

MICHIGAN



2015 - 2025

FENS

Wildlife Action Plan

Today's Priorities, Tomorrow's Wildlife

WHAT ARE FENS?

Fens are diverse peat-accumulating wetlands found throughout Michigan that receive water that has been in contact with mineral soils or bedrock. They are dominated by grasses, forbs, shrubs, and stunted conifers. The saturated soils typically range from slightly acidic to alkaline peats and can include alkaline marl. Fens occur primarily on glacial outwash plains, outwash channels, lakeplains, and kettle depressions in outwash plains and moraines. Natural processes that influence species composition and community structure of fens are groundwater seepage, fluctuating water levels, lateral water flow, peat accumulation and erosion, fire, insect outbreaks, windthrows, and flooding by beaver. Fens rely on groundwater that can come from miles away, so it can be difficult to determine threats to these ecosystems.

This priority within the Wildlife Action Plan focuses on prairie fen, northern fen, patterned fen and coastal fen. These fen types are separated geographically and are dominated by different types of plants. Prairie fens, dominated by sedges and grasses, are unique to the glaciated Midwest, and exist south of the climatic tension zone in the southern Lower Peninsula. Northern fens are dominated by sedges and rushes, and are found north of the climatic tension zone in both the northern Lower Peninsula and the Upper Peninsula. Patterned fens, characterized by a series of peat ridges and hollows, are found in Michigan's Upper Peninsula. The hollows are dominated by sphagnum mosses, sedges, and rushes, while the ridges are dominated by sedges, shrubs, and scattered, stunted trees. Coastal fens are dominated by sedges, rushes, and shrubs and occur on calcareous substrates along Lake Huron and Lake Michigan in the northern Lower Peninsula and Upper Peninsula

– Adapted from Cohen et al. 2015



Yellow Rail



Whitetailed Deer



Showy Lady's Slipper



Hine's Emerald Dragonfly



Mitchell's
Satyr Butterfly



Eastern
Massasauga



Pitcher
Plant



Wild
Turkey

WHAT USES FENS?

WHY ARE FENS IMPORTANT?

Fens are among our rarest habitat types and are the unique result of glacial lakes, groundwater springs, and thousands of years of growing sedges, cedars, and lady's slippers. These wetland systems are fed by a steady flow of groundwater that they filter to fuel dense vegetation growth and the accumulation of peat. The health of our fens acts as a barometer for the health of the groundwater that we all depend on. With their rich and diverse vegetation, fens are home to a variety of wildlife including American Woodcock, Ruffed Grouse, Cottontail Rabbit, and the endangered Mitchell's Satyr Butterfly. Their open waters attract waterfowl, frogs, toads, and turtles, along with the Mink, Raccoons, and herons that feed on them. The rich resources that our fens support are as much of a draw for the birder as they are for the amateur botanist and the hunter.

PLAN CONTRIBUTORS

- Michigan Army National Guard
- Michigan Department of Natural Resources
- Michigan Environmental Council
- Michigan Nature Association
- Michigan Natural Features Inventory
- The Nature Conservancy
- U.S. Fish and Wildlife Service

WHAT IS THE HEALTH OF FENS?

The state's Natural Heritage Database tracks natural communities, and provides information about their locations, their quality, and often the associated plants and wildlife. This data provides an index of the overall health of fens across the state. Between 2005 and 2015, an additional 106 fen element occurrences were added to the Natural Heritage Database for a total of 278 tracked systems. About a third of these were evaluated to determine quality or health. Of those assessed only 13% were upgraded in quality; 55% were downgraded.

An element occurrence is the basic unit of record for documenting and delimiting the presence and geographic extent of a species or natural community on the landscape in the state's Natural Heritage Database. Element occurrences are defined as an area of land and/or water where a species is, or was, present, and which has practical conservation value; for species, element occurrences commonly reflect populations or subpopulations.

GOALS

- Increase or maintain quality of fen habitats.
- Complete groundwater watershed mapping for fens in southern Lower Peninsula.



Prairie Indian-plantain
(*Arnoglossum plantagineum*)

Mat muhly
(*Muhlenbergia richardsonis*)

White lady slipper
(*Cypripedium candidum*)



Prairie dropseed
(*Sporobolus heterolepis*)



Rosinweed
(*Silphium integrifolium*)

Edible valerian
(*Valeriana edulis var. ciliata*)

ASSOCIATED
RARE PLANTS

WHAT ARE THE FEN FOCAL SPECIES?

Where we are now and what we think we can realistically achieve over the next 10 years.



Mitchell's Satyr (*Neonympha mitchellii mitchellii*) Federally and State Endangered

Mitchell's Satyr is a medium-sized, chocolate-colored butterfly with yellow-ringed black eyespots that are dotted with silver or yellow scales (Hyde 2012). They stay close to the ground and don't fly far, moving about lazily in a slow, bobbing flight pattern (Hyde 2012). Mitchell's Satyr habitats are usually dominated by narrow leaved sedges, including *Carex stricta*, and contain scattered tamarack (*Larix laricina*) and poison sumac (*Toxicodendron verniz*) (Kost and Hyde 2009). Dispersal among populations and colonization of new sites is highly unlikely if unassisted. They are one of the most endangered butterflies in North America. Michigan is the stronghold for this species, yet their populations continue to decline. There are 10 extant populations in Michigan; only 3 are considered likely viable and 3 are considered potentially viable (D. Hyde, personal communication, Sept. 2015).



GOALS

- Maintain at least 6 viable populations in Michigan. [MSB]
- Reintroduce Mitchell's Satyr to 2 new sites. [MSB, MSB2]
- Improve 2 non-viable populations to viable. [MSB, MSB2]

Poweshiek Skipperling
(Oarisma poweshiek)
Federally Endangered, State Threatened

Poweshiek Skipperling are inch-long, orange butterflies with somewhat triangular wings. The adults have a whirling flight pattern with a lot of forewing movement and little forward velocity (Glassberg 1999). Adults nectar on black-eyed susan (*Rudbeckia hirta*), pale spike lobelia (*Lobelia spicata*), shrubby cinquefoil (*Dasiphora fruticosa*), and other wild flowers. Larval host plants are still unconfirmed in Michigan, but Poweshiek larvae are not found far from prairie dropseed (*Sporobolus heterolepis*, state special concern) or mat muhly (*Muhlenbergia richardsonis*, state threatened). In Michigan, they are known from only five sites. There has been a long-term population decline of more than 90% across their range and the cause of the decline is unknown. Michigan is the stronghold for Poweshiek, which is found only in high-quality prairie fens.



- GOALS**
- > Prevent extirpation.
 - > Identify critical management needs.



- GOALS**
- > Maintain the existing viable elemental occurrences. ^[HE]



Hine's Emerald Dragonfly
(Somatochlora hineana)
Federally and State Endangered

This green-eyed dragon relies on coastal northern fen. These wetlands often contain seeps or slow moving streams required by the larvae (Cuthrell 1999); the aquatic larvae use crayfish burrows for habitat. There are currently 16 known element occurrences in the state's Natural Heritage Database, eight of which are considered likely viable (MNFI 2007).



Eastern Massasauga
(Sistrurus catenatus catenatus)
Federally Threatened

The Eastern Massasauga is Michigan's only rattlesnake, and is a shy docile snake that prefers to remain hidden. When threatened, they typically will sound their rattle and try to escape, preferring to avoid confrontations. Hedgecock (1992) found that the only thing that elicited a striking response from a Massasauga was being stepped on, and that was only 7% of the time. This snake offers little threat to reasonably careful people willing to leave them alone. Massasauga sites are characterized by a combination of open and shaded areas for thermoregulation, hibernation areas with the water table near the surface, and a juxtaposition of wetlands and upland areas (Lee and Legge 2000). Michigan is the last stronghold for this snake in the United States, which is listed as endangered in every other state and province where it occurs. This species has likely declined by 30% over the last 30 years, although it appears to be somewhat stable in the southwest and northern portions of its range in Michigan. According to the state's Natural Heritage Database there are 127 potentially viable element occurrences in Michigan.



GOALS

- Maintain known populations and continue to identify additional populations.



GOALS

- Maintain existing viable element occurrences.

Tamarack Tree Cricket
(Oecanthus laricis)
Special Concern

Tamarack Tree Cricket are small crickets with green wings that live in tamarack trees in southeastern Michigan, and in hemlock trees in northeastern Ohio. They appear to be specifically tied to tamarack in Michigan. This species is globally rare. Since 1994, 48 occupied sites have been documented in the state's Natural Heritage Database (MNFI 2015).



GOALS

> Increase state population by 50%. ^[MJ]



Yellow Rail (*Coturnicops noveboracensis*) State Threatened

Yellow Rail are small, secretive birds with a stocky body and short tail. They call at night but tend to be sedentary and do most of their feeding during the day (Hyde 2001). To the untrained ear, Yellow Rail has a call that sounds like Morse code: a metallic clicking in strict cadence, “tic-tic, tic-tic-tic”. Yellow Rail relies on inland northern fen, and uses the edges of wet meadows dominated by wiregrass sedge (*Carex lasiocarpa*) or fine-stemmed grasses and emergent aquatic plants (Soulliere et al. 2007). The few known breeding sites are relatively protected from disturbance (Hyde 2001). Yellow Rail are a priority and focal species for the Great Lakes Region Joint Venture. Michigan’s population is difficult to assess without a standardized targeted survey for the species (Olson 2011). It is estimated that Michigan sustains 100 Yellow Rail (Potter et al. 2007); there are 9 known element occurrences, 4 of which are considered potentially viable, in the state’s Natural Heritage Database (MNFI 2015).





HOW VULNERABLE ARE FOCAL SPECIES TO CLIMATE CHANGE?

Hoving et al. (2013) determined climate vulnerabilities for focal species. See threats section for more specifics about how climate change may affect species and habitats.

Mitchell's Satyr are predicted to be extremely vulnerable to climate changes. Prolonged and increased summer temperatures could promote a second generation, after the host plants have already senesced. Further, insulating snow is needed during the winter to protect larvae from freezing or desiccation. With less consistent snow cover, the larvae may not be able to survive repeated freeze-thaw cycles during the winter (Hoving et al. 2013; USFWS 2014b).

Climate vulnerabilities are based on projected changes in the abundance or range of a species by 2050 - extreme = greatly reduced or the species would disappear; high = significantly decrease; moderate = likely decrease.

	Climate Vulnerability
Mitchell's Satyr	Extreme
Poweshiek Skipperling	Extreme
Eastern Massasauga	High
Yellow Rail	Moderate
Tamarack Tree Cricket	Extreme
Hine's Emerald Dragonfly	Extreme



WHAT ARE THE CONSERVATION THREATS & ACTIONS?

Major threats that need to be addressed and key actions that need to be implemented over the next 10 years.



THREATS to Habitat

> Invasive & Other Problematic Species, Genes & Diseases

- Invasive plants and animals can degrade habitats (Kost et al. 2009; USFWS 2001). Invasive plants can out-compete native plants that are important as nectar and food sources. Feral hogs could significantly degrade the quality of fen ecosystems (USFWS 1997).

> Natural Systems Modifications

- Loss of key disturbance regimes that historically kept fen ecosystems open, such as fire and hydrology. Prescribed fire can be difficult to implement due to the location of individual fens and concerns over rare species impacts (USFWS 1997).
- Conversion to impervious surfaces across the groundwater watershed alters the quantity and quality of water coming to fens (USFWS 2001).
- Changes in surface and sub-surface hydrology can significantly alter fens; these changes can come from roads or ponds created for personal and agricultural use (USFWS 2001).
- Loss of connectivity between fens and open habitats that allows movements by wildlife (USFWS 1997).

> Agriculture & Aquaculture

- Groundwater extraction as agricultural practices shift to highly irrigated crops can alter fen hydrology (USFWS 2001).
- Drains and tiling alter fen hydrology (USFWS 1997).

> Human Intrusions & Disturbance

- Lack of understanding of the value of fens and focal species.
- Lack of strong policies to help protect the groundwater watershed of fens, especially to address cumulative effects (USFWS 2001).

> Pollution

- Runoff of salt from roads can aid invasive species colonization and degrade habitats (USFWS 2001).
- Agricultural runoff and leaking septic fields from housing developments surrounding fens can increase nitrification (USFWS 2001).
- Groundwater pollution degrades habitats (USFWS 2001).

> Climate Change & Severe Weather

- Fen ecosystems are expected to be impacted by climate change. Without connecting corridors between fens, species won't be able to move and adapt; even with connecting corridors, some fen species won't be able to adapt (Hoving et al. 2013).

Conservation **ACTIONS** for Habitat

> Land & Water Management

- H1. Conduct habitat management to mimic natural disturbance regimes, control invasive species, and implement timber harvest best management practices. [SWR; TIS; TNC]
- H2. Work with road commissions to develop and/or implement best management practices around important fens.
- H3. Create opportunities for regular communication and collaboration between land managers to disseminate best management practices and lessons learned for managing fen habitats.
- H4. Implement invasive species decontamination and prevention protocols. [TIS]
- H5. Continue early detection and response efforts for invasive species; continue management to eradicate feral swine in Michigan. [SWR; TIS]

> Raising Awareness

- H6. Educate local land managers about focal species, their habitats, and conservation needs. [WCA]
- H7. Work with land planners and local governments to encourage groundwater and fen conservation. Provide resources to aid them in considering these values during Green Infrastructure and other local planning efforts. [CC-7.1]
- H8. Promote management and restoration of fen habitats and the positive impacts they have on improving deer and turkey hunting experiences.
- H9. Promote voluntary best management practices for stopping the introduction and spread of invasive species for recreational users, researchers, and industry.

> Conservation Designation & Planning

- H10. Work with the Natural Resources Conservation Service (NRCS), Farm Bill programs, and other private landowner programs on habitat management, conservation easements, and acquisition to protect fens, to connect fens with other critical habitats for focal species, and to protect important groundwater recharge zones. [CC-1.4; HE-1.1; MSB-3.2; TNC]
- H11. Identify fens in climate resilient landscapes and incorporate into conservation planning and management; currently being developed by The Nature Conservancy. [CC-1.2]
- H12. Complete planning and then implement fen ecological reference areas in the State Forest management system. [FA]

> Law & Policy

- H13. Keep prohibited species list (NREPA Part 413) current and implement enforcement.
- H14. Continue to administer an effective Michigan Department of Environmental Quality protection program for wetlands and provide incentives for conservation practices.

> Research & Monitoring

- H15. Develop or use an existing system to track fen management across the state.
- H16. Complete groundwater modeling efforts to map groundwater watersheds for priority fens. [HE-2.3; MSB3]
- H17. Use and promote the Midwest Invasive Species Information Network (MISIN) to monitor invasive species. [CC-7.3; TIS]

THREATS to Mitchell's Satyr

- **Lack of Knowledge**
 - Lack of information on the effects of Wolbachia, a bacteria, on Mitchell's Satyr populations (USFWS 2014b).
- **Invasive & Other Problematic Species, Genes & Diseases**
 - Invasive species, plant and animal, may be impacting populations (USFWS 2014b).
- **Natural Systems Modifications**
 - Inbreeding depression is a concern due to low population numbers.
- **Pollution**
 - Pesticides and herbicides may significantly impact populations near agricultural fields (USFWS 2014b; Pecenka and Lundgren 2015).
- **Climate Change & Severe Weather**
 - Climate change could have a variety of impacts: less consistent precipitation can affect winter survival; consistent snow cover is needed or eggs can desiccate; more growing season droughts and increased temperatures can affect reproduction; and more intense storms and precipitation can kill larvae and adults during flight (Hoving et al. 2013; USFWS 2014b).

Conservation ACTIONS for Mitchell's Satyr

- **Land & Water Management**

MS1. Implement and promote the Mitchell's Satyr and Poweshiek Skipperling Habitat Conservation Plan, which provides guidance for habitat management to limit negative impacts on both species. ^[MSB, MSB2, MSB3]
- **Species Management**

MS2. Implement the Mitchell's Satyr Conservation Strategy. ^[MSB3, MSB]
- **Research & Monitoring**

MS3. Determine if herbicides and pesticides are affecting Mitchell's Satyr populations.

MS4. Determine other limiting factors to populations.



THREATS to Poweshiek Skipperling

- **Lack of Knowledge**
 - Lack of information about why the species is declining and critical life history needs (USFWS 2014a).
- **Pollution**
 - Pesticides and herbicides may significantly impact populations near agricultural fields (Pecenka and Lundgren 2015).
- **Climate Change & Severe Weather**
 - Concerns over mismatching phenology with plant hosts as climate changes (Hoving et al. 2013).



Conservation ACTIONS for Poweshiek Skipperling

- **Land & Water Management**
 - PS1. Implement and promote the Mitchell's Satyr and Poweshiek Skipperling Habitat Conservation Plan, which provides guidance for habitat management to limit negative impacts on both species. ^[MSB2]
- **Species Management**
 - PS2. Create a captive breeding program for Poweshiek Skipperling. ^[CC-2.3]
 - PS3. Bank genetic material from Poweshiek Skipperling.
- **Conservation Designation & Planning**
 - PS4. Develop and implement a Poweshiek Skipperling recovery plan or conservation strategy. ^[MSB2]
- **Research & Monitoring**
 - PS5. Determine if herbicides and pesticides are affecting Poweshiek Skipperling populations.
 - PS6. Determine causes of Poweshiek Skipperling population declines.



THREATS to Hine's Emerald Dragonfly

> Lack of Knowledge

- Lack of information on specific habitat requirements, hydrologic needs, and general life history (USFWS 2001).

> Pollution

- Sensitive to degraded water quality (USFWS 2001).

Conservation ACTIONS for Hine's Emerald Dragonfly

> Species Management

HE1. Implement the Hine's Emerald Dragonfly Recovery Plan. ^[HE]

> Conservation Designation & Planning

HE2. Develop site conservation plans for Hine's Emerald Dragonfly. ^[HE]

> Research & Monitoring

HE3. Determine feasibility and cost effectiveness of larval surveys for Hine's Emerald Dragonfly. ^[HE-2]

HE4. Determine other limiting factors affecting populations to aid management.

THREATS to Eastern Massasauga

- **Lack of Knowledge**
 - Lack of information on the effects of snake fungal disease on Massasauga populations, hibernacula habitat requirements and locations, gestation or parturition locations, and factors that affect persistence and viability (Szymanski et al. 2015; for more information about snake fungal disease, see the Emerging Diseases mini-plan).
- **Residential & Commercial Development**
 - Fragmentation and lack of connectivity of transition zones between key habitats can be a significant limiting factor (Lee and Legge 2000; Szymanski et al. 2015).
- **Human Intrusions & Disturbance**
 - Persecution from humans (Lee and Legge 2000; Szymanski et al. 2015).
- **Natural System Modifications**
 - Poorly timed habitat management without sufficient refuge provisions (Szymanski et al. 2015).
- **Climate Change & Severe Weather**
 - Growing season droughts due to climate changes may cause increased predation, decreases in prey, and decreases in reproductive success (Hoving et al. 2013).

Conservation ACTIONS for Eastern Massasauga

- **Land & Water Management**
 - EM1. Implement and promote the Eastern Massasauga Candidate Conservation Agreement with Assurances practices, which provide guidance for habitat management to limit negative impacts on the species. ^[EMR]
- **Raising Awareness**
 - EM2. Continue outreach and education on snakes and their ecological value.
- **Conservation Designation & Planning**
 - EM3. Develop and implement Eastern Massasauga conservation strategy for the state.
- **Research & Monitoring**
 - EM4. Develop a cost-effective monitoring protocol for determining the status of Eastern Massasauga.
 - EM5. Survey and assess viability at new sites to implement appropriate management.
 - EM6. Determine impacts of different management activities to better inform management and policies.





THREATS to Tamarack Tree Cricket

- **Lack of Knowledge**
 - Lack of basic information about life history and distribution.
- **Natural System Modifications**
 - Lack of regeneration of tamarack, and red maple intrusion or conversion in fens.

Conservation ACTIONS for Tamarack Tree Cricket

- **Land & Water Management**
 - TC1. Conduct habitat management for tamarack at known Tamarack Tree Cricket sites.
 - TC2. Develop best management practices for tamarack management to support the Tamarack Tree Cricket.
- **Research & Monitoring**
 - TC3. Use citizen science efforts and work with land managers to expand survey efforts for Tamarack Tree Cricket.



THREATS to Yellow Rail

- **Lack of Knowledge**
 - Lack of basic life history information (Hyde 2001).

Conservation ACTIONS for Yellow Rail

- **Land & Water Management**
YR1. Conserve known breeding and non-breeding habitats for Yellow Rail. [JV; WCA]
- **Research & Monitoring**
YR2. Assess productivity of Yellow Rail at known sites. [JV; WCA]

WHAT ADDITIONAL CONSERVATION ACTIONS ARE NEEDED?

These additional conservation actions were identified by partners and should be addressed as resources become available.

> Law & Policy

1. Explore ways to regulate groundwater protection.


> Research & Monitoring

2. Determine impacts of new invasive species on focal species.
3. Determine Eastern Massasauga hibernacula needs to inform management.
4. Monitor and assess genetic diversity of extant populations of Eastern Massasauga.
5. Determine effective population size and habitat quantity and quality needed to maintain viable Massasauga populations.
6. Gain better understanding of Tamarack Tree Cricket habitat needs.

WHERE ARE THERE PLACES FOR PARTNERSHIP?

This map was designed by partners to help them connect around important places for focal species. Working together on conservation actions on a voluntary basis provides great benefits to wildlife and people.



 Priority areas for conservation actions

This map is based on focal species occurrences in level III and IV Ecoregions of Michigan.



HOW WILL WE MONITOR?

Assessing status and measuring progress towards goals.



HABITAT

- Continue to survey and update quality rankings for fen natural communities in the state's Natural Heritage Database.



MITCHELL'S SATYR

- Conduct time-meander survey transects regularly. [MSB-1]
- Continue to update element occurrences in the state's Natural Heritage Database. [MSB-3.3]



POWESHIEK SKIPPERLING

- Conduct time-meander survey transects regularly.
- Continue to update element occurrences in the state's Natural Heritage Database.



HINE'S EMERALD DRAGONFLY

- Conduct adult surveys at known occupied sites regularly. [HE]
- Continue to conduct surveys to find new Hine's Emerald Dragonfly occupied sites. [HE]
- Use larval surveys at known sites regularly, if determined effective.
- Continue to update element occurrences in the state's Natural Heritage Database.



EASTERN MASSASAUGA

- Continue presence/absence monitoring at known occupied sites regularly.
- Continue and expand intensive monitoring at a subset of known occupied sites that represent a range of conditions where Eastern Massasauga occurs.
- Continue to update element occurrences in the state's Natural Heritage Database.



TAMARACK TREE CRICKET

- Use citizen science opportunities to monitor presence/absence of Tamarack Tree Cricket to better understand distribution.
- Continue to update element occurrences in the state's Natural Heritage Database.



YELLOW RAIL

- Continue annual North American Breeding Bird Survey to identify population trends. ^[JV]
- Continue the Michigan Breeding Bird Atlas every 10 years. ^[JV]
- Use citizen science programs, such as e-Bird, to help assess distribution and relative abundance.
- Expand secretive marsh bird monitoring for Yellow Rail. ^[JV]
- Continue to update element occurrences in the state's Natural Heritage Database.



HOW DOES THIS PLAN LINK WITH OTHER CONSERVATION PLANS?

There has been a multitude of relevant planning efforts across the state and country over the past ten years. Bracketed superscripts throughout the Wildlife Action Plan indicate where the conservation action, goal, or monitoring strategy aligns with those from another plan. For conservation plans with distinct objectives, the objective or strategy number is also included. This linking of plans is meant to facilitate the expansion of partnerships.

[CC] National fish, wildlife and plants climate adaptation strategy (National Fish, Wildlife and Plants Climate Adaptation Partnership 2012)

[EMR] Eastern Massasauga candidate conservation agreement with assurances (DNR in review)

[FA] Michigan forest resource assessment and strategy (DNR 2010)

[HE] Hine's Emerald Dragonfly (*Somatochlora hineana*) recovery plan (USFWS 2001)

[JV] Upper Mississippi River and Great Lakes region joint venture waterbird habitat conservation strategy (Soulliere et al. 2007)

[MSB] Recovery plan for Mitchell's Satyr Butterfly (*Neonympha mitchellii mitchellii*) (USFWS 1997)

[MSB2] Mitchell's Satyr and Poweshiek habitat conservation plan (DNR draft)

[MSB3] Mitchell's Satyr Butterfly conservation strategy (USFWS 2015)

[PBMP] Pollinator-friendly best management practices for federal lands. (USFS 2015)

[SWR] Wildlife Division Southwest regional habitat guidance – wetlands (DNR 2015)

[TIS] Michigan terrestrial invasive species state management plan (DNR draft)

[TNC] Southern fens and savannas conservation business plan (The Nature Conservancy 2015)

[WCA] Waterbird conservation for the Americas: the North American waterbird conservation plan, version 1 (Kushlan et al. 2002)

FOR MORE INFORMATION/REFERENCES

Cohen, J.G., M.A. Kost, B.S. Slaughter, and D.A. Albert. 2015. A field guide to the natural communities of Michigan. Michigan State University Press, East Lansing, MI. 362 pp.

Cuthrell, D.L. 1999. Special animal abstract for *Somatochlora hineana* (Hine's Emerald Dragonfly). Michigan Natural Features Inventory, Lansing, MI. 3 pp.

Cuthrell, D.L. and M.A. Kost. 2001. Assessing the use of Tamarack Tree Cricket (*Oecanthus laricis* T.J. Walker), a rare species, as an indicator of biological integrity. Report Number 2001-09. Michigan Natural Features Inventory, Lansing, MI. 6 pp.

Cuthrell, D.L. and B.S. Slaughter. 2012. Special animal abstract for *Oarisma poweshiek* (Poweshiek skipperling). Michigan Natural Features Inventory, Lansing, MI. 4 pp.

Dean, L.F. and M.A. Wyckoff. Community planning & zoning for groundwater protection in Michigan – a guidebook for local officials. Michigan Society of Planning and Office of Water Resources, Michigan Department of Natural Resources, 152 pages, paperback.

Environment Canada. 2013. Management plan for the Yellow Rail (*Coturnicops noveboracensis*) in Canada. Species At Risk Act Management Plan Series. Environment Canada, Ottawa. iii + 24 pp.

Faust L., J. Szymanski, M. Redmer. 2011. Range wide extinction risk modeling for the eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*). U.S. Fish and Wildlife Service, Fort Snelling, MN. 66 pp.

Glassberg, J. 1999. Butterflies through binoculars: The East Oxford University Press, New York. 242 pp.

Hedgecock, K. 1992. Defensive behavior of the Eastern Massasauga Rattlesnake. Pp. 99–103, In B. Johnson and V. Mexies (Eds.). Proceedings Of The International Symposium And Workshop On The Conservation Of The Eastern Massasauga Rattlesnake, *Sistrurus catenatus catenatus*. Metro Toronto Zoo, West Hill, ON, Canada. 136 pp.

Hoving, C.L., Y. Lee, P.J. Badra, and B.J. Klatt. 2013. Changing climate, changing wildlife: a vulnerability assessment of 400 species of greatest conservation need and game species in Michigan. Wildlife Division Report No. 3564. Lansing, MI. 82 pp.

Hyde, D. 2001. Special animal abstract for *Coturnicops noveboracensis* (Yellow Rail). Michigan Natural Features Inventory. Lansing, MI. 4 pp.

Hyde, D. 2012. Update of Lee, Y. 2000. Special animal abstract for Mitchell's Satyr butterfly (*Neonympha mitchellii mitchellii*). Michigan Natural Features Inventory, Lansing, MI. 7 pp.

Hyde, D.A., B.S. Slaughter, D.L. Cuthrell, H.D. Enander, Y. Lee, M.R. Penskar, B.J. Barton, M.A. Kost, M.A. Sanders, P.J. Badra, and M.J. Monfils. 2009. Development of a multi-state Mitchell's Satyr habitat conservation plan: Michigan portion - 2009 Annual Report. Report number MNFI 2009-18. Report to DNR, Wildlife Division, Lansing, MI. 75 pp. + appendices.

Kost, M.A. and D.A. Hyde. 2009. Exploring the prairie fen wetlands of Michigan. Extension Bulletin E-3045. Michigan Natural Features Inventory, Michigan State University Extension, East Lansing, MI. 106 pp.

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird conservation for the Americas: The North American waterbird conservation plan, Version 1. Waterbird Conservation for the Americas, Washington, DC, U.S.A., 78pp.

Lee, Y. and J.T. Legge. 2000. Special animal abstract for *Sistrurus catenatus catenatus* (Eastern Massasauga). Michigan Natural Features Inventory, Lansing, MI. 8 pp.

Michigan Department of Natural Resources (DNR). 2010. Michigan forest resource assessment and strategy. Lansing, MI. 124 pp.

Michigan Department of Natural Resources (DNR). 2015. Wildlife Division Southwest regional habitat guidance - wetlands. Unpublished report.

Michigan Department of Natural Resources (DNR). In review. Eastern Massasauga candidate conservation agreement with assurances.

Michigan Department of Natural Resources (DNR). (2015). Draft Michigan terrestrial invasive species state management plan. Michigan Department of Natural Resources, Lansing MI. Manuscript in preparation.

Michigan Department of Natural Resources (DNR). Draft. Mitchell's Satyr and Poweshiek habitat conservation plan.

Michigan Natural Features Inventory. 2007. Rare Species Explorer (Web Application). Available online at mnfi.anr.msu.edu/explorer [Accessed Sep 23, 2015]

National Fish, Wildlife and Plants Climate Adaptation Partnership. 2012. National fish, wildlife and plants climate adaptation strategy. Association of Fish and Wildlife Agencies, Council on Environmental Quality, Great Lakes Indian Fish and Wildlife Commission, National Oceanic and Atmospheric Administration, and U.S. Fish and Wildlife Service. Washington, DC.

Olson, D. 2011. Yellow Rail (*Coturnicops noveboracensis*). In A.T. Chartier, J.J. Baldy, and J.M. Brenneman, editors. The Second Michigan Breeding Bird Atlas. Kalamazoo Nature Center, Kalamazoo, Michigan, USA.

Pecenka, J.R. and J.G. Lundgren. 2015. Non-target effects of clothianidin on monarch butterflies. *Science of Nature*. 102:19, Published online: 03 April 2015.

Potter, B.A., G.J. Soulliere, D.N. Ewert, M.G. Knutson, W.E. Thogmartin, J.S. Castrale, and M.J. Roell. 2007. Upper Mississippi River and Great Lakes Region Joint Venture Landbird Habitat Conservation Strategy. U.S. Fish and Wildlife Service, Fort Snelling, MN. 124 pp.

Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr., and W. A. Link. 2014. The North American breeding bird survey, results and analysis 1966 - 2013. Version 01.30.2015 USGS Patuxent Wildlife Research Center, Laurel, MD.

Soulliere, G.J., B.A. Potter, D.J. Holm, D.A. Granfors, M.J. Monfils, S.J. Lewis, and W.E. Thogmartin. 2007. Upper Mississippi River and Great Lakes Region Joint Venture waterbird habitat conservation strategy. U.S. Fish and Wildlife Service, Fort Snelling, MN. 68 pp.

Szymanski, J., C. Pollack, L. Ragan, M. Redmer, L. Clemency, K. Voorhies, and J. JaKa. 2015. Species status assessment for the Eastern Massasauga Rattlesnake (*Sistrurus catenatus*). U.S. Fish and Wildlife Service. July 23, 2015 (v1).

The Nature Conservancy. 2015. Southern fens and savannas conservation business plan.

U.S. Fish and Wildlife Service (USFWS). 1997. Recovery plan for Mitchell's Satyr butterfly *Neonympha mitchellii mitchellii* French (Lepidoptera: Nymphalidae: Satyrinae). Fort Snelling, MN. Viii + 71 pp.

U.S. Fish and Wildlife Service (USFWS). 2001. Hine's Emerald Dragonfly (*Somatochlora hineana*) recovery plan. Fort Snelling, MN. 120 pp.

U.S. Fish and Wildlife Service (USFWS). 2014a. Poweshiek Skipperling (*Oarisma poweshiek*) fact sheet. Accessed on 09/15/15 at www.fws.gov/MIDWEST/Endangered/insects/posk/pdf/poskFactSheetOct2014.pdf.

U.S. Fish and Wildlife Service (USFWS). 2014b. Mitchell's Satyr butterfly (*Neonympha mitchellii mitchellii*) 5-year review: summary and evaluation. East Lansing Field Office, East Lansing, MI. 38 pp.

U.S. Fish and Wildlife Service (USFWS). 2015. Mitchell's Satyr Butterfly conservation strategy. East Lansing, MI.

United States Forest Service (USFS). 2015. Pollinator-friendly best management practices for federal lands.

Wires, L.R., S.J. Lewis, G.J. Soulliere, S.W. Matteson, D.V. Weseloh, R.P. Russel, and F.J. Cuthbert. 2010. Upper Mississippi Valley / Great Lakes waterbird conservation plan. A Plan associated with the Waterbird Conservation for the Americas Initiative. Final report submitted to the U.S. Fish and Wildlife Service, Fort Snelling, MN.

Young, B., E. Byers, K. Gravuer, K. Hall, G. Hammerson, and A. Redder. 2011. Guidelines for using the NatureServe climate change vulnerability index, Release 2.1. NatureServe, Arlington, VA.

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ABOUT THE WILDLIFE ACTION PLAN

Today's Priorities, Tomorrow's Wildlife

Every state has a Wildlife Action Plan, which taken together create a national conservation strategy for safeguarding wildlife and their habitats for current and future generations. Each state's action plan is uniquely designed to serve the needs of that state. These plans provide a framework for proactive conservation and management of fish and wildlife before they become imperiled, which is more straightforward, cost-efficient, and effective.

Michigan's Wildlife Action Plan was developed by conservation partners across the state. It provides information about those species in greatest conservation need. The plan is organized by chapters or mini-plans. Each mini-plan outlines priorities for the next 10 years. The mini-plans detail priority habitats and focal species of greatest conservation need, status of species and habitats, critical threats, needed conservation actions, places for partnerships, monitoring needs, and goals. This is one of 15 mini-plans. For more information about how the plan was built and to read other mini-plans, please visit: www.michigan.gov/dnrwildlifeactionplan.