U.S. Fish and Wildlife Service

Draft Post-Delisting Monitoring Plan
for
Running Buffalo Clover
(Trifolium stoloniferum)

Prepared by:

U.S. Fish and Wildlife Service

Ohio Ecological Services Field Office

Columbus, Ohio

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I. Summary of Cooperator Roles in the Post-Delisting Monitoring Planning Effort

Post-delisting monitoring refers to activities undertaken to verify that a species delisted due to recovery remains secure from risk of extinction after the protections of the Endangered Species Act of 1973, as amended (Act; 16 U.S.C. 1531 et seq.) are no longer necessary. Section 4(g)(1) requires the U.S. Fish and Wildlife Service (Service) to implement a system in cooperation with the States to monitor effectively, for not less than five years, the status of all species that have recovered and been removed from the Federal List of Endangered and Threatened Wildlife and Plants (List). Section 4(g) of the Act explicitly requires cooperation with the States in development and implementation of post-delisting monitoring programs, but the Service remains responsible for compliance with section 4(g) and therefore, should remain actively engaged in all phases of the monitoring program.

The Service prepared this draft post-delisting monitoring (PDM) plan (Plan) for running buffalo clover (*Trifolium stoloniferum*) in coordination with the Ohio Department of Natural Resources Division of Natural Areas and Preserves (DNAP); the U.S. Forest Service, Wayne National Forest (WNF); Monongahela National Forest (MNF) Fernow Experimental Forest; Wildlife Diversity Program, West Virginia Division of Natural Resources; Indiana Department of Natural Resources, Division of Natural Resources; Missouri Department of Conservation; Pennsylvania Natural Heritage Program, Western Pennsylvania Conservancy; Eastern Kentucky University; and Kentucky State Nature Preserves Commission. The goals of the Plan are to (1) outline the monitoring program for both species abundance and threats and (2) identify when there are no longer concerns for running buffalo clover and the PDM plan requirements have been fulfilled. The PDM is designed to detect substantial changes in habitat occupied by running buffalo clover and declines in running buffalo clover occurrences with reasonable certainty and precision.

Running buffalo clover (RBC) occurs on Federal lands such as the Wayne National Forest, Monongahela National Forest, and Bluegrass Army Depot (BGAD), as well as on State-owned lands in Kentucky Ohio, Missouri, and West Virginia. There are also populations on property owned by local governments, such as Great Parks of Hamilton County in Ohio and the Dearborn County Farm in Indiana.

The role of non-Service partners is to review and provide comments on this post-delisting monitoring plan, monitor RBC populations according to the guidelines in the PDM, report information about existing populations using the agreed upon form, and report any newly discovered populations.

II. Summary of Species Status at Delisting

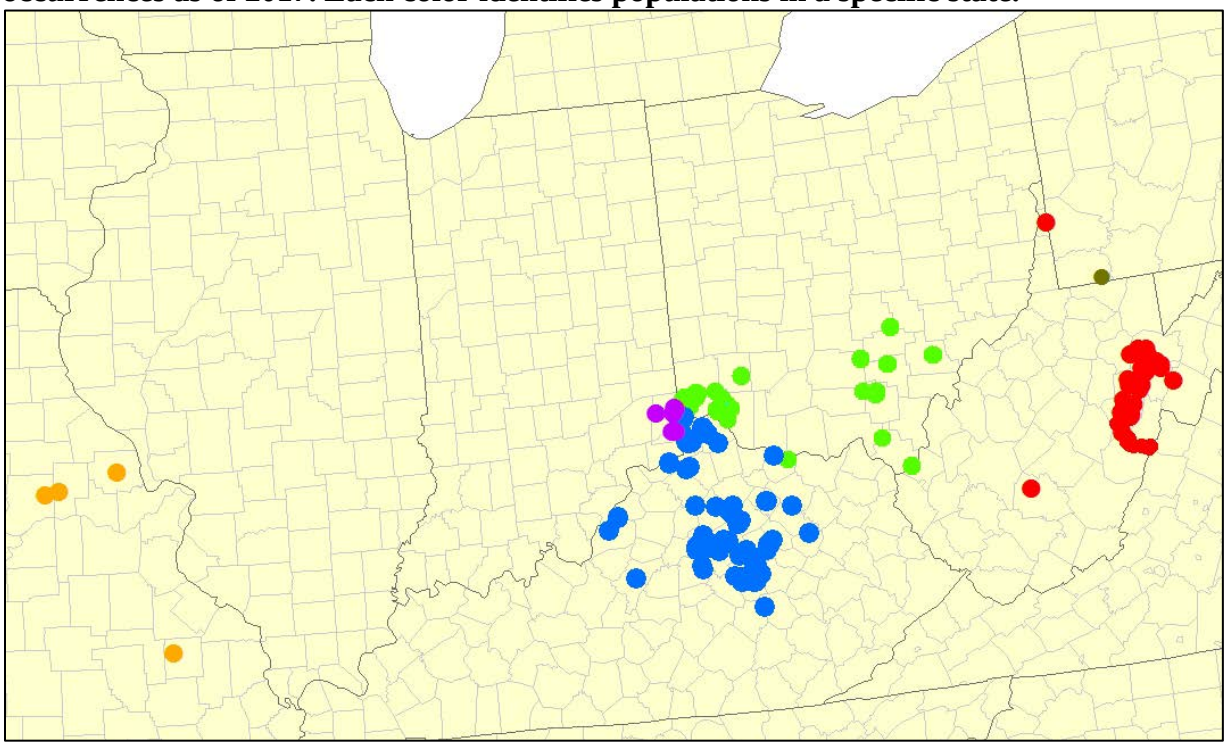
A. Demographic Parameters

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, selective logging, or flood-scouring. Sites that were recently found in West Virginia occur in *Crataegus* thickets and locust savannah communities (Short 2017, personal communication).

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. In West Virginia, sites have been identified on the Mauch Chunk Formation, which is primarily shale (Harmon 2016, personal communication). The species flowers from May through June. Seeds are most likely dispersed by gravity. Some seed may be consumed and distributed by herbivores such as deer or rabbits. This species does not produce a high amount of viable seed. Vegetative reproduction can occur if stolons are separated from the rooted crown and root at the node.

Running buffalo clover occurs in three ecoregions, as described by Bailey (1998): Hot Continental, Hot Continental Mountainous, and Prairie. For recovery purposes, the populations are divided into three regions based on proximity to each other and overall habitat similarities. These regions are Appalachian (West Virginia, Pennsylvania, and southeastern Ohio), Bluegrass (southwestern Ohio, central Kentucky, and Indiana), and Ozark (Missouri).

Figure 1. Current range of running buffalo clover, including locations of all known occurrences as of 2017. Each color identifies populations in a specific state.



B. Discussion of Populations

Populations consist of rooted crowns in proximity to one another. These populations are often identified as “elemental occurrences” in state heritage databases. Typically populations are separated from each other by a set distance or by unsuitable habitat.

Since the Recovery Plan was written in 2007, populations have been ranked based on the number of individual rooted crowns. For recovery purposes these populations have also been evaluated

based on viability and level of management commitment. Populations are considered "stable" if no change in rank occurred between the last 5-year review and the most current 5-year review. If the population ranking declined or there were threats to the site that were not being addressed, those populations were considered to be declining. The current ranking is primarily based on the population number. Threats to the site are considered when the population has not been monitored recently. In summary, A-ranked populations are those with 1,000 or more naturally occurring rooted crowns; B-ranked populations have between 100 and 999 naturally occurring rooted crowns; C-ranked populations have between 30 and 99 naturally occurring rooted crowns; and D-ranked populations have between 1 and 29 naturally occurring rooted crowns.

Based on information from the 2016 field season, there are a total of 152 extant, naturally occurring populations across all three recovery regions, and in 2017, this species was found for the first time in Pennsylvania, and additional populations were found in Missouri. The 152 populations are ranked as follows: A-ranked: 16 populations, B-ranked: 35 populations, C-ranked: 42 populations; and D-ranked: 59 populations (2017). Of the 152 extant populations, 74 (49% percent) are located on private land, with the remainder located on federal, state, or local park land. For all extant populations, 68 (45%) were considered to be viable. Viability as identified in the 2007 Recovery Plan includes: seed production, a stable or increasing population based on ten years of data, and appropriate management is occurring for the population. The viable populations include: 7 A-ranked populations, 13 B-ranked populations, 21 C-ranked populations, and 27 D-ranked populations.

Populations are considered to have management agreements if there is a formal agreement that prioritized management of RBC by the landowner of that population. Across the range, 23 sites currently have management agreements.

C. Residual Threats

Site protection and habitat management efforts by Missouri State Parks, Great Parks of Hamilton County, Wayne National Forest, Fernow Experimental Forest, Congress Green Cemetery, and other entities have reduced habitat degradation and competition of invasive species. We expect this to continue as the lands containing the 23 occurrences with management agreements will remain protected and will be managed to maintain suitable habitat conditions.

Canopy closure through natural succession is a threat to populations that are not managed. This threat increases slowly over time. However, natural processes, such as tree falls and flood scouring, will continue to maintain habitat suitability for the species. Nonnative species will also continue to affect some populations; however, invasive species are not a risk factor at all sites. Continued education of landowners on the importance of forest management will help to reduce these threats.

Populations that occur on private land continue to be threatened by development. Currently 74 out of 152 populations rangewide occur on private property, and 60 additional populations occur on publicly owned lands. Future surveys may detect new populations.

Small population size at individual sites continues to be a threat to some populations. However, some of these populations, when managed appropriately, are continuing to persist as stable C or D-ranked populations for years.

D. Legal and/or Management Commitments for Post-delisting Conservation

Twenty-three populations currently have management agreements to maintain habitat for the species and address threats. Twenty of these are owned by some type of public agency and 3 are privately owned. An additional 58 populations occur on publicly owned lands but do not have specific management plans. These sites receive a range of legal protection and management activities. We are confident that these occurrences on public land will continue to receive long-term protection from development, and delisting of RBC will not reduce these agencies' commitment to the conservation of the species.

Some populations occur on Federal lands, including lands owned by the U.S. Forest Service. RBC will continue to be protected on Forest Service land as a regionally sensitive species (RSS) for at least the next several years. In addition, due to the Forest Service's actions to promote native biodiversity, these species are expected to receive long-term consideration under forest plans.

RBC is also protected by various State laws. Ohio and Kentucky have similar laws against removal of plants. In Ohio, as a State-listed species, RBC cannot be removed within a permit from the Ohio Department of Natural Resources and the permission of the land owner. In Indiana, the Natural Resource Commission can consider listed plants if they have jurisdiction over a proposed project.

A total of 74 populations occur on privately-owned land. Three of these populations are protected with some type of management agreement. The other 71 have very limited protection form development.

III. Monitoring Methods and Locations

Post-delisting monitoring for RBC will be conducted annually in May through June for at least 5 years. PDM methods will be similar to those used previously. At each population, rooted crowns will be counted (or estimated for A-ranked populations), the number of flowering stems will be recorded, and estimates of percent flowering will be recorded on the RBC field monitoring form (Appendix B). Notes about recruitment of seedlings and other aspects of life history will also be recorded. Where populations are exceptionally large, such as A-ranked populations (these populations have over 1,000 individuals), an estimate of the total number of rooted crowns will be made based on extrapolation from a smaller sample area. In addition, photographs will be taken of visited occurrences and, when necessary, hand-drawn maps will be created to help with location of individual patches within the occurrences. Potential threats, such as the presence of invasive plants or changes in the composition of the surrounding forest, will be recorded as may be appropriate.

The following practices will be followed in order to minimize variability that could be introduced by inconsistent sampling practices:

- The entity conducting the PDM will be the same entity that has conducted previous monitoring for that population. These entities are familiar with RBC identification, population locations, and sampling procedures.
- The RBC field monitoring form (Appendix B) will be completed at each population. This will ensure that all necessary data are recorded for each population during each site visit.
- Monitoring will be completed during the period, May 1–June 30.
- All data sheets will be submitted to the Ohio Field Office

PDM will be initiated during the first growing season following the publication of a final rule to delist RBC and will extend, at a minimum, through the fifth growing season following delisting. There are currently a total of 51 A- and B-ranked populations. These populations have a minimum of 100 individuals. Each year 20 A- or B-ranked populations will be monitored so that all 100 A- and B-ranked populations will be scheduled to be monitored over the 5-year period. Agencies will have to seek permission from individual landowners to monitor privately-owned sites. If permission is not obtained, not all privately-owned sites may get monitored over the 5 years. A- and B-ranked populations are larger populations and as such are less vulnerable to stochastic events such as flooding or disease. In addition, these larger populations often occur in clusters of patches making it unlikely that all patches within a population would be impacted. Since these populations are more stable they are less likely to change rankings and therefore do not require as frequent monitoring.

There are currently a total of 101 C- and D-ranked populations, which are more likely to fluctuate. Due to seasonal variation and small population size, 34 C- or D-ranked populations will be monitored each year so that the C- and D-ranked populations will be scheduled to be monitored over 3 years. Agencies will have to seek permission from individual landowners to monitor privately-owned sites. If permission is not obtained, not all privately-owned sites may get monitored over the 5 years. These smaller populations are more susceptible to stochastic events and event normal population fluctuations can cause these populations to decline from C-ranked to D-ranked. These smaller populations may be found in a single patch and therefore may be more vulnerable to isolated incidents which impact small areas such as intensive grazing or dense invasive species colonization. Due to the increased potential for changes in ranking, these smaller populations are monitored more frequently with sites monitored approximately every 3 years. It is expected that all C- and D-ranked populations will be monitored at least once over the next 5 years and most sites will be monitored twice. Surveys will be conducted at 44 populations or approximately 43% of the populations each year as displayed in Table 1 (Appendix A).

In addition to monitoring the number of individuals in each population, other threats to the populations will be monitored. This includes habitat components, such as the disturbance regime and whether it is a natural (e.g., stream scour or flooding) or anthropomorphic (e.g., logging or mowing) disturbance.

Competition is also a threat and will be recorded. Invasive species presence/absence will be recorded as well as whether the levels are increasing or decreasing. Native species can also provide competition and may need to be managed.

High levels of canopy cover will produce shade that can make the habitat unsuitable for RBC. However, high levels of sun also are not ideal for RBC.

Some agencies have conducted seed collection either in an attempt to establish new populations or to seedbank seed for potential augmentation or restoration of existing populations. If seed collection is conducted or seed production is monitored, that information can also be included on the monitoring form.

IV. Definition of Response Triggers for Potential Monitoring Outcomes

Effective PDM requires timely evaluation of data and responsiveness to observed trends. In order to assure timely response to observed trends, it is necessary to identify possible outcomes from monitoring that could be anticipated and general approaches for responding to these scenarios. In order to identify thresholds that would trigger alternative responses in the case of RBC it will be necessary to analyze data from the pre-delisting monitoring period to identify the range of variability that has been observed with respect to each of the variables that will be monitored during the PDM period. From this analysis, it will be possible to categorize observations into one of the following three possible PDM outcomes.

A. Category I

RBC remains secure without protections of the Act. This would be true if:

1) The number of rooted crowns for each C- and D-ranked naturally occurring population remains above half of average value for 80% of those populations, and

2) No new or increasing threats (such as invasive species) to the species are observed, and

3) There is no net decrease in the number of A- and B-ranked populations.

In this case, PDM would be concluded at the end of the 5-year timeframe specified in this Plan.

B. Category II

RBC may be less demographically stable than anticipated at the time of delisting, but information does not indicate that the species meets the definition of threatened or endangered. These are indicators that the species may not be trending toward recovery as quickly as anticipated:

1) The average number of rooted crowns for C- and D-ranked naturally occurring populations falls below the 50th percentile of average values for 50% of those populations, and

2) There are no new or increasing threats (such as invasive species) that are considered to be of a magnitude and imminence that may threaten the continued existence of RBC within the foreseeable future, and

3) There is a net decrease in the number of A- and B-ranked populations of not more than 15%.

In this case, the PDM period should be extended for an additional five years, and if necessary, sampling intensity could be increased to provide greater precision in detecting trends. Existing data will be analyzed to determine if any management actions should be implemented that would be expected to reverse declines and stabilize or improve population trends for the species.

C. Category III

PDM yields substantial information indicating that threats are causing a decline in the status of RBC since the time of delisting, such that listing the species as threatened or endangered may be warranted. These are indicators that the species may not be trending toward recovery as quickly as anticipated and should be evaluated to see if the protections of the Endangered Species Act are still needed:

1) The average number of rooted crowns for C- and D-ranked naturally occurring populations falls below the 50th percentile of average values for 80% of those populations, or

2) There are new or increasing threats (such as invasive species) that are considered to be of a magnitude and imminence that they could threaten the continued existence of RBC within the foreseeable future, or

3) There is a net decrease in the number of A- and B-ranked populations of more than 30%.

If any of these conditions are true, then the Service should initiate a formal status review to assess changes in threats to the species and changes in its abundance and distribution to determine whether a proposal for relisting is appropriate. Existing data will be analyzed to determine if any management actions should be implemented that would be expected to reverse declines and stabilize or improve population trends for the species.

V. Data Compilation and Reporting Procedures

Annual reports summarizing the PDM activities accomplished, data collected, and results will be submitted to the Service's Ohio Ecological Services Field Office. These reports will be prepared in a timely manner to ensure that adequate data are being collected, to allow evaluation of the efficacy of the monitoring program, and to provide a periodic assessment of the status of RBC. Each annual report will synthesize all monitoring data and comment on observed trends and status of RBC with respect to management and the presence of threats. After five years of data are available, the field collection data will be reviewed to determine overall population change and status with respect to threats to the species. The Service will compile the data contained in each annual report into a final monitoring report that will be available to the public. The final monitoring report will summarize the data in the annual reports and will include a description of the geographic areas surveyed, the survey protocol, and updated population numbers for each occurrence surveyed.

If response triggers in Section IV are met or exceeded, the Service will consult with DNAP, WNF, and other partners to determine whether to conclude the PDM process or to pursue the management actions as described in Section IV. Our review will also include, if necessary, an evaluation of the threats to RBC using the five factors required under the Act to list a species on the Federal List of Threatened and Endangered Species.

VI. Estimated Funding Requirements and Sources

Post-delisting monitoring is a cooperative effort among the Service, other Federal agencies, state, local park districts, and other non-governmental partners under the Act. Although the Act authorizes expenditures of both recovery funds and section 6 grants to the States to plan and implement PDM, Congress has not allocated nor earmarked any special funds for this purpose. To the extent feasible, the Service may provide funding for PDM efforts from annual Endangered Species general Recovery Program appropriations, if they are available. Nonetheless, nothing in this Plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in contravention of the Anti-Deficiency Act (31 U.S.C. § 1341) or any other law or regulation.

The primary entity compiling the PDM data and preparing reports will be the Service's Ohio Field Office. This office will provide assistance as resources permit. Annual costs to the Ohio Field Office are not expected to exceed $5,000 annually for time spent assisting in monitoring of sites, coordinating monitoring efforts, compiling reports, and providing technical assistance as needed. The ODNR DNAP expects to assist in monitoring of 8 populations that occur on state land. The annual cost to ODNR DNAP is expected to be approximately $2,500 annually. This does not include costs associated with management of these sites. The West Virginia Department of Natural Resources, Missouri Department of Conservation, and Kentucky State Nature Preserves Commission also periodically monitor RBC as personnel and funding allows.

VII. PDM Implementation Schedule

The implementation schedule was developed in coordination with Ohio Department of Natural Resources Division of Natural Areas and Preserves; Monongahela National Forest, Fernow Experimental Forest; Wildlife Diversity Program, West Virginia Division of Natural Resources; Indiana Department of Natural Resources, Division of Natural Resources; Missouri Department of Conservation; Pennsylvania Natural Heritage Program, Western Pennsylvania Conservancy; and Kentucky State Nature Preserves Commission in order to ensure that it was more feasible to accomplish and yet provided sufficient data to determine the status of running buffalo clover . See Appendix A for the suggested Monitoring Schedule of Running Buffalo Clover Populations.

VIII. Literature Cited

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Appendix A – Monitoring Schedule of Running Buffalo Clover Populations

Monitoring Schedule of A and B Ranked Populations

State	Population	2016 Ranking	1st	2nd	3rd	4th	5th
KY	Adair WMA	A	X				
KY	BGAD 34	A		X			
KY	BGAD 46	A			X		
KY	Scrubgrass Creek	A				X	
KY	Ashland	B					X
KY	Beaver Branch	B	X				
KY	BGAD40	B		X			
KY	BGAD 51	B			X		
KY	BGAD 56	B				X	
KY	BGAD 59	B					X
KY	BGAD64	B	X				
KY	Dinsmore Cemetery; Middle Creek Park	B		X			
KY	Kleber WMA	B			X		
KY	Montogmery Co	B				X	
KY	Upper Howards Creek	B					X
KY	Willsrupard Rd	B	X				
OH	Boch Hollow SNP (Hocking County)	A		X			
OH	Shawnee Lookout: Miami Fort	A			X		
OH	Baker Easement	B				X	
OH	Coalton WA East (Jackson County)	B					X
OH	Coalton WA West (Jackson County)	B	X				
OH	Lake Katherine Pine Ridge	B		X			
OH	Morgan's Riverside Campground	B			X		
OH	MWF: Shaker Trace Bike Trail	B				X	
OH	Shawnee Lookout: Oxbow	B					X
OH	Wayne NF: Lawrence	B	X				
OH	Wayne NF: Vinton	B		X			
WV	Beverage Road	A			X		
WV	Bowden	A				X	
WV	Crouch Knob	A					X
WV	Elk Mountain	A	X				
WV	Fernow	A		X			
WV	Laurel Mountain, Aggregates	A			X		
WV	McGee Run-Back Fork Tribs	A				X	
WV	Pond Lick Mountain	A					X
WV	Tallow Knob, Gibson Knob	A	X				
WV	White Oak Fork	A		X			
WV	Buckeye Creek Trib	B			X		
WV	Clover Creek	B				X	
WV	Coberly Sods North	B					X
WV	Laurel Mountain, Clay Lick Run	B	X				
WV	Leading Ridge, Glenmore	B		X			
WV	McGowan Mountain	B			X		
WV	Millstone Run	B				X	
WV	Mingo Run	B					X
WV	Mowry Run	B	X				
WV	Rafe Run (Westvaco Wuchner Tract 801)	B		X			
WV	Rattlesnake Run, Baker Sods	B			X		
WV	Rich Mountain West, Microwave	B				X	
WV	Spruce Run	B					X

Monitoring Schedule of C and D Ranked Populations

State	Population	2016	1st	2nd	3rd	4th	5th
IN	Dearborn County Farm	C	X			X	
IN	Doublelick Run	C		X			X
IN	Glenn Woods Lane	D			X		
IN	Greendale	D	X			X	
IN	Henschen Branch	D		X			X
IN	Hidden Valley	D			X		
KY	Barry Bingham Property	C	X			X	
KY	Beasley Creek	C		X			X
KY	BGAD 52	C			X		
KY	BGAD 63	C	X			X	
KY	Big Bone at Dark Hollow	C		X			X
KY	Big Bone Lick SP East	C			X		
KY	Big Bone Lick SP West	C	X			X	
KY	Clear Creek Tributary	C		X			X
KY	Eagle Creek	C			X		
KY	Garrison Creek	C	X			X	
KY	Lower Howards Creek	C		X			X
KY	Mount Zion Road	C			X		
KY	Phillips Creek	C	X			X	
KY	Stephens Branch	C		X			X
KY	Veterans Memorial WMA	C			X		
KY	Wolf Pen Branch	C	X			X	
KY	Across from Big Bone Lick State Park	D		X			X
KY	Ashby's Fork	D			X		
KY	BGAD 35	D	X			X	
KY	BGAD 50	D		X			X
KY	BGAD Muddy Creek	D			X		
KY	Big Farm WMA	D	X			X	
KY	Brush Creek	D		X			X
KY	Clear Creek	D			X		
KY	Iroquois Hunt Club	D	X			X	
KY	Landing Creek	D		X			X
KY	Larchmont Farm	D			X		
KY	Little Clover Creek	D	X			X	
KY	Lulbregrud North	D		X			X
KY	Paris Pike North	D			X		
KY	Silver Creek	D	X			X	
KY	Spears House	D		X			X
KY	West side of Boonesboro Rd.	D			X		
KY	Camp Michaels Boy Scout Camp	D	X			X	
MO	Crow's Fork Creek (Mudd Property)	C		X			X
MO	Cuivre River State Park Site 1	C			X		
MO	Cuivre River State Park site 2	C	X			X	
MO	Graham Cave State Park	D		X			X
MO	Van Dyke Property	D			X		

Monitoring Schedule of C and D Ranked Populations

State	Population	2016	1st	2nd	3rd	4th	5th
OH	Ault Park	C	X			X	
OH	Brown County	C		X			X
OH	Congress Green	C			X		
OH	Gatch	C	X			X	
OH	Lake Katherine: Salt Creek	C		X			X
OH	Mitchell Memorial: East	C			X		
OH	Pike County	C	X			X	
OH	Richardson Forest Preserve	C		X			X
OH	Sharon Woods	C			X		
OH	Tar Hollow State Forest	C	X			X	
OH	AEP Lic-Addison	D		X			X
OH	Cincinnati Nature Center 2016	D			X		
OH	Fankhauser	D	X			X	
OH	MWF Bowles Woods	D		X			X
OH	MWF Lake	D			X		
OH	Mitchell Memorial: Wood Duck	D	X			X	
OH	Newberry	D		X			X
OH	Shawnee Lookout: Bobcat Ridge	D			X		
OH	Shawnee Lookout: Cabin View	D	X			X	
OH	Shawnee Lookout: Little Turtle Trail	D		X			X
OH	SR 32 (Lunken Connector Trail)	D			X		
OH	Warder-Perkins/Niehaus	D	X			X	
WV	Brushy Run	C		X			X
WV	Clover Creek	C			X		
WV	Cotton Hill	C	X			X	
WV	Dry Fork of the Elk River	C		X			X
WV	Hoe Lick Run	C			X		
WV	Laurel Mountain	C	X			X	
WV	Laurel Mountain, Mill Creek	C		X			X
WV	Linwood	C			X		
WV	Rich Mountain East: Snyder Run	C	X			X	
WV	Rich Mountain West: Lookout Tower	C		X			X
WV	Right Fork Files Creek	C			X		
WV	Shaver's Fork: Floodplain	C	X			X	
WV	Shaver's Fork: Porterwood	C		X			X
WV	Valley Fork	C			X		
WV	Valley Mountain, Dry Fork	C	X			X	
WV	Wolf Run	C		X			X
WV	Alpena -Schimdlen Farm	D			X		
WV	Briery Mountain	D	X			X	
WV	Buzzard Ridge	D		X			X
WV	Camp Run	D			X		

Monitoring Schedule of C and D Ranked Populations

State	Population	2016	1st	2nd	3rd	4th	5th
WV	Franklin	D	X			X	
WV	Kelley Mountain Quarry	D		X			X
WV	Kingwood	D			X		
WV	Left Fork of Clover Run	D	X			X	
WV	Parsons	D		X			X
WV	Rattlesnake Run, Lower John's Run	D			X		
WV	Rattlesnake Run, Upper John's Run	D	X			X	
WV	Rich Mountain East: Brush Heap	D		X			X
WV	Rich Mountain West, Mill Creek	D			X		
WV	Rich Mountain West, Quarry	D	X			X	
WV	Right Fork Chenoweth Creek	D		X			X
WV	Right Fork Pierce Run	D			X		
WV	Seneca Creek	D	X			X	
WV	Shaver's Mountain	D		X			X
WV	Sunny Day Pit	D			X		

Appendix B – Running Buffalo Clover Field Monitoring Form

Running buffalo clover Monitoring Form

Observer: ☐ **Date:** ☐ **State:** ☐ **EO#:** ☐

Site Name: ☐ **Previous Ranking (circle): A B C D**

A=1,000+; B=100-999; C=30-99; D=<29 rooted crowns

A. Population Information:

Are there more than 100 rooted crowns? YES ☐ NO ☐

If No: Enter Number of rooted crowns: ☐

Enter the number of flowering stems: ☐

If Yes: Count up to 500 rooted crowns

If less than 500:

Enter number of rooted crowns: ☐

Enter number of flowering stems: ☐

If none flowering check here: ☐

If more than 500:

Estimate number of rooted crowns: ☐

Estimate number of flowering stems: ☐

If none flowering check here: ☐

B. Disturbance Regimen:

Is disturbance (management) occurring? YES ☐ NO ☐

Is disturbance (management) expected to continue for the next 5 years? YES ☐ NO ☐

C. Invasive species/competition:

Are invasive species present? YES ☐ NO ☐

Are the levels of invasive species increasing? YES ☐ NO ☐

Are native species outcompeting running buffalo clover? YES ☐ NO ☐

Is there a need for management at the site? YES ☐ NO ☐

D. Canopy Cover:

Is the canopy cover greater than 95 %? YES ☐ NO ☐

If yes, selective harvest is recommended.

If no, no additional action required.

Is the canopy cover less than 15 %? YES ☐ NO ☐

If yes, understory recruitment is needed.

If no, no additional action required.

E. Seed Production:

Date of trip to check seed production: ☐

Was any seed produced? YES ☐ NO ☐

What percentage of flowers produced seed? 0.00%

Has seed from this population been banked at an appropriate facility? YES ☐ NO ☐

F. Management Recommendations:

Is the site being managed according to USFWS management protocol/recommendations?

YES☐ NO☐

G. Other concerns:

H. What is the total number of red boxes checked?

Current Ranking (circle): A B C D **Is this a decrease in ranking? YES☐ NO☐**

Is this a decrease in number of individuals?

YES☐ NO☐

Were photos of the site taken? YES☐ NO☐

If photos were taken please file with this form.

Please provide coordinates or a map of the site below:

Appendix C. Recommended Rangewide Management Actions for Running Buffalo Clover (*Trifolium stoloniferum*)

Recommended Rangewide Management Actions for Running buffalo clover (*Trifolium stoloniferum*)

Maintain Filtered Sunlight:

Running buffalo clover does not grow well in areas of open sun or complete shade. Suitable habitat will provide partially filtered sunlight. Ideally canopy coverage should be maintained between 15 and 95 %. For heavily forested sites tree thinning may be required. For other sites where trees may be in a significant decline due to pests (such as the emerald ash borer) and disease, tree planting may be required.

Maintain Periodic Moderate Disturbance:

Running buffalo clover is a disturbance adapted species and some level of disturbance is required to maintain populations. Naturally occurring disturbances such as periodic flooding should be maintained. Other naturally occurring events such as tree falls and animal trails can also provide some limited disturbance. The less intensive the disturbance the more frequently it needs to occur. An example would be a population disturbed by a deer trail or pedestrian use. These types of trails may be used weekly if not daily. A high intensity disturbance such as selective logging should occur over an interval of approximately 14 years (Burkhart 2013).

Some types of disturbance and recommendations for levels of disturbance are listed below.

Deer and pedestrian use of trails may occur as frequently as daily.

Periodic flooding and stream scour levels should be maintained. Depending on the site, flooding may occurs once or multiple times per year. More intensive stream scour may occur every couple of years. However, extreme scour that alters the stream and adjacent topography can be detrimental and has resulted in the loss of a population in Ohio.

Very light grazing can be used to maintain disturbance in areas with appropriate canopy cover (Perkins 2015).

Mowing plants prior to blooming and after seed set will reduce competition. In areas with micro-topography the mower blade may also scrape the soil and improve seed germination. For sites with significant micro-topography, mowing may be used to sustain the population for the long-term. Mowing with a brush hog on an annual basis maybe sufficient to reduce competition. For other sites that are more lawn like, an early spring mow can reduce competition, while regular mowing may be resumed after the plants have set seed (Becus and Klein 2002).

Light ATV use, which does not create ruts or erosion, can provide disturbance and provide exposed soil for seed germination. ATV use should occur several times every year to maintain disturbance.

Some running buffalo clover populations occur along gravel roads and trails. Re-grading actions every other year or every 2 years can provide the required level of disturbance for these sites.

Periodic selective logging and the disturbance associated with log landings and skid road and skid trails may scour the soil and expose seeds as well as reduce competition in areas of disturbance. While these disturbances may cause a temporary decline in running buffalo clover, the population usually increases two years later (Madarish and Schuler 2002). Populations that had been disturbed by logging activity within the last 14 years had the highest density of plants on the Fernow Experimental Forest (Burkhart 2013). Uneven-aged forest management such as single-tree selection and other partial harvesting are appropriate. Sites that have not been disturbed within the last 20 years are unlikely to support running buffalo clover (Burkart 2013). Based on the research at Fernow Experimental Forest, forest management activities such occur at an interval of 8-14 years (Burkhart 2013).

Prescribed fire is not recommended as method of disturbance.

Reduction of competition:

For most sites the periodic disturbance and removal or control of invasive species is enough to reduce competition. However, for some sites, aggressive native species can also be a threat and may need to be maintained. Some native competitive species that have threatened running buffalo cover sites include: wingstem (*Verbesina alternafolia*) and ground ivy (*Glechoma hederacea)*. If these species are at a running buffalo clover site, they should be monitored.

Remove or control invasive species:

Invasive species create significant competition, reducing the viability of RBC populations. Japanese stiltgrass (*Microstegium vimineum)* is present at multiple sites in Ohio as well as West Virginia. Once this species is present it often produces prolific amounts of seed. Thus, existing running buffalo clover plants are impacted as well as many future generations as management must then occur annually to limit the impacts of the invasive species. *Rosa multiflora* is a treat at sites in both West Virginia and Missouri.

Invasive species can be treated with a variety of methods from hand pulling to selective herbicide.

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