Running Buffalo Clover
(Trifolium stoloniferum)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Ohio Field Office
Reynoldsburg, OH

September 2008

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 Sarena Selbo, Endangered Species Biologist, U.S. Fish and Wildlife Service (Service), Reynoldsburg 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 (70 FR 41423) initiating the 5-year review. We reviewed past and recent literature, public comments, the final listing rule (52 FR 21478), and the recently revised running buffalo clover recovery plan which we relied heavily on (USFWS 2007), to prepare this 5-year review.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:
70 FR 41423 (July 19, 2005)

1.3.2 Listing history

Original Listing
FR notice: 52 FR 21478
Date listed: July 6, 1987
Entity listed: species
Classification: endangered

1.3.3 Associated rulemakings: none

1.3.4 Review History:

June 27, 2007: Revised Recovery Plan for Running Buffalo Clover available (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 five-year review of all species listed before January 1, 1991 (56 FR 56882). The five-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 or Outline

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 2 (overutilization) and 3 (disease and 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:

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.

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). Rankings refer to the Element Occurrence (EO) ranking categories (USFWS 2007).

This criterion has been met. Populations are distributed as follows: A = 11, B = 27, C = 29 and D = 40 and occur in all three regions across the range of the species (USFWS 2007, Appendix 2). This criterion addresses listing factor 1 (the present or threatened destruction, modification, or curtailment of its habitat or range), factor 4 (inadequacy of existing regulatory mechanisms), and factor 5 (other factors).

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2. For each A-ranked and B-ranked population described in #1, population viability analysis 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.

This criterion has been met. Currently, four A-ranked and three B-ranked populations are considered viable based on PVA or 5 years of data (USFWS 2007, see Appendix 5). The

criterion requires one A-ranked and three B-ranked populations be considered viable. This criterion addresses listing factor 1 (the present or threatened destruction, modification, or curtailment of its habitat or range).

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3. The land on which each of the populations described in #1 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 meeting this criterion. This criterion will ensure that habitat-based threats for the species are addressed.

This criterion has been met. The number of populations that meet this criterion are distributed as follows: A = 7, B =17, C = 5, D = 11. Most populations are located on Federal property (Forest Service or Department of Defense lands). Several are located on state property. A memorandum of understanding (MOU) between the Ohio Historical Society and the U.S. Fish and Wildlife Service (see Appendix 1) provides for running buffalo clover protection, management, and monitoring at one of the private sites. Five populations meet this criterion as well as downlisting criteria #2; two A-ranked, and three B-ranked. This criterion addresses listing factor 1 (the present or threatened destruction, modification, or curtailment of its habitat or range) and factor 4 (inadequacy of existing regulatory mechanisms).

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 persistence within the next 20 years; this number was doubled to ensure biological redundancy across the range of the species. Rankings refer to the Element Occurrence (EO) ranking categories (USFWS 2007).

This criterion has been met. It addresses listing factor 1 (the present or threatened destruction, modification, or curtailment of its habitat or range), factor 4 (inadequacy of existing regulatory mechanisms), and factor 5 (other factors). Populations are distributed as follows: A = 11, B = 27, C = 29 and D = 40 and occur in all three regions across the range of the species (USFWS 2007, Appendix 2).

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2. For each A-ranked and B-ranked population described in #1, population viability analysis 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.

This criterion has NOT been met. Currently, four A-ranked and three B-ranked populations are considered viable based on PVA or 10 years of data (USFWS 2007, Appendix 5). The criterion requires two A-ranked and six B-ranked populations be considered viable. This criterion addresses listing factor 1 (the present or threatened destruction, modification, or curtailment of its habitat or range).

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

This criterion has NOT been met. The number of populations that meet this criterion are currently distributed as follows: A = 7, B =17, C = 5, D = 11. Protection and management plans need to be implemented for additional populations for this criterion to be met. This criterion addresses listing factor 1 (the present or threatened destruction, modification, or curtailment of its habitat or range) and factor 4 (inadequacy of existing regulatory mechanisms).

2.3 Updated Information and Current Species Status

Running buffalo clover was listed as endangered in 1987. At the time of listing only one population was known; in 1989 when the original recovery plan was completed, running buffalo clover was known from 13 populations. When the revised recovery plan was finalized there were 101 known populations of running buffalo clover (USFWS 2007, Appendix 2). Since that time, new populations have been reported from Indiana (1 C-ranked population on private land) and West Virginia (1 A-ranked on Federal land; 2 B-ranked, one Federal, one private; 3 D-ranked, one Federal, two state lands).

2.3.1 Biology and Habitat

Running buffalo clover has been collected historically from Arkansas, Illinois, Indiana, Kansas, Kentucky, Missouri, Ohio, and West Virginia. Running buffalo clover (*Trifolium stoloniferum*) currently occurs in 108 populations in three geographical regions: Appalachian (West Virginia and southeastern Ohio), Bluegrass (southwestern Ohio, central Kentucky and Indiana), and the Ozarks (Missouri). The majority of 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; see Table 1 of recovery plan for discussion of rankings). In 2005, the total number of ranked populations included: 10 A-ranked, 25 B-ranked, 27 C-ranked, and 38 D-ranked (USFWS 2007). At the end of the 2007 field season, 108 populations of running buffalo clover were known throughout the range and were ranked as follows: 11 A-ranked, 27 B-ranked, 29 C-ranked, and 40 D-ranked.

Running buffalo clover occurs in mesic habitats with partial to filtered sunlight, where there is a prolonged pattern of moderate, periodic disturbance, such as mowing, trampling, or grazing. It is most often found in regions underlain with limestone or other calcareous bedrock, but not exclusively. It has been reported from a variety of habitats, including mesic woodlands, savannahs, floodplains, stream banks, sandbars (especially where old trails cross or parallel intermittent streams), grazed woodlots, mowed paths (e.g. in cemeteries, parks, and lawns), old logging roads, jeep trails, ATV trails, skid trails, hiking trails, game trails, mowed wildlife openings within mature forest, and steep ravines (USFWS 2007).

Genetic studies of running buffalo clover have been conducted rangewide. The results from allozyme electrophoresis (Hickey *et al.* 1991) and random amplified polymorphic DNA markers (RAPD) (Crawford *et al.* 1998) show relatively low levels of diversity and low levels of gene flow between populations, even between those separated by short distances. In contrast, the results from the two techniques differ in that RAPD marker variation was detected in all populations sampled, with levels of diversity in several smaller populations equal to that in larger ones. No allozyme variation was detected in half of the populations sampled, and smaller populations were often monomorphic. The RAPD study suggested that to conserve maximum levels of diversity in running buffalo clover, as many populations as possible should be preserved across its range because much of the total diversity resides among populations. Small populations of running buffalo clover contribute as much genetic diversity as large populations and exhibit unique banding patterns, which is important for the species adaptability and genetic stability.

Biological constraints of running buffalo clover include reproductive requirements (reliance on pollinators, seed scarification, and dispersal mechanisms) and dependence on disturbance to maintain a filtered sunlight habitat. Seed scarification may enhance germination of running buffalo clover (Campbell *et al.* 1988), and it appears that chemical scarification (i.e. through a digestive tract) is most effective (Hattenbach 1996). As deer do not appear to be highly successful at dispersing running buffalo clover seed (Ford *et al.* 2003), the species dependence on ungulate herbivores for seed germination and dispersal has not been resolved. If bison were the original dispersal and disturbance agent for maintenance of running buffalo clover, their disappearance from the landscape may be an irresolvable biological constraint to recovery.

Variation in seed set from year-to-year and population to population is also a biological trait of running buffalo clover that makes it vulnerable. Although running buffalo clover is self-compatible, it requires a pollinator to move the pollen from the anthers to the stigma (Franklin 1998). Little information exists about the effect of pollinators on seed set. It has been observed in the field that flowers sometimes appear devoid of viable seeds (Franklin 1998, Marjie Becus, private botanist, personal communication, 2004). Pollinators may have difficulty detecting small populations of running buffalo clover especially in marginal habitat where running buffalo clover plants are competing with other vegetation. Weather may also play a role in successful seed set as data suggest that extremely wet or dry years result in reduced seed production (Franklin 1998).

Habitat for running buffalo clover must include filtered sunlight. This requirement often means removal of competing vegetation (especially invasive plants) and selective tree removal to prevent overshading. Running buffalo clover occurs in two fairly distinct habitat types (shaded lawn and mesic forest) thus, management recommendations are required for the clover in both habitats. Lawn populations include cemeteries, parks, and old home sites. Mesic forest populations are often associated with streams and trails. Forested populations require open areas where the clover is exposed to indirect sunlight. Controlling invasive species such as multiflora rose (*Rosa multiflora*), Japanese stiltgrass (*Microstegium vimineum*), garlic mustard (*Alliaria petiolata*), Japanese honeysuckle (*Lonicera japonica*), Amur honeysuckle (*Lonicera maackii*), wintercreeper (*Euonymus fortunei*), and periwinkle (*Vinca minor*) is critical in both lawn and forested populations. Ongoing management of running buffalo clover habitats is critical for maintaining the sunlight conditions and reducing competition required for maintaining populations of this species (USFWS 2007).

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

The final rule (52 FR 21478) listing running buffalo clover as endangered identified the threats to the survival of running buffalo clover as habitat destruction, competition from invasive species, lack of a rhizobial associate, small population sizes, herbivores, and pathogens. Specific threats identified by the Running Buffalo Clover Recovery Team in 1995 were: 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 plant species (USFWS 2007).

With the exception of viral and fungal diseases, excessive herbivory, and lack of a rhizobial associate, the threats identified in both 1989 and 1995 are still affecting the species. The most significant threats rangewide are habitat destruction, habitat succession, and invasive plant competition.

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

Threats to running buffalo clover's habitat are largely due to direct and indirect human impacts that have lead to habitat loss, alternation, and significant degradation. Homoya *et al.* (1989) stated that the removal or suppression of vegetation by bison may have created the open understory and light gaps necessary for this species. Jacobs and Bartgis (1987) suggested that bison may have provided the right balance of periodic disturbance, soil enrichment, seed dispersal, and seed scarification necessary to maintain running buffalo clover. According to Homoya *et al.* (1989), the removal of bison does not completely explain the range-wide depletion of this species; they suggested that there was not a sufficient time interval between the loss of bison and the introduction of cattle to account for the rarity now present in the species because cattle should have satisfied the same biological necessities as bison. However, unlike bison, cattle are not migratory and may provide long-term grazing pressures to running buffalo clover populations. According to many researchers the ecological equivalency of bison and other ungulates is also uncertain. Investigations into the influences of white-tailed deer on running buffalo clover germination have shown that although deer are viable vectors for running buffalo clover seed, the rates of germination of ingested seeds are low (Ford *et al*. 2003).

In some populations, it appears that both overgrazing and no grazing at all are threats to running buffalo clover. In Kentucky, overgrazing poses threats to running buffalo clover, but removal of cattle from clover populations has resulted in overshading and competition from other vegetation (White *et al.* 1999). Periodic grazing at the Bluegrass Army Depot has probably provided the moderate disturbance needed to maintain running buffalo clover (Fields and White 1996). Without some level of disturbance, a population will become too shaded to provide enough sunlight for the species (Cusick 1989, Homoya *et al.* 1989). Grazing schemes were modified in the late 1920s, resulting in the suspension of grazing at some sites and continued grazing (at varying levels of intensity) at other sites (USFWS 2007). A review of running buffalo clover monitoring data from 2003 to 2005 revealed preliminary trends regarding grazing and the total number of rooted crowns recorded from each patch (Elliot 2003-2005 in USFWS 2007). Because many areas excluded from grazing since the late 1990s have displayed an increase in rooted crowns from 2003 to 2005, it appears that grazing (i.e., disturbance) by cattle is required at less frequency and intensity than was commonly believed

necessary to provide the appropriate disturbance regime for this species (Floyd 2006 in USFWS 2007). A greater understanding is needed concerning the level of disturbance required by this species.

Various researchers have supported the hypothesis that during pre-settlement time running buffalo clover habitat was likely produced through canopy gaps created by the felling of large old-growth trees (Madarish and Schuler 2002). Current logging practices may also benefit running buffalo clover. At the Fernow Experimental Forest in north-central West Virginia, running buffalo clover is most often associated with skid roads in uneven-aged silvicultural areas (Madarish and Schuler 2002). A study examining running buffalo clover abundance before and after logging suggests that populations may initially decrease after disturbance, but then rebound to higher than pre-disturbance levels (Madarish and Schuler 2002).

Land development and the consequential loss of habitat is also a serious threat to running buffalo clover. Cusick (1989) noted that running buffalo clover was formerly relatively frequent in central and southwestern Ohio, particularly in the vicinity of Cincinnati prior to urban sprawl. Remnant populations have become even more isolated, persisting in areas maintained by appropriate disturbance.

Jacobs and Bartgis (1987) suggested that along with the destruction of habitat, the introduction of non-native species may have contributed to the decline of running buffalo clover. Non-native white clover may have invaded the habitat of running buffalo clover, out-competing it for available resources (Jacobs and Bartgis 1987). Other invasive plants that compete with running buffalo clover include Japanese stiltgrass, garlic mustard, Japanese honeysuckle, Amur honeysuckle, wintercreeper, and periwinkle.

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

Running buffalo clover is not known to be used for any commercial or recreational purpose. When originally listed in 1987 (52 FR 21478), overutilization for scientific or educational purposes was clearly a threat given the fact that only one population consisting of four individuals was known. Today, collection for scientific or educational purposes is limited and distributed among many populations.

2.3.2.3 Disease or predation:

Although at the time of listing, disease was predicted to threaten running buffalo clover, recent studies indicate that disease and predation are not major threats. Jacobs and Bartgis (1987) suggested that the decline of this species may have partially centered on a pathogen introduced from the

exotic white clover, but no specific disease has been identified. A number of viral and fungal diseases are reported to have attacked the species in greenhouses at the Missouri Botanical Garden, including cucumber mosaic virus and the comovirus (Sehgal and Payne 1995). No evidence has been gathered showing these viruses' impact on running buffalo clover decline in the wild.

Parasitism by root-knot nematodes (*Meloidogyne* spp.) is common in clovers and often limits productivity in cultivated clovers used as forage crops (Quesenberry *et al.* 1997). Investigations have been conducted on the effects of root-knot nematodes on native North American clovers, including running buffalo clover. After inoculation of the parasite, running buffalo clover displayed high resistance to three of the four nematode species analyzed, and only an intermediate response to the fourth species of nematode (Quesenberry *et al.* 1997). Thus, the threat from this parasite is not considered significant.

Although, herbivory by a variety of species has been reported for running buffalo clover, it is not considered a primary threat. In Missouri, running buffalo clover plants are repeatedly grazed by rabbits, rodents, and slugs (Pickering 1989). Similar observations have been made in Kentucky (Davis 1987) and West Virginia (Paul Harmon, West Virginia Natural Heritage Program, personal communication, 2003). The Fayette County, West Virginia population was eaten to the ground by a ground hog, but more than a dozen rooted crowns were observed at the population the following year. White-tailed deer can also consume large amounts of running buffalo clover (Miller *et al.* 1992). It should be noted that herbivores are also the potential dispersers of seeds for this species, so palatable greens may be an evolutionary advantage for the species as a whole (Michael Vincent, Miami University, personal communication, 2004). In sum, although a population may be entirely consumed during a growing season, plants may return again the next year. If herbivory occurs after seed is set, the species may benefit from increased seed dispersal.

2.3.2.4 Inadequacy of existing regulatory mechanisms:
With the exception to the protection that the ESA provides listed plants on Federal lands, current state and Federal laws provide little or no protection to plants listed under the ESA. Plants are viewed as property of the landowner and in most cases landowners need not provide protection to these populations under the law. Several states provide protection against commercial taking and subsequent trade or sale of endangered plants, as described in the following paragraph. 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 purpose.

As well as being federally listed, running buffalo clover is state listed as endangered in Missouri, Indiana, Ohio, Kentucky, and West Virginia. The degree of provided protection varies among the states. 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.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Additional factors that may threaten running buffalo clover include small population sizes, inadequate seed dispersal, and poor seed quality. It has been suggested that running buffalo clover has a limited seed dispersal mechanism (Cusick 1989). Deforestation, farming, and other human activities created many new habitats for the species, but with the loss of large herbivores after European settlement, Cusick (1989) suggested that there were no effective means of dispersal remaining for the species. White-tailed deer and bison were effectively eliminated from the landscape due to over-hunting. Only recently have deer returned to pre-settlement numbers. According to this theory, habitat in which running buffalo clover formerly occurred gradually closed due to the absence of disturbance. Although a presumed primary disperser (deer) is again present, the rate of seed germination from seeds ingested by deer is low, and relatively few populations of running buffalo clover have survived as compared to presumably larger pre-settlement populations (Cusick 1989).

Although researchers have speculated that inbreeding depression may have contributed to the decline of running buffalo clover (Hickey *et al.* 1991, Taylor *et al.* 1994), selfed seeds have been shown to germinate well and develop into vigorous plants (Franklin 1998). However, temporal variations in seed quality have been reported. Seed quality may be correlated with rainfall; quality decreases in years with unusually high rainfall (Franklin 1998).

Long-term monitoring data suggest that running buffalo clover populations often display widely fluctuating population size. The cause for changes in population size may be due to disturbance, weather patterns, management strategy, natural succession, or other unknown factors. The cyclic nature of running buffalo clover and the high probability of small populations disappearing one year and returning a subsequent year, may lead to difficulty in protecting small populations.

Regardless, small populations have displayed high levels of genetic diversity (Crawford *et al.* 1998) that is important for survival of the species as a whole.

2.4 Synthesis

Since listing running buffalo clover in 1987, several positive outcomes have been realized due to recovery implementation: 1) more information is available regarding the species biology; and 2) the known number of populations has dramatically increased as survey efforts have expanded throughout the historic range. Running buffalo clover currently occurs in 108 populations in the Appalachian, Bluegrass and the Ozarks regions. At the end of the 2007 field season, the 108 populations were ranked as follows: 11 A-ranked, 27 B-ranked, 29 C-ranked, 40 D-ranked, and one unranked. Although many of the threats to running buffalo clover populations still exist, two initially identified potential threats, lack of a rhizobium associate and viral pathogens do not appear to be a threat to the species.

Given the known threats and constraints, improving the status of the species focuses primarily on increasing the number of protected and managed populations, determining the viability of existing populations, and research into the species ecological requirements. Key to this strategy is the protection and ecological management of various-sized populations of running buffalo clover throughout its geographic range. The recovery criteria and recovery actions rely heavily on retaining and managing the habitats on which running buffalo clover needs to maintain viability (USFWS 2007). In addition, recovery relies on a greater understanding of the biotic and abiotic needs of running buffalo clover in order to apply adequate management.

To that end, the recovery criteria for reclassifying running buffalo clover from an endangered species to a threatened species have been achieved. A change in the species classification to threatened status is recommended. Running buffalo clover is no longer in danger of extinction throughout all of a significant portion of its range, due to its distribution (all 3 regions), numbers (108 populations), and reduction in threats (increases in the number of protected and managed populations).

3.0 RESULTS

3.1 Recommended Classification: Downlist to Threatened.

3.2 New Recovery Priority Number: Retain as 8. No change is needed, the recovery priority number was recently changed from a 2 to an 8 which indicates the species has a moderate degree of threat and a high recovery potential.

3.3 Reclassification Priority Number: Reclassification priority number is 4. We have not been petitioned to reclassify running buffalo clover. The management impact/burden of this species being listed as endangered is considered moderate.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Conduct censuses on an annual basis where data gaps on population viability occur. (Recovery Action 1.4)
  A population cannot be considered viable for purposes of reclassification if fewer than 5 years of census data exist. Ohio and West Virginia have many sites with more than ten years of census data. States with newly discovered populations or states with less census effort should work towards conducting annual censuses until 5-10 years of data have been collected. Sites with ample data to indicate viability may be censused less frequently.

- Develop site specific protection and management agreements. (Recovery Action 1.3)
  For a population to be considered protected for purposes of reclassification, it needs to occur on land 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. Agreements can be in the form of a Memorandum of Understanding (MOU) between the landowner and the local U.S. Fish and Wildlife Service Field Office (see Appendix 1 for an example).

- Determine and implement appropriate habitat management techniques. (Recovery Actions 1.1 and 1.2)
  Although some management techniques such as mowing, grazing, and invasive plant control have been shown to be effective for maintaining populations of running buffalo clover, little experimental data exists. The number of known running buffalo clover populations is large enough to withstand some experimentation in developing effective techniques for managing the species. A small number of experimental sites should be established which utilize different management regimes. Such regimes

may include various forms of planned disturbance, such as livestock grazing, mowing, canopy reduction, and various techniques to control invasive plant species (hand pulling, weed-wacking, raking, etc.). A small number of experimental management sites should be established with the goal of developing practical long-term practices that conserve or enhance running buffalo clover populations. Regular monitoring and adaptive management should be practiced at all experimental management sites, where adaptive management is described as a continuous process implementing new knowledge and corrective actions, as necessary.

- Update the Population Viability Analysis (PVA)
  Additional census data should be added to the PVA. Populations that were not included in the analysis previously (USFWS 2007) could be included now if data gaps have been removed. Updating the PVA analysis can be a tool to assess the viability of populations for delisting purposes.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Trifolium stoloniferum*

Current Classification: **E**

Recommendation resulting from the 5-Year Review
Downlist to Threatened

Appropriate Recovery Priority Number: **8**
Appropriate Reclassification Priority Number: **4**

Review Conducted By: Sarena M. Selbo

FIELD OFFICE APPROVAL:
Lead Field Supervisor, Fish and Wildlife Service

Approve Mary Knapp Date 9/12/08
Mary M. Knapp, Ph.D.

REGIONAL OFFICE APPROVAL:
Assistant Regional Director, Ecological Services, Fish and Wildlife Service, Midwest Region

Approve Lynn M. Lewis Date 9/15/08

Acting **Cooperating Regional Director, Fish and Wildlife Service, Northeast Region**

Signature Thomas J Healy Date 11.19.08

Cooperating Regional Director, Fish and Wildlife Service, Southeast Region

Signature Jon Andrew Date 11-10-08