Final 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

April 2021

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Acknowledgements:
The Post-delisting Monitoring Plan for Running Buffalo Clover was prepared by biologists of the U.S. Fish and Wildlife Service (Jenny Finfera, Ohio Ecological Services Field Office). We wish to acknowledge assistance that we received in preparing this plan from Marjie Becus, volunteer with the Ohio Department of Natural Resources; Richard Gardner of the Ohio Department of Natural Resources, Division of Natural Areas and Preserves; and Paul Harmon of the West Virginia Division of Natural Resources.

Recommended Citation:
U.S. Fish and Wildlife Service. 2021. Final post-delisting monitoring plan for Running Buffalo Clover (*Trifolium stoloniferum*). U.S. Fish and Wildlife Service, Ohio Ecological Services Field Office, Columbus, Ohio. 24 pp.

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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; West Virginia Division of Natural Resources, Wildlife Diversity Program; 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, (2) determine if protected sites are being managed sufficiently, and (3) 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. Other sites occur on land owned by private individuals or corporations. Just over half of populations occur on privately owned land, with most of these sites being vulnerable to destruction.

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, describe any new or increasing threats, and report any newly discovered populations to their respective state agency that has authority over plants and to their local field office of the U.S. Fish and Wildlife Service.

II. Summary of Species Status at Delisting

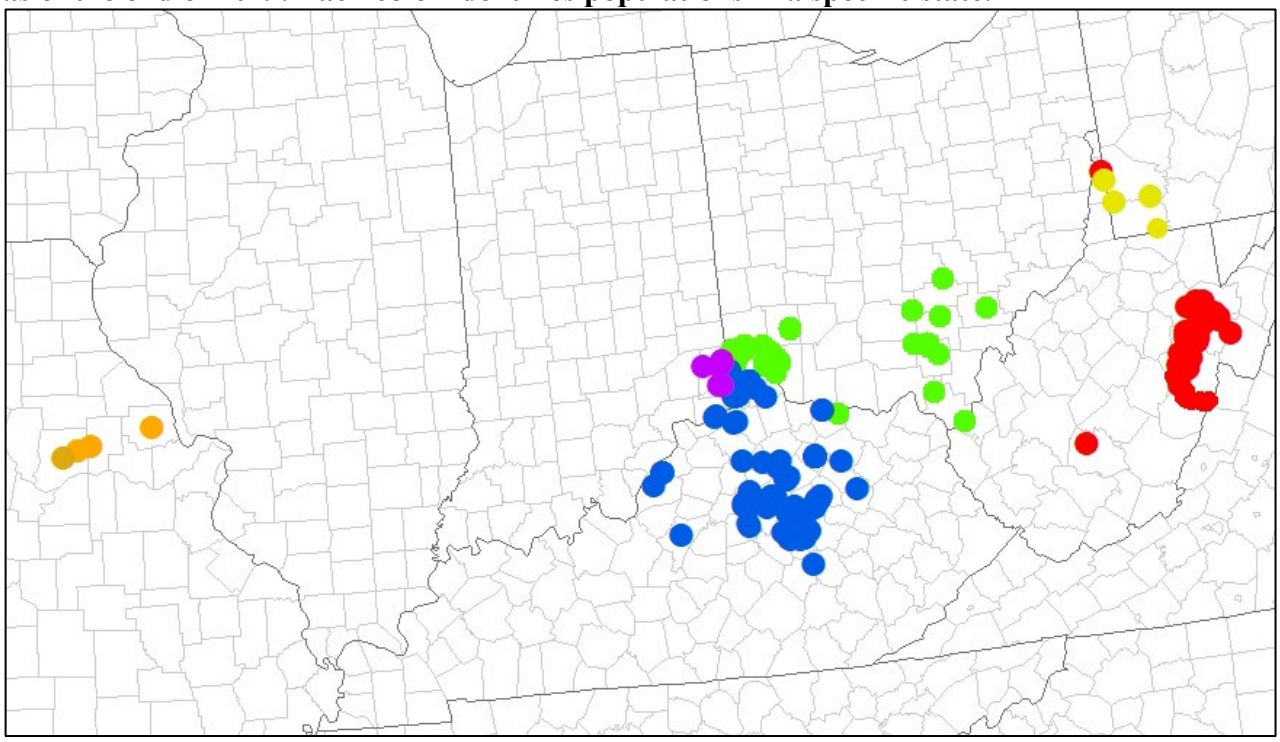
A. Demographic Parameters

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 July depending on elevation and local conditions. 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 the end of 2019. 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 (Ohio uses ½ mile) or by unsuitable habitat.

Since the Recovery Plan First Revision 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 as adequate information on the level of threats is usually lacking. 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, and new population discoveries since that time, there are a total of 175 extant, naturally occurring populations across all three recovery regions. In 2017, this species was found for the first time in Pennsylvania, and additional populations were found in Missouri. A few additional populations have been identified in Pennsylvania in recent years. The 175 populations are distributed as follows: approximately 10% are A-ranked, 27% are B-ranked, 23% are C-ranked, and 40% are D-ranked. Of the 175 extant populations, 88 (50% percent) are located on private land, with the remainder located on federal, state, or local park land.

For all extant populations, based on information from the 2016 field season, 69 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, 14 B-ranked populations, 21 C-ranked populations, and 27 D-ranked populations as of the 2016 field season. Populations discovered within the last 10 years do not have long-term trend data available and therefore cannot currently be considered viable. Viable A- and B-ranked populations count toward delisting criteria 2.

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, 22 sites currently have management agreements.

C. Residual Threats

Site protection and habitat management efforts by Congress Green Cemetery, Ohio Department of Natural Resources Division of Natural Areas and Preserves, Great Parks of Hamilton County, Wayne National Forest, Fernow Experimental Forest, Missouri State Parks, and other entities have reduced habitat degradation and competition of invasive species. We expect that the 22 populations with management agreements will remain protected and will be managed to maintain suitable habitat conditions. In addition, another 66 populations occur on public land and are protected from some forms of destruction and development.

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 some populations of this 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 and addressing nonnative, invasive species will help to reduce these threats.

Populations that occur on private land continue to be threatened by development. New populations may be discovered by amateur botanists as well as botanical surveys. Currently, slightly more than half of populations rangewide occur on private property, and the remaining occur on publicly owned lands, such as state and local parks, state nature preserves and national forests. Because this species will remain a state-listed species in some states (Missouri and Pennsylvania), it may be protected from some forms of development in those states.

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-two populations currently have management agreements to maintain habitat for the species and address threats. An additional 66 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 the Wayne National Forest 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, this species is expected to receive long-term consideration under forest plans for both the Wayne National Forest and Monongahela National Forest.

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 without a permit from the Ohio Department of Natural Resources and the permission of the landowner. In Indiana, the Natural Resource Commission can consider listed plants if they have jurisdiction over a proposed project.

Just over half of all RBC populations occur on privately owned land and have very limited protection from development and other habitat destruction.

III. Monitoring Methods and Locations

Post-delisting monitoring for RBC will be conducted annually in May through July, based on local conditions, for at least 5 years. Most states conduct monitoring in May or June. However, due to the elevation of the sites where RBC is frequently found in WV, monitoring in that state is usually conducted in July. 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 C). Notes about recruitment of seedlings and other aspects of life history will also be recorded as well as threats to the population, and if the site is managed, a determination if it is being managed appropriately. 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 or forest cover, will be recorded.

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

- The entity conducting the PDM should be the same entity that has conducted previous monitoring for that population. These entities are familiar with RBC identification, population locations, and sampling procedures. If these entities can no longer monitor that population, they should train those who will be monitoring the population.

- The RBC field monitoring form (Appendix C) 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 of May–July, depending on local conditions.
- Copies of all data sheets will be submitted to the Ohio Field Office on an annual basis to track trends.

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.

All 21 viable A- and B-ranked populations, as well as all 22 populations that are protected by management agreements, will be monitored approximately every other year over the PDM period. These populations are listed in Appendix A. Due to some overlap between the viable and managed populations, the number of unique populations that meets either of these criteria is 37.

By monitoring all viable A- and B-ranked populations, we ensure that delisting criterion 2 continues to be met.

All populations that are currently protected by management agreements (and any additional populations that become protected during the post-delisting monitoring period) will be monitored approximately every other year. Monitoring of these populations will ensure that management agreements are adequately addressing current and future threats to these populations. Most of these protected sites are on public land, such as State Nature Preserves. Frequent monitoring of these sites will provide an indication if local weather conditions, such as drought or excessive rainfall, are impacting populations. These populations are also listed in Appendix A.

In addition to the frequent monitoring of the populations described above, approximately 40 additional unprotected sites (Appendix B) will be monitored over the post-delisting monitoring period. These should be selected so that the total number of protected and unprotected sites monitored each year should be representative of the distribution between public and private sites. In addition, the unprotected sites should be selected so that monitoring of all populations corresponds to the representative percentage of A-, B-, C-, and D-ranked populations mentioned above.

Of the 40 additional populations to be monitored, A- and B-ranked populations are the most stable; therefore, those that are not protected by management agreements are expected to be monitored only once during the post-delisting monitoring period. However, we encourage additional monitoring of these sites if time and resources permit. C- and D-ranked populations are smaller and more likely to have seasonal variability. Unprotected C- and D-ranked populations should be monitored a minimum of at least twice during the post-delisting monitoring period. Monitoring of these 40 populations without management agreements will provide information on slightly less than 25% of the rangewide population. In addition, this will provide much needed information on C- and D-ranked populations that occur on unprotected land and are most at risk of decline.

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.

Approximately 63% of all populations are C- or D-ranked, which are more likely to fluctuate. These smaller populations are more susceptible to stochastic events, and even normal population fluctuations

can cause these populations to alternate between C-ranked and D-ranked. These smaller populations may be found in a single patch and therefore may be more vulnerable to isolated incidents, such as intensive grazing or dense invasive species colonization, which impact small areas. Due to the increased potential for changes in ranking, these smaller populations are monitored more frequently. Due to seasonal variation and small population size of C- or D-ranked populations, we encourage these populations that are selected for monitoring to be monitored at least twice over the post-delisting monitoring period.

Agencies will have to seek permission from individual landowners to monitor privately owned sites. If permission is not obtained, the percentage of privately owned populations that get monitored over the post-delisting monitoring period may be less than desired. Public sites may be substituted for these sites instead.

Surveys of 40 populations (slightly less than a quarter of the rangewide populations) without management agreements will occur over the post-delisting monitoring period. These sites will be selected from currently extant populations identified in the 2017 5-Year Review. In addition, all viable A- and B-ranked populations and all ranked populations with management agreements will be monitored over the post-delisting monitoring period, providing information on a total of 77 individual populations or slightly less than half of the total rangewide populations of 175.

Additional populations may be protected with management agreements as draft agreements are finalized during the PDM period. Once these populations are protected, they will follow the monitoring protocol recommended for populations protected with management agreements.

In addition to monitoring the number of individuals in each population, other threats to the populations will be monitored. These include 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.

Vegetative competition is a threat to RBC 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. Canopy levels can be manipulated to provide the appropriate levels of light.

Some agencies have conducted seed collection either to establish new populations or to store 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 21 A- and B- ranked viable populations continue to remain viable, and

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

3. The number of rooted crowns for C- and D-ranked naturally occurring populations remains above 50% of the average value for all of those populations, and

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

5. For those populations that have a management agreement, management is occurring as identified in the agreement.

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 as stable as anticipated:

1. The number of viable A- and B-ranked populations decreases to a total of 8 or less, or

2. There is a net decrease in the number of A- and B-ranked populations to 8 or less, or

3. The number of rooted crowns for C- and D-ranked naturally occurring populations falls below 50% of the average values for more than 50% of those populations, or

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

5. For those populations that have a management agreement, management is not occurring as identified in the agreement and threats are increasing.

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 should be evaluated to see if the protections of the Endangered Species Act are needed:

1. The number of viable A- and B-ranked populations decreases to 4 or less, or

2. There is a net decrease in the number of A- and B-ranked populations to a total of 4 or less, or

3. The average number of rooted crowns for C- and D-ranked naturally occurring populations falls below 50% of average values for more than 75% of those populations, or

4. 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

5. For those populations that have a management agreement, management is not occurring as identified in the agreement and threats at those populations are increasing so that 17 or fewer populations with management agreements are having threats addressed.

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 immediately that would be expected to reverse declines and stabilize or improve population trends for the species.

V. Data Compilation and Reporting Procedures

Copies of documents summarizing the PDM activities accomplished, data collected, and results will be submitted to the Service's Ohio Ecological Services Field Office. These documents 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 year the Ohio Field Office of the Service will compile an annual report, which 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 and annual reports 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 census numbers for each population surveyed.

If response triggers in Section IV are met or exceeded, the Ohio Field Office will consult with Service field offices and State and other partners in Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia 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, States, 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 $10,000 annually for time spent assisting in monitoring of sites, coordinating monitoring efforts, compiling reports, and providing technical assistance as needed. The Ohio Department of Natural Resources Division of Natural Areas and Preserves (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 allow.

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; West Virginia Division of Natural Resources, Wildlife Diversity Program; 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 to ensure that PDM is feasible to accomplish and yet provides sufficient data to determine the status of running buffalo clover. See Appendix A and B for the suggested Monitoring Schedule of Running Buffalo Clover Populations.

VIII. Literature Cited

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Appendix A: 37 Running Buffalo Clover Populations that are Viable and A- or B-ranked or have Management Agreements and will be monitored at least twice during the PDM period.

State	Population	EO #	Viable	Management Agreement
KY	Dinsmore	1	Yes	
KY	Ashland	2	Yes	
KY	BGAD 34	34	Yes	Yes
KY	BGAD 35	35		Yes
KY	BGAD 40	40		Yes
KY	BGAD 46	46	Yes	Yes
KY	BGAD 50	50		Yes
KY	BGAD 51	51	Yes	Yes
KY	BGAD 52	52		Yes
KY	BGAD 56	56	Yes	Yes
KY	BGAD 59	59	Yes	Yes
KY	BGAD 61	61		Yes
KY	BGAD 63	63		Yes
KY	BGAD 64	64	Yes	Yes
KY	Montgomery Co 93	93	Yes	
KY	Beaver Branch	102	Yes	
KY	Scrubgrass Creek	116	Yes	
OH	Congress Green	1		Yes
OH	SL Miami Fort	3	Yes	
OH	Boch Hollow Nature Preserve	30		Yes
OH	Lake Katherine Salt Creek	35		Yes
OH	Coalton WA East	37		Yes
OH	Coalton WA West	38		Yes
OH	Lake Katherine Pine Ridge	39		Yes
OH	Baker Easement	41		Yes
OH	Coalton WA Johnstown	57		Yes
OH	Wayne NF: Lawrence	29		Yes
OH	Wayne NF: Vinton	36		Yes
WV	Rich Mountain West, Microwave	11	Yes	
WV	MNF: Baker Sods/Upper John's Run/Rattlesnake Run	13	Yes	
WV	MNF: Bowden/Bickle Run	17	Yes	
WV	MNF: Fernow	20	Yes	
WV	MNF: McGee Run-Back Fork Tribs	24	Yes	
WV	Mowry Run	28	Yes	
WV	Rafe Run (Westvaco Wuchner Tract 801)	32	Yes	
WV	Millstone Run	35	Yes	
WV	MNF: Coberly Sods North	40	Yes	
Total		**37**	**21**	**22**

Appendix B: Running Buffalo Clover Populations which 40 sites may be selected for monitoring.

State	Population	EO #	Recent Rank
IN	Dearborn County Farm		C
IN	Doublelick Run		C
IN	Greendale		D
IN	Henschen Branch		D
IN	Hidden Valley		D
IN	Water Tower (Hidden valley)		D
KY	Ashbys Fork	24	D
KY	Thompson House	27	B
KY	Spears House	28	D
KY	Mt. Zion Road	30	C
KY	Paris Pike	76	D
KY	Silver Creek	77	D
KY	Clear Creek	80	D
KY	Adair WMA	81	A
KY	Larchmont farm	82	D
KY	Big Bone Lick SP East	85	B
KY	Big Bone Lick SP West	86	B
KY	Little Clover Creek	87	C
KY	Willsrupard Road	89	B
KY	Wolf Pen Branch	90	B
KY	Iroquois Hunt Club	91	D
KY	Lower Howards Creek	92	B
KY	Lulbegrud Creek	94	D
KY	Upper Howards Creek	95	B
KY	Big Bone at Dark Hollow	101	C
KY	Barry Bingham Property	104	C
KY	Phillips Creek	105	C
KY	Brush Creek	106	D
KY	Garrison Creek	107	C
KY	Eagle Creek	109	C
KY	Clear Creek Tributary	110	C
KY	Veterans Memorial	111	B
KY	Landing Creek	112	C
KY	Across from Big Bone Lick State Park	113	D
KY	Stephens Branch	114	C
KY	West side of Boonesboro rd	115	D
KY	Kleber WMA	118	D
KY	Beasley Creek/EKPC	121	B
KY	Big Farm WMA	122	C
KY	Camp Michaels Boy Scout	123	B
KY	Sleepy Hollow Conservancy/Kenton WMA	126	C
KY	Kenton Conservancy	129	D

State	Population	EO #	Recent Rank
MO	Crow's Fork Creek		C
MO	Cuivre River State Park 1		C
MO	Cuivre River State Park 2		C
MO	Graham Cave State Park (Sugar Creek)		D
MO	Van Dyke Property		D
OH	Fankhauser	4	D
OH	MWF Bowles Woods	5	D
OH	Newberry	11	D
OH	SL Bobcat/Cabin View	12	D
OH	Warder-Perkins/Niehaus	13	D
OH	Mitchell Memorial Silver Lake	16	D
OH	SL Oxbow	17	D
OH	MWF Lake property	18	D
OH	Ault Park	21	D
OH	Mitchell Memorial Wood Duck Trail	22	C
OH	Richardson Forest Preserve Beckmeyer Tract	23	D
OH	SL Little Turtle Trail	24	D
OH	Brown Co.	26	D
OH	Sharon Woods	31	D
OH	SR 32 (Lunken Connector Trail)	32	D
OH	Morgan's Campground	33	B
OH	Tar Hollow State Forest	34	B
OH	Gatch	40	D
OH	Pike County (Hunting Club)	43	D
OH	Cincinnati Nature Center 2	45	C
OH	MWF Shaker Trace	46	B
OH	AEP Lic-Addison	47	D
OH	Hyde Park (Weebetook)	54	D
OH	AEP Pine Ridge	55	D
OH	Story Wood Park	56	D
OH	MWF Timberlake	58	D
OH	Felicity	59	D
OH	Baker Swamp	60	D
OH	Hall's Property	61	B
OH	Clear Creek Metropark Tulip Tree Trail	62	D
OH	Clear Creek Metropark-Pipeline	63	D
PA	West Finley	2	C
PA	Sugarcamp Run South	3	D
PA	Maggie Lynn Quarry	4	D
PA	Ohiopyle State Park	5	D

State	Population	EO #	Recent Rank
WV	Cotton Hill WMA	3	D
WV	MNF: Brushy Run	5	C
WV	Rich Mountain Quarry	6	D
WV	Laurel Mountain	7	C
WV	Rich Mountain West, Mill Creek	8	D
WV	Rich Mountain East, Brush Heap Knob	9	D
WV	MNF: Rich Mountain East, Snyder Run	10	C
WV	MNF: Shavers Fork Porterwood	12	C
WV	MNF: Lower John's Run	14	D
WV	Right Fork Chenoweth Creek	16	D
WV	Pond Lick Mountain	19	A
WV	MNF: Shaver's Mountain	21	D
WV	Dry Fork of the Elk River	25	C
WV	Parsons	26	D
WV	MNF: Hoe Lick Run	27	C
WV	MNF: Becky's Creek/Crouch Knob	29	A
WV	Franklin	30	B
WV	Shaver's Fork Floodplain	31	B
WV	MNF: Left Fork of Clover Run	33	D
WV	Rich Mountain West, Lookout Tower	34	C
WV	MNF: Seneca Creek	36	D
WV	Briery Mountain	37	B
WV	Kingwood	38	D
WV	Leading Ridge - Glenmore	39	B
WV	MNF: White Oak Fork	41	A
WV	Laurel Mountain Clay Lick Run	43	B
WV	Laurel Mountain Mill Creek	44	D
WV	MNF: McGowan Mountain	46	A
WV	Right Fork Pierce Run	48	B
WV	Laurel Mountain Aggregates	49	B
WV	Spruce Run	51	B
WV	Alpena-Schmidlen Farm	54	D
WV	Buckeye Creek Trib	55	A
WV	Kelley Mountain Quarry	56	D
WV	Sunny Day Pit	57	D
WV	Mingo Run	58	B
WV	MNF: Right Fork Files Creek	59	C
WV	MNF: Wolf Run	60	C
WV	Tallow Knob-Gibson Knob	61	A
WV	Clover Lick Mountain	62	B

State	Population	EO #	Recent Rank
WV	Beverage Road	63	A
WV	Linwood	64	C
WV	MNF: Buzzard Ridge	65	C
WV	Clover Creek	66	B
WV	Valley Fork	67	B
WV	Elk Mountain	68	A
WV	Valley Mountain - Dry Fork	69	B
WV	Camp Run	70	D
WV	Bishops Hodges Catholic Pastoral Center	72	C
WV	South Beverage Road	73	C
WV	MNF: Coberly Sods FS 91d	76	A
WV	Canaan Valley SP above limestone quarry	77	D
WV	Sugarcamp Run South	78	C
WV	Buffalo Creek South	79	C
WV	Castleman Run Lake West	80	D
WV	MNF: Tallow Knob North, ACP corridor	81	D
Total Populations			**138**

Appendix C – Running Buffalo Clover Field Monitoring Form

Running buffalo clover Monitoring Form

Observer: _____ **Date:** _____ **State:** ____ **EO#:** _____

Site Name: _____ **Previous Ranking:** ◯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: (Trail activity; stream scour; timber harvest; grazing; etc.)

Is disturbance occurring? YES ☐ NO ☐

Is disturbance 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 80 %? YES ☐ NO ☐

If yes, selective harvest may be needed.

If no, no additional action required.

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

If yes, understory recruitment may be needed.

If no, no additional action required.

E. Seed Production:

Date of trip to check seed production: _____

Was any seed produced? YES ☐ NO ☐

Estimate the percentage of flowers produced _____ %

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:

Current Ranking: ◯ A ◯ B ◯ C ◯ D

Is this a decrease in ranking? YES ☐ NO ☐

Is this a decrease in number of individuals? YES ☐ NO ☐

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

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:

Lat: _____ Long: _____

D. 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 80%. However, the impacts from the midstory and even herbaceous vegetation should be considered. In areas where selective harvest has occurred, a sudden increase in the midstory growth can significantly reduce the amount of sunlight available for RBC. In addition, for one site in WV with virtually no canopy cover, wingstem was able to provide the filtered sunlight needed for that RBC population. 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. Modifications to the midstory, as well as periodic mowing of the herbaceous plants, may also be needed to achieve the appropriate light conditions.

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 occur once or multiple times per year. More intensive stream scour may happen 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 may be 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 3 years can provide the required level of disturbance for these sites.

Periodic selective logging and the disturbance associated with log landings and skid roads and 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 should 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 managed. 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 to determine if they are becoming a threat.

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 as well as many future generations are impacted as management must then occur annually to limit the impacts of the invasive species. *Rosa multiflora* is a threat at sites in both West Virginia and Missouri.

Invasive species can be treated with a variety of methods from hand-pulling to selective herbicide. In an effort to reduce Japanese stiltgrass, mowing is usually conducted in early September before flowering. In years with warm falls and a late frost, the Japanese stiltgrass may regrow to flowering or seed stage. If this occurs, mowing may be conducted twice in late fall to address this.

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