Veterinary, Medical, and Urban Entomology (NP 104)

External Inputs on Priorities for NP 104 Action Plan

2, 4, 6, 8: Protecting two- and four-legged animals from the six- and eight-legged arthropods

External inputs on priorities:

Stakeholder webinars were held during the last two weeks of February, 2013 in order to assess the needs of customers and to get their opinions of what NP 104 should emphasize during the next program cycle. These webinars were organized according to the components of the previous Action Plan[1]: Medical Entomology for the Public, Medical Entomology for the Military, Veterinary Entomology, and Ants. Participants were asked five questions: 1) What is your business, 2) What are you trying to protect, 3) What are your target arthropods, 4) What diseases are you trying to prevent, and 5) What are your unmet needs in this area. The following is a brief account of the results of those webinars and other comments sent directly.

Medical Entomology for the Public

Businesses: Military, state government, universities, industry, industry association, public health.

Trying to protect: Humans in the United States and overseas, military personnel, people in cities and towns, people at work.

Target arthropods (order based on stakeholder frequency):

- mosquitoes
- ticks
- bed bugs
- flies and sand flies and chiggers

Diseases (order based on stakeholder frequency):

- West Nile virus disease
- dengue
- chikungunya virus disease and Chagas disease.

Unmet needs:

Zoonosis control in Texas
Research on effectiveness of vector control and repellents for disease prevention
Surveillance and monitoring tools, along with the statistics to make good use of data
Effects of climate change
Insecticide resistance management
New adulticides for mosquito control

[1] The component on termites was not included because that program was eliminated in FY 2012.

Easy pathogen detection in vectors
Regulatory support for development of new insecticides, repellents, attractants
National surveillance of vectors and bed bugs
Methods for easy vector identification

Medical Entomology for the Military[2]

Businesses: Office of the Secretary of Defense, Armed Forces Pest Management Board, U.S. Army Biodebridement Program, Military Infectious Diseases Program, Walter Reed Army Institute of Research, U.S. Air Force Academy, U.S. Army Medical Materiel Development Activity, Naval Medical Research Center, Navy Entomology Center of Excellence, Deployed Warfighter Protection Program, industry, universities.

Trying to protect: Deployed military personnel; Department of Defense personnel in general; military dependents; military working animals; victims of disasters; and those in need of humanitarian assistance.

Target arthropods (order based on stakeholder frequency):
- mosquitoes
- ticks
- flies
- sand flies
- bed bugs and chiggers

Diseases (order based on stakeholder frequency):
- malaria
- dengue
- rickettsioses and chikungunya virus disease
- arboviral encephalitides and leishmaniasis

Unmet needs:

New adulticides for mosquito control
Alternatives to pyrethroids for bed net treatment
Alternatives to permethrin for uniform treatment
Better surveillance tools and improvements in how to interpret data
New surveillance tools for *Anopheles* and *Aedes aegypti*
Sustainability of control programs
Effects of infection on vector behavior and responses to insecticides and repellents
Spatial repellents
Remotely sensed risk assessment and better risk assessment
Molecular pesticides (dsRNA)
Faster, lighter, cheaper, and autonomous systems (i.e., perform without individual effort by personnel)

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[2] See also Appendix 1: Recommendations from the Armed Forces Pest Management Board

Logical multiplexing of pathogen and vector detection according to region
Transition of science and invention to products

Veterinary Entomology[3]

Businesses: Military, universities, USDA APHIS Plant Health, Plant Protection and Quarantine, livestock industry, agriculture, pest management industry, parks and conservation associations, nursery and landscape industry, electric and communications industries, state pesticide regulation.

Trying to protect: Wildlife, endangered wildlife, native plants, livestock, agriculture, chickens, people, electrical equipment, shipment of goods.

Target arthropods (order based on stakeholder frequency):

- ticks
- mosquitoes
- flies and biting midges and horn flies
- stable flies
- lice

Diseases (order based on stakeholder frequency):

- West Nile virus disease
- epizootic hemorrhagic disease and blue tongue
- equine encephalitides and bovine babesiosis
- Lyme disease and anaplasmosis

Unmet needs:

Determination of relationship of cattle fever ticks to wildlife other than white-tailed deer
Effect of flies on food safety and cow-calf operations
Resistance management for flies
Sustainable control systems for vectors
Active surveillance for bluetongue virus, key vectors, emerging pathogens, and zoonotic pathogens
Studies of arthropod species distribution
Additional study of environmental safety of insecticides and acaricides
Development of more active ingredients to expand tool box
Influence of microbial communities on arthropods

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[3] See also Appendix 2: Recommendation from APHIS Technical Director for Screwworm Production

Ants

Businesses: Military, universities, USDA APHIS Plant Health, Plant Protection and Quarantine, beef industry, pest control, industry, conservation association, state pesticide regulation.

Trying to protect: Wildlife, endangered wildlife, native plants, cattle, horses, chickens, people, equipment for shipment.

Target arthropods (order based on stakeholder frequency):

- imported fire ants
- Argentine ant
- crazy ants
- little fire ant and carpenter ants
- Asian needle ant
- white footed ant and odorous house ant
- dark rover ant and Pharaoh ant and big head ant

Diseases: Not relevant to this topic.

Unmet needs:

- Surveillance and detection
  - Current infestations to determine need for treatment
  - Highly sensitive surveillance to detect hidden infestations
  - Pheromone based lures and traps to use them
  - Detection of new introductions of invasive species
  - Methods to evaluate success of control
- Control
  - Methods for control of ants under more different circumstances
  - Methods for control of ants for regulatory purposes
  - Methods for eradication of invasive species
  - Control of crazy ants and Argentine ants in agricultural and non-agricultural settings
  - Update treatment manual and assist with updating USDA APHIS quarantine program
  - Replace fipronil and pyrethroids for Argentine ants and avoid runoff contamination
  - Find new active ingredients, including RNAi, pyrazine pheromone attractants
  - Develop baits for crazy ants
  - Improve formulation of baits and biopesticides
  - Develop baits for use in tall trees (e.g., coconuts)
  - Methods for specialized areas like electrical boxes, irrigation equipment
  - Develop insect growth regulators for ant control
  - Develop “green” methods of ant control

- Biological control
    - Phorid flies: Continue importation of more species
    - Development of microsporidians and viruses for self-sustaining biological control
    - Biology of *Solenopsis daguerri*
- Identification
    - Identification methods for alate ants that might be introduced
    - Molecular identification techniques that are useful at the field level, especially for *Solenopsis*
    - Identification of worker crazy ants
    - Identification methods for pest control operators
- Economics
    - Calculate return on investment of fire ant control in agricultural settings
    - Evaluate damage from Argentine ants and crazy ants
- Basic
    - Biology of Asian needle ant and crazy ants
    - Reasons for expansion of crazy ants
    - Food preferences of ants
    - Characterize Gp-9 supergene complex that underlies many reproductive features
    - Phylogenomics and population genetics of IFA
- Examine potential range expansions and new susceptibilities to invasives as a result of climate change

External Expert Panel

An external expert panel met at the end of January, 2013 to evaluate progress of NP 104 during the previous five years (2007-2011). Their report was generally favorable and they had the following suggestions for the program:

1) Follow up on Lyme disease work that had been performed at Yale University (terminated FY2011)
2) Create stronger integration between components of the Action Plan
3) Provide more resources to the bed bug research program
4) Stimulate more collaboration between laboratories
5) Work more on bed nets for the military
6) Work more on large scale, as well as small scale, spatial repellents
7) Work on other invasive *Stomoxys*
8) Develop economic threshold data
9) Emphasize fundamental research more than in previous cycle
10) Work on larval control of biting midges
11) Publish the Formosan subterranean termite genetic sequence that was completed before the program terminated in FY2012
12) Evaluate effectiveness of phorid flies as biocontrol agents of fire ants
13) Perform systematic surveillance for new invasive ants in the United States

DoD Research Priorities for USDA ARS National Program 104 (Medical, Veterinary and Urban Entomology) March 22, 2013

One of the goals of the Department of Defense (DoD) is to reduce the risk of vector-borne diseases and manage other pests that impact its personnel, working animals, structures, and materiel. USDA ARS National Program 104 is particularly looked upon by the DoD to help develop and field new or improved technologies, materials, and techniques focused on reducing vector-borne disease risk for those DoD personnel that are deployed overseas. Table 1 at the end of this document provides a prioritized list of the infectious diseases, including vector-borne, of importance to the U.S. military.

The DoD most desires solutions that are "leap forward" technologies resulting in dramatic improvements as opposed to incremental changes that offer only slight improvements over items that are currently used in the field. In addition, deployed personnel face significant resource constraints and logistical challenges. Therefore, such improvements need to take into account the following features:

- User acceptability (desirable personal repellents, user-friendly equipment, etc.)
- Portability (the smaller the size and weight, the better)
- Cost effectiveness (includes initial procurement and operational costs)
- Sustainability (power requirements, fuel source, replacement parts, etc.)
- Labor requirements (autonomous systems are most desired)
- System compatibility (e.g., can integrate with currently fielded systems)
- Efficacy (significant performance improvement over available materials)

To assist NP 104 in developing its Action Plan, the Armed Forces Pest Management Board (AFPMB) submits the following list of technologies, materials, and techniques needed by the DoD:

TOP PRIORITY AREAS:

- Develop and evaluate new (including molecular insecticides) and existing insecticide active ingredients, synergists and formulations of residual, barrier, space spray materials for control of mosquitoes, sand flies, filth flies, ticks, mites and other arthropods of military significance.

- Develop and evaluate replacements for, or supplements to, permethrin as a military uniform/textile insecticidal treatment. This includes efficacy assessment/quality assurance testing of factory and field treated uniforms and improvement of those evaluation techniques.

- Develop and evaluate new and/or improved active ingredients and formulations for spatial repellents which provide: (1) Individual protection (e.g., an individual's exposed skin); and (2) Area protection (e.g., tents, rooms, guard posts, etc.) from biting arthropods. (Topical repellents are addressed elsewhere.)

- Develop and evaluate mosquito, sand fly, filth fly, and other vector attractants for surveillance, lure and kill, and push-pull methodologies.

- Develop and evaluate devices, techniques, insecticides, or spatial repellents which prevent vectors and other arthropods from entering the country via aircraft and vessels to include their elimination while passengers are still onboard and travelling from one country to another (i.e., aircraft/ship disinsection).

- Develop and evaluate mosquito, sand fly, and other vector surveillance systems and devices.

- Develop and evaluate integrated vector control techniques to include pesticide delivery technologies which are more effective, cheaper, autonomous, targeted, etc.

OTHER PRIORITY AREAS:

- Develop and evaluate active ingredients and formulations of topical repellents that are at least 2X more efficacious than DEET.

- Develop and evaluate vector-borne disease risk assessment technologies (e.g., remote surveillance systems, GIS, etc.) to protect service members overseas.

- Assess DEET and other EPA approved repellents against vectors infected with pathogens.

- Develop and evaluate surveillance/early detection and control methods for invasive species (e.g., ants, mosquitoes, human pathogens, etc.).

Table 1. Infectious Disease Threats to the U.S. Military Prioritization Panel Results (Memorandum dated 23 April 2010)	
Disease	**Threat Ranking**
Malaria	1
Dengue	2
Diarrhea, bacterial	3
Multi Drug Resistant wound pathogens	4
Leishmaniasis	5
Q fever (Coxiella burnetti)	6
Norovirus and other viral diarrhea	7
Influenza	8
Adenovirus	9
Leptospirosis	10
Diarrhea, protozoal	11
TB	12
CCHF	13
HIV	14
HFRS	15
Chikungunya	16
Meningococcal meningitis	17
Plague	18
Rickettsioses	19
Viral encephalitides	20
HEP E	21
Lassa fever and other arenaviuses	22
TBE	23
RVF	24
HEP C	25
Brucellosis	26
Other arboviral illnesses	27
Typhoid fever	28
Cholera	29
Schistosomiasis	30
Tularemia	31
Trypanosomiasis	32
Ebola/Marburg hemorrhagic fever	33
Chagas' disease	34
Yellow fever	35
Lyme disease	36
Bartonellosis (Oroya fever)	37
Soil-transmitted helminths	38
Gonorrhea	NA
Sand fly fever	see # 27
Onyong-onyong fever	see # 27
Sindbis	see # 27
Scrub typhus	see # 19

ARS Screwworm Research Support

- Development of transgenic male-only strain in cooperation with scientists of North Carolina State University (NCSU). Scientists involved: Steve Skoda (USDA-ARS; Kerrville, Texas), Agustin Sagel (USDA-ARS; Pacora Panama) Max Scott (NCSU; Raleigh, North Carolina) and Carolina Concha (NCSU [post-doc]; Pacora, Panama). **IMPACT:** The development of a male-only strain could possibly reduce the cost of production and increase the efficiency of sterile males in the field by eliminating sterile females.

- Development of screwworm attractants and oviposition stimulants. Scientists involved: Muhammad Chaudhury (USDA-ARS; Lincoln, Nebraska) in collaboration with Jerry Zhu (USDA-ARS; Lincoln, Nebraska). **IMPACT:** An attractant for gravid females would be extremely useful for field surveys and the possible development of lethal traps. New oviposition stimulants could increase efficiency in the sterile fly mass production facility and the collection and development of new strains.

- Investigation of screwworm nutrition and diets. Scientist involved: Hong Chen (USDA-ARS [post-doc]; Lincoln, Nebraska). **IMPACT:** Development of a nutritionally better and less expensive diet would be very beneficial to the eradication program.

- Investigation of screwworm habitats and ecology. Scientist involved: Pamela Phillips (USDA-ARS; Pacora, Panama). **IMPACT:** A better understanding of favorable screwworm habitats would lead to more efficient field operations in the barrier zone, outbreaks, and in eradication operations.

- Characterization of screwworm DNA for identifying outbreak populations. Scientist involved: Steve Skoda (USDA-ARS; Kerrville, Texas). **IMPACT:** Characterization of the DNA of outbreak populations would be beneficial in the epidemiological understanding of the sources and means of introduction of screwworm into uninfested areas. Measures to prevent reintroduction could potentially be established

- Investigation of the utility of a Geographic Information System inside the sterile fly production plant. Scientist involved: Pamela Phillips (USDA-ARS; Pacora, Panama). **IMPACT:** The sterile fly production facility in Pacora was designed to produce approximately 100 million sterile pupae per week. Current needs of sterile fly production for maintenance are approximately 18 million per week. A better understanding of the micro environments within the production facility could possibly lead to more efficient rearing protocols and a reduction in costs of production.

Research support personnel at Pacora, Panama, include three locally hired technicians and four laboratory assistants.

Additional research support personnel in Pacora are needed to facilitate the work of Pamela Phillips, Muhammad Chaudhury, and Hong Chen.