A Statewide Status Assessment of *Mimulus michiganensis* (Michigan monkey-flower)

Prepared by:
Michael R. Penskar

Michigan Natural Features Inventory
Stevens T. Mason Bldg.
P.O. Box 30444
Lansing, MI 48909-7944

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Cover photograph: A colony of Michigan monkey-flower (*Mimulus michiganensis*) flowering profusely in a seep along the northern Lake Michigan shoreline east of Brevort, August 23, 2012. Photo by Michael R. Penskar.

Executive Summary

A statewide status assessment of the federal and state endangered Michigan monkey-flower (*Mimulus michiganensis*) was conducted throughout the known range of the species in northern Lower Michigan and the eastern Upper Peninsula in July and August, 2012. The purpose of the study was to visit all 19, known, documented occurrences, consisting of 17 extant and 2 historical records of this species to determine its contemporary status, including an assessment of population size, spatial extent, condition, and threats. Where accessible, selected sites – focusing on recently reported observations of potential new occurrences – were also surveyed to confirm and formally document previously unknown populations, and where validated, status assessments were conducted.

Prior to field surveys, the MNFI database was reviewed, including the specific locations for all occurrences and their spatial extent. Aerial imagery with the depicted spatial distribution of populations was also studied and interpreted to identify optimal access and survey routes and potential new habitat in relative proximity to known sites. Following the review of Michigan monkey-flower occurrence records and aerial imagery, a site package for each occurrence was compiled to facilitate field surveys, with a separate file prepared containing the available information for site leads. Each site package contained a printed occurrence record, field forms, threat assessment and invasive species recording forms, and several GIS maps, including views with aerial imagery, USGS topography, and ownership or plat layers.

Field survey were conducted during three targeted weeks of inventory, beginning on July 10 and ending on August 24, 2012, timed to coincide with the peak blooming period for this species. Field surveys were conducted on 20 sites, including 17 of 19 previously known occurrences and 3 newly documented sites. The Manitou Payment Highbanks locality in Mackinac County was not surveyed due lack of permission from the landowner (Sand Products Company), and Mullet Lake-West Shore in Cheboygan County was not surveyed owing to insufficient time to access and examine (via boat) a large shoreline area based on a vague collection record. Three new monkey-flower occurrences reported as site leads were documented during field surveys, and a fourth site was reliably reported by staff of the Little Traverse Conservancy at the time of the field assessments. Following surveys, Michigan monkey-flower is now known to be documented from a total of 23 sites, of which 21 are considered to be extant.

Localized infestations of non-native invasive plant species were observed during site surveys, including forget-me-not, Canada thistle, swamp thistle, and coltsfoot (Tussilago farfara), the latter the most significant invasive found throughout most of the Glen Lake colonies, where control measures are taking place. Relatively few significant human threats were observed during the status assessment, consisting primarily of moderate foot-traffic in shoreline areas. As has been reported by researchers, only a single occurrence of Michigan monkey-flower was observed to be fertile, producing filled capsules and maturing seed, whereas all other occurrences examined were found to have abortive ovaries.

Overall, the status of Michigan monkey-flower was considered to remain stable. Several colonies received slightly downgraded ranks based on more limited patches than observed previously, whereas one occurrence received a slightly higher rank score. Further survey within and adjacent to the known range, as well as continued efforts to assess the Manitou Payment Highbanks locality, the Mullet Lake West Shore site, and the second Harbor Springs locality were strongly recommended. Primary research needs were concluded to be studies to determine genetic diversity and structure, and life history, demography, and breeding system investigations. Detailed study of virtually any aspect of natural history and the demography of Michigan monkey-flower populations will provide useful information to help determine conservation priorities and guide future management activities.

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Introduction

Michigan monkey-flower (*Mimulus michiganensis* (Pennell) Posto & Prather) is an aquatic to semi-aquatic, perennial, mat-forming forb of marly springs, cold streams and seeps. It is most commonly associated with white cedar swamps, calcareous northern Great Lakes shores, and alkaline lakeshores at the mouth of small drainages. This globally imperiled species is known only from Michigan, where it is endemic to the Straits of Mackinac and Grand Traverse regions, including outlying colonies documented on Beaver Island in northern Lake Michigan. The range encompasses Benzie, Charlevoix, Cheboygan, Emmet, and Mackinac counties (Figure 1, Voss and Reznicek 2012). Long known as a member of the figwort family (Scrophulariaceae), the genus *Mimulus* is now placed in the Phrymaceae (lopseed family), based largely on advances in plant systematics in recent decades, primarily due to molecular and genetic research that has strongly revised many long-held taxonomic relationships. These same techniques were applied by Posto and Prather (2003) to elevate Michigan monkey-flower to full species status from its former classification as an endemic variety of the widespread *Mimulus glabratus* Kunth.

Significant work was completed for Michigan monkey-flower prior to its Federal listing, including preliminary taxonomic investigations (Minc 1989, Bliss 1982) and an important breeding system study (Bliss 1986, 1983). An early status summary was compiled by Crispin (1981), followed by the first rangewide status survey (Crispin and Penskar 1989). Following the listing of Michigan monkey-flower as a federal endangered species in 1990, and later as a state endangered species, a federal Recovery Plan was completed and formally approved (USFWS 1997). However, it subsequently became apparent, via periodic five-year status reviews and examination of available occurrence data, that a number of data gaps continued to persist. This is not unexpected given that substantive inventories of numerous monkey-flower occurrences have not been conducted in more than two decades. Moreover, most early surveys took place well before the common use and availability of hand-held GPS units, GIS applications, geo-referenced aerial imagery, and other tools now routinely employed by field biologists and ecologists to search for, assess, and study rare species and natural communities.

The purpose of this project was to conduct a rangewide status assessment of Michigan monkey-flower by surveying and updating all documented occurrences tracked by the Michigan Natural Features Inventory (MNFI) comprehensive, statewide database. An additional objective was to survey selected additional sites to detect new colonies or occurrences based on credible reports, site leads, and the delineation of potential areas through aerial photo review. The principal objectives of this status assessment effort were to methodically locate and examine populations to determine their contemporary status and condition, precise location and spatial extent, and the presence of significant threats. Particular attention was given to examining populations for evidence of fruit set (i.e. filled capsules), as little sexual reproduction has been reported for this species (Bliss 1986, 1983).

Study Area

The study area was circumscribed by the known state distribution of Michigan monkey-flower (Figure 1). This species ranges from Benzie County in northern Lower Michigan to eastern Mackinac County in the Upper Peninsula, with outlying populations on Beaver Island in northern Lake Michigan, Charlevoix County. The 19 occurrences documented prior to the status assessment are distributed as follows: 1 occurrence in Benzie County, 2 occurrences in Charlevoix County, 6 occurrences in Cheboygan County, 2 occurrences in Emmet, 3 occurrences in Leelanau County, and 5 occurrences in Mackinac County. For the purposes of this status survey, based on its limited scope, determining new sites for this species was necessarily constrained to considering areas of potential habitat in relatively close proximity to known sites. It is recognized that potential habitat occurs well beyond the currently documented range and thus this should be considered in all future *de novo* inventories to detect new populations.

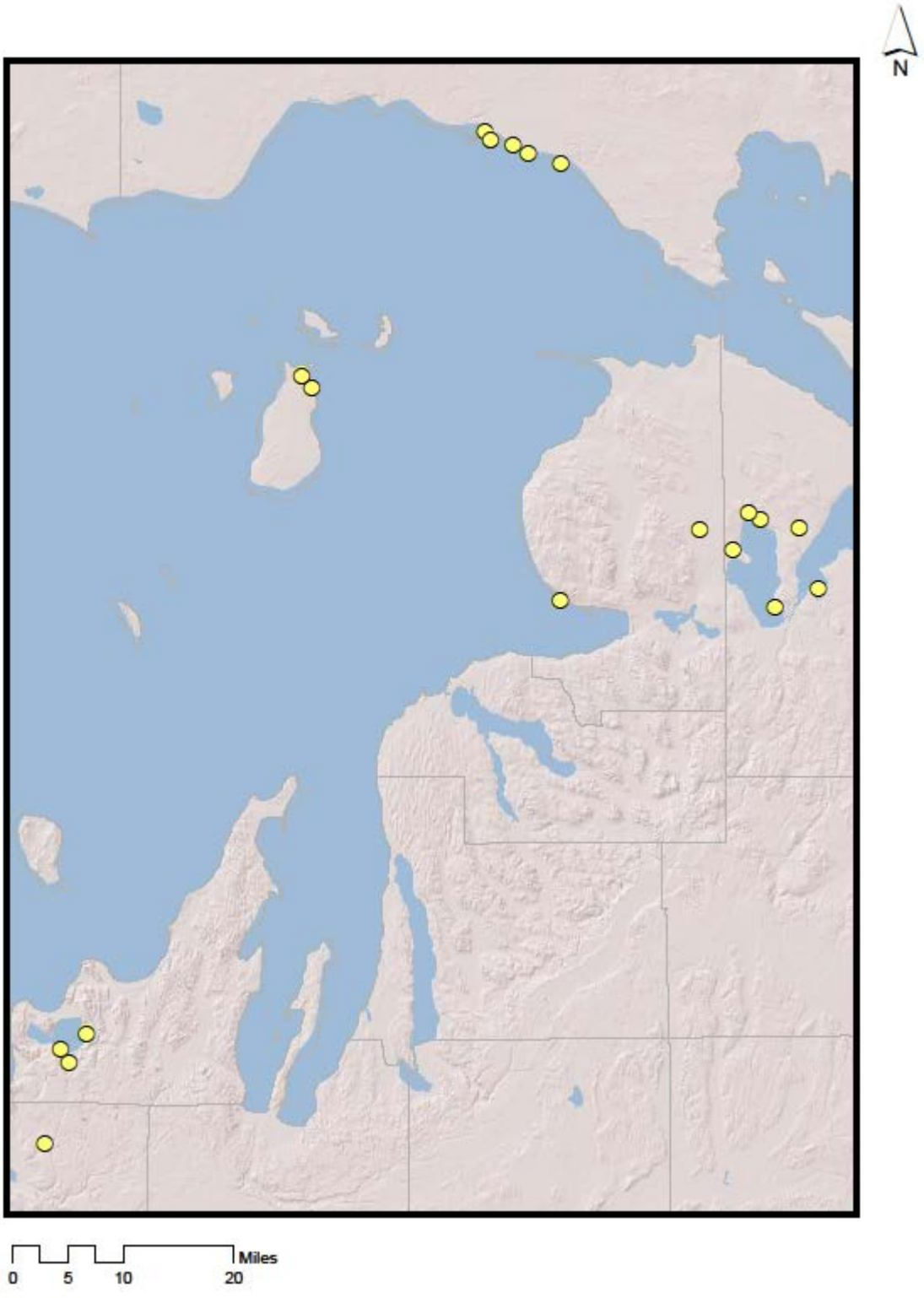

Figure 1. The global distribution of *Mimulus michiganensis* based on occurrences delineated and mapped by Michigan Natural Features Inventory prior to the 2012 status assessment (MNFI 2012).

Methods

Prior to field surveys, the known, tracked occurrence records of Michigan monkey-flower were reviewed via the MNFI statewide database, and a printed copy of each record was made, including the mapped spatial extent as known and depicted prior to field survey. For every occurrence, a site package of reference materials was compiled to assist in field surveys. Each site package contained a printed occurrence record, a special plant field form, a threats assessment form and an invasive species recording form. Additional materials included several GIS maps, comprising several views with different sets of aerial imagery (e.g. 1998 color infrared and recent MDNR aerial and BING imagery), USGS topography, and ownership (plat) layers. Aerial imagery was consulted to study optimal access and survey routes, as well as to highlight adjacent areas of potential habitat. Contacts were made concerning accumulated site leads to plan survey visits of potential new sites, based on file information regarding reports of new monkey-flower sightings on Beaver Island and at a state fish hatchery in Emmet County near Conway. Contacts were also made with local and regional land conservancy staff for general information and particularly for advice and assistance in gaining access to private tracts. These contacts included the Leelanau Land Conservancy (LLC), the Grand Traverse Regional Land Conservancy (GTRLC), and the Little Traverse Conservancy (LTC). Jody Marquis of Mama Bear Restorations, and a project partner, was also contacted to arrange site access to a large number of private tracts on the eastern shore of Glen Lake. Additional contacts were made for Beaver Island (Pam Grassmick) and with Sand Products Company; the latter delayed until field season when the Mackinac County sand mining facility was in operation[1].

Field surveys were conducted during three targeted weeks of inventory, beginning on July 10 and ending on August 24, timed to coincide with the peak blooming period for the species. Inventories were conducted by accessing and systematically traversing the habitats of occurrences while methodically recording representative GPS waypoints to depict the spatial extent of colonies. Data recording included compiling a list of associated plant species and notes on the condition of populations (e.g. whether sterile or blooming, observations of potential pollinators, and the presence or absence of capsules). In addition, significant non-native invasives were identified and recorded on an invasive plant field form with waypoints designed for subsequent submission to the Michigan Invasive Species Information Network (MISIN). Each survey site was liberally photo documented to record the general setting, habitat and microhabitat, examples of significant invasive species and other potential threats, and appropriate plant close-ups of blooms and floral visitors or potential pollinators. Photo series were also taken as appropriate to demonstrate the general variation in vigor and the vegetative condition of clones in different microhabitats (e.g. in shaded coastal seeps versus along streams and rivulets in beach flats) and between different sites.

Following field surveys, MNFI special plant forms were completed using field notes. All GPS data were downloaded, organized into directory files by site and survey date, and incorporated into GIS, from which maps were produced, printed (see Appendices) and included with plant forms for data processing. Photos were similarly downloaded and organized, and representative images were printed and attached to field forms for processing into the MNFI statewide database. Using the completed special plant forms, all known occurrences surveyed were updated in the Michigan monkey-flower database and then submitted to the MNFI data manager for processing, which will include QC and respatialization as appropriate. New occurrences that were documented were first mapped and then entered into the statewide database per established data management protocols. Other data obtained during field surveys, such as invasive species information and waypoints, were compiled, organized and cached for subsequent submission to the MISIN.

[1] In retrospect this delay may have been a factor in the failure to gain access to the Manitou Payment Highbanks occurrence, as explained in the discussion section.

Results and Discussion

Results

Field surveys and status assessments were conducted on a total of 20 sites, consisting of 17 of the 19 previously documented occurrences and three new occurrences verified during site visits. Table 1 and Figure 2 show the current status of the statewide and global Michigan monkey-flower database as a result of the 2012 status assessment. Two previously documented occurrences that were not assessed consisted of the Mullet Lake West Shore locality and the Manitou Payment Highbanks site. Mullet Lake West Shore was not surveyed due to insufficient time, whereas Manitou Payment Highbanks could not be surveyed owing to a lack of permission from the corporate owner, Sand Products Company, despite repeated requests to the plant manager and the company president. Three new occurrences of Michigan monkey-flower were confirmed and surveyed during the status assessment, consisting of two new sites on Beaver Island, Charlevoix County, along the southeast shoreline near La Par Point and Martin Point, respectively, and an occurrence at the Oden fish hatchery and visitor center near Conway in Emmet County. A fourth occurrence, based on a reliable sighting and confirmation by staff of the Little Traverse Conservancy, is reported for an additional site in Harbor Springs, although sufficient data have not been obtained to date for entry in the statewide database (see discussion section).

Recordation of waypoints for monkey-flower colonies as well as track logs significantly enhanced the spatial database of the species for several if not most occurrences, particularly for the Harbor Springs occurrence, the McFarlane Woods occurrence, the Carp Creek-Reese's Swamp occurrence, and the Burt Lake Southeast occurrence. Field survey of the Harbor Springs occurrence, for example, revealed that monkey-flower colonies occurred in several additional patches within adjacent, spring-fed wetland openings. In other landscapes, such as the Mackinac County sites along the northern Lake Michigan shoreline, more extensive colonies were recorded as a result of prolonged lake recession and the colonization of exposed habitat.

Non-native plant species considered to be significant invasives were recorded in several sites, with *Cirsium palustre* and *Cirsium arvense* among the most commonly observed taxa. *Myosotis scirpoides* (forget-me-not), a common garden escape, was found frequently in Michigan monkey-flower sites, where it has long been known as a typical associate, although it is unknown whether this species should be considered a significant competitor. *Tussilago farfara* (coltsfoot), as reported, has invaded much of the shoreline on Glen Lake, particularly within monkey-flower habitat, where it was observed during the status assessment of the Burdickville-Settler's Park locality and essentially all of the eastern shore of Glen Lake. Few urgent human threats were noted during status surveys. In shoreline habitats, monkey-flower occupies small springs, streams, and wetlands largely ignored by recreationists, although some patches may be vulnerable to foot traffic in areas that receive higher levels of seasonal use, such as the Cut River localities. Monkey-flower persists in several highly developed areas, such as Glen Lake, and along the Lake Michigan shoreline, where many residents are aware of its protected status. However, in these sites the species remains vulnerable to future development and other activities (e.g. lawn maintenance and herbicide use) that may directly impact colonies or otherwise adversely affect their hydrology.

All populations surveyed were briefly examined to determine seed set, and similar to previous observations, only the Maple River Dam locality was apparently fertile, exhibiting fully developed fruits (capsules) with seeds (see photo plates in Appendices). No other occurrences surveyed and assessed resulted in an observation of apparently successful sexual reproduction, with flowers, when dissected, exhibiting only narrow, small, abortive ovaries bearing no seeds. Potential pollinators, usually small bees, were observed in a few localities, including instances where floral tubes were fully entered and ostensibly pollination was attempted.

Table 1. Summary of Michigan monkey-flower sites as known and ranked following the 2012 status assessment.

Site name	County	Rank	Landowner(s)	Status
Brevort	Mackinac	B	Multiple private	Locally abundant
Burdickville – Settlers Park	Leelanau	BC	Multiple private	Patchy to locally abundant
Burt Lake Southeast	Cheboygan	C	Little Traverse Conservancy, multiple private	Localized patches
Burt Lake West	Cheboygan	H	Unknown	Did not survey, last observed 1933
Carp Creek – Reese's Swamp	Cheboygan	A	University of Michigan Biological Station (UMBS)	Localized patches, pristine habitat
Cut River East	Mackinac	BC	State of Michigan	Locally abundant
Cut River West	Mackinac	A	State of Michigan	Abundant
Epoufette Bay	Mackinac	B	Township, Michigan Nature Association, multiple private	Small patches to locally abundant
Harbor Springs	Emmet	C	Idylwilde Association	Localized patches
Harbor Springs	Emmet	-	Unknown	**New occurrence**, no data provided to date[2]
Hatlems Creek	Leelanau	B	Multiple private	Patchy to locally abundant
Little Sand Bay – Beaver Island	Charlevoix	BC	Little Traverse Conservancy	Restricted to mouth of creek and beach flats
Manitou Payment Highbanks	Mackinac	BC	Sand Products Company	Permission to survey denied
Maple River Dam	Emmet	B	Private	Locally abundant, only fertile colony
Martin Point North	Charlevoix	C	Private	**New occurrence**, patch at creek mouth
McFarlane Woods	Leelanau	B	National Park Service, Sleeping Bear National Lakeshore	Small, patchy colonies
Mullet Lake SE – Parrott Point	Cheboygan	D	Private	Local, persistent, vigorous patch
Mullet Lake – West Shore	Cheboygan	H	Unknown	Did not survey
Oden Fish Hatchery	Emmet	BC	State of Michigan	**New occurrence**, vigorous local patches
Platte River – North Branch	Benzie	C	Private	Small, local patches persist
Point La Par South	Charlevoix	C	Private	**New occurrence**, patch at creek mouth
Reese's Swamp	Cheboygan	A	University of Michigan Biological Station (UMBS), multiple private	Scattered patches in high quality habitat
St. James Harbor – Beaver Island	Charlevoix	D	Private	Colony appears to be extirpated

[2] Information concerning this occurrence was requested through the Little Traverse Conservancy and is pending, owing to the sensitivity of the information with respect to a potential land-use issue.

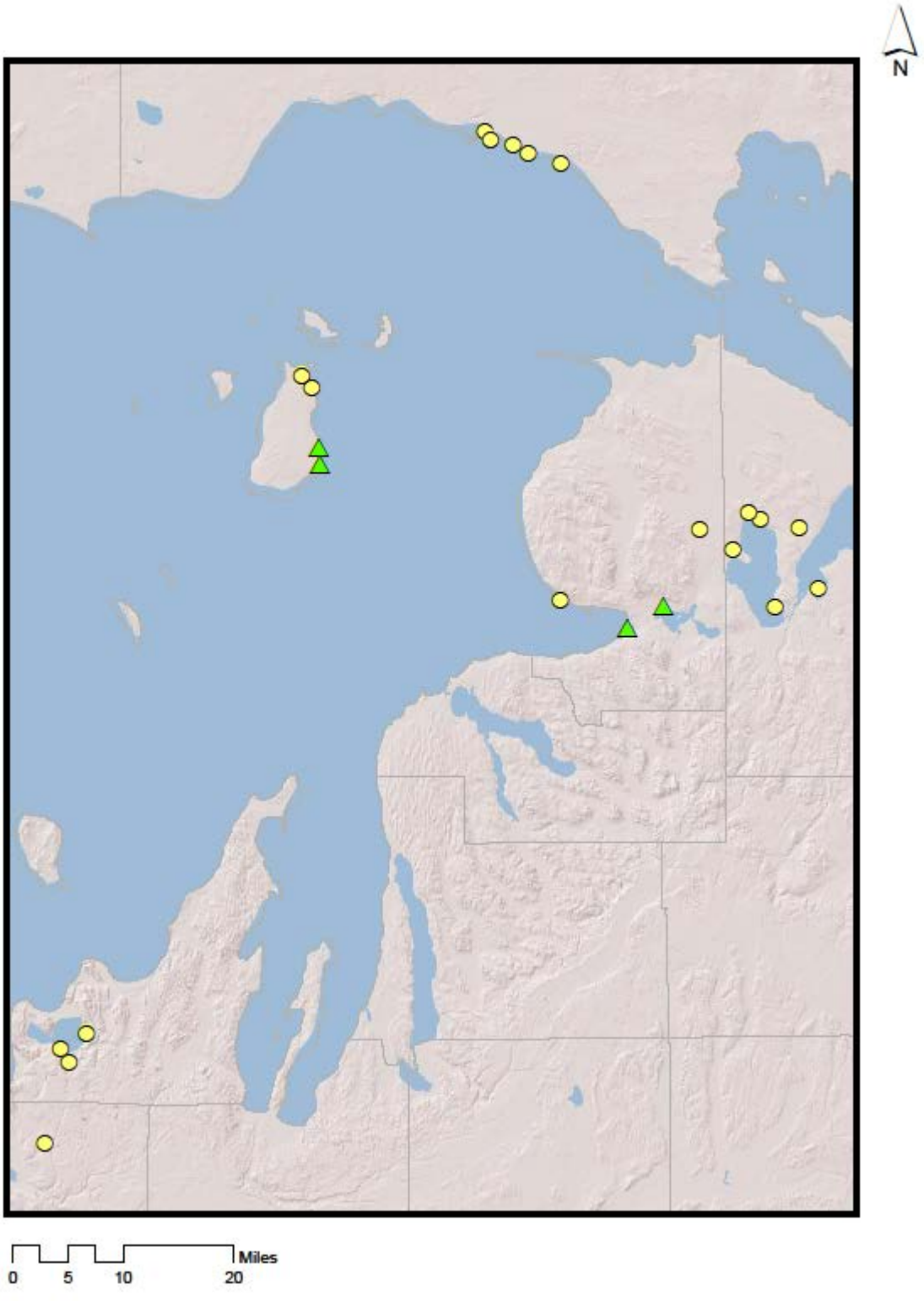

Figure 2. The distribution of *Mimulus michiganensis* following the 2012 status assessment. Green triangles display the location of newly documented occurrences as a result of the status assessment.

Discussion

In this section, a brief overview is provided for each monkey-flower site surveyed and assessed, summarizing the results of the specific site inventories that took place. These brief summaries are paired with the maps and photo plates presented in the appendices.

1. **Brevort**
Landscape setting: Northern Lake Michigan shoreline including ravines and coastal wetlands, associated with the Manitou Payment Highbanks bluff formation.
Habitat: Springs, seeps, and small streams and rivulets, primarily occurring at the base of the bluff and, at least formerly, occurring in ravines landward within spring-fed gullies.
Abundance-Population condition: Patchy to locally dense, large colonies, particularly in more extensive shoreline flats and wetlands , flowering profusely in larger colonies along the exposed shoreline owing to extended lake drawdown, with smaller colonies occurring in spring-fed seeps, including seeps with dense algae colonies. No filled capsules observed.
Artificial disturbance-threats: Little human disturbance noted, other than seasonal beach use and low to moderate foot-traffic in the immediate beach areas and not within monkey-flower colonies.
Invasive plant species: No significant invasives recorded.
Rank and rationale: B, no rank change, vigorous colonies with no current threats. Return of higher lake levels likely to reduce the abundance of this occurrence.

2. **Burdickville – Settlers Park**
Landscape setting: Eastern shoreline of Glen Lake, ranging from the upper eastern shore to the southeastern shoreline area.
Habitat: Springs, pools, seeps, and rivulets from the immediate shoreline to streams and wetlands on the east side of the resident's homes.
Abundance-Population condition: Sparse to moderate patches, with occasional large, dense colonies in cold pools and at the base of low bluffs, extending to the beach area within a highly developed residential area of large homes, occurring in shaded to partially filtered sunlight to open areas at beach area. No filled capsules observed.
Artificial disturbance-threats: Area is heavily developed, with local construction and yard improvements ongoing; heavy foot traffic in shoreline area, although many landowners are engaged in restoration and protection work with Mama Bear Restorations; likely ongoing threats due to yard/lawn maintenance and herbiciding.
Invasive plant species: Local infestations of *Cirsium arvense* (Canada thistle), and particularly problematical infestation of *Tussilago farfara* (coltsfoot), the latter being actively managed by Mama Bear Restorations, with some residents independently spraying their infestations.
Rank and rationale: BC, no rank change, relatively vigorous colonies of moderate size, many of which are undergoing restoration and are protected by residents.

3. **Burt Lake Southeast**

Landscape setting: Southeast shoreline of Burt Lake.
Habitat: Colonies restricted to small seeps and springs along the immediate shoreline, often on small, open terraces above a 1-2 foot abrupt bank at the shore.
Abundance-Population condition: Small, often obscure colonies, at least as observed within the Little Traverse Conservancy preserve, although larger patches are known in adjacent areas near residential homes, in cold pools, rivulets, and springs. Low level of flowering, no filled capsules observed.

Artificial disturbance-threats: No threats observed in nature preserve, patches in residential area may be threatened by home and yard maintenance activities and future development, although only the preserve was assessed in 2012.
Invasive plant species: No significant invasives observed.
Rank and rationale: C, no rank change, small colonies in restricted area of shoreline.

4. **Burt Lake West (no photo plates)**

Landscape setting: West side of Burt Lake, based on vague 1933 collection record.
Habitat: Seeps and small streams within and near mouth of Crooked River, and similar habitat along shoreline from Crooked River mouth to Kings Point, as assessed in 2012. Additional habitat in this very extensive area occurs to the north, including the shoreline from Colonial Point to the Maple River mouth and south to the Crooked River mouth, which was not surveyed.
Abundance-Population condition: No colonies observed.
Artificial disturbance-threats: Heavy seasonal use of lake by recreational boats.
Invasive plant species: No significant invasives observed.
Rank and rationale: H, no rank change, additional areas of this extensive shoreline merit further survey owing to the presence of potential habitat.

5. **Carp Creek – Reese's Swamp**

Landscape setting: High quality stream drainage deriving from steep ravine and extending through former embayment with extensive rich conifer swamp at the north end of Burt Lake
Habitat: Numerous microhabitats within and adjacent to a complex, stream drainage, with colonies occurring on stream edge, at the base of hummocks within the stream, and occurring in mucky spring-fed pools and shaded seeps and pools in seepage area in swamp adjacent to Carp Creek.
Abundance-Population condition: Relatively small colonies, very patchy in this heterogeneous, complex, meandering stream. Some colonies sterile, particularly those in shaded areas, but flowering is frequent within the stream. No filled capsules observed.
Artificial disturbance-threats: Habitat is pristine, essentially remote and not easily accessed and traversed, thus virtually no human threats.
Invasive plant species: Localized infestations of *Cirsium arvense* (Canada thistle) and *Cirsium palustre* (swamp thistle) observed and recorded.
Rank and rationale: A, rank downgraded slightly to AB based on the somewhat modest size of the population, despite the pristine quality and protection status. If future surveys corroborate the presence of larger colonies, the rank can be considered for A rank.

6. **Cut River East**

Landscape setting: Northern Lake Michigan shoreline including ravines and coastal wetlands, associated with the Manitou Payment Highbanks bluff formation.
Habitat: Primarily small rivulets, springs, and cold, spring-fed beach pool and wetlands at the base of the Manitou Payment Highbank formation and especially in the wetlands along a broad zone behind the beach area.
Abundance-Population condition: Small, sparse patches to locally dense patches, profusely flowering. No filled capsules observed.
Artificial disturbance-threats: Area is a well-known tourist attraction near the Cut River Bridge, and although there is extensive foot-traffic near the mouth of the river, which is in proximity to some monkey-flower colonies, the remainder of foot-traffic is primarily within the immediate beach area. No significant threats observed.
Invasive plant species: No significant invasives observed in this occurrence.

Rank and rationale: BC, rank elevated slightly owing to the moderate number of vigorous patches observed.

7. **Cut River West**

Landscape setting: Northern Lake Michigan shoreline including ravines and coastal wetlands, associated with the Manitou Payment Highbanks bluff formation.
Habitat: Similar to the adjoining Cut River East occurrence, but more frequent, with much larger colonies in much more extensive wetlands and stream drainages.
Abundance-Population condition: Relatively frequent and locally abundant, forming large, dense flowering patches in well-developed small stream drainages and beach pools, and throughout some large wetland areas. No filled capsules observed.
Artificial disturbance-threats: No artificial disturbance observed other than light beach foot-traffic.
Invasive plant species: A few small areas of *Pinus sylvestris* (Scotch pine), and several areas infested locally with *Cirsium palustre* (swamp thistle).
Rank and rationale: A, no rank change, numerous patches of large colonies.

8. **Epoufette**

Landscape setting: Northern Lake Michigan shoreline, including spring-fed ditches and numerous small stream drainages within wetlands and meadows adjacent to the shore.
Habitat: Primarily occurs in the spring-fed ditch along Epoufette Bay road, which ponds water from the adjacent rich conifer swamp at the base of the Manitou Payment Highbanks bluff, and particularly in several braided stream drainages south of the road in extensive wetlands between the road and the shoreline on the east side of the bay.
Abundance-Population condition: Very patchy and discontinuous in the road ditch, with moderately large, vigorous colonies within and along braided stream channels within extensive wetland flats on the east side of the bay. No filled capsules observed.
Artificial disturbance-threats: Ditch impacted by scraping to remove accumulated sediment, which removed overwintering colonies that have recolonized portions of the ditch. No artificial disturbance noted elsewhere within this population.
Invasive plant species: No significant invasives noted.
Rank and rationale: B, no rank change despite extensive damage to ditch colonies, due to the presence of fairly large colonies in the braided stream channels on the east side of the bay.

9. **Harbor Springs**

Landscape setting: Along the eastern shoreline of Little Traverse Bay, within wooded residential area in relatively close proximity to shoreline.
Habitat: A series of cold, spring-fed pools in wooded area below residential homes within ca. 100-200m of beach area, the complex occurring below a steep bluff above the bay.
Abundance-Population condition: More or less small patches at edges of cold pools dominated by *Myosotis scirpoides* (forget-me-not), occurring in one main pool by boardwalk and discovered to also occur in adjoining series of springs extending to the east-southeast.
Artificial disturbance-threats: No particular artificial threats currently, landowners and the homeowner association well aware of and protecting population.
Invasive plant species: As noted above, forget-me-not may be a significant competitor in this site; also noted were local infestations of *Cirsium arvense* (Canada thistle) and *Lonicera morrowii* (Morrow's honeysuckle).
Rank and rationale: C, no rank change, small localized patches protected within private home association.

10. **Hatlems Creek**

Landscape setting: Extensive meandering stream drainage, coursing through complex, undulating topography and large swamp areas.
Habitat: Colonies occur within and along the banks of the creek, especially in small springs on the stream banks, and in more extensive, spring-fed meadow areas adjacent to the creek; with small, obscure colonies extending nearly to the south edge of a large ponded area created by beaver activities.
Abundance-Population condition: Very patchy to locally common, flowering most profusely in open streamside meadows where insect visitors were observed entering flowers. No filled capsules observed.
Artificial disturbance-threats: Some tree cutting in localized areas by private landowners, and old two-track roads, but otherwise little disturbance.
Invasive plant species: *Typha angustifolia* (narrow-leaved cat-tail), *T.* X*glauca* (hybrid cat-tail), and *Cirsium palustre* (swamp thistle) noted in meadow areas.
Rank and rationale: B, no rank change. A portion of the area is currently under conservation easement with the Leelanau Land Conservancy, which is considering purchase of an adjoining tract that also contains this species.

11. **Little Sand Bay – Beaver Island**

Landscape setting: Small stream drainage originating upslope in rich conifer swamp and draining to mouth in Little Sand Bay on the NE shoreline of Beaver Island.
Habitat: Once occurring well inland of the bay, the colony is now restricted to the creek mouth and shoreline wetland flats owing to the extensive modification of the creek by beaver activity.
Abundance-Population condition: Local, occurring within a relatively small area of the creek at its mouth and extending toward the lake in the small, braided channels in wetland flats. Flowering well, no filled capsules observed.
Artificial disturbance-threats: No artificial disturbance observed, light foot-traffic in this frequently visited area, where the monkey-flower colony is not advertised as a feature.
Invasive plant species: Some invasives noted in adjacent sandy areas, such as *Centaurea stoebe* (spotted knapweed).
Rank and rationale: BC, downgraded slightly to reflect current status due to beaver activity.

12. **Maple River Dam**

Landscape setting: High quality pristine river and associated adjacent wetlands immediately below a dam.
Habitat: Restricted to large spring-fed wetland area upslope of the west side of the Maple River, although colonies included in this occurrence have also been reported for an adjacent section.
Abundance-Population condition: Locally abundant in large, spring-fed, mucky wetland below steep road embankment on the west side of the river, the spring area dominated by the non-native *Myosotis scirpoides* (forget-me-not). Population with filled capsules and maturing seeds (see photo plates).
Artificial disturbance-threats: Adjacent to paved road and thus likely some impacts due to run off, although population has persisted for many years. Foot-traffic evident, as this site is apparently visited by classes from the U-M biological station on a yearly basis, which if excessive may represent a threat. Dam removal, which reportedly has been proposed, may impact this important occurrence and should be evaluated.
Invasive plant species: The forget-me-not appears to be a strong competitor in this colony, although its impact is not known.
Rank and rationale: B, no rank change; this is perhaps the single most important monkey-flower colony owing to its ability to produce what have been shown in the past to be viable seeds.

13. **Martin Point North (no photo plates)**

Landscape setting: The southeastern shore of Beaver Island within a small stream drainage.
Habitat: The colony is restricted to the mouth of a small, unnamed stream.
Abundance-Population condition: Very local, but flowering abundantly. No filled capsules observed.
Artificial disturbance-threats: No artificial disturbance noted.
Invasive plant species: No significant invasive plant species observed during brief visit to confirm this locality.
Rank and rationale: C, modest colony at stream mouth.

14. **McFarlane Woods**

Landscape setting: The south shore of Glen Lake.
Habitat: Occurring at the base of an extensive, long, steep slope, occurring in close proximity to the abrupt shoreline, principally occurring in seepage pools, small springs, and rivulets, at the forest edge where the colonies are often obscure.
Abundance-Population condition: Although once observed as locally abundant, the colonies were not found to be particularly large during the status assessment, although this area was not surveyed until late August and this could have been a factor. Few flowering patches were noted, perhaps owing to the time of the survey, but this may also be due to the shading in this locality. No filled capsules observed.
Artificial disturbance-threats: No artificial disturbances noted in this remote portion of the lakeshore, which now occurs within the national lakeshore where it is landlocked between private tracts.
Invasive plant species: No significant invasives noted.
Rank and rationale: B, rank downgraded from A rank based on limited size of the colonies, despite the current protection status, although there is strong merit for further evaluation and survey.

15. **Mullet Lake SE – Parrott Point**

Landscape setting: The southeastern shore of Mullet Lake, at the base of a small peninsula.
Habitat: The small but dense, vigorous colony is restricted to a spring-fed seepage area in the middle of lawn area between a small cottage and the lakeshore.
Abundance-Population condition: As noted, this very local colony is very local, occurring within a few meters of the shoreline, and comprising less than ca. 2 square meters in area, but it remains healthy, vigorous, and flowers profusely. No filled capsules were observed.
Artificial disturbance-threats: The colony occurs within an artificial habitat, and per previous occurrence data the lawn area is mowed and maintained, although the owners are aware of the protection status and assured this author, during the site visit, that they do nothing to harm the colony.
Invasive plant species: Colony surrounded by planted lawn.
Rank and rationale: D, no change in range based on artificial habitat, limited size, and inherent vulnerability.

16. **Oden Fish Hatchery**

Landscape setting: Stream drainage upslope from the northern shoreline of Crooked Lake.
Habitat: A high quality, spring-fed stream for which portions were once incorporated into the operation of a former fish hatchery (now used as a visitor and interpretation center), and has had some alteration to include a fish viewing chamber. Most of this drainage remains in good to high quality condition.
Abundance-Population condition: Scattered, mostly small colonies along the stream bank, but comprising what appears to be a viable occurrence in good habitat. Flowering well, no filled capsules observed.

Artificial disturbance-threats: Part of stream modified upslope as part of the former, old fish hatchery operation, but downslope the stream runs fast, cold, and clear. Hatchery staff is aware of the monkey-flower population and its protected status.
Invasive plant species: A few patches of *Cirsium vulgare* (bull thistle) noted along the stream.
Rank and rationale: C, tentatively ranked as viable occurrence, but site warrants further survey downstream to determine if additional colonies occur outside the hatchery grounds.

17. **Platte River – North Branch**

Landscape setting: High quality, meandering, complex tributary of the Platte River within a rural area.
Habitat: Moist river banks with seeps, seepage pools, and small rivulets, with colonies also occurring on moist hummocks within the shallow, rocky river branch.
Abundance-Population condition: Very local, sparse patches, but with very few flowers, persisting as small, inconspicuous colonies over several years. No filled capsules observed.
Artificial disturbance-threats: No artificial disturbance noted in this relatively remote private land tract.
Invasive plant species: No invasive plant species noted during survey.
Rank and rationale: C rank, downgraded slightly from BC based on the persistently small size of the colonies, although rank could increase if further survey identified additional and more extensive colonies elsewhere in this drainage. Previously, additional surveys downstream did not result in the identification of more colonies; however, much more extensive inventory is necessary throughout this area based on the available suitable habitat.

18. **Point La Par South**

Landscape setting: The southeastern shoreline of Beaver Island, at the mouth of a small stream drainage.
Habitat: In sandy, mucky substrate at the edge of a small stream mouth.
Abundance-Population condition: Very local small patch, less than one square meter in extent, occurring only at the mouth of a small stream drainage, flowering vigorously. No filled capsules observed.
Artificial disturbance-threats: No artificial disturbance noted, shoreline a low human use area.
Invasive plant species: No significant invasive species observed, although *Centaurea stoebe* (spotted knapweed) noted in adjacent sandy areas.
Rank and rationale: C rank, tentative rank based on limited extent, pending further assessment and inventory of the stream drainage.

19. **Reese's Swamp**

Landscape setting: An extensive rich conifer swamp complex and associated drainages within an embayment on the north end of Burt Lake.
Habitat: Numerous small streams, moist banks, seepage pools, springs, seeps and rivulets with the complex microtopography of Reese's Swamp.
Abundance-Population condition: Colonies occur primarily within the northeast region of the lakeside road junction, where they occur within and adjacent to the small stream drainages that flow toward the north end of Burt Lake. Survey was brief for this well documented site, and conducted late, with the only colonies observed occurring in the vicinity of the stream culvert on lakeside drive. Locally the larger patches likely occur in greater abundance within the now private, developed tracts along the immediate lakeshore. No filled capsules were observed.
Artificial disturbance-threats: Little artificial disturbances noted; some local ORV use of UMBS trails and dumping of trash and yard refuse, although not within monkey-flower colonies.
Invasive plant species: No invasive plant species noted.
Rank and rationale: A, no change but further survey of occurrence needed to determine if rank should be slightly downgraded based on population size being smaller in comparison to other A ranked sites.

20. **St. James Harbor – Beaver Island**

Landscape setting: The northeast shoreline of Beaver Island, in the southwest corner of St. James Harbor.
Habitat: The species was reported from a small drainage originating in an adjacent swampy area and forming a beach pool, but not observed since 1989. Shoreline modification by a landowner was reported to have affected the hydrology. During the 2012 status assessment of the area, including the mouth of one stream drainage and a beach pool, no colonies were noted. It was also reported to this author that scientists from the Central Michigan University biological station explored recently in this area and did not identify any colonies. It is not known, however, if this occurrence has been exhaustively surveyed, and thus there may be merit in further searching, although permission will be required to conduct a diligent inventory.
Abundance-Population condition: No colonies were identified.
Artificial disturbance-threats: Site may have undergone modifications.
Invasive plant species: N/A
Rank and rationale: D, no change in rank, though with definitive, unsuccessful survey, rank would change to X.

Conclusions and Recommendations

In terms of general conclusions, the status of Michigan monkey-flower remains stable. Although as an overall trend there was a slight downgrading of ranks to better reflect the current status of four previously documented occurrences (Carp Creek-Reese's Swamp, Platte River-North Branch, Little Sand Bay-Beaver Island, and McFarlane Woods), there was an increase in rank for one occurrence (Cut River East). Moreover, three new occurrences were verified during field surveys, consisting of two sites on Beaver Island in Charlevoix County (Martin Point North and Point La Par South) and a site in Emmet County (Oden Fish Hatchery). In addition, a fourth new site was reported and confirmed by the Little Traverse Conservancy for the Harbor Springs area, for which data have been requested. In summary, prior to the status assessment there were 19 known occurrences of Michigan monkey-flower, comprised of 17 extant sites and two historical records. As a result of status surveys, there are now 23 documented occurrences, consisting of 21 extant sites and 2 historical records. Information for the new, second Harbor Springs locality will continue to be pursued such that these data can be incorporated into the MNFI statewide database for future reference by the USFWS, scientists, and other data users.

As noted above, the Manitou Payment Highbanks locality, an extant site, could not be accessed for survey owing to a lack of permission from the landowner, Sand Products Company. Although inventory would have resulted in acquiring improved spatial location data, as well as anticipated new colonies (the latter a plausible reason for the denial), the site has been monitored as a requirement of a Michigan Department of Environmental Quality (MDEQ) permit, and this information has been regularly included in updating the occurrence record. Mullet Lake-West Shore, a historical site based on a vague, 80 year old collection record, entailed assessing the entire western shore of the lake by boat for adequate survey, and thus there was insufficient time and resources to initiate such a site examination. Both of these sites should be considered priorities for future status surveys, as well as additional portions of the western shore of Burt Lake, another historical locality inventoried in part during 2012 but which requires further effort.

The status assessment indicated that further surveys to detect new Michigan monkey-flower occurrences has strong merit and should continue to be conducted in northern Lower Michigan and the eastern Upper Peninsula, and perhaps should not be restricted to these areas. Additional reports and site leads have been obtained, such as a recent report from the Grand Traverse Regional Land Trust, and these should be pursued where possible.

Lastly, numerous questions remain for Michigan monkey-flowery with regard to key aspects of life history, genetics, and breeding system. Molecular and genetic research conducted by Posto and Prather (2003) resolved the longstanding question regarding the proper classification of this taxon, elevating Michigan monkey-flower to full species status from its former placement as a variety of *Mimulus glabratus*. They also offered a plausible hypothesis as to origin, likely arising as a result of hybridization between *M. glabratus* and *M. guttatus*. Despite this taxonomic resolution, there is much that remains unknown about Michigan monkey-flower occurrences, including the genetic diversity within and between patches or populations/occurrences and the basic genetic structure of populations. Understanding genetic diversity in this species is important and in fact may be crucial to conservation as well as future management, thus such research should be considered a priority. In addition to genetic research, the life history, demography, and breeding system of Michigan monkey-flower deserve considerable attention, as many fundamental aspects of natural history are poorly known. Given the existence of a single occurrence (Maple River Dam) known to reproduce sexually, this area of investigation should be considered a strong priority. At this point in time, detailed study of virtually any aspect of the natural history and demography of Michigan monkey-flower will provide information useful for management and greatly assist in establishing conservation priorities.

Acknowledgements

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Literature Cited

Bliss, M. 1986. The morphology, fertility and chromosomes of *Mimulus glabratus* var. *michiganensis* and *M. glabratus* var. *fremontii* (Scrophulariaceae). American Midland Naturalist 116: 125-131.

Bliss, M. 1983. A comparative study of the two varieties of *Mimulus glabratus* (Scrophulariaceae) in Michigan. M.S. thesis, University of Michigan, Ann Arbor, Michigan. 58 pp.

Bliss, M. 1982. The taxonomic status of *Mimulus glabratus* var. *michiganensis* (Pennell) Fassett. Unpublished report. 16 pp.

Crispin, S.R. and M.R. Penskar. 1989. Rangewide status survey of *Mimulus glabratus* var. *michiganensis* (Pennell) Fassett, Michigan monkey-flower (Scrophulariaceae). Unpublished report. Submitted to U.S. Fish & Wildlife Service, Ft. Snelling, Minnesota. 14 pp. + appendices.

Crispin, S.R. 1981. *Mimulus* glabratus var. *michiganensis* (Pennell) Fassett, Michigan monkey-flower (Scrophulariaceae) in Michigan. Unpublished report. Submitted to U.S. Fish & Wildlife Service, Ft. Snelling, Minnesota. 6 pp.

Minc, L.D. 1989. A morphometric comparison of *Mimulus glabratus* var. *michiganensis*, *M. glabratus* var. *fremontii*, and *M. guttatus* based on floral characters. Unpublished report. Michigan Natural Features Inventory, Lansing, Michigan. 20 pp.

Posto, A.L. and L.A. Prather. 2003. The evolutionary and taxonomic implications of RAPD data on the genetic relationships of *Mimulus michiganensis* (*comb. et stat. nov*.: Scrophulariaceae). Syst. Bot. 28: 172-178.

U.S. Fish and Wildlife Service. 1997. Recovery Plan for Michigan monkey-flower (*Mimulus glabratus* var. *michiganensis*). Ft. Snelling, Minnesota. vii+ 37 pp.

Voss, E.G. and A.A. Reznicek. 2012. Field manual of the Michigan Flora. University of Michigan Press, Ann Arbor, MI. 990 pp.

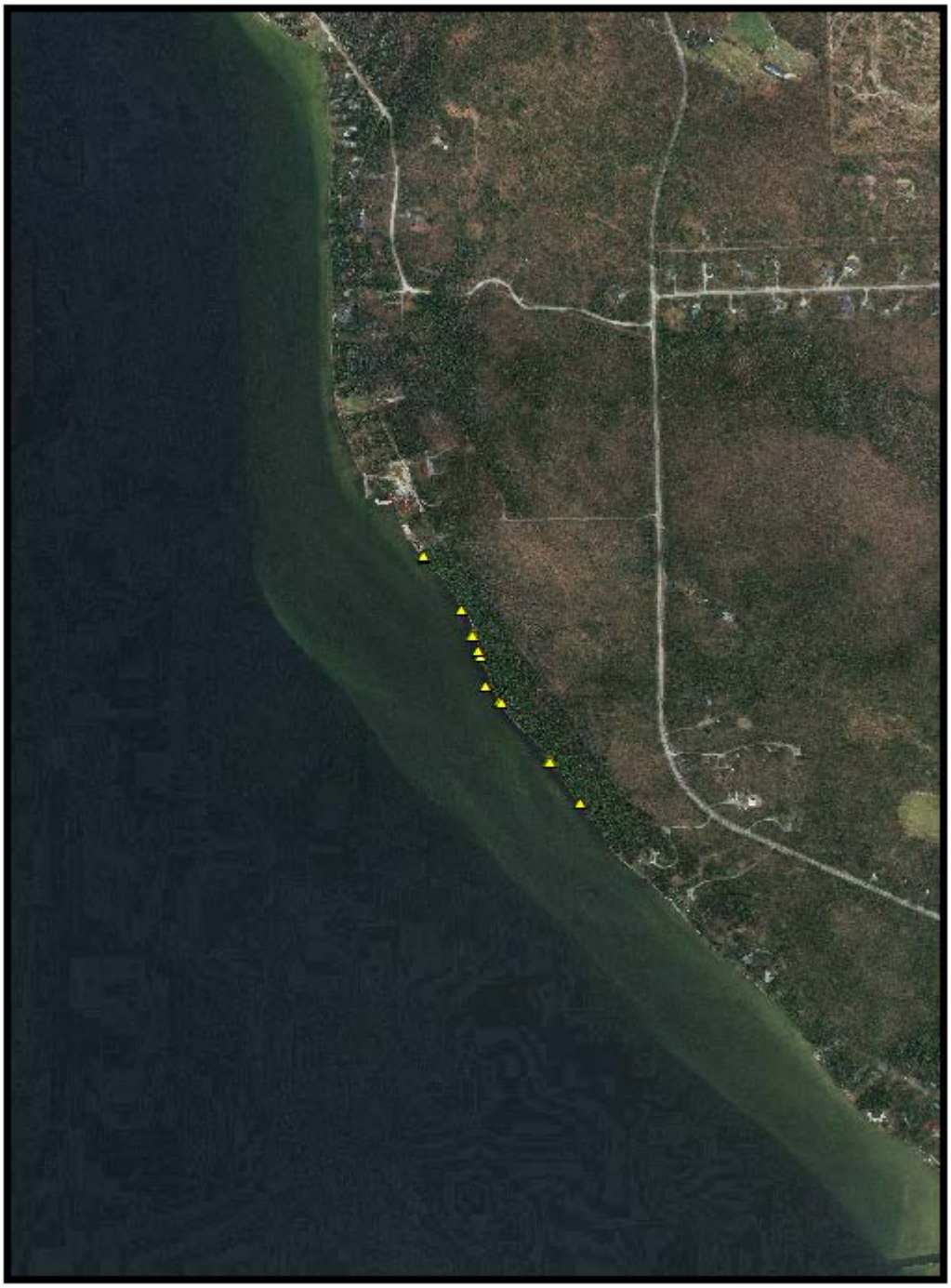
Appendix I

Occurrence Maps and Waypoints

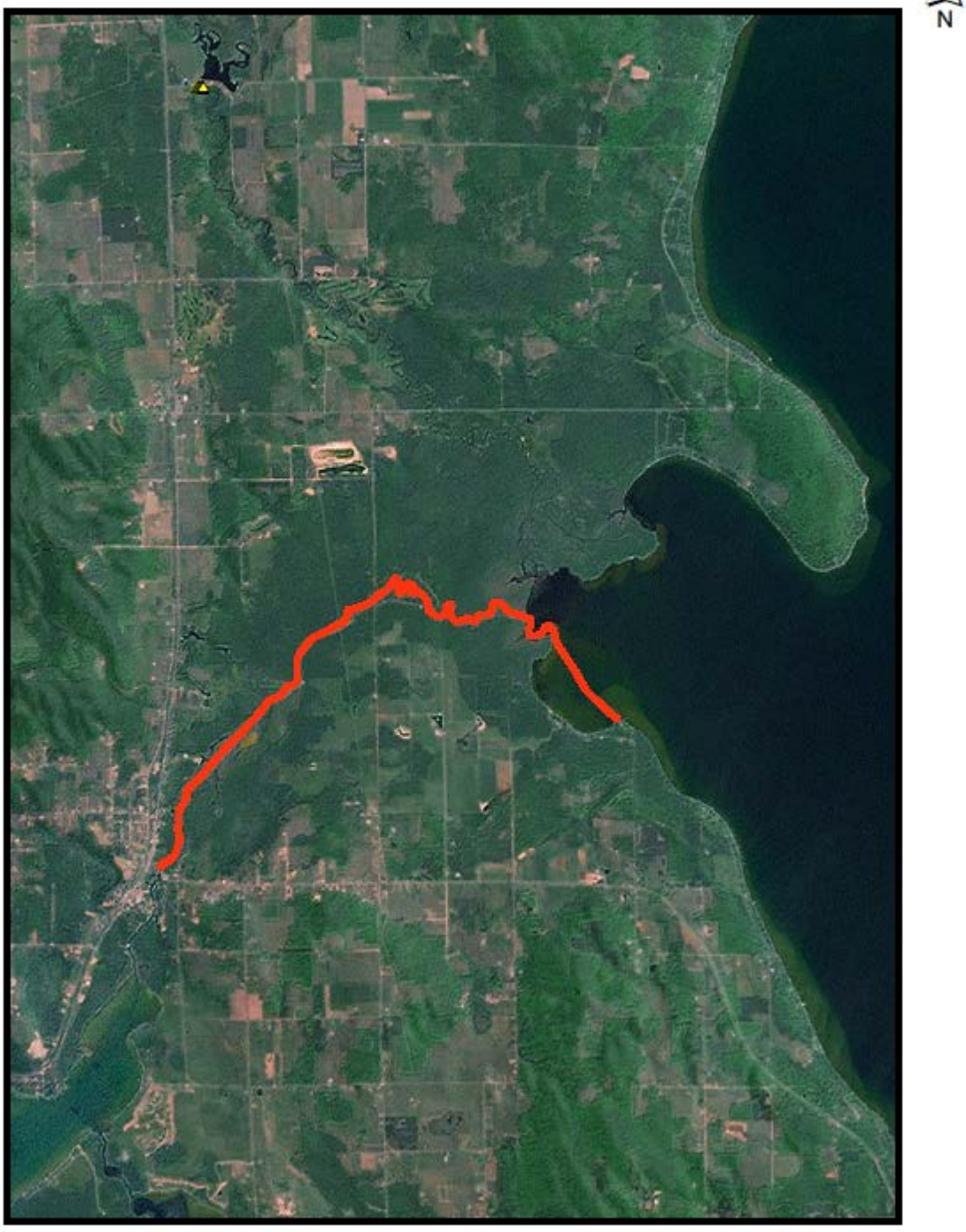
Monkey-flower EOR #.012, Brevort track log and waypoints

Monkey-flower EOR #.007, Burdickville-Settlers Park waypoints

Monkey-flower EOR #.017, Burt Lake Southeast waypoints



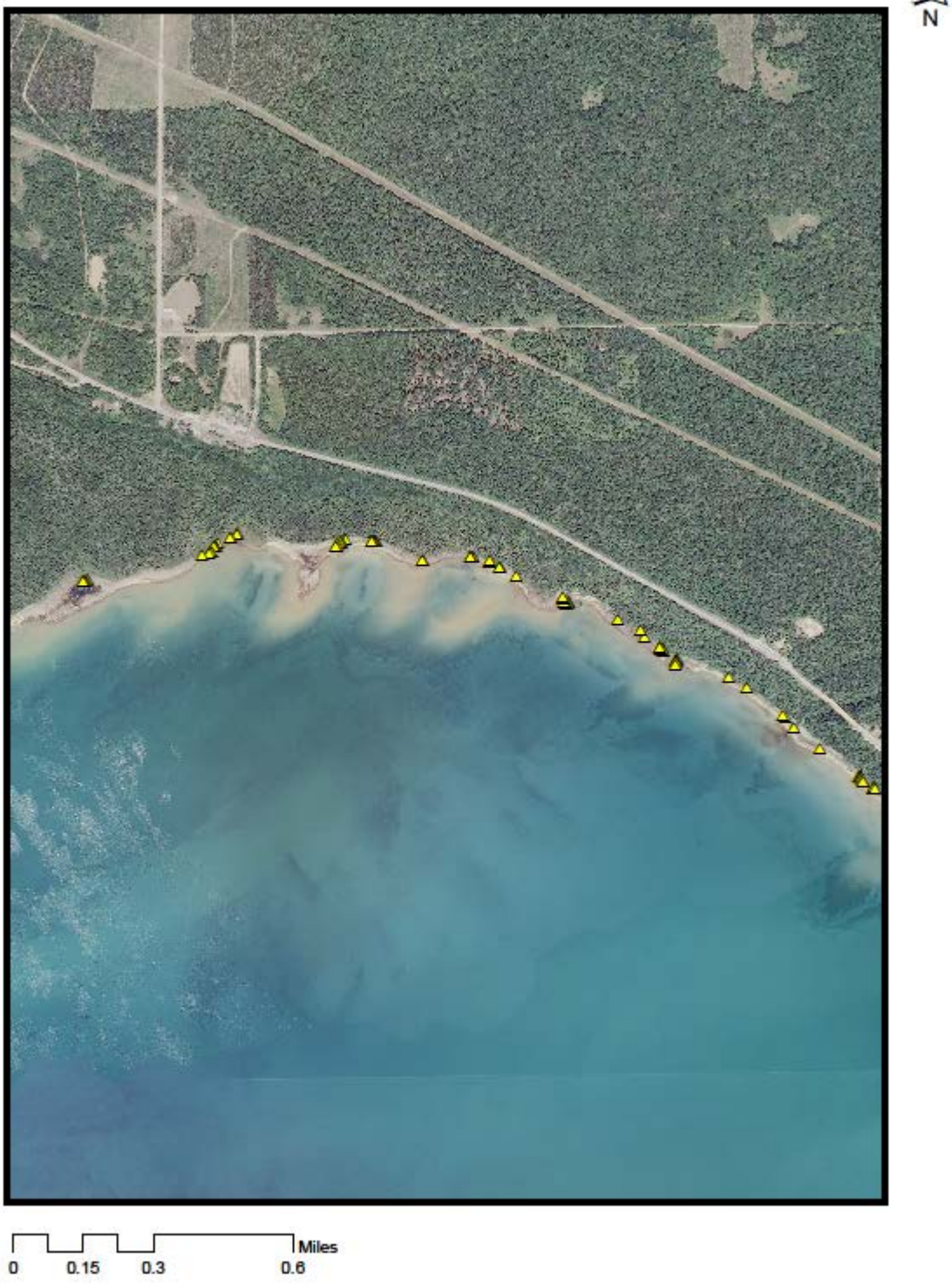
EOR # .002, Burt Lake Southwest, Float Route for Survey



Monkey-flower EOR #.002, Carp Creek - Reese's Swamp waypoints

Monkey-flower EOR #.018, Cut River East waypoints

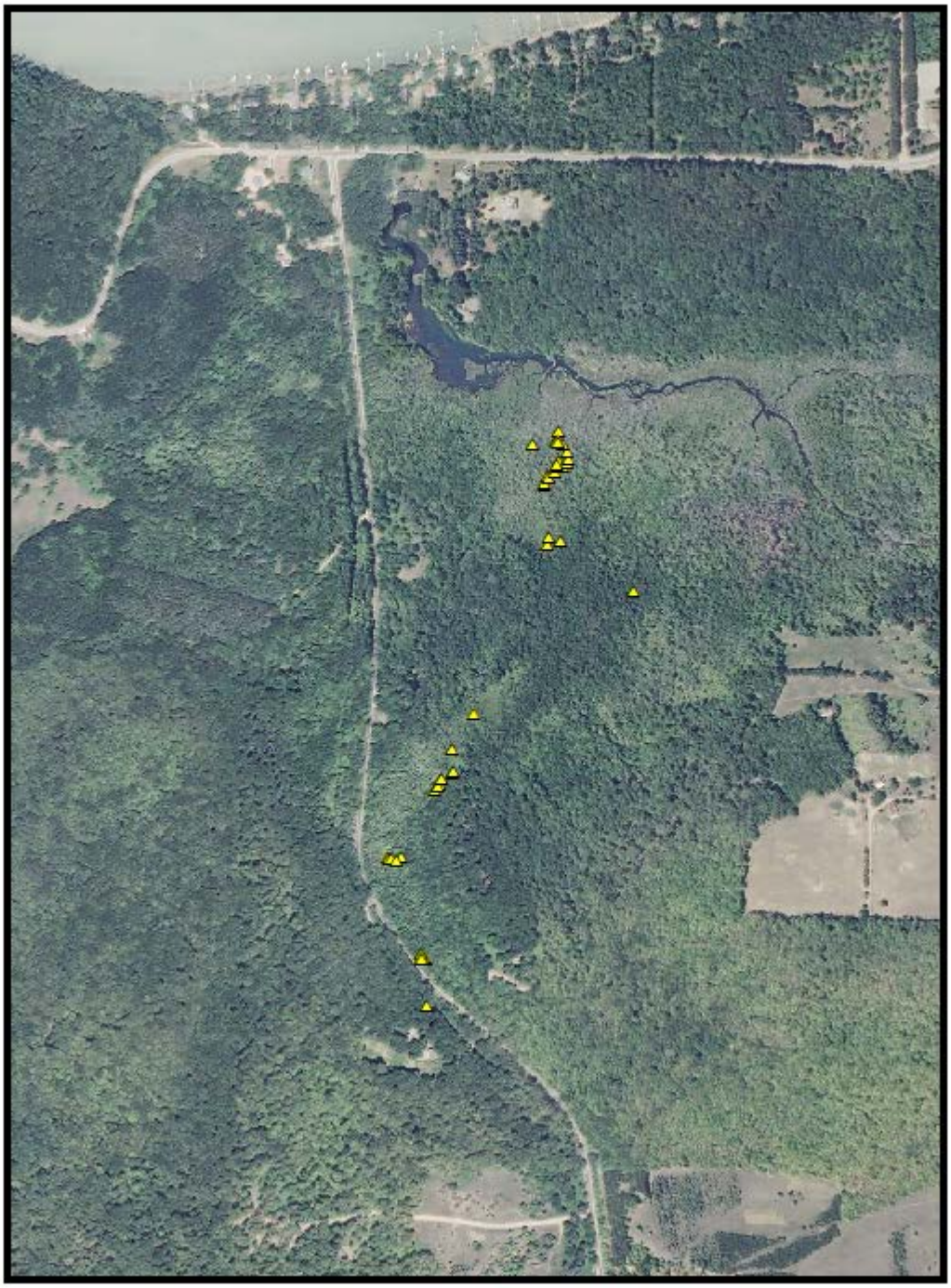
Monkey-flower EOR #.014, Cut River West waypoints



Monkey-flower EOR #.009, Epoufette waypoints

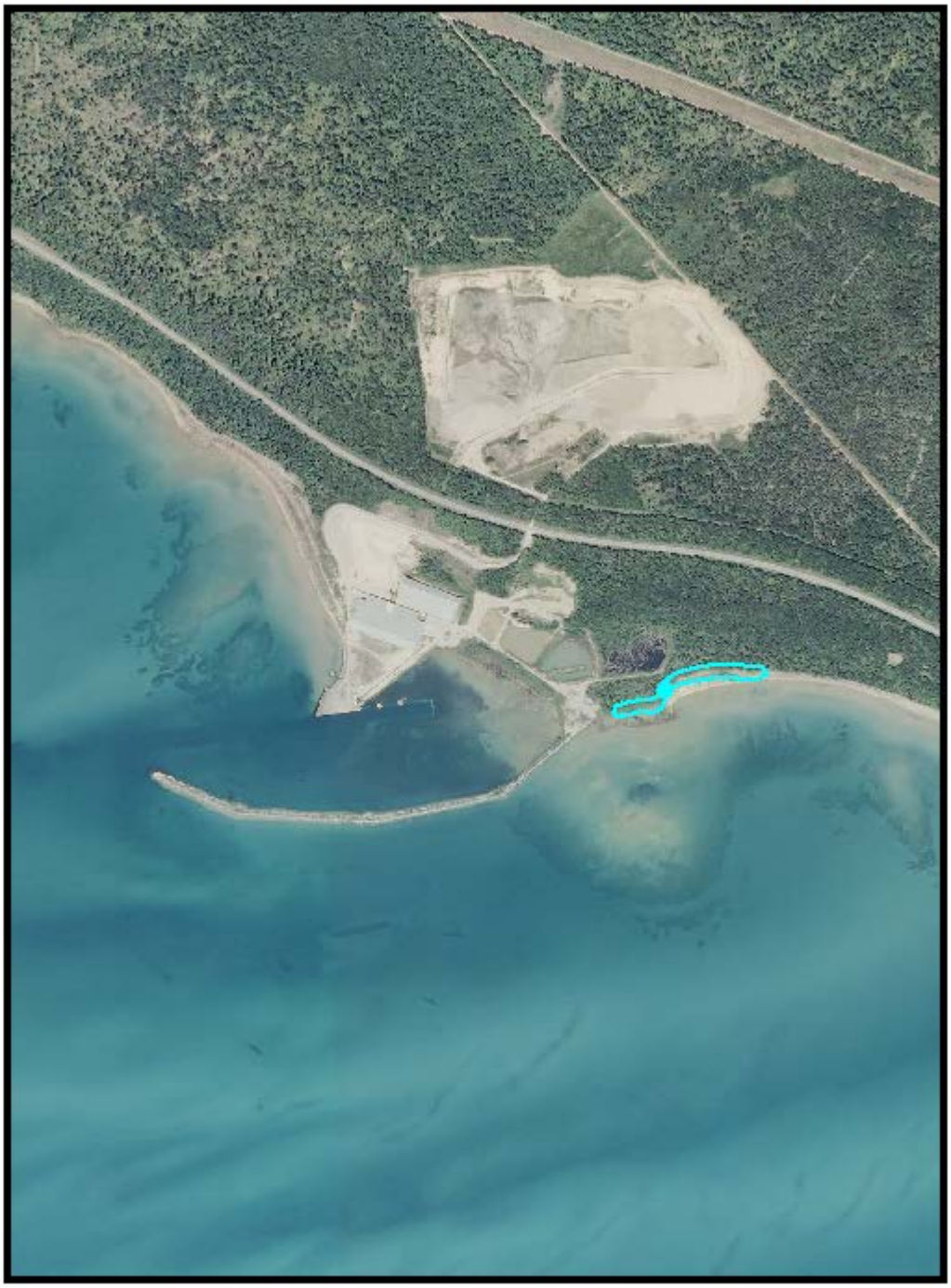
Monkey-flower EOR #.016, Harbor Springs waypoints,
with shoreline waypoints representing Lake Huron Tansy colonies.

Monkey-flower EOR #.019, Hatlem Creek waypoints,



Monkey-flower EOR #.013, Little Sand Bay waypoints,

Monkey-flower EOR #.011, Manitou Payment Highbanks,
where access was not permitted by Sand Products Company.



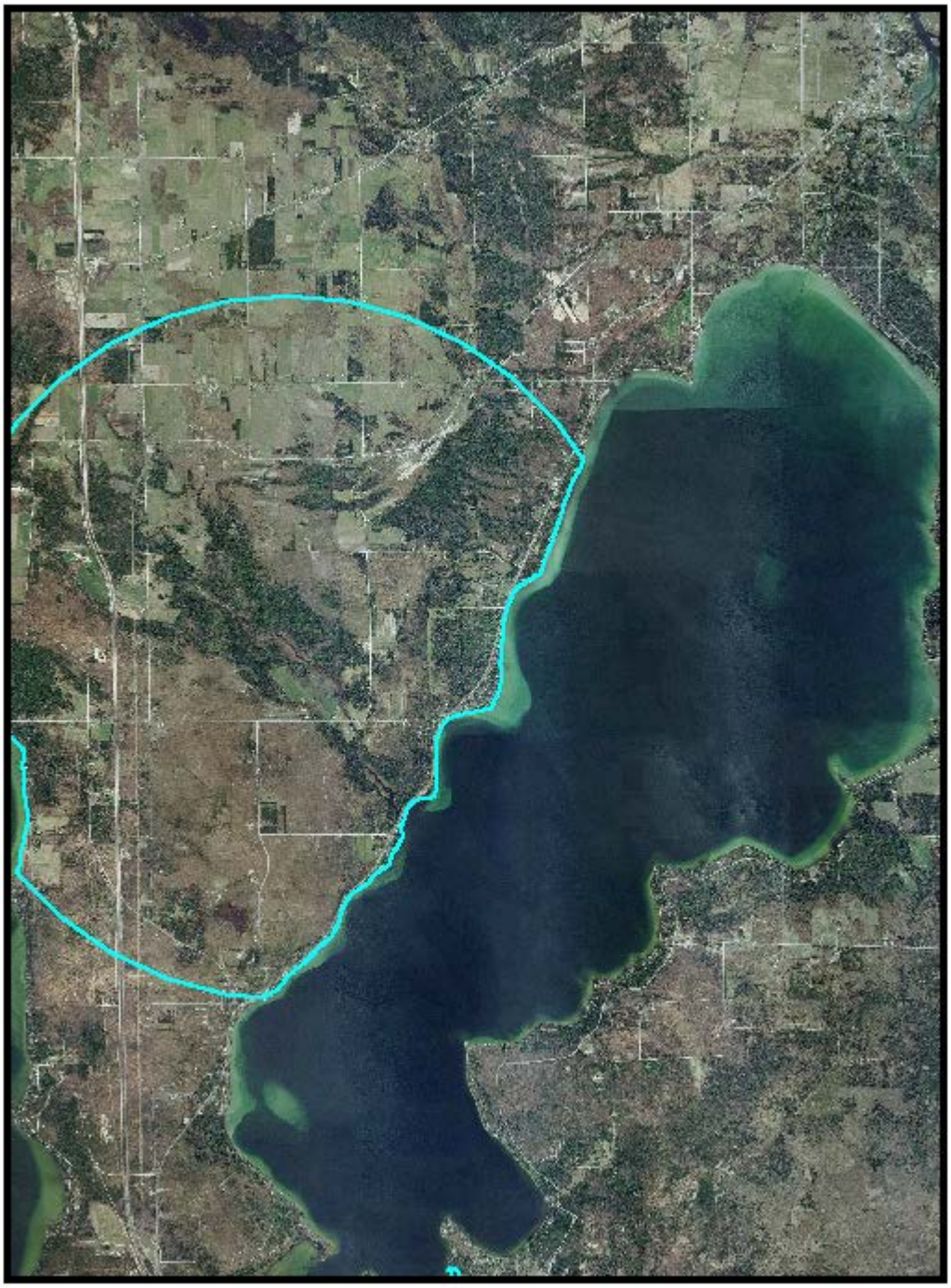
Monkey-flower EOR #.005, Maple River Dam waypoints

Martin Point North - new occurrence, southernmost waypoint

Monkey-flower EOR #.015, McFarlane Woods waypoints

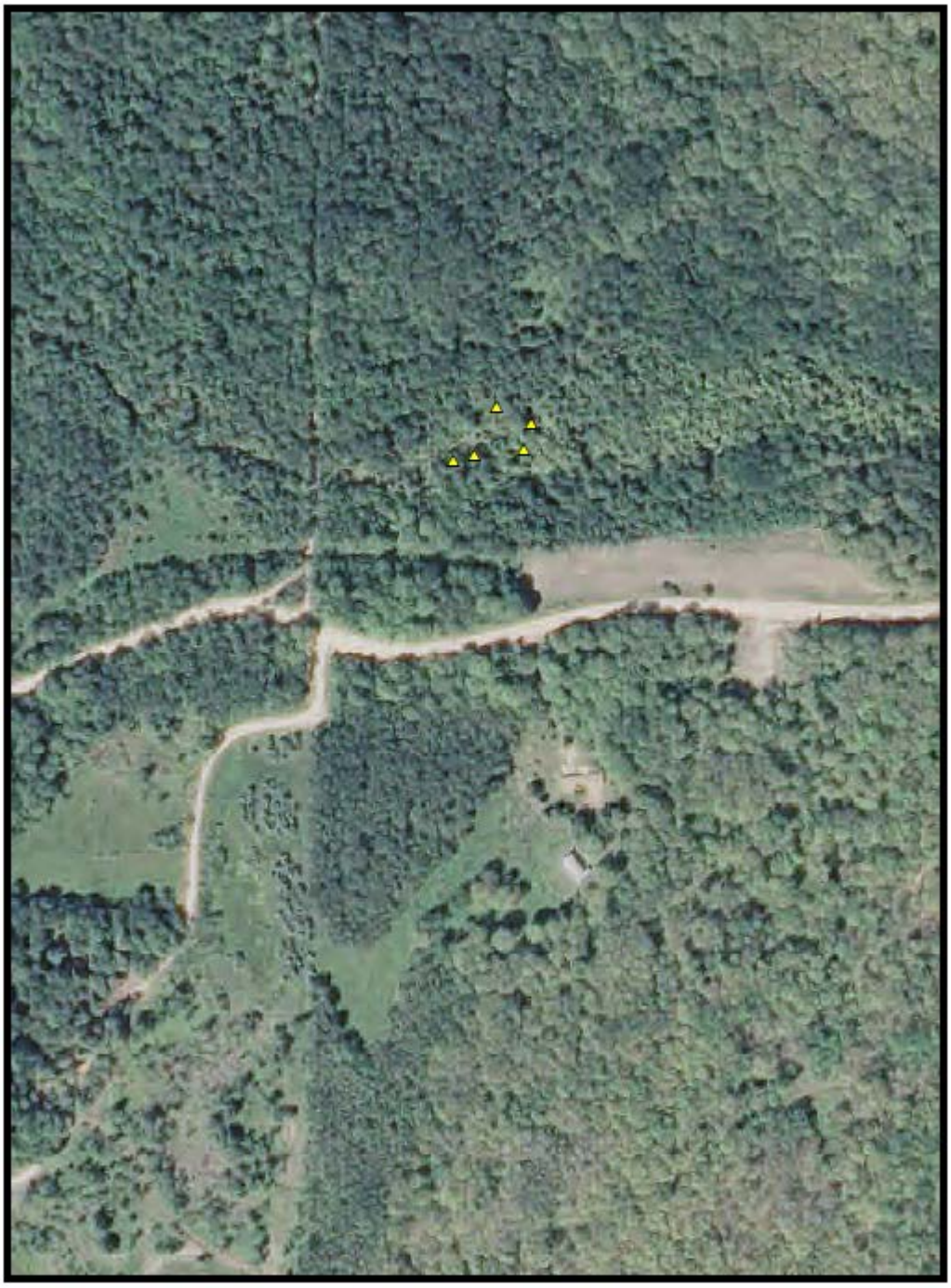
Monkey-flower EOR #.006, Mullet Lake SE - Parrott Point waypoints

Monkey-flower EOR #.017, Mullet Lake - West Shore occurrence



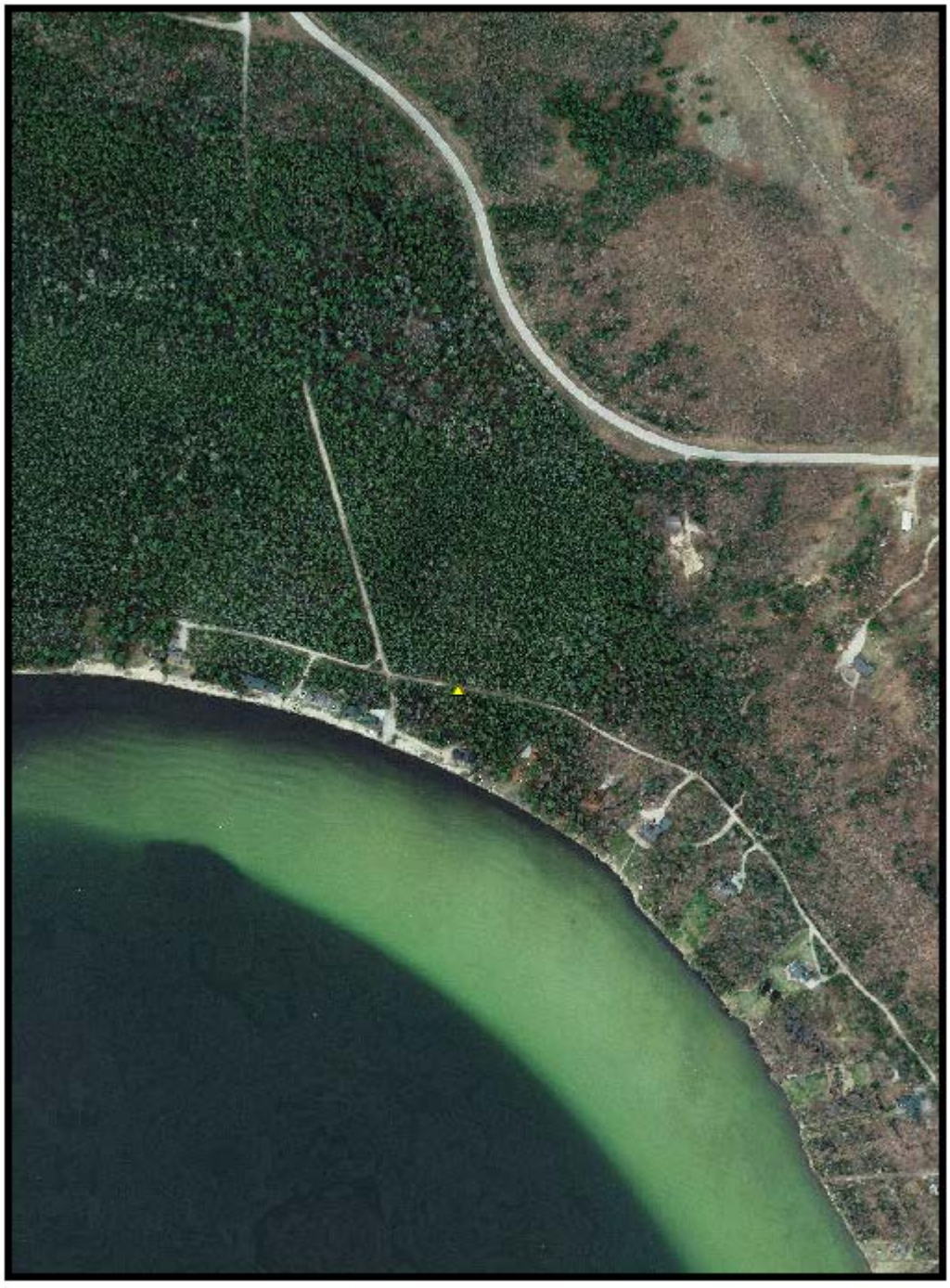
Oden Fish Hatchery, new occurrence waypoints

Monkey-flower EOR #.010, Platte River - North Branch waypoints

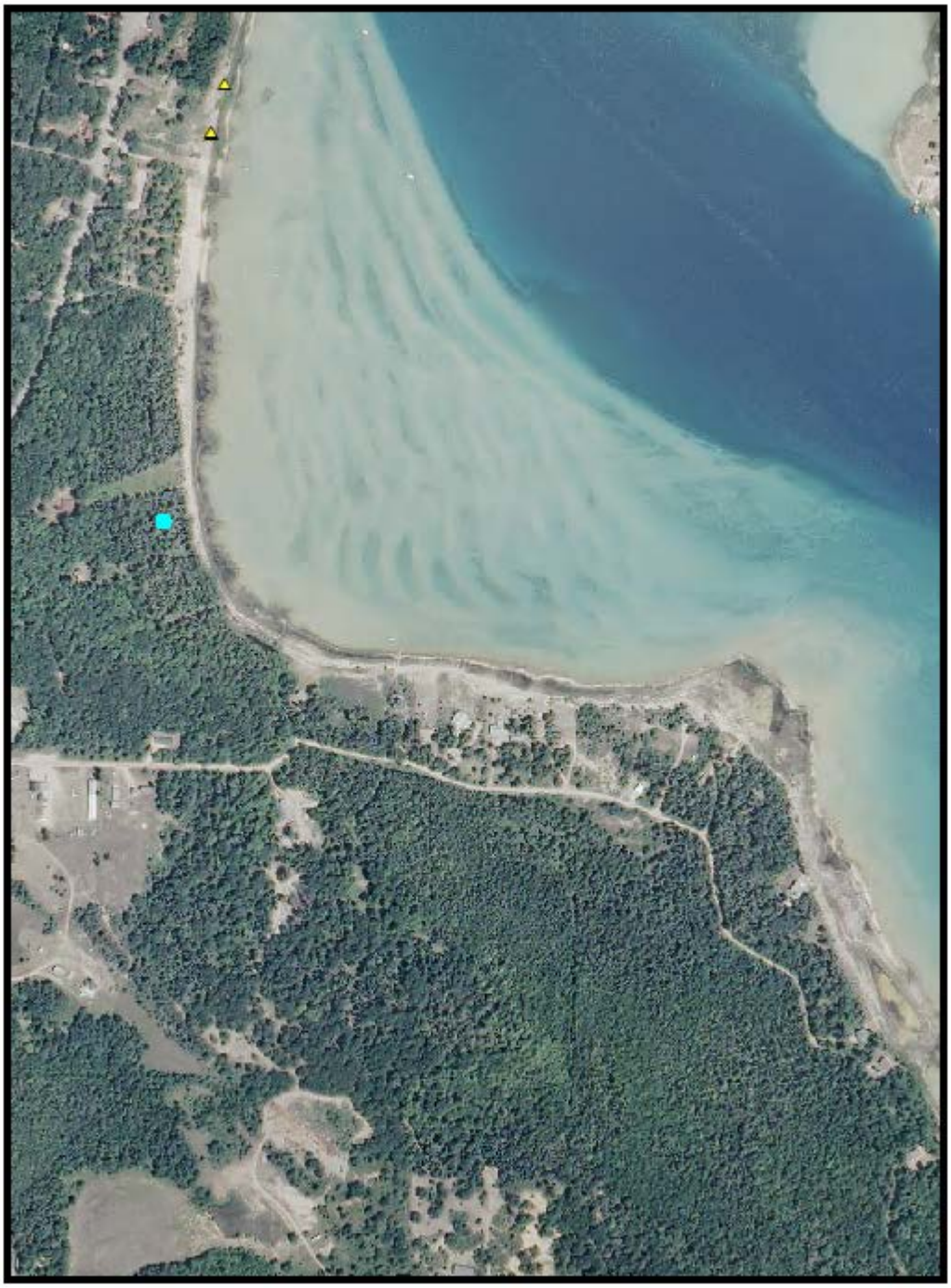


Point La Par South - new occurrence, waypoint north of Martin Point

Monkey-flower EOR #.003, Reese's Swamp waypoints



Monkey-flower EOR #.008, St. James Harbor site



Appendix II

Photo Plates

Plate 1. Brevort shoreline habitat.

Plate 2. Densely flowering colony along Brevort shoreline.

Plate 3. Burdickville-Settlers Point shoreline habitat, note *Myosotis* in foreground and coltsfoot on beach.

Plate 4. Monkey-flower colony in shoreline seep, Burdickville.

Plate 5. Burt Lake Southeast shoreline habitat.

Plate 6. Monkey-flower colony on moist bank, Burt Lake Southeast.

Plate 7. Carp Creek-Reese's Swamp habitat.

Plate 8. Small monkey-flower colony along Carp Creek.

Plate 9. Cut River East shoreline habitat expanse.

Plate 10. Dense monkey-flower colony along shoreline rivulet, Cut River East.

Plate 11. Cut River West habitat expanse just west of Cut River mouth.

Plate 12. Dense monkey-flower colony in shoreline wetland, Cut River West.

Plate 13. Epoufette ditch along Epoufette Bay Road.

Plate 14. Monkey-flower colony at edge of ditch, Epoufette Bay Road.

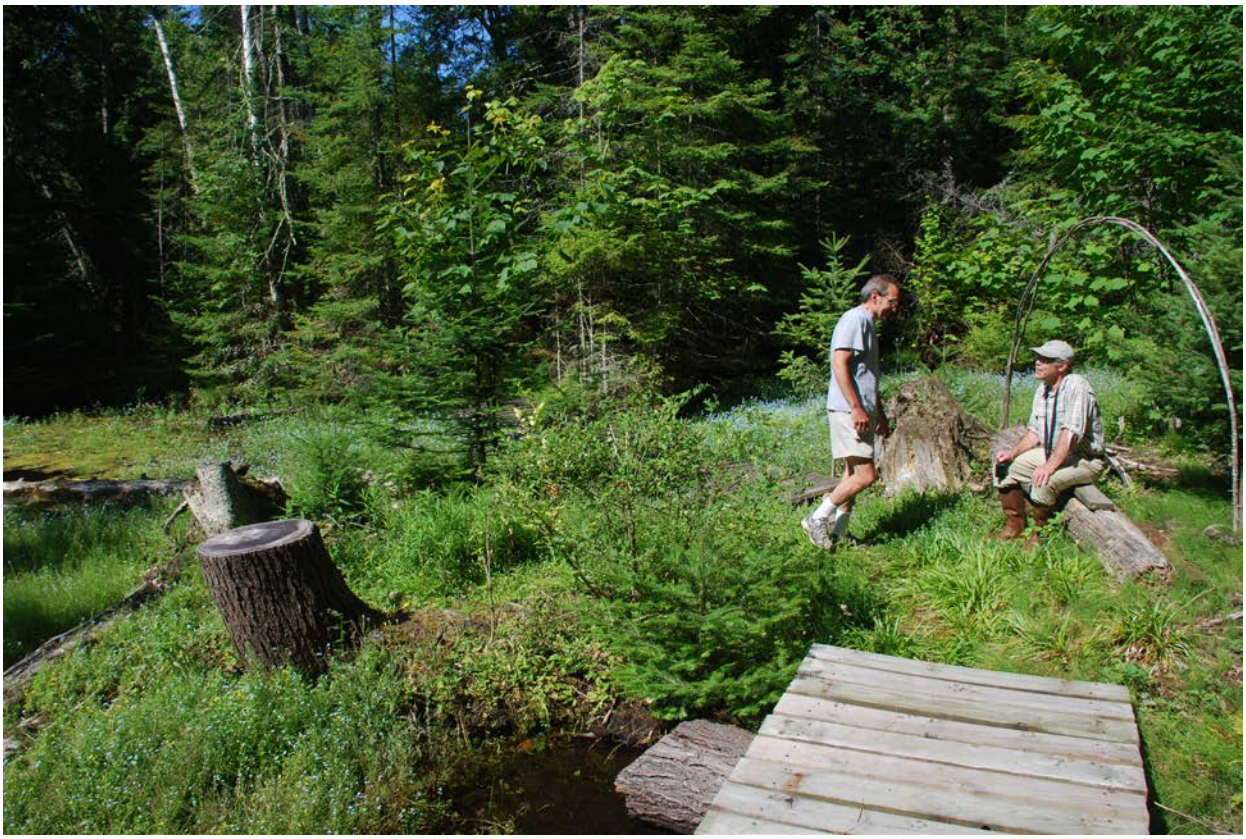


Plate 15. Boardwalk next to spring-fed pool, Harbor Springs occurrence (Idylwilde).

Plate 16. Vigorous monkey-flower patch at edge of pool, Harbor Springs locality (Idylwilde).

Plate 17. Hatlems Creek, streamside meadow habitat.

Plate 18. Monkey-flower colony along bank of Hatlems Creek.

Plate 19. Creek mouth, Little Sand Bay.

Plate 20. Dense monkey-flower colony near mouth of creek, Little Sand Bay.

Plate 21. Maple River Dam habitat.

Plate 22. Monkey-flower patch, Maple River Dam.

Plate 23. Fertile, fruiting monkey-flower stem with calyx enclosing mature capsule, Maple River Dam.

Plate 24. Mature capsule, Maple River Dam occurrence.

Plate 25. McFarlane Woods shoreline habitat.

Plate 26. Localized, dense colony at McFarlane Woods locality.

Plate 27. Mullet Lake SE – Parrott Point occurrence and habitat view.

Plate 28. Dense, localized, vigorous colony of Parrott Point monkey-flower.

Plate 29. Oden fish hatchery and visitor center habitat, at base of stream near entrance.

Plate 30. Monkey-flower colony on moist bank near visitor center entrance.

Plate 31. Platte River – North Branch habitat.

Plate 32. One of the obscure, small patches of monkey-flower at the Platte River locality.

Plate 33. Point La Par South locality on Beaver Island.

Plate 34. Monkey-flower patch at the mouth of unnamed creek, Point La Par South.

Plate 35. Reese's Swamp habitat, demonstrating the dense vegetation in monkey-flower habitat.

Plate 36. Monkey-flower patch, Reese's Swamp during a late season visit.

Plate 37. St James Harbor – Beaver Island habitat in area of reported record.

Plate 38. St James Harbor locality, area of currently tracked record where monkey-flower was not found.