Kentucky Glade Cress
(*Leavenworthia exigua* var. *laciniata*)

5-Year Status Review:
Summary and Evaluation

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

September 2025

5-YEAR STATUS REVIEW

Kentucky glade cress (*Leavenworthia exigua* var. *laciniata*)

GENERAL INFORMATION

Current Classification: Threatened

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Reviewers:

Lead Regional Office: Southeast Region, Carrie Straight, carrie_straight@fws.gov, 404-679-7226

Date of original listing: May 6, 2014 (79 FR 2563; May 6, 2014)

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 best available information about the biology, habitat, and threats of the Kentucky glade cress (*Leavenworthia exigua* var. *laciniata*) to inform this status review.

We announced initiation of this review in the Federal Register on June 6, 2024 (89 FR 48437), with a 60-day comment period. No public comments were received. The primary sources of information used in this analysis were the 2014 final listing rule (79 FR 2563), 2020 Species Status Assessment Report (Service 2020a), 2020 five-year review (Service 2020b), 2022 recovery plan (Service 2022), peer-reviewed reports, agency reports, unpublished survey data and reports, and personal communications with recognized experts. This review was completed by the U.S. Fish and Wildlife Service, Kentucky Ecological Services Field Office, Frankfort, Kentucky. All literature and documents used for this review are on file at the Field Office. All recommendations resulting from this review are the result of thoroughly reviewing the best available information on the Kentucky glade cress.

FR Notice citation announcing the species is under active review: June 6, 2024 (89 FR 48437.

Species' Recovery Priority Number at start of 5-year review (48 FR 43098): 9. This number indicates that Kentucky glade cress is a subspecies with a moderate degree of threat and a high recovery potential.

Review History:

Five-Year Review: A five-year review was completed on September 3, 2020 (Service 2020b). In this review, the Service evaluated recovery progress, summarized the species' biology and status, and described the species' current threats. The review recommended no change in status for the species.

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature

In his monograph on the genus Leavenworthia, Rollins (1936) described the Kentucky glade cress as a new variety of *Leavenworthia exigua*. The taxon was subsequently recognized as a distinct variety by Kral (1983), Kartesz (1991), and Weakley (2012). Al-Shehbaz and Beck (2010) did not recognize Kentucky glade cress as a distinct taxon, or any other infraspecific *L. exigua* taxon, because of the subtle morphological differences between the three varieties of *Leavenworthia*. Based on new genetic analyses, Edwards (2018) suggested that Kentucky glade cress may warrant recognition as a unique species. Any uncertainty regarding the Kentucky glade cress' nomenclature does not affect our assessment of the listed entity (*e.g.*, does not change its distribution, biology, life history, or threats), and the taxon is still considered a valid entity by the Service. Until the Kentucky glade cress' taxonomy is resolved, we will continue to reference it using the name under which it was listed.

Distinct Population Segment (DPS)

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 not a vertebrate, the DPS policy does not apply.

Recovery Criteria

Recovery Plan or Outline:

Final Recovery Plan for the Kentucky glade cress (*Leavenworthia exigua* var. *laciniata*), March 31, 2022 (Service 2022)

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 protection 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). Delisting criteria are listed below (Service 2022).

Delisting Criteria.

Criterion 1. At least 40 Kentucky Glade Cress populations[1], distributed across its range, exhibit a stable or increasing trend over 10 years of monitoring (Factors A and E).

Criterion 2. At least 20 populations from Criterion 1 occur on natural or restored high-quality glade habitat and have 1,000 or more plants during 5 of the past 10 years of monitoring.

Criterion 3. All populations in Criterion 1 are permanently protected and managed under an agreement such that threats are abated to the extent to ensure population viability for the foreseeable future.

The Service believes these criteria are appropriate and relevant; however, no criteria have currently been met.

Biology and Habitat

For details on the species' biology, habitat, and life history, please see the species' final recovery plan (Service 2022), the species' 2020 species status assessment (Service 2020a), and the references therein.

Distribution and Abundance

Kentucky glade cress is endemic to northeastern Bullitt County and southeastern Jefferson County, Kentucky, where it occurs in cedar glades and glade-like habitats. Based on current monitoring and distributional data compiled by the Office of Kentucky Nature Preserves (OKNP 2025), the taxon is known from 84 extant occurrences (populations). This total includes 4 A-rank populations (excellent resiliency), 5 B-rank populations (good resiliency), 34 C-rank populations (fair resiliency), and 41 D-rank populations (poor resiliency) (Table 1). Compared to the previous five-year review, the number of extant populations increased by seven. Since 2020, OKNP personnel rediscovered four previously known occurrences (EOs 31, 33, 40, 53), and survey efforts by OKNP and Resource Environmental Solutions LLC resulted in discovery of three new occurrences in Bullitt and Jefferson counties (EOs 98-100). The number of A-rank occurrences increased by 1, the number of B-rank occurrences increased by 1, and the number of C-rank occurrences increased by 12 (see Table A-1 in Appendix A for a description of resiliency ranks).

Table 1. Summary of Kentucky glade cress occurrences (2020-2025)[1].

Resiliency Rank	2020	2025
A - Excellent	3	4
B - Good	4	5
C - Fair	22	34
D - Poor	48	41
Total	**77**	**84**

[1]Occurrence data provided by OKNP.

[1]Populations are equivalent to element occurrences (EO) delineated by OKNP for the Natural Heritage Program and listed in the Kentucky glade cress SSA (Service 2020a).

Threats (Five-Factor Analysis) Summary

As specified in section 4 (a)(1) of the Act, a species' status must be determined through consideration of the following five factors:

A. present or threatened destruction, modification, or curtailment of its habitat or range;
B. over-utilization of the species for commercial, recreational, scientific, or educational purposes;
C. disease or predation;
D. inadequacy of existing regulatory mechanisms; and
E. other natural or manmade factors affecting its continued existence.

The species continues to be threatened by habitat destruction and disturbance associated with residential, commercial, and industrial development; off-road vehicle use; horseback riding (trampling); and forest encroachment (Factor A). Urban development continues throughout the species' range as the Louisville metropolitan area continues to expand to the south. Since listing, at least four development projects (two road alignments and two residential developments) have destroyed portions of populations.

Most Kentucky glade cress occurrences are in private ownership and receive no protection under federal or state law. The few occurrences in public ownership and several others protected through conservation agreements have greater protection from habitat loss and degradation (see Appendix A, Table A-2). The Nature Conservancy owns and manages Pine Creek Barrens Nature Preserve in Bullitt County, and OKNP owns and manages two nature preserves (EOs 57 and 98) in Bullitt and Jefferson counties. The Pennsylvania Run properties (EOs 43 and 68) were purchased by Kentucky Natural Lands Trust to offset negative effects to the species from a highway widening project; the site is managed with assistance from OKNP (OKNP 2025). Multiple occurrences (*e.g.*, EO37 and EO80) are now managed and protected as part of the Parklands at Floyds Fork, a linear public park system developed along the Floyds Fork corridor in Bullitt and Jefferson counties and managed by 21st Century Parks and Future Fund Land Trust. Rocky Run Glade is the only privately owned occurrence of Kentucky glade cress to have Registered Natural Area (RNA) status; however, multiple other private properties containing Kentucky glade cress are in the process of becoming RNAs. RNA status gives recognition to a landowner's ecological stewardship but does not afford any regulatory protections to the property.

The species is not overutilized for commercial, recreational, scientific, or educational purposes (Factor B), and we have no information indicating overutilization is likely to become a future threat. Disease or predation are not considered to be factors in the decline of the Kentucky glade cress (Factor C), and we have no information indicating that these factors are likely to become a threat in the future.

The Office of Kentucky Nature Preserves lists Kentucky glade cress as endangered (OKNP 2019) under the Kentucky Rare Plants Recognition Act (KRS 146:600–619). The statute recognizes the need to develop and maintain information regarding distribution, population, habitat needs, limiting factors, other biological data, and requirements for the survival of plants native to Kentucky; however, the statute does not include any regulatory prohibitions of

activities or direct protections for any species included in the list, and expressly states that the list of threatened or endangered plants shall not obstruct or hinder any development or use of public or private land (Factor D).

With respect to natural or manmade factors affecting the Kentucky glade cress' existence (Factor E), the taxon's inherently narrow range puts it at a higher risk of extinction from natural or anthropogenic events. This lack of redundancy across a large area means that certain events could affect the entire range of the species. For example, a series of drought years could reduce the taxon's reproductive capacity by reducing seed production and depleting the soil seed bank. The taxon's entire range is south of and immediately adjacent to a rapidly expanding urban area.

Small populations are vulnerable to extirpation from single adverse natural or manmade events. Small population size was considered a threat at the time of listing when 33 of the 61 extant occurrences (54 percent) had 100 or fewer individuals. Currently, 16 of the 84 extant occurrences (19 percent) are estimated to have 100 or fewer individuals. This does not necessarily indicate an improvement in status, because population sizes of annual plants, such as the Kentucky glade cress, can vary greatly from year to year. Thus, patch size may be a better indicator of a Kentucky glade cress population's vulnerability to extirpation. The very specific habitat requirements of Kentucky glade cress results in populations composed of scattered patches confined to very small areas. Activities like herbicide application, development, or shading and leaf litter accumulation from forest encroachment could eliminate a patch or an entire population.

The genetic diversity of the Kentucky glade cress appears to be inherently low (Edwards 2018). This low representation, along with its poor dispersal ability, limits the Kentucky glade cress' ability to adapt to changing environmental conditions. Compared to sexually reproducing species, adaptation is slow in asexual species with no genetic recombination (Edwards 2018). Adaptation in asexual species occurs through recent somatic mutations (genetic alterations in cells of the body that are not passed on to offspring), most of which are not expected to be beneficial (Orr 2010).

In its Sixth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) concluded that warming of the climate system is unequivocal (IPCC 2023). The climate in the southeastern United States has warmed about 2 degrees Fahrenheit (1.1 degrees Celsius) from a cool period in the 1960s and 1970s and is expected to continue to rise by 4-8 degrees Fahrenheit (2.2-4.4 degrees Celsius) by 2100 (Kaushal *et al.* 2010). In Kentucky, average annual rainfall is increasing (EPA 2016), with more frequent flooding and longer and more severe droughts.

Taxa like the Kentucky glade cress that are dependent on specialized habitat types (*e.g.*, glades) or limited in distribution may be the most susceptible to the effects of climate change (Byers and Norris 2011, Anacker *et al*. 2013). There is evidence that some terrestrial plant populations have been able to adapt and respond to changing climatic conditions (Franks *et al*. 2014); both plastic (phenotypic change such as leaf size or phenology) and evolutionary (shift in allelic frequencies) responses to changes in climate have been detected. Evolutionary changes are unlikely to be options for Kentucky glade cress based on its very low levels of genetic variation. Given enough time, some plant species may alter their ranges, resulting in range shifts, reductions, or increases (Kelly and Goulden 2008, Loarie *et al*. 2008). The habitat specialization and limited seed dispersal of Kentucky glade cress make it unlikely that it will be able to shift its range. A

NatureServe climate change vulnerability assessment ranked the species as extremely vulnerable to climate change (with very high confidence) due to its limited habitat and poor dispersal ability (Young *et. al.* 2015).

Synthesis

The Kentucky glade cress is an annual herb that grows in cedar glades or glade-like areas in southeastern Jefferson and northeastern Bullitt counties, Kentucky. The taxon's current range includes a total of 84 extant populations, and over 89 percent of these populations are estimated to have fair (34 occurrences) or poor (41 occurrences) resiliency.

Kentucky glade cress populations continue to be threatened by destruction/modification of habitat and range curtailment (Factors A and D), most of which is associated with rapidly expanding residential, commercial, and industrial development south of Louisville. The patchy distribution of Kentucky glade cress in small areas of suitable habitat makes it vulnerable to local extirpations. Recent genetics research has shown that the taxon has extremely low genetic diversity, which lowers its adaptive capacity for changing environmental conditions (Factor E). Changes in precipitation and temperature have the potential to adversely affect the Kentucky glade cress due to its small range, specialized habitats, and limited dispersal ability.

At the time of listing, this taxon had a moderate degree of threat and a high recovery potential, resulting in a recovery priority number of 9. At present, the Service has no additional information to suggest that the degree of threat or the recovery potential has changed. Therefore, we believe the recovery priority number for Kentucky glade cress should remain at 9 (moderate threat, high recovery potential, subspecies level taxonomy).

Delisting criteria have not been met for this species. Long-term management and protection have not been achieved for a sufficient number of occurrences, and populations in private ownership continue to be threatened by development. Because of the restricted distribution of the species, extirpation of some occurrences, continued moderate to high magnitude threats from development, and lack of progress toward achievement of recovery criteria, the Kentucky glade cress continues to meet the definition of a threatened species.

RECOMMENDED FUTURE ACTIVITIES

Recovery Activities

- Continue management actions for permanently protected occurrences owned and managed by OKNP (Table A-2)
- Continue management actions for privately-owned occurrences listed in Table A-2; provide technical assistance to landowners through conservation programs administered by the Kentucky Department of Fish and Wildlife Resources (Private Lands program), Natural Resources Conservation Service, OKNP, and the Service (Partners for Fish and Wildlife program).
- Secure permanent protection for a minimum of two privately-owned occurrences through conservation agreements or land acquisition using multiple funding sources (*e.g.*,

Heritage Land Conservation Fund, Land and Water Conservation Fund, Recovery Land Acquisition funds)
- Improve resiliency (rank) for two extant occurrences through habitat management and/or augmentation
- Acquire currently unoccupied, suitable habitat where the species can be introduced and managed in perpetuity; establish a minimum of two new occurrences in these habitats through cooperative efforts of the Kentucky Department of Fish and Wildlife Resources (Private Lands program), Natural Resources Conservation Service, OKNP, and the Service (Partners for Fish and Wildlife program).

Monitoring and Research Activities

- Increase survey efforts for new populations in high quality habitat
- Continue to investigate the life history and ecological requirements of the species (*e.g.*, seedling establishment, seed, and pollen dispersal)

REFERENCES

Al-Shehbaz, I.A., and J.B. Beck. 2010. Leavenworthia. Flora of North America north of Mexico, 7, 485-489.

Anacker, B.L., M. Gogol-Prokurat, K. Leidholm, and S. Schoenig. 2013. Climate change vulnerability assessment of rare plants in California. Madroño, 60:193-210.

Byers, E. and S. Norris. 2011. Climate change vulnerability assessment of species of concern in West Virginia. West Virginia Division of Natural Resources, Elkins, West Virginia.

Edwards, C. 2018. Final report for Range-wide conservation genetics of Kentucky glade cress (*Leavenworthia exigua* var. *laciniata*). Kentucky Glade Cress Project MOU between Missouri Botanical Garden, U.S. Fish and Wildlife Service, Kentucky Natural Lands Trust. 34 pp.

Franks, S.J., J.J. Weber, and S.N. Aitken. 2014. Evolutionary and plastic responses to climate change in terrestrial plant populations. Evolutionary Applications 7:123-139.

Intergovernmental Panel on Climate Change (IPCC). 2023. Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001.

Kaushal, S.S., G.E. Likens, N.A. Jaworski, M.L. Pace, A.M. Sides, D. Seekell, K.T. Belt, D.H. Secor, and R.L. Wingate. 2010. Rising stream and river temperatures in the United States. Frontiers in Ecology and the Environment 8:461-6.

Kartesz, J.T. 1991. Synonymized checklist of the vascular flora of the United States. Biota of North America Program, North Carolina Botanical Garden, University of North Carolina at Chapel Hill.

Kelly, A. and M. Goulden. 2008. Rapid shifts in plant distribution with recent climate change. Proceedings of the National Academy of Sciences 105:11823-11826.

Kral, R. 1983. A report on some rare, threatened, or endangered forest-related vascular plants of the south, Volume I Isoetaceae through Euphorbiaceae. U.S. Dept. Agric., Forest Service, Southern Region, Technical Publication RP-TP 2, Atlanta, Georgia.

Loarie, S., B. Carter, K. Hayhoe, S. McMahon, R. Moe, C. Knight, and D. Ackerly. 2008. Climate change and the future of California's endemic flora. PloS one 3: e2502.

Office of Kentucky Nature Preserves (OKNP). 2025. Element Occurrence Record for *Leavenworthia exigua* var. *laciniata*. Frankfort, Kentucky. Printed 28 August 2025.

Office of Kentucky Nature Preserves (OKNP). 2019. Endangered, Threatened, and Special Concern Plants, Animals, and Natural Communities of Kentucky. Updated July 2019.

Orr, H.A. 2010. The population genetics of beneficial mutations. Philosophical Transactions of the Royal Society B 365: 1195-1201.

Rollins, R.C. 1963. The evolution and systematics of *Leavenworthia* (Cruciferae). Contributions from the Gray Herbarium of Harvard University No. CXCII, Cambridge, Massachusetts.

United States Environmental Protection Agency (EPA). 2016. What climate change means for Kentucky. EPA 430-F-16-019. 2 pp.

U.S. Fish and Wildlife Service (Service). 2014. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for Leavenworthia exigua var. laciniata (Kentucky Glade Cress) 79: 25683.

U.S. Fish and Wildlife Service (Service). 2020a. Species status assessment report for the Kentucky Glade Cress (*Leavenworthia exigua* var. *laciniata*), Version 1.0. Atlanta, Georgia. 110 pp.

U.S. Fish and Wildlife Service (Service). 2020b. Kentucky glade cress (*Leavenworthia exigua* var. *laciniata*) 5-year review: summary and evaluation. Atlanta, Georgia. 13 pp.

U.S. Fish and Wildlife Service (Service). 2022. Final recovery plan for the Kentucky glade cress (*Leavenworthia exigua* var. *laciniata*). Atlanta, Georgia. 6 pp.

Weakley, A.S. 2012. Flora of the Southern and Mid-Atlantic States. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina at Chapel Hill.

Young B.E., E. Byers, G. Hammerson, A. Frances, L. Oliver, and A. Treher. 2015. Guidelines for using the NatureServe Climate Change Vulnerability Index Release 3.0. Arlington, VA: NatureServe.

RESULTS / SIGNATURES

U.S. Fish and Wildlife Service
Status Review of Kentucky glade cress

Status Recommendation:

Based on 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.

____ Downlist to Threatened
____ 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:

acting **Field Supervisor, Kentucky Ecological Services Field Office, U.S. Fish and Wildlife Service** JOSHUA LILLPOP Digitally signed by JOSHUA LILLPOP Date: 2025.09.23 15:10:14 -04'00'

Approve _____

* Since 2014, Field Supervisors in the Region have been delegated authority to approve 5-year reviews that do not recommend a status change.

APPENDIX A – SUPPORTING INFORMATION

Table A-1. Element occurrence rank descriptions for Kentucky glade cress (Service 2020a).

EO Rank/Resiliency	Description
A – excellent resiliency	2,500 or more plants, at least 10 acres of high-quality habitat (A rank).
B – good resiliency	100 to 2,500 plants in high quality habitat OR greater than 2,500 plants in habitat that is generally natural but may be degraded (B or AB rank).
C – fair resiliency	100 to 2,500 plants, habitat generally natural but may be somewhat degraded OR fewer than 100 plants in high quality habitat OR greater than 5,000 plants in highly degraded habitat (C or BC rank).
D – poor resiliency	Up to 5,000 plants in highly degraded habitat with non-native plants OR fewer than 100 plants in somewhat degraded but generally natural habitat (CD or D rank).

Table A-2. Kentucky glade cress occurrences in public ownership or protected through conservation agreements (OKNP 2025).

Site	Landowner	Current Resiliency Rank*	Most Recent Population Assessments (Year)
Pine Creek Barrens Nature Preserve (EO2)	The Nature Conservancy	A	1,798 plants (2024) 4,958 plants (2023) 3,376 plants (2022)
Apple Valley Glades State Nature Preserve (EO57)	Office of Kentucky Nature Preserves	A	1,756 plants (2024) 4,873 plants (2023 4,040 plants 2022)
McNeely Lake Park (EO72)	Louisville Metro Parks and OKNP conservation easement	B	4,868 plants (2024) 3,193 plants (2023) 2,974 plants (2022)
Pennsylvania Run 1 (EO43)	Kentucky Natural Lands Trust (potential for future transfer to OKNP)	C	213 plants (2025), augmented with seed in May 2025 31 plants (2022) 29 plants (2021)
Pennsylvania Run 2 (EO68)	Kentucky Natural Lands Trust (potential for future transfer to OKNP)	BC	500 plants (2022) 250+ plants (2021) 200+ plants (2017)
Parklands at Floyds Fork (EO80) – formerly Floyds Fork area (2)	Future Fund Land Trust and 21st Century Parks	C	1000s of plants (2025) 1000s of plants (2016)
Blackacre State Nature Preserve (EO98)	Office of Kentucky Nature Preserves	C	400 plants (2024) 350 plants (2023) 400 plants (2021)
Old Mans Run – Floyds Fork (EO37)	Future Fund Land Trust and 21st Century Parks	BC	1,000s of plants (2025) 1,000s of plants (2021) 1,000s of plants (2018)

Site	Landowner	Current Resiliency Rank*	Most Recent Population Assessments (Year)
Rocky Run RNA (EO41)	Private, Registered Natural Area	A	5,498 plants (2022) 5,797 plants (2012)

*A = excellent, B = good, BC = good or fair, C = fair, and D = poor.
^This property is currently slated for development.