

Ecological Surveys of the River Run Preserve Springfield Township, Oakland County, MI



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Cover: Former MNFI Botanist Mike Penskar surveying the Shiawassee Headwater Meadow in the River Run Preserve, 2022 (Photo by Joshua G. Cohen).

Table of Contents

Acknowledgements.....	ii
Introduction.....	1
Methods	2-3
Results.....	4-5
Site Summaries.....	6
Dry-Mesic Southern Forest.....	6-9
Rich Tamarack Swamp	10-13
Southern Shrub-Carr	14-17
Southern Wet Meadow	18-21
Conclusion	22
Literature Cited.....	23

List of Figures

Figure 1. <i>Natural community element occurrences within the River Run Preserve</i>	4
Figure 2. <i>2016 aerial photograph of Buteo Woods dry-mesic southern forest.</i>	8
Figure 3. <i>2016 aerial photograph of Shiawassee Headwaters Swamp rich tamarack swamp.</i>	11
Figure 4. <i>2016 aerial photograph of Shiawassee Headwaters Carr southern shrub-carr.</i>	15
Figure 5. <i>2016 aerial photograph of Shiawassee Headwaters Meadows southern wet meadow.</i>	19

List of Appendices

Appendix 1. Global and State Element Ranking Criteria

Appendix 2. Floristic Quality Assessments

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Introduction

In late summer of 2022, Michigan Natural Features Inventory (MNFI) conducted rare species and natural features assessment surveys at properties managed by the Springfield Township Parks and Recreation Department (Oakland County, Michigan). MNFI conducted ecological surveys in the River Run Preserve targeting rare and high-quality natural communities. This information will be used during planning for future land management within the project areas, and to serve as a baseline to allow long-term trends to be assessed. Data on high-quality natural communities were documented and entered into MNFI's Natural Heritage Database. This final report details our survey methodology, results, and management recommendations.

Methods

Field Survey Prioritization

The MNFI natural community classification system was used as the classification framework (Kost et al. 2007; Cohen et al. 2015; Cohen et al. 2020). Prior to on-the-ground-surveys, MNFI ecologists conducted aerial photo interpretation to evaluate potential survey targets. To help focus surveys, multiple series of aerial imagery and spatial data layers were evaluated. Available imagery and spatial data layers that informed this process included historical imagery (1949 and 1967), color infrared imagery (1998), recent true color leaf-off imagery (2015-2018), recent true color leaf-on imagery (2018-2020), and topographic maps.

Field Survey

A qualitative, plotless sampling design was employed to survey natural communities within the River Run Preserve. The meander survey involved investigating unique aerial signatures, traversing topographic variation, and visiting noticeable vegetation zones and soil moisture types. A Samsung Tablet in tracking mode was used during the meander surveys to create a record of routes taken. If a site met defined requirements for ecological condition, landscape context, and size of the area of interest (MNFI 1988) it was categorized as a high-quality example of that specific natural community type, entered into MNFI's database as an element occurrence (EO), and given a letter rank. Ecological field surveys were conducted during the growing season to evaluate the condition and classification of the sites. To assess natural community size and landscape context, a combination of field surveys, aerial photographic interpretation, and Geographic Information System (GIS) analysis was employed.

The ecological field surveys involved:

- a) compiling comprehensive plant species lists to be summarized in a floristic quality index and noting dominant, co-dominant, and representative species
- b) estimating percent coverage of prevalent or key overstory and understory species
- c) describing site-specific structural attributes (e.g., vegetative zonation, vegetative strata, and coarse woody debris) and ecological processes (e.g., windthrow, ground-water seepage)
- d) measuring tree diameter at breast height (DBH) of representative canopy trees and aging canopy dominants (where appropriate)
- e) analyzing soils and recording representative soil texture, pH, and depth
- f) describing hydrology
- g) noting current and historical anthropogenic disturbances
- h) evaluating potential threats to ecological integrity
- i) ground-truthing aerial photographic interpretation using GPS (Garmin units and Samsung Tablets were utilized)
- j) taking digital photos and GPS points at significant locations
- k) surveying adjacent lands when possible to assess landscape context
- l) evaluating the natural community classification
- m) determining the ecological integrity of high-quality natural communities by assigning or updating element occurrence ranks
- n) noting management needs and restoration opportunities or evaluating past and current restoration activities and noting additional management needs and restoration opportunities



For each high-quality natural community element occurrence, comprehensive plant lists were compiled. Photo by Joshua G. Cohen.

Following completion of the field surveys, the collected data were analyzed and transcribed to create element occurrence records in MNFI's statewide biodiversity conservation database (MNFI 2022). Tracks and GPS points collected during the field visits were transposed on aerial imagery to facilitate the generation of natural community boundaries for new element occurrences. Data compiled from the field surveys were used to produce site descriptions, threat assessments, and management recommendations for each natural community element occurrence, which appear within the **Results** section.

For each high-quality natural community, floristic data were compiled into the Universal Floristic Quality Assessment Calculator (Reznicek et al. 2014, Freyman et al. 2016) to determine the Floristic Quality Index (FQI) for each natural community element occurrence. The floristic quality assessment is derived from a mean coefficient of conservatism and floristic quality index. Each native species is assigned a coefficient of conservatism, a value of 0 to 10 based on probability of its occurrence in a natural versus degraded habitat. Species restricted to a specialized or undisturbed habitat are assigned a value of 10, implying the species has extremely strong fidelity to a specific habitat. Native species that are not particular or indicative of natural conditions are assigned a low value of 0 or 1. The coefficient of conservatism is determined by experts on the flora of a region, and so may vary for a given plant species from region to region. We employed the regionally appropriate FQA for Michigan (Reznicek et al. 2014). From the total list of plant species for an area, a mean C value is calculated and then multiplied by the square root of the total number of plant species to calculate the FQI. Michigan sites with an FQI of 35 or greater possess sufficient conservatism and richness that they are considered floristically important from a statewide perspective (Herman et al. 2001). Species lists for each natural community element occurrence are provided in Appendix 2.

Results

Natural community surveys were conducted on June 23rd, 2022, and September 9th, 2022. Four element occurrences (EOs) of high-quality natural communities were documented in the River Run Preserve during the 2022 field season (**Figure 1**). The four natural community EOs included dry-mesic southern forest (1 EO), rich tamarack swamp (1 EO), southern shrub-carr (1 EO), and southern wet meadow (1 EO). In addition, a small prairie fen was documented in the northwestern portion of the preserve but is too small to be included as an EO.

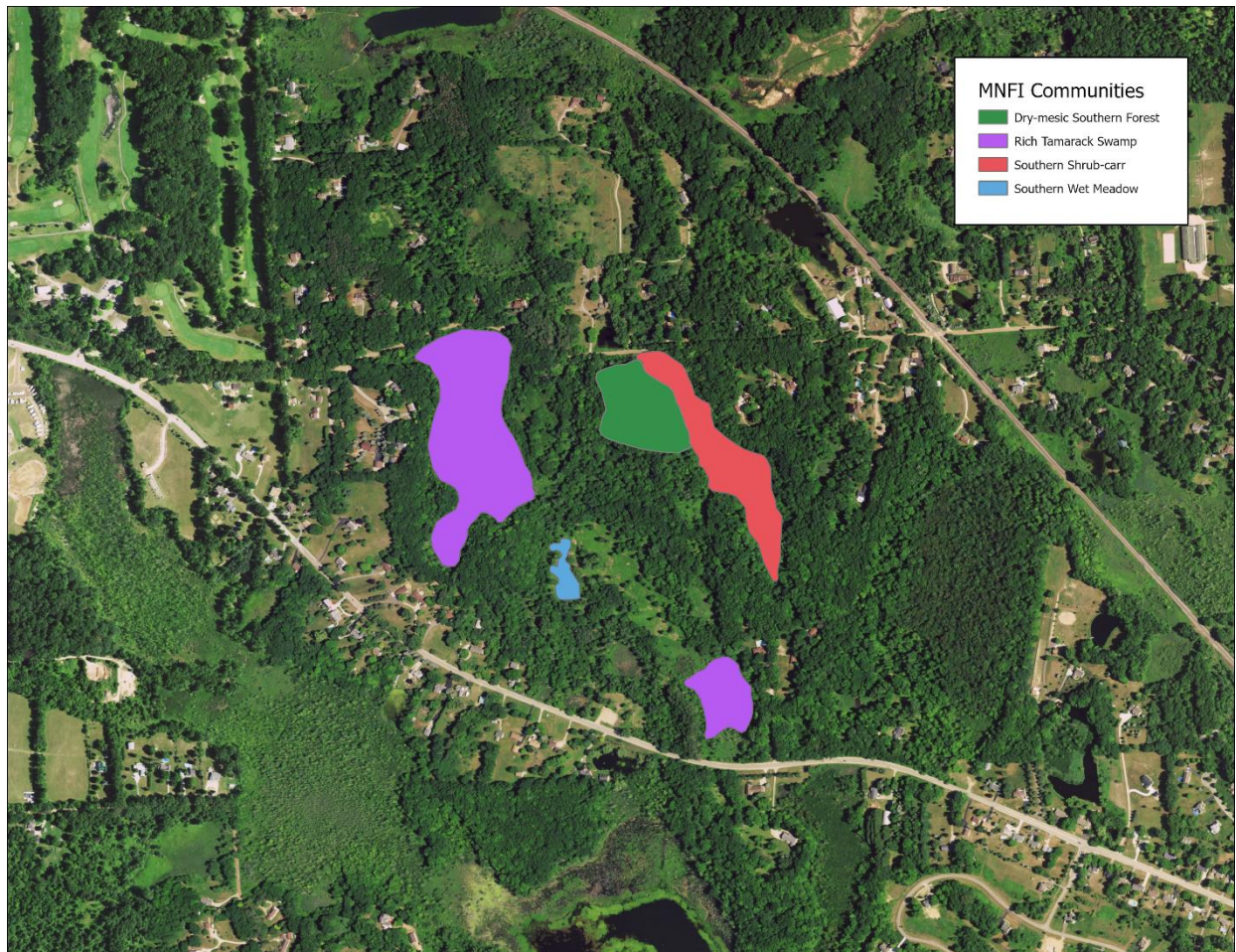


Figure 1. Natural community element occurrences within the River Run Preserve.

The following site summaries summarize threats and management recommendations for each of the four natural community EOs visited in 2022 organized alphabetically by community type. Each grouping of communities begins with an overview of the natural community type, which was adapted from MNFI's natural community classification (Kost et al. 2007, Cohen et al. 2015). In addition, an ecoregional distribution map is provided for each natural community type (Albert et al. 2008). For each site summary, we provide the following information:

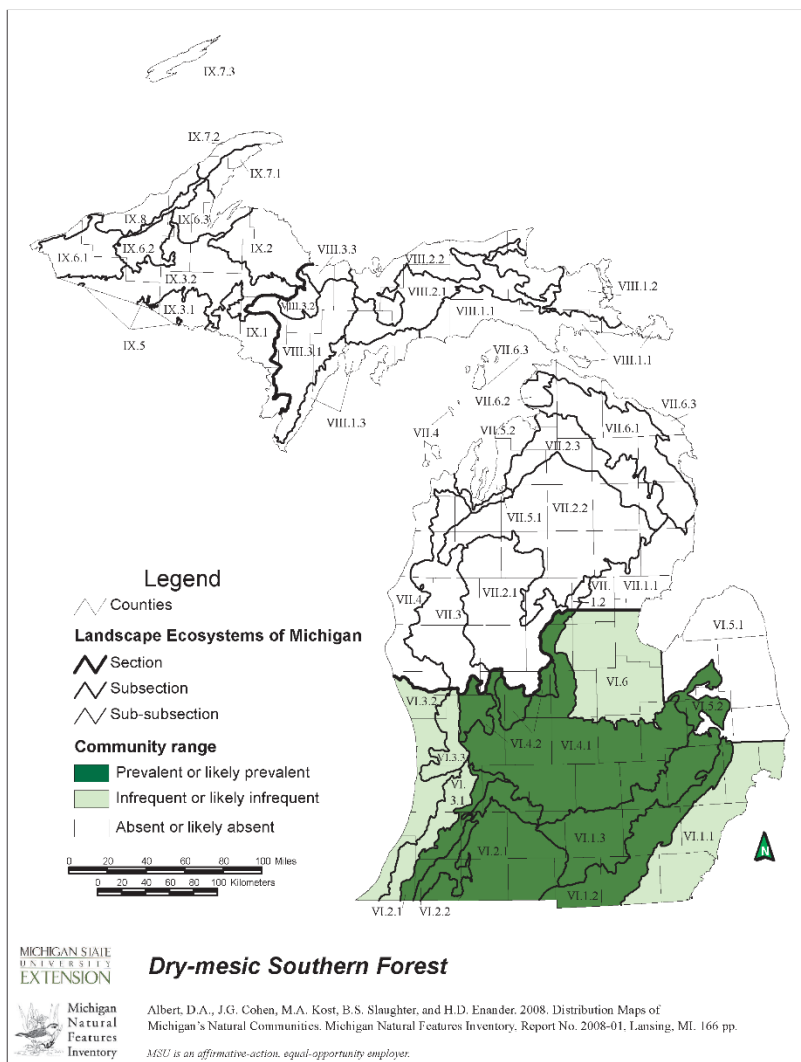
- a) site name
- b) natural community type
- c) global and state rank (see **Appendix 1** for ranking criteria)

- d) element occurrence rank
- e) size
- f) digital photographs
- g) site description
- h) threat assessment
- i) management recommendations

SITE SUMMARIES

DRY-MESIC SOUTHERN FOREST

Overview: Dry-mesic southern forest is a fire-dependent, oak or oak-hickory forest type on generally dry-mesic sites found south of the climatic tension zone in southern Lower Michigan. This natural community occurs principally on glacial outwash, coarse-textured moraines, sandy glacial lakeplains, kettle-kame topography, and sand dunes. Soils are typically sandy loam or loam and slightly acid to neutral in pH. Frequent fires maintain semi-open conditions, promoting oak regeneration and ground and shrub layer diversity (Kost et al. 2007, Cohen et al. 2015).



Map 1. Distribution of dry-mesic southern forest in Michigan (Albert et al. 2008).

1. Buteo Woods

Natural Community Type: Dry-Mesic Southern Forest

Rank: G4 S3, apparently secure globally and vulnerable within the state

Element Occurrence Rank: CD

Size: 5.2 acres

Element Occurrence Identification Number: 26376

Site Description: A small stand of oak-hickory forest occurs on rolling topography of ice-contact terrain of variable aspect (**Figure 2**). A kettle depression occurs within the forest, which also occurs immediately adjacent to a poorly drained outwash channel that supports southern shrub-carr. Soils of the dry-mesic southern forest are fine- to medium-textured, acidic (pH 5.0) loamy sands. A 64 cm white oak (*Quercus alba*) was cored and estimated to be over 205 years old.

The overstory ranges from 75 to 95% and the canopy is dominated by white oak and black oak (*Q. velutina*) with canopy associates including pignut hickory (*Carya glabra*) and red oak (*Q. rubra*). Canopy trees typically range in diameter from 50 to 70 cm. The subcanopy is scattered (5-15%) with red maple (*Acer rubrum*), black cherry (*Prunus serotina*), basswood (*Tilia americana*), and ironwood (*Ostrya virginiana*). The understory is sparse (5-10%) with white ash (*Fraxinus americana*), autumn olive (*Elaeagnus umbellata*), and common buckthorn (*Rhamnus cathartica*). The low shrub layer is sparse to patchy (10-15%) with white ash, ironwood, white oak, common privet (*Ligustrum vulgare*), and multiflora rose (*Rosa multiflora*). Pennsylvania sedge (*Carex pensylvanica*) is prevalent in the homogenous ground cover (65-80%) with scattered associates including may-apple (*Podophyllum peltatum*), zigzag goldenrod (*Solidago flexicaulis*), and river-bank grape (*Vitis riparia*).

The Buteo Woods dry-mesic southern forest was surveyed June 23rd and September 9th, 2022. A total of 20 plant species was documented with 15 native species and 5 non-native species (**Appendix 2.1**). The total FQI was 13.9. A nesting red-shouldered hawk (*Buteo lineatus*, state threatened) was documented in this forest in 2022.

Threats: Species composition, vegetative structure, and successional trajectory have been influenced by past selective logging, windthrow, fire suppression, invasive species, and deer herbivory. The prevalence of mesophytic species in the subcanopy and understory layers suggests that the forest has been fire suppressed for several decades. Invasive species documented within the forest include autumn olive, common buckthorn, common privet, multiflora rose, and oriental bittersweet (*Celastrus orbiculatus*).

Management Recommendations: The primary management needs are to maintain the closed-canopy conditions, allow the forest to continue to mature, and reintroduce fire as a prevalent disturbance factor. In addition, reducing local deer densities will reduce deer browse pressure on the understory and ground cover. Invasive plants should be controlled through cutting and/or herbicide if burning does not eliminate them. All prescriptions within this forest should avoid when red-shouldered hawk nests are active. This time period ranges from the third week in March through the fourth week in June. Monitoring should be implemented for efforts to control non-native plant populations, to gauge the impact of deer herbivory, and evaluate oak regeneration following prescribed fire.

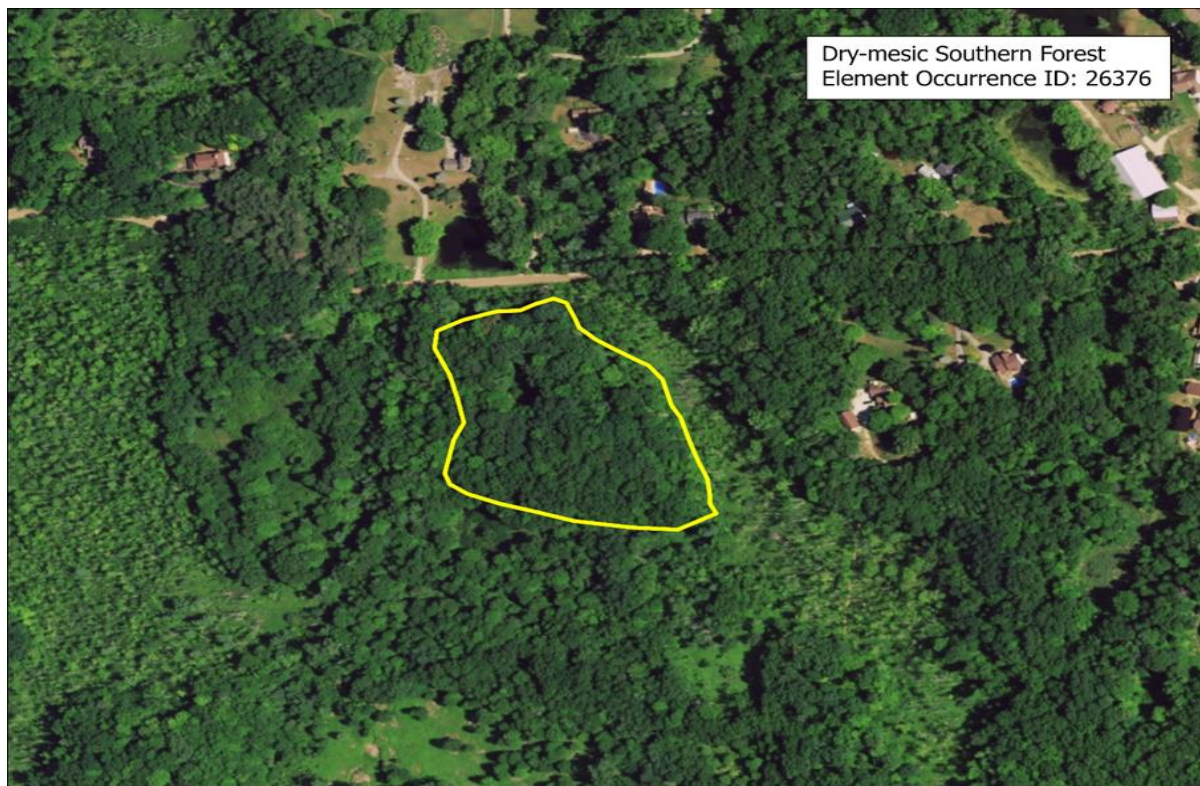


Figure 2. 2016 aerial photograph of Buteo Woods dry-mesic southern forest.



Buteo Woods dry-mesic southern forest. Photo by Joshua G. Cohen.

All management activities that include multiple individuals and/or loud equipment, within this forest should avoid the period when red-shouldered hawk nests are active. This time period ranges from February 15th through July 1st (MDNR 2015). This period would include time when birds are actively setting up breeding territories (February/March), incubating (March/April), when young birds are in the nest (April/May), and when young of year birds are still acclimating to forest and learning to hunt on their own (May/June). Any single-person management activities would be permissible during this time period as long as hawks are not actively agitated. If hawks are vocal, activities should cease and the individual should leave the forest.

In addition, the newly constructed/proposed hiking trail loop should have a seasonal closure during the most disruptive time period of February 15th through May 15th each year (MDNR 2015). The proposed trail was walked with the help of MNFI Zoologist David Cuthrell (who has over 20 years of experience with nesting red-shouldered hawks) to route it around the nest to allow enough buffer as to minimize any potential disruptions. There were limited route options due to the landscape, therefore the idea of seasonal loop route closures was proposed. If these guidelines are followed, there will be very limited disturbance to nesting red-shouldered hawks within the forest. However, continued monitoring for nesting hawks, including determining if young successfully fledge, is recommended each year.



Red-shouldered hawk nest photo from 2019. The planned trail should be routed around the nest to minimize potential disruptions. Photo by David L. Cuthrell.

RICH TAMARACK SWAMP

Overview: Rich tamarack swamp is a groundwater-influenced, minerotrophic, forested wetland dominated by tamarack (*Larix laricina*) that occurs on deep organic soils predominantly south of the climatic tension zone in southern Lower Michigan. This natural community type was known as relict conifer swamp in previous versions of the natural community classification. (Kost et al. 2007, Cohen et al. 2015).



Map 2. Distribution of rich tamarack swamp in Michigan (Albert et al. 2008).

2. Shiawassee River Headwaters Swamp

Natural Community Type: Rich Tamarack Swamp

Rank: G4 S3, apparently secure globally and vulnerable within the state

Element Occurrence Rank: C

Size: 16.9 acres

Element Occurrence Identification Number: 26373

Site Description: Two polygons of rich tamarack swamp occur on poorly drained depressions within ice-contact outwash (**Figure 3**). In addition to rich tamarack swamp, the swamp complex includes southern shrub-carr and southern wet meadow. The rich tamarack swamp is characterized by deep (> 1 meter), saturated, circumneutral to alkaline (pH 7.0-7.3) hemic to sapric peats. The saturated conditions of the organic soils are maintained by groundwater seepage. Sphagnum hummocks and hollows, tip up mounds, and sedge tussocks provide microsite diversity by creating small-scale gradients in soil moisture and soil chemistry. A 27.5 cm tamarack (*Larix laricina*) was cored and estimated to be over 100 years old and an 18.3 cm tamarack was cored and estimated to be over 65 years old.

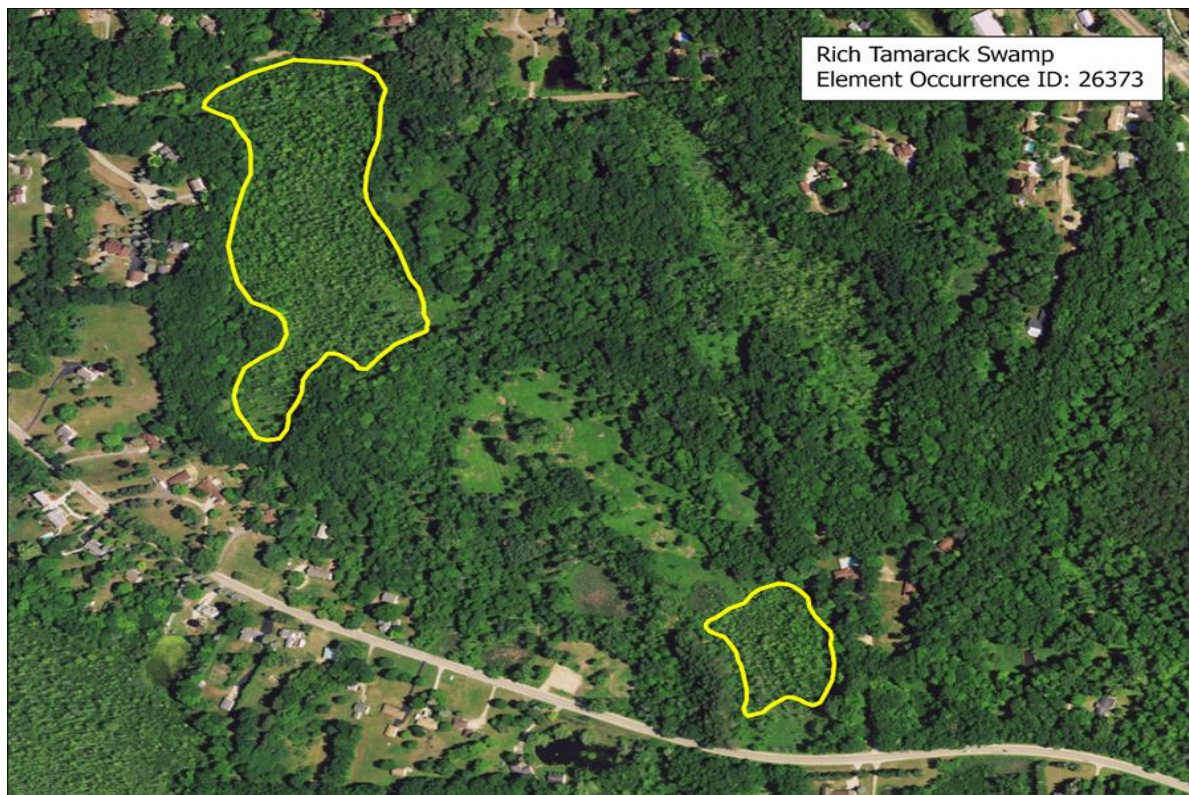


Figure 3. 2016 aerial photograph of Shiawassee Headwaters Swamp rich tamarack swamp.

The swamp is characterized by an open canopy (25-50%) of tamarack with canopy associates including American elm (*Ulmus americana*), black spruce (*Picea mariana*), quaking aspen (*Populus tremuloides*), swamp white oak (*Quercus bicolor*), black ash (*Fraxinus nigra*), and paper birch (*Betula papyrifera*). Canopy trees range in diameter from 10 to 20 cm. The understory is patchy to dense (40-60%) with prevalent species including poison sumac (*Toxicodendron vernix*), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), silky dogwood (*Cornus amomum*), red-osier (*C. sericea*), mountain holly (*Ilex mucronata*), Michigan holly (*I. verticillata*), bebb's willow (*Salix bebbiana*), pussy willow (*S. discolor*), and highbush blueberry (*Vaccinium corymbosum*). Scattered invasives occur within the understory and low shrub layer and include autumn olive (*Elaeagnus umbellata*), glossy buckthorn (*Frangula alnus*),

common buckthorn (*Rhamnus cathartica*), and multiflora rose (*Rosa multiflora*). The low shrub layer is patchy (15-30%) with common species including chokeberry (*Aronia prunifolia*), bog birch (*Betula pumila*), silky dogwood, red-osier, common juniper (*Juniperus communis*), spicebush (*Lindera benzoin*), alder-leaved buckthorn (*Rhamnus alnifolia*), wild black currant (*Ribes americanum*), swamp gooseberry (*R. hirtellum*), swamp rose (*Rosa palustris*), meadowsweet (*Spiraea alba*), and bog willow (*Salix pedicellaris*). Characteristic species of the diverse herbaceous layer include lake sedge (*Carex lacustris*), blue-joint (*Calamagrostis canadensis*), marsh-marigold (*Caltha palustris*), tussock sedge (*Carex stricta*), sensitive fern (*Onoclea sensibilis*), marsh fern (*Thelypteris palustris*), false nettle (*Boehmeria cylindrica*), goldthread (*Coptis trifolia*), water horsetail (*Equisetum fluviatile*), joe-pye-weed (*Eutrochium maculatum*), northern bugle weed (*Lycopus uniflorus*), dwarf raspberry (*Rubus pubescens*), great water dock (*Rumex orbiculatus*), smooth swamp aster (*Symphyotrichum firmum*), swamp milkweed (*Asclepias incarnata*), cinnamon fern (*Osmunda cinnamomea*), skunk-cabbage (*Symplocarpus foetidus*), boneset (*Eupatorium perfoliatum*), spotted touch-me-not (*Impatiens capensis*), cut grass (*Leersia oryzoides*), swamp goldenrod (*Solidago patula*), rough leaved goldenrod (*S. rugosa*), broad-leaved cat-tail (*Typha latifolia*), and royal fern (*Osmunda regalis*).

The Shiawassee Headwaters Swamp rich tamarack swamp was surveyed June 23rd and September 9th, 2022. A total of 86 plant species was documented with 81 native species and 5 non-native species (Appendix 2.2). The total FQI was 41.7.

Threats: Species composition, vegetative structure, and successional trajectory are influenced by groundwater seepage, fire suppression, and invasive species. As noted above, invasive shrubs occur scattered within the understory and low shrub layer and include autumn olive, glossy buckthorn, common buckthorn, and multiflora rose.

Management Recommendations: The primary management recommendations are to maintain a forested buffer surrounding the swamp to preserve the hydrology and to control invasive shrubs through herbiciding and cutting. Efforts to control invasive species should be monitored. Reducing invasive species throughout the surrounding area is recommended in order to reduce the local seed source.



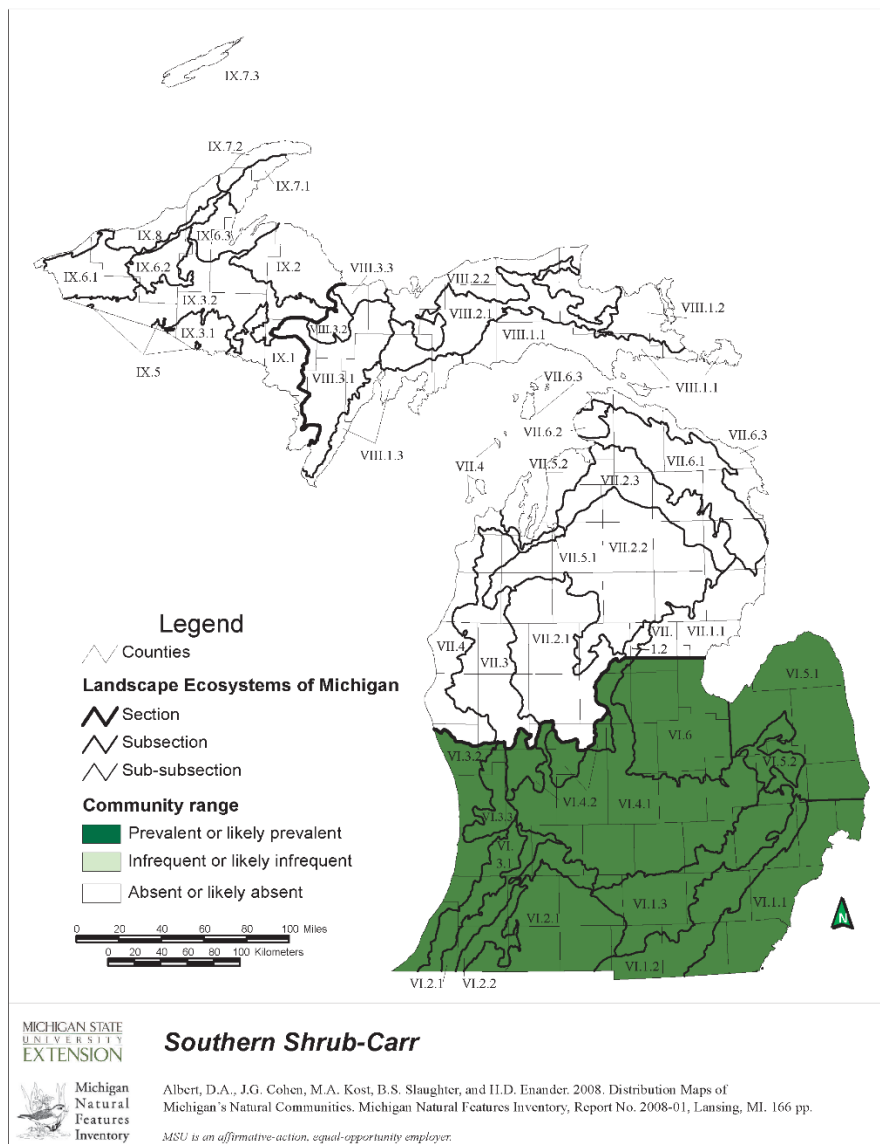
Shiawassee Headwaters Swamp rich tamarack swamp. Photo by Joshua G. Cohen.



Shiawassee Headwaters Swamp rich tamarack swamp. Photo by Joshua G. Cohen.

SOUTHERN SHRUB-CARR

Overview: Southern shrub-carr is a moderate to long persistent successional shrub community dominated by willows (*Salix* spp.), dogwoods (i.e., *Cornus sericea*, *C. foemina*, and *C. amomum*), winterberry (*Ilex verticillata*), and bog birch (*Betula pumila*). This community is successional intermediate among a variety of open, herbaceous wetlands (i.e., southern wet meadow, prairie fen, wet-mesic prairie, and lakeplain wet-mesic prairie) and forested wetlands such as rich tamarack swamp and southern hardwood swamp. It typically occurs on saturated, organic soil and is characterized by fluctuating water levels and poor drainage conditions. Southern shrub-carr is found primarily south of the climatic tension zone in southern Lower Michigan (Kost et al. 2007, Cohen et al. 2015).



Map 3. Distribution of southern shrub-carr in Michigan (Albert et al. 2008).

3. Shiawassee River Headwaters Carr

Natural Community Type: Southern Shrub-Carr

Rank: GU S4, globally unrankable and apparently secure within the state

Element Occurrence Rank: C

Size: 7.2 acres

Element Occurrence Identification Number: 26374

Site Description: Southern shrub-carr occurs on a poorly drained depression within ice-contact outwash in the northeastern portion of the River Run Preserve (**Figure 4**). The shrub swamp is characterized by deep (> 1 meter), saturated, alkaline (pH 7.2-7.3) hemic to sapric peats. The saturated conditions of the organic soils are maintained by groundwater seepage. Sedge tussocks, ant mounds, sphagnum hummocks and hollows, and tip-up mounds provide microsite diversity by creating small-scale gradients in soil moisture and soil chemistry.



Figure 4. 2016 aerial photograph of Shiawassee Headwaters Carr southern shrub-carr.

The shrub-carr is characterized by a dense (50-75%) tall shrub layer with prevalent species including poison sumac (*Toxicodendron vernix*), grey dogwood (*Cornus foemina*), red-osier (*C. sericea*), Michigan holly (*Ilex verticillata*), pussy willow (*Salix discolor*), and spicebush (*Lindera benzoin*). The tall shrub layer is overtopped by a scattered overstory (10-25%) with tamarack (*Larix laricina*), American elm (*Ulmus americana*), quaking aspen (*Populus tremuloides*), red maple (*Acer rubrum*), bur oak (*Quercus macrocarpa*), and yellow birch (*Betula alleghaniensis*). Scattered invasives occur within the understory and low shrub layer and include autumn olive (*Elaeagnus umbellata*), common privet (*Ligustrum vulgare*), and multiflora rose (*Rosa multiflora*). The low shrub layer is patchy (20-40%) with common

species including wild black currant (*Ribes americanum*), swamp gooseberry (*R. hirtellum*), swamp rose (*Rosa palustris*), meadowsweet (*Spiraea alba*), and common blackberry (*Rubus allegheniensis*). Characteristic species of the diverse herbaceous layer (80-95%) include lake sedge (*Carex lacustris*), blue-joint (*Calamagrostis canadensis*), sensitive fern (*Onoclea sensibilis*), marsh fern (*Thelypteris palustris*), false nettle (*Boehmeria cylindrica*), joe-pye-weed (*Eutrochium maculatum*), dwarf raspberry (*Rubus pubescens*), great water dock (*Rumex orbiculatus*), smooth swamp aster (*Symphyotrichum firmum*), swamp milkweed (*Asclepias incarnata*), skunk-cabbage (*Symplocarpus foetidus*), boneset (*Eupatorium perfoliatum*), spotted touch-me-not (*Impatiens capensis*), cut grass (*Leersia oryzoides*), swamp goldenrod (*Solidago patula*), and broad-leaved cat-tail (*Typha latifolia*).

The Shiawassee Headwaters Shrub-Carr was surveyed June 23rd and September 9th, 2022. A total of 55 plant species was documented with 49 native species and 6 non-native species (**Appendix 2.3**). The total FQI was 28.2.



Shiawassee Headwater Carr southern shrub-carr. Photo by Joshua G. Cohen.

Threats: Species composition, vegetative structure, and successional trajectory are influenced by groundwater seepage, fire suppression, and invasive species. As noted above, invasive shrubs occur scattered within the understory and low shrub layer and include autumn olive, common privet, and multiflora rose. In addition, oriental bittersweet (*Celastrus orbiculatus*), purple loosestrife (*Lythrum salicaria*), and forget-me-not (*Myosotis scorpioides*) occur occasionally within the ground cover.

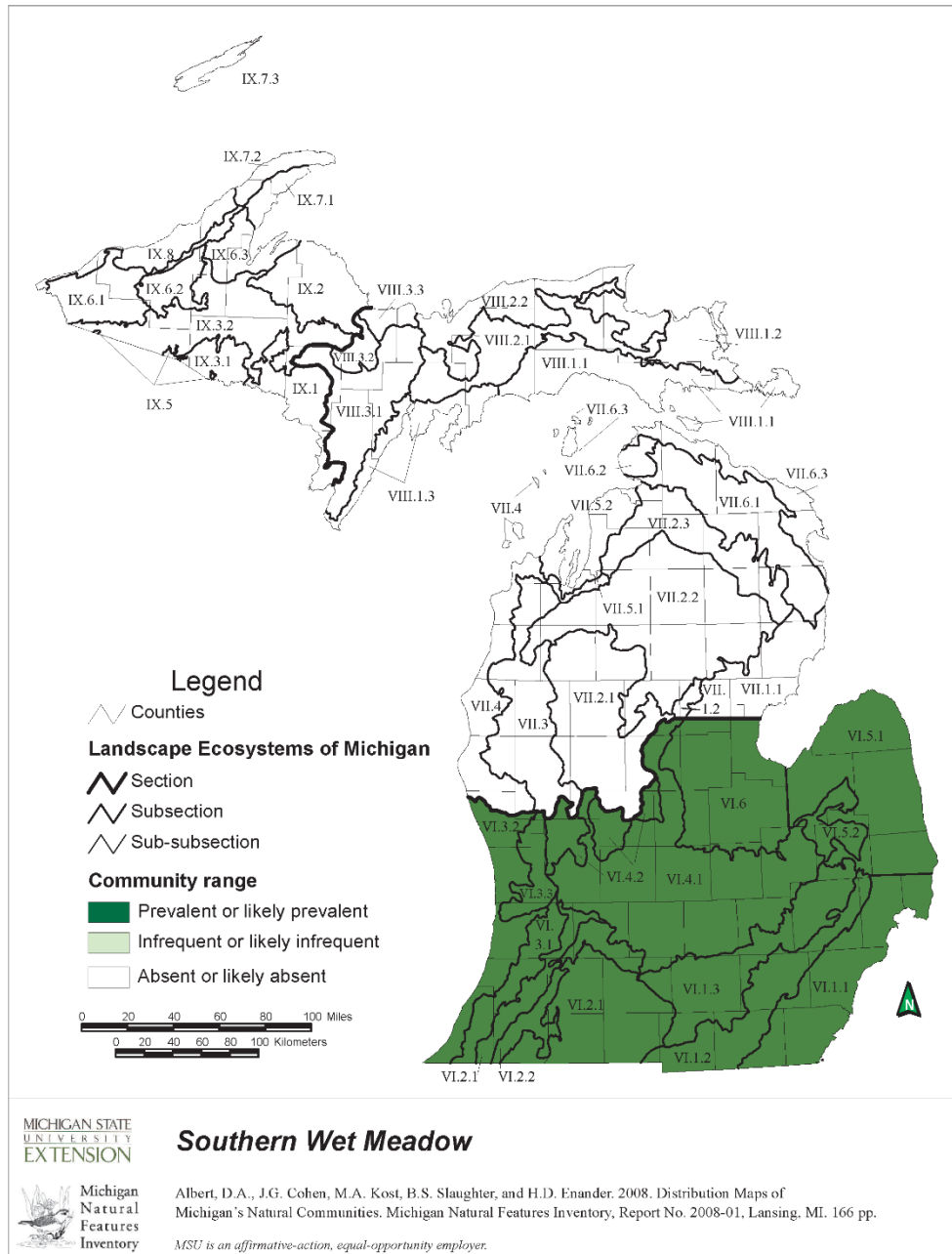
Management Recommendations: The primary management recommendations are to maintain a forested buffer surrounding the shrub swamp to preserve the hydrology and to control invasive species through herbiciding and cutting. Efforts to control invasive species should be monitored. Reducing invasive species throughout the surrounding area is recommended in order to reduce the local seed source.



Shiawassee Headwater Carr southern shrub-carr. Photo by Joshua G. Cohen.

SOUTHERN WET MEADOW

Overview: Southern wet meadow is an open, groundwater-influenced (minerotrophic), sedge-dominated wetland that occurs in central and southern Lower Michigan. Open conditions are maintained by seasonal flooding, beaver-induced flooding, and fire. Sedges in the genus *Carex*, in particular tussock sedge (*Carex stricta*), dominate the community (Kost et al. 2007, Cohen et al. 2015).



Map 4. Distribution of southern wet meadow in Michigan (Albert et al. 2008).

4. Shiawassee River Headwaters Meadow

Natural Community Type: Southern Wet Meadow

Rank: G4 S3, apparently secure globally and vulnerable within the state

Element Occurrence Rank: D

Size: 0.9 acres

Element Occurrence Identification Number: 26375

Site Description: A small pocket of southern wet meadow occurs along the headwaters of the Shiawassee River within ice-contact outwash (**Figure 5**). The meadow occurs on saturated organic soils that are slightly acidic (pH 6.5-6.8) and range from 15 to 20 cm deep. The peats overly alkaline (pH 7.2-7.5) sandy clay loam. Water levels in southern wet meadow fluctuate seasonally, reaching their peak in spring and lows in late summer.



Figure 5. 2016 aerial photograph of Shiawassee Headwaters Meadow southern wet meadow.

The meadow is characterized by a diverse herbaceous layer with characteristic species including tussock sedge (*Carex stricta*), lake sedge (*C. lacustris*), sensitive fern (*Onoclea sensibilis*), joe-pye-weed (*Eutrochium maculatum*), northern bugle weed (*Lycopus uniflorus*), wild blue flag (*Iris versicolor*), purple avens (*Geum rivale*), swamp milkweed (*Asclepias incarnata*), golden alexanders (*Zizia aurea*), boneset (*Eupatorium perfoliatum*), golden-seeded spike rush (*Eleocharis elliptica*), grass-leaved goldenrod (*Euthamia graminifolia*), spotted touch-me-not (*Impatiens capensis*), cut grass (*Leersia oryzoides*), swamp goldenrod (*Solidago patula*), rough leaved goldenrod (*S. rugosa*), late goldenrod (*S. gigantea*), calico aster (*Symphotrichum lateriflorum*), and Culver's-root (*Veronicastrum virginicum*). Reed canary grass (*Phalaris arundinaceae*) and purple loosestrife (*Lythrum salicaria*) occur locally

within the ground cover. The low shrub layer is sparse (5-10%) with swamp rose (*Rosa palustris*), buttonbush (*Cephalanthus occidentalis*), and scattered seedling glossy buckthorn (*Frangula alnus*), multiflora rose (*Rosa multiflora*), willows (*Salix* spp.), cottonwood (*Populus deltoides*), and American elm (*Ulmus americana*). The tall shrub layer is sparse (2-5%) with scattered red-osier (*Cornus sericea*), Michigan holly (*Ilex verticillata*), bebb's willow (*Salix bebbiana*), pussy willow (*S. discolor*), poison sumac (*Toxicodendron vernix*), American elm, autumn olive (*Elaeagnus umbellata*), and honeysuckles (*Lonicera* spp.). Scattered cottonwood trees occur within the meadow.



Shiawassee Headwater Meadow southern wet meadow. Photo by Joshua G. Cohen.

The Shiawassee Headwaters Meadow was surveyed June 23rd and September 9th, 2022. A total of 76 plant species was documented with 68 native species and 8 non-native species (**Appendix 2.4**). The total FQI was 30.5.

Threats: Species composition, vegetative structure, and successional trajectory are influenced by seasonal flooding, fire suppression, and invasive species. As noted above, invasive shrubs occur scattered within the understory and low shrub layer and include autumn olive, glossy buckthorn, honeysuckles, and multiflora rose. In addition, oriental bittersweet (*Celastrus orbiculatus*), purple loosestrife, perennial sow-thistle (*Sonchus arvensis*), timothy (*Phleum pratense*), and Queen-Anne's-lace (*Daucus carota*) occur within the ground cover.

Management Recommendations: The primary management recommendations are to continue stewardship activities to maintain the open condition of the meadow through a combination of mowing, prescribed fire, and mechanical and herbicide treatment of invasive species. Efforts to control invasive species should be monitored. Reducing invasive species throughout the surrounding area is recommended in order to reduce the local seed source.



Shiawassee Headwater Meadow southern wet meadow. Photo by Joshua G. Cohen.

Conclusion

This report provides site-based assessments of four natural community element occurrences within the River Run Preserve. Threats, management needs, and restoration opportunities specific to each individual site have been discussed. The baseline information presented in the report provides resource managers with an ecological foundation for prescribing site-level biodiversity stewardship, monitoring these management activities, and implementing landscape-level biodiversity planning to prioritize management efforts. All four of these natural community element occurrences correspond to areas identified by Springfield Township staff as “High” priorities for ecological management within the Ecological Management Plan and Visitor Access Recommendations for River Run Preserve (Losey 2015). We encourage the continued restoration of these ecological assets as the integrity of these sites will increase with continued biodiversity stewardship.

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Appendices

Appendix 1. Global and State Element Ranking Criteria

GLOBAL RANKS

- G1** = critically imperiled: at very high risk of extinction due to extreme rarity (often 5 or fewer occurrences), very steep declines, or other factors.
- G2** = imperiled: at high risk of extinction due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors.
- G3** = vulnerable: at moderate risk of extinction due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors.
- G4** = apparently secure: uncommon but not rare; some cause for long-term concern due to declines or other factors.
- G5** = secure: common; widespread.
- GU** = currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
- GX** = eliminated: eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.
- G?** = incomplete data.

STATE RANKS

- S1** = critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.
- S2** = imperiled in the state because of rarity due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.
- S3** = vulnerable in the state due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
- S4** = uncommon but not rare; some cause for long-term concern due to declines or other factors.
- S5** = common and widespread in the state.
- SX** = community is presumed to be extirpated from the state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
- S?** = incomplete data.

APPENDIX 2 – Floristic Quality Assessments

For each high-quality natural community, floristic data were compiled into the Universal Floristic Quality Assessment Calculator (Reznicek et al. 2014; Freyman et al. 2016) to determine the Floristic Quality Index (FQI) for each natural community element occurrence. The floristic quality assessment is derived from a mean coefficient of conservatism and floristic quality index. Each native species is assigned a coefficient of conservatism, a value of 0 to 10 based on probability of its occurrence in a natural versus degraded habitat. Species restricted to a specialized or undisturbed habitat are assigned a value of 10, implying the species has extremely strong fidelity to a specific habitat. Native species that are not particular or indicative of natural conditions are assigned a low value of 0 or 1. The coefficient of conservatism is determined by experts on the flora of a region, and so may vary for a given plant species from region to region. From the total list of plant species for an area, a mean C value is calculated and then multiplied by the square root of the total number of plant species to calculate the FQI. In addition, each species is assigned a coefficient of wetness (W) based on its affinity to wetland or upland habitat. Michigan sites with an FQI of 35 or greater possess sufficient conservatism and richness that they are considered floristically important from a statewide perspective (Herman et al. 2001). For each high-quality natural community element occurrence, we generated a floristic quality assessment (FQA). The FQA includes a comprehensive list of the species documented in the element occurrence along with each species C and W values. In addition, for each site we present the accompanying conservatism-based metrics, species richness, species wetness, physiognomy metrics, and duration metrics.

Appendix 2.1. Buteo Woods Dry-Mesic Southern Forest FQA

Conservatism-Based Metrics:

Total Mean C:	3.1
Native Mean C:	4.1
Total FQI:	13.9
Native FQI:	15.9
Adjusted FQI:	35.5
% C value 0:	25
% C value 1-3:	25
% C value 4-6:	50
% C value 7-10:	0
Native Tree Mean C:	4.1
Native Shrub Mean C:	n/a
Native Herbaceous Mean C:	4

Species Richness:

Total Species:	20	
Native Species:	15	75.00%
Non-native Species:	5	25.00%

Species Wetness:

Mean Wetness:	2.9
Native Mean Wetness:	2.9

Physiognomy Metrics:

Tree:	12	60.00%
Shrub:	3	15.00%
Vine:	2	10.00%
Forb:	2	10.00%
Grass:	0	0.00%
Sedge:	1	5.00%
Rush:	0	0%
Fern:	0	0.00%
Bryophyte:	0	0%

Duration Metrics:

Annual:	0	0.00%
Perennial:	20	100.00%
Biennial:	0	0.00%
Native Annual:	0	0.00%
Native Perennial:	15	75.00%
Native Biennial:	0	0.00%

Appendix 2.1. Buteo Woods Dry-Mesic Southern Forest FQA

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Carex pensylvanica</i>	sedge	CXPENS	native	4	5
<i>Carya glabra</i>	pignut hickory	CARGLA	native	5	3
<i>Celastrus orbiculatus</i>	oriental bittersweet	CELORB	non-native	0	5
<i>Elaeagnus umbellata</i>	autumn-olive	ELAUMB	non-native	0	3
<i>Fraxinus americana</i>	white ash	FRAAME	native	5	3
<i>Ligustrum vulgare</i>	common privet	LIGVUL	non-native	0	3
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	OSTVIR	native	5	3
<i>Podophyllum peltatum</i>	may-apple	PODPEL	native	3	3
<i>Populus grandidentata</i>	big-tooth aspen	POPGRA	native	4	3
<i>Prunus serotina</i>	wild black cherry	PRUSER	native	2	3
<i>Quercus alba</i>	white oak	QUEALB	native	5	3
<i>Quercus rubra</i>	red oak	QUERUB	native	5	3
<i>Quercus velutina</i>	black oak	QUEVEL	native	6	5
<i>Rhamnus cathartica</i>	common buckthorn	RHACAT	non-native	0	0
<i>Rosa multiflora</i>	multiflora rose	ROSMUL	non-native	0	3
<i>Solidago flexicaulis</i>	zigzag goldenrod	SOLFLE	native	6	3
<i>Tilia americana</i>	basswood	TILAME	native	5	3
<i>Vitis riparia</i>	river-bank grape	VITRIP	native	3	0

Appendix 2.2. Shiawassee Headwaters Swamp Rich Tamarack Swamp FQA

Conservatism-Based Metrics:

Total Mean C:	4.5
Native Mean C:	4.8
Total FQI:	41.7
Native FQI:	43.2
Adjusted FQI:	46.6
% C value 0:	7
% C value 1-3:	22.1
% C value 4-6:	55.8
% C value 7-10:	15.1
Native Tree Mean C:	4.4
Native Shrub Mean C:	4.9
Native Herbaceous Mean C:	4.8

Species Richness:

Total Species:	86	
Native Species:	81	94.20%
Non-native Species:	5	5.80%

Species Wetness:

Mean Wetness:	-2.4
Native Mean Wetness:	-2.6

Physiognomy Metrics:

Tree:	15	17.40%
Shrub:	26	30.20%
Vine:	3	3.50%
Forb:	27	31.40%
Grass:	3	3.50%
Sedge:	7	8.10%
Rush:	0	0%
Fern:	5	5.80%
Bryophyte:	0	0%

Duration Metrics:

Annual:	3	3.50%
Perennial:	83	96.50%
Biennial:	0	0.00%
Native Annual:	3	3.50%
Native Perennial:	78	90.70%
Native Biennial:	0	0.00%

Appendix 2.2. Shiawassee Headwaters Swamp Rich Tamarack Swamp FQA

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Aralia nudicaulis</i>	wild sarsaparilla	ARANUD	native	5	3
<i>Aronia prunifolia</i>	chokeberry	AROPRU	native	5	-3
<i>Asclepias incarnata</i>	swamp milkweed	ASCINC	native	6	-5
<i>Betula alleghaniensis</i>	yellow birch	BETALL	native	7	0
<i>Betula papyrifera</i>	paper birch	BETPAP	native	2	3
<i>Betula pumila</i>	bog birch	BETPUM	native	8	-5
<i>Bidens trichosperma</i>	tickseed-sunflower	BIDTRI	native	7	-5
<i>Boehmeria cylindrica</i>	false nettle	BOECYL	native	5	-5
<i>Bromus ciliatus</i>	fringed brome	BROCIL	native	6	-3
<i>Calamagrostis canadensis</i>	blue-joint	CALCAN	native	3	-5
<i>Caltha palustris</i>	marsh-marigold	CALPAR	native	6	-5
<i>Carex comosa</i>	sedge	CXCOMO	native	5	-5
<i>Carex lacustris</i>	sedge	CXLACU	native	6	-5
<i>Carex leptalea</i>	sedge	CXLEPA	native	5	-5
<i>Carex pseudo-cyperus</i>	sedge	CXPSEU	native	5	-5
<i>Carex sterilis</i>	sedge	CXSTER	native	10	-5
<i>Carex stricta</i>	sedge	CXSTRI	native	4	-5
<i>Carpinus caroliniana</i>	blue-beech	CARCAO	native	6	0
<i>Cicuta bulbifera</i>	water hemlock	CICBUL	native	5	-5
<i>Cirsium arvense</i>	canada thistle	CIRARV	non-native	0	3
<i>Clintonia borealis</i>	bluebead-lily; corn-lily	CLIBOR	native	5	0
<i>Comarum palustre</i>	marsh cinquefoil	COMPAL	native	7	-5
<i>Coptis trifolia</i>	goldthread	COPTRI	native	5	-3
<i>Cornus amomum</i>	silky dogwood	CORAMO	native	2	-3
<i>Cornus sericea</i>	red-osier	CORSER	native	2	-3
<i>Corylus americana</i>	hazelnut	CORAMA	native	5	3
<i>Dioscorea villosa</i>	wild yam	DIOVIL	native	4	0
<i>Elaeagnus umbellata</i>	autumn-olive	ELAUMB	non-native	0	3
<i>Eleocharis elliptica</i>	golden-seeded spike rush	ELEELL	native	6	-5
<i>Equisetum fluviatile</i>	water horsetail	EQUFLU	native	7	-5
<i>Eupatorium perfoliatum</i>	boneset	EUPPER	native	4	-3
<i>Euphorbia maculata</i>	spotted spurge	EUPMAC	native	0	3
<i>Eutrochium maculatum</i>	joe-pye-weed	EUTMAC	native	4	-5
<i>Frangula alnus</i>	glossy buckthorn	FRAALN	non-native	0	0
<i>Fraxinus nigra</i>	black ash	FRANIG	native	6	-3
<i>Galium asprellum</i>	rough bedstraw	GALASP	native	5	-5
<i>Ilex mucronata</i>	mountain holly	ILEMUC	native	7	-5
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Impatiens capensis</i>	spotted touch-me-not	IMPCAP	native	2	-3
<i>Juniperus communis</i>	common or ground juniper	JUNCOI	native	4	3
<i>Juniperus virginiana</i>	red-cedar	JUNVIR	native	3	3
<i>Larix laricina</i>	tamarack	LARLAR	native	5	-3
<i>Leersia oryzoides</i>	cut grass	LEEORY	native	3	-5
<i>Lindera benzoin</i>	spicebush	LINBEN	native	7	-3

Appendix 2.2. Shiawassee Headwaters Swamp Rich Tamarack Swamp FQA

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Lycopus uniflorus</i>	northern bugle weed	LYCUNI	native	2	-5
<i>Maianthemum canadense</i>	canada mayflower	MAICAN	native	4	3
<i>Maianthemum trifolium</i>	false mayflower	MAITRI	native	10	-5
<i>Onoclea sensibilis</i>	sensitive fern	ONOSEN	native	2	-3
<i>Osmunda cinnamomea</i>	cinnamon fern	OSMCIN	native	5	-3
<i>Osmunda regalis</i>	royal fern	OSMREG	native	5	-5
<i>Parthenocissus quinquefolia</i>	virginia creeper	PARQUI	native	5	3
<i>Persicaria amphibia</i>	water smartweed	PERAMP	native	6	-5
<i>Picea mariana</i>	black spruce	PICMAR	native	6	-3
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Quercus bicolor</i>	swamp white oak	QUEBIC	native	8	-3
<i>Quercus macrocarpa</i>	bur oak	QUEMAC	native	5	3
<i>Quercus rubra</i>	red oak	QUERUB	native	5	3
<i>Rhamnus alnifolia</i>	alder-leaved buckthorn	RHAALN	native	8	-5
<i>Rhamnus cathartica</i>	common buckthorn	RHACAT	non-native	0	0
<i>Ribes americanum</i>	wild black currant	RIBAME	native	6	-3
<i>Ribes hirtellum</i>	swamp gooseberry	RIBHIR	native	6	-3
<i>Rosa multiflora</i>	multiflora rose	ROSMUL	non-native	0	3
<i>Rosa palustris</i>	swamp rose	ROSPAL	native	5	-5
<i>Rubus pubescens</i>	dwarf raspberry	RUBPUB	native	4	-3
<i>Rumex orbiculatus</i>	great water dock	RUMORB	native	9	-5
<i>Salix bebbiana</i>	bebb's willow	SALBEB	native	1	-3
<i>Salix discolor</i>	pussy willow	SALDIS	native	1	-3
<i>Salix pedicellaris</i>	bog willow	SALPED	native	8	-5
<i>Salix sericea</i>	silky willow	SALSEC	native	6	-5
<i>Scutellaria galericulata</i>	marsh skullcap	SCUGAL	native	5	-5
<i>Solidago patula</i>	swamp goldenrod	SOLPAT	native	6	-5
<i>Solidago rugosa</i>	rough-leaved goldenrod	SOLRUG	native	3	0
<i>Spiraea alba</i>	meadowsweet	SPIALB	native	4	-3
<i>Symphyotrichum firmum</i>	smooth swamp aster	SYMFIR	native	4	-3
<i>Symphyotrichum puniceum</i>	swamp aster	SYMPUN	native	5	-5
<i>Symplocarpus foetidus</i>	skunk-cabbage	SYMFOE	native	6	-5
<i>Thelypteris palustris</i>	marsh fern	THEPAL	native	2	-3
<i>Tilia americana</i>	basswood	TILAME	native	5	3
<i>Toxicodendron vernix</i>	poison sumac	TOXVER	native	6	-5
<i>Typha latifolia</i>	broad-leaved cat-tail	TYPLAT	native	1	-5
<i>Ulmus americana</i>	american elm	ULMAME	native	1	-3
<i>Vaccinium corymbosum</i>	highbush blueberry	VACCOR	native	6	-3
<i>Viburnum lentago</i>	nannyberry	VIBLEN	native	4	0
<i>Vitis riparia</i>	river-bank grape	VITRIP	native	3	0
<i>Zanthoxylum americanum</i>	prickly-ash	ZANAME	native	3	3

Appendix 2.3. Shiawassee Headwaters Carr Southern Shrub-Carr FQA

Conservatism-Based Metrics:

Total Mean C:	3.8
Native Mean C:	4.2
Total FQI:	28.2
Native FQI:	29.4
Adjusted FQI:	39.6
% C value 0:	10.9
% C value 1-3:	27.3
% C value 4-6:	52.7
% C value 7-10:	9.1
Native Tree Mean C:	3.8
Native Shrub Mean C:	3.9
Native Herbaceous Mean C:	4.6

Species Richness:

Total Species:	55
Native Species:	49 89.10%
Non-native Species:	6 10.90%

Species Wetness:

Mean Wetness:	-2.3
Native Mean Wetness:	-2.6

Physiognomy Metrics:

Tree:	10	18.20%
Shrub:	17	30.90%
Vine:	2	3.60%
Forb:	22	40.00%
Grass:	1	1.80%
Sedge:	1	1.80%
Rush:	0	0%
Fern:	2	3.60%
Bryophyte:	0	0%

Duration Metrics:

Annual:	4	7.30%
Perennial:	50	90.90%
Biennial:	1	1.80%
Native Annual:	4	7.30%
Native Perennial:	44	80.00%
Native Biennial:	1	1.80%

Appendix 2.3. Shiawassee Headwaters Carr Southern Shrub-Carr FQA

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Acer rubrum</i>	red maple	ACERUB	native	1	0
<i>Acer saccharinum</i>	silver maple	ACESAI	native	2	-3
<i>Asclepias incarnata</i>	swamp milkweed	ASCINC	native	6	-5
<i>Betula alleghaniensis</i>	yellow birch	BETALL	native	7	0
<i>Boehmeria cylindrica</i>	false nettle	BOECYL	native	5	-5
<i>Caltha palustris</i>	marsh-marigold	CALPAR	native	6	-5
<i>Carex lacustris</i>	sedge	CXLACU	native	6	-5
<i>Carpinus caroliniana</i>	blue-beech	CARCAO	native	6	0
<i>Celastrus orbiculatus</i>	oriental bittersweet	CELOBR	non-native	0	5
<i>Chelone glabra</i>	turtlehead	CHEGLB	native	7	-5
<i>Cirsium muticum</i>	swamp thistle	CIRMUT	native	6	-5
<i>Clematis virginiana</i>	virgins bower	CLEVIR	native	4	0
<i>Cornus foemina</i>	gray dogwood	CORFOE	native	1	0
<i>Cornus sericea</i>	red-osier	CORSER	native	2	-3
<i>Corylus americana</i>	hazelnut	CORAMA	native	5	3
<i>Elaeagnus umbellata</i>	autumn-olive	ELAUMB	non-native	0	3
<i>Eupatorium perfoliatum</i>	boneset	EUPPER	native	4	-3
<i>Eutrochium maculatum</i>	joe-pye-weed	EUTMAC	native	4	-5
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Impatiens capensis</i>	spotted touch-me-not	IMPCAP	native	2	-3
<i>Larix laricina</i>	tamarack	LARLAR	native	5	-3
<i>Leersia oryzoides</i>	cut grass	LEEORY	native	3	-5
<i>Ligustrum vulgare</i>	common privet	LIGVUL	non-native	0	3
<i>Lindera benzoin</i>	spicebush	LINBEN	native	7	-3
<i>Lobelia siphilitica</i>	great blue lobelia	LOBSIP	native	4	-3
<i>Lythrum salicaria</i>	purple loosestrife	LYTSAL	non-native	0	-5
<i>Mitella nuda</i>	naked miterwort	MITNUD	native	8	-3
<i>Myosotis scorpioides</i>	forget-me-not	MYOSCO	non-native	0	-5
<i>Onoclea sensibilis</i>	sensitive fern	ONOSEN	native	2	-3
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	OSTVIR	native	5	3
<i>Persicaria hydropiper</i>	water-pepper	PERHYR	native	1	-5
<i>Persicaria sagittata</i>	arrow-leaved tear-thumb	PERSAG	native	5	-5
<i>Pilea pumila</i>	cleaverweed	PILPUM	native	5	-3
<i>Populus tremuloides</i>	quaking aspen	POPTRE	native	1	0
<i>Quercus macrocarpa</i>	bur oak	QUEMAC	native	5	3
<i>Ranunculus hispidus</i>	swamp buttercup	RANHIS	native	5	0
<i>Ribes americanum</i>	wild black currant	RIBAME	native	6	-3
<i>Ribes hirtellum</i>	swamp gooseberry	RIBHIR	native	6	-3
<i>Rosa multiflora</i>	multiflora rose	ROSMUL	non-native	0	3
<i>Rosa palustris</i>	swamp rose	ROSPAL	native	5	-5
<i>Rubus allegheniensis</i>	common blackberry	RUBALL	native	1	3
<i>Rubus pubescens</i>	dwarf raspberry	RUBPUB	native	4	-3
<i>Rumex orbiculatus</i>	great water dock	RUMORB	native	9	-5
<i>Salix bebbiana</i>	bebb's willow	SALBEB	native	1	-3
<i>Salix discolor</i>	pussy willow	SALDIS	native	1	-3

Appendix 2.3. Shiawassee Headwaters Carr Southern Shrub-Carr FQA

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Solidago patula</i>	swamp goldenrod	SOLPAT	native	6	-5
<i>Spiraea alba</i>	meadowsweet	SPIALB	native	4	-3
<i>Symphyotrichum firmum</i>	smooth swamp aster	SYM FIR	native	4	-3
<i>Symplocarpus foetidus</i>	skunk-cabbage	SYMFOE	native	6	-5
<i>Thelypteris palustris</i>	marsh fern	THEPAL	native	2	-3
<i>Tilia americana</i>	basswood	TILAME	native	5	3
<i>Toxicodendron vernix</i>	poison sumac	TOXVER	native	6	-5
<i>Typha latifolia</i>	broad-leaved cat-tail	TYPLAT	native	1	-5
<i>Ulmus americana</i>	american elm	ULMAME	native	1	-3
<i>Verbena hastata</i>	blue vervain	VERHAS	native	4	-3

Appendix 2.4. Shiawassee Headwaters Meadow Southern Wet Meadow FQA

Conservatism-Based Metrics:

Total Mean C:	3.5
Native Mean C:	3.9
Total FQI:	30.5
Native FQI:	32.2
Adjusted FQI:	36.9
% C value 0:	13.2
% C value 1-3:	39.5
% C value 4-6:	35.5
% C value 7-10:	11.8
Native Tree Mean C:	1.7
Native Shrub Mean C:	4
Native Herbaceous Mean C:	4

Species Richness:

Total Species:	76	
Native Species:	68	89.50%
Non-native Species:	8	10.50%

Species Wetness:

Mean Wetness:	-1.8
Native Mean Wetness:	-2.3

Physiognomy Metrics:

Tree:	3	3.90%
Shrub:	14	18.40%
Vine:	2	2.60%
Forb:	41	53.90%
Grass:	3	3.90%
Sedge:	10	13.20%
Rush:	1	1%
Fern:	2	2.60%
Bryophyte:	0	0%

Duration Metrics:

Annual:	2	2.60%
Perennial:	71	93.40%
Biennial:	3	3.90%
Native Annual:	2	2.60%
Native Perennial:	64	84.20%
Native Biennial:	2	2.60%

Appendix 2.4. Shiawassee Headwaters Meadow Southern Wet Meadow FQA

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Apocynum cannabinum</i>	indian-hemp	APOCAN	native	3	0
<i>Asclepias incarnata</i>	swamp milkweed	ASCINC	native	6	-5
<i>Asclepias syriaca</i>	common milkweed	ASCSYR	native	1	5
<i>Bidens cernua</i>	nodding beggar-ticks	BIDCER	native	3	-5
<i>Bidens trichosperma</i>	tickseed-sunflower	BIDTRI	native	7	-5
<i>Carex brevior</i>	sedge	CXBREV	native	3	0
<i>Carex granularis</i>	sedge	CXGRAN	native	2	-3
<i>Carex lacustris</i>	sedge	CXLACU	native	6	-5
<i>Carex leptalea</i>	sedge	CXLEPA	native	5	-5
<i>Carex stricta</i>	sedge	CXSTRI	native	4	-5
<i>Carex vesicaria</i>	sedge	CXVESI	native	7	-5
<i>Celastrus orbiculatus</i>	oriental bittersweet	CELORB	non-native	0	5
<i>Cephalanthus occidentalis</i>	buttonbush	CEPOCC	native	7	-5
<i>Chelone glabra</i>	turtlehead	CHEGLB	native	7	-5
<i>Cicuta maculata</i>	water hemlock	CICMAC	native	4	-5
<i>Cirsium muticum</i>	swamp thistle	CIRMUT	native	6	-5
<i>Cornus sericea</i>	red-osier	CORSER	native	2	-3
<i>Corylus americana</i>	hazelnut	CORAMA	native	5	3
<i>Cyperus strigosus</i>	long scaled nut sedge	CYPSTR	native	3	-3
<i>Daucus carota</i>	queen-annes-lace	DAUCAR	non-native	0	5
<i>Decodon verticillatus</i>	whorled or swamp loosestrife	DECVER	native	7	-5
<i>Desmodium canadense</i>	showy tick-trefoil	DESCAD	native	3	0
<i>Doellingeria umbellata</i>	flat-topped white aster	DOEUMB	native	5	-3
<i>Elaeagnus umbellata</i>	autumn-olive	ELAUMB	non-native	0	3
<i>Eleocharis elliptica</i>	golden-seeded spike rush	ELEELL	native	6	-5
<i>Equisetum arvense</i>	common horsetail	EQUARV	native	0	0
<i>Eupatorium perfoliatum</i>	boneset	EUPPER	native	4	-3
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	EUTGRA	native	3	0
<i>Eutrochium maculatum</i>	joe-pye-weed	EUTMAC	native	4	-5
<i>Fragaria virginiana</i>	wild strawberry	FRAVIR	native	2	3
<i>Frangula alnus</i>	glossy buckthorn	FRAALN	non-native	0	0
<i>Gentiana andrewsii</i>	bottle gentian	GENAND	native	5	-3
<i>Geum rivale</i>	purple avens	GEURIV	native	7	-5
<i>Helianthus giganteus</i>	tall sunflower	HELGIG	native	5	-3
<i>Ilex verticillata</i>	michigan holly	ILEVER	native	5	-3
<i>Iris versicolor</i>	wild blue flag	IRIVER	native	5	-5
<i>Juncus dudleyi</i>	dudleys rush	JUNDUD	native	1	-3
<i>Juniperus virginiana</i>	red-cedar	JUNVIR	native	3	3
<i>Leersia oryzoides</i>	cut grass	LEEORY	native	3	-5
<i>Liatris spicata</i>	marsh blazing-star	LIASPI	native	8	0
<i>Lobelia siphilitica</i>	great blue lobelia	LOBSIP	native	4	-3
<i>Lycopus americanus</i>	common water horehound	LYCAME	native	2	-5
<i>Lycopus uniflorus</i>	northern bugle weed	LYCUNI	native	2	-5
<i>Lythrum salicaria</i>	purple loosestrife	LYTSAL	non-native	0	-5
<i>Onoclea sensibilis</i>	sensitive fern	ONOSEN	native	2	-3

Appendix 2.4. Shiawassee Headwaters Meadow Southern Wet Meadow FQA

Scientific Name	Common Name	Acronym	Native?	C	W
<i>Packera aurea</i>	golden ragwort	PACAU	native	5	-3
<i>Persicaria amphibia</i>	water smartweed	PERAMP	native	6	-5
<i>Phalaris arundinacea</i>	reed canary grass	PHAARU	native	0	-3
<i>Phleum pratense</i>	timothy	PHLPRA	non-native	0	3
<i>Populus deltoides</i>	cottonwood	POPDEL	native	1	0
<i>Rosa multiflora</i>	multiflora rose	ROSMUL	non-native	0	3
<i>Rosa palustris</i>	swamp rose	ROSPAL	native	5	-5
<i>Rubus flagellaris</i>	northern dewberry	RUBFLA	native	1	3
<i>Rudbeckia hirta</i>	black-eyed susan	RUDHIR	native	1	3
<i>Rumex orbiculatus</i>	great water dock	RUMORB	native	9	-5
<i>Salix bebbiana</i>	bebb's willow	SALBEB	native	1	-3
<i>Salix discolor</i>	pussy willow	SALDIS	native	1	-3
<i>Scirpus atrovirens</i>	bulrush	SCIATV	native	3	-5
<i>Scirpus cyperinus</i>	wool-grass	SCICYP	native	5	-5
<i>Solidago altissima</i>	tall goldenrod	SOLALT	native	1	3
<i>Solidago gigantea</i>	late goldenrod	SOLGIG	native	3	-3
<i>Solidago patula</i>	swamp goldenrod	SOLPAT	native	6	-5
<i>Solidago rugosa</i>	rough-leaved goldenrod	SOLRUG	native	3	0
<i>Solidago speciosa</i>	showy goldenrod	SOLSPE	native	5	5
<i>Sonchus arvensis</i>	perennial sow-thistle	SONARV	non-native	0	3
<i>Symphyotrichum firmum</i>	smooth swamp aster	SYM FIR	native	4	-3
<i>Symphyotrichum lateriflorum</i>	calico aster	SYMLAT	native	2	0
<i>Symphyotrichum novae-angliae</i>	new england aster	SYMNOV	native	3	-3
<i>Symphyotrichum urophyllum</i>	arrow-leaved aster	SYMURO	native	2	5
<i>Toxicodendron vernix</i>	poison sumac	TOXVER	native	6	-5
<i>Ulmus americana</i>	american elm	ULMAME	native	1	-3
<i>Verbena hastata</i>	blue vervain	VERHAS	native	4	-3
<i>Veronicastrum virginicum</i>	culvers-root	VERVIR	native	8	0
<i>Viburnum lentago</i>	nannyberry	VIBLEN	native	4	0
<i>Vitis riparia</i>	river-bank grape	VITRIP	native	3	0
<i>Zizia aurea</i>	golden alexanders	ZIZAUR	native	6	0