Short's Goldenrod (*Solidago shortii*)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Southeast Region
Ecological Services
Frankfort, Kentucky

5-YEAR REVIEW

Short's Goldenrod (*Solidago shortii*)
Torrey and Gray 1842

GENERAL INFORMATION

Methodology used to complete this 5-year review*:
Public notice was provided in the Federal Register on July 26, 2005 (70 FR 43171), and a 60-day comment period was opened. During this comment period, we obtained information on the status of this species from several experts; additional data was obtained from the recovery plan, peer-reviewed scientific literature, and our state partners. Once all known literature and information was collected for this species, Dr. Michael A. Floyd, Recovery Biologist with the Kentucky Ecological Services Field Office, completed the review. The draft document was peer-reviewed by Deborah White, Kentucky State Nature Preserves Commission, Frankfort, Kentucky; Michael A. Homoya, Indiana Department of Natural Resources, Indianapolis, Indiana; and Johnny B. Varner, Third Rock Consultants, LLC, Lexington, Kentucky, and comments received were incorporated as appropriate.

**Please see Appendix B (pages 21-26) for updated information on this plant that we have gained while conducting our new five-year review initiated in 2014 (79 FR 16366). Our new signature page is included on page 20. What precedes this new information (pp. 2-19) is the first five-year review announced in July 2005 (70 FR 43171) and completed and signed in 2007.*

Reviewers
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Background

1. **FR Notice announcing initiation of this review:** July 26, 2005; 70 FR 43171

2. **Species status**: 2006 Recovery Data Call; Stable. No recent reports of extirpations or serious population declines.

3. **Recovery achieved:** Short's goldenrod, 2 (2 = 26% to 50% of recovery objectives achieved)

4. **Listing History**
   Original Listing:

FR notice:	Endangered and Threatened Wildlife and Plants; Endangered Status for *Solidago shortii* (Short's Goldenrod). 50 FR 36085
Date listed:	September 5, 1985
Entity listed:	Species
Classification:	Endangered

5. **Review History:**
   Short's Goldenrod Recovery Plan, 1988, U. S. Fish and Wildlife Service, Atlanta, GA
   Recovery data call, 2004-2006, U. S. Fish and Wildlife Service, Kentucky Ecological Services Field Office

6. **Species Recovery Priority Number at start of review (48 FR 43098):** Short's goldenrod, 8

7. **Recovery Plan**
   Name of Plan: Short's Goldenrod Recovery Plan. U. S. Fish and Wildlife Service, Atlanta, Georgia. 27 pp.
   Date issued: May 25, 1988

8. **Reference documents**
   Baskin, J.M., J.L. Walck, C.C. Baskin, and D. E. Buchele. 2000. Ecology and conservation biology of the endangered plant species *Solidago shortii* (Asteraceae). Native Plants Journal. 1:35-41.

   Homoya, M. A. and D. B. Abrell. 2005. A natural occurrence of the federally endangered Short's goldenrod (*Solidago shortii* T. & G.) (Asteraceae) in Indiana: its discovery, habitat, and associated flora. Castanea 70:255-262.

   Smith, B. D., A. T. Denham, J. B. Beck, and P. J. Calie. 2004. High resolution GIS mapping and current status of the ten viable populations of Short's goldenrod (*Solidago shortii*-Asteraceae) in Kentucky. SIDA 21:1121-1130.

REVIEW ANALYSIS

1. Application of the 1996 Distinct Population Segment (DPS) Policy

A. Is the species under review listed as a DPS? No. The Act defines species to include any distinct population segment of any species of vertebrate wildlife. This definition limits listings as distinct population segments (DPS) only to vertebrate species of fish and wildlife. Because the DPS policy is not applicable to this plant, it is not addressed further in this review.

2. Recovery Criteria

A. Does the species have a final, approved recovery plan? Yes

B. Does the recovery plan contain recovery (i.e., downlisting or delisting) criteria? Yes

C. Do the recovery criteria reflect the best available (i.e., most up-to-date) information on the biology of the species and its habitat? Yes

D. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and there is no new information to consider regarding existing or new threats)? Yes

E. List the recovery criteria as they appear in the recovery plan and discuss how each criterion has or has not been met, citing supporting information. For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5 listing factors are not relevant to this species, please note that here.

Criteria for downlisting to threatened status

Downlisting of *S. shortii* will be possible when the first three recovery criteria listed below have been met (criteria a, b, and c).

a. Adequate protection is obtained for the nine high priority occurrences and the habitat in which they occur.

When the recovery plan was completed in 1988, all 13 known occurrences of Short's goldenrod were within 2.7 km of Blue Licks Battlefield State Resort Park in Fleming, Nicholas, and Robertson counties, Kentucky (Table 1). The recovery plan (USFWS 1988) prioritized these occurrences based on the size and vigor of each occurrence, the existing habitat quality, and existing threats. Based on these criteria, the following nine occurrences were considered as highest priority for protection: occurrence numbers 1, 2, 3, 4, 6, 7, 8, 11, and 13. Occurrence numbers 5, 9, 10, and 12 were considered lower-priority because of their small size and poor habitat quality. (Note: The recovery plan (USFWS 1988) did not provide a definition for "occurrence" or contrast the term with "population" in the plan; however, the recovery plan did state that the 13 Blue Licks occurrences were likely part of one former, contiguous population that had been fragmented by land use changes. For the purposes of this five-year review, we define an occurrence as a cluster of plants within a single geographic location that is separated from other such groups by unsuitable habitat. All subsequent discussions using the term "occurrence" in this five-year review will be based on this definition.) The number of populations of Short's goldenrod in the Blue Licks area is roughly equal to the number of occurrences, but the actual number of populations is unknown because relatively little information is available on actual species dispersal rates and mechanisms, either by seed, pollinators, or some other method.

At present, permanent protection has been achieved for five (numbers 1, 2, 4, 7a, and 8b) of the original nine highest priority occurrences (Table 1). Occurrences 1, 2, and 4 are located within Blue Licks State Park Nature Preserve, a 53-acre preserve in Robertson County, Kentucky, that is part of the larger Blue Licks Battlefield State Resort Park managed and operated by the Kentucky Department of Parks. (Note: Subsequent to completion of the recovery plan, occurrences 1 and 4 were combined by the Kentucky State Nature Preserves Commission (KSNPC) due to their close proximity within Blue Licks Battlefield State Resort Park). An agreement between KSNPC and the Kentucky Department of Parks provides protection for all *S. shortii* on park property by prohibiting any construction activity or habitat disturbance that could affect known occurrences (except dirt trails), including power line construction and maintenance. A portion of occurrence 7 (identified as 7a in the recovery plan) is protected through a Memorandum of Understanding (MOU) between KSNPC and the Kentucky Transportation Cabinet that provides protection and management for this occurrence along the right-of-way of KY 165 (KSNPC 1989). The MOU permits KSNPC to erect fences at these sites to protect habitat; allows for management of the sites through burning, planting, mowing, cutting, or other techniques; prohibits mowing by KYTC between May and October; provides KSNPC with the option to erect signs to mark boundaries of important habitat areas; allows KSNPC to undertake research projects at the sites; and prohibits the spraying of chemical herbicides, the storage of equipment, or the deposition of construction materials at these sites by KYTC. The remaining portion of occurrence 7 (identified as 7b in the recovery plan) was destroyed by the landowner in the late 1990s. A portion of occurrence 8 (identified as 8a in the recovery plan) is protected by its location on Buffalo Trace Preserve, which is owned by The Nature Conservancy and managed in cooperation with KSNPC (Deborah White, personal communication, KSNPC, 2006; White 2001). The remaining part of occurrence 8 (identified as 8b in the recovery plan) occurs within the right-of-way and fenceline of old US 68 and has no current protection.

Permanent protection has also been secured for two of the lower-priority sites identified in the recovery plan (occurrences 5 and 12) and one additional Blue Licks occurrence discovered in 1999 (Table 1). Occurrence 5 receives protection because it occurs within (along with occurrences 1, 2 and 4) Blue Licks State Park Nature Preserve; a portion of occurrence 12 (identified as 12a in the recovery plan) is protected through the MOU described above between KSNPC and the KYTC [KSNPC 1989]; and the new *S. shortii* occurrence discovered in 1999 (White 2001) is protected by its location on a new 129-acre, state nature preserve known as Short's Goldenrod State Nature Preserve (SNP) (Deborah White, personal communication, KSNPC, 2006).

In summary, some progress has been made toward meeting this criterion. Permanent protection has been achieved for five of the original, high priority occurrences (numbers 1, 2, 4, 7a, and 8a). While not contributing toward

meeting this criterion, protection has been secured for two lesser priority occurrences (numbers 5, 12a), and one occurrence that was discovered in 1999 by KSNPC and dedicated as a state nature preserve in 2005.

b. Protected occurrences are determined to be self-sustaining and maintaining current population levels or above.

A summary of current protection status, ownership, and population levels (rooted stems) for all historic and extant occurrences is provided in Table 1. Smith *et al.* (2004) conducted the last range-wide survey of the Blue Licks area in 2001 and provided population estimates (number of stems) and area of coverage for all known occurrences. Based on these results, it was determined that 2 of the original 13 occurrences (occurrences 10 and 13) had been extirpated (since 1989), 10 declined in number of stems present, 1 increased in both number of stems and area of coverage, and 1 new occurrence was discovered. Since 2001, additional surveys by KSNPC staff (Deborah White, personal communication, KSNPC, 2006) have documented either an increase in the number of plants or no change since the previous observation (typically the previous year) for eight occurrences (numbers 1, 2, 5, 7a, 8a, 9, 11, and Short's Goldenrod SNP). During surveys by Service and KSNPC personnel in October 2006, plants were rediscovered at occurrences 10 and 13. At occurrence 10, approximately 100 stems were observed growing along the top, base, and small ledges of a disturbed, man-made cliff line. Occurrence 13 consisted of approximately 25 stems in an open field. In summary, the Blue Licks area of Kentucky contains seven protected occurrences (1, 2, 5, 7a, 8a, 12a, and Short's Goldenrod SNP) that are self-sustaining and at least maintaining current population levels.

An Indiana occurrence discovered in 2001 along the Blue River in Harrison County appears to be stable (Michael A. Homoya, personal communication, Indiana Department of Natural Resources [DNR], 2006). Approximately 139 clumps of *S. shortii* were counted in 2001 when the occurrence was first discovered; additional counts in 2005 revealed 191 clumps (Michael A. Homoya, personal communication, Indiana DNR, 2006). The increased number is suspected to be the result of more careful counting by Indiana DNR biologists, but the numbers have at least remained stable.

c. Species biology and ecological requirements are sufficiently understood to determine and implement long-term management strategies.

When the recovery plan was completed in 1988 (USFWS 1988), little was known regarding the biological and ecological requirements of Short's goldenrod (Baskin and Baskin 1985, 1984; Kral 1983; Medley 1980; Braun 1941). The species appeared to favor sites that were dry and open with rocky and droughty soils, such as cedar glades and former bison traces. These sites ranged from relatively flat to steeply sloping with mostly western or southern

solar exposures. It was determined that the species did not compete well and could not tolerate dense shade or low light conditions. Occupied sites were underlain by bedrock composed of interbedded layers of Ordovician limestones, shales, and siltstones. Soils on which the plant occurred were described as having a flaggy, silty clay texture with 20 to 30 percent rock fragments. Flowering occurred from mid-August to early November with fruits maturing several weeks after flowers withered. Pollinators were suspected to include sweat bees (Family Halictidae) and perhaps blister beetles (Family Meloidae), and wind played a small role in seed dispersal.

Since completion of the recovery plan, various aspects of the biology, ecology, and conservation of this narrow endemic have been investigated by Baskin *et al.* (2000), Buchele *et al.* (1992a, 1992b, 1991a, 1991b, 1989), Smith et al. (2004), and Walck *et al.* (2001, 1999a, 1999b, 1999c, 1999d, 1999e, 1998, 1997a, 1997b, 1997c, 1997d, 1997e). Collectively, these investigations (1) provided an overview of the historical and present geographical distribution of *S. shortii*, describing each of the extant occurrences and summarizing general vegetation and cultural changes at the sites between 1937 and 2003; (2) described and characterized the physical habitat of *S. shortii*; (3) proposed a model of the successional relationships for the species; and (4) investigated various aspects of its life history – seed production, seed bank, seed germination, drought resistance, and colonization ability. The number of seeds per flowering stem ranged from approximately 250 to 1700, and a high percentage of seeds were viable. Seeds of *S. shortii* did not have any special dormancy-breaking or germination requirements that could not be fulfilled outside its present-day geographic range. The soil seed bank of *S. shortii* was shown to be smaller and depleted at a faster rate than those of two other goldenrod species, *S. altissima* and *S. nemoralis*, but these studies did show that *S. shortii* can form a persistent seed bank. Seed germination of *S. shortii* occurred over a broad range of environmental conditions, suggesting that this phase of the life cycle probably does not contribute to the narrow endemism of the species. Morphological traits of *S. shortii* appear to enable it to tolerate drier habitats than *S. altissima*, but it was shown to compete poorly with *S. altissima* on wetter sites. Finally, it was shown that both high light and high nutrient levels are necessary to maintain high vigor of *S. shortii*. In areas subject to invasion by woody plants or *Solidago* species, periodic disturbance may be required to prevent population extirpation.

Although these studies have shown that the life cycle characteristics of *S. shortii* are actually quite similar to more widespread *Solidago* species, the poor competitive and colonization abilities of *S. shortii* appear to contribute most to its narrow endemism (Baskin *et al.* 2000). In the long term, it appears that the species can survive only in early successional, short-term habitats (resulting from some disturbance), natural openings associated with animal movements or rock outcrops, or dynamic rocky shorelines along rivers

(Indiana occurrence). Consequently, these ecological characteristics will define its management needs.

Criteria for delisting

Delisting of *S. shortii* will be possible when the first three recovery criteria listed above (a, b, and c) and the final criterion listed below (criterion d) have been met.

d. At least nine additional protected occurrences, equal in size and significance to the high priority occurrences mentioned above, are discovered in the vicinity of the Blue Licks population or at a currently unknown location.

Intensive surveys of the Blue Licks area have been conducted by Evans (1987), Buchele *et al.* (1989), White (1994), White (2001), and Smith *et al.* (2004), but only one, significant occurrence (number 14) has been discovered in Kentucky since completion of the recovery plan (Deborah White, personal communication, KSNPC, 2006). This site (discovered in 1999 and formerly known as Old Buffalo Trace) was dedicated by KSNPC in 2005 as Short's Goldenrod SNP. The preserve is situated along a former bison trace north of Blue Licks Battlefield State Park and west of existing US 68. Because this occurrence is now protected and is of similar size and status (Table 1) to the nine high priority sites noted in the recovery plan (occurrence numbers 1, 2, 3, 4, 6, 7, 8, 11, and 13), it should be counted as one of the nine additional occurrences needed to satisfy this delisting criterion.

A new occurrence of *S. shortii* was discovered in Indiana's Harrison-Crawford State Forest (Harrison County) during a 2001 inventory of riparian habitats bordering the Blue River (Homoya and Abrell 2005). Approximately 191 stems were counted within an area approximately 170 meters long and 7 meters wide that extends along the northern shore (outer bend) of the Blue River, approximately 1.5 to 2.25 meters above the riverbed. This protected Indiana site is equal in size and significance to the higher priority sites in Kentucky. Consequently, it would qualify as one of the nine additional occurrences needed to satisfy this delisting criterion.

In summary, only two significant occurrences of *S. shortii* have been discovered since completion of the recovery plan – an occurrence on Short's Goldenrod SNP in Kentucky (Fleming County) and the single occurrence in Indiana (Harrison County).

3. Updated Information and Current Species Status

A. Biology and Habitat

Updated information on biology and habitat is summarized above in Section 2.E (Recovery Criteria) and below in Sections 3.B (Five-Factor Analysis) and 4 (Synthesis).

B. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms).

Present or threatened destruction, modification, or curtailment of its habitat or range.

Occurrences of *S. shortii* located within Blue Licks Battlefield State Resort Park are protected from general habitat disturbance due to their location on park property and their location within an area that has been dedicated by KSNPC as a state nature preserve (Blue Licks State Park Nature Preserve). These occurrences could be adversely affected, however, through accidental trampling by park workers/visitors and inadvertent destruction resulting from park activities (USFWS 1988; Deborah White, personal communication, KSNPC, 2006). Crown vetch (*Coronilla varia*), Queen Anne's lace (*Daucus carota*), sweet clover (*Meililotus alba*), tall fescue (*Festuca arundinacea*), musk thistle (*Carduus nutans*) and other exotic plants are a continuous threat to the occurrences on the preserve (Deborah White, personal communication, KSNPC, 2006). Research by Baskin *et al.* (2000) has shown that, in the long-term, *S. shortii* can survive only in early successional habitats due to its low competitive ability. KSNPC field crews work on these sites for a week or so every year, but it is still unclear whether these species are being controlled. The Short's Goldenrod Preserve (occurrence 14) is new, and the occurrence is only beginning to benefit from management activities on the site.

Occurrences on private property are more severely threatened by direct habitat disturbance. These occurrences could be adversely affected by construction activities (land-clearing, grading, bulldozing); agricultural practices (improvement of pastures through grading and planting of fescue, trampling by livestock); fire (at wrong time of year); highway maintenance (right-of-way disturbance, spraying of herbicides); and power line maintenance (spraying of herbicides). A portion of occurrences 7a and 12a receive some protection from private landowner disturbance because they are located within the rights-of-way of US 68 and KY 165 (these occurrences occur along rights-of-way fencelines so a portion of each extends onto private land). Plants within these rights-of-way are protected through a MOU between KSNPC and KYTC that controls potential habitat disturbance and allows for habitat management within these rights-of-way.

The Indiana occurrence is threatened by competition from exotics and the potential raising of the Ohio River's pool level (Michael A. Homoya, personal communication, Indiana DNR, 2006). At present, trampling by visitors does not seem to be a serious threat; recreational use of the area does occur, but the plants do not seem to have been affected. The raising of the Ohio River's pool level (and subsequently the Blue River) is unlikely but could change the hydrologic dynamics of the site and cause a vegetative shift surrounding the *S. shortii* occurrence. The routine scour provided by high flows of the Blue River provides the necessary disturbance to reduce competition and maintain the occurrence.

Reduced flows and inundation of the Blue River resulting from an increased Ohio River pool level would alter these conditions. The most serious threat to the Indiana occurrence is competition from exotics. At present, little management has occurred at the site aside from pulling and cutting of a few exotic species. Indiana DNR is currently working on a long-term strategy to deal with this threat (Michael A. Homoya, personal communication, Indiana DNR, 2006).

In summary, the Kentucky occurrences are most threatened by competition from exotics such as crown vetch, tall fescue, and other species described above, habitat disturbance on private property, and highway and powerline maintenance activities. The Indiana occurrence is most threatened by competition from exotics. The potential raising of the Ohio River's pool level is a possible threat but is unlikely to occur.

Overutilization for commercial, recreational, scientific, or educational purposes.

Blue Licks Battlefield State Resort Park is a popular park within northeastern Kentucky, offering a new lodge and restaurant, a museum, access to the Licking River, hiking trails, a 51-site campground, and a public swimming pool. Recent park improvements (*i.e.*, lodge) are expected to increase the recreational use of the park and could lead to adverse impacts to *S. shortii* individuals if recreational activities (*e.g.*, hiking) are not directed away from *S. shortii* occurrences. A major segment of the park's *S. shortii* population was lost during construction of the current campground, and remaining individuals could be trampled if visitors stray from marked trails. The species' small range and low number of individual plants make it vulnerable to overcollecting for scientific purposes (Medley1980; Baskin and Baskin 1984). Plants within Blue Licks Battlefield State Resort Park cannot be collected without a permit from the Kentucky Department of Parks and KSNPC; these permits are only issued for valid scientific purposes. Plants occurring on private property are not afforded this protection. The Indiana occurrence is also potentially threatened by recreational use (trampling by fishermen, canoeists, hikers) (Michael A. Homoya, personal communication, Indiana DNR, 2006). At present though, recreational use does not appear to be a significant threat in Indiana. In addition, these plants occur on state property and cannot be collected without a permit.

Disease and predation.

No diseases are known to be adversely impacting the species. Over-grazing by cattle on private property has the potential to adversely affect the species by eliminating flower production, but this effect has not been observed directly.

Inadequacy of existing regulatory mechanisms.

Occurrences at Blue Licks Battlefield State Resort Park are protected from unauthorized taking; permits administered by the Kentucky Department of Parks and KSNPC are only issued for valid scientific purposes. Portions of occurrences 7a and 12a are protected through an MOU between KSNPC and KYTC (KSNPC

1989) that restricts habitat disturbance within these road rights-of-way. The Indiana occurrence occurs on state property (Harrison-Crawford State Forest) and is also protected from unauthorized taking. No such protection is available for occurrences located on private property in Kentucky or Indiana.

Other natural and manmade factors affecting its continued existence.
The species has been reduced to a small number of occurrences with a limited number of individuals. Consequently, the species is vulnerable to natural or human-induced factors (fire suppression) that might directly destroy individuals and further reduce population size (Federal Register 1985). Natural (secondary) succession can eliminate potential habitat for *S. shortii* through changes in vegetational composition. As old-field habitats and closed canopy woodlands develop, potential *S. shortii* habitat is lost.

4. Synthesis

Short's goldenrod was first collected in 1840 at Rock Island, adjacent to the Falls of the Ohio, Jefferson County, Kentucky. This site was later inundated by dam construction on the Ohio River, and the occurrence was lost. The species was considered extinct until 1939, when Dr. E. Lucy Braun discovered additional occurrences of the species in the vicinity of Blue Licks, Kentucky. She reported numerous occurrences growing on rocky slopes and in pastures in Nicholas, Robertson, and Fleming counties. When *S. shortii* was listed in 1985 (USFWS 1985), it was only known from five locations in Nicholas, Robertson, and Fleming counties, Kentucky (four privately owned properties and one location within Blue Licks Battlefield State Park). Based on the results of numerous surveys and investigations over the past 25 years, the current distribution of *S. shortii* is restricted to 13 occurrences within a 2-mile radius of Blue Licks Battlefield State Resort Park in Fleming, Nicholas, and Robertson counties, Kentucky and one occurrence along the Blue River in Harrison County, Indiana (Harrison-Crawford State Forest). Despite numerous, intensive searches of similar habitats, only two occurrences (one within Short's Goldenrod SNP in Fleming County, Kentucky and the Indiana occurrence) have been discovered since completion of the recovery plan in 1988. At present, eight Kentucky occurrences (numbers 1, 2, 5, 7a, 8a, 11, 12a, and Short's Goldenrod SNP) and the Indiana occurrence appear to be stable, and some level of protection has been achieved for all but one of these occurrences (number 11). The remaining Kentucky occurrences have shown declines in the number of stems and surface area since 1989 (Smith *et al.* 2004; Buchele *et al.* 1989). The reason for these declines is unknown, but competition from exotics and land-clearing activities on private property appear to be the primary causes.

The final rule (USFWS 1985) listed habitat destruction or alteration and possibly other natural or man-made factors such as fire suppression and the elimination of bison as the primary reason for the current endangered status of *S. shortii*. Increased visitor usage of Blue Licks Battlefield State Resort Park and further changes in land use (more intensive agricultural practices, natural succession, and additional construction activities) were listed as the primary future threats to the species. Due to its low competitive abilities, *S. shortii* is also threatened by weedy exotics, and even non-weedy natives, if there is not

some disturbance maintaining the open character of the habitat. All of these threats remain.

Management of *S. shortii* on Blue Licks State Park Nature Preserve is on-going (Deborah White, personal communication, KSNPC, 2006). These actions have included (1) the clearing and removal of woody vegetation in order to control succession and (2) the removal of invasive species. Eastern red cedar (*Juniperus virginiana*) has been selectively removed from most of the sites because its numbers have increased with natural succession. Exotic species, including crown vetch, musk thistle, tall fescue, Queen Anne's lace, and sweet clover, have been hand-cleared and treated with herbicide. These actions appear to have benefited the species and will continue to be the focus of management for the state nature preserve within Blue Licks Battlefield State Resort Park. Controlled burns have also been employed at several locations within the park. Burns have appeared to be effective in controlling exotics and providing favorable conditions for *S. shortii* if done outside of the growing and/or flowering season. The Indiana DNR is currently developing a management strategy for the Indiana occurrence that will focus primarily on the removal and control of exotic species (Michael A. Homoya, personal communication, Indiana DNR, 2006).

Although recovery progress has been made, the recovery criteria listed above in Section 2.E have not been met for delisting or downlisting the species. Two significant occurrences have been discovered since completion of the recovery plan, but several of the original 13 occurrences (including one of the original high priority sites, number 13) have been severely degraded due to habitat destruction and alteration by landowners. One of the original 13 occurrences (and also one of the nine highest priority sites) has apparently been destroyed. Some initial progress was made by KSNPC in the 1980s and 1990s regarding the development of registry agreements with landowners as a means of protecting occurrences on private lands. Unfortunately, these agreements have expired, and no new agreements have been developed. Because of the restricted distribution of the species, loss of occurrences, and continued threats, *S. shortii* remains in danger of extinction throughout all or a significant portion of its range. Therefore, we believe that the status of Short's goldenrod should remain as endangered.

At the time of listing (Federal Register 1985), this species had a moderate degree of threat and a high recovery potential, resulting in a Recovery Priority Number of 8 for the taxonomic level of species. At present, the Service does not have any additional information to suggest that the degree of threat or the recovery potential has changed. Therefore, we believe the recovery priority for Short's goldenrod should remain at 8 (moderate threat, high recovery potential, species level taxonomy).

RESULTS

1. Recommended Classification

No change is needed for the existing classification of endangered.

2 New Recovery Priority Number

No change is needed for the existing Recovery Priority Number of 8.

RECOMMENDATIONS FOR FUTURE ACTIONS

- Continue searches for new occurrences in the Blue Licks area, especially near known buffalo traces
- Conduct searches for new occurrences in riparian outcrop habitats of central Kentucky and southern Indiana or in upland areas of the region with suitable habitat
- Continue to investigate the life history and ecological requirements of the species (e.g., seedling establishment, seed and pollen dispersal distances)
- Continue to pursue permanent protection (through registry agreements, easements, or land purchases) of occurrences located on private property
- Expand the size of extant occurrences through habitat management and augmentation
- Establish viable occurrences in areas within the historical range that have suitable habitat, especially the Blue Licks Area of Fleming, Nicholas, and Robertson counties; develop criteria for establishing experimental populations in Kentucky
- Acquire potentially suitable but currently unoccupied habitat for the species where the species can be introduced and managed
- Continue implementation of management actions for permanently protected occurrences; develop a management strategy for the Indiana occurrence
- Revise the recovery plan

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Peer Review (2007)

Name of Reviewer(s):

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Results of Peer Review: Comments received from each of the reviewers were incorporated as appropriate.

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW on *Solidago shortii* (Short's goldenrod)

CURRENT CLASSIFICATION Endangered

RECOMMENDATION resulting from the 5-Year: No Change

REVIEW CONDUCTED BY: Dr. Michael A. Floyd, Kentucky ES FO

Lead Field Supervisor, Fish and Wildlife Service

Approve Virginia Tu Andrews Date 4/9/07

Do not Approve _____ Date _____

Lead Field Offices must ensure that all other Field Offices within the range of the species have been provided an adequate opportunity to review and comment prior to the review's completion. If it is concluded that a change in classification is warranted, written concurrence from other Field Offices is required.

Cooperating Field Supervisor, Fish and Wildlife Service

Concur _____ Date 10/15/07

Not concur _____ Date _____

Lead Regional Director, Fish and Wildlife Service

Concur _____ Date 4/10/07
Acting ARD-ES

Not concur _____ Date _____

The Regional Director must sign all 5-year reviews, unless the authority has been delegated by the Regional Director to the ARD of Ecological Services.

Cooperating ~~Regional Director~~ Acting ARD, Ecological Services, Fish and Wildlife Service

Concur _____ Date 10/25/07

Not concur _____ Date _____

The Lead Region must ensure that any other Regions within the range of the species have been provided an adequate opportunity to review and comment prior to the review's completion. If it is concluded that a change in classification is warranted, written concurrence from other Regional Directors is required.

Appendix A - Table 1. Current Ownership/Protection Status of *Solidago shortii* Occurrences in Kentucky

Occurrence No.			Former	Current	Protection Status		Current	
USFWS (1988)[1]	KSNPC	Tract or Site Name	Ownership (1988)	Ownership	USFWS (1988)	Current (Oct 2006)	Species Status[2]	Comments
1	1	Blue Licks Battlefield State Park	KY Dept. of Parks	KY Dept. of Parks	dedicated as Blue Licks State Park Nature Preserve (SPNP)	Protected (Blue Licks SPNP)	S	Based on observations in 2006 and 2004, number of stems (in the 1,000s) appeared to be increasing or stable compared to 2003 and earlier observations
2a	2A	Craig	Private	KY Dept. of Parks	verbal registry with landowner	Protected (Blue Licks SPNP)	S	08-16-06: no change in status; 09-10-2004: 1,309 stems observed in monitoring area; 805 stems in 2003
2b	2B	Blue Licks Battlefield State Park	KY Dept. of Parks	KY Dept. of Parks	KY Dept. of Parks notified but no formal protection	Protected (Blue Licks SPNP)		
3	13	Hunter	Private	Private	signed registry with landowner	No protection - registry discontinued	D	08-16-06: no change in status; 09-10-2004: 20 plants observed along wooded edge, none in field; part of site scraped to bare soil in 2000; 1,000s of stems observed in late 1980s
4	1	Blue Licks Battlefield State Park	KY Dept. of Parks	KY Dept. of Parks	KY Dept. of Parks notified but no formal protection	Protected (Blue Licks SPSNP)	S	KSNPC combined this occurrence with original number 1 of recovery plan (due to close proximity); plant condition and abundance in 2006 appeared the same as observations made in 2004 and 2000
5	6	Smoot	Private	KY Dept. of Parks	KY Dept. of Parks notified but no formal protection	Protected (Blue Licks SPNP)	S	08-16-06: no change in status; 09-10-2004: 3542 stems - an increase compared to 2486 stems on 10-14-2002
6	12	Rice I	Private	Private	signed registry with landowner	No protection - registry discontinued	D	08-16-06: no change in status; 09-10-2004: one clump remaining in fencerow along US 68; site bulldozed in 1988 when 100s of stems present
7a	4A	Highway 165 site	KYTC	KYTC	notified	Protected through MOU between KYTC and KSNPC	S	08-16-06: no change in status (1,347 stems counted); 09-10-2004: Plants along roadway (KYTC site - 004A) appear to be stable compared to last observation (Sep 2000); plants on Rice tract destroyed by landowner
7b	4B	Rice II	Private	Private	notified	No protection - destroyed		
8a	9B	Buffalo Trace Preserve	Private (TNC)	Private (TNC)	private preserve (TNC)	Protected (TNC ownership)	S	08-16-06: no change in status (100s of stems observed); last observation was 2002 by Smith et al (2004) - 672 rooted stems; last KSNPC observation was 1997
8b	9B	Frey / Roadside	Private	Private	signed registry	No protection - registry discontinued		
9	9A	None provided	Private	Private	No protection	No protection - purchase pending under RLA funds	U	Last stem count performed in 2005, estimated at 25-50 stems; approved for purchase under Recovery Land Acquisition funding in 2006, purchase imminent; 79 stems noted in 1993.
10	3	Allison	Private	Private	notified	No protection	D	Occurrence rediscovered in Oct 2006, with approx. 100 stems observed; 09-10-2004: plants not observed - population likely extirpated
11	8	Abnee I	Private	Private	verbal registry	No protection - registry discontinued	S	08-16-06: no change in status (approx. 1,300 rooted stems); 09-10-2004: Condition and abundance appear to be same since last observation (Sep 2000), little flowering
12a	7A	Right-of-way	KYTC	KYTC	notified	Protected through MOU between KYTC and KSNPC	S	08-16-06: no change in status; approx. 1,800 stems observed in 2000 by Smith *et al.* (2004); last KSNPC observation was Sep 2000
12b	7B	Abnee II	Private	Private	No protection	No protection		
13	11	-----	Private	Private	No protection	No protection	D	Private Ownership - thought to be extirpated, but one clump rediscovered in Oct. 2006
N/A	5	Short's Goldenrod SNP ("Old Bufffalo Trace")	N/A	KSNPC	occurrence unknown	Protected - purchased, dedicated as Short's Goldenrod SNP	S	Discovered by KSNPC in 1999 and dedicated as SNP in 2005; 219 stems observed in 2006, an increase from 120 stems observed in 2003

[1]USFWS (1988): Recovery plan for Shorts goldenrod (*Solidago shortii*). U. S. Fish and Wildlife Service, Atlanta, Georgia.

[2]Populations Status: Status categories include Stable/Increasing (S), Decreasing (D), and Unknown (U); based on stem counts by Buchele *et al.* (1989), Smith *et al.* (2004), and numerous observations by KSNPC (see comments column)

FY 2017 APPROVAL*

Current Classification: Endangered

Review conducted by: Dr. Michael A. Floyd, Kentucky ES FO

Lead Field Supervisor, Fish and Wildlife Service

VIRGIL ANDREWS Digitally signed by VIRGIL ANDREWS
Date: 2017.08.31 10:49:34 -04'00'

Approve _____Date_____

*In 2014, Southeast Region Field Supervisors were delegated authority to approve 5-year reviews that do not recommend a status change.

Field Supervisor signature on this document reflects:

1. _____ We have no new information, received no new public comments, and the original five factor analysis remains an accurate reflection of the species' current status.
2. __X__ We have obtained a small amount of new information that we have summarized in Appendix B, received no new public comments, and the original five factor analysis remains an accurate reflection of the species' current status.

   Lead Field Offices must ensure that all other Field Offices within the range of the species have been provided an adequate opportunity to review and comment prior to the review's completion. If it is concluded that a change in classification is warranted, written concurrence from other Field Offices is required.

Cooperating Field Supervisor, Fish and Wildlife Service

Concur SCOTT PRUITT Digitally signed by SCOTT PRUITT
DN: c=US, o=U.S. Government, ou=Department of the Interior, ou=U.S. Fish and Wildlife Service, cn=SCOTT PRUITT, 0.9.2342.19200300.100.1.1=14001000671805
Date: 2017.08.31 12:26:52 -04'00' Date_____

Not concur_____Date_____

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW OF Short's Goldenrod (*Solidago shortii*)

Appendix B. Summary of new information obtained since the 2007 5-Year Review

We initiated a new five-year review for Short's Goldenrod on March 25, 2014 (79 FR 16366). We received no public comments during the comment period. We received comments from three peer reviewers and have incorporated their comments as appropriate in this revised review (see *Summary of Peer Review*). All new information we have gathered in the time since our last five-year review is outlined below along with our current recommendation of status. This completes our review initiated in 2014.

Distribution/Status

Kentucky
In 2003, KSNPC discovered a new Kentucky occurrence (Element Occurrence (EO) 15) within Shorts Goldenrod State Nature Preserve (SNP) (Figure 1). Since that time, the occurrence (15-20 stems) has persisted along a forest edge adjacent to old US Highway 68 in Fleming County. One Blue Licks occurrence (EO 11) was not observed during the last field survey in 2015, but all other Kentucky occurrences have persisted and have not changed significantly with respect to stem total or rank (T. Littlefield, personal communication, KSNPC, 2017). In 2011, 2014, and 2015, KSNPC completed intensive searches of rocky shoreline habitats along the Licking River, Ohio River, and Salt River in Kentucky; no new populations were discovered (T. Littlefield, personal communication, KSNPC, 2017). Intensive management of occurrences on Short's Goldenrod SNP (EOs 5, 9, and 15) is scheduled for fall/winter 2017 (T. Littlefield, personal communication, KSNPC, 2017).

Between 2006 and 2014, the Service (KFO) worked with multiple partners to introduce *S. shortii* at five sites in Kentucky (Figure 2). In April 2006, the Service, KSNPC, and Bernheim Arboretum and Research Forest (Bernheim) introduced the species (total of 50 plants) at an upland site above Beaver Creek, approximately 1 km southwest of Claysville in Harrison County (EO 16). The site is located on a 113-acre property purchased in 2004 using recovery land acquisition funds. Seeds were collected from several Blue Licks occurrences by KSNPC in 2005 and later transferred to Bernheim for propagation. Since 2006, competing vegetation has been reduced through mowing and herbicide treatments (i.e., Fusilade® and Select®), and plants continue to persist at all three patches at the site (100s of flowering plants documented by KSNPC in 2014). The property is owned by Southern Conservation Corp. (SCC), a non-profit land trust headquartered in McMinnville, Tennessee.

The Service introduced the species (100 plants) at a second Harrison County site in May 2008 (EO 18). Partners included KSNPC, the Kentucky Transportation Cabinet (KYTC), Federal Highways Administration, East Kentucky Power Cooperative, Cincinnati Zoo and Botanical Garden, and SCC. The 608-acre site is located approximately 4.2 km west-southwest of Claysville. Since 2008, competing vegetation has been reduced through mowing and herbicide treatments. Plants continue to persist at the site, which is owned and managed by SCC in cooperation with the Service.

A third reintroduction (about 30 plants, EO 19) was completed in April 2011 at a site along the Licking River in Robertson County (Figure 2). Plants continue to persist at the site, which will continue to be managed by the Service and the landowner through a combination of mowing and herbicide treatments. In September 2014, 25 plants were added to a third Harrison County site (owned by SCC), approximately 2.5 km southwest of Claysville (EO 17); plants continue to persist at the site but actual stem counts have not been made by KSNPC or the Service. The fifth reintroduction effort (about 20 plants remaining from the Harrison County effort, EO 17) was completed by KSNPC in late 2014 along the Licking River in Kenton County (not shown on Figure 2). The site is located on Morning View Heritage Area, a 220-acre property owned and managed by the Kenton County Conservation District and purchased through a grant provided by the Kentucky Heritage Land Conservation Fund Board. Neither the Service nor KSNPC has revisited the site, so the status of the occurrence is unknown.

Indiana

The single Indiana occurrence of *S. shortii* continues to experience occasional flooding of the Blue River, and there is limited competition from invasive plants such as Chinese Lespedeza (*Lespedeza cuneata*), Crown Vetch (*Securigea varia*), and Stiltgrass (*Microstegium*) (Indiana Division of Nature Preserves 2016, p. 2). Despite this competition, the species has persisted at the site, and the occurrence remains essentially unchanged since the 2007 review that reported the species as stable (M. Homoya, personal communication, Indiana Department of Natural Resources (DNR), 2017). The routine scour provided by occasional flooding of the Blue River appears to provide the necessary disturbance to help reduce competition and maintain the occurrence. The occurrence has also benefited by repeated hand-pulling of competing vegetation by Indiana DNR personnel. This occurrence is now part of Greenbrier Knob Nature Preserve, which was dedicated by the Indiana Natural Resource Commission in January 2017. The site continues to be owned and administered by the Indiana Division of Forestry, but the dedication provides additional protection under Indiana state law.

Seed Collection

The Missouri Botanical Garden (MOBOT) collected seed from the Indiana and Blue Licks populations of *S. shortii* in October 2014 (Recovery Action 5.1). New seed collections were warranted due to the small size and old age of MOBOT's *S. shortii* collections and because MOBOT is the primary custodian for *S. shortii* in the Center for Plant Conservation network (Q. Long, personal communication, MOBOT, 2016).

Five Factor Analysis:

A bacterial leaf spot was noted on plants in a few occurrences in 2013 and 2015 and is particularly abundant within plants at EO 1. Effects of this condition on population viability is unknown but will be studied further during a planned 2018 status survey (T. Littlefield, personal communication, KSNPC, 2017). EOs 4 and 7 had previously received protection through memoranda of agreement between KSNPC and KYTC; however, these agreements lapsed since completion of the previous five-year review. KSNPC is currently working with KYTC to renew those agreements (T. Littlefield, personal communication, KSNPC, 2017). KSNPC is also

currently negotiating with TNC to transfer ownership of the Buffalo Trace Preserve (EO9) from TNC to KSNPC (T. Littlefield, personal communication, KSNPC, 2017).

A cultivar of Short's Goldenrod called *Solidago shortii* 'Solar Cascade' is now available commercially from several online retailers (nurseries) identified with a google search. It is unknown whether 'Solar Cascade' represents a true horticultural selection or is merely a marketing strategy for *S. shortii*. It is also unclear how the commercialization of this cultivar represents a potential threat or contributes to the conservation of *S. shortii* (Q. Long, personal communication, MOBOT, 2017). Other than these additions, we consider the previous 5-factor analysis to be an accurate representation of the species' threats and current status.

Synthesis

Short's Goldenrod has a restricted range and continues to face threats of moderate magnitude. The recovery criteria have not been met, but the species continues to have a high recovery potential. Therefore, the status of Short's Goldenrod should remain as endangered, and the Recovery Priority Number should remain as an 8.

Additional Recommendations for Future Actions

- Continue management and monitoring of naturally occurring and reintroduced occurrences in Kentucky and Indiana, with consideration of intensified management at selected sites
- Consider expansion of reintroduction efforts, with careful consideration of seed origin and genetics
- Investigate and compare the genetic diversity/structure of Kentucky and Indiana populations, including the reintroduced occurrences in Harrison County, Kentucky
- Investigate potential impacts of the bacterial leaf spot observed on occurrences in the Blue Licks area of Kentucky
- Explore the potential threat posed by the horticultural cultivar *S. shortii* 'Solar Cascade'

Summary of Peer Review

The draft document was peer-reviewed by Mike Homoya, Indiana DNR, Bloomington, Indiana; Tara Littlefield, KNSPC, Frankfort, Kentucky; and Dr. Quinn Long, Missouri Botanical Garden, St. Louis, Missouri; and comments received were incorporated as appropriate. Peer reviewers were asked to read the draft review and provide any comments, both editorial and technical, but they were asked to refrain from commenting on the recommendation regarding listing status. In general, all peer reviewers agreed that the data and analyses relied upon for the review were sufficient to support the conclusions of the review, but the reviewers did provide new comments and information (e.g., future management recommendations, potential threats, and genetic considerations) that have been incorporated into this revised review.

Mr. Homoya offered some editorial and technical suggestions regarding our description of the Indiana occurrence and provided new information regarding its location within Greenbrier Knob Nature Preserve, which was dedicated by the Indiana Natural Resources Commission in January

2017. Ms. Littlefield provided updated information on management agreements between KSNPC and KYTC; a potential land transfer between TNC and KSNPC (Buffalo Trace Preserve); new survey efforts along the Licking River, Ohio River, and Salt River in Kentucky; new management actions planned at Short's Goldenrod SNP in 2017; and new observations regarding a bacterial leaf spot at several Blue Licks occurrences.

Dr. Long provided citations for several *S. shortii* publications/reports not included in the 2007 review. He also suggested we investigate the genetic diversity of populations in Indiana and Kentucky; recommended the augmentation of reintroduced populations (EOs 16-19) to increase the size and genetic diversity of these occurrences, with careful consideration and documentation of seed origin; recommended that management be intensified at known and reintroduced sites; and recommended we add new summary information regarding a *S. shortii* cultivar ('Solar Cascade') that is now commercially available from several nurseries in the eastern United States.

References

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Long, Q. 2017. Personal communication regarding seed collection and new cultivar of Short's Goldenrod in Kentucky. Missouri Botanical Garden, St. Louis, Missouri.

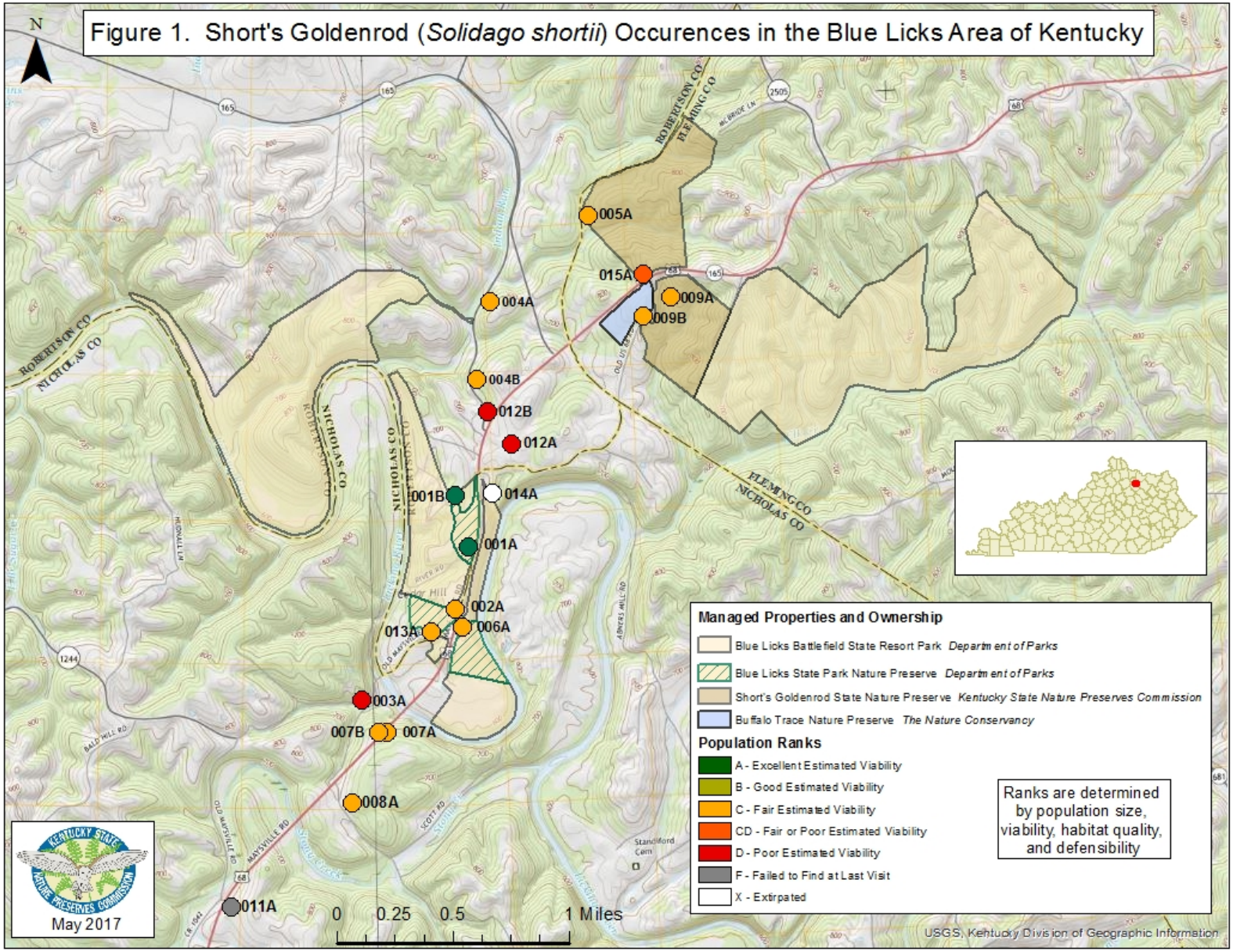
Figure 1. Short's Goldenrod (*Solidago shortii*) Occurences in the Blue Licks Area of Kentucky
N
005A
015A
009A
009B
004A
004B
012B
012A
001B
014A
001A
002A
006A
013A
003A
007B
007A
008A
011A
ROBERTSON CO
NICHOLAS CO
FLEMING CO
0 0.25 0.5 1 Miles
Managed Properties and Ownership
Blue Licks Battlefield State Resort Park *Department of Parks*
Blue Licks State Park Nature Preserve *Department of Parks*
Short's Goldenrod State Nature Preserve *Kentucky State Nature Preserves Commission*
Buffalo Trace Nature Preserve *The Nature Conservancy*
Population Ranks
A - Excellent Estimated Viability
B - Good Estimated Viability
C - Fair Estimated Viability
CD - Fair or Poor Estimated Viability
D - Poor Estimated Viability
F - Failed to Find at Last Visit
X - Extirpated
Ranks are determined by population size, viability, habitat quality, and defensibility
KENTUCKY STATE NATURE PRESERVES COMMISSION
May 2017
USGS, Kehtucky Division of Geographic Information

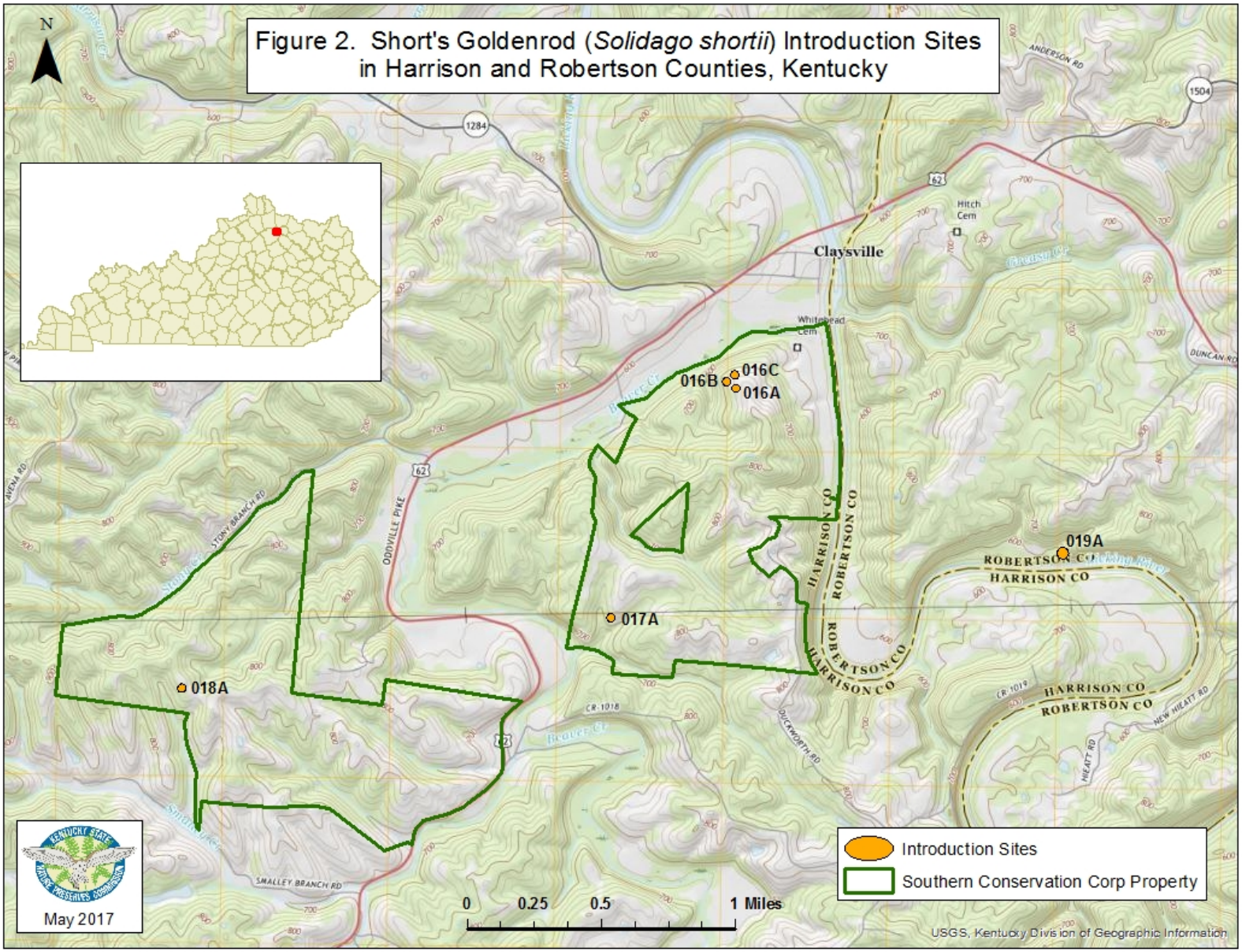
Figure 2. Short's Goldenrod (*Solidago shortii*) Introduction Sites in Harrison and Robertson Counties, Kentucky
N
Claysville
Hitch Cem
Whitehead Cem
016B
016C
016A
017A
018A
019A
ODDVILLE PIKE
STONY BRANCH RD
SMALLEY BRANCH RD
DUCKWORTH RD
HILEATT RD
NEW HILEATT RD
DUNCAN RD
ANDERSON RD
CR 1018
CR 1019
HARRISON CO
ROBERTSON CO
Introduction Sites
Southern Conservation Corp Property
0 0.25 0.5 1 Miles
May 2017
USGS, Kentucky Division of Geographic Information