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Invasive Species Management Environmental Assessment

Shawnee National Forest

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Saline, Union and Williamson Counties, Illinois

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This document and supporting documents can be found on our website:
http://fs.usda.gov/goto/shawnee

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Chapter 1 – Purpose of and Need for Proposed Action

The Forest Service has prepared this environmental assessment in compliance with the National Environmental Policy Act and other applicable federal and state laws and regulations. It discloses the direct, indirect and cumulative environmental effects expected to result from the proposed action and alternatives to the proposed action. The document is organized into three parts:

Chapter One. Purpose of and Need for the Proposed Action: This section includes information on the purpose of and need for the project and our proposal for achieving that purpose and need.

Chapter Two. Alternatives: This section provides a description of the proposed action and the alternatives that were developed based on issues raised during scoping.

Chapter Three. Affected Environment and Environmental Consequences: This section describes the effects of implementing the proposed action and the alternatives.

Additional documentation, including working papers with detailed analyses of project-area resources, maps of the areas with invasive species proposed for treatment, modeling, data and scientific references, is filed in the project record, located at the Shawnee National Forest Supervisor's Office, 50 Highway 145 South, Harrisburg, Illinois.

Background

Invasive species problem: The Shawnee National Forest (Forest) has numerous and abundant populations of invasive plant species that pose an increasingly serious threat to plant and animal community health and diversity. Our employment of integrated pest-management principles—Setting Action Thresholds, Identifying and Monitoring Pests, Prevention, and Control—for the prevention/ eradication of invasive species has lacked all the tools available for responsible control. Prevention measures have been inadequate to stop the spread of the most invasive species. We have tried mechanical and manual control methods with varying degrees of minimal success. As we see many areas of the Forest infested and overcome by invasives and recognize the potential loss of biodiversity caused by their establishment, we know the "action threshold" has been crossed.

Invasive species can have serious adverse impacts in unique habitats such as barrens and seep-springs. These trees, shrubs and vines can thrive in areas where they would be kept out by fire. These species can take up space that could be used by other native species and even cause springs to go dry by de-watering the fragile ecosystems. Non-native invasive plant species, displaced from their original ranges, often lack natural controls like disease, predators, parasites, or climate. They tend to out-compete and eventually replace native species. Not only do non-native invasive species compete with natives for resources, they can cause the loss of habitat and food for wildlife, alter soil structure and chemistry, modify fire regimes, alter plant succession, hybridize with natives to compromise local genetic diversity, and replace and possibly lead to the local extirpation of native plant species, including threatened, endangered and sensitive species.

Field surveys and inventories of invasive species have been conducted in designated natural areas on the Forest for over 20 years and locations of non-native invasive species on the Forest have been recorded for decades. In 2004, we entered into a cooperative agreement with Southern Illinois University to develop a systematic database of existing inventory records of invasive species sites on the Forest. Over 1600 sites of non-native invasive species infestation have been identified, involving over 65 different species. Database management being a continuous effort, inventory information as of January, 2010 has been used for this analysis. These data are the best available scientific information regarding the type and extent of invasive species on the Forest.

Although over 65 non-native invasive species are currently found on the Forest, a few are highly invasive and pose a measurably greater threat to natural resources. The project interdisciplinary team identified four species that pose an increasingly serious threat to rare species or communities on the Forest. These four species had been mapped and categorized as highly invasive during past field surveys: Amur honeysuckle, Chinese yam, garlic mustard and kudzu (Figure 1). This determination was based on published scientific information, consultation with the Illinois Department of Natural Resources (IDNR) and other resource experts, and/or field observations of current conditions on the Forest. These four species have characteristics that permit them to rapidly invade and dominate new areas and out-compete other vegetation for light, moisture and nutrients.

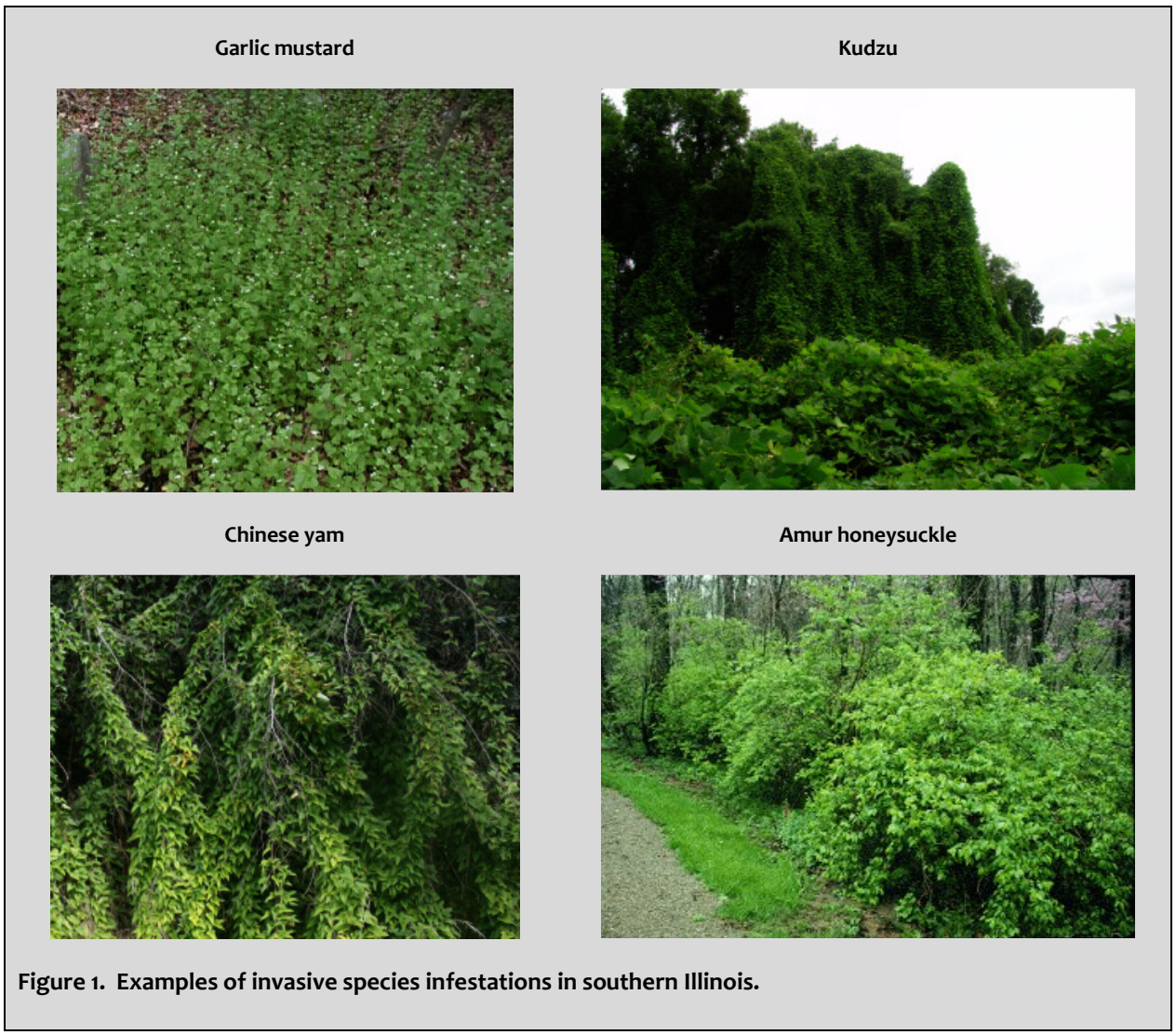

Figure 1. Examples of invasive species infestations in southern Illinois.

Natural areas: Recognizing the value of their unique biological features, we have designated 80 sites on the Illinois Natural Areas Inventory as "natural areas" in our Forest Plan. Under the Plan's Natural Area management prescription, these areas are managed for the protection and perpetuation of their significant and exceptional features. These features are generally ecological in nature, with unique plant and/or animal communities. Most of the natural areas have not been actively managed in ten years or more, leading to the general degradation of their natural communities. Invasive plant species are encroaching on them; many limestone and sandstone barrens are reverting to forested conditions. This degradation is confirmed by field surveys and reports by IDNR that indicate these communities require active management to maintain their integrity.

Snow Springs, Kickasola Cemetery, Dean Cemetery West and Cretaceous Hills are natural areas designated for their ecological value. These areas contain acid seep-springs that are a unique habitat-type being impacted by invasive species and a lack of fire. Fire plays an important role in the maintenance of this habitat-type. Because of the lack of disturbance by fire, several native and non-native species have become established near the springs. These native trees, poplar and oak, are having a drying effect on the springs, and the non-natives—stiltgrass, honeysuckle and multiflora rose—are crowding out several sensitive species. Management is needed to prevent the loss of the twining screwstem, New York fern and several other species (Figure 2).

Twining Screwstem (*Bartonia paniculata*)	**New York Fern** (*Thelypteris noveboracensis*)
 Picture by Kay Yatskievych (www.discoverlife.org)	
Large Whorled Pogonia (*Isotria verticillata*)	**Brome-like Sedge** (*Carex bromoides*)
	

Figure 2. Rare species found in seep-spring habitats that are threatened by a lack of fire and invasive species.

Purpose of and Need for Action

The purpose of this project is to protect and restore native ecosystems on the Forest by utilizing all environmentally responsible tools for the control or elimination of populations of invasive plants. Forest-wide action is needed at this time because:

- invasive species are jeopardizing the survival of some ecological communities,
- invasive species are increasingly degrading native plant communities,
- established invasive species populations are serving as a source for spreading infestations
- taking action now can avert a more widespread and costly future problem,
- existing invasive species populations can spread to adjacent lands,
- past control efforts in small areas using mainly manual methods have been only marginally effective in preventing the establishment of invasive species populations,
- invasive species populations are persisting and continuing to spread, pointing to the need for a comprehensive and integrated approach to treatment, and
- prevention of the establishment of new infestations is more effective than trying to control and eradicate entrenched infestations.

Action is necessary to put in effect the guidance in the Forest's Land and Resource Management Plan (Plan):

> The risk and damage from existing non-native invasive species would be reduced through integrated pest management. Invasion-prevention measures would be implemented to maintain native ecosystems. Existing populations of non-native invasive species would be eradicated, controlled and/or reduced. Effects of management activities on the invasion and spread of non-native invasive species would be considered and mitigated, if needed. Natural areas and lands adjacent to natural areas have the highest priority for the prevention and control of non-native invasive species (FW34.2.1).

Proposed Action

The Forest Service proposes to take a four-point approach to the control of invasive species:

1. **Forest-wide treatment with manual, mechanical and/or chemical control methods of all known sites of the four highly invasive species: Amur honeysuckle, Chinese yam, garlic mustard and kudzu**

2. **Forest-wide management of 23 natural areas and their treatment zones, including control of invasive species**

3. **Treatment for control of invasive species within the main pathways of invasion**

4. **Rapid response to newly discovered invasive species infestations**

The proposed action would integrate various control methods—manual, mechanical and chemical—to eliminate or control invasive species populations. The proposal would target both aggressive, non-native plants as well as native plants that threaten unique ecosystems or are degrading natural-area community integrity. This work would be accomplished over the next ten years and would be reviewed and evaluated annually.

Decision Framework

Given the purpose and need, the responsible official, the Forest Supervisor, will review the alternatives in order to make the following decisions:

- Should herbicides and prescribed fire be used to eradicate, control and/or reduce invasive species?
- What design features and mitigation should be used to achieve resource objectives?
- What monitoring should be done to evaluate the implementation of the project?

Public Involvement

The public and concerned agencies were notified about the proposed invasive plant control project and encouraged to comment on the proposal. A scoping letter was mailed on April 29, 2008 to about 350 individuals and agencies who have requested to be informed about Forest proposals. The scoping letter, attachments and maps were also placed on the Forest's website.

Twelve responses were received as a result of public scoping. The interdisciplinary team analyzed the responses in order to identify issues. Most were supportive of invasive species control on the Forest; but there were some differing opinions on what species to control and what methods to use. Additional species and treatment methods were suggested. Some stated that herbicides should not be used due to concerns about human health and safety and possible effects on native species.

In addition to the public involvement described above, we partnered with the Sierra Club and the River-to-River Cooperative Weed Management Area to enlist the public's help in increasing our knowledge of invasive species distribution on the Forest. In 2008 and 2009, we worked with about 35 volunteers to increase our knowledge of invasive species in natural areas. Between the volunteers and our staff we identified many new invasive species infestations, clarifying the extent of the threat.

Following publication of the environmental assessment, we received comments from 35 individuals and governmental and non-governmental organizations, as well as three form letters. We received positive, supportive endorsements of our proposal from the IDNR, the Illinois Nature Preserves Commission, the Illinois Invasive Species Plant Council, the River-to-River Cooperative Weed Management Area, The Nature Conservancy, and several individuals. Some individuals and the form letters expressed concern and opposition. The comments and our responses to them can be found in the Appendix.

Issues

Issues are points of debate, disagreement, or dispute about the environmental effects of a proposed action. Following our scoping of the public and other agencies, the interdisciplinary team identified the issues related to the invasive species control proposal and divided them into two groups, key and non-key. Key issues are those directly or indirectly caused by implementing the proposed action or alternatives. (Non-key issues are listed and explained in the project record.) The list of issues was reviewed and approved by the responsible official.

Key Issues and Indicators:

- The application of herbicides may affect humans.
  - Human Health Indicator: The response of the general populace will be discussed in terms of the effect that the approved and properly applied herbicides could have on public health and employees/applicators.

- ❖ The establishment and growth of invasive species may affect natural areas and ecosystems, including plants and wildlife.
  - Plant Community Indicator: The response of the plant community will be discussed in terms of acres of invasive species reduced and native species restored.
  - Wildlife Community Indicator: The response of federally listed species will be discussed in terms of potential changes in their habitat.

- ❖ The application of prescribed fire and mechanical treatments may affect designated natural areas and ecosystems, including soil, water, plants and wildlife.
  - Soil and Water-Quality Indicator: The predicted amount of soil erosion (tons/acre/year).
  - Plant Community Indicator: The response of the plant community will be discussed in terms of potential changes in the number and frequency of invasive and native plant species.
  - Wildlife Community Indicator: The response of Regional Forester Sensitive Species and species with viability concern will be discussed in terms of potential changes in the habitat.

- ❖ The application of herbicides may affect designated natural areas and ecosystems, including soil, water, plants and wildlife.
  - Soil and Water Quality Indicator: Persistence of the herbicides used will be discussed.
  - Plant Community Indicator: The response of the plant community will be discussed in terms of the potential effect on the natural area's significant and exceptional features.
  - Wildlife Community Indicator: The response of the wildlife community to the proposed action will be discussed in terms of potential changes in the habitat of management indicator species.

Chapter 2 - Alternatives

This chapter describes each alternative and compares the alternatives considered.

Common to All Alternatives: Prevention and Education

Prevention and education are important elements of our overall invasive species management strategy (project record). Prevention of the spread of invasive species is recognized as a primary part of the mission of the Forest Service (USDA Forest Service 2003) and the Forest is implementing prevention measures currently, including the washing of equipment before and after entry onto Forest lands, ensuring the revegetation of treated invasive species sites, and education.

Our invasive species prevention and education program includes our participation in the River-to-River Cooperative Weed Management Area (CWMA) partnership. This is a group effort of 12 federal and state agencies, organizations and universities whose goal is the coordination of efforts and programs for addressing the threat of invasive plants in southern Illinois. The CWMA was established in 2006 and addresses invasive plant species through collaborative projects and activities focused on education and public awareness, early detection and rapid response, prevention, control and management, and research.

Alternative 1 – No Action

Under this alternative, we would continue current strategies of invasive species management: Pulling and torching of about 100 to 150 acres of invasive species, inventory and mapping of infestations, and the burning of about 6,000 acres per year to set back the invasive species, including in some designated natural areas. We apply herbicides in campgrounds and at administrative sites (about 50-100 acres per year), contributing to invasive species control in those areas. No ground-disturbing mechanical treatments could be done, nor could herbicide be applied outside of administrative sites and campgrounds.

Alternative 2 – Proposed Action

Under this alternative, we would treat invasive plant infestations using an integrated combination of prescribed fire and manual, mechanical and/or chemical methods. Additionally, we would continue to use public information and education to increase awareness of invasive species issues. We would treat specified Forest lands (see maps), given available time and resources. Post-treatment monitoring would evaluate success, which we would disclose in our annual monitoring reports. Our proposal is a four-point approach to treating invasive species:

1. Forest-wide treatment of all known sites with four highly invasive species: The project interdisciplinary team reviewed the many invasive species on the Forest and identified four as priorities to be targeted Forest-wide: Amur honeysuckle *(Lonicera maackii*), on about 750 acres at about 40 sites, Chinese yam *(Dioscorea oppositifolia*), on about 1600 acres at about 45 sites, garlic mustard (*Alliaria petiolata*), on about 800 acres on about 70 sites, and kudzu (*Pueraria* m*ontana*), on about 75 acres at 6 sites (see maps for locations*).* For the most part, these species were chosen because of their high degree of invasiveness and/or their ability to suppress or extirpate native vegetation by their aggressive growth characteristics. Published science, monitoring, and field study indicate that active management of these species can greatly reduce both their current and potential adverse effects on native plants and animals with minimal impact on the surrounding environment. An integrated treatment approach using manual, mechanical and, where appropriate, herbicide treatments is proposed to control and eliminate the four highly invasive species from the sites where they occur.

Of the four species, kudzu does not fit the “highly invasive" description in Illinois. However, we are targeting kudzu because the State of Illinois has an aggressive kudzu eradication program and, as a partner of the state, we are assisting in the eradication effort and including it as a priority species for this analysis. Kudzu sites would be burned before and after herbicide treatments. The fires would clear the vines to permit applicators to safely walk the areas as well as expose the potential hazards of fallen logs and gullies. Fire would also reduce the amount of herbicide required for treatment. Garlic mustard is very invasive and has allelopathic properties that suppress native vegetation and change soil properties to favor itself. This species would be the highest priority for treatment. Kudzu, Chinese yam and Amur honeysuckle would follow in order of priority.

2. Management of 23 designated natural areas and their treatment zones:
The interdisciplinary team reviewed the information on invasive species in natural areas and identified those most threatened with vigorous infestations or with the most vulnerable natural communities. Based on these factors, the team selected 23 high-priority natural areas for analysis (Table 1). All invasive species would be targeted in these areas.

Management would include the application of prescribed fire in the natural areas and the pathways of invasion—along stream corridors, roads and trails (treatment zones)—about 12,000 acres. Existing fire-breaks, such as roads, trails, streams and other natural features, would be used as firelines where possible; but mechanically constructed firelines would be used where necessary. We expect to install about 14 miles of lines by hand and 6 miles mechanically.

The treatment zones would be burned at intervals of 1-3 years, depending on fuel availability and the monitoring and assessment of effects to determine the need for additional fire. The fire would help restore native vegetation and set back the progression of invasive species. Further burns would be done as needed to maintain the areas’ ecological integrity once invasive vegetation has been suppressed.

Herbicides could be applied to control invasive species either before or after the initial burns, depending on the species present. Some species, such as grasses, grow well in response to fire and would be targeted before the burns. Other species, such as Japanese honeysuckle and multiflora

rose, are generally set back by fire, so burning them off before applying herbicides would limit the amount of herbicide required for control or eradication. We anticipate applying herbicides until infestations are controlled or eliminated.

The proposal includes basal-bark treatment (i.e., "hack-and-squirt": Cutting into a tree's cambium and applying herbicide) and cutting and stump-spraying and/or girdling of some native trees and shrubs on about 275 acres of barrens, glades and seep-springs to improve growing conditions for natural communities. Barrens and glades are unique native plant communities that traditionally have sparse vegetation. With the exclusion of fire, some of these areas have grown up in shrubs and trees that shade out native and sensitive plant species, limiting the diversity of the plant community. Thinning the barrens and glades helps to restore their naturally dry condition and the species adapted to it. Similarly, we would control the trees and shrubs that are encroaching on seep-spring areas and dewatering their rare plant communities.

Table 1. High-Priority Natural Areas*.

Name**	Ranger District	Name	Ranger District
Ava ZA	Mississippi Bluffs	Keeling Hill South EA	Hidden Springs
Barker Bluff RNA	Hidden Springs	Kickasola Cemetery EA	Hidden Springs
Bell Smith Springs EA	Hidden Springs	LaRue-Pine Hills RNA	Mississippi Bluffs
Bulge Hole EA	Hidden Springs	Massac Tower Springs EA	Hidden Springs
Cretaceous Hills EA	Hidden Springs	Odum Tract EA	Hidden Springs
Dean Cemetery West EA	Hidden Springs	Panther Hollow RNA	Hidden Springs
Double Branch Hole EA	Hidden Springs	Poco Cemetery East EA	Hidden Springs
Fink Sandstone Barrens EA	Hidden Springs	Poco Cemetery North EA	Hidden Springs
Fountain Bluff GA	Mississippi Bluffs	Reid's Chapel EA	Hidden Springs
Hayes Creek/Fox Den EA	Hidden Springs	Russell Cemetery EA	Hidden Springs
Jackson Hole EA	Hidden Springs	Snow Springs EA	Hidden Springs
Keeling Hill North EA	Hidden Springs		

***** None of the natural areas proposed for treatment are located within wilderness.
****** ZA=zoological area, RNA=research natural area, EA=ecological area, GA=geological area, BA=botanical area

The highest priority natural areas for prescribed fire and herbicide treatment would be those with acid seep-springs: Cretaceous Hills, Dean Cemetery West, Kickasola, Massac Tower Springs and Snow Springs. These are the most threatened by invasive species and changes. The encroachment of aggressive invasive species into these areas threatens to dry up the springs and dramatically degrade the plant community, destroying the spring habitat. Rare plant resources rely on this habitat type, including Regional Forester's Sensitive Species, such as twining screwstem (*Bartonia paniculata*), purple five-leaf orchid (*Isotria verticillata*), longbeak arrowhead (*Sagittaria australis*) and New York fern (*Thelypteris noveboracensis*). Additional plant species of this community-type, including several listed as threatened or endangered by the State of Illinois, are also vulnerable to local extirpation without immediate management.

Of the remaining 18 natural areas, 11 have Regional Forester's Sensitive Species and numerous other rare plant resources: Double Branch Hole, LaRue-Pine Hills, Poco Cemetery East, Poco Cemetery North, Bulge Hole, Fink Sandstone Barrens, Bell Smith Springs, Hayes Creek/Fox Den, Panther Hollow, Jackson Hole and Barker Bluff. Streams run through, or are adjacent to, all of these areas, providing a corridor for invasive plant species, especially Nepalese browntop. These areas would be the second priority for invasives treatments.

The remaining seven natural areas, Fountain Bluff, Ava Zoological Area, Keeling Hill North, Keeling Hill South, Odum Tract, Russell Cemetery and Reid's Chapel, contain dry to dry-mesic barren-communities, which provide a unique assemblage of rare plant resources. These areas would be our third priority for treatment. The other 57 natural areas also contain non-native invasive species;

however, in order for us to systematically control and eradicate invasive plant species, it is imperative that we prioritize the natural areas that require immediate attention to preserve their integrity.

3. Treatment of invasive species within main pathways of invasion:
Stream, road, trail and utility rights-of-way corridors are the main invasion pathways for most invasive species. Stream corridors are a dynamic environment, with flooding that exposes bare soil. Similarly, road and trail corridors are heavily used and maintained; they also have exposed soil. All these areas are susceptible to the establishment and growth of invasive species. Certain species are expected in these invasion corridors and would be targeted (project record), but any invasive species discovered could be treated.

Forest-wide treatments would be prioritized based on the threats posed by individual species and the potential for successful control. Stream, road and trail corridors extend 100 feet from each side of the respective feature: All mapped perennial and intermittent streams, all roads on the Forest, and all system and mapped non-system trails. While we expect many corridors to be unaffected, invasive species found within them could be treated with herbicides and prescribed fire. Herbicide treatments and the application of prescribed fire could be done beyond the 100-foot corridors if needed to control an infestation, but would not exceed 300 feet.

Treatment of infestations beyond 300 feet with herbicides or prescribed fire may require new environmental analysis; however, manual or mechanical treatment could be used to control these populations. The 300-foot zone was defined by considering the extent of existing populations in these areas and the distance they appear from the road corridors. By extending the treatments to 300 feet, we believe that the majority of infestations could be treated. Rights-of-way are defined by their managed corridors—mowed or maintained areas. These areas could be treated with herbicides over the next 10 years, but most would likely not be treated due to a lack of resources. We would prioritize treatments to protect natural areas and slow the spread of invasive species Forest-wide.

4. Rapid response to newly discovered invasive species infestations:
The Forest would have the ability to respond rapidly to invasive plant infestations newly discovered outside the areas defined above. While treatments of newly discovered populations with herbicides or prescribed fire would require additional environmental analysis and decision, the application of manual or mechanical treatment methods could be used to reduce the threat of spread.

Herbicide Treatments

In order to limit the potential effects of herbicide treatments and to quantify the effects for our analysis, we propose to treat annually no more than 500 acres in any HUC6 watershed and no more than 3,000 acres Forest-wide. We are proposing to use five herbicides to treat invasive plants: triclopyr, clopyralid, glyphosate, sethoxydim and/or picloram (Table 2). We have selected commonly used, low-impact herbicides that should provide effective treatment. Additionally, we propose to use the most controllable application methods that would have the least residual impact:

1) a hand-held applicator, hack-and-squirt, sprayer, or wick applicator,
2) backpack sprayer, or
3) boom-mounted spray rig (on an all-terrain or utility vehicle, pickup truck, or tractor).

We do not propose aerial applications.

Herbicide application would be done at the label-recommended rates for spraying. We would use only those herbicides registered by the Environmental Protection Agency for the specific type of site and use proposed. All applicable state and federal laws would be followed. Herbicides would be applied according to label directions and monitored in accordance with best management practices and direction in the Forest Service Manual (2080, 2150 and 2200). A Pesticide Use Proposal (FS-

2100-2) and safety plan (FS-6700-7) would be completed prior to any herbicide use. Signs would be posted to alert the public as to the location and types of treatments being done and the date when the area can be re-entered.

Herbicide treatments would be done during the time of year when chemical application is most effective for a particular species and its life-cycle. At any site on which herbicides are used, a recurrence of an infestation would be treated to ensure complete removal or control. Reseeding with native species would be done at some sites to aid the re-establishment of native vegetation.

Table 2. Proposed Chemical Controls in Alternative 2.

Chemical Name	Examples of Trade Names	Targeted Use	Examples of invasive plants to be targeted	Risk Assessment
Clopyralid	Curtail™ Reclaim™ Transline™	Foliar spray; broadleaf selective–especially composites and legumes	kudzu, thistles, teasels, mimosa	SERA 2004a
Glyphosate	Accord® Roundup Pro® Roundup®	Stump treatment, foliar spray; non-selective; woody and broadleaf plants	Amur honeysuckle, autumn olive, kudzu, Japanese honeysuckle, garlic mustard, tree-of-heaven	SERA 2003a
Glyphosate (aquatic)	Aquamaster® Rodeo®	Foliar treatment, weeds near open water, nonselective	purple loosestrife, any species near open water	SERA 2003a
Sethoxydim	Poast® Vantage®	Foliar spray; narrowleaf selective (grasses)	Nepalese browntop, Johnson grass, cheat grass,	SERA 2001
Triclopyr	Crossbow™ Garlon™3A Garlon™4 Habitat®; Pasturegard™ Vine-X®	Stump and/or basal-bark treatment, foliar spot spray; broadleaf selective; woody plants	Amur honeysuckle, autumn olive, kudzu, Japanese honeysuckle, garlic mustard, tree-of-heaven	SERA 2003b
Picloram	Tordon K Tordon 22k; Grazon	Stump and/or basal-bark treatment	kudzu	SERA 2003c

(http://www.fs.fed.us/foresthealth/pesticide/risk.shtml)

Control techniques could vary depending on the size or location of the infestation. Proposed methods were developed after review of scientific literature, discussions with invasive species experts, and from field experiences by Forest botanists and wildlife biologists. If an initial control method proves ineffective and the infestation is not reduced, we may employ alternative methods. For example, if a plant re-sprouts despite being treated with one herbicide, we could treat with another the following year.

Alternative 3 – Four-Point Treatment Action without Synthetic Herbicides

Under this alternative, no synthetic herbicides would be used to control invasive species. The methods proposed rely on aggressive manual or mechanical treatments as the first course of control. Natural weed-killers would be applied when manual and mechanical methods are ineffective. This alternative was developed in response to public concerns about unintended consequences of the use

of synthetic herbicides. It is designed to control some invasive species, but would not eradicate many populations because the natural weed-killers only top-kill the plants.

1. Forest-wide treatment of four highly invasive species:

Under this alternative we would concentrate on the same four highly invasive species as the proposed action, but would use manual and mechanical methods as a first line of treatment (Table 3). Kudzu sites would be treated initially with prescribed fire, with a backhoe or bulldozer used to remove individual plants, concentrating on the root crowns. Amur honeysuckle and garlic mustard sites would be removed by concentrating on individual plants. Amur honeysuckle would be pulled or grubbed out. Garlic mustard would be hand-pulled or torched. Chinese yam would be treated initially by continual mowing, clipping or torching. For all four species, natural herbicides could be applied after initial work has reduced the vigor of populations.

Table 3. Proposed Treatment Methods under Alternative 3.

National Forest Lands		
Species	**Methods***	**Approximate Acres**
Garlic mustard	Pulling, Torching	800
Kudzu	Prescribed Burn, Bulldozer/Back Hoe **	75
Bush honeysuckle	Cutting, Pulling, Torching	1600
Chinese yam	Repeated Clipping, Torching,	750
	Subtotal	**3225**
23 Priority Natural Areas and Treatment Zones		
Example Species	**Methods**	**Approximate Acres**
Nepalese browntop	Pulling, Weed-Whipping	1150
Sweetclover	Burning, Cutting, Pulling	25
Autumn olive	Cutting, Grubbing	1275
Multiflora rose	Cutting, Grubbing	775
Tall fescue	Tilling, Smothering	500
Sericea lespedeza	Pulling, Weed-Whipping, Cutting	130
Japanese knotweed	Grubbing, Pulling	8
Japanese honeysuckle	Torching, Cutting, Grubbing	1400
Princesstree	Grubbing, Cutting	2
Crownvetch	Pulling, Grubbing	5
Asiatic dayflower	Pulling, Grubbing	3
Common sheep sorrel	Pulling, Grubbing	10
Common periwinkle	Pulling, Grubbing	2
Tree of heaven	Pulling, Grubbing, Cutting	10
Beefsteak plant	Pulling, Grubbing	35
Shortleaf pine	Cutting, Pulling	255
Queen-Anne's lace	Pulling	25
	Subtotal	**5610**
	Total	**8835**
Methods	**Pulling, Cutting, Grubbing**	**7510**
	Bulldozer / Backhoe	**75**
	Tilling, Smothering, Clipping, Torching	**1250**

***** Natural weed-killer could be used for all species.
****** Only non-motorized would be used within wilderness.

Natural herbicides are simple substances that directly top-kill plants upon application. These substances are encountered naturally, but in small quantities. Food-grade vinegar and clove oil are the main active ingredients in one type of natural herbicide. However, the concentrations used in the natural weed-killers are higher than available at a grocery store. Vinegar at the grocery store is usually 5 percent acetic acid, while the natural weed-killer contains a 20-percent solution. These ingredients are relatively well known and normally not harmful to humans or animals. However, when

applied in large doses, the results are usually obvious in a very short time. After treatment, their damaging effect is quickly dissipated. Vinegar is acetic acid along with other weak organic acids. Clove oil is an essential oil from the clove plant (*Syzygium aromaticum)*. This mixture works by disrupting plant membranes and causing the leakage of cells. The damage to plants appears rapidly, in 1-2 days. The mixture breaks down quickly and would not have a lasting effect on earthworms, soil invertebrates or the breakdown of organic matter.

A hot-foam machine could be used along roads and some trails to steam-kill invasive species. The Waipuna® hot-foam system, for example, is comprised primarily of a diesel-powered boiler and foam generator that deliver hot water with a foam surfactant to target weeds via a supply hose and a treatment wand. The superheated hot foam (sugar is added to achieve a higher boiling point than water) is applied to the targeted vegetation at a high temperature (200°F) and low pressure; the foam traps the steam, giving it time to "cook," or "blanch," the vegetation. This causes a cellular collapse of the treated aboveground vegetation. This control method is limited in mobility and is best used near developed sites such as campgrounds and trailheads and along roadsides and accessible trails.

2. Management of 23 designated natural areas and their treatment zones:
All invasive species within the specified natural areas (Table 1) would be treated using the methods outlined in Table 3. Management would include the application of prescribed fire in the natural areas and the pathways of invasion—stream corridors and roads and trails (treatment zones), about 12,000 acres. Existing fire-breaks, such as roads, trails, streams and other natural features, would be used as firelines where possible; but mechanically constructed firelines would be used where necessary. We expect to install about 14 miles of lines by hand and 6 miles mechanically.

The treatment zones would be burned at intervals of 1-3 years, depending on fuel availability and the assessment of effects to determine the need for additional fire. The fire would help restore native vegetation and set back the development of invasive species. Further burns would be done as needed to maintain the areas' ecological integrity once invasive vegetation has been suppressed. Manual and mechanical weed-treatment methods would be applied to manage invasive species either before or after the initial burns, depending on the species present.

The highest priority natural areas for prescribed fire and natural herbicide treatment would be those with acid seep-springs: Cretaceous Hills, Dean Cemetery West, Kickasola, Massac Tower Springs and Snow Springs. These are the most threatened by invasive species and changes. The encroachment of aggressive invasive species into these areas threatens to dry up the springs and dramatically degrade the plant community, destroying the spring habitat. Rare plant resources rely on this habitat type, including Regional Forester's Sensitive Species, such as twining screwstem (*Bartonia paniculata*), purple five-leaf orchid (*Isotria verticillata*), longbeak arrowhead (*Sagittaria australis*) and New York fern (*Thelypteris noveboracensis*). Additional plant species of this community-type, including several listed as threatened or endangered by the State of Illinois, are also vulnerable to local extirpation without immediate management.

Of the remaining 18 natural areas, 11 have Regional Forester's Sensitive Species and numerous other rare plant resources: Double Branch Hole, LaRue-Pine Hills, Poco Cemetery East, Poco Cemetery North, Bulge Hole, Fink Sandstone Barrens, Bell Smith Springs, Hayes Creek/Fox Den, Panther Hollow, Jackson Hole and Barker Bluff. Streams run through, or are adjacent to, all of these areas, providing a corridor for invasive plant species, especially Nepalese browntop. These areas would be the second priority for invasives treatments.

The remaining seven natural areas, Fountain Bluff, Ava Zoological Area, Keeling Hill North, Keeling Hill South, Odum Tract, Russell Cemetery and Reid's Chapel, contain dry to dry-mesic barren-communities, which provide a unique assemblage of rare plant resources. These areas would be our third priority for treatment. The other 57 natural areas also contain non-native invasive species;

however, in order for us to systematically control and eradicate invasive plant species, it is imperative that we prioritize the natural areas that require immediate attention to preserve their integrity.

3. Treatment of invasive species within main pathways of invasion, and
4. Rapid response to newly discovered invasive species infestations:
Our approach under this alternative to the invasion pathways and unknown or new infestations of invasive species would be the same as under the proposed action, except that we would use the methods described in Table 3 and natural herbicides.

Actions Common to the Action Alternatives

Design Criteria

In order to minimize impacts on the environment from invasive species management, several design criteria would be applied under both action alternatives (Tables 4 and 5). These criteria are mitigation measures incorporated into the design of the project rather than as a response to concerns or ongoing effects. All treatment locations will be recorded with global positioning systems and tracked in a database to plan out-year program needs.

Table 4. Design Criteria for Invasive Species Management.

Resource Area	Design Criteria	Rationale / Effectiveness
Invasive Plant Treatments	Clean all equipment before entering and leaving project sites.	Minimizes spread of noxious weeds from one site to the next (USDA-FS 2004). Guide to Noxious Weed Prevention Practices (2001).
	Workers should inspect, remove and properly dispose of plant parts found on clothing and equipment before entering or leaving the project area.	
	Minimize soil disturbance to avoid creating favorable conditions that encourage weed establishment.	
Invasive Plant Treatments	All treatment locations will be marked with global positioning systems and tracked in a database.	
	Known or new occurrences that cross ownership boundaries will be noted and data shared with landowners and other agencies.	Improves effectiveness of control and increases opportunities for treatment on other lands.
Botanical	Ensure that rare plant resources, including state-listed threatened and endangered species, are protected from mechanical or chemical treatments.	Rare plant resources will be protected and habitat enhanced. Known locations of state-listed plant species will be protected by request of the Illinois Department of Natural Resources.
Wildlife	Retain all standing dead trees unless necessary to cut for human safety or to accomplish project objectives.	These design criteria are required "terms and conditions" or "reasonable and prudent measures" in US Fish and Wildlife Service Biological Opinion for the Forest Plan (Forest Plan, Appendix H, C.1.b. and C.1.c.).
	To reduce the chances of affecting bat maternity roosts and foraging habitats, no prescribed burns shall be done in upland forests from 5/1-9/1.	
	Burning near known timber rattlesnake den locations will be done only during hibernation - 11/1-3/31.	Den sites are extremely important to the maintenance of populations (Forest Plan).
	For protection of nesting migratory birds, burns should be done as early or late in the season as possible, preferably before 4/1 and after 8/1.	For the protection migratory birds (Forest Plan, FW51.1.2.6.
	In order to protect eastern small-footed bats, fires will not be ignited near known-occupied rock outcroppings or cave entrances in the project area. No firelines would be constructed in or immediately adjacent to cave habitat.	This species require additional RFSS protection identified in the Forest Plan (USDA 2006).
	High-intensity prescribed fire should not be applied to known locations of the carinate pill snail in LaRue-Pine Hills Research Natural Area.	This is protection suggested in the conservation assessment for the carinate pill snail (Anderson 2005).

Table 4. Design Criteria for Invasive Species Management.		
Resource Area	**Design Criteria**	**Rationale / Effectiveness**
Heritage	The Area of Potential Effects will be reviewed and inventoried as needed to ensure that all heritage resources are adequately protected.	Implementing protocol methods will ensure protection of heritage resources (SHPO/IHPA 2009).
Recreation and Visual	Ensure visitor safety before, during and after burning activities. Burn areas should be closed to the public.	Forest Plan, Chap. I, B; FW23.2 & FW23.3.
	Protect recreational improvements, (campgrounds, trailheads and trail-signing).	Forest Plan, FW23.2
	Damage to trails and roads used as firebreaks or for access should be repaired to standard.	Forest Plan, Chap. FW23.3
Wilderness	Ensure non-motorized NNIS treatments are utilized.	Wilderness Act of 1964, Forest Plan WD19.3
	Avoid treatments during periods with typical high visitor volume (holidays).	Mitigate impacts on solitude.
Soil and Water	Use erosion-control measures, including seeding, for firelines that could erode soil into water resources.	Illinois Forestry Best Management Practices are designed to ensure that prescribed fire does not degrade the forested site and that waters associated with these forests are of the highest quality (IDNR et al. 2000). We have monitored the effectiveness of mitigation measures on several past prescribed fire projects and found that the measures were effective in minimizing soil erosion and subsequent sedimentation in streams.
	Avoid intense burns that remove forest-floor litter and expose excessive bare soil.	
	Maintain soil-stabilization practices until the site is fully revegetated and stabilized.	
	Avoid operating heavy equipment to cause excessive soil displacement, rutting or compaction.	
	Apply guidelines for protection of water quality and riparian areas; guidelines for the reduction of bare-soil disturbance; retain native vegetation and limit soil disturbance as much as possible.	Implementation of the protection measures and management recommendations at Forest Plan FW25 will prevent excessive sedimentation.
Soil and Water	Revegetate soils disturbed by management activities by allowing growth of existing on-site vegetation where possible and desirable or by planting or seeding native vegetation.	Adherence to Forest Plan direction and Illinois Department of natural Resources Best Management Practices regarding protection of aquatic habitats will prevent damage to these areas.
	Fueling or oiling mechanical equipment must be done away from aquatic habitats.	
	When using pesticides in riparian areas and within 100 feet of sinkholes, springs, wetlands and cave openings, adhere to the following: Minimize the use of pesticides, herbicides; use only pesticides labeled for use in or near aquatic systems; and use only herbicides based on analysis that shows they are environmentally sound and the most biologically effective method practicable.	
	No triclopyr (ester formulation) or surfactants used with glyphosate (terrestrial version) will be applied within riparian areas or within 100 feet of lakes, ponds, sinkholes or wetlands.	Compliance with herbicide label directions will prevent misuse of chemicals used for treatment of invasive species.
	Consider prevailing weather conditions and use lower volatility formulations under conditions that might result in a high risk of volatilization.	

Table 5. Design Criteria for Human Health and Safety.
Implementing safe handling and application guidelines will ensure the health and safety of employees and the public will be protected. Job Hazard Analyses (JHA), Material Safety Data Sheets (MSDS) and product labeling will be reviewed and followed in order to ensure the preservation and protection of human health and safety. Applicators will be trained in the safe handling and application of all natural and synthetic herbicides. All requirements in a Safety and Spill Plan will be followed. The following application standards will be rigorously adhered to.
Pre-application • Herbicides will be used only when they will provide the most effective control relative to the potential hazards of other proposed management techniques; choose the most effective herbicide requiring the least number of applications. • The use of pesticides must comply with the product label. • All applications will be under the direction of a certified pesticide applicator. • All individuals working with herbicides will review corresponding Material Safety Data Sheets. • Herbicide label directions will be carefully followed. This could include temporary closure of treatment areas in order to prevent or limit public exposure and insure public health and safety. • Weather forecasts will be obtained prior to herbicide treatment. Treatment will be halted or delayed, if necessary, to prevent runoff during heavy rain or high wind. Herbicide will be applied only when wind speeds are less than 10 mph, or according to label direction, to minimize herbicide drift. Appropriate protective gear will be worn by herbicide applicators.
Application •Use the lowest pressure, largest droplet size, and largest volume of water permitted by the label to obtain adequate treatment success; use the lowest spray boom and release height possible consistent with operator safety. •Apply pesticides during periods of low visitor use when possible; areas treated with pesticides shall be signed, as appropriate, to ensure users are informed of possible exposure. •When using herbicides where runoff may easily enter the water table, (i.e. creeks, rivers, wetlands, caves, sink-holes, or springs), minimize the use of pesticides, herbicides, fertilizers or hazardous materials; use only pesticides labeled for use in or near aquatic systems.
Post-Application • All herbicides will be stored in approved buildings when not in use. • Herbicides will have Material Safety Data Sheets per Forest Service guidelines. • Washing and rinsing of equipment used in the mixing and application of pesticides will be done in areas where runoff will not reach surface waters, wetlands, fens, sinkholes, or other special habitats. • Rinse water from cleaning or rinsing actions in conjunction with herbicide treatment will be disposed of according to the Federal Insecticide, Fungicide and Rodenticide Act (http://www.purdue.edu/dp/envirosoft/pest/src/container.htm). • Herbicide containers will be stored and disposed of following label specifications.

Monitoring

Monitoring would demonstrate whether or not implementation of Alternative 2 and expected outcomes are accomplished (Table 5). If monitoring reveals unacceptable outcomes, appropriate measures would be implemented to correct problems.

Table 6. Monitoring under any Alternative.

Monitoring Activity	Description	Location and Timing
Soil Resources	Visual inspection for sheet, rill and gully erosion. Inspection of soil disturbance.	Before, during and after project activities are completed in project area.
Invasive Species	Samples of project area would be surveyed to assess invasive species increase/decrease.	Selected locations would be monitored before and after implementation.
	Ensure that invasive species design criteria are implemented.	Selected locations would be monitored during and after implementation.
Rare Plant Resources	Monitor known rare plants to ensure no adverse impacts.	Selected locations would be monitored during and after implementation.
Heritage Resources	Ensure that heritage resources are protected during and after implementation.	This project would be checked annually to assess damage to historic properties.

Alternatives Eliminated from Detailed Study

Treatment of Invasive Species without Prescribed Fire

The interdisciplinary team considered an alternative that would not utilize prescribed fire to help treat invasive species. After discussion, the team determined that prescribed fire was needed for two important reasons. First, the use of fire would reduce the density of some invasive species and, so, reduce the amount of herbicide required for control. Second, the team concluded that the ecological benefits of prescribed fire were needed in the natural areas. These areas require fire to maintain the diversity of species in their habitats. Additionally, kudzu sites are too dense to treat without the application of fire to expose hazards to applicators.

Use of Goats or Other Grazers to Reduce Invasive Species

The interdisciplinary team considered the use of goats or cows to graze infestations and, so, reduce the vigor and density of some invasive species. After consulting available literature and discussing this method with people who had tried it, the team recommended that this alternative be eliminated from further study. We visited sites where goats were being used to control invasives and observed that goats were "hard on the land," were indiscriminate as to the vegetation they consumed and, so, would be a threat to any sensitive plant species requiring protection, and noted that their use achieved no real control of the targeted invasive species. Additionally, our invasives infestations are in specific areas distributed broadly across the landscape and the resulting requirement to fence the animals into an area and provide supplemental feed and water would be overly burdensome, practically and economically. This is especially true when the animals would need to be moved several times in a month to be effective.

Comparison of Alternatives

Table 7 provides a summary of the effects of implementing each alternative.

Table 7. Effects of the Proposed Alternatives on the Key Issues.

Issue Statement: The application of herbicides may affect humans.			
Indicator	**Alternative 1**	**Alternative 2**	**Alternative 3**
Effect on public health and employees/applicators.	Minimal herbicide exposure; minimal exposure to smoke.	Minimal herbicide exposure; minimal exposure to smoke.	Minimal natural herbicide exposure; minimal exposure to smoke.
Issue Statement: The establishment and growth of invasive species may affect natural areas and ecosystems, including plants and wildlife.			
Indicator	**Alternative 1**	**Alternative 2**	**Alternative 3**
Plant community response: invasive species reduced and native species restored.	Overall, Invasives will increase and native species decline.	Invasive species will be controlled fairly rapidly and native species will increase in treated areas.	Invasive species will decrease over time with repeated treatments and native species will increase in treated areas.
The response of the federally listed species will be discussed in terms of potential changes in the habitat.	Little to no effect.	Invasive species removal and habitat restoration will have beneficial effects.	Similar to Alternative 2, but to a lesser extent over longer time.
Issue Statement: The application of prescribed fire may affect designated natural areas and ecosystems, including soil, water, plants and wildlife.			
Indicator	**Alternative 1**	**Alternative 2**	**Alternative 3**
Predicted soil erosion (tons/acre/year).	Less than 1 ton/acre	Average less than 2 – 5 tons/acre from prescribed burning and mechanical treatments. (Natural Resource Conservation Service acceptable level)	Average less than 2 – 5 tons/acre from prescribed burning and mechanical treatments. (Natural Resource Conservation Service acceptable level)
Plant community response: invasive species reduced and native species restored.	Overall, Invasives will increase and native species decline.	Invasive species will be controlled fairly rapidly and native species will increase in treated areas.	Invasive species will decrease over time with repeated treatments and native species will increase in treated areas.

Table 7. Effects of the Proposed Alternatives on the Key Issues.			
The response of the Regional Forester Sensitive wildlife species and Species with Viability Concern.	Adverse effects as invasive plants replace native species.	Invasive species removal and habitat restoration will have beneficial effects.	Similar to Alternative 2, but to a lesser extent over longer time.
Issue Statement: The application of herbicides may affect designated natural areas and ecosystems, including soil, water, plants and wildlife.			
Indicator	**Alternative 1**	**Alternative 2**	**Alternative 3**
Persistence of herbicide used.	Limited herbicide use in campgrounds and administrative buildings, with minimal persistence in the environment.	Selected herbicides generally demonstrate minimal persistence in the environment.	Limited herbicide use in campgrounds and around administrative buildings and natural weed-killer use, both with limited persistence in the environment.
Effect on the natural area's significant and exceptional features.	Habitat for rare plant resources will continue to decline.	Habitat for rare plant resources will be improved.	Habitat for rare plant resources will be improved.
Changes in management indicator species habitat.	Negative effects as invasive plants replace native species.	Positive effects on habitat with reduced invasive plants.	Similar to Alternative 2 but to a lesser extent.

Chapter 3 – Affected Environment and Environmental Consequences

This chapter describes, by resource area, the physical, biological and health and safety conditions that may be affected by the alternatives. As directed by the Council on Environmental Quality's implementing regulations for the National Environmental Policy Act, the discussion focuses on resource conditions associated with the key issues. The discussion of environmental consequences forms the scientific and analytical basis for comparing the alternatives. Environmental consequences are discussed in terms of direct, indirect and cumulative effects.

Direct effects are caused by the proposed activities and occur at the same time and place. Indirect effects are caused by proposed activities and occur later in time or are further removed in distance. Cumulative effects result from the incremental effects of proposed activities when added to other past, present and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions.

This analysis is tiered to the 2006 Forest Plan programmatic final environmental impact statement and incorporates by reference the programmatic biological assessment and opinion for the Plan. The biological assessment determined that implementation of projects that furthered the goals and objectives of the Forest Plan could, but was not likely to, affect federally listed species on the Forest. The U.S. Fish and Wildlife Service issued a biological opinion with restrictions intended to ensure project-implementation would not likely affect federally listed species on the Forest. This analysis also incorporates by reference the human health and ecological risk assessments of the herbicides proposed for use. These risk assessments, available at www.fs.fed.us/foresthealth/pesticide/risk.shtml, indicate the relative safety of the respective herbicides.

Cumulative Effects

Resource specialists analyzed the cumulative effects of implementing the alternatives on their respective resource areas. These cumulative effects are disclosed in each resource section presented in this chapter. The spatial and temporal boundaries for the cumulative effects analysis may differ for each resource area.

Past Actions

Southern Illinois, including the Forest, has a rich agricultural history. Settlers cleared the forested land for fields and homestead development, and some of this land eventually became part of the Forest. Both active and passive management have shaped the Forest today. Shortly after the Forest was established, pine and hardwood were planted to stabilize eroding old fields and to begin the process of reforestation. Throughout the years, specific management objectives for the Forest have changed, but the goal of sustainable, multiple-use resource management has remained the same.

Table 8. Past, present and reasonably foreseeable future actions, with the potential for cumulative effects, within the Forest watersheds. This information includes National Forest System and private lands.

Action	Scope of Action
Agriculture (cultivated/row-cropping)* (Includes fertilizer and pesticide use)	About 230,000 acres (past, present and future), HUC 6 watersheds
Agriculture (cultivated/row-cropping)* (Includes fertilizer and pesticide use)	About 1,054,168 acres (past, present and future), HUC 4 watersheds
Agriculture (pasture)* (Includes fertilizer and pesticide use)	About 230,000 acres (past, present and future), HUC 6 watersheds
Agriculture (pasture)* (Includes fertilizer and pesticide use)	About 784,548 acres (past, present and future), HUC 4 watersheds
Prescribed fire **	About 3,000 acres per year (past). About 10,000 acres (present and future).
Wildfires	About 85 acres per year (past). About 1,000 acres per year (future).
Timber harvest/firewood cutting	About 1,000 acres per year (past, present and future).
Timber stand improvement (some herbicide use)	About 800 acres per year (past, present and future).
Recreational use ***	About 300,000 people visited the Forest for recreation. About 37,000 for horseback riding About 150,000 for hiking or walking About 37,000 for hunting About 16,000 for fishing About 5,000 for gathering mushrooms, berries and others. About 600 for bicycling.
ATV use	Variable use in watersheds (past, present and future).
Road (including right-of-way) maintenance (Includes herbicide use.)	About 300 miles per year (past, present and future).
Tree planting	About 500 acres per year (past, present and future).
Utility ROW maintenance (Includes herbicide use.)	About 250 miles per year (past, present and future).
Trail construction, reconstruction and maintenance	About 75 miles maintained per year (past, present and future).
Non-system trails	Less than 100 miles of trail (past, present and future).
Special-use permits -telephone, electric, driveways.	Less than 20 acres per year (past, present and future).
Residential use and Invasive species control (Includes fertilizer and pesticide use.)	About 1,000 acres treatment per year (past, present and future).
Openlands management	Disking and planting about 200 acres (past). Disking and planting about 100 acres (future).
Residential development	About 2,000 new houses per decade (past and future).

*Agriculture data is based on watershed size. The Hydrologic Unit Code (HUC) is based on a system of defining watersheds based on size. The HUC6 is smaller, 10,000-30,000–acre, watersheds while the HUC4 is larger watersheds, hundreds of thousands of acres. A HUC6 watershed would be like the Lusk Creek drainage. A HUC4 watershed would be like the entire Big Muddy River drainage.

** The Forest is planning to burn about 8,000-12,000 acres per year in the future. The prescribed burns in the proposed project (about 12,000 acres) would be included in these acres.

*** Based on the 2008 National Visitor Use Monitoring Survey.

Activities over the years on National Forest System and private lands in project-area watersheds include, but are not limited to, farming—including extensive herbicide use—and grazing; mining; timber harvest, primarily on private land; wildfires and prescribed fires; development and use of system and non-system equestrian and hiker trails; wildlife management, including wildlife openings and pond and waterhole construction; outdoor recreational use, including picnicking, hunting, fishing, hiking; use of authorized and unauthorized all-terrain vehicles and off-highway vehicles; artifact hunting and collection; special-use permits; construction, maintenance and use of recreational facilities and roads; tree-planting and timber-stand improvements, including tree-thinning; powerline construction and maintenance, including extensive herbicide use. Activities occurring on national forest and private lands in the project area are included in Table 8.

Present Actions

Many of the past activities on Forest and private land in project-area watersheds are still occurring; however, the prevalence of many of the past activities has changed. Present actions in project-area watersheds include, but are not limited to, trail construction, maintenance and use; powerline maintenance; campground maintenance; all-terrain vehicle use, authorized and unauthorized; timber harvest, predominantly on private lands; agricultural management, with row-cropping, pasturing and pesticide use; fire, wild and prescribed, and fire suppression; development and use of non-system trails; road maintenance and use; tree-planting; equestrian use; public visitation and outdoor recreational use, hiking and hunting; special-use permitting and openlands management.

Reasonably Foreseeable Future Actions

Reasonably foreseeable future actions on National Forest System lands include activities awaiting implementation, planned or listed in out-year schedules such as the Quarterly Schedule of Proposed Actions. Activities similar to past activities on National Forest system lands are reasonably foreseeable in the future (see Table 8). In the next 15 years, the Forest plans to continue to maintain roads and construct and maintain trails; remove trees for ecological restoration; issue special-use permits for access-roads, utilities and outfitter-guides; suppress wildfires as they occur, and implement prescribed burning. Generally, special-use permits allow activities like communications, outfitting and guiding for hunting, hiking and horseback riding, roads, water, power, gas and telephone utilities, commercial and non-commercial recreation events, and cemetery and church access.

Herbicide Use

Invasive species are having a severe impact on native vegetation on the Forest. Our current approach, using torching and hand-pulling, is not effective for controlling or eradicating invasive species, and populations continue to spread. Although the costs of treating invasives exceeds available resources, undertaking invasive species management on the Forest in a strategic manner with the most effective and efficient tools available is a crucial start to protecting and enhancing native vegetation and sensitive natural areas.

In the past, the use of herbicides on the Forest has generated opposition, and we are sensitive to the issues surrounding the use of herbicide. Some have suggested options such as grazing, mechanical methods and natural weed-killers. These options are explored in the alternatives. We have chosen to propose for use the least toxic herbicides available, herbicides that generally degrade relatively quickly (3-6 months) into carbon dioxide and water. Given the level of infestation, we believe that the judicious use of herbicides is the most effective way, practically and economically, to limit the impacts of invasive species.

The use of herbicides is common in southern Illinois, as in most of the United States. The State of Illinois uses herbicides to maintain roadsides; the electric companies use herbicides to maintain utility rights-of-ways; and the most common herbicide uses are in agriculture. In southern Illinois, the majority of watersheds that contain forested lands also contain cropland. In the relatively small watersheds (HUC6 = 10,000-30,000 acres) that contain National Forest System lands, there are

about 230,000 acres of cropland and about 230,000 of pastureland. Most of this land is treated with herbicides, fungicides and fertilizers on an annual basis.

Within these same watersheds, the Forest consists of about 287,000 acres, on which we are proposing to apply herbicides to no more than 500 acres per watershed, and no more than 3,000 acres per year Forest-wide. Compared to the other uses mentioned above, this annual maximum application of herbicides would not perceptibly increase the amount of herbicides applied locally (see Table 12, page 39). Additionally, our predominant methods of application would be with backpack sprayers and with hand-held applicators. Some would be applied with small, boom-mounted equipment. These application methods allow for a great deal of control as compared to other methods, such as large spray-rigs, herbicide cannons, or aerial application.

Human Health and Safety

This section describes the human health and safety concerns within the project area.

Affected Environment

Human health and safety is a primary issue in relation to the application of herbicides. Potentially hazardous materials, including synthetic and natural herbicides, have been proposed for use. Trained Forest Service personnel, partners or contractors would be applying these chemicals and participating in other invasive species management activities that may have an effect on human health and safety.

The boundaries for this project were determined through an analysis of the proposed treatments, chemical, mechanical and manual; protections resulting from implementation of treatment protocols and design criteria prescribed to prevent herbicides from drifting and entering waterways; the limited mobility of the proposed herbicides; the relatively quick decomposition of the manufactured and natural herbicides; and the inability of the Forest Service to predict or control activities beyond Forest boundaries. It is understood that on nearby and adjacent private lands, around both homes and farms, many of the same or similar herbicides are used.

The project area is within the boundaries of the Forest. A temporal boundary of ten years was selected because that is the length of the expected life of the effects of the proposed invasive species management activities, as well as the extent to which these effects are measurable and meaningful. Beyond that timeframe, any impacts from these activities would have been stabilized**.** Five years was chosen to look back because past project effects would not be discernible beyond a five-year timeframe.

Design Criteria – The Forest Service implements a Safety and Health Program that is an integral part of the national and international mission of the agency. The Health and Safety Code Handbook is the primary source of standards for safe and healthful workplace conditions and operational procedures and practices in the Forest Service. The handbook is consistent with the standards and regulations of the Occupational Safety and Health Administration (OSHA). The design criteria included in Table 4 is consistent with all safety practices and procedures included in the Forest Service Handbook and Manual.

The handbook includes safety practices and procedures for activities included in the action alternatives, such as manual and mechanical vegetation treatment, prescribed fire (brushing and piling, torching and chainsaw operation), herbicide application and other activities associated with invasive species management. Personal protective equipment is required for use by all applicators. A Job Hazard Analysis is also required. The Job Hazard Analysis is a process used to identify safety and health hazards in work projects or activities. It is used to identify potential hazards and develop actions to reduce those hazards.

The agency's Forest Health Protection staff has the responsibility of managing and coordinating the proper use of pesticides on national forests. It is responsible for providing technical advice and support, and for conducting training to maintain technical expertise. In order to achieve this function, the Forest Service maintains a cadre of pesticide coordinators and specialists located at regional offices and at some forest offices. Forest Service policy and direction on pesticide use is outlined in the Forest Service Manual Chapter 2150.

The Forest Service is authorized by the Federal Insecticide, Fungicide and Rodenticide Act and the Cooperative Forestry Assistance Act to use pesticides for multiple-use resource management and to restore and maintain the value of the environment, within the legal framework provided by the National Environmental Policy Act and the Council on Environmental Quality's regulations. The significance of the three Acts is described as follows:

- The Federal, Fungicide and Rodenticide Act, as amended, is the authority for the registration, distribution, sale, shipment, receipt, and use pesticides. The Forest Service may use only pesticides registered or otherwise permitted with this act;
- The Cooperative Forestry Assistance Act of 1978, as amended by the Food, Agriculture and Trade Act of 1990 is the authority for assisting and advising states and private forest land-owners in the use of pesticides and other toxic substances applied to trees and other vegetation and to wood products; and
- The provisions of the National Environmental Policy Act and the Council on Environmental Quality's implementing regulations apply to pesticide management proposals.

Federal law requires that before selling or distributing a pesticide in the United States, a person or company must obtain a registration or license from the U.S. Environmental Protection Agency (EPA). Before registering a new pesticide or new use for a previously registered pesticide, the U.S. EPA must first ensure that the pesticide, including all adjutants, surfactants, or other ingredients included within the product content, when used according to label directions, can be used with a reasonable certainty of no harm to human health and without posing unreasonable risks to the environment. To make such determinations, the U.S. EPA requires more than 100 scientific studies and tests from applicants (US EPA 204). In 1966, Illinois became one of the first states to regulate pesticides and continues to have one of the most thorough licensing and enforcement programs, surpassing even federal guidelines.

The Illinois Department of Agriculture Environmental Program administers programs directed toward the control and eradication of plant pests and diseases. It regulates pesticide use by registering products, certifying and licensing applicators, and investigating suspected misuse. Illinois Department of Agriculture staff also administers programs concerning proper pesticide recordkeeping and waste reduction; pesticide and fertilizer storage, containment and disposal; pesticide container recycling; noxious weed control; and underground water protection initiatives. A department laboratory tests underground water, plant, animal and soil samples for pesticide residues.

Alternative 1 – There would be no additional direct or indirect effects on human health and safety as a result of the implementation of this alternative because no proposed invasive species management would be implemented. Current levels of mechanical, biological, or chemical control measures would continue, including the pulling or spot-torching of 100-150 acres of invasive species. Openlands management, including mowing, disking and bush-hogging on about 150 acres per year, also contributes to a reduction in invasive species. Herbicides are applied in campgrounds and at administrative sites on about 50-100 acres per year, which also contributes to invasive species management. Hand-pulling or spot-torching of invasive species such as garlic mustard and Japanese stiltgrass would generally have no effect on human health and safety. In addition, the Forest burns about 6,000 acres per year, which impedes the growth of most invasive species. As a result, there are currently short-term effects as a result of the use of prescribed fire.

The production of smoke from prescribed fire would temporarily reduce visibility and produce some pollutants, especially near the fire. Some, including firefighters, might experience short-term irritation (coughing, watery eyes and runny noses). Any raised level of particulate matter from smoke in the air can cause a health problem for individuals with a history of respiratory disease, or who are elderly (Core and Peterson 2001; Gill 1999; Sharkey 1997). Past experience has shown that these effects are greatly diminished with increasing distance from the fire: the greater the distance, the more air is available to dilute harmful effects of smoke. Smoke is expected to last only 4-6 hours, although smoldering may occur over several days. In addition, some characteristics of smoke accumulation are predictable, based on wind speed and direction, and can be managed effectively to reduce effects on humans.

The Illinois EPA has developed a statewide smoke-management plan to address smoke from prescriptive fires used to achieve resource benefits. The goals of the smoke management plan are to coordinate with land managers to develop a basic framework of procedures and requirements for managing smoke, to avoid significant deterioration of air quality and potential national ambient air-quality standards violations, and to mitigate the nuisance and public safety hazards posed by smoke in populated areas. Prescribed fires on the Forest are in compliance with this plan and follow detailed burn plans and strict prescription standards. Prescribed burns are also evaluated using smoke-management models (V-Smoke and/or SASEM). Because prescribed fires are planned, and even though there maybe some short-term, indirect effects from smoke, people living or working in areas adjacent to the project area who might be at risk can be warned to take necessary precautions.

At least one species of invasive plants poses a potential risk to human health: tree-of-heaven. It has been reported that exposure to the sap of tree-of-heaven by workers clearing infested areas has caused fever, chills, chest pain and shortness of breath, as well as inflammation of the heart. Its pollen is also suggested to have caused rhinitis, conjunctivitis and asthma (Beck et al. 2008; Ballero et al. 2003). Tree-of-heaven is known in a number of locations across the Forest, and probably occurs in many more areas yet to be inventoried. Although injury has not been reported to date, under Alternative 1, failure to control tree-of-heaven infestations on National Forest System lands could indirectly pose a health threat to workers and Forest visitors as it is allowed to spread.

Alternative 2 – There would be no direct or indirect effects on human health and safety as a result of implementing the proposed action. The proposed manual, mechanical and/or chemical control-methods pose minimal safety risks to workers or the public, as routine safety practices would be implemented. These practices address hazards related to operating mechanical equipment such as weed wrenches, brush cutters and spot-torches, as well as exposure of workers to tree-of-heaven sap and other natural hazards such as poison ivy, stinging insects, or falling branches. Non-Forest personnel working to eradicate invasive species on the Forest would be provided with safety orientation, training and personal protective equipment.

The herbicides proposed for use were selected largely for their low toxicity to humans and the environment (see Table 9), and the quantity used would not exceed recommended application levels. Human Health and Ecological Risk Assessments have been prepared for the proposed herbicides (SERA 2001; 2003a; 2003b; 2004a; and 2004b). In these documents, the risk analysis process is used to quantitatively evaluate the probability that use of a given herbicide might harm humans or other species in the environment. Measures of risk were based on typical Forest Service uses of each herbicide.

Potential effects relate to direct contact with the herbicide, exposure to treated vegetation, or consumption of contaminated water, fish or vegetation. The possibility of direct exposure of workers or the public to vegetation that has been treated is low, since notices would be posted. The greatest risk of exposure to herbicides would be for the workers mixing and applying them. Adherence to label directions would minimize the exposure of workers during application and apparatus cleanup.

Table 9. Human Health Risk Characterizations for Herbicides Proposed for use in Alternative 2 (SERA 2001; 2003a; 2003b; 2004a; 2004b; Tu et al. 2001).	
Clopyralid • Eye Risk • Inhalation Risk • Dermal Risk • Cancer Risk • Reproductive Effects	• Can cause persistent damage to eyes if direct contact occurs. • Harmful if inhaled. Does not readily volatize. • Transient dermal redness; does not cause skin sensitization. • No evidence of cancer with use of clopyralid. However, the technical grade contains hexachlorobenzene as a contaminant; it is classified as a potential human carcinogen by US EPA. No basis for asserting that its presence in technical grade clopyralid will substantially impact cancer risk under conditions characteristic of applications made in Forest Service programs. • Does not produce developmental effects at doses that do not produce maternal toxicity.
Glyphosate • Eye Risk • Inhalation Risk • Dermal Risk • Cancer Risk • Reproductive Effects	• Non-irritating to slightly irritating with direct contact; no permanent damage reported. • Inhalation is not an important exposure route because of its low volatility. • Poorly absorbed through skin. • Classified as Group E pesticide by US EPA: "Evidence of non-carcinogenicity for humans". • Adverse human reproductive effects have not been noted.
Sethoxydim • Eye Risk • Inhalation Risk • Dermal Risk • Cancer Risk • Reproductive Effects	• Irritating upon direct contact. • Some irritation at high exposure levels. Does not readily volatize. • Irritating to the skin. • Based on studies, no evidence of cancer risk. • Based on studies, no evidence of reproductive risks.
Triclopyr • Eye Risk • Inhalation Risk • Dermal Risk • Cancer Risk • Reproductive Effects	• May cause irritations to eyes. • Inhalation exposures to not be of toxicological concern. Ester formulations can be volatile, and care should be taken during application. Salt formulation is much less volatile than the ester formulation. • May cause irritations to skin. • The U.S. EPA/OPP has reviewed these studies and determined that the evidence for carcinogenicity is marginal (Group D pesticide). • Does not produce reproductive or developmental effects at doses that do not produce maternal toxicity.
Picloram • Eye Risk • Inhalation Risk • Dermal Risk • Cancer Risk • Reproductive Effects	• Can cause irritation to the eyes. • No toxic effects from acute inhalation exposure to aerosolized picloram. • Although picloram is not a strong skin irritant, repeated dermal exposures may lead to skin sensitization. • Out of several bioassays, none have shown that picloram has carcinogenic potential. Technical grade picloram does contain hexachlorobenzene, a compound that has shown carcinogenic activity in three mammalian species and has been classified as a potential human carcinogen (US EPA). • Does not produce reproductive or developmental effects at doses that do not produce maternal toxicity.

The design criteria were constructed with Alternative 2 foremost in mind because it proposes synthetic herbicide use. Because adherence to all label instructions is expected, the design criteria reduce the risk of herbicide drift or the possibility of off-site movement into water or wetlands. If necessary, amendments can be added to the mixture to reduce drift. Herbicides may be hand-applied, which can ensure limited environmental exposure to the chemicals, or applied with a boom-mounted powered sprayer on an all-terrain or utility vehicle, pickup truck, or tractor. When using spraying apparatus, label directions place restrictions on applications at certain wind speeds.

Some chemical solutions have an odor that may persist at spray sites for several days. The proposed chemicals do not readily volatilize, that is, vaporize into the air, with the exception of triclopyr. In order to protect the public and applicators, volatilization would be minimized by applying the herbicide according to label directions.

The proposed herbicides have relatively short half-lives and would not build up in the environment. They have limited ground-mobility, and only herbicides approved for aquatic use would be applied near water. No proposed application methods pose a substantial risk to underground water. Based on the estimated levels of exposure and the criteria for chronic exposure developed by the U.S. EPA, there is no evidence that typical or accidental exposures would lead to dose-levels that exceed the level of concern. In other words, all of the anticipated exposures—most of which involve highly conservative assumptions—are at or below the reference dose.

The use of the reference dose, which is designed to be protective from chronic or lifetime exposures, is itself a very conservative component of this risk characterization because the duration of any plausible and substantial exposures is far less than lifetime (SERA 2003a; 2003b; 2004a; and 2004b). No application would exceed the threshold of the amount of herbicide allowed per label instruction; therefore, there would be no measurable direct, indirect, or cumulative effects on human health and safety. Alternative 2 also includes the use of prescribed fire to control invasive species and would have effects similar to Alternative 1.

Alternative 3 – The effects on human health and safety under Alternative 3 would be similar to those described for mechanical controls under Alternative 2. The difference is related to the additional mechanical controls proposed in Alternative 3. Mechanical control of certain plants (e.g., multiflora rose and tree-of-heaven) could increase the risk of worker injury. For example, workers would more likely be scratched and cut by multiflora rose if they were grubbing out plants than if they were applying herbicides. Similarly, workers could be more likely to come in contact with tree-of-heaven sap if they chainsaw and grub out stumps, rather than apply a basal-bark application of herbicide. Adherence to the design criteria would protect applicators from natural herbicide applications, as well as manual and mechanical treatments.

Table 10. Human-Health Risk-Characterizations for Natural Herbicides Proposed in Alternative 3 (MSDS).

Acetic Acid (Vinegar) • Eye Risk • Inhalation Risk • Dermal Risk • Ingestion Risk • Cancer Risk • Reproductive Effects	• Immediate pain; may cause eye irritation and possible damage; can cause injury to corneal membrane. • Effects may be delayed. May cause respiratory tract irritation. • May cause severe skin irritation. May cause skin sensitization, an allergic reaction, which becomes evident upon re-exposure to this material. • May cause gastrointestinal irritation with nausea, vomiting and diarrhea. • Not considered to be a carcinogen. • At the highest dose tested (1600 mg/kg/day) in the mouse, the rat and the rabbit, there were no effects on fertilization, or on maternal or fetal survival.
18% Clove Oil/ 30% Citric Acid • Eye Risk • Inhalation Risk • Dermal Risk • Ingestion Risk • Cancer Risk • Reproductive Effects	• Contact with this product will result in eye irritation. • Breathing vapors will cause significant respiratory irritation. • Contact with this product will cause severe skin irritation. • Ingestion of this product could cause burns and destroy tissue in the mouth, throat and digestive tract. • Not considered to be a carcinogen. • Not available.

Natural weed-killers, such as a clove oil-acetic acid (vinegar) mixture, appear to be safe for human health and safety (see Table 10). However, it is important to note that vinegar with acetic acid concentrations greater than 5 percent may be hazardous and should be handled with appropriate precautions. Vinegar solutions of 11-percent strength can cause skin burns and eye injury.

Another plant-killing tool included in Alternative 3 is the Waipuna® hot-foam system. It poses minimal threat to health and safety since no synthetic produced herbicides are used. However, because the foam is very hot, protective clothing and gloves are necessary when using the system. Alternative 3

includes the use of prescribed fire to control invasive species and would have effects similar to Alternative 1.

Cumulative Effects – The area under consideration is the project area within the Forest. Potential effects include the use of prescribed fire on 12,000 acres of land in and around the natural areas; therefore, it is reasonable to include in this analysis the 11 counties in which the Forest is situated. Although the amount of time required for a proposed herbicide (if any) to break down is relatively short, the temporal boundary of ten years was selected because that is the length of the expected life of the effects of invasive species management activities, as well as the extent to which these effects are measurable and meaningful. Five years past was chosen to consider these specific actions because their effects would not be discernible beyond a five-year timeframe.

Past, present and reasonably foreseeable future actions within the analysis area are discussed at the beginning of Chapter 3. Smoke production as a result of prescribed fire has the potential to affect human health and safety in the area; however, adherence to the design criteria will lessen the effects to a minimal level. Smoke production would have no cumulative effect in the project area or adjacent properties because there are minimal direct and indirect effects under all three alternatives. Since the application of herbicides, natural or synthetic, would have no direct or indirect effect on human health or safety, no cumulative effects are anticipated.

Botanical Resources

This section discusses botanical resources and the anticipated effects of the alternatives on those resources. This section is a summary of the Botanical working papers in the project record. The analysis focuses on the environmental effects of the alternatives on the significant and exceptional features for which natural areas were designated and on rare plant resources. Rare plant resources are further divided into plants of specific habitats.

Natural Areas

Alternative 1 – Forested areas would continue their conversion toward shade-tolerant, late-successional forest-types. The understory would become increasingly shaded, preventing oaks and other sun-dependent species from germinating and growing. As dominant canopy trees die, they would be replaced by shade-tolerant trees that have grown into the midstory. The rare community-types, including barrens and seep-springs, would be directly impacted by the lack of prescribed fire and herbicide use.

The barrens communities consist of species that are fire-adapted and fire-dependent, species that rely on a more-open woodland and glade condition in order to compete and support their health and vigor. Without the use of herbicides in several of the barrens communities and in all the seep-spring areas, rare species would eventually wane, being overcome by invasive plants. Consequently, species identified as significant and exceptional features of the natural areas face the threat of extirpation at these sites. Nepalese browntop (*Microstegium vimineum*) is the main culprit in the seep-springs, with Japanese honeysuckle and Amur honeysuckle encroaching into the barrens.

Under the no-action alternative, changes in forest-type due to succession and lack of fire would continue to cause an increase in shade-tolerant species at the expense of the oak-hickory community-type and associated understory species. Plant species that depend on open forest, natural openings or dry environments would likely decline due to the increase in canopy cover. A reduction in the diversity of vegetation would likely result from the absence of fire on the landscape, with the exception of those areas that are currently under a fire regime on the Forest. Additionally, invasive species are likely to increase over time, except in administrative and recreational areas, where invasives are commonly controlled with herbicides.

Many vectors exist to bring invasive species into the project area and many activities could create favorable seedbeds. Without active management, the current spread of invasive species would be expected to continue. Invasive species can cause changes in fuel characteristics and moisture as well as the chemical composition of the soil through allelopathic compounds. These changes could have an adverse impact on sensitive plant species and their habitats.

Alternative 2 – Prescribed fire would kill many seedlings, saplings and vines, opening the understory and increasing sunlight to the forest floor. This would stimulate oak seedlings to sprout even if top-killed during the prescribed fire. Because subsequent prescribed fire may kill a higher proportion of shade-tolerant stems, the relative abundance of oak would likely increase (Brose 2006). Prescribed fire would allow existing oak and hickory seedlings to compete when a new canopy gap is created through fire-induced mortality, windthrow, or other means. Young oak and hickory trees in heavily storm-damaged areas have already been released from overhead competition. Prescribed fire in natural areas would give the species restricted to these fire-adapted and fire-dependent community-types a better chance to germinate and grow into the vacated canopy gaps. The additional use of herbicides to control or eradicate invasive plant species would be beneficial to those plant species that are significant and exceptional features in these natural areas.

Through monitoring, we have concluded that there is minimal overspray onto native grasses when using a grass-specific herbicide on Nepalese browntop. In most cases, Nepalese browntop becomes a dense stand inhibiting the growth of native grasses and other vegetation, so spraying a patch does not cause direct or indirect death or damage to native vegetation at any level of concern. When glyphosate is applied to other invasive plant species, it occasionally kills some of the native species intertwined in the application zone. Only common species are adversely impacted and only for a short time period; within the next year, seeds from adjacent areas easily re-populate a previously sprayed area. Herbicide spraying has not been done where rare plants exist; but, if it is done, these plants would be protected by the placement of a cover or barrier.

This alternative would have beneficial direct and indirect, short- and long-term environmental effects on the 23 natural areas—both from the use of prescribed fire to maintain and enhance the community-types and the use of herbicides to control invasive species. In addition, the use of tree and shrub removal would also benefit the seep-springs and barrens areas, allowing the canopy to become more open and removing those encroaching woody species that are de-watering the seep-springs. Our experience with the application of herbicides at recreation and administrative sites indicates that the direct and indirect effects on native plant species as a result of herbicide application would be negligible. On a larger scale, the same negligible effects on native plant species can be expected under Alternative 2 from the application of herbicides to areas with invasive species infestations. When spraying in areas of known rare plant resources or uncommon species, covers and barriers would be placed to prevent damage to these species.

Alternative 3 – Prescribed fire in Alternative 3 would have the same beneficial direct and indirect, short-term and long-term effects as Alternative 2; however, the rapidly spreading invasive species would have adverse long-term effects on all the natural areas, as well as adverse short-term effects on the natural areas with seep-springs. Prescribed fire alone would not prevent the Nepalese browntop from its swarming behavior in these delicate community-types and, in some situations, could stimulate this aggressive grass while controlling other invasive herbs.

The edges of most of the 23 natural areas are already invaded by multiflora rose, autumn olive, Amur honeysuckle and other aggressive species that are moving into the interior of natural areas. Internally, Nepalese browntop and Chinese yam have invaded the streambanks. These invasives are moving in rapidly, displacing native species in sensitive natural areas. Our experience with the application of herbicides at recreation and administrative sites indicates that the direct and indirect effects on native plant species as a result of herbicide application would be negligible. The same

negligible effects on native plant species can be expected under Alternative 3 from the application of herbicides to areas with invasive species infestations.

The use of a clove oil (eugenol)-vinegar (acetic acid) mixture for plant control in natural areas should kill annuals at the appropriate time of the growing season when they do not have the energy stored to resprout but may be ineffective on most perennials, since the effects are on aboveground parts of the plants. This natural herbicide does not get into the roots and repeat applications are most likely to be needed in order to kill or control the invasives. As when using synthetic herbicides, it would be necessary to cover or provide barriers to rare plants or uncommon species, since this substance can be damaging or detrimental to annual plants, although less so than synthetics.

The hot-foam method would be more difficult to control and would not likely be used in natural areas, since the mobility of the equipment is restricted to a short distance from roads and trails. It could be used on edges of natural areas where roadways exist. The hot-foam method is indiscriminate in its blanching of vegetation; it should only be used in areas where large blocks of invasives are a problem since it would be extremely difficult to protect adjacent desirable vegetation from potential damage or death. This method should be effective on annuals; however, it will be similar in effect to clove oil-vinegar, in that perennials may resprout and require further applications. Repetitive applications on the same plants (generally perennials) would limit the resources necessary to apply treatment to several areas on the Forest; therefore, covering less acreage and allowing invasives to seed and spread at a greater rate than Alternative 2.

Rare Plant Resources

Federally Listed Species – Mead's milkweed (*Asclepias meadii*) is the only plant species federally listed as threatened known to occur on the Forest. None of the alternatives would have any effect on Mead's milkweed since none of the alternatives propose prescribed fire or herbicides where this species occurs. (Mead's milkweed habitat is already being treated with prescribed fire and is responding favorably.)

Regional Forester Sensitive Species (RFSS) and Species with Viability Concern – There are 69 Regional Forester Sensitive Species and 5 species with viability concern reported to occur within the project area. Field reconnaissance of the project area has been conducted for decades by naturalists, researchers, Forest employees and other professionals. The species identified are documented in records, literature, herbaria and databases. These 74 plant species are grouped into eight categories according to their habitats and each is discussed in detail in the biological evaluation in the Botanical Working Papers (project record).

1. Swamps and Floodplain Forests
2. Seep-Springs
3. Streambanks and Creeks
4. Mesic to Dry-Mesic Woodlands
5. Cliffs and Overhangs
6. Dry-Mesic Barrens and Rich Uplands
7. Open Barrens and Glades
8. Lichens on Trees

1. Swamps and Floodplain Forests – This group includes 14 species in wet floodplain forests, wet woodlands, pin oak flatwoods, swamps, spring-fed ditches, or the sandy beaches of lakes: *Carex decomposita* (cypress-knee sedge), *Carex gigantea* (giant sedge), *Carex lupuliformis* (false hop sedge), *Carex socialis* (low woodland sedge), *Chelone obliqua* var. *speciosa* (red turtlehead), *Cynosciadium digitatum* (finger dogshade), *Dichanthelium joorii* (variable panic grass), *Eleocharis wolfii* (Wolf's spikerush), *Heteranthera reniformis* (kidneyleaf mudplantain), *Hottonia inflata* (American featherfoil), *Hydrolea uniflora* (one-flowered false fiddleleaf), *Platanthera flava* var. *flava (palegreen orchid), Schoenoplectus purshianus* (weakstalk bulrush), and *Vitis rupestris* (sand grape).

Alternative 1 – The majority of these species do not rely on prescribed fired for their existence, and fire would not get into swamps and wet floodplain forests with such intensity that it would adversely affect them. Finger dogshade, palegreen orchid, weakstalk bulrush and sand grape may experience indirect adverse effects from the continued encroachment of invasives in the long term (over the next 10 years). The other species do not currently require the use of herbicides or aggressive invasive species management in their habitat. Garlic mustard is making its way into the drier portions of LaRue Swamp via the roadway and appears to survive the periodic flooding.

Other species that may impact these areas include Nepalese browntop, Amur honeysuckle, Japanese honeysuckle, multiflora rose, privet and beefsteakplant. The wetter areas are vulnerable to reed canarygrass, common reed, parrot feather watermilfoil and Eurasian watermilfoil.

Alternative 2 – This alternative would have no adverse effects on species found in swamps, floodplain forests and lake edges. There would be beneficial, indirect, short-term and long-term effects from prescribed fire on finger dogshade at LaRue-Pine Hills. The other species do not inhabit areas that a prescribed fire will generally burn through and, therefore, would experience no effects. Prescribed fire would enhance communities adjoining swamps and floodplain forests. Fires would help retard or kill several invasive species, while allowing the native species to compete better and with more vigor. This indirectly benefits the swamp and floodplain-forest species by being surrounded by more native vegetation and less likely to be influenced by aggressive invasive species.

Herbicide use would also have beneficial, indirect, short- and long-term effects on finger dogshade, palegreen orchid, weakstalk bulrush and sand grape. The use of herbicides on aggressive invasives would mostly occur on the edges of swamps and along roadways. Controlling the movement of invasive species and maintaining the native ecosystem of the swamps can be accomplished with little to no use of herbicides in the swamp areas; however, the floodplain forests may need some herbicide use where encroaching invasives are moving into the communities inhabited by RFSS and species with viability concern.

Alternative 3 – Alternative 3 would have the same environmental effects on swamp and floodplain-forest species as Alternative 1 as it pertains to the lack of herbicide use, even though the use of a clove oil-vinegar or hot-foam application may be effective in the short-term on some perennial invasives and in the long-term on some of the annual invasives. Re-sprouting of the invasives will be a continuous control problem. This alternative would have the same environmental effects as Alternative 2 as it pertains to prescribed burns.

2. Seep-Springs – This group includes six species in seep-springs and adjacent mesic barrens: *Bartonia paniculata* (twining screwstem)*, Isotria verticillata* (large whorled pogonia)*, Platanthera clavellata* (small green wood orchid)*, Rudbeckia fulgida* var. *sullivantii* (Sullivant's coneflower)*, Sagittaria australis* (longbeak arrowhead) and *Thelypteris noveboracensis* (New York fern).

Alternative 1 – The above species would experience direct and indirect, adverse, short- and long-term effects from the lack of prescribed fire and continued invasive species encroachment. The seep-springs are the most threatened community-type on the Forest, and major portions of these seeps have been critically impacted by encroaching woody native species, such as maples, and non-native species, such as Nepalese browntop and Japanese honeysuckle. Maples are de-watering the seeps, while Nepalese browntop is taking over the habitat crucial to these species. The seep-springs and their adjacent mesic barrens are vulnerable to plant-community extirpation if the damage is not reversed or controlled immediately. We anticipate that, without human intervention, virtually none of these species can survive in the seeps.

Alternative 2 – The seep-springs species and the Sullivant's coneflower, which occurs in the adjacent mesic barrens of one of the springs, are found within fire-adapted communities. Prescribed fire would have beneficial, direct and indirect, short- and long-term effects on these species, as the fire helps restore the community-types surrounding them. Sullivant's coneflower was discovered following a prescribed burn and tree-girdling activities at the Kickasola seep during the spring of 1993. It was also found at Poco Cemetery North following the prescribed burn of 1995. With fire suppression and the canopy starting to close in, this species has not been seen in the last 15 years.

Tree and shrub removal may also be necessary at some of the springs where woody encroachment is changing the hydrology to a drier one. The de-watering of these seeps is also detrimental to this community-type; de-watering at one of the seeps is suspected to have led to the disappearance of the longbeak arrowhead. The use of herbicides to eradicate or control Nepalese browntop and Japanese honeysuckle is of upmost importance in the short term, resulting in beneficial effects, both short-term and long-term. The infiltration of Nepalese browntop into the seep-springs will certainly extirpate species such as the small and delicate twining screwstem unless immediate action is taken.

Alternative 3 – Alternative 3 would have the same effects on seep-spring species as Alternative 1 as it pertains to the continued encroachment of invasive species, and Alternative 2 as it pertains to prescribed burns. Some tree and shrub removal (or girdling) would also be implemented in this alternative, which would have beneficial, direct and indirect effects by relieving the seeps from de-watering by trees and partially opening the canopy for more sunlight to the forest floor. Alternative 3 would also have some direct, short-term, beneficial effects from the use of clove oil-vinegar, which may be able to help control Nepalese browntop if applied at the appropriate time of the growing season. Re-sprouting of perennial plants is expected with the clove oil-vinegar solution as well as with the hot-foam method, although hot foam would likely not be used because of the distances of the seeps from trails and roads.

3. Streambanks and Creeks – This group includes nine species in moist thickets, streambanks, sandy soil of mesic forests near streams, rich mesic woodlands, cool moist ravines, creeks prone to flooding, springfed streambeds, and sandbars of creeks: *Amorpha nitens* (shining false indigo)*, Dichanthelium yadkinense* (Yadkin's panicgrass)*, Lilium superbum* (Turk's-cap lily)*, Lysimachia fraseri* (Fraser's loosestrife)*, Oxalis illinoensis* (Illinois wood sorrel)*, Plantago cordata* (heartleaf plantain)*, Rhynchospora glomerata* (clustered beaksedge)*, Stenanthium gramineum*(eastern featherbells) and *Synandra hispidula* (Guyandotte beauty).

Alternative 1 – The majority of the species that occur along the streambanks and creeks will not be affected in the short term by Alternative 1; but, in the long term, over the next 10 years, most may experience adverse, indirect effects from the continued encroachment of invasive species. In many cases, the lack of prescribed fire would also have adverse, indirect, long-term effects on these species. Many of these species are not located in areas that a prescribed fire would reach; but the adjacent burned areas would have an influence on the habitat they occupy.

One species, Fraser's loosestrife, would have short-term adverse effects from the invasion of Chinese yam in its habitat. This invasive has infested the banks of Lusk Creek and threatens the native integrity of this high-gradient stream and its associated flora. Fraser's loosestrife has not been seen since 1999 at Lusk Creek; however, a seedbank may still be available if invasive species are eradicated or controlled. Yadkin's panicgrass is currently threatened by Nepalese browntop along the streams it inhabits. This species cannot compete with the dense matting of the Nepalese browntop.

Alternative 2 – Alternative 2 would have beneficial, direct and indirect, short- and long-term effects on Yadkin's panicgrass (Jackson Hole), Turk's-cap lily (Fink Sandstone Barrens), and clustered beaksedge (Bell Smith Springs) from the use of prescribed fire. Prescribed fire is not planned for the areas in which the other six species occur, so there would be no direct or indirect effects on them from

fire. With regard to herbicide use, Alternative 2 would have beneficial, direct and indirect, short- and long-term effects from the elimination or control of invasive species that compete for the same habitat of all of these species.

Alternative 3 – Alternative 3 would have the same effects on the nine species that occur along streambanks as Alternative 1 as it pertains to the continued encroachment of invasive species, and Alternative 2 as it pertains to prescribed fire. Alternative 3 would also have direct, short-term, beneficial effects from the use of clove oil-vinegar, which may be able to help control the Nepalese browntop if applied at the appropriate time of the growing season; however, this substance would be virtually ineffective in the long term on Japanese honeysuckle and other woody and perennial species. Re-sprouting of perennial plants is expected with the clove oil-vinegar, as well as with the hot-foam method, although hot foam would likely not be used because of the distances of the streams and creeks from trails and roads.

4. Mesic to Dry-Mesic Woodlands – This group includes nine species in mesic woodlands, dry-mesic to mesic rocky upland woods, generally north-sloped woods, talus slopes, thickets, rich woods, rich woods with calcareous bluffs, springy ground, bottomlands and their floodplains: *Actaea rubifolia* (Appalachian bugbane), *Carex oxylepis* var. *pubescens* (sharpscale sedge), *Chamaelirium luteum* (fairywand), *Cladrastis kentuckea* (Kentucky yellowwood), *Dryopteris goldiana* (Goldie's woodfern), *Juglans cinerea* (butternut), *Panax quinquefolius* (American ginseng), *Poa alsodes* (autumn bluegrass) and *Styrax grandifolia* (bigleaf snowbell).

Alternative 1 – The majority of the species that occur along the moister areas of mesic and dry-mesic woodlands would not be affected in the short term by Alternative 1; but, in the long term, over the next 10 years, most could experience adverse effects from the continued encroachment of invasive species. In particular, Nepalese browntop, garlic mustard, multiflora rose, autumn olive and Chinese yam threaten habitats for species such as the sharpscale sedge, Goldie's woodfern, butternut and autumn bluegrass. Many of these are not located in areas that would be reached by prescribed fire; but any adjacent burned areas would have a beneficial influence on their habitats.

Alternative 2 – Alternative 2 would have beneficial, direct and indirect, short- and long-term effects on American ginseng from prescribed fire. Prescribed fire is not planned for the areas in which the other eight species occur, so there would be no direct or indirect effects from fire. With regard to herbicide use, Alternative 2 would have beneficial, direct and indirect, short- and long-term effects resulting from the elimination or control of invasive species that compete for the same habitat of all of these species.

Alternative 3 – Alternative 3 would have the same effects on the nine species as Alternative 1 as it pertains to the continued encroachment of invasive species, and Alternative 2 as it pertains to prescribed burns. Alternative 3 would also have direct, short-term, beneficial effects from the use of clove oil-vinegar, which may be able to help control the Nepalese browntop if applied at the appropriate time of the growing season; however, this substance would be virtually ineffective in the long term on Japanese honeysuckle and other woody and perennial species. Re-sprouting of perennial plants is expected with the clove oil-vinegar, as well as with the hot-foam method, although hot foam would likely not be used because of the distances of these areas from trails and roads.

5. Cliffs and Overhangs – This group includes nine species in dry or moist-shaded or open sandstone or limestone cliffs and chert outcrops, driplines under sandstone cliffs, moist humid crevices of sandstone overhangs, dry to xeric upland bluff tops and sandstone ledges: *Asplenium bradleyi* (Bradley's spleenwort), *Asplenium resiliens* (black-stem spleenwort), *Dennstaedtia punctilobula* (eastern hay-scented fern), *Dodecatheon frenchii* (French's shootingstar), *Hylotelephium telephioides* (Allegheny stonecrop), *Lonicera dioca* var. *glaucescens* (limber honeysuckle), *Lonicera flava* (yellow honeysuckle), *Trichomanes boschianum* (Appalachian bristle fern) and *Waldsteinia fragarioides* (Appalachian barren strawberry).

Alternative 1 – These species do not rely on fire for their existence and fire is unlikely to reach the cliff faces and overhangs with such intensity that it would adversely affect them. Prescribed fire should be applied to the area surrounding the habitat of several of the species to enhance them and their vigor. These species would likely experience adverse, indirect, long-term effects from the continued encroachment of invasive species over the next 10 years. Invasive species currently impacting their habitats include Nepalese browntop, Amur honeysuckle, Japanese honeysuckle, and multiflora rose. In addition, there is an overabundance of native poison ivy and Virginia creeper.

Alternative 2 – This alternative would have no adverse effects on the nine species. There would be beneficial, indirect, short-term and long-term effects from the proposed prescribed fire. Prescribed fire would enhance the communities adjoining cliffs and overhangs; although, being low in intensity, it would be incapable of passing up the nearly bare cliff/s. Fires would help retard or kill several invasive species, while allowing the natives to compete better and with more vigor. This would indirectly benefit the cliff and overhang species by improving the native vegetation surrounding them and diminishing the influence of aggressive invasives. Herbicide use would have beneficial, direct and indirect, short- and long-term effects on these rare species. The use of herbicides on aggressive invasives would mostly occur along the edges of cliffs and away from beneath overhangs. Controlling the movement of invasive species and maintaining the native ecosystem of the cliff communities and overhang species can be accomplished with little to no use of herbicides in the overhang areas and minimal herbicide use where encroaching invasives are moving into the cliff communities.

Alternative 3 – Alternative 3 would have the same effects on the species as Alternative 1 as it pertains to the continued encroachment of invasive species, and Alternative 2 as it pertains to prescribed fire. Alternative 3 would also have direct, short-term, beneficial effects with the use of clove oil-vinegar, which may be able to help control annual invasives if applied at the appropriate time of the growing season; however, this substance would be virtually ineffective in the long-term on Japanese honeysuckle, Virginia creeper and other woody and perennial species. Re-sprouting of perennial plants is expected with the clove oil-vinegar, as well as with the hot-foam method, although hot foam would likely not be used because of the distances of these areas from trails and roads.

6. Dry-Mesic Barrens and Rich Uplands – This group includes five species in a combination of rich, north-facing wooded slopes; dry to moist or mesic, rich upland woods; and mesic and dry-mesic prairies and barrens: *Cypripedium parviflorum* var. *pubescens* (greater yellow lady's slipper), *Matelea obliqua* (climbing milkvine), *Polytaenia nuttalii* (Nuttall's prairie parsley), *Sanicula smallii* (Small's blacksnakeroot) and *Silene ovata* (Blue Ridge catchfly).

Alternative 1 – Alternative 1 would have adverse effects in the long term on the greater yellow lady's slipper, climbing milkvine and Nuttall's prairie parsley in the areas that would not be burned. These species occur in fire-adapted and fire-dependent communities that are being encroached upon by maple trees, shrubs and non-native invasive species. These species respond well to fire and are able to compete better in their habitat when it is burned. Small's blacksnakeroot and Blue Ridge catchfly are not dependent on fire; but will not be adversely impacted if fire is applied to their habitats. All the species would experience adverse impacts in the long term with continued encroachment of invasive species. Invasives currently impacting their habitats include Nepalese browntop, Amur honeysuckle, Japanese honeysuckle, multiflora rose and an overabundance of poison ivy. With time, after another 10 years, these rare species may be outcompeted by the aggressive invasives and become extirpated from their habitats.

Alternative 2 – Alternative 2 would have beneficial, short- and long-term effects on climbing milkvine in the areas that will be burned. The other four species, in the dry-mesic barrens and rich uplands, are not in areas planned for prescribed fire. Alternative 2 would also have beneficial, short- and long-term effects from the use of herbicide. Controlling and/or eradicating aggressive invasives that

threaten these species and their community-type would greatly enhance the ability of these rare species to compete and persist.

Alternative 3 – Alternative 3 would have the same effects on these species as Alternative 1 as it pertains to the encroachment of invasive species, and Alternative 2 as it pertains to prescribed burns. This alternative would also have direct, short-term, beneficial effects from the use of clove oil-vinegar, which may be able to help control the Nepalese browntop if applied at the appropriate time of the growing season; however, this substance would be virtually ineffective in the long-term on Japanese honeysuckle and other woody and perennial species. Re-sprouting of perennial plants is expected with the clove oil-vinegar, as well as with the hot-foam method, although hot foam would likely not be used because of the distances of these areas from trails and roads.

7. Open Barrens and Glades – This group includes 21 species in open barrens and prairies, old native fields, dry rocky north-sloped woodlands and adjacent dry limestone cliffs and sandstone outcrops, bluff-top communities, rich north-facing wooded slopes, dry open woodlands on rocky ledges, limestone and sandstone glades, open roadsides and dry cherty limestone slopes in woodlands: *Buchnera americana* (American bluehearts), *Calamagrostis porteri* var. *insperata* (Porter's reedgrass), *Carex communis* (fibrous-root sedge), *Cirsium carolinianum* (soft thistle), *Dichanthelium ravenelii* (Ravenel's rosette grass), *Echinacea simulata* (wavyleaf purple coneflower), *Eupatorium hyssopifolium* var. *hyssopifolium* (hyssop leaf thoroughwort), *Festuca paradoxa* (clustered fescue), *Gentiana alba* (plain gentian), *Helianthus silphioides* (rosinweed sunflower), *Hexalectris spicata* (spiked crested coralroot), *Pinus echinata* (shortleaf pine), *Polygala incarnata* (procession flower), *Pycnanthemum albescens* (whiteleaf mountainmint), *Pycnanthemum torrei* (Torrey's mountainmint), *Rhexia mariana* (Maryland meadowbeauty), *Rhododendron prinophyllum* (early azalea), *Silphium pinnatifidum* (tansy rosinweed), *Silphium trifoliatum* (whorled rosinweed), *Trifolium reflexum* (buffalo clover) *and Vaccinium stamineum* (deerberry).

Alternative 1 – Alternative 1 would have adverse effects on these species in the long term in the areas that will not be burned. These species occur in fire-adapted and fire-dependent communities that are being encroached upon by maple trees, shrubs and non-native invasive species. They respond well to fire and are able to compete better in their habitat if it is burned. They would also experience adverse impacts in the long term from continued encroachment of invasive species. Invasives currently impacting their habitat include Nepalese browntop, Amur honeysuckle, Japanese honeysuckle, multiflora rose and an overabundance of poison ivy. Prescribed fire is an important component for their continued existence and the community-types they inhabit.

Alternative 2 – Alternative 2 would have beneficial, short- and long-term effects on any of these species in areas that would be burned. Alternative 2 would also have beneficial, short- and long-term effects from the reduction in invasive species. Controlling and/or eradicating aggressive invasive species that threaten these species and their community-type will greatly enhance the ability of these rare species to compete and persist.

Alternative 3 – Alternative 3 would have the same effects on these species as Alternative 1 as it pertains to the continued encroachment of invasive species, and Alternative 2 as it pertains to prescribed fire. Alternative 3 would also have direct, short-term, beneficial effects from the use of clove oil-vinegar, which may be able to help control the Nepalese browntop if applied at the appropriate time of the growing season; however, this substance would be virtually ineffective in the long-term on Japanese honeysuckle, multiflora rose, Amur honeysuckle and other woody and perennial species. The hot-foam method would likely not be used because of the distances of these areas from trails and roads.

8. Lichens on Trees – A single lichen species, *Phaeophyscia leana* (wreath lichen), is found in this habitat along the Ohio River.

Alternative 1 – Alternative 1 is not expected to have any environmental effects on the wreath lichen. As long as this lichen is capable of out-competing other lichens with the aid of natural flooding at Tower Rock, it would remain in a stable condition.

Alternative 2 – Alternative 2 is not expected to have any environmental effects on the wreath lichen. No prescribed burns are scheduled for its habitat and herbicides would not be used on trees on which this species is present.

Alternative 3 – Alternative 3 is not expected to have effects on the wreath lichen since no prescribed fires are scheduled for its habitat and no herbicides, clove oil-vinegar, or hot foam would be used on trees on which this species occurs.

Cumulative Effects – The geographic boundary for the cumulative effects analysis of botanical resources is the Forest boundary itself. This boundary was selected because Forest management actions, natural processes and other activities that occur on the Forest are confined to the Forest itself and the areas immediately adjacent. The temporal boundary for the cumulative effects analysis of botanical resources is from the past ten years to ten years in the future. The past temporal boundary was selected because impacts from activities generally fade into the landscape in ten years. Ten years in the future is long enough to accurately gauge management effects and short enough that any unforeseeable deleterious effects could be addressed, reversed and/or mitigated.

Alternative 1 – Considering the effects of the past, present and reasonably foreseeable future actions (listed at the beginning of Chapter 3), the cumulative effects of implementing Alternative 1 would be generally adverse. In terms of the control and/or eradication of invasive species, the application of prescribed fire would contribute minimally to the effort. Without the application of herbicides, the invasion of harmful species would continue from within and outside the Forest.

Alternative 2 – Considering the effects of the past, present and reasonably foreseeable future actions, the cumulative effects of implementing Alternative 2 would be generally beneficial. The affected natural areas and the rare plant resources would be protected by the application of herbicides on and off the Forest, in spite of recreational activities on the Forest that aid in the spread of invasives. The application of prescribed fire, both on and off the Forest, would also contribute beneficially to the eradication or slowing of the spread of invasives.

Alternative 3 – The cumulative effects of implementing Alternative 3 would be generally similar to those of Alternative 1. The application of clove oil-vinegar or hot foam would be limited in scope and effectiveness and, considered together with the effects of the past, present and reasonably foreseeable future actions, would contribute minimally to the control or eradication of invasive species.

Watershed Resources

Soil – The soils in the project area are nearly all silt loams, which have low rock content. Many of these soils developed in a layer of loess, or silt-sized particles transported by wind. In some places, this loess layer is thin and the soils developed in both loess and the underlying sandstone or shale bedrock. Many of the bottomland and floodplain soils were developed in alluvial, or water-transported, material. Some of the soils are upland soils and erosion ranges from slight at gentler slopes (less than five percent) to high at steeper slopes (above 18 percent). Some of the bottomland soils are classified as floodplain soils and some are identified as hydric soils. Nearly all the soil mapping units have a high potential for compaction. Most of the soils have slight limitations for prescribed burning (NRCS ratings).

Soils-mapping units are also delineated according to pesticide leaching-potential and pesticide runoff-potential. Most of the soils-mapping units have slight-to-moderate leaching potential and moderate-to-high pesticide runoff potential. Pesticide runoff is not expected on this project as pesticides would be applied in precise areas and according to the design criteria.

Water – Water-quality information is provided in tables in the working paper appendices (project record). Overall, the water quality of Forest streams is very good. A few are listed as impaired, but that is generally related to mining, agriculture, or other off-Forest impacts. Table 11 presents the acreage of National Forest System lands in our major watersheds.

Air – The Illinois EPA air-quality report was consulted (IEPA 2009). The air-quality data from monitoring stations in the airsheds in which the project area is located can be found in the working paper appendices (project record). Massac County generally has the highest estimated levels of the five monitored pollutants—carbon monoxide, nitrogen oxides, particulate matter, sulfur dioxide and volatile organic matter—and Pope County the lowest. Atmospheric deposition in southern Illinois has been becoming less acidic over the past few decades. Sulfates have decreased over the long term while nitrate and ammonia levels have fluctuated. None of these changes are attributed to Forest management. Overall, air quality across the Forest is good.

The Illinois EPA has developed a statewide Smoke Management Plan to address smoke from prescriptive fires used to achieve resource benefits. The goals of the plan are to coordinate with land managers to develop a basic framework of procedures and requirements for managing smoke from prescribed fires, to avoid significant deterioration of air quality and potential national ambient air quality standards violations, and to mitigate the nuisance and public-safety hazards posed by smoke intrusions into populated areas.

Table 11. HUC4 Watersheds containing Project Area

Watershed	Forest Service Acres	Non- Forest Service Acres	Total Acres
Big Muddy River	48,809	1,478,053	1,526,862
Cache River	14,815	219,056	233,871
Lower Ohio River	6,998	375,685	382,683
Lower Ohio River-Bay Creek	117,771	265,186	382,957
Saline River	45,659	707,549	753,208
Upper Mississippi River-Cape Girardeau	51,607	384,545	436,152
TOTAL	**285,658**	**3,430,074**	**3,715,732**

Prescribed fires on the Forest are in compliance with this plan and the Forest Plan and follow detailed burn plans and strict prescription standards. Prescribed fires also are evaluated using smoke-management models (FOFEM, V-Smoke and/or SASEM*).* Recent burns on the Forest, the Blowdown project, One Horse Gap, Cedar Grove, Eagle Mountain, and others, raised no concerns and were in compliance with the Forest Plan and followed burn plans and prescriptions.

Alternative 1 – No new management activities would occur; therefore, land productivity would be unaffected. Soils would be impacted by the regular maintenance and use of roads, by planned and ongoing natural resource management activities and by recreational activities such as hiking and horseback-riding. Current runoff and erosion patterns would be maintained, assuming the general

absence of wildfire. In the absence of fire, the Forest Service Water Erosion Prediction Projects model predicts an upland erosion rate of less than one ton per acre per year on steep slopes. Soil organic matter is expected to increase, accompanied by an increase in microorganisms and fungi.

There would be no direct or indirect effects on soil or water from proposed management activities. Soil quality and productivity would be increased in the long term as organic matter decomposes. Water quality would be maintained at current levels, considering anticipated future actions and assuming inputs from private land remain stable. Some geologic erosion could be expected to continue and some of this sediment could be expected to enter the streams. This alternative would likely result in less soil erosion, compaction, sediment load and percentage of bare ground than the other alternatives. Since there would be no project-related effects under this alternative, cumulative effects would be minimal.

Alternative 2 – Activities associated with invasive species control include prescribed burning, the application of herbicide, and mechanical and manual treatments. These activities have the potential to expose soil and cause some compaction. Exposed soil can erode at a faster rate than normal geologic rates. Soil particles can be loosened and transported in overland flow. Direct effects would be minimized through preventative and mitigating actions. Preventative measures and project design criteria are based on Illinois Forestry Best Management Practice Guidelines and Forest Plan standards and guidelines.

The effects of prescribed burning on soil erosion and nutrient loss are related to the severity of the burn. These effects are complex and depend on a variety of factors, but certain generalizations are relatively consistent. Burning has the most pronounced effect on the forest floor, where carbon, nitrogen and sulfur are volatilized, and calcium, magnesium, potassium, phosphorus and other elements are left as ash. The ash is leached by rainfall into the mineral soil, which increases its base saturation and pH (Alban 1977). Increased nutrient availability at higher pH's may result in beneficial plant responses following fire (Van Lear and Kapeluck 1989). The beneficial response of plants leads to less soil erosion because plants hold the soil and slow the impact of rainfall. These findings coincide with results from a variety of other reviews and studies (DeBano 1998, Liechty *et al.* 2004, and Neary *et al.* 2005).

Low-intensity prescribed fire would not be expected to have an adverse effect on the quantity of water flow, nutrient budgets or soil quality over the long term. Prescribed fire can reduce organic-matter content and increase the loss of soil organisms through erosion. However, monitoring data from prescribed fires on the Forest show that an average of one to two centimeters of litter are consumed, with the majority of litter unburned (Soil and Water working paper). Repeated fires to kill non-native invasive species and mesophytic species in order to allow oak to establish may be necessary to achieve multiple-use objectives (Nowacki, Region 9 Ecologist, personal communication 2010). Forest burns are typically low-intensity–low-consumption burns. Burning that achieves variable consumption in mosaic patterns can provide substrate and habitat for microbial re-colonization following a fire. Monitoring shows this pattern in Forest burns.

Fireline construction associated with prescribed burning would be done under this alternative. Erosion levels would vary depending on climatic conditions, slope, soil texture and other factors. Erosion-control measures would reduce these levels to the minimum. Ground-disturbing activities, particularly in wet-soil conditions, would have the potential to degrade soil structure, especially on soils with fragipans present. The hazard to these soils would result from machine-based fireline construction.

Some landscape-scale prescribed fires are ignited on the Forest by means of dropping “ping-pong” balls containing potassium permanganate—often used to treat drinking water and as a disinfectant—injected with ethylene glycol (automotive antifreeze). These two substances react together in the sphere and begin an exothermic reaction, at which point they are dropped from an aircraft.

Potassium permanganate and ethylene glycol are highly reactive and ignite easily. In the unlikely event that the two do not ignite, potassium permanganate is a strong oxidizing agent that will react with organic matter without creating any toxic byproducts. Ethylene glycol, on the other hand, is toxic if ingested. It is, however, readily biodegradable in the environment within 1 to 21 days, with much of the primary degradation occurring within three days. Ethylene glycol is not known to bio-accumulate (Peterson and Gallagher, personal communication 2010). As one substance reacts with organic matter without creating toxic byproducts and the other substance is biodegradable and not known to bio-accumulate, no adverse effect on watershed resources is expected from this action.

Synthetic Herbicide Application – Five herbicides are proposed for use: clopyralid, glyphosate, picloram, sethoxydim and triclopyr. These herbicides would have a minimal impact on soil and water resources. In most cases, soil microorganism populations would increase in the presence of these herbicides but, these increases would be short-lived (6-12 months).

Clopyralid – Clopyralid is a broadleaf-selective herbicide that is degraded almost entirely by soil microbes and is not susceptible to photo- or chemical degradation. Once in soil, the chemical rapidly dissociates and becomes extremely soluble in water. Although its inability to bind with soils and its persistence imply that it has the potential to be highly mobile and a contamination threat to water resources and non-target plant species, no extensive offsite movement has been documented. It is degraded almost entirely by microbial metabolism in soils and aquatic sediments. As proposed for use, clopyralid would be applied to the most susceptible broadleaf, leguminous and composite plants. Its direct effects would be limited to the targeted plants.

Glyphosate - Glyphosate is a non-specific herbicide that is readily metabolized by soil bacteria, and many species of soil microorganisms use it as a sole source of carbon. There is little information suggesting that glyphosate would be harmful to soil microorganisms under field conditions and a substantial body of information indicating that glyphosate is likely to enhance or have no effect on soil microorganisms. Most field studies involving microbial activity in soil after glyphosate exposure note an increase in microorganisms and/or activity. While the mechanism of this apparent enhancement is unclear, it is plausible that glyphosate treatment causes an increase in pathogenic fungi in soil (sometimes noted in field studies) because it is used as a carbon source by the fungi and/or treatment results in increased nutrients for fungi. There is no indication that the transient enhancement of populations of soil fungi or bacteria result in any substantial or lasting damage to soil ecology (Durkin 2003).

The most widely used type of surfactants in glyphosate formulations are known as ethylated amines. POEA (polyoxy-ethyleneamine) has been frequently mentioned as a surfactant, but in fact it refers to a group of ethylated amine products used in glyphosate formulations. The principal manufacturer that markets the chemical is aware of the irritant and toxic potential of the surfactants in general and has developed new surfactants, none of which has toxic effects. This information is taken from an article that first appeared in *Pesticides News* No.33, September 1996. In addition, the relatively small amount of glyphosate and surfactant applied is not expected to have an adverse effect on watershed resources.

Picloram - In heavy clay soil, picloram has a half-life of slightly over two months. However, when more organic material is present, the half-life nearly doubles. Breakdown by soil microorganisms occurs slowly, resulting in the formation of carbon dioxide and the release of a chloride ion. The compound is mobile and relatively persistent in soil and, therefore, can be leached to underground

water. Because of the relative toxicity of this chemical, it is proposed for use only as a treatment on kudzu stumps. It would be brushed on the stump to prevent the growth of new sprouts at a time when rainfall was not expected. The minimal amount proposed for use would have no direct effect other than on the target plant.

Sethoxydim - Sethoxydim targets grasses. It is moderately to slightly toxic to aquatic species, but has a low persistence in soil and underground water. It has a very low volatility and a weak tendency to adsorb to soil particles. In field tests, sethoxydim did not leach below the top four inches of soil, and it did not persist. On soil, photodegradation of sethoxydim takes less than four hours. The disappearance of sethoxydim is primarily due to action by soil microbes. In water, photodegradation of sethoxydim takes less than one hour. Considering the likely amount of this chemical that would be applied over ten years, direct effects would be on the target grasses, with no measurable effect on soils or water.

Triclopyr - Triclopyr is practically non-toxic to fish and aquatic invertebrates. In soil and aquatic environments, the chemical formulations rapidly convert to an acid that is neutralized to a salt. Triclopyr is not strongly adsorbed to soil particles, has the potential to be mobile and is fairly rapidly degraded by soil microorganisms. Its half-life in soil ranges from 30 to 90 days, depending on the soil-type and environmental conditions, with an average of about 46 days. The chemical readily breaks down in sunlight and rapidly degrades in soil. Used as proposed, triclopyr would have minimal direct effects other than on target plants.

Mechanical Methods – Pulling, digging, cutting, mowing, tilling and smothering would have minimal to no effects on soil or water. Hack-and-squirt and torching would have minimal impact on any watershed resources. Overall, these methods would have a minor impact on soil erosion, compaction, sediment load and the percentage of bare ground. These impacts would occur in individual, widely spread watersheds and should not impact soil productivity. Affected areas would be scattered across the landscape and minimal soil would actually be transported off-site.

Table 12. Comparison of Herbicide Active Ingredient (AI) Application Quantity (in Pounds) on National Forest Land vs. Agricultural Land (Calculating at Same Application Rate)

Herbicide	Forest Service Lands		Agricultural Land	
	AI / 500 Acres	AI / 3000 Acres	AI / HUC6 629,936 Acres	AI / HUC4 1,838,716 Acres
Clopyralid	250	1,500	NA	NA
Glyphosate	1,200	7,200	1,511,846	4,412,918
Sethoxydim	188	1,128	NA	NA
Triclopyr	1,875	11,250	NA	NA
TOTAL all herbicides	**3,513***	**21,078****	**1,511,846**	**4,412,918**

Forest Service proposed use is:
* 0.002% of HUC6 Agricultural Use and 0.0008% of HUC4 Agricultural Use, and
** 0.014% of HUC6 Agricultural Use and 0.005% of HUC4 Agricultural Use

Cumulative Effects – The cumulative effects of all the activities proposed in Alternative 2, considered together with past, present and reasonably foreseeable future actions, would be imperceptible and non-measurable. The annual application of herbicides by the Forest is limited to 500 acres per HUC6 watershed, up to 3,000 acres Forest-wide. Considering the vast amounts of herbicides and pesticides applied on the acres of agricultural fields within the HUC6 and larger HUC4 watersheds that contain the Forest—1,511,846 and 3,188,076 acres, respectively—the amount of herbicide use proposed by the Forest is infinitesimal. Thus, the cumulative effects of the proposed herbicide use would be so insignificant as to be virtually non-existent (see Table 12).

The prescribed burning would have no measurable cumulative effects when considered together with the effects of past, present and reasonably foreseeable future actions on and off the Forest. Air-quality monitoring this year has shown that any effects of fire on the Forest persist for only a very short time, with no cumulative effects, and our soils monitoring indicates that most of the duff on the ground before a burn remains after a burn.

***Alternative 3* – Prescribed Fire** - The application of prescribed fire in this alternative would have the same direct and indirect effects as Alternative 2.

Natural Herbicide Application – *Clove Oil-Vinegar Solution* – Clove oil (eugenol) is expected to be short-lived and rapidly dissipated by volatilization and atmospheric deposition. Eugenol is broken down rapidly by soil microbes. One study found that *Pseudmonas fluorescens* bacteria (common soil bacteria) degraded eugenol. As eugenol volatilizes rapidly and is broken down rapidly in soils through microbial activity, it is not considered to be a potential underground water contaminant, and substantial surface-water runoff is not anticipated. When dissolved in water, eugenol volatilizes slowly in the air and can occur in wet soils as well, though microbial degradation may occur in soils first. Air transport of eugenol can occur after application by spray drift and over time by volatilization (Marin Municipal Water District 2008). The direct and indirect effects of the application of the clove oil-vinegar natural herbicide would be similar to the minimal effects of herbicide use in Alternative 2.

Mechanical and Combination Methods – The effects in this alternative of the mechanical and combination methods would be similar to the effects in Alternative 2.

***Cumulative Effects* –** The cumulative effects of this alternative would be similar to those of Alternative 2, the only difference being the use of natural herbicides instead of synthetic herbicides. Even though repeated treatments of natural herbicide might be required, the cumulative effects would be virtually the same as described under Alternative 2: so insignificant as to be virtually non-existent (see Table 12).

Wildlife Resources

This section discusses the wildlife resources within the project area and the effects of the alternatives on these resources. Two federally listed species are known in the project area, the Indiana bat and the gray bat, and seven other federally listed or candidate species may have potentially suitable habitat in the Big Muddy River and/or some perennial streams on the Forest that are direct tributaries of the Mississippi and/or Ohio Rivers. Twenty-seven Regional Forester Sensitive Species, nine wildlife species of viability concern, and five management indicator species are known or suspected from the project area. This section is a summary of the wildlife working papers and biological evaluations prepared for this project. More detail can be found in those documents (project record). Table 13 summarizes effects on the five Management Indicator Species.

Significant portions of the Forest, including natural areas, openlands and timber stands, have been surveyed many times by numerous researchers from Southern Illinois University, IDNR Heritage Staff and Forest wildlife biologists and botanists over the last 30 years, and especially since the early 1970s.

The geographic boundary of the analysis of effects on endangered, threatened, Regional Forester Sensitive Species and species with viability concern will be different for each species based upon its distribution and/or habitat distribution in the project area. The temporal boundary for the effects analysis is the estimated 10-15 year life of the Forest Plan for present and future actions. Actions on non-federal land in the project area vicinity are anticipated to be similar to present actions on these areas during this timeframe. The temporal boundary for past actions is the last ten years. Any projects beyond ten years in the past are considered part of the baseline.

Table 13. Summary of Effects on Management Indicator Species			
Common Name	**No Action**	**Alternative 2**	**Alternative 3**
Northern bobwhite	Continued loss of habitat, downward trending population.	Improvement of habitat, decrease in invasive plant, increased native herbaceous ground cover, seed production, plant diversity, increase in oak-hickory forests and more early successional forest and field habitats. Increase in population.	Improvement of habitat, herbaceous ground cover, seed production, plant diversity, increase in oak-hickory forests and more early successional forest and field habitats. Adverse effects from not completely controlling invasive plants.
Wood thrush	Adverse effect on native overstory and understory plant species and thus on food and cover for most of upland and hardwood forest dependent species.	Beneficial effects: Improved native overstory and understory plants and/or native prey that depend upon them are maintained or improved.	Their native habitats that provide food and cover would be improved and/or maintained, although not to the extent of Alt 2. Adverse effects from not completely controlling invasive plants.
Yellow-breasted chat	Continued loss of habitat, downward trending of population.	Maintenance and improvement of native plant foods, nesting cover, and insect prey for the species. Net indirect effects would probably be an increase in populations of the species in both the short and long terms.	Their native habitats that provide food and cover would be improved and/or maintained, although not to the extent of Alt 2. Adverse effects from not completely controlling invasive plants.
Scarlet tanager	Adverse effects to nesting habitats, native plant foods and insect prey for the species, resulting in declines in populations for the species in the project areas and across the entire Forest.	Maintenance and improvement of native plant foods, nesting cover and insect prey for the species. Net indirect effects would probably be an increase in populations of the species in both the short and long terms.	Beneficial effects from prescribed burning and maintaining oaks. Adverse effects from not completely controlling invasive plants.
Worm-eating warbler	Adverse effect on native overstory and understory plant species and thus on food and cover for most of upland and hardwood forest dependent species.	Beneficial effects: Improved native overstory and understory plants and/or native prey that depend upon them are maintained or improved.	Their native habitats that provide food and cover would be improved and/or maintained, although not to the extent of Alt 2. Adverse effects from not completely controlling invasive plants.

Federally Listed Species – The project area contains habitat for the Indiana bat (*Myotis sodalis*) and the gray bat (*Myotis grisescens*). Indiana bats have been documented in the project area and currently or historically in most counties in southern Illinois (Carter 2005; Herkert, ed. 1992). Gray bats have been documented within or directly adjacent to the Forest in Pope and Hardin counties.

The other federally listed or candidate species are dependent upon open water (see Table 14). All are known adjacent to the Forest in either the Mississippi and/or the Ohio River, and known habitats and populations could be indirectly affected by actions upstream in the watersheds of these rivers that are part of this proposal. Table 14 presents a summary of the analysis of these effects.

The pallid sturgeon and the mussels would not likely be affected because all possible effects are considered insignificant and/or discountable. The Indiana bat and gray bat would not likely be affected because all possible effects are considered beneficial, insignificant and/or discountable. Determinations of no-effect are related to species that lack documented occurrences on national forest system lands, the ranges of which are known to occur outside the project area and/or for which design criteria were incorporated into the project proposal that will be implemented to protect them.

Table 14. Summary of Effects on Federally Listed and Candidate Species						
CLASS	SPECIES	COMMON NAME	STATUS*	Alternative*		
				1	2	3
Mollusk	*Lampsilis abruptus*	pink mucket pearly mussel	Endangered	NE	NLAA	NLAA
Mollusk	*Plethobasus cooperianus*	orange-footed pearly mussel	Endangered	NE	NLAA	NLAA
Mollusk	*Potamilus capax*	fat pocketbook pearly mussel	Endangered	NE	NLAA	NLAA
Mollusk	*Cumberlandia monodota*	Spectaclecase	Candidate	NE	NLAA	NLAA
Mollusk	*Plethobasus cyphus*	Sheepnose	Candidate	NE	NLAA	NLAA
Bird	*Sterna antillarum*	least tern	Endangered	NE	NLAA	NLAA
Mammal	*Myotis sodalist*	Indiana bat	Endangered	NE	NLAA	NLAA
Mammal	*Myotis grisescens*	gray bat	Endangered	NE	NLAA	NLAA
Fish	*Scaphirhynchus albus*	pallid sturgeon	Endangered	NE	NLAA	NLAA
* NE = No Effect; NLAA = Not Likely to Adversely Affect						

Indiana and Gray Bats – *Alternative 1 –* Alternative 1 would have no direct, indirect or cumulative effects on the Indiana bat or gray bat. Although adverse effects have been documented in various situations with regard to rare species and invasive plant infestations in other areas of the United States, it is unlikely that adverse cumulative effects would occur on these species as a result of Alternative 1 and minimally controlled invasive plant infestations.

Alternatives 2 and 3 – These alternatives may affect, but are not likely to adversely affect, the Indiana or gray bat. These effects are considered beneficial, insignificant and discountable. This was determined primarily because smoke could enter caves, fire could burn unknown roost trees and burning could cause a temporary decrease in insect abundance. Additionally, if smoke lingered within forested areas at dusk when Indiana bats are foraging, it could temporarily displace individuals. The treatment of invasive plants may also be beneficial for the gray and Indiana bats because it would help maintain native habitats and the native insects (prey species) that have evolved with native plants. With the implementation of Forest Plan standards and guidelines, along with design criteria for Alternatives 2 and 3, both species would be protected from direct and indirect effects.

The treatment of terrestrial habitats under Alternatives 2 or 3 is not expected to cause adverse cumulative effects on the gray bat or the Indiana bat. Although direct or indirect, short-term and localized effects may occur on the gray or Indiana bats, there would be little to no incremental effect when combined with impacts of other past, present and reasonably foreseeable future activities. Cumulative impacts on water quality, caves, terrestrial and aquatic prey, and roost trees are not anticipated because the scope of the proposed actions is extremely small and scattered, and caves, mines and maternity roosts would be protected by Forest Plan standards and guidelines and/or project design criteria.

There could be possible declines in bat populations in the future if white-nose syndrome spreads to native bats that hibernate and/or roost in mines and caves in Illinois regardless of the vegetation management. However, no declines associated with this disease are anticipated to date for the project area vicinities (US Forest Service, RONI, 2008).

Federally Listed or Candidate Aquatic Species – *Alternative 1 –* This alternative would result in no direct effects on aquatic threatened, endangered or candidate birds, mussels, or fish. None of these species are known to occur on the Forest and/or no actions are planned near perennial streams that could directly affect the species. No indirect effects on habitats are predicted because no measurable sedimentation or herbicide residue would occur in potential or known habitats for these species as a

result of this alternative. Although adverse effects have been documented in various situations with regard to rare species and invasive plant infestations in other areas of the United States, it is highly unlikely adverse cumulative effects would occur on aquatic federal/candidate species as a result of Alternative 1 and the uncontrolled invasive plant infestations.

Alternatives 2 and 3 – Prescribed burning as planned in either alternative would have minor adverse effects, if any, on water quality and sedimentation. Impacts on known or potential suitable habitats of aquatic threatened, endangered or candidate species would be minimal to immeasurable. Most of these species inhabit the large river systems, which would not be affected by proposed activities.

While any adverse effects from herbicide treatments in Alternative 2 would be minimal and temporary, the beneficial effects of eliminating invasive plants from terrestrial habitats would be more wide-spread and long-term in plant and animal communities on the Forest. The proposed actions of Alternatives 2 and 3 could cumulatively contribute infinitesimally to sedimentation and herbicide runoff when combined with past, present and reasonably foreseeable future activities. However, these effects would not add measurably to the existing effects on aquatic habitats and associated species.

Regional Forester Sensitive Species and Species with Viability Concern

Regional Forester Sensitive Species and species with viability concern are grouped by habitat for this analysis: Aquatic, Cave, Grassland/Oldfield, Cliff and Upland and Bottomland Hardwood Forest.

Aquatic – Alternative 1 would have no direct or indirect effects on aquatic species. No actions are planned near perennial streams that could directly affect the species. Because long-term impacts of uncontrolled invasive plant infestations on these species are not clearly understood, cumulative effects from the implementation of Alternative 1 are difficult to assess. Invasive plant infestations are dynamic and spread by humans and wildlife and continue to be documented, and all outbreaks have not been discovered in their entirety. Limited research exists regarding the impacts of invasive plants on wildlife.

Burning as proposed in Alternatives 2 and 3 would have minor adverse effects, if any, on water quality and sedimentation. Potential effects on aquatic wildlife species under Alternative 2 could include direct exposure as herbicides are applied to stream corridors and terrestrial areas adjacent to aquatic settings, although only herbicides approved for aquatic use would be applied. Indirect effects on the aquatic species would be minimal and immeasurable, given the implementation of Forest Plan standards and guidelines and design criteria, the scattered location of treatments within a watershed, and the relatively small individual sites being treated. Overall, while any adverse effects from Alternatives 2 and 3 would be relatively small and temporary, beneficial effects from reducing or eliminating invasive plants from terrestrial habitats would be more wide-spread and long-term in plant and animal communities on the Forest.

The treatment of terrestrial habitats under Alternative 2 or 3 could cumulatively contribute to sedimentation and herbicide/natural herbicide runoff when combined with past, present and reasonably foreseeable future activities. However, these effects would be minimal and would not add measurably to the existing effects on aquatic habitats and associated species.

Cave – Cave-obligate species are dependent on subterranean environments in caves or mines to live all or a portion of their life cycle. Alternative 1 would have no direct or indirect effects on these species because none are known from the project areas and/or no actions are planned near perennial or intermittent streams and/or caves that could directly affect the species.

Minimal to no direct or indirect effects are expected on any of these species from planned actions in Alternatives 2 and 3 as no major soil, water and/or noise disturbances would occur near cave entrances that might harbor unknown populations, as a result of adherence to the standards and

guidelines for Indiana and gray bats and design criteria for eastern small-footed bats. All planned actions would include standards and guidelines and/or design criteria to prevent any indirect effects on cave obligate species.

Alternative 1 would have no direct or indirect effects and, thus, no cumulative effects on cave-obligate species. Sedimentation due to burning and herbicide runoffs from planned actions in Alternatives 2 and 3 may contribute, but would not add measurably, to the existing effects on cave systems. Cumulative effects of these two alternatives would be minimal to immeasurable on habitat for, and populations of, cave-obligate species.

Grassland/Oldfield – Alternative 1 would have no direct effects on the these three species, since actions are very limited and no adverse impacts on Henslow's sparrow, loggerhead shrike, or bobwhites have been reported or are anticipated. This alternative could have indirect adverse effects on these grassland/oldfield-associated birds, as invasive plants invade and replace native grassland and openland plant species throughout the project area without more aggressive invasive plant treatments.

Alternatives 2 and 3 would have no direct effects on grassland/oldfield-specific species, but would have major, beneficial, indirect effects on bobwhites from the burning of natural areas. Under Alternative 2, there would be beneficial, indirect effects on Henslow's sparrow, loggerhead shrike and bobwhites from herbicide treatments of the worst infestations of invasive plant plants on the Forest, reducing the spread of non-native invasive species and improving native vegetation.

Cumulative effects of Alternatives 2 and 3 on grassland/oldfield-specific species would be moderate; overall improvements of food and cover for the species would result in minor, overall improvements in populations for the species.

Cliff – Alternative 1 would have no direct effects on any of the cliff-dependent species as no actions beyond pulling and spot-torching of invasive plants would occur. Indirect adverse effects could occur on all of the cliff-dependent species as their habitats could change as invasive plants are not adequately controlled. Their food that evolved with native vegetation, or that is native vegetation, would diminish.

Alternatives 2 and 3 could have some adverse, direct effects on all of the above species from burning and/or ingestion of herbicides in some of the project areas. However, implementation of the design criteria would prevent and/or alleviate most of these adverse effects by avoiding known habitats of all four species. Indirect effects would be mostly beneficial under Alternatives 2 and 3 because invasive plants would be reduced or diminished in the vicinity of cliff habitats and provide additional or continued food and cover for all cliff-dependent species.

Alternative 1 would result in adverse cumulative effects on populations of the carinate pillsnail, eastern woodrat and timber rattlesnake as their habitat declines in diversity and quality. Cumulative effects for these three species under Alternatives 2 and 3 would be beneficial, as known cliff habitats dominated by native plants are protected by controlling invasive plants and improving overall, native plant diversity. Alternative 1 would have no effect and, therefore, no cumulative effects on eastern small-footed bats. Alternatives 2 and 3 would have no cumulative effects on the eastern small-footed bat with implementation of design criteria protecting cliff areas and caves from any direct adverse effects from prescribed burning.

Upland and Bottomland Hardwood Forest – Alternative 1 would have no direct effects, but could have adverse indirect and cumulative effects on most of the hardwood forest-dependent species. Declines in native plant communities, prey abundance and/or cover may result when invasive plants are not controlled. Cumulative effects from Alternative 1 on habitats and, subsequently, on

populations of upland and bottomland hardwood-dependent species would be adverse and more pronounced in the long term (10-15 years out) than in the short term (1-5 years out).

Alternatives 2 and 3 would have no, or only minor, adverse, direct or indirect effects on forest-dependent species. Some direct impacts could occur on the gray treefrog and American woodcock from herbicide and burning activities. These effects would be reduced or eliminated on these species either because they are not present seasonally, not affected—as nests or roosts are protected by Forest Plan standards and guidelines and/or project design criteria , or are mobile and can move to avoid impacts. Both action alternatives would have relatively major, beneficial, indirect effects on forest-dependent species, as native overstory and understory plants and/or native prey that depend on them are maintained or improved in both alternatives, with the most improvement and beneficial effects resulting from Alternative 2.

Wilderness Resources

Invasive species are present in all seven wildernesses on the Forest. The proposed action would treat infestations to restore and maintain the natural character of wilderness. The introduction of invasive species is a result of human manipulation of the environment. Invasive species impact the natural condition and natural processes that wilderness was established to protect. In addition, the presence of invasive species compromises the "untrammeled" condition described in the Wilderness Act:

> A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man…

Wilderness Indicators – The effects of the proposed action on the wilderness resource will be discussed in relation to two indicators of wilderness character (Landres et al 2005).

- **Untrammeled Condition**: "Untrammeled" is defined as being unconfined or unhindered, and is a measure of the control or manipulation that human activities exert over the components or processes of ecological systems inside wilderness. Invasive species are considered trammeling because they are introduced, in part, by human activities and damage the biological diversity and ecological integrity of wilderness. Invasive plants displace native plants and wildlife habitat and forage.

- **Natural Condition**: The natural condition of wilderness is a measure of the effect that human activity has on the individual components of the natural community. This indicator examines the impairment of soil, water, wildlife, aquatic organisms and native and non-native plants. It is recognized that, when natural conditions are manipulated for the purpose of restoring ecological systems, both anticipated and unforeseen impacts can occur (Landres *et al* 2005).

Alternative 1 – In this alternative, invasive species would continue to be treated using hand-pulling, torching and digging. These methods are not effective for the control and eradication of invasive species. This alternative would have a direct and adverse effect on both the natural condition and the untrammeled character of wilderness. Invasive species populations would continue to expand and new populations would continue to become established.

Alternative 2 – This alternative is likely to be successful in the control and reduced spread of the four highly invasive species and is likely to control and reduce the spread of the other invasive species. Because of the increase in Forest personnel in the wilderness and the visible effects of killing unwanted vegetation, this alternative would have a minimal, adverse effect in the short term on the untrammeled character of wilderness. However, in the long term, the number of treatments and size of treatment areas would decrease as infestations are controlled. The eventual reduction

of invasive species would improve the untrammeled character of wilderness over time, a beneficial effect. This action would have a beneficial effect on the natural condition of the wildernesses, since native plants would return to the treated areas and reduce the encroachment of invasive species.

Alternative 3 – Under this alternative, wilderness infestations would be initially treated with hand-pulling, torching and/or digging. Natural weed-killers would be applied manually from a backpack sprayer. They would top-kill plants, much like torching, but would not kill the roots. This treatment would be effective on Nepalese browntop (an annual), and garlic mustard (a biennial) during certain times of the year prior to seeding. This treatment would top-kill perennial plants, but the plant would re-sprout the following year. Eradication of invasives infestations is not likely under this treatment regime.

Additionally, hot foam would be used along roads adjacent to wilderness. The reach could extend from the road and into the boundary of wilderness to specifically treat invasive species. Hot foam is expected to primarily top-kill the plant and not kill the roots. Again, this treatment is not likely to eradicate major invasive species infestations.

This alternative would require frequent treatments of annual and biennial invasive species. This treatment may successfully eradicate Nepalese browntop and garlic mustard, but would be ineffective on perennial species, which would continue to spread, having a direct adverse effect on the untrammeled and natural conditions of wilderness.

Cumulative Effects – The spatial boundary for wilderness includes the proclamation boundary of the Forest and Crab Orchard Wilderness, adjacent to Panther Den Wilderness. This boundary was selected because management actions, natural processes and recreational activities that occur on the Forest are confined to the Forest and areas immediately adjacent to it. The temporal boundary dates from the 1930's, when invasive species were commonly planted as soil stabilizers and as food for wildlife and domestic animals to ten years into the future—long enough to accurately gauge the management effects.

When considered with the effects of past, present and reasonably foreseeable future actions, the actions proposed in this analysis would have a beneficial, cumulative effect on the untrammeled character and natural condition of the wildernesses by slowing down the establishment and encroachment of invasive species that are transported by wind, water, humans and animals.

Heritage Resources

This section describes the heritage resource concerns with the project area. The primary issue in this analysis is the preservation and protection of heritage resources and the assurance that significant heritage resources will not be affected by project implementation. Archaeological sites are located on and in the ground and are affected by any activity that disturbs the soil. Since project activities are confined to the project area and other heritage resources beyond the project boundary are protected by law, it is reasonable to limit the analysis to the project area boundary.

The design criteria included methods developed decades ago with the passage of the National Historic Preservation Act of 1966 and its implementing regulations. According to Section 106 of the National Historic Preservation Act, "The agency official shall take the steps necessary to identify historic properties within the area of potential effects. The area of potential effect is defined as "….the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties…The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking" [36CFR 800.16(d)].

Much of the project area is located in areas that have been previously subjected to decades of traditional farming activities such as plowing and disking and, therefore, the top 4-8 inches of soil are already disturbed and the cultural deposits are mixed. This mixed layer of soil is called the plow zone. Invasive species management activities that further mix the soil within the plow zone will not adversely affect any cultural material that might be contained in the plow zone.

The area of potential effects may vary depending upon the level of disturbance and what earth-disturbing activities are planned. Invasive species management activities include both non-earth–disturbing activities, as well as a variety of earth-disturbing activities, which also include variations in earth disturbance. Mowing, weed-whipping, smothering, spot-torching and herbicide treatments are not considered to be earth-disturbing activities, and will not have an effect on heritage resources. However, there is also variation within the earth-disturbing activities. Hand-pulling, digging with a shovel and tilling, which are included in Alternative 2, are all considered to be earth-disturbing activities, but are much less invasive than bulldozing, backhoeing and grubbing, as called for in Alternative 3. Because of this variation, the level of inventory and other archaeological investigations will vary within the area of potential effects.

Alternative 1 – There would be no direct, indirect or cumulative effects on heritage resources as a result of the implementation of this alternative because no herbicide-related non-native invasive species eradication projects would be implemented and, therefore, activities that might potentially damage archaeological sites and other historic properties would not take place. Treatment of invasive species with manual methods or torching would have no effect on subsurface or sub-plow zone heritage resources. Although some invasive vegetation can affect heritage sites, especially in non-forested areas, this would be comparable to natural vegetation encroachment. Prescribed fire project areas are inventoried according to a programmatic agreement among the Forest, the Illinois State Historic Preservation Officer and the Advisory Council on Historic Preservation, and all openland project areas are located in old agricultural fields inventoried for heritage resources as part of the standard operating protocol. Herbicide use in our campgrounds would have no effect on heritage resources.

Alternative 2 – There would be no direct, indirect or cumulative effects on heritage resources as a result of the implementation of this alternative. A methodology is in place to protect heritage resources from earth-disturbing activities associated with prescribed fire, under the programmatic agreement among the Forest, the Illinois State Historic Preservation Officer and the Advisory Council on Historic Preservation. The protocol and mitigation measures included in the programmatic agreement were designed to protect heritage resources that might be adversely affected during prescribed fire.

Of the remaining proposed activities, mowing, weed-whipping, smothering, spot-torching and herbicide treatments are not considered to be earth-disturbing activities, and would not have an effect on heritage resources. In general, herbicide treatments do not have the resident time of pesticides and would not affect the chemical structure or character of surface or subsurface archaeological materials. However, hand-pulling, digging with a shovel and tilling are all earth-disturbing activities.

The great majority of the project area is located on ridge tops that have already been disturbed by decades of plowing and other agriculturally-related activities. Manual and mechanical-pulling, digging with a shovel to a depth of eight inches or less, and tilling in previous plowed and disked oldfields would not further affect heritage resources. Areas known to contain invasive plant species that have not been previously disturbed by agricultural activities will be reviewed and inventoried for heritage resources prior to project implementation.

Alternative 3 – There would be no direct, indirect or cumulative affects on heritage resources as a result of implementing this alternative. This alternative is designed to control invasive plant species, but not eradicate them. Although much of the same methodology proposed for Alternative 3 is the same as Alternative 2, this alternative proposes more aggressive earth-disturbing activities, such as grubbing (repeatedly hacking at individual plants) and excavating the invasive plant populations with bulldozers and/or backhoes. Areas for which this type of eradication is proposed will be reviewed and inventoried for heritage resources prior to implementation. However, the level of earth-disturbance included in these aggressive management activities is much higher and more likely to extend below the plow zone and adversely affect any archeological materials located there. Therefore, the level of heritage inventory will be greater for Alternative 3, than either Alternatives 1 or 2. Although there will be greater heritage program involvement if Alternative 3 is selected, all heritage resources will be protected during invasive species management activities.

Disclosures

Agencies and Persons Consulted
Illinois Department of Natural Resources
Illinois Nature Preserves Commission
Illinois Invasive Plant Species Council
River-to-River Cooperative Weed Management Area

Clean Water Act – Activities identified in the alternatives comply with Section 319 of the Federal Clean Water Act. The Illinois Non-point Source Management Program, which recommends using Illinois Department of Natural Resources Best Management Practices, was developed to comply with Section 319 of the Federal Clean Water Act (IDNR et al., 2007 [revision]). These practices, as well as Forest Plan Standards and Guidelines and soil suitability and limitations, as determined by the Natural Resources Conservation Service will be used to guide the action alternatives.

Air Quality – The air quality in the Forest meets EPA standards. Implementation of any of the alternatives would result in a few hundred hours of heavy equipment use over the next 1-3 years. The amount of exhaust generated from the level of activity expected would not have a measurable effect on air quality. There would be a short-term detrimental effect on air quality in the project area and in the watershed during periods of prescribed burning. This would result in long-term negligible direct and indirect effects and an insignificant addition to cumulative air quality in the Forest.

Migratory Bird Treaty Act – This proposal complies with the Migratory Bird Treaty Act and Executive Order 13186. Please see the Wildlife working paper for details.

Prime Farmland, Rangeland and Forestland – Site productivity would be maintained in the project area in all alternatives; therefore, also on the prime farmland and forestland in the project area.

Floodplains – Site productivity and riparian function would be maintained in the project area in all alternatives; therefore, also on the floodplains in the project area.

Wetlands – None of the alternatives would have an adverse effect on the site productivity or function of the sites near the project area identified as having one or more wetland characteristics.

Irreversible or Irretrievable Commitment on Resources – None of the project alternatives would have an irreversible or irretrievable commitment in the project area or adjacent analysis area if mitigation measures are adhered to. There are no known irreversible effects on soil and water resources from any alternative. Soil erosion above natural rates is an irretrievable effect. Alternatives 2 and 3 would result in a temporary, slight increase in erosion rates above natural geologic rates.

Roadless – The Secretary of Agriculture issued a memo reserving the authority for approval of road construction and timber harvest in 2001 inventoried roadless areas. Our invasive species management proposal includes the management (herbicide treatments and prescribed fire) of two designated natural areas in the 6200-acre Burke Branch Inventoried Roadless Area. Additionally, invasion pathways consist of herbicide-treatment corridors extending 300 feet on each side of a stream, road, or trail (600 feet total corridor). These corridors exist in all roadless areas on the Forest. Forest-wide, the corridors for potential herbicide treatments constitute about 4900 acres within 2001 inventoried roadless areas (about 46 percent of the Forest's 10,642 acres of inventoried roadless areas).

Regional Forester Kent P. Connaughton has reviewed our proposal and allowed us to continue our analysis. The proposed activities comply with condition 2 (B)(2)(c) of the Secretary's Memorandum of May 28, 2010. Condition 2 (B)(2)(c) recognizes the need "to improve threatened, endangered proposed, or sensitive species habitat" [and] "to maintain or restore the characteristics of ecosystem composition and structure, such as to reduce the risk of uncharacteristic wildfire effects..." We have reviewed the roadless direction and have determined that the activities planned are consistent with the 2001 roadless rule. The proposed actions would improve the roadless character by eliminating exotic species and improving the ecological condition of these areas.

Social and Economic Environment and Environmental Justice – Executive Order 12898 requires federal agencies to respond to the issue of environmental justice by "identifying and addressing disproportionately high and adverse human activities on minority and low income populations. Ethnic minorities are defined as African Americans, American Indian and Alaska Native, Asian, Hispanic or Latino, and Native Hawaiian and other Pacific Islanders. Low income persons are defined as people with incomes below the federal poverty level, which was defined in 2009 as $22,050.00 for a family of four.

According to "Social Assessment of the Shawnee National Forest" (Welch and Evans 2003), "Several key characteristics distinguish southern Illinois from the rest of the state. Perhaps the most striking is the level of poverty in the region…Southern Illinois, still recovering from job losses due to coal mine closings, had relatively high rates of unemployment in 2000; "…Jackson and Massac counties had the lowest rates in the region" (Welch and Evans 2003:8). The area is also characterized by low population density and declining population numbers.

Although the area is marked by high unemployment, high poverty rates, and lower-than-average minority numbers, the action alternatives described in this environmental assessment are limited to Forest Service-managed lands, and potential effects resulting from these activities would not affect residents, including minority or low-income populations, bordering the Forest Service lands. The Project Design Criteria outlined in Chapter 2, including herbicide application procedures, short-term closures during herbicide applications and other mitigation measures, would ensure that the proposed activities would have no effect on neighboring private property or on the health and safety of forest visitors and, therefore, the health of minorities or low-income individuals will not be affected.

Minimum Requirements Decision Guide for Proposed Actions in Wilderness – The Minimum Requirements Decision Guide assists wilderness managers in making appropriate decisions regarding management actions in wilderness areas. The concept of Minimum Requirements comes from Section 4(c) of the Wilderness Act of 1964:

> Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and except as necessary to meet *minimum requirements* for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no

temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area. (Emphasis added.)

Applicable actions include, but are not limited to, scientific monitoring, research, recreational developments and, as proposed in this environmental assessment, invasive species treatment and control. We have prepared a Minimum Requirements Decision Guide to identify, analyze and select the minimum actions necessary for the treatment and control of invasive species in the wilderness areas on the Forest. Its findings are incorporated in the environmental assessment and it is included in the project record.

Forest Plan – All actions proposed under any alternative are consistent with the Forest Plan.

Appendix – Response to Comments

We received comments on our proposal from 35 individuals and governmental and non-governmental organizations, as well as three form letters from several individuals. We received positive, supportive endorsements of the proposal from the Illinois Department of Natural Resources, the Illinois Nature Preserves Commission, the Illinois Invasive Species Plant Council, the River to River Cooperative Weed Management Area, The Nature Conservancy, and several individuals. Some individuals and the form letters expressed concern and opposition. We have grouped the comments (*in italic type*) by subject matter and, where possible, combined similar comments for one response.

HUMAN HEALTH AND SAFETY

1. *The human-health risk assessments on which you relied for information about the herbicides you propose to use are inadequate; they were prepared by a private contractor with no public involvement or review; they are being "put up…as a firewall" against your obligations under NEPA; they don't evaluate the potential endocrine-disrupting capabilities of the herbicides you propose to use; they are flawed because they don't contain a cumulative risk baseline that could indicate the additional risk of cancer from an herbicide when considered together with the ambient background cancer-risk; their development violates the Federal Advisory Committee Act.*

The Forest Service places the highest priority on human and ecological health and safety. To assess the potential health effects of herbicides proposed in management, the Forest Service relies not only on the toxicology data used by the U.S. EPA to certify the safety of pesticides, but also on risk assessments produced for the agency independently by Syracuse Environmental Research Associates. Assessments conducted for the Forest Service consider data from published scientific literature as well as the data submitted to the U.S. EPA to support pesticide product registration. Since the risk assessments are prepared by a private contractor, as is noted in the comment, the Federal Advisory Committee Act does not apply. For the analysis of this proposal, we reviewed and incorporated, as appropriate, relevant information from the risk assessments into the environmental assessment, both to inform our decision-making as well as to disclose to the public potential environmental effects.

All the risk assessments reviewed during this analysis are available to the public at the Forest Service risk-assessment website (http://www.fs.fed.us/foresthealth/pesticide/risk.shtml) and in the project record. The public is invited to comment on any assessment at any time, especially to report new information. We have received no specific information from anyone that the science, data, or conclusions of the human-health risk assessments are inadequate or scientifically deficient. We have carefully reviewed the information in these assessments and are unaware of any scientific flaw. Our use of the risk

assessments during preparation of the environmental assessment has informed and strengthened our environmental effects analysis, enabling our compliance with the National Environmental Policy Act (NEPA), not shielding us from it.

With reference to evaluation of the endocrine-disrupting capabilities of the herbicides we propose for use, in a paper produced by Syracuse Environmental Research Associates in 2002 (www.fs.fed.us/foresthealth/pesticide/pdfs/seratr01_43_08_04.pdf) on the neurotoxicity, immunotoxicity and endocrine disruption of glyphosate, triclopyr, and hexazinone, the authors state:

> This paper addresses the impact of and approach to three specific toxicologic endpoints considered in risk assessments—neurotoxicity, immunotoxicity, and endocrine disruption—and applies the general discussion of each of these endpoints to three herbicides used by the USDA Forest Service—glyphosate, triclopyr, and hexazinone.
>
> These three endpoints applied to these three chemicals address the broader issue of uncertainties that exist in any risk assessment. Chemicals may cause a large number of different effects. For example, most standard texts in toxicology (e.g., Klaassen et al. 1996) consist of many chapters covering how chemicals enter and are handled by the body (i.e., pharmacokinetics and metabolism), several specific types of effects (e.g., carcinogenicity, mutagenicity, birth defects, and developmental effects) as well as effects based on anatomical classification (e.g., effects on the blood, immune system, liver, kidney, respiratory system, nervous system, circulatory system, skin, eyes, and endocrine system).
>
> For each of these basic groups of effects, a large number of specific tests are available that provide different types of information concerning the potential for a specific chemical to cause a specific effect. Virtually no chemical has been tested for each class of effects in each of the many specific tests that are available. Thus, in every risk assessment, the available and often limited information must be used to make judgments concerning what levels of exposure are acceptable and whether or not a specific use of a chemical presents a plausible risk.

Inasmuch as our proposal includes the use of glyphosate and triclopyr, the conclusions of this paper are relevant to our analysis and responsive to the commentators' perception of a lack of information in the risk assessments:

> Neurotoxicity, immunotoxicity, and endocrine disruption are three classes of effects that are important in any risk assessment. There are a large number of different tests that can be conducted for each of these endpoints. Of the three herbicides under review in this document, glyphosate has the most extensive database and, for the effects under consideration, fewer directly relevant studies are available on triclopyr and hexazinone. Nonetheless, each of these herbicides has been subject to a number of standard toxicity studies that are required by the U.S. EPA for pesticide registration. In addition, there is a substantial amount of information on glyphosate, triclopyr, and hexazinone in the open literature.
>
> This information has been reviewed by the Forest Service and incorporated into publicly available risk assessments. Based on these risk assessments and the review of the more recent literature conducted in the preparation of this paper, there is no scientific basis for asserting that glyphosate, triclopyr, or hexazinone cause specific toxic effects on the nervous system, immune system, or endocrine function.

Regarding clopyralid, picloram and sethoxydim, Syracuse Environmental Research Associates report, "In terms of functional effects that have important public health implications, effects on endocrine function would be expressed as diminished or abnormal reproductive performance." Referring to clopyralid:

> Clopyralid has not been tested for activity as an agonist or antagonist of the major hormone systems…nor have the levels of circulating hormones been measured following clopyralid exposures. Thus, all inferences concerning the potential effect of clopyralid on endocrine function must be based on inferences from standard toxicity studies…(E)xtensive data are available on the reproductive and developmental effects of clopyralid in experimental animals…The available data suggest that clopyralid does not produce developmental effects at doses that do not produce maternal toxicity.

In reference to picloram:

> Picloram…has not been tested for activity as an agonist or antagonist of the major hormone systems…Thus, all inferences concerning the potential effect of triclopyr on endocrine function must be based on inferences from standard toxicity studies. A two-generation reproduction study of picloram (K salt) in CD rats reported no endocrine effects at doses as high as 1000 mg/kg/day (Breslin et al. 1991, as reviewed by U.S. EPA 1995b)…Of the other studies reviewed in this risk assessment, no evidence for picloram producing direct effects on the endocrine system was found…(and) no effects (were found) on reproductive performance (Breslin et al. 1991).

In reference to sethoxydim:

> Sethoxydim has been tested for its ability to cause birth defects…as well as its ability to cause reproductive impairment. Two studies…were conducted on sethoxydim: one in rats and one in rabbits. In the rat study…no effects on fetuses were noted at the highest dose tested, 250 mg/kg/day. In the rabbit study, the highest dose tested (480 mg/kg/day) resulted in toxic effects to the dams (decreased weight gain) and fetuses (decreased number of viable fetuses and decreased fetal weight)…U.S. EPA/OPP (1998a) summarizes the results of a two-generation reproduction study in which rats were fed diets…(that) resulted in daily doses of approximately 0, 7.5, 30, and 150 mg/kg. No effects were observed in dams or offspring.

The risk assessments that informed our analysis do not establish a cumulative cancer-risk baseline for the herbicides we have proposed for use. However, since none are known to be carcinogens, it is reasonable to conclude that there would be no increase in cancer risk from the use of any.

The following information is from the Forest Service risk-assessment webpage and explains the use of risk assessments in the NEPA process.

> Forest managers frequently make decisions regarding the use of pesticides on forest lands. These decisions must be based not only on the effectiveness of these tools, but also on an understanding of the risks associated with their use. For the pesticides commonly used by the Forest Service in its management activities, Human Health and Ecological Risk Assessments (HERAs) are prepared.
>
> In these documents, the process of risk assessment is used to quantitatively evaluate the probability (i.e. risk) that a pesticide use might pose harm to humans or other species in the environment. It is the same assessment process used for regulation of allowable residues of pesticides in food, as well as safety evaluations of medicines, cosmetics, and other chemicals. The Forest Service incorporates relevant information from the HERA into environmental assessment documents prepared for pesticide projects, and the information is used to guide decision-making and to disclose to the public potential environmental effects.

Risk is defined as the likelihood that an effect (injury, disease, death or environmental damage) may result from a specific set of circumstances. It can be expressed in quantitative or qualitative terms. While all human activities carry some degree of risk, some risks are known with a relatively high degree of accuracy, because data have been collected on the historical occurrence of related problems (i.e. lung cancer caused by smoking, auto accidents caused by alcohol impairment, and fatalities resulting from airplane travel). For several reasons, risks associated with activities including exposure to chemicals such as pesticides cannot be so readily determined. The process of risk assessment helps evaluate the risks resulting from these situations.

When evaluating risks from the use of pesticides proposed in a NEPA planning document, reliance on U.S. EPA's pesticide registration process as the sole demonstration of safety is insufficient. The Forest Service and Bureau of Land Management were involved in court cases in the early 1980's that specifically addressed this question (principally Save Our Ecosystems v. Clark, 747 F.2d 1240, 1248 (9th Circuit, 1984) and Southern Oregon Citizens v. Clark, 720 F. 2d 1475, 1480 (9th Cir. 1983)). These court decisions and others affirmed that although the Forest Service can use U.S. EPA toxicology data, it is still required to do an independent assessment of the safety of pesticides rather than relying on FIFRA registration alone. The Courts have also found that FIFRA does not require the same examination of impacts that the Forest Service is required to undertake under NEPA.

Further, Forest Service assessments consider data collected from both published scientific literature and data submitted to U.S. EPA to support FIFRA product registration, whereas U.S. EPA utilizes the latter data only. The U.S. EPA also considers many forestry pesticide uses to be minor. Thus, the project-specific application rates, spectrum of target and non-target organisms, and specialized exposure scenarios evaluated by the Forest Service are frequently not evaluated by U.S. EPA in its generalized registration assessments.

2. *The Endocrine Society advises the use of a "precautionary principle" when considering releasing chemicals into the environment because of the uncertainty associated with exposure. Why isn't the Forest Service adopting the precautionary principle? Why would you ever think of putting these toxins out in public land so that the general public can get exposed to them? Why would the Forest Service want to poison land that has never been sprayed, or hasn't been sprayed for decades?* A*s an active hiker, I am concerned about the potential, longer-term effects on the people that use the forest and on the plants and animals that live there.*

We disclose in the environmental assessment the minimal effects of the herbicides we propose to use and the resulting minimal risk to human and ecological health. We base our disclosure on the risk assessments prepared for the Forest Service by Syracuse Environmental Research Associates. Our examination of the effects of the selected herbicides indicates that their application as proposed has a minimal risk of harming water, plants or wildlife on the Forest, much less the land or any human who visits.

The environmental effects analysis is grounded in published science, field surveys, and the experience of others, such as the State of Illinois and The Nature Conservancy, in the use of herbicides in similar settings. Our consideration of these herbicides and determination of their safety, documented in the record, confirms that we have adhered to the precautionary principle.

As we specified in the human health and safety design criteria in the environmental assessment, since we would post notices at all treatment areas, there is very little risk that the public would unknowingly come into direct contact with vegetation treated with herbicides. The prevention of human contact with treated areas is an important consideration of this analysis.

The design criteria adhere to all label instructions and, therefore, minimize the risk of herbicide drift or the possibility of off-site movement into water or wetlands. We have shown in the environmental assessment that the herbicides we propose to use would not have a long-term presence in the environment and, contrary to the comment's assertion, would in no way "poison" the land.

3. *Sethoxydim is for the most part untested.*

As is reported in the Human Health and Ecological Risk Assessment prepared for the Forest Service by Syracuse Environmental Research Associates (in the project record), sethoxydim has, in fact, been tested in several contexts. The risk assessment provides an overview of these tests, and we report our analysis of potential environmental effects and conclusions in the environmental assessment (page 38).

WATERSHED RESOURCES / FOREST HEALTH / HERBICIDE-USE

4. *Comments of support and endorsement:*

- *The Illinois Department of Natural Resources and the Illinois Invasive Species Plant Council support the safe and judicious use of pesticides on public lands for a variety of natural resource management purposes and strongly support using the integrated management of prescribed fire and manual, mechanical and chemical methods as described throughout Alternative 2 of your proposed action.*

- *The Illinois Nature Preserves Commission has been managing natural areas using the same techniques as proposed for 25 years and found them successful in protecting natural areas with sensitive plant species in Illinois.*

- *The Nature Conservancy is a strong supporter of using various methods, including manual, mechanical, and chemical, to control invasive species and abate the threat from invasive species. The ability of the Forest Service to use various methods of control, specifically the use of herbicides, will not only leverage the work we are doing on state and private lands, but will enable us to work more closely at a regional level.*

- *I applaud the Forest Service in their attempt to keep non-native and exotic species in check and support the use of appropriate chemical herbicides to reduce the populations of invasive species.*

- *From the information provided in the environmental assessment, as well as in other literature, I firmly believe that herbicides, when used correctly, prudently, and within the label restrictions, do not pose a threat to human health, water quality, wildlife, or natural resources. Many of the invasive species that are present in southern Illinois cannot be adequately controlled using mechanical means alone.*

- *The proposed treatment of 160 sites is a huge step forward in the management/control of invasive plants within the Forest. Streams, roads, trails and utility rights-of-way across the Forest (including in wilderness) need to be treated to control, eradicate, slow, or prevent invasion.*

- *Due to our discovery of approximately ten acres of Forest Service land totally inundated by kudzu, we agree it has become more important to integrate manual, mechanical and chemical methods for treatment of invasive species on Forest Service land.*

- *The speed at which invasive species spread across vast acreages allows for no other reasonable, immediate option than the* responsible *use of chemical herbicides.*

- *Have the individuals or organizations opposed to the use of herbicides for exotics control witnessed the extent of the damage due to these invaders? Perhaps meetings could be organized on before-and-after sites? It is amazing to see the resilience of native species in the absence of exotics.*

- *When possible, I would also like to see invasive species controlled on a watershed basis beginning at the highest elevation in the watershed.*

- *Implement the plan as proposed without delay.*

We welcome the support of the state and organizations and individuals. The contribution of scientific information and "lessons learned" from herbicide use on other lands in southern Illinois played an important role in the design of our proposal. Our assessment of the environmental effects of herbicide use was informed in part by what other landowners have done and the results and effects they have observed on wildlife, plants, water, and people.

We appreciate the willingness of others to share information and experience with us so that we might ensure effective treatment and mitigation, especially in regard to potential human contact with herbicides. We have also considered the experience of landowners who, like us, have tried other than chemical means to control and eradicate invasives. We hope that through partnerships and cooperation we can proceed with implementing this important project to enhance and perpetuate our native plant communities, especially those remnant community-types inhabited by rare and listed plant and animal species.

5. *If the targeted species are determined to have entered through natural processes, then we should admit that we do not fully understand how these processes work or what the most desirable outcome would be. If they entered through human activity or management policy, then we should learn from this and prevent it from happening in the future rather than trying to "control" something we know cannot be fully controlled.*

We know that many of the targeted non-native species came to be in the United States through human ignorance and we can surmise the natural routes by which they arrived in southern Illinois. The ones that were not carried directly here by humans most likely came by air or the great rivers, the Mississippi and Ohio. Scientists will continue studying to determine the precise routes and timeframes of introduction.

We agree that complex processes are involved, all of which point to the obliteration of our native species and community-types, and the dominance of the non-native species threatening the diversity, resilience and value of the Forest habitats. We designed our proposal taking into account the mechanisms by which the invasive species arrived here and it includes measures that seek to prevent the further introduction and spread of these species.

For us on the Forest simply to do research to fully understand the dynamics of non-native species is fiscally beyond our capability, especially when research into the problem is ongoing nationwide. This research, some of which is cited in our supporting documentation, has so far failed to discern a positive or beneficial outcome from the invasion of non-natives, certainly in this time of global climate change when we must conserve and maintain the resilience of our native ecosystems more than ever.

While recognizing the large scale of the invasive-species problem, we have targeted our priority species because our management can reduce their numbers and prevent their widespread distribution throughout southern Illinois. We have chosen to focus on the 23 natural areas because we know that, at that scale, we can effectively control the invasives. We have identified the main pathways of invasive species infestation in order to prevent the rapid spread of invasives to the extent possible.

The only way to "fully control" invasive species is to eradicate them from the region. We acknowledge that there are invasives that we cannot eradicate now; but these can be controlled and kept out of the most sensitive areas, total eradication not being practical at this time given the current scale of infestation and our present funding.

6. *Protect forest ecosystems; foster them to be strong and diverse and free from chemical and commercial use. It seems that the clearings created in the forest by logging are the reason invasives have had such ready access to these areas.*

A healthy forest ecosystem is the goal of our Forest Plan, and the projects we implement consistent with the Plan will restore and maintain the dynamic biodiversity necessary for a healthy, resilient forest. Past commercial logging, old wildlife openings, roads, trails and other openings in the Forest are areas in which invasive species can become established and spread, if left unmanaged. Much of the spread of the invasives has occurred over the past 10 to 20 years, a time during which logging and road construction on the Forest has greatly declined. To the extent the comment suggests that no logging or road construction means there would be no invasive species on the Forest, it is based on an inaccurate premise.

If left untreated, openings created by natural disturbances, such as ice storms or tornados, could be avenues for the ready access of invasives into the Forest. That is why treating selected areas could go a long way to help prevent further spread and aid in controlling invasives. Invasion pathways—regardless of origin—are where invasive species become established; once established, they can spread further into other areas.

Invasive species can be found in areas of past management; they also have become established in places where no management has occurred. There are some areas of the Forest where logging has been done that are free of any invasive species. We have taken a focused, hard look at the invasive-species problem in light of our current management capabilities and, in the analysis of our proposal, the potential effects of alternative courses of action, or no action, to address the problem. We have moved past broad generalizations and assertions in order to effectively address the causes and the spread of invasive species.

7. *Science has shown that there are viable non-chemical alternatives that can be utilized. A study at the University of Indiana finds that mowing or burning at a particular time can help control* microstegia (*stiltgrass*) *at effective levels.*

In the environmental assessment, we took a hard look at the effects and results of non-chemical alternatives of addressing the spread of invasive species on the Forest (pages 26, 28, 30-35, 39, 41-45, 47). Our assessment of mechanical and non-chemical methods of controlling invasives is a key part of the analysis and our decision-making. No viable, non-chemical alternative that was brought to our attention was ignored or overlooked.

It is important to note that we examined these alternatives in the context of our on-the-ground management situation, funding, and staffing and our long history of responding to invasive species with mechanical and manual methods. We acknowledge that there are some promising techniques for treating invasive species with viable non-chemical alternatives. Mowing or burning prior to seed-

set can help control *microstegia*, but "effective" levels have not been defined (Flory and Lewis 2009). We are adjusting our mowing contracts to take advantage of this research and reduce roadside stiltgrass. We will continue to use non-chemical alternatives where it is possible in order to reduce or eliminate herbicide use.

Under Alternative 2, the selected alternative, the Forest will continue to utilize non-chemical alternatives where possible in order to avoid herbicide use. We view the use of herbicides as a mechanism for arresting the continued spread of invasive species in situations where we know that alternative, non-chemical methods have failed. We have learned from our past attempts to remove invasives without using herbicides, and have now completed the analysis of herbicide use in order to move forward. Our targeted approach to specific areas is a logical progression from what we have learned on the Forest, and from what we have learned from others' experiences with herbicides in similar settings.

8. *Major human interventions in the environment set succession back. What is most importantly demonstrated by this is that there is value over time in the process of natural succession. And while that isn't to suggest that humans shouldn't have an impact on the environment—they do and will, specific to management of a national forest, especially a small one in a state where only a tiny portion of the land-base goes through any natural succession, the importance of having a land-base that is allowed to naturally succeed with as little human intervention as possible needs to be considered in this decision.*

As we discussed in the *Final Environmental Impact Statement for the 2006 Forest Plan*, the health, biodiversity, and sustainability of the oak-hickory hardwood forest-type depends on our use of prescriptive fire and canopy-tree removal to affect the course of natural succession on the Forest. In that environmental impact statement, we considered alternative management that would allow the Forest to succeed without disturbance and determined this would diminish the health, biodiversity, and sustainability essential for the health and well-being of the wildlife dependent on the oak-hickory forest-type.

The comment seems to imply that the invasion of non-native species and their destruction of our native habitats and ecosystems is "natural succession." To the extent the commentator is suggesting that invasive species supplanting the diversity of plant and animal communities on the Forest is a beneficial effect or a desirable natural succession, we respectfully disagree. In the design of our proposal, as described in the environmental assessment (pages 7-12), our intent is to restore and allow natural ecological processes to proceed and continue to reproduce a diverse hardwood forest.

The proposed project is consistent with the Forest Plan's goal of managing for a diverse and resilient forest where ongoing ecological processes and functions ensure sustainability. As was recognized during Plan revision, much of the Forest has been altered and impacted by centuries of human use. We have consulted the science and research on natural succession and the sustainability of the oak-hickory hardwood forest-type, and are working to apply the best available science on the ground to ensure that the forces of natural succession continue to maintain the health of this forest-type. Our proposed, targeted control of invasive species at key locations is in accord with the goals set forth in the Forest Plan.

9. *There is no plan to ensure that more invasive species won't come into areas where the current vegetation is killed, and research points to the probability that this will be a problem. And if this kind of disturbance is introduced regularly, it is going to make the risk even higher. What steps will the agency take to avoid an even worse invasion when the disturbance is applied to the environment? Without such mitigation, how can the agency say that there may not be a significant effect if the problem that is supposedly being lessened may just be worsened?*

For the last 25 years, the Illinois Nature Preserves Commission, the Department of Natural Resources and The Nature Conservancy have been successfully using the same techniques—including the same or similar herbicides—that we have proposed and examined in the environmental assessment (page 12). Working together with these experienced agencies, we have found that native vegetation replaces invasive species more times than not. We are aware of the possibility that further treatments could be needed in areas in which invasive species recur following treatment. We have provided for the monitoring of treated areas to ensure that they are repopulated with native plant species.

We know that invasive-species intrusions are a risk following almost any disturbance, including natural disturbances like wildfires and ice storms. Understanding the means by which invasive species come to the Forest and become established was an important preliminary step in the development and analysis of our proposal. The effects and possible risks associated with treatment have been considered in the environmental assessment (Chapter 3). Additionally, the selected alternative includes re-seeding with native species, as well as natural regeneration, in areas that need help to support native plant populations (EA page 12). Allowing natural revegetation in treated areas has proven to be the least expensive and most ecologically correct answer to this question. Monitoring and field observation have shown that native seed survives well in the soil and readily repopulates treated areas where unnatural competition has been removed (EA pages 27-28).

10. *The issue of what to do about exotic species is very complex. In locations where exotics invasions are threatening to extirpate rare or uncommon native species, a trained hand crew with a highly trained crew boss is the least toxic and least risky alternative for control. The best way to control exotic species without causing wholesale damage to the forest ecosystem is to remove them by hand with crews trained in the appropriate skills and tools to minimize damage to the native flora.*

We agree that the issue of invasive species is scientifically complex and requires the exercise of the agency's technical expertise in a difficult environment. For this reason, we have consulted the best available scientific information to inform our selection of treatments, including which particular herbicides might be the most effective and present the least risk to people, wildlife, and other forest resources. Our proposal and mitigation measures were developed in the light of field experience and scientific information on the effects of herbicides and other possible treatments.

Field surveys indicated that natural areas and their sensitive plant communities are being threatened by invasive species. The extent of this threat and our experience in addressing it, as well as the experience of state and non-governmental agencies, indicated that manual and mechanical methods of treatment would not likely be successful in protecting the natural-area communities. The protection of sensitive species is a very high priority for the Forest. Under the selected alternative, treatments in the vicinity of sensitive plants would be done under the supervision of a Forest botanist or other suitably trained personnel to minimize the risk of unintended effects. The design criteria for the project specify that sensitive species will be protected from the effects of manual, mechanical, or chemical treatments. This is especially true in natural areas, where the highest diversity of sensitive species exists.

Protecting our native ecosystems and habitats is the focus of the purpose and need for the current proposal. While skilled hand crews capable of effectively treating many acres of invasive plants would be an ideal solution, it is not a practical alternative. We have many hundreds of acres to treat just within the affected natural areas, and we have found manual methods to be an inadequate response to invasive species in many places. Monitoring data and experience make clear that taking no action, or responding to the spread of invasives near natural areas with ultimately inefficient mechanical or manual methods, carries unacceptable risks to the sensitive-species populations in these areas.

We have been using manual and mechanical methods for the past decade and have not effectively controlled or eliminated many invasive species populations. The risk to natural areas has increased, not diminished. Cautious herbicide use combined with mechanical and manual treatments is much more practical and effective in achieving control, and would in no way cause "wholesale damage" to the forest, as the comment suggests. Identifying the trade-offs between our taking no action and implementing one of the action alternatives is a critical part of the analysis documented in the environmental assessment (pages 27 and 28).

11. *Continued study is required of how invasive species' range expansions are related to climate change, what ecological niches they are filling and creating, and the best possible solutions that include factors of climate change (i.e. some present native plants may die out and need to be replaced). There is a lot of rhetoric about how it is a threat, but little hard data as to what is really happening.*

The impact of invasive species and the role they play in ecosystems are the subject of ongoing scientific investigation. As we noted earlier, this proposed project involves the exercise of the agency's technical expertise, as well as an understanding of dynamic, complex scientific issues. The published research is clear that invasive species pose an ecological threat to our native ecosystems and habitats. This is confirmed by years of monitoring and field work on the Forest, as well as the lessons we have learned from other landowners in southern Illinois.

We know that acres of land occupied by these invasive species are taking away living space from native species, thus reducing the resilience of the Forest and reducing its capacity to overcome forest-health stressors. We know that native species return to sites from which invasives have been removed, improving diversity and sustainability over time. We know that we must maintain our native ecosystems and habitats in as resilient a condition as possible in the face of global climate change, and the dominance of invasives produces a less-resilient forest-floor monoculture.

In considering the issue of global climate change, we have followed the agency's internal guidance in the context of this relatively small-scale proposal. Removal or control of invasive species improves forest health and ecosystem resilience. The intent of our proposed action is to restore native-species diversity and allow natural ecological functions and processes to continue in the project area. "Hard data" are difficult to obtain because areas are invaded by exotic species in a matter of one season to a few short years. It is not always possible to predict where an invasion will occur, since so many invasives are not only spread by humans, but also by animals, wind and water.

We have compiled the best available information on the sources and establishment of invasive species on the Forest. Generally, our resources have been devoted to arresting the spread of invasive species, and there are little to no funds or personnel to document the negative effects that occur in the immediate aftermath of an invasion.

Several local graduate students and their professors have produced short-term studies (2-3 years) focusing on certain aspects of non-native plant species. Examples of these are: "Habitat and Life History Characteristics of *Dioscorea oppositifolia*, an Invasive Plant Species in Southern Illinois" by Tammie Beyerl (2001) and "Effect of Exotic Seeds Transported via Horse Dung on the Vegetative Composition of Trails in Southern Illinois" by Jonathon E. Campbell (1996). These theses and others may be obtained from the Department of Plant Biology at Southern Illinois University-Carbondale.

On the Forest, we have mostly qualitative information referring to the invasion of seep springs by non-native plant species, in particular, Nepalese browntop. The thesis entitled "Vegetation of Some Seep Springs in the Cretaceous Hills of Southern Illinois" by John E. Schwegman (1969) describes a vast difference between the conditions of the springs then and Mr. Schwegman's observations today. In the past 20 years, our botanist has documented in annual monitoring reports the gradual invasion of

natural areas by exotic species. Documentation has also been provided periodically by the Illinois Department of Natural Resources and other professional botanists.

The field work and qualitative information presented in the environmental assessment (page 5) demonstrate that unmanaged invasive plant species invariably out-compete the native vegetation, especially rare or sensitive plant species. The environmental assessment in Chapter 3 takes a hard look at the trade-offs between our taking no action and implementing one of the action alternatives to manage invasive species. The risks and adverse consequences of the continued spread of invasives are well documented by field work and published science. The stakes are high for natural areas, where the continued spread will surely result in the loss of sensitive plant-species populations.

12. *Using poisons to combat the supposed problem of "undesired species" is as ridiculous as clear-cutting. The growing season in southern Illinois keeps kudzu in check. A patent is being sought for the use of kudzu as a biofuel. You should harvest it for something useful.*

We respectfully disagree with the commentator's observation that there is a "supposed problem of 'undesired species'" on the Forest. Biologists, hikers, trail riders, and almost any casual Forest user can see the negative consequences associated with the increasing presence of invasive species on the Forest. It is not difficult to comprehend the loss of biodiversity of species and habitats that results when the Forest does nothing to address these invasives, or uses its scarce resources on manual and mechanical treatments alone.

It is not simply a matter of certain plant species being undesirable, but also recognition of the documented loss of sensitive plant species from natural areas (EA pages 5, 27-35). We have carefully designed this proposed project to arrest the further adverse consequences of the spread of invasive species and the loss of sensitive species and habitats, and to improve or restore ecological processes and functions in targeted areas of the Forest.

Both field work and decades of published science prove that kudzu is by no means a benign species, as is suggested in this comment. It is steadily and surely swallowing up ecosystems and landscapes on the Forest just as it has been for years throughout the South. Additionally, its aggressive and fast growth can alter the nitrogen cycle in the air and soil it invades. Researchers have found that kudzu caused a doubling of nitrogen oxide emissions from soils, along with volatile organic compounds, the key precursor of ozone pollution in the lower atmosphere and the main component of urban smog. In the lower atmosphere, ozone can damage other plants and cause respiratory problems for humans (Hickman et al, 2010).

Kudzu continues to spread northward, and field work confirms—contrary to the supposition in the comment—that it is not held in check by the growing season in southern Illinois. With global climate change warming growing seasons around the planet, the species will be enabled to spread ever more northward. Even if we could hold it "in check," there are many other invasive species endangering natural areas and special habitats on the Forest that once supported diverse populations of flora and fauna.

Kudzu may be under investigation as a possible biofuel, but it has not been developed fully as a feasible alternative fuel. Even if it were proven to be a viable biofuel and all the kudzu were cut down today, there would be no place to take it, since the infrastructure for converting it to biofuel is not established nor has it been shown to be economically or environmentally viable. Within the time all the contingencies are being worked out, kudzu-affected ozone levels will continue to increase and the biodiversity of the Forest will continue to decline. Kudzu, however, is not the only invasive species that is threatening and destroying ecological communities of the Forest and is not the only species with which this project is concerned. Moreover, our project proposal development has been

influenced by the efforts on state land and other places by the State of Illinois to remove kudzu entirely from the state.

13. *The use of herbicides is appropriate only as a last resort.*

We agree that herbicides should be used only when other methods will not practically solve the problem. It is inaccurate to assume that we considered only the use of herbicides, or favored the use of herbicides or any one treatment method, in this analysis. We recognize the social concerns and environmental effects associated with the use of herbicides. We devoted considerable study to the trade-offs between implementing the no-action and action alternatives. We considered continuing our existing program of manual and mechanical response to invasive species in light of our limited success and the continuing and increasing rate of spread of invasives on the Forest. Herbicide use must be considered and evaluated in the context of the present, existing, altered condition of the Forest: an environment where invasives have gained a foothold and are spreading at an increasing rate, despite our past work to respond to them.

We have made the determination, based on ten years of manual and mechanical treatments, that herbicides would be the most cost-effective and least environmentally damaging approach to invasive species control (EA page 6). We will continue to use manual and mechanical methods in places where sensitive species must be protected and herbicides would pose an unacceptable risk to the environment. However, these methods are labor-intensive and we cannot feasibly treat enough acres to make a difference if we restrict our efforts to manual and mechanical means. The trade-offs and risks between the alternatives are clearly set forth in Chapter 3 of the environmental assessment and allow for an informed decision

14. *Poisonous chemicals should not be used to control the growth of "invasives" in public lands. The biggest problem with using herbicides is that they do not know when to stop killing. These poisons will negatively affect the health of the animal population as well as run off to local water supplies.*

The statement that herbicides "do not know when to stop killing" is inaccurate in reference to the herbicides we propose to use. We have carefully considered all available published science concerning the persistence and degradation of herbicides in the environment (EA page 25). We have deliberately sought out non-persistent herbicides with a proven record (field study and published science) regarding their propensity to degrade rapidly in the environment. Most of them degrade into non-toxic compounds in the presence of light or are consumed by soil micro-organisms (EA pages 24-25). Applied in accordance with the Forest Plan and the design criteria specified in the environmental assessment, it is unlikely that any would persist in the environment long enough to be carried by overland run-off to a waterbody.

Within 100 feet of aquatic areas—lakes, ponds, sinkholes, wetlands, or streams—we would apply with care only herbicides approved for aquatic use by the U.S. EPA. We would apply no herbicides directly to streams or other waterbodies. We likewise took a hard look at the potential effects of the proposed herbicides on wildlife (EA pages 40-44). Based on the relatively small scale of this proposed project, our study of the published science, and the mitigation measures/design criteria included in the selected alternative, we have concluded that there would be no significant adverse wildlife effects. This conclusion is well documented in the record, and we are aware of no evidence to the contrary.

15. *Herbicides will poison all of the wildlife and all of the native species in the Forest.*

The invasive species found in the natural areas and other habitats on the Forest are gradually taking over these areas and will, over time, destroy the desirable native species and their habitats. The consequences of our taking no action, that is, continuing our current approach to responding to

invasive species, are documented in the record and the environmental assessment (pages 27, 29-34, 41-44). Left uncontrolled, invasive species can eliminate whole ecosystems and habitats. This has already occurred, and is continuing to occur, as the invasives gain a greater hold on the Forest.

Considering the scattered locations of the relatively small, proposed treatment-sites within a watershed, our implementation of Forest Plan standards and guidelines and the design criteria specified in the environmental assessment, and the information found in published scientific studies, we have concluded that the selected alternative can be implemented without significant adverse effects on the Forest's wildlife populations. The environmental assessment describes the purpose and intended effects of the proposed action: control of invasive species and the protection of native habitats used by Forest wildlife. In no way could proper application of the proposed herbicides result in the "poisoning of all wildlife and native species in the Forest," as is asserted in this comment.

The risk to wildlife associated with implementation of our proposal was studied in this analysis, and we researched and compiled the scientific information concerning mitigation. We selected herbicides with the least possible impact in order to avoid significant adverse effects on wildlife populations. We considered both the short- and long-term effects on wildlife populations. The environmental assessment documents our hard look at the potential effects of our proposal on wildlife populations, including field work and the study of published scientific information on wildlife habitat requirements (EA pages 40-44).

The science we used in developing our programmatic 2006 Forest Plan was likewise available to us during the development and design of this project proposal. We also considered monitoring information and lessons learned from the application of herbicides on state and other lands in southern Illinois. No information brought to our attention concerning wildlife effects was overlooked or ignored. Based on scientific information, mitigation, and the limited scale of our proposed action, we reasonably concluded there would be no significant effects on wildlife.

16. *The proposed chemicals are highly refined and mixed petrochemicals. They do not appear in nature and must be manufactured. They do not just "go away." They are either taken up into the food chain or break down into degradation products that then can be taken up into the food chain, or further degrade. They are not organic. They will persist in the environment long enough at some level to get into water or attach to soil, or some percentage will degrade at various rates, some of which will be detectable for many months afterward. A person with information about where and how much of these chemicals were applied could find traces of them remaining in the environment.*

As we described in the environmental assessment, four of the five herbicides we propose to use are readily broken down by soil micro-organisms or degraded fairly rapidly by light. As is noted in the comment, these chemicals have been highly formulated, ensuring that adverse environmental effects on water, soil, wildlife and other forest resources are as minimal as possible. Of the five proposed herbicides, only picloram is slowly broken down; but we propose only to apply it by hand directly on cut kudzu stumps to prevent resprouting. The potential for picloram to be "taken up into the food chain" after application on a stump is very low (EA page 38).

In a relatively short time, all the proposed chemicals are converted to non-toxic substances. The herbicides do not persist in the environment; but do, in fact, degrade and "go away"—that is, the herbicide can no longer be found in the environment. Contrary to the assertion in the comment, some of the proposed herbicides are indeed organic (composed of carbon compounds), and soil micro-organisms use the carbon compounds as a food source in the first stages of chemical breakdown. The environmental assessment took a hard look at the persistence of the selected herbicides in the environment (page 25).

Persistence and degradability were key issues in our review and selection of potential herbicides. We weighed and considered both the short-term effects of the herbicides and the recovery of native plants in the long term. Based on mitigation and published science, we concluded that there would be no significant adverse effect on water, wildlife, plants, or people from the implementation of our proposal.

17. *Some questioned the use of chemicals on a large scale across the Forest. They believe that the invasive species should be treated without chemicals because the use of chemicals would be more harmful than the invasive species. They believe that the example of the herbicide 2-4-5-T, the use of which was later banned, indicates why we should not use herbicides on the Forest.*

The environmental assessment acknowledges that the use of herbicides carries some level of risk. The U.S. EPA regulates the use of pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act and requires the testing of chemicals before they are approved for use. Some chemicals were used in the past that subsequent research showed to have undesirable side-effects, resulting in their being banned from use. The herbicide 2-4-5-T, itself only moderately toxic, was approved for use and then subsequently banned because it contained trace amounts of TCDD, a contaminant introduced during the manufacturing process. When TCDD was discovered to be highly toxic to humans, its use on food crops was terminated. Eventually its use in the United States was banned by the U.S. EPA.

The problems found with this and other chemicals that have been banned led to the development of different classes of modern chemicals that do not have the same deleterious effects. To the extent the comments assert that all herbicides have the same adverse consequences, this is incorrect. Different chemicals have been formulated and approved for different uses based upon scientific study of persistence and adverse effects. This science is a major part of our analysis. The type of herbicide, the method by which it is applied, the extent of application, the time at which it is applied, and the environment in which it is used must all be considered.

The comments generalize, without presenting scientific evidence, that all herbicides are more harmful than the presence of invasive species themselves. The science presented in this analysis (EA Chapter 3), strongly refutes this assertion and indicates that the herbicides we have chosen can be used in a way that presents no significant adverse risks to the environment, and presents less risk to sensitive species than the spread of the invasives. The herbicides we are proposing to use are, in general, the least toxic alternatives available. They do not bio-accumulate and most of them break down to water and carbon dioxide within days to several weeks of application. We have carefully considered the effects of using these herbicides to combat invasive species and determined that their use would cause less of an impact to the environment than the presence and aggression of the invasives.

Contrary to the comments' assertion that chemicals would be used "on a large scale across the Forest," the opposite is true: We have proposed the use of carefully selected herbicides in small amounts on specific, targeted areas to affect the worst of the invasive species infestations. We would treat relatively few acres in any given year—no more than 500 in any HUC6 watershed, up to a *maximum* of 3,000 acres Forest-wide. Our implementation of the proposal in compliance with the design criteria specified in the environmental assessment would ensure that the direct, indirect, and cumulative effects would be minimal. Taking all this into account, the record shows that the selected alternative will not have significantly adverse effects on water, wildlife, sensitive plants, or people.

18. *There is a cumulative impact in adding to the ambient chemical load in the environment to which we are exposed already. What about all of the pesticides used in Illinois? These chemicals will be applied in huge quantities in vast areas by largely unsupervised crews of contract employees; the potential for spills and misapplications is tremendous. What kind of planning has the Forest Service done in the case of a spill or major release of the chemicals? Sensitive areas and non-target plants*

and animals, including rare or listed native species, may be affected by exposure. It is almost certain that one treatment will not kill the populations targeted and repeated applications will be made.

Rather than constituting "huge quantities in vast areas," the amount of herbicides we propose to apply annually—on no more than 500 acres in any given HUC6 watershed, up to a maximum of 3,000 acres Forest-wide—would be virtually indiscernible compared to the chemicals already being applied in these same watersheds on a yearly basis by other landowners and agricultural applicators. In the environmental assessment (page 38, Table 12), we point out that our maximum allowable chemical application annually would be about fourteen-thousandths of one percent of the chemical load already being applied in these watersheds—a high estimate based on the improbable assumption that we would apply all of the herbicides over all of the 3,000 acres we could treat annually, which is the maximum amount of treatment possible under the selected alternative. We agree, and the environmental assessment acknowledges, that agricultural herbicide and pesticide use is by far the dominant chemical input in the watersheds within the project area (EA page 38). Additionally, right-of-way maintenance and private landowner use, of themselves, likely exceed the herbicide applications considered in this environmental assessment.

Recognizing that many landowners in these watersheds use herbicides, we devoted considerable effort to understanding the types, application, levels, locations, and mitigation used by others in order to take a hard look at cumulative effects. The record contains both quantitative and qualitative information concerning past, present, and reasonably foreseeable use, both on federal and non-federal lands (EA pages 20 and 38). Again, the mitigation specified in the design criteria for the use of herbicides on the Forest would greatly offset the potential for any significant cumulative effects. Likewise, the herbicides we selected for possible use on the Forest were chosen because of their non-persistence in the environment and low toxicity to wildlife and people.

Although it is true (as is documented in this analysis) that herbicides are currently widely used in these watersheds, there is no evidence that the small amount of herbicides we have proposed for use on a limited portion of the Forest would have any significant cumulative effects on any forest resource or people in the area of analysis. We have taken a hard look at the cumulative use of herbicides in the project area and the potential incremental contribution of the selected alternative, but there simply is nothing to suggest that the minor amount of herbicide used would have a significant effect on the environment.

The application of all herbicides would be accomplished under the direct supervision of trained and certified pesticide applicators. The procedures for chemical handling are specified in the design criteria in the environmental assessment. Spill prevention and control will be in compliance with all applicable laws and regulations (EA pages 16-17, Table 5). Several applications of herbicide over a period of years are possible for the control or eradication of some invasive species. This possible repeated application over a period of years is discussed in the proposed action section of the environmental assessment (page 12).

The environmental assessment specifies design criteria the implementation of which would prevent as much as possible the mishaps envisioned in the comment. While accidents and spills can happen, prudent planning minimizes the potential for their occurrence. Avoiding unintentional human contact with herbicides by operators, adjacent landowners and Forest users was a major consideration in our design of the project. For the most part, the Forest would probably do most invasives treatments in-house or in partnership with The Nature Conservancy. Contractors could also be used, but contract specification would require adherence to the design criteria and label direction.

19. *There is no monitoring plan to test for surface or underground water contamination after the application of large amounts of toxic herbicides. Without such mitigation, how can the agency determine that there is no uncertainty or threat to human health and the environment? This is especially true in the very delicate seep springs, where little is understood about the relationship between surface and underground water. The high-quality streams of the Forest will be degraded.*

The specific herbicides and minimal amounts we propose to use do not have the potential to reach underground water since they would be relatively quickly degraded by soil micro-organisms or sunlight into non-toxic components (EA page 25). The published science we reviewed in the development of this project indicated that there would be no significant adverse effects on underground water as a result of our limited use of the selected herbicides. The protection of water quality, especially of streams and underground water, was an important concern in the development of mitigation for this project (EA pages 15-16, Table 4). Additionally, near aquatic areas—lakes, ponds, streams, sinkholes, or wetlands—we propose to use with care only herbicides approved by the U.S. EPA for aquatic use. Neither would we apply herbicides directly to streams or other waterbodies.

We comply with the State of Illinois Forestry Best Management Practices that are designed to ensure that silvicultural chemicals and forest operations do not degrade forested sites, and that waters associated with these forests are of the highest quality (IDNR et al, 2007). These best management practices are periodically reviewed and revised. In 2007, the Forest Service Southern Research Station reviewed the scientific basis of the best management practices for silvicultural chemicals::

> BMPs (best management practices) provide guidelines for protection of water quality and some of these guidelines are well founded in science and practicality. The most important features are the guidelines that govern handling of silvicultural chemicals and stream management zone width recommendations. Increasing stream management zone width beyond 10 meters on each side of the channel may not provide much additional protection against water contamination from the use of silvicultural chemicals. It is clear that protection of the intermittent and ephemeral channels may provide much additional protection for water quality, especially in reference to erosion and sedimentation…(www.springerlink.com/content/ h6p3433885j48788/ fulltext.pdf).

The guidelines in the Forest Plan meet and exceed the conclusions of the research station's review. Additionally, the Illinois EPA conducts extensive water monitoring of many stream-reaches on and off the Forest, including agricultural areas that employ herbicides and pesticides to a far greater degree than we are proposing. We are aware of no adverse findings on the Forest related to herbicide use in these watersheds. We monitor their findings and maintain the high quality of Forest streams. The application of herbicides as we have proposed poses no risk to our high-quality streams, since published scientific studies indicate that none of the chemicals would persist in the environment long enough to threaten waterbodies.

20. *Picloram is highly soluble in water and is considered by the Pesticide Action Network to be a bad-actor chemical contaminating streams and underground water.*

As we stated in the environmental assessment, because of the relative toxicity of picloram, we propose it for use only as a treatment on kudzu stumps. It would be applied by hand directly onto the cut stump to prevent the growth of new sprouts at a time when rainfall is not expected. The minimal amount we have proposed for use would have no effect other than on the target plant and there is very little potential for it to enter the soil, streams, or underground water, or to have an effect on wildlife or people.

As part of our response to this comment we again reviewed the published literature on the potential effects of picloram on water quality, and again considered whether the application of picloram on kudzu stumps would have a significant adverse effect on water quality. Based on our proposed limited use of picloram and mitigation, we confirmed our conclusion that there would be no significant adverse effects from picloram use. Monitoring of water quality will ensure that our use of picloram has no environmental consequences beyond those anticipated by this analysis.

21. *Clopyralid is so persistent and toxic that grass clippings from lawns on which it was applied for weed control cannot be used in some California municipal composting facilities because it contaminates them.*

According to The Nature Conservancy's *Weed Control Methods Handbook: Tools & Techniques for Use in Natural Areas*, in a highly organic medium, clopyralid can take over a year to decrease to undetectable levels. The half-life of clopyralid in soil ranges from 15-56 days, which means that within 30-112 days over 99 percent of the herbicide would break down. Clopyralid was banned from some municipal compost in California because it persisted in composted grass clippings, which, if later applied to plants, would adversely affect those plants. We have no reason to expect this occurrence on forested lands because they are not rich in material such as grass clippings composting on the ground. Additionally, the relatively moist soils of the forest floor would enable the dissipation of the chemical (Marin Municipal Water District 2008).

While clopyralid can be fairly persistent in composted grass clippings, it has very low toxicity to most animals. As The Nature Conservancy reports, clopyralid is 1) practically non-toxic to birds and mammals, 2) of low toxicity to aquatic life, and 3) of very low toxicity to soil invertebrates and microbes. We are aware of the persistence of this chemical in composted grass clippings and have investigated the published scientific information on this subject. The environmental assessment discloses the characteristics and potential environmental effects associated with clopyralid use, including both long- and short-term effects (pages 24-25 and 37). There is no evidence of a potential significant adverse environmental effect resulting from our proposed use of clopyralid.

22. *Triclopyr is persistent, an eye irritant, and toxic to wildlife such as ducks.*

The level of triclopyr we propose to use for invasive species treatment is far below the reported lethal dosage for mallard ducks. As proposed for use, the herbicide would be readily absorbed by the target tree or shrub and poses no threat to wildlife. According to the risk assessment, this chemical is relatively non-toxic to terrestrial vertebrates. We are aware of the potential for adverse effects from herbicide use and have developed this project to avoid toxicity in wildlife, including ducks.

23. *Some approved of the safety measures outlined in the environmental assessment and thought that, if followed, they would assure the safety of Forest users, herbicide applicators, wildlife, and the ecosystem.*

The safety measures specified in the environmental assessment are based on Forest Service Manual procedures (FSM 2150) and herbicide label directions. We selected herbicides based on their relatively low rate of non-target effects. We are confident that, by following these measures, we will ensure that undesirable effects are minimized and that the safety of Forest users, herbicide applicators, wildlife and the ecosystem will be protected.

24. *Some understand that budgets are seeing shortfalls, and for us to clear the proposed acreage by hand would be a massive undertaking. They suggest 1) that we take the money to be spent on contracting herbicide sprayers to pay coordinators to organize and motivate volunteers to remove the invasives and replace them with natives, 2) that there are youth programs working on the Forest that*

could pull the bad plants, 3) that we sponsor an all-day weed-pulling event with a catchy name and contact the schools.

The current outlook for budgets is not encouraging. The amount of money available for herbicide treatments is not likely to be greatly enhanced during the life of the project. We currently enjoy the service of many volunteers who survey invasives and map them for us. We appreciate the suggestion regarding a weed-pulling event and will consider the possibility. Our own experience in trying to treat these species manually has shown that it does not work over the long term (several years); but, in those areas where the sensitivity of hand-pulling would be a more desirable approach, we could certainly employ the assistance of volunteers.

BOTANY / INVASIVE SPECIES / NATURAL AREAS

25. *Any attempt to eradicate these now-established species from the Forest should be limited to those specific locations where threatened or endangered native species are present and actually at risk from non-native species.*

We have provided maps that display the known distribution on the Forest of the four target species, as well as the main pathways of invasive species infestation. We have determined that the invasives' distribution and rate of spread can be reduced by implementing control actions. If we were to treat only small patches currently being affected by invasives, we would not be reducing these species' impacts across southern Illinois. A portion of our approach focuses on those areas where sensitive species are being most threatened: the natural areas, which have the highest density of such species and which we have targeted because of the ongoing adverse effects on those species.

26. *In the biological evaluation,* Pinus echinata (*shortleaf pine*), *a state-listed endangered species, is not on your list of Illinois state endangered and threatened species.*

The native shortleaf pine is a state-listed endangered species as well as a species with viability evaluation on the Forest. It is native only to LaRue-Pine Hills/Otter Pond Research Natural Area in Union County and Piney Creek Ravine Nature Preserve in Randolph County. Because it is listed and protected on the Forest as a species with viability evaluation, it was unnecessary to also place it on the list of state endangered and threatened species.

27. *Making public the specific locations of endangered and threatened species increases the potential for their destruction. There are many collectors of these species, as well as people who believe they are impediments to progress, who would think nothing of destroying them.*

We agree with your statement; however, this information is not protected under law and is already available to the public. We discuss the habitat and general locations of listed species in the environmental assessment to emphasize that they will be protected and their habitats enhanced during implementation of this project.

28. *A blanket policy of identifying certain species that must be eliminated regardless of environmental damage is ill-advised and arbitrary, and many hundreds of exotic species will remain in the environment.*

Our interdisciplinary team of scientists and resource professionals, which included a botanist, wildlife biologists and an ecologist, took a hard look at the most pervasive species currently impacting native plants in southern Illinois. During the design of our project proposal, we consulted with natural resource heritage professionals with the Illinois Department of Natural Resources and other experts who are also dealing with the spread of invasive species in Illinois. We focused on natural areas where we have an abundance of sensitive plant species that are being adversely affected by

invasives, on priority invasive species that pose the greatest resource threats, and on the main pathways of invasive species infestation. We evaluated species based on growth habits, rate of spread and current distribution. This is a well considered, targeted approach. We may not be able to eliminate all occurrences of invasives, but action now can prevent more widespread distribution in the future.

The environmental assessment discloses the potential effects of implementing our proposal throughout the project area, describing a relatively minimal level of environmental impact. We cannot completely eliminate exotic species from southern Illinois, but a targeted approach can make a difference for natural areas and the Forest as a whole. As we determined in our environmental analysis, rather than causing environmental damage, implementation of our proposal would prevent the damage inherent in the advance and deleterious effects of invasive species on the Forest.

29. *Some felt that invasive species are one of the biggest threats to ecosystem health and functioning, that they severely impact recreation and have the ability to readily move off of the forest onto adjacent private lands, that it is imperative to protect the Forest and assist private landowners in maintaining the health of their lands, and that they should be controlled.*

National Forest System lands are spread across southern Illinois, often in a checkerboard fashion, and many private lands are being impacted by invasive species coming from National Forest System lands. Conversely, the Forest is being impacted by invasives coming from other lands. One solution to this problem is for adjacent landowners to work with the Forest to the benefit of all. The Forest Service is very approachable relative to working with our neighbors. Unfortunately, the reality of the situation is that we do not have the resources to affect every adjacent landowner's needs. Certainly we do not have the resources to identify these situations on the ground. The Forest encourages adjacent landowners to talk with us about areas where they have problems and to work in concert with us to resolve those issues.

30. *Please do further study to see if this is really necessary. Many native non-target plants and animals, including rare or listed native species, could be affected by exposure to herbicides. There is no plan and no practical way for these species to be protected from herbicides. A trained crew could go through these patches and hand-pull the invasives, leaving the native species.*

We have made every effort, in cooperation with other agencies, volunteers, and knowledgeable individuals, to identify the locations of all federally and state-listed plant and animal species, Regional Forester's Sensitive Species, and species with viability concerns. By implementing the design criteria specified in the environmental assessment, we will ensure that these locations and species are protected. Individuals trained to identify the listed species would be present during execution of any eradication or control treatments, with the exception of prescribed fire. In the case of prescribed fire, species that cannot tolerate burns will be protected by implementing burn-plan provisions that exclude them from an intentional burn. Moreover, our experience during the past decade of limited success with hand and mechanical treatments in response to the spread of invasives is a major part of the context of our proposal.

Some non-target plants that are not protected by listing could be damaged or destroyed by hand-pulling, propane-torching, herbicide-use, or other means. We would avoid impacts on non-target plants as much as possible; the avoidance of these species is in our best interest, since these same species will be needed to re-establish themselves in areas where invasive species are controlled or from which they have been removed. Our avoidance of impacts on non-target plants will help the plant community in its competitiveness against invasive species.

31. *You should put a greater emphasis on educating Forest users about not spreading invasive species and focus on controlling invasive plants at high-use locations, such as campgrounds and trailheads.*

We agree that the education of Forest users about not spreading invasive species is a critical part of an integrated approach to controlling invasive species. We also agree that high-use recreational areas are logical places to contact a large segment of Forest users. Currently, our efforts include the posting of informational signs and the installation of boot-brush stations with educational information at campgrounds, trailheads, and other high-use areas. With more funding, more could be done.

Currently, our funding is limited; but, working with partners, we can increase the visibility of the invasive species threat and our management efforts. We have found that most Forest users readily understand the threat of invasive species to native biodiversity. The River-to-River Cooperative Weed Management Area, working with the Department of Plant Biology at Southern Illinois University-Carbondale, is collecting information on the use and effectiveness of boot-brush stations. In partnership with these groups, we also offer several educational events and presentations each year. We intend to continue being effective at educating people on the threats and prevention of invasive species.

32. *Management of invasive plants in the proposed 23 natural areas is necessary to ensure continued survival of the rare species within them.*

We agree, which is why we have proposed this project to implement integrated invasive plant species management, including the application of prescribed fire and herbicides.

33. *The idea that a so-called "natural area" can remain natural when significant amounts of man-made compounds are introduced into the environment is irrational and must be "significant." Flaming hydrocarbons and man-made, synthetic poisons should not be used anywhere on the Forest—least of all in natural areas. This portion of your proposal should be dropped immediately. Most of the State of Illinois is subjected to man-made, artificial chemicals on an ongoing basis. It is unacceptable to intentionally poison the last rare remnants of relatively natural land in the Forest. This is especially true when other options (e.g., hand removal) are available. Introducing totally man-made compounds that are killing-agents into a designated natural area has to be considered significant.*

The term "natural area" has been questioned or commented on ever since the term began being used for various reasons world-wide. All persons and agencies do not apply the term to exactly the same conditions. On one hand, persons opposing the concept of "natural areas" may claim that nothing is natural because of the human influences affecting the land; yet, on the other hand, many would disagree and insist that humans are part of the environment and, therefore, very much a part of the "naturalness" of an area. The Forest Plan describes what natural areas are on the Forest:

> [The Natural Area] management prescription provides for the preservation, protection and/or enhancement of the unique scientific, educational or natural values found on about 15,000 acres of research natural areas, national natural landmarks, ecological areas, geological areas, zoological areas and botanical areas…The areas are biologically or geologically unique and contain a variety of wildlife species and diverse vegetation, predominantly in a natural-appearing condition (page 76).

The Forest Plan also describes management objectives for the Forest's 80 designated natural areas and details the management needs for each of their community-types, including non-native invasive species control:

> Existing populations of non-native invasive species should be eradicated, controlled and/or reduced…Natural areas and lands adjacent to natural areas have the highest priority for the prevention and control of non-native invasive species (FW34.2.1).

Where the community-type requires non-native invasive species control, it states, "Except for removal by cutting or prescribed fire, the control of non-native species by other management technologies would necessitate a species-specific evaluation" (Appendix D, page 164) We have accomplished that evaluation with this environmental assessment, identifying the priority natural areas to be treated with prescribed fire and manual, mechanical and chemical means, and evaluating the effect of treatment on the human and natural environment. Clearly, the Forest Plan anticipates the necessity of management activities in the Forest's natural areas, and does not automatically excluded them.

The use of herbicides will not "poison" our designated natural areas. Rather, it will help to enhance the natural areas by controlling or eliminating invasive species that have become established in the rare community-types. The comments opposing the use of herbicides in natural areas imply that blanket spraying will be used with no regard for the significant and exceptional features for which these areas are designated. This is entirely inaccurate. We would only apply herbicides judiciously when it is not feasible to hand-pull, cut, or dig up roots with hand tools. We currently use these methods, as well as bulldozers and tractors for pushing over autumn olive and propane-torching (the "flaming hydrocarbons" of the comment) for control, but not elimination, of garlic mustard, Nepalese browntop, and Chinese yam.

34. *Some felt that infested sites within the Wolf Creek Natural Area and in other natural areas correlate directly with evidence of illegal use of all-terrain vehicles (ATVs) on National Forest System property. ATV trails are major conduits of the spread of invasive species and should be addressed. Effective control of invasive species will require the restriction of ATV usage.*

ATV traffic, like other forms of motorized access to the Forest, is a vector for the spread of invasive species. This traffic has been a serious resource-management problem on the Forest for years. Our law enforcement officers write about 350 tickets a year for illegal ATV use, but catching and ticketing illegal ATV users is a difficult and time-consuming task. We would be hard-pressed to increase the level of enforcement given current funding. The spread of invasive species by illegal ATVs will continue to be an issue without easy resolution. In developing this project, we considered lessons learned from monitoring, enforcement efforts, and the experiences of other landowners. We recognize that illegal ATV use has the potential to introduce and spread invasive species, and will continue to address and mitigate the effects of illegal ATV use with aggressive education and law-enforcement efforts. The public has been helpful in cooperating with the agency's efforts to curb illegal ATV use, and we will continue to seek the help of volunteers in mitigating the effects of illegal ATVs.

PRESCRIBED FIRE

35. *The best and cheapest method of controlling invasive species is maintaining a healthy and dynamic natural community. Keeping natural communities healthy involves the reduction of unnatural disturbance and replicating as closely as possible all the past natural processes that shaped these plant communities.*

Healthy and dynamic natural communities are precisely that for which we are striving. The application of prescribed fire is one of our best tools for enhancing native plant and animal communities; but, with the rapid encroachment of invasive plant species, the integrity of many of these communities has been compromised or is currently threatened. With our proposal and careful planning, we are encouraged that we will be able to achieve beneficial results for the natural resources on the Forest and our future generations.

36. *Prescribed fire on public lands (including those of the Forest) is necessary to help maintain native species diversity and to better control the invasive species susceptible to this treatment option.*

We agree. Controlling many invasive species through the application of prescribed fire will not only help stimulate native plants and maintain their diversity, but will help in reducing the need for other means of invasive species control or eradication, whether manual, mechanical or chemical. Some invasive species, such as Nepalese browntop (stiltgrass), could benefit from burns, as their seed germination becomes prolific in the absence of competition from native plant species. But this sudden emergence of plants would appear in large masses and, so, be easier to detect and eradicate or control early. In the absence of fire, this species germinates at a slower rate and seeds can remain in the soil seedbank for several years before emergence, releasing smaller patches of plants over an extended period of time, making treatments annually repetitive and more difficult.

On the other hand, Japanese honeysuckle would be aggressively knocked back or killed by prescribed fire. This species could require additional control methods, but would not be favored by fire. The application of prescribed fire gives most native plant communities a competitive edge since they are adapted to or, in some cases, dependent on fire disturbance for their perpetuation. It is better to be proactive with the benefits of applied fire than to wait until a community is on the verge of its demise before responding.

37. *What is the benchmark that will indicate when the fire regime has accomplished its goals and should be reduced or if more prescribed fires are needed? Several of the project documents state that the goal is pre-settlement conditions, but how are you determining what the pre-settlement conditions were? How did you come up with your fire frequencies? The plant communities of the region for at least the past few hundred years have developed and been maintained with frequent fires. This suggests that, in order to bring back and maintain the past richness and value of this region's plant communities and wildlife, a fairly frequent fire regime will be necessary. It will take more than four annual burns to get most of these sites even close to conditions that existed even 55 years ago (Jones 2010, Nowacki 2008). Would not a healthy plant community that is most able to resist the influx of non-native species be one closely resembling that of pre-European settlement? Have you studied the public land survey notes to determine the composition and tree-density of these forests before the time of settlement? Do you know what the ground-layer here was made up of at the time of settlement?*

Benchmarks are mostly qualitative in nature and specific to each prescribed-burn area. Burn plans further break down the management areas into burn units, depending on the structure of the plant-community-types. All lands to which we apply prescribed fire are monitored to varying degrees and by different disciplines for different purposes. For example, the fire specialist monitors for compliance with various aspects of the burn plan and documents pre- and post-burn conditions. The botanist may monitor the effects of the burn on rare and listed plant species or invasive plant species or the diversity of native plant species. The soil scientist may monitor for soil erosion and water quality. The wildlife biologist may monitor bats, birds, and other wildlife species for impacts and population-trends. The silviculturalist may monitor for hardwood regeneration. The information we gather from monitoring determines if the fire regime should be altered or continued as prescribed.

Natural plant-community types are grouped in the Forest Plan for the purpose of generalizing the management of each category, but no two areas under a community-type are identical. Although we have vegetative plots scattered on the Forest, it would be unwarranted to have plots in every prescribed fire unit. It would be neither efficient nor necessary.

The Forest Plan notes that, "... fire applied... could be optimal in simulating pre-settlement conditions." Although we do not know exactly what pre-settlement conditions were for all areas of the Forest, we can deduce what many of the section lines were like from the Surveyor's Notes of the early 1800's,

which are stored on microfilm by The Nature Conservancy. We have also obtained data from the Morton Arboretum staff, which has done a tremendous amount of documentation pertaining to pre-settlement information for various townships/ranges in Illinois. We have also relied on publications for Illinois and neighboring states with glimpses of how the vegetation was or may have been prior to settlement. We likely can never achieve pre-settlement condition, but we are confident that, through prescribed burns and invasive plant management, we will be able to enhance and perpetuate remnants of the past for future generations to enjoy and study.

Fire frequencies will likely vary from site to site following monitoring of resulting site conditions. We would burn the natural area treatment zones at intervals of 1-3 years, depending on fuel-availability and our assessment of the effects. These areas would likely be burned annually for the first two years to restore native vegetation and set back the development of invasive species, and then as needed to maintain the areas' characteristics, once invasive vegetation has been suppressed.

The Forest Plan offers varying burning frequencies and prescriptions specific to the community-types. We derived the fire-frequencies for each of these community-types from years of qualitative and quantitative monitoring and scientific publications pertaining to the restoration of native communities in the Midwest, as well as in other states that have similar community-types and species compositions. In the end, however, the frequency at which we are able to burn will depend in large part on Forest Plan burning restrictions, seasonal environmental conditions, staffing, funding, and partnerships.

38. *Your project documents refer to creating firebreaks around specific natural communities. One of the strengths of the natural communities of the past is that they were a continuum. They had few sharp borders; but, instead, had transition zones that gradually blended from one community into the other, species by species. Would it not be better to allow the fire to enter neighboring communities and let topography, soil, weather, the different fuel-types and fuel moisture-content determine fire strength and what plant communities will develop in the surrounding areas?*

In one of the documents supporting the environmental assessment, "Natural Community Types for 23 Natural Areas, Impacts of Fire Management and Herbicide," we cite the Forest Plan:

> Fire-lines outside of the [community-type] forest site may be constructed with heavy equipment if it is determined that such construction will not indirectly affect the forest community, and that terrain and soils are suitable for heavy-equipment use (page 164).

This is to protect adjacent private lands and areas that could be impacted by applying prescribed fire to natural community-types. Heavy equipment, such as a bulldozer, is not generally used within natural areas; but it has been used in the past (15 to 25 years ago) to build firebreaks along boundaries or between the natural area and an adjoining pine plantation. These firebreaks often follow old roadbeds. The preferred means of creating firebreaks in and adjacent to natural areas has always been with leaf-blowers and raking.

We assume the comment is referring to the natural area treatment-zone maps and point out that the prescribed-fire maps depict a much larger area than the actual size of the natural area. We did this in order to allow the fire to enter adjacent areas and provide a continuum. More often than not, the firebreaks are roads, abandoned roadbeds, trails, creeks, and other logical areas within the watershed where a prescribed fire can be more easily controlled. We also utilize back-burns to blacken areas where a firebreak is required, but it is not practical to be placed with only a leaf-blower.

When we apply fire to the community-types within natural areas, we do not re-light an area that the fire has gone around or missed. We prefer a mosaic burn to be left alone and serve as a refuge for wildlife. Depending on the fuels available, the moisture-content of the ground litter, the time of year, and other factors, certain plant species will be favored by the prescribed fires (e.g., grasses with fall

burns and forbs with spring burns). Each treatment area that would be burned has its own burn plan that takes into account the unique or shared features that make up that area. If treatment areas are close to each other, a burn plan can be written for those areas jointly, as long as the site-specific characteristics are similar in nature. We strictly satisfy the requirements of our burn plans for the purpose of safety and the protection and enhancement of our natural resources. We put careful thought and preparation into every area on the Forest to which we apply prescribed fire.

39. *Prescribed fires will likely not match the intensity of fires of the past. Your project documents state to keep fires cool enough that they do not burn away the leaf litter. This can be a problem for some species.*

The Soil and Water design criteria for invasive species management specify: "Avoid intense burns that remove forest-floor litter and expose excessive bare soil…that may erode into surface water." The design criteria cite the Illinois Forestry Best Management Practices, our compliance with which ensures that prescribed fires do not degrade forested sites and that waters associated with these forests are of the highest quality (IDNR et al 2000). Prescribed fires on the Forest are mostly of low intensity because the fuels are not available to produce hot, intense fires. Even in some of our barrens areas, where we would expect a hotter fire, the leaf litter and organic layer may blow away on windy days, leaving only dry, standing vegetation to burn.

We agree that the fires may never reach the intensity of the past, but vegetative conditions on the Forest have changed greatly since pre-settlement times, to the point that low-to-moderate–intensity fires are all that we can achieve. Occasionally a small area may burn intensely, such as a "chute" in a canyon-like area, or a flat opening with primarily tall, dried grasses; but the majority of fires are low-intensity. According to the Surveyor's Notes from the early 1800's, trees were much more scattered and shrubby in most areas of the Forest. The now-forested southern region of Illinois is described as an open woodland, with several references to "barren land" and "scattered oak." It is true that not having intense fires may be a problem for some species; however, we are comparing landscapes 200 years apart, and the environmental changes that have occurred can never be reversed.

40. *Prescribed burning is a scientifically sound, cost-effective tool in the management of biotic communities and is an essential ingredient of recovery plans for various species of endangered plants and animals. Years of fire exclusion and suppression in the Shawnee Hills have caused the habitat for many communities to decline. The few remaining limestone glades, for example, are remnants of a once larger population that has been fragmented by the encroachment of woody vegetation resulting from the years of fire suppression. Such habitat loss and modification represent the greatest threat of the past, present, and future of the Forest.*

We agree with the comments and refer to the previous four comments and responses. We appreciate the support and partnership of the Illinois Department of Natural Resources.

41. *It isn't unreasonable to raise the issue of all of the agency-planned prescribed burning on all the federal lands either west (upwind) of us or in close proximity over the next decade. It is likely thousands of square miles. How much carbon is released from all that? How many total particulates are being put into the air? When a burn in Arkansas affects southern Illinois at the time when the Forest plans to burn, how will that affect air quality? This is especially important in the Ohio Valley, which has historically had particulate pollution problems due to industries and agriculture.*

The effects of prescribed fire are related to the severity of specific burns as well as the type of fuel being burned. Prescribed fires on the Forest are of low-to-moderate intensity and do not consume standing trees. The typical fuel on the Forest consists of perennial and annual grasses and forbs and dried vegetative litter, the burning of which is unlikely to result in a net release of carbon (CO_2) into the atmosphere. As Gerould Wilhelm (of the Conservation Research Institute of Elmhurst, Illinois)

explains in his paper, “The Realities of Carbon Dioxide: Seeing through the Smog of Rhetoric and Politics”:

> Most of (the carbon) that is fixed above the ground in leaf and stem tissue is returned to the atmosphere during the…burn as water vapor, light, and CO_2—CO_2 that was fixed in our current era (post-glacial or Holocene), not the Paleolithic as is largely the case with fossil fuels. Given the fact that more carbon is fixed than burns or is decomposed after a growing season, there is a net removal of CO_2 from the atmosphere every year.
>
> The “smoke” is composed largely of CO_2 and water vapor. Generally, the more opaque the smoke, the greater the proportion of water vapor. The removal of atmospheric CO_2 is optimized in those grasslands that burn after each growing season, because the surface-area development of green leaves (photosynthetic surface) is maximized for the following year.
>
> The annual, one-time event of grassland combustion…is not only a clean burn but one that contributes positively to air quality by facilitating the grassland’s removal of net amounts of CO_2 from the atmosphere.

Although Wilhelm is addressing grassland burning specifically, his conclusions can be applied to our burning of grasses and forbs, all of which fix CO_2 to some extent in the soil and release less CO_2 in their burning than the amount of which they have stored in the soil. Since trees, which have “stored” carbon mostly as cellulose within roots and trunk, are not consumed in our prescribed fires, the carbon they have stored is not released to the atmosphere.

The Illinois EPA has developed a statewide smoke management plan to address smoke from prescriptive fires (prairie and forest) used to achieve resource benefits. The goals of the smoke management plan are 1) to coordinate with land managers to develop a basic framework of procedures and requirements for managing smoke from prescribed fires; 2) to avoid significant deterioration of air quality and potential violations of national ambient air-quality standards; 3) to mitigate the nuisance and public safety hazards posed by smoke intrusions into populated areas; and 4) to avoid visibility impacts in Federal Class I Areas (none of which are in Illinois, but some of which are downwind from Illinois). Prescribed fires on the Forest are in compliance with this plan as well as the Forest Plan. Our prescribed-fire treatments follow a detailed burn plan and strict prescription standards and are evaluated using smoke-management models (V-Smoke and/or SASEM).

As for the possible effects on southern Illinois of a prescribed fire in Arkansas, it is extremely unlikely that smoke from a controlled burn on the nearest federal land in Arkansas could reach our area from 250 miles or more, much less combine with the effects of a prescribed fire on the Forest. Additionally, we note that the U.S. EPA finds no area of the Ohio River valley bordering Illinois in non-attainment for air-quality standards, including particulate matter of any size.

42. *The U.S. Department of Agriculture, which sets overall policy for the Forest Service, is responsible for introducing many of these exotics to the environment, either directly or indirectly. Now the department is trying to rid the environment of the very species it brought in. In addition, the Forest Service, after many decades of cautioning against forest fires via Smokey the Bear, now tells us that forest fires are a good thing. These kind of ecological mistakes do not instill trust, especially to allow the agency to handle these very dangerous chemicals in our national forest.*

It is a fact that some of our problem invasive species were brought in by the federal government to improve habitat or reduce erosion. Many more were imported through human ignorance or neglect without the knowledge of the government. It is also true that the Forest Service has altered the message of Smokey Bear to focus on preventing wildfires. Past mistakes provide us lessons of what to avoid in the future. To paraphrase the great American poet Maya Angelou, “We did then what we

knew how to do. Now that we know better, we do better." Undoubtedly, as humankind moves society forward through time, other mistakes will occur. That is the nature of learning, and it plays an essential role in human development. The purpose of this environmental assessment—and the National Environmental Policy Act—is to disclose to the public the government's proposal and its expected effects so that supporting or opposing viewpoints and other opinions can be voiced. Such efforts are designed to reduce the potential for future errors.

Using the best available science as a foundation, we have designed the current proposal to foster the existence and evolution of our native species and to reduce the destructive impact of invasive species, regardless of how they came to be on the Forest. We know that fire has an essential, natural role to play in the central hardwoods ecosystem and that the prudent use of herbicides and prescribed fire can enhance native habitats and reduce the incursion of invasive species. And, while mistakes of the past can cause mistrust, the proposal we have put forth to control invasive species does not request the public to allow us "to handle very dangerous chemicals," as the commentator asserts. We have, in fact, proposed for use the least toxic herbicides available, herbicides that do not bio-accumulate and, with one exception, that break down to water and carbon dioxide within days to several weeks of application.

The principles of integrated pest management have been proven over the past decades and are now widely accepted. Many national and local environmental and conservation organizations now support the cautious use of herbicides in the face of the threat of invasive species. The Central Hardwoods Joint Venture, The Nature Conservancy, the Natural Area Association, and the Illinois Native Plant Society all support our efforts to protect and maintain the central hardwoods ecosystem and designated natural areas with the careful use of herbicides. Additionally, the Illinois Nature Preserves Commission, the Illinois Department of Natural Resources, and the Illinois Invasive Species Plant Council have all endorsed the current proposal as prudent and necessary management.

WILDLIFE

43. *The herbicide Roundup™ has been found to be highly toxic to frogs and we know that frogs and amphibians are disappearing all over the world. It is probably toxic to many other life forms as well.*

Some data have shown that the former surfactant in Roundup™ (brand name of an herbicide containing glyphosate) was moderately to highly toxic to amphibians. The studies that yielded these data in fact represented worst-case scenarios, when Roundup™, meant for terrestrial applications, was directly applied to a small body of water or directly to a frog or toad. Monsanto, the manufacturer of Roundup™, states on its website:

> In 2000, three internationally recognized experts in environmental toxicology published an ecotoxicological assessment of glyphosate and the original Roundup herbicide (Giesy et al, 2000). Using very conservative assumptions, the authors established hazard quotient (HQ) values for the various life forms that could be exposed to the formulation and glyphosate in the environment, for both acute and chronic exposures. An HQ lower than 1.0 indicates minimal risk of adverse effects, while HQ values greater than 10 suggest significant risk. The experts found that no terrestrial use of the formulated herbicide produced an HQ of 1.0 or greater.

Our implementation of the design criteria specified in the environmental assessment would prevent the use of the terrestrial form of glyphosate from being applied in or near aquatic settings. Thus, the use of glyphosate under the selected alternative would not occur in water and, so, would have no significant effects on amphibians. Furthermore, considering the scattered location of our proposed treatments within a watershed and across the Forest, the relatively small size of the individual sites being treated, and the secretive nature and habitat preference of amphibians, these animals are less likely to be exposed and, therefore, affected either directly or indirectly by herbicide treatments

(Wildlife working paper, pages 13-14). We have carefully considered both the on-the-ground circumstances as well as published science concerning the use of glyphosate and amphibians; there is no evidence that a significant environmental impact would occur.

44. *There is another important cumulative impact, the impact of the additives to the active ingredients. Findings have shown that these additives, which function as surfactants and catalysts, can add significantly to the toxicity of the various commercial formulations.*

The risk assessments developed by Syracuse Environmental Research Associates for the Forest Service and, specifically, the risk assessments we consulted during the environmental analysis of our proposal, considered the commercial herbicide formulations used by the Forest Service. These formulations include the additives/adjuvants mixed with the chemicals to produce the commercial herbicides. The risk assessments indicate a minimal level of risk to human health and safety or to the environment from the herbicides we propose to use. We have taken a hard look at the issue of toxicity and the role of herbicide additives (EA page 16, Table 4). Based on published science and the mitigation incorporated in the project, the record supports our finding of no significant impact from the implementation of the project as proposed.

45. *There are going to be impacts on threatened and endangered species. For example, the critically endangered Indiana bat could be using areas that will be sprayed. There are some theories that exposure to chemicals in the environment is weakening the bat and making it more susceptible to the white-nose syndrome, which has killed hundreds of thousands of bats, including Indiana bats. This is potentially significant.*

Potential effects on threatened and endangered bats have been thoroughly analyzed and discussed in the Wildlife working paper. Indiana and gray bats are nocturnal and typically remain in roosts during the day (trees for Indiana bats and caves for gray bats). Therefore, there is little risk they would directly contact any herbicide applied during the day to ground-level or mid-level vegetation. Possible indirect effects on bats include exposure to herbicides through the ingestion of insects that had come in contact with an applied herbicide. The likelihood of this occurrence is very low, especially when one considers the small area that would be treated at any one time and the relatively rapid degradation of the proposed herbicides after they have been applied.

The facts that the proposed herbicides are of low toxicity and being applied on small treatment areas, combined with the minimal likelihood that an Indiana or gray bat would be in a treatment area foraging at the time of treatment, indicate that these potential indirect effects are insignificant and would not rise to the level of take or harm (EA pages 41-42). In December, 2010 the U.S. Fish and Wildlife Service concurred with our conclusion that implementation of our proposal would not have an adverse effect on any threatened or endangered species.

The commentator makes reference to “some theories that exposure to chemicals in the environment is weakening the bat and making it more susceptible to the white nosed syndrome…” We are unable to find any published documentation regarding a relationship between chemicals in the environment and the white-nose syndrome, and the commentator fails to cite any reference to such documentation. We have been closely monitoring the white-nose syndrome and keep abreast of published information from the state, the U.S. Fish & Wildlife Service, and others regarding its effects on bat populations.

46. *Shouldn’t you be looking at the cumulative effects of herbicide residue in birds, deer and other wildlife, some of which are taken and consumed from the Forest? There is no doubt that birds, deer, and other wildlife can ingest plants with herbicide residue and that this can be transferred to the flesh, which can then be consumed by humans.*

The chemicals we propose for use are not known to bioaccumulate in wildlife. We have found no studies that indicate that these herbicides can be transferred to the flesh of any game species on the Forest, and no studies indicating the contrary are cited or provided by the commentator. The environmental assessment includes a comprehensive look at cumulative effects on wildlife (pages 40-44). The experience of herbicide use by other landowners, including the Illinois Department of Natural Resources and The Nature Conservancy, support our view that there will be no significant adverse effects on wildlife. Likewise, the limited extent to which we would use herbicides targeted at select locations on the Forest, coupled with wildlife mitigation, additionally support our conclusion that there will be no significant adverse effects on birds, deer, or other wildlife.

47. *Some of the plants being targeted may be part of an historic landscape. For example, the project targets a kudzu vine in south Pope County at the site of a historical settlement—the Golightly store and residence, once part of the defunct town of Azotus. According to oral and photographic evidence, this vine was brought in by the Golightlys as an ornamental plant—called a porch vine—early in the 20th century. This vine may very well have value for its properties as part of an historic landscape. This can only be determined by a proper consultation process under National Historic Preservation Act regulations. This hasn't been done. Further, the neighborhood residential area in and around what used to be Azotus does not want this poisoning done to our community. It is agreed unanimously in the neighborhood that the kudzu vine, which has been there the better part of a century, is not causing anyone harm. We have observed all kinds of wildlife using it. It is great cover, and its area of spread is not significant, considering the amount of time that it has been growing there.*

Destructive plants imported for ornamental purposes through ignorance do not contribute to the historic significance of a landscape, although they may be excellent examples of human ignorance and the unplanned negative results of the importation. Such is the case with the importation of kudzu. Whether as a well meaning attempt to control erosion, provide quick-growing fodder, or decorate a garden, the mere presence of the invasive plant would ordinarily merit no historic preservation or consultation under the National Historic Preservation Act. However, although the State Historic Preservation Office had already concurred with our determination of no-effect on heritage resources from implementation of our invasives species management proposal, we did, in fact, further consult with the office regarding the specific issue of the kudzu in the former community of Azotus. We received encouragement for its removal.

Contrary to the commentator's assertion, the implementation of our proposal would poison no community. The minimal applications of herbicide that we have proposed could have virtually no effect beyond the killing of the target plants. While we note that this "neighborhood" has some affection for a destructive plant, we must, nonetheless, remove it for the protection of the Forest and other ecosystems in the state. Kudzu is an invasive species for which the State of Illinois has a high priority for removal, in *all* its locations.

Even though people living near a kudzu infestation might take no notice of its deleterious effects over time, they exist nonetheless. The plant annually produces seeds that allow it to infest other areas on the Forest and in the state. If it were allowed to grow near a house, it would cover it and take it down. Even though the occasional wildlife might be observed using this plant for cover, it is effectively taking over and destroying the habitat/homes of many animals in this place. Potential Indiana bat roost-trees that were once in this place are no more because of the kudzu infestation. Foraging habitat for the endangered timber rattlesnake that was once in this place is no more because of the kudzu infestation. The herbaceous and hard-mast food source that was once in this place is no more because of the kudzu infestation. Natural regeneration and native-community successional patterns are completely reversed by this invader. Without treatment and removal, this plant will continue taking over and destroying more-suitable wildlife habitat.

NEPA ANALYSIS AND PROCESS

48. *The proposed action is a major federal action that requires analysis in an environmental impact statement.*

The President's Council on Environmental Quality defines a "major federal action" as one with effects that may be major. The council's regulations state that, "'Major' reinforces but does not have a meaning independent of significantly" (40 CFR 1508.18). Although we propose a federal action, we have demonstrated in the environmental assessment that the effects of implementing the proposed action would not be significant, based upon our consideration of both context and intensity (40 CFR 1508.27). The context here is the limited, focused use of specified methods to address an altered condition of the natural environment—invasive species. The trade-offs between the action and no-action alternatives are stark and clear to the decisionmaker and the public. This action sets no precedent for any other Forest Service unit, nor does it establish precedent for any other action on the Forest. Future efforts to address invasive species, if any, will be subject to additional site-specific analysis with public participation.

From the outset, we recognized that the effects of invasive species on native plants and animals are a broad, national problem on private, state, and federal lands. The circumstances on the Forest are a microcosm of a national problem. The purpose and need for this action is local and limited in time and scope. We are committed to working with state agencies and local southern Illinois landowners to do what we can at this time with available resources to address the altered condition of the environment, particularly where diversity is threatened in natural areas. The context of this proposal is the targeted action on 23 natural areas, four key invasive species of most importance to this Forest at this time, and the main pathways of invasive species infestation. We have carefully analyzed the context of this project and have concluded that it does not support a finding of significance under 40 CFR 1508.27(a).

Likewise, we have carefully considered each of the ten intensity-factors set forth in 40 CFR 1508.27(b). The mitigation measures and design criteria incorporated into this project were explicitly created and incorporated into this action to avoid significant direct, indirect, and cumulative effects on non-target wildlife and plant species, as well as people. The minor beneficial effects associated with the control or elimination of priority invasive species, invasives from natural areas, and invasive species from the main pathways of infestation are documented in the environmental assessment, but were not used to offset adverse effects.

The limited scale and duration of this action is part of the consideration of NEPA significance. Only a small portion of the Forest would be treated at any one time, in any one location. The areas we have selected for treatment have a high risk of adverse environmental effects if no action is taken. The ongoing deleterious effect of invasive species on natural areas was taken into consideration, and we see that the natural environment has already been altered by the invasives. Likewise, the beneficial effects on biodiversity and forest health in the long term of restored natural areas and invasive species control are important to consider. Based on the analysis as a whole and considering both long- and short-term effects, the record supports a finding of no significant impact.

49. *Some are opposed to all or part of the proposal because they believe its implementation would apply herbicides in undisclosed locations at undisclosed times without site-specific NEPA analysis, public notice or public involvement. Some think the analysis for points 1 and 2 of the proposal needs to discuss each location to be treated.*

The environmental assessment addresses the site-specific environmental effects of the treatment of invasive species in several areas specifically identified in the environmental assessment (Chapter 3) and mapped in the supporting documentation. We identified for specific treatment 23 natural areas,

the locations of four priority invasive species, and the main pathways of invasive species infestation. These areas are clearly described and mapped in the record, and this information is, and has been, available to the public. There is nothing "undisclosed" or unknown about the specific geographic locations or the context of the treatments.

The comments suggest that each specific piece of ground on which we propose to treat invasive plants with the selected herbicides be analyzed in depth. As is documented in the record, what we found during the analysis, and reported in the environmental assessment, is that the effects in any given area of applying any of the selected herbicides—*in compliance with the design criteria specified in the environmental assessment*—would be essentially the same, no matter in what area they are applied. We based this conclusion on the fact that the application of any of the selected herbicides, in compliance with the design criteria specified in the environmental assessment, would have an adverse effect only on the plant(s) to which it might be applied. No matter where the target plants are located, the herbicide would have no significant adverse effect on people, soil, water, wildlife, plants, or any other resource; only the targeted plants would suffer a significant adverse effect. With the exception of picloram, which we would only apply directly to the cut stumps of kudzu, the selected herbicides are of low toxicity to wildlife, sensitive species, or people.

Our proposal specifies which areas of the Forest we would treat to control invasive species. The first point of the proposal, the treatment of four priority species, was discussed in each resource section. The specific locations of these four priority species are mapped and in the project record. The second point of the proposed action focuses on 23 natural areas and their respective treatment zones. Likewise, these areas are mapped and their locations can be found in the record. The environmental assessment includes a site-specific discussion of the potential impacts on these natural areas. The third point of the project proposal focuses on the main pathways of species invasion. All of the areas proposed for the treatment of invasive species are clearly identified on the project-area maps in the record. By providing maps of the proposed treatment areas, we have indicated the specific geographic location of the areas we intend to treat under the proposed action.

The actual timing of individual treatments is impossible to predict because the amount of area to be treated each year will vary depending on funding and priorities; but it will never exceed 500 acres in any HUC6 watershed or 3,000 acres Forest-wide. We have stated that treatment of the natural areas and the four species would be our top priorities. Contrary to comment's assertion, the environmental assessment provides the public with notice and evaluation of our proposed action and the opportunity to be involved in our decision-making process. The purpose of the environmental assessment is to disclose the potential effects of the proposed action so that the public and the decision-maker can understand the environmental consequences. As is required by federal regulation, the environmental assessment presents a thorough and concise analysis of the proposed action, describing the positive and negative impacts of the proposal and forming a solid foundation upon which the decision-maker can base an informed decision.

50. *The Forest Service did not take a hard look at grazing before eliminating it from detailed study. Elimination of grazing is arbitrary and capricious because it fails to address a legitimate control method brought up in the scoping comments. The legal effect of the elimination of grazing is that the option will not be available for use on the Forest for ten years or more.*

As we disclosed in the environmental assessment, we eliminated grazing from detailed analysis because our research and investigation showed that grazing for the control of invasive species was not an effective tool for the work we need to accomplish. We spoke with several people who had used goats for controlling invasives and all reported limited success. We visited two sites in the St. Louis area where goats were used for invasives control and found that grazing by goats has strong, adverse, indirect effects, being "hard on the land." First, we observed that goats are not particular as to the type of vegetation they consume. While they appear to favor honeysuckle as forage, they also

consume any other edible material in the area to which they are confined, including desirable native species that we would not want to be consumed. Second, we noted that the action of their hooves churns up the soil, disturbing the ground and increasing the risk of erosion and the invasion of other undesirable species. Third, and most importantly, nowhere did we see that target species were successfully removed using grazing as the sole treatment. While grazing did give short-term control, plants survived and were thriving with just one season of rest. Additionally, we note that the State of Illinois does not use grazing on its lands in response to invasive species, due to these and perhaps additional reasons.

Based on our research, and confirmed by our visits to the two grazing operations, we concluded that it was reasonable to eliminate grazing from detailed consideration in this project proposal analysis. This finding applies only to this analysis and does not mean that we would never again consider the use of grazing for invasive species control. It certainly does not mean that the consideration of grazing is foreclosed to us for the next ten years, as the comment states. If the opportunity to use grazing effectively in a specific place on the Forest should arise at any time in the future, the Forest could propose the action and analyze it appropriately under NEPA. But, at this time, we do not see it as an option to be analyzed in detail. The fact that we considered and eliminated grazing as an option for detailed study clearly shows that we indeed considered the scoping comment that suggested it.

51. *Some questioned our choice of priority species to be treated and thought that the purpose and need was arbitrary because it picked a small number of species to target without addressing hundreds of other exotic species. Some questioned why certain species are targeted and others would be allowed to spread. Some thought that there is a sort of "boom-and-bust" cycle with many of these species and that we should have knowledge of and consider these cycles to maximize net public benefit.*

The task of treating invasive species on more than 280,000 acres of National Forest System property across southern Illinois is daunting. The Forest never has had, and likely never will have, the resources to remove all exotic species and restore the entire Forest to native species. Given this simple fact, our interdisciplinary team of scientists and resource professionals examined the exotic species found on the Forest and their potential impacts. The team included a botanist, wildlife biologists, and an ecologist. Each of these professionals has over 20 years of experience in resource management in southern Illinois and all have extensive knowledge of the natural areas on the Forest. The members of the team consulted with their counterparts in the Illinois Department of Natural Resources and the River-to-River Cooperative Weed Management Area and worked with the botanical community to identify species that are aggressively invasive and the spread of which could be managed or controlled, and identified our four priority species. We updated a comprehensive field study that identified the invasive species that occur on the Forest and where they occur. We examined information concerning the natural and human vectors for the introduction and spread of invasives.

This team effort continued over a period of several months and produced a thorough analysis of the threats of invasive species in southern Illinois. We received comments that other species, such as Japanese stiltgrass (Nepalese browntop), Johnsongrass and autumn olive should be added to the priority list. We determined that these species were too widespread to be effectively treated on a scale that could make a discernible difference in their spread at this time. Future efforts to control invasives on the Forest may someday address these threats, or others. Instead, we chose to focus our efforts on four key invasive species, the main pathways of species invasion, and the natural areas most threatened by invasive species.

We selected the 23 natural areas to protect the high-quality biodiversity of these botanical communities in southern Illinois. All invasive species would be treated in these areas in order to protect the native vegetation and distinct features of the areas. All invasive species could be treated

in the main pathways of species invasion as well. The process we used to shape this project proposal is documented in the record, including the rationale for selecting those species that will be treated at this time, and those that will not. While this project may not be a perfect or complete answer to the issue of invasive species, it is an approach that we can implement if future funding allows. It is a cautious yet efficacious approach to do what can be done at this time, given the circumstances on the ground.

52. *The cumulative effect of burning land on which herbicides have been applied is not adequately assessed. When a landscape is treated with herbicides, those species that die obviously have "taken up" the herbicide because it caused them to die. That means that those plants have herbicide residues in their cell composition. When those residues are burned, it would seem that they form other compounds that could be even more damaging to human health. There should be an assessment of what these herbicides break down into when taken up by trees and other vegetation and burned, and how that might affect human health and the environment. The fact is that these chemicals accumulate in the environment. That is the definition of cumulative impacts, and because of the impacts of this on human health and the environment, it is a significant cumulative impact.*

The Center for Invasive Species and Ecosystem Health of the University of Georgia addresses the question of the effects of prescribed fire on vegetation treated with herbicides. Contrary to the assertions in the comment, they found in a study by McMahon and Bush (1992) that:

> …Fourteen prescribed burning operations were monitored to determine possible worker exposure. Field-worker breathing-zone concentrations of smoke-suspended particulate matter, herbicide residues, and carbon monoxide were monitored on sites treated with labeled rates of forestry herbicides containing the active ingredients imazapyr, triclopyr, hexazinone, and picloram. The sites were burned 30-169 days after herbicide application. No herbicide residues were detected in 140 smoke samples from the 14 fires. These detection levels are several hundred to several thousand times less than any occupational exposure limit for these herbicides.

Further, they found:

> Worker exposure to herbicide residues released from burning treated vegetation was estimated in the U.S. Department of Agriculture Forest Service Southern Region Environmental Impact Statement (Weeks et al. 1988). This analysis assumed that: 1) $3.0x10^7 m^3$/ha smoke is produced, 2) herbicides are applied at maximum labeled application rates, 3) herbicides degrade with time at published dissipation rates, and 4) no thermal decomposition of the parent compound occurs in the burning process. Margins of safety (MOS's) were estimated for *all registered herbicides*, comparing predicted smoke residue levels to threshold limit values. All MOS's were found to be >150 except for triclopyr ester, which had a MOS of 84…Herbicide concentrations in the air dissipate with distance from the burn site; thus the public would be expected to have lower exposures than on-site workers (http://www.bugwood.org/factsheets/98-021.html) (Bush et al 1998).

NOTE: "Margin of safety" is the ratio between the animal NOEL (no observed effect level) and the estimated human dose received. A larger MOS indicates a smaller dose compared with the NOEL and thus a smaller human risk. In order to satisfy the criterion suggested by the U.S. EPA and adopted by the Forest Service, the quotient of this formula must be greater than or equal to 100.0 to pose an acceptable level of risk.

We also note that we do not propose to treat "landscapes" with herbicides, as is asserted in the comment, but only specific, targeted areas with invasive species. Additionally, the herbicides we propose to use will not persist in the environment long enough to accumulate; but, as noted above,

were chosen in part because they are not persistent and readily degrade into non-toxic compounds. As we discussed in the environmental assessment, the cumulative effects of implementing our proposal would be minimal to non-existent. The herbicides "taken up" into plants that later die will have been degraded long before the areas are burned. We have considered the potential for adverse effects on air quality and human health resulting from burning after treatment (EA pages 22-27, 34-39, and 47). We have examined the potential effects of burning treated vegetation and, based on mitigation and published studies and scientific information, have concluded that there will be no significant adverse effects on the air, water, soil, wildlife, or people.

53. *Under this proposal, it appears that 1) projects could be carried out under a decision for ten or more years, so the Forest Service needs to know what the law will be ten years from now in order for a finding of no significant impact not to be arbitrary; 2) the Forest Service would not perform a site-specific NEPA analysis for projects the decision would approve; 3) the Forest Service would not make a site-specific NEPA decision for anything done under point 3; 4) the public would have no right to any notice of what the Forest Service is going to do under point 3; 5) while the environmental assessment has some general guidelines for what herbicide would be used for the first attempt, the Forest Service is free to use any of the listed herbicides without notice to the public; and 6) what the Forest Service does under point 3 would not be subject to public comments and appeals. We request a clear and specific explanation for each point.*

1) Given the difficult circumstances involved in the treatment of invasive species, including the possible need for repeated treatments, the life of this project could be up to ten years. The analysis and disclosure of effects in the environmental assessment explicitly considered this possibility (pages 5 and 20-21). Based on our monitoring of project implementation, the analysis of effects will be reviewed annually to ensure that the analysis remains current. We will review new information and changing circumstances as often as necessary to determine whether additional analysis is required in light of any changes in law, funding, or the physical environment, for example. We are committed to involving the public in the ongoing implementation of this action and will keep its monitoring information current and available to the public. Briefings, field tours, and after-action meetings are also a possibility if the public has an interest in further information.

2) The site-specific environmental analysis and decision authorizes the use of prescribed fire, mechanical and manual treatments and selected herbicides on up to 3,000 acres per year in 23 natural areas, the known areas of infestation of four key invasive species, and the main pathways of invasive species infestation. We have presented and analyzed a targeted, reasonable approach to effectively restoring natural areas presently at risk, controlling invasive species identified as a grave resource threat, and treating the pathways of invasion. Specific sites that are treated will be monitored and re-treated, if necessary, to ensure that we have attained invasive-species control-objectives. We have addressed the site-specific treatment effects on people, water, soil, wildlife, sensitive plants, air and other resources keeping in mind the potential need for re-treatment.

The indirect and cumulative effects of all treatments are disclosed in the environmental assessment. We developed the environmental analysis to inform the public and the decision-maker of the tradeoffs associated with various alternatives compared to taking no action at this time. The advice and counsel of the public, as well as state and non-governmental agencies and other landowners experienced in addressing invasive species was an important part of this analysis. Based on a comprehensive field inventory and other local field work, published science, lessons learned from other landowners in the control of invasives, and proven mitigation, the record supports a finding of no significant impact on the environment. This site-specific analysis and decision authorizes action in the areas identified in the environmental assessment and decision; no other "projects" for the treatment of invasive species are proposed at this time.

3) We have identified in the environmental assessment the specific sites proposed for the treatment of invasive species: Under Point 1, the locations of the four key invasive species; Point 2, 23 natural areas with their treatment zones; and Point 3, the main pathways of invasive species infestation along streams, roads, trails and rights-of-way. All of the areas included under Point 3 are clearly identified on the project-area maps in the record. By providing maps of the proposed treatment areas, we have indicated the specific geographic location of the areas we intend to treat under the proposed action.

The environmental assessment addresses the site-specific environmental effects of the treatment of invasive species in all the areas identified in the assessment and mapped in the supporting documentation, including those under Point 3. As is stated above, what we found in the analysis and reported in the environmental assessment is that the effects in any specific area of applying any of the selected herbicides, in compliance with the design criteria specified in the environmental assessment, would be essentially the same, no matter in what area they are applied, including the areas identified under Point 3.

We based this conclusion on the fact that the application of any of the selected herbicides, in compliance with the design criteria specified in the environmental assessment, would have an adverse effect only on the plant(s) to which it might be applied. No matter where the target plants are located, the herbicide would have no significant adverse effect on people, soil, water, wildlife, plants, or any other resource; only the targeted plants would suffer a significant adverse effect. With the exception of picloram, which we would only apply directly to the cut stumps of kudzu, the selected herbicides are of low toxicity to wildlife, sensitive species or people. The decision notice and finding of no significant impact document these conclusions and apply to all areas proposed for treatment in the environmental assessment, including those identified under Point 3.

4) We address the site-specific environmental effects of the treatment of invasive species—whether by applying prescribed fire, manual or mechanical treatments, or herbicides—in several areas specifically identified in the environmental assessment and mapped in the supporting documentation, including the areas identified under Point 3. These areas are clearly described and mapped in the record, and this information is, and has been, available to the public. The public has been notified in the environmental assessment of our intention to treat invasive species in the areas under Point 3 and the decision notice and finding of no significant impact include all the areas analyzed in the environmental assessment.

5) In the environmental assessment we analyzed and disclosed the potential effects of using the selected herbicides in compliance with the design criteria specified in the assessment. To prevent human contact with treated areas, the treated areas will be posted with warnings about the treatment and adjacent landowners will be notified of treatments. We understand that the potential for public contact with chemicals is a concern and, as a result of this comment, we have again reviewed the mitigation proposed for this action, as well as the methods used by the state and non-governmental agencies on their lands. The decision to proceed with implementation of the project takes into consideration the finding of no significant impact and would allow us to use any of the selected herbicides in compliance with the design criteria in any of the proposed treatment areas during the life of the project.

6) The site-specific analysis in the environmental assessment considers the treatment of specific areas, including those identified under Point 3. We would treat no areas outside of the defined project area. We have made a comprehensive analysis of the effects of our proposal, disclosed to the public in the environmental assessment the anticipated effects, including those in the areas identified under Point 3, and notified the public of the opportunity to comment. The decision to implement the proposal is subject to administrative appeal. If additional areas are proposed to be treated, or different herbicides proposed to be used, additional site-specific analysis, including notice, scoping, comment, and administrative appeal would be required.

SUGGESTIONS / MANAGEMENT ADVICE

54. *The Forest Service should: Do only what federal law allows; operate in accordance with your statutory mandates; not utilize available funding sources in your management of public resources; concentrate your resources on recreation, facilities maintenance and enforcement of your current regulations; relinquish your role as resource managers because you cannot understand ecosystem management; cease adapting your management to new knowledge and understanding because of mistakes made in the past; explore the creation of a categorical exclusion allowing the treatment of invasive species; explore rulemaking under the Council on Environmental Quality regulations; and join with other agencies in establishing a browsing academy at the Dixon Springs Agricultural Center.*

We agree that we should always exercise our stewardship of the Forest within the mandates and confines of federal law. We can say with confidence that our stewardship of the Forest is responsive to our mandate under the law and always executed in observance of the law. We manage the Forest with a reasonable certainty that the actions that we propose will enhance the overall health and vigor of the ecosystems and landscapes that we are charged to manage under federal law. We acknowledge serious differences of opinion over some of the agency's actions in the past and disagreements over their effectiveness. But, as the federal agency responsible for the stewardship of the Forest, we have not just the right but the obligation to ensure the health and sustainability of the ecosystems that make up the Forest.

Our mandate is to "Care for the Land and Serve People." In caring for the land, we serve people. Our care of the land requires that as an agency we stay abreast of the current knowledge in land resource management and help to advance the state of that knowledge. Realizing that the intention to do no harm to the resources is not the same as doing no harm, we have proceeded with care in our implementation of the 2006 Forest Plan. Our application of prescribed fire to the Forest since 2006 is one example of the successful adaptation of our management practices to the current understanding of, in this case, one of the most ancient of landscape-management practices. Just as this practice contributes over time to the overall health of the Forest, so does the elimination of noxious, invasive species.

Our understanding of these species is informed by several important facts: 1) They were introduced to our native ecosystems by humans, 2) they have no natural predators or other diminishing factors, and 3) in many cases, they rapidly overrun the native species populations and can amend the surrounding soil with poisons that inhibit the growth of other plants. We are unaware of any evidence that has emerged from any source that attests to the beneficial nature of the invasions of these species. It is certain that their presence can be accepted and allowed to become the dominant groundcover in the Forest, but this is known to lead to the extirpation of native plant communities and an accompanying decrease in the biodiversity of local ecosystems. In an age of global climate change, any decrease of local or global biodiversity results in a loss of system variability, adaptability, and resilience. Conversely, we know from study that in those places where noxious invasive species are eliminated, native species return to their place in the forest.

Accordingly, we as an agency undertake to prevent the introduction and spread of such invasive species and, where that is not sufficient to ensure against their establishment, we work to remove them by the simplest method that is the most effective. Where possible, we remove these plants by hand; if unsuccessful, we turn to tools such as machinery or prescribed fire; if still unsuccessful, we turn to the last tool available, the chemical tool.

The suggestions regarding the agency's pursuit of a categorical exclusion allowing the application of herbicides and regarding rule-making are noted. They are outside the scope of the current analysis and beyond comprehensive response here. And, although our consideration of grazing or browsing for the control of invasives species was not analyzed in detail in the environmental assessment (see

response to comment 49), we would be interested in cooperating in any venture to develop effective grazing/browsing opportunities in southern Illinois.

55. *You should reopen the Forest Plan for full public review and participation as well as for the review of qualified scientists and lay persons because it was developed during illegal and secret meetings of a federal advisory committee, and you should amend the Forest Plan to address invasive species and herbicide use.*

The Forest Plan was developed in the early 2000's with the full and robust participation of all interested parties in southern Illinois and across the country. Numerous meetings and scopings were conducted with the public throughout the state and southern Illinois to determine the need for change in the previous Forest Plan and to identify alternative management scenarios for environmental impact analysis. Many scientists and management professionals were consulted during the process as well. Among these were scientists engaged by the Forest Service's North Central Research Station to conduct an ecological assessment of the Shawnee (Illinois) and Hoosier (Indiana) National Forests. The scientists followed the research station's standard, peer-reviewed protocol that included no "secret meetings" and produced an assessment that received wide acclaim in southern Illinois and Indiana as useful, scientific information.

When the Forest Service declined to release a draft of the assessment under the Freedom of Information Act, the agency was sued to force its release. A federal judge ruled that the research station's preparation of the assessment was subject to the rules of the Federal Advisory Committee Act and that the Forest Service was required to release the draft document. The Chief of the Forest Service reviewed this same issue during administrative appeals of the 2006 Forest Plan. The Chief pointed out that the federal judge had made no finding concerning the substance of the assessment, did not consider or rule upon the quality of the data or scientific information in the assessment, and—contrary to the commentator's assertion—never ruled that the assessment was illegal. (The *Hoosier-Shawnee Ecological Assessment*, General Technical Report NC-244, was published in 2004.)

The Forest Plan addresses invasive species and herbicide use in two places and requires no amendment:

> The introduction of non-native invasive species shall be prevented to the extent practicable… The risk of damage from existing non-native invasive species should be reduced through integrated pest-management. Invasion-prevention measures should be implemented to maintain native ecosystems. Existing populations of non-native invasive species should be eradicated, controlled and/or reduced. Effects of management activities on the invasion and spread of non-native invasive species should be considered and mitigated, if needed. Natural areas and lands adjacent to natural areas have the highest priority for the prevention and control of non-native invasive species (Plan FW34).
>
> The use of pesticides and biological treatments to meet management objectives is allowed following appropriate environmental consideration…Pesticides must be applied in accordance with federal and state regulations. To protect human health and safety and the environment, product label directions and guidelines must be followed for pesticide mixing and application methods, rates and timing (Plan FW21).

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