

## Department of Entomology Strategic Plan 2002– 2007

(revised May 2004)

### Preamble

Entomology, agriculture and Purdue have been intertwined since the university was founded in 1869. The first university curriculum focused on agriculture and included courses on economic entomology and bee keeping. The expansion of agriculture at the beginning of the 20<sup>th</sup> century increased the demand for entomology and led to the establishment of a separate department in 1912 and a greatly expanded faculty in the 1950s and 1960s.

During the past 40 years, Entomology provided the teaching, research and extension support expected in our agricultural production systems, and met the rising demand from urban ecosystems. We have provided the frontline defenses required to thwart an ever-changing complex of insect, mite, nematode, and vertebrate pests, as we engaged in a wide range of cutting-edge investigations focused on basic life science.

As we enter the 21<sup>st</sup> century, Entomology is moving in lock step with the leading edge of the life sciences in alignment with the strategic plans of the University and the School of Agriculture. Our programs embrace the discoveries and opportunities of the post-genomic era, and promote the applications of biotechnology. In addition, a new chapter in conservation biology is opening; one focused on biodiversity, conservation biology, and environmental risk assessment. Entomology will harness the power of information technology, and promote the transfer and adoption of technology at home and abroad with international partners, while always maintaining the flexibility and foresight to take on new opportunities and challenges as they arise.

Students are a priority in our current and future plans, and as such, we strive to provide them with the very best learning experiences they'll need for their future success. To this end, we continually review and update our courses and curricula to reflect the current and future needs of our students and stakeholders.

Our engagement activities adjust with current demand, but leave room to anticipate emerging challenges. We pursue sustainable development practices that assure profitability and address concerns raised by the Food Quality Protection Act and other government actions, and improve our ability to leverage technology to improve our information dissemination efficiency. We use our outreach programs as a unique opportunity to be proactive in the message and lessons we deliver to the public.

The Department embraces a number of values and attributes as fundamental in our approach to learning, discovery and engagement. We strive to be pace setting in everything we do. We encourage the highest standards of ethics and citizenship, and operate in an open, objective, and inclusive environment. We are a community of scholars committed to excellence and teamwork, and promote the synergism that comes from interdisciplinary interactions. We recognize the value of our human capital, embrace and promote increased diversity, and support activities that enhance this capacity. We adopt emerging information and other technologies as tools - not final solutions, and are resolved to actively disseminate our knowledge to people of all ages.

### **Mission**

To improve the quality of life for the state, nation and the world by advancing scientific knowledge through the development and application of arthropod/nematode science.

### **Vision**

To be a leader recognized worldwide for the solutions and discoveries generated through the application of science focused on arthropod and nematode biology.

### **Discovery Goals**

Problem solving and scientific discovery in arthropod and nematode science has never been more exciting. The complete genomic sequences of several insects and nematodes have been completely determined, and others will soon follow. Furthermore, the technology that has made this possible is steadily improving, becoming more accessible, and being adapted to novel applications. We can expect that the developments of large genomic libraries, EST databases, proteomics, and RNA interference will provide a look at the complexity of the genes, gene products, and the genetic interactions that underlie the spectacular array of diversity that exists among the arthropods and nematodes, the most species rich groups of organisms on the planet. At the same time, developments in global positioning and computer capacity, coupled with advances in molecular biology, are making basic and applied ecology and population biology equally powerful and sophisticated. Although basic biological investigations may remain focused primarily on the most highly developed model insect and nematode species (i.e. *Drosophila melanogaster* and *Caenorhabditis elegans*), there will be growing interest in comparing the biology of these organisms with that of real pest and beneficial species that impact our daily life. Therefore, the promise that the most powerful tools available in biology will be focused on applied arthropod and nematode research is greater today than ever before.

New challenges will arise with the power and promise of these new developments in research capacity. We will be challenged to prevent the sophistication of arrays, filters, satellites, and computers from diminishing that “feeling for the organism” that is so important to successful research and training. Moreover, we can expect that the pace of discovery will move faster than ever and will need to be more rapidly communicated to an increasingly global community.

Furthermore, in an increasingly global economy, the problems themselves are certain to become more national and international in nature. Taken together, these changes will mean that arthropods and nematodes will continue to pose serious problems in agriculture and to human health. It will also mean that fewer scientists will be able to work in isolation, and that continued technical training, technical support and increased funding will be essential. Therefore, the only realistic manner to move forward will be through increased cooperation between areas of expertise that range in focus from the molecule to the ecosystem. In short, we will be challenged to communicate across disciplines as never before.

### *Goal 1 - Discovery*

Develop and maintain nationally and internationally acclaimed research and development programs in arthropod/nematode pest management, functional genomics/proteomics and conservation biology.

- 1.1. A pest management program focused on fundamental mechanisms underlying insect/host interactions, and application of practical and useful knowledge in programs here and abroad.
  - 1.1.1. Focus on pest management activities where we have a comparative advantage.
    - 1.1.1.1. Increase research on invasive species that pose serious economic, environmental, and aesthetic threats to citizens, homeowners, and businesses in Indiana and the Midwest.
      - 1.1.1.1.1. Create the R&D capacity necessary to detect, diagnose, monitor, control, and eliminate those pests and disease vectors that pose a threat to homeland security.
  - 1.1.2. Promote applied research that develops pest management strategies to support the reduce-risk goals of Food Quality Protection Act (FQPA), and promote economic and environmental sustainability.
  - 1.1.3. Apply basic science, biotechnology, and information technology, to international development programs.
- 1.2. Become acknowledged as a national leader in the application of arthropod and nematode functional genomics and proteomics for the solution of problems and the discovery of new scientific knowledge.
  - 1.2.1. Determine the influence of environmental and endogenous regulatory factors on gene expression during insect growth, development, reproduction, and adaptation.
  - 1.2.2. Develop molecular genetic markers to map and clone genes for economically important traits in insects and nematodes and their hosts and utilize those markers as diagnostics in pest management and population biology.

- 1.2.3. Characterize the temporal and spatial expression of genes that influence insect growth, development, reproduction, and adaptation and influence insect interactions with hosts and environment.
  - 1.2.4. Apply the tools of biochemistry, genomics and proteomics to identify novel insecticide target sites and new modes of action.
  - 1.2.5. Utilize high-throughput genomics and proteomics technology to provide additional characters for improving our understanding of evolution, systematics and taxonomy.
- 1.3. Expanded program in conservation biology focused on biodiversity, environmental biology, and risk assessment.
- 1.3.1. Promote an applied biodiversity program that includes elements of systematics, biodiversity dynamics, and taxonomic information resources.
  - 1.3.2. Contribute to the development of a multi-disciplinary environmental biology capacity through integrative biology, ecology and ecosystems studies, and biocomplexity contributions.
  - 1.3.3. Develop and implement a risk assessment and management framework for pest control technologies which addresses pesticide & environmental toxicology, resistance management, target/non-target impacts to species at risk, environmental fate of interventions, public health and biotechnology concerns.
    - 1.3.3.1. Create interdisciplinary risk assessment working group.
    - 1.3.3.2. Initiate a program on invasion biology.
- 1.4. Resource needs, metrics, and implementation plan.
- 1.4.1. Resource needs:
    - 1.4.1.1. Continued access to modern molecular biology facilities and services.
    - 1.4.1.2. A quarantine/containment facility to rear and evaluate natural enemies, other species that require quarantine, and transgenic organisms
    - 1.4.1.3. New faculty hires that would fill current research gaps and priorities as outlined above including (in no particular order) positions in population genetics, bioinformatics, environmental biology, risk assessment, systematics, and chemical ecology. Homeland security concerns will likely drive some of these new opportunities. Most new hires will have either specific training in molecular biology or a working knowledge of the technology.
  - 1.4.2. Metrics/benchmarks:
    - 1.4.2.1. Number and success of students

- Increase the number of undergraduates presenting their research at professional meetings by two per year.
  - Have a continuously active undergraduate student research program.
- 1.4.2.2. Quantity and quality of publications
- Increase the impact of publications as measured by the numbers of refereed publications, the citation index, journal impact factor, and influence on the discipline or field of investigation.
- 1.4.2.3. Patents and other impacts
- Increase the number of disclosures, patents, and licenses granted by an average of eight percent per year.
  - Increase the number of new business or enterprise initiatives started or assisted.
- 1.4.2.4. Amount of extramural support
- Expectation that all faculty will solicit extramural support for their program as appropriate including an average salary savings of 5%.
  - Double the research expenditures from extramural sponsors for environmental programs.
  - Double NIH funding in the next five years.
  - Increase NSF funding by 10 percent per year.
  - Increase expenditures from extramural sponsors for research, extension and teaching by 10 percent a year.
  - Increase submissions of multi-investigator grant proposals.
  - Increase numbers of new interdisciplinary collaborations and participation in Centers of Excellence.
  - Increase non-appropriated funds by 50 percent over the next five years.
- 1.4.2.5. Awards and other recognition
- Double the number of faculty serving on review panels and journal editorial boards over the next five years.
  - Nominate 10% of the faculty and staff for university, state, regional, national, and international awards and recognitions each year.
- 1.4.2.6. Research facilities
- Create new insectary capacity by renovating facilities in EEL.
  - Renovate research laboratory space each year with a combination of institutional and faculty-generated support.
  - Acquire 3000 square feet of new research laboratory space for new initiatives and priorities by 2008.

- Have entomology faculty constituting 2% of Discovery Park activities.

1.4.3. Implementation plan to be developed as needed.

### **Learning Goals**

The Department is committed to excellence in education, and the future of our students. Our undergraduate program benefits from a core of exceptional and dedicated faculty widely acclaimed for their teaching skills, expertise, and attention given to students. The selection of courses we offer are continually reviewed to assure they meet the needs of our students, and reflect the changing opportunities and challenges in the work place. Many of our survey courses reach out to a broad cross section of the general student population, while our more specialized courses are designed to appeal to entomology students, and other students interested in insects and entomology as models in the life sciences. In addition to coursework, our undergraduates are encouraged to broaden their undergraduate experiences with appropriate laboratory practicals, relevant field experiences, academic and industrial internships, international experiences, and other activities that promote experiential learning. Qualified undergraduates are encouraged to participate in faculty mentored undergraduate research. Our graduate program is built on providing a customized core of disciplinary training and research mentoring, and learning the skills and practices necessary to perform as a professional in the discipline.

### *Goal 2 – Learning*

2. Recruit high quality students, provide an excellent educational experience, and increase the visibility of entomology in the life sciences and other university programs.
  - 2.1. Entomology student enrollment and diversity significantly increased.
    - 2.1.1. Develop and implement a recruitment strategy with a target of 10-15 new undergraduate majors and 8-10 new graduate students each year.
    - 2.1.2. Increase diversity in both the undergraduate and graduate programs.
      - 2.1.2.1. Initiate a summer internship program with selected institutional partners with a target of 2 to 4 interns each summer.
      - 2.1.2.2. Link with the existing MARC-AIM program
      - 2.1.2.3. Develop long term strategy for increasing the number of minority students interested in entomology and biological sciences through links with science education outreach activities

- 2.2. Students receive a superior and well-rounded education.
  - 2.2.1. Establish and update guidelines for assuring a quality educational experience including counseling, courses, mentoring, and program administration each academic year.
    - 2.2.1.1. Dedicate specific faculty as counselors for undergraduate students.
  - 2.2.2. Establish a culture of curriculum development, implementation, and review that reflects the evolving needs and opportunities of our students.
    - 2.2.2.1. Appoint faculty members to establish and coordinate separate undergraduate and graduate programs.
    - 2.2.2.2. Promote honors activities for qualified students.
  - 2.2.3. Evaluate student-learning experiences.
    - 2.2.3.1. Develop and implement procedures for evaluating the quality of teaching and student learning through course instructor evaluations, peer review, and other methods as my appropriate.
    - 2.2.3.2. Develop and implement a protocol to debrief all future graduates.
    - 2.2.3.3. Develop and implement a protocol for periodic assessment of alumni and industry views of our programs.
  - 2.2.4. Promote innovative and enhanced teaching opportunities, techniques and technologies.
  - 2.2.5. Promote opportunities and target 50% of our undergraduates for research experiences.
  - 2.2.6. Encourage and provide opportunities for undergraduate and graduate students to gain international experiences.
    - 2.2.6.1. Target 50% of the undergraduate students for international experiences.
    - 2.2.6.2. Encourage graduate students to engage in international experiences.
    - 2.2.6.3. Offer an international entomology short course at least every other year.
- 2.3. Teach courses and maintain curricula that give our students a competitive advantage and meet the evolving needs of our students and stakeholders.
  - 2.3.1. Offer courses that are current and relevant.
    - 2.3.1.1. Conduct periodic review of courses and curricula.
  - 2.3.2. Undergraduate courses and curricula.
    - 2.3.2.1. Maintain a diversity of well-taught courses for our majors.
    - 2.3.2.2. Promote interdisciplinary courses to appeal to broader audiences from all units of the university and community.
      - 2.3.2.2.1. Support the multi-school forensic science initiative as a novel campus-wide interdisciplinary undergraduate curriculum, and as

the academic component of a homeland security portfolio that covers learning, discovery, and engagement missions.

- 2.3.2.2.2. Encourage and facilitate internship and research experiences for 50% of our undergraduates.

### 2.3.3. Graduate courses and curriculum

- 2.3.3.1. Periodically review our graduate program requirements to assure our students receive essential knowledge in entomology and related fields, and enrichment experiences such as topical seminars, student teaching, and international experiences.
- 2.3.3.2. Consider offering specialized MS in science education outreach, and other interdisciplinary opportunities.

## 2.4. Resource needs, metrics, and implementation plan.

### 2.4.1. Resource needs:

- 2.4.1.1. Acquire additional support for student recruitment and student scholarships.
- 2.4.1.2. Remodel student resource room.
- 2.4.1.3. New faculty hires to fill current teaching gaps and priorities including forensic entomology/biothreat detection, diagnosis, and monitoring.

### 2.4.2. Metrics/benchmarks:

- 2.4.2.1. Number of students.
- 2.4.2.2. Success of graduates e.g. employment and salaries of both undergraduate and graduate students.
  - 2.4.2.2.1. Annually track placement of all graduates.
- 2.4.2.3. Awards and other recognition.

### 2.4.3. Implementation plan to be developed as needed.

## **Engagement Goals**

Extension Entomology will face a number of challenges and opportunities during the life of this strategic plan. The most serious challenge facing Extension in Indiana and most other states is likely to be flat or declining budgets. This challenge will be addressed by setting priorities to focus efforts, and improved efficiency, such as replacing paper publications with web-based publications and reducing travel costs through increased use of videoconferences, seeking additional sources of revenue to support Extension activities, and exploring additional opportunities for partnering with Extension entomologists in neighboring states.

The next several years will also provide Extension Entomology with exciting opportunities. As the demand for Extension services by urban and suburban clientele increases, Extension Entomology is positioned to meet those needs. Specialists with expertise in urban and structural pest management, turf and ornamental pest management, stored product and food pest management, and public health are actively involved in developing Extension programs to address the societal concerns in those areas. The new emphasis on Homeland Security will provide opportunities that will allow Extension Entomology to develop an infrastructure for providing biosecurity by early detection of intentionally or accidentally introduced invasive species. At the same time, Extension Entomology will continue to serve traditional clientele involved in production agriculture, helping them confront the problems of low prices, high input costs, increased regulation, and the need for increased diversification through new and value-added crops.

### *Goal 3 - Engagement*

3. Effectively address the extension/outreach needs of society both here and abroad through education, partnerships, and leadership in knowledge and technology transfer.
  - 3.1. Development of environmentally and economically sustainable best management practices (BMP) that meet current, emerging and future pest related challenges (see appendix for program specifics).
    - 3.1.1. Accelerate the development of alternatives to technologies affected by the Food Quality Protection Act (FQPA).
      - 3.1.1.1. Promote the development of bio-based practices.
    - 3.1.2. Address emerging issues such as organic agriculture, nutraceuticals, value-added production, and invasive species.
    - 3.1.3. Protect natural, urban and agricultural environments from bioterrorism.
  - 3.2. Implementation and adoption of the best management practices (see appendix for program specifics).
    - 3.2.1. Adoption by a significant proportion of area affected.
  - 3.3. Engagement with stakeholders, end-users, policy makers, and the general public greatly enhanced (see appendix for program specifics).
    - 3.3.1. Provide learning opportunities through public engagement to increase interest about insects and the science of entomology through self-supporting educational programs for individuals of all ages.
    - 3.3.2. Promote life long learning and adult continuing education programs.

- 3.4. Resource needs, metrics, and implementation plan.
  - 3.4.1. Resource needs:
    - 3.4.1.1. Public outreach office
    - 3.4.1.2. Information and media manager
    - 3.4.1.3. New faculty hire that specializes in measuring how new technologies diffuse through clientele groups. This innovation adaptation facilitator will cut across traditional commodity based orientations to develop more integrated and efficient program delivery.
  - 3.4.2. Metrics/benchmarks (see appendix for details):
    - 3.4.2.1. Demand for extension expertise
    - 3.4.2.2. Number adopting BMP
    - 3.4.2.3. Impact of programs
    - 3.4.2.4. Number of public receiving outreach message
    - 3.4.2.5. Quantity and quality of publications
    - 3.4.2.6. Amount of extramural support
    - 3.4.2.7. Awards and other recognition
    - 3.4.2.8. Number of students involved in entomology activities and recruited as undergraduates
  - 3.4.3. Implementation plan to be developed as needed.

## Appendix

A list of actions and targets are provided below for specific extension programs corresponding to subgoals 3.1, 3.2, and 3.3 above.

### *Engagement Subgoal*

3.1 - Development of environmentally and economically sustainable best management practices (BMP) that meet current, emerging and future pest related challenges.

1. Field and Forage Crops
  - a. Increase educational opportunities that inform producers when and where transgenic crops are likely needed while encouraging them to implement insect resistance management strategies.
  - b. Increase awareness of soybean aphid, a new pest of soybean, and refine its management strategies that maximize economic gain, while minimizing environmental impact.
  - c. Determine and promote alternative non-host crops of soybean cyst nematode (SCN).
  - d. Promote cultivars with resistance to SCN
  - e. Encourage development of new pesticides with nematicidal activity.
2. Vegetable and Fruit Crops
  - a. Expand program for improving organic production of vegetables and fruits.
  - b. Evaluate potential replacements for organophosphate insecticides on apples, as driven by FQPA.
3. Livestock and Poultry Industry
  - a. Monitor for cattle fly resistance and develop resistance management strategies for cattle producers.
  - b. Determine effective dispersal range of house fly population originating from confined livestock and poultry operations.
  - c. Develop and implement IPM programs for filth-breeding flies associated with confined livestock and poultry with anticipated changes in management practices and available pesticide registrations.
4. Apiculture
  - a. Educate beekeepers on best-management techniques by maintaining the web site, participating in workshops and beekeeper associations.

- b. Attempt to foster a queen-rearing industry in Indiana with mite-tolerant, locally-bred queens.

## 5. Urban and Green Industry

- a. Create and empower an urban management team to identify and pursue common needs and interests.
- b. Public Health:
  - Conduct a needs assessment for clientele groups and develop a plan to address the prioritized needs associated with public health entomology in the state of Indiana.
  - Develop a public outreach program aimed at increasing public awareness and education of vector borne disease and adoption of BMP for vector and disease control.
  - Develop genomic and molecular research capabilities to investigate aspects of vector biology and disease epidemiology that impact vector surveillance and control.
- c. Stored Products and Food Industry
  - Determine IPM program requirements for the industry that can be included within current BMP guidelines.
  - Investigate novel and innovative BMP that would provide alternatives for current management practices.
- d. General and Structural Pests
  - Utilize the IPM in Schools program as a template to develop comprehensive programs that manage pests of structures, food, interior and exterior landscapes.
  - Develop an IPM certification program for pest control operators.
  - Lead the legislature and other policy-making bodies in the development of rules and regulations pertaining to IPM in urban areas.
  - Facilitate new and emerging urban IPM users in developing pest management strategies.
- e. Home Horticulture
  - Support a network of home gardeners dedicated to inventing and testing alternatives to pesticides in urban landscapes.
  - Increase adoption of biological control and bio-based pesticides in the urban landscape.
- f. Turf and Green Industry
  - Increase participation by Indiana golf course personnel and professional lawn care managers in IPM training activities by 50%.

Facilitate the implementation of at least one IPM strategy for insect control by each participant.

- Decrease the use of organophosphates on turfgrass by 50%.
- Increase landscape, nursery and Christmas tree industry adoption of biological control and bio-based pesticides by initiating a network of innovative companies interested in testing new tactics and new approaches to adopting IPM.
- Establish a working group of urban foresters to develop IPM tools from GIS-based forest inventories that facilitate monitoring invasive species.

## 6. Invasive Species

- a. Establish an invasive species working group and regional network to establish policies that protect environmental and economic resources from invasive pests.
- b. Develop an invasive species education network in accordance with needs defined by the working group.
- c. Target wood boring insects as the focal point of cooperative research and monitoring efforts.
- d. Coordinate monitoring surveillance and containment activities with Homeland Security efforts.
- e. Work with federal and state agencies to implement monitoring programs for exotic wood boring insects. Collaborate with federal and state agencies to educate and implement monitoring programs for target sites that have a high risk for the introduction of exotic wood boring insects into Indiana.

## 7. Wildlife and Vertebrate Pests (USDA APHIS WS)

- a. Provide Indiana residents with accurate information on legal control alternatives for vertebrate and wildlife pests through 1-800 service and companion website.
- b. Cooperate with other departments to develop comprehensive program in the next 3 to 5 years.

## 8. Outreach

- a. Develop a fundraising portfolio for organizations and individuals that highlights the benefits of Bug Bowl sponsorship.
- b. Collaborate with 4-H and Youth Development staff and Entomology Department faculty to create an Entomology Science Workshop for youth.
- c. Monitor resources allocated to the Tours and Talks program.

- d. Collaborate with K-12 teachers to develop insect related classroom activities that address Indiana Science Standards.

#### 9. Homeland Security

- a. Assess current homeland security programs and develop state recommendations focused on protecting ag and natural resources from bioterrorism.
- b. Provide local and state components of regional and national surveillance and response network.
- c. Investigate novel and innovative BMP for monitoring, early detection, and rapid response of biothreat agents.
- d. Assess current emergency response capabilities for threats of potential insect related bioterrorism and add homeland security components to existing extension programs including CAPS (Cooperative Agricultural Pest Survey).

#### *Engagement Subgoal*

#### 3.2 – Implementation and adoption of best management practices.

##### 1. Field and Forage Crop

- a. Facilitate a 30% shift from traditional insecticides used for soil insects in corn to insecticides applied at lower rates and new chemistries/technologies.
- b. Educate and encourage Indiana farmers to comply with EPA's insect resistance refuge requirements for transgenic crops from the current 87% to approach total adoption.
- c. Increase field scouting by agribusiness personnel by 10%.
- d. Increase number of grower submitted nematode samples by 5%.

##### 2. Vegetable and Fruit Crops

- a. Develop and publish handbooks for organic production of small fruits and tree fruits by 2005.
- b. Reduce the use of organophosphate insecticides on apples in Indiana by 25% by 2005.

##### 3. Livestock and Poultry Industry

- a. Establish one educational training programs/website resources for helping livestock and poultry producers implement and maintain IPM programs.

- b. Assess current and promising products and management practices to provide the most feasible efficient and safe control recommendations of livestock and poultry pests to reduce pesticide usage by 25% by 2005.

#### 4. Apiculture

- a. Increase web hits 25% by 2006.
- b. Evaluate success of stock releases by determining how many queens are being locally produced and sold in Indiana.

#### 5. Urban and Green Industry

##### a. Public Health:

- Accomplish at least one of the prioritized goals identified by the needs assessment.
- Impact and engage public through the development of a public health entomology website, at least one extension publication and participation in at least two public presentations and policy making.

##### b. Stored Products and Food Industry:

- Annual review of current IPM material and determine if novel/additional IPM material for the industry are needed.
- Conduct annual reviews and updates of the Quality Grain Management on-line certification course.
- Develop CD-Based PAT training material for distribution on a regional basis.

##### c. General and Structural Pests:

- IPM in school policy adopted by 90% of Indiana public schools by 2007.
- Certify 300 pest control practitioners as IPM ready.
- Develop and implement one new correspondence course addressing the IPM needs of urban pest managers.

##### d. Home Horticulture:

- Increase Master Gardener use of biological control and bio-based pesticides in home gardens by 25% via implementation participatory research programs.

##### e. Turf and Green Industry:

- Increase by 20% the number golf course and professional lawn care managers by participating in IPM workshops or training.
- Facilitate a 25% increase in use of biological control, bio-based pesticides and low impact pesticides.

- 25% of urban foresters implementing an IPM-based pest and invasive species monitoring system.

## 6. Invasive Species

- a. Establish a prioritized target list to guide implementation of invasive species programs.
- b. Implement invasive species education programs that reaches 25% of schools and extension programs.
- c. Make available two invasive species identification kits to all Extension Educators in the state to provide hands-on supplements to web-based education programs.

## 7. Wildlife and Vertebrate Pests (USDA APHIS WS)

- a. Identify the vertebrate pests of greatest concern to Indiana residents. Update list annually.
- b. Identify and rank counties according to amount of vertebrate pest damage, based on calls on the Wildlife Conflicts Hotline and update annually.
- c. Record and track number of hits on website annually to determine trends in information requested and given.
- d. Identify and update annually, the resources most frequently reported as damaged.
- e. Track type and number of disease related questions taken on Hotline on a yearly basis.

## 8. Outreach

- a. Increase Bug Bowl fundraising by 50% by 2005.
- b. Initiate new programs and training to increase youth involvement in the Entomology Science Workshop to 25 participants by 2005.
- c. Increase returns from Tours and Talks by 25% by 2005.
- d. Support K-12 teachers by developing three insect related classroom activities and curriculum that address Indiana Science Standards and will be available to 100% of Indiana teachers by 2005.

## 9. Homeland Security

- a. Develop a single state protocol for handling and communicating homeland security threat information and invasion.
- b. Identify all major partnerships for implementing homeland security programs in conjunction with E.D.E.N.

*Engagement Subgoal*

3.3 - Engagement with stakeholders, end-users, policy makers, and the general public greatly enhanced.

1. Engage the public and provide opportunities to learn about insects. Reach local, regional and national audiences through the coordination of events, media and school programs.
2. Conduct a minimum of six electronic surveys of commodity or other clientele groups to assess IPM adoption and needs by 2005.