# Texas A&M University Department of Entomology
# Fourteenth Annual Graduate Student Forum

## Reflections from the Chair

**Raul F. Medina**
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### The Value of Effective Communication

People engaged in scientific endeavors have the wonderful opportunity to uncover the secrets nature conceals. Often times, these secrets are well hidden and finding them requires hard work, dedication, inspiration and patience plus a considerable amount of accumulated knowledge and specialized training. In our efforts to acquire the tools we need to uncover nature's wonders and to understand nature ways, we often forget an important aspect of science. We often forget to communicate our findings to people outside our specific fields in an engaging manner. You may ask why should people outside our fields care about our findings. Well, there are many answers to this question. Although you may be surprised, people actually do care. If you think about it, most of our research is possible due to the funds that society (i.e., people) makes available through their contributions to federal and private entities. In conservation biology there is an old mantra stating that people do not preserve things they do not know. In the same venue people won't fund things they do not know or are not excited about. You may think that you are trying to comprehend an important yet uninteresting aspect of nature's collection of wonders. Probabilities are that if you are interested, several people will be as well. The difference between you and people outside your field is that you have spent more time thinking about these phenomena than they have and consequently you know much more about these wonders than they do. Thus, before lamenting people lack of interest in your study subjects you should try to transmit your excitement about your discoveries to them, so they know and so they care. I need to admit though, that societies' interests are not always a good measure of scientific relevance. However, why should you claim to be a misunderstood researcher before you even try to be understood?

Generating excitement can be a challenging task (especially for scientists). Learning to communicate in an engaging way may do the trick though. Like most activities in live, learning to transmit information effectively, requires a little dosage of innate abilities and huge amounts of practice. In other words if you are not a naturally born communicator you can learn to be one. The roman author Publilius Syrus already said several centuries ago "practice is the best of all instructors". The Graduate Student Forum is the perfect place to acquire the practice you need to engage us in your scientific world and to learn about your peers' research activities. The Graduate Student Forum is also an ideal venue to obtain and to give new ideas and points of view, to enrich your vision and to look at your research questions from a different perspective. As graduate students you should dedicate yourselves to be ready to do good science and to communicate your excitement to others. In a time in which hearing what scientist have to say may decide the future of our society as we know it, it is not only necessary but crucial to be able to effectively communicate to others at a faster and more engaging way than our field has traditionally done. Let the flow of information and excitement begin!

## Thursday, August 25, 2011

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**Dr. Mariana Mateos**
Assistant Professor
Department of Wildlife & Fisheries
Texas A&M University

Dr. Mateos was born and raised in Mexico City. She conducted her undergraduate work (Biochemical Engineering in Aquatic Resources) at the Tecnologico de Monterrey in northwestern Mexico on the shores of the Gulf of California (1991–1995). She then worked for six months as the coordinator's assistant at Conservation International-Gulf of California program. She was awarded a Fulbright Scholarship to conduct her Ph.D. work in Ecology and Evolution at Rutgers University (1996–2002). She spent the first three years of her Ph.D. work in New Jersey and then moved to the Monterey Bay Aquarium Research Institute, where completed her Ph.D. research on the evolution and historical biogeography of sexual and asexual lineages of freshwater fishes in the Poeciliid family. During this time, she was also involved in hydrothermal vent research. She did her postdoctoral work at the University of Arizona (2002–2005), where she conducted research on endosymbionts of genus *Drosophila*. She was assistant professor at University of Texas at El Paso for one year (2005–2006). She has been an assistant professor in the Department of Wildlife and Fisheries at Texas A&M University since 2006. She lives in College Station with her husband, son, and daughter.

Dr. Mateos has two main lines of research: (a) evolutionary ecology of insect-bacteria associations; and (b) phylogenetics and phylo/biogeography of freshwater fishes and coastal isopods (mostly Mexico and neighboring regions). Most of the insect-bacteria research focuses on the association of *Drosophila* flies and *Spiroplasma* bacteria. These bacteria are maternally-transmitted in *Drosophila* (and a few other insects), and can be reproductive parasites (son-killers) and/or defensive mutualists (defend the host against parasitoid attack). Although most of her research is basic, her findings have implications for pest control, and some of her collaborative research focuses on endosymbionts of pest species. Her research has received funding from the NSF, NIH, and TAMU-CONACyT programs.

## Thursday, August 25, 2011

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## "Influence of genetic variation on colony-level foraging behavior of the red imported fire ant (*Solenopsis invicta*)"

**Alison Bockoven**
Major Professor: Dr. Micky D. Eubanks

Among social insects, genetic variation in a behavior can allow a colony to exhibit more flexible, rapid responses to environmental changes and promote homeostasis. Such variation enables adaptive evolution and can increase colony fitness in multi-lineage colonies, such as polygynous fire ants. Our preliminary research demonstrated significant and persistent colony-level variation in fire ant foraging behavior. Variation in foraging behaviors and division of labor in some social insects has been associated with variation in expression of the *foraging* gene (*for*). We founded single lineage colonies and assayed foraging behavior and *for* expression. Colonies varied in *for* expression levels, and decreased *for* expression correlated with increased foraging. We also compared the foraging behavior of groups of single and multilineage workers. We further examined the effects of cGMP-dependent protein kinase G (PKG), the enzyme product of *for*, on foraging behavior by treating lab colonies with 8-Br-cGMP to artificially activate PKG. Behavioral assays revealed that this treatment had a significant effect on fire ant recruitment and predation compared to control colonies. Notably, changes in fire ant foraging behavior had significant indirect effects on plant damage due to herbivory. This study suggests that significant variation in foraging behavior exists among fire ant colonies and may underlie variation in the ecological effects of fire ants and variation in methods necessary for their control.

## Thursday, August 25, 2011

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## "Feeding and oviposition performances of corn leafhopper (Dalbulus maidis) along maize's domestication and selection gradients"

**Edwin Bellota**
Major Professor: Dr. Julio Bernal & Dr. Raul Medina

Feeding and oviposition performance of the corn leafhopper *Dalbulus maidis* (Hemiptera: Cicadellidae) were assessed in a suite of five taxa or genotypes representing the domestication and selection gradients of maize (*Z. mays* ssp. *mays*): 1 perennial teosinte (*Zea diploperennis*), 2 annual teosinte (*Zea mays* ssp. *parviglumis*), 1 Tuxpeno landrace maize, and 1 Mexican commercial hybrid maize. Corn leafhopper is an economically important pest of maize and vector of maize pathogens, including Maize Rayado Fino Virus, Corn Stunt Spiroplasma, and Maize Bushy Stunt Phytoplasma. The performances of the leafhoppers were assessed in terms of (i) number of honeydew droplets excreted and oviposition attempts performed during a fixed period of time, as determined through direct observation with the aid of a video camera; and (ii) number of feeding scars and eggs found on leaves, as determined using the McBride's staining technique. The results of these observations were compared with previously gathered data concerning leaf toughness, a trait considered deterrent to oviposition and feeding. Altogether, our data contribute to understanding the role, if any, of physical herbivore defenses in corn leafhopper's host range expansion from the wild relatives of maize to the crop following domestication ~9000 years ago.

## Thursday, August 25, 2011

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## "Genetic Isolation between Populations of the West-African Malaria Vector *Anopheles melas*"

**Kevin Dietz**
Major Professor: Dr. Michael Slotman

*Anopheles melas* is a brackish water-breeding member of the *Anopheles gambiae* complex, and is distributed along the coast of West-Africa from The Gambia to Angola. It is considered a secondary malaria vector due to its limited range; however, in localized regions it can be the most abundant vector of malaria. Due to its classification as a secondary vector, it is not as well studied as other species in the *An. gambiae* complex, and little is known about its population genetic structure. *An. melas* is an important vector on Bioko Island, Equatorial Guinea, where it can comprise up to 100% of the local malaria infective mosquito population, and is responsible for a high entomological inoculation rate. As part of the Bioko Island Malaria Control Program (BIMCP), *An. melas* and other malaria vectors are targeted with anti-vector control measures. In conjunction with the BIMCP, we have investigated the population structure of *An. melas* on Bioko and mainland Africa to determine the level of migration between various populations on the mainland and Bioko Island.

## Thursday, August 25, 2011

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## "Leaf orientation and biomechanical properties do not explain Western Flower Thrips preference for feeding on the undersides of leaves"

**Justin Fiene**
Major Professor: Dr. Marvin Harris

Understanding why phytophagous insects often show distinct preferences for particular feeding locations on a host-plant is of fundamental importance in the field of host-plant resistance. While it is commonly observed both in the field and laboratory that Western Flower Thrips *Frankliniella occidentalis* prefer to feed on the undersides of cotton leaves, the reason for this preference is unknown. We examined the influences of leaf orientation and leaf biomechanical properties on thrips feeding preferences. To determine whether leaf orientation affects feeding preference, we conducted bioassays where an excised cotyledon was placed in a Petri-dish with either adaxial side-down (normal) or adaxial side-up (upside-down). To determine whether resistance to mandible penetration (energy to fracture) affects feeding preference, we compared two leaf biomechanical properties; punch strength and specific punch strength, between the adaxial and abaxial surfaces of cotyledons. These properties were measured using a penetrometer and were correlated with a no-choice feeding bioassay where thrips were forced to feed either on top or bottom only. Manipulating the orientation of an excised leaf such that the abaxial side is face-up and adaxial face-down did not change the preference for feeding on the abaxial side. When thrips fed only on the top or bottom leaf surface, plant feeding was significantly less on the top leaf surface compared to the bottom. While this feeding pattern was consistent for two different plant genotypes, leaf surface biomechanical properties between genotypes were variable and did not correlate with plant feeding.

## Thursday, August 25, 2011

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**"Herbivores as plant mutualists: A budding potential for herbivores to increase plant fitness"**

**Loriann Garcia**
Major Professor: Dr. Micky D. Eubanks

Plants are able to compensate for herbivory by altering their growth and development patterns after damage. With this defense strategy, known as the tolerance defense strategy, plant fitness is unaffected by herbivore feeding. Tolerance is common in agrosystems and tends to increase with plant age. In previous studies, cotton (*Gossypim hirsutum)* has been found to tolerate early season herbivory by thrips spp. (Thysansura) and aphids (Hemiptera:Aphididae). In this study we set out to determine if the timing of attack affects cotton's ability to tolerate herbivory by the cotton fleahopper, *Psedatomoscelis seriatus* (Hemiptera: Miridae). We used cages to manipulate fleahopper presence on cotton during different weeks of flower bud production. We found no effects on plant growth and development parameters (rate of flower production and number of fruiting and vegetative branches), but fleahopper infested plants produced 13% more fruit than controls. Thus, cotton has overcompensated for fleahopper herbivory, and is likely to have improved fitness. This study suggests that fleahoppers participate in mutually beneficial interaction with its host plant.

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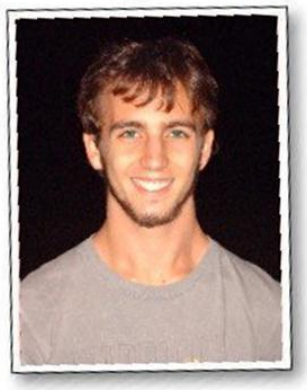

## "Aquaporin Identification and Analysis in the Asian Citrus Psyllid (*Diaphorina citri*)"

**Joseph Hancock**

Major Professor: Dr. Cecilia Tamborindeguy

Phloem feeding insects must overcome a major problem: how to avoid dehydration as they feed. In aphid and whitefly species it has been shown that osmotic pressure from ingested phloem is lowered by water circulation through the gut and other mechanisms, such as rapid transglucosidation. Water transport proteins known as aquaporins have been shown to be linked to water circulation within aphid and whitfly guts, yet aquaporins have not been proven to play such a role in other phloem feeding species. To better understand aquaporin function in phloem feeding insects, we have identified a putative aquaporin gene in *Diaphorina citri*, the Asian citrus psyllid, using the available genomic data. We have confirmed the transcription of this gene in gut tissue by reverse transcription of tissue specific RNA and amplification of this complementary cDNA using gene specific primers. Currently, we are attempting to identify other aquaporin isoforms using Rapid Amplification of Complementary 5' ends (5' RACE). Future experiments will be aimed at localizing the proteins in gut tissue, as well as using RNA interference (RNAi) to study the role of this aquaporin.

## Thursday, August 25, 2011

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## "Identifying native ants for use in field studies on fire ants"

**Johnny Johnson**
Major Professor: Dr. Marvin Harris

Food lures are an integral part in assessing population densities amongst ant species. They serve as a tool to estimate relative population densities among species in field studies, providing insights into the different behaviors they exhibit during recruitment (discovery and dominance). These lures consist of chicken, beef, pork and other ingredients. Lure placement in space and the frequency of monitoring them are important variables that affect how ants will be measured in the databases obtained in field studies. This technique can be used as support in an Integrated Pest Management program for management of targeted ant species or as a method for assessing relative densities of various ant species across ecosystems. Food lures such as hotdog slices are effective in attracting carnivorous, ground foraging ants. A broad range of species can be found foraging on food lures throughout the state. While some species are only encountered locally in high densities, others are found with regularity across Texas. Someone with little to no knowledge of ant identification in the field can easily misidentify species which can cause data to become skewed. We are developing an illustrated guide to the most common ants found foraging on food lures in Texas. Pictures will consist of the species foraging on hot dogs in the field and an image of each ant taken with a microscope camera. A general description of each species describing taxonomy, behavior, and size of colonies will accompany each picture. This work will be the basis of a pocket-size, laminated field guide that an individual can carry with them for quick identifications in the field.

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**"Identification of CTCF binding sites in *Anopheles gambiae*"**

**Michael Johanson**
Major Professor: Dr. Craig Coates

CTCF is a DNA binding protein that has been identified in vertebrate, Drosophilid and mosquito species. Studies in vertebrates and Drosophila demonstrate that this protein plays a role in insulating genes from illegitimate enhancer, silencer and heterochromatin interactions that would otherwise interfere with their normal expression profiles. It is our hypothesis that CTCF plays the same role in mosquito species. Using immunostaining, we have identified chromosomal regions of DNA, near heterochromatin/euchromatin borders to which CTCF binds in the Anopheles gambiae genome. Using the bioinformatics program, Patser, in conjunction with two similar position specific scoring matrices for a published Drosophila CTCF binding consensus published, we identified potential CTCF binding sites in the *Anopheles gambiae* genome. Subsequently, primers were designed and PCR performed with DNA immunoprecipitated with *An. gambiae* CTCF anti-serum as a template. Using this bioinformatics approach and the ChIP assay, we have identified two regions at which CTCF binding occurs near heterochromatin/euchromatin borders. One is found at base pair position 59,016,524 of the 2R chromosomal region. The other is found at 2,606,591 of the 2L Chromosomal region.

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## "Trophobiotic relationship between *Solenopsis invicta* and Rhodesgrass mealybug: Implications for fire ant management in grassland habitats"

**Melissa K. Layton**
Major Professor: Dr. Julio Bernal

Fire ant mounds are common in habitats dominated by grasses such as lawns, parks, athletic fields, golf courses, pastures, and roadsides. These habitats often have limited plant diversity and few nectar-producing species. For this reason, rhodesgrass mealybug, *Antonina graminis* (Hemiptera: Pseudococcidae), appears to be the dominant source of carbohydrates utilized by fire ants in these habitats. Studies on the interactions between rhodesgrass mealybug and fire ants provide evidence that the relationship goes beyond a coincidental overlap in habitats, but that these two invasive pests maintain a mutualistic relationship. To test the impact of reducing rhodesgrass mealybug populations on fire ant activity, plots were established in roadside grassland habitats and half the plots were treated with insecticide to reduce rhodesgrass mealybug popultions. When mealybug populations were significantly different in treated and controlled plots ($t_{18}$=2.9836, P=0.0080), there was a change in the number of fire ants collected; the reduction in mealybug populations showed a corresponding reduction in the number of fire ants collected using protein baits ($F_{1,19}$=4.931, P=0.039). Based on this information, preliminary trials have been conducted to determine how access to carbohydrates impacts fire ant feeding preferences, aggression, and resource utilization.

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## "Silencing the calcitonin receptor-like receptor 1 (AaegGPRCAL1) directly affects urination of female mosquitoes *Aedes aegypti* (Diptera: Culicidae)"

**Hyeogsun Kwon**
Major Professor: Dr. Patricia Pietrantonio

G protein-coupled receptors (GPCRs) composed of seven transmembrane domains play an essential role in regulating physiological functions and mediating responses to environmental stimulants, biogenic amines, proteins, lipids, and hormones. Calcitonin-like peptide ($DH_{31}$), insect diuretic hormone 31, has been proved to increase intracellular cyclic AMP levels by activating calcitonin receptor like-receptor 1 (GPRCAL1) in mammalian cell lines and regulate water and cation ($K^+/Na^+$) excretion from Malpighian tubules (M. tubules) of *Anopheles gambiae* and *Aedes aegypti*. This implicates a role for calcitonin receptor like-receptor 1 (GPRCAL1) in primary urine production (diuresis) when activated by $DH_{31}$. However, the contribution of GPRCAL1 itself to water excretion in insects has been unclear. Thus, we cloned the *AaegGPRcal1* cDNA from female M. tubules and identified the expression and localization of AaegGPRCAL1 protein in those tubules. Additionally, we utilized RNA interference (RNAi) to investigate the receptor contribution to water loss via two precision assays: a M. tubules fluid secretion assay in the presence of $DH_{31}$ and a whole- mosquito humidity chamber assay. The mosquitoes that underwent knock-down of the *AaegGPRcal1* exhibited up to 57% lower rate of M. tubule fluid secretion and a ~30% reduction in whole-mosquito water excretion. To our knowledge, this is first evidence of an RNAi-induced phenotype, allowing to quantify the contribution of single family B GPCR to water loss in any invertebrate.

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**"Nutrient-allelochemical interactions: metabolic effects on a generalist insect herbivore"**

**Marion Le Gall**
Major Professor: Dr. Spencer Behmer

Secondary metabolites exhibit the potential to direct food selection by herbivorous insects. In this study, I examine and quantify the interactive effects on a generalist insect herbivore of a plant allelochemical (gramine, an alkaloid) and dietary macronutrients. The grasshopper *Melanoplus differentialis* (Orthoptera : Acrididae) was reared across the fifth larval stadium on one of 12 foods with fixed total macronutrient content (42%), but varying in protein:carbohydrate (P:C) ratio (14:28, 21:21, 28:14) and gramine content (0, 0.5, 1, or 2% dry weight). The effects of the allelochemical on consumption, nutrient uptake, development rate, and survivorship were measured. Additionally, I recorded the effects of gramine on metabolic rates a week after the beginning of the experiment, using flow through respirometry. The effects of the allelochemical on food consumption and nutrient uptake were dependent on the balance of macronutrients in the food. Calculation of the respiratory quotient (RQ) showed effect of macronutrient content on the substrate used by the insect during respiration. Metabolic rates were dependant of the allelochemical concentration in the diet. I interpret these results in the context of plant secondary metabolite detoxification and discuss their significance for the field of nutritional ecology.

## Thursday, August 25, 2011

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## "Plant, ants and herbivores: untangling the complexities of ant attraction in non-myrmecophilous plants"

**Collin McMichael**
Major Professor: Dr. Micky D. Eubanks

The scientific literature is replete with examples of both ant-plant mutualisms and responses of predatory hymenoptera to herbivore- induced plant volatiles, yet few studies to date have examined the role of ants responding to such volatile emissions. The red imported fire ant, *Solenopsis invicta*, was recently reported to have more olfactory receptors than any known organism. With this amazing "nose", it is likely that ants can key into plant-produced cries for help when searching for prey. In this study I examine the ability of the red imported fire ant to discern between herbivore infested and naïve plants both in lab and field conditions. I also examined the effects of fire ants on herbivore populations, community composition, and behavior on the plant.

Ants were significantly more likely to forage on plants that had experienced previous herbivory than naïve plants, even when herbivores had fed but were no longer present. This enhanced foraging effort on the part of the ants leads to decreased feeding by chewing herbivores. Similarly, exogenously applied jasmonic and salicylic acid, which induce plant defenses against herbivory and pathogens respectively, greatly increased the number of ants found on plants. Jasmonic and salicylic acid both had negative impacts on herbivores, which were compounded by the effects of ant foraging.

This data strongly suggests that ants are in constant communication with the plants around them, listening for cries for help in order to more easily find tasty treats feeding in the canopy.

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## "The effects of pulsed plant stress on herbivore abundance and plant defense"

**Warren Sconiers**

Major Professor: Dr. Micky D. Eubanks

Plant physiology is altered dramatically when water stressed. Nitrogen (N) availability, digestible carbohydrates, and nutrients all change when plants are water limited and changes in the availability of these resources may benefit insect herbivores. Currently, we are unable to accurately predict herbivore response to host water-deficit stress. The literature suggests contrasting responses even for the same herbivore guild, such as phloem feeding aphids and cell feeding thrips. Huberty & Denno (2004) conducted a meta-analysis of herbivore response and concluded that pulsed stress increases host plant quality for a variety of herbivores including thrips and aphids. They hypothesized that N availability was increased by water stress and that plant turgor increases when the plants recover from stress. The increased turgor pressure associated with plant recovery from stress allows herbivores to access the excess N. We examined the effects of pulsed and continuous stress on cotton (Gossypium hirsutum) physiology and herbivore abundance. Anti-stress enzymes, herbivore defense compounds, and herbivore abundance were quantified on continuously stressed, pulse stressed, and non-stressed plants. The defensive and stress repair enzyme peroxidase was significantly more abundant in pulsed treated plants and may provide insight into how plants utilize resources during stress. Thrips abundance was significantly higher on pulse stressed plants versus continuously stressed plants. The effects of pulsed stress on thrips were also supported with greenhouse studies. This study will help us more accurately predict herbivore response to water stressed plants and allow for insight in the design of irrigation regimes to avoid pest outbreaks.

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**"*Bellopius* (Braconidae) parasitoids of fruit-infesting Tephritidae (Diptera)"**

**Lauren Ashley Ward**
Major Professor: Dr. Robert Wharton

*Bellopius* is a little-studied neotropical subgenus placed within what is possibly the largest genus of Braconidae- *Opius*. All known members are koinobiont larval-prepupa endoparasitoids that attack cyclorrhaphous fruit and flower-infesting Diptera in the family Tephritidae. Previous work on the group has been limited to original descriptions with the exception of studies on two species reared in association with pest tephritids. Morphometric data and morphological characters will be used to delineate species and these results will be compared to putative species groupings previously generated by collaborators using sequence data. Results of this study will aid in identification of *Bellopius* species and increase our knowledge of braconid parasitoid biodiversity in the Neotropics.

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| Year | 1st | 2nd | 3rd |
|---|---|---|---|
| 2010 | Cymon Kersch | Luciano Cosme | Alison Bockoven |
| 2009 | Katelyn Chalaire | Kyeogsun Kwon | Aaron Dickey |
| 2008 | Bradley Hopkins | Hsiao-Ling Lu | Karl Adam Roeder |
| 2007 | Christopher Jagge | Kristi Reddick | Hsiao-Ling Lu |
| 2006 | Matt Yoder | Christopher Jagge | Mark Johnsen |
| 2005 | Sonia Kjos | Robert Puckett | Jiri Hulcr |
| 2004 | Darren Hagen | Jeremy Hudgeons | Michael (Walker) Hale |
| 2003 | Mei-Er Chen | Andrea Julian | Jared Burks |
| 2002 | Mei-Er Chen | Christine E. Gray | Steven P. Holmes |
| 2001 **(Three way tie)** | Christine E. Gray **(Three way tie)** | Steven P. Holmes **(Three way tie)** | Ronald D. Weeks **(Three way tie)** |
| 2000 | Jarrad Prasifka | Robert Kula | Ahmed Mohammed |
| 1999 | Carlos Bográn | Jarrad Prasifka | Karol Burns |
| 1998 | Carlos Bográn | Richard Houseman | Jim Martin |

## Committee Members

Dr. Raul Medina, Chair
Dr. Cecilia Tamborindeguy, Co-Chair
Angie Rollins, Assistant to Chair

Dr. Michel Slotman, Abstract Editor
Dr. Albert Mulenga, Program Editor

**Thursday, August 25, 2011**