

**Running Buffalo Clover**  
*(Trifolium stoloniferum)*

**5-Year Review:**  
**Summary and Evaluation**

**U.S. Fish and Wildlife Service**  
**Columbus, Ohio Field Office**  
**Columbus, Ohio**

**5-YEAR REVIEW**  
**Running buffalo clover/*Trifolium stoloniferum***

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

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**1.2 Methodology used to complete the review:**

This 5-year review was prepared by Julie Proell, Fish and Wildlife Biologist, U.S. Fish and Wildlife Service (Service), Columbus, Ohio Ecological Services Field Office, in consultation with other field office staff in the Southeast, Northeast, and Midwest regions. The Service requested new scientific or commercial data and information that may have a bearing on the species' classification of endangered status through a *Federal Register* notice (75 FR 55820) initiating the 5-year review. We reviewed past and recent literature, state heritage data, public comments, the final listing rule (52 FR 21478), the Running Buffalo Clover Recovery Plan (USFWS 2007), and the 5-year review for the species (USFWS 2008) which we relied heavily on to prepare this 5-year review. Peer review will be conducted when the proposed rule to reclassify the species to threatened status is issued.

### **1.3 Background:**

#### **1.3.1 FR Notice citation announcing initiation of this review:**

75 FR 55820 (September 14, 2010)

#### **1.3.2 Listing history**

##### Original Listing

**FR notice:** 52 FR 21478

**Date listed:** June 5, 1987

**Entity listed:** species

**Classification:** endangered

#### **1.3.3 Associated rulemakings: none**

#### **1.3.4 Review History:**

September 2008: 5-year review for Running Buffalo Clover (*Trifolium stoloniferum*). This 5-year review summarized all new information regarding the species status, distribution, and threats, leading to a recommendation to downlist the species to threatened status.

June 27, 2007: Revised Recovery Plan for Running Buffalo Clover notice of availability (72 FR 35253). The notice of availability summarized the species status, distribution, and recovery objectives that were reviewed and developed in the revised recovery plan.

June 14, 2007: Running buffalo clover (*Trifolium stoloniferum*) Recovery Plan: First Revision. This first Revision of the Recovery Plan provides updated information on the status and biology of the species and guides the recovery of Running buffalo clover throughout its range.

Running buffalo clover was included in a cursory 5-year review of all species listed before January 1, 1991 (56 FR 56882). The 5-year review resulted in no change to Running buffalo clover's listing classification of endangered.

#### **1.3.5 Species' Recovery Priority Number at start of 5-year review: 8**

#### **1.3.6 Recovery Plan**

**Name of plan:** Running buffalo clover (*Trifolium stoloniferum*) Recovery Plan: First Revision

**Date issued:** June 14, 2007

## 2.0 REVIEW ANALYSIS

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

2.1.1 Is the species under review a vertebrate? No

### 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.

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. Listing Factors B (overutilization for commercial, recreational, scientific, or educational purposes) and C (disease or predation) are not relevant for this species.

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information

#### Downlisting Recovery Criteria

Running buffalo clover may be reclassified from endangered to threatened when the following criteria are met. Numerical goals are based on most recently available scientific information and are subject to revision as new information becomes available. The results of the most recent 5-year review for this species state that the recovery criteria for reclassifying running buffalo clover from an endangered species to a threatened species have been achieved (USFWS 2008).

1. Seventeen populations, in total, are distributed as follows: 1 A-ranked, 3 B-ranked, 3 C-ranked, and 10 D-ranked populations across at least 2 of the 3 regions in which Running buffalo clover currently occurs (Appalachian, Bluegrass, and Ozark). The number of populations required in each rank is based on what would be necessary to achieve a 95% probability of persistence within the next 20 years based on population viability analysis (PVA; Appendix 5 of USFWS 2007). Rankings refer to the Element Occurrence (EO) ranking categories (Table 1 of USFWS 2007).

**Downlisting Criterion 1 has been met.** Populations are distributed as follows: A = 10, B = 29, C = 30, D = 47 and occur in all three regions across the range of the species (Table 1). This criterion addresses listing Factor A (the present or threatened destruction, modification, or

curtailment of its habitat or range), Factor D (the inadequacy of existing regulatory mechanisms), and Factor E (other natural or manmade factors affecting its continued existence).

2. For each A-ranked and B-ranked population described in #1, PVA indicates a 95% probability of persistence within the next 20 years, OR for any population that does not meet the 95% persistence standard, the population meets the definition of viable. For downlisting purposes, viability is defined as follows: A) seed production is occurring; B) the population is stable or increasing, based on at least five years of censusing; and C) appropriate management techniques are in place.

**Downlisting Criterion 2 has been met.** In 2008, four A-ranked and three B-ranked populations were considered viable based on PVA or 5 years of data (USFWS 2007 - Appendix 5, 2008). Of the populations ranked A in 2008, two have remained A-ranked while two have decreased to B-ranked as of 2010. Of the populations ranked B in 2008, one increased to A-ranked, one remained at B-ranked, and one decreased to C-ranked as of 2010. This leads to a total of three A-ranked, three B-ranked, and one C-ranked population in 2010 that were considered to be viable in 2008 through the PVA (USFWS 2007). Downlisting Criterion 2 requires that one A-ranked and three B-ranked populations be considered viable. This criterion addresses listing Factor A (the present or threatened destruction, modification, or curtailment of its habitat or range).

3. The land on which each of the populations described in #1 occurs is owned by a government agency or private conservation organization that identifies maintenance of the species as one of the primary conservation objectives for the site, OR the population is protected by a conservation agreement that commits the private landowner to habitat management for the species. Natural Resource Management Plans on Federal lands may be suitable for the meeting of this criterion. This criterion will ensure that habitat-based threats for the species are addressed (Appendix 6 of USFWS 2007).

**Downlisting Criterion 3 has been met.** The number of populations that meet this criterion are distributed as follows: A-ranked = 6 and 1 partially protected, B-ranked = 12 and 2 partially protected, C-ranked = 10, D-ranked = 13 and 1 partially protected. Most of the protected populations are located on Federal property (Forest Service or Department of Defense lands). Several are located on state property. Five populations meet this criterion as well as downlisting Criterion 2; three A-ranked (Fernow, Bowden, and Magee Run in West Virginia; Harmon 2010a) and two B-ranked (Crouch Knob Becky Creek in West Virginia [Harmon 2010a] and Congress Green in Ohio [Becus *et al.* 2010]). This criterion addresses listing Factor A (the present or threatened destruction, modification, or curtailment of its habitat or range) and Factor D (the inadequacy of existing regulatory mechanisms).

## Delisting Recovery Criteria

Running buffalo clover may be removed from the List of Endangered and Threatened Plants (50 CFR 17.12) when the following have been met:

1. Thirty-four populations, in total, are distributed as follows: 2 A-ranked, 6 B-ranked, 6 C-ranked, and 20 D-ranked populations across at least 2 of the 3 regions in which Running buffalo clover occurs (Appalachian, Bluegrass, and Ozark). The number of populations in each rank is based on what would be required to achieve a 95% probability of the persistence within the next 20 years; this number was doubled to ensure biological redundancy across the range of the species. Rankings refer to the EO ranking categories (USFWS 2007).

**Delisting Criterion 1 has been met.** It addresses listing Factor A (the present or threatened destruction, modification, or curtailment of its habitat or range), Factor D (the inadequacy of existing regulatory mechanisms), and Factor E (other natural or manmade factors affecting its continued existence). Populations are distributed as follows: A-ranked = 10, B-ranked = 29, C-ranked = 30, D-ranked = 47, and occur in all three regions across the range of the species (Table 1).

2. For each A-ranked and B-ranked population described in #1, PVA indicates 95% probability of persistence within the next 20 years, OR for any population that does not meet the 95% persistence standard, the population meets the definition of viable. For delisting purposes, viability is defined as follows: A) seed production is occurring; B) the population is stable or increasing, based on at least 10 years of censusing; and C) appropriate management techniques are in place.

**Delisting Criterion 2 has NOT been met.** The number of populations that met this criterion is four A-ranked and three B-ranked which are considered viable based on PVA or 10 years of data (USFWS 2007 - Appendix 5, 2008), and therefore additional populations should be assessed with PVA. The criterion requires two A-ranked and six B-ranked populations to be considered viable. This criterion addresses listing Factor A (the present or threatened destruction, modification, or curtailment of its habitat or range).

3. Downlisting criterion #3 is met for all populations described in delisting criterion #1.

**Delisting Criterion 3 has NOT been met.** The number of populations that meet this criterion is as follows: A-ranked = 6 and 1 partially protected, B-ranked = 12 and 2 partially protected, C-ranked = 10, D-ranked = 13 and 1 partially protected (see Table 1). Protection and management plans need to be implemented for additional populations for this criterion to be met. This criterion addresses listing Factor A (the present or threatened destruction, modification, or curtailment of its habitat or range) and Factor D (inadequacy of existing regulatory mechanisms).

## 2.3 Updated Information and Current Species Status

Running buffalo clover (*Trifolium stoloniferum*) was listed as endangered in 1987, and at that time, only one population was known. When the original recovery plan was issued in 1989, the number of known running buffalo clover populations had grown to 13 populations, and when the revised recovery plan was issued in 2007, the number of known populations had increased to 108 (USFWS 2007, Appendix 2). Since that time, 15 new populations have been discovered in four states as follows: Kentucky (1 B-ranked, 2 C-ranked, and 2 D-ranked), Missouri (1 D-ranked), Ohio (1 A-ranked), and West Virginia (3 A-ranked, 4 B-ranked, and 1 D-ranked), and a 2008 prescribed burn at the Mark Twain National Forest in Missouri triggered the revival of a reintroduced population that was established in 1994, but had since disappeared. Additionally, Kentucky and West Virginia have added experimental populations (Kentucky: 1 C/D-ranked; West Virginia: 1 D-ranked). Therefore, with the discovery of 15 new natural populations, the apparent extirpation of 9 populations, and the introduction of 2 populations, running buffalo clover is now found in 116 populations throughout its range (Table 1).

### 2.3.1 Biology and Habitat

Running buffalo clover has been historically documented from Arkansas, Illinois, Indiana, Kansas, Kentucky, Missouri, Ohio, and West Virginia. At the end of the 2007 field season, the total number of ranked populations included: 11 A-ranked, 27 B-ranked, 29 C-ranked, and 40 D-ranked (USFWS 2008). Running buffalo clover currently occurs in 116 populations in three geographical regions: Appalachian (West Virginia and southeastern Ohio), Bluegrass (southwestern Ohio, central Kentucky, and Indiana), and the Ozarks (Missouri) and the total number of ranked populations include: 10A-ranked, 29 B-ranked, 30 C-ranked, and 47 D-ranked. Nine populations that were included in the 2008 USFWS review of the species are now presumed extirpated and one population that was presumed extirpated has been rediscovered (see Table 1). The majority of the populations occur within the Appalachian and Bluegrass regions, with the largest population in West Virginia and the most populations in Kentucky. Element occurrence rankings (EOs), which integrate population size and habitat integrity, indicate that known populations fall into all ranking categories (A-D; USFWS 2007, Table 1).

Running buffalo clover usually is found in mesic habitats with partial to filtered sunlight and a prolonged pattern of moderate and periodic disturbance, such as grazing, mowing, trampling, or flood-scouring. Running buffalo clover is often found in regions with limestone or other calcareous bedrock underlying the site, though limestone soil is not a requisite determining factor for the locations of populations of this species. Populations of running buffalo clover have been found in a variety of habitat types, including mesic woodlands, streambanks, grazed woodlots, mowed paths, old logging roads, trails, mowed wildlife openings within mature forests, savannahs, sandbars, and steep ravines (USFWS 2007, 2008).

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

Not applicable.

### **2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:**

Many running buffalo clover populations are being monitored, restored, and protected throughout its range, and new populations are being discovered almost annually.

In Indiana, many populations are not monitored annually, and therefore it is difficult to assess trends in the populations (Homoya 2009). There are currently six populations of running buffalo clover in Indiana: 2 C-ranked and 4 D-ranked populations. A Section 6 Conservation Strategy for the species within the state aims to research and compile heritage data, and develop a plan for protection, management, and monitoring of populations of running buffalo clover. The site of a population discovered near the town of Greendale in 2007 is currently private, but is being considered for state acquisition due to its archeological significance. A major management need in this state is the control of non-native invasive species such as garlic mustard (*Allaria petiolata*), Japanese stiltgrass (*Microstegium vimineum*), and, to a lesser degree, ground ivy (*Glechoma hederacea*; Homoya 2009).

Kentucky contains the most populations of running buffalo clover, including 2 A-ranked, 13 B-ranked, 14 C-ranked, and 20 D-ranked populations. Populations appear to fluctuate annually due to variation in temperature, rainfall, competition, disturbance, and light; and management for disturbance and non-native invasive species has yielded both positive and negative results for population numbers. One example is the increase in population size of running buffalo clover as a result of cattle management at the Willsrupard Road site in 2010 (White and Littlefield 2010). The Bluegrass Army Depot (BGAD) in Madison County, Kentucky, is the site of 16 populations of running buffalo clover, and recent monitoring by Eastern Kentucky University (EKU) has shown notable declines in some areas (Brown and Goode 2010).

In Missouri, populations are mainly located within protected land and are ranked as follows: 1 B-ranked and 4 D-ranked. Populations within Missouri appear stable, though the Graham Cave State Park has declined from 137 rooted crowns in 2006 to just a few dozen plants in 2009, likely due to the lack of habitat management. Additionally, a prescribed burn in March of 2008 at the Mark Twain National Forest appears to have created the conditions required for the reappearance of running buffalo clover at a site where introductions occurred in 1994 and 1995 (Hickey 2010). The Forest Service removed blowdown from this



site in winter of 2010 to encourage summer growth (Lynda Mills, Mark Twain National Forest, pers. comm. 2011).

Ohio contains 17 extant populations that are ranked as follows: 2 A-ranked, 5 B-ranked, 2 C-ranked, and 8 D-ranked in 2010, compared to 2 A-ranked, 6 B-ranked, 5 C-ranked, and 6 D-ranked in 2007 (USFWS 2007). Many of the populations in Ohio are located on county property, two populations are located on state property, and one population is located on Federal land within the Wayne National Forest. The majority of populations are either remaining stable or decreasing, with only two populations showing an increase in their rank (SL Oxbow from C-rank to B-rank; Marjie Becus, volunteer botanist, pers. comm. 2010) and Wayne NF-Ironton from D-rank to B-rank (Chad Kirschbaum, Wayne National Forest, pers. comm. 2010). The stagnation or decrease in population sizes may be due to lack of management or disturbance or competition with non-native invasive species in areas where running buffalo clover occurs. Major non-native invasive species that pose a threat to populations of running buffalo clover in Ohio are Amur (=bush) honeysuckle (*Lonicera maackii*), Japanese stiltgrass, and garlic mustard (Jennifer Windus, Ohio Division of Natural Resources, pers. comm. 2011). A memorandum of understanding between the Ohio Historical Society and the Service for the Congress Green Cemetery population has allowed for the continued management of that site, including non-native invasive species control, ground-disturbance raking in the fall, and the planting of several oak trees in 2009 to provide shade in an increasingly opening canopy due to the Emerald ash borer (Robert Glotzhober, Ohio Historical Society, pers. comm. 2010).

West Virginia contains the largest population of running buffalo clover (Fernow Experimental Forest) and a total of 39 extant populations that are ranked as follows: 6 A-ranked, 10 B-ranked, 12 C-ranked, and 11 D-ranked. Twenty-three of the populations within West Virginia are located on private land, with the other populations at least partially located on Federal or state lands. West Virginia does not have protections in place for listed plant species beyond the Endangered Species Act, which may lead to the destruction of several populations: two running buffalo clover populations are located near a wind farm development, two are being affected by quarrying activities, and one site is proposed for a housing development (USFWS 2010a). The majority of the populations in West Virginia appear to be doing well, with six populations increasing in rank and one population in which no individuals have been seen since 2008 (Left Fork of Clover Run). However, management actions are planned at this site in an effort to revive this population. Fernow Experimental Forest biologists continue to perform management activities on Federal land, including silviculture treatments, prescribed burns, ammonium sulfate fertilization, and herbicide application for the benefit of running buffalo clover and other species. Fernow biologists have control over future development projects within the area, except for the development of subsurface mineral rights (USFWS 2010a).

### **2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):**

While no new research has been conducted on the genetics of running buffalo clover since the last 5-year review was completed, the summary of genetics studies included in that review remain valid. Small populations continue to contain high levels of genetic variation (USFWS 2008), and therefore it is important that small and large populations are maintained throughout the range of running buffalo clover.

Charles Minars of Eastern Kentucky University received a permit from the Service to perform genetic analysis of running buffalo clover plants from four locations within the Bluegrass Army Depot between August 2010 and August 2014 (USFWS 2010). Additionally, seeds from several sites in Kentucky were collected in 2010 and sent to Valerie Pence, the director of plant research, at the Center of Conservation and Research of Endangered Wildlife at the Cincinnati Zoo and Botanical Garden. While not necessarily genetics research-based, the greenhouse-propagated plants may be used for research to determine best propagation methods and may be used to augment populations in the spring of 2011 (White and Littlefield 2010).

Running buffalo clover seeds were also collected from several populations in West Virginia (Coberly Sods, McGee Run, and Shaver's Fork Floodplain) and sent to Michael Kunz of the North Carolina Botanical Garden at the University of North Carolina, Chapel Hill, North Carolina. These seeds will be stored at the National Center for Genetic Resource Preservation in Fort Collins, Colorado and NC Botanical Garden, Center for Plant Conservation Seed Collection in Chapel Hill, NC as a seed source for reintroductions and augmentations (Harmon 2010a).

### **2.3.1.4 Taxonomic classification or changes in nomenclature:**

Not applicable.

### **2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):**

Running buffalo clover is found within three distinct areas within its range: Appalachian, Bluegrass, and the Ozarks. Fifteen new populations have been discovered since the last 5-year review of this species, though these populations do not appear to lie outside of the established spatial distribution of the species.

In Kentucky, running buffalo clover has been discovered in several new counties within the state (Bath, Campbell, Grant, and Owen). One new population was

discovered in 2008: Phillips Creek; three new populations were discovered in 2009: Brush Creek, Eagle Creek, and Garrison Creek; and one new population were discovered in 2010: Clear Creek. Additionally, a running buffalo clover population was established at Meadowbrook Farm in 2009 (White and Littlefield 2010).

In Missouri, A new population was located in Cuivre River State Park in 2009 with approximately 15 rooted crowns (Schuette 2010). Additionally, a prescribed burn in March of 2008 at the Mark Twain National Forest allowed for the reappearance of running buffalo clover at a site of introductions in 1994 and 1995 (Hickey 2010).

A new population was discovered on Boch Hollow State Nature Preserve in Ohio in June of 2009 with approximately 100 flowering stems. A survey in 2010 of the Boch Hollow population discovered 1,277 rooted crowns along the stream (Melissa Moser, Ohio Department of Natural Resources, pers. comm. 2010).

Eight new populations (Aggregates, Bowden/Coberly Sods, Coberly Sods, Leading Ridge, Bellington Knob, Claylick Run, Spruce Run, and White Oak Fork) have been discovered in West Virginia since the last 5-year review of running buffalo clover was conducted (USFWS 2008). Coberly Sods was discovered in 2007 near the Bowden population within Monongahela National Forest, and in 2010, recent surveys discovered a large number of running buffalo clover plants between Bowden and Coberly Sods (included in this review as Bowden/Coberly Sods). West Virginia DNR is in the process of determining whether Bowden and Coberly Sods should be combined into one EO. (Harmon 2010a).

#### **2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):**

Running buffalo clover is usually found in mesic habitats with partial to filtered sunlight, and requires a prolonged pattern of moderate and periodic disturbance (USFWS 2008). Invasive species continue to pose a threat to running buffalo clover, and management of sites where running buffalo clover occurs may help mitigate these impacts. In January 2008, four trees-of-heaven (*Ailanthus altissimus*) were removed from the Ashland population in Fayette County, Kentucky. The Kentucky State Nature Preserves Commission, along with the Ashland staff, work within four “recovery zones” located at Ashland. As part of this management program, the trees-of-heaven will eventually be replaced with ironwood trees (*Carpinus caroliniana*; Mead 2008 ).

Burkhart *et al.*, in a study performed at Fernow Experimental Forest in West Virginia, found that logging-related disturbances greatly contribute to the presence of running buffalo clover within the Forest. Additionally, they found

that interactions between canopy structure, basal tree area, and disturbance history determined running buffalo clover patch abundance (Burkhart *et al.* 2010). This suggests that management activities currently underway at Fernow are beneficial for the continued survival and stability of running buffalo clover at this site.

### **2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)**

When running buffalo clover was listed as federally endangered (52 FR 21478), threats were listed as habitat destruction, competition from invasive species, lack of a rhizobial associate, small population sizes, herbivores, and pathogens. In 1995, the Running Buffalo Clover Recovery Team identified eight major threats to the species: 1) any irreversible, permanent habitat loss such as road construction, that completely destroys the habitat and/or kills all plants and seeds within the path of the disturbance; 2) the closing of forest canopies through succession to the point of severe shading, leading to reduced flower and fruit production; 3) the elimination of bison leading to reduced seed dispersal and release of competing vegetation; 4) small population size and associated fragility and susceptibility to catastrophe; 5) excessive herbivory; 6) viral and fungal diseases; 7) reduction in pollinators; and 8) competition from non-native invasive species (USFWS 2007, 2008). The threats identified in 1989 and 1995, except viral and fungal disease, excessive herbivory, and lack of rhizobial associate, continue to pose a threat to this species. Additionally, the impact of bison and their effects on the habitat as it relates to the survival of running buffalo clover is speculative. Other grazing animals may have acted, and continue to act as seed dispersal agents, and through grazing, limit competition from other plant species. Currently, the major threats to this species throughout its range are habitat destruction, habitat succession, and invasive plant competition (USFWS 2008).

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

As discussed in the previous 5-year review of running buffalo clover, this species is mainly threatened by direct and indirect human impacts that lead to habitat loss, alteration, and significant degradation, such as the removal of bison from eastern forests, development, and the introduction of non-native invasive species (USFWS 2008).

For example, all but one of the Indiana populations are located on private land and are threatened by lack of management and disturbance, and by competition with non-native invasive species such as garlic mustard and Japanese stiltgrass (Homoya 2009). Additionally, populations in Kentucky are threatened by a lack of a disturbance regime and competition with non-native invasive species, particularly Japanese stiltgrass, and to a lesser extent, bush honeysuckle, multiflora rose (*Rosa multiflora*), and garlic mustard; White and Littlefield 2010).

At the BGAD in Kentucky, significant damage from an ice storm and tornado in 2009 opened the canopy over several populations of running buffalo clover, and flooding in 2010 led to submersion, scouring, and deposition of debris and sedimentation of populations (Brown and Goode 2010). The populations at Warder-Perkins and Niehaus in Ohio appear to be overgrown with Japanese stiltgrass and other invasives (Becus *et al.* 2010) and management activities to increase disturbance and slow natural succession are planned for the future (Shannon Hoffer, Ohio Department of Natural Resources, pers. comm. 2010). Invasive species such as multiflora rose and Japanese stiltgrass, a lack of protection from heavy trail use, and shading are also severe threats to populations in West Virginia (Harmon 2010b).

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

As summarized in the previous 5-year review for this species (USFWS 2008), several states provide protection against commercial taking and subsequent trade or sale of endangered plants. Regardless of the lack of existing protections, commercial taking does not appear to be a threat to running buffalo clover, because it is not known to be used for any commercial or recreational purposes.

When running buffalo clover was listed as endangered in 1987 (52 FR 21478), Factor D (overutilization for commercial, recreational... purposes) was a clear threat as only one population was known at the time. Now, overall collection for scientific or educational purposes is limited and distributed among many populations (USFWS 2008). However, several studies that are ongoing or have requested the use of running buffalo clover sites or seeds, may pose a threat to the continued existence of individual populations being impacted by the studies (USFWS 2010b; Albrecht and McEwan 2010).

#### **2.3.2.3 Disease or predation:**

When running buffalo clover was originally listed as endangered in 1987 (52 FR 21478), disease was considered a threat to this species. However, as reviewed in the previous 5-year review, disease and parasitism do not appear to significantly threaten this species (USFWS 2008). Additionally, herbivory by deer, rabbits, rodents, and slugs is not considered to be a significant threat to the species, especially as herbivores may aid in dispersal of seeds (USFWS 2008).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

The ESA provides protection to federally listed plants on Federal land, though current state and Federal laws provide little to no protection to federally listed plants on state or private property. Additionally, management plans have not been written for all populations of running buffalo clover on Federal lands, suggesting a need for landscape-wide plans to be in place to aid in the species'

protection and management. As reviewed in the previous 5-year review, existing state regulatory mechanisms vary among the states where running buffalo clover occurs (USFWS 2008); however, this does not appear to be a significant threat to the species, as there are no current commercial or recreational uses for this species.

Running buffalo clover is state listed as endangered in Missouri, Indiana, Ohio, Kentucky, and West Virginia. Ohio and Missouri have similar laws prohibiting commercial taking of plants. Kentucky's Rare Plant Recognition Act provides no protection to state listed plant species. Indiana has a non-rule policy, where the Natural Resources Commission takes listed plants into consideration if a project over which they have jurisdiction contains those listed plants. West Virginia has been unsuccessful in passing an endangered species law, but state agencies are encouraged to consult with the Natural Heritage Database for known locations of running buffalo clover on proposed project sites (USFWS 2008).

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

As summarized in the previous 5-year review for this species, additional threats to running buffalo clover include small population size for selected patches, inadequate seed dispersal, and poor seed quality (USFWS 2008). Climate change is a new and serious threat to this species, as precipitation patterns change and air temperatures increase, the hydrology of the habitat in which running buffalo clover currently exists may change (IPCC 2007; Hayhoe 2010). Additionally, an increased amount of carbon dioxide (CO<sub>2</sub>) in the atmosphere may cause trees and other competitors for sunlight to grow faster (Amthor 1995) and shade out existing populations of running buffalo clover. Non-native invasive species may become more aggressive and invasive with higher levels of CO<sub>2</sub> (Rogers *et al.* 2008).

## **2.4 Synthesis**

The number of known populations of running buffalo clover has increased from a single known population at the time of listing in 1987 (52 FR 21478) to over 100 populations today. Additionally, ongoing management activities at many sites are allowing these populations to remain stable or increase in size. There are currently 116 populations of running buffalo clover distributed across all three regions in which the species was historically known, including 10 A-ranked, 29 B-ranked, 30 C-ranked, and 47 D-ranked populations. Additionally, many of the populations are located on protected lands (6 totally and 1 partially protected A-ranked, 12 totally and 2 partially protected B-ranked, 10 totally protected C-ranked, and 13 totally and 1 partially protected D-ranked populations), and many with associated management plans will lead to the potential persistence of these populations. Similar to the previous 5-year review for this species, the current major threats to running buffalo clover consist of direct and indirect human impacts that lead to habitat loss, alteration, significant degradation such as development, and

the introduction of non-native invasive species (USFWS 2008). Climate change, which was not addressed in the previous 5-year review, poses an additional threat.

According to recovery criteria outlined in the recovery plan's first revision (USFWS 2007), running buffalo clover can be downlisted from endangered to threatened when 1) at least 17 populations are distributed across the species' range and rankings to achieve a 95% probability of persistence for 20 years; 2) at least 1 A-ranked and 3 B-ranked populations either meet the 95% probability of persistence for 20 years or are producing seeds, are increasing in size, and are being managed; and 3) at least 17 populations from Criterion 1 are located on protected land or are being protected by a conservation agreement. Based on the analysis conducted for this 5-year review, all of the above downlisting criteria have been met.

For running buffalo clover to be delisted from the List of Endangered and Threatened Species, the following criteria must be met: 1) 34 populations must be distributed across at least two regions and the number of populations in each rank is based on to achieving a 95% probability of persistence for 20 years; 2) at least 2 A-ranked and 6 B-ranked populations either meet the 95% probability of persistence for 20 years or are producing seeds, are increasing in size, and are being managed; and 3) downlisting Criterion 3 is met for all populations described in delisting Criterion 1. Based on the analysis conducted for this 5-year review, only delisting Criterion 1 has been met.

Therefore, because the criteria has been met to reclassify running buffalo clover from being listed as federally endangered, it is recommended that the species be reclassified to a status of threatened. Running buffalo clover is no longer in danger of extinction throughout all or a significant portion of its range, as 116 populations are distributed across all three regions in which it occurs, and more populations are being protected and managed throughout its range.

### 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*
- No change is needed**

#### 3.2 New Recovery Priority Number: Retain as 8.

**Brief Rationale:** No change in the Recovery Priority Number is needed – a recovery priority of 8 indicates the species has a moderate degree of threat and a high recovery potential.

#### 3.3 Reclassification (from Endangered to Threatened) Priority Number: 4

**Brief Rationale:** Reclassification priority number is 4. The U.S. Fish and Wildlife Service has not been petitioned to reclassify running buffalo clover. The management impact from reclassifying this species is considered moderate.



## **4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

### **Determine and implement appropriate habitat management techniques.**

(Recovery Actions 1.1. and 1.2).

While management activities are being implemented for the recovery of the species throughout its range, these management activities are not standardized and are not being tracked for their effectiveness in all populations. Additionally, as summarized in the previous 5-year review for this species, experimental sites should be established that utilize different management regimes to identify adaptive management techniques (USFWS 2008).

### **Develop site specific protection and management agreements.**

(Recovery Action 1.3)

Populations may be protected either by occurring on land owned by a government agency or a private conservation organization that identifies maintenance of the species as one of the primary conservation objectives for the site OR through a conservation agreement that commits the private landowner to habitat management for the species. This can be achieved through the development of a memorandum of understanding (MOU) between the landowner and the local U.S. Fish and Wildlife Service Field Office.

### **Conduct censuses on an annual basis where data gaps on population viability occur.**

(Recovery Action 1.4)

In order for a population to be considered viable for reclassification purposes, it must be monitored for at least 5 years. Several populations in Ohio and West Virginia have been monitored for more than 10 years, and new populations are being discovered almost annually. Newly discovered populations or those with fewer years of censusing data should be censused annually until at least 5 to 10 years of data have been collected for each population. Once that data have been collected for a given population, it may be censused less frequently.

### **Update the Population Viability Analysis (PVA)**

No new data have been added to the PVA since it was previously established in 2007 (USFWS 2007) for this species. Populations that were not initially included due to too little data having been collected may now be included if data gaps have been removed. Updating the PVA can be a tool to assess the viability of populations for downlisting and delisting purposes.

**Table 1. Extant populations of Running Buffalo Clover**

<b>Population</b>	<b>State</b>	<b>Region</b>	<b>2007 Ranking</b>	<b>2010 Ranking</b>	<b>Habitat</b>	<b>Ownership</b>	<b>Protected?</b>
Dearborn County Farm	IN	B	C	C	forested terrace	L	N
Doublelick Run	IN	B	C	C	floodplain	P	N
Greendale	IN	B	D	D	mesic upland forest	P	N
Henschen Branch	IN	B	D	D	wooded ravine terrace	P	N
Hidden Valley	IN	B	A	D	wooded ravine and lawn	P	N
Island Branch	IN	B	D	D	wooded ravine terrace	P	N
Adair WMA	KY	B	A	A			Y
Ashbys Fork	KY	B	D	D	floodplain	P	N
Ashland	KY	B	C	B	lawn	L	N
Beaver Branch	KY	B	B	B	wooded stream terrace with trails	P	N
BGAD 34	KY	B	A	B	floodplain	F	Y
BGAD 35	KY	B	D	D	floodplain	F	Y
BGAD 40	KY	B	B	B	floodplain	F	Y
BGAD 41	KY	B	D	D	floodplain	F	Y
BGAD 45	KY	B	D	D	floodplain	F	Y
BGAD 46	KY	B	A	A	floodplain	F	Y
BGAD 50	KY	B	C	D	floodplain	F	Y
BGAD 51	KY	B	B	B	floodplain	F	Y
BGAD 52	KY	B	B	C	floodplain	F	Y
BGAD 56	KY	B	B	C	floodplain	F	Y
BGAD 57	KY	B	D	D	floodplain	F	Y
BGAD 59	KY	B	B	B	floodplain	F	Y
BGAD 61	KY	B	D	D	floodplain	F	Y
BGAD 63	KY	B	C	C	floodplain	F	Y
BGAD 64	KY	B	B	B	floodplain	F	Y
BGAD tree tag 703	KY	B		D	floodplain	F	Y

Population	State	Region	2007 Ranking	2010 Ranking	Habitat	Ownership	Protected?
Big Bone at Dark Hollow	KY	B	C	C	stream terrace	P	N
Big Bone Lick SP East	KY	B	A	C	lawn	S	Y
Big Bone Lick SP West	KY	B	D	B	lawn	S	Y
Boone Creek	KY	B	B	B	floodplain	P	N
Brush Creek	KY	B	D	D		P	N
Clear Creek	KY	B	X	D	floodplain	F	Y
Craig Creek Tributary	KY	B	C	D	floodplain	P	N
Dinsmore	KY	B	C	C	open woods/trail	L	N
Doe Run Lake	KY	B	D	D	young forest	L	N
Eagle Creek	KY	B	C	C		P	N
Garrison Creek	KY	B	C	B		P	N
Griers Creek	KY	B	D	D	floodplain	P	N
Gum Branch Wildlife Management Area	KY	B	A	B	woodland and stream terrace	S	N
Larchmont Farm	KY	B	D	D	lawn	P	N
Lower Howards Creek	KY	B	C	C	wooded cattle trail along stream	L	Y
Lulbegrud North	KY	B	C	CD	floodplain	P	N
Meadowbrook Farm	KY	B		C		S	N
Montgomery Co	KY	B	D	D	floodplain	P	N
Mt. Zion Road	KY	B	C	C	floodplain/trails	P	N
Oakland Farm	KY	B	D	D	lawn	P	N
Paris Pike North	KY	B	C	C	lawn	P	N
Phillips Creek	KY	B	CD	C		P	N
Second Creek	KY	B	D	D	floodplain	P	N
Silver Creek	KY	B	D	D	floodplain/trails	P	N
Site 100 (Intc Ford and Phelps Rds)	KY	B	D	D	woodland	P	N
Spears House	KY	B	D	D	lawn	P	N
Upper Howards Creek	KY	B	B	B	grazed wooded floodplain	P	N

Population	State	Region	2007 Ranking	2010 Ranking	Habitat	Ownership	Protected?
Willsrupard Road	KY	B	C	B	grazed wooded	P	N
Wolf Pen Branch	KY	B	B	C	woodland	P	Y
Cedar Bottom Woodland	MO	O	D	D	open woods	P	N
Cuivre River State Park	MO	O	B	B	floodplain	S	Y
Cuivre River State Park Albreck	MO	O		D	floodplain	S	Y
Graham Cave State Park	MO	O	B	D	floodplain	S	Y
Mark Twain National Forest	MO	O		D	mesic forest	F	Y
Boch Hollow	OH	B		A	mesic forest/trail	S	Y
Brown Co./Adams Co.	OH	B	C	D	mesic forest/trail	P	N
Congress Green	OH	B	B	B	lawn, cemetery	S	Y
Fankhauser	OH	B	D	D	lawn	P	N
Gatch	OH	B	C	C	lawn	P	N
Mitchell Memorial-east	OH	B	C	D	mesic forest	L	N
Mitchell Memorial-west	OH	B	A	B	open woods	L	N
MWF Bowles Woods	OH	B	B	D	lawn	L	N
MWF Lake	OH	B	D	D	mesic forest	L	N
Newberry	OH	B	D	D	mesic forest	L	N
Richardson Forest Preserve Beckmeyer Tract	OH	B		B	mesic forest	L	Y
SL Bobcat/Cabin View	OH	B	D	D	lawn	L	N
SL Little Turtle Trail	OH	B	B	D	mesic forest	L	N
SL Miami Fort	OH	B	A	A	lawn	L	N
SL Oxbow	OH	B	C	B	floodplain	L	N
Warder-Perkins/Niehaus	OH	B	B	C	mesic forest	P	Y
Wayne NF- Ironton	OH	A	D	B	forested along trail	F	Y
Aggregates	WV	A		A			
Bellington Knob	WV	A		D			
Bowden	WV	A	B	A	ORV trail	F	Y

Population	State	Region	2007 Ranking	2010 Ranking	Habitat	Ownership	Protected?
Bowden/Coberly Sods	WV	A		A	ORV trail, forest	F	Y
Briery Mountain	WV	A	D	D			
Brush Heap Knob Rich Mountain East	WV	A	D	C	wooded cow path	P	N
Brushy Run	WV	A	D	C	oak/hickory forest	F	Y
Cheat River	WV	A	H	H		P	N
Claylick Run	WV	A		B			
Coberly Sods	WV	A		B		F	Y
Cotton Hill	WV	A	D	D	forest in floodplain	P	Y
Crouch Knob Becky Creek	WV	A	A	B	old skid roads, young woodland	F,S	Y,N
Dry Fork of the Elk River	WV	A	C	C	old logging roads	P	N
Fernow	WV	A	A	A	logging roads, skid trails, wildlife path	F	Y
Franklin	WV	A	B	C	stream bottom	P	N
Hoe Lick	WV	A	B	C	old logging roads	F	Y
Kelley Mountain Quarry	WV	A		D	quarry and asphalt company land	P	N
Kingwood	WV	A	D	D			
Laurel Mountain	WV	A	C	C	forested jeep trail	P	N
Leading Ridge	WV	A		B			
Left Fork of Clover Run	WV	A	D	D	old logging roads	F	Y
Lower John's Run	WV	A	D	D	old logging roads	F,P	Y,N
McGee Run-Back Fort-A,B,C	WV	A	B	A	old logging roads, young forest	P	Y,N
McGowan Mountain	WV	A	A	B	old skidder road adj a new clear cut	F	Y
Mill Creek	WV	A	D	D	old road and logged clearing	P	N
Millstone Run	WV	A	B	B	old logging road	P	N
Mowry Run	WV	A	B	B	old logging road	S,P	N
Parsons	WV	A	D	D	ATV track in mesic woods	P	N
Porterwood	WV	A	D	C	along ORV trail within a floodplain forest	P	N

Population	State	Region	2007 Ranking	2010 Ranking	Habitat	Ownership	Protected?
Rafe Run (Westvaco W Tract 801)	WV	A	C	C		P	N
Rattlesnake Run-A	WV	A	B	B	mesic forest, old logging roads, deer trails	F,P	Y,N
Rich Mountain West, Lookout Tower	WV	A	C	C	logging road	P	N
Rich Mountain West, Microwave	WV	A	C	B	old road in secondary forest	P	N
Rich Mountain West, Quarry	WV	A	D	D	jeep trail	P	N
Seneca Creek	WV	A		D			
Shaver's Fork Flood Plain	WV	A	C	C	in floodplain along footpath	P	N
Shaver's Mountain	WV	A	B	C	old skid trail and logging road	F	Y
Snyder Run, Rich Mountain E	WV	A	C	C	trail in mesic forest	P	N
Spruce Run	WV	A		B			
White Oak Fork	WV	A		A			

Region: A = Appalachian, B = Bluegrass, O = Ozark

EO Ranking for rooted crowns: A = 1000+, B = 100-999, C = 30-99, D = <30, E = Extant but not ranked, H = historical X =Extirpated

Ownership: F = Federal, S = State, L = County, city, or other local government, P = Private

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**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of Running buffalo clover (*Trifolium stoloniferum*)**

Current Classification: E

Recommendation resulting from the 5-Year Review

- Downlist to Threatened**
- Uplist to Endangered**
- Delist**
- No change is needed**

Appropriate Recovery Priority Number: 8

Appropriate Listing/Reclassification Priority Number, if applicable: 4

Review Conducted By: Julie M. Proehl

**FIELD OFFICE APPROVAL:**

Lead Field Supervisor, Fish and Wildlife Service

Approve Mary M. Knapp Date 2-23-11  
Mary M. Knapp

**REGIONAL OFFICE APPROVAL:**

Assistant Regional Director, Ecological Services, Fish and Wildlife Service, Midwest Region

AdBQ

Approve Sean Waver Date 3/18/11

Cooperating Regional Director, Fish and Wildlife Service, Northeast Region

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Acting Regional Director

Cooperating Regional Director, Fish and Wildlife Service, Southeast Region

Signature Katitha Date 4/22/11