Component I: Systematics and Identification

1a. Insect and Mite Identification, Taxonomy, and Systematics

(U.S. Value 1906-1991: $93 billion)

Problem Statement: Insect and mite systematists confront on a daily basis the challenge of identifying new, potentially invasive species that affect biological diversity and the agricultural landscape, as well as developing effective systems of names, descriptive and identification tools, and predictive genetic relationships for these organisms with the following targeted research programs:

- Diagnostic Detection Technology
- Genetic Relationships and Identities of Insects and Mites

***Research Needs*:**

1. **Diagnostic Detection Technology**

   Importance: Insects and mites enter the United States every day with the potential to become invasive pests or, perhaps, as beneficial arthropods in the control of noxious weeds and other insects, or as pollinators. Accurate identification of insects and mites is required before action can be determined. Efficacious exclusion of invasive plant pests, successful detection and management of those already established in the United States, and the selection of appropriate biological control agents all require the accurate identification of these insects and mites.

   Research Gaps: For most insect and mite groups [particularly for weevils, gypsy moths, scale insects, gall midges, plant-feeding true bugs, bark beetles, metallic wood-boring beetles, scarab beetles, plant-feeding flies (non-agromyzids), click beetles, and gelechioid moths] and animal feeding mites, our customers and stakeholders do not have expertise to do in-house identification. ARS fills this gap.

   Actions: ARS will:

   - Identify insects and mites (over a million species comprising 85 percent of all known organisms) for: regulatory officials in the U. S. Department of Agriculture/Animal and Plant Health Inspection Service/ Plant Protection and Quarantine (USDA/APHIS/ PPQ), the U.S. Department of Homeland Security, and state departments of agriculture; researchers in USDA/Agricultural Research Service (USDA/ARS) and universities implementing biological control programs; pest managers, conservation biologists, pest control services, homeowners, physicians, medical laboratories, and entomologists in the United States and foreign countries.

- Maintain a database of insects and mites entering U.S. ports.

2. Genetic Relationships and Identities of Insects and Mites

Importance: Insects and mites are the most diverse groups of organisms on the planet; however, the number of unknown species may be greater than the number known. Lineages need to be determined to show the genetic relationships among known species with human impact. This will provide predictive power and help anticipate future and/or potential pest status of related species. Because new species that may have human impact will more likely be closely related genetically to species that already have human impact, the more we know about the current species, the better scientists can predict potential problem species. Newly developed molecular methods will be particularly useful in this work.

Research Gaps: For several insect groups [weevils, gypsy moths, scale insects, gall midges, plant-feeding true bugs, bark beetles, metallic wood-boring beetles, scarab beetles, plant-feeding flies (non-agromyzids), click beetles, and gelechioid moths, some groups of native bees] and animal feeding mites, there are currently no scientists working on the genetic relationships among these species. Much work remains for other taxa, particularly for ones that contain newly introduced invasive species.

Actions: ARS will:

- Create original scientific treatments describing the genetic relationships among species in the following groups:
  - aphids;
  - mites;
  - termites;
  - thrips;
  - fruit flies;
  - pest leaf-mining flies;
  - tachinid fly parasitoids of moth pests;
  - flower flies predacious on pest aphids,
  - whiteflies and other plant lice;
  - soldier flies and flower flies useful as nutrient recyclers;
  - fergusoniid flies that are weed biological control agents;
  - longhorned beetles that attack living trees, woody plants and timber, particularly those that are potentially invasive and commonly transported through commerce;

- flea beetles, including known crop pests as well as prospective biological control agents of noxious introduced weeds;
- predatory ladybeetles that feed on plant lice and mites;
- wasps for biological control that are parasitic on pests or are plant feeding pests in their own right;
- native pollinator bees;
- plant-feeding caterpillars such as leafrolling moths, armyworms, and snout moths;
- predatory plant bugs; and
- leafhoppers.

***Anticipated Products*:**

- Enhancement and greater efficacy of the Systematic Entomology Laboratory Identification System (SELIS).
- Print and electronic databases of identified insects and mites.
- Increased specimen representation of insect and mite species in the U.S. National Insect Collection (Smithsonian Institution).
- New identification tools, accurate systems of names, and predictive genetic relationships of insect and mites.
- Print and electronic databases of host plants, geographic distributions, and vectors of plant diseases.
- Species inventories for use in conservation and management of native landscapes and natural habitats.
- Online interactive identification systems such as web pages and/or expert systems.
- Catalogs of important groups of insects and mites.

Potential Benefits (Outcomes):

- More accurate and timely identifications of key insect and mite species for SEL customers.
- Reduced risk of invasion from non-native insect and mite species.
- More accurate target in management and conservation using insect and mite species for biological control.

***USDA ARS Resources*:**

- Systematic Entomology Laboratory, Beltsville, Maryland

- Systematic Entomology Laboratory Identification System (SELIS), Beltsville, Maryland