Price's Potato-bean
(*Apios priceana*)

5-Year Review:
Summary and Evaluation

Photo of *Apios priceana* by David Duhl.

U.S. Fish and Wildlife Service
Southeast Region
Mississippi Ecological Services Field Office
Jackson, Mississippi

September 2022

STATUS REVIEW
Price's Potato-bean (*Apios priceana*)

GENERAL INFORMATION

Current Classification: Threatened

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Date of original listing: January 5, 1990 (55 FR 429)

Methodology used to complete the review:

In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants (50 CFR 424.11). The U.S. Fish and Wildlife Service (Service) evaluated the biology, habitat, and threats of the Price's potato-bean to inform this status review. We announced initiation of this review in the Federal Register (FR) on June 23, 2021 (86 FR 32965) with a 60-day comment period and received no public comments. The primary sources of information used in this analysis were the 1990 final listing rule (55 FR 429), the 1993 recovery plan (Service 1993), peer-reviewed reports, agency reports, unpublished survey data and reports, and personal communication with recognized experts. This review was completed by the U.S. Fish and Wildlife Service, Mississippi Ecological Services Field Office, Jackson, Mississippi. All literature and documents used for this review are on file at the Mississippi Ecological Services Field Office. All recommendations resulting from this review are the result of thoroughly reviewing the best available information on Price's potato-bean.

FR Notice citation announcing the species is under active review: June 23, 2021 (86 FR 32965)

Species' Recovery Priority Number at start of 5-year review (48 FR 43098): 8. Price's potato-bean is a species with a moderate degree of threat and a high recovery potential.

Review history:

November 6, 1991 (56 FR 56882) – In the 1991 review, multiple species were simultaneously evaluated with no species-specific, in-depth assessment of the five factors or threats as they pertained to each species' recovery. The notices listed these species and stated that no changes in the designation of these species were warranted at that time, including no changes to the status of Price's potato-bean.

September 2, 2016 (July 6, 2009, 74 FR 31972) – In the 2016 review, the Service recommended that the Price's potato-bean remain a threatened species. Price's potato-bean was considered stable overall, with many new populations discovered since completion of the species' 1993 recovery plan. There were 59 extant populations, 23 of which were located on public lands or privately owned conservation lands. Most populations were small.

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature

We are not aware of any changes to the taxonomy of this entity, and it is still considered valid by the Service. *Apios priceana* (B. L. Rob.) is recognized as a valid species in family Fabaceae (Weakley 2022; see also *Integrated Taxonomic Information System* [https://www.itis.gov, accessed June 1, 2022] and *World Flora Online* [http://www.worldfloraonline.org/taxon/wfo-0000169596, accessed June 1, 2022]).

Distinct Population Segment (DPS) (61 FR 4722)

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing of a DPS to only vertebrate species. Because the species under review is a not a vertebrate, the DPS policy does not apply.

Recovery Criteria

Recovery Plan

Recovery Plan for Price's Potato-Bean (*Apios priceana*), February 10, 1993

Recovery plans are not regulatory documents and are intended to provide guidance to the Service, States, and other partners on methods of minimizing threats to listed species and on criteria that may be used to determine when recovery is achieved. If the recovery criteria defined in the plan are still valid, meeting recovery criteria can indicate that the species no longer requires protections under the Act. However, when recommending whether a listed species should be delisted, the Service must apply the factors in section 4(a) of the Act (84 FR 45020).

"Price's potato-bean will be considered for delisting when there are at least 25 geographically distinct, self-sustaining, protected populations and they have been maintained for 10 years. A population will be considered self-sustaining if the population size is stable and there is evidence

of successful reproduction. Protected populations will have appropriate legal protection and appropriate management" (Service 1993).

The recovery criteria for Price's potato-bean have not been met.

Biology and Habitat Summary

Limited new information on Price's potato-bean is available since completion of the Service's previous 5-year review (Service 2016). For the purposes of this review, we consider each distinct element occurrence (EO) tracked by state Natural Heritage Programs to constitute separate populations. For a detailed definition of EOs, please see the previous 5-year review (Service 2016).

Distribution, Populations, and Trends

There are now 57 extant populations of Price's potato-bean distributed among 27 counties in 4 states (Table 1; Figure 1; ANHP 2022; KSNPC 2022; MNHP 2022; TDEC 2022). These populations are distributed across multiple U.S. Environmental Protection Agency (EPA) Level III ecoregions, which represent different ecological zones that share a characteristic set of natural communities, floral and faunal species, ecological dynamics, and environmental conditions (Figure 1; Omernik 1987). We are presuming the 15 populations that were not surveyed since the last 5-year review remain extant (Service 2016; ANHP 2022; KSNPC 2022; MNHP 2022; TDEC 2022). The general spatial extent of the species remains similar to what was reported in the last 5-year review. There is one new county included in the species distribution (e.g., adding Warren County, Kentucky), and the species remains extirpated from Illinois. A number of the populations are small and isolated from other known extant populations, limiting connectivity and potential gene flow. Because Price's potato-bean is known to periodically assume dormancy during the growing season until conditions are more suitable, numbers in this document should be considered best available estimates (Service 1993; Schotz 2018).

Of the 59 total populations reported in the 2016 5-year review, 7 are presumed extirpated. However, an additional five populations have been identified since the last 5-year review (Service 2016). Four of the new populations were found in Alabama ranging in size from 12-24 plants and an additional new, very small population, i.e., 2 plants, was discovered in Kentucky. Of the extant populations, 13 in Alabama, 5 in Kentucky, 2 in Mississippi, and 6 in Tennessee are located on publicly owned lands or private conservation lands that are currently considered protected (Table 2).

Table 1. Number of extant Price's potato-bean populations by county in 1993, 2016, and 2022 status reviews. Parentheses indicate number of populations included in the total that are uncertain and are only presumed extant.

State	County	1993 Recovery Plan	2016 5-Year Review	2022 5-Year Review
Alabama	Autauga	2	2	2 (1)
Alabama	Butler	-	1	1 (1)
Alabama	Dallas	-	2	3 (1)
Alabama	Jackson	-	2	2
Alabama	Lawrence	-	1	4 (1)
Alabama	Madison	1	5	5 (4)
Alabama	Marshall	1	1	1 (1)
Alabama	Monroe	-	1	1 (1)

State	County	1993 Recovery Plan	2016 5-Year Review	2022 5-Year Review
Alabama	Wilcox	-	1	1 (1)
Kentucky	Livingston	1	2	1
Kentucky	Lyon	1	3	3
Kentucky	Trigg	2	2	2
Kentucky	Warren	-	-	1
Mississippi	Clay	1	-	-
Mississippi	Kemper	-	1	1 (1)
Mississippi	Lee	1	2	2
Mississippi	Oktibbeha	2	1	1 (1)
Tennessee	Dekalb	1	1	1
Tennessee	Franklin	-	2	2 (1)
Tennessee	Giles	-	2	2
Tennessee	Hardin	-	3	3
Tennessee	Hickman	6	10	6
Tennessee	Marion	1	1	1
Tennessee	Maury	1	2	2 (1)
Tennessee	Montgomery	1	1	1
Tennessee	Stewart	-	2	2
Tennessee	Wayne	-	4	4
Tennessee	Williamson	3	4	2
Total		**25**	**59**	**57 (15)**

Sources: ANHP 2022; KSNPC 2022; MNHP 2022; TDEC 2022.

Research and Conservation Activities

The conservation and management of rare species is aided by understanding population genetic structure and genetic diversity levels. Genetic studies found that Price's potato-bean has relatively high levels of within-population genetic diversity (Lindsey et al. 2019; Ray 2020) and geographic patterns (Ray 2020; Chowdhury 2021). Preliminary results also indicate that flowering Price's potato-bean populations are not mate-limited, and limits to seed production may either be pollinator- or resource-dependent (Ray 2020).

Various floral visitors (potential pollinators) have been identified, including *Bombus* spp. (bumble bees), *Megachile sculpturalis* (giant resin bee), *M. campanulae* (bellflower resin bee), and *Hemaris thysbe* (hummingbird clearwing) (Campbell et al. 2016). Of note is *M. sculpturalis*, which is non-native to the U.S., originating in eastern Asia, but may provide pollination services to dozens of plant species in the U.S. (including *A. priceana*) and is generally considered a benign introduced species (Campbell et al. 2016; Stevens et al. 2019). Paris and Boyd (2018) found multiple bee species were equally effective pollinators for Price's potato-bean, indicating pollinator redundancy provides resilience from the species perspective (Senapathi et al. 2015). Considering reports of widespread declines in North American bumblebee populations (e.g., Cameron et al. 2011), reliance of Price's potato-bean upon a suite of pollinating bees might buffer potential impacts of individual bumblebee population declines. However, the bee fauna Price's potato-bean relies on may need additional conservation consideration to sustain adequate pollination services (Paris and Boyd 2018). Additionally, loss of pollination services by native bees may be offset somewhat by non-native bees, such as *M. sculpturalis* (Campbell et al. 2016),

although the effectiveness of such non-native species as pollinators of Price's potato-bean is unknown.

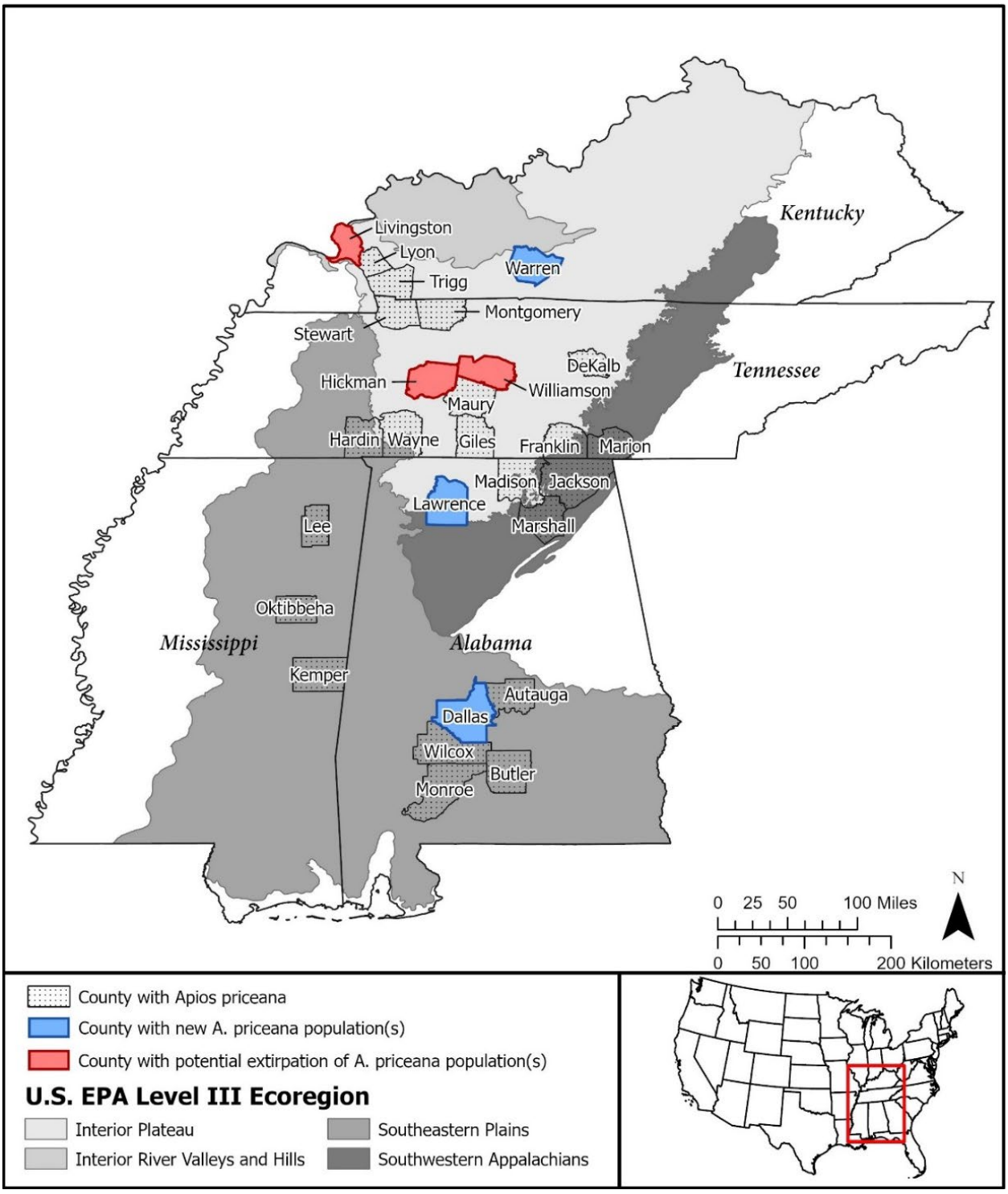

Figure 1. Price's potato-bean range by county occurrence.

Table 2. Price's potato-bean populations on protected lands.

State	County	Site (EO Number)	Ownership	2016 5-year Review	Last Observation
Alabama	Autauga	Jones Bluff (6)	COE	21 vines – 2010	>30 vines – 2020
Alabama	Dallas	Old Cahawba Prairie Tract (22)	ADCNR	Estimate not provided – 2014	Estimate not provided – 2014
Alabama	Dallas	Pine Barren Creek Tract (n/a)	ADCNR	-	20 vines, 2 flowering – 2021
Alabama	Jackson	Little Coon Creek (8)	ADCNR	5 vines – 2012	5 vines – 2012
Alabama	Jackson	Sauta Cave (13)	FWS	152 vines – 2011	172 vines – 2017
Alabama	Lawrence	Bankhead NF – Gillespie Creek (10)	FS	-	12 vines (estimate) – 2022
Alabama	Lawrence	Bankhead NF (n/a)	FS	-	24 vines (estimate) – 2022
Alabama	Madison	Blevins Gap (11)	ADCNR, LTNA	32 vines – 2011	32 vines – 2011
Alabama	Madison	Monte Sano State Park (19)	ADCNR	27 vines – 2011	27 vines – 2011
Alabama	Madison	Redstone Arsenal (7)	DoD	2158 vines – 2011	>1000 vines – 2019
Alabama	Madison	Rainbow Mountain (20)	LTNA	42 vines – 2011	42 vines – 2011
Alabama	Madison	Hale Mountain (16)	ADCNR	6 vines – 2011	6 vines – 2011
Kentucky	Livingston	Corley Farm (12)	Private	4 vines – 2014	0 vines – 2021 (presumed extirpated)
Kentucky	Livingston	Livingston Co. WMA (13)	Livingston Co.	41 vines – 2013	196 vines, 288 flowers – 2021
Kentucky	Lyon	Mammoth Furnace (15)	FS	9 vines, 7 flowers, 1 legume – 2014	13 vines, 63 flowers, 29 legumes – 2021
Kentucky	Lyon	Pisgah Bay (16)	FS	3 vines – 2011	1 vine – 2021
Kentucky	Trigg	Hematite Lake (3)	FS	23 vines, 401 flowers – 2014	197 vines, 1072 flowers, 449 legumes – 2021
Kentucky	Trigg	Laura Furnace (5)	FS	42 vines, 611 flowers, 53 legumes – 2014	>212 vines, 2136 flowers, 775 legumes – 2021
Mississippi	Lee	Coonewah (n/a)	AC, NMLT	>500 vines – 2012	>1000 vines – 2021
Mississippi	Lee	Natchez Trace (n/a)	NPS	53 vines – 2014	53 vines – 2016
Tennessee	DeKalb	Center Hill Bluffs (5)	COE	44 vines, 5 flowering – 2011	79 vines, 12 flowering – 2017
Tennessee	Franklin	Bear Hollow Mtn. WMA (36)	TWRA	100s of vines – 2012	376 vines – 2015
Tennessee	Franklin	Bear Hollow Mtn. WMA (37)	TWRA	1 vine – 2011	1 vine – 2011
Tennessee	Hardin	Ross Forest SNA (32)	Private	10 vines – 2014	21 vines – 2021
Tennessee	Montgomery	Barnett's Woods SNA (2)	TDEC	96 vines, 17 flowering – 2011	79 vines, 15 flowering – 2021
Tennessee	Stewart	Neville Creek (17)	FS	48 vines, 14 flowers – 2014	40 vines, 18 flowers – 2021
Tennessee	Stewart	Ft. Donelson NB (24)	NPS	16 vines – 2010	7 vines – 2021

Notes: Acronyms – AC = Archaeological Conservancy; ADCNR = Alabama Department of Conservation and Natural Resources; COE = U.S. Army Corps of Engineers; DoD = U.S. Department of Defense; FS = U.S. Forest Service; FWS = U.S. Fish and Wildlife Service; LTNA = Land Trust of North Alabama; NB = National Battlefield; NF = National Forest; NMLT = North Mississippi Land Trust; NPS = U.S. National Park Service; SNA = State Natural Area; TDEC = Tennessee Department of Environment and Conservation; TWRA = Tennessee Wildlife Resources Agency; WMA = Wildlife Management Area. Sources – Boyd 2014; Chowdhury 2020; Schotz 2018; TDEC 2022; ANHP 2022; KSNPC 2022; A. Cochran pers. comm. 2022; A. Schotz pers. comm. 2021.

Threats (Five-Factor Analysis) Summary

A detailed review of the species' threats can be found in the 2016 Price's potato-bean 5-year review (Service 2016). The status of a species is determined from an assessment of factors specified in section 4(a)(1) of the Act.

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

Incompatible logging (i.e., clearcutting or heavy logging), excessive shading by canopy trees, right-of-way maintenance for roads and utilities (mowing, landslides, etc.), and competition with non-native, invasive plants remain ongoing, severe, and occur throughout the species range, and we expect these to persist in the future. Furthermore, additional threats have emerged affecting several populations across the species' range.

Foremost, we have identified feral hogs (*Sus scrofa*) as a potential new threat to the species. Noted to be among the most destructive exotic vertebrates established in the Southeast, feral hogs severely damage a variety of habitats and sensitive ecological communities, including those containing federally listed species (Lewis et al. 2019; Fern et al. 2020; Glow et al. 2020). Extensive feral hog damage has been observed across Bankhead National Forest, Alabama, where three protected Price's potato-bean sites occur (A. Cochran pers. comm. 2022). While there is no known record of direct damage to Price's potato-bean plants therein, as feral hog numbers increase, direct impacts to the species are anticipated, which necessitates additional research to assess their impacts on Price's potato-bean populations and habitats.

In addition, we have identified herbicide overspray from agricultural fields as another emerging threat. Overspray has been observed near a protected population in Tennessee, but is most notable in Mississippi, where three of four known Price's potato-bean populations occur on property adjacent to cropland (MNHP 2022). Most recently, the Chickasaw Preserve (part of the larger Coonewah population and one of Mississippi's two protected populations) sustained substantial herbicide damage due to its proximity to neighboring soybean fields (J. Franklin pers. comm. 2022). While seed set is expected to be reduced or eliminated for the year because of exposure, uncertainty remains regarding the extent, severity, and precise impacts of how Price's potato-bean individuals will be affected by herbicide activity for agricultural purposes; therefore, more directed assessments are required (J. Franklin pers. comm. 2022).

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

Currently not considered a threat to the species.

Factor C. Disease or predation

The 2016 5-year review for Price's potato-bean posited that herbivory by the bean leaf beetle (*Certoma trifurcate*) in some Alabama populations may be an emerging threat to the species (Service 2016). The presence and level of this threat is still being evaluated. Recent observations indicate the ongoing presence of insect herbivory at various sites across the species' range. At Sauta Cave National Wildlife Refuge, Alabama, for example, internal staff reports indicate the presence of herbivory (Gates 2017; Gates 2019). Evidence of herbivory has also been observed in 2019 and 2021 in Tennessee populations, with one case suggesting that snails may be responsible for small holes in Price's potato-bean leaves. Another noted that a Japanese beetle (*Popillia japonica*) was seen eating the flower (TDEC 2022). In 2021, a Kentucky population

exhibited many aborted flower buds with piercing damage and holes in leaves, indicative of insect herbivory (KSNPC 2022). While not yet recorded for Price's potato-bean, some *Apios* pollinators (i.e., *Megachile sculpturalis*) have been observed to leave permanent puncture marks on flower petals, which could deter pollinator visitation and thus reproductive output (fruit and seed set) (Cardel and Koptur 2010; Stevens et al. 2019). More evaluation is required to determine level of threat destructive insect activity might pose to the species. We have no evidence that disease currently poses a threat to Price's potato-bean populations.

Factor D. Inadequacy of existing regulatory mechanisms

We have no indication that inadequacy of existing regulatory mechanisms poses a significant threat for the species.

Factor E. Other natural or manmade factors affecting its continued existence

The 1993 recovery plan for Price's potato-bean discussed threats related to small population size and apparent low reproductive vigor, including potential for diminished genetic variation within the species (Service 1993). The 2016 5-year review for Price's potato-bean further postulated that there is evidence of insufficient seedling recruitment into larger size classes capable of reproduction, which contributes to overall poor reproductive vigor (Service 2016). Both of these threats are still a concern for the species.

Climate Change

First proposed as an emerging issue in the 2016 5-year review, the threat of climate change has been intensifying in recent years and is now considered a major driver limiting species viability (Service 2016). Climate change has the potential to affect distribution and abundance of plants by influencing seasonal weather patterns, frequency and timing of severe weather events, species interactions, and myriad plant physiological responses (Hawkins et al. 2008). The predicted increase in drought frequency, intensity, and duration could adversely affect the habitats inhabited by Price's potato-bean by reducing soil moisture and increasing plant mortality rates or reducing flowering and seed production rates. A positive effect of increased drought could result from increased mortality of woody vegetation and reduced rates of vegetation succession. Climate change may also disrupt plant-pollinator interactions via phenological shifts in flowering and/or pollinator activity (Hawkins et al. 2008; Hegland et al. 2009), which may thereby reduce sexual reproduction of Price's potato-bean. However, while climate has changed in recent decades in the region where Price's potato-bean occurs and the rate of change is expected to continue increasing for the foreseeable future, uncertainty remains regarding the extent, severity, and precise impacts of how Price's potato-bean's habitats and its interspecific interactions will be affected by these changes and how the species will respond to these changes.

Although the species is presumed extirpated from Illinois, Baty et al.'s (2015) vulnerability assessment in Illinois concluded that Price's potato-bean is "extremely vulnerable" to potential climate change due in large part to the species' presumed inability to cross anthropogenic barriers (e.g., large areas of intensive urban or agricultural development), limited dispersal abilities, and historical hydrological niche, although other factors also influenced this assessment. In contrast, in Tennessee's vulnerability assessment (prepared for the Tennessee Wildlife Resources Agency), Glick et al. (2015) ranked the species as "presumed stable" under climate change scenarios included in the assessment. Alabama Natural Heritage Program has

noted the prevailing drought conditions across the Southeast and their potentially limiting influence on Price's potato-bean reproduction (ANHP 2022).

Synthesis

Price's potato-bean is a twining, herbaceous perennial vine in the pea family (Fabaceae) endemic to the southeastern United States (Alabama, Kentucky, Mississippi, Tennessee; and historically occurred in southern Illinois). It is often found in open, low areas near streams or along the banks of streams and rivers. There are now 57 extant populations distributed among 27 counties in 4 states. The species continues to have a limited distribution with isolated populations. Threats to the species—excessive shading by canopy trees and competing ground cover, right-of-way maintenance for roads and utilities, competition with exotic, invasive plants, insect herbivory, and climate change—still overwhelmingly affect many populations. While none of the 27 protected populations are necessarily subject to all of the above threats, insect herbivory and competition via invasive species continue to be ubiquitous, adverse influences. Furthermore, emerging threats—from feral hogs and herbicide overspray—have been observed near or directly impacting three protected Alabama populations, one protected Tennessee population, and three of the four Mississippi populations, two of which are protected. Only 22 of the 57 currently extant populations are known to be adequately protected and all populations continue to require monitoring to ensure they meet the 10-year maintenance recovery criterion. Based on the best available information, Price's potato-bean still meets the definition of a threatened species.

RECOMMENDED FUTURE ACTIVITIES

A detailed discussion of recovery criteria and actions is presented in the species' recovery plan (Service 1993). In conducting this status review new and/or targeted potential recovery activities were identified and are included below.

These actions are recommended to support and promote recovery of Price's potato-bean. Use of a numbered list for these recommendations is for convenient reference only and does not necessarily imply prioritization of any activity over others.

Recovery Activities

1. Continue efforts to work with local governments and highway officials to reduce threats associated with roadside maintenance, including installing signage, training staff and contractors on appropriate management techniques and avoidance measures, and establishing cooperative agreements, when possible.
2. Continue management at Land Between the Lakes National Recreation Area and Sauta Cave National Wildlife Refuge to reduce canopy cover and invasive species encroachment and promote flowering, seed production, and population growth. Encourage similar management efforts at other protected sites.
3. Work cooperatively with the National Park Service and U.S. Forest Service to develop conservation strategies for populations at Fort Donelson National Battlefield in Tennessee, Natchez Trace National Parkway in Mississippi, and Bankhead National Forest in Alabama.
4. Collaborate with State and Federal agencies to initiate and perform feral hog eradication and control efforts across the range of Price's potato-bean.

5. Work with landowners of protected sites to develop conservation agreements that establish biological goals for Price's potato-bean, identify management strategies to achieve those goals, and include a monitoring plan for measuring effectiveness of conservation efforts as related to the species' status.
6. Work cooperatively with the Chickasaw Nation to develop strategies for expanding populations at Chickasaw Preserve in Mississippi, while also increasing protections for the existing population.
7. Ensure that *ex situ* accession information and propagation protocols are maintained and curated in the Center for Plant Conservation National Collection of Endangered Plants centralized database.

Monitoring and Research Activities

1. Work with state Natural Heritage Programs, National Park Service, U.S. Forest Service, National Wildlife Refuges, and other partners to establish a consistent range wide monitoring program.
2. Coordinate with the National Park Service, Mississippi Natural Heritage Program, and other partners to identify suitable outplanting strategies and locations at Natchez Trace Parkway in Mississippi.
3. Build on earlier experimental studies that examine the species habitat needs to develop/improve management protocols that bolster population size and fitness. Future work should include design of experiments to examine the response of natural or experimental populations to fire, canopy thinning, herbicide application, and other management tools, as well as to emerging threats.

RESULTS / SIGNATURES

U.S. Fish and Wildlife Service
5-Year Review of Price's Potato-bean (*Apios priceana*)

Status Recommendation:

On the basis of this review, we recommend the following status for this species. A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the Act.

____ Uplist to Endangered
____ Delist:
____ *The species is extinct*
____ *The species does not meet the definition of an endangered or threatened species*
____ *The listed entity does not meet the statutory definition of a species*
__X__ No change needed

FIELD OFFICE APPROVAL:

Field Supervisor, Mississippi Ecological Services Field Office, Fish and Wildlife Service

JAMES AUSTIN Digitally signed by JAMES AUSTIN
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Approve _____

COOPERATING REGIONAL OFFICE APPROVAL:

We emailed this 5-year review to the Bloomington, Minnesota, Regional Office for their concurrence prior to finalizing the document. We will retain any comments that we received, as well as verification of concurrence from other regions, in the administrative record for this 5-year review.

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