Leafy Prairie-Clover
(*Dalea foliosa*)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Tennessee Ecological Services Field Office
Cookeville, Tennessee

June 2022

5-YEAR REVIEW

Leafy Prairie-Clover / *Dalea foliosa*

1.0 GENERAL INFORMATION

1.1 Methodology used to complete the review:

In conducting this 5-year review, we relied on the best available information pertaining to historic and current distributions, life history, and habitat of this species. Our sources include the final rule listing this species under the Endangered Species Act (Act); the recovery plan; unpublished field observations by the U.S. Fish and Wildlife Service (Service), U.S. Forest Service (USFS), State and other experienced biologists; unpublished survey reports; and notes and communications from other qualified biologists or experts. We published an announcement of this review in the *Federal Register* and requested information on this species on June 23, 2021 (86 FR 32965), and a 60-day comment period was opened. We received comments only from the Illinois Department of Natural Resources, reporting that the species has been listed as endangered by the State of Illinois since 1980 along with updated monitoring and distribution data for the species in Illinois. No part of this review was contracted to an outside party. This review was completed by the Service's lead recovery biologist in the Tennessee Ecological Services Field Office and a biologist from the Chicago, Illinois Ecological Services Field Office.

1.2 Reviewers

Lead Regional Office: South Atlantic-Gulf and Mississippi Basin Regions, Carrie Straight, 404-679-7226

Lead Field Office: Tennessee Ecological Services Field Office, Geoff Call, 931-525-4983

Cooperating Field Offices: Alabama Ecological Services Field Office, Erin Lentz, 251-298-3853; Chicago, Illinois Ecological Services Field Office, Cathy Pollack, 847-608-3101

Cooperating Regional Office: Great Lakes Region, Laura Ragan, 612-713-5157

1.3 Background

1.3.1 FR Notice citation announcing initiation of this review:

June 23, 2021; 86 FR 32965.

1.3.2 Listing history

Original Listing
FR notice: 56 FR 19953
Date listed: May 1, 1991
Entity listed: Species
Classification: Endangered

1.3.3 Associated rulemakings: N/A

1.3.4 Review History: June 4, 2015, 5-Year Review for Leafy Prairie-Clover; no change in status recommended.

1.3.5 Species' Recovery Priority Number at start of 5-year review: 5 (a species with a high degree of threat and low recovery potential)

1.3.6 Recovery Plan or Outline

Name of plan or outline: Recovery Plan for the Leafy Prairie-clover (*Dalea foliosa*)
Date issued: September 30, 1996

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

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 DPSs to only vertebrate species of fish and wildlife. Because the species under review is a plant, the DPS policy is not applicable.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? Yes

2.2.2 Adequacy of recovery criteria. The recovery criteria are adequate.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? Yes

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

2.2.3 List the recovery criteria as they appear in the recovery plan.

The reclassification and delisting criteria from the 1996 recovery plan are as follows (Service 1996):

> *Dalea foliosa* will be considered for reclassification from endangered to threatened when the first three of the following criteria have been met for a minimum of 5 years. Delisting the species will be considered when all four criteria have been met for 10 years.
>
> 1. A minimum of three populations ranked as high viability are protected and managed in Alabama.
> 2. A minimum of three populations ranked as high viability are protected and managed in Illinois.
> 3. A minimum of twelve populations ranked as high viability are protected and managed in Tennessee.
> 4. Restored populations persist at high or moderate viability for a minimum of 10 consecutive years.

None of the above criteria have been met.

The criteria listed above were based upon the population viability index (PVI) framework presented in the species recovery plan (Service 1996). The PVI relies upon several types of measurements to fully assess the viability of a population. These variables include population size, habitat size, the degree of disturbance and succession, the need for management, off-site threats, and whether the habitat has long-term protection. See Appendix 1 for a brief description of each of these variables that influence the viability of a *Dalea foliosa* population. The PVI is based on the rankings of these biological and habitat variables (Table 1). For each variable, a ranking from 0-3 (0-4 for population size) is assigned and the sum of all variable rankings is divided by 19 to produce an index ranging from 0-1. Where no data is available, the variable is not included in the viability assessment. Populations with an index greater than 0.75 have high viability, an index between 0.50 – 0.75 have moderate viability, and an index less than 0.50 have low viability. Under this index, population viability is determined using multiple factors, and gives a more accurate indication of a population's viability or likelihood of persisting.

In Alabama and Illinois, site locations of *Dalea foliosa* are mapped as distinct populations. The Tennessee Department of Environment and Conservation (TDEC) maps occurrences of *Dalea foliosa*, generally following NatureServe (2020) protocols, at discrete locations where the species is observed. However, many of these occurrences are separated from one another by less than one kilometer. Work is currently underway to analyze the genetic structure of mapped occurrences in Tennessee and, if warranted, aggregate closely related occurrences into populations. For the purpose of conducting PVIs (Appendix 2) and evaluating

the status of *Dalea foliosa* in Tennessee relative to recovery criteria, each mapped occurrence has been treated as a distinct population.

Table 1. Description and rankings of the criteria used to determine viability of extant leafy prairie-clover populations. PVI=the assigned values for (A+B+C+D+E+F)/19. Low population viability ≤.50 PVI, moderate viability >.50-.75 PVI, and high population viability >0.75 PVI.

Variable Rank	Population Size	Habitat Size	Degree of Disturbance and Succession	Management Needs	Offsite Threats	Protection Status
0	Seed bank or dormant plants only	Very small (≤ ha)	Very High (heavy/early successional)	High	High	Private; none
1	Small (≤ 100 plants or no flowering plants)	Small (>1 ha to ≤ 5 ha)	High (high/early successional)	Moderate	Moderae	Private, with informal agreement
2	Moderate (> 100 to ≤ 500 plants)	Moderate (> 5 ha to ≤ 20 ha)	Moderate (moderate/mid succession)	Low	Low	Public; not-for-profit or private conservation easement or landmark
3	Large (> 500 to ≤ 1000 plants)	Large (> 20 ha)	Low (low/stable and late succession)	Community maintenance	None	Public or private; State Nature Preserve
4	Very large (> 1,000 plants)	n/a	n/a	n/a	n/a	n/a

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

The Alabama Department of Conservation and Natural Resources recently sponsored a study to identify the insect pollinators of *Dalea foliosa* in the remaining two Alabama populations. Observations of its pollination ecology were also categorized with results forthcoming.

In Franklin County, Alabama the following insects were collected on *Dalea foliosa* flowers: *Megachile campanulae* (bellflower resin bee), *Megachile petulans* (petulant leaf cutter bee), *Megachile mendica* (leaf cutter bee), *Megachile brevis* (leaf cutter bee), *Anthidiellum notatum notatum* (no

common name), *Bombus pensylvanicus* (American bumble bee), Melissodes bimaculatus (two spotted long horn bee), *Lasioglossum* sp. (sweat bees), *Epargyreus clarus* (silver spotted skipper), *Erynnis* sp. (skipper sp.) (Ray 2021). In Franklin and Lawrence counties, Alabama, *Baridinae* (weevil) was observed on *Dalea foliosa* (Ray 2021).

Insect observations and foraging behavior on Alabama *Dalea foliosa* flowers included *Bombus* sp. (bumblebees), *Xylocopa virginica* (eastern carpenter bees), skipper butterflies, and grasshoppers. The grasshoppers appeared to be feeding on the inflorescences (Ray 2021).

Larger bees, such as bumblebees and carpenter bees, tended to visit more plants in a foraging trip and travel longer distances between plants (Ray 2021). It appears that insects visit the largest inflorescence on an individual plant, and most foraging by insects occurs in the mid-afternoon (Ray 2021).

2.3.1.2 Abundance, population trends, demographic features, or demographic trends:

Available data indicate that there have been few changes documented regarding abundance, population trends, or demography of *Dalea foliosa* since the 2015 5-year review. Alabama continues to support two populations of unknown viability, but there are no monitoring data available for calculating PVI ranks for these populations or to determine whether population size or resiliency have changed. Changes that have been documented in Illinois and Tennessee are summarized below.

Illinois supports 11 populations of which two are considered highly viable, five are moderately viable, and four are of low viability (Table 2). The 2015 5-year review reported that Illinois supported 14 extant populations. At this time, one population (Rock Run Land & Water Reserve) is now considered extirpated as the last observation of plants was in 2007 with zero plants observed in 2016, 2017, and 2020. No data was taken in 2019. The remaining difference in Illinois extant populations from 2015 to 2020 (from 14 populations in 2015 down to 11 populations in 2020) reflects the grouping of closely clustered subpopulations within two sites for this review (Fabyan and West DuPage Woods) that in 2015 were each reported as separate populations. One of the two subpopulations at the Waterfall Glen site is considered extirpated, but this does not change the number of extant populations in Illinois. Attempts to introduce and restore populations have occurred only in Illinois, where four of the extant populations were established through introduction of seed or propagated plants. All these restoration attempts began in 2010 or earlier. Two additional attempts to establish introduced populations in Illinois have apparently failed, based on the absence of plants during the most recent surveys at these sites. Four of the

seven natural populations in Illinois were augmented in 2008 and/or 2009 with plants grown from seed.

Table 2: Results of Population Viability Index assessments for leafy prairie clover.

State	Year	Low	Moderate	High	N/A
Alabama	1996[1]	1	1	0	0
Illinois	1996[1]	1	1	1	0
Illinois	1999[2]	1	2	1	0
Illinois	2021	4	5	2	0
Tennessee	1996[1]	14	9	1	0
Tennessee	2003[3]	49	16	0	0
Tennessee	2020[4]	6	10	1	33

[1]Service (1996)
[2]Bowles et al. (1999)
[3]TDEC (2004)
[4]TDEC (2021)

Based on available data, Tennessee supports 50 populations of *Dalea foliosa*, 17 of which TDEC routinely monitors to provide data for calculating PVIs. As of 2020, 1 of these populations ranked highly viable, 10 ranked moderately viable, and 6 ranked as having low viability (Table 2). For the remaining 33 Tennessee populations, monitoring data are not available and current population viability is unknown (Table 2). In addition to conducting PVIs at routinely monitored sites, TDEC collects more detailed life history stage-based data, using a variable number of fixed, 2-meter^2 (m^2) (21.5-feet^2 (ft^2)) plots. These data continue to demonstrate considerable inter-annual variability in plant density (see 2015 5-Year Review for discussion of inter-annual variability in monitoring results). It is notable that densities observed in 2017 and 2018 were the highest on record since this plot-based monitoring began in 2009 (TDEC 2019).

Based on the PVI analysis, range wide PVI ranks were high for three populations (two in Illinois and one in Tennessee), moderate for fifteen populations (five in Illinois and ten in Tennessee), and low for ten populations (four in Illinois and six in Tennessee (Appendix 2, Table 2). PVIs for the remaining thirty-five populations (two in Alabama and thirty-three in Tennessee) are unknown (Table 2).

In comparison: The 2015 5-year review indicated only one population (Illinois) range wide was highly viable (Table 2). Currently (2022) three are highly viable (one in Tennessee and two in Illinois) (Table 2), clearly well below recovery criteria for delisting or reclassification to threatened but marking an improvement in resiliency of some populations since the 2015 Five Year Review (Service 2015).

2.3.1.3 Genetics, genetic variation, or trends in genetic variation:

Research continues to indicate that genetic diversity is limited in *Dalea foliosa* (Morris 2022). A study of genetic variation and structure using microsatellites across the geographic range of the species is ongoing (Morris et al. unpublished). Preliminary assessment of these data indicates extremely low levels of diversity in the Illinois and Alabama populations (Morris 2022). Based on the data collected so far, it appears that Illinois populations do not harbor any unique alleles, with all detected alleles being observed in Tennessee populations (Morris 2022). In contrast, there is limited overlap in alleles between Illinois and Alabama populations, although most alleles detected in Alabama are also observed in Tennessee (Morris 2022). There do appear to be some unique alleles in Alabama populations that have not yet been observed in Tennessee or Illinois (Morris 2022). The data continues to be formally analyzed to provide additional clarity on structuring among populations.

2.3.1.4 Taxonomic classification or changes in nomenclature:

There have been no changes in the taxonomic classification or nomenclature for *Dalea foliosa*.

2.3.1.5 Spatial distribution, trends in spatial distribution, or historic range:

Available data indicate that the spatial distribution of leafy prairie-clover remains unchanged in Alabama since the 2015 5-year review but has changed minimally in Illinois and Tennessee. These changes have resulted in a slight increase in redundancy in Tennessee but no change in redundancy in Illinois, as explained below.

There has been one additional population brought to our attention in Illinois on land owned by the Cook County Forest Preserve District. In preparing this review we learned that Cook County supports a population of leafy prairie clover, which includes both a natural subpopulation first observed in 2001 and a subpopulation resulting from the scattering of seeds during 1989 through 1999. The 2015 5-year review reported the existence of a population in Cook County; however, we have determined that was an introduced population on the grounds of the Chicago Botanical Garden and have no current information on its status. As noted above, one Illinois population that was treated as extant in the 2015 5-year review is now considered extirpated. It is also the case that some Illinois populations that were treated as distinct populations in the 2015 5-year review should have been treated as subpopulations. For this reason, we now understand the species distribution in Illinois to include 11 distinct populations, with minimal changes since the 2015 5-year review. Four of the eleven distinct populations were introduced by sowing seed or planting nursery-grown plants. Ten of these populations occur on protected land, and

one is on private lands that are covered in a low-effect HCP for multiple species, including *Dalea foliosa.*

In Tennessee, five populations have been discovered since the last review, two of which are located on privately owned lands. The other three new Tennessee populations were discovered in Designated State Natural Areas (DSNA). However, since the last review TDEC has updated the status of four populations from extant to historical, meaning they are now likely extirpated. Additionally, the species was not found during the most recent surveys conducted at two other populations, the status of which TDEC (2020) has revised from extant to "failed to find" and which we continue to treat as extant until such time as TDEC revises their status to either historical or extirpated. Based on this updated information, the number of extant populations in Tennessee has increased from 49 to 50 and the species spatial distribution has remained similar in extent in Tennessee compared to estimates in the 2015 5-year review.

2.3.1.6 Habitat or ecosystem conditions:

We are not aware of any new information related to changes in habitat or ecosystem conditions in Illinois or Alabama since the 2015 5-Year Review. In Tennessee, the TDEC continues to increase the scale and frequency of management using prescribed fire in limestone glades and barrens of the Central Basin, where *Dalea foliosa* occurs. In combination with efforts to control invasive species and control illegal access to DSNAs where *Dalea foliosa* occurs, increased use of prescribed fire is improving habitat conditions in Tennessee and is expected to result in increased resiliency of affected populations. However, additional time will be needed to evaluate effectiveness of these management actions at reducing threats to the species.

2.3.2 Five-Factor Analysis

We have received little new information related to factors affecting the status of *Dalea foliosa* since the last status review. For this reason, we refer readers to the 2015 5-Year Review for a detailed discussion of factors affecting the species and its habitat.

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

The threat of outright habitat destruction still affects some populations in Alabama and Tennessee despite the protection of many previously threatened sites since the release of the recovery plan (Service 2015). However, threats to *Dalea foliosa* from habitat disturbance remain much the same as documented in the 2015 5-year review and have the potential to affect this species even in protected sites, namely from degradation due to invasive exotic or native

species encroachment, illegal outdoor recreational vehicle (ORV) use, and incompatible management of utility rights-of-way. Many populations continue to suffer from inadequate management regimes to control encroachment by invasive exotic or native species as seen in the PVI rankings for "management needs" (Appendix 2). The four Tennessee populations that have been designated as historical since the 2015 review were in privately owned sites where habitat has become unsuitable due to encroachment of native and invasive exotic plants or other habitat disturbance.

We have received limited information related to conservation efforts for the species since the last status review. In 2019 the State of Alabama and the Service established a Section 6 Cooperative Agreement for Threatened and Endangered Plant Species, providing an opportunity to fund future implementation of recovery actions in Alabama. As noted above in Section 2.3.1.6, increased scale and frequency of habitat management in limestone glades and barrens by TDEC is expected to provide habitat conditions that will promote population growth and increase resiliency of populations located in DSNAs in Tennessee. These efforts are expected to continue with funding provided by Section 6 grants from the Service. In addition, the Service awarded a FY 2020 Recovery Challenge Grant to TDEC to support Strategic Habitat Conservation for *Dalea foliosa* and *Astragalus bibullatus* (Pyne's ground-plum). This project will result in improved habitat mapping, prioritization of habitat management activities, and increased management efforts for approximately 1,900 acres of priority limestone glade and barren habitats where these species occur in Tennessee. Results of these efforts have yet to be assessed.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

We are not aware of any new information related to this factor and have no current information to suggest that *Dalea foliosa* is threatened by over-collection for any purpose (Service 2015).

2.3.2.3 Disease or predation:

Available data indicate that herbivory by eastern cottontail rabbit (*Sylvilagus floridanus*) and white-tailed deer (*Odoicoileus virginianus*) herbivory continue to threaten the species. The recovery plan (Service 1996) identified livestock grazing and selective browsing by eastern cottontail rabbits and white-tailed deer as threats to *Dalea foliosa*. We currently are not aware of any sites where livestock grazing poses a threat to the species.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

We are not aware of any new information related to this factor. *Dalea foliosa* remains state-listed in Illinois and Tennessee, but not in Alabama (Service 2015). These state-listings provide some level of protections for the species in those states, and listing under the act protect the species on any federal lands.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

We are not aware of any new information related to this factor. That is, drought continues to threaten populations of the species, and projected climate change resulting in more severe (i.e., frequent, intense, or prolonged) drought conditions across the species range will continue to threaten the species in the foreseeable future (Service 2015).

2.4 Synthesis

Range wide *Dalea foliosa* occurs within 63 populations. Of those, 50 are located in central Tennessee, while 11 are disjunct in northeast Illinois and 2 in northwest Alabama. Available data indicate that few populations are highly resilient, with the overwhelming majority ranked as moderate to low resiliency using the PVI framework. While efforts to manage habitats to provide conditions suitable for increasing resiliency are underway in Tennessee, it is too early to judge their effectiveness. Similar efforts are currently lacking in Alabama and limited in Illinois. Since the 2015 status review, four populations in Tennessee have been reclassified from extant to historical because the habitat is no longer considered suitable for the species and the species is no longer found at the site. However, five populations have been discovered in Tennessee since the last review, producing a net increase of one population within the core of the species range.

Threats of habitat destruction and degradation continue to affect populations throughout the species' range to varying degrees, as do threats from herbivory and climate change, including risk from more severe drought conditions. The effects of these threats place smaller, isolated populations with low resiliency at greatest risk; though, all populations are at risk due to low genetic variation, which could limit potential for adapting to changing conditions. The effects of these threats are likely to be exacerbated in sites where management to provide suitable habitat conditions is lacking or ineffective, as is currently the case in Alabama and some sites in Illinois and Tennessee. Of the 28 *Dalea foliosa* populations that are currently ranked using PVI analysis, 25 are ranked as either having low or moderate viability (Table 2) illustrating that many threats are still acting upon this species across its range. For these reasons, *Dalea foliosa* continues to meet the definition of an endangered species.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (*Indicate reasons for delisting per 50 CFR 424.11):*
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
_X__ **No change is needed**

4.0 RECOMMENDED FUTURE ACTIVITIES

- Since preliminary genetic testing reveals that genetic diversity in all *Dalea foliosa* populations is limited, evaluate whether a genetic management plan for potential movement of individuals between populations, potentially between states, is needed.
- Determine the number of populations that are represented by element occurrences throughout the range of *Dalea foliosa*. This is of highest priority in Tennessee, where multiple occurrences within a single protected area are often tracked as distinct populations. This is especially relevant when calculating PVI values for populations, as aggregating multiple occurrences into what are believed to be biological populations could have the effect of increasing the population size, and in turn the calculated PVI for those populations. The two Alabama occurrences appear to be separated by sufficient distance to warrant treatment as separate populations. All Illinois populations are distinct.
- Across the species range, plan and implement strategies to increase resiliency of populations that are ranked as having low or moderate viability, prioritizing those on publicly protected lands or where landowners are willing to enter into conservation agreements for the species.
- Standardize annual monitoring methods by applying the PVI framework from the recovery plan throughout the species' range.

5.0 REFERENCES

Bowles, M., T. Bell, and M. DeMauro. 1999. Establishing recovery targets for leafy prairie clover (*Dalea foliosa*). Unpublished report for Illinois Endangered Species Protection Board, Springfield, Illinois. 20 pp.

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U.S. Fish and Wildlife Service [Service]. 1996. Leafy Prairie-clover Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 74 pp.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Dalea foliosa* (Leafy prairie-clover)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X__ No change needed

Review Conducted By: Geoff Call, Tennessee Ecological Services Field Office

FIELD OFFICE APPROVAL:

Field Supervisor Tennessee Ecological Services Field Office, U.S. Fish and Wildlife Service*

Approve DANIEL ELBERT Digitally signed by DANIEL ELBERT Date: 2022.06.23 12:29:03 -05'00' Date _____

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

COOPERATING REGIONAL OFFICE APPROVAL:

We emailed this 5-year review to the following regional and/or field offices for their concurrence prior to finalizing the document: Bloomington Regional Office; Chicago, Illinois Ecological Services Field Office; and Daphne, Alabama Ecological Services Field Office. 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.

Appendix 1
Variables Used in the Leafy Prairie Clover Viability Index (Service 1996)

Population Size - Leafy prairie-clover population sizes are from the most recent census data. Populations were given a PVI value of 0 if plants were not located, but a seed bank or dormant plants may still persist because suitable habitat was intact. Populations with 100 or less total plants or without flowering plants were assigned a value of 1. Moderate (>100 to <500plants) and large (>500 to <1,000 plants) populations were assigned values of 2 and 3, respectively, while very large populations (>1,000 plants) were given the highest value of 4.

Habitat Size - Sites were evaluated by the presence and approximate amount of suitable habitat patches, not on site size, although a large site typically has more suitable habitat than a small site. Included in the evaluation was the occurrence of specific microhabitat components and unless otherwise indicated, are assumed to be present. Although the size classes are somewhat arbitrary, the assumption is that as habitat size increases, the population viability also increases because the site can support more *Dalea foliosa* plants and include a wider range of microhabitats (especially the wet-mesic soil moisture component). This assumption is supported by the observed site, habitat, and population sizes; the smallest leafy prairie-clover populations typically occur in sites that are less than 1 hectare (2.2 acres).

Degree of Disturbance - The degree of disturbance was assessed by the successional stage and natural quality of the plant community. The underlying assumption is that stable native plant communities have characteristic dominant and indicator, or conservative, plant species. Under different disturbances of varying intensities, community structure is altered, indicator species are lost, and disturbance-tolerant native and exotic species increase. Vegetative changes can also occur in relatively undisturbed sites in which the ecological processes that historically maintained the natural community are lost; e.g., woody succession due to fire suppression or exotic plant species that become established.

The PVI values for disturbance range from severe (=0, the near or complete loss of the natural community) to low (=3, a stable, diverse natural community). The largest leafy prairie-clover populations are found in the least disturbed sites, but plants can survive in disturbed early- to mid-successional sites, such as along roadsides and power lines or in partial shade. Populations on the latter sites have a lower viability because the threats from disturbance and woody succession still persist and the early- to mid-successional stages are transitory.

Management Needs - The degree of human disturbance and the successional stage of a plant community are usually related to the site's management needs. Specific community management problems may include woody succession, exotic species invasion, hydrologic changes, grazing impacts, and long-term fire suppression. Specific population management needs may include enhancing population size, monitoring existing populations, and assessing new habitat patches for population recovery. Leafy prairie-clover populations on late successional, relatively undisturbed sites that require only routine maintenance or some control of woody or exotic species are assigned a higher PVI values (3 and 2, respectively). The level of management

increases as the extent and severity of the threats increase, with a concomitant decline in the PVI value.

Off-site Threats - Leafy prairie-clover populations are also threatened by activities originating off the site, such as ORV use, grazing, dumping, road or power line maintenance, development, and drainage alterations. Sites that are highly threatened by adjacent land uses or are vulnerable because of a historical use (e.g., illegal dumping or ORVs) have a low PVI value (=0). As the buffer between the site and the threat increases and the severity and likelihood of occurrence decreases, the PVI value increases.

Protection Status - Protection status was determined by evaluating the ownership and the degree of legally binding deed restrictions. Public or private lands dedicated under a State nature preserve act have the highest legal protection at the State level and are given the highest PVI value (=3). Although land in public ownership is formally protected, the responsible agency may have primary management goals that do not include preservation (PVI=2). Private land may have formal protection under a legal conservation easement (PVI=2) or informal protection through a volunteer registry program or a renewable lease/management agreement in which the long-term land use remains at the owner's discretion (PVI= 1).

Appendix 2
Population Viability Index Criteria Rankings For Each Extant Population

Population Name or EO Number	State	Population Size	Habitat Size	Degree of Disturbance and Succession	Management Needs	Offsite Threats	Protection Status	PVI	Viability
5	TN	1	1	2	1	2	3	0.53	Moderate
11	TN	4	1	3	2	3	3	0.84	High
14	TN	1	2	3	3	2	3	0.74	Moderate
24	TN	1	0	2	1	1	3	0.42	Low
26	TN	2	2	2	1	1	3	0.58	Moderate
30	TN	2	0	2	1	1	3	0.47	Low
32	TN	3	1	2	1	2	3	0.63	Moderate
33	TN	3	1	2	1	1	3	0.58	Moderate
40	TN	4	0	2	1	1	3	0.58	Moderate
47	TN	0	0	0	0	1	3	0.21	Low
49	TN	1	1	0	0	2	3	0.37	Low
54	TN	4	1	2	1	2	3	0.68	Moderate
59	TN	2	0	3	2	3	3	0.68	Moderate
60	TN	0	0	1	1	2	3	0.37	Low
64	TN	2	0	3	2	2	3	0.63	Moderate
68	TN	1	0	0	0	1	3	0.26	Low
76	TN	2	0	2	1	2	3	0.53	Moderate
Lockwood East/Dellwood NP	IL	3	2	2	2	2	3	0.73	Moderate
Lockport Prairie NP	IL	2	3	3	3	2	3	0.84	High
Romeoville NP	IL	2	1	2	1	2	3	0.57	Moderate
Fabyan FP	IL	1	1	2	1	2	2	0.42	Low
Keepataw	IL	0	1	0	1	0	2	0.21	Low
Theodore Stone	IL	1	0	1	1	1	2	0.31	Low
DCA	IL	2	1	2	2	1	2	0.52	Moderate
Waterfall Glen	IL	3	1	2	2	2	2	0.63	Moderate
Midewin	IL	4	2	3	2	2	3	0.84	High
West DuPage Woods	IL	1	2	2	1	1	2	0.47	Low
Material Service	IL	4	2	1	1	0	2	0.52	Moderate