Conservation of Rare Fen Insects in Michigan

Daria Hyde Michigan Natural Features Inventory Michigan State University Extension Michigan Wetlands Association Conference, September 28, 2017

Michigan Natural Features Inventory

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Today's Topics

- Michigan's groundwater fed wetlands
 - Coastal, northern and prairie fens
- Rare fen insects why are they declining?
- Threats to fens and associated species
- Current & future conservation strategies







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Michigan Natural Features Inventory

Michigan's Groundwater Fed Wetlands

- Coastal Fen
- Northern Fen
- Prairie Fen
- Hydrology maintained by constant seepage of cold groundwater rich in calcium and magnesium carbonates



Coastal fen - S2/G1G2

- Globally imperiled
- Occurs on calcareous soils along Lake Huron and Lake MI
- Marl and peat soils
- Sedge and rushes dominant
- Pitcher plant, Ohio goldenrod Shrubby cinquefoil
- Strongly influenced by Great Lakes water levels



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Northern Fen – S3/G4G5

Occur where calcareous bedrock underlies a thin mantle of glacial drift

- Saturated peat neutral to slightly alkaline
- Sedge and rush dominated
- Scattered and clumped conifers
- High in diversity

Supports many rare plant and animals

Northern Fen in old lake basin



Marl is produced by metabolism of algae in warm, shallow, calcium-rich waters

Natural Processes of Coastal and Northern Fens

- Constant saturation by cold, mineral-rich groundwater
 - Open conditions maintained by hydrologic and chemical conditions that limit the establishment and growth of woody plants
- Flooding
 - Beaver activity
 - Wave and ice action (Coastal Fens)
- Fire
 - Occasional fire sets back shrub and tree invasion and helps maintain open structure and high levels of floral diversity
- Windthrow and insect outbreaks
 - Impacts tree survival

Hines Emerald Dragonfly (Somatachlora hineana)

- Endangered (state & federal)
- 48 occurrences in world
- Only 16 in Michigan
- 4 in NE Lower



Illinois (9), Wisconsin (20) Missouri (3) Alabama - extirpated Ohio - extirpated Illinois - extirpated

Male and Female Hine's Emerald Dragonfly



- Brilliant green eyes
- Metallic green/brown thorax
- Two yellow lines on thorax
- Body ~ 2.5 inches
- Wingspan ~ 3.3 inches.
- Male Distinct appendage
- Females Distinct ovipositor

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- HED typically spend 4 to 5 years as larvae
- Long larval stage is part of species vulnerability
- Larvae most critical stage for conservation

Hine's emerald dragonfly

Development Stressers Impervious surfaces allow no inhitration Groundwater wells pull water away -Potential for contaminated natoff

Slow Infiltration

Sands and Gravel Rapid Infiltration

Groundwater Flow Paths

A STREET STREET STREET

Dolomite BedRock





4th-5th Year Larvae

Life Cycle

Egg Overwinter Hatch in spring

> Young of Year Larvae active until fall or until drought overwinter



1st - 3rd Year Larvae active until fall or drought



Crayfish provide burrows that HED use for drought and overwintering refugia, though they also predate HED. HED aquatic larvae live in rivulets fed by clean groundwater for 3-5yrs

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Crayfish burrows at Thompson's Harbor S.P.

Pumping burrows for larvae.

Incurvate Emerald (Somatachlora incurvata) Special Concern, S3S4/G4



- Brilliant green eyes
- Brown thorax w/metallic sheen
- Body ~ 2 inches
- Distinguished from HED and other emerald dragonflies by their genitalia
- Only documented in U.P. in MI

ORV damage to HED habitat



Threats to Fen Dragonflies

- Fragmentation and destruction of habitat
- Changes in surface and subsurface hydrology
- Degradation of habitat from invasive species
- Contamination from habitat altering chemicals
 - Chemicals in muck sediments can persist and remain toxic for long periods of time and may be difficult if not impossible to treat.
- Adult mortality: impacts with vehicles and trains

Conservation Actions

Designation of critical habitat

- Avoid quarrying, creating landfills, pipelines, and filling wetlands
- Only applies to projects with federal nexus
- Protect hydrology and water quality
 - Avoid building roads, pipelines, ditches,
 - Avoid pumping of groundwater for irrigation
 - Prevent improper ORV use
 - Control invasive plants

• Avoid use of habitat altering chemicals

- No-cut or selective cut buffer around these fens
 - Protect microclimate, habitat for feeding and shelter
- <u>Reduce vehicle speed on adjacent roads</u>

https://www.fws.gov/midwest/endangered/insects/hed/index.html

Prairie Fen S3/G3G4

- Marl and peat soils
- Saturated conditions maintained by calcareous groundwater seeps
- Sedge and grasses dominant
- Tamarack, poison sumac, shrubby cinquefoil
- **3-4 distinct vegetation zones**

Natural Processes of Prairie Fens

- Constant saturation by cold, mineral-rich groundwater
 - Saturated peat is maintained by a constant inflow of groundwater rich in calcium and magnesium from surrounding glacial deposits
- Flooding
 - Beaver activity
- Grazing
- Fire
 - Occasional fire sets back shrub and tree invasion and helps maintain open structure and high levels of floral diversity

Groundwater Flow and Prairie Fens



Tamarack Tree Cricket (Oecanthus laricis)

Special Concern



18 MI counties, previously only 4

Fens and tamarack swamps



 Avoid draining, filling, and other hydrologic alteration

 Avoid cutting tamarack, but girdle shade-tolerant trees (red maple) if shading out tamarack

Apply fire conservatively

Spittlebugs, leafhoppers and borer moths



Angular spittlebug-(*Lepyronia anguilifera*) - SC



Kansan Leafhopper (*Dorydiella kansana*) SC



Silphium borer moth (*Papapeima silphi*) ST



Lake Huron Leafhopper (*Flexamia huroni*) Michigan Endemic, ST





Blazing star borer moth (*Papapeima beeriana*) SC

Culver's root borer moth (*Papapeima sciata*) SC

Mitchell's Satyr (Neonympha mitchellii) LE, SE

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Historical Distribution



Federally listed as
 Endangered in 1992

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 Known historically from 30 sites spread across 4 states (Michigan, Indiana, Ohio, New Jersey)

Current Distribution



Currently only known regionally from Michigan and Indiana (outliers in AL, MS, VA)

In 2017:

- 9 occupied sites in MI
- 1 site in Indiana
- 2 sites uncertain status
- 12 extirpated sites
- 5 historical sites

Habitat requirements



 Small rooms occurring within complex of shrubs, trees, forbs, sedge

Habitat requirements



Captive Rearing/Headstarting

- 2004: Toledo Zoo staff began rearing surrogate
- 2005- began rearing MS
- 2007-2009- food studies
- 2010-present- perfected rearing techniques
- 2016- KNC reared and released MS caterpillars
- 2017- Toledo Zoo released MS adults at IN site
- Planned releases (2), augmentation (2)
- Challenges: Butterflies develop too fast





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Swamp Metalmark





Documented last in 2008 in Oakland and Jackson Co.

May be extirpated from MI

Swamp Metalmark



Swamp Thistle (*Cirsium muticum*)



Poweshiek Skipperling (*Oarisma poweshiek*) Federally Endangered, State Threatened

Native remnant tall grass prairies, moist meadows and prairie fens

Diverse and abundant nectar for adults during flight period

Black-eyed susan, shrubby cinquefoil,

Abundant fine stemmed native grasses for larval feeding



Photos: E. Runquist, Minnesota Zoo; Wisconsinbutterflies.org; Susan Borkin, Milwaukee Public Museum

Suspected Poweshiek hostplants in MI



Mat muhly- State Threatened Muhlenbergia richardsonis



Prairie dropseed – Special Concern Sporobulus heterolopsis

Historical range of Poweshiek skipperling



~296 Locations

Once common and abundant in native prairies

Found in 8 states and at least one Canadian province

> Tamara Smith-USFWS

"much of tallgrass prairie was extirpated prior to extensive ecological study" (Steinauer and Collins 1994)

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Current locations of Poweshiek skipperling



"much of tallgrass prairie was extirpated prior to extensive ecological study" (Steinauer and Collins 1994)



PS- Population viability analysis: C. Pogue- unpublished

- 8 Michigan sites
- Used count data
- Indicates that the species faces a probability of extinction in MI of:
 - 16.7% in 5 years
 - 55.8% in 10 years
 - 75.5% in 20 years



Threats to Poweshiek skipperling, Mitchell's satyr and swamp metalmark

- Fragmentation and destruction of habitat
 - Conversion to agriculture, gravel mining, development, overgrazing
- Changes in surface and subsurface hydrology
 - Groundwater withdrawals and alteration, chemical contamination
- Degradation of habitat from invasive species
- Climate change
 - Droughts, floods, lack of winter snow cover
- Geographic isolation
 - Inbreeding depression and vulnerability to stochastic processes
- Unknown stressors
 - Herbicides, pesticides, disease/pathogen, fires/wildfires

Conservation Actions

- USFWS –ESA Protections
 - Critical habitat designation for Poweshiek,
 - HCP for PS & MS (pending), Safe Harbor



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- Research David Cuthrell and Mike and Anna Monfils
 - Population status assessments for PS, MS and Swamp metalmark
 - Ecological risk assessment for 4 PS sites and 4 MS sites
 - Assess local and landscape-level environmental factors
 - Tested pesticide drift hypothesis.
- Habitat management, protection and planning
 - Conservation plans for MS, working with partners and landowners
 - Protect fen hydrology!!!
 - Acquire land/conservation easements
- Genetics research E.Saarinen, MN Zoo, Mississippi Ent. Museum
- Headstarting/capitve rearing Borkin & MN Zoo, Toledo Zoo, KNC
 Very challenging- MS- mixed results, PS- poor results

Questions and Future Efforts?

- Protect groundwater recharge locally and regionally
- Landscape-scale conservation
 - Dispersal corridors to facilitate metapopulation structure
 - Resources and commitment from many partners
 - Assisted migration to respond to climate change
 - Move to northern fens?
 - How will this impact species which currently occur there?
 - Can they find host plants and adapt?
- Other ideas?
- Landis et. al 2011, Insect conservation in Michigan prairie fen: addressing the challenge of global change. J. Insect Conser.

Questions/Discusson?