An Inventory

Of Special Plants

Within the

U.S. Army

Jefferson Proving Ground

Phase II

1999

AN INVENTORY
OF
SPECIAL PLANTS
WITHIN THE
U.S. ARMY JEFFERSON PROVING GROUND

PHASE II

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Dear Reader,

This report on endangered, threatened, rare and watch list plant species 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 Indiana's natural biological 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,

Larry D. Macklin
Director
Indiana Department of Natural Resources

Acknowledgements

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AN INVENTORY OF SPECIAL PLANTS WITHIN THE JEFFERSON PROVING GROUND Phase II

INTRODUCTION

The Indiana Department of Natural Resources, Division of Nature Preserves conducted the first inventory of Special Plants and Natural Areas within Jefferson Proving Ground (JPG) in 1992 (Hedge et al. 1993). In that survey, 29 species of vascular plants listed as endangered, threatened, rare or watch list were documented from the site. Because JPG is so large (roughly 55,000 acres) and because the U.S. Fish and Wildlife Service now has an agreement with the Department of Defense to manage the natural resources following closure of the base, a phase II special plant inventory was conducted.
The objectives of the inventory were to:

1. Expand the coverage of the earlier inventory to previously unsurveyed portions of the installation;
2. Provide historic and current Federal and State statuses for all plant species found;
3. Provide species descriptions for plant species designated as endangered or threatened;
4. Provide a complete annotated list of all species designated as endangered, threatened, rare or watch list;
5. Provide maps showing specific locations for species listed as endangered, threatened or rare;
6. Provide specific management recommendations to perpetuate the listed species found.

STUDY AREA

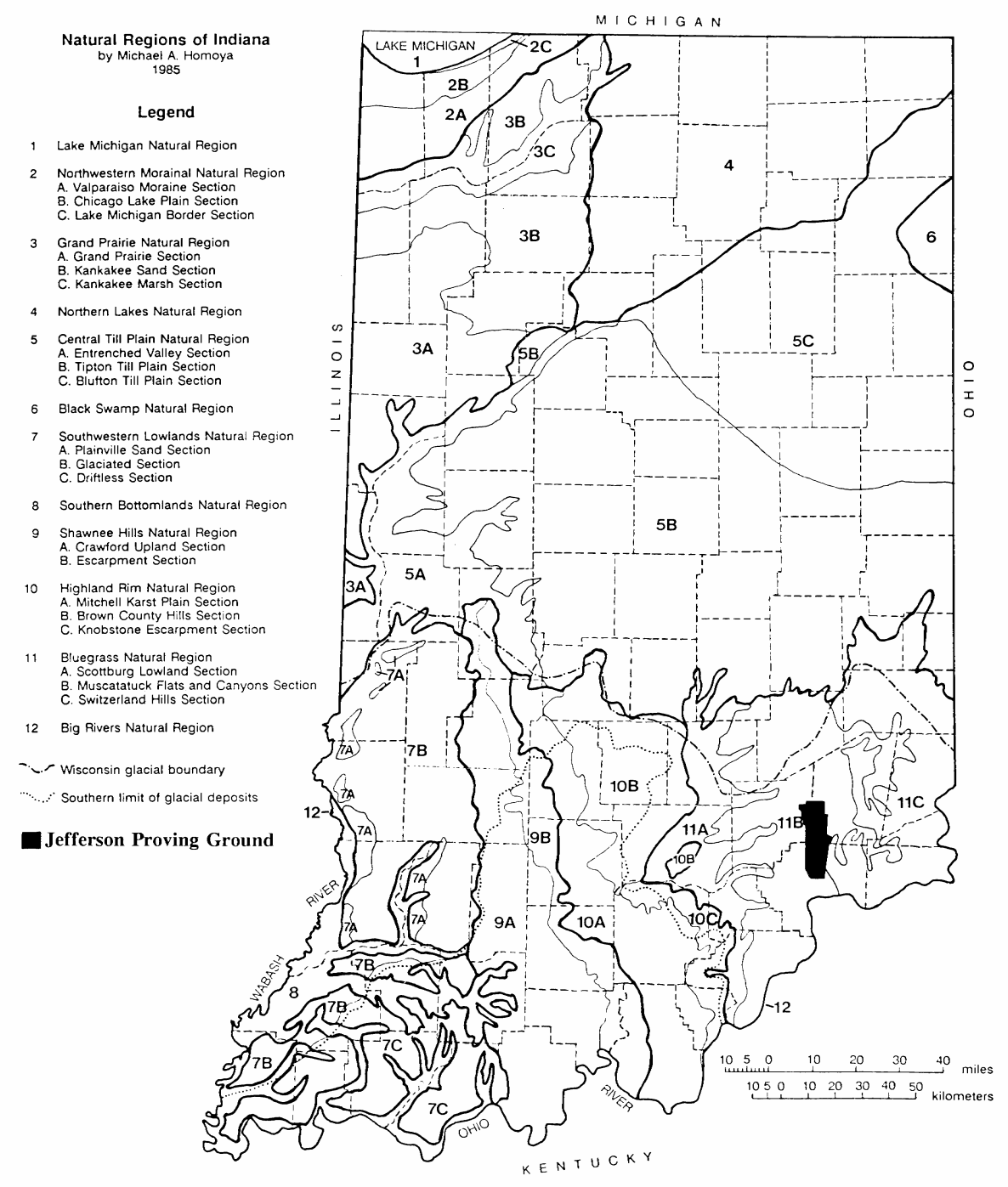
A more detailed accounting of the study area, including location, landscape, watershed, and natural regions (see Figure 1) can be found in the Phase I inventory of the JPG (Hedge et al. 1993). The site contains large tracts of open grasslands important for sun-loving plants as well as grassland birds. Large blocks of flatwoods forest from very early successional to mature aged stands are also present; in fact the largest tracts of these forest types anywhere are found at JPG. Finally, the wooded stream valleys at JPG support large acreages of upland forests. The main change since that report is that the Department of Defense has closed JPG and signed an agreement with the U.S. Fish and Wildlife Service for managing the natural resources of the site.

METHODS

Using data from the 1993 report and additional knowledge concerning rare plants and rare plant habitats statewide acquired since then, field botanists attempted to survey as many habitats as possible in the time allotted. The primary goal was to survey areas that had not been visited during the field studies in 1992. However, especially productive sites were revisited to survey for additional populations of species known to occur in JPG, and for new species that might be expected in those same habitats. The habitats of greatest interest to rare plant botanists are the young, wet, acidic flatwoods and fields and small areas where extreme erosion has resulted in extreme conditions favorable to a select suite of plants.

Fieldwork was made more efficient during this survey by obtaining a key for entrance through the north end of the site, and by using a cell phone to clear entry at that point.

Figure I. Natural Regions of Indiana, showing the location of JPG.



RESULTS

As a result of this study, there are now 46 species of vascular plants designated as endangered, threatened, rare or watch list documented from JPG (Table I). No Federally listed plants were found. However, there is excellent habitat present in JPG for the Federally endangered *Trifolium stoloniferum*, running buffalo clover. The known Indiana occurrences are in the southeastern part of the State just east of JPG. Therefore, it is recommended that searches for this endangered species continue.

As mentioned in the introduction, the 1992 inventory produced 29 taxa, thus an increase of 17 taxa resulted from this inventory. The breakdown by designation is as follows: endangered-9; threatened-3; rare-6; watch list-28 (Table I). The 17 new taxa added to the total list as a result of this inventory are shown in bold in Table I. Of these 17 newly added taxa, 6 are designated as endangered, 1 as threatened, 3 as rare, and 7 as watch list. The 29 taxa documented during the 1992 study have also experienced some changes in status. Sixteen have been downgraded in status and 1 was changed from rare to threatened. The large number of downgrades is attributable to two main things: statewide inventory efforts have shown that these species are more common than in 1993; some of the species have been proven to be more common as a result of this inventory project within JPG and its extremely large blocks of suitable habitat. Thus, although there are 28 so-called watch list species found at JPG, many of these have most of their known occurrences within the site, and are dependent on continued management for their survival in Indiana.

The 1992 survey documented 65 occurrences of species designated as endangered, threatened, rare or watch list. As a result of this inventory, there are now 299 occurrences of these taxa (Table II). For taxa designated endangered, threatened or rare, the map (Figure II) shows roughly the locations. Also included is an annotated list of species designated endangered, threatened, rare or watch list (Appendix I). Another annotated list is included which contains plants termed “additional species of interest” (Appendix II). JPG continues to exceed botanists’ expectations, both in terms of the diversity of rare plants and in terms of the vast acres of suitable habitat available in this special place.

MANAGEMENT RECOMMENDATIONS

The management recommendations that follow are organized into groups of species by habitat (Table III). The habitat groups were chosen from a management perspective to make management planning and implementation more easily applied. A set of management prescriptions is provided for each of the groups depending on the specific needs.

Table I. Endangered, Threatened, Rare and Watch List plants documented from JPG.

Species Name	Common Name	1993 Status	1999 Status
Aesculus octandra	Yellow buckeye	R	WL
Agalinis fasciculata	Clustered foxglove	E	WL
Andropogon ternarius	Silver bluestem	NL	WL
Antennaria solitaria*	Single-head pussytoes	R	WL
Asplenium ruta-muraria	Wall-rue spleenwort	E	T
Bartonia paniculata	Twining bartonia	E	WL
Botrychium biternatum	Sparse-lobe grape-fern	T	WL
Botrychium oneidense	Blunt-lobe grape fern	R	WL
Carex abscondita	Thicket sedge	WL	WL
Carex louisianica	Louisiana sedge	R	WL
Carex woodii	Pretty sedge	R	WL
Chimaphila maculata	Spotted wintergreen	WL	WL
Cimicifuga racemosa	Black bugbane	WL	WL
Crotonopsis elliptica	Elliptical rushfoil	E	E
Dentaria diphylla	Crinkleroot	R	WL
Eupatorium rotundifolium	Round-leaved boneset	E	WL
Helianthus angustifolius	Narrow-leaved sunflower	NL	E
Hydrastis canadensis	Goldenseal	WL	WL
Hypericum gymnanthum	Clasping St. John's wort	NL	E
Linum striatum	Ridged yellow flax	R	WL
Lycopodeiella inundata	Northern bog clubmoss	E	E
Lycopodium clavatum	Running pine	R	WL
Lycopodium obscurum	Tree clubmoss	E	R
Lygodium palmatum	Climbing fern	E	E
Monotropa hypopithes	American pinesap	WL	WL
Najas gracillima	Thread-like naiad	E	E
Oenothera perennis	Small sundrops	R	T
Oxalis illinoensis	Illinois woodsorrel	R	R
Panax quinquefolium	American ginseng	WL	WL
Panax trifolium	Dwarf ginseng	R	WL
Panicum scoparium	Broom panic-grass	E	E
Platanthera lacera	Green-fringed orchis	WL	WL
Platanthera peramoena	Purple fringeless orchis	WL	WL
Poa wolfii	Wolf bluegrass	E	R
Rhexia mariana var. *mariana*	Maryland meadow beauty	E	E
Sagittaria australis	Longbeak arrowhead	E	R
Salix caroliniana	Carolina willow	R	WL
Scirpus purshianus	Weakstalk bulrush	NL	E
Scleria pauciflora	Fewflower nutrush	NL	WL
Spiranthes ovalis	Lesser ladies'-tresses	R	WL
Spiranthes tuberosa	Little ladies'-tresses	R	WL
Strophostyles leiosperma	Slick seed wild-bean	T	T
Veratrum woodii	False hellebore	WL	WL
Viola blanda	Smooth white violet	R	WL
Waldsteinia fragarioides	Barren strawberry	T	R
Woodwardia areolata	Netted chain-fern	E	R
	Totals:	65	234

Bold indicates a newly added listed species. *indicates tentative identification. E=endangered; T=threatened; R=rare; WL=watch list.

Table II. Occurrences of Endangered, Threatened, Rare and Watch List plants documented from JPG.

Species Name	Common Name	1993 Occ.	1999 Occ.	Total
Aesculus octandra	yellow buckeye	Not recorded	1+	1+
Agalinis fasciculata	clustered foxglove	Abundant (3)	30+	33+
Andropogon ternarius	silver bluestem	Not recorded	Abundant	Abundant
Antennaria solitaria*	single-head pussytoes	Not recorded	1	1
Asplenium ruta-muraria	wall-rue spleenwort	Not recorded	2	2
Bartonia paniculata	twining bartonia	Abundant (6)	25+	31+
Botrychium biternatum	sparse-lobe grape-fern	Not recorded	1	1
Botrychium oneidense	blunt-lobe grape fern	1	1	2
Carex abscondita	thicket sedge	1	2	3
Carex louisianica	louisiana sedge	3	4	7
Carex woodii	pretty sedge	1	2	3
Chimaphila maculata	spotted wintergreen	1	0	1
Cimicifuga racemosa	black bugbane	1	4+	5+
Crotonopsis elliptica	elliptical rushfoil	1**	1	2
Dentaria diphylla	crinkleroot	4	6	10
Eupatorium rotundifolium	round-leaved boneset	Fairly common (4)	30+	34+
Helianthus angustifolius	narrow-leaved sunflower	Not recorded	4	4
Hydrastis canadensis	goldenseal	Throughout (1)	13+	14+
Hypericum gymnanthum	clasping St. John's wort	Not recorded	1	1
Linum striatum	ridged yellow flax	1	20	21
Lycopodeiella inundata	northern bog clubmoss	Not recorded	1	2***
Lycopodium clavatum	running pine	5	5	10
Lycopodium obscurum	tree clubmoss	3	3	6
Lygodium palmatum	climbing fern	1	2	3
Monotropa hypopithes	American pinesap	Not recorded	2	2
Najas gracillima	thread-like naiad	Not recorded	1	1
Oenothera perennis	small sundrops	3	9	12
Oxalis illinoensis	Illinois woodsorrel	Not recorded	1	1
Panax quinquefolium	American ginseng	1	6	7
Panax trifolium	dwarf ginseng	1	7	8
Panicum scoparium	broom panic-grass	Not recorded	1	1
Platanthera lacera	green-fringed orchis	3	5	8
Platanthera peramoena	purple fringeless orchis	1	3	4
Poa wolfii	wolf bluegrass	Not recorded	1	1
Rhexia mariana var. *mariana*	Maryland meadow beauty	1****	5	5
Sagittaria australis	longbeak arrowhead	1	6	7
Salix caroliniana	Carolina willow	Not recorded	1	1
Scirpus purshianus	weakstalk bulrush	Not recorded	3	3
Scleria pauciflora	fewflower nutrush	Not recorded	1	1
Spiranthes ovalis	lesser ladies'-tresses	1	2	3
Spiranthes tuberosa	little ladies'-tresses	1	3	4
Strophostyles leiosperma	slick seed wild-bean	1	4	5
Veratrum woodii	false hellebore	4	3	7
Viola blanda	smooth white violet	5	4	9
Waldsteinia fragarioides	barren strawberry	Not recorded	2	2
Woodwardia areolata	netted chain-fern	5	5	10
	Totals:	65	234	299

Bold indicates a newly added listed species. *tentative identification; **occurrence possibly extirpated; ***1 occurrence found in 1994; ****1992 occurrence lumped with a 1998 site.

Figure II.

Table III. Habitat Management Species Groups.

A. Upland/Floodplain Forests
Aesculus octandra
Antennaria solitaria
Carex abscondita
Carex woodii
Cimicifuga racemosa
Dentaria diphylla
Hydrastis canadensis
Monotropa hypopithes
Oxalis illinoensis
Panax quinquefolium
Spiranthes ovalis
Veratrum woodii
Viola blanda
Waldsteinia fragarioides

B. Young Flatwoods/Grasslands
Agalinis fasciculata
Andropogon ternarius
Bartonia paniculata
Botrychium biternatum
Chimaphila maculata
Eupatorium rotundifolium
Helianthus angustifolius
Linum striatum
Lycopodium clavatum
Lygodium palmatum
Oenothera perennis
Panicum scoparium
Scleria pauciflora

C. Mature Flatwoods
Botrychium oneidense
Carex louisianica
Panax trifolius
Viola blanda

D. Limestone Cliffs/Boulders
Asplenium ruta-muraria
Poa wolfii

E. Ponded Water
Najas gracillima
Scirpus purshianus
Lycopodeiella inundata

F. Eroded Banks/Scrapes
Crotonopsis elliptica
Hypericum gymnanthum

G. Scoured Stream Channels
Salix caroliniana

MANAGEMENT PRESCRIPTIONS

A. Upland/Floodplain Forests

Fifteen species of plants depend largely on the non-flatwoods forests at JPG. Most of these (13) are watch list, while the remaining 2 are designated Rare. The management prescription is relatively simple for these forests: minimize disturbance and control exotics. Although several species of exotics are present at JPG (and throughout Indiana), there are only 3 that at this point seem to pose serious threats within the upland/floodplain forest setting: garlic mustard (*Alliaria petiolata*); stilt grass (*Microstegium vimineum*); and moneywort (*Lysimachia nummularia*). (Moneywort is confined mostly to floodplains).

Early detection and control is the best way to keep these aggressive plants from dominating forest communities. Once established, they are difficult to control because of the large acreage and numbers of plants that result. Control methods include manual pulling in small-scale situations, to mowing or weed whipping in larger scale problem areas, to burning or herbiciding in especially problematic areas.

Summary:

1. Set up early detection program, especially in best quality forest communities.
2. Use pulling, mowing, burning or herbicides depending on the scale of the infestation.
3. Minimize disturbances (e.g. roads, openings) which provide opportunities for exotic plants to become established.

B. Young Flatwoods/Grasslands

Next to upland/floodplain forests, these early successional plant communities provide habitat for the highest number of rare plants in the study area. As mentioned earlier, a number of species previously listed have been downgraded to watch list, largely because of their abundance at JPG in these habitats. Nine species are watch list, 1 is rare, 1 is threatened, and 3 are endangered.

Invasive exotic plants are generally not a problem in the young flatwoods and grasslands, perhaps due to the relative acidic nature of the soils. The only exotic problems associated with these open areas are the result of plantings, primarily fescue, along roadsides. However, plant succession is a problem because it results in increased invasion by woody plants ultimately shading sun-loving rare plants. Thus, the management prescription for young flatwoods and grasslands is to retard plant succession. Note also that large portions of these flat, clay-soil areas are relatively wet, at least during part of the year. The only prescription for these wetlands is to maintain hydrology: don't drain or fill.

Because JPG contains such large acreages of these communities, an efficient and effective method of controlling succession is needed; prescribed burning is that tool. Periodic burning kills or slows the advance of most woody plants and can be applied over large areas at relatively low cost. JPG is an especially good property to use fire, because if is publicly owned and it has a network of roads, streams, etc. which serve as effective fire breaks. In some instances where fire cannot be used, mowing or bush-hogging may be also be used.

Although these methods are proven to be effective as just described, there is a special case at JPG which may require special treatment: the populations of climbing fern (Lygodium palmatum). Our recommendation for this endangered fern is to select a sample of sub-populations in order to conduct experimental management treatment. This fern seems to thrive best in slightly advanced successional thickets, where the canopy is still open enough to permit filtered light to reach the ground. Suggested management is to lightly thin a number of trees in these sub-populations and monitor the response of climbing fern to this treatment.

Summary:

1. Control succession using periodic prescribed burning.
2. In areas where prescribed fire is not feasible, use mowing or bush-hogging.
3. Maintain hydrology in wetland portions of the flats.
4. Select a sample of sub-populations of climbing fern (from the far northeastern portion of JPG) for selective tree removal (to allow for increased sunlight) and monitor the response of the fern.

C. Mature Flatwoods

Although mature flatwoods provide habitat for only 4 rare plants, all watch list, these old forests are nonetheless important natural communities. First, the 4 watch list plants are largely restricted to the more mature flatwoods forests. In addition, there are numerous other plants (e.g. *Carex intumescens* and *Thelypteris palustris*) which are not rare, but which seem to thrive best in them.

Like the young flatwoods, mature flatwoods do not have exotic plant problems. The primary goal is to minimize disturbance to these old forests. Specifically, avoid activities which open the canopy, increase fragmentation, or alter hydrology. However, note that some of the mature forests present at JPG appear to have benefitted from some light burning. Apparently, relatively cool, ground fires have occurred in some stands, resulting in a somewhat open sub-canopy, with a diverse ground flora.

Summary:

1. Minimize physical disturbance such as timbering, roads, etc. to maintain unfragmented forest blocks.
2. Maintain hydrology in wetland portions of mature flatwoods.
3. Consider use of some prescribed burning to foster a more diverse ground flora in some stands.

D. Limestone Cliffs/Boulders

Although these comprise a relatively small percentage of JPG, and only two rare plants require the habitat, both species are listed; one rare and one threatened. Invasive plants are a potential threat, especially when some physical disturbance occurs which speeds the invasion. Thus, the management prescription is to avoid disturbances that would create openings or corridors for exotic plant invasion. Even with no disturbance, however, invasive plants, primarily garlic mustard, moneywort, and stilt grass, can find their way into these habitats. Like the upland and floodplain forests, it is important to detect invasives early and then to control them before they can get established in large numbers. The same control methods apply, except that control is much more local and restricted.

Summary:

1. Set up monitoring program to detect invasive species.
2. When detected, remove invasives by hand pulling as soon as possible before larger, less manageable populations can become established.
3. Minimize physical disturbances such as roads and openings that speed up exotic plant invasions.

E. Ponded Water

JPG contains numerous ponded water habitats, from artificial impoundments and depressions caused by explosions, to naturally occurring depressions and beaver ponds. Although they amount to a small percentage of the total acreage of JPG, they are extremely important because the plants that inhabit them can grow nowhere else. Eight species, 2 rare, 4 endangered, and 2 watch list, require permanently or ephemerally ponded water to survive. Generally, the management prescription for these ponded areas is to maintain the hydrology: no draining or filling. It is also important to note that the plants that occur in the ephemerally ponded areas occupy shallow water or recently exposed shallows. Thus, it is important to allow the normal drying for these plants to survive.

Although no invasive plants were noted in these habitats at this time, there is always the possibility that one or more will appear. Thus, it is important to monitor these habitats so that any invasives that do arrive can be detected and controlled.

Summary:

1. Maintain existing hydrology, whether permanent or ephemeral.
2. Monitor for invasive plants, and if detected, control quickly.

F. Eroded Banks/Scrapes

Four species (1 watch list; 1 threatened; 2 endangered) are found at JPG in dry, eroded banks or areas scraped by heavy machinery. These harsh growing sites are inhabited by a suite of plants that apparently thrive at least in part because of a lack of competition from other species that require better growing conditions. The management guidelines are to maintain the dry, open, competition-free "barrens" by either neglect (in the case of erosion), periodic physical maintenance (in the case of scrapes), and always avoiding the use of the standard, non-native seed mixes or turf grasses to control

erosion. Also, these areas should not have lime or fertilizers added. Left alone, eroded sites will be colonized by these rare plants plus an assortment of other plants adapted to such conditions. Because they provide habitat for the listed species, an assortment of other native species, and because they are relatively local, we advocate a management regime that allows for their continuance.

Summary:

1. Allow the existing small number of dry, eroded banks and scrapes to remain at JPG.
2. Avoid using standard turf grass and seed mixtures that compete with the natives that naturally colonize.
3. Avoid addition of lime or fertilizers.

G. Scoured Stream Channels

Although only 1 watch list plant species occupies this habitat, the stream community is still important. The streams provide important aquatic habitat, as well as scoured gravel, sand and rock habitat important to several common but nevertheless native plants. Thus, maintaining this important community is well within the conservation goal for protecting the indigenous biodiversity present at JPG. It is especially important because the streams at JPG have the benefit of being largely (although not entirely) included on the installation. This helps to avoid or at least reduce some of the problems of siltation and pollution present in the outside, more intensively used landscape. The management prescription for maintaining the streams is to manage the JPG watershed's upland natural communities to maintain vegetated cover, which in turn prevents excessive input into the streams. Beyond that, allowing the streams to function naturally, periodic flooding and scouring, etc. will be adequate.

Summary:

1. Keep JPG upland communities intact to provide a vegetated watershed.
2. Allow streams to flood, scour and recede naturally.

CONCLUSION

The results of the field surveys that yielded 17 new rare taxa and 234 occurrences of rare taxa exceeded expectations. The authors attribute these extraordinary results to two causes: (1) more field time and effort were expended because there was no active military testing and access was available through the gates in the north end; (2) JPG's large size and diversity of habitats is very productive. As with all studies of this kind, there will be a point of diminishing returns, but that point has not yet been reached at JPG. JPG is indeed a natural treasure that contains a full array of the region's natural communities and species assemblages. The cooperative natural resource management effort between the Department of Defense, U.S. Fish & Wildlife Service, as well as the contribution from the Department of Natural Resources is extremely important to perpetuating this natural heritage.

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APPENDIX I

Annotated List of
Watch List, Rare, Threatened, and Endangered Plants
Within the Jefferson Proving Ground

An annotated list of state rare, threatened, and endangered plants within the Jefferson Proving Ground.

Aesculus octandra — Hippocastanaceae
yellow buckeye — Buckeye Family
Watch List in Indiana

This eastern species is confined mostly to the southeastern portion of the state, especially in ravine forests that flow directly into the Ohio River. At JPG trees were noted as being locally common on the forested slopes bordering Graham Creek, a tributary of the Wabash River drainage.

Agalinis fasciculata — Scrophulariaceae
clustered foxglove — Figwort Family
Watch List in Indiana

Like many of the grassy field species at JPG, the clustered foxglove has geographic affinities to the southern U.S. It is seemingly in every old field, especially if it is moist, as well as in young regrowth flatwoods.

Asplenium ruta-muraria — Aspleniaceae
wall-rue spleenwort — Spleenwort Family
Threatened in Indiana

In Indiana this fern grows exclusively on limestone cliffs and boulders, typically on those within a few miles of the Ohio River. The populations at JPG, both occurring on cliffs along Little Otter Creek, represent a significant northern extension of the known range of the species in the state.

Andropogon ternarius — Poaceae
silver bluestem — Grass Family
Watch List in Indiana

A southern grass found in Indiana for the first time in 1987, it has since been found to be a relatively common grass in old fields and grassy barrens in the southern part of the state. It typically grows with other *Andropogons*, especially *A. gyrans* and *A. virginicus*, as well as *Schizachyrium scoparium*. Several old fields at JPG have this species.

Antennaria solitaria — Asteraceae
single-head pussytoes — Aster Family
Watch List in Indiana

This is a tentative identification, based upon vegetative parts only. The population was observed during a prolonged period of drought, and perhaps the plants were simply dwarfed and dehydrated *Antennaria plantaginifolia*. An inspection during the flowering period (early spring) would confirm species identification.

Bartonia paniculata — Gentianaceae
twining bartonia — Gentian Family
Watch List in Indiana

Populations of this annual gentian fluctuate from year to year. The growing season of 1998 was a very good one for the species, as seemingly every flatwoods, particularly those that are relatively open and with young trees, had high numbers of plants. Clearly more plants of this species occur at JPG than anywhere else in the state.

Botrychium biternatum — Ophioglossaceae
sparse-lobe grape-fernAdder's tongue fern family
Watch List in Indiana

Similar to the more common bronze grape fern, this species occurs near the northern limit of its range in southeastern Indiana. The Proving Ground is one of the few places where *Botrychium biternatum*, *B. oneidense*, and *B. dissectum* occur in proximity. This species, like *B. dissectum*, does well in a variety of habitats, including old fields. Although only one population was found at JPG, others are very likely present.

Botrychium oneidense — Ophioglossaceae
blunt-lobe grape-fern — Adder's tongue fern family
Watch List in Indiana

This species is typical of more northern latitudes, and occurs at its southernmost range in the Midwest in southern Indiana. In the latter its preferred habitat is mature flatwoods, especially the type of poorly drained acid flatwoods such as occur at JPG. Generally it is not a common plant at any site.

Carex abscondita — Cyperaceae
thicket sedge — Sedge Family
Watch List in Indiana

Mesic and dry-mesic forests are the prime habitats for this sedge. The thicket sedge is characterized by a dense tuft of narrow leaves within which the flowering and fruiting spikes are hidden. It is commonly overlooked, and probably occurs at several sites in the stream valleys at JPG.

Carex louisianica — Cyperaceae
Louisiana sedge — Sedge Family
Watch List in Indiana

The Louisiana sedge is typically a floodplain species, but at JPG it is known only from a few wet depressions in flatwoods. It is colonial, a character useful in separating this species from the similar looking species with which it grows, *Carex intumescens*.

Carex woodii — Cyperaceae
pretty sedge — Sedge Family
Watch List in Indiana

Occurrences of this plant of mesic woodlands at JPG are at the southernmost edge of its range in the Midwest. Flowering and fruiting spikes of this species are rather uncommon; fortunately it is easily identified by vegetative characters.

Cimicifuga racemosa — *Ranunculaceae*
black bugbane — Buttercup Family
Watch List in Indiana

Numerous populations of this forest plant were found in the major stream valleys of JPG. This plant is becoming more sought after by root diggers who sell to the herbal products industry. Numbers will likely decline if demand on the herbal market increases.

Crotonopsis elliptica — Euphorbiaceae
elliptical rushfoil — Spurge Family
State Endangered in Indiana

A second site at JPG was found for this inconspicuous annual herb. It prefers very dry, exposed mineral soil, such as is provided by eroded banks of hillsides and bladed roadbanks. It probably occurs at additional sites at JPG, but may not be present at any given site every year.

Dentaria diphylla — Brassicaceae
two-leaf toothwort — Mustard Family
Watch List in Indiana

This spring ephemeral lasts but a few weeks in spring before it goes dormant for the year. Most JPG populations occur on mesic forested slopes in the major stream valleys. It very likely occurs at additional sites at JPG.

Eupatorium rotundifolium — Asteraceae
round-leaved boneset — Aster Family
Watch List in Indiana

Most grassy fields and young regrowth flatwoods have this species. It is a southern species that probably invaded the property within the past few decades. It will likely remain as long as its habitats are maintained at JPG.

Helianthus angustifolius — Asteraceae
narrow-leaved sunflower — Aster Family
State Endangered in Indiana

It was somewhat of a surprise to encounter this species, as it has not been seen in the state for numerous decades. It thrives in acid, wet grasslands at the southern end of the property. The very narrow leaves of this handsome sunflower are quite distinctive.

Hydrastis canadensis — Ranunculaceae
goldenseal — Buttercup Family
Watch List in Indiana

Although still relatively common in mesic ravine forests at JPG, this plant has the potential to decline precipitously as its popularity increases with the medicinal herb users. Some form of monitoring is recommended to document decline and possible need for a moratorium on collecting.

Hypericum gymnanthum — Clusiaceae
clasping St John's wort — St. John's wort Family
State Endangered in Indiana

This tiny flowered member of the genus had, prior to its discovery at JPG, been known in Indiana from only one other site (Newton County). The plants at JPG were found in a sparsely vegetated and eroded area that has previously been scraped by heavy machinery. To thrive this species needs full exposure to the sun and little or no competition; seeding this site with any of the turf grasses or standard mix of plants for erosion control would likely bring about this rare plant's demise.

Linum striatum — Linaceae
ridged yellow flax — Flax Family
State Threatened in Indiana

Wet, regrowth and/or burned flatwoods is the preferred habitat type for the ridged yellow flax. It is apparent that the species is not uncommon at JPG, occurring in several sites on the property. It is probably correct that JPG contains the majority of plants of this species in the state. Its rarity status will likely change because of its abundance at JPG.

Lycopodiella inundata — Lycopodiaceae
northern bog clubmoss — Clubmoss Family

State Endangered in Indiana

The occurrence of this northern species at JPG is unusual. Typically this species occurs in wet, exposed sand in the northern U.S. Other records for it in Indiana are from the northern tier of counties. Yet, two populations are known at JPG, both in shallow ditches. One is in an open flat and the other along the south side of Serano Brett Road. (The borders of Serano Brett Road contain a number of other interesting and uncommon species, such as *Hypericum gymnanthum*, *Rhynchospora capitellata*, *Viola lanceolata*, and *Crotonopsis elliptica*)

Lycopodium clavatum — Lycopodiaceae
running pine — Clubmoss Family
Watch List in Indiana

Running pine is a plant mostly of regrowth flatwoods, but a few colonies are found on upland forested slopes. Like the Lycopodiella, this species is one of mostly northern geographic affinities. Clearly most of the southern Indiana populations occur at JPG, and represent some of the most southerly in the Midwest.

Lycopodium obscurum — Lycopodiaceae
tree clubmoss — Clubmoss Family
State Rare in Indiana

This is another northern clubmoss that occurs at JPG at or near the edge of its southern Midwestern range. It occurs in older regrowth flatwoods in similar habitats to *Lycopodium clavatum*, as well as sites more shaded than preferred by that species.

Lygodium palmatum — Schizaeaceae
climbing fern — Curly grass fern Family
State Endangered in Indiana

Two additional populations for JPG (and the state) of climbing fern were found during this survey. This indicates apparent local reproduction, and the likelihood that other populations exist on the property. Currently, this unusual and very rare fern is known from nowhere else in the state but at JPG.

Monotropa hypopithes — Monotropaceae
American pinesap — Indian pipe Family
Watch List in Indiana

American pinesap is a close relative of Indian pipe. Both are non-chlorphylous vascular plants that occur in a wide range of forest types. Their occurrence is unpredictable at any given site. Typically the pinesap is the rarer of the two.

Najas gracillima — Najadaceae
thread-like naiad — Water-nymph Family
State Endangered in Indiana

Plants were collected from the shallow water of Hydes Pond. This fine-leaved species is a true aquatic, and perhaps occurs in other bodies of water on the property.

Oenothera perennis
small sundrops
State Threatened in Indiana

Onagraceae
Evening primrose Family

Most of the known populations of this species are in the southern portion of the property, but it occurs in the north as well. Clearly the greatest number of plants of this species in the southern half of the state, if not the entire state, occur at JPG. It is a small plant, and easy to miss if not observed when in full morning flower (commonly shrivels by afternoon).

Oxalis illinoensis
Illinois woodsorrel
State Rare in Indiana

Oxalidaceae
Woodsorrel Family

The Illinois woodsorrel is a close relative of the giant woodsorrel, and they are commonly confused. The Illinois woodsorrel is much less common, and typically grows in more moist and richer habitats than the giant woodsorrel. At JPG two populations of the Illinois woodsorrel were found, both in the sandy floodplain of Otter Creek.

Panax quinquefolium
American ginseng
Watch List in Indiana

Araliaceae
Ginseng Family

Plants of this highly sought-after medicinal herb occur sparingly throughout the moist stream valleys of JPG. Typically only a few plants are seen at a time. A moratorium on collecting for a few years might allow the population to recover.

Panax trifolius
dwarf ginseng
Watch List in Indiana

Araliaceae
Ginseng Family

Several populations of dwarf ginseng were found in the northern portion of JPG. Although the classic habitat for this species in southern Indiana is flatwoods, it also does well in mesic upland forest. This species, unlike the American ginseng, does not have medicinal value, and thus generally is not collected.

Panicum scoparium
broom panic-grass
State Endangered in Indiana

Poaceae
Grass Family

Prior to its discover at JPG this species of panic grass was known from only one site in far southwestern Indiana (Posey County). It is a southern species that thrives in wet, acidic soil, and such is the habitat where it occurs at JPG. Thousands of plants were found, these in an area that had been burned just a few months prior. Burning is a management tool that will benefit this species.

Platanthera lacera — Orchidaceae
ragged-fringed orchid — Orchid Family
Watch List in Indiana

This orchid is not all that uncommon at JPG, especially in wet, open grassy flats and in young regrowth flatwoods. Its flowers are green and deeply cut, thus the common name.

Platanthera peramoena — Orchidaceae
purple-fringeless orchid — Orchid Family
Watch List in Indiana

The purple-fringeless orchid is one of the showiest wildflowers at JPG. It is not as common as the ragged-fringed orchid, but probably does occur throughout the property. It prefers wet, acid soil, and will grow in both full sun and shade.

Poa wolfii — Poaceae
Wolf bluegrass — Grass Family
State Rare in Indiana

Limestone boulders scoured by flood water of Otter Creek provide habitat for this rare bluegrass. It is an extremely rare grass in southeastern Indiana, being known from only one other site in that part of the state. The specimens from JPG are somewhat atypical for the species, in that the lemmas are practically glabrous (typical specimens have lemmas with a greater degree of pubescence).

Rhexia mariana var. *mariana* — Melastomataceae
Maryland meadow beauty — Melastome Family
State Endangered in Indiana

Most of the populations of this showy wildflower occur in the far southern portion of the property. Outside of JPG all other populations in Indiana occur in the southwestern counties. It thrives in wet, acid grasslands, and benefits from prescribed fire.

Sagittaria australis Alismataceae
longbeak arrowhead Water-plantain Family
State Rare in Indiana

As the name implies, the longbeak arrowhead is a plant of southern geographic affinities. It does well in wetland situations, including depressions in flatwoods, stream banks, and roadside ditches.

Salix caroliniana Salicaceae
Carolina willow Willow Family
Watch List in Indiana

What appears to be this species was located on exposed gravel bars in Otter Creek. In Indiana this willow typically takes on a shrubby growth form, developed in part because of its preference for gravel bars that get frequent scouring by flood water.

Scirpus purshianus Cyperaceae
weakstalk bulrush Sedge Family
State Endangered in Indiana

Almost pure stands of this sedge were noted growing along the shores of Old Timber Lake, as well as Hydes Pond. A third population exists in a small pond along the West Perimeter Road. Seeds of this bulrush were probably introduced into these locations by waterfowl or shorebirds.

Scleria pauciflora Cyperaceae
fewflower nutrush Sedge Family
Watch List in Indiana

Although only one population of the nutrush has been found at JPG, others likely exist. The known population occurs in a grassy field that had burned in 1997. Most occurrences of this species in Indiana are found in the dry barrens openings in the south-central part of the state. The population at JPG is the only one known for southeastern Indiana.

Spiranthes ovalis Orchidaceae
lesser ladies'-tresses Orchid Family
Watch List in Indiana

This orchid has increased significantly in the Midwest over the past few decades, and its occurrence at JPG is expected. Unlike most ladies'-tresses, the lesser ladies'-tresses does well in rather shaded forest environments, including floodplain forests. Although only two populations were found, it undoubtedly occurs in greater numbers.

Spiranthes tuberosa _Orchidaceae
little ladies'-tresses Orchid Family
Watch List in Indiana

The little ladies'-tresses prefers sunny dry environments, and thrives in eroded old field situations on south-facing slopes. It can also be found in dry upland forests, but generally so in low numbers.

Strophostyles leiosperma Fabaceae
slick-seed wild-bean Bean Family
State Threatened in Indiana

The mostly bare, rocky mineral soil exposed on eroded hillsides and shoulders of roads is the only known habitat for this species at JPG. It is typically common where found. The usual associates include *Diodia teres*, *Aristida* spp., *Solidago nemoralis*, *Agalinis fasciculata*, and locally, *Crotonopsis elliptica*.

Veratrum woodii Liliaceae
false hellebore Lily Family
Watch List in Indiana

False hellebore occurs mostly on mesic, steep forested slopes in ravines and narrow stream valleys. At JPG all of the known populations of this distinctive plant occur in the Otter Creek and Little Otter Creek drainage system. It would not be surprising however to find it along Graham Creek or Big Creek.

Viola blanda Violaceae
smooth white violet Violet Family
Watch List in Indiana

Most populations of smooth white violet in southeastern Indiana occur in mature to old growth flatwoods, but others are known from mesic upland forest habitats. Both habitats occur at JPG and both harbor this tiny flowered species.

Waldsteinia fragarioides Rosaceae
barren strawberry Rose Family
State Rare in Indiana

Two sites with *Waldsteinia* were found during the survey at JPG. One of them is an especially large population, perhaps the largest in the state. The plant prefers well-drained rocky slopes just above steep slopes or cliffs. The foliage looks somewhat like an edible strawberry but its flowers are yellow and the fruit is dry.

Woodwardia areolata — Blechnaceae
netted chainfern — Deer-fern Family
State Rare in Indiana

Without question the greatest concentration of populations of the netted chainfern occur at JPG. The extensive area of regrowth flatwoods at JPG provides prime habitat for a species that prefers wet, acidic substrates. This fern is superficially similar to sensitive fern; the latter is abundant at JPG.

Appendix II

Jefferson Proving Ground: additional species of interest

ADDITIONAL SPECIES OF INTEREST

Perry Scott and Mike Homoya
1998

Ravine Woods

Aster macrophyllus — grows in many places on steep dryish slopes at JPG; has a curious N/SE distribution in Indiana; Deam has no record from Jennings Co.; grows with *Waldsteinia* at the more western site (Jennings Co.).

Bromus nottowayanus — grows in the alluvial woods by Little Otter Creek near Shaped Charge Road.

Carex picta — grows in a west-facing dryish upper slope woods in the Otter Creek Ravine; a significant eastward range extension in Indiana; collected 5/15/98.

Cypripedium calceolus var. *pubescens* — reported from one spot in the 1993 JPG report; found at an additional site in Jennings Co. in the Otter Creek Ravine; Homoya shows no previous reports from Jennings Co.

Ceanothus americanus — grows on a dry west-sloping ridge by Otter Creek with *Desmodium cuspidatum* and *Physostegia virginiana*. Deam has no reports from Ripley Co.

Desmodium cuspidatum — grows on a dry west-sloping ridge by Otter Creek with *Ceanothus americanus* and *Physostegia virginiana*; Deam has no reports from Ripley Co.

Galium lanceolatum — grows in mesic woods near the edge of a steep N slope to Falling Timbers Creek and at other places in this woods; Deam says it is "very local".

Physostegia virginiana — grows on a dry west-sloping ridge by Otter Creek with *Ceanothus americanus* and *Desmodium cuspidatum*.

Trillium nivale — grows near the top of steep N facing slopes and on top of room-sized boulders in the Otter Creek, Little Otter Creek, and Little Graham Creek Ravines; Deam has no reports from SE Indiana.

Viola canadensis — interesting N/SE distribution in Indiana.

Viola rostrata — interesting N/SE distribution in Indiana; Deam has no reports from Ripley Co.; Ripley Co. collection 4/10/98.

Regrowth Flatwoods

Dryopteris carthusiana — found in 7 places in Ripley and Jennings Co. in regrowth flatwoods (also in 1993 JPG report); Deam has no reports from these two counties; Collected in Ripley Co.

Dryopteris cristata — found in both Ripley and Jennings Co. in regrowth flatwoods (also in 1993 JPG report); Deam has no reports from SE Indiana.

Gentiana saponaria — found in regrowth flatwoods; interesting NW/SE distribution in Indiana.

Juncus canadensis — found in one wet, fairly open, young regrowth flatwoods in Ripley Co.; Deam has no records from this county; collected 9/21/98.

Lycopodium lucidulum — found at 4 spots in Ripley Co. in regrowth flatwoods; Deam has no records for SE Indiana.

Osmunda cinnamomea — found in Ripley Co. in regrowth flatwoods (also in 1993 JPG report); Deam has no reports from Ripley Co.

Populus heterophylla — found in regrowth flatwoods in Jefferson and Jennings Cos.; Deam has no records from SE Indiana; collected 6/9/98 in Jefferson Co.

Rhexia virginica — (see under **Open Flats**)

Sphagnum — found regularly in regrowth flatwoods throughout JPG.

Spiranthes cernua — a distinctive form of this species is found throughout the regrowth flatwoods (see Mike Homoya for morphological details) at JPG; the normal form of the species is also present at JPG in other habitats; collected 10/9/98.

Open Flats

Asclepias hirtella — found in all counties at JPG in open flats and eroded places; Deam has no records in SE Indiana.

Desmanthes illinoensis — found in various roadsides at JPG in Ripley, Jefferson, and Jennings Cos.; Deam has no records from Ripley or Jennings Cos.; Ripley Co. collection 6/2/98 and later.

Liatris spicata — collected in an open flat in Jefferson Co. and an open roadside in Ripley Co.; Deam has no reports from SE Indiana.

Lobelia puberula — common in open flats in the southern part of JPG; Deam has no records from Jennings Co.; found in fields about Hydes Pond, Jennings Co.

Physostegia virginiana — found in an open flat in Jefferson Co.

Rhexia virginica — found in open flats and young regrowth flatwoods in Jefferson Co. and collected from a young regrowth flatwoods in Ripley Co.; Deam has no reports from Ripley Co.; interesting N/S distribution in Indiana.

Rhynchospora capitellata — known from only one location as of the 1993 JPG report; this plant is abundant in some roadside ditches and open low spots in regrowth flatwoods; found in all three JPG counties.

Viola sagittata — collected in one moist Ripley Co. roadside; Deam has no records from this county; another plant with N/S distribution in Indiana.

Fields

Asclepias verticillata —collected in rolling fields south of Graham Creek; Deam has no records from SE Indiana.

Crotolaria sagittalis —collected in fields just south of Little Graham Creek, Ripley Co.; alien? Deam has no collections from this county.

Veronicastrum virginicum — seen in a moist bottomland field in Jefferson Co.

Miscellaneous

Eleocharis quadrangulata — collected in Hydes Pond where it grows in shallow water with *Scirpus purshianus*; Deam has no Jennings Co. records.

Gentiana andrewsii — collected on a stream bank in Ripley Co.; Deam has no reports from this county.

Hypericum gentianoides — collected in an eroded spot in Jefferson Co.; Deam has no reports from SE Indiana.

Lilium michiganense — found at the edge of a flatwoods in Ripley Co.; Deam has no records from SE Indiana.

Osmunda claytoniana — found in an upland woods/flatwoods transition in Ripley Co.; Deam has no reports from SE Indiana.

Pteridium aquilinum — found at the southern end of JPG by a road, edge of woods.