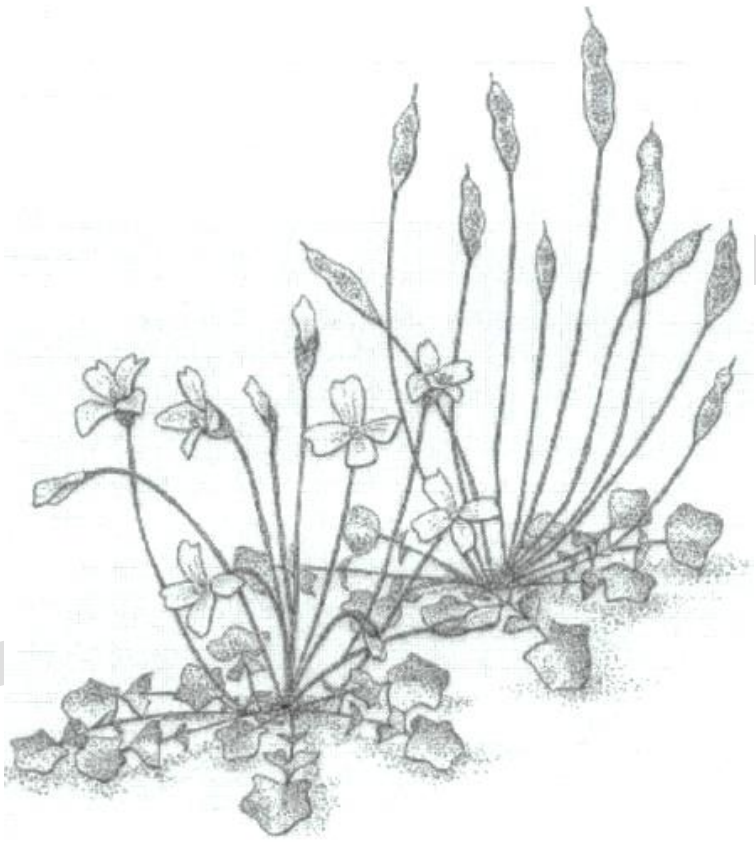
Draft Recovery Plan
for the

Kentucky Glade Cress

(*Leavenworthia exigua* var. *lacinata*)



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DISCLAIMER

Recovery plans delineate reasonable actions that are believed necessary to recover and/or protect the species. We, the U.S. Fish and Wildlife Service (Service), publish recovery plans, sometimes with the assistance of recovery teams, contractors, State agencies, and others. Plans are reviewed by the public and subject to additional peer review before they are adopted by the Service. Objectives of the recovery plan will be attained and funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not obligate other parties to undertake specific tasks. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the Service. They represent our official position only after they have been signed by the Director or Regional Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

By approving this document, the Regional Director certifies that the information used in its development represents the best scientific and commercial data available at the time it was written. Copies of all documents reviewed in development of the plan are available in the administrative record, located at the Service's Kentucky Ecological Services Field Office, Frankfort, Kentucky.

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Draft Recovery Plan for the Kentucky Glade Cress (*Leavenworthia exigua* var. *lacinata*)

This Recovery Plan describes criteria for determining when the Kentucky Glade Cress should be considered for delisting, lists site-specific actions that will be necessary to meet those criteria, and estimates the time required and costs for implementing actions necessary to achieve recovery. Additionally, cursory information on the species' biology and status are included, along with a brief discussion of factors limiting its populations. The Recovery Plan was informed by a Species Status Assessment (SSA), which provides a more detailed account of the species' status, distribution, biology, and threats. A Recovery Implementation Strategy (RIS) has also been developed; it is the operational document that details on-the-ground activities for implementing recovery actions. The RIS and SSA are finalized separately from the Recovery Plan and will be updated on a routine basis.

Species Status:

The Kentucky Glade Cress (*Leavenworthia exigua* var. *lacinata*) was federally listed as threatened on May 6, 2014 (79 FR 25683) under the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq*.) (Act). Critical Habitat was also designated for the species on May 6, 2014 (79 FR 25689). The Kentucky Glade Cress is assigned a recovery priority number of 9, which indicates the taxon faces a moderate degree of threat and a high recovery potential. Recovery potential is considered high because the biological and ecologically limiting factors for this species are relatively well understood. However, threats to the species' existence are primarily habitat related, and active management is needed to maintain populations. The species is listed as endangered by the Commonwealth of Kentucky.

Habitat Requirements and Limiting Factors:

Kentucky Glade Cress grows in shallow soils of cedar glades and glade-like areas underlain with Silurian dolomite or dolomitic limestone in portions of Bullitt and Jefferson counties, Kentucky. It can continue to persist for some time in glades that have been converted from their natural conditions to pastures, lawns, and roadsides. The areas that meet the specific habitat needs of the Kentucky Glade Cress are patchily distributed throughout its range. Kentucky glade cress' annual life cycle relies on a cyclic hydrologic regime involving saturation and/or inundation of habitat in the winter and early spring that quickly dries in the summer.

At the time of listing, the primary threats to Kentucky Glade Cress were associated with the destruction, modification, or curtailment of its habitat or range. Glade habitat throughout its range is threatened by urban development associated with the expanding Louisville Metropolitan Area. Placement of roads, utilities, and residential and commercial developments can destroy the habitat required by the taxon. Other consequences of development, such as lawns and landscaping, can render habitat unsuitable for the Kentucky Glade Cress and introduce weedy or invasive species that outcompete the taxon. Forest encroachment of glades results in shaded conditions and soil structures unsuitable for Kentucky Glade Cress.

Recovery Strategy

The recovery strategy for Kentucky Glade Cress is to ensure long-term viability of the taxon by protecting it from threats, especially threats associated with urban development occurring across its narrow range. Recovery of Kentucky Glade Cress is founded upon the ecological principles of resiliency, redundancy, and representation (Wolf et al. 2015). Currently, over half of the 77 known extant populations of the species are characterized by low quality habitat. Habitat improvements are necessary to increase populations' ability to withstand stochastic events (resiliency). Protecting multiple resilient populations is necessary to enable the taxon to withstand catastrophic events and reduce the risk of extinction (redundancy). Though its genetic diversity is inherently nearly nonexistent (Edwards 2018), phenotypic variation has been observed among Kentucky Glade Cress populations that may potentially influence its ability to withstand changing environmental conditions (representation) (Williams 2020, pers. comm.). Until we know enough about this variation to target conservation efforts, we should preserve many populations broadly across the range.

Conservation of Kentucky Glade Cress will focus primarily on protection and management of natural glade habitats where the species currently occurs, and may also include reintroductions. Because most of the known extant populations occur on private land, recovering Kentucky Glade Cress will require significant outreach and coordination to permanently protect and manage populations. Conservation efforts will focus on the 18 populations in areas designated as critical habitat, although the Service and its partners will take advantage of other opportunities that would benefit additional populations. Management of disturbance, invasive species, and forest encroachment will likely be required to maintain habitats long-term for the taxon. Coordination with our partners will be essential in our efforts to monitor populations and to coordinate with private landowners to protect, manage, and restore habitats for Kentucky Glade Cress.

Recovery Goal: The goal of this Recovery Plan is to ensure the long-term viability of Kentucky Glade Cress in the wild to the point that it can be removed from the Federal List of Endangered and Threatened Wildlife (50 CFR 17.11). This Recovery Plan establishes delisting criteria for the species. Criteria will be reevaluated as new information becomes available.

Recovery Criteria for Delisting

Criterion 1. At least forty (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 of the 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 of the 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.

[1] We define populations as equivalent to element occurrences (EO) delineated by OKNP for the Natural Heritage Program and listed in the SSA (Service 2020).

Justification for Recovery Criteria

The proposed recovery criteria reflect the best available and most recent information on the Kentucky Glade Cress. These criteria address the five factors described in section 4(a)(1) of the Act and incorporate the conservation principles of representation, resiliency, and redundancy (Wolf *et al*. 2015).

Criterion 1: Populations that exhibit a stable or increasing trend demonstrate that the population is secure and will be resilient to stochastic events. We believe that forty resilient populations will provide sufficient redundancy to withstand catastrophic impacts and provide sufficient representation by conserving any phenotypic and epigenetic variation that potentially exists between populations (Factors A and E).

Criterion 2: As an annual plant, Kentucky Glade Cress populations fluctuate in numbers of individuals in response to environmental conditions and are vulnerable to extirpation by stochastic events (Factor E). Populations of large numbers of individuals have more robust seed banks that increase the potential for annual regeneration. Populations that occur on natural or restored high-quality glade habitat experience fewer threats from invasive species relative to populations on more degraded habitats (Factor A).

Criterion 3: Kentucky Glade Cress requires a specific habitat type that is threatened by development. To ensure viability of the Kentucky Glade Cress, populations must be protected from habitat destruction and degradation and managed to maintain the glade habitat on which it depends (Factors A and D).

Actions Needed:

The recovery actions identified in the table below are those we believe are necessary to recover the Kentucky glade cress, based on the best available science.

Recovery Action	**Estimated Cost[1]**	**Priority[2]**
1. Permanently protect Kentucky Glade Cress populations and immediate surrounding habitat from destruction and degradation by development, with an emphasis on those in designated critical habitat and other areas of high-quality glade habitat.	$17,000,000	1
2. Conduct routine monitoring of Kentucky Glade Cress populations.	$100,000	1
3. Implement management activities to restore degraded glades and maintain high-quality glades that contain Kentucky Glade Cress populations.	$50,000	1
4. Encourage measures to avoid Kentucky Glade Cress patches in proposed developments.	-	1

5. Foster public appreciation for Kentucky Glade Cress and glade habitat through public outreach within and in the vicinity of its range.	$15,000	1
6. Research the biology of Kentucky Glade Cress.	$259,000	2
7. Reintroduce or introduce populations in suitable habitat within the taxon's range.	$10,000	3
Total Estimated Cost: $17,434,000		

[1] Costs covered under existing programs are not included in this table.

[2] Recovery actions are assigned numerical priorities to highlight the relative contribution they may make toward species recovery (48 FR 43098):

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 – An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 – All other actions necessary to provide for full recovery of the species.

***Estimated Cost of Delisting*:** The estimated costs associated with implementing recovery actions for delisting are $17,434,000. Some costs are not determinable at this time, and therefore the total cost of recovery may be higher than this estimate.

***Date of Recovery*:** If all actions are fully funded and implemented as outlined, including full cooperation of all partners needed to achieve recovery, we anticipate that recovery criteria for delisting could be met by 2040.

Literature Cited:

Edwards, C. 2018. Final report for Rangewide 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.

Williams, B. 2020. Email about phenotypic differences in Kentucky glade cress.

Wolf. S., B. Hartl, C. Carroll, M.C. Neel, and D.N. Greenwald. 2015. Beyond PVA: why recovery under the Endangered Species Act is more than population viability. BioScience 65:200-207.