Invasive Plants and the 2007 Farm Bill

Workshop Results

March 20-21, 2007
Bozeman, MT

Definitions

For the purposes of this workshop, participants applied the federal definition of "invasive species" used in Presidential Executive Order 13112 (Feb. 1999) to the concept of an "invasive plant." An "invasive species" is defined by the Executive Order as a species: 1) that is non-native to the ecosystem under consideration, and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

Context Sensitivity and Generalizations

Workshop recommendations are tempered by the notion that nothing in invasive plant management is absolute in all situations. Local ecological and land-use situations vary tremendously, challenging our ability to make generalized statements that apply appropriately across the nation. That said, workshop participants did their best to identify broadly applicable statements and scientific consensus where possible.

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Introduction

Non-federal agricultural and forested lands represent approximately 1.4 billion acres in the contiguous United States (NRCS 2004). The conservation programs of the Farm Security and Rural Investment Act of 2002 (Farm Bill) committed extensive resources to conservation on these private lands (NRCS 2002). Since its inception, the Farm Bill has continued to evolve from a program focused on protecting eroding cropland and reducing overproduction of major crops to emphasizing conservation and environmental improvements. Key conservation and environmental benefits of these volunteer programs now include conservation of soil, wetlands, wildlife habitat, water quantity, and water and air quality. However, new issues that impact the ecosystem services of farmlands and ranchlands enrolled in these programs continue to emerge. One of the most pressing issues in the 21st century is the impact of invasive plants.

In 2005-2006, Farm Bill Forums were held to solicit public input on the formulation of the 2007 Farm Bill. Invasive plant management was identified as a key issue for future programs (USDA 2006). Invasive plants may affect conservation programs in numerous ways. It is critical that science-based recommendations addressing invasive plants be compiled, given the potential impacts of invasive plants on the ecosystem services that Farm Bill conservation programs are intended to provide.

Workshop

The Center for Invasive Plant Management (CIPM) organized and sponsored a workshop of invited scientists to provide the scientific underpinnings to inform policy for the 2007 Farm Bill Conservation Title concerning the management of invasive plants. The workshop was held March 20-21, 2007, at Montana State University-Bozeman. Participants considered impacts on wildlife, water quality, water quantity, production (agriculture, grazing, and forestry), and wetlands. They assessed the state of the science relevant to conservation programs, considered implications for future management, and developed science-based recommendations.

Workshop Participants

A limited number of highly respected scientists were invited by CIPM to participate in the workshop. They were expert in a range of scientific disciplines relevant to Farm Bill conservation programs in diverse geographies. Workshop conclusions were drawn from their discussions. Participants (and their expertise) were:

- **Dr. Sara Baer**, Southern Illinois University (grasslands, soils, ecology)
- **Dr. Terrance Bidwell**, Oklahoma State University (wildlife, forests, grasslands, extension)
- **Dr. David Engle**, Iowa State University (rangeland ecology, grazing and fire, grasslands, grassland birds)
- **Dr. Johannes Knops**, University of Nebraska (plant and ecosystem ecology)
- **Dr. Kenneth Langeland**, University of Florida (aquatic and upland vegetation management, management technologies, plant pest ecology)
- **Dr. Bruce Maxwell**, Montana State University (crop-weed competition, plant population and ecosystem dynamics)
- **Dr. Fabian Menalled**, Montana State University (plant community dynamics, cropping systems, herbicide resistance)
- **Dr. Steve Whisenant**, Texas A&M University (ecological restoration)

Acknowledgments

CIPM requested scientific data and background information from several sources:

- **Dr. Joel Brown**, USDA NRCS Soil Scientist, Jornada Experimental Range, New Mexico
- **Dr. Amy Symstad**, US Geological Survey, Rapid City, SD
- **Carrie Mosely**, USDA NRCS Assistant State Conservationist, Montana
- **Dr. Jim Jacobs,** USDA NRCS Invasive Species Specialist, Montana

Will Murray, a professional facilitator based in Boulder, CO, guided the group through the workshop and provided the workshop proceedings report upon which this report is based.

The workshop was organized and hosted by **Mara Johnson**, CIPM Technology Transfer Coordinator, and **Janet Clark**, CIPM Director.

Recommendations for the 2007 Farm Bill

Elevate invasive plant management as a critical conservation concern in the 2007 Farm Security and Rural Investment Act (Farm Bill). Invasive plants can change soil properties and reduce soil stability and productivity, alter natural hydrologic regimes, degrade wildlife and migratory bird habitat, degrade wetlands, and alter fire regimes.

Prioritize funding for USDA conservationists and technical advisors working with invasive plants and require comprehensive training of technical service providers who may be consulted regarding invasive plants, site- and ecosystem-appropriate vegetation, and management strategies.

Prioritize prevention and early detection of invasive plants. Invasive plant prevention is more cost-effective, efficient, and successful than management of invaded habitats.

Make maintenance and restoration of biodiversity an explicit program objective. Diverse plant communities are more stable, more consistently productive, and, in concept, may sequester more carbon due to diverse lifeforms.

Prohibit using invasive plants for biofuel production on Conservation Reserve Program (CRP) lands and elsewhere to avoid spreading invasive plants. Furthermore, Plants considered for biofuels production should be screened for invasive traits.

Allow haying, mowing, burning, and grazing to manage invasive plants. All actions should be NRCS-approved and strategically timed to manage wildlife habitat, allow reproduction of native birds and other wildlife, remove decadent vegetation, and provide other ecological benefits.

Expand program eligibility to include non-producers. Invasive plants on non-agricultural lands can threaten the productivity of agricultural lands and the integrity of wildlife habitat.

Provide increased incentives for long-term, multi-stakeholder efforts to prevent or manage invasive plants at multiple spatial scales. Cooperative weed management engages more people and is more sustainable than single-landowner and single-stakeholder efforts.

Invasive plants should be explicitly excluded from definitions of "appropriate vegetative cover." Define "appropriate vegetative cover" as species deemed appropriate by NRCS Ecological Site Descriptions.

Require monitoring of land-condition indicators and management effects to provide a basis for management adaptations and program accountability. Long-term data are essential to evaluate program effectiveness and determine future strategies.

Workshop Conclusions* with Scientific Rationale

Conclusion 1. Ensure that invasive plant management becomes a central part of the Farm Security and Rural Investment Act (Farm Bill) conservation title to conserve ecosystem processes such as productivity, carbon sequestration, and nutrient cycling in terrestrial and aquatic habitats, and ecosystem drivers such as fire and herbivory.

The conservation title of the Farm Bill focuses attention and resources on conserving soil, wetlands, wildlife habitat, and water quantity and quality. Invasive plants alter these systems in ways and at levels that vary from site to site. Therefore, workshop participants concluded, well-informed, local technical advisors and comprehensive monitoring are critical to meeting Farm Bill conservation goals.

Invasive plants can change soil properties and reduce soil stability and soil productivity.

- Discussion of biogeochemical properties (Vitousek and Farrington 1997).
- Spotted knapweed (*Centaurea maculosa*) increases soil erosion (Lacey and others 1989).
- Garlic mustard (*Alliaria petiolata*) and spotted knapweed were shown to have mycorrhizal and allelopathic impacts (Hierro and Callaway 2003).
- In concept, species-poor set-aside lands will likely sequester less carbon than those seeded with multiple species. However, this is difficult to demonstrate in the short-term because soil-carbon concentrations change slowly after revegetation to perennial cover (Anderson and Coleman 1985; Baer and others 2002; Knops and Tilman 2000; Potter and others 1999).
- Soil carbon in grassland soils regenerates slowly after cultivation ceases (Baer and others 2002; Knops and Tilman 2000; McLauchlan 2006; Potter and others 1999; Schlesinger and others 1999).
- Carbon allocation shifts from belowground to aboveground when Midwest grasslands are invaded by woody plants such as eastern redcedar (*Juniperus virginiana*) and Autumn olive (*Elaeagnus umbellata*) (Baer and others 2006; Norris and others 2001).
- Invasive plants affect soil mineralization and make the grasslands more sensitive to aboveground processes—fire, drought, grazing, etc.
- Invasive plants can alter soil properties and processes (Baer and others 2006; Blank and Young 2002; Ehrenfeld 2003; Kourtev and others 1998)
- Invasive plants can impact nitrogen availability in arid grasslands (Evans and others 2001).
- There is evidence that certain soil biota and processes are similar in native and invaded tall grass prairies (Porazinska and others 2003).

* Workshop conclusions were drawn from discussion of a number of "strawman" statements that were provided by CIPM to provoke debate. Discussion statements can be found in Appendix A.

- Significant differences in soil properties between invaded and uninvaded hardwood forests of New England have been recorded but cause-and-effect have not been established (Ehrenfeld 2004; Ehrenfeld and others 2001; Ehrenfeld and others 2005; Ehrenfeld and Scott 2001; Kourtev and others 1998).

Invasive plants can alter natural hydrologic regimes.

- Melaleuca (*Melaleuca*) leaf litter and roots change elevation profiles (Serbesoff-King 2003), which has a strong influence on hydrology in low-gradient systems.
- Invasive plants alter ecosystem processes (Gordon 1998).
- Chinese tallow (*Triadica* spp.) has affected hydrologic regimes in the South.
- Giant reed (*Arundo donax*) transpirational processes can alter hydrology.
- Comparisons between saltcedar (*Tamarix* spp.) and replacement vegetation indicate that water salvage from saltcedar removal varies depending primarily on the leaf area index of the replacement vegetation compared to that of the saltcedar (Shafroth and others 2005).
- Consider canopy interception and stem flow, e.g., junipers (*Juniperus* spp.) in grasslands.
- See the review paper by Mack and others (2000).
- See Levine and others (2003) for impacts on hydrology.
- In some cases, tamarisk removal has resulted in increased water levels in streams, lakes, and reservoirs.
- Water hyacinth (*Eichhornia crassipes*) (Gowanloch 1944) and hydrilla (*Hydrilla*) clog flood structures (Langeland 1996).
- Increased surface overflow and less infiltration has been documented on spotted knapweed (*Centaurea maculosa*) fields (Lacey and others 1989).
- Juniper-invaded grasslands exhibit increased runoff, erosion, and hydrologic complexity (Ludwig and others 2005; Miller and others 2005; Schlesinger and others 1999).
- Altered hydrologic regimes can promote invasive plant movement and spread (Perkins and Wilson 2005). For example, reed canarygrass (*Phalaris arundinacea*) and giant reed have washed downstream and piled up in front of dams after floods, causing damage.
- Draining wetlands to allow cultivation in the Pothole region of the Midwest accentuates peak flood events and spreads propagules of some invasive plants such as reed canarygrass (Apfelbaum and Sams 1987; Barnes 1999; Volker and Smith 1965).
- Plants associated with nitrogen-fixing microorganisms may increase surface and/or groundwater nitrogen (Hurd and Raynal 2004).

Invasive plants can degrade wildlife habitat.

- "Native wildlife habitat" should imply plants indigenous to the ecological zone and appropriate for wildlife indigenous to that zone.

- Invasive plants seeded in Conservation Reserve Program (CRP) lands managed for game species (e.g., pheasants, whitetail deer) are misguided attempts to create "wildlife habitat."
- Water hyacinth (*Eichhornia crassipes*) and hydrilla (*Hydrilla*) alter fisheries (Toft and others 2003).
- Invasive plants (e.g., spotted knapweed [*Centaurea maculosa*]) reduce elk habitat (Rice and others 1997; Thompson 1996).
- Winter range for ungulates may be reduced by cheatgrass (*Bromus tectorum*) invasion and subsequent greater fire frequency (Jost and others 1999; Trammell and Butler 1995).
- Melaleuca (*Melaleuca*) displaces native plant communities and wildlife habitat (see Laroche 1999, and citations therein).
- Spartina (*Spartina* spp.) (Levin and others 2006) and small-leaf (or Old world) climbing fern (*Lygodium microphyllum*) (Brandt and Black. 2001) impact migratory bird habitat.
- Cheatgrass (*Bromus tectorum*) in the West and tall fescue (*Schedonorus phoenix*) in the East make forage less palatable for wildlife (Washburn and others 2000).
- Tall fescue reduces bobwhite reproduction (Barnes and others 1995).
- Tamarisk (*Tamarix* spp.) has impacted fish populations (Kennedy and others 2005).

Invasive plants can degrade migratory bird habitat.

- Birds are great biological indicators to assess success of Farm Bill programs because there are long-term data sets, etc. (Coppedge and others 2006).
- Non-native Chinese tallow (*Triadica* spp.) and Brazilian peppertree (*Schinus terebinthifolius*) are used by migratory birds – but how do these species impact native migratory bird food plants?
- Grassland bird populations are declining because of habitat fragmentation and change of habitat structure, some of which is the result of invasive plants (Chapman and others 2004; Coppedge and others 2001).
- See review paper about woody plants and grassland birds (Bakker and Higgins 2003) .
- Invasive plant removal may provide few benefits to birds if subsequent management (or lack of management) results in incompatible habitat structures.
- There is evidence that birds have benefited from the Conservation Reserve Program (CRP) (Gill and others 2006), but invasive plant seedings in CRP are considered undesirable for birds because of the tendency to crowd out other plant species (Rodgers 2005).
- CRP plots affect surrounding land and vice-versa; wildlife needs the variety of habitats appropriate to the local situation.
- While hydrilla (*Hydrilla*) in the right concentrations provides some benefits for bass and diving ducks, other species are harmed.
- Arthropod diversity is correlated with plant diversity (Jonas and others 2002).

- Plant diversity (forbs) on CRP positively affects bird populations (Hickman and others 2006).
- Purple loosestrife (*Lythrum salicaria*) can reduce avian diversity (Whitt and others 1999). Some birds avoid purple loosestrife stands for foraging and nesting (Lor 2000; Rawinski 1982; Whitt and others 1999).
- Invasive grasses in South Texas appear to provide inferior habitat for some breeding birds (Flanders and others 2006).
- Invasion of non-native plants in a Mojave Desert watershed did not appear to negatively impact species richness of native birds provided adequate structural diversity was retained (Fleishman and others 2003).
- Leafy spurge *(Euphorbia esula)* invasion resulted in variable effects on grassland birds in a study in North Dakota (Scheiman and others 2003).

Invasive plants can degrade wetlands.

- Purple loosestrife (*Lythrum salicaria*), melaleuca (*Melaleuca*), giant reed (*Arundo donax*), reed canarygrass (*Phalaris arundinacea*), phragmites (*Phragmites australis*), Chinese tallow (*Triadica* spp.), spartina *(Spartina alterniflora*), and torpedo grass (*Panicum repens*) can be invasive in a variety of wetlands.
- Invasive plants in wetlands can impact recreational opportunities (fishing, swimming, boating, etc.), consumer communities, biogeochemical cycling, water levels (Shafroth and others 2005), and diversity (Schooler and others 2006).
- Wetland restoration is challenging and often unpredictable; among other difficulties, there is a high potential for nonnative plants to dominate and persist, thereby halting succession (Zedler 2000).

Intact grasslands with undisturbed soil can be more resistant to invasive plants.

- Non-native forage grasses require more external inputs for maintenance than native grasses.
- Many plant communities require some disturbance (fire, grazing) to remain resistant and resilient.
- Unbroken sod (as per the Sodbuster program) is preferable for many reasons.
- Soil disturbance makes land more susceptible to invasion; however, we haven't proven the opposite (i.e., undisturbed lands resist invasive plants).
- Frequently burned warm-season grasslands are more resistant to invasive plants.
- Cheatgrass (*Bromus tectorum*) increases fire frequency.
- Leafy spurge (*Euphorbia esula*) has been shown to be more abundant in areas of soil disturbance areas.
- Increasing shrubs changes carbon allocation patterns in xeric (12-14" rainfall) grasslands (Jackson and others 2002) and more mesic systems(Norris and others 2001).
- A 2004 meta-analysis (Levine and others 2004) concluded that resident plant-species interactions rarely allow plant communities to resist invasion but may help in slowing invasive plant spread once established.

Invasive plant-infested lands are less productive than non-invaded lands.

- Invasive plants can reduce carrying capacity on rangelands.
- Introduced forage plants have some mechanism to tolerate herbivory, which makes them attractive to ranchers but highly invasive (Baker 1974; Rejmánek and Richardson 1996).
- Invasion of non-native plants shifts grazing pressure to preferred native species, which subsequently allows invasive plants to increase and productivity (in terms of grazing) to spiral downward.
- Tropical soda apple (*Solanum viarum*) occurs in pastures and is unpalatable to cattle (Mullahey and others 1996).
- Invasive plants reduce the yield and quality of forage (DiTomaso 2000).
- The spines of yellow starthistle can reduce an animal's ability to access forage.
- Spotted knapweed reduces forage quality (Watson and Renney 1974).

Functionally diverse plant communities are preferable for wildlife habitat. Invasive plants can decrease biodiversity.

- Forbs and legumes are important in plant communities but they are susceptible to broadleaf herbicides. Be sensitive to forb management.
- In concept, native plant communities result in more below-ground carbon sequestration due to greater structural diversity.
- More diverse plant communities may sequester more carbon (Russell and others 2004).
- Forb communities are more diverse than grasses, generally.
- Plant communities that are more resilient over the long term tend to be more functionally diverse with more redundancies (Naeem 2006).
- Invasive plants can displace diverse native plant communities with monocultures.
- Invasive plant prevention is the best (most economical) approach.
- (Levine and D'Antonio 1999; Tyser and Key 1988)
- Conversion of native to introduced pasturelands can alter the diversity and abundance of soil macro-invertebrates, depending on site characteristics and management (Brown and others 2004).
- It is difficult to test the impacts of invasive plants and determine whether "passengers or drivers" degrade the systems (Didham and others 2005).
- In a recent experimental test of the passenger-versus-driver model of invaded communities, the "passenger" model appeared to be supported, suggesting that nonnative plants dominate because they are less limited by noninteractive factors such as environmental change and dispersal limitation (MacDougall and Turkington 2005).

Invasive plants can compromise ecosystem services.

- Invasive plants can impact human health: Some have reported allergies from juniper (*Juniperus* spp.) pollen in the Midwest; some plants (e.g., giant hogweed

[*Heracleum mantegazzianum*], leafy spurge [*Euphorbia esula*]) can cause skin reactions.
- Taking lands out of production and putting them into the Conservation Reserve Program (CRP) reduced airborne dust CRP near Lubbock, TX.
- Fire suppression has allowed native plants to become invasive in some cases.
- Native plant communities provide more below-ground carbon sequestration due to greater structural diversity.
- Switchgrass (*Panicum virgatum*) monocultures used in CRP in the shortgrass steppe region of eastern Colorado perished under extended drought, which led to wind erosion on sites planted to switchgrass under CRP contracts.
- The long-term sustainability of more complex systems is logically supported, even if we don't have the science now. But what about 50-year-old monocultures of crested wheatgrass in the northern Great Plains?
- Many non-native forage grasses require inputs for long-term maintenance.
- Invasive plants can compromise ecosystem drivers, such as fire and herbivory.

Conclusion 2. Redefine "appropriate vegetative cover" to describe native species deemed appropriate by NRCS Ecological Site Descriptions; invasive plants should not be considered "appropriate vegetative cover."

Conclusion 3. Continue to keep invasive plants out of technical guides; unify USDA definitions and specifications across agencies to avoid use of invasive plants (e.g., ARS activities). Disallow new payments or incentives and recommendations for using invasive plants. Include lists of prohibited plants in technical guides.

- Redefine "appropriate vegetative cover" toward appropriate native species and avoid planting non-natives. Non-natives are useful in certain circumstances, but overall native species are preferred
- Matching land use to the broadscale native natural communities as defined by NRCS Ecological Site Descriptions (Bestelmeyer and others 2003; Herrick and others 2006) reduces need for anthropogenic inputs.
- Native species reseeded to restore or rehabilitate lands should be appropriate to the existing natural communities, see NRCS Ecological Site Descriptions (get this to USDA Farm Services Agency).
- Appropriate plants for vegetative cover should be locally defined.
- Consider using native animal species in the context of natural communities to drive desired future conditions.
- Continue to keep invasive plants out of technical guides; unify USDA agencies regarding the use of invasive plants; discontinue payments and recommendations for using invasive plants.
- Consider using "non-invasive" in this context.

- Native plants are "preferred" because they are best suited to the local climate, but they should not be required. Non-native transition species are sometimes useful.
- According to (Rice and Emery 2003), addressing changing climate into planting recommendations may involve incorporating a range of genotypes with adaptations to wide-ranging conditions for each species. These mixtures may increase establishment success in altered or unpredictable conditions (Lesica and Allendorf 1999).
- Native seed availability is an issue—we need more support for NRCS Plant Materials Centers.

Conclusion 4. Keep lands enrolled in long-term Conservation Reserve Program (CRP) in appropriate native perennial cover to provide environmental benefits, including invasive plant management.

- Keeping CRP lands in appropriate native perennial cover long-term provides public benefits including invasive plant control.
- CRP lands should not be cultivated or have soil disturbance.
- Tilling the soil impedes rebuilding soil structure and quality on CRP sites.
- If CRP lands are not re-enrolled, soil disturbance can promote invasive plants.
- It is necessary to address invasive plants on some CRP lands.
- Depending on the management practices, invasive plants might not be a problem on former (i.e., tilled) CRP lands, but loss of soil, water, and wildlife values would be large.
- What about lands planted to non-natives early in CRP history?
- Local management decisions (Hobbs and Huenneke 1992).

Conclusion 5. Prohibit establishment of known and potential invasive plants for biofuel production in new Conservation Reserve Program (CRP) contracts to avoid spreading invasive plants and undermining the intention of CRP (i.e., protection of highly erodible lands by removing them from production).

Conclusion 6. Discourage using CRP lands primarily for biofuels production.

Conclusion 7. Determine the invasive potential of plants being considered for biofuel production.

Conclusion 8. Explore the use of weed-free buffers to contain vegetative spread of biofuel plants into surrounding areas.

- CRP lands by virtue of their low productivity and high erodibility are probably not good candidates for biofuel production.
- If it is invasive, we shouldn't plant it.
- Species introduced as biofuels should undergo agronomic and ecological analyses to ensure that they're not invasive (Raghu and others 2006).
- Sustainability calculations should be considered in choosing biofuels. Selected genotypes of switchgrass (*Panicum virgatum*) selected for biofuels will require inputs for long-term maintenance – this is not now being included in yield calculations.
- Encourage multiple management objectives in addition to biofuels production on CRP lands to ensure less intensive management.
- Weed-free buffers might be useful to contain vegetative spread of biofuel plants.
- Determine the nature of plant invasiveness; conduct risk assessments (California Invasive Plant Council 2006; Hughes and Madden 2003).

Conclusion 9. CRP lands should be eligible to be hayed, mowed, burned, or grazed in order to manage invasive plants, but only under an NRCS-prescribed plan that simulates ecological drivers that regulate invasive plants; all actions should be strategically timed to allow reproduction of native birds and production of native seed.

Conclusion 10. Emphasize avoiding disturbances and practices that spread invasive plants with equipment, in hay, and in other ways.

- CRP lands should be eligible to be hayed, mowed, burned, or grazed to manage invasive plants under an NRCS approved plan.
- CRP land use alternatives could encourage new farmers.
- Strategically timed mowing can be used as a surrogate of natural processes of fire and grazing (Fuhlendorf and Engle 2001; Knopf 1996) that provide habitat structure variability while allowing reproduction of native birds, native seed, etc. (Vickery and others 1999).
- Avoid spreading invasive plants with equipment and in hay.
- Litter build-up reduces the vigor of grasses (although examples can be found to support the opposite). This relationship depends largely on primary productivity and therefore potential for litter accumulation that reduces photosynthetically active radiation (Branson 1985; Hulbert 1969; Knapp and Seastedt 1986).
- Grazing and burning can be used as invasive plant management tools.
- Fire-grazing interactions on sericea lespedeza (*Lespedeza cuneata*) have been documented (Brandon and others 2004).
- Wildfire and invasive plants literature review (Johnson and others 2006).
- Invasive plants can be reduced with controlled burning (DiTomaso and others 2006).

- Prescribed burning, which is often used to maintain native tallgrass species' dominance, may result in altered ecosystem processes if certain invasive grasses dominate the system (Reed and others 2005).
- Combinations of mowing and certain herbicides have proven effective at controlling invasive plants in wetland and riparian areas (Renz and DiTomaso 2006).
- Mowing has proven to be an effective tool for controlling invasive grasses in native grasslands in western Oregon resulting in restored native grasslands (Wilson and Clark 2001). This study also indicated that long-term studies are needed on the effects of native grassland restoration efforts as well as experienced and proper application of mowing treatments to achieve the desired results.

Conclusion 11. Encourage Integrated Invasive Plant Management at all scales.

Conclusion 12. Prioritize prevention, and early-detection and rapid-response practices (e.g., in the Conservation Security Program).

- Every land grant university has an Integrated Pest Management (IPM) coordinator; IPM is a widely accepted practice.
- Research integrated 2-4D and sheep grazing for restoration (Sheley and Krueger-Mangold 2003).
- See many and various Extension bulletins on IPM.
- Effective invasive plant control encourages replacement with desirable species to avoid bare soil and re-invasion (D'Antonio and Chambers 2006).
- Prevention is more cost-effective than management of invaded habitats.
- Emphasize prevention and early detection and response; educate growers, have early detection programs.
- Discourage planting of invasive plants.
- Require weed-free hay for hunters and backcountry uses.
- Redcedar (*Juniperus virginiana*) in Oklahoma cost $5/ac to prevent every 5-10 years, instead of $300/ac treatment under the Environmental Quality Incentives Program (EQIP) (Bidwell and others 2002; Engle and others 1996).
- A dyer's woad eradication program in Montana has been assessed (Pokorny and Krueger-Mangold 2007).
- Reward prevention practices (e.g., through the Conservation Security Program).
- Implications for the management of invasions (Hulme 2006)
- The use of complementary invasive plant control measures has been shown to be an effective strategy (Buckley and others 2004).
- Authors concluded that removal of low-density sub-populations was preferable for control of *Spartina alterniflora* in a comparison of prioritizing outliers or core populations combined with different control budgets (Taylor and Hastings 2004).

Conclusion 13. Require monitoring to ensure program accountability and success for site-specific actions.

Conclusion 14. Increase the number and qualifications of technical service providers to conduct monitoring that provides accountability for expenditure of public dollars.

- We need long-term data provided by monitoring of Farm Bill-affected lands.
- Monitor different taxa, including invasive plants and physical factors.
- Water quality impact of riparian buffers depends on numerous factors and buffers alone cannot universally restore water quality and aquatic health (Correll 2005; Lowrance and others 1997).
- Review of efficacy of riparian buffers (Mayer and others 2006).
- Need enough money to hire and train USDA field advisors to monitor.
- Monitoring provides accountability for expenditure of public dollars.
- Easements and commodity production are already being monitored.
- Evaluation of long-term impacts of invasive plants on native species and ecosystems must rely on long-term data; monitoring is critical (Blossey 2004).
- Adaptive management and monitoring can improve management of invasive plants (Foxcroft 2004).

Conclusion 15. Retain the ability to use the full array of invasive plant management tools, including herbicides.

Conclusion 16. Prohibit the use of invasive plants as cover crops.

- Certain farming systems are better at controlling weeds and invasive plants while providing other environmental benefits such as soil and water quality.
- There have been no conclusive studies correlating organic farming with invasive plants.

Conclusion 17. Encourage long-term, area-wide cooperative efforts including communities of stakeholders and landowners to determine and engage in the most effective management practices as appropriate to the area.

- Certain invasive plants can only be managed at large spatial scales.
- Managing populations is more effective than managing species (Smith and others 2006).

- Effective management may require a scale of management larger than a single management unit.
- There are many examples of successful cooperative efforts, e.g., Cooperative Weed Management Areas, TEAM Leafy Spurge, TEAM Melaleuca, preventing melaleuca (*Melaleuca*) from entering Everglades National Park, community-driven Mediterranean sage (*Salvia aethiopis*) eradication project in Boulder, CO.
- Farm Bill conservation programs should encourage the most effective strategy such as prevention on lands relatively free of invasive plants, not just the most infested lands.
- Long-term planning and projects should be encouraged.
- Accelerated payments on cost-share ratio for community-based programs.
- Community-based programs are more likely to have synergistic effects, ownership, community pride, more sustainability.
- Provide incentive for partnerships.
- We need to engage absentee and recreational landowners.
- Encourage special initiatives under the Environmental Quality Incentives Program (EQIP) for NRCS staff to work with landowners to identify and address invasive plants.
- Early detection and prediction reference (Peterson 2005).
- See *Guidelines for Coordinated Management of Noxious Weeds: Development of Weed Management Areas* (BLM and others 2002).

Conclusion 18. Expand program eligibility to include small-acreage and recreational property owners participating in long-term, area-wide cooperative efforts to prevent or manage invasive plants.

- Fewer people are involved in U.S. agriculture every year.
- Big ranches also are going into recreation and wildlife and leaving agriculture.
- Farm Bill conservation program eligibility should be expanded to include small, non-agricultural landowners.
- Provide incentives for small landowners to manage invasive plants.
- More disturbances occur on smaller, recently subdivided parcels, so there is a higher threat of invasive plants' introduction and spread.
- Provide management options and let local management teams decide what strategies are most appropriate.
- County weed programs usually don't have the resources to manage invasive plants on private lands, so funnel Farm Bill conservation program funds through the county programs (where they exist) to expand into this audience.
- Cooperative Weed Management Areas often comprise non-producers, but they should get Farm Bill conservation program funding.

- See *Guidelines for Coordinated Management of Noxious Weeds: Development of Weed Management Areas* (BLM and others 2002) and *CWMA Cookbook* (VanBebber 2003).
- Society and environmental issues (Brunson and Shindler 2004; Kreuter and others 2005).

Conclusion 19. "Designer weed" programs should be discontinued to prevent developing the next cohorts of invasive plants.

Research

In the course of their discussions, workshop participants identified a number of invasive plant issues that require further research:

- Converting land from highly invaded to native plant communities.
- Developing rapid-assessment methods for invasiveness and impacts of invasive plant populations.
- Invasive plant response to haying, mowing, and grazing on CRP lands.
- Establishing native plant communities in highly disturbed areas.
- Response of invasive plants to climate change, CO_2, and nutrient levels.
- Developing more selective invasive plant management techniques.
- Organic farming and invasive plant interactions.

Additional Conclusions

Additional conclusions provide the context for more effective invasive plant management:

1. Organize the Conservation Title into fewer, broader programs with more discretion for implementation by technically competent people.
2. Make ranking and selection of cost-share and incentive payment process more transparent and understandable.
3. Encourage longer tenure of enrollment to prevent cycling of entry and withdrawal to avoid steady decline in resource values.
4. Encourage community-based, cooperative efforts at spatial scales including at larger than individual sites.

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Appendix A

Workshop conclusions were drawn from a number of Discussion Statements that were provided by CIPM to provoke debate. The Discussion Statements were:

1. The Conservation Title of the Farm Bill currently emphasizes conservation or improvement of soil & water resources and wildlife habitat in the conservation programs.

Discussion Statement: Invasive plant species management should be a critical conservation concern for the Farm Bill Conservation Programs. The broad response to this statement will be developed by discussing the following bullet points:

- **Soils:** Invasive plants change soil properties and reduce soil stability and soil productivity. What science supports or disproves this statement?
- **Water:** Invasive plants alter natural hydrologic regimes and increase flooding. What science supports or disproves this statement?
- **Wildlife:** Invasive plants degrade wildlife habitat. What science supports or disproves this statement?
- **Birds:** Invasive plants degrade migratory bird habitat. What science supports or disproves this statement?
- **Wetlands:** Invasive plants degrade wetlands. What science supports or disproves this statement?
- **Grasslands:** Intact, undisturbed grasslands are more resistant to weed invasion. What science supports or disproves this statement?
- **Forage:** Invasive plant-infested lands are less productive than noninfested lands. What science supports or disproves this statement?
- **Biodiversity:** Functionally diverse plant communities are preferable for wildlife habitat. Invasive plant species decrease biodiversity. What science supports or disproves this statement?

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2. At several places in the Farm Bill “appropriate vegetative cover” is required.

Discussion Statement: "Native" plant species are preferable to "nonnative" plant species for land and water restoration, wildlife habitat, and wetlands and should be preferred for these practices.

What science supports or disproves this statement?

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3. Several million acres are up for re-enrollment in the Conservation Reserve Program.

Discussion Statement: Removal of lands from set-aside status in conservation programs (particularly the Conservation Reserve Program) would have negative effects by increasing invasive plant species populations and decreasing environmental quality (soil, water, wildlife habitat).

What science supports or disproves this statement?

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4. "Biomass production" on conservation lands will likely be a market force in the future. It has been suggested that the Farm Bill provide incentives for biofuel production which may include cropping on previously set-aside lands and that biofuels production should include certain invasive plant species.

Discussion Statement: Invasive plant species should not be used as crops for biofuels programs due to potential environmental impacts.

Secondary Discussion Statement: Biofuels production would disturb lands and thus increase risk of invasive plant species into these areas.

What science supports or disproves this statement?

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5. Mowing, haying, and grazing are currently allowed only under certain circumstances on conservation program lands.

Discussion Statement: Mowing, haying, and grazing are critical invasive plant species management practices for grassland/rangeland conservation and should be allowed as a management tool under the conservation programs.

- Indirect effects from not using these management tools include increased wildfire danger that could promote invasive plant species.
- On the other hand, inappropriate grazing and haying can increase the introduction of invasive plants.
- Grazing should also be considered a restoration tool.

What science supports or disproves this statement?

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6. Some management practices are given priority in the farm bill.

Discussion Statement: Integrated invasive plant management – i.e., the consideration of different control methods to contain or eradicate invasive plants – should be encouraged.

- **Prevention:** Invasive plant prevention is more cost-effective than management or restoration.

What science supports or disproves this statement? Please specify effects on soil & water quality and wildlife habitat and include any regional concerns.

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7. Monitoring is currently advocated in the Farm Bill.

Discussion Statement: Monitoring of the effects of invasive plant species management is critical for conservation program lands.

What science supports or disproves this statement?

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8. Certain structural practices such as riparian buffers are supported by the farm bill.

Discussion Statement: "Weed-free buffer zones" are effective in preventing dispersion of invasive plant species into natural rangelands and grasslands.

What science supports or disproves this statement?

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9. Certain restored grasslands and wetlands are supported by farm bill programs.

Discussion Statement: It is critical to support native plant species restoration in order to provide environmental benefits on conservation lands if invasive plant species are present on those lands.

What science supports or disproves this statement?

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10. The farm bill provides incentives for different farming systems.

Discussion Statement: Certain farming systems are better at controlling weeds and invasive plant species while providing for other environmental benefits such as soil and water quality. Organic farming reduces the incidence of invasive plants over time and improves soil and water quality.
What science supports or disproves this statement?

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11. The farm bill currently provides incentives for cooperative conservation efforts and in some cases provides greater benefits if a certain percent of a watershed are signed up for conservation programs.

Discussion Statement: It is more effective and efficient to manage invasive plants at a watershed, landscape, or ecosystem scale than on a site-by-site basis. Landscape location is also important in determining how to management invasive plant species.

What science supports or disproves this statement?

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12. Lands that are eligible for most conservation programs must be owned by producers.

Discussion Statement: One of the greatest threats by invasive plant species are previously cropped or grazed lands owned by non-producers ("ranchettes") and thus non-producers should be considered eligible for conservation programs that could help manage invasive plant species.

What science supports or disproves this statement?

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13. Discussion Statement: Soil disturbance increases the probability of invasive plant invasion and spread.

What science supports or disproves this statement?

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14. Discussion Questions: What critical research questions must be answered to improve invasive species management and to conserve or preserve environmental benefits on conservation lands? Please indicate regional priorities and potential pilot projects.