Component III: Protection of Natural Ecosystems

3b. Weeds in Terrestrial Ecosystems (U.S. Value: Over $1 billion)

***Problem Statement*:** Prevention of non-indigenous terrestrial invasive plant species in natural systems and reduction of economic and environmental harm caused by these weeds is limited by a lack of effective, affordable, and environmentally sound management strategies for:

- Prevention and Early Control of New Invasive Weeds
- Control of Widespread Invasive Weeds in Terrestrial Natural Systems

***Research Needs*:**

1. **Prevention and Early Control of New Invasive Weeds**

   Importance: Non-indigenous invasive plant species (NIPS) threaten the function and integrity of terrestrial ecosystems throughout North America. The number of these species is increasing in the United States as is their abundance and distribution. Natural systems are often adjacent to managed systems such as rangelands and weeds therefore invade from natural ecosystems. Impacts of plant invasions in natural areas have become painfully clear and include: damaging shifts in fire and nutrient cycles; increasing erosion and declines in water quality; increasing negative effects on human and livestock health; reducing diversity and resilience of native plant communities; and altering trophic webs.

   The number of new NIPS has been growing due to increased trade and intentional or inadvertent movement of plants by people. Some of these species become invasive and add to already large economic and environmental impacts. Often the environmental impacts of these new species are unknown and are not recognized until they have spread too far to be easily controlled.

   Research Gaps: Prevention is the most cost-effective control strategy. Study of invasion pathways can be used to identify the most important sources of new plant species and aid in design of prevention strategies. Some NIPS are more invasive than others. As weed management budgets are small, it is important to determine which of these species could cause the greatest impacts. Methods must be developed to control new NIPS before they become widespread. Study of the biology of new invaders helps to predict ranges of invasions and aid in design of control strategies. Economic impacts of new NIPS need to be determined.

   Actions: ARS will:

   - Determine pathways that potential NIPS utilize to colonize new areas.
   - Determine evolutionary potential of NIPS to expand ranges
   - Determine impacts of NIPS.

- Develop integrated chemical and non-chemical control measures for NIPS. Study the biology of NIPS.
- Determine invasive potential of plant species proposed for use in biofuel production.

2. Control of Widespread Invasive Weeds in Terrestrial Natural Systems

Importance: Numerous NIPS have already established and are causing significant economic and environmental harm to natural systems. Populations are too large to allow for economic control using cultural or chemical methods. It may not be feasible to use these methods due to labeling problems, harm to non-target species, public concern, or labor.

Research Gaps: Economic impacts of NIPS in natural systems include environmental and aesthetic impacts which are difficult to measure and to assign economic value. Biological control agents are needed to manage widespread NIPS in natural systems where they have adapted and become widespread. Biological controls must be shown to be effective and must not harm non-target species. Research needs include: study of invasive weed biology to determine the most effective life stage and plant structure for biological control, identification of potential control agents, control agent biology and rearing studies, and screening for efficacy and effects on non-target species.

Actions: ARS will:

- Discover and collect potential biological control agents for non-indigenous invasive plant species from foreign and domestic ecosystems.
- Conduct invasive weed demography studies to determine most effective life history stages and plant parts for biological control.
- Conduct studies on agent biology to determine best rearing/production methods.
- Determine effectiveness of control agents and screen for non-target effects.
- Release and measure impacts of control agents on target and non-target plant species.
- Work to develop biological controls including agents for control of:
    - Australian Pine (*Casuarina* spp.)
    - Bermudagrass [*Cynodon dactylon* (L.) Pers.]
    - Brazilian Peppertree (*Schinus terebinthifolius* Raddi)
    - Canada Thistle [*Cirsium arvense* (L.) Scop.]
    - Cheatgrass (*Bromus tectorum* L.)
    - Dodder (*Cuscuta* spp.)
    - Garlic Mustard [*Allaria petiolata* (M. Bieb) Cavara and Grande]
    - Giant Reed (*Arundo* donax L.)
    - Hawkweeds (*Hieracium* spp.)
    - Knapweeds (*Centaurea* spp.)

- Kudzu [*Pueraria montana* (Lour.) Morr.]
- Leafy Spurge (*Euphorbia esula* L.)
- Medusahead [*Taeniathernum caput-medusae* (L.) Nevski]
- Melaleuca [*Melaleuca quinquenervia* (Cav.) S. F. Blake]
- Old World climing fern
- Russian Thistle (*Salsola kali* L.)
- Salt Cedar (*Tamarix ramossima* Ledeb.)
- Skunk Vine (*Paederia foetida* L.)
- Small-leaf Climbing Fern [*Lygodium microphyllum* (Cav.) R. Br.]
- Swallow-worts (*Vincetoxicum* spp.)
- Whitetop (*Lepidium draba* L.)
- Yellow Starthistle (*Centaurea solstitialis* L.)

***Anticipated Products*:**

- Increased knowledge of pathways for NIPS colonization leading to strategies for prevention of new introductions.
- Increased knowledge of the effects of NIPS on other species and ecosystems, enabling prioritization of control efforts.
- Increased knowledge of NIPS biology and ecology, to predict potential distributions and to target early detection and control measures.
- Cultural and chemical methods to eradicate infestations of new NIPS.
- Increased knowledge of NIPS demography to better target control measures on the most susceptible life stages and plant parts.
- New biological control agents.
- Increased knowledge of genomics, basic biology and ecology of biological control agents.

Potential Benefits (Outcomes):

- Strategies for improved IPM of NIPS in natural systems.
- Reductions in economic and environmental harm to natural systems by NIPS.
- IPM tactics that are ecologically sound.
- Restoration of degraded habitats and improvement of wildfire management on western uplands.

USDA ARS Resources:

- Beneficial Insects Research Unit, Weslaco, Texas
- Biological Integrated Pest Management Unit, Ithaca, New York
- Center for Medical, Agricultural, and Veterinary Entomology, Tallahassee, Florida
- Crop Protection and Management Research Unit, Tifton, Georgia

- European Biological Control Laboratory, Montpellier, France
- Exotic and Invasive Weeds Research Unit, Albany, California and Reno, Nevada
- Foreign Disease-Weed Science Research, Fort Detrick, Maryland
- Insect Genetics and Biochemistry Research Unit, Fargo, North Dakota
- Invasive Plant Research Laboratory, Fort Lauderdale, Florida
- Invasive Weed Management Unit, Urbana, Illinois
- Beneficial Insects Research Unit, Weslaco, Texas
- Pest Management Research Unit, Sidney, Montana
- Plant Science Research Laboratory, Fargo, North Dakota
- Range and Meadow Forage Management Research Unit, Burns, Oregon
- Southern Weed Science Research Unit, Stoneville, Mississippi
- Subarctic Agricultural Research Unit, Fairbanks, Alaska