

**An Inventory
of Special Plants
and Natural Areas
within the
U.S. Army Jefferson Proving Ground,
in Southeastern
Indiana**

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Prepared by

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Colleen Baker '92

Dear Reader,

This report on special plants and natural areas within Jefferson Proving Ground is another example of the professional excellence found in the Indiana Department of Natural Resources. It also moves us closer to our goal of adequately protecting the most important remnants of Indiana's natural heritage. I am proud to submit this report with the hopes that it will help guide decision-makers in the protection and management of the natural features of Jefferson Proving Ground.

Sincerely,

A handwritten signature in black ink, reading "Patrick R. Ralston". The signature is written in a cursive style with a large, looping initial "P".

Patrick R. Ralston

Director

Indiana Department of Natural Resources

Acknowledgements

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An Inventory of Special Plants and Natural Areas within the U.S. Army Jefferson Proving Ground in Southeastern Indiana

Introduction

Indiana Department of Natural Resources, Division of Nature Preserves, was established in 1967 and charged with locating, evaluating and preserving the state's best remaining examples of natural areas. The Indiana Natural Heritage Data Center, within the Division of Nature Preserves, was established in 1978 and given the responsibility of collecting data regarding the state's rarest plants, animals, natural communities and other natural features. The Heritage Data Center collects and maintains this information, from both current and historical sources, in a computerized and mapped data base. With this information, the Division began a systematic, county-by-county inventory of the remaining natural areas (including rare species habitats) in the state.

As part of the management goals and planning, Jefferson Proving Ground (JPG) is seeking to identify and protect special areas within the property that are representative of the natural diversity of Indiana. These special areas include sites that support endangered and threatened plant and animal species as well as significant natural communities and natural features.

This inventory of natural areas and special plant species within JPG has been prepared by the Division of Nature Preserves under MIPR Number B2-1-8C823-B2-NR. This inventory is part of the on-going effort by the Division to identify, evaluate and properly manage areas of state and federal significance. The information will also be very useful to the Department of Defense in deciding on possible reuse options for JPG. This report summarizes the inventory of special plant species and natural areas within JPG.

Study Area

Location:

The Jefferson Proving Ground (JPG) is a 55,000 acre area in southeastern Indiana in Ripley, Jennings, and Jefferson Counties (Figure 1). JPG is located in the region centered around 38° 56' 07" North latitude and 85° 25' 01" West longitude. The area is roughly bounded by County Road 400 West on the west side, County Road 500 North on the south side, Michigan Road on the east side, and County Road 100 South on the north side.

Landscape:

The JPG consists primarily of poorly drained flats in various stages of succession from open fields to regrowth forested flatwoods. (Flatwoods are forested areas that occur on level or nearly level soils that are poorly drained, having a shallow perched water table.) Soils are predominantly Cobbsfork (Clermont) and Avonburg silt loams in the flats. Also present are wooded stream valleys with better drainage. Community types inventoried included bottomland forests, upland forests, and cliffs along these major drainages.

Watershed:

Major drainages include Otter Creek and Little Otter Creek in the extreme northern portion of the property, Graham Creek and Little Graham Creek in the north-central portion of the property, and Big Creek in the southern part of the property. Otter Creek, Little Otter Creek, Graham Creek, and Little Graham Creek all flow through portions of Jennings and Ripley Counties in JPG. Big Creek is restricted to Jefferson County in JPG.

Natural Regions:

Natural regions are distinct areas grouped together by similar natural features, including climate, soils, glacial history, topography, exposed bedrock, presettlement vegetation, species composition, physiography, and flora and fauna. In Indiana, there are 12 primary Natural Regions (Homoya et al. 1985) and 20 Sections or Subtypes within these Regions (Figure 1). The JPG is confined to the Muscatatuck Flats and Canyons Section of the Bluegrass Natural Region.

Bluegrass Natural Region: This natural region is identified and named not for a predominance of bluegrass (*Poa* spp.), but for similarities of the physiography and natural communities to the Bluegrass Region of Kentucky. Traditionally, this portion of Indiana has not been considered a part of the Interior Low Plateaus Bluegrass Region as outlined by Fenneman. However, several geologists have pointed out similarities in the Kentucky Bluegrass Region and the Indiana area, including Malott and Ray, the latter placing them together in the Bluegrass part of the Interior Low Plateaus. Major portions of three of Malott's physiographic regions are included in the Bluegrass Natural Region: the Dearborn Upland, the Muscatatuck Regional Slope, and the Scottsburg Lowland. The three sections of this natural region, the Switzerland Hills Section, the Muscatatuck Flats and Canyons Section, and the Scottsburg Lowland Section, approximate the area of these physiographic units.

Although the entire natural region has been covered by one or more of the pre-Wisconsin ice sheets, today much of it is mantled by only a relatively thin veneer of till. The northern boundary of the region approximates the southern terminus of Wisconsinan glaciation. This boundary marks the northern limit in this region for several southern plant species, as well as many herpetofaunal species.

Most of the natural region was originally forested, although a few glade, cliff, and barrens remnants are known, as well as non-forested aquatic communities.

Muscatatuck Flats and Canyons Section: This section consists primarily of a broad, relatively flat west-sloping plain with steep-walled canyons entrenched by major streams. The plain is characterized best by the presence of poorly drained, acidic Cobbsfork and Avonburg silt loam soils and the occurrence of a southern flatwoods natural community type. These flatwoods typically have beech (*Fagus grandifolia*), red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), pin oak (*Quercus palustris*), swamp chestnut oak (*Q. michauxii*), and tulip tree (*Liriodendron tulipifera*). A few species are restricted geographically here, including fox grape (*Vitis labrusca*), blunt-lobed grape-fern (*Botrychium oneidense*), swamp dewberry (*Rubus hispidus*), dwarf ginseng (*Panax trifolium*) and false lily-of-the-valley (*Maianthemum canadense*). In canyons, cliffs and slopes of Silurian and Devonian limestone provide an environment quite unlike the flats. These sites are comparatively rich floristically, and have a predominantly mixed mesophytic forest composition. Canada violet (*Viola canadensis*), long-spurred violet (*V. rostrata*), and crinkleroot (*Dentaria diphylla*) are more common here than elsewhere in southern Indiana. American pennywort (*Hydrocotyle americana*), wideleaf ladies'-tresses (*Spiranthes lucida*), and *Carex pedunculata* are restricted geographically here. *Sullivantia* (*Sullivantia sullivantii*) and golden St. John'swort (*Hypericum frondosum*) are known in Indiana only from canyons in this section. The dusky salamander (*Desmognathus fuscus*) is a distinctive species of this section and Bluegrass Natural Region. Non-forested community types include small areas of limestone gravel wash and limestone glade, the latter harboring the only Indiana occurrence of Michaux leavenworthia (*Leavenworthia uniflora*). Minor areas of karst topography occur along valley borders. The major aquatic features include medium-gradient streams with beds of pavement-like limestone, such as Graham Creek, Big Creek, and the upper stretches of the Vernon Fork of the Muscatatuck River.

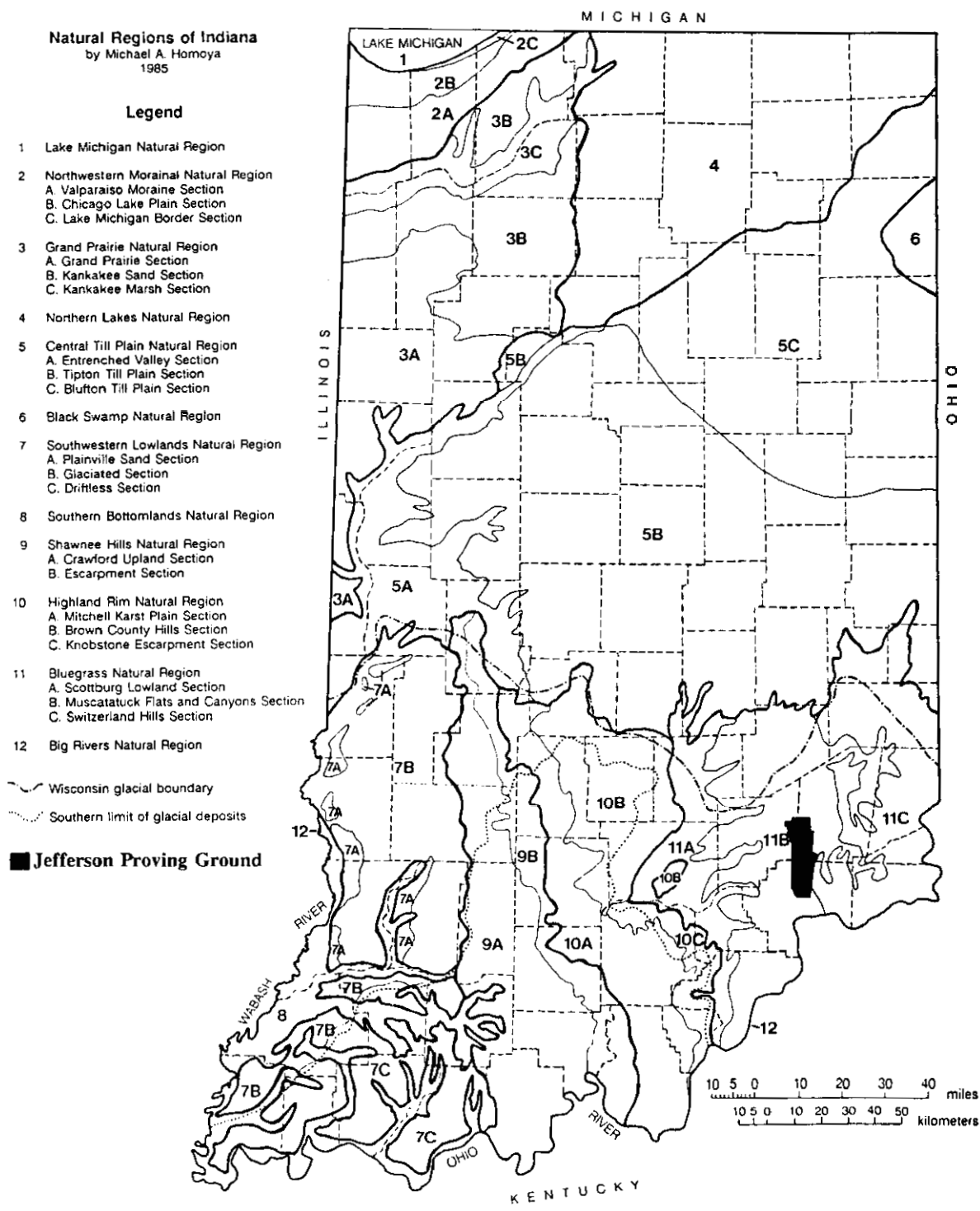


Figure 1. Natural Regions of Indiana, showing the location of Jefferson Proving Ground.

Methods

Potential Natural Communities:

To locate rare species in an area, it is helpful to first determine the natural communities present, and then determine those species anticipated to occur in them.

A natural community is a group of organisms that are interrelated to each other and their environment. The natural community concept is a useful way to categorize the natural landscape because it is operative at a scale which relates well to conservation initiatives, including rare plant protection. Using the Indiana Heritage natural community classification (Homoya et al.), there are nine potential natural community types in the survey area (Table I).

Table I. Jefferson Proving Ground potential natural communities, including brief descriptions.

Natural Community	Descriptions
Bluegrass Till Plain Flatwoods	Forested areas on level or nearly level soils that are poorly drained, having a shallow perched water table. Primary tree species include red maple (<i>Acer rubrum</i>), sweetgum (<i>Liquidambar styraciflua</i>), black gum (<i>Nyssa sylvatica</i>), pin oak (<i>Quercus palustris</i>), swamp chestnut oak (<i>Q. michauxii</i>), swamp white oak (<i>Q. bicolor</i>), American beech (<i>Fagus grandifolia</i>), and tulip tree (<i>Liriodendron tulipifera</i>).
Mesic Upland Forest	Forested uplands on moist but well drained soils. Trees include beech (<i>Fagus grandifolia</i>), sugar maple (<i>Acer saccharum</i>), tulip tree (<i>Liriodendron tulipifera</i>).
Dry-mesic Upland Forest	Forested uplands on well drained slopes. Trees include white oak (<i>Quercus alba</i>), red oak (<i>Q. rubra</i>), black oak (<i>Q. velutina</i>), shagbark hickory (<i>Carya ovata</i>).
Limestone Cliff	Vertical exposures of resistant bedrock; soils are generally non-existent. Plants include bulblet fern (<i>Cystopteris bulbifera</i>), columbine (<i>Aquilegia canadensis</i>), live forever (<i>Sedum ternatum</i>), and wild hydrangea (<i>Hydrangea arborescens</i>).
Mesic Floodplain Forest	Forested floodplains which are infrequently flooded for short periods of time. Soils are well drained. Trees include beech (<i>Fagus grandifolia</i>), sugar maple (<i>Acer saccharum</i>), tulip tree (<i>Liriodendron tulipifera</i>).
Medium-gradient Stream	Gradient of 1 to 10 feet per mile (0.2 to 1.9 m per km). Includes larger riffles, pools, sand and gravel bars.
Marsh	Herbaceous wetland with more or less permanent non-flowing water. Species are cattail (<i>Typha latifolia</i>), sedges (<i>Cyperaceae</i>).
Terrestrial Cave	A solution or collapse feature, or a crevice underground. Animals may include bat species, salamanders, and various invertebrates.
Circumneutral Seep	Spring-fed wetland on organic soil, usually along major drainages at the base of a slope. Species include sedge (<i>Carex</i>), marsh marigold (<i>Calitha palustris</i>), skunk cabbage (<i>Symplocarpus foetidus</i>), boneset (<i>Eupatorium perfoliatum</i>).

Potential Rare Plant Species:

The Indiana Natural Heritage Data Center is a continuously updated data management system for the conservation of biological diversity. The Heritage database contains locations of all rare species in Indiana, both historical collections and recent discoveries. Using the Heritage database, a list of all rare plants known from Jefferson, Jennings, and Ripley Counties was produced. Using additional knowledge of the Indiana flora of the Bluegrass Natural Region, staff botanists then annotated that list to produce a final list of potential rare plants (Table II).

Table II. Potential extirpated, endangered, threatened, rare, and watch list plants for Jefferson Proving Ground.

Species name	Common name	Status
<i>Aesculus octandra</i>	yellow buckeye	R
<i>Agalinis fasciculata</i>	clustered foxglove	E
<i>Antennaria solitaria</i>	single-head pussytoes	WL
<i>Arabis patens</i>	spreading rockcress	E
<i>Asplenium ruta-muraria</i>	wallrue spleenwort	T
<i>Bartonia paniculata</i>	twining bartonia	E
<i>Botrychium biternatum</i>	sparse-lobed grape-fern	T
<i>Botrychium oneidense</i>	blunt-lobed grape-fern	R
<i>Carex eburnea</i>	ebony sedge	T
<i>Carex louisianica</i>	Louisiana sedge	R
<i>Carex pedunculata</i>	longstalk sedge	R
<i>Carex seorsa</i>	weak stellate sedge	T
<i>Cyperus pseudovegetus</i>	green flat sedge	E
<i>Dentaria diphylla</i>	crinklroot	R
<i>Dentaria multifida</i>	divided toothwort	E
<i>Eleocharis wolfii</i>	wolf spikerush	T, C2
<i>Galactia volubilis</i> var. <i>mississippiensis</i>	eastern milk-pea	WL
<i>Hydrocotyle americana</i>	American water-pennywort	E
<i>Hypericum frondosum</i>	golden St. John'swort	X
<i>Lilium canadense</i>	Canada lily	T
<i>Linum striatum</i>	ridged yellow flax	R
<i>Linum sulcatum</i>	grooved yellow flax	T
<i>Lycopodium clavatum</i>	running pine	R
<i>Lycopodium hickeyi</i>	Hickey's clubmoss	R
<i>Oenothera perennis</i>	small sundrops	R
<i>Oryzopsis racemosa</i>	black-fruit mountain-ricegrass	T
<i>Oxalis illinoensis</i>	Illinois woodsorrel	R
<i>Panax trifolium</i>	dwarf ginseng	R
<i>Penstemon canescens</i>	gray beardtongue	T
<i>Poa alsodes</i>	grove meadow grass	T
<i>Poa wolfii</i>	wolf bluegrass	T

Table II. cont.

<i>Ranunculus laxicaulis</i>	Mississippi buttercup	E
<i>Ranunculus pusillus</i>	pursh buttercup	E
<i>Rubus centralis</i>	Illinois blackberry	T
<i>Salix caroliniana</i>	Carolina willow	WL
<i>Selaginella apoda</i>	meadow spike-moss	R
<i>Solidago hispida</i>	hairy goldenrod	WL
<i>Spiranthes lucida</i>	shining ladies'-tresses	T
<i>Spiranthes ovalis</i>	lesser ladies'-tresses	WL
<i>Sullivantia sullivantii</i>	sullivantia	E
<i>Thalictrum polygamum</i>	meadowrue	T
<i>Triadenum tubulosum</i>	large marsh St. John'swort	WL
<i>Trifolium stoloniferum</i>	running buffalo clover	E, LE
<i>Viola blanda</i>	smooth white violet	R
<i>Waldsteinia fragarioides</i>	barren strawberry	T
<i>Wisteria macrostachya</i>	Kentucky wisteria	T

State Status: E - Endangered; T - Threatened; R - Rare; WL - Watch List; X - Extirpated

Federal Status: C2 - Candidate for Listing; LE - Listed Endangered

Potential Natural Areas (PNAs):

With the lists of potential natural communities and rare plants in mind, JPG was studied using aerial photographs, U.S. Geological Survey 7.5' Quadrangle maps, the Ripley, Jennings, and Jefferson County Soil Surveys, and the U.S. Fish and Wildlife Service's National Wetland Inventory maps. In addition, Division of Nature Preserves' Heritage database and natural area files for Jefferson, Jennings, and Ripley County were checked. The goal was to select those areas which appeared to have the greatest potential for significant natural communities and/or rare species. These areas with the greatest potential included: (a) habitats which were the least disturbed (e.g. old growth forest); (b) habitats which appeared most dissected (e.g. steep wooded ravines and cliffs); (c) habitats which were wettest. These were delineated on U.S. Geological Survey 7.5' Quadrangle maps which cover the area.

Field Assessment:

During the 1992 growing season, PNAs were surveyed in the field to determine the presence of rare plant species, and the type and quality of the natural communities present. The PNAs which were checked are shown in Figure 2. Several PNAs were not checked because of access limitations and/or restrictions. Field work began in April and ended in September.

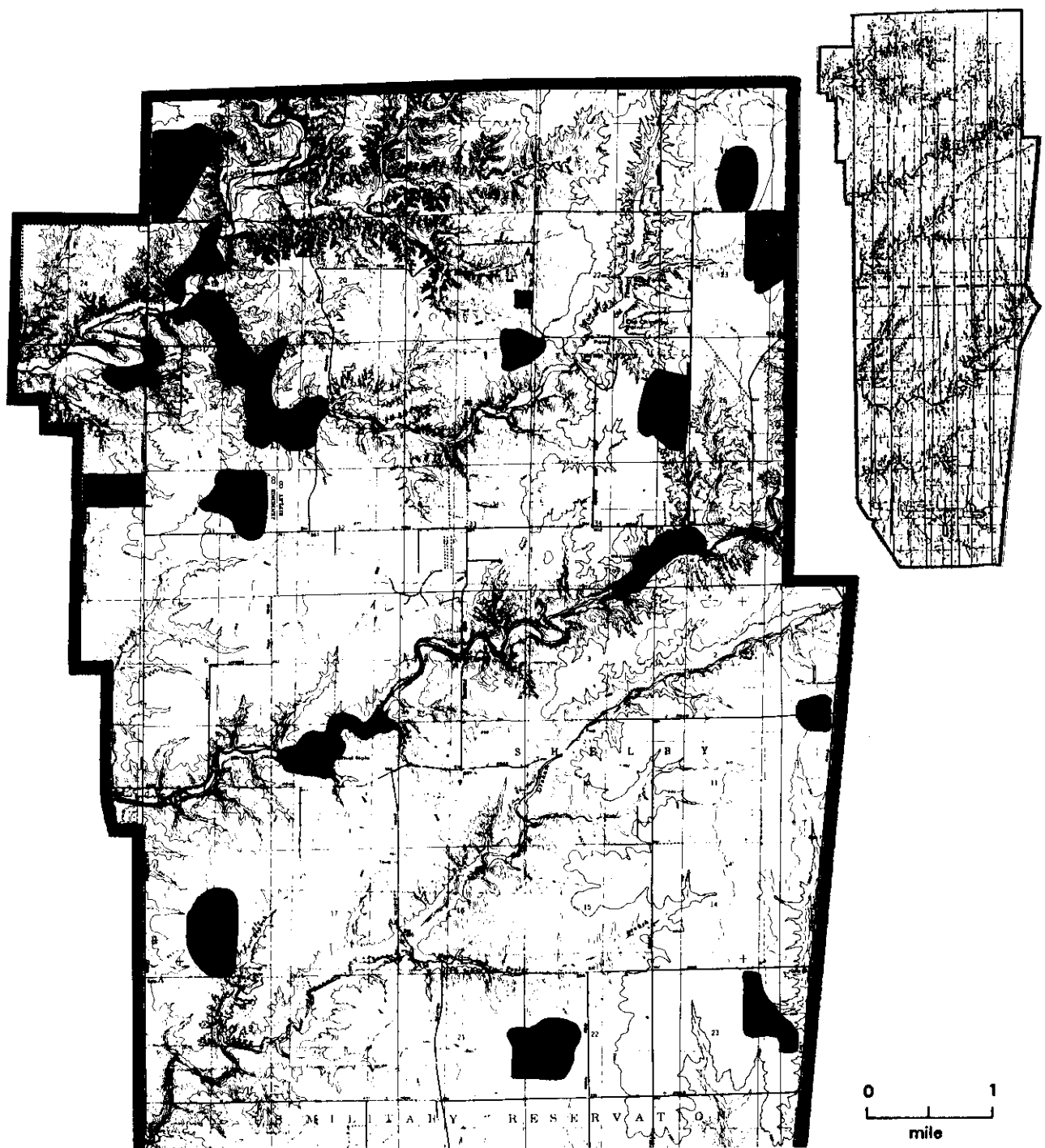


Figure 2a. Location of potential natural areas in the northern section of Jefferson Proving Ground.

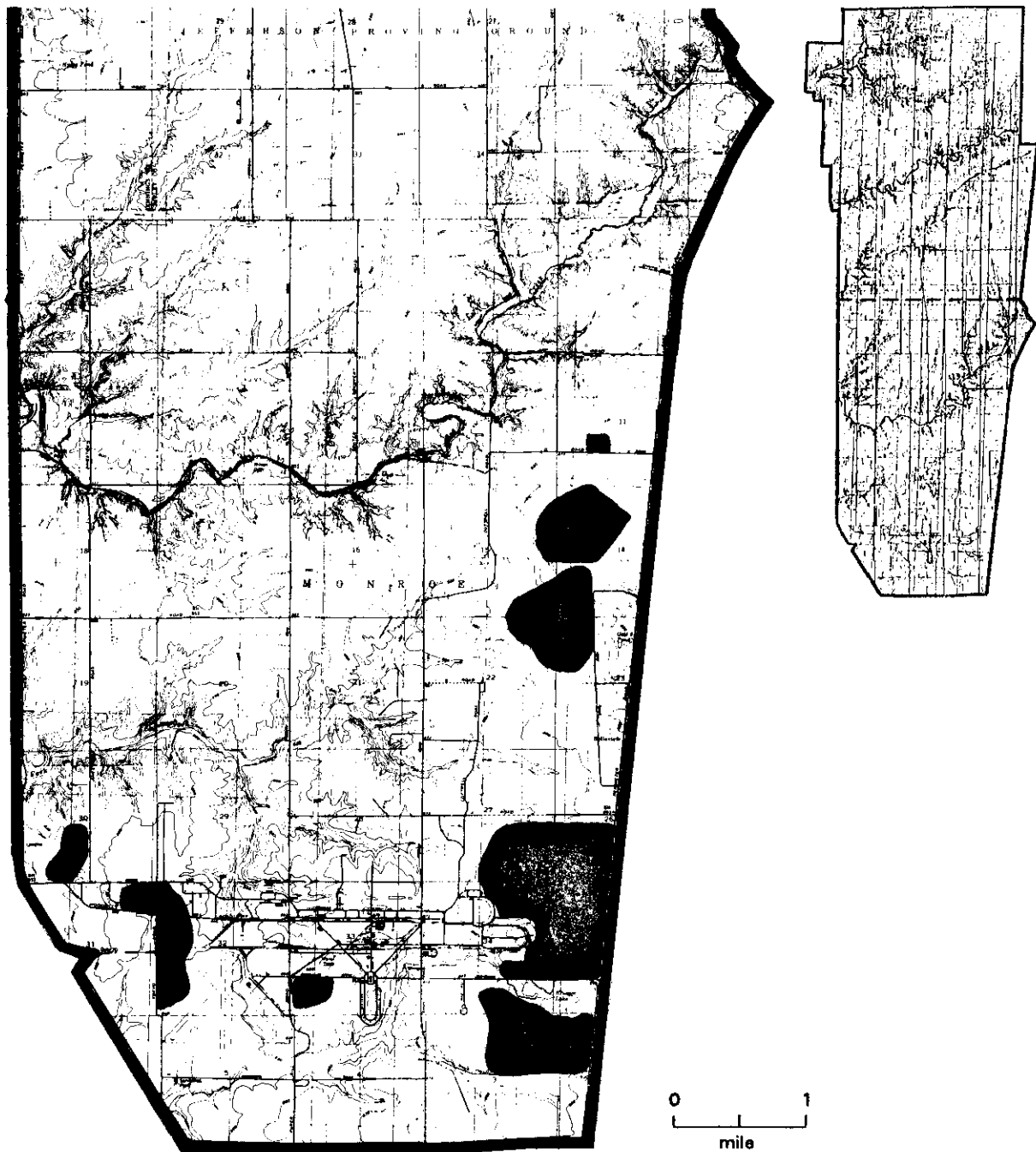


Figure 2b. Location of potential natural areas in the southern section of Jefferson Proving Ground.

Results

Natural Areas:

The highest quality natural communities exhibit the least amount of past disturbance: large tree canopies; good structure and composition; lack of exotic species. Table III shows the community types present within those natural areas which exhibited the highest natural quality. These highest quality natural areas are shown in Figure 3.

Table III. High Quality Natural Areas at JPG.

7.5' Quad. Township, Range, Section		Natural Community
Holton	T7N R10E S18	Mesic Upland Forest
	T7N R10E NWQ S19	Mesic Upland Forest, Dry-mesic Upland Forest, Limestone Cliff
	T7N R10E S19, SWQ S20, NW & SWQ S29, NE & SEQ S30	Mesic Upland Forest, Dry-mesic Upland Forest, Dry Upland Forest, Limestone Cliff
	T7N R9E SEQ S24, NEQ S25 & T7N R10E SWQ S19, NWQ S30	Mesic Upland Forest, Dry-mesic Upland Forest, Limestone Cliff
	T7N R10E NEQ S31	Flatwoods
San Jacinto	T6N R10E SEQ S21, SWQ S22	Flatwoods

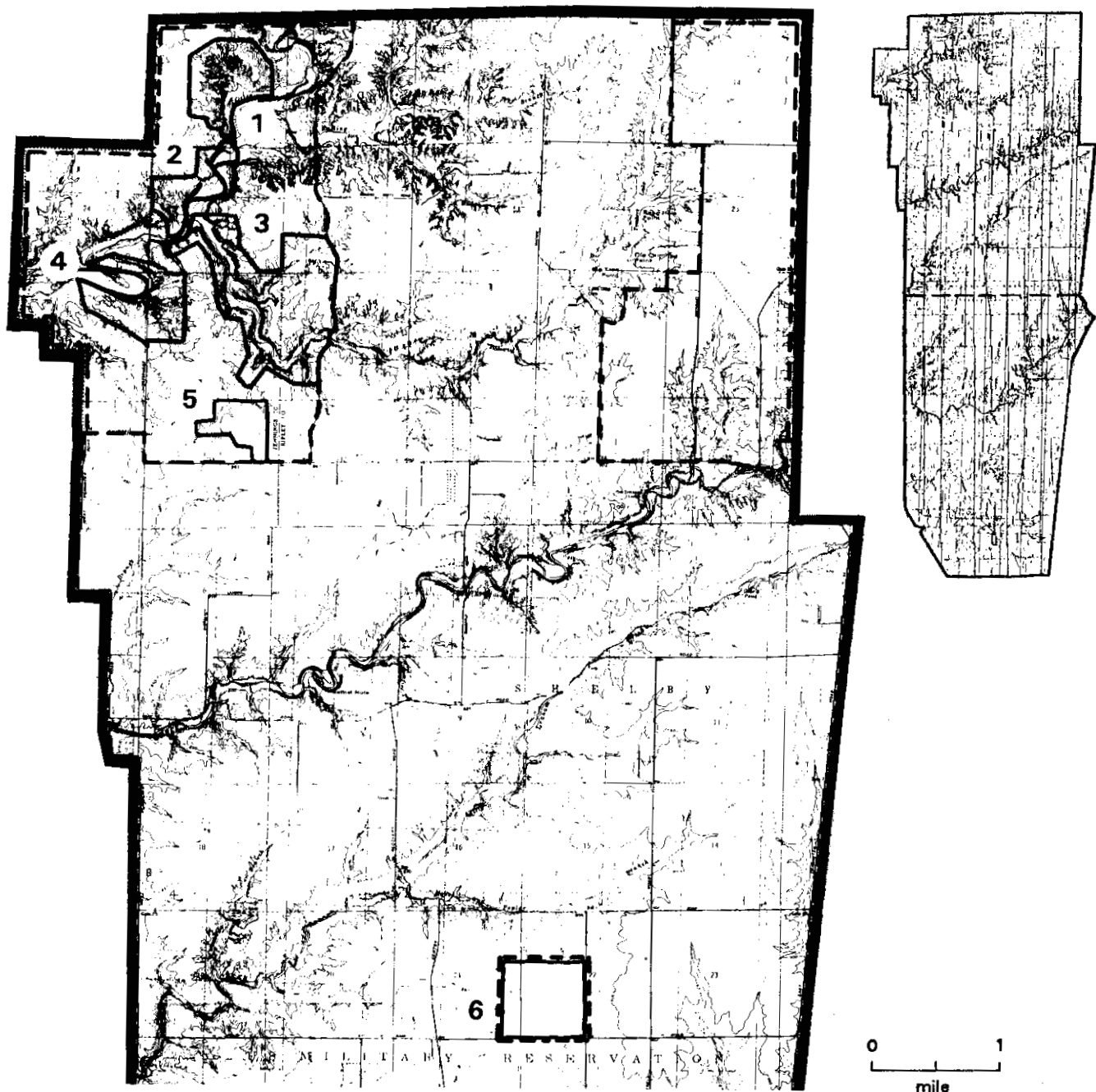


Figure 3a. Location of high quality natural areas (numbered areas), and proposed protected areas (dashed lines) found in the northern section of Jefferson Proving Ground.

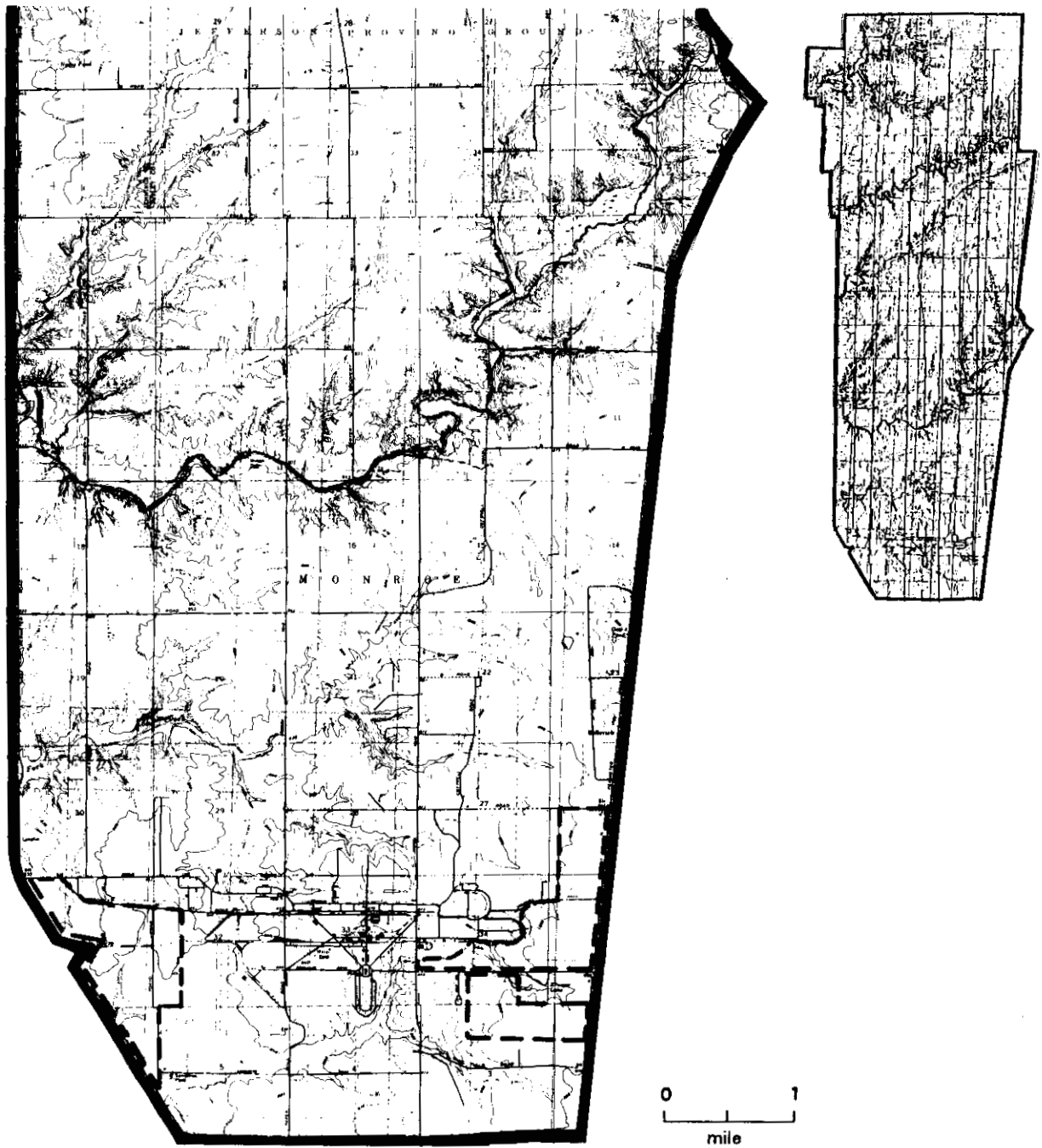


Figure 3b. Location of proposed protected areas (dashed lines) found in the southern section of Jefferson Proving Ground.

Natural Communities:

Historically, the majority of JPG consisted of forested natural communities, predominantly flatwoods. Today, these areas are in various stages of regrowth or succession, ranging from open flats to relatively mature flatwoods. Other community types inventoried include floodplain forests, mesic upland forests, dry-mesic upland forests, and cliffs along or in the vicinity of the major drainages. See Appendix C for color photographs of some of the natural communities discussed below.

Flatwoods

The flatwoods at JPG are the southern or bluegrass till plain natural community type and are characterized by having poorly drained acidic soils, predominantly Cobbsfork silt loams, and to a lesser degree Avonburg silt loams. These areas are in various stages of succession, ranging from open flats to regrowth flatwoods. Disturbances from past agricultural uses, and more recently fire are evident in most areas. These disturbances are undoubtedly a factor in species density and diversity. Although there is overlap of species among the various stages of successional flats, there are some noticeable differences in composition. See Appendix A for a list of species characteristic of this community type (includes all successional stages).

Bluegrass Till Plain Flatwoods: Characteristic species in this community are red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), pin oak (*Quercus palustris*), American beech (*Fagus grandifolia*), and tulip tree (*Liriodendron tulipifera*). More mature flatwoods tended to have more of an oak component and included swamp white oak (*Quercus bicolor*) and swamp chestnut oak (*Q. michauxii*). Cleared open flats were characterized by spike-rush (*Eleocharis tenuis*), early goldenrod (*Solidago juncea*), beard-tongue (*Penstemon digitalis*), narrow-leaved mountain mint (*Pycnanthemum tenuifolium*), boneset (*Eupatorium perfoliatum*), hyssop-leaved boneset (*E. hyssopifolium*), and hardhack (*Spiraea tomentosa*).

Upland Forest

Most of the upland forest, aside from flatwoods, occurs at the north end of JPG, in areas dissected by the major westward-flowing streams and their tributaries, e.g., Otter Creek, Graham Creek, Little Graham Creek, etc. The major type, by far, is mesic upland forest. There are also areas of dry-mesic forest on some of the south-facing slopes, and even a few, very small areas of dry forest. See Appendix A for a list of species characteristic of this community type. Brief descriptions are as follows:

Mesic Upland Forest: Mesic upland forests in this section of the Bluegrass Natural Region typically have a mix of canopy dominants (= mixed mesophytic). Characteristic trees include American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), black maple (*A. nigrum*), tulip tree (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), red oak (*Quercus rubra*), American basswood (*Tilia americana*), black walnut (*Juglans nigra*), and black cherry (*Prunus serotina*). Herbs are many, particularly the spring ephemerals.

Dry-mesic Upland Forest: This forest type is less common than the above, occurring mainly on better drained upper slopes that have a south or west aspect. Oaks are more common on these sites, including chinquapin oak (*Quercus muhlenbergii*), white oak (*Q. alba*), and some black oak (*Q. velutina*). Other dominants include shagbark hickory (*Carya ovata*), blue ash (*Fraxinus quadrangulata*), white ash (*F. americana*), and hop hornbeam (*Ostrya virginiana*). Because of the small area of this type at JPG, and the overlap between it and the mesic forest, species found here are included in Appendix A.

Dry Upland Forest: This is a very uncommon type at JPG, restricted to the crests of the steepest, rockiest, south and southwest facing slopes. The reason for the rarity is perhaps due to the relatively deep, rich soils that occur in the entrenched valleys of the till plain. Such soils apparently retain sufficient moisture to preclude the development of dry forests. Some canopy trees are black oak (*Quercus velutina*), scarlet oak (*Q. coccinea*), white oak (*Q. alba*), redbud (*Cercis canadensis*), and red cedar (*Juniperus virginiana*). Characteristic species include poverty

grass (*Danthonia spicata*), leather flower (*Clematis viorna*), nodding onion (*Allium cernuum*), low bush blueberry (*Vaccinium pallidum*), hairy hawkweed (*Hieraceum gronovii*), and *Carex artitecta*.

Floodplain Forest

Because of the few sizable streams that flow through the property, and the narrowness of the valleys through which they flow, floodplain forests are a rather minor component of JPG's forest system. For the most part, they are similar to some of the mesic ravine flora, but other species, more tolerant of wetness, are also present. American sycamore (*Platanus occidentalis*), Eastern cottonwood (*Populus deltoides*), boxelder (*Acer negundo*), silver maple (*A. saccharinum*), red maple (*A. rubrum*), bluebells (*Mertensia virginiana*), false mermaid weed (*Floerka proserpinacoides*), blue-eyed Mary's (*Collinsia verna*), and cutleaf coneflower (*Rhudebeckia laciniata*) are typical.

Limestone Cliff

All cliffs observed at JPG were composed of limestone. They are for the most part small, and confined to the borders of the larger westward-flowing streams at the northern end of the property, e.g., Otter Creek, Graham Creek, etc. Some smaller cliffs and isolated boulders were noted on the higher slopes of hills in the above-mentioned stream systems. Limestone cliffs are typically rather rich floristically, and are prime areas for rare species, e.g. *Dentaria diphylla* and *Veratrum woodii*. Characteristic species include columbine (*Aquilegia canadensis*), Hepatica (*Hepatica acutiloba*), bulblet fern (*Cystopteris bulbifera*), live forever (*Sedum ternatum*), wild hydrangea (*Hydrangea arborescens*), blue ash (*Fraxinus quadrangulata*), and running euonymus (*Euonymus obovatus*).

Rare Plants:

Twenty-nine species of listed plants were found during the survey (Table IV). The locations of these species are shown on general site maps (Figure 4). These species are described in Appendix B, and nine of them are illustrated in Appendix C.

Table IV. Endangered, threatened, rare and watch list plants discovered in Jefferson Proving Ground.

Species name	Common name	Status
<i>Agalinis fasciculata</i>	clustered foxglove	E
<i>Bartonia paniculata</i>	twining bartonia	E
<i>Botrychium oneidense</i>	blunt-lobed grape-fern	R
<i>Carex abscondita</i>	thicket sedge	WL
<i>Carex louisianica</i>	Louisiana sedge	R
<i>Carex woodii</i>	pretty sedge	R
<i>Chimaphila maculata</i>	spotted wintergreen	WL
<i>Cimicifuga racemosa</i>	black bugbane	WL
<i>Crotonopsis elliptica</i>	elliptical rushfoil	E
<i>Dentaria diphylla</i>	crinkleroot	R
<i>Eupatorium rotundifolium</i>	round-leaved boneset	E
<i>Hydrastis canadensis</i>	goldenseal	WL
<i>Linum striatum</i>	ridged yellow flax	R
<i>Lycopodium clavatum</i>	running pine	R
<i>Lycopodium obscurum</i>	tree clubmoss	E
<i>Lygodium palmatum</i>	climbing fern	E

<i>Oenothera perennis</i>	small sundrops	R
<i>Panax quinquefolium</i>	American ginseng	WL
<i>Panax trifolium</i>	dwarf ginseng	R
<i>Platanthera lacera</i>	green-fringed orchis	WL
<i>Platanthera peramoena</i>	purple fringeless orchis	WL
<i>Rhexia mariana</i> var. <i>mariana</i>	Maryland meadow beauty	E
<i>Sagittaria australis</i>	longbeak arrowhead	E
<i>Spiranthes ovalis</i>	lesser ladies'-tresses	R
<i>Spiranthes tuberosa</i>	little ladies'-tresses	R
<i>Strophostyles leiosperma</i>	slick seed wild-bean	T
<i>Veratrum woodii</i>	false hellebore	WL
<i>Viola blanda</i>	smooth white violet	R
<i>Woodwardia areolata</i>	netted chain-fern	E

Status: E - Endangered; T - Threatened; R - Rare; WL - Watch List

Figure 4a. Location of listed species found in the northern section of Jefferson Proving Ground (map next page).

1 = <i>Bartonia paniculata</i> <i>Lycopodium obscurum</i>	7 = <i>Botrychium oneidense</i> <i>Panax trifolium</i> <i>Sagittaria australis</i>	16 = <i>Carex louisianica</i>
2 = <i>Bartonia paniculata</i> <i>Lygodium palmatum</i> <i>Viola blanda</i> <i>Woodwardia areolata</i>	8 = <i>Dentaria diphylla</i> <i>Viola blanda</i>	17 = <i>Agalinis fasciculata</i> <i>Bartonia paniculata</i> <i>Eupatorium rotundifolium</i> <i>Lycopodium clavatum</i>
3 = <i>Carex louisianica</i> <i>Linum striatum</i> <i>Spiranthes ovalis</i>	9 = <i>Dentaria diphylla</i>	18 = <i>Carex abscondita</i> <i>Lycopodium clavatum</i> <i>Viola blanda</i>
4 = <i>Platanthera lacera</i> <i>Viola blanda</i>	10 = <i>Veratrum woodii</i>	19 = <i>Bartonia paniculata</i> <i>Carex louisianica</i> <i>Eupatorium rotundifolium</i> <i>Lycopodium clavatum</i> <i>Lycopodium obscurum</i> <i>Platanthera lacera</i> <i>Woodwardia areolata</i>
5 = <i>Carex woodii</i> <i>Cimicifuga racemosa</i> <i>Hydrastis canadensis</i> <i>Panax quinquefolium</i>	11 = <i>Dentaria diphylla</i> <i>Veratrum woodii</i>	20 = <i>Bartonia paniculata</i> <i>Eupatorium rotundifolium</i> <i>Lycopodium obscurum</i> <i>Viola blanda</i> <i>Woodwardia areolata</i>
6 = <i>Bartonia paniculata</i> <i>Chimaphila maculata</i> <i>Lycopodium clavatum</i>	12 = <i>Veratrum woodii</i>	
	13 = <i>Spiranthes tuberosa</i>	
	14 = <i>Agalinis fasciculata</i> <i>Crotonopsis elliptica</i> <i>Strophostyles leiosperma</i>	
	15 = <i>Dentaria diphylla</i> <i>Veratrum woodii</i>	

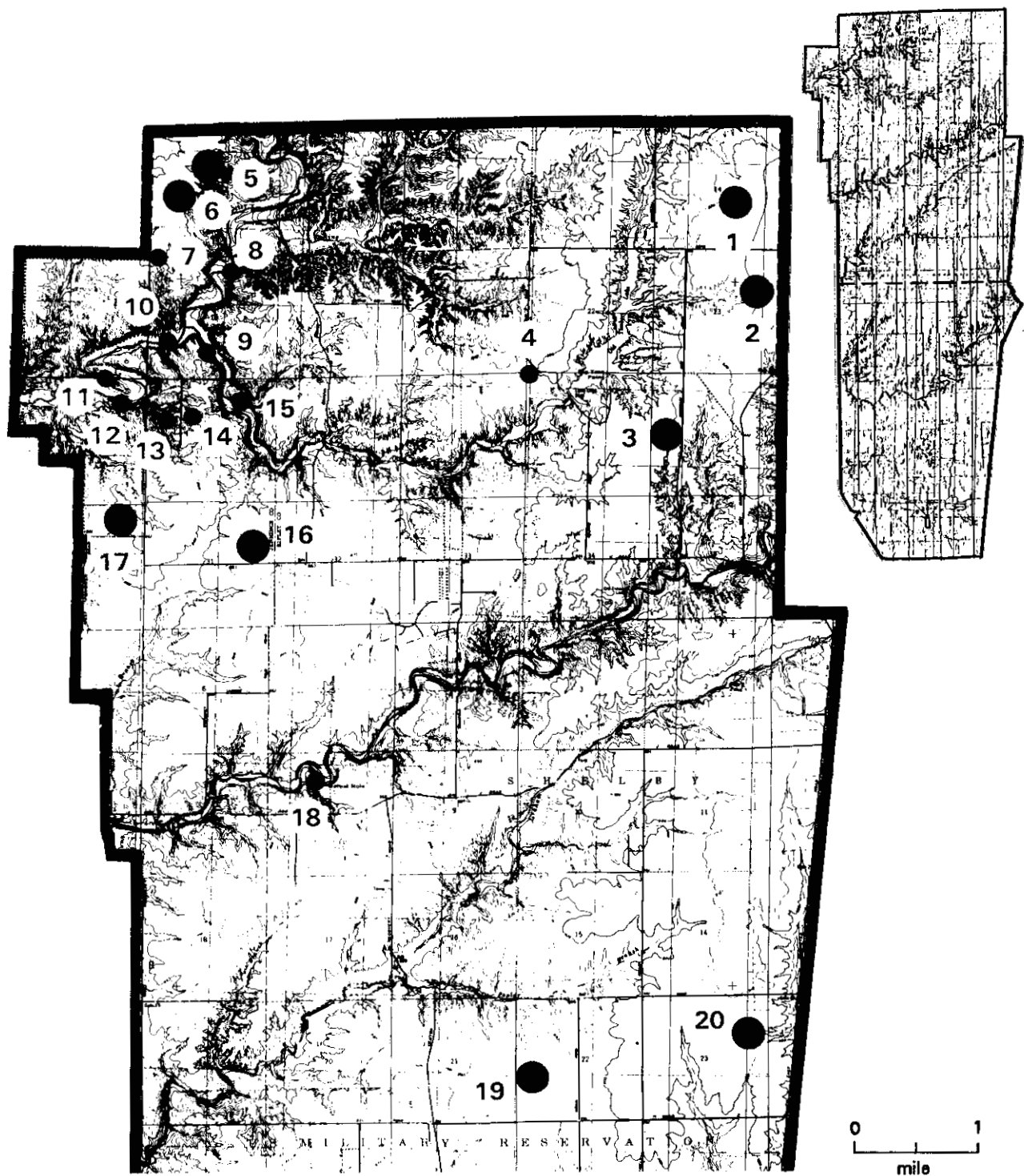


Figure 4a. Location of listed species found in the northern section of Jefferson Proving Ground (list on previous page).

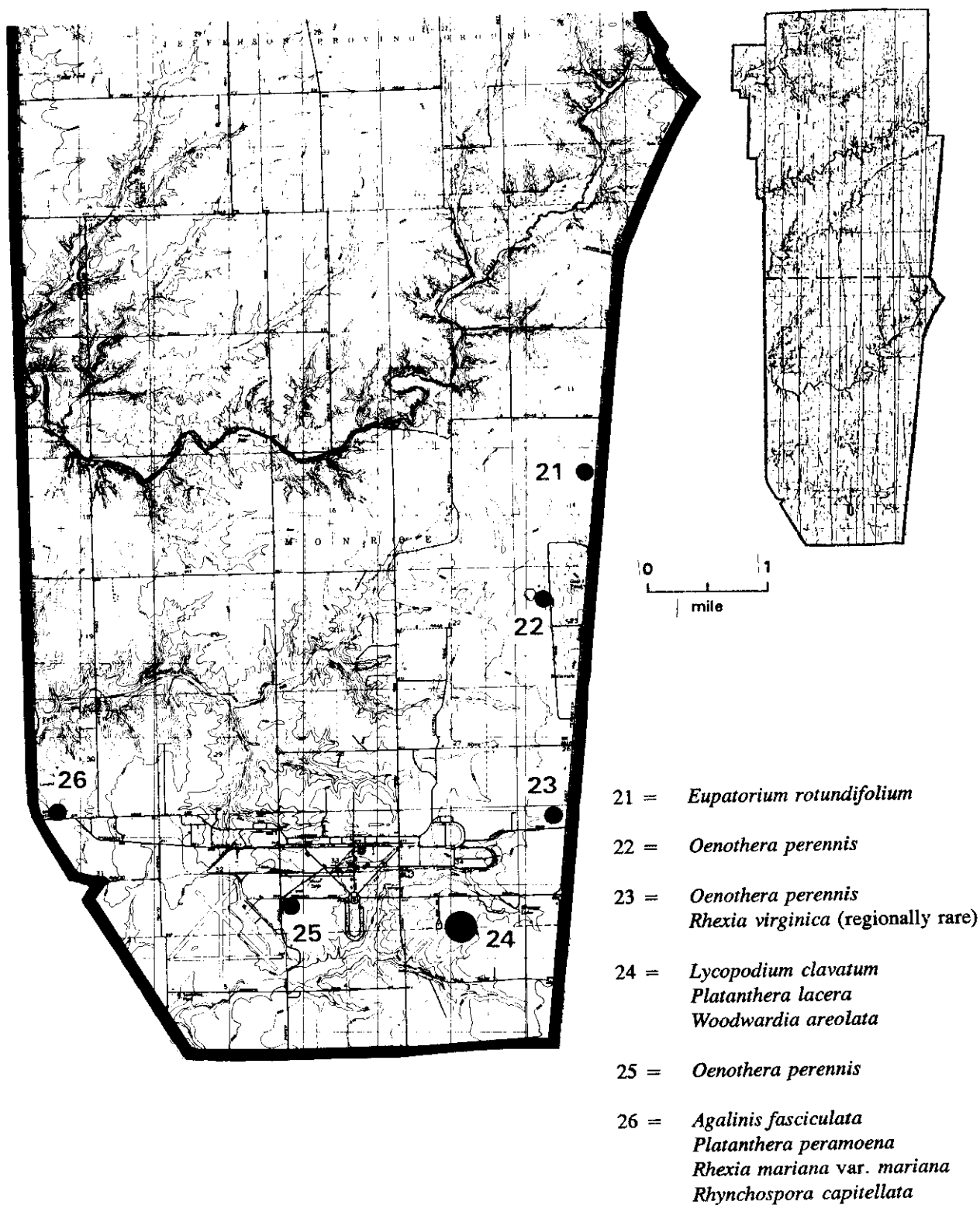


Figure 4b. Location of listed species found in the southern section of Jefferson Proving Ground.

Recommendations for Management and Protection of Natural Areas, Natural Communities and Biodiversity, Including Special Plant Species

There is a tremendous amount of biological diversity present within the confines of JPG, as well as the presence of good quality natural communities. Maintaining the communities and natural diversity of JPG will require continued management and protection. We recommended the following: 1) consider a large portion of JPG as an ecosystem reserve; 2) designate the highest quality natural communities (natural areas), the best rare species sites, and selected clusters of these smaller sites as Research Natural Areas, or State Nature Preserves; 3) control exotic species; 4) restrict timber harvest (in select areas); 5) control frequency and timing of mowing; 6) maintain natural hydrology; 7) use prescribed fire; 8) conduct additional evaluations site by site as areas are cleaned up.

1) Regional Significance of JPG

JPG sits on a flat plain known as the "Illinoian Till Plain" which was created thousands of years ago by the Illinoian ice sheet. This plain is an area of glaciated terrain which covers parts of several midwestern states. The vegetation on a small portion of this plain, occurring in southeastern Indiana, southwestern Ohio, and a sliver of Kentucky is quite distinct from the vegetation typical of the rest of the Illinoian Till Plain. (In Indiana, this area is equivalent to the Muscatatuck Flats and Canyons Section of the Bluegrass Natural Region.) E. Lucy Braun, a noted forest ecologist, stated in her book, Deciduous Forests of Eastern North America, that "the area of Illinoian glaciation in southwestern Ohio and southeastern Indiana is vegetationally distinct from the Bluegrass to the south and the younger glaciated land to the north". She wrote that the forests were made up of a wide variety of successional types with sweetgum (*Liquidambar styraciflua*) being a major component, and American beech (*Fagus grandifolia*) and white oak (*Quercus alba*) being dominant in more mature stands.

Most of the original forest of this region, including much of what is now JPG, were cleared for agriculture. This conversion was especially thorough because of the flat terrain present in this region. While most of the surrounding land is still in agricultural use, JPG, because of the special military uses has largely reverted to forest and other natural vegetation types. During this study, we have observed an almost overwhelming variety of successional natural vegetation types, as well as mature forests, which uniquely represent the vegetation of this entire region. Nowhere can such an assortment of the region's natural heritage be found; it just does not exist, especially at the scale found in JPG, anywhere else.

Although this survey did not include animals, we know that JPG also provides a refuge for most, if not all, animal species native to the region. In addition, JPG offers a relatively unfragmented block of habitat for many species of animals which are otherwise declining as a result of habitat fragmentation.

Thus, JPG is extremely important, not just as a large block of land with lots of rare plants and animals living there, but as a regional treasure containing an ecosystem-sized cross section of a distinct vegetation association. In addition, there is no other tract of public land even remotely close in size to JPG in this region, making this installation even more important. Based on these factors, we recommend that, during the reuse options discussions, very serious consideration be given to the conservation of a large portion of JPG as an ecosystem reserve. The combination of high quality natural areas, rare species, lack of habitat fragmentation, and the absence of unexploded ordinance makes the area north of K road an excellent candidate for this designation. This opportunity to protect such a large, functional example of the biota of this region will almost certainly never come again.

Synopsis: Consider a large portion of JPG as an ecosystem reserve.

- 2) Those areas which were found to be the best natural areas (exhibited the least amount of disturbance) and those areas which contain the best populations of rare species are very important biological assets. Some areas which were surveyed are clustered within large blocks of continuous habitat. We recommend designating these blocks as Research Natural Areas. Also, should these blocks be excessed, we recommend that they be protected as State Nature Preserves. Refer back to Figure 3 which shows these proposed protected areas.

Synopsis: Protect the best blocks as Research Natural Areas, or as State Nature Preserves.

- 3) Exotic species are some of the greatest threats to native biota. They tend to displace species, and thus reduce overall diversity. Several invasive exotic species were noted but the most serious include Japanese honeysuckle (*Lonicera japonica*), yellow king-devil hawkweed (*Hieracium caespitosum*), tall fescue (*Festuca pratensis*), Eulalia grass (*Microstegium vimineum*), moneywort (*Lysimachia nummularia*), and garlic mustard (*Alliaria petiolata*). All are particularly serious and difficult to control once they reach large numbers. Thus, in controlling exotics, it is infinitely easier to prevent their proliferation than to attempt to reduce large existing populations. Surveillance for the appearance of new exotic populations, and quick eradication upon discovery, is essential. Fortunately, much of the JPG landscape is free from serious exotics contamination. However, there are problem areas, and others that will be future problems if not treated. Because most of these exotics prefer alkaline substrates, they are most prevalent at JPG in the drainages entrenched through limestone, e.g., Otter Creek, Graham Creek, etc. Fortunately, the acidic flats are relatively free of exotics, save for the occurrence of the yellow king-devil hawkweed, and areas intentionally planted with them, e.g., roadsides, lawns, and the like. In regard to the latter, our recommendation is to avoid planting non-native plants, even along roadsides, ditches, and rights-of-ways. Our observation is that native species (e.g., rushes, grasses, sedges) quickly colonize disturbed sites, increasing diversity locally, precluding the need for exotics such as fescue.

Synopsis: Survey landscape for exotics; eradicate where feasible; do not plant invasive exotics.

- 4) We believe it would be desirable to manage certain areas for old growth timber. This would benefit those species that perhaps do best under such conditions (e.g., forest interior birds), and would add to the overall diversity of age and size classes of JPG forests. We recommend that old growth management at least include sites that are identified as important areas in this report. Forest—on steep and/or rocky slopes, adjacent to cliffs, or in riparian areas—should also be considered for harvest free zones. Forested sites harboring rare species should also be under old growth management where appropriate.

Synopsis: Manage for old growth timber in areas that are important natural and rare species areas, that harbor or have potential for rare species (such as cliffs), and are subject to erosion.

- 5) Mowed rights-of-ways and shoulders of roads are important habitats for many sun-loving native species, including several rare ones, e.g., Maryland meadow beauty (*Rhexia mariana* var. *mariana*) and small sundrops (*Oenothera perennis*). These species do best where the frequency of mowing is not great, and there is not a dense turf of fescue, bluegrass, or other exotic grass. Mowing one time a year, during the non-growing season, would seem to accomplish the suppression of any woody growth posing a safety hazard, and allow a full growing season for desirable herbaceous plants. One time mowing would not only be beneficial for the plants, but would also reduce the expense caused by frequent mowing.

Synopsis: Reduce mowing frequency to one time a year.

- 6) The maintenance of natural hydrologies is critical to the occurrence of wetland species present at JPG. This is especially true in the flatwoods area of the property. These poorly drained flats are host to most of the wetland plants at JPG; ditching and the subsequent draining of them would certainly lower natural diversity. Conversely, riparian biota would suffer from too much water, such as would be caused by the damming of free-flowing streams.

Synopsis: Prohibit the draining of flats and other wetlands; prohibit the construction of dams.

- 7) Fire appears to be one of the most important factors in shaping the appearance of the landscape at JPG. By our accounts fire has been beneficial to the natural communities, including the wet flatwoods. We noted a greater diversity and vigor of herbaceous plants in the burned areas (compared to the unburned); even large-canopy trees appeared for the most part to be unaffected. Continuation of burning in areas so treated previously, and even expansion into untreated areas, is a prescription that we think will help in maintaining the biodiversity of JPG.

Synopsis: Continue fire treatment and expand into previously unburned areas.

- 8) As stated earlier, we were not able to survey many areas because of access limitations and/or restrictions (Figure 5). Our impression from surveying other areas is that JPG has excellent potential for rare species populations throughout the property. Given that potential, we recommend that, as clean-up and reuse decisions are made, additional rare species surveys be conducted to evaluate that additional potential.

Synopsis: Conduct additional rare species surveys as clean-up and reuse progresses.

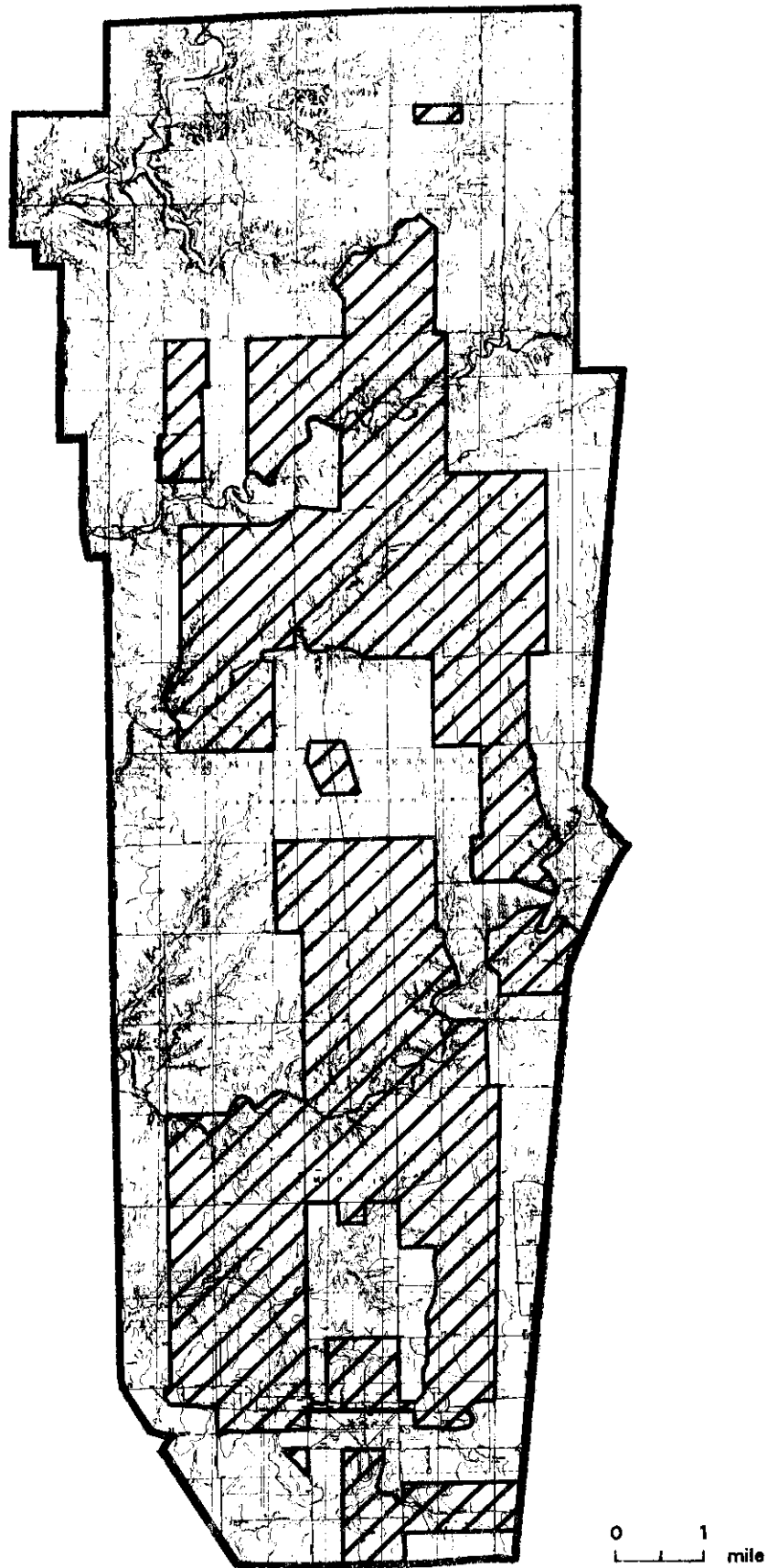


Figure 5. Location of limited or restricted access areas (shaded sections) within the Jefferson Proving Ground.

Appendix A: List of some plants characteristic of Jefferson Proving Ground.

Scientific name	Common name
Upland Forest (includes mesic, dry-mesic, and dry types)	
<i>Acer saccharum</i>	sugar maple
<i>Actaea alba</i>	white baneberry
<i>Adiantum pedatum</i>	maidenhair fern
<i>Allium burdickii</i>	onion
<i>Allium tricoccum</i>	wood leak
<i>Amphicarpaea bracteata</i>	hog peanut
<i>Aquilegia canadensis</i>	wild columbine
<i>Arisaema triphyllum</i>	small Jack-in-the-pulpit
<i>Aristolochia serpentaria</i>	Virginia snakeroot
<i>Asarum canadense</i>	wild ginger
<i>Asimina triloba</i>	pawpaw
<i>Aster cordifolius</i>	heart-leaved aster
<i>Aster macrophyllus</i>	large-leaved aster
<i>Aster shortii</i>	Short's aster
<i>Athyrium pycnocarpon</i>	narrowleaf spleenwort
<i>Athyrium thelypteroides</i>	silvery spleenwort
<i>Brachyelytrum erectum</i>	a grass
<i>Carex albursina</i>	a sedge
<i>Carex communis</i>	a sedge
<i>Carex laxiflora</i>	a sedge
<i>Carex rosea</i>	a sedge
<i>Carex virescens</i>	a sedge
<i>Carex woodii</i>	pretty sedge
<i>Carya glabra</i>	pignut hickory
<i>Carya laciniosa</i>	shellbark hickory
<i>Carya ovata</i>	shagbark hickory
<i>Caulophyllum thalictroides</i>	blue cohosh
<i>Cercis canadensis</i>	redbud
<i>Chaerophyllum procumbens</i>	chervil
<i>Cimicifuga racemosa</i>	black bugbane
<i>Claytonia virginica</i>	spring beauty
<i>Collinsonia canadensis</i>	horse-balm
<i>Conopholis americana</i>	squawroot
<i>Corallorhiza odontorhiza</i>	late coralroot
<i>Cryptotaenia canadensis</i>	honewort
<i>Cypripedium calceolus</i> var. <i>pubescens</i>	small yellow lady's slipper
<i>Cystopteris protrusa</i>	fragile fern
<i>Dentaria diphylla</i>	crinkleroot
<i>Dentaria heterophylla</i>	slender toothwort
<i>Dentaria laciniata</i>	cut-leaved toothwort
<i>Desmodium glutinosum</i>	pointed-leaf tick trefoil
<i>Desmodium nudiflorum</i>	naked-flower tick trefoil
<i>Diarrhena americana</i>	a grass
<i>Dioscorea quaternata</i>	wild yam
<i>Dirca palustris</i>	leatherwood

Upland Forest continued

<i>Erigenia bulbosa</i>	harbinger-of-spring
<i>Erythronium americanum</i>	trout lily
<i>Euonymus obovatus</i>	running euonymus
<i>Eupatorium rugosum</i>	white snakeroot
<i>Fagus grandifolia</i>	American beech
<i>Festuca subverticillata</i>	nodding fescue
<i>Fraxinus americana</i>	white ash
<i>Fraxinus quadrangulata</i>	blue ash
<i>Galium circaeazans</i>	wild licorice
<i>Galium concinnum</i>	shining bedstraw
<i>Galium triflorum</i>	sweet-scented bedstraw
<i>Geranium maculatum</i>	wild geranium
<i>Hepatica acutiloba</i>	Hepatica
<i>Hybanthus concolor</i>	green violet
<i>Hydrastis canadensis</i>	goldenseal
<i>Hydrophyllum canadense</i>	broad-leaved waterleaf
<i>Hystrix patula</i>	bottle-brush
<i>Jeffersonia diphylla</i>	twinleaf
<i>Juglans nigra</i>	black walnut
<i>Laportea canadensis</i>	wood nettle
<i>Lindera benzoin</i>	spicebush
<i>Liparis liliifolia</i>	large twayblade
<i>Liquidambar styraciflua</i>	sweetgum
<i>Liriodendron tulipifera</i>	tulip tree
<i>Monarda</i> spp.	bee balm
<i>Nyssa sylvatica</i>	black gum
<i>Osmorhiza claytonii</i>	sweet cicely
<i>Ostrya virginiana</i>	hop hornbeam
<i>Panax quinquefolium</i>	American ginseng
<i>Panicum boscii</i>	large-fruited panic grass
<i>Parthenocissus quinquefolia</i>	Virginia creeper
<i>Phlox divaricata</i>	wild blue phlox
<i>Phryma leptostachya</i>	lopseed
<i>Pilea pumila</i>	clearweed
<i>Podophyllum peltatum</i>	mayapple
<i>Polygonatum pubescens</i>	hairy Solomon's seal
<i>Polygonum virginiana</i>	Virginia knotweed
<i>Polymnia canadensis</i>	small-flower leafcup
<i>Polystichum acrostichoides</i>	Christmas fern
<i>Prenanthes altissima</i>	tall white lettuce
<i>Prunus serotina</i>	black cherry

Upland Forest continued

<i>Quercus alba</i>	white oak
<i>Quercus muhlenbergii</i>	chinquapin oak
<i>Quercus rubra</i>	Northern red oak
<i>Sanicula canadensis</i>	short-styled snakeroot
<i>Sanicula gregaria</i>	clustered snakeroot
<i>Sanicula trifoliata</i>	long-fruited snakeroot
<i>Sassafras albidum</i>	sassafras
<i>Scutellaria incana</i>	downy skullcap
<i>Sedum ternatum</i>	wild stonecrop
<i>Silene stellata</i>	starry catchfly
<i>Silene virginica</i>	firepink
<i>Smilacena racemosa</i>	false Solomon's seal
<i>Smilax hispida</i>	hispid greenbrier
<i>Smilax rotundifolia</i>	roundleaf greenbrier
<i>Solidago caesia</i>	blue-stemmed goldenrod
<i>Solidago flexicaulis</i>	zigzag goldenrod
<i>Staphylea trifolia</i>	American bladdernut
<i>Stellaria pubera</i>	great chickweed
<i>Thelypteris hexagonoptera</i>	broad beech fern
<i>Tilia americana</i>	American basswood
<i>Trillium flexipes</i>	drooping trillium
<i>Trillium sessile</i>	toadshade
<i>Ulmus rubra</i>	slippery elm
<i>Uvularia grandiflora</i>	large-flowered bellwort
<i>Valeriana pauciflora</i>	large-flower valarian
<i>Verbesina alternifolia</i>	yellow ironweed
<i>Viburnum acerifolium</i>	mapleleaf viburnum
<i>Viburnum prunifolium</i>	black haw
<i>Viola canadensis</i>	Canada violet
<i>Viola pubescens</i>	downy yellow violet
<i>Viola rostrata</i>	long-spurred violet
<i>Viola sororia</i>	downy blue violet
<i>Vitis aestivalis</i>	summer grape

Scientific name	Common name
Flatwoods (includes all successional stages)	
<i>Acer rubrum</i>	red maple
<i>Agalinis fasciculata</i>	clustered foxglove
<i>Agrimonia pubescens</i>	agrimony
<i>Agrostis perennans</i>	upland bent grass
<i>Andropogon virginicus</i>	broom sedge
<i>Aster umbellatus</i>	flat-topped aster
<i>Athyrium filix-femina</i>	lady fern
<i>Bartonia paniculata</i>	twining bartonia
<i>Boehmeria cylindrica</i>	false nettle
<i>Botrychium dissectum</i> var. <i>obliquum</i>	lace-frond grape-fern
<i>Botrychium oneidense</i>	blunt-lobed grape-fern
<i>Carex bromoides</i>	a sedge
<i>Carex</i> cf. <i>artitecta</i>	a sedge
<i>Carex crinita</i>	a sedge
<i>Carex debilis</i>	a sedge
<i>Carex gracillima</i>	a sedge
<i>Carex grayii</i>	a sedge
<i>Carex intumescens</i>	a sedge
<i>Carex laxiflora</i>	a sedge
<i>Carex louisianica</i>	Louisiana sedge
<i>Carex rosea</i>	a sedge
<i>Carex swanii</i>	a sedge
<i>Carpinus carolinianus</i>	blue beech
<i>Carya ovata</i>	shagbark hickory
<i>Cinna arundinacea</i>	woodreed
<i>Claytonia virginica</i>	spring beauty
<i>Desmodium paniculatum</i>	panicked tick trefoil
<i>Dryopteris carthusiana</i>	wood fern
<i>Dryopteris cristata</i>	crested fern
<i>Eleocharis tenuis</i>	spike-rush
<i>Eupatorium fistulosum</i>	trumpetweed
<i>Eupatorium hyssopifolium</i>	hyssop-leaved boneset
<i>Eupatorium perfoliatum</i>	boneset
<i>Eupatorium rotundifolium</i>	round-leaved boneset
<i>Eupatorium serotinum</i>	late-flowering boneset
<i>Euthamia graminifolium</i>	flat-topped goldenrod
<i>Fagus grandifolia</i>	American beech
<i>Fraxinus pennsylvanica</i>	green ash
<i>Galium obtusum</i>	bedstraw
<i>Galium triflorum</i>	sweet-scented bedstraw
<i>Glyceria striata</i>	fowl mannagrass

Flatwoods continued

<i>Helenium flexulosum</i>	sneezeweed
<i>Hieraceum caespitosum</i>	yellow king-devil hawkweed
<i>Hieraceum gronovii</i>	hairy hawkweed
<i>Hieraceum scabrum</i>	rough hawkweed
<i>Ilex verticillata</i>	winterberry
<i>Juncus biflorus</i>	a rush
<i>Juncus brachycarpus</i>	a rush
<i>Juncus diffusissimus</i>	a rush
<i>Juncus effusus</i>	soft rush
<i>Juncus marginatus</i>	a rush
<i>Juncus tenuis</i>	path rush
<i>Leersia virginica</i>	whitegrass
<i>Lindera benzoin</i>	spicebush
<i>Linum medium</i>	common yellow flax
<i>Linum striatum</i>	ridged yellow flax
<i>Linum virginiana</i>	wild yellow flax
<i>Liquidambar styraciflua</i>	sweetgum
<i>Liriodendron tulipifera</i>	tulip tree
<i>Lobelia cardinalis</i>	cardinal flower
<i>Lobelia inflata</i>	Indian tobacco
<i>Ludwigia alternifolia</i>	seedbox
<i>Lycopodium clavatum</i>	running pine
<i>Lycopodium digitatum</i>	southern ground-cedar
<i>Lycopodium obscurum</i>	tree clubmoss
<i>Lygodium palmatum</i>	climbing fern
<i>Medeola virginiana</i>	Indian cucumber root
<i>Mitchella repens</i>	partridgeberry
<i>Nyssa sylvatica</i>	black gum
<i>Onoclea sensibilis</i>	sensitive fern
<i>Osmunda cinnamomea</i>	cinnamon fern
<i>Osmunda regalis</i>	royal fern
<i>Panax trifolium</i>	dwarf ginseng
<i>Panicum anceps</i>	panic grass
<i>Panicum microcarpon</i>	panic grass
<i>Parthenocissus quinquefolia</i>	Virginia creeper
<i>Platanus occidentalis</i>	sycamore
<i>Podophyllum peltatum</i>	mayapple
<i>Polygala sanguinea</i>	purple milkwort
<i>Polygala verticillata</i>	whorled milkwort
<i>Polygonum virginiana</i>	Virginia knotweed
<i>Pycnanthemum tenuifolium</i>	narrow-leaved mountain mint

Flatwoods continued

<i>Quercus alba</i>	white oak
<i>Quercus michauxii</i>	swamp chestnut oak
<i>Quercus palustris</i>	pin oak
<i>Quercus rubra</i>	Northern red oak
<i>Ranunculus hispidus</i>	hispid buttercup
<i>Rhus radicans</i>	poison ivy
<i>Rubus hispidus</i>	swamp dewberry
<i>Sassafras albidum</i>	sassafras
<i>Scirpus atrovirens</i>	a bulrush
<i>Scirpus cyperinus</i>	wool grass
<i>Scutellaria lateriflora</i>	mad-dog skullcap
<i>Smilax rotundifolia</i>	roundleaf greenbrier
<i>Solidago rugosa</i>	rough-stemmed goldenrod
<i>Spiranthes cernua</i>	nodding ladies'-tresses
<i>Spiraea tomentosa</i>	hardhack
<i>Thelypteris hexagonoptera</i>	broad beech fern
<i>Thelypteris noveboracensis</i>	New York fern
<i>Ulmus americana</i>	American elm
<i>Viburnum dentatum</i>	southern arrowwood
<i>Viola blanda</i>	smooth white violet
<i>Vitis labrusca</i>	fox grape
<i>Woodwardia areolata</i>	netted chain-fern

**Appendix B: Annotated list of state rare, threatened, and endangered plants within the Jefferson Proving Ground.
See Appendix C for illustrations of nine plants.**

Agalinis fasciculata
clustered foxglove
Endangered in Indiana

Scrophulariaceae
Figwort Family

This showy wildflower is abundant at JPG, especially in young flatwoods and mowed road borders. This species was not known to occur in Indiana until its discovery in Spencer County in the early 1980's. Since then several populations have been found, and *A. fasciculata* is no longer a threatened species in Indiana. See Appendix C for illustration.



Bartonia paniculata
twining bartonia
Endangered in Indiana

Gentianaceae
Gentian Family

This tiny Atlantic coastal plain species was previously known in Indiana from only two sites, both of which are in the southeastern section of the state. In the survey area, it occurs abundantly in regrowth successional flatwoods. See Appendix C for illustration.



Botrychium oneidense
blunt-lobed grape-fern
Rare in Indiana

Ohioglossaceae
Adder's Tongue Family

A fern of more northern affinities, *B. oneidense* is a characteristic member of the wet, acidic flatwoods in southeastern Indiana. Oddly, only one population was found at JPG, perhaps because it is not normally very visible during the growing season (obscured by other vegetation). Winter is the best time to inventory for this species.



Carex abscondita
thicket sedge
Watch List in Indiana

Cyperaceae
Sedge Family

Only one population was found of this low-growing sedge. It is easily overlooked, and therefore may be more common at JPG than our survey indicates. It prefers mesic to dry-mesic upland forest environments.

Carex louisianica
Louisiana sedge
Rare in Indiana

Cyperaceae
Sedge Family

This colonial sedge is a southern species that reaches the northern edge of its range in southern Indiana. It occurs for the most part in wet and wet-mesic floodplain forests, but is also known from wet flatwoods, such as at JPG. At JPG it is uncommon, apparently restricted to those flatwoods that have had minimal soil disturbance.



Carex woodii
pretty sedge
Rare in Indiana

Cyperaceae
Sedge Family

This sedge was previously known in Indiana no further south than Marion County, in the central part of the state. However, it is apparent that this species has been overlooked in the past and will probably prove to be more common with future field work. It was found in mesic upland forest in the survey area. See Appendix C for illustration.



Chimaphila maculata
spotted wintergreen
Watch List in Indiana

Pyrolaceae
Shinleaf Family

Although found at only one site at JPG, this small trailing shrub probably occurs at several sites on the property. It is a colonizer of early to mid-successional forests on acid soils; such conditions are common at JPG.



Cimicifuga racemosa
black bugbane
Watch List in Indiana

Ranunculaceae
Buttercup Family

This is perhaps Indiana's tallest member of the buttercup family, occurring sparingly in mesic forests throughout much of southern Indiana. It is not uncommon in the mesic ravines bordering the larger streams that flow through the northern portion of JPG, e.g., Otter Creek, Graham Creek, etc.

Crotonopsis elliptica
elliptical rushfoil
Endangered in Indiana

Euphorbiaceae
Spurge Family

Prior to its discovery in the survey area, this inconspicuous species was known only from a post oak barrens in Spencer County in southwestern Indiana. At the JPG, the species was found at a single site in dry eroded soils in full sunlight. Interestingly, it was co-occurring with another rare plant previously known only from southwestern Indiana, the slick seed wild-bean (*Strophostyles leiosperma*).



Dentaria diphylla
crinkleroot
Rare in Indiana

Brassicaceae
Mustard Family

Restricted in Indiana to the southeastern portion, this toothwort is commonly associated with sandy soils near limestone outcroppings. In addition to these cliff areas, it was found in more mesic soils as well as a single population in floodplain forest. It is similar in appearance to the more common *Dentaria heterophylla* (slender toothwort) of which it may be associated. Both species have a pair of basal leaves and a pair of upper stem leaves. The upper and basal leaves of crinkleroot are roughly the same size. In slender toothwort, the upper leaves are much narrower than its basal leaves.



Eupatorium rotundifolium
round-leaved boneset
Endangered in Indiana

Asteraceae
Aster Family

A plant of the southeastern U.S., this attractive boneset was known only from a handful of sites in southeastern Indiana prior to the survey. It was a fairly common sight in open wet flats and regrowth successional flatwoods in the survey area.



Hydrastis canadensis
goldenseal
Watch List in Indiana

Ranunculaceae
Buttercup Family

Distributed statewide, this species was occasionally in rich, moist soils of mesic upland forests throughout the survey area.

See Appendix C for illustration.

Linum striatum
ridged yellow flax
Rare in Indiana

Linaceae
Flax Family

Ridged yellow flax has two principal ranges in Indiana: northwest and southeast parts of the state. Although there are several historical collections, only two have been made in the last few decades. One of those was made during our inventory of JPG.



Lycopodium clavatum
running pine
Rare in Indiana

Lycopodiaceae
Clubmoss Family

A fern ally of more northern distribution, this "running pine" surprisingly occurs in the flatwoods of southeastern Indiana as well. In some of the early successional flatwoods at JPG it forms large carpets; most populations are not as dense.



Lycopodium obscurum
tree clubmoss
Endangered in Indiana

Lycopodiaceae
Clubmoss Family

Like *L. clavatum*, this northern clubmoss also occurs in southeastern Indiana flatwoods. The identity of this taxon is tentative, as it appears to be intermediate between *L. obscurum* and *L. hickeyi*. Regardless of which taxon is present, the plant is uncommon at JPG, and in Indiana as a whole.



Lygodium palmatum
climbing fern
Endangered in Indiana

Schizaeaceae
Curly Grass Family

With its discovery in a regrowth flatwoods, this species was recorded for the first time in Indiana. Less than ten colonies of this distinctive fern were found in a relatively small area. Clambering over adjacent vegetation, it was associated with *Lycopodium digitatum* (ground cedar), etc.
See Appendix C for illustration.

Oenothera perennis
small sundrops
Rare in Indiana

Onagraceae
Evening Primrose Family

Like several of the plants at JPG, small sundrops occurs in northern Indiana, skips central Indiana, and then occurs again in southeastern Indiana. This attractive plant thrives in full sun, and is one of the rare plants that occurs in infrequently mowed shoulders of JPG's roadways.



Panax quinquefolium
American ginseng
Watch List in Indiana

Araliaceae
Ginseng Family

Ginseng is a plant of commercial interest, and its sale is monitored by the Indiana Department of Natural Resources. It is not currently a rare plant in Indiana, but IDNR is tracking it to determine population trends. We did not encounter many plants at JPG, but many were probably overlooked. See Appendix C for illustration.



Panax trifolium
dwarf ginseng
Rare in Indiana

Araliaceae
Ginseng Family

This small relative of the American ginseng is restricted in southeastern Indiana to acidic flatwoods. Only one population was found at JPG, but it undoubtedly occurs elsewhere; its ephemeral nature caused it to be overlooked in flatwoods inventoried later in the growing season.



Platanthera lacera
green-fringed orchid
Watch List in Indiana

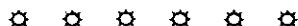
Orchidaceae
Orchid Family

A single plant of this inconspicuous orchid was seen at the base of a tree in regrowth flatwoods. Its distribution in Indiana is restricted to the northern tier counties and the southeastern part of the state. The species epithet refers to the fringe-like or lacerated lobes of the flower lip.

Platanthera peramoena
purple fringeless orchis
Watch List in Indiana

Orchidaceae
Orchid Family

The purple fringeless orchis is one of Indiana's most attractive native orchids, as well as one of its more common. Surprisingly, only one population was discovered at JPG. Undoubtedly it occurs elsewhere on the property. See Appendix C for illustration.



Rhexia mariana var. *mariana*
Maryland meadow beauty
Endangered in Indiana

Melastomataceae
Melastome Family

Primarily a coastal plain species, this attractive plant was found at only one site along a roadside in wet soils with *Solidago juncea* (early goldenrod), *Sabatia angularis* (rose pink), *Polygala sanguinea* (purple milkwort), *Helenium flexuosum* (sneezeweed), and *Rudbeckia hirta* (black-eyed Susan). This is the first record of this plant in this section of the state. It was previously known only from southwestern Indiana.



Sagittaria australis
longbeak arrowhead
Endangered in Indiana

Alismataceae
Water Plantain Family

A small colony of this arrowleaf was discovered in a wet depression in full sun at the north end of JPG. This wetland species may occur elsewhere at JPG in ditches, ponds, and lakes.



Spiranthes ovalis
lesser ladies'-tresses
Rare in Indiana

Orchidaceae
Orchid Family

An inconspicuous member of the orchid family, this ladies'-tresses prefers sparsely forested sites as opposed to those in full sun (the preferred habitat of most *Spiranthes*). JPG offers a tremendous amount of habitat for *S. ovalis*, but we encountered only one population.

Spiranthes tuberosa
little ladies'-tresses
Rare in Indiana

Orchidaceae
Orchid Family

One population of *S. tuberosa* was discovered growing in an eroded old field near Otter Creek. This appears to be near the northern limit of its range in eastern Indiana. Because this orchid prefers dry, sterile, thinly vegetated sites, reforestation of eroded old fields would bring about its demise.

✧ ✧ ✧ ✧ ✧ ✧

Strophostyles leiosperma
slick seed wild-bean
Threatened in Indiana

Fabaceae
Pea Family

This species of wild bean was discovered growing on a dry road bank at the north end of JPG. This occurrence is considerably disjunct from other populations in southwest and northwest Indiana. Interestingly, the wild bean was growing with another disjunct, *Crotonopsis elliptica*; both occur in JPG at only this one site.

✧ ✧ ✧ ✧ ✧ ✧

Veratrum woodii
false hellebore
Watch List in Indiana

Liliaceae
Lily Family

A conspicuous, large-leaved herb of mesic environments, most plants of the false hellebore found at JPG grow on steep, moist limestone slopes and forested hillsides. This species has a propensity for alkaline substrates, and is therefore confined in JPG to those entrenched valleys where limestone crops out, e.g., Otter Creek, Graham Creek, etc.

See Appendix C for illustration.

✧ ✧ ✧ ✧ ✧ ✧

Viola blanda
smooth white violet
Rare in Indiana

Violaceae
Violet Family

In Indiana, this tiny violet occurs as a disjunct in northwestern and southeastern counties. In the survey area it was found in slightly acid soils of flatwoods and in sandy soils above and below exposed limestone cliffs.

Woodwardia areolata
netted chain-fern
Endangered in Indiana

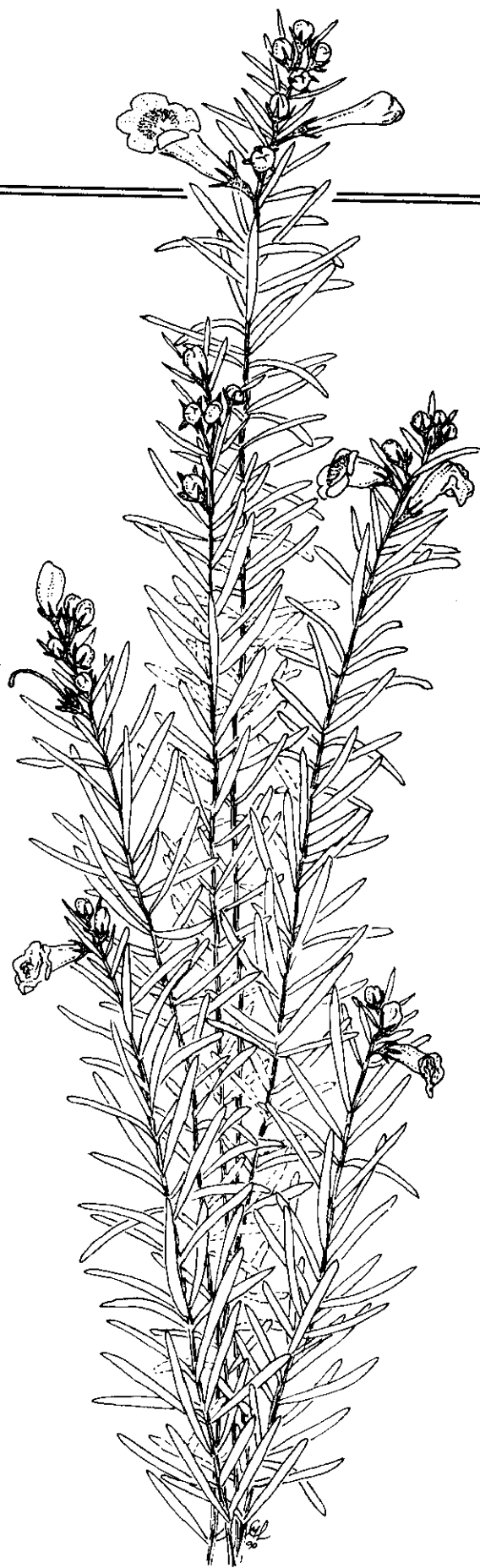
Blechnaceae
Deer Fern Family

This conspicuous fern is primarily restricted to southeastern Indiana from counties bordering the Ohio River, although there is a single extant occurrence from Porter County. It was found in flatwoods in the survey area. Superficially, the species resembles the more common sensitive fern (*Onoclea sensibilis*), but is more alternately branched, is finely serrated along the margins, and is deeper green in color. See Appendix C for illustration.

Appendix C. Illustrations of nine state rare, threatened, and endangered plants found within the Jefferson Proving Ground.

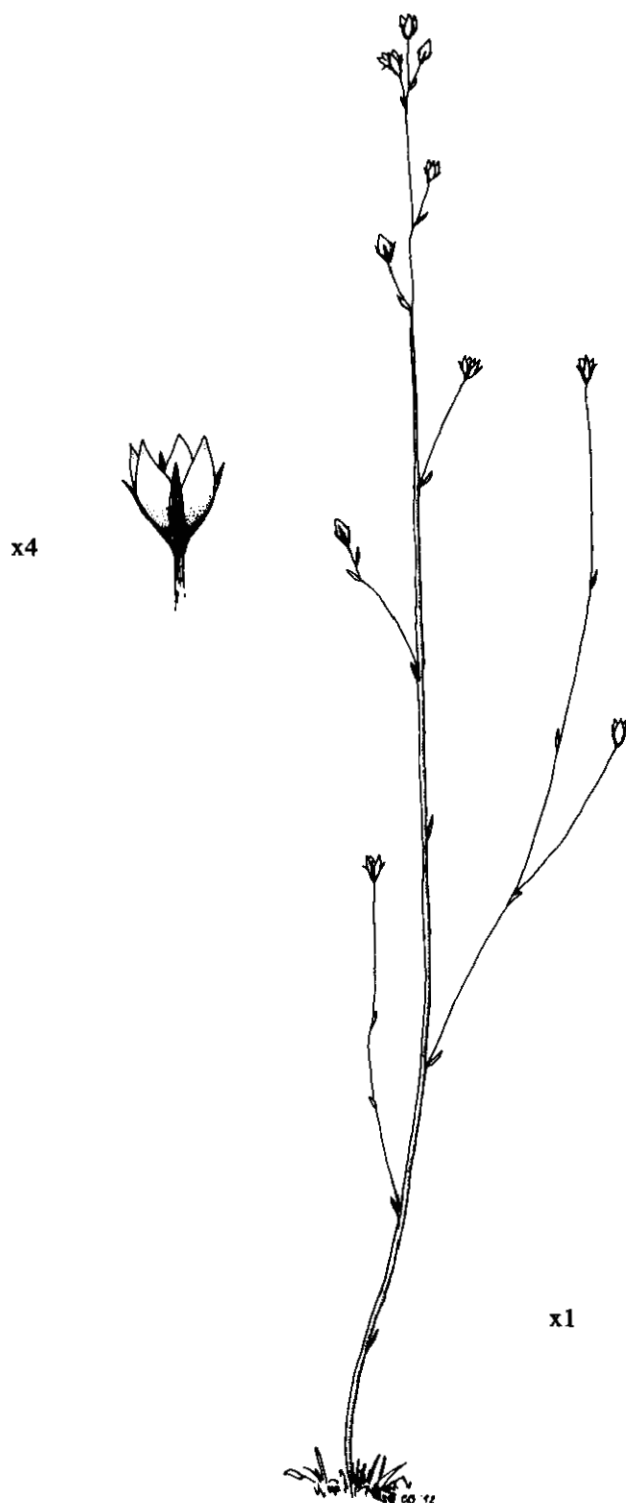
Agalinis fasciculata
clustered foxglove
Endangered in Indiana

Scrophulariaceae
Figwort Family



Bartonia paniculata
twining bartonia
Endangered in Indiana

Gentianaceae
Gentian Family



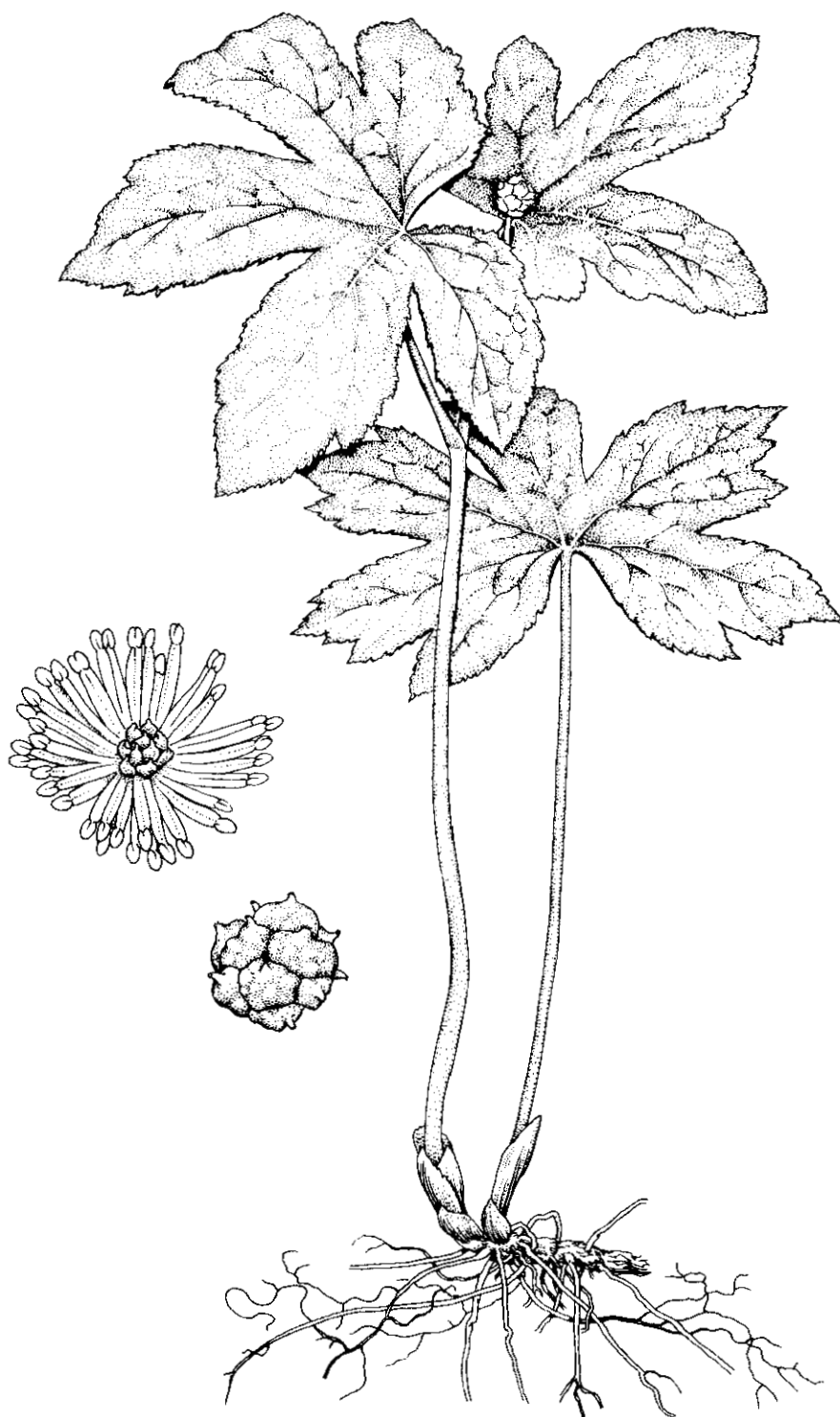
Carex woodii
pretty sedge
Rare in Indiana

Cyperaceae
Sedge Family



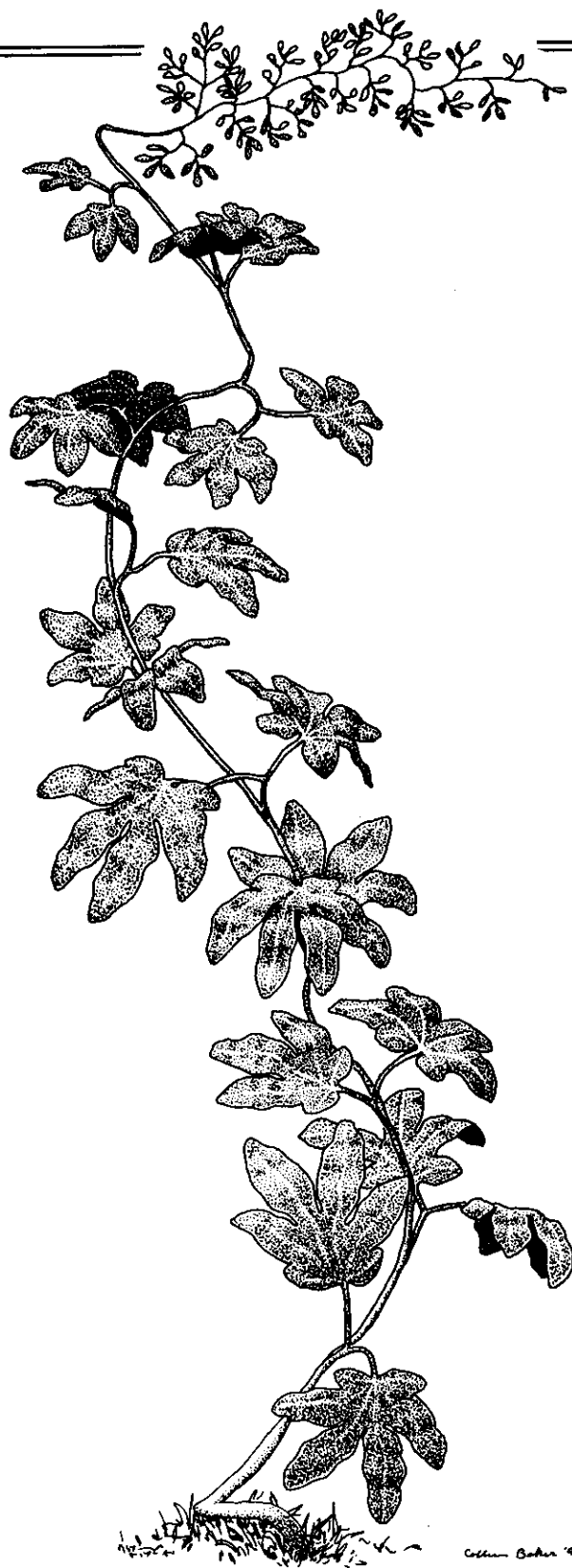
Hydrastis canadensis
goldenseal
Watch List in Indiana

Ranunculaceae
Buttercup Family



Lygodium palmatum
climbing fern
Endangered in Indiana

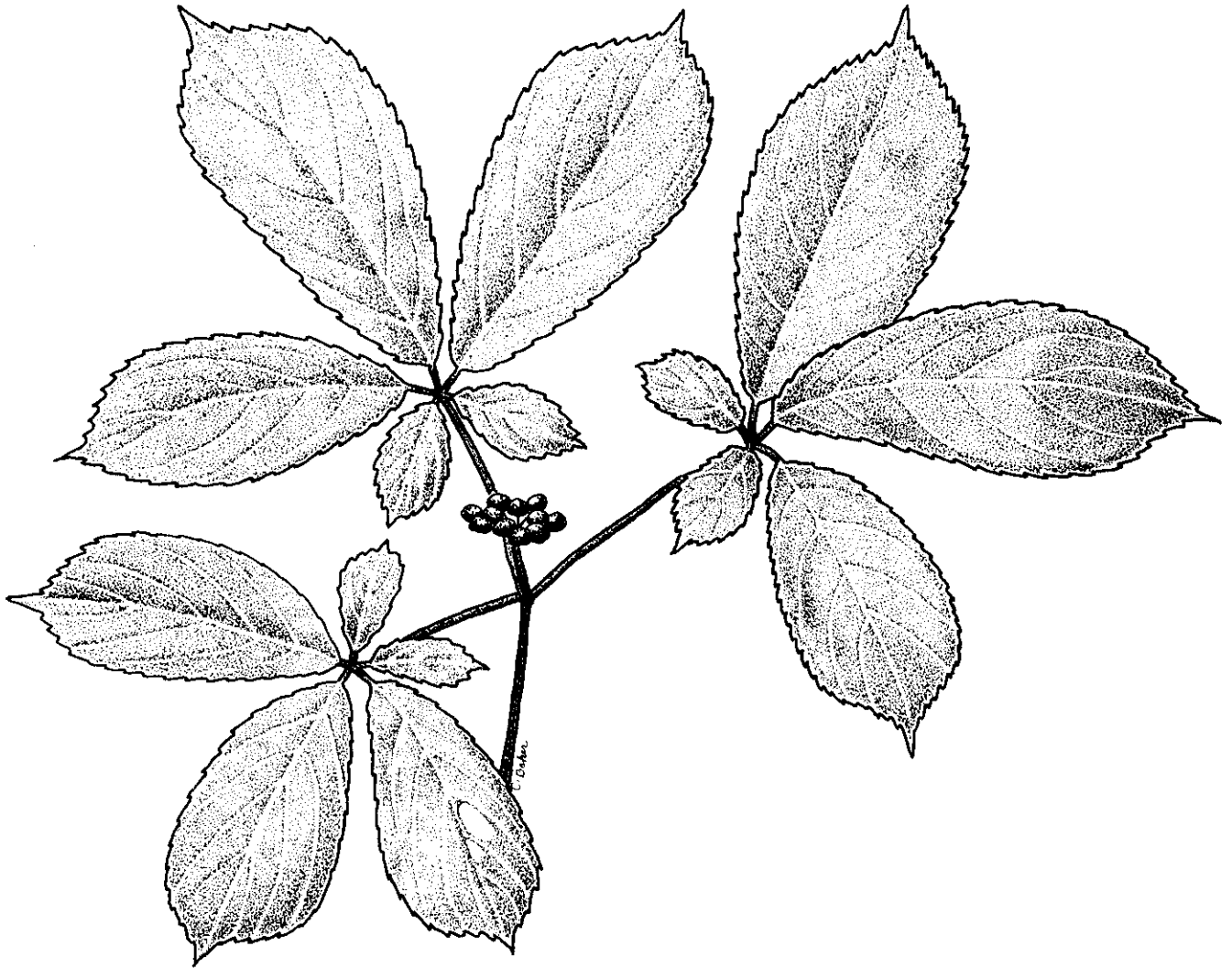
Schizaeaceae
Curly Grass Family



William Baker '92

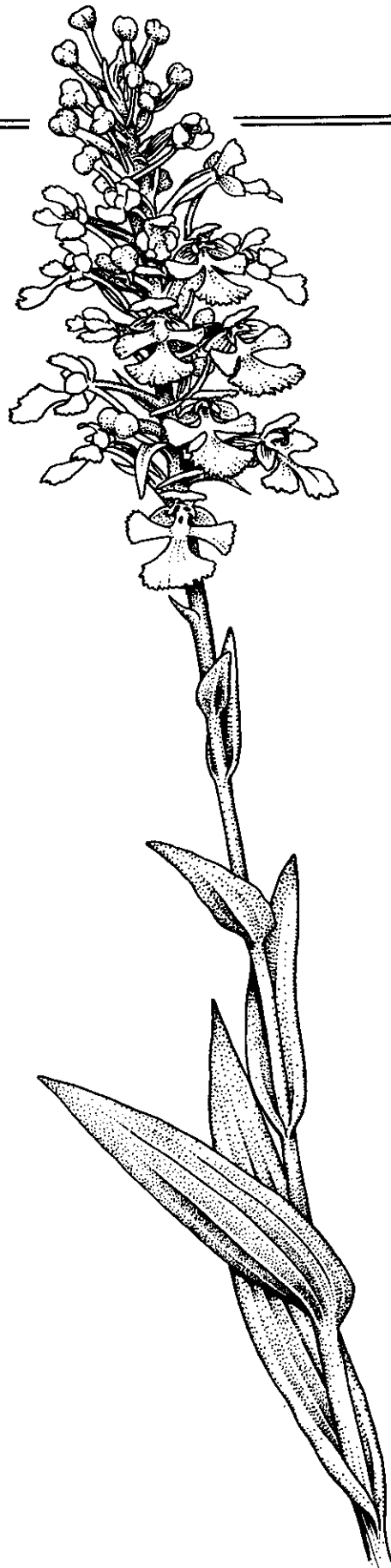
Panax quinquefolium
American ginseng
Watch List in Indiana

Araliaceae
Ginseng Family



Platanthera peramoena
purple fringeless orchis
Watch List in Indiana

Orchidaceae
Orchid Family



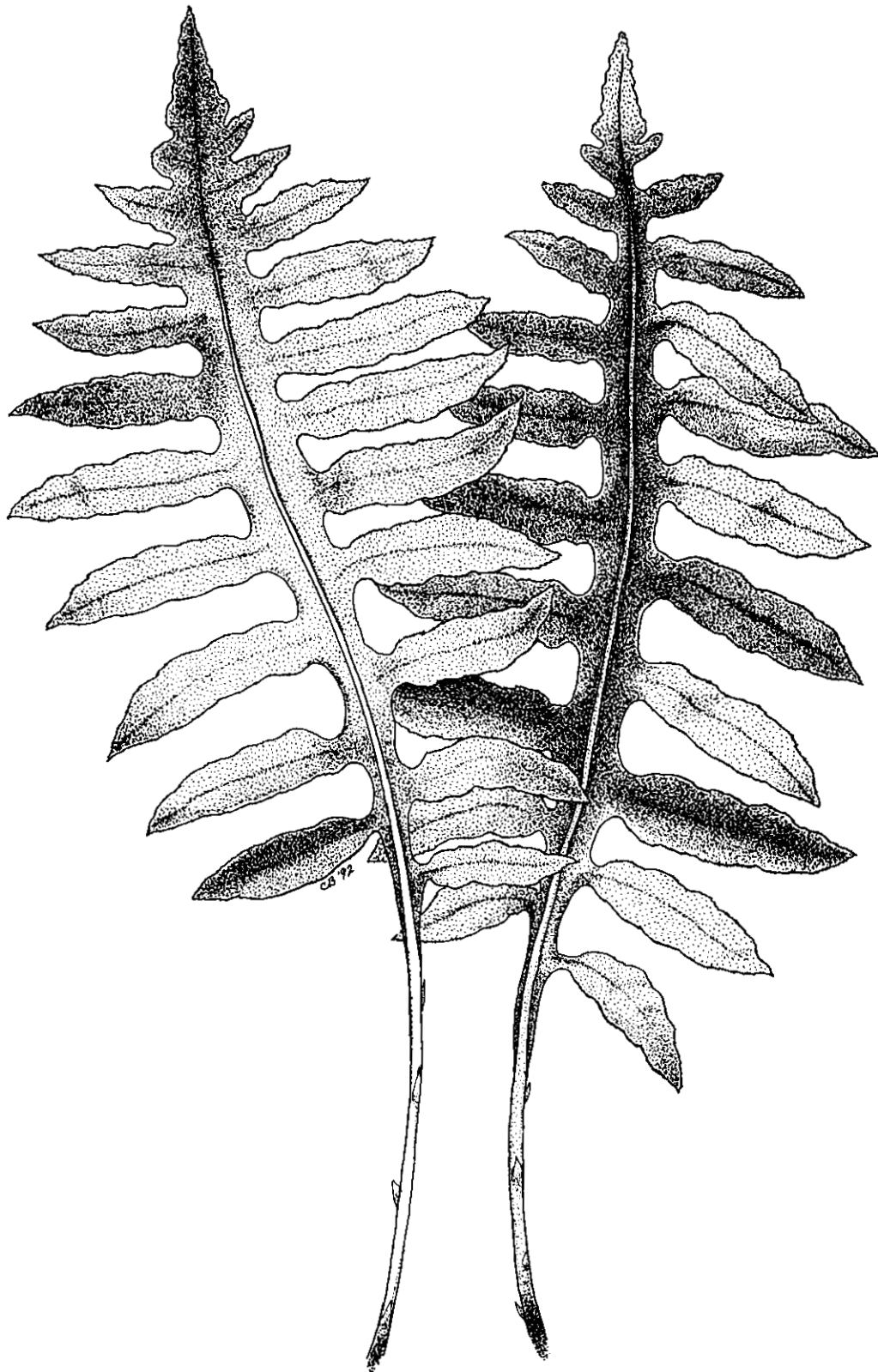
Veratrum woodii
false hellebore
Watch List in Indiana

Liliaceae
Lily Family



Woodwardia areolata
netted chain-fern
Endangered in Indiana

Blechnaceae
Deer Fern Family



Appendix D. Color photographs of some of the natural communities found in Jefferson Proving Ground.

Photograph 1. A regularly burned field in Area 57. This field consists mostly of native species that thrive in full-sun conditions. Conspicuous species here include hardtack (*Spiraea tomentosa*), early goldenrod (*Solidago juncea*), and narrow-leaved mountain mint (*Pycnanthemum tenuifolium*).





Photograph 2. An early successional forest of sweetgum and red maple. These conditions are typical of the expansive flats found at JPG, and harbor more rare species than any other habitat.

Photograph 3. A mature flatwoods in Area 35. This flatwoods is apparently burned on a regular basis, resulting in an open understory and lush groundlayer. Burning increases the diversity and vigor of the herbaceous species, as can be seen here.





Photograph 4. A roadside display of wildflowers, including the state endangered Maryland meadow beauty (*Rhexia mariana* var. *mariana*), in area 58. Infrequently mowed roadsides are important habitats for native plants at JPG.

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