PENNSTATE

Department of Entomology
Strategic Plan: 2009-2014

Executive Summary:

The Department of Entomology is recognized among our peers for its excellence in several areas of research focus: in its emerging global approach towards interdisciplinary graduate education, and its high impact extension and outreach efforts. During the last two strategic planning cycles we have made great strides towards developing excellence in several areas of scientific inquiry, despite the multiple budget rescissions that accompanied this period. With the hiring of senior faculty members who are recognized as international leaders in their disciplines and our highly talented junior faculty, we are making substantial progress towards enhancing the excellence of our programs. The collective efforts of our faculty, staff, and students have contributed to Penn State Entomology becoming a leader in our discipline as measured through our ongoing benchmarking exercises.

The outcome of budgetary rescissions is that they demand focus. During the previous budgetary cuts we have sacrificed disciplinary breadth, but have sharpened our aim to become international leaders in several areas including chemical ecology, disease ecology and biology, and ecological applications. Over the last two planning cycles, our inter-disciplinary hires have placed us on the cutting edge of these research areas and enhanced our national and international visibility. COAS investments in support for people and renovations of space were essential during this time. These achievements have been made in part through interdisciplinary partnerships with the Huck Institute of Life Science and Penn State Institute of the Energy and the Environment. Our programs are thriving as measured by funding levels, student numbers and quality, and extension program impacts.

However, our efforts will not be sustainable without strategic investments in our people and our infrastructure. During this current planning period the need is to strengthen our target areas of excellence and explore new opportunities where we are poised to become national/international leaders. We fully understand that the current economic situation places significant constraints upon realizing our aims for excellence; however these constraints also provide unique opportunities for partnerships. Future hires will no doubt result from re-direction of positions resulting from retirements, but will also require strong interdisciplinary partnerships. Besides partnerships with the Institutes, split faculty appointments with other units in COAS and across Colleges (e.g., Eberly College of Science, College of Earth and Mineral Sciences) may be necessary to achieve our aims of excellence.

In order to continue our momentum in achieving excellence in our research, teaching and extension missions, we specifically propose to:

1. Attain critical expertise in insect evolutionary biology and systematics
2. Actively participate in University initiatives in infectious disease
3. Enhance our web presence for improved communication with stakeholders, alumni, prospective students, and the scientific community.

Crucial to maintaining our progress is investment in infrastructure. With the projected loss of current greenhouse facilities, head house and the Frost Museum, it is vital that we find suitable replacement space. The Frost Museum is vital to our Department in terms of its value for research, extension, education, and outreach. Many of our laboratories and offices, particularly in ASI, are overcrowded and are creating unnecessary hindrances to our success.

As we enter the next five years, our Department is poised to become an international leader in several disciplinary areas. Key investments by administration will be critical for achieving academic excellence. However, our priorities will require further funding beyond what may be available. Thus it is vital that we enhance our public and private funding. New opportunities abound for funding in areas of pollinator health and infectious disease. Considerable funding from NSF and USDA is available to support programs in Evolutionary Biology and Systematics and to support facilities improvements for museums.

We have made significant progress during the last strategic planning process towards enhancing our graduate program, developing strong areas of research focus, and improving infrastructure. Our current priorities will help maintain academic rigor and vigor in our core disciplinary strengths, further our aim to become leaders in arthropods-infectious disease, and increase our visibility to the public and scientific communities. Furthermore, our priorities strongly support both College and campus-wide initiatives.

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STRATEGIC PLANNING PROCESS

The strategic planning efforts began with the faculty and staff identifying areas of our strengths, weaknesses, and areas for de-emphasis. Extension faculty and staff continued this process with an identification of the Strengths, Shortfalls, Opportunities and Cost-cutting Proposals for Extension. The Entomology Strategic Planning Committee (ESPC) convened on February 2 and identified those same categories for research, education and outreach. The following Entomology Strategic Planning Committee members provided the framework for this plan: Diana Cox-Foster, Shelby Fleischer, Christina Grozinger, Steven Jacobs, Kerry Mauck, Raul Ruiz, Matt Thomas, and John Tooker, representing faculty, staff and students. Drs. Gary Felton, K.C. Kim and Michael Saunders, and Mrs. Ellen Johnson, Mrs. Roxie Smith, Ms. LuAnn Weatherholtz contributed additional information.

We utilized Strategic Plans of the Department of Entomology (2005-2008), the College of Agricultural Sciences (2008-2013) and The Penn State Strategic Plan (2009-2010 through 2012-2014) in preparation of this document. Stakeholder inputs, through first-hand knowledge of committee and other department members were incorporated to authenticate the Goals and Targets.

The initial draft of the Plan was presented at the Department of Entomology Faculty Meeting on February 25 and various comments and suggestions were incorporated. An electronic version of the Plan was emailed to faculty for further input. The ESPC met for a final meeting on March 6 to complete the document which was then presented to the faculty on March 18, 2009, for vote.

Vision

Our vision for the future of the Department of Entomology is to be a globally recognized research, education and outreach entity that encourages bold approaches to solving difficult problems, produces students that become leaders in their field, and provides valuable and trusted information for all stakeholders.

Mission

Our mission is to serve our students, the Commonwealth, and National and International interests through the acquisition, dissemination, and application of scientific knowledge in Entomology and related sciences. We use our entomological knowledge to improve human health, quality of life, and sustainability of natural, managed, and agricultural ecosystems.

Core Values

- Excel in research, both basic and applied
- Excel in our educational endeavors
- Conduct all activities in an ethical manner
- Develop and convert scientific knowledge to useful technologies and solutions
- Serve our stakeholders locally, nationally, and internationally, including students, the scientific community, the public, industry, action groups, and policy makers
- Empower students through effective mentoring by faculty, staff, and other students
- Promote open communication, intellectual risk-taking, life-long learning, creativity and innovation, respect for differences among individuals, and entrepreneurial activities
- Maintain an environment that fosters individual and collective professional growth and satisfaction
- Promote networking among agencies having similar missions around the world
- Foster a scientific world view that is sensitive to the needs of society
- A healthy work place, with state of the art facilities, promotes a productive workforce
- Encourage an appreciation of racial, gender, intellectual and philosophical diversification
- Collaboration among our personnel and with other departments, colleges, universities and other partners is essential for intellectual growth and sustainability

BACKGROUND

The 2005-2008 Entomology Strategic Plan

The Department of Entomology is currently positioned to build on our areas of excellence in chemical ecology, pollinator biology and disease ecology. In the 2005-2008 Entomology Strategic Plan we identified several key goals and corresponding measurable targets/actions that have assisted in this transition.

In Education – To redesign our graduate program and to increase enrollment by: 1) increasing the quantity and quality of our graduate students via distribution of recruitment information, 2) hosting a recruitment weekend for selected, prospective students, and 3) increasing our assistantship funding base by utilizing returned indirect costs, encouraging faculty to submit grant proposals that would support at least one graduate student per year, and to secure scholarships and other support opportunities through promotion of the outstanding caliber of incoming students.

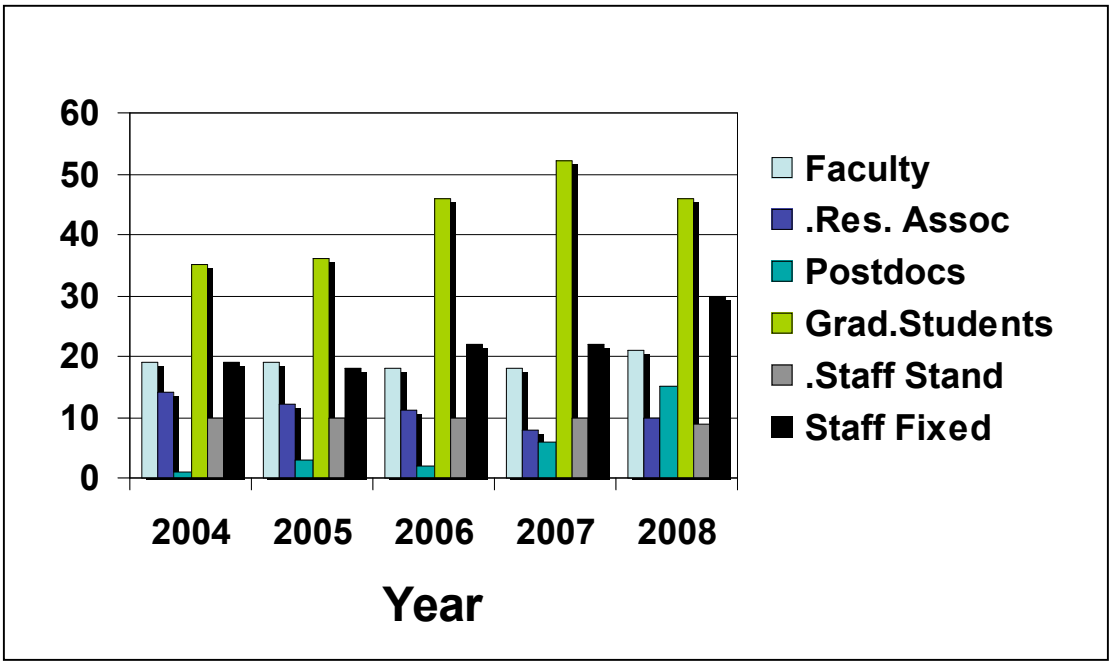
In Research – To leverage Huck Institute seed funding in order to expand participation in the Chemical Ecology Center and to develop new systems-based initiatives in Ecological Applications and Disease Ecology by: 1) nominating distinguished faculty in our chosen areas of excellence for Honorary Degrees, 2) capitalizing on our interdisciplinary programs to aid in acquisition of new faculty, 3) strengthening ties with our partners such as PDA, ARS, APHIS, NIH, EPA and others, and 4) to host the International Society for Chemical Ecology in 2008.

In Extension – To increase our ability to support and improve the quality of our research and outreach activities by: 1) continuing to improve our ability to reach our stakeholders through expanded and enhanced web-based information, 2) effectively marketing our extension/outreach activities, and 3) encouraging the formation of a Metro Research and Outreach Center.

Recent Successes During the 2005-2008 Strategic Planning Period

Despite numerous budgetary constraints, The Department of Entomology was positioned to continue in our growth toward excellence. We were able to prevail during this period with expansion despite budgetary constraints. The total number of Entomology personnel increased nearly 48% during this period, primarily through extramural funding (Chart 1). These successes are due in no small part to symbiotic relationships with our many partners, including the Huck Institute.

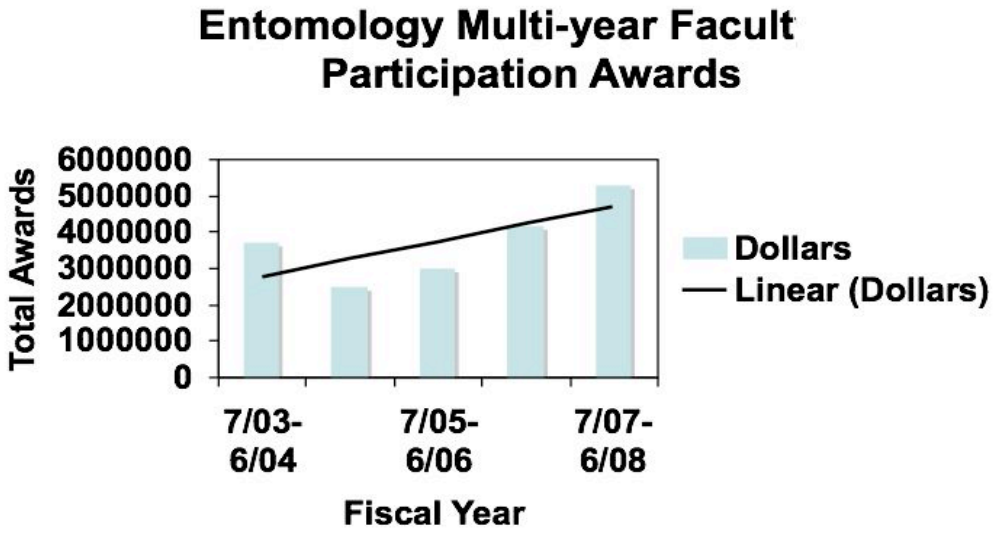
Chart 1. Numbers of Entomology personnel during 5-year period from 2004-2008



Other significant accomplishments during the 2005-2008 planning period include:

- $18,845,191 in external funding 2004-2008 (Chart 2)
- Increased enrollment of graduate students with particular focus on Ph.D. graduates
- Enhancement of robust, web-based extension and outreach campaigns

Chart 2. Entomology Multi-Year Faculty Participation Award Summary 2004-2008



Excellence in Systems-Based, Interdisciplinary Research

Development of Research in Ecological Applications:

During the past five years (2004-2008), we have developed several areas in ecological applications and taken these to new levels of international expertise. Some of the notable accomplishments are as follows:

1. Pollinator Health and Biology. We have been one of the key responders to the crisis that has developed among pollinators, in particular the honey bee. Prior to Colony Collapse Disorder being first detailed in fall of 2006, we developed base knowledge and translational research on problems related to varroa mites, diseases, and small hive beetles in honey bees. These expertises were expanded with the onset of CCD to include disease discovery via metagenomic analysis, evolutionary studies of diseases, investigation of disease interactions, epidemiological studies of diseases, and toxicological investigations of the impact of pesticides on honey bees. Our studies have expanded to other pollinators as well, with the discovery that many of the same issues are influencing native pollinators and may be involved in declines in the species numbers and populations, and with ecological studies of pollinator diversity that are demonstrating the current ecosystem services of non-*Apis* species in fruit and vegetable agroecosystems in the Commonwealth. The number of faculty and senior extension associates involved in research investigations has grown significantly among pre-existing faculty and staff and has been greatly complemented by the hiring of Dr. Christina Grozinger, who brings to Penn State expertise in pollinator behavior, chemical ecology, disease interactions, and functional genomics. Our research has been recognized by

increased grant funding, gifts from private and corporate donors, and increased partnership with other researchers in the United States and in other countries. This development of the research and extension area in Pollinator Health and Biology has uniquely positioned us to creatively unravel the causes of pollinator decline and develop mitigation strategies.

2. Renewable Energy and Biofuel. Through the basic research into the mechanisms of how wood-feeding insects effectively and efficiently convert heartwood into biomass, we have made seminal discoveries on the role of the microbial symbionts of these wood-boring beetles in converting lignin-cellulose into energy. This research has led to an increased focus on the genetics of the beetles and their symbionts, with the goal of discovering new genes that can be exploited for the efficient development of biofuels from waste plant material. DOE and other federal agencies, and private foundations have funded this research.

3. Pest Detection, Management and Mitigation. Several lines of investigation have led to new methods in pest diagnosis and management utilizing information technology for monitoring and predicting pest populations.

    a. In the area of pest diagnosis, DNA barcoding projects have been developed for fruit flies in collaboration with USDA-APHIS-PPQ and with funding from NSF and USDA. This research will result in methodology to allow effective identification of invasive fruit fly species that would damage many agricultural crops or limit their opportunity for export. Additional seminal research was developed on invasive pest species of forests (gypsy moth, Asian longhorned beetle, emerald ash borer, Sirex wood wasp, etc.). These research investigations have lead to fundamental discoveries of basic biology that can now be exploited for new detection and mitigation measures. This research has enabled additional partnership with USDA-APHIS-PPQ and the USDA Forest Service.

    b. In pest prediction and management, new information technology applications have been developed. Examples include the PA-PIPE and Pestwatch. Penn State is a national leader in these technologies which have been adopted by grower groups at semi-continental scales and supported through federal agencies like APHIS. International collaborations are being supported by USDA-APHIS-PPQ.

    c. These avenues of research have caused USDA-APHIS-PPQ to seek out potential partnership with PSU to develop programs in detection, diagnosis, and monitoring of pest species. Additional governmental agencies have expressed interest in participation in these programs.

<u>Increased Excellence at the Center of Chemical Ecology (CCE)</u>

Membership in the Center for Chemical Ecology has grown to 70 people comprised of 25 faculty with homes in two colleges and seven departments; 33 students; 8 postdoctoral researchers and 4 staff. During fiscal year 2007-2008, CCE members reported 27 funded grants through the following agencies among others: USDA–NRI, USDA-APHIS, USDA-CSREES, USDA-ARS, NSF, DARPA, DOE, IRRI, and PSU.

In 2008 CCE hosted the 25th Anniversary Meeting of the International Society for Chemical Ecology (ISCE) on the University Park Campus of Penn State. This six day meeting was attended by 233 scientists, representing 25 countries. The ISCE meeting gave us the opportunity to highlight our strengths in chemical ecology, the Penn State campus and facilities, and our region. It is noteworthy that this meeting was hailed as one of the best ISCE meetings to date.

CCE members have an on-going relationship with Cornell University's Cornell Institute for Research in Chemical Ecology (CIRCE) to develop joint research projects and funding opportunities. Both groups are working toward establishing a Regional Center of Excellence in Chemical Ecology. In 2007, CCE hosted a regional mini-symposium with faculty, students, and postdocs from Cornell. In 2009, Cornell will host PSU CCE members.

In alignment with University goals toward excellence in the global arena, the CCE is developing international partnerships with institutes of chemical ecology at the Max Planck Institute of Chemical Ecology (Jena, Germany) and The International Centre of Insect Physiology and Ecology [ICIPE], Nairobi, Kenya, to develop international programs to support student and faculty exchanges as well as collaborative research.

Other significant CCE accomplishments include:

- In 2007, members participated in "Chemical signaling and host--vector dynamics", a joint symposium of the Center for Chemical Ecology and the Center for Infectious Disease to foster collaboration across these two Centers for Excellence.
- CCE holds an annual student-organized members retreat to highlight research progress, particularly that of students, and to encourage collaborations.
- CCE faculty, postdoctoral researchers, and students continue to conduct collaborative, interdisciplinary research within PSU, but also nationally and internationally.
- CCE has supported numerous national and international seminar speakers over the past three years.

<u>Development of Disease Ecology Center of Excellence:</u>

The Department of Entomology played a key role in the development and expansion of the Center for Infectious Disease Dynamics; a "virtual" center bringing together theoreticians and empirical scientists in a wide variety of disciplines to collaborate and innovate in the area of infectious disease research.

Through the links with CIDD, the Department secured co-funding from the Huck Institutes of the Life Sciences for new faculty with a focus on Infectious Disease dynamics.

Many new cross-departmental collaborations were facilitated and more than $20M in collaborative grants were secured by various configurations of CIDD faculty sponsored by NIH, NSF, DHS and The Bill and Melinda Gates Foundation.

In addition to the development of CIDD, additional research in arthropod-borne disease issues has greatly grown in our department. For human disease, we now have one of the key groups of investigators working on malaria and other mosquito borne diseases. Our research into the basic

biology of *Plasmodium* is unique in that we have developed the ability to work with *P. vivax*, a species found in Asia and previously recalcitrant to *in vitro* research. This research has obtained significant funding from NIH and established unique partnerships with one of the international centers of research on disease in Thailand and with groups in Africa. This research area has been greatly complemented by the addition of two new faculty hires, Matt Thomas, Professor of Entomology and Andrew Read, Professor of Biology and Entomology. These researchers are investigating the epidemiology of malaria in Africa and developing novel methods of malaria control. Within the department, these researchers are forming a team having unique capabilities and expertise.

Excellence and Growth in Educational Programs

Development of Agroecology Undergraduate Major and Other Entomology Courses for Undergraduates:

During the past five years we have increased involvement of faculty and graduate students with undergraduate education through several strategies:

1. Creation of the Agroecology major: Since implementation the Agroecology (AGECO) undergraduate major has maintained stable enrollment and produced some of the highest quality students. Although this major has resisted major recruitment efforts designed to increase its numbers, the quality of students in the major cannot be disputed. AGECO places 100% of graduates in the Plant Sciences option in graduate degree programs. In recent years we have sent students to Cornell, Wisconsin, and NC State. In two of the last three college graduations, an AGECO student was selected as student marshal, in recognition of having the highest GPA of any graduating student in the college. There are recurring rumors that the student enrollment in AGECO is not robust enough to keep it from being folded into the batter. Those that directly teach and advise students in AGECO will agree that it is a worthwhile program of study and that the students in the major are truly exceptional.

2. Offering of entomology courses for non-science and science-based majors: Courses include ENT 202, Insect Connection, which fulfills a general science requirement and provides a basic understanding of insect biology, ecology, and the cultural relevance of insects. Enrollment began at around 50 students and quickly increased to 150-200 students per class, with the course now being offered in both spring and fall semesters. ENT 313, Introduction to Entomology, provides a more in-depth examination of insect biology and includes a lab component that allows interaction among graduate students and undergraduates from various agricultural and biology-based majors. This course continues to have high enrollment (between 30-80 students per semester) and to provide teaching opportunities for graduate students.

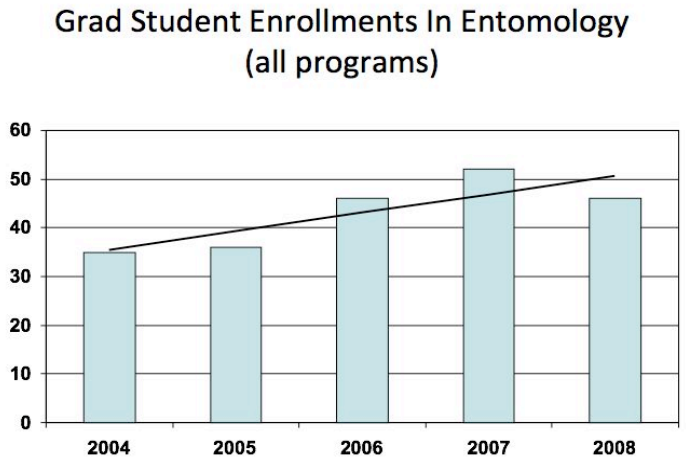
3. Development of entomology minor: The Entomology Minor was approved by the faculty senate and officially began in Fall 2008. To date we have two students enrolled in the Minor. The coordinator of the new Forensic Sciences major has expressed a great deal of interest and expects students from that major to sign up the Entomology Minor. Interest in taking more entomology courses among undergraduates in ENT 313 indicates that enrollment will

increase, as the minor becomes better known. Requirements for the minor are attached (Appendix I).

Increase In and Quality Of our Graduate Students:

We have successfully increased our graduate enrollment by 32% since 2005 (Chart 3).

Chart 3. Graduate Student Enrollment 2004-2008



During the 2004-2008 period our graduate students successfully competed for University Graduate Fellowships and Awards. Several received NSF doctoral fellowships or NSF Dissertation Improvement Grants. We are confident that this trend will continue (Chart 4), given the high quality of recent applicants as measured by GRE scores (Chart 5) as well as by other indicators (GPA, accomplishments, etc.). Our success in attracting quality graduate students continues. We have proffered admittance to our Entomology Graduate Program to seven promising graduate students and have had a 100% acceptance rate.

Chart 4. Number of Graduate Students Receiving Fellowships 2004-2008

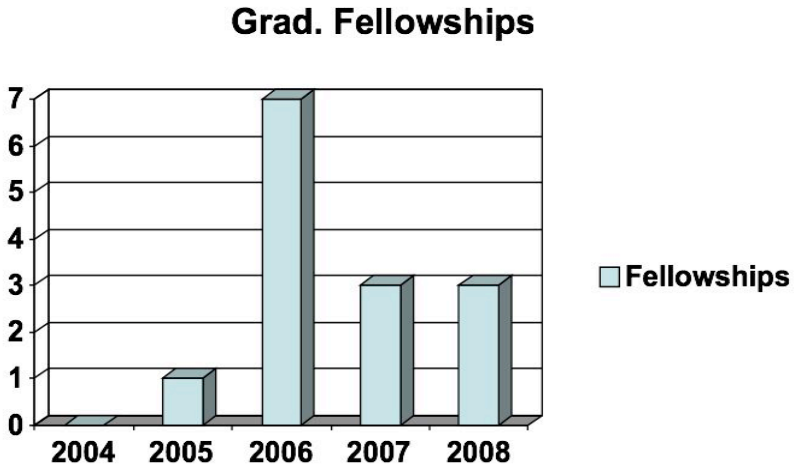
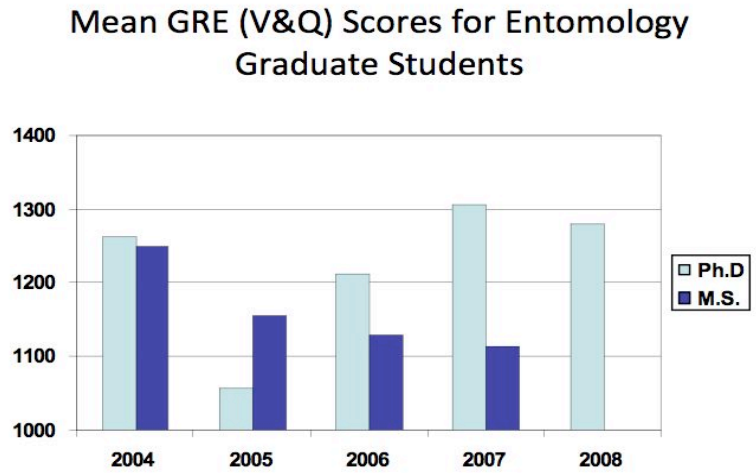


Chart 5. Mean GRE Scores for Incoming Graduate Students



Strengthen and Enhance Our Entomology Outreach

The Great Insect Fair:

The flagship of our outreach programs, the Great Insect Fair (GIF) continually attracts greater numbers of visitors, collaborators and supporters. During the 2004-2008 period, we moved the GIF to Ag Arena and received the cooperation of the Centre County Visitors and Business Center to utilize their auditorium and conference room to provide additional enclosed areas. Currently we entertain and educate more than 7,000 visitors during the 6-hour GIF and have over 200 volunteers and collaborators.

The Frost Entomological Museum:

The Frost Museum houses the insect and related arthropod collections of The Pennsylvania State University. It has a vital role in the university as a biodiversity library, a repository for research materials, and as a research center. The research collection comprises over 2,000,000 specimens of insects representing at least 15,000 species. Specimens are pinned, slide mounted, and liquid preserved in alcohol. The important collection holdings include the George and Alice Beatty Odonata Collection, John Pepper Aphid Collection, K.C. Kim Anoplura Collection and others. In addition, the Museum serves a valuable educational function by promoting the concept of insect biodiversity through displays for the casual visitor, and educational visits for school groups and other interested organizations. Annually 4,000-5,000 people visit the Museum. The booklet "Biodiversity, Our Living World: Your Life Depends On It!" is handed out in the museum (and elsewhere) and has a current distribution of nearly 30,000 copies exemplifying the importance the public places on biodiversity.

The Forensic Entomology Workshop:

This globally-recognized course is intended for forensic investigators working for law-enforcement agencies, including state police, municipal police, forensic pathologists, and coroners and has been approved by the State Board of Coroners. Nearly 30 students attend this course each year and preparations are underway for the 16th annual workshop in May 2009.

Youth-Focused Presentations:

Involvement in outreach to the local community has increased over the past five years through a diversity of programs:

1. Library presentations. Graduate students have overseen the coordination and delivery of hands-on programs presented at libraries throughout Pennsylvania, with assistance from office staff.

2. Elementary school presentations. Graduate students have also coordinated outreach efforts to local schools at the request of educators and as components of school-wide events.

3. WISE (Women in Science and Engineering). Several labs and individuals within the department have consistently participated in this program on a yearly basis over the past 5 years. Components of participation include day-long and week-long hands-on workshops that provide insect-focused educational experiences to high-school girls considering careers in science or engineering.

4. Involvement with campus-wide events targeting young people. Programs involving hands-on insect interactions have consistently been a component of events such as Exploration Days (formerly BioDays) and Fourth Fest.

Outreach Via Media Coverage of our Research:

Several areas of research/outreach in the department have garnered media attention during the past five years. These include the following:

1. Introduction of invasive insects such as the brown marmorated stink bug, the emerald ash borer and the Asian longhorned beetle.

2. Plant/Insect interaction. Several studies on the chemical ecology underlying plant/insect or plant/plant interaction have received national and international media attention.

3. Climate change impacts on pest species and insect vectors.

4. Resistance management to transgenic crops.

5. Biofuel research via symbionts of wood boring beetles.

6. Pollinator health and biology. Research into Colony Collapse Disorder caught the attention of numerous media outlets (news-organization sponsored, web-based articles, popular magazines, scientific magazines, radio, TV-news, and TV documentaries) not only here in the United States, but also internationally.

Outreach to Policy Makers on Issues Related to our Research:

Several areas of research in the department have warranted the attention of policy makers. These include the following:

1. Resistance Management in Transgenic Crops. The impacts of insecticidal proteins on non-target insects and the resistance management protocols needed to maintain pest susceptibility have been of interest to the Environmental Protection Agency and to Non-Government Organizations interested in ecosystem health.

2. Pollinator Health and Biology. Several areas have been of interest to policy makers. Two members of our research team have testified before different Congressional subcommittees in the U.S. House of Representatives and Senate on issues related to honey bee health. Our Senators Specter and Casey have taken an active role in promoting honey bee health and have made several inquires about our research and its implications. Federal regulatory agencies (EPA, FDA and APHIS) and the Pennsylvania Department of Agriculture have sought PSU researchers' advice on threats to pollinator health with particular attention to introduced diseases and environmental pesticide contaminations. Research at Penn State has led to revised monitoring of and continued efforts in mitigating these threats. In particular, with partnership with NAPPC (North American Pollinator Protection Campaign), we are striving to enable changes in pesticide regulations and pesticide education in conjunction with EPA, pesticide manufacturers, grower groups, and other federal agencies. International governments and organizations have also asked for our input and advice, including Parliament members of the United Kingdom, the French Parliament, members of agricultural

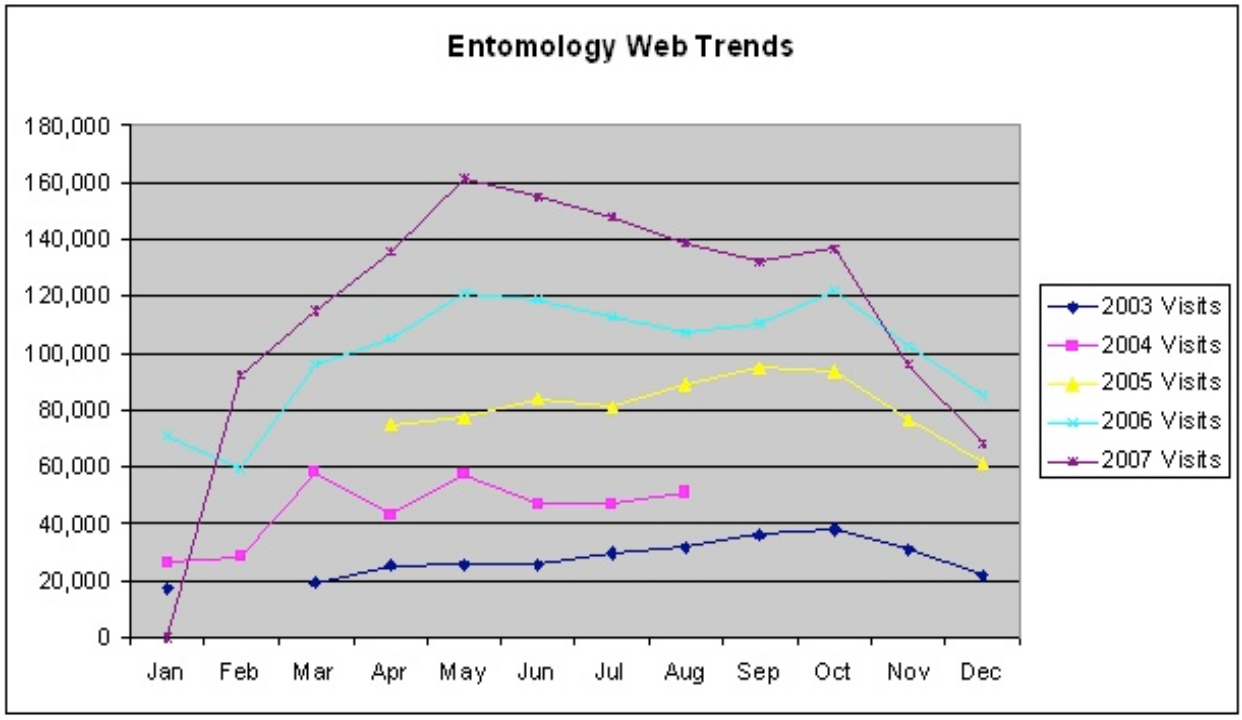
agencies in New Zealand, Israel, Japan, Australia, South Korea, and the Wellcome Trust located in England. Additional partnerships are being formed with researchers in Belgium, Nepal, India and China. Lastly, our research has been of interest to DOD-related groups and to MITRE (a not-for-profit national technology resource that partners with government agencies in the area of Defense and Intelligence, and Homeland Security).

Strengthen Mutual Communications and Education with Current and New Extension Stakeholders

Expansion and Enhancement of our Web Site and Information:

During the 2003-2007 period, our Entomology web sites have had continually increasing traffic (see Chart 6.) The College of Agricultural Sciences began to utilize Google Analytics on May 1, 2008, to perform analysis of the College's traffic. An analysis by Google Analytics from May 1, 2008, through February 23, 2009, demonstrates the high degree to which Entomology sites are visited. Using 'Exit Page Views' as a benchmark[1], we find that of the more than 30,000 pages accessed on the College server, nearly 30% of the top 100 pages reside on the Entomology site accounting for 11.3% of ALL exit pages[2]!

Chart 6. Entomology Web Trends 2004-2008



[1] Exit Page Views are an important indicator of the information that a client seeks because it is the page at which a visitor leaves the College server, presumably after discovering the sought-after information

[2] See Appendix II.

Challenges and Opportunities for Continual Growth in Excellence

Challenges

Funding Shortfall:

The impact of the economy will no doubt produce significant challenges to enhancement of all of our programs.

Space Constraints:

Space constraints continue to be the primary, major obstacle to our continued successes as an entomology department, and hamper our ability to economically, efficiently and collaboratively integrate our programs. As depicted in Table 1, we have grown our department 33.6% over the five-year period 2004-2008 without an appreciable increase in overall space. We continue to attract excellent students and faculty but are constrained from further growth until additional resources are allocated. The Department of Entomology is now at a point where personnel (faculty, staff and students) are sharing labs and offices. Examples of current and expected facility shortfalls include: secure insect rearing/containment facilities; BL3 containment for more research programs; museum/taxonomic research/outreach; greenhouses; specialized research labs; specialized teaching labs; additional office space for faculty, staff and students; space and facilities for visiting scientists.

Although everyone in Entomology is trying to maintain a positive working environment and realize that there are budgetary constraints, we are nevertheless concerned that the current situation in not sustainable. To further demonstrate our plight, we currently have four faculty that either share or have no laboratory space. We recognize that there are numerous capital projects in progress and that the likelihood of an Entomology building is not on the horizon.

We do anticipate the initiation of the Chemical Ecology Laboratory addition, and believe that this will aid our space constraints to some degree. This addition will increase the size of the original structure by 50,000 square feet – more than doubling the size of the current facility. Also, improvements to Merkle Lab will hopefully provide space for labs and containment facilities in the near future; however, even this will not completely alleviate the space problem. Though lacking concrete timetables, additional PSU infrastructure plans include a 40,000 sq. ft. addition to ASI that will be 5 stories along the length of the NW side and approximately 50 ft. in width. It is unclear, however, whether any of this space is slated for our usage. Additionally, the greenhouses and associated Headhouses 1-3 are scheduled for demolition in the next five years. It is absolutely essential that we acquire new facilities for both the museum and greenhouses, and that some of this space be suitable for projects requiring quarantine facilities with containment – both in headhouse and greenhouses. The proposed sites for the greenhouses will also create additional problems in that they will be located at great distance from current research space and it will be difficult to transport either plant or insect material back and forth. It is also imperative that the museum facility be located near its current location to facilitate its use in outreach (especially for visiting school kids) and for research. According to Dr. K.C. Kim, the Frost Entomological Museum hosts an average of 4,000-5,000 visitors annually, both in small groups

and larger school-sponsored tours. One of our major concerns is that all of our facilities will be greatly dispersed from one and another, inhibiting intra-departmental interactions and impeding the formation of new collaborations and continued increased excellence in our programs.

Opportunities

Need for Insect Evolutionary Biology and Systematist:

We propose a new faculty hire to provide new opportunities in research and education. This individual will fill a void in the department and graduate student curriculum. Currently, Entomology has no faculty that specializes in insect systematics, biodiversity, or conservation. A person with these types of expertise would greatly enhance most of our programs. Furthermore, this disciplinary expertise in systematics is critical towards meeting the College Initiative in Pest Prediction and Response.

Need for Public Health Entomologist:

We propose to hire a public health entomologist(s) that will function at regional Extension facilities, Commonwealth Campuses, and/or the Urban/Metro Research and Extension Center. Public Health entomology faculty could teach introductory entomology and biology/ecology at Commonwealth Campuses and collaborate with UP faculty on vectored disease ecology research such as Lyme disease, West Nile Virus, Rocky Mountain Spotted Fever and others impacting our stakeholders in Pennsylvania. This position could be enhanced with Public Health Entomology extension associate hires that will compliment the work of entomology faculty through translation and delivery of new knowledge to our clients.

Need for Web Master:

We petition for the replacement of our current web development person who will be retiring in June. It is essential we re-staff this position if we are to build upon our highly recognized success in this area and to maintain excellence in our web-based initiatives, and to utilize developing technologies to enhance and elevate our visibility on the Internet. Web-based delivery of information will greatly enable delivery of our research to our stakeholders and the public.

Cost Reduction

Distance Communication:

Utilize VTC technology to maximize our impact on stakeholders:

- 50 of the 67 county extension offices have VTC capabilities
- 23 Commonwealth campuses have VTC capabilities

We can reduce our expenses for travel and reduce downtime due to travel, thereby allowing personnel to be more productive.

Seminar Expenses:

We can reduce seminar expenditures 10%-20%, utilizing several methods:

- Have outside invited seminar speakers stay with their hosts or other Entomology personnel
- Have more Entomology and other University Park faculty, staff and students present seminars

Areas of De-emphasis for Full-time Faculty with Sole Responsibilities:

We have opted to de-emphasize the following commodity areas for research, teaching and extension:

- Livestock Entomology
- Potato Entomology
- Mushroom Entomology

Co-Funding of Future Positions Across Departments:

The Department of Entomology is positioned to further our excellence in research and teaching through the sharing of faculty hires with other units in the College and in other Colleges/Units. We have benefitted from this philosophy during the 2005-2008 planning cycle and anticipate the opportunity to leverage resources along these lines in the future.

College Initiatives

The College of Agricultural Sciences has identified five strategic initiatives based on extension input from stakeholders, faculty, staff and the CAS Strategic Initiative Team. These initiatives include: Entrepreneurship, Pest Prediction and Response, Water Quality and Quantity, Energy, and Food, Diet and Health. The Department of Entomology has an obvious and intrinsic association with Pest Prediction and Response. We also have a significant association and commitment to excellence in our contribution towards Energy and Food, Diet and Health. Many aspects of our research have the potential to translate into applications that can be utilized by our stakeholders for entrepreneurial initiatives. In addition, many of our research avenues are developing new insect control measures that will enable decreased chemical use to mitigate pests, and all of our extension programs promote IPM. These complementary efforts can aid in increased water quality. All of our target areas for enhancement in the next five years (2009-2013) will include at least one of these college initiatives and help promote the overall success for the College of Agricultural Sciences in its strategic plan.

Goal 1. Promote Excellence and Growth in our Academic Educational Programs
Measurable Targets

1. Further develop graduate curriculum to ensure excellence and diversity.

   Strategies and Actions:

   a. Propose a new faculty hire in insect evolutionary biology and systematics to provide new opportunities in research and education.
      i. Fill void in the department and graduate student curriculum, which no longer has faculty that specialize in evolutionary systematics, taxonomy, biodiversity, and conservation.
      ii. Manage and better position the new Frost Museum/Center for Insect Biodiversity that must be moved because Head House III is slated for demolition.
      iii. Allow Department to increase diversity of graduate training opportunities by competing for NSF training grant in evolutionary biology and taxonomy ("Partnerships for Enhancing Expertise in Taxonomy" [PEET]).
      iv. Help provide a base for future hire in Insect Population Genetics.
      v. Provide a 'hybrid' of the McPheron and Kim positions.

   b. Require students to complete a self-evaluation at the completion of their graduate program as a part of an exit interview with the Department Head.

   c. Provide training for our faculty and staff on effective mentoring, and problem-based and active-learning approaches.

2. Continue to recruit outstanding and diverse students to graduate program.

   Strategies and Actions:

   a. Target more diverse group of applicants.
      i. Recruit in non-traditional venues such as ecology and biology departments, Ecological Society of America, other professional societies and maintain active participation in SROP and McNair Scholars programs.
      ii. Publicize availability of fellowships more widely.
         1. Include information about fellowships (departmental, university, national) which are available to graduate students on departmental website. Highlight information about students who have received these fellowships.
         2. Market fellowships to appropriate audiences (e.g., social insect groups, pollinator groups).
      iii. Make graduate program website more user-friendly with respect to information about programs, application materials, and deadlines.

b. Increase number of dual-degree programs with other departments or programs.
   i. Current examples included CIED (Comparative and International Education), HDNRE (Human Dimensions of Natural Resources and the Environment), and Operations Research (OR).

c. Allow for concentrations or focus areas within graduate program (e.g., plant-insect interactions, disease ecology, pollinator biology, etc.).

d. Continue to host successful recruiting weekend for prospective students.

e. Increase our funding base goals for graduate assistantships from our current 3% to 7.5% of our total research budget by 2013.

f. Explore diverse and interdisciplinary training opportunities (USDA, NSF, NIH).

g. Where appropriate, faculty will be encouraged to include graduate student support in grant proposals.

3. Expand international opportunities for graduate students so that by 2013, 25% of our students will have had at least one international experience.

   Strategies and Actions:

   a. Encourage students to participate in international programs, e.g., SUSPROT, WUN, CRSP, and the College Tag-Along Program.

   b. Explore additional international programs such as Organization for Tropical Studies (OTS), Smithsonian Tropical Research Institute (STRI), etc.

   c. Continue support for existing international programs and add others.

4. Promote diversity and interactions among students to foster cross-cultural experiences.

   Strategies and Actions:

   a. Consolidate core requirements in first year of graduate program to encourage interactions among graduate students.

   b. Encourage students in other graduate programs to take advantage of Entomology courses.

   c. Require graduate students to present research or proposed research in departmental colloquium (Colloquium will meet every two weeks for two hours; two students will present each class period; presentations should last 30 minutes followed by time for discussion; 1 credit course).

   d. Increase number of departmental members that contribute to our own seminar series.

e. Continue to house students from multiple graduate programs in offices and labs in entomology facilities.

f. Maintain a diverse mix of international and domestic students to provide enhanced cross-cultural experiences.

5. Increase national fellowship applications by our graduate students so that 25% of all students will have applied in any given year.

   Strategies and Actions:

   a. Encourage students to participate in Fellowship Application/General Grant Writing workshops.

   b. Encourage students to pursue extramural funding, including small grant opportunities.
      i. Assemble and maintain a webpage listing graduate student funding opportunities, including both large (NSF, USDA, EPA, NASA) and smaller grants (Sigma Xi, Land Institute, etc.) and travel grants.

6. Ensure that the majority of our graduates will achieve their educational goals with high satisfaction.

   Strategies and Actions:

   a. Continue to actively mentor students and offer a core-course in professional development, designed to provide an introduction to essential career skills.

   b. Provide opportunities for professional development for diverse career tracks.
      i. Provide a more diverse seminar series exposing students to range of career options.
      ii. Provide graduate students with more undergraduate teaching opportunities, perhaps in other departments (e.g., Biology) because graduates may be employed in a diverse array of departments other than Entomology.

   c. Increase access to extension experiences to expose students to different career tracks and promote recognition of these activities.

   d. Measure the percentage of first choices achieved by our graduates into their next position, and/or their first permanent position.

   e. Document professional awards, leadership, and rapid career progress among our graduates at 1, 3, and 5 years post graduation.

7. Increase our involvement in undergraduate teaching.

   Strategies and Actions:

   a. Increase participation in Agroecology major, IPM, and Entomology minor within the college, and also by undergraduates in other colleges.

   b. Continue to increase faculty participation in undergraduate education.

   c. Explore ways to utilize distance education/learning to deliver undergraduate entomology courses to PSU Commonwealth campuses.

   d. Participate in the development of new undergraduate curricula in Environmental Studies in accordance with the recommendations of the Environmental Curriculum Studies group.

   e. Develop additional undergraduate course options, such as Pollinator Biology, Ecosystem Services, and Disease Ecology.

8. Effectively market our educational activities focusing on our areas of strength and unique offerings.

   Strategies and Actions:

   a. Maintain excellence in our web-based initiatives and utilize developing technologies to enhance and elevate our visibility on the Internet.
      i. Petition for the replacement of our current web development person who will be retiring in June. It is essential we re-staff this position if we are to build upon our highly recognized success in this area.

   b. Develop a communications strategy that consists of diverse media and approaches to deliver technical information and to educate the public about the relevance of teaching activities in our department.
      i. Continue to improve the quantity and quality of and access to our web-based information.
      ii. Develop resources that utilize and highlight areas of excellence in the department including chemical ecology, pollinator biology and disease ecology.
      iii. Promote the use of Webinar presentations to broaden our impact and provide entomology course material to students unable to attend University Park classes.

Goal 2. Promote Areas of Excellence in Systems-Based Science

Measurable Targets

The following targets are synergistic in nature and each will complement and enhance each other to increase our ability to excel in discovery of basic knowledge and mechanisms that can then be used in translational research to address problems of importance to the Commonwealth, the Nation, and to the International arena.

Note: Strategies and Actions for Goal 2, Measurable Targets, are applicable to all targets and have been listed collectively on pages 30-31.

1. Continue to enhance participation in the **Center for Chemical Ecology** with specific objectives to:

    a. Acquire new interdisciplinary research and educational grants by 2014, including (but not limited to) expansion of research towards chemical ecology of disease vectors.

    b. Build on existing expertise in insect-inspired biomimetics and use it to increase efforts to secure funding, e.g., from DARPA and DTRA, to develop new knowledge and technologies.

2. Continue to enhance and expand a systems-based initiative in **Ecological Applications** with an emphasis on addressing research challenges and opportunities in the areas of:

    a. Renewable energy and biofuels. Microbial symbionts of wood-eating insects are highly likely to have unique enzymes that can be exploited for greater development of biofuels in a sustainable manner. Continue to expand existing knowledge base and develop translational research.

    b. Agricultural Sustainability. Continue development of integrated pest management strategies and enhanced ecosystem services (pollination, natural enemies, and biocontrol) that lead to sustainable, economically valid practices and enable long-term viability.

    c. Climate adaptation. Climate change will affect all aspects of insect interactions in vector-borne diseases and ecosystems. Develop base knowledge on changes in pest and insect vector activities. Develop anticipated strategies and applications to counter act impacts on beneficials, pests and insect vectors.

    d. Plant-Insect Interactions. Enhance current knowledge base of plant/insect interactions and develop translational research directed at pest disruption and enhancement of beneficial insects.

3. Continue to enhance and expand a systems-based initiative in **Disease Ecology and Biology** with specific objectives to:

    a. Strengthen links with the Centre for Infectious Disease Dynamics.

    b. Diversify activities and funding portfolio to encompass broader range of ecological and evolutionary research relating to disease, with greater integration of empirical and theoretical approaches.

    c. Continue to explore the interactions between the insect vector, pathogens, and other factors, to develop novel mechanisms for control of major diseases.

    d. Play a lead role in new interdisciplinary research activities centered on predicting and mitigating the effects of climate change on the ecology and evolution of disease.

    e. Build capacity to engage with novel vector borne diseases.

4. Develop a new systems-based initiative in **Pest Detection, Management and Mitigation** by 2014. Specific objectives to include:

    a. Build on existing expertise by hiring an insect evolutionary biologist with skills in systematics, molecular evolution, population genetics, molecular diagnostics and identification.

    b. Continue to enhance knowledge base underlying pest detection, diagnostics, management, information technology in pest prediction, and ecosystem services. Perform translational research to directly address issues of importance to the Commonwealth, national and international arena.

    c. Create short- and long-term training opportunities regarding current detection, diagnostics, and management of pest as a means of improving upon current skill set and knowledge of PSU students and stakeholders.

    d. Enhance extension/outreach and assign a liaison to communicate benefits of partnership with PSU and investigate needs of stakeholder grower organizations and state and federal agencies in a more interactive manner with administrators, executive teams, and National Science Program leaders.

    e. Create cooperative agreements that initiate or enhance the development of quick and effective methods for response to introduced or emerging pests and diseases.

    f. Designate building space to accommodate training of personnel and development of research projects by Government agencies.

5. Continue to enhance and expand a systems-based initiative in **Pollinator Health and Biology** with the goal to develop translational research to enhance their populations and

ensure continued security of the food supply and human health via a diversified diet of fruits, nuts, and vegetables. The following are specific objectives to:

a. Continue to develop base knowledge of disease and pest threats to pollinators and translational research to mitigate these threats.

b. Continue to develop base knowledge on the toxicology of pollinators and the threats facing their populations.

c. Continue to develop knowledge on the basic biology and diversity of pollinators and their pests, with the goal of developing translational research to improve pollinator health and their ability to perform ecosystem services via pollination of agricultural crops and native plants.

d. Enhance current expertise in pollinator diversity, specifically in the areas of pollinator systematics, evolutionary biology and pollination ecology.

e. Develop predictive management and diagnostic tools to counter any new threats to pollinator health by building on existing expertise in epidemiology, disease dynamics, population biology, and systems modeling.

f. Continue to develop strategies to enhance pollinator nutrition via management of pollinator habitat and plantings.

g. Enhance and build on existing national and international partnerships with other researchers, government regulatory agencies, and stakeholders to mitigate threats to pollinators. Translational research may enable stakeholders to acquire new entrepreneurial activities in pollinator services.

h. Strengthen ability to discover mechanisms underlying genetics traits and perform translational research in pollinator biology by adding staff versed in queen bee breeding and rearing. This person would also facilitate transfer of bee genetic stocks and research findings to stakeholders for their entrepreneurial development.

i. Develop programs with agencies that promote conservation programs on farms that result in conservation of pollinators.

<u>Strategies and Actions (apply to all targets)</u>:

a. Capitalize on the Penn State interdisciplinary programs for the acquisition of new faculty positions related to and/or bridging our areas of excellence. Examples include insect evolutionary biology, public health/urban entomology, disease ecology/vector biology, and community ecology/pollination ecology as related to ecosystem services. These positions would synergize with existing faculty. In particular, some will be able to capitalize on pending BSL3 facilities potential for mosquito/pathogen research and greatly enhance current research in disease ecology and biology.

b. Institute aggressive retention practices to maintain departmental strengths.

c. Develop a new central facility for the Frost Insect Museum/Center for Insect Biodiversity for use in research and extension/outreach.

d. Actively partner with other departments, colleges, and/or agencies to develop additional biocontainment facilities for invasive species, biological control agents, insect vectors/plant diseases/plants, and pollinators/pests/diseases, to enable foundational research on basic biology and development of mitigation strategies. These facilities would complement and not overlap with the possible BSL3 facilities for mosquito/pathogen containment.

e. Take the lead in developing a new interdisciplinary Center of Excellence in Pollinator Health and Biology.

f. Take the lead in developing a new interdisciplinary Center of Excellence in Pest Detection, Management and Mitigation. Center will encompass research on detection, diagnosis, management applications using information technology, prediction and integrated management of pests and develop ecosystem services. Develop active partnerships with agencies such as USDA-APHIS-PPQ, USDA Forest Service, etc.

g. Develop central themes to research activities to address major drivers such as climate and environmental change, with both fundamental and translational activities to develop strategies for community response and adaptation. Target research to respond to RFP's from national agencies.

h. Capitalize on Penn State's satellite research facilities and Extension offices for the acquisition of faculty or staff who will advance conservation of resilient pollinator communities in fruit and vegetable production, through the combination of applied community ecology research, education programs, and collaboration with government programs such as NRCS.

i. Strengthen the departmental ties with agencies with similar or complementary missions, e.g., PDA, ARS, APHIS, National Forest Service, NRCS, and Food Security Initiatives.

j. Strengthen partnerships with other academic and research institutions that share complementary strengths and goals, especially via international cooperative agreements and research/graduate training initiatives.

k. Host international workshops and other promotional events on the Penn State campus to raise profile and strengthen links with international collaborators.

l. Nominate distinguished faculty in our chosen areas of excellence for Penn State Honorary Degrees, and host their visits to campus.

m. Utilize the department Development Committee to target fundraising efforts on selected priorities from these new initiative areas, to enhance research infrastructure and graduate training.

Goal 3. Strengthen Education and Communication with Cooperative Extension Stakeholders

Measurable Targets

1. Enhance impact of recent research hires affiliated with the Center for Infectious Disease Dynamics.

   Strategies and Actions:

   a. Hire public health entomologist(s) that will function at regional Extension facilities, Commonwealth Campuses, and/or the Urban/Metro Research and Extension Center.
      i. Public Health entomology faculty could teach introductory entomology and biology/ecology at Commonwealth Campuses and collaborate with UP faculty on vectored disease ecology research such as Lyme disease, West Nile Virus, Rocky Mountain spotted fever and others impacting our stakeholders in Pennsylvania.
      ii. Public Health entomology extension associate hires will complement the work of entomology faculty through translation and delivery of new knowledge to our clients.

   b. Increase funding from NIH and related programs in support of human health, life quality, and safety.

2. Strengthen our abilities to identify emerging/invasive arthropod pests and beneficials and determine their ecosystem function in order to mitigate negative impacts on agriculture, natural resources and human health, and advance resilience of sustainable ecosystem functions.

   Strategies and Actions:

   a. Encourage the replacement of recently vacated insect evolutionary biology/systemtics position.

   b. Provide for curatorial assistance in the Frost Insect Museum.

   c. Petition for acquisition of resources to build new Frost Museum/Center for Insect Biodiversity facility with adequate space for offices, laboratories, classrooms and collections.

   d. Strengthen ability to discover mechanisms underlying genetics traits and perform translational research in pollinator biology by adding staff versed in queen bee breeding and rearing. This person would also facilitate transfer of bee genetic stocks and research findings to stakeholders, for their entrepreneurial development.

   e. Provide the public with access to museum displays, tours and educational programming.

f. Maintain and strengthen our associations with USDA-APHIS-PPQ, USDA, USDA-FS, PDA, DEP and other partners.

3. Effectively market our extension activities focusing on our areas of strength and unique offerings.

Strategies and Actions:

a. Maintain excellence in our web-based initiatives and utilize developing technologies to enhance and elevate our visibility on the Internet for all stakeholders.
   i. Petition for the replacement of our current web development person who will retire in June. It is essential we re-staff this position if we are to build upon our highly recognized success in this area.

b. Develop a communication strategy that consists of diverse media and approaches to deliver technical information and to educate the public about the relevance of research, teaching and extension activities in our department.
   i. Foster the development of educational tours, networks, learning circles and roundtables for disseminating information to traditional and non-traditional groups.
   ii. Continue to improve the quantity and quality of, and access to, our web-based information.
   iii. Utilize state-of-the-art information technologies (IT) to deliver information to our increasing diverse stakeholder groups.
   iv. Develop resources that utilize and highlight areas of excellence in the department, including chemical ecology, pollinator biology, and disease ecology.

4. Increase our ability to support and to improve the quality of extension activities that fully integrate all members of the Department.

Strategies and Actions:

a. Initiate and reward the development of strong interdisciplinary, multifunctional, teams to address complex problems using a systems-based approach.
   i. Increase access to extension experiences to expose students to different career tracks and promote recognition of these activities.
   ii. Expand teaching requirement for students to encompass highly structured extension activities and responsibilities.

b. Address resource acquisition issues to support our extension/outreach and educational activities.
   i. Initiate cost recovery for educational programs to offset declining federal and state support and to improve the quality of educational programs.
   ii. Seek external funding to support major educational programming efforts with links to applied research initiatives.

5. Expand international programs and partnerships in research, teaching and extension, e.g., SUSPROT and IPM/CRSP, and incorporate new international partners for additional 3-5 year periods by 2013.

   Strategies and Actions:

   a. Utilize our existing faculty involvement and new initiatives in international programs and activities to build our involvement with new partners.

   b. Utilize university programs, e.g., the International Office Tag-a-Long program, for increasing both faculty and student travel and international exposure.

6. Develop and promote research, extension, and educational teams, programs and materials reaching non-traditional clientele. Foster the development of networks, learning-circles and roundtables for disseminating information to traditional and non-traditional groups.

   Strategies and Actions:

   a. Form mutually beneficial partnerships with specific special interest groups.
      i. Industry, governments and NGOs.
      ii. Benefits can include enhanced publicity for departmental programs, additional training opportunities for students, and increased networking with policymakers and social interest groups.

Goal 4: Enhance and Expand our Public Outreach Efforts
Measurable Targets

1. Increase our ability to deliver quality educational experiences and programs to local community organizations, schools, libraries, and the general public.

   Strategies and Actions:

   a. Create formal opportunities for graduate students to perform outreach to the public.
      i. Institute optional course credit for organizing and administering presentations.
      ii. Create a system for receiving, processing, and delivering requests for outreach.
      iii. Involve faculty and extension personnel in the evaluation of teaching tools and activities developed for our outreach programs, and in the supervision of graduate student involvement for course credit.

   b. Initiate semi-permanent local and wider-ranging relationships with educational institutions that would benefit from our programs.
      i. Create a regular schedule of recurring outreach experiences to be presented to each institution/group on a yearly or bi-yearly basis (also provides a solid foundation for institution of course credit for outreach).
      ii. Maintain and foster involvement with Ag Progress Days.
      iii. Initiate programs targeting pollinator health and pollination biology education to be delivered to the general public (e.g. programs at Longwood Gardens, Arboretum at Penn State, etc.)

   c. Continue to invest in more formal outreach opportunities such as the Great Insect Fair and Bug Camp for Kids.
      i. Create a wider diversity of opportunities – one day workshops targeted at different interest groups. Foster the development of networks, learning-circles and roundtables for disseminating information to traditional and non-traditional groups.
      ii. Seek external sources of funding that allow for the lowering of costs associated with fee-based programs in order to increase accessibility.
      iii. Continue to improve the quantity and quality of, and access to, our web-based information.

   d. Address resource acquisition issues to support our outreach and educational activities.
      i. Initiate new cost recovery strategies for educational programs to offset declining federal and state support and to improve the quality of educational programs.

2. Develop the Frost Museum/Center for Insect Biodiversity as a research and outreach resource for the University, the Department, and the general public.

   Strategies and Actions:

   a. Create a work-study program for undergraduates that entail maintenance of living display organisms and other exhibits.

b. Formalize a scheduling process for outside groups to visit, tour, or utilize the museum that is compatible with the responsibilities and schedules of graduate students and museum personnel.

c. Hire a systematist/taxonomist that fulfills the teaching and expertise needs of the department and who is able to play an active role in maintenance of the museum collection.
   i. Take advantage of the NSF Partnership for Enhancing Expertise in Taxonomy (PEET) to bring in funding for special projects related to specific taxonomic areas.

d. Find a new location for the Frost Insect Museum/Center for Insect Biodiversity that enhances its use in outreach and in research. This is necessary because the current facility is slated for demolition.

3. Provide outreach to policy-makers and the media in order to focus the attention of larger agencies on the research activities within our department and their impact on broad-interest issues such as agricultural sustainability, human health, disease dynamics, and ecosystem services.

   Strategies and Actions:

   a. Continue to strengthen our focus on systems-based research to develop centers of authority on key topics (e.g. chemical ecology, disease ecology, climate change, pollinator biology).

   b. Develop effective ways to communicate details about our research and potential impacts to non-scientists.
      i. Integrate components of current and developing research systems into our existing outreach venues to bring public attention to key areas of research.

   c. Seek out opportunities to garner media attention and to participate in policy-making.

Goal 5. Maintain a Dynamic and Rewarding Learning and Work Environment in the Department

Measurable Targets

1. Increase the sense of community among students, faculty, and staff.

   Strategies and Actions:

   a. Develop an electronic newsletter for enhancing departmental communication.

   b. Maintain departmental socials to recognize graduates' completion of programs of study, special awards, publications, etc.

   c. Increase student members' involvement in departmental Standing Committees and recognize their accomplishments.

   d. Expand our social opportunities and incorporate more interdisciplinary opportunities for interactions.

2. Continue to creatively utilize constrained space and seek additional opportunities.

   Strategies and Actions:

   a. Identify a new location for the Frost Insect Museum/Center for Insect Biodiversity that will promote outreach impact and use in research. This is necessary because the current facility is slated for demolition.

   b. Partner with other departments, colleges, universities, and federal agencies to create biocontainment facilities for invasive species, insect vectors/disease/plants, and for pollinators/disease.

   c. Space Committee will regularly audit space use and make recommendations on more effective use of space.

   d. Identify additional space in the college to accommodate growth in programs, e.g., Agricultural Administration and Ferguson buildings, a new wing on ASI, Innovation Park.

   e. Secure University Park-based land for student research and education.

3. Maintain and enhance the exceptional level of information within, and traffic to our web sites.

Strategies and Actions:

a. Develop standing position for staff web-professional to fulfill essential and urgent needs and tasks of creating and maintaining web-based outreach materials and extension programming. The current position will become vacant through retirement of the current web professional.

b. Continue to advocate staff to partake in professional development activities.

c. Encourage all to have utmost respect and consideration of all staff members.

APPENDIX I

Entomology – Minor

University Park, College of Agricultural Sciences (ENT)
Professor Michael C. Saunders, *in charge*

Through the Department of Entomology, the minor in Entomology is primarily designed for (but not restricted to) students in the Agroecology major seeking additional studies in the entomological sciences. Successful completion of this minor area of study will help prepare students for graduate studies in entomology and related fields. A grade of C or better is required in every course used to satisfy the requirements of the minor.

A minor in Entomology requires 18 credits in approved courses in addition to the major requirements of the student's choice. Appropriate course substitutions may be considered with minor adviser approval.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 18 credits

PRESCRIBED COURSES (6 credits):
ENT 313(2) (Sem:2-4)
ENT 314(1) (Sem 2-4)
OR
ENT 316(1) Sem: 2-4)
ENT 457(3) (Sem 6-8)

ADDITIONAL COURSES (12 credits)
Select 6 credits from ENT 410(3), ENT 412(3) or ENT 420(3) (Sem: 4-8)
Take 3 credits of ENT 496(3) (Sem: 4-8)
Select 3 credits from AGECO 201(3), BIOL 222(3), BIOL 427(3), or PPATH405(3) (Sem: 3-8)

APPENDIX II

College of Agricultural Sciences (external traffic only)

Top Exit Pages

May 1, 2008 - Feb 23, 2009

Comparing to: Site

1,631,035 visits exited from 30,576 pages

Exit Pages

Exits	Pageviews	% Exit
1,631,035 % of Site Total: 98.25%	4,089,233 % of Site Total: 96.36%	39.89% Site Avg: 39.12% (1.97%)

Page	Exits	Pageviews	% Exit
cas.psu.edu/	135,717	225,859	60.09%
ento.psu.edu/extension/factsheets/brownmarmoratedstinkbug.htm	81,014	87,688	92.39%
www.cas.psu.edu/	54,247	81,638	66.45%
it.cas.psu.edu/	31,188	49,059	63.57%
extension.psu.edu/	25,960	80,762	32.14%
foodscience.psu.edu/outreach/fun_food_science.html	20,083	38,456	52.22%
horticulture.psu.edu/node/386	19,515	34,696	56.25%
creamery.psu.edu/flavors.htm	16,942	24,714	68.55%
creamery.psu.edu/	14,917	37,383	39.90%
das.psu.edu/	12,018	36,020	33.36%
extension.psu.edu/extmap.html	10,325	32,676	31.60%
ento.psu.edu/extension/factsheets/centipedehouse.htm	9,254	11,128	83.16%
cropsoil.psu.edu/	9,021	14,969	60.26%
ento.psu.edu/lyme/symptoms.htm	6,722	7,673	87.61%
tfpg.cas.psu.edu/	6,476	14,110	45.90%
/www.cas.psu.edu/	6,225	8,811	70.65%
www.ento.psu.edu/extension/factsheets/carpenter_bees.htm	6,066	6,605	91.84%
ento.psu.edu/extension/factsheets/blk_carpet_beetle.htm	6,037	7,121	84.78%
sfr.cas.psu.edu/employment/job_announcements.htm	6,020	10,537	57.13%
ento.psu.edu/	5,973	14,884	40.13%

energy.cas.psu.edu/costcomparator.html	**2,960**	4,053	73.03%
sftrc.cas.psu.edu/lessonplans/forestry/identifyingsummer.html	**2,951**	3,667	80.47%
ento.psu.edu/extension/factsheets/birdmites.htm	**2,937**	3,457	84.96%
aginfo.psu.edu/news/2002/7/marinade.html	**2,832**	2,908	97.39%
sftrc.cas.psu.edu/lessonplans/wildlife/animalsneed.html	**2,796**	4,181	66.87%
ento.psu.edu/extension/fact_sheets.html	**2,779**	13,445	20.67%
pubs.cas.psu.edu/publications.asp	**2,770**	24,690	11.22%
www.ento.psu.edu/	**2,760**	6,440	42.86%
ento.psu.edu/extension/factsheets/common_ticks.htm	**2,708**	4,245	63.79%
www.ento.psu.edu/extension/factsheets/carpenter_ants.htm	**2,705**	3,020	89.57%
foodscience.psu.edu/public/kitchen-chemistry	**2,631**	6,027	43.65%
chemicalecology.psu.edu/	**2,573**	3,762	68.39%
sftrc.cas.psu.edu/lessonplans/forestry/forestrykto5.html	**2,556**	8,879	28.79%
www.cas.psu.edu/AcademicUnits.html	**2,537**	9,801	25.89%
ppath.cas.psu.edu/extension/plant_disease/mulchfun.html	**2,534**	2,956	85.72%
centre.extension.psu.edu/	**2,520**	3,387	74.40%
lancaster.extension.psu.edu/	**2,498**	4,726	52.86%
it.cas.psu.edu/newnews.htm	**2,460**	5,597	43.95%
foodscience.psu.edu/explore/explore.html	**2,452**	5,868	41.79%
water.cas.psu.edu/	**2,442**	4,906	49.78%
apd.cas.psu.edu/	**2,413**	6,473	37.28%
www.ento.psu.edu/extension/factsheets/birdmites.htm	**2,359**	2,680	88.02%
ento.psu.edu/extension/factsheets/bagworm.htm	**2,346**	2,659	88.23%
maarec.cas.psu.edu/index.html	**2,327**	6,226	37.38%
extension.psu.edu/hort.html	**2,296**	12,586	18.24%
ento.psu.edu/extension/factsheets/amer_cockroach.htm	**2,291**	2,636	86.91%
ento.psu.edu/extension/factsheets/carpenter_ants.htm	**2,245**	2,597	86.45%
extension.psu.edu/base_agriculture.htm	**2,184**	10,482	20.84%
mercer.extension.psu.edu/	**2,168**	3,460	62.66%
ppath.cas.psu.edu/extension/plant_disease/pythrrot.html	**2,135**	2,395	89.14%

sfr.psu.edu/employment/job_announcements.htm	**2,105**	3,190	65.99%
clinton.extension.psu.edu/	**2,079**	3,356	61.95%
sftrc.cas.psu.edu/lessonplans/wildlife/organisms.html	**2,063**	2,641	78.11%
sftrc.cas.psu.edu/lessonplans/wildlife/animalcamouflage.html	**2,059**	2,483	82.92%
cas.psu.edu/facultystaff/	**2,056**	4,539	45.30%
maplesyrup.cas.psu.edu/	**2,055**	3,209	64.04%
creamery.psu.edu/directions.htm	**2,022**	6,071	33.31%
aginfo.psu.edu/news/2000/7/corn.html	**1,997**	2,077	96.15%
pa4h.cas.psu.edu/77.htm	**1,990**	8,767	22.70%
dauphin.extension.psu.edu/	**1,975**	3,737	52.85%
sftrc.cas.psu.edu/lessonplans/wildlife/birdsnest.html	**1,960**	2,305	85.03%
washington.extension.psu.edu/	**1,957**	4,152	47.13%
www.ento.psu.edu/extension/factsheets/brownmarmoratedstinkbug.htm	**1,957**	2,129	91.92%
www.ento.psu.edu/extension/factsheets/common_ticks.htm	**1,954**	3,122	62.59%
sftrc.cas.psu.edu/lessonplans/wildlife/animalclassification.html	**1,922**	2,397	80.18%
erie.extension.psu.edu/	**1,891**	3,211	58.89%
das.psu.edu/dairy/teams/characteristics	**1,883**	2,246	83.84%
www.ento.psu.edu/extension/factsheets/bed_bugs.htm	**1,866**	2,143	87.07%
sftrc.cas.psu.edu/lessonplans/forestry/weneed.html	**1,861**	2,379	78.23%
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