Michigan Monkey-flower
(Erythranthe michiganensis)

5-Year Review:
Summary and Evaluation
September 24, 2018

U.S. Fish and Wildlife Service
Michigan Field Office
East Lansing, Michigan

5-YEAR REVIEW

Michigan monkey-flower (*Erythranthe michiganensis*)

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1. GENERAL INFORMATION

1.1 Reviewers

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Lead Field Office: Michigan Field Office, 517-351-2555
Scott Hicks, Field Supervisor; Tameka Dandridge, Biologist; Carrie Tansy, Biologist

1.2 Methodology used to complete the review

The U.S. Fish and Wildlife Service (Service) conducts status reviews of species on the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12) as required by section 4(c)(2)(A) of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 *et seq.*). The Service provided notice of this status review for the Michigan monkey-flower via the *Federal Register* (80 FR 78751) and requested new scientific or commercial data and information that may have a bearing on the Michigan monkey-flower's classification as endangered.

The Michigan Field Office (MIFO), in coordination with Midwest Regional Office Ecological Services staff, conducted this review. We reviewed literature, the Michigan Monkey-flower Recovery Plan (USFWS 1997), the Michigan Natural Features Inventory (MNFI) database, and reports since the last status review (USFWS 2011) to prepare this 5-year review. The Service's 5-Year Review Guidance does not require peer review if a 5-year review results in a recommendation to leave the status unchanged because there was no significant new information or all new information has undergone prior peer review.

1.3 Background

1.3.1 FR Notice citation announcing initiation of this review

80 FR 78751, Thursday, December 17, 2015

1.3.2 Listing history

Original Listing
FR notice: 55 FR 25596
Date listed: June 21, 1990
Entity listed: Subspecies
Classification: Endangered

1.3.3 Associated rulemakings:

75 FR 55686–55689 (September 14, 2010) - Technical Corrections for Three Midwest Region Plant Species. Direct final rule (revised the

scientific name from *Mimulus glabratus* var. *michiganensis* to *Mimulus michiganensis*) effective December 13, 2010.

1.3.4 Review History: The Service initiated a cursory 5-year review of all species listed before January 1, 1991, which included Michigan monkey-flower (56 FR 56882). This review resulted in no change to the Michigan monkey-flower listing classification of endangered.

In 2011, the Service completed a 5-year review for Michigan monkey-flower (74 FR 11600). This review resulted in no change to the species' listing classification of endangered.

1.3.5 Species' Recovery Priority Number at start of 5-year review: 8C.

- 8 – moderate degree of threat and high recovery potential.
- C – conflict with construction or other development projects or other forms of economic activity.

1.3.6 Recovery Plan or Outline

Name of plan or outline: Michigan Monkey-flower Recovery Plan
Date issued: September 17, 1997
Dates of previous revisions, if applicable: N/A

2. 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. When the recovery plan was issued, Michigan monkey-flower was listed as a variation of the *glabratus* species, *Mimulus glabratus* var. *michiganensis*. Since then, genetics analyses have revealed that it is a full species, previously recognized as *Mimulus michiganensis* and currently recognized as *Erythranthe michiganensis* (see 2.3.1.4 Taxonomic classification or changes in nomenclature).

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

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

The fundamental recovery objective for Michigan monkey-flower is to secure long-term protection for all of its 15 known occurrences as well as viable or restorable occurrences discovered subsequent to the preparation of the recovery plan, or newly identified extant colonies in historical sites.

Michigan monkey-flower will be considered for reclassification from endangered to threatened status when protection is secured for all eight occurrences ranked "A" or "B" ("Excellent Occurrence" and "Good Occurrence", respectively). When all known Michigan occurrences are sufficiently protected, delisting can be considered.

Table 1 provides a summary of the Michigan monkey-flower element occurrence records (EOR) and discussion of recovery criteria is derived from this table.

- 23 known Michigan monkey-flower element occurrences (Figure 1)
- 4 new occurrences discovered subsequent to the USFWS 2011 status review (Figure 1)
- Eight EORs have higher rankings of A–B
  - Five high-ranked sites are protected
- One of the new occurrences has not been ranked, as additional data is needed
- Nine occurrences are considered secured for long-term protection since they are located partially or fully on lands owned by the State of Michigan, federal government, land conservancies, or biological stations. Of the nine protected sites:
  - Three sites are ranked A
  - Two sites are ranked B
  - Three sites are ranked BC
  - One site ranked C
- Four sites have been down-graded in rank
- One site has been up-graded in rank
- Maple River Dam occurrence, the only known fertile population, is not protected

The previous status review for Michigan monkey-flower listed a total of 19 EORs (USFWS 2011). In 2012, the MNFI conducted a statewide status assessment of the species to document known occurrences and to survey for new occurrences (Penskar

2012). This assessment resulted in documenting 23 records, of which 21 are considered to be extant (Penskar 2012).

Protection is secured for five occurrences with ranks of A to B. These sites may have a variety of landowners and, therefore, provide either full or partial protection (Table 1). The University of Michigan Biological Station (UMBS) provides protection for two EORs: #1 Carp Creek–Reese's Swamp and #3 Reese's Swamp. The Michigan Nature Association (MNA) provides protection for EOR #9 Epoufette Bay. The State of Michigan protects EOR #14 and Sleeping Bear Dunes National Lakeshore protects and manages EOR #15 at McFarlane Woods.

Long-term protection is not secured for all known occurrences. Nine element occurrences are located on protected lands, although not all are high ranking. These sites range in rank from A to C. At the time the recovery plan was issued, there were only 15 known extant occurrences and the recovery criteria directed that a little more than half of the occurrences needed to be high ranking and protected to be considered for downlisting. Currently, there are 23 known extant populations and less than half of the populations are high-ranking and protected. As such, recovery criteria have not been met.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

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

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

In 2012, MNFI conducted a Michigan statewide status assessment for Michigan monkey-flower that focused on the known range and reported observations of potential new occurrences. The purpose of the study was to visit all known documented occurrences, which consisted of 20 sites and 19 element occurrences (Figure 1; Appendix A), to assess the population size, spatial extent, condition, and threats. Potential new sites were also surveyed to confirm presence and formally document previous unknown populations and, where validated, conduct status assessments.

Table 1. Michigan monkey-flower element occurrence records and ranks as of 2012.

EOR#	Site name	County	Current rank*	Last review*	Recovery plan*	Landowner	Status
1	Carp Creek – Reese's Swamp	Cheboygan	A	A	A	Univ. of Michigan Biological Station (UMBS)	Localized patches, pristine habitat
2	Burt Lake West	Cheboygan/ Emmet	H	H	H	unknown	Last observed in 1933
3	Reese's Swamp	Cheboygan	A	A	A	UMBS; multiple private	Scattered patches in high quality habitat
4	Mullet Lake – West Shore	Cheboygan	H	H	H	unknown	
5	Maple River Dam	Emmet	B	B	B	Private	Locally abundant, only fertile colony
6	Mullet Lake SE – Parrott Point	Cheboygan	D	D	D	Private	Local, persistent, vigorous patch
7	Burdickville & Settler's Park	Leelanau	BC	BC	BC	multiple private	Patchy to locally abundant
8	St. James Harbor – Beaver Island	Charlevoix	D	D	B	Private	Colony appears to be extirpated
9	Epoufette Bay	Mackinac	B	B	BC	Township, Michigan Nature Assoc., multiple private	Small patches to locally abundant
10	Platte River - North Branch	Benzie	C	BC	BC	Private	Small, local patches persists
11	Manitou Payment Highbanks	Mackinac	BC	BC	BC	Sand Products Corp.	
12	Brevort	Mackinac	B	B	B	Multiple Private	Locally abundant
13	Little Sand Bay – Beaver Island	Charlevoix	BC	B	B	Little Traverse Conservancy	Restricted to mouth of creek & beach flats
14	Cut River West	Mackinac	A	A	B?	State of Michigan	Abundant
15	McFarlane Woods	Leelanau	B	A	A	National Park Service, Sleeping Bear Dunes	Small, patchy colonies
16	Harbor Springs	Emmet	C	C	BC	Idylwilde Association	Localized patches
17	Burt Lake Southeast	Cheboygan	C	C	C	Little Traverse Conservancy; multiple private	Localized patches
18	Cut River East	Mackinac	BC	C	-	State of Michigan	Discovered since recovery plan; locally abundant
19	Hatlem's Creek	Leelanau	B	B	-	Multiple private	Patchy to locally abundant
-	Harbor Springs	Emmet	-	-	-	Unknown	New occurrence, no data provided to date
-	Martin Point North	Charlevoix	C	-	-	Private	New occurrence, patch at creek mouth
-	Oden Fish Hatchery	Emmet	BC	-	-	State of Michigan	New occurrence, vigorous local patches
-	Point La Par South	Charlevoix	C	-	-	Private	New occurrence, patch at creek mouth

Table derived from (USFWS 1997 and 2011) and Penskar (2012). **EOR ranks (estimated viability values): A- excellent, B- good, C- fair, D- poor, H- historical*

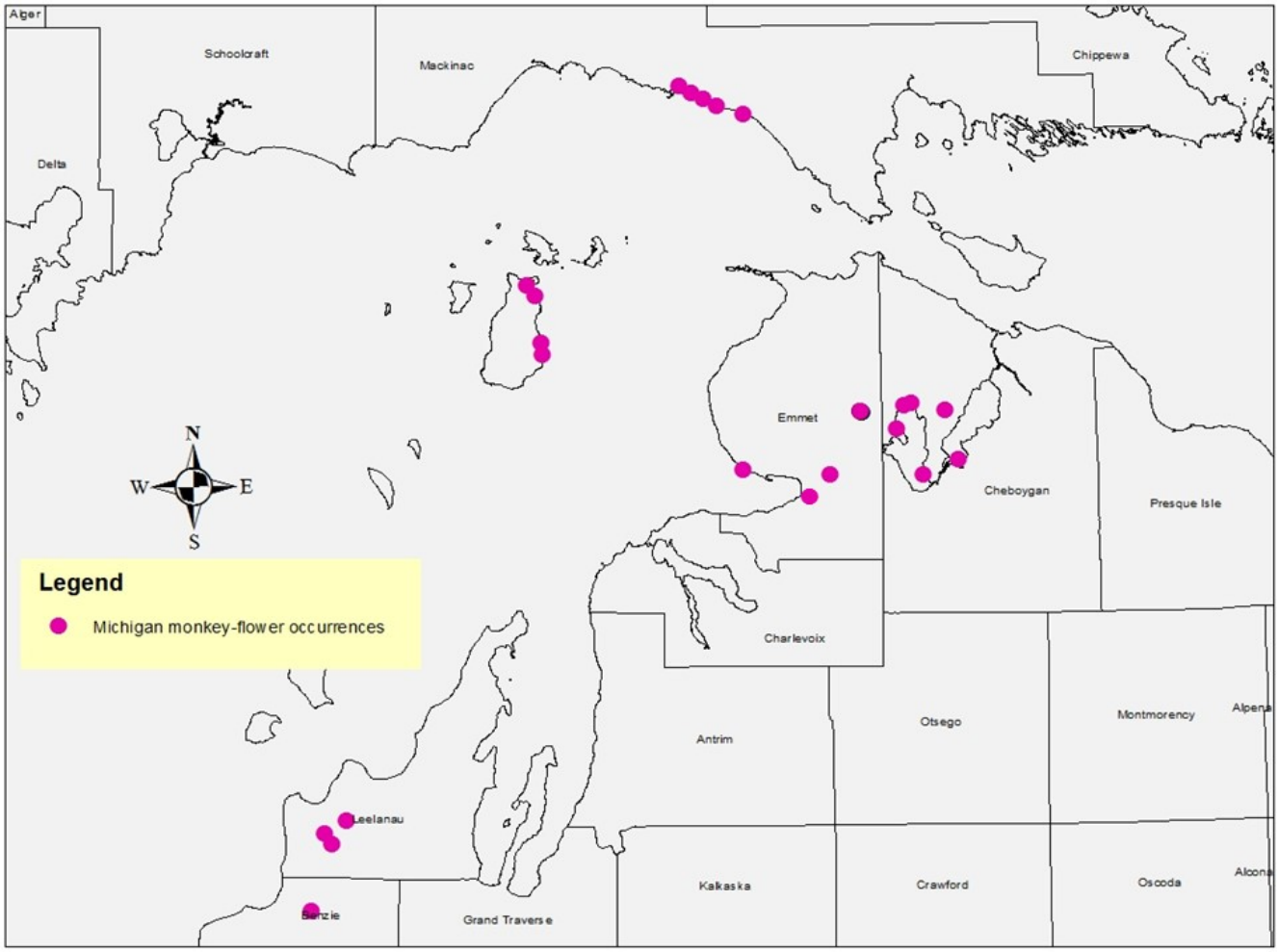

Figure 1. Known and verified Michigan monkey-flower occurrences.

MNFI confirmed and surveyed three new occurrences during the assessment on Beaver Island, Charlevoix County and at Oden Fish Hatchery, Emmet County (Figure 1, Table 1). A fourth occurrence was documented and confirmed by staff of the Little Traverse Conservancy at an additional site in Harbor Springs, Emmet County. MNFI does not have sufficient data to rank this site yet. There are now 23 element occurrences of Michigan monkey-flower. The overall population remains stable.

Maple River population and Lake Kathleen Dam removal

The Maple River population is known for its relatively high levels of sexual reproduction compared to other populations that exhibit primarily vegetative reproduction (Bliss 1986, Penskar and Higman 2001). Penskar and Higman (2001) reported the Maple River population had a greater percentage of viable pollen and greater number of mature shoots with seed set, when compared to other studied

populations. Because of this, Slaughter (2015) suggested that this population of Michigan monkey-flower is perhaps the single most important colony. In 2015, Slaughter reported that only 1% of plants at this site had seed capsules, and notes that several colonies were "sterile" (which we understand to mean were not flowering and/or did not form a capsule). Flowering stems were reported on both sides of the Maple River (Slaughter 2015); it was not noted whether any of the capsules were full or had set seed. The status of this valuable population faces numerous stressors. Some of the Michigan monkey-flower colonies at the Maple River site are in pockets of habitat with up to 99% invasive species (Canada thistle and forget-me-not), with only scattered Michigan monkey-flower stems remaining. In addition, a dam immediately above the population both threatens (through potential failure and washing out any colonies) and conversely potentially supports the hydrology of the population through seepage from the impoundment.

In 2017, the Service consulted on removal of the dam at Lake Kathleen and removing existing culverts at Woodland Road and replacing them with a channel spanning timber bridge (USFWS 2018). The Lake Kathleen dam (also known as the Maple River dam) is just below the confluence of the East and West Branches of the Maple River and forms 42-acre Lake Kathleen, just above Woodland Road where the Maple River population of Michigan monkey-flower occurs. The dam is deteriorating, and the landowner is unwilling to continue to maintain the structure. Through the consultation process, indirect effects to Michigan monkey-flower as a result of this proposed action were considered and minimized through incorporation of conservation measures, as well as reasonable and prudent measures. For more information on this consultation, see Biological Opinion 18-R3-ELFO-01 (USFWS 2018). This population will continue to be monitored, along with seepage levels, to assess the effects to Michigan monkey-flower. In addition, some Michigan monkey-flower were transplanted to habitat with stable hydrology and no invasive species in order to minimize adverse effects associated with drawing down the impoundment and to increase the likelihood of persistence of this population. Invasive species control at the Maple River population will further offset any adverse effect as a result of dam removal.

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

No new information since last five year review (USFWS 2011)

2.3.1.4 Taxonomic classification or changes in nomenclature:

Barker et al. (2012) revised the taxonomy of the Phrymaceae family, also known as the lopseed family, based on phylogenetic relationships and separate evolutionary lineages, resulting in a change to the genus from *Mimulus* to *Erythranthe* for

Michigan monkey-flower. The change of genus is simply a change in nomenclature and does not reflect any change regarding Michigan monkey-flower's status as a species (as described by Posto and Prather (2003)).

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

Although MNFI documented four new element occurrences, the spatial distribution remains unchanged (Penskar 2012). The new occurrences are located within counties and/or islands with previously known occurrences (Figure 1).

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

Penskar (2012) noticed that lower lake levels in the vicinity of some sites appear to have benefitted Michigan monkey-flower. MNFI recorded more extensive colonies in several additional patches caused by prolonged lake recession and colonization of exposed habitat (Penskar 2012). As higher lake levels return, Penskar (2012) suspects that abundance may be reduced.

Michigan monkey-flower colony numbers are increasing and the population is slowly recovering in the Epoufette Bay population after a ditch scraping event in February 2011 (Bacon and Bozic 2012). The MNA owns the 1.91 acre sanctuary. MNA records from 2001 indicated the occurrence of 20 clumps of 50 shoots each in a 10 x 300 meter area concentrated in the ditch along the road in slow-flowing water on mucky sand and filtered sun and shade (Bacon and Bozic 2012). Baseline data collected in 2010, prior to the ditch scraping, indicated the presence of two colonies near the west end of the ditch, encompassing an area of 90.6 m^2 (Bacon and Bozic 2012). Data collected later in 2011, after ditch scraping, revealed a 94% decrease in the amount of area colonized by Michigan monkey-flower between 2010 and 2011 (Bacon and Bozic 2012).

Bacon and Bozic (2012) also noted changes in the water depth, alteration in the soil substrate, amount of dead and living vegetation, and the levels of habitat suitability within the ditch after the scraping. Ditch scraping increased the water depth in most areas, as well as removed the accumulated sediment and living and dead plant materials (Bacon and Bozic 2012). During surveys in mid-2012 after the ditch scraping, Bacon and Bozic (2012) found 16 colonies located in the same stretch of the ditch as 2010 and 2011, as well as various other locations within the ditch. Bacon and Bozic (2012) suggested that ditch scraping may have assisted in moving

Michigan monkey-flower plant material up and down the ditch and establishment of new colonies where previous ones had been eliminated by sediment and vegetation accumulation.

Depending upon the spatial extent, some invasive plants have the ability to alter the required ecosystem conditions native plants rely on for survival. Kevin Skerl (NPS, pers. commun. 2016) advised that Sleeping Bear Dunes National Lakeshore has been treating reed canary grass (*Phalaris arundinacea*) and coltsfoot (*Tussilago farfara*). Both species are aggressive and known to spread rapidly and without control, and likely to cause extirpations of local Michigan monkey-flower populations. Penskar (2012) also noted invasive plant species at other Michigan monkey-flower sites.

Other human threats are also occurring within or affecting Michigan monkey-flower habitat. Plants within shoreline areas are vulnerable to recreation and foot-traffic and those that occur within developed areas, such as Glen Lake, Leelanau County, could be affected by future development pressures and activities that may directly impact the colonies themselves or negatively influence the hydrology (Penskar 2012).

2.3.1.7 Other: *N/A*

2.3.2 Threats, conservation measures, and regulatory mechanisms

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range: No new information

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes: No new information

2.3.2.3 Disease or predation:
The NPS at Sleeping Bear Dunes National Lakeshore (Jennifer Chaffin, NPS pers. commun. 2011) observed evidence of deer browse in the past and, more recently, evidence of insect browse on Michigan monkey-flower plants in the vicinity of their Orr Restoration Site. The average insect browse in 2011 was three percent for the whole Michigan monkey-flower population within the restoration site while deer browse prior to 2011 was observed to be as much as 25 percent (Chaffin, pers. commun. 2011).

2.3.2.4 Inadequacy of existing regulatory mechanisms: No new information

2.3.2.5 Other natural or manmade factors affecting its continued existence:

The number of known Michigan monkey-flower populations has increased slightly; however, the species remains vulnerable to extirpation due to low numbers and limited capability for sexual reproduction. Invasive species continue to be a problem at some sites. MNFI recorded non-native invasive species at several sites during the statewide status assessment (Penskar 2012). The most commonly found were marsh thistle (*Cirsium palustre*) and Canada thistle (*Cirsium arvense*); others frequently encountered include forget-me-not (*Myosotis scirpoides*) and coltsfoot (*Tussilago farfara*). Forget-me-not is a common garden escape known as an associate species; however, its status as a significant competitor of Michigan monkey-flower is unknown (Penskar 2012). Coltsfoot was previously reported as invasive along the Glen Lake shoreline population of Michigan monkey-flower (USFWS 2011).

Climate Change

Since 1900, annual average temperatures have increased by 2°F (1.1°C) across the Great Lakes states (Walsh et al. 2014). Climate change models predict future temperatures will continue to rise resulting in warming of the Great Lakes, declining winter ice coverage, shorter winters, changes in precipitation patterns and water quality, decrease in water availability across land surfaces, prolonged periods of both high and low water levels (Walsh et al. 2014; Pryor et al. 2014), and increase in amount and range expansion of some non-native species throughout the region (Wilcox et al. 2003). Despite increasing precipitation, warmer temperatures are expected to increase rates of evaporation and transpiration, offsetting any increases in precipitation and contributing to significant reductions in lakes, rivers, and stream levels (AMEC 2006; Kling et al. 2003).

All of these factors are also likely to lead to lower inland stream flow levels in the summer and reduced water flow into the upper Great Lakes (USEPA 2008). Alternatively, AMEC (2006) predicts that increased precipitation will increase the flow rates of some rivers and streams, resulting in increased scouring, deposition of sediments, nutrients, and pesticides, bank erosion, channel widening, and siltation of gravel beds and estuaries. Thus, climate change could significantly alter the natural stream morphology and hydrology, and cause the habitat to become unsuitable for this Michigan endemic.

2.4 Synthesis

Michigan monkey-flower is a rare Michigan endemic with very specific habitat requirements and occurs within a restricted range. When the recovery plan was issued, there were 17 EORs (15 extant occurrences and 2 historical populations) and the last USFWS (2011) status review reported 19 EORs. Since the last status review, MNFI's 2012 statewide status assessment of the species documented 23 records, which includes four new records (Penskar 2012).

Although the population appears to be increasing, the fundamental recovery objective within the recovery plan states long-term protection needs to be secured for all occurrences. At this

time, the population remains stable but long-term protection has not been secured for all occurrences.

MNA has found that their Epoufette Bay population is slowly recovering from a ditch-scraping event that occurred a few years ago. Although many Michigan monkey-flower plants were destroyed in the process, the remaining plant material was likely moved up and down the ditch resulting in establishment of new colonies in new locations. In this case, ditch-scraping appears to have provided a beneficial effect to this population in terms of habitat maintenance of occupied ditches.

The Maple River population faces potential changes to hydrology as a result of proposed removal of a deteriorating dam above the population. The impoundment may be the source of some seepage that creates suitable habitat for Michigan monkey-flower at this site. Invasive species (i.e., forget-me-not and Canada thistle) are in high densities at this site as well. Efforts to relocate some of the Michigan monkey-flower, monitor remaining plants and hydrologic changes, and control invasive species are underway to increase the likelihood that this population will persist and should result in overall improvements to the population when compared with pre-dam removal.

Michigan monkey-flower colonies have also spread into additional patches of habitat within adjacent, spring-fed wetland openings possibly due to lower lake levels in the vicinity of some populations. The plants colonized exposed habitat that was previously inaccessible to them. While population increase is occurring, certain populations are under threat from loss and alteration of habitat and hydrological disruptions. Non-native invasive species encroachment is an additional threat in some locations. The species is also vulnerable due to low numbers and limited capability for sexual reproduction.

Climate change models predict a warmer and wetter Great Lakes region. However, despite increased precipitation, the models also predict possibly drier conditions in some areas of the Great Lakes due to increased evapotranspiration, which could lead to decreased water availability and flow into the upper Great Lakes. A warmer climate will facilitate encroachment of more invasive and non-native species, while increased precipitation could increase the flow rates of rivers and streams. For Michigan monkey-flower, the increased flow rates could alter the natural stream morphology and hydrology of its habitat. These events, combined with low population numbers, fragmented populations, and reduced fertility makes Michigan monkey-flower even more susceptible to stochastic events that could result in extinction.

Overall, the population has improved slightly. However, known threats have not diminished since the last status review. A systematic survey was recommended in the USFWS (2011) status review to provide a more accurate and current description of Michigan monkey-flower habitat and population trends. Michigan Natural Features Inventory conducted this survey in 2012 (Penskar 2012). Other than four new populations being discovered since the last status review (with EOR ranks of good/fair, fair, or unknown), no significant new information is

available to suggest the species' status has changed. Therefore, the listing classification should remain as endangered under the Act.

3. RESULTS

3.1 Recommended Classification

_____	**Downlist to Threatened**
_____	**Uplist to Endangered**
_____	**Delist**
X	**No change is needed**

3.2 New Recovery Priority Number: No change

3.3 Listing and Reclassification Priority Number: N/A

4. RECOMMENDATIONS FOR FUTURE ACTIONS

- Develop a plan for conducting regular surveys, assessments, and monitoring at all known extant and historical Michigan monkey-flower locations. Continue exploration for new occurrences in the Lower Peninsula and eastern Upper Peninsula, and provide detail mapping of all occurrences. Document habitat and status conditions and population trends during these assessments. *Recovery plan action numbers: 2-21, 2-22, 2-23, 2-45*
  - Penskar (2012) was not able to access the Manitou Payment Highbanks occurrence due to a lack of permission from the landowner, and the historical Mullet Lake-West Shore occurrence was not accessed due to insufficient time and resources. Both of these sites should be considered priorities for future surveys.
- Research is needed to understand the genetic diversity within and between patches or populations. *Recovery plan action number: 2-44*
- Research is needed to understand the life history, demography, and breeding system of Michigan monkey-flower. *Recovery plan action numbers: 2-41, 2-43*
- Work with public and private landowners, site managers, and other stakeholders to protect the species and its stream/seep habitat upstream, if possible. Acquire land containing occupied or suitable Michigan monkey-flower habitat. *Recovery plan action numbers: 2-13, 2-15*
- Provide education and outreach to stakeholders and the public. *Recovery plan action number: 1-121*
- Monitor approach of non-native species and control as appropriate. *Recovery plan action number: N/A*
- Evaluate if the fundamental recovery objective in terms of the number of previously known and newly discovered occurrences requiring long-term protection warrants revision.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Michigan monkey-flower (*Mimulus michiganensis*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

_____	**Downlist to Threatened**
_____	**Uplist to Endangered**
_____	**Delist**
X	**No change is needed**

Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: Tameka N. Dandridge

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

Approve Scott Hicks Date 9-24-2018