnats significantly when compared to controls without nematodes. This study shows it is possible to deliver nematodes using plant propagation media. Such system, if implemented by commercial growers, could prevent potential fungus gnat's infestation and reduce the cost of nematode use.

Key words: fungus gnats, *Bradysia difformis*, entomopathogenic nematodes, *Steinerma feltia*, *Heterorhabditis bacteriophora*, plant propagation media.

Master of Science

Ants of Indiana (Hymenoptera: Formicidae)

Tabbatha Carroll

Department of Entomology, Purdue University

Myrmecology in Indiana is a field which many choose to study. There has been little to no work recently on the taxonomy of Indiana ants, and there is potential to find new species for the state and counties. As ants become more of a problem pest, it is useful to know which species are being dealt with in rural settings. These studies examined the diversity of ant species in Indiana through institutional collections and field work, as well as identify the common pest species. Prior to field work, there were 67 counties in Indiana that had less than or equal to 10 species recorded. Three of these counties had zero species recorded. Post field work provided a closer look at the diversity of Indiana ants and a growth of species recognition per county. In addition to this, couplet images and images of common pest species were created to help pest control operators know which species are being dealt with. These images will be used in a key that is both accurate and easy to use.

Master of Science

Effects of sustainable and conventional fertilizers on poinsettia growth and life history traits of *Bemisia tabaci* Genn. biotype B (Homoptera: Aleyrodidae)

Katie England

Department of Entomology, Purdue University

Increased nitrogen in plants has been shown to increase the population growth rate of many pest species. Little is known about the effects on pest abundance of sustainable and controlled release fertilizers, however, as these fertilizers are becoming more common in greenhouse production systems. A study was conducted to test the effects among a sustainable water-soluble fertilizer, a conventional water-soluble fertilizer, an alternation of these, a controlled-release fertilizer, and a clear water control on poinsettia (*Euphorbia pulcherrima* Willd.) on growth and subsequent effects on life history traits of *Bemisia tabaci* Genn. biotype B (Homoptera: Aleyrodidae). Free amino acids in petioles were measured to estimate plant nutrient assimilation and phloem nutritional quality for *B. tabaci* biotype B. Differences in plant growth traits were slight among treatments. No differences were observed between plants in the sustainable and conventional water-soluble fertilizer treatments. I observed that an optimum whitefly survival rate was reached at intermediate levels of poinsettia petiole amino acids. All fertilizer treatments except the sustainable treatment produced plants whose whiteflies had higher fecundity than on clear water control plants, although fecundity was negatively correlated with total amino acids on individual plants. Variation in total amino acid concentration in petioles of plants treated with fertilizers makes it difficult to predict whether a particular fertilizer will produce plants with enough amino acids to deleteriously affect both survivorship and fecundity. However, my observations allow me to conclude that the use of this sustainable fertilizer will not cause increases in whitefly populations relative to plants fertilized with water-soluble and slow release fertilizers that deliver the same level of nitrogen to the plant.

Master of Science

Reconstituting the wax layer of solvent-washed female locust borers, *Megacyllene robiniae* (Förster), alters hydrocarbon profiles

Gabriel P. Hughes, Annie E. Spikes and Matthew D. Ginzel

Department of Entomology, Purdue University, West Lafayette, IN

Contact pheromones play an important role in mating systems of longhorned beetles (Coleoptera: Cerambycidae) by mediating mate recognition. Recently a common bioassay has been used in studies of contact chemoreception in cerambycids where a male beetle is presented with a freeze-killed female in a Petri dish arena. If the male mates with this female, it confirms that mate recognition cues are intact and behavioral cues are not involved. The same female is then washed with a non-polar solvent, stripping her of cuticular hydrocarbons and resulting in a crude cuticular extract. The washed female is then presented to the male again and, if he displays no mating behavior towards the washed female, it confirms that cuticular compound(s) mediating mate recognition have been removed. To test the bioactivity of the solvent wash, the same female is then reconstituted with the crude cuticular extract and presented again to the male. In spite of the widespread use of this assay to determine the role of contact pheromones in the mating systems of cerambycids, males of some species, including *Megacyllene robiniae*, respond less readily to reconstituted females than to those that are freeze-killed. In this study, we used solid phase microextraction to sample cuticular hydrocarbons of female *M. robiniae* after they were freeze-killed, solvent washed, and reconstituted with crude cuticular extracts. We found that reapplying the crude cuticular extract to a solvent-washed female scrambles the hydrocarbon profile, altering the natural ratios of cuticular compounds within the wax layer and influencing the mating response of males.

Key words: Solid-phase microextraction, cuticular hydrocarbons, contact pheromone

Master of Science

Clock gene sequence and expression in the overwintering diapause of the mosquito, *Culex pipiens*

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Over the past several decades a great deal of work has been done to determine roles of certain clock genes, especially *period* and *timeless*, in driving daily circadian rhythms. However implicating these same genes in the generation of a photoperiodic response has proven difficult. To determine whether *period* and *timeless* play a role in initiating the overwintering diapause of female *Culex pipiens* mosquitoes, we first obtained full length sequences of these genes. We then compared *C. pipiens period* and *timeless* sequences to those of a close relative, *Culex quinquefasciatus*, which does not enter an ovarian diapause. Additionally, we measured expression of *period* and *timeless* over a 24 hour period in adult *C. pipiens* mosquitoes that were reared under diapausing conditions (short day 18˚C), or non-diapausing conditions (long day at 25 or 18˚C). Gene expression in diapausing mosquitoes was measured 1 week (early) and 1 month after eclosion (late), and after diapause had been broken, while non-diapausing mosquitoes were sampled one week after adult emergence.

Master of Science

The first contact pheromone identified for a prionine longhorned beetle (Coleoptera: Cerambycidae)

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Little is known of the role pheromones play in the mating systems of longhorned beetles (Coleoptera: Cerambycidae) in the primitive subfamily Prioninae. *Mallodon dasystomus* (Say), the hardwood stump borer, is a widely distributed prionine native to the southern United States. In this study, we explore the chemically-mediated mating behavior of *M. dasystomus* and test the hypothesis that males recognize females by a contact pheromone. In mating bioassays, all males tested attempted to mate with females only after contacting them with their antennae. Moreover, all males attempted to mate with solvent-washed dead females treated with as little as 0.153 ± 0.03 female equivalents of conspecific cuticular extracts, confirming that non-polar compounds on the cuticle of females are essential for mate recognition. Cuticular hydrocarbon profiles of females contain 13 compounds not present in those of males. Among the female-specific compounds, two codominant methyl-branched alkanes, 2Me-C_{26} and 2Me-C_{28}, account for 17% of the total hydrocarbons. Our strategy for identifying the contact pheromone was to synthesize and test the bioactivity of female specific compounds, starting with the most abundant. In bioassays, males displayed mating behavior in response to synthetic 2Me-C_{26} and 2Me-C_{28} when tested individually. However, when these compounds were tested in combination they elicited the full progression of mating behaviors, suggesting both 2Me-C_{26} and 2Me-C_{28} make up the contact pheromone. These findings are further evidence of the critical role pheromones play in mating systems of longhorned beetles.

Key words: contact chemoreception, Prioninae, hydrocarbon, mating behavior, solid phase micro-extraction

Master of Science

The effect of polydomy on food distribution in the odorous house ant

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Colony spatial structure in the odorous house ant (*Tapinoma sessile*) exhibits immense variation as compared to other Hymenoptera. This variation can influence various aspects of the species' ecology, including foraging behavior and intracolony food distribution. We examined the effect of colony spatial structure (i.e. variation in nest number) on food distribution in laboratory-held colonies. Sucrose water spiked with a protein marker (rabbit IgG) was presented to colonies containing single nests (monodomy) or multiple nests (polydomy), and later detected using DAS-ELISA. We predicted that increasing the number of nests would slow the rate and level of food distribution throughout the colonies. Distribution of food was rapid and complete in monodomous colonies, with a majority of the workers testing positive for the marker after 1h. Polydomous colonies that were presented with food at every nest exhibited similar results. Distribution of food was initially delayed and incomplete at polydomous colonies where food was presented at only one nest. After 8h, a higher percentage of workers scored positive for the marker. Polydomous colonies that were given food at one nest, and not allowed to share the food until after an initial feeding interval exhibited comparable results. In addition, we observed that food distribution was more complete in workers than in queens, due to delayed feeding.

Master of Science

Ew, that's icky: Assessing children's attitudes towards the insects of Connecticut

Faith J. Weeks

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This study investigated children's attitudes towards insects, focusing on how attitudes change from fascination to repulsion as the children age. This study involved 127 elementary students (grades 4-6) and 139 high school students (grades 9-12) from New Haven public schools. Students were administered Likert type surveys to evaluate their attitudes after viewing photos of 8 common insects of Connecticut; the butterfly, ladybug, dragonfly, ant, moth, cricket, beetle, and fly. Scores from elementary school students were compared with high school students to determine if attitudes towards insects became less favorable as the children age. The results were also analyzed to determine if attitudinal changes were consistent between girls and boys. It was found that elementary school students did not hold more negative attitudes than high school students, but girls did hold more negative attitudes towards insects than boys. These results indicate that there are, overall, negative attitudes from all students towards the insects of Connecticut, and more of an effort should be made to incorporate insects into school curriculums in the hopes of changing these attitudes.

Doctor of Philosophy

Secretion of the tick large wax gland: functional morphology and role during heat tolerance

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Large wax glands of metastriate ticks (*Amblyomma*, *Dermacentor*, *Hyalomma*, and *Rhipicephalus*) secrete hydrocarbon-based defensive chemicals in response to a predator. These glands are concentrated above each tick leg, producing droplets of fluid around the edges of the tick's body. We observed that these glands secrete during blood engorgement of the brown dog tick, *Rhipicephalus sanguineus*. Here, we examined the functional morphology of these glands, and determined a role for the secretion in relation to blood feeding. The gland is innervated and responds to pressure stimulation as a proprioceptor. Histology of the glands (before and after secretory release) revealed that the entire contents and associated cells of these glands are ejected duringbsecretion.

Likely, semiochemicals from these glands are released when epidermal cells associated with the gland reach the surface of the tick and burst. Glands remain nonfunctional for 1-2d during cellular regeneration, and then after 10d recovery period are able to fully secrete based on gravimetric methods. Short-term heat exposure (50°C for 1h) was improved by gland secretion. When exposed to host temperature (37°C) after gland secretion, survival was increased by nearly 1 week compared to non-secreted ticks. Application of squalene, main component of the secretion, to the tick dorsal surface did not alter heat tolerance, suggesting the act of secretion, rather than the secretion itself, is responsible for the increased heat tolerance. Thus, large wax glands of ticks are holocrine with intermittent regeneration. Additionally, the presence of these glands on metastriate, but not prostriate (*Ixodes*), may be responsible for allowing this group of ticks to tolerate host temperature during their extended feeding period compared to prostriate individuals (12-14d for metastriate ticks vs. 5-8d for prostriate ticks). Overall, this is the first study to demonstrate the mechanism of tick gland secretion and its relation to host-parasite interactions.

Key words: large wax glands, tick, heat tolerance, secretion

Doctor of Philosophy

Efficacy of high concentrations of ozone on adult maize weevil (*Sitophilus zeamais* (Motsch.)), rice weevil (*S. oryzae* (L)) and all life stages of red flour beetle (*Tribolium castaneum* (Herbst))

Marissa McDonough

Department of Entomology, Purdue University

A biologically safe alternative is needed to control pests in stored raw grains. Ozone is an excellent alternative to currently available products especially for on-farm use and bulk grain storage. The need to treat moving streams of grain for very short periods of time necessitates generating efficacy data on stored product pests. This experiment studied the efficacy of ozone on all life stages of red flour beetle (*T. castaneum* (Herbst)), adult maize weevil (*S. zeamais* (Motsch.)) and rice weevil (*S. oryzae* (L)). Insects were treated with ozone at various dosages for 30 and 60m. If 100% mortality was not reached by 60m, more time was added in intervals of 30m. Concentrations of ozone tested ranged from 50-1800ppm (50, 100, 500, 1000, 1500, 1800 ppm). Results showed 100% mortality of adult red flour beetle was reached at 1800ppm for 120m; pupae at 1800ppm for 180m; larvae at 1800ppm for 90m; and eggs at 1800ppm for 180m. Complete mortality for adult maize weevil was achieved at a treatment of 1800ppm for 120m. One hundred percent mortality of adult rice weevil was achieved at a treatment of 1800ppm for 60m. In order to treat moving streams of grain, higher concentrations will be needed. These results show promise for reducing the current recommended treatment time of 3d.

Key words: ozone, maize weevil, red flour beetle, rice weevil, *Sitophilus zeamais*, *Tribolium castaneum*, *S. oryzae*

Doctor of Philosophy

Molecular phylogeny of the long-horned beetles (Family: Cerambycidae)

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Department of Entomology, Purdue University

The family Cerambycidae (long horned beetles) is an important and diverse group of phytophagous insects. Some of these beetles are serious pests of the timber industry, whereas many others fill important roles in balanced ecosystems as deadwood decomposers, pollinators, and food sources. We sequenced DNA for part of the cytochrome oxidase I gene from Indiana specimens of the subfamilies Lepturinae, Cerambycinae and Lamiinae, and constructed a phylogenetic tree based on our DNA data. The three subfamilies of the Cerambycidae were monophyletic on the phylogenetic tree, with good bootstrap support at the nodes where the subfamilies branched from each other.

Doctor of Philosophy

Impact of life-shortening *Wolbachia* infection on larval competitiveness in *Aedes aegypti*

Eunho Suh, David R. Mercer and Stephen L. Dobson

Department of Entomology, University of Kentucky

Endosymbiont bacteria *Wolbachia* affect host fitness in various ways. An example of the latter is the manipulation of host reproduction by *Wolbachia* induced cytoplasmic incompatibility (CI), which increases the relative fitness of infected adults, promoting the spread of infection into an uninfected population. The reproductive advantage afforded by *Wolbachia* has been suggested as a way to drive desirable phenotypes into natural populations to reduce transmission of insect vectored diseases. Life-shortening *Wolbachia* (*w*MelPop, *popcorn*) has previously been shown to induce complete CI in uninfected females mated with infected males of the dengue virus vector *Aedes aegypti.* Although the fitness advantage due to CI in the adult reproduction of infected individuals may alone have the potential to invade and replace the uninfected population, it is also crucial to understand the effect of *popcorn Wolbachia* on other life stages such as larvae. We examine cohort larvae competing within and between strains (infected and uninfected) at two different larval densities. The results demonstrate significantly reduced competitiveness in infected larvae with decreased survival and increased development time particularly when competitive effects were high. The results are discussed within the context of using *popcorn Wolbachia* infections to reduce transmission of the dengue virus by *Ae. aegypti*.

Key words: larval competition, fitness, development, population replacement

Doctor of Philosophy

The role of calcium signaling during cellular cold-sensing and rapid cold-hardening in the goldenrod gall fly, *Eurosta solidaginis*

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Ohio State University, Department of Entomology

The goldenrod gall fly, *Eurosta solidaginis* (Diptera: Tephritidae), overwinters as third instar larvae inside stem galls on goldenrod plants (genus *Solidago). E. solidaginis* has been long-studied for its extreme freeze-tolerance, but very few studies have addressed cellular-level responses to cold in *E. solidaginis.* Recent literature on other species suggests that isolated cells directly respond to changes in temperature without nervous or hormonal input and that calcium signaling pathways may be responsible for triggering this response. Therefore, our objectives in this study were to determine 1) whether isolated tissues of *E. solidaginis* undergo cold-sensing and rapid cold-hardening (RCH) *in vitro*, and 2) whether calcium signaling pathways mediate cellular cold-sensing and RCH in *E. solidaginis* tissues. Midgut and salivary glands were dissected from third instar larvae, exposed to various temperature regimes, and tested for viability with a LIVE/DEAD dye exclusion assay. Direct exposure to -20°C for 2 h caused significant cell death; only 51.1% of midgut cells and 60.5% of salivary gland cells survived this treatment. However, cell survival significantly increased to 84.2% in midgut and 85.6% in salivary gland when tissues were exposed to a 1 h RCH period prior to the 2h at -20°C. Meanwhile, inhibitors of calcium signaling prevented RCH from occurring in tissues; for example, only 44.5% of midgut cells and 62.5% of salivary gland cells survived the RCH treatment after being loaded with the calcium chelator BAPTA. Other pharmacological inhibitors that significantly inhibited RCH were W-7 (calmodulin inhibitor), KN-93 (CaM kinase inhitor), and LaCl3 (calcium channel antagonist). Meanwhile, 2-APB, an inhibitor of IP3 receptors, did not affect cell survival during RCH. Thus, we conclude that *E. solidaginis* tissues are capable of RCH *in vitro*, and that calcium signaling is an essential component of the signal transduction pathway mediating cellular cold-sensing and RCH.

Key words: Rapid cold-hardening, calcium signaling, freeze tolerance, cold-sensing, *Eurosta*

Appendix I
Past Winners of the Annual Forum for the Student Paper Competition

Undergraduate Competition			
Year	**First Prize**	**Second Prize**	**Third Prize**
1985	D. Craig Heim University of Kentucky	Valerie Kuglar Earlham College	Raymond E. Siegel Purdue University
1986	Sunedha Weeratunga University of Kentucky	Timothy Coppess Anderson University	Not awarded
1988	Kathy A. Mitktuk University of Kentucky	David Rivers Ball State University	Not awarded
1989	Douglas D. Anspaugh Purdue University	Margaret Buxton University of Kentucky	Britt Bunyard Kent State University
1990	Jaime D. Coots Anderson University	Shephen R. Skaggs Northern Kentucky Univ.	Peggy Sue merchant Earlham College
1991	Kenneth W. Blank Northern Kentucky Univ.	Corey R. Gerber Purdue University	Russell May University of Kentucky
1992	Betty Krueger University of Kentucky	Thomas O. Swinford IU-PU Fort Wayne	Judy Neff Purdue University
1993	Carl Harper University of Kentucky	Not awarded	Not awarded
1994	Jason Scannell University of Kentucky	Jeff Bedel Purdue University	Michael K. Agenter Northern Kentucky Univ.
1995	Deborah L. Finke Centre College	Jason A. Scannell University of Kentucky	Leslie Horne College of Mt. St. Joseph
1996	Mark Doyle Purdue University	John Shea Rachel Bartholomew Cleveland Museum of Natural History	Leo Niemeier Kentucky State University
1997	Anthony Hanley Kentucky State University	Nicola T. Gallagher College of Mt. St. Joseph	Andrew Nuss Purdue University
1999	Tonja Wilkins Kentucky State University	Tyler Eaton University of Kentucky	Louie Rivers III Kentucky State University
2000	Kara Mobray University of Kentucky	Jennifer Steill Purdue University	Philip Gonista University of Kentucky
2003	Ruth Hagarty Purdue University	Brenda Graves University of Kentucky	Rebecca Baumler University of Kentucky
2004	Eric Rellinger Wittenberg University	Rianna Arcinas Purdue University	Joshua Benoit Wittenberg University
2005	Jacob Ark Wittenberg University	M. Walter Baldauf Purdue University	Jonathan Clark Kentucky State University
2006	John Shukle Purdue University	Zachary Bozic Wittenberg University	Ceryl Lindsay and Justin Tank (tie), Univ. of Kent. Wittenberg Univ.
2007	Justin Tank Wittenberg University	Zachary Bozic Wittenberg University	Chad Andrews College of Mt. St. Joseph
2008	Megan Meuti The Ohio State University	Michael Chambers Wittenberg University	Matt Paschen Purdue University

Master of Science Competition			
Year	**First Prize**	**Second Prize**	**Third Prize**
1985	Joseph E. Huesing University of Kentucky	F. Gordon Carter University of Kentucky	Kevin A. Shufran University of Kentucky
1986	Wayne G. Buhler Purdue University	Denise Coar University of Kentucky	Billy Annan Purdue University
1988	Neal H. Haskell Purdue University	Joseph J. DeMark Purdue University	Dottie C. Clements University of Kentucky
1989	Joseph J. Demark Purdue University	C. J. Voglewede Purdue University	Carl T. Redmond University of Kentucky
1990	Lisa S. Whitt University of Kentucky	Alan W. Davidson University of Kentucky	Deborah M. Campero University of Kentucky
1991	C. J. Voglewede Purdue University	Alan W. Davidson University of Kentucky	Harry B. Meyers Purdue University
1992	Jim P. Vandercoevering Purdue University	Barry Pittendrigh Purdue University	Harry B. Meyers Purdue University
1993	Will McClintock University of Cincinnati	Darcy C. Willis University of Kentucky	Sue Simon College of Mt. St. Joseph
1994	William J. Rowe II University of Kentucky	Scott P. Dideon Purdue University	Corey K. Gerber Purdue University
1995	Kurt D. Saltzmann Purdue University	Aaron C. Anderson University of Kentucky	W.E. Snyder University of Kentucky
1996	R. Chris Stanton Ohio State University	Betty Krueger University of Kentucky	Margaret Nichols Ohio State University
1999	Daniel Hemmann University of Kentucky	Blake Newton University of Kentucky	Marisa Griffin University of Kentucky
2000	Lauren Pintor University of Kentucky	Michael Rodgers University of Kentucky	Bryan Price Kentucky State University
2002	Amanda Staley University of Kentucky	Charlene Rucker University of Kentucky	Tonja Wilkin Kentucky State University
2003	Kimberly Rebek Purdue University	Reid Maier University of kentucky	Beth Choate University of Kentucky
2004	Shelly Kellogg University of Kentucky	Rebecca Trout University of Kentucky	Justin Vitullo Purdue University
2005	Aerin Land University of Kentucky	Nick Geraci Purdue University	Rebecca Trout University of Kentucky
2006	Ye Ye Ohio State University	Paul Marquardt Purdue University	Thelma Heidel (tie) Purdeu University Leo Stellwag (tie) Ball State University
2007	Thelma Heidel Purdue university	Ashley Walter Purdue University	Ye Ye The Ohio State University
2008	Annie Spikes Purdue University	Paul Ayayee University of Kentucky	Terri Hoctor Purdue University

Doctor of Philosophy Competition			
Year	**First Prize**	**Second Prize**	**Third Prize**
1985	M. C. Shaw Purdue University	Gary Brookhard Purdue University	David McShaffrey Purdue University
1986	Mark A Zajac Ohio State University	S. Kristine Braman University of Kentucky	Sven Strnad Purdue University
1988	Gary A. Braness Purdue University	Donald R. Ross Purdue University	J. Edward King Purdeu University
1989	Danise Coar University	Chaoxian Geng Purdue University	Marvin D. Sigal Ohio State University
1990	David L. Clark University of Cincinnati	Wayne G. Buhler Purdue University	Doreen K.S. Goh University of Kentucky
1991	John McHugh Purdue University	Joseph J. DeMark Purdue University	Herbert Eichenseer University of Kentucky
1992	Keyan Zhu Purdue University	Ana I. Soldevila University of Kentucky	Matthew Enrico Bur University of Kentucky
1993	Janet L. Murphy Ohio State University	James D. Wagner University of Kentucky	Robert S. Pfannenstiel University of Kentucky
1994	Constance A. Hallberg Purdue University	Patchanee Tuntibunpakul University of Kentucky	Not awarded
1995	Kevin R. Hopper University of Kentucky	F. Anthony DiLuna University of Kentucky	Liwang Cui University of Kentucky
1996	Matthew Persons University of Cincinnati	Sandra DeBano University of Kentucky	Charlotte Bedet Ohio State University
1999	Patrick Cumrine University of Kentucky	Kenneth Blank University of Kentucky	Eileen Eliason University of Kentucky
2000	Matthew Turnbull University of Kentucky	Valerie Bennet Miami University	Chris Stanton Ohio State University
2002	Randy Hamilton Purdue University	Eric Rebek Purdue University	Hong Mei Li Purdue University
2003	Al Fournier Purdue University	Eric Rebek Purdue University	Joao Pedra Purdue University
2004	Craig Stillwell University of Kentucky	Michael Seagraves University of Kentucky	Tom Coleman (tie) University of Kentucky Shujuan Li (tie) Purdue University
2005	Cynthia Khoo University of Kentucky	Omprakash Mittapalli Purdue University	Michael Seagraves University of Kentucky
2006	Alvaro Romero University of Kentucky	R. Craig Stillwell University of Kentucky	Joshua Benoit Ohio State University
2007	Joshua Benoit The Ohio State University	Corey L. Brelsfoard University of Kentucky	Tonya Fisher University of Kentucky
2008	Alexzandra Murphy Purdue University	Huh Biah University of Kentucky	Eunho Suh University of Kentucky

Appendix II

BYLAWS

Ohio Valley Entomological Association

PREAMBLE

In order to promote the study of entomology as a science; to improve public awareness and understanding; and to recognize the achievements of students and practitioners of entomology, the Ohio Valley Entomological Association has been organized; and to such ends the BYLAWS of which this preamble is a part, are set forth.

Article I

NAME AND DEMOGRAPHICS

Section 1. Name. This organization shall be known as the *Ohio Valley Entomological Association*, hereafter referred to as the **ASSOCIATION**.

Section 2. Demographics. The primary activity of the **Association** shall be restricted to the States of Indiana, Kentucky and Ohio.

Article II

OBJECTIVES

Section 1. The objectives of the **Association** are (1) to promote the study of the science of entomology; (2) to cultivate student interest in the science of entomology and to provide recognition for outstanding achievement; (3) to improve public awareness and better understanding of the science of entomology; and (4) to promote the interaction of interdisciplinary sciences and societies.

Article III

MEMBERSHIP

Section 1. Association membership shall be open to persons interested in entomology.

Section 2. Membership shall be granted by a simple majority vote at a regular meeting to persons who quality under Section 1.

Section 3. Membership privileges. All members shall have equal privileges as to serving on committees, discussion at meetings and participation in **Association** activities.

Section 4. Provisions for Resignation. Any member may resign from **Association** membership effective at the close of any **Association** year. If desired, the resignee may file written reasons for resignation with the Secretary-Treasurer to become a part of the permanent **Association** record.

Section 5. Termination of Membership. The **Association** reserves the right to terminate the membership of any member upon the recommendation of the Executive Committee after due process, and by a two-thirds vote of the active membership present at any regular meeting.

Section 6. Suspension of Membership. The **Association** reserves the right to suspend membership of any member delinquent in payment of dues in excess of six months.

Article IV

OFFICERS, TERMS, DUTIES, ELECTION AND VACANCIES

Section 1. Officers. Officers of the **Association** shall consist of a PRESIDENT, PRESIDENT-ELECT and SECRETARY-TREASURER. The president and President-elect shall serve a term of one year each, after which the President-Elect accedes to the Presidency. The Secretary-Treasurer shall be elected biennially for a term of two years.

Section 2. Duties. The President shall preside at all **Association** meetings, regular or special. The President shall appoint all necessary special committees and, subject to approval by the Executive Committee, all standing committees necessary for conducting **Association** affairs.

The President-Elect shall assist the President in administrative affairs and assume the presidential duties if the President is absent from a regular or special meeting. In the event a President is unable to complete the term of office for any reason, the President-Elect shall complete that term as Acting President, the immediate Past President shall serve as President-Elect until an election is held.

The Secretary-Treasurer shall make necessary arrangements for **Association** meetings, maintain and distribute to the membership, at least annually, a roster of **Association** members, record all **Association** proceedings, maintain adequate minutes of meeting and attend to general correspondence as may be required. The Secretary-Treasurer shall collect all monies due to the **Association**, pay all bills incurred and maintain adequate records accounting of all **Association** assets. The account shall be audited annually by a committee appointed by the President. In anticipation of an absence from a regular or special meeting, the Secretary-Treasurer shall arrange for an Acting Secretary to assume the prescribed duties.

Section 3. Election of Officers. Officers shall be elected by Active members by a majority vote at the last regular meeting of each **Association** year. A slate of candidates shall be presented by a Nominating Committee prior to the vote. In the event that more than two nominees are presented for an office, runoff balloting shall proceed until one receives a majority of the votes cast. In the event of a tie, the Executive Committee shall be responsible for the administration of an unbiased tie breaking procedure. Newly elected officers will assume office at the last regular meeting of each **Association** year.

Section 4. Vacancies. Vacancy in the office of president and President-Elect shall be filled as provided in Article IV, Section 2. A vacancy in the office of Secretary-Treasurer shall be filled by the Executive Committee for the remaining portion of the **Association** year only, at which time a new Secretary-Treasurer will be elected as provided in Article IV, Section 3.

Article V

EXECUTIVE COMMITTEE

Section 1. Membership. The **Association** executive committee shall consist of the President; and four Executive committee Members-At-Treasurer; immediate Past President; and four executive committee Members-At-Large, two of which are elected annually for two-year terms.

Section 2. Election of Executive Committee Members. Executive Committee Members-At-Large will serve two years on the Executive Committee, except two of those initially elected who will serve only one year. Thereafter, two Executive Committee Members-At-Large will be elected annually to succeed those whose terms are expiring.

Section 3. Voting Privilege of Presiding Officer. The presiding officer (see Article IV, Section 2) may vote on matters considered by the Executive Committee only in the event of a tie by the other Committee Members.

Section 4. Duties. The Executive Committee shall have authority to transact necessary **Association** business during the interim between **Association** meeting any business transacted and action taken on behalf of the **Association**. It shall also refer to the **Association** membership all items of business requiring the consideration of action by the membership.

Section 5. Quorum. Five members of the Executive Committee shall constitute the necessary quorum tor the transaction of **Association** business. A majority vote shall be necessary for action of any matter.

Article VI

ASSOCIATION YEAR AND MEETINGS

Section 1. Association Year. The **Association** year shall be the calendar year.

Section 2. Regular Meetings. A special meeting called for any purpose shall be announced by letter from the president or Secretary-treasurer mailed at least 14 days prior to the meeting date.

Section 3. Special Meetings. A special meeting called for any purpose shall be announced by letter from the President or Secretary-Treasurer mailed at least 14 days prior to the meeting date.

Section 4. Quorum. A quorum for the transaction of **Association** business at regular of special meetings shall consist of 20% of the current Active Membership.

Article VII

DUES

Section1. Amount and When Payable. Association dues shall be determined by the Executive Committee and passed by a two-thirds majority vote of the Active Members present at any regular meeting. The Secretary-Treasurer shall notify members by mail before December 20 of each year that dues are payable for the **Association** year. If dues are not received by February 1, one month after becoming delinquent, the Secretary-Treasurer shall mail a second and final notice.

Section 2. Penalty for Non-Payment of Dues. Any member allowing dues to become more the six months delinquent shall be notified by the Executive Committee that the member will be suspended form Active **Association** membership unless delinquent dues are received within six weeks. Reinstatement of active membership shall require payment of delinquent dues plus a 20% penalty.

Article VIII

COMMITTEES

Section 1. Appointment of Committees. The President shall have authority to appoint Special Committees to consider specific items necessary for the transaction of normal **Association** business. Appointments to standing committees whose activities span more than one **Association** year may be made by the President with approval of the Executive Committee.

Section 2. Ex-Officio Membership. The President may serve as an Ex-Officio member of all committees except for the Nominating Committee.

Article IX

AMENDMENT OF BYLAWS

Section 1. Procedure. Amendments to Bylaws may be made by a two-thirds vote of the Active members present at any regular meeting, provided that the membership have been given written notice of the proposed amendment at least 30 days before the meeting during which it will be considered, and provided that a quorum of the members is present (Article VI, Section 4).

Article X

PARLIAMENTARY AUTHORITY

Section 1. The rules contained in *Robert's Rules of Order, Revised,* shall govern this **Association** in all cases to which they are applicable and in which they are not inconsistent with these Bylaws.

Annual Membership Form: Ohio Valley Entomological Association (OVEA)

Make checks payable to OVEA. Do not send cash. Sorry we don't take credit cards.

Mail to:

Dr. John Sedlacek, OVEA Treasurer
Principal Investigator
Kentucky State University
Atwood Research Facility, Room 126
400 East Main St.
Frankfort, KY 40601

Name: _____
First M.I. Last

Title: _____

Business or Affiliation: _____

Department: _____

Address: _____

_____

City: _____

State: _____ Zip Code: _____

Telephone Number: (_____) _____ -- _____

E-mail Address: _____

Student Membership: ($5.00) _____

Regular Membership ($20.00) _____