

Michigan's Wildlife Action Plan

State Wildlife Grants Funding in Action



Project Summaries 2005-2010



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Introduction

The goal of Michigan's Wildlife Action Plan is to provide a common strategic framework that will enable Michigan's conservation partners to jointly implement a long-term holistic approach for the conservation of all wildlife species.

Michigan's Wildlife Action Plan (WAP) is part of a national conservation strategy for safeguarding wildlife (aquatic and terrestrial) and their habitats for current and future generations. Michigan's action plan is uniquely designed to serve our needs. The current version of the WAP provides a status assessment of 404 species thought to be declining in Michigan and their habitats (or landscape features). The WAP describes threats to and conservation actions needed to help these species of greatest conservation need and their habitats. Conservation of endangered species is complicated and expensive. Proactive conservation and management of species before they become endangered is more straightforward, cost-efficient, and effective.

State Wildlife Grants (SWG) have been critical to implementing the WAP. This funding comes from revenues collected from Outer Continental Shelf Oil and Gas royalties and is appropriated to the states through the U.S. Fish and Wildlife Service. Although these funds have been provided every year since 2002, they are appropriated through the annual federal budget process. Unlike Pittman-Robertson funds, SWG funds are not automatically appropriated; consequently, the Department must wait for each year's federal budget to know how much will be available, if any. These funds also require a non-federal match, with states required to provide 50% of the funds for implementation projects and 25% of the funds for planning projects.

As such, this funding source leverages significant additional resources that benefit wildlife and their habitats in Michigan. This small amount of funding has a huge impact, especially for wildlife most in need.

What is this report?

This report provides short summaries for projects that have been fully or partially funded by SWG. Many of the projects provide critical information to help us better manage a species or habitat type. The report provides information about who the lead of the project was, who the partners were, and where it occurred. Citations for all published literature, reports, or web sites produced through the projects are also listed in the back of the report. This report is set up in different sections to provide easier access to specific topics that are of interest to the user.

Why was this report produced?

Much of the work reported here was conducted because there was an information or management need identified by staff to help better manage Michigan's wildlife and their habitats. This report is designed to communicate the results of the work back to our staff and partners, thereby completing the communication loop.

For more information about the WAP visit:
www.michigan.gov/dnrwildlifeactionplan

For more information about SWG visit:
<http://wsfrprograms.fws.gov/Subpages/GrantPrograms/SWG/SWG.htm>

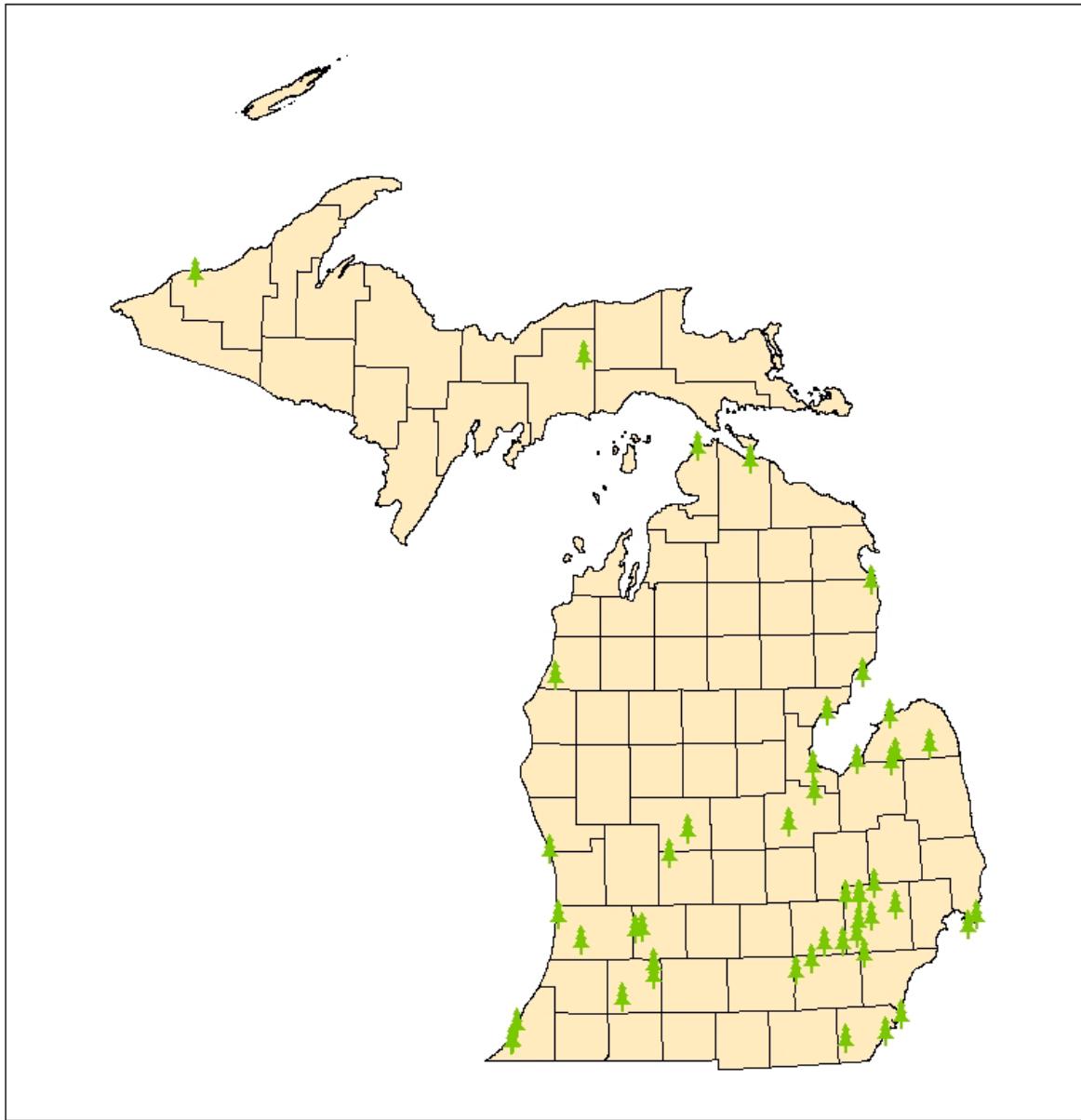
For more information about the projects describe in this publication contact the authors or Amy Derosier, the Wildlife Action Plan Coordinator at derosiera@michigan.gov or 517-373-1263.

Habitat Management – Project Summaries



On-the-Ground Habitat Restoration and Management

Michigan Department of Natural Resources - Wildlife Division and Parks and Recreation Division



The following text describes the habitat restoration and management efforts that occurred at different state game areas, recreation areas, and parks using SWG. This is only part of the story of restoration efforts that the Department has conducted over the years. This work benefits endangered and threatened species, species of greatest conservation need, game species, and many other more common wildlife.

*note: letters and numbers in brackets refer to individual projects or Wildlife Division WIPs.

Southeast Michigan

Algonac State Park

2006: 11 acres planted with 8,132 plugs of native grasses and forbs; 16 hours of rare insect monitoring; 95 acres of various herbaceous invasive control; 30 acres of invasive buckthorn control; 111 acres of various invasive species brush control; 148 acres of *phragmites* control; 210 hours of seed collection; and 5 miles of fire break preparation.

Project Summaries – Habitat Management

2007: 35.5 acres of invasive buckthorn control by contractor; 145 acres of *phragmites* control (follow-up contract); 81 acres of woody invasive shrub control; 93 acres of herbaceous invasive control; 32 hours of brush pile burning; 13 acres of site preparation for restoration; 12 acres planted with 7,900 plugs; 330 hours of seed collection; 5 miles of prescribed fire break preparation.

2008: 82 acres of buckthorn control by contractor; 147 acres of *phragmites* control; 23 acres of woody invasive species control; 109 acres of herbaceous invasive species control; 70 hours of brush pile burning; 5 miles of prescribed fire break preparation; 286 acres of prescribed fire; 16 acres preparation and plantings; 185 hours of native seed collection.

2009: 183 acres of invasive species control, including: stump-treated invasive shrubs with significant quantities of glossy buckthorn; pulled over 13 bags of garlic mustard; pulled wild parsnip, sweet clover and other herbaceous plants; sprayed *phragmites* by contractor; released 240 *Galerucella* beetles to control purple loosestrife; 5 acres of grassland restoration and maintenance, including: planting of native forbs; sprayed planted area; collected native seed for 55 hours; ~5 miles of prescribed fire break were prepared.

2010: 508 acres of invasive species control including: pulled 8 bags of garlic mustard; pulled wild parsnip; treated *phragmites* and reed canary grass by contract; treated purple loosestrife; treated invasive woody plants, including large quantities of buckthorn, by contract; completed 1 prescribed burn. Grassland restoration and management on 154 acres efforts included: planting native plugs; pulling, mowing, and spraying weeds in planted areas; collecting native seed for 381 hours; 3.5 miles of prescribed fire break preparation; completing 2 prescribed burns.

Bald Mountain Recreation Area

2006: 10 acres of invasive brush control; 2 acres of garlic mustard control (checked 9 miles of trails); 0.25 acres of *phragmites* control; 72 hours of brush pile burning; *Galerucella* released at 2 sites to control purple loosestrife.

2007: 4.75 acres of invasive brush control; 2.1 acres of garlic mustard control (checked 14.4 miles of trails); 0.25 acres of other herbaceous invasive plant control; *Galerucella* beetle release at 1 site for purple loosestrife control; 0.5 miles of prescribed fire break preparation.

2008: 3 acres of invasive shrub control; 83 acres of garlic mustard checked and pulled; *Galerucella* beetle release at 1 site for purple loosestrife control; 0.5 miles of prescribed fire break preparation.

2009: 80 acres of invasive species control for buckthorn; pulled 5 bags of garlic mustard; completed 1 prescribed burn; 0.5 miles of prescribed fire break was prepared.

2010: 11 acres of invasive species control including garlic mustard (17 bags), glossy buckthorn, and other woody plants.

Bay City Recreation Area

2006: 1 acre of site preparation and planting with 3,268 plugs of native grasses and forbs; 14 hours of seed collection; 3 miles of prescribed fire break preparation.

2007: Treated 5 acres of *phragmites* and purple loosestrife. 50 hours of native seed collection; 3 miles of prescribed fire break preparation.

2008: 107 acres of prescribed burn; 1 miles of prescribed fire break preparation; 19.7 acres of prescribed fire.

2009: 268 acres of invasive species control, including: spraying *phragmites*, reed canary grass, purple loosestrife and invasive shrubs by contractor; 82 acres of invasive species control by hand pulling and herbicides; 3 prescribed burns were completed; 1 mile of prescribed fire break was prepared; 20 acres of grassland restoration and maintained by prescribed burning.

2010: 9 acres of restoration efforts, including: transplanting native plugs within a prairie and completing 1 prescribed burn.

Brighton Recreation Area

2006: 10 acres of invasive brush and garlic mustard control (Teahen Prairie); 7 acres of invasive shrub control (Little Appleton Fen); 1.5 acres of *phragmites* control at various sites; 4 hours of rare insect monitoring; 1 mile of prescribed fire break preparation.

2007: 3.35 acres of invasive shrub, garlic mustard, & sweet clover control (Teahen Prairie); 1.5 acres of invasive shrub control (Little Appleton Fen); 3 acres of glossy buckthorn control (Bauer Rd Fen); 1 acre of *phragmites* control; 27.5 hours of brush pile burning; *Galerucella* beetle released at 2 sites for purple loosestrife control; 51 hours of native seed collection; 2 miles of prescribed fire break preparation.

2008: 7 acres of garlic mustard control; 15.5 acres of invasive shrub control; 9 acres of purple loosestrife control; *Galerucella* beetle released at 2 sites for purple loosestrife control; 1 mile of prescribed fire break preparation; 11 acres of prescribed fire; 90 hours of native seed collection.

2009: 20 acres of invasive species control, including: stump-treated and foliar spraying of buckthorn and other woody invasive plants; pulled 7 bags of garlic mustard; collected native seed for 5 hours; 1 mile of prescribed fire break was prepared.

2010: 20 acres of invasive species control including: garlic mustard (4 bags), *phragmites*, buckthorn and other invasive plants (contractors and volunteers); released *Galerucella*

beetles to control purple loosestrife; collected native seed for 173 hours.

Fish Point, Gagetown, Verona, and Wigwam Bay State Game Areas

2006: Cutting, mowing and treating invasive plant species with herbicides was conducted in lakeplain prairies on state wildlife and game areas (SGA) in the Saginaw Bay Management Unit; invasive plant control included: *phragmites*, willow, cottonwood, purple loosestrife, autumn olive, honeysuckle, buckthorn and spotted knapweed; 60 acres of spot spraying of invasive species at Wigwam Bay, Fish Point and Gagetown; 30 acres mowed to control invasive plants at Wildfowl Bay and Caro Pheasant Management Area. [SBM-11]

2007: 10 acres of glossy buckthorn cut and treated at Gagetown SGA by contractors; 65 acres of autumn olive control at Vernoia SGA; 10 acres of *phragmites* treated at Fish Point State Wildlife Area. [SBM-11]

2008: Fish Point SGA - 25 acres of grassland and lakeplain habitat to control invasive woody vegetation by contractors. [SBM-17]

Highland Recreation Area

2006: 2 acres of invasive brush control (Haven Hill Natural Area); 2 acres of garlic mustard control (field trial area woods); 10 acres of *phragmites* control; 2 acres of various other herbaceous invasive species control (Silo FTA); *Galerucella* beetle released at Haven Hill to control purple loosestrife; 10 acres of trees removed from grassland on field trial area by contract; 16 acres of brush and tree removal on field trial area; 53 hours of seed collection; 0.5 acres planted with 1,368 plugs; 4.5 miles of prescribed fire break preparation.

2007: 2.25 acres of invasive shrub control (Haven Hill Natural Area); 4.35 acres of garlic mustard control (checked 5+ miles of trails); 15 acres of various other herbaceous invasive species control including *phragmites*; 30 brush piles burned; *Galerucella* beetle release at 1 site for purple loosestrife control; 10.8 acres of trees removed from grassland on field trial area by contractor; 20 acres of brush & tree removal on field trial area by Michigan Civilian Conservation Corps & volunteers; 214 hours of native seed collection; 24 acres of site prep and 26.5 acres planted with warm season grass and 1,400 grass & wildflower plugs; 4.5 miles of prescribed fire break preparation.

2008: 141 acres of woody invasive species control; 1,094 acres of garlic mustard checked along trails and pulled where necessary; 36 acres of spotted knapweed control; 252 hours of brush pile construction; *Galerucella* beetle release at 1 site for purple loosestrife control; 1 mile of prescribed fire break preparation; 272 hours of native seed collection; 26 acres of

site preparation; 3.5 miles of prescribed fire break preparation; 185 acres of prescribed fire.

2009: 190 acres of invasive species control, including: stump-treated invasive shrubs, foliar sprayed tree-of-heaven, black locust, swallow-wort, Japanese knotweed, and *phragmites*; pulled over 17 bags of garlic mustard; 34 acres of grassland restoration or maintenance, including: one prescribed burn; mowed and sprayed on the barn course; collected seed for 399 hours; 3.5 miles of prescribed fire break were prepared.

2010: 1,061 acres of invasive species control, including: hand pulling garlic mustard (58 bags); herbicide garlic mustard, swallow-wort, bittersweet, and Japanese knotweed; stump treated woody plants; mapped and pulled invasive plants in the Haven Hill Natural Area by contract; completed 1 prescribed burn. Grassland restoration and maintenance efforts on 229 acres, including: cut and stump treated invasive tree and shrubs by contract; collected native seed for 245 hours; prepared 2.7 miles of prescribed fire break; can completed 3 prescribed burns.

Holly Recreation Area

2006: 1 acre of *phragmites* control at various sites within park.

2008: 24 acres of *phragmites* control.

2009: 3 acres of invasive species control, including: foliar sprayed *phragmites*; released 250 *Galerucella* beetles for purple loosestrife control; collected native seed for 4 hours.

Holly State Wildlife Area

The prairie fen off Brandt Road in the Holly State Recreation Area is one of the highest quality fens in the state. Invasive species are a major threat to this site. All of the following work was conducted in the Brandt Road Fen.

2006: Contracted clearing invasive shrubs using a hydroaxe and treating stumps with herbicides. Work was completed during the winter months after freeze-up to minimize damage to native vegetation and to avoid potential impacts to animals, particularly eastern massasauga rattlesnakes. Project was continued in FY 2007. [SEM-90]

2007: 10 acres treated for glossy buckthorn and other invasive shrub by contractor. [SEM-81]

2008: 25 acres of glossy buckthorn and autumn olive removed and treated; 8 acres removed of cherry, maple sassafras, and autumn olive for oak savanna; additional local treatments for autumn olive, bittersweet, Japanese knotweed, swallowwort, oriental bittersweet, *phragmites*, and glossy buckthorn. [SEM-80]

Island Lake Recreation Area

2006: 8 acres of invasive brush removed by contract; 15 acres of invasive brush control by volunteers; 13 acres of garlic mustard control; 2 acres of *phragmites* and other herbaceous invasive plant control; 10 acres of brush removal in partnership with Michigan Civilian Conservation Corps; 223 hours of brush pile building and burning; 129 hours of seed collection; 7 miles of prescribed burn line preparation.

2007: 37.6 acres of invasive shrub removal; 143 acres of herbaceous invasive control; 500 hours of brush pile building and burning; *Galerucella* beetle release at 1 site for purple loosestrife control; 5 miles of prescribed fire break preparation; 293 hours of seed collection.

2008: 21 acres of woody invasive species removed; 76 acres of herbaceous invasive species control; 5 miles of prescribed fire break preparation; 284.5 hours of native seed collection; 203 acres of prescribed fire.

2009: 55 acres of invasive species control, including: cut and stump treated woody invasive plants; Asian bittersweet, buckthorn, black locust, and swallow-wort were treated by contractor; pulled garlic mustard (42 bags) and other herbaceous invasive plants; foliar sprayed Japanese knotweed; collected native seed for 491 hours.

2010: 54 acres of invasive species control, including: hand pulling herbaceous invasive species such as garlic mustard (14 bags) and spotted knapweed; sprayed garlic mustard, Japanese knotweed, and woody invasive plants; cut and stump-treated woody invasive plants. Grassland restoration and maintenance efforts on 94 acres, including: collecting native seed for 198 hours and completing 1 prescribed burn.

Maybury State Park

2009: Sprayed *phragmites* on 0.5 acres.

Ortonville Recreation Area

2009: Pulled one bag of garlic mustard.

2010: 2.8 acres of invasive species control, including cut and stump-treated buckthorn.

Petersburg State Game Area

Petersburg SGA has unique lakeplain communities which are globally rare and used by the Karner blue butterfly. The addition of prairie grasses was an important step for maintaining nesting, brood rearing and winter cover for a variety of species.

2006: Native prairie grass seed and plugs were purchased for a 100 acre lakeplain prairie restoration; lime was spread on 5 acres in preparation for planting in 2007; this site is being considered for Karner blue butterfly reintroduction in cooperation with the Toledo Zoo. [SEM-06]

2007: Prescribed burns were conducted in areas that were planted to native grasses in previous years; surveys have shown lack of wild lupine nectar sources for Karner blue butterfly, so seed and plugs of local genotype lupine were acquired and planted; exotic invasive species were also spot treated. [SEM-05]

2008: 20 acres prescribed burn to control woody vegetation and stimulate regeneration of native vegetation for Karner blue butterfly. [SEM-03]

2010: Surveys showed that addition nectar sources for the Karner blue were needed, so seeds and plugs were purchased to plant in the area; lime was added to each area of management to assist in the creation of the appropriate pH to grow native plants; removal of autumn olive and other invasive species; this work is part of a 180 acre restoration effort. [SEM-03]

Pinckney Recreation Area

2006: 1 acre planted with 188 plugs; 2.5 acres of invasive brush control by volunteers; 1.1 acres of herbaceous invasive species control by volunteers; 33 acres of garlic mustard control; 1 acre of *phragmites* control; *Galerucella* beetle released at 2 sites to control purple loosestrife; native seed collected for 3 hours; 1 acre planted with 188 plugs; 2.5 miles of prescribed burn line preparation.

2007: 11 acres of invasive shrub control; 33 acres of garlic mustard control; *Galerucella* beetle released at 1 site for purple loosestrife control; 2.5 miles of prescribed fire break preparation; 15 hours of native seed collection; 2 acres site prepped and planted with 684 grass and wildflower plugs.

2008: 5 acres of invasive shrub control; 140 acres of garlic mustard checked along trails and pulled where found; 29 acres of herbaceous invasive species control; 0.75 miles of prescribed fire break preparation; 0.75 miles of prescribed fire break preparation; 45 hours of native seed collection; 6 acres planted.

2009: 85 acres of invasive species control, including: cut and stump-treated invasive woody plants; cut conifers in a prairie & oak barrens; pulled garlic mustard (88 bags) and other herbaceous invasive plants; foliar sprayed garlic mustard. 1 acre of grassland restoration and maintenance, including: planted native forbs, collected native seed for 92 hours, three-quarters of a mile of prescribed fire break were prepared.

2010: 167 acres of invasive species control, including: hand pulling garlic mustard (31 bags), wild parsnip, and young conifers; cut and stump treated woody invasive species; released *Galerucella* beetles to control purple loosestrife; prepared 0.7 miles of fire break; and completed 1 prescribed burn. Grassland restoration and maintenance efforts on 129 acres, including: planting native plugs, pulling weeds in

Project Summaries – Habitat Management

planted areas, collecting native seed for 62 hours, and completing 1 prescribed burn.

Pontiac Lake Recreation Area

2010: Collected native seed for 2 hours.

Proud Lake Recreation Area

2009: 25 acres of garlic mustard control (pulled 29 bags).

2010: 120 acres of invasive species control, including: pulling 171 bags of garlic mustard.

Pte. Mouilee State Game Area

2006: Vermet Unit - Inaccessible areas of *phragmites* infestations in the Vermet Unit of Pointe Mouilee SGA were aerially sprayed under contract by contractor helicopter. The herbicide Rodeo was applied during the late summer of 2006. The objective of the treatment was to reduce cover of the invasive *phragmites* to encourage the reestablishment of native species that provide food and cover for numerous native species. A total of 100 acres were treated; the area will be monitored and the efficacy of the treatment assessed in subsequent years. [SEM-05]

2008: 110 acres of *phragmites* was treated by contractor. [SEM-02]

Seven Lakes State Park

2006: 2 acres of *phragmites* control; 138 hours of brush pile burning as site prep for planting; 51 hours of native seed collection; 1.5 miles of prescribed fire break preparation.

2007: 2 acres of *phragmites* were treated; 1 mile of prescribed fire break preparation; 108 hours of native seed collection.

2008: 3 acres of *phragmites* treated; 1 acre of woody invasive species control; 1 mile prescribed fire break preparation; 225 acres of prescribed fire; 0.5 mile of prescribed fire break preparation; 85.5 hours of native seed collection; 12 acres of prescribed fire.

2009: 12 acres of grassland restoration and maintenance, including: planted native forbs and 0.5 mile of prescribed fire break was prepared.

2010: 0.5 acres of invasive species control, including: hand pulling wild parsnip, spraying swallow-wort, and stump-treating autumn olive. Grassland restoration and maintenance efforts on 173.4 acres, including: preparing burn line and completing 3 prescribed burns.

Shiawassee River, Crow Island, and Wigwam Bay State Game Areas

2007: Shiawassee River, Crow Island, and Wigwam Bay SGA – wetland areas were surveyed for invasive plants, of particular concern was tracking spread of glossy buckthorn, garlic mustard, and spotted knapweed by contractor. [SBM-66]

Sleeper State Park

2009: 58 acres of prescribed burn.

St. Clair Flats State Game Area

This work is part of restoring and managing a complex of lakeplain prairie, lakeplain oak openings, and Great Lakes marsh communities at the St. Clair Flats SGA. All three of these communities are very rare and globally imperiled. Historically, all three of these communities were tied together by fluctuating water levels of Lake St. Clair, which altered the size and boundaries of these systems both seasonally and annually. Great Lakes marsh communities are productive natural systems in the temperate zone, and provide important habitat for a wide diversity of animal species including waterfowl, shorebirds, songbirds, turtles, crayfish, snakes, frogs, insects, fish, and small mammals. This area is home to the federally-threatened eastern prairie fringed orchid (*Platanthera leucophaea*). Lakeplain prairie communities are threatened from habitat destruction, local changes in hydrology from drainage and ditching, shrub and tree encroachment, influxes of polluted water, fire suppression, and invasive species.

2006: Several miles of prescribed burn trails were mowed and scraped; 20 acres of woody/invasive plants were treated with herbicides; prescribed burn was completed on 200 acres of Great Lakes Marsh habitat [SEM-24]. Saint Clair Flats Wildlife Area – 200 acres of *Phragmites* control using contracted helicopter spraying of several large blocks ; this site will be monitored in subsequent years and retreated as necessary. [SEM-23]

2007: Several miles of prescribed burn trails were maintained; 20 acres were mowed and treated for exotic invasive plant species by contractor; prescribed fire conducted on a 30-acre prairie restoration [SEM-23]; 200 acres treated for *phragmites* by contracted helicopter. [SEM-22]

2008: 200 acres chemically treated for *phragmites* using contracted helicopter; 80+ acres of invasive species control. [SEM-24]

2009: 300 acres of *phragmites* treated using contracted helicopter [SEM-24]; maintained several miles of burn trails; mowed and applied herbicide to 20 acres; conducted a prescribed burn. [SEM-25]

Project Summaries – Habitat Management

2010: Over 200 acres of common reed grass and *phragmites* were treated within the SCFWA by a contracted helicopter. *Phragmites* control work was initiated on the newly acquired 445 Acre parcel that is now a part of the St. Johns Marsh Wildlife Area [SEM-24]. Maintained several miles of prescribed burn trails; mowed and treated with herbicide 20 acres of undesirable vegetation; conducted control burns on 80+ acres and replanted and maintained 25 acres of prairie; selective harvest of undesirable tree species throughout the area; most of this work was completed by the local prison crew, with some items completed by contractors, volunteers, and Department personnel. [SEM-25]

Sterling State Park

2006: 348 acres of *phragmites* control by contractor (follow-up from previous years); 12 acres of herbaceous and woody invasive species control by volunteers & state worker 4s; 22 acres planted with 10,130 plugs; 33 hours of native seed collection; 1 mile of prescribed fire break preparation.

2007: 200 acres of *phragmites* control (follow-up from previous years); 30 acres of various herbaceous plant control; 27 acres of woody invasive plant control; 1 mile of prescribed fire break preparation; 110 hours of native seed collection; 37 acres of site prep; 16 acres planted with 14,000 grass, sedge, rush and wildflower plugs.

2008: 348 acres of *phragmites* control; 1 mile of prescribed fire break preparation; 151 hours of native seed collection; 138 acres of site preparation; 6 acres planted; 217 acres of prescribed fire.

2009: 697 acres of invasive species control, including: foliar sprayed and aerial sprayed *phragmites* and loosestrife by contractor; foliar sprayed reed canary grass and other invasive herbaceous plants; cut and stump treated woody invasive plants; released 600 *Galerucella* beetles for purple loosestrife control; 75 acres of grassland restoration and maintenance, including: two prescribed burns, planted native grasses and forbs, sprayed and mowed planted areas, collected native seed for 26 hours, one mile of prescribed fire break was prepared.

2010: 143 acres of invasive species control, including: pulling 7 bags of garlic mustard, stump-treating woody plants, and completed 1 prescribed burn. Grassland restoration and maintenance efforts on 36 acres, including: preparing site to be planted, planting native plugs, mowing planted area, collected native seed for 110 hours, prepared 5.5 miles of prescribed burn lines, and completed 2 prescribed burns.

Waterloo Recreation Area

2006: 10 acres of *phragmites* control by contractors (bog & Glenn fen); 2.3 acres of invasive brush control by volunteers; 8 acres of garlic mustard control by volunteers; 1 acre of site preparation and planting with 3,192 plugs; 63 hours of native seed collection; 1 mile of prescribed fire break preparation.

2007: 3.25 acres of invasive shrub control; 2.25 acres of garlic mustard control; 15 acres of *phragmites* control; 25 hours of brush pile burning; *Galerucella* beetle release at 1 site for purple loosestrife control. One half mile of prescribed fire break preparation; 44 hours of native seed collection; 1 acre site prepped and planted with 1,140 warm season grass plugs.

2008: 8 acres of woody invasive species control; 7 acres of herbaceous invasive species control; 0.5 mile of prescribed fire break preparation; 99 hours of native seed collection; 4 acres of site preparation; 5 acres planted.

2009: 13 acres of invasive species control, including: stump treated woody invasive plants, pulled garlic mustard (more than 16 bags) and other herbaceous invasive plants, cut Japanese knotweed, foliar sprayed swallow-wort and Asian bittersweet. Two acres of grassland restoration and maintenance, including: planted plugs and broadcast seed; mowed, weeded, and maintained a portion of planted area; collected native seed for 87 hours; half a mile of prescribed fire break was prepared.

2010: 257 acres of invasive species control, including: pulling 62 bags of garlic mustard, prepared 0.5 miles of fire break, and completing 1 prescribed burn. Grassland restoration and maintenance efforts on 2 acres, including: planting native seeds and plugs, pulled weeds in planted areas, and collected native seed for 94 hours.

Southwest Michigan

2006: Oak savanna maintenance at Flat River, Portland, and Stanton SGAs – spotted knapweed, honeysuckle, autumn olive control on 150 acres that had been previously planted to native warm season grasses. [SCM-23]

2008 - Several miles of AuSable River treated by hand removal of purple loosestrife.

Allegan State Game Area

2006: Fennville Farm – non-native tree and shrub removal by contractor [SWM-22]. Winter mowing to remove woody encroachment of Karner blue butterfly occupied areas by contractors [SWM-23].

2006: Volunteers and private donations were used to rear and release purple loosestrife eating *Galerucella* beetles; work was conducted at an outdoor discovery center to educate children and adults of all ages about invasive species; during this initial demonstration project 47 plants were treated with 30 beetles. [SWM-27]

2007: Fennville Farm – 25 acres of invasive shrub was cleared by contractors and a cover crop was planted to benefit Henslow's sparrow, bobolinks, meadowlarks, and other species like deer and turkey. [SWM-05]

2010: The Fennville Farm Unit had 6 sites that woody encroachment and invasive species were removed and native type grasslands were established; this was achieved through contractors and a partnership with Pheasants Forever. [SWM-11]

2010: 3 sites were mowed in the winter to restore savanna habitat for the Karner blue butterfly; woody stems were cut and chemically treated; part of work was conducted by contractors. [SWM-01]

2010: 18.2 acres of warm season grasses were planted; 60 acres of grasslands on the Farm Unit were mowed and sprayed for invasive species and woody vegetation. Nearly 60 acres of ground were prepared for planting in FY2011 by tilling and planting rye. [SWM-10]

Augusta Creek Fish and Wildlife Area

Augusta Creek prairie restoration has been a multi-year project to ultimately restore 160 acres of contiguous native prairie at the Augusta Creek Fish and Wildlife Area. Since 2001, 140.2 acres of the planned 160 acres have been cleared of trees and brush and have either been planted with grasses and forbs or prepped for planting in subsequent years. Area sensitive grassland songbird species (e.g., Grasshopper Sparrow and Henslow's Sparrow) and upland game birds are expected to benefit from this management. In addition, the upland prairie restoration will help maintain the hydrological processes that are critical to the fens associated with Augusta Creek, which provide important habitat for massasauga rattlesnakes and the federally listed endangered Mitchell's satyr butterfly.

2006: Trees and shrubs were removed on 2 sites totaling 11.3 acres; three sites were seeded to warm season grasses totaling 27.4 acres and bringing the grand total to 93.4 acres; forb plugs were interplanted into established grass fields totaling 110 trays of mixed forbs (4200 individual plants); grass seed was purchased; 66 acres were mowed to control invasive species; 30.2 acres were fitted and planted to wheat in preparation for 2008 seeding; part of this work was conducted by contractors. [SWM-10]

2007: 21.5 acres of native forbs and 4 warm season grasses of local genotype were planted by contractors. [SWM-16]

Barry State Game Area

The Turner Creek fen complex within the Barry SGA is one of only 18 sites in Michigan where the federally endangered Mitchell's satyr is known to occur. The unique flora and structure of the prairie fen ecosystem were historically maintained by periodic fires and occasional flooding; however, these natural processes have been disrupted and the Turner Creek fen complex has been steadily shrinking and deteriorating due to succession and encroachment of woody

vegetation. Michigan Natural Features Inventory (MNFI) staff have prepared a Mitchell's satyr site conservation plan for the Turner Creek wetlands which details specific tasks and locations where management is needed to protect and enhance the Mitchell's satyr population.

2006: Control of invasive plant species within a Wolverine Power right-of-way for the state-endangered three-staff underwing moth and its host plant the native leadplant. This work is part of a partnership with the National Wild Turkey Federation (NWTF) Energy for Wildlife program and includes assistance from Wolverine Electric Company, MNFI, local NWTF chapter (Thornapple Valley) and the Department's Wildlife Division. Work included cutting, chipping and stump treatment of encroaching invasive brush. These release cuts were scheduled for the dormant period of January to March to optimize site conditions for leadplant. Wolverine Electric Company donated their herbicide contractor to selectively hand spray invasive trees/shrubs within the right of way corridor during the dormant period of leadplant growth. Additional labor was donated by local NWTF chapter. 120 leadplant plugs were grown by a local high school student for a horticulture project and were planted in the right of way under transmission lines. Evaluation of herbicide treatment is ongoing and will continue to be periodically monitored. Preliminary monitoring results and meeting with Wolverine Electric personnel and their contractor resulted in modified application procedures, rates, and herbicides to be used in future treatments. Some collateral damage occurred to a few leadplants, but they were replaced with stock grown from local seed. This project is ongoing with more areas planned for future years to enhance this plant community. [SWM-16]

2006: 9 acres of the Turner Creek Fen complex was removed of trees and invasive shrubs including autumn olive, tartarian honeysuckle, and glossy buckthorn by contractors; a total of 20 acres of tree and shrub removal is planned over several funding cycles. [SWM-17]

2006: 7 sites and an additional 20 acres were controlled for non-native trees and shrubs (autumn olive, multiflora rose, and tartarian honeysuckle) by contract. [SWM-18]

2007: Partnered with Wolverine Electric Co., NWTF Energy for Wildlife program, MNFI, NWTF Thornapple Valley Chapter for invasive plant removal to benefit the 3-staff underwing and its host plant leadplant; 20 leadplants were planted on site to help fill a recently cleared area. [SWM-12]

2007: 11.5 acres of invading shrub and undesirable tree species were removed from the upslope side of the prairie fen in the savanna-fen complex by contractors. An additional 4 sites containing 39.3 acres were cleared in the oak savanna by contractors. [SWM-15]

Flat River State Game Area

2006: 37 acres of exotic plant species control and native warm season grasses and forbs were established to restore oak

Project Summaries – Habitat Management

savanna. Project is adjacent to an occupied Karner blue site and is designed to provide a link to over 200 acres of additional suitable habitat. [SCM-20]

2010: To enhance oak savanna barrens, invasive plant species such as spotted knapweed, autumn olive, and willow were treated with herbicides by contractor. [SCM-31]

Fort Custer Recreation Area

2006: 130 acres of stump grinding, slash & debris removal/cleanup; planted a one-acre Indian grass propagation plot using 9,120 plugs; 40 hours of rare turtle and snake monitoring; 5 miles of prescribed fire break preparation; 186 acres surveyed and 40 acres of buckthorn control by contract.

2007: 107 acres of slash & debris removal/cleanup (including 144 hours of slash pile burning of 18 piles); 85 acres of site prep and maintenance; 76.5 acres planted with warm season grass seed and 8,800 plugs; 395 hours of native seed collection; 7 miles of prescribed fire break preparation.

2008: 0.25 acre of herbaceous invasive species control; 727 hours of slash removal and brush pile construction and burning; 805 acres of prescribed fire; 5 miles of prescribed fire break preparation; 540 hours of site preparation and maintenance, including 293 acres of soil treatment; 50 acres planted; 584 hours of native seed collection; 2 miles of prescribed fire break preparation; 370 acres of prescribed fire; 2 acres of invasive herbaceous plant control.

2009: 26 acres of invasive species control, including: stump treating invasive woody plants by contractor; cleared invasive trees and ground stumps by contractor; 162 acres of grassland restoration or maintenance was completed, including: six prescribed burns, planting plugs in 74 acres, mowing, foliar sprayed, and boom sprayed areas to help planting establishment in prairies and propagation fields, collected seed for 294 hours, and two miles of prescribed fire break were prepared.

2010: 509 acres of invasive species control including: herbicide treatment of Japanese knotweed, stump-treating invasive shrubs; and completed 3 prescribed burns. Grassland restoration and maintenance efforts on 91 acres, including: planting native plugs, pulling and mowing weeds in planted areas, collecting native seed for 260 hours, and completed 3 prescribed burns.

Gourdneck State Game Area

2006: Brush and exotic/invasive woody species, including autumn olive, were removed for oak savanna restoration by contractor. [SWM-03]

2010 - Contractors removed several large piles of woody debris to another, more suitable, location on the state game area; these piles are from a previous project to remove

invasive species and are all invasive plant debris that needed to be burned; prairie seed was purchased. [SWM-12]

Grand Mere State Park

2006: Planted 5 acres of upland with 3,420 plugs; 21 hours of seed collection; control of garlic mustard, *phragmites*, and other woody and herbaceous invasive plant species within 315 acres of woods and wetlands.

2007: 13 acres of herbaceous and wood invasive plants control; planted 15 acres of wetland and upland with 3,000 plugs.

2008: 4 acres of garlic mustard control; 6 acres of woody invasive plants control by contractor; 13 acres of *phragmites* control.

2009: 40 acres of invasive species control, including: stump-treated and foliar sprayed Asian bittersweet and pulled and foliar sprayed garlic mustard by contractors.

Hoffmaster State Park

2010: 99.9 acres of invasive species control including: hand pulling and spraying of garlic mustard.

Saugatuck Dunes State Park

2008: 3 acres of pine removed.

2009: 6 acres of invasive species control, including: cut and removed Austrian pine from open dunes; pulled more than 25 bags and foliar sprayed garlic mustard by contractor and volunteers.

2010: 42 acres of invasive species control, including: hand pulling 17 bags of garlic mustard using volunteers and contractors.

Stanton State Game Area

2006: 50 acres of autumn olive were cleared with a hydroaxe and the remaining stumps were treated with Roundup by contract; this was the first year of a 6-10 year project to establish a complex of permanent grasslands, annual food plots, and scattered forest stands; this project is being conducted in conjunction with the Montcalm Chapter of Pheasants Forever. [SCM-21]

Yankee Springs Recreation Area

2006: 3 miles of prescribed fire break preparation.

2008: 20 acres of prescribed fire; 60 acres of prescribed fire; 1.3 miles of prescribed fire break preparation.

2010: 159 acres of invasive species control through 2 prescribed burns.

Project Summaries – Habitat Management

Warren Dunes State Park

2006: 21 hours of native seed collected.

2008: 10 acres of garlic mustard control and 6 acres of bittersweet control.

2009: 18 acres of invasive species control, including: pulled and foliar sprayed garlic mustard; cut and stump treated tree-of-heaven, black locust, and Lombardy poplar; pulled spotted knapweed; cut and stump treated Japanese knotweed.

Warren Woods State Park

2008: 8 acres of garlic mustard control.

2009: 10 acres were pulled and sprayed for garlic mustard by contractor.

Northern Lower Peninsula

2007: All 27.2 acres of the *pragmites* occurrences (each less than 2 acres) on Beaver Island were treated. This early intervention project was designed to eradicate *phragmites* before it could spread and gain a firm foothold on Beaver Island. This is a cooperative effort between the townships of Peane and St. James along with the Beaver Island Property Owners Association (they contributed funding and volunteer labor). Survey of High and Hog Islands and no infestations were found. The success of this project was due largely to an aggressive and comprehensive outreach campaign by Peane Township with assistance from the Department, Michigan Department of Environmental Quality (DEQ), Ducks Unlimited, The Nature Conservancy, University of Michigan and other organizations and volunteers. A video on *phragmites* was produced by Peane Township and is available online at: <http://www.agreatlakesjewel.org>. [NEM-14]

Cheboygan State Park

2010: 168.5 acres of invasive species control including: hand pulling and herbicide of sweet clover, spotted knapweed, and reed canary grass by contractor.

Great Lakes Islands

2008: Beaver, High, and Garden Islands - continuation of *phragmites* surveys along shorelines and treated 10 acres.

Negwegen State Park

2008: 17 acres of *phragmites* control.

2009: 17 acres sprayed for *phragmites* and reed canary grass by contractor.

Manistee River State Game Area

2008: 19 acres were treated for *phragmites* in the Manistee Marsh by contractor; treatment showed greater than 85% die off. [SWM-05]

Tawas Point State Park

2009: 146 acres of *phragmites* and purple loosestrife control by contractor.

Wilderness State Park

2006: 34 acres of invasive herbaceous species control along the shoreline.

Upper Peninsula

Glossy buckthorn control in Schoolcraft County is a cooperative project with the U.S. Fish and Wildlife Service (USFWS) Seney National Wildlife Refuge (SNWR) that started in summer 2003. The US FWS and the Department are working on state lands adjacent to the refuge cutting and treating glossy buckthorn with herbicides. Refuge personnel monitored results of control efforts. Removal of scotch pine has also been removed to prevent further dispersal and replacement of native pines in the East Upper Peninsula. Removal of Scotch pine has been done using prison crews to reduce costs. Garlic mustard management is also ongoing at the Cut River Bridge and is primarily being done through the Michigan Department of Transportation (MDOT) with some assistance from the Department's Forest Resources Division (FRD).

2007: 88 acres were treated using hand pulling, applying herbicide, and mowing; this effort was part of a cooperative project with Seney NWR; 30 acres of glossy buckthorn was treated on state lands adjacent to the refuge; 15 acres in Delta County were treated to eliminate autumn olive and Russian crab; prison crews were contracted. [EUP-01]

2006: 10 acres of buckthorn control in association with the Seney National Wildlife Refuge; 354 acres of Scotch pine and exotic shrubs eliminated in the Shingleton Forest Management Unit, prison crews were contracted. [EUP-01]

Porcupine Mountains Wilderness State Park

2010: 76.3 acres of invasive species control, including: mapping, hand pulling, and spraying garlic mustard.

Native Grassland Restoration and Management

Michigan Department of Natural Resources – Wildlife Division and Parks and Recreation Division

An estimated 2.3 million acres of grasslands were present before European settlement. These grassland ecosystems included several plant communities such as wet prairies, tall grass prairies, pine barrens, oak barrens, and oak savanna. The majority of large contiguous acreage of grasslands occurred primarily in the glacial interlobate regions of southern Michigan. Approximately 99% of these original grasslands have been lost or relegated to small remnant patches due to agriculture, urban sprawl, fire suppression, and forest succession.

The significant loss of contiguous habitat has impacted many grassland interior species. Notably, populations of Henslow Sparrow (*Ammodramus henslowii*), Savannah Sparrow (*Passerculus sandwichensis*), Grasshopper Sparrow (*Ammodramus savannarum*), Upland Sandpiper (*Bartramia longicauda*), Bobolink (*Dilichonyx oryzivorus*), and Short-eared Owl (*Asio flammeus*) have shown drastic declines. Plants such as prairie smoke (*Geum triflorum*), prairie Indian plantain (*Cacalia plantaginea*), prairie dropseed (*Sporobolus heterolepis*), and eastern prairie-fringed orchid (*Platanthera leucophaea*) depend on grassland communities and have become rare. Other species that depend on grasslands for a portion of their life history are also affected including Eastern

Fox Snake (*Pantherophis gloydi*), Prairie Warbler (*Dendroica discolor*), Eastern Wild Turkey (*Meleagris gallopavo*), Ring-necked Pheasant (*Phasianus colchicus*) and Bobwhite Quail (*Colinus virginianus*).

The loss of grassland communities and the resultant impact on ecosystems has been severe. Remaining grasslands are relegated to small remnant patches where their continued existence is threatened by lack of management and restoration of natural processes. The restoration of large contiguous grasslands is necessary to restore and maintain grassland species in Michigan. Grassland restoration is also necessary to restore proper community composition to interlobate ecosystems primarily in southern Michigan.

For more information on where native grassland management has occurred see the On-the-Ground Habitat Restoration and Management section in this report.

Location: Lower Peninsula
Year(s): 2005-2010

Local Genotype Collection and Propagation

Department of Natural Resources – Wildlife Division and Parks and Recreation Division

A propagation program was needed to provide the native seed source for grassland restorations. In addition, the collection and propagation of local genotypes will help ensure a bank of native biodiversity exists to mitigate the further loss of remnant grassland patches.

Local genotype grassland seeds from remnant stands and developed propagation fields at the Rose Lake State Wildlife Research Area and selected recreation areas have been used for a number of grassland restoration projects. Seed has also been collected from successful restoration projects. With the addition of specialized collecting and cleaning equipment, the Department has been able to collect, clean, and provide much more seed to restoration projects than originally planned.

Accomplishments:
2006: 1,289 lbs of seed collected and propagated
2007: 1,775 lbs of seed collected and propagated
2008: 751 lbs of seed collected and propagated
2009: 1,167 lbs of seed collected and propagated
2010: 500 lbs of seed collected and propagated

Location: Lower Peninsula
Year(s): 2005-2010



Jack Pine Barrens Management and Kirtland's Warbler Recovery

Michigan Department of Natural Resources – Wildlife Division

The jack pine barrens ecosystem in Michigan is a uniquely adapted system that developed on the dry sand outwash glacial plains and historically relied on periodic wildfire for regeneration. Fire suppression in modern times has interrupted the disturbance regime of the jack pine forest and eliminated the maintenance of much of the early successional stage on the landscape. Consequently, those species dependent on young jack pine stands also declined. Most notable of these declines is the Kirtland's Warbler, but other species such as the Upland Sandpiper (*Bartramia longicauda*) and Black-Backed Woodpecker (*Picoides arcticus*), which depend on the standing dead pine left after burns, also declined. These areas also provide key habitats for the Eastern Bluebird (*Sialia sialis*), white tailed deer (*Odocoileus virginianus*), black bear (*Ursus americanus*), and snowshoe hare (*Lepus americanus*).

The Kirtland's Warbler is the rarest warbler in North America and is federally listed as endangered. This songbird is dependent on dense, young jack pine habitat for breeding. This habitat type was historically created and maintained by periodic wildfires. Prescribed fires need to be used to mimic this ecological process. Development in the area, however, limits the extent that prescribed fires can be used. Therefore, other mechanical techniques will have to be developed and used to recreate the necessary disturbance regime of the jack pine ecosystem. In the absence of fire, seeding and planting activities must occur to generate new stands of jack pines.

The management of the jack pine barrens ecosystem and the Kirtland's Warbler is a controversial issue. Jack pine management in itself requires the use of techniques, such as clear cutting and prescribed fires, which are not well supported or understood by the public. These techniques, however, are critical to jack pine and Kirtland's Warbler management. The size of clear cuts needed to optimize nesting is beyond what is normally tolerated by the public. Additionally, jack pines are not traditionally attractive trees and their importance within their ecosystem is not well understood by the public. Yet by managing jack pine stands on a 50-year harvest rotation, nesting habitat can be maintained for the warblers while supporting the commercial harvest of jack pine.

The management of jack pine ecosystems is still somewhat experimental; therefore, techniques used must be evaluated to ensure they are having the desired effect. The results of monitoring and evaluation need to be incorporated into a planning system to make sure management is suitably adapted to changing information. To fulfill the recovery needs of the Kirtland's Warbler, surveys and population assessments are



needed. This information will be used to modify recovery planning as necessary.

The goal of this project is to reestablish the disturbance regime necessary to provide a sufficient amount of early successional jack pine forest necessary to maintain dependant species and aid in the recovery of the Kirtland's Warbler.

Accomplishments:

2006: 2,070 acres of jack pine regeneration, acres surveyed, and Kirtland's Warbler habitat management; 1 Kirtland's Warbler survey; 1 jack pine barrens plan; 6 meetings for Kirtland's Warbler recovery planning.

2007: 9,774 acres of jack pine regenerated; 1,000 acres surveyed and recommendations made.

2008: 3,400 acres regenerated of jack pine; 3,400 acres surveyed; 7 recommendations for jack pine management made.

2009: 2,734 acres of jack pine regenerated, and 37,211 acres surveyed.

2010: 14,023 acres of jack pine regenerated, and 9,200 acres surveyed.

Location: Northern Lower Peninsula

Year(s): 2006-2010

Partners: Michigan Department of Natural Resources – Forest Resources Division, Forest Industry

Wetlands Restoration, Enhancement, and Management

Department of Natural Resources – Wildlife Division

Coastal wetlands

Statewide, approximately half of the coastal wetlands present before European settlement have been lost; many of those that remain have been severely degraded. Coastal wetlands have been impacted primarily by urban and agricultural development. Impacts include: armoring of shoreline and dredging channels that eliminate wetland habitat; water quality issues; shipping traffic and the associated wave action that erodes the shoreline; marina development and beach grooming to remove aquatic vegetation whose roots stabilize bottom sediments; increases in turbidity due to erosion and sedimentation; nutrient loading reduces oxygen levels and prompts harmful algal blooms; and the introduction of exotic invasive plants and animals.

Coastal wetlands are often critical foraging habitats for migrating wading and shorebirds. The severe loss of mud flat feeding habitat along the western shore of Lake Erie, Lake St. Clair, and the southeast shore of Lake Huron from Detroit north to Saginaw Bay has been devastating for these birds. The majority of coastal wetlands in these areas have been impacted or lost due to shoreline development, dredging and filling activities to provide shipping routes to inland rivers, and pollution. The habitat loss and degradation has been extensive enough to act as a barrier to migrating birds in this area. Exposed mud flats with suitable invertebrate food are needed in this area to help restore this migration corridor.

To mitigate these impacts and prevent further decline of many sensitive species, existing coastal wetlands need to be managed and enhanced while lost wetlands need to be restored. This project supported restoring and managing wetlands including surrounding buffer and filter strips. This project also provided for short-term water level manipulations to provide mudflat foraging habitat for migrating wading and shorebirds.

Accomplishments:

2007: 200 acres maintained primarily in the Saginaw Bay Management Unit.

2008: 80 acres maintained – prescribed burn trails, remove 20 acres of undesirable vegetation, control burn 80+ acres, replant and maintain 25 acres of lakeplain prairies and selective harvest of undesirable tree species. [SEM-25]

Inland wetlands

As a group, inland wetlands provide habitat for the greatest diversity of species in Michigan. Wetland habitats, however, have been severely impacted, particularly in southern Michigan. Following the national trend, a large portion of wetlands in Michigan that were present before European settlement have been lost. Virtually all remaining wetlands have suffered some degree of degradation. Impacts to water quality from development and agriculture, loss of buffer and filter areas, altered hydrology from ditching and draining, introduction of invasive exotic species and interrupted successional patterns have all affected Michigan's wetlands. As a general rule, degradation is most severe in the Southern Lower Peninsula with less impacts moving north. Some wetlands in the Upper Peninsula remain nearly pristine, although no wetlands have been unaffected.

Some of Michigan's rarest species are wetland obligates. The federal candidate species, eastern massasauga rattlesnake, depends on wetlands for hibernacula and spring and fall foraging habitat. The federally-listed endangered Mitchell's satyr butterfly depends on prairie fens for all portions of its life cycle. A number of freshwater mussels have been severely impacted at least partially from declining water quality and increased turbidity resulting from a decreased filtering capacity of wetlands in riparian areas.

This project supported restoration and management activities that may have included: breaking drainage tiles; plugging ditches; installing water control structures; mechanical or chemical techniques to control undesired vegetation; prescribed fire; plantings of seedlings and plugs; planting of buffer and filter strips to assist in ground water infiltration and to reduce runoff.

Accomplishments:

2006/2007: 6 acres restored; 5.7 acres of fen management at Turner Creek Fen for Mitchell's satyr butterfly and eastern massasauga rattlesnakes [SWM-19].

2008: 4 acres restored

Location: Statewide

Year(s): 2007-2008

Partners: Ducks Unlimited

Conservation Tools – Project Summaries



The Natural Heritage Database

Michigan Natural Features Inventory

The Natural Heritage Database (NHD) is a comprehensive resource that documents significant natural features within the state. The NHD houses information on species that are threatened or endangered in Michigan, as well as other rare species and high-quality examples of natural communities. The NHD is absolutely unique in this regard; it is the only comprehensive source of known information on the location of protected and other rare species in the state of Michigan. The NHD provides many agencies and organizations with critical information related to distribution, abundance, and population status of threatened and endangered species and the factors that threaten these species' viability.

The database is a compilation of information from a broad range of sources including museum and herbarium collection records, publications, knowledgeable experts, and field work. The database is continuously updated and improved as new data become available. The database tracks 304 animals, 400 plants, and 76 natural communities that are exemplary, rare, or imperiled at the state or global level. It contains more than 15,772 records of locations for rare plants, animals, and natural communities as of the end of 2010; more are added all the time.

The Department makes extensive use of the NHD to help ensure the activities necessary for the management of public trust resources do not have adverse impacts on threatened and endangered species. The NHD is critical during environmental crises such as oil spills and dam failures. The data are used in the state's Geographic Decision Support Environment (GDSE) and subsequently accessed via the Integrated Forest Monitoring, Assessment, and Prescription (IFMAP) system.

The information is used by a variety of state agencies for environmental reviews, endangered species reviews, natural resource planning, and transportation planning. The departments of Environmental Quality and Transportation rely on this data for permitting and planning. The NHD data are also used in the Department's Endangered Species Assessment web tool. Text-based information on species and natural communities is available to land management agencies and private entities through the on-line web database hosted by



Michigan Natural Features Inventory. Element occurrence information, species and occurrence ranks, directions to sites, survey dates, etc. are available for all of the elements and communities tracked in the MNFI database.

The NHD also has regional and national implications. The data in the NHD is aggregated at least annually to the NatureServe database, which is a national-level database on species and natural communities. This database in turn is used by federal agencies to conduct "multi-jurisdictional" reviews and assessments of activities at the federal level. Similarly, individual groups may cooperate on a regional basis to address natural resource issues and use the NatureServe database. It also provides information for NatureServe's public information web resource.

The maintenance of this database is critical to ensure management and land use planning and decisions have the best available information in Michigan.

Location: Statewide

Year(s): 2005-2010

Partners: Michigan Department of Natural Resources – Wildlife Division; agencies, universities, and individuals contribute to the data in the NHD; and the users of the information include state and federal agencies, Tribal agencies, consultants, industry, local governments, and individuals

Environmental Review

Lori Sargent

Michigan Department of Natural Resources – Wildlife Division

The Environmental Review process plays a key role in wildlife conservation, especially for threatened and endangered species. Environmental review evaluates the impact of proposed development or land management activities on federal and state endangered and threatened species, special concern species, high quality natural communities and other unique natural features. Over 2,000 permits are reviewed annually; about 25% of them have the potential to affect listed wildlife species and/or their associated habitats. If impacts to species are identified, the Department works closely with the permittees to either modify the planned project or mitigate the expected impacts. Additionally, this information is used by Department staff when developing strategic and operational plans for species and habitats. These reviews are based on the State's comprehensive Natural Heritage Database that is maintained by Michigan Natural Features Inventory (MNFI).

Environmental review requests also arrive through the Endangered Species Assessment (ESA) Tool web application (<http://www.mcgi.state.mi.us/esa/>). The environmental review

process helps the Department maintain compliance with Part 365, Endangered Species Protection, of the Natural Resources and Environmental Protection Act (Act 451 of the Michigan Public Acts of 1994).

Year	Number of Projects Reviewed	Number of New Permits Issued
2006	4,240	60
2007	3,202	44
2008	2,576	50
2009	2,250	37
2010	2,303	39

Location: Statewide

Year(s): 2006-2010

Partners: Michigan Department of Environmental Quality, Michigan Natural Features Inventory

Endangered Species Assessment Tool

Michigan Department of Natural Resources – Wildlife Division

The Endangered Species Assessment (ESA) Tool was created in partnership between the Departments of Information Technology (Center for Geographic Information) and Natural Resources, and Michigan Natural Features Inventory. The ESA web application was released in October 2004 and was designed to provide Internet users with a preliminary evaluation of whether rare species or unique natural features have been known to occur near a designated site of interest. The evaluation is a presence/absence based response only. Users of the ESA tool had the opportunity to request a formal response from the Department through the website if desired. The response will either indicate that “no unique natural features are known to occur at or near your site of interest” thereby providing authorization for the project to proceed without any further rare species concerns from the Department, or the response will indicate “there is potential for rare species or unique natural features to occur at or near the site of interest” and the project will be automatically submitted for further environmental review evaluation. Users of this application include state and federal agencies, local governments, engineering firms, Tribes, universities, utility companies, land trusts, and private landowners.

This site provides a simplified and efficient assessment of rare species and other unique natural features to help users make better informed decisions.

To view the tool, go to: <http://www.mcgi.state.mi.us/esa/>

Year(s): 2007

Partners: Michigan Department of Environmental Quality – Coastal Management Program, National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, Michigan Natural Features Inventory, Michigan Department of Information Technology

Threatened and Endangered Species List Review

Michigan Department of Natural Resources

In 2005, the state Threatened and Endangered Species list was due for a full review. Technical advisory committees were convened for each taxa group to review the list and make recommendations of additions or removals. These technical advisory committees were made up of taxa experts from across the state. Their recommendations were provided to the Department to update the state list.

Location: Statewide

Year(s): 2005

Partners: Michigan Natural Features Inventory, universities, and other partners with expertise in species



Biological Rarity Index and Probability Mapping Tool

Michigan Natural Features Inventory

This tool provides Geographic Information System (GIS) coverages by county of areas predicted to be of importance to maintaining rare biodiversity. Two models are used, a probability model and a biological rarity index model. Both models are based on the state heritage database of known sightings of threatened, endangered, or special concern species and high quality natural communities. The model values are reported on a 40 acre polygon grid for the state of Michigan, or a subset of MI and show potentially important areas to Michigan's rare biodiversity.

To view the tool, go to:

<http://web4.msue.msu.edu/mnfi/data/rarityindex.cfm>

Year(s): 2007

Partners: Michigan Department of Natural Resources – Wildlife Division, U.S. Fish and Wildlife Service, Michigan Department of Environmental Quality – Coastal Management Program, National Oceanic and Atmospheric Administration

A screenshot of the "Biological Rarity Index and Probability Mapping Tool" website. The header features the Michigan Natural Features Inventory logo, navigation links for About MNFI, Contact Us, Services, Data Resources, Publications and Reports, Education, Invasive Species, and Links, and the Michigan State University Extension logo. Below the header is a section titled "Biological Rarity Index and Probability Value - 40 Acre Grid" with a dropdown menu for choosing a county. A "Description" section explains the two models (probability and biological rarity index) and their data source. To the right is a map showing red polygons representing the 40-acre grids. Below the map are sections for "View Metadata" and "File Format". At the bottom, there is a note about funding and logos for DEQ and NOAA.

Protecting High Quality Riparian Corridors through the Natural Rivers Program

Steve Sutton

Michigan Department of Natural Resources – Fisheries Division

Natural riparian areas provide valuable wildlife habitat, as well as important water quality benefits such as nutrient uptake, bank stabilization, and erosion control (Karr and Schlosser 1978, Osborne and Kovacic 1993). Natural riparian areas help protect fish spawning beds, instream habitat, protect water quality, and moderate temperature changes, all of which helps maintain productive, self-sustaining aquatic communities (Gregory et al. 1991). Riparian areas also provide critical habitat for many wildlife species and are important corridors for wildlife movements (Goforth et al. 2002).

Since 1970, 2,091 miles on sixteen rivers or segments of rivers have been designated into Michigan's Natural River System. The Natural Rivers program helps to engage local land owners, local conservation interests and local zoning authorities in preserving the natural aspects of riparian property that contribute to both high quality habitat and high quality aesthetic and recreational appeal. The designation process begins by development of a comprehensive river management plan written by an advisory group. Advisory groups include essentially any group, agency, unit of government, property owner, or citizen with an interest in the process and in protecting the river system. By working cooperatively with communities within the designated Natural River corridor through education and outreach to property owners, zoning and planning boards, the riparian zone of designated natural rivers are preserved, enhanced and restored, providing valuable, contiguous fisheries and wildlife habitat. Major objectives for this program are:

1. Review permits and monitor compliance to ensure that buildings and other modifications within the designated Natural River corridors are consistent with existing Natural River management plans, administrative rules, and Department best management practices.
2. Provide guidance to land owners, participate in local zoning Boards, and assist in the development and review of proposed zoning ordinances that help implement riparian area protections in designated Natural River districts.
3. Review and update management plans and administrative rules as appropriate.

Accomplishments

2005-2007: Took action on 361 permit applications and completed 7 contested case hearing files regarding matters of non-compliance.

2007-2009: Took action on 459 permit applications and completed 11 contested case hearing files regarding matters of non-compliance or dispute resolution.

2010: Took action on 140 permit applications; organized and participated in 14 local zoning review board meetings to take public comment.

A single set of administrative rules was drafted to minimize inconsistencies between rivers and administration of the program statewide. A completely revised set of electronic Natural River zoning maps has also been developed to accompany the rules revision and is posted on the program web site for public use.

Staff review and comment on Department of Environmental Quality permit applications that affect fish and wildlife habitat along designated rivers. Program staff continue to work with private landowners and the 172 county and township governments affected by Natural River zoning to insure consistent state-wide administration of the program.

Completed research regarding the effectiveness of the Natural River designation at protecting the resource values within a natural river system (Sutton 2009). This research will help establish the effectiveness of Natural River designation over time based on the natural resource values as found within the Natural River Act. This information will provide the metrics for identifying program success and where changes may be made to increase program effectiveness over time.

Completed protocol for field surveys of stream morphology at gaging stations in Michigan. Now available on the Michigan Stream Team website: www.michigan.gov/deq - follow the links for Water/water management to the Michigan Stream Team page.

Partnered with U.S. Geological Survey and Calhoun County Conservation District to develop regional reference curves.

Restoration plans were developed and approved for re-creating wetlands in the Kalamazoo River corridor following dam removal in 2008. Monitoring started in 2005.

Developed an assessment tool and database of state owned dams for prioritizing dam management actions (removal or repair).

Location: Statewide
Year(s): 2005-2010

Partners: Michigan Department of Environmental Quality, U.S. Geological Survey, Calhoun County Conservation District, local planning groups

The Digital Water Atlas and Conservation Planning Guide for Michigan's Inland Waters

Dr. James Breck and Lidia Szabo Kraft

Michigan Department of Natural Resources – Fisheries Division

The Digital Water Atlas is a Geographic Information System (GIS) project aimed at compiling, integrating, and delivering spatial and tabular data and assessment tools for Michigan's inland waters. The goal of this project is to assist resource management and conservation planning for aquatic habitats and species. This tool will be especially useful in developing management plans to implement the conservation strategies contained in Michigan's Wildlife Action Plan. Datasets will include map themes depicting hydrography and the spatial patterning of environmental, climatic, biological, and anthropogenic features, as well as integrated databases containing site measures of aquatic characteristics.

Accomplishments

Substantial work was done delineating lake catchment boundaries for all of Michigan's inland lakes, using the newly completed high-resolution (1:24,000) National Hydrography Dataset (NHD). In total, catchments for all 11,213 lakes and ponds greater than or equal to 5 acres were completed. Much of this work was done using a newly developed automated process.

Catchment boundaries were used to summarize landscape variables for direct, tributary, and buffer (100 m) catchments. 1,627 lakes were determined to be headwater lakes (where a lake starts the stream network, it may or may not be on the main network), 4,088 were inline lakes connected to the stream network (where at least one stream entered and exited the lake), and 5,498 were disconnected from the network. Each inline lake or pond that is connected to the stream network had a tributary catchment delineated.

For each direct, tributary, and buffer catchment the following datasets describing the landscapes' natural variation were summarized: acres, land cover (2001), bedrock geology, bedrock depth, quaternary geology, elevation, slope, soil permeability, Darcy value, growing-degree day, precipitation, mean July and annually temperatures, and minimum and maximum July temperatures. Datasets describing the variation in the landscape due to human influence were also summarized including: population density, percent impervious surface, number of pollution sites, nitrogen and phosphorus loading and yields, stewardship status, proportion of area treated with fertilizer, proportion of area treated with herbicide, proportion



of area treated with insecticide, proportion of area treated with manure, and proportion of area treated with manure from animal feeding operations.

Morphometric calculations, such as mean depth and volume, were completed for 1,007 lakes.

Two new river assessment tools were developed and two were updated. A Dam Removal Scenario Tool was developed, which is a GIS-based decision-support tool, in conjunction with the Great Lakes GIS project. A GIS-based protocol to capture biologists' professional judgments about fish spatial distributions in the river network was also developed and distributed. This information was only previously captured in river assessment reports as figures. This protocol will now save this information in a reusable and electronic format facilitating future work on species and population modeling in designated river systems.

To view available data layers, go to:
<http://ifrgis.svre.umich.edu/projects/DWA/dwa.shtml>

Location: Statewide
Year(s): 2005-2008

Partners: University of Michigan

Great Lakes Geographical Information System

*Christine Geddes, Dr. Ed Rutherford, Lidia Szabo Kraft, and Minako Kimura
Michigan Department of Natural Resources – Fisheries Division*

This project is designed to compile existing data and conduct analyses to develop planning tools for Great Lakes aquatic species of greatest conservation need and their habitats. The main objectives for this project include:

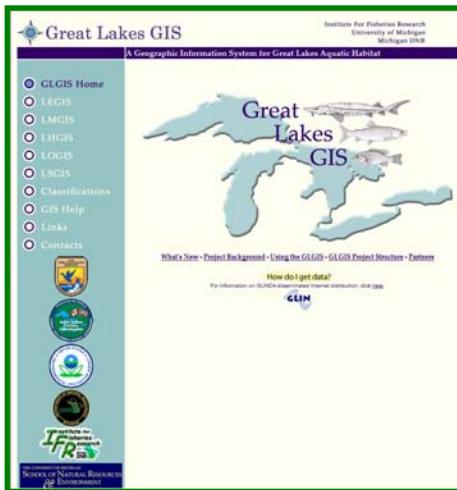
- Develop an ecological database on aquatic habitats in the Great Lakes;
- Create ecological classification of nearshore and offshore Great Lakes habitats in Lakes Huron, Superior, and Ontario;
- Determine suitable indices of relative habitat quality for sensitive life stages of priority non-game species;
- Develop GIS-based decision support projects to facilitate evaluation of potential impacts to non-game wildlife habitats;
- Develop and implement long-term, internet-based strategies for project maintenance and distribution.

Database accomplishments

Spatially explicit, ecological databases were maintained and upgraded for Lakes Michigan, Erie, Huron, and new ones acquired and spatially referenced for lakes Superior and Ontario. Datasets include base and political, biological, chemical, physical, and ecological classifications. The dams database was updated to include Erie and Superior Basins. Between 2007 and 2008, 986 new files were added to the central repository of Great Lakes data, of which a substantial number relate specifically to distributions of non-game species in and near Michigan waters. Species represented in these data sets from the U.S. Geological Survey long-term repositories, include rockbass, carp, quillback, freshwater drum, crappies, brown bullhead, goldfish, suckers, and burbot.

Classification accomplishments

Using physical habitat variables for open water habitats, ecoregions were defined for Lakes Michigan, Erie, and Huron using a two-step cluster algorithm. Habitat classifications were tested using biological data as well as statistical analyses. During 2007 and 2008, further refinements were made to the nearshore classifications for Lakes Michigan and Huron, specifically input data were expanded to improve the nearshore classifications. These areas were classified through a series of cluster analyses and tested by similar means as previous years. Two clusters of unique habitats were found in the nearshore areas of Lake Michigan, and six were found in the nearshore areas of Lake Huron.



Habitat suitability accomplishments

Habitat suitability indices were derived for nearshore areas of Lakes Michigan and Huron for 11 non-game species (emerald shiner, common shiner, trout-perch, three-spine stickleback, nine-spine stickleback, spottail shiner, Johnny darter, rockbass, longnose dace, golden shiner, and longnose sucker). Classification trees for six species were found to reasonably classify habitats.

Decision support accomplishments

Decision support projects were started. One project evaluated siting of wind farms in coastal waters. Another looked at dam removal scenarios. This project created a toolbar that can be added to the ArcMap workspace and users are able to address questions about actual and potential fish habitat (Kraft and Geddes 2006).

In 2007 and 2008, substantial progress was made on a GIS-based tool to support decisions related to lakebed alteration scenarios (e.g., dredging, windfarm development) in the Michigan waters of the Great Lakes. Users are able to map relevant data layers, define scenarios of lakebed alteration based on user-specified criteria, and map the scenario output to identify areas that are potentially suitable for alteration.

Maintenance and distribution accomplishments

Workshops and self-paced tutorials were developed to familiarize end-users with data in the Great Lakes GIS and uses for science inquiry and decision support. The Great Lakes GIS website was redesigned and made available to the public (www.glfrc.org/glis). During 2007-2008, over 78,476 unique visitors visited the Great Lakes GIS portal, and approximately 83 GB of data were downloaded.

An improved application is now available that allows users to download individual files via an Internet browser (www.gis.glin.net). This site allows users to preview data, metadata, and download ESRI shape files or files can be viewed via Google Earth.

Location: Statewide

Year(s): 2005-2008

Partners: Army Corps of Engineers, Fisheries Solutions, Great Lakes Fishery Commission, National Oceanic and Atmospheric Administration, Natural Resources Research Institute at the University of Minnesota Duluth, University of Michigan, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service

Invasive Species Field Guide to Michigan

Michigan Natural Features Inventory

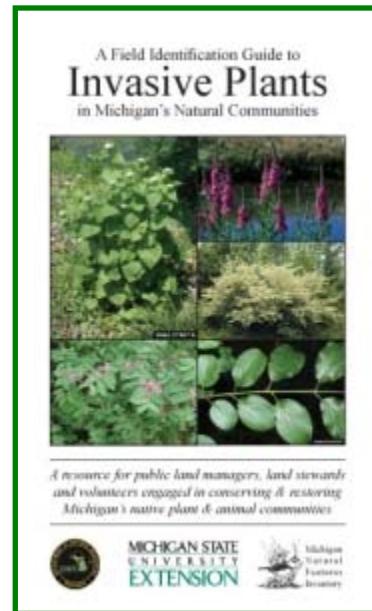
This field guide is intended to help reader's identify key invasive species early so that a rapid response can be initiated while successful treatment is still likely. This guide provides a concise overview of invasive plants including specific threats they pose, the importance of early detection, and the elements of a more comprehensive approach for addressing their impacts. It features 47 species, with detailed photos, plant descriptions, habitat preferences, modes of reproduction, and guidance for monitoring and rapid response. The helpful tips, comprehensive glossary, and distribution maps based upon documented herbarium records make this field guide truly unique.

For more information: <http://web4.msue.msu.edu/mnfi/invasive-species/index.cfm>

Location: statewide

Year(s): 2006-2007

Partners: Michigan Department of Natural Resources – Wildlife Division, U.S. Fish and Wildlife Service, University of Michigan, Michigan State University Extension



Development and Evaluation of a Citizen Conservationist Program in Southern Michigan

Dr. Shari Dann, Heather Van Den Berg

Michigan State University – Department of Community, Agriculture, Recreation, and Resource Studies

Citizen volunteers can provide support to wildlife conservation efforts by gathering information to aid with monitoring and management activities. Conservation education and outreach programs can inform and involve the public to raise awareness, improve knowledge, acquire attitudes and skills, and encourage participation to help achieve resource management goals. The goal of this project was to develop a program that encourages environmental stewardship through volunteer activism in wildlife-related activities.

Michigan State University Extension (MSUE) and the Department developed the Michigan Conservation Stewards Program (CSP) as its state Master Naturalist™ program. The partners' goals were to determine the educational needs of residents, test the pilot program, evaluate the initial effort and impacts, and make recommendations for a sustained effort.

The MSUE convened a Cooperators Leadership Team that consisted of the Department, Michigan Natural Features Inventory, other MSUE staff (state and local), and staff members from The Nature Conservancy and The Stewardship Network. This Leadership Team then drew together a stakeholder meeting involving more than 30 conservation and educational organization representatives and outlined an ecosystem-based curriculum. Feedback resulted in major modifications to the CSP objectives and content for the next phase of pilot testing the program. The CSP consists of 40 hours of instruction regarding ecosystems and resource management. In addition, it requires 40 hours of volunteer service annually.

Participant Characteristics

The CSP does attract a new Extension and nontraditional conservation-related audience. More than 75% had never taken part in Extension programs such as Master Gardener, Citizen Planner, Master Woodland Manager, or Lake and Stream Leader. About 62% are female (a higher proportion than in some traditional conservation organizations). More than 57% are residents of suburban or urban areas; and nearly half (48%) had grown up in such areas. In addition, only a small proportion of this group participates in the traditional outdoor recreation activities of hunting (15%) or fishing (28%) more than twice per year. Instead, this group has high levels of participation in the nontraditional active recreational activities of walking or hiking (90%), and in nature-related activities of wildlife viewing

(87%), bird feeding (67%), nature study (65%) or bird watching (57%). The CSP program participants were from middle- and high-income families, were well educated (with nearly all having some post-secondary education), and predominantly Caucasian. Future programs, however, will need to strive for greater participant diversity in income and ethnicity.

Impacts of the CSP

Attitudes toward specific conservation techniques and toward the state resource management agency became significantly more positive with participation in the CSP. After the program, respondents had significantly more positive attitudes toward hunting as a technique to manage wildlife populations, prescribed fire as a means of maintaining ecosystems, herbicide use for invasive plants, clearcutting as acceptable for grouse habitat management, management of watersheds for biodiversity and ecological integrity, and managing for both wildlife and timber in forest communities. The strongest gain in attitudes toward the Department are in participants' agreement with the statements that the agency provides high quality service to the public and provides adequate opportunities for public participation in natural resource decisions. Most CSP graduates were interested in contributing their volunteer time to complex, long-term, hands-on, in-field conservation projects, rather than administrative or outreach-related tasks. The CSP had a remarkably high level of participation, and a high retention rate from an audience which can be considered nontraditional from both the Department and MSUE perspectives.

This program will be a tremendous asset for Extension, which is seeking new audiences to diversify its reach and support base, and for wildlife agencies seeking committed, long-term volunteers who can contribute to conservation efforts.

Location: Statewide

Year(s): 2006-2008

Partners: Michigan State University Extension, Michigan Department of Natural Resources – Wildlife Division, Michigan Natural Features Inventory, The Nature Conservancy, The Stewardship Network, Oakland County Planning and Economic Development Services – Environmental Stewardship Program, Alliance for Natural Resource Outreach & Service Programs – National Master Naturalist Program

Natural Communities of Michigan: Classification and Description

*Michael Kost, Dr. Dennis Albert, Joshua Cohen, Bradford Slaughter, Rebecca Schillo, Christopher Weber, and Kim Chapman
Michigan Natural Features Inventory*

This natural community classification is designed to serve as a tool for those seeking to understand, describe, and document the diversity of natural communities in Michigan. A natural community is defined as an assemblage of interacting plants, animals, and other organisms that repeatedly occurs under similar environmental conditions across the landscape and is predominantly structured by natural processes rather than modern anthropogenic disturbances. Natural communities were classified based on a combination of data from state-wide and regional surveys, intensive sampling and data analysis, literature review, and expert assessment. Within this document are: a list of the 76 recognized natural communities (arranged both ecologically and alphabetically with associated global and state ranks), a dichotomous key to help users identify community types, and detailed descriptions of each natural community. The community descriptions provide information on landscape context, soils, natural processes, vegetation, rare species, biodiversity management considerations, and relevant literature.

Protecting and managing representative natural communities is critical to biodiversity conservation, since native organisms are best adapted to environmental and biotic forces with which they have survived and evolved over the millennia. Michigan Natural Features Inventory maintains a database of occurrences of exemplary natural communities, rare plants, and rare animals found in Michigan. These occurrences provide critical information for assessing the conservation status of each natural community and rare species. The natural community classification and database make it possible for exemplary occurrences of each community to be identified, documented, and described. Together, the classification and associated database of exemplary natural community occurrences serve as a powerful tool for setting conservation goals aimed at protecting, monitoring, and managing a network of lands that represent the broad range of native ecosystems known to occur in Michigan. This “coarse filter” approach provides a strategy for identifying the critical lands necessary for conserving the diversity of native plants and animals that represent Michigan’s natural heritage.

This classification is available through the Michigan Natural Features Inventory web site, where it is accompanied by photographs of the natural communities and links to related information.

The image shows two screenshots of the Michigan Natural Features Inventory (MNFI) website. The top screenshot displays the 'Key to Michigan's Natural Communities' page, featuring a dichotomous key with two options: A. Subterranean or sink feature located in areas of karst topography primarily along the Niagara Escarpment in the eastern Upper Peninsula and northeastern Lower Peninsula, and B. Terrestrial (upland) or palustrine (wetland) community or a relatively equal mixture of both. The bottom screenshot shows the detailed profile for the 'Bog' community, including sections for Overview, Landscape Context, Soils, and Natural Processes, along with a photograph of a bog landscape.

To view the classification, go to:

<http://web4.msue.msu.edu/mnfi/communities/index.cfm>

Location: Statewide

Year(s): 2006-2007

Partners: Michigan Department of Natural Resources – Wildlife Division

Integration of Natural Resources Data in Local Land Use Planning

Jennifer Olson, John Paskus
Michigan Natural Features Inventory

Michigan is a “home rule” state, where local governments create regulations and make decisions that affect residents at the local level. The roles and responsibilities of land use planning and zoning in Michigan are numerous, complex, and at times, overlapping. Regional planning commissions bring county and township governments together to identify, administer and provide information, programs, and planning at a more economical and effective scale. Local land use decision making is a difficult balancing act between public versus private interests and frequently competing social, economic and environmental objectives. In 1992, the Michigan Environmental Science Board identified the lack of land use planning in consideration of natural resources and ecosystem integrity as one of the greatest risks to the state’s environment. Land use directly affects water quality, natural habitats, biodiversity, public health, ecological services, socio-economic conditions and community character.

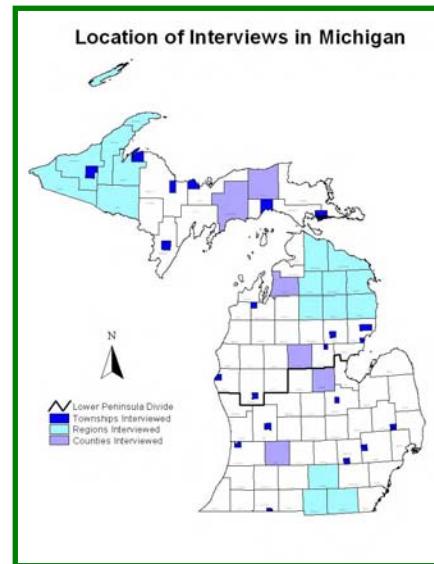
Based on land transformation models, if current development trends continue between 1980 and 2040, projections indicate that built areas of Michigan will increase by 178%. During the same time period agriculture, wetlands, forest and other vegetation are expected to decrease by 17%, 10%, 8%, and 24% respectively. The landscape fragmentation associated with a significant increase in the built environment will make resource production and resource conservation much more difficult.

This project assessed how or if natural resource objectives were addressed by local governments, where local governments were obtaining natural resource information, what challenges and barriers exist when trying to integrate natural resource information, what tools or services should be provided, and how natural resource information was being incorporated into local land use planning efforts. To assess these questions: 1) a survey was sent to all townships, counties and regional planning commissions (N = 1,339), and 2) 30 in-person interviews with local government officials were conducted.

Results

The survey had a 70% response rate. The 30-personal interviews were geographically stratified across Michigan with 10 interviews conducted in Southern Lower Peninsula, 10 interviews in the Northern Lower Peninsula, and 10 interviews in the Upper Peninsula. Interviews purposely targeted local officials in a variety of positions. Most of the local governments interviewed had a natural resource goal stated in their Master Plan or Annual Strategic Plan.

Most natural resource information is incorporated into conservation measures such as ordinances that protect water quality and open/green spaces and secondarily to assist in determining where development should and shouldn’t occur.



Recommendations:

Given that there are only 14 regional planning commissions in Michigan, it would be practical and make fiscal sense to tailor some natural resource information to their needs. Admittedly, regional planning commissions are membership based and not all local governments in their regions are members. Nevertheless, they provide a reasonable point of contact to disseminate information and products to a large network of local governments.

Recommendations for improving the usefulness of natural resource information include providing:

- more detailed, accurate, and updated information;
- access to multiple types of information such as rare species, soils, floodplain, and invasive species information in one location. The Departments of Natural Resources and Environmental Quality are the most frequently contacted for information. Townships were most interested in accessibility of data;
- educational programs that focus on current natural resource issues, the value of natural resources, the relationship between land use and natural resources, how to apply and interpret natural resource information, and examples of defendable conservation measures including green infrastructure plans; counties were most interested in learning;
- grant opportunities to local governments to specifically acquire and utilize natural resource information.

Location: Statewide

Year(s): 2005-2006

Partners: Michigan Department of Natural Resources – Wildlife Division, Land Policy Institute, Non-Game Wildlife Fund

Biodiversity Assessment, EO Inventory and Systematic Inventory

*John Paskus, Amy Derosier, Edward Schools, Helen Enander, Bradford Slaughter, Michael Kost, and Rebecca Rogers
Michigan Natural Features Inventory*

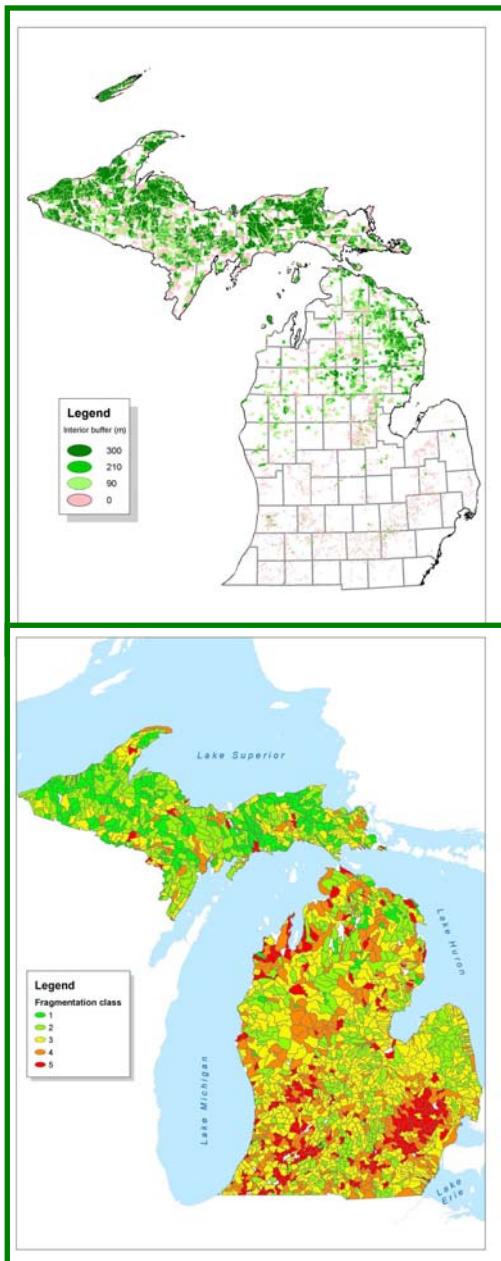
Michigan is a state that has over 15,000 native species of insects, 1,815 native species of vascular plants, and 691 native species of vertebrate animals. Michigan's landscape, however, has undergone major changes over the last century and the pace of this change is rapidly increasing. As a result of these and other changes to the landscape, 665 species of the state's plants, birds, mammals, reptiles, amphibians, fish, insects, and mollusks are listed as threatened, endangered, and special concern. In addition, 46 plants and 10 animals are currently extinct or extirpated from Michigan (Michigan Natural Features Inventory 2006). The major factor contributing to this loss of biodiversity is loss of habitat.

One of the first steps towards conserving Michigan's natural heritage is knowing what is left on the landscape. With limited resources it is especially important to be able to identify and prioritize the best places to conserve biodiversity. The primary goal of this project was to gather, develop, and assess a series of data layers for both terrestrial and aquatic natural features that can be mixed and matched depending on the end users needs, preferences, and values for conservation planning efforts.

Major steps of this project included:

1. review other states biodiversity projects
2. enhance the natural heritage database
3. develop an approach and methodology
4. develop a technical product

The biodiversity assessment of Michigan was completed using available spatial data along with known occurrence data to determine areas of significant importance to species of greatest conservation need. The findings of this effort are documented in a final report called *Biodiversity Assessment of Michigan: Technical Report* that is available to help guide planning, management, and surveys. The report details the approach



taken and includes many maps showing different ways of looking at the biodiversity of the state.

Terrestrial maps include, but are not limited to: Circa 1800 vegetation map; natural vegetation core areas defined by all roads with a 0, 90, 210, and 300m buffer; potentially unchanged vegetation core areas; likelihood of a known rare terrestrial species occurrence still occurring; high quality natural communities with an EO rank of >B/C; the three best occurrences of each natural community type at the statewide scale; locations of the best occurrence for each element by watershed; prioritized terrestrial biodiversity areas; and high priority Great Lakes shoreline areas.

Aquatic maps include, but are not limited to: unique river ecosystem in Michigan using the 5% rule; unique river ecosystems in Michigan by EDU using the 1% rule; high quality river ecosystems in Michigan by EDU; intact watersheds of headwater streams in Michigan; percent natural land cover in watersheds of headwater streams in Michigan; unique lake ecosystems using the 5% rule; unique lake ecosystems by EDU using the 1% rule; fragmentation analysis by sub-watershed; pollution analysis by sub-watershed; sub-watersheds in Michigan scored from least-modified to most-modified; and prioritized aquatic biodiversity areas.

For more information: go to <http://web4.msue.msu.edu/mnfi/pub/publications00.cfm> and the report can be downloaded.

Location: Statewide

Year(s): 2007 (completed)

Partners: Michigan Department of Natural Resources – Wildlife and Fisheries Divisions, The Nature Conservancy, U.S. Forest Service, Michigan State University

Evaluating the Effectiveness of the Environmental Review Process Along the Great Lakes Shoreline

Daria Hyde, John Paskus, and Michael Penskar
Michigan Natural Features Inventory

The environmental review (ER) process involves evaluating the impacts of proposed development or management projects on federal and state endangered and threatened species, special concern species, high quality natural communities and other unique natural features (or elements). Unfortunately, the ability to follow-up and monitor compliance of rare species protection efforts has not been a part of the environmental review process, and understanding the effectiveness of this program has been a challenge.

This project evaluated the review process by assessing application files and conducting targeted field visits in the eastern portion of the Upper Peninsula and northeast Lower Michigan, where the potential for impacts to rare and high quality elements is known to be high. The project also included a statewide survey of the Department of Environmental Quality - Water Resources Division (WRD) staff to evaluate their opinions of the existing environmental review process, as well as an extensive national survey to ascertain the status of other state environmental review programs to provide a broader perspective.

Results

The file evaluation of the environmental review program revealed that although the process is working fairly well in flagging rare species at potential project sites in Great Lakes wetlands and screening out “no impact” projects from review, there is duplication of effort and inefficiencies that hinder the process. Improving coordination and implementing innovative technologies is needed to expedite the review process.

The results of the external evaluation at project sites indicated that although adequate screening and/or surveys are being conducted for rare species in the coastal zone, project compliance is not being assessed effectively and there is no system for flagging rare species that occur in upland habitats. For the most part, potential impacts to rare species from projects occurring in wetlands are being mitigated with minimal burden to applicants; however, there is insufficient coordination between WRD and the Department of Natural Resources – Wildlife Division to ensure that projects do not proceed without both wetland permits and the required endangered species clearances. Compliance is critical for preventing cumulative impacts to listed species found along the Great Lakes coastal zone and protecting rare species in adjacent upland habitats.

The results from the internal and national surveys yielded 24 recommendations in five main categories, consisting of: 1) training, 2) procedures, 3) staffing, 4) information resources/tools, and 5) public outreach, education and community planning.



The full set of recommendations were further evaluated and scored by applying cost, benefit, and time-frame criteria to identify 10 priority recommendations stratified by short-, moderate- or long-term implementation:

Short-term

- Conduct annual cross-training workshops in different regions
- Develop checklist of documents required of applicants
- Implement standardized survey reporting form
- Increase collaboration/ assistance on large projects

Moderate-term

- Increase number of staff that conduct environmental review
- Provide certification training to all department staff on threatened and endangered species screening
- Update the Endangered Species Assessment web application
- Provide overview of ER process on website with links to resources

Long-term

- Conduct annual visits to a sample of sites to evaluate compliance
- Improve/ update Natural Heritage database

Identifying a set of clear outcomes for Michigan’s environmental review process might provide the paradigm shift needed to build a stronger, more sustainable program that evaluates the effectiveness of the environmental review process in a more meaningful way over time.

Location: Statewide

Year(s): 2008-2010

Partners: Michigan Department of Natural Resources – Wildlife Division, Michigan Department of Environmental Quality – Michigan Coastal Management Program, National Oceanic and Atmospheric Administration

Development of Tools to Support the Aquatic Portion of the Wildlife Action Plan

*Liz Hay-Chmielewski, Minako Edgar, and Dr. Li Wang
Michigan Department of Natural Resources – Fisheries Division*

The goal of this project is to refine the aquatic portion of Michigan's Wildlife Action Plan, specifically the objectives of this project are to:

1. Update and maintain Michigan's river classification framework and databases and coordinate the development of Michigan's inland lake GIS databases and classification framework;
2. Refine Michigan's ecological drainage units (EDUs) that were developed by The Nature Conservancy;
3. Define aquatic ecological systems (AES, subwatersheds with distinct characteristics in physiochemical and biological properties);
4. Identify high priority conservation areas for both inland lakes and rivers;
5. Assess environmental conditions of Michigan's rivers and inland lakes;
6. Identify key environmental threats to each water body; and
7. Develop GIS application tools to meet the other implementation needs of the Wildlife Action Plan.

Data

The aquatic habitat database for the Wildlife Action Plan was developed and includes physical and human disturbance data and links to the Michigan Inland Lake Dataset. The 1:100,000 river valley segment types were updated to the 1:24,000 river dataset. Discussion with experts started on ecological drainage units and aquatic ecological systems. GIS application tools, including python programs, were developed and include: calculating stream order for the river dataset, summarizing dam occurrence for river dataset, and linking values between 100k and 24k river datasets. The stream order program produces Shreve stream order, Strahler steam order, and downstream linkage number. The dam program produces the total number of upstream dams in main stem, total number of downstream dams in main stem, distance to upstream dam, distance to downstream dam, distance to first dam from Great Lakes, and dam density.

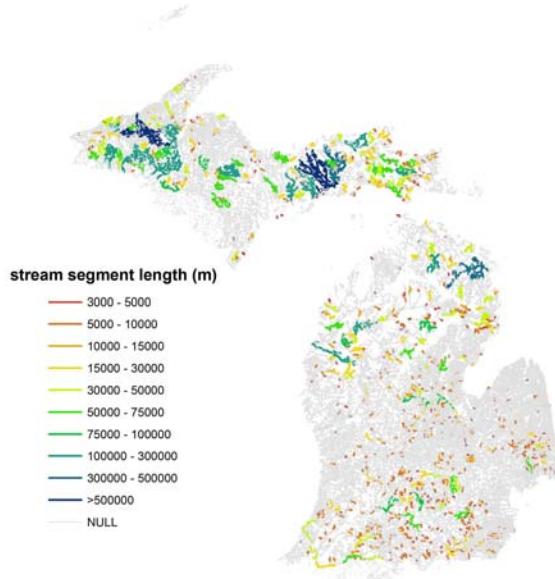
EDUs and AESs

Based on the updated river dataset and using the Great Lakes Aquatic GAP methodology, Michigan ecological drainage units (EDUs) and aquatic ecological systems (AESs) are under development.

Aquatic conservation areas

Various computer modeling tools were explored to aid in defining critical conservation areas. High priority conservation areas were developed for streams for three fish groups: large body, small body, and species of greatest conservation need, using MARXAN software that delivers decision support for reserve system design. Analyses will continue.

High priority conservation stream segments for large body fish group



Key environmental threats

Key environmental threats were identified for Michigan inland lakes and wadeable streams. The strength of this analysis is that it is linked to the scale of disturbances that affect a stream. The disturbances that had the greatest affect on moderately- to severely-disturbed streams were nutrient loading and percent urban land use with in network watersheds. Among the anthropogenic disturbances that contributed the most to lake disturbance index scores, nutrient yields and farm animal density affected the highest number of lakes, agricultural land use affected a moderate number of lakes, and point source pollution and road measures affected the least number of lakes.

Tools

Two GIS application tools, including python programs, have been developed: 1) aggregation tool for summarizing local watersheds into a network watershed for each stream segment based on stream connectivity, 2) selecting high priority conservation areas using MARXAN.

Location: Statewide

Year(s): 2008-2010; This project is continuing.

Partners: U.S. Geological Survey, The Nature Conservancy

Mussels – Project Summaries



An Online Resource for the Distribution and Natural History of Freshwater Mussels of Michigan

Dr. Phil Myers, Renee Sherman Mulcrone
University of Michigan

Freshwater mussels in the family Unionidae have been declining over the past fifty years primarily due to pollution and invasive species. Information specific to Michigan mussels was not readily accessible to researchers, resource managers and/or the general public. This project completed a database of Michigan mussel records from the University of Michigan Museum of Zoology's Mollusk Division. Collection information were used to generate distribution maps. Web accounts on the natural history and distribution were developed for the University of Michigan's Animal Diversity Web Special Topics section. This information is now available online to the general public.

Over 7,000 lots of Michigan mussels were computerized; lots consist of one or more specimens of a species collected from a particular locality at a particular time. Number of individual specimens in a lot can range from 1 to several hundred. Information in the file includes: museum number, current nomenclature, number of specimens, date collected, drainage, main drainage, Great Lakes basin, locality, town range section, county, collection, and remarks. Additionally, 45 species

accounts were created and are available online. These accounts include information such as: physical description, distribution in Michigan, fish hosts, and conservation status. All of this information can be used to develop strategic watershed plans, species recovery plans, and planning restoration activities.

To access the mussel database, go to:

http://www.ummz.lsa.umich.edu/mollusks/databases/ummz_sea_rch.html

University of Michigan's Animal Diversity Web site:

<http://animaldiversity.ummz.umich.edu/site/accounts/information/Unionidae.html>

Location: Statewide

Year(s): 2005

Partners: Michigan Department of Natural Resources – Wildlife Division

Freshwater Mussel Survey of the Lower Black River, Sanilac and St. Clair Counties, Michigan

Douglas Sweet
Detroit Zoological Society

Freshwater mussel populations in southeast Michigan are dramatically declining. Historical reasons for these declines (siltation, pollution, host fish population changes, and habitat modifications e.g., dams, impoundments, and dredging) have recently been exacerbated by competition from exotic species like zebra mussels (*Drissena polymorpha*) and Asiatic clams (*Corbicula fluminea*). Watersheds not impacted by exotics need to be identified, studied, and recorded as possible refugia sites where native mussels may continue to thrive. A concerted effort to keep these areas free of exotics and other disturbances needs to be implemented before important elements of Michigan's freshwater mussel diversity are lost. The lower Black River, in Sanilac and St. Clair Counties, has promise as potential refugia.

The Black River is a potential native mussel refuge because it has few impoundments suitable for boat launches and has relatively high mussel diversity. The small number of boat launches and reservoirs make it unlikely that zebra mussels, a major threat to native mussels, will be introduced. And if they are, it is unlikely they will achieve high numbers that would negatively impact native mussels. Historically 18 species of mussel have been found in the Black River. The Black River also holds promise for containing some very important faunal remnants. As late as 1988, the state and now federally endangered northern riffleshell (*Epioblasma torulosa rangina*) was found living in the upper reaches of the Black River between Applegate and French Line Roads. Unfortunately, the 118 live specimens found were all relocated to the Detroit River because at that time, a 25 mile length of this river stretch was dredged for flood control. This was one of two locations riffleshells where known in Michigan. The other location, the Detroit River, has lost all riffleshell due to zebra mussel competition.

A detailed and quantitative survey of the lower Black River needed to be completed to define the richness and density of native mussels. Particularly important is the presence or absence of federally- and state-listed endangered, threatened or special concern species such as the northern riffleshell, salamander mussel (*Simpsonaias ambigua*), snuffbox (*E. triquetra*), and round hickorynut (*Obovaria subrotunda*). This information will be used to define the importance of this area as a refuge site for native freshwater mussels. This information can also be used in developing watershed plans and state recovery plans.

Results

The lower Black River is habitat for at least 15 species of Unionid mussels. In general, mussel density was highest in the northern, most upstream portion of the survey (at Applegate Road). They were least abundance between Jeddo and



Comstock Roads, with no live representatives found by quantitative methods.

No state or federally listed species were found alive. Dead northern riffleshells and wavy-rayed lamp mussels (state threatened; *Lampsilis fasciola*) were found but the shells seemed old. Elktoe (*Alasmidonta marginata*) and rainbows (*Villosa iris*) shells were also found, which are state species of special concern. The fauna of the Black River is characteristic of a silt and disturbance tolerant fauna. Hardy, common, and tolerant representatives of the subfamilies Unioninae and Anodontinae make up the majority of the fauna (three-ridge, *Amblema plicata*; Wabash pigtoe, *Fusconaia flava*; white heelsplitter, *Lasmigona complanata*; giant floater, *Pyganodon grandis*; pink heelsplitter, *Potamilis alatus*; fragile papershell, *Leptodea fragilis*; fluted-shell, *Lasimigona costata*) with most representatives of the subfamily Lampsiliinae being the minority and at the lowest densities (plain pocketbook, *Lampsilis cardium*; fat-mucket, *Lampsilis siliquoidea*; rainbow, *V. iris*).

Location: Black River, Sanilac and St. Clair Counties
Year(s): 2005

Partners: Michigan Department of Natural Resources – Wildlife Division, Belle Isle Aquarium, volunteers, landowners, Non-Game Wildlife Fund

Status of Native and Exotics Mussels, Including the Northern Riffleshell and Rayed Bean, at the Detroit River International Wildlife Refuge

Peter Badra

Michigan Natural Features Inventory

The Detroit River has historically supported some of the most diverse native freshwater mussel (Unionidae) communities in Michigan, including globally significant populations of rare mussel species. The Detroit River International Wildlife Refuge (DRIWR) may potentially support some of the last populations of the federally endangered northern riffleshell (*Epioblasma torulosa rangiana*) and other rare unionids in Michigan. No thorough survey of the DRIWR has been performed and hence a species list was not available for the DRIWR.

The mussel communities in the Detroit River have experienced severe declines over the past 20 years due largely to the introduction of the zebra and quagga mussels (*Dreissena polymorpha* and *Dreissena bugensis*; Schloesser et. al. 1998). The northern riffleshell had not been recorded in the Detroit River since 1996; however, several recently dead valves of the northern riffleshell were found by Michigan Natural Features Inventory staff in August of 2005, indicating the potential continued presence of this rare species. The status of native freshwater mussels, including the northern riffleshell, at the DRIWR needs to be ascertained in order to effectively conserve these taxa.

Results

A total of fourteen sites in five different areas were surveyed at the DRIWR. Thirteen unionid species were observed. No live individuals or empty shells of the northern riffleshell or rayed bean were found. The only live unionid mussels found, two giant floaters (*Pyganodon grandis*), were located within the Brancheau Tract of the DRIWR. All other unionid species recorded were represented by empty shell only. None of the species found are state or federally listed, however, the eastern pondmussel (*Ligumia nasuta*) is rare in Michigan.

Live zebra mussels were observed at two sites. One live zebra mussel was observed at a site and several hundred were observed at another site. Dreissenid mussel shells were encountered at an additional seven sites. No live unionids were observed with live dreissenid mussels attached, however, empty fragile papershell (*Leptodea fragilis*) and threeridge (*Amblema plicata*) shells at a site had numerous live zebra mussels attached to them. One live Asiatic clam (*Corbicula fluminea*) was found at a site. Two sites at Humbug Island and one site at Calf Island had substrate compositions and current similar to that required to support northern riffleshell (i.e. sand and gravel).



Discussion

Due to the presence of sand and gravel substrates, relatively low proportions of silt, absence of live dreissenid mussels, and good current speed at two sites, one on the northern end of Humbug Island and the other on the western side of Calf Island, have the most potential to support northern riffleshell and other rare mussels.

The only species found live, the giant floater, is one of the most tolerant unionids to mud and silt substrates, and low current. It frequently occurs in ponds, lakes, and mud bottomed pools of rivers. Several species represented by shell, including the fatmucket (*Lampsilis siliquoidea*), pocketbook (*Lampsilis ventricosa*), white heelsplitter (*Lasmigona complanata*), fragile papershell, pink heelsplitter (*Potamilus alatus*), and strange floater (*Strophitus undulatus*), also tend to be tolerant to high levels of silt. The prevalence of these species and the high proportions of silt found at a majority of the sites provide evidence that substrate composition is a factor contributing to the decline and/or exclusion of listed species in the DRIWR, which generally require lower proportions of silt and higher proportions of sand and gravel.

It appears that high levels of silt as well as infestation by dreissenid mussels have impacted the less silt tolerant unionid populations in the DRIWR. The five sites that were free of dreissenid mussel shell or live individuals had high proportions of silt (45-90%) and no gravel. Other stressors may also be having a negative impact. Further investigation into the potential effects of chlorinated sewage, road salt, oil, ammonia, and discharges of other substances on native mussels in the DRIWR may provide relevant information for their conservation. Though dreissenid mussels have had a clear and dramatic impact in this region, the conservation of native mussels in the DRIWR will require addressing water quality and habitat alteration as well.

Location: Detroit River

Year(s): 2006

Partners: Michigan Department of Natural Resources – Wildlife Division, Detroit River International Wildlife Refuge, U.S. Fish and Wildlife Service, Non-Game Wildlife Fund

Investigations on the Species-Level Validity and Geographic Range of the Round Floater

Dr. Randolph Hoeh

Kent State University – Department of Biological Sciences

Pyganodon subgibbosa is currently listed as threatened under the State of Michigan's Endangered Species Act. However, this species is currently not listed by some malacologists as a valid species (e.g., Turgeon et al, 1998). Voucher specimens from the University of Michigan - Museum of Zoology's Mollusk Division collection indicate only one locality record, "Black Lake," (now called Lake Macatawa) near Holland, MI. Currently, no additional localities are known to harbor this species.

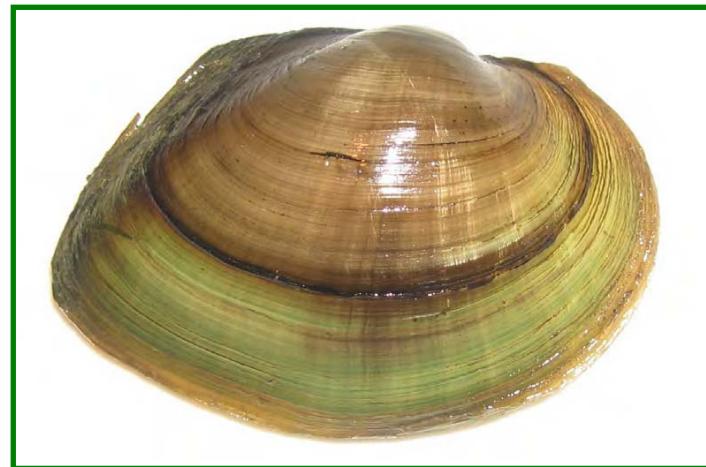
The objectives of this study were to use DNA and shell characteristics to examine the species-level validity and taxonomic status of the round floater, *Pyganodon subgibbosa*. DNA techniques were proposed to examine the genetic distinctiveness of this species and its genetic relationships to other *Pyganodon* species. Morphometric techniques were proposed to identify diagnostic shell characteristics for *P. subgibbosa* and, subsequently, these characteristics would be integrated into existing dichotomous keys covering Michigan's freshwater mussel species.

Taxonomic Issues

Four species of *Pyganodon* (*P. cataracta*, *P. grandis*, *P. lacustris* and *P. subgibbosa*) may exist within Michigan's aquatic habitats. Some of these species are often found living together (e.g., *P. grandis* and *P. lacustris*) and can be difficult to distinguish when using only shell characters.

Results

No specimens were found at the type locality for *P. subgibbosa*, hence an additional search of the Lake Michigan drainage was undertaken. Only one *P. subgibbosa*-like specimen was collected during the course of this study from Mona Lake in Muskegon County. Its shell morphology is clearly distinct from that of typical *P. grandis*, *P. cataracta* and *P. lacustris*. For the genetic analyses, a 654 nucleotide matrix representing 80 anodontine individuals was constructed using FCOI sequences while a 654 nucleotide MCOI matrix contained sequences from 105 anodontine individuals. Based on both FCOI and MCOI phylogenetic analyses, the Mona Lake *P. subgibbosa*-like specimen is closely related to *P. grandis*. The Mona Lake *P. subgibbosa*-like specimen yielded an unremarkable FCOI DNA sequence which is very similar to that found in *P. grandis* specimens from Michigan. However, the MCOI sequence of the Mona Lake specimen represents a unique mitochondrial genotype in this study. This MCOI genotype has three nucleotide substitutions which were not detected in any other *P. grandis* MCOI DNA sequence.



Discussion

The lack of replicate individuals for the *P. subgibbosa*-like shell morphotype from Mona Lake, Muskegon County, Michigan prevents meaningful morphometric comparisons with other *Pyganodon* species and a definitive statement regarding its species-level status. The Mona Lake specimen could represent a distinct species or it could simply represent an ecophenotype (= an environmentally induced, distinct shell morphology) of *P. grandis* that has, by chance, a distinct MCOI genotype. However, if there is an absolute linkage, demonstrated in multiple individuals, between possession of the *P. subgibbosa*-like shell morphology and possession of the unique MCOI genotype found in the Mona Lake specimen, then this would represent evidence supporting species-level distinction for the *P. subgibbosa*-like shell morphotype from Mona Lake.

Recommendations

1. Emphasis should be placed on thoroughly sampling Mona Lake in Muskegon County, Michigan to assess the population size of the distinct *P. subgibbosa*-like shell morphotype detected there.
2. If additional specimens of the *P. subgibbosa*-like morphotype are found, tissues should be biopsied from these specimens (as well as from specimens of any other *Pyganodon* morphotype found in Mona Lake), and the production of MCOI DNA sequences from these specimens facilitated.
3. If the additional MCOI DNA sequencing is done, a determination should be made regarding the strength of the correlation between the *P. subgibbosa*-like shell morphology and the unique MCOI genotype detected in the single Mona Lake individual analyzed to date.

Location: Muskegon County

Year(s): 2006

Partners: Michigan Department of Natural Resources – Wildlife Division, Non-Game Wildlife Fund

Butterflies – Project Summaries



Investigations of Karner Blue Butterfly Dispersal, Habitat Quality Analysis, Identification of Management Action Triggers, and the Development of Practical Monitoring Techniques within the Muskegon Recovery Unit

Dr. James P. Dunn

Grand Valley State University – Biology Department

The Karner blue butterfly (*Lycaeides melissa samuelis*) is a federally endangered species that occupies oak savanna and barrens, which are some of the rarest and most threatened ecosystems in Michigan. This butterfly is assumed to be a true meta-population made up of interacting (extirpation, dispersal, re-colonization) subpopulations within lupine patches dispersed throughout a landscape. Yet, no research has ever directly investigated the meta-population dynamics of the Karner. Understanding this aspect of the butterflies' biology is key to protecting the species. If there is only very limited (or no) Karner migration among patches and high extirpation within patches then merely saving the remaining patches may not be enough to ensure recovery. And the translocation of butterflies may need to be incorporated into the recovery plan. Or if butterflies are found not to migrate through certain types of habitat (dense forest) then particular vegetative corridors would need to be established by managers.

The Muskegon Recovery Unit has the potential to sustain the largest and most readily protected and manageable meta-population of the Karner. The region has many acres of savanna/barrens and forested matrix that are contiguous within the Manistee National Forest. Therefore private property concerns are minimized. Also there are many Karner subpopulations, which suggest the robustness of this meta-population.

Past work has shown that species at higher trophic levels, species specialized in their habitat or food plant requirements, species with limited dispersal abilities, species with restricted geographical range, and species with low populations are more endangered by the fragmentation process (Lawton 1995, Holt et al. 1999, Thomas 2000). Unfortunately, the Karner fits four of the five criteria suggesting a high probability to extinction even if all remaining patches are saved, unless, migration among habitats is high.

This study investigated the connectivity of Karner subpopulations by mark-release-recapture techniques, assessed the role of habitat quality on population densities of Karner, and developed management recommendations.

Results

This study showed that the Karner has a strong ability to disperse among isolated subpopulations. Using mark-recapture methods, 168 cases of between patch dispersal of Karner was seen among isolated sub-populations within a matrix of closed canopy oak



and mature red pine plantation during the flight of the first brood. Ninety-six percent of the dispersal flights among patches (sub-populations) were greater than 200 m average maximum suggested by the U.S. Fish and Wildlife Service (USFWS) Recovery Plan, with mean dispersal of males being 393 m and females 400 m. The maximum dispersal distance measured was a male that moved 1.6 km. More importantly, closed canopy forest did not act as a barrier to dispersal, which suggests that efforts to construct connecting corridors through forested areas may not be necessary.

Habitat analysis indicated that the “quality” of oak savanna habitat in the area and its ability to support a robust Karner population may be poor and that management is needed to release lupine and important nectar plants from the heavy cover of sedge and woody seedlings.

Results of surveys at 47 sites found an occupancy rate of 91.5%, which has increased from 2004 where an occupancy rate of 77% was found. These results surpass the goal of 80% occupancy stated in the USFWS Recovery Plan, suggesting a robust and growing meta-population.

Location: Oceana and Muskegon Counties
Year(s): 2005 -2008

Partners: Michigan Department of Natural Resources – Wildlife Division, U.S. Fish and Wildlife Service

Energy for Wildlife - Leadplant

John Lerg

Michigan Department of Natural Resources – Wildlife Division

The three-staff underwing moth (*Catocala amestris*) is an endangered species in Michigan. The larvae of this moth feeds exclusively on leadplant (*Amorpha canescens*), a special concern plant found in southern Michigan. The leadplant is a prairie-associated species, which is often threatened by encroachment of non-native invasive woody species. This little gray and orange moth brought some unlikely partners together to help protect its critical habitat in the Barry State Game Area.

The three-staff underwing moth and the leadplant are found along Wolverine Power's transmission line right-of-way in Barry State Game Area. Wolverine Power Supply Cooperative, Inc., the National Wild Turkey Federation's Energy for Wildlife program, and the Wildlife Division of the Department of Natural Resources worked together to develop a management plan that protects the moth and leadplant while allowing the power company to control vegetation along their transmission line. They now mow during the coldest months when the moths are dormant, instead of during the summer months. This group also created 3 additional acres of habitat for the endangered moth adjacent to the right-of-way.

The partnerships didn't stop there. Hastings High School Agri-science program students germinated leadplant seeds that were collected in 2006. Although the success was limited due to the sensitive germination conditions required for this species, 20 plants were raised and planted on site to help fill the recently cleared areas surrounding the utility right-of-way. This partnership not only supplemented the leadplant population but it also gave students an opportunity to be part of the management and restoration of an endangered species.

Location: Barry State Game Area

Year(s): 2005-2007

Partners: National Wild Turkey Federation (NWTF), Wolverine Electric Company, Michigan Natural Features Inventory, Thornapple Valley NWTF Chapter, Hastings High School Agri-science program students

Developing a Management Strategy for Dwarf Bilberry and Northern Blue Butterfly in the Ottawa National Forest

Sue Trull

Ottawa National Forest – USDA Forest Service

Dwarf bilberry (*Vaccinium cespitosum*) and northern blue butterfly (*Lycaeides (Plebejus) idas nabokovi*) are state threatened species with a host plant-larvae relationship. Dwarf bilberry populations are often small and vegetative reproduction of clones is common while flowering and fruit set may not occur every year (Penskar and Higman 2001). The northern blue is related to the federally endangered Karner blue (*Lycaeides melissa samuelis*), which does not occur in the Upper Peninsula. Some known northern blue populations have not been relocated in recent surveys (Cuthrell 2001), suggesting a possible decline. The northern blue has only one generation per year (Cuthrell 2001), limiting its ability to regain larger populations. Larvae appear to be totally dependent on dwarf bilberry in Michigan (Wolf and Brzeskiewicz 2002), although they use other plants in Canada (Cuthrell 2001).

Both species are known to occur in a very limited extent in Michigan's Upper Peninsula and in the Ottawa National Forest. Neither species is likely to recover without management efforts. This project conducted surveys for both bilberry and northern blue to determine site conditions and threats, and to identify recovery options in the Ottawa National Forest. The information was used to develop a management plan that includes recovery efforts to sustain viability for this shrub and butterfly.

Results

Approximately 210 acres of openings on national forest land were surveyed for dwarf bilberry in the summer of 2005. Another approximately 10 acres were surveyed on private land by the land owner and a local botanist after Forest Service personnel found one bilberry close on his land, adjacent to Ottawa National Forest land. Bilberry populations were found at three sites; most plants were in the general area of previously known populations. However, one site is a large range extension, from Marquette County to Ontonagon County. This latter site was on quite different soils from known sites in the McCormick Wilderness, changing previous interpretation of potential habitat for this dwarf shrub. Soils data was collected from this area and the McCormick area to add to habitat information.

Threats to Bilberry and Butterfly Viability

At many of the sites the main threat to persistence of the bilberry population is natural succession. The shaded bilberry plants appear to be larger and to have fewer berries, while the



plants in sunnier spots have smaller leaves but more berries. If the sites proceed along a successional pathway leading to northern hardwoods like the forest around the sites, the bilberry will presumably disappear.

Discussion and Recommendations

Finding a new site for dwarf bilberry on clay soil and a site well removed from previously known sites suggests that dwarf bilberry can tolerate a wider range of site conditions than previously thought. This suggests it may be found in more places. Not finding the northern blue butterfly in smaller openings that have bilberry suggests it may be more at risk than the plant. Larger openings are less frequent in the hardwood forest-dominated Western Upper Peninsula. Additional butterfly surveys are recommended.

Recommendations include to: 1) conduct additional surveys for dwarf bilberry and the northern blue butterfly; 2) continue active recovery efforts for this plant and butterfly,

which may include site manipulation to slow natural succession, propagation, out-planting and butterfly transplants; and; 3) continue sharing information on habitat and known locations among managers of these species.

Location: Ottawa National Forest

Year(s): 2005

Partners: Michigan Department of Natural Resources – Wildlife Division, private landowners in Ontonagon County and near McCormick Wilderness area, Non-Game Wildlife Fund

Amphibians and Reptiles – Project Summaries



Michigan Frog and Toad Survey

Lori Sargent

Michigan Department of Natural Resources – Wildlife Division

Frogs and toads can be great indicator species because their permeable skins are sensitive to environmental conditions. Additionally, they rely on both aquatic and terrestrial habitats during their life cycles making them particularly vulnerable to a variety of threats. Globally, amphibian populations have declined over the last 3 decades, likely due to habitat degradation or loss, invasive species, and pathogens. In 1996, the annual Michigan Frog and Toad Survey was initiated to provide baseline data on Michigan's calling frog and toad populations and to evaluate trends in the state. This survey is a citizen science program. Volunteers conduct surveys three times annually: early spring, late spring, and summer.

Over a 10-year period a total of 22,040 sites were surveyed (an average of 2,204 sites per year). Overall, most frog and toad species appear to be stable. However, there is some evidence that local and regional declines have occurred in Fowler's toads, pickerel frogs, mink frogs, and wood frogs.

There is growing concern over Fowler's toad populations. Targeted surveys are needed to get a better understanding of what is happening to this species' populations in Michigan. Mink frog observations continue to be low, however this species can be difficult to survey since they call at very early hours in the morning; targeted surveys for this species are also needed.

Location: Statewide

Year(s): 2007-2010

Partners: volunteers, Non-Game Wildlife Fund



	Number of sites surveyed				
Year	Zone 1	Zone 2	Zone 3	Zone 4	Notes
2007	906	237	90	80	Spring peeper was the most frequently heard species in most counties.
2008	824	238	50	106	Spring peepers were the most frequently heard species in most counties. Mink frog observations continue to be low.
2009	759	1,218	20	100	Fowler's toads were not heard in this year. Mink frog, pickerel frog, and Cope's gray treefrog observations continue to be low. Northern leopard frog observations are increasing.
2010	785	199	59	107	For a second year in a row, Fowler's toads were not heard. Mink frog, pickerel frog, and Cope's gray treefrog observations continue to be low. Northern leopard frog observations are increasing.

Michigan Herpetological Atlas Surveys

*David Mifsud
Herpetological Resources and Management*

Reptiles and amphibians (herps) are large and important taxonomic classes of organisms. They are valuable to many biotic communities and are good indicators of environmental quality. To develop effective long-term management plans, it is critical to obtain baseline data on species locations and diversity. Through this project, biological inventories were conducted to identify amphibian and reptile species that occur in select portions of southeast Michigan along the Detroit River Wildlife Refuge. By surveying multiple sites along the Refuge in the same field season, both managers and regulators will have consistent baseline data that reflects environmental and habitat conditions at the same point in time.

Pointe Aux Peaux Wildlife Area

A total of 10 species of herps were observed at Pointe Aux Peaux, including: eastern fox snake (*Elaphe gloydi*), northern brown snake (*Storeria dekayi dekayi*), eastern garter snake (*Thamnophis sirtalis sirtalis*), northern water snake (*Nerodia sipedon sipedon*), Midland painted turtle (*Chrysemys picta marginata*), common snapping turtle (*Chelydra serpentina serpentina*), American toad (*Bufo americanus americanus*), green frog (*Rana clamitans melanota*), bullfrog (*Rana catesbeiana*), and gray treefrog (*Hyla sp.*). *Phragmites* dominates about half of the entire site, including all of the marsh, and will eventually eliminate the open water in the canal, an important turtle habitat.

Elizabeth Park, Wayne County Park on Detroit River

Elizabeth Park supports a modest diversity of herp species, including: common map turtle (*Graptemys geographica*), red-eared slider (*Trachemys scripta elegans*), eastern garter snake, American toad, and green frog. The canal provides significant turtle habitat, but diversity in the rest of the park is limited by intense human use and invasive species. The greatest limitation to herp diversity at Elizabeth Park, and the hardest to overcome, is the seawall, which renders the entire river shoreline inaccessible to many herps.

Celeron Island in the Detroit River just south of Grosse Is.

A total of 8 species of herps, including: northern brown snake, eastern garter snake, northern water snake, common map turtle, Midland painted turtle, common snapping turtle, American toad, and bullfrog. Herp populations on this island do not appear to be large. This island would greatly benefit from invasive species control, especially to keep higher quality areas intact.

Grosse Ile – Grosse Ile Township natural areas/ open space

A total of 12 species of herps, including: common map turtle, Midland painted turtle, red-eared slider, common snapping turtle, eastern fox snake, eastern garter snake, Butler's garter snake (*Thamnophis butleri*), northern water snake, American



toad, green frog, bullfrog, and western chorus frog (*Pseudacris triseriata*).

Grosse Ile has the greatest herp diversity of any of the Detroit River islands surveyed. Management suggestions include maintaining the old field edge along roads, but restricting mowing to a height of at least 6 inches above the ground. Based on the number of young turtles observed in the canal, it appears to be an important location for reproduction. Discouraging the use of seawalls along the canal and river will benefit a wide variety of wildlife.

General recommendations

1. control exotic and invasive plant species with herp-friendly techniques;
2. manage herp predator numbers;
3. create and maintain no-mow zones to allow herps safe havens in old field, grassland, and prairie habitats;
4. provide educational interpretive signs to inform people about herps and their habitats.

Location: Detroit River Wildlife Refuge in Wayne and Monroe Counties – Stony Island, Humbug Marsh Complex, Grosse Ile Natural Area, Point Mouillee State Game Area, Sterling State Park

Year(s): 2005

Partners: Michigan Department of Natural Resources – Wildlife Division and Parks and Recreation Division, U.S. Fish and Wildlife Service, Grosse Isle Nature and Land Conservancy, DTE Energy, Friends of the Detroit River

Herpetofaunal Distributions in Gogebic County, Michigan

Dr. Karen Franc
University of Notre Dame

This project provides valuable data for the Michigan Herp Atlas where there was a significant geographical gap. Wide and intensive surveys were conducted at 75 sites in Gogebic County. Surveys with pitfalls and drift fences, visual searches of 25 m x 25 m plots, and visual open water surveys for turtles were used to maximize species observations. These surveys were supplemented by night driving surveys and anecdotal observations. From the known localities, habitat types, large-scale landscape “preferences,” barriers to dispersal, and species distribution maps were created to predict presence throughout the county. This information could be used in developing forest management plans and identifying unique habitats for management planning.

Objectives of this work were to:

1. determine presence and relative abundance of reptiles and amphibians throughout Gogebic County, Michigan, using multiple surveying techniques.
2. use GIS techniques to document species distribution and determine the influence of surrounding habitat features (at multiple scales).

Results

Nineteen species of herps were captured, totaling 3,048 adults, tadpoles, and larvae. Uncommon captures included a state species of concern, the wood turtle (*Clemmys insculpta*), and several other patchily-distributed species (e.g., four-toed salamander, *Hemidactylum scutatum*; smooth green snake,

Opheodrys vernalis). Based on habitat assessments of capture sites and literature reviews, species distribution maps were created to predict presence throughout the county. Statistical analyses indicated that the species did not stray from their acknowledged microhabitat preferences, but that larger-scale landscape patterns were not influential. Although some were rarely captured, no single species appeared to be at risk of extirpation in Gogebic County (based on available habitat). Additionally, a county-wide landuse GIS layer was created, which may prove valuable to future studies in the region.

Recommendations

Pitfall methods proved to be a time consuming method and in this study only collected American toads. Pitfalls may not be the preferred sampling method for future large scale surveys. Active searches, on the other hand, proved to be very effective during this study. Further work is needed to document distribution and abundance of vernal pools.

Location: Gogebic County

Year(s): 2005

Partners: Michigan Department of Natural Resources – Wildlife Division, U.S. Department of Agriculture – Ottawa National Forest, University of Notre Dame Environmental Research Center, Non-Game Wildlife Fund

Eastern Lower Peninsula Herp Survey: Alpena, Alcona, Iosco, Huron, Tuscola, & Sanilac Counties

Jim McGrath, Carol McGrath, and small group of high school students
Nature Discovery

Nature Discovery recruited and coordinated a small group of high school students to survey for herps in seven counties. Seventeen species were documented in the thumb survey, and 18 species in the more northern survey, with numbers of individuals tallied and survey locations and habitat descriptions reported. The survey data will be included in the ongoing Michigan Herp Atlas Project.

The absence of any northern water snake (*Nerodia sipedon*) sightings during the survey is noteworthy in light of this species' commonality and relatively high visibility along shorelines. Also noteworthy is the absence of American bullfrog (*Rana catesbeiana*). Other species, such as western chorus frogs (*Pseudacris triseriata*), are more understandably missed because of their size, in combination with the density of vegetation in foraging areas. American bullfrogs, if present, should be much more apparent, especially the vocalizations of breeding males in early July. The first record of common map turtle (*Graptemys geographica*) in Alcona County was found on

the AuSable River at the western edge of the county. In a large portion of survey locations, especially in the thumb area, green frog (*R. clamitans*) was the only anuran species evident or exhibiting evidence of breeding (vocalizations, metamorph-sightings). Over much of the thumb area, agricultural practices are so intensive, there is little to no suitable foraging habitat. In other areas, while the habitat is still present, it appears to be overused or degraded to a degree that successful reproduction of many species is limited. Conversely, the handful of areas that appeared most undisturbed harbored the greatest species diversity.

Location: Alpena, Alcona, Iosco, Huron, Tuscola, and Sanilac counties

Year(s): 2006

Partners: Michigan Department of Natural Resource – Wildlife Division, Non-Game Wildlife Fund

Central Upper Peninsula, Newaygo and Oceana County Herp Surveys

Jim McGrath and high school students
Nature Discovery

Nature Discovery recruited and coordinated a small group of high school students to survey for herps in the Central Upper Peninsula, Newaygo and Oceana counties for five days. Distribution and population status information is lacking for most herp species in northern portions of Michigan. This information is critical in determining status and conservation needs of these species. The survey data will be included in the ongoing Michigan Herp Atlas Project. Eighteen species of herps were found.

Due to time, funding and transportation constraints, most surveying was done in areas along or near roads focusing on areas nearby to wetlands. One main issue that made the survey areas limited was the amount of privately owned land. Surveys were mainly conducted on public lands such as road-sides or boat launches.

Of the locations observed, the most herp diversity was found around Diamond Lake. From the location along the northwest

shore, the lake appeared to be un-developed and no residences were visible.

The Muskegon River was surveyed using personal rafts, and floating down the river to check shorelines, emergent snags and rocks for herps. Some species observed included red-backed salamanders (*P. cinereus*), wood frogs (*R. sylvatica*), green frogs (*R. clamitans*), northern map turtles (*G. geographica*), spiny soft-shell turtles (*Apalone spinifera*) and northern water snakes (*N. sipedon*).

Location: Delta, Alger, Schoolcraft, Newaygo, and Oceana counties

Year(s): 2005

Partners: Michigan Department of Natural Resource – Wildlife Division, Kalamazoo Nature Center

Surveys for Small-Mouthed Salamander

Michigan Natural Features Inventory

The small-mouthed salamander (*Ambystoma texanum*) is state-listed as endangered, and little is known about this species, including their full distribution in Michigan. Currently, they are only found in southeast Michigan; Michigan is the northern edge of their range. Updated surveys were needed at known historical locations. Sampling techniques included: dip netting, aquatic trapping techniques, and visual encounters.

Surveys were conducted in 27 ponds associated with 15 different sites in four counties (Hillsdale, Lenawee, Monroe, and Wayne). Surveys included six sites where the small-mouthed salamander had historically been documented. Nine *de novo* sites were also surveyed that were identified as potential sites through habitat models. Small-mouthed salamanders were found at only four sites in Hillsdale County, three of which were new

sites, and an additional site in Monroe County. Males were only found at two of the sites. Salamanders that appeared to be hybrid smallmouth-blue-spotted salamanders (*Ambystoma texanum-laterale*) were found at all five sites. The first cases of an oomycete infection in this species were also documented. This work provided needed up-to-date information on this species that will be used to update the Wildlife Action Plan and as a baseline for monitoring this species.

Location: Hillsdale, Lenawee, Monroe, and Wayne counties

Year(s): 2005

Partners: Michigan Department of Natural Resources – Wildlife Division

Factors Influencing Herp Diversity on Differing Land Ownership Types in a Human-Dominated Landscape

Tracy E. Grazia, Dr. Kelly Millenbah

Michigan State University – Department of Fisheries and Wildlife

In recent decades, much attention has focused on the global decline of amphibian and reptile (herp) populations throughout the world. Although all causes of declines have not been clearly determined, anthropogenic habitat modification including habitat loss and fragmentation is the best-documented cause of herp declines, particularly amphibian declines.

The Southern Lower Peninsula of Michigan is home to many of Michigan's herps. Better understanding their habitat needs and how they are distributed on the landscape can help us improve protection and management of their populations and habitats. This study examined how important state game and wildlife areas (SGAs) are compared to privately-owned lands to herp conservation in southern Michigan. It also assessed the importance of landscape scale influences on determining herp occurrence and relative abundance.

Comparisons between land ownerships

Overall, more species were detected on SGAs including Blanding's turtle (*Emys blandingii*), painted turtle (*Chrysemys picta marginata*), common snapping turtle (*Chelydra serpentine serpentine*), Butler's garter snake (*Thamnophis butleri*), and northern red-bellied snake (*Storeria occipitomaculata occipitomaculata*). However, herp communities as a whole were similar between SGAs and private lands. For both land ownership types, wood frogs (*Rana sylvatica*) followed by American toad (*Bufo americanus*) were the most abundant. Wood frogs were more abundant on SGAs and American toads were more abundant on private lands. On SGAs, spring peepers (*Pseudacris crucifer crucifer*) and red-backed salamanders (*Plethodon cinereus*) were more abundant than the next most abundant species on private lands (green frogs, *Rana clamitans melanota* and northern leopard frogs, *Rana pipiens*). Three species were located solely on private land: the eastern box turtle (*Terapene carolina carolina*), northern water snake (*Nerodia sipedon sipedon*), and eastern milk snake (*Lampropeltis triangulum triangulum*). These differences in abundances of individual species between land ownership are likely due to species-specific life history requirements, habitat conditions and availability, micro-site and environmental conditions, and the difficulty of efficiently sampling some of the species.

Importance of landscape variables

Not surprisingly, the results of this study showed that amphibian and other herp species richness and diversity were related to a combination of factors, with temperature and soil association as

the most important variables. Warmer temperatures and poorly drained soils support greater species richness and diversity. However when interpreting individual species habitat requirements and the factors that can influence community composition, a combination of environmental variables (overstory canopy cover, litter depth, and distance to the nearest water body), especially canopy cover, were important. Land ownership did not play a significant role in the findings, suggesting that at least in this study area, SGAs and private lands support similar herp communities. These findings are encouraging for herp conservation, as private lands form the landscape matrix in most regions of the Midwest United States.

A consistent positive relationship was found between amphibian species richness, herp species richness, and herp species diversity and forest cover. At a 100 m scale, it was the most important factor in determining richness and diversity. It was important to amphibian species richness at a 200 m scale and herp species richness at a 1000 m scale. Open water had a negative effect on amphibian species richness, herp species diversity, and herp species diversity at a 200 m scale, as well as to amphibian species richness and herp species diversity at a 1000 m scale, likely due to increased numbers and types of predators. A positive relationship was found between species richness and diversity and wetlands, where as a negative association was found with agricultural areas.

Management recommendations

Although it is clear that land use affects species richness and diversity, the results of this study suggest the importance of species specific conservation strategies. When investigating factors that structure herp community composition, individual requirements must be taken into consideration. To preserve herp communities in the ecoregion, existing habitat should be maintained or managed for needed habitat requirements with regard to the broader southern Michigan landscape to ensure the integrity of the herp community will persist throughout the ecoregion.

Location: Clinton, Ingham, Barry, Shiawassee, Ionia, Livingston and Eaton Counties

Year(s): 2005 -2006

Partners: Michigan Department of Natural Resources – Wildlife Division

Impacts of Raccoons on Turtle Recruitment

Dr. Bruce Kingsbury and John Rhine

Indiana / Purdue University Fort Wayne – Center for Reptile and Amphibian Conservation and Management

Many populations of turtles appear to be functionally extirpated, because while adults are able to persist in areas for years, no recruitment is occurring. Raccoon (*Procyon lotor*) predation of turtle nests is well-established. In some areas, nest destruction verges on 100%, with raccoons at least anecdotally implicated as the principal nest forager. This small grant is a contribution to a larger project investigating the impacts of raccoon predation on juvenile recruitment into turtle populations. Turtle recruitment was monitored on the Edward Lowe Foundation property (Cass County) and Crane Pond State Game Area (SGA), where they were actively engaged in raccoon control. This funding allowed for added staff and resources to increase sampling efforts and enhance scientific controls by adding sites on adjacent public property.

Methods

The Edward Lowe Foundation property had an intensive raccoon control program, whereas the Crane Pond SGA located nearby with similar habitats did not. Surveys focused on the Eastern box turtle (*Terrapene carolina carolina*), Midland painted turtle (*Chrysemys picta*). Sampling included line transects, hoop traps, basking traps, and drift fences.

Results

Only 2 box turtles were found at Crane Pond SGA while driving on roads. Thirty-five box turtles were found at the Lowe property. At Crane Pond, 433 painted turtles were found, whereas on 266 painted turtles were found at the Lowe property.

Due to the low number of Eastern box turtles collected during the survey, effects of raccoon control on the turtle population could not be fully assessed. All adult box turtles collected were over the age of 20, indicating there may be a lack of recruitment into the adult population.

Raccoon control alone did not prove to be an effective management strategy for immediately increasing painted turtle recruitment at the Lowe property. Other factors are likely limiting turtle recruitment.

Recommendations

More work is needed to better understand if raccoon control can be a useful management tool to increase turtle populations. A better understanding of demographics of the turtle and raccoon populations being studied and more sites could provide more insights into predator control as management strategy for turtles.

Location: Crane Pond State Game Area and the Edward Lowe Foundation, Cass County

Year(s): 2005

Partners: Michigan Department of Natural Resources – Wildlife Division, Edward Lowe Foundation

Monitoring of Eastern Fox Snakes in Response to Habitat Restoration at Sterling State Park in Southeast Michigan

Yu Man Lee

Michigan Natural Features Inventory

The eastern fox snake (*Pantherophis gloydi*) is state threatened in Michigan and primarily inhabits emergent wetlands along Great Lakes shorelines and associated nearshore areas along southern Lake Huron, the Detroit River, Lake St. Clair and western Lake Erie. A population of eastern fox snakes occurs in Sterling State Park in Monroe, Michigan. Since 2003, the Department's State Park Stewardship Program has been actively restoring portions of Sterling State Park's landscape to native lake-plain prairie and Great Lakes marsh. In coordination with the State Park Stewardship Program, Michigan Natural Features Inventory initiated a monitoring and radio-telemetry study of the eastern fox snake population at Sterling State Park in 2003 and continued the study in 2004 and 2005 to assess impacts of the habitat restoration efforts on the fox snake population in the park. The goal of this monitoring program is to detect a biologically significant change in the eastern fox snake population in areas targeted for habitat restoration in the park.

Methods

Mark-recapture surveys and radio-telemetry were conducted in 2005 to collect data on fox snake presence, relative abundance, movement, and habitat use to assess impacts on fox snake populations in management units undergoing active restoration during and after habitat management activities. Line-transect and time-constrained visual encounter surveys were also conducted in all nine management units within Sterling State Park.

Results

Field surveys in 2005 resulted in a total of only six eastern fox snake observations, of which only five were captured. The five captured snakes were all new, unmarked snakes. The eastern fox snakes primarily used open upland and wetland habitats such as old field, palustrine emergent wetland, and palustrine scrub-shrub habitats. All were located primarily along the dike or along the edge of the lagoons and generally near the water or emergent wetland's edge (i.e., generally within 1-3 m). Snakes were often found in or under open or thick grass, shrubs or dense emergent vegetation, on or along the side of paved trails, in or under concrete slabs or rock riprap along the shore of the open water lagoons, underground in tree root networks or burrows, or on the surface or underground along the embankment of the dike. Cover was very important for the fox snakes in the study.

Results indicate that fox snakes may exhibit some site fidelity and return to the same hibernation site from one winter to the next. Results also suggest fox snakes may emerge from their overwintering sites a little later in the spring than other snakes,



and may stay near their overwintering sites for some time after emergence. Fox snakes also may enter their overwintering sites earlier than expected (i.e., around or by mid-September).

Survey and radio-telemetry results suggest that fox snake use of particular management units within the park may have been impacted to some degree. A majority of locations that fox snakes were found occurred in areas that had undergone some habitat restoration but generally had not been dramatically altered. Prior to this study, eastern fox snakes had been documented in these management units as well as other units in the park which have undergone substantial alterations due to habitat restoration activities, such as the Campground Restoration Unit.

This study suggests that eastern fox snakes can inhabit highly disturbed and actively managed sites; however the fox snake population within the park continues to face a number of threats. Efforts to minimize threats to the fox snake population within Sterling State Park should continue. Since fox snakes have been found primarily in the Hunt Club, Interpretive Kiosk and Facilities units during this study, consideration of management activities and ways to minimize potential adverse impacts on eastern fox snakes is especially warranted in these units.

Location: Monroe County, Sterling State Park

Year(s): 2005

Partners: Michigan Department of Natural Resources – Wildlife Division and Parks and Recreation Division, Indiana / Purdue University at Fort Wayne, Potter Park Zoo, Michigan State University, volunteers, Great Lakes Coastal Restoration Grants

Ecology, Conservation, and Response to Habitat Restoration of Eastern Fox Snakes in Southeastern Michigan

Yu Man Lee, Dr. Bruce Kingsbury, Brian Putnam

Michigan Natural Features Inventory, Indiana / Purdue University Fort Wayne - Center for Reptile and Amphibian Conservation and Management

The state threatened eastern fox snake (*Pantherophis gloydi*), is known only from the Great Lakes basin and primarily inhabits coastal marshes along the shores of Lakes Erie, St. Clair, and Huron in southeastern Michigan, northern Ohio, and southern Ontario (Harding 1997). Eastern fox snakes have declined in many areas where they were once abundant but can be locally common in areas where extensive habitat is still available. As management and restoration of remaining coastal wetlands become more prevalent and intensive in response to severe invasion by plants like the common reed or *Phragmites*, natural resource managers need to know more about the life history, ecology, population parameters, and response to habitat management of the eastern fox snake to ensure their successful management and survival into the future. Specific objectives of this study were to: 1) determine seasonal activity patterns and habitat use in natural, managed, and disturbed habitats; and 2) document population distribution and abundance of eastern fox snakes at each site; this information provides a baseline for monitoring.

Erie Marsh

Of the 23 snakes that were radio-tracked in 2006- 2007, 18 were used for the habitat analyses and 15 snakes for the movement/home range analyses due to limited movement data. Results and observations regarding fox snake habitat use and spatial ecology at the Erie Marsh Preserve indicate that fox snakes primarily use the western portion of the preserve and the adjacent area just outside the preserve boundary. Fox snakes appear to regularly use or prefer old field habitats near water, yet this habitat is very limited within the preserve. The other major habitats within the preserve are agricultural areas, marsh, and open water, which fox snakes appear to avoid.

All the snakes tracked hibernated in natural habitats or structures in close proximity (i.e., less than 15 meters) to a body of water. Because snakes were tracked less frequently just prior to hibernation, exact ingestion dates were not obtained. However, it appeared that most snakes were in or near their hibernation sites by late September, and that all were hibernating by early October. Dates of egression or emergence

are poorly understood. In 2007, snakes appeared to remain at their hibernation sites as late as early May.

Sterling State Park

Thirteen individual snakes were radio-tracked at Sterling State Park during this study in 2006 and 2007. Snakes that had limited radio-telemetry relocation data were removed from the habitat and movement/home range analyses, resulting in a total of 12 snakes for the habitat analyses. Nine of the snakes were also used for the movement/activity range analyses. Data were combined across years, when possible.

Observations from Sterling State Park were similar to Erie Marsh regarding hibernation sites, ingress, and egress. Fox snakes from Sterling also appear to be moving back to their hibernation sites in September. In terms of egress, snake emergence times appeared to range from late April to early May, with some snakes emerging even later. One snake apparently did not emerge until mid- to late May. After the second week in July, the majority of the radio-tracked fox snakes were under cover when they were located; two snakes spent time in trees.

Recommendations

Consideration of management plans and activities that may minimize potential and current adverse impacts to fox snakes should be continued, if not increased. It is also advised that current efforts for restoration and conservation of fox snake habitats should continue. Both sites should maintain contact and share/compare results to learn more about fox snakes' ecology and response to habitat management activities.

Location: Erie Marsh, Sterling State Park - Monroe County
Year(s): 2006-2008

Partners: Michigan Department of Natural Resources – Wildlife Division and Parks and Recreation Division

An Assessment of the Population Status of the Blanchard's Cricket Frog in Southern Michigan

Edythe Sonntag, Dr. Thomas Burton
Michigan State University – Department of Fisheries and Wildlife

Blanchard's cricket frogs (*Acris crepitans blanchardi*) are rare and are continuing to decline in Michigan. Therefore, it is essential that baseline data are collected on the status of this species in Michigan. The objective of this study was to extensively survey the state to identify remaining populations and obtain data on habitat use and meta-population dynamics for this species.

Results

Call surveys performed at 176 sites across the southern half of Michigan showed 27 locations sustaining cricket frogs. Of these sites, it appears that there may only be between 21 and 24 meta-populations in the state. There was at least an 84% decline statewide based on historical call survey locations and possibly as much as 88% over the last 10-20 years. This decline may be caused by a number of factors including habitat loss, predation, small populations, and disease. More unreported populations may exist in the state; however it is most likely that the unreported populations are faced with the same pressures as the known populations.

In sites containing cricket frogs, all individuals were found in semi-open, shallow sloping shoreline areas. This is characteristic of early successional wetland. The lack of natural disturbances and water level fluctuation in some areas may be unintentionally decreasing the amount of habitat available for cricket frogs. No Blanchard's cricket frogs were found in, nor heard calling from, *phragmites* stand or dense cattail stand at any site. However, there were sites with apparently ideal habitat characteristics yet no cricket frogs. This study showed that water chemistry is most likely not playing a significant role in the decline of the cricket frog. A study in 2004/2005 by Sonntag for her Master's thesis, is consistent with these results. In both studies, no single water chemistry characteristic or combination of water quality characteristics was correlated with the presence or absence of cricket frogs.

Bullfrogs and fish were present at some sites where cricket frogs remain, however, in areas with large bullfrog populations calling, cricket frogs were not heard. It is not clear what role bullfrogs and other predators play in the cricket frog decline, if any, but in the more altered areas like the southeast portion of the state, the remaining populations are all free of bullfrogs. In addition, the southeastern sites with populations all lack fish. The highly altered nature of these sites may have eliminated the population's ability to deal with these predators in addition to fragmentation and limited habitat availability.

Disease and genetics may be playing roles in the decline of the cricket frog; however, much more work is needed to understand



these aspects. Results from the chytrid swabs collected indicate that chytrid is found in many areas across the state. Yet susceptibility of cricket frogs to chytrid is unknown. Studies are needed to determine this and other important aspects of chytrid's role in the cricket frog decline.

Recommendations

There is a significant amount of information lacking on the Blanchard's cricket frog in Michigan and in the region. Planned genetic assessments will be a powerful tool for understanding some of the basic natural history and behavior of this species. Further research efforts should be focused on determining connectivity between subpopulations, the impacts of predators on populations, the impacts of chytrid on individuals and populations, and possible mitigation actions that would assist in sustaining this species. Regionally, more effort needs to be focused on protecting the remaining areas of appropriate habitat that sustain cricket frogs, as well as the habitat corridors connecting those subpopulations. Areas such as gravel pits and restored/created wetlands can be designed to suit this species in an attempt to create new habitat and habitat corridors near existing populations. At this time, the status of Species of Special Concern for this species may be insufficient to allow for the long-term sustainability of the species. Increasing legal protection and assessment requirements for the alteration of habitat may help in identifying undiscovered populations and protecting known populations.

Location: Statewide
Year(s): 2006-2007

Partners: Michigan Department of Natural Resources – Wildlife Division, Non-Game Wildlife Fund

Eastern Massasauga Rattlesnake – Project Summaries



Massasauga Ecology and Response to Construction and Restoration Efforts

Dr. Bruce Kingsbury, Scott Hecht

Indiana / Purdue University Fort Wayne – Center for Reptile and Amphibian Conservation and Management

The Eastern massasauga (*Sistrurus c. catenatus*) is considered imperiled across its range, is listed in Michigan as a Species of Special Concern, and is currently a Candidate Species for federal listing under the jurisdiction of the U.S. Fish and Wildlife Service. Due to this, there is considerable interest in using active habitat management techniques to help conserve and enhance existing populations of this species. Current management strategies for the massasauga are aimed at conserving habitats in open wetlands and adjacent uplands. Evidence suggests that these snakes are extremely selective when choosing hibernacula and that suitable hibernacula are very limited. The observed range-wide variation in habitat use suggests that further study is needed to understand the specific factors important in their habitat selection during the summer and hibernation.

Project objectives for this study were:

1. evaluate movements;
2. identify habitat used, especially in relation to active management; and
3. develop management recommendations.

Results

A total of 34 massasauga were tracked through radio-telemetry. Massasaugas at Indian Springs were found to have intermediate sized activity ranges compared to other studies. Their activity ranges averaged ~10 ha. This may simply be a result of the amount of available, open-canopied habitat accessible to the snakes. Males had the largest average daily movements, with an average maximum daily distance traveled of 35.6 m; the average total distance traveled for the entire season was about 2,955 m. Non-gravid females traveled less with an average daily movement of 13.7 m and an average total distance traveled of 1,435.5 m. Not surprisingly, gravid females had the lowest average daily movements of 7.9 m and an average total distance traveled of only 522.2 m over the course of the season. Males tended to travel the most during

mid- to late-summer, while gravid females traveled the most during the early part of the summer. Males and non-gravid females tended to increase their movements over the course of the season, whereas gravid females decreased their movements. Increased activity later in the season by males is likely due to searching for mates. The decreased movements of gravid females are likely due to minimizing their energetic costs, as most females gave birth in mid-August.

There were no observed differences in movement patterns of snakes between the active management site and the “quiet” site. Massasaugas were seen using the restored prairie habitat. They seemed to use the restored sites more as detritus began to build up. They did avoid the construction areas, likely due to the lack of cover. Massasaugas in this study used almost exclusively open canopy habitats, and as the season progressed, preferences shifted from wetlands to uplands. However, lowland forests were consistently ranked above dry forests, indicating that when the snakes use closed canopy areas they prefer lowland forests.

Recommendations

Due to various preferred types of habitat, it is advisable that any potentially dangerous management plans be carried out and completed before the massasaugas emerge from their hibernacula. Some management practices may threaten individuals such as burning or mowing to create a more desired cover height.

Location: Indian Springs Metropark and Camp Grayling - Crawford, Kalkaska, Oakland counties

Year(s): 2005- 2006

Partners: Michigan Department of Natural Resources – Wildlife Division

Modeling Habitat Ecology and Populations Viability of the Eastern Massasauga Rattlesnake in Southwestern Michigan

Kristin Bissell, Dr. Rique Campa

Michigan State University – Department of Fisheries and Wildlife

Michigan is considered the last stronghold for the Eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*), where it is a species of special concern. Understanding the habitat ecology and characteristics of massasauga populations is essential to conservation efforts. Populations of massasaugas have not been previously examined in southwestern Lower Michigan. The objectives of this study were to: 1) quantify movement and habitat use patterns, 2) develop a habitat suitability model, and 3) conduct a population viability analysis (PVA) for massasaugas in southwestern Lower Michigan.

Methods

This study was conducted at 2 sites in Barry County, Michigan. Massasaugas ($n = 12$ in 2004, $n = 18$ in 2005) were captured, implanted with radio transmitters, and tracked daily throughout April – October. Data were collected on snake location, vegetation type, structure, and composition, and population demographics.

Movement and habitat use

The total distances traveled during an activity season ranged from 235.2 m to 5,369.3 m with a mean of 1,334 m. Males traveled greater distances than gravid females; there was no difference between gravid and non-gravid female total distance traveled during the active season. Mean distance traveled per day was 11.8 m and maximum daily distance moved was 315.6 m by a male. Mean daily movements for males (20.8 m) were significantly longer than gravid (7.1 m) and no-gravid (7.6 m) females. Mean 95% fixed kernel home range size was 2.8 ha. The home ranges of females were smaller than males. Home ranges documented in this study were at the lower end of the scale than what is found in the literature, and cannot be attributed to restrictions or barriers such as roads. This may mean that massasaugas at these sites can fulfill their life requisites within a relatively small area. Snakes did show some site fidelity with overlapping home ranges and selection of hibernation areas.

Massasaugas most commonly used early successional deciduous upland and wetland vegetation types. Snakes in this area used herbaceous openland, oak association, and mixed non-forested wetland in greater proportions than available. Suitability of vegetation types increased with higher percentages of live (62–71%) and dead (90–96%) herbaceous cover and decreased as stem density and absolute dominance of trees/shrubs >3 m tall increased. There was a seasonal shift in habitat use, from approximately 90% of locations in early successional deciduous uplands in early spring, to approximately 50% in uplands and 50% in early successional deciduous wetlands in the summer to

a return to 90% of locations in uplands, illustrating movements from and to hibernacula. In this study, massasauga used small mammal and crayfish burrows for overwintering in upland vegetation adjacent to a wetland.

Habitat suitability model

Massasauga displayed a preference for thick live and dead herbaceous vegetation; however optimal vertical ground cover was <100%. Efforts focusing on locating areas supporting massasaugas in southwestern Michigan should concentrate surveys in landscapes consisting of an area with early successional deciduous uplands (43–57%) and early successional deciduous wetlands (32–42%) and in early successional scrub-shrub fens. Live and dead herbaceous cover, stem density of trees and shrubs >3 m tall and absolute dominance of trees > 3 m tall may indicate suitable habitat.

Population viability analysis (PVA)

Snakes in southwestern Michigan had a higher mean annual survival than massasaugas in Canada or the repatriated massasaugas in Wisconsin. Overall mean annual survival of massasauga was 71% and at least some females reproduced annually, suggesting food intake and energy stores are plentiful enough for some individuals to invest in annual reproduction. Based on PVA simulations, populations may be increasing over the next 50 years if following an extant trajectory. Caution must be used when applying these results due to data variability. Results of this study have implications for future conservation of massasaugas in the area.

Management recommendations:

Because massasauga showed some fidelity with home ranges and hibernation areas, these sites should be identified and major disturbances within those areas should be avoided. Efforts to decrease mortality of snakes are encouraged. Education efforts and road signs urging drivers to “Please break for snakes” like those in Ontario Canada could be useful efforts. Validation of the developed Habitat Suitability Index model is still needed.

Location: Barry County

Year(s): 2005

Partners: Michigan Department of Natural Resources – Wildlife Division and Parks and Recreation Division, U.S. Fish and Wildlife Service, Lansing Potter Park Zoo, Pierce Cedar Creek Institute for Ecological Education, Michigan Agricultural Experiment Station, Michigan Society of Herpetologists

Surveys to Assess the Conservation Status and Population Viability of the Eastern Massasauga in Michigan

Yu Man Lee

Michigan Natural Features Inventory

Eastern Massasauga is a federal candidate and state special concern species. Surveys and confirmed reports from 2001-2004 documented over 70 extant massasauga sites in Michigan. However, little information is available on the status and viability of individual massasauga populations, as well as the overall population of this species in Michigan. This information is needed to develop and implement effective conservation and management efforts for this species. The goal of this project was to continue efforts to assess the status and viability of the massasauga in Michigan.

Methods

Intensive mark-recapture surveys were conducted at nine sites throughout the species' range in the state to develop estimates of relative abundance or population size, assess population status, and document habitat use. Visual encounter surveys were conducted at each site consisting of 2-4 surveyors per visit and multiple survey visits from April-September. Drift fences also were used at several sites. Observed snakes were captured, measured, weighed, and marked. Tissue and blood samples were collected from captured snakes for a massasauga genetics study conducted in collaboration with Central Michigan University.

Results

Mark-Recapture Surveys

In 2006, mark-recaptures surveys at 9 sites resulted in 138 total massasauga observations or captures and 43 total recaptures. This data was combined with data collected in 2004, which resulted in a total of 231 individual massasauga observations/captures and 56 recaptures across the nine sites, and a mean of 26 massasauga observations/captures (range 5-47) and 6 recaptures (range 0-16) per site. A total of 116 blood and/or tissue samples were collected during the mark-recapture surveys in 2006. Unfortunately, the number of massasauga observations or captures and the number of recaptures at each site were too low to generate reliable estimates of population size.

Statewide Surveys and Status

Massasauga surveys and confirmed reports from 2001 to 2006 resulted in the identification of 93 extant sites in 31 counties in Michigan's Lower Peninsula. This included at least 33 new occurrences (including one new county record), and updates of at least 57 occurrences, of which about 40 occurrences had massasaugas last observed or reported at the site 10-20 years ago. Of the known extant sites, 77 are located primarily on public or protected lands, and 16 sites are located entirely on private lands. Massasaugas were not documented at 36 previously documented sites and 48 *de novo* sites.



Discussion and Recommendations

Surveys and confirmed reports in 2006 and 2001-2004 determined that the massasauga and suitable habitat for the species still occur at a fairly large number of sites in the state. However, the status and viability of massasauga populations in Michigan remain unclear. Based on observability rate or ease of finding massasaugas, habitat quantity and quality, and evidence of reproduction/recruitment and different age classes, approximately 37 massasauga populations in the state are potentially viable or are likely viable with proper management.

Future efforts and data from these sites could be used to develop an effective survey and monitoring protocol and evaluate the feasibility of developing an index of abundance that could be used to interpret survey data from other massasauga sites. Other survey and monitoring approaches or methods also should be further investigated.

This work was used to help identify potential sites for inclusion in Michigan's Eastern massasauga Candidate Conservation Agreement with Assurances with the U. S. Fish and Wildlife Service (USFWS).

Location: Statewide, with particular focus on sites in Allegan, Barry, Kalamazoo, Livingston, Oakland, Kalkaska, Mackinac, and Montmorency counties.

Year(s): 2006

Partners: Department of Natural Resources – Wildlife Division, Parks and Recreation Division, and Forest Resources Division; Indiana/ Purdue University at Ft. Wayne – Center for Reptile and Amphibian Conservation and Management; Central Michigan University – Department of Biology; U.S. Forest Service – Huron-Manistee National Forest; U.S. Fish and Wildlife Service – Region 3 Office and East Lansing Field Office; and numerous volunteers and landowners

Enhancing the Conservation of Eastern Massasauga Rattlesnakes in Michigan: Human Dimensions of Rare Reptile Management

Rebecca Christoffel, Dr. Shawn Riley

Michigan State University – Department of Fisheries and Wildlife

Michigan is the last stronghold for Eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) within their range. Michigan's only venomous snake is a rare sight for most Michiganders. These snakes are typically shy and sluggish and avoid interactions with humans when possible. They are not prone to strike but prefer to leave the area when they are threatened; but like any animal, they will protect themselves if they have no escape. When compared to other rattlesnakes found in the United States, the massasauga is the smallest and has the least toxic venom. This species is a species of special concern in Michigan and the U.S. Fish and Wildlife Service is currently evaluating the Great Lakes Population to determine whether it should be listed as a federally threatened species. In Michigan it remains an important part of our natural history.

Massasaugas are found throughout the Lower Peninsula, but mainly concentrated in Oakland, Livingston, Jackson, Washtenaw, Allegan, Barry, Kalamazoo, Iosco, Crawford, and Kalkaska counties. Because this snake is shy and rarely seen, it is often misunderstood and feared. These snakes are not aggressive and most of the people who are bitten by them have been attempting to hurt or handle them. They have relatively short fangs that often fail to penetrate clothing and can deliver only small amounts of venom with each bite. Most people recover completely from their bites.

In the case of snakes, human-wildlife encounters frequently result in the death of the animal. Because of this, we need to improve our understanding of the social factors that affect the social carrying capacity for the massasauga in Michigan. Long-term viability of massasauga populations in Michigan likely depends on human tolerance and support for rattlesnake management. This project provides some insight into the social attitudes to help conserve and manage the species.

Results

People with a higher understanding of rattlesnakes are more tolerant of rattlesnakes, suggesting that education outreach efforts can be very effective in influencing people's attitudes towards rattlesnakes and other wildlife. Further, people who currently believe they live in the presence of rattlesnakes have more of a positive attitude towards the snakes, likely due to people acclimating to their presence and recognition that encounters are very rare and so the risks are minimal. Yet, more than one in five people surveyed were unsure whether they lived



in an area with rattlesnakes. Consequently, people living in areas with snakes may not be able to make well-informed decisions or provide relevant input into rattlesnake management in their areas. People are more likely to kill or have a rattlesnake removed from their property, even if the results are detrimental to the snake. Over 80% of people were unaware of existing regulations that protect snakes.

Recommendations

- Building stakeholder capacity to co-exist with snakes can enhance snake conservation and management
- Education is needed in areas with snakes, and efforts should include information about biology and regulations, as well as how the presence of snakes may positively impact their quality of life; this is one of the characteristics of the most successful symbols of environmental concern and would perhaps make snake conservation and management a more salient issue.
- State agencies should develop accurate outreach materials concerning: rattlesnake bites in their state, actions people can take to reduce risk of snakebites, and appropriate actions to take should a person be bitten by a rattlesnake.

Location: Statewide

Year(s): 2007

Partners: Michigan Department of Natural Resources – Wildlife Division, Michigan Natural Features Inventory, U.S. Environmental Protection Agency

A Genetic Evaluation of the Eastern Massasauga in Michigan

Dr. Brad Swanson

Central Michigan University – Department of Biology

Michigan remains the last stronghold of Eastern massasauga rattlesnakes (*Sistrurus catenatus catenatus*). Understanding their population dynamics is crucial to conserving and managing the species. This project used genetic techniques and analyses to better understand the population dynamics of Michigan's massasauga populations.

Results

Our results indicate that massasaugas in most of the Lower Peninsula do not exist as small isolated populations or experience the extreme degree of isolation suggested by other studies (Gibbs et al. 1997). Rather, our results indicate that the Eastern massasauga rattlesnake exists in larger meta-populations, although localized populations also are present within the state. We found two distinct populations of massasaugas in the northern part of Michigan. Not unexpectedly, the population on Bois Blanc Island appears to be more isolated than any of the other populations. The results suggest that the Bois Blanc population has avoided inbreeding despite the dispersal and population size restrictions inherent in an island population. This aspect of the Bois Blanc population does support Gibbs et al.'s (1997) hypothesis that massasauga can survive in small isolated populations.

Based on these results, Oakland, Lenawee, Barry, and Van Buren counties were identified as a single population; suggesting the massasauga must be able to travel greater distances than previously thought. Given the distance between several of the sampling locations within the north and south populations, it is unlikely that direct exchange of individuals is occurring. Most likely dispersal is occurring via stepping stone migration through "ghost populations" (*sensu* Slatkin 2005) not sampled in this study. This type of dispersal is becoming increasingly common as habitat fragmentation continues and can be a powerful mode of gene flow (Schultz 1998, Hale et al. 2001, Peterson 1996, Burton et al. 2002). For snakes in Michigan, dispersal via stepping-stone migration is supported by reports of massasaugas living in most counties between the study populations (Szymanski 1998).

Three additional populations were found in the Lower Peninsula: Livingston, Kalamazoo, and Allegan County. While the Kalamazoo samples fell out as their own population, all of the genotypes appeared to be comprised of Allegan and south alleles. This analysis most likely placed these individuals into

their own populations because it was unable to unambiguously attribute them to either the south population or Allegan. Given the placement of Kalamazoo County this is not overly surprising as Kalamazoo county shares several borders with counties assigned to the south population and with Allegan, reinforcing the concept that animals are moving between locations. Based on the analysis, it appears that the Michigan populations of massasauga are experiencing some inbreeding, however is not yet a major concern within Michigan.

The most surprising population was the Livingston county population. The majority of individuals (22 of 26; 85%) within Livingston County were strongly associated only with this county. The four snakes which did not assign to the Livingston population were a mélange of the other populations and failed to exhibit a strong enough genetic signature to assign them to any of the other populations. The high percentage of the Livingston snakes' genotypes coming only from Livingston indicates that there is little dispersal between the Livingston and south populations. The lack of inter-population dispersal suggests that some barrier to the movement of snakes exists between Livingston county and the counties making up the south population. Identification of this barrier will be an important step in better understanding how massasauga view their landscape and should help to improve conservation and management for the species.

Conclusions

Currently, the massasauga in Michigan appear to be in a stable situation. They do not exhibit the same level of fragmentation found in previous studies and appear to be exchanging individuals across large areas of the state. However, this level of connectedness is likely due to many populations that were not sampled in this study. The maintenance of the massasauga in Michigan likely depends upon identifying and protecting the integrity of the dispersal corridors being used by the massasauga.

Location: Statewide

Year(s): 2006-2007

Partners: Michigan Department of Natural Resources – Wildlife Division, Michigan Natural Features Inventory, Non-Game Wildlife Fund

Bird Recovery Efforts – Project Summaries



Osprey Re-Introduction in Southern Lower Michigan

Lori Sargent
Michigan Department of Natural Resources – Wildlife Division



Historically, Ospreys (*Pandion haliaetus*) and Bald Eagles (*Haliaeetus leucocephalus*) were found throughout Michigan but both declined due to pesticide poisoning. While both populations have rebounded in Michigan, Ospreys only rebounded in the northern part of the state. To aid their restoration statewide, an Osprey reintroduction program was started in southern Michigan.

Programs where chicks are raised to fledgling stages and released in suitable habitat, or hacking programs, have shown success in increasing the rate of colonization in osprey. There is an abundance of suitable habitat for osprey in southern Michigan. The hacking program was needed to speed the natural expansion of the bird's current range and speed the rate of recovery in these areas to enhance the populations, and ultimately remove them from the state threatened list. Osprey that have been reintroduced through this program, as well as their offspring, continue to return to restoration sites. The main goal for the program is to establish 30 nesting pairs of osprey in southern Michigan by 2020.

Accomplishments:

2005: Two chicks were taken from nests in northern Michigan and successfully fledged at Stony Creek Metropark.

2006: Two Osprey chicks were collected from the Backus Creek area in Roscommon County, reared, and were successfully released. Five chicks were collected from the Pike Marsh and Dead Horse Floodings in Roscommon County and released at Stony Creek Metropark. One chick died of West Nile virus shortly after arrival to hack site. The other four chicks were released successfully. Birds were all monitored until the end of August when they presumably moved out of the areas.

2007: Four chicks were collected, reared, and released.

A total of 59 birds have been successfully reared and released through this program. Several nests of hacked birds have successfully fledged young for 5 years. And as of 2007 there were 12 known active nests in the Southern Lower Peninsula.

Location: Southern Lower Peninsula

Year(s): 2005-2007

Partners: Stony Creek Metropark, The Detroit Zoological Society, DTE Energy, Non-Game Wildlife Fund

Nesting Structures Construction and Maintenance

Ray Rustem

Michigan Department of Natural Resources – Wildlife Division

Wildlife restoration for birds sometimes relies on enhancing nesting opportunities by installing nest boxes or platform structures. This project focused on creating Osprey nesting platforms to enhance the hacking program. Wildlife Division staff built and installed nesting platforms, and also provided technical assistance to others doing the same. In subsequent years, all constructed structures were inspected and maintained in useable condition. All structures will be monitored for use and productivity. Based on monitoring results, plans for construction, site selection criteria, and placement guidance may be modified.

Accomplishments:

A total of 8 structures were built and installed and 7 monitoring for effectiveness trips were made.

Location: Statewide

Year(s): 2006-2008

Partners: volunteers



Piping Plover Recovery Management

Ray Rustem

Michigan Department of Natural Resources – Wildlife Division

The Great Lakes population of Piping Plover (*Charadrius melanotos*) is listed as endangered at both the federal and state level. Their reproductive success is affected by human disturbance on the open sandy beaches where they nest. The Wildlife Action Plan identifies protection of breeding pairs and nest sites, and public education and awareness as key components for successful recovery of the species (Eagle et al. 2005). A nest protection program was needed to identify nesting areas, enclose individual nests to prevent trampling and predation of the camouflaged eggs, band chicks and adults to determine reproductive outputs, and educate beach-goers from inadvertently disturbing nests and chicks.

This program works with partners to annually protect all known nesting locations in Michigan by erecting nesting area fencing, individual nest predator exclosures, and provide education and outreach to beach-goers.

Accomplishments:

2006: 7 coordination meetings; 287 nesting surveys were conducted, which exceeded the planned number of surveys due to the identification of new potential habitats; partners in the Piping Plover recovery program conducted nest-protection activities at all known nests resulting in 170 nests protected; 127

birds banded; 9 outreach materials produced including: a Piping Plover fact sheet, a standard Piping Plover information booklet, a Natural Heritage Program coastal ecosystem poster, a plover-focused web page, an education video, PowerPoint presentations, educational signage near nesting sites, beach-closure signage, and regular communications with landowners.

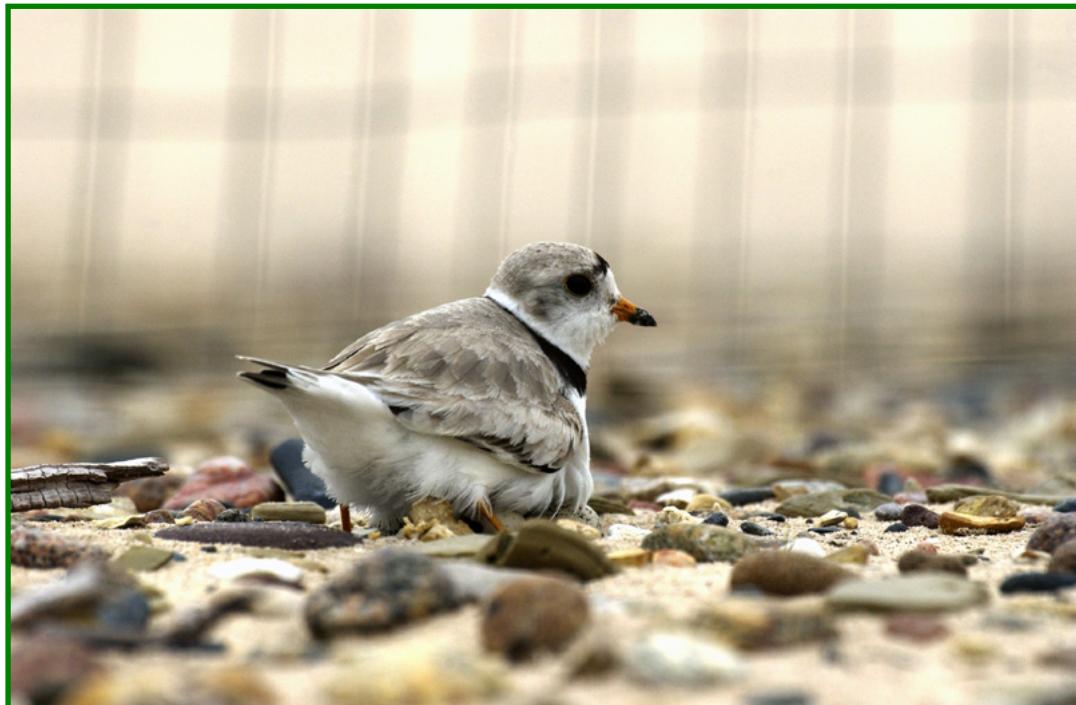
2007: 62 fences were constructed; 187 birds were banded; 1 material was developed

After 2007, Piping Plover management activities have been funded through a Cooperative Endangered Species Conservation Fund grant.

Location: Great Lakes Coast

Year(s): 2006-2007

Partners: U.S. Fish and Wildlife Service, U.S. Forest Service, Little Traverse Bay Band of Odawa Indians, University of Michigan Biological Station, Central Michigan University Biological Station, Detroit Zoo, John Ball Zoo, Saginaw Zoo, and many local volunteers



Peregrine Falcon Nesting Project

*Joe Rogers
Wildlife Recovery Association*

Peregrine Falcons were reintroduced to Michigan's Upper Peninsula from 1988 to 1992. The goal of this effort was to restore wild populations that were decimated by pesticide poisoning and by other human-related activities. After the first nesting pair became established at the Porcupine Mountains Wilderness State Park in 1990, peregrine nests at five wild sites were monitored and protected. Monitoring of these nest sites continued through 2002, establishing fairly consistent nesting records for Porcupine Mountains Wilderness State Park, Trap Hills, Grand Island/AuTrain Island, Pictured Rocks National Lakeshore, and the International Bridge at Sault Ste. Marie. In 2004, only three successful peregrine nests were noted. Additional surveys were needed to determine if other nesting sites exist and the nesting success of those newly identified sites. This information was used in developing each site's annual use plan and in developing banding and management plans for Peregrine Falcons.

Objectives for this project were to 1) locate and/or confirm nesting activity at known nest sites in the Upper Peninsula; 2) locate new Peregrine Falcon nest sites that have not been recorded (including Huron Mountains, Huron Islands); and 3) identify problems with local land management units in locating nests.

Accomplishments:

2005: 9 known nesting areas were investigated for peregrine falcon activity. No Peregrines were observed at 4 of the sites. Nesting was confirmed at 3 sites. No new nest sites were discovered.

Location: Upper Peninsula

Year(s): 2005

Partners: Michigan Department of Natural Resources – Wildlife Division, Non-Game Wildlife Fund



Birds – Project Summaries



Whip-Poor-Will and Common Nighthawk Surveys

Barbara Barton

Michigan Natural Features Inventory

Understanding current population trends and habitat use for selected species of greatest conservation need is necessary to prioritize management activities when budgets and personnel are limited. Species that are largely nocturnal or crepuscular are typically underrepresented in large-scale breeding bird surveys, such as state atlas projects and the North American Breeding Bird Survey (BBS). Due to the difficulty of data collection and recent concerns about possible population declines, special surveys for these species were warranted. Focused surveys increase our knowledge of these birds and provide improved data for the Michigan Breeding Bird Atlas II project, as well as the Wildlife Action Plan. In particular, more comprehensive range distribution and baseline population data was needed for Whip-poor-will (*Caprimulgus vociferus*) and Common Nighthawk (*Chordeiles minor*). Sampling occurred from mid-May to the end of June.

Results

Land cover data was collected at all survey points. Points with Whip-poor-wills were dominated by deciduous forests (37.3%), whereas Common Nighthawk points were associated with deciduous forests (22.8%) and other open areas (19.7%). The majority of Whip-poor-will and Common Nighthawk occurrences were in managed clear cut forests in undeveloped areas of the Northern Lower and Upper Peninsula. Further research on habitat preferences of Whip-poor-wills and Common Nighthawks is needed to better understand their habitat needs in Michigan.



Location: Statewide

Year(s): 2005 – 2007

Partners: Michigan Department of Natural Resources – Wildlife Division

Year	Number of BBS Routes	Number of survey points	Whip-poor-will abundance	Common Nighthawks abundance	Notes
2005	15	131	70	81	Whip-poor-wills were observed at a higher rate in the Northern Lower Peninsula. Neither species was found in the Southern Lower Peninsula.
2006	28	498	101	26	Abundance was greater for both birds in the Upper Peninsula; few birds were found in the Southern Lower Peninsula.
2007	15	141	35	3	Majority of birds were found in the Upper Peninsula.
		<i>Totals:</i>	206	110	

Owl Surveys in Support of the Breeding Bird Atlas II

Michael Monfils
Michigan Natural Features Inventory

Woodland owls are largely nocturnal, often use remote habitats, and breed in the late winter or early spring. As such, they are typically underrepresented in large-scale bird surveys. Consequently, information is lacking on the distribution, abundance, breeding phenology, and habitat use of woodland owls. This work supplements the Michigan Breeding Bird Atlas II project.

Surveys

Six owls were heard, in decreasing order: Eastern Screech-Owl (*Otus asio*), Barred Owl (*Strix varia*), Great Horned Owl (*Bubo virginianus*), Northern Saw-whet Owl (*Aegolius acadicus*), Long-eared Owl (*Asio otus*), and Boreal Owl (*Aegolius funereus*). Boreal Owls were not heard in 2004 or 2005. In the Southern Lower Peninsula Eastern Screech-Owls were recorded more than four times as often as Great Horned or Barred Owls. Great Horned Owl observation rates were similar among survey periods and zones of the state and low compared to Eastern Screech-Owl and Barred Owl. Barred owl was more common than any other species in the Northern Lower Peninsula and Upper Peninsula.

Year	Number of BBS Routes	Number of owls	Number of species
2004	19	456	6
2005	19	634	5
2006	19	949	6
Total:		2,039	6

Detection Probabilities

Likelihood-based models were used to estimate site occupancy rates and detection probabilities for Eastern Screech-Owl, Great Horned Owl, and Barred Owl. This approach also allowed for an assessment of how these estimates were influenced by landscape-level habitat and environmental factors.

The best-approximating model for 2006 Eastern Screech-Owl data indicated that the estimated proportion of sites occupied increased with increasing amounts of agriculture and herbaceous upland. Detection probability varied by survey and appeared to be higher when survey time was later at night. Wind was negatively related to probability of detection. The estimated proportion of sites occupied was similar to our observed proportion. Using the range of estimated probabilities of detection, it was estimated that 2-3 surveys would be needed to have 80% confidence that lack of detection means Eastern Screech-Owl is not present at a site.



The Great Horned Owl model best supported by our 2006 data indicated increasing site occupancy with higher proportions of agricultural and herbaceous upland and lower amounts of coniferous and mixed forest, water, and bare/ sparsely vegetated ground. Wind again appeared to negatively affect detection probability. Model-estimated site occupancy was more than three times as high as the observed proportion. Probability of detection was low. Using the range of estimated probabilities of detection, it is estimated that 11 surveys would be required to have 80% confidence that Great Horned Owl is absent from a site when not detected.

The model best supported by the 2006 Barred Owl data indicated that the proportion of sites occupied appeared to increase with increasing proportions of forest and decreasing amounts of agriculture, herbaceous upland, and urbanized land. Wind again was negatively related to detection probability. The model-estimated proportion of sites occupied was higher than the observed proportion. Probability of detection increased with each successive survey. Using the lowest and highest detection probabilities, it was estimated that 2-9 surveys (mean of 4) would be needed to have 80% certainty that Barred Owl is really absent when not observed.

Location: Statewide
Year(s): 2005 – 2006

Partners: Michigan Department of Natural Resources – Wildlife Division

Avian Collisions with Communication Towers: A Quantification of the Associated Tower Variables

Dr. Joelle Gehring

Central Michigan University – Department of Biology

Avian mortality has been documented at communication towers for over 50 years (Bernard 1966, Shire et al. 2000). Past research suggests that birds, primarily night migrating songbirds, become disoriented when night skies are overcast and are then attracted to the lights of tall structures, such as communication towers (Larkin 2000). The U.S. Fish and Wildlife Service (USFWS) estimates that as many as 4-5 million birds per year collide with and die at communication towers, however, some sources suggest the number could be significantly higher (Shire et al. 2000). Several studies have recorded thousands of birds colliding with individual towers during a single night of migration (Breckenridge 1958, Bernard 1966). Shire et al. (2000) compiled information from documented cases of bird mortalities at communication towers throughout the United States. They found that 230 species of birds, greater than 25% of all bird species in the U.S., are killed at towers. In Michigan (USFWS Region 3), 77% of the bird species on the Birds of Conservation Concern (BCC) list have been found dead under communication towers. Despite these documented mass kills of a diversity of bird species, little formal, experimental, large-scale research has been conducted to identify tower variables likely to increase the risk to migrating birds (Shire et al. 2000). In addition, towers continue to be constructed throughout the U.S. at a rate of approximately 5,000 per year (Shire et al. 2000). The increased use of cellular phones via the Personal Communication Service Industry and digital television will continue the need for and construction of these structures.

The Federal Communications Commission and the general public are growing increasingly aware of the risk these towers present to migrating birds, predominantly neo-tropical migratory birds. Medium-sized towers (116-146 m) attract and cause bird mortality and are also frequently constructed for cell phone users, and increase in numbers every year. When working towards neo-tropical migratory bird conservation, the cumulative bird mortality caused by collisions with the many towers across a landscape or a nation need to be considered.

This study examined the relationship among tower height, light types (red strobes, white strobes, and red blinking incandescent), guy wires, and avian mortality during the spring and fall migrations. This research is a first step to quantifying that cumulative effect and preventing it. The following night-time tower light systems were compared: 1) towers with white strobe lights but no steady burning (non-flashing) lights; 2) towers with red strobe lights but no steady burning lights; 3) towers with red, flashing, incandescent lights but no steady burning lights;

and 4) towers with both flashing red strobe lights and steady burning lights (status quo). Nine of the towers were self-supporting (no guy wires) and the remaining 12 were supported by guy wires.

Results

Over 20 days a total of 173 birds were found killed under towers. Observer detection and bird carcass removal (scavenging) rates were also quantified. A mean of 3.7 birds were found under towers 116-146 m Above Ground Level (AGL) that lacked non-blinking lights while towers of the same height configured with non-blinking lights killed 13.0 birds per season. Two 20-day sample periods detected a mean of 42.0 birds per tower under towers >305 m AGL. Using the Kruskal-Wallis test, Analysis of Variance, student-t test, and multiple comparisons procedures it was determined that towers lit at night with only blinking lights were involved in fewer avian fatalities than towers lit with systems that included non-blinking lights. In addition, guyed towers >305 m AGL were shown to be involved in significantly more avian collisions than both guyed and unguyed towers 116-146 m AGL. Previous field seasons of this research determined that unguyed (self-supported) towers were involved in significantly fewer avian fatalities than towers supported with guy wires. Therefore, avian fatalities can be minimized via directing future tower construction toward unguyed towers, shorter towers, and towers configured with only blinking light systems. Used in concert these findings provide communication tower stakeholders and bird conservation stakeholders with multiple, legitimate, scientifically-supported options by which to greatly reduce bird collisions while maintaining our use of communication towers.

This research revealed that easy, cost-effective changes in light types significantly decreased bird mortality. Partly because of this research, the Federal Aviation Administration is considering changes in tower lighting regulations.

Location: Statewide

Year(s): 2005

Partners: Michigan Department of Natural Resources – Wildlife Division, Michigan Natural Features Inventory, Michigan Office of the Attorney General, U.S. Fish and Wildlife Service, Federal Aviation Administration, Federal Communications Commission, U.S. Forest Service, American Bird Conservancy

Grassland Bird Surveys in Support of the Breeding Bird Atlas

*Julie Gibson, Helen Enander
Michigan Natural Features Inventory*

Grassland birds, as a group, have suffered the most severe population declines of any other birds. Many historic grasslands are fragmented and undergoing succession to shrubland and early successional forest. Most of the existing grasslands are managed wildlife plantings and openings on state lands. This project identifies the most critical sites in Michigan for the continued conservation of grassland birds, and supplements the Michigan Breeding Bird Atlas II. This work will also help land managers and planners prioritize their work.

Surveys

A total of 14,529 individuals were detected, of which 931 were grassland obligate with state listed species status. State-listed species documented include: Dickcissel (*Spiza Americana*), Grasshopper sparrow (*Ammodramus savannarum*), Henslow's Sparrow (*Ammodramus henslowii*), Sharp-tailed Grouse (*Tympanuchus phasianellus*), Western Meadowlark (*Sturnella neglecta*), Hooded Warbler (*Wilsonia citrina*), and Prairie Warbler (*Dendroica discolor*). All state-listed species information was entered into the state's natural heritage database. New and updated occurrences were used to create distribution maps of select grassland obligate species throughout Michigan.

Year	Number of surveys	Number of BBA survey blocks	Number of state listed species
2005	175	81	5
2006	300	191	6
2007	106	128	7
<i>Totals:</i>	<i>581</i>	<i>338</i>	

Microhabitat analysis

Logistic regression was used to describe and compare microhabitats of Bobolink (*Dolichonyx oryzivorus*), Grasshopper Sparrow, and Henslow's Sparrow based on several habitat parameters. Decreased litter depth separated Grasshopper Sparrow from Bobolink and Henslow's Sparrow habitat, while the latter two species did not appear to select different habitat from one another, based on the variables measured. Grasshopper Sparrow is widely recognized as preferring relatively short, somewhat sparse and patchy grass with some bare soil. Bobolink is more of a grassland generalist, preferring medium to dense vegetation of medium to tall height. Finally, Henslow's Sparrow is known to occupy tall, dense vegetation, often with a well developed litter layer (Sample and Mossman 1997). These results confirm reports that Grasshopper



Sparrow prefers grasslands with decreased litter depth. These results showed no separation between Bobolink and Henslow's Sparrow habitat preferences, further emphasizing the generalist nature of Bobolink.

Predictive distribution modeling

This project generated, compared, and validated three element distribution model types for Henslow's Sparrow using recently collected presence/absence data and environmental features of the Lower Peninsula. The models implement the maximum entropy method Maxent (Phillips et al. 2004, 2006), Domain (Carpenter et al. 1993), and Classification and Regression Tree (CART) analysis based on the randomForest package for R. (Breiman et al. 2004). All models produced results better than random, according the AUC (area-under-the-curve) criterion. The best model describing environmental variables related to the predicted presence (and absence) of suitable Henslow's Sparrow habitat was Maxent at the 250-m scale. This model based suitability primarily on increased pasture/forage, Ecoregional subsection, and decreased forest. These top three combined variables explained 53.9% of the model variation. Results indicate local selection for openlands in specific regions of (primarily) the Southern Lower Peninsula. At the largest scale (1 km), a low proportion of cropland was the best predictor of suitability, followed by soil surface texture and Ecoregional subsection, explaining 34.2%, 13.1% and 12.4% variation, respectively, for a combination of 59.7%. The negative impact of cropland at the 1 km scale suggests that suitable Henslow's Sparrow habitat includes areas of pasture/forage locally, however the species ultimately does not benefit from intensively farmed areas where croplands dominate the larger landscape.

Landscape analysis

Results showed that Henslow's Sparrow favored the agriculture dominated Southern Lower Peninsula. However, a low proportion of cropland increased suitability at the largest scale (1000 m). These results may suggest that the species is selecting areas of pasture/forage at a smaller scale, but is ultimately not benefiting from intensively farmed areas where croplands dominate the larger landscape.

Location: Statewide

Year(s): 2005 – 2007

Partners: Michigan Department of Natural Resources – Wildlife Division, Kalamazoo Nature Center, Michigan State University, local birders

Kirtland's Warbler Protection: Revealing the Links Between Breeding and Wintering Habitats

Kimberly Hall, Dr. David Ewert

Michigan State University – Department of Fisheries and Wildlife, The Nature Conservancy

Development of a comprehensive conservation program to protect the federally-endangered Kirtland's Warbler (*Dendroica kirtlandii*) requires managing and conserving breeding and wintering grounds and migratory stopover sites. This project evaluated the degree to which birds banded within four wintering areas on Eleuthera (the Bahamas) are spatially associated on the Michigan breeding territories. In addition, the project provided valuable data for estimating both rate and timing (migration, breeding season, or wintering season) of mortality, and duration of migration. This information will be used to update the Kirtland's Warbler recovery plan and future planning efforts in the Bahamas.

Results

A total of 952 Kirtland's Warblers (848 males, 104 females) were observed sufficiently well to determine their banding status; eleven of the 848 males (approximately 1%) were banded. Eight of the 11 banded birds we found had been color-banded in the Bahamas, and three had been banded in Michigan. Using the official Kirtland's Warbler count of 1,418 as an estimate of the total number of singing males, approximately 61% of males found by the census were checked for bands. The eight banded males found represent approximately 15 % of all the male Kirtland's Warblers banded in the Bahamas from March 2002-April 2005. However, many of the birds banded in the Bahamas are likely to have died prior to this breeding season, so detection was probably a much higher proportion of the total number of banded males present in Michigan. When combined with other banded males located in prior years (1 in 2003, 5 in 2004), we identified a breeding territory for 26% of the Bahamas-banded males, and these territories have been scattered among the townships within the species' breeding range. Interestingly, all five of the newly-located males were banded in the 2004-2005 Bahamas field season, leading to a 36% detection rate for this subgroup of birds newly banded and known to be alive in the winter directly before this season of our study. We were not able to locate any of the 25 female Kirtland's Warblers that were banded in the Bahamas over the same time period (March 2002-April 2005). For one of the Bahamas-banded birds, we were able to work with our collaborators on the Bahamas to estimate a maximum duration of migration of 34 days; this bird was first confirmed in Michigan on May 11, but was likely present on May 10 as well.

In addition to searching for banded Kirtland's Warblers, this project provided data on birds observed in 20+ blocks to the in-progress update of Michigan's Breeding Bird Atlas II.



Discussion

Although sample size was very small, these data suggest that Kirtland's Warblers overwintering at the same site (there are several sites for banding in the Bahamas) breed at two or more different sites. In other words, there is no tight linkage between wintering and breeding areas at such a fine spatial scale. This is consistent with the dispersal of birds on the Michigan breeding grounds as individuals have been documented to breed at different sites in different years and nestlings have been located up to 676 km from their natal site (Walkinshaw 1983). This result is also in agreement with stable isotope work on Bicknell's Thrush (*Catharus bicknelli*, Hobson et al. 2001) and Black-throated Blue Warblers (*Dendroica caerulea*; Chamberlain et al. 1997), which suggests that other migratory songbirds that breed in different regions of species' ranges mix at wintering sites. However, it is possible that there is some level of association (i.e., when compared to random assortment) at larger scales, and these analyses are currently in progress.

An exciting, unexpected result was locating two very old birds – 10 and 11 years old. The previous longevity record for Kirtland's Warblers listed at the U.S. Geological Survey Breeding Bird Laboratory (the entity that permits all banding of birds) was nine years (Klimkiewicz 2005). The age of 11 years ties the longest-lived warbler of any species known to the Breeding Bird Lab; we hope to search for these birds again in 2006 to see if the Kirtland's Warbler can set a new record.

Location: Northern Michigan
Year(s): 2005-2006

Partners: Michigan Department of Natural Resources – Wildlife Division, Non-Game Wildlife Fund

Examining the Structure and Productivity of Avian and Vegetative Grassland Communities in Michigan CREP Lands

Dr. Kelly Millenbah, Dr. Henry Campa, III, and Adria Van Loan; Michael Donovan and Mark Sargent

Michigan State University – Department of Fisheries and Wildlife; Michigan Department of Natural Resources – Wildlife Division

In Michigan, it is estimated that at least 39 native prairies covering approximately 1 million hectares existed prior to European settlement, mostly in the Southern Lower Peninsula (Sargent and Carter 1999). Currently it is estimated that fewer than 810 hectares remains. The drastic decline of native grasslands has had significant negative impacts on the plant and animal species that inhabit them. Grassland birds, particularly endemic species, have declined more rapidly, more consistently, and over a wider geographic area than any other guild of North American birds (Knopf 1996).

Although native grasslands in Michigan have become rare, non-native grasslands, including old fields and other agricultural land use types, occur widely. Some of these grassland types can provide important wildlife habitat functions, such as nesting cover and food provision. Set-aside programs such as the U.S. Department of Agriculture's Conservation Reserve Enhancement Program (CREP) increase the number of native and non-native grasslands in Michigan and may diminish or reverse the decline of some grassland bird species (Knopf 1996).

The purpose of this study is to evaluate and compare the vegetation and avian community characteristics of native and non-native CREP grasslands in Michigan to determine the habitat suitability of different CREP fields for grassland bird communities (Lamp et al. 2004).

Fourteen whole field grassland CREP fields in Tuscola County were selected for the study. In an effort to determine differences in wildlife response to different planting regimes, seven fields were selected from each of two categories: 100% native grasses (CP 23 field types); and 30:70 native to non-native grasses (CP1 field types). Field size ranged from 7.3 to 23.9 hectares. Study fields were located in relatively close proximity and had similar topography and landform.

Vegetation

Native and non-native areas of CREP fields were intentionally planted to create differing species compositions. The native fields were planted with a larger variety of species. The native and non-native fields had clear structural differences, both to the eye and when statistically analyzed. The results of the analysis showed that one of the most significant differences between the two types of CREP fields was the significantly larger amount of bare ground not covered by the canopy or by the leaf litter in native planted fields. Areas of bare ground are known to be

useful to both insectivorous and grainivorous birds, particularly in winter (Atkinson et al 2004, Moorcroft et al. 2002). Another clear difference between the native and non-native planted fields was the significantly greater amount of standing dead vegetation that persisted in the native fields. As a result, the native fields provide shelter to wildlife from wind and other harsh winter weather that the flattened dormant vegetation of non-native fields do not. This tendency has been observed by natural resource managers and utilized by them to supply winter cover for wildlife and game species such as pheasants. In fact, the standing-dead cover that native grasses create is a main reason that 30% of the area of CP1 fields are planted with native vegetation. In addition to the differences in resources that they offer for birds, the native and non-native grasslands provided resources at different times of the breeding season.

Avian species richness and abundance

The community of birds in native plantings was both richer and more diverse than in non-native plantings, even when the native portions of CP1 fields were included in the analysis. Avian densities were not significantly different in the fields, likely due at least in part to the red-winged blackbird population, which were present in high numbers in both types of vegetation but were much more abundant in the non-native plantings. The community of grassland specialist species was also richer in native planted fields than in non-native fields, and the densities of species in the grassland bird community tended to be higher in native plantings.

Recommendations

Management recommendations for avian species management and grassland bird conservation on CREP lands include the following:

- maintain existing whole-field (CP23) plantings of native grasses and forbs; and
- increase the number of whole-field (CP23) plantings where avian species management and grassland bird conservation are priorities.

Location: Tuscola County

Years: 2005-2008

Partners: Michigan Department of Natural Resources – Wildlife Division

Michigan Breeding Bird Atlas

Kalamazoo Nature Center

In 1983, the Department initiated Michigan's first comprehensive statewide breeding bird survey, leading to the publication of the first statewide *Atlas of Breeding Birds of Michigan* in 1991. This information provided a reference point for the abundance and distribution of birds statewide. Since its publication, the book and data have provided vital information for a number of planning and management efforts across the state and nationally. This information was vital in developing the species of greatest conservation need list as well as priority threats and conservation needs for many avian species in the Wildlife Action Plan. Updated information is critical for understanding population trends and providing up-to-date information for management and planning activities. This updated data will also provide the basis for re-assessing the species of greatest conservation need list. The project objectives were to:

1. collect baseline data using an accepted protocol that will allow for long-term monitoring of trends; and
2. gather information on the habitat use of nesting species at the landscape level that can be used in conservation planning and management.

The Michigan Breeding Bird Atlas II effort also provides an opportunity to improve and increase the data collected on species or guilds that are rare, were under surveyed in the initial project, or are inherently difficult to survey.

This project is still on-going. Species accounts have been drafted and data has been entered into a database.

Accomplishments:

2006: Work included coverage of 3,648 blocks, of which 1,203 were priority blocks.

2007: Focused work on increasing coverage of priority blocks and special surveys, developing the publication proposal, and analyzing data. This year was one of the most productive. A total of over 100,000 records were collected during 2007. Forty-two of the 43 state or federally listed bird species were reported by participants to date.

Location: Statewide

Year(s): 2006 – continuing

Partners: Michigan Department of Natural Resources – Wildlife Division, Michigan Natural Features Inventory, U.S. Fish and Wildlife Service, Michigan Audubon Society, Arcus Gay and Lesbian Fund, Herbert H. and Grace A. Dow Foundation, Saginaw Bay Watershed Initiative Network, Kalamazoo Community Foundation, Frey Foundation, volunteers

Michigan Important Bird Areas

Caleb Putnam

Michigan Audubon Society

The Important Bird Areas Program (IBA) is an international effort coordinated by BirdLife International to identify and preserve essential bird habitat world-wide. The program currently operates in 178 countries and has identified over 8,000 IBA sites. The United States (U.S.) partner, the National Audubon Society, has IBA programs in 48 states with 1,162 state-level sites recognized. Nearly 100 sites in the U.S. are global-level IBAs and five are continental-level IBAs.

The Michigan Important Bird Areas Program is a joint effort with the Michigan Audubon Society, Michigan Department of Natural Resources, Detroit Audubon Society, National Audubon Society, and Kalamazoo Nature Center. This project officially began in March 2006. Working from a list compiled by the partners of over 120 potential sites and over 350 additional sites worthy of consideration, the Michigan Technical Committee first reviewed the potential global and continental sites for referral to the national level technical committee. Over 20 IBAs have been formally identified. Four sites had public recognition ceremonies: Kirtland's Warbler Management Units near

Grayling, Tawas Point State Park, Barry State Game Area, and Yankee Springs Recreation Area.

Accomplishments

Meetings were held with Site Support Groups, also known as Adoption Groups, to discuss monitoring and protecting IBAs. This project focused on identifying global and continental IBA sites to be recommended to the US Technical Committee. GIS spatial layers were created for the 100 “best” potential IBA sites. State criteria for IBAs are currently underway.

For more information:

<http://web4.audubon.org/bird/iba/michigan/>

Location: Statewide

Year(s): 2006

Partners: Michigan Department of Natural Resources – Wildlife Division, Kalamazoo Nature Center, Detroit Audubon Society, National Audubon Society, Non-Game Wildlife Fund

Differential Habitat Use by Long- and Short-Distance Migrants at Nayanquing Point State Wildlife Area, Lake Huron, Michigan

Ryan Dziedzic, Dr. Michael Hamas

Central Michigan University – Department of Biology

During seasonal migrations, forest-dwelling birds encounter diverse habitats as they migrate along the shorelines of the southern Great Lakes where the lack of continuous arboreal cover in some coastal wetlands may constitute an ecological barrier for some species. However, dispersed stands of woody vegetation can help to sustain migrants by providing vital protection and foraging substrate. Systematic sampling in wetland habitats at Nayanquing Point State Wildlife Area provided a measure of avian diversity and densities in addition to abundance of arthropod resources available to migrants.

Methods

Six transects, each 200 m long, were established at Nayanquing Point. Each transect was a different habitat: forest-dune (eastern cottonwood and ash), short-wetland-scrub (<3 m tall; sandbar willow and red-osier dogwood), tall-wetland-scrub (>3 m tall; sandbar willow), intermittent-scrub (along road and sandbar willow and red-osier dogwood), scrub-saplings (red-osier dogwood and ash saplings), and a control (grasses and forbs, no woody). Bird surveys were conducted at two to three day intervals during the migratory period in April and May for a total of 15 surveys. Vegetation was characterized along each transect.

Results

Habitat heterogeneity appears to be a decisive factor determining forest-dwelling, long- and short-distance migrant's stopover areas during spring migration along Lake Huron's Saginaw Bay. The forest-dune transect consistently exhibited a great diversity of species, higher species richness, and higher densities than other transects likely because other transects lacked mature trees with a complete understory of shrubs. Tall-wetland-scrub, and to an extent scrub-saplings, contained disproportionately more migrants (especially long-distance migrants) than the short-wetland, intermittent-scrub, or the control, likely due to dense cover that provides adequate foraging habitat during necessary refueling and rest periods.

Overall, long-distance migrants, comprised mainly of vireos, thrushes, warblers, flycatchers, and some blackbirds, most readily displayed habitat use trends more so than short-distance migrants being mostly composed of sparrows, thrushes, and kinglets. Two factors, density of breeding wetland sparrows and foraging plasticity, permitted short-distance migrants to better utilize all habitats at Nayanquing Point State Wildlife Area. Short-distance migrants demonstrated no trends specific to any transect's habitat, not only because common breeding sparrows, the Song Sparrow (*Melospiza melodia*) and the Swamp Sparrow (*Melospiza georgiana*) populate the entire coastal wetland

Figure 1: Average species richness of both long- and short-distance migrants along each transect per survey period

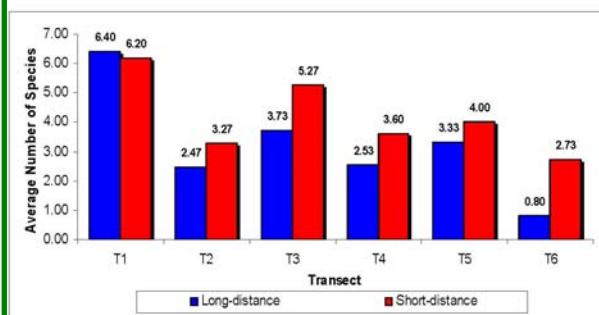
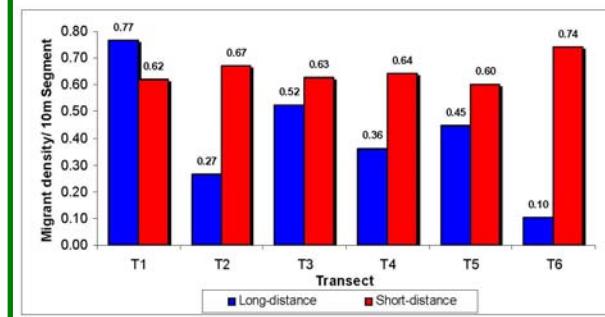


Figure 2: Average long- and short-distance migrant density along each transect per every 10m



complex, but they may also be finding the structure necessary to serve their needs along all transects which is intuitively plausible since several short-distance migrants are birds of the forest edge and/or low, dense shrub cover. Thus, densities appear higher for short-distance migrant regardless of habitat type.

Conclusions and Recommendations

It appears that habitat comprised of mature trees forming a canopy (or are canopy-like) with an extensive shrub layer best serves the needs of forest-dwelling long- and short-distance migrant landbirds when they encounter extensive wetland complexes during spring migration along Lake Huron's Saginaw Bay. If forested habitat is not feasible, tall (>3m), dense shrubs may offer adequate shelter and foraging substrate for a wide array of migrating, forest-dwelling landbirds.

Location: Bay County

Years: 2005-2006

Partners: Michigan Department of Natural Resources – Wildlife Division, Non-Game Wildlife Fund

Determining Critical Spring Stopover Sites for Neotropical Migrants in the Beaver Archipelago of Northern Lake Michigan

Dr. Nancy Seefelt

Central Michigan University – Department of Biology

Information about stopover ecology of Neotropical migrants is lacking and has been identified by The North American Landbird Plan as a priority need. This project examined the use of the Beaver Island area as a potentially important stopover site for migrating landbirds. Because of its location in the open waters of Lake Michigan, the Beaver Archipelago appears likely to provide habitats that are important for migrating birds.

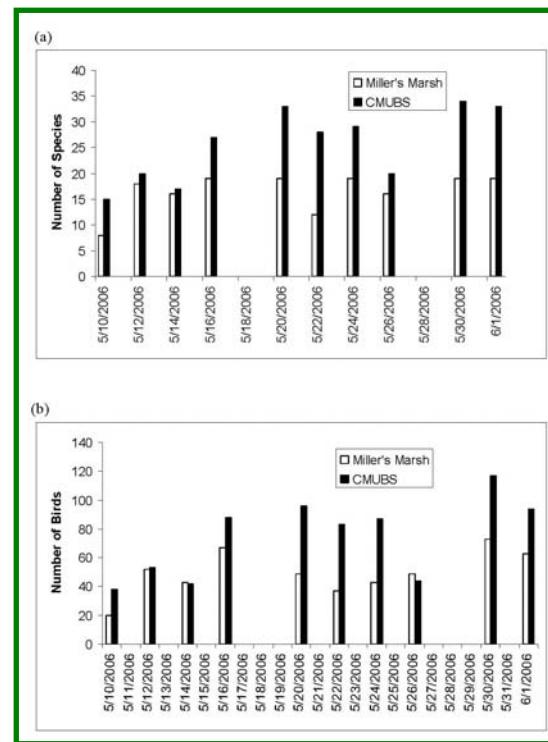
Results

Using a modified-area search method, a total of 35 avian species were documented to use an inland site during spring migration; of these, 13 species are listed as Neotropical migrants. At a shoreline site, 53 avian species were documented during spring migration; of these, 20 Neotropical migrant species were recorded. Twenty-one avian species were found in both habitats during the study period. A total of 65 species (108 nests and/or territories) were confirmed or probable breeders during the breeding bird survey of selected Beaver Archipelago locations. A total of 58 species were observed on Beaver Island, however, 16 species were recorded on Gull, Hat, High, Pismire, Garden and/or SE Garden Islands.

Discussion

This preliminary research has begun to shed light on which species are using the Beaver Island area. Overall, both the inland (Miller's Marsh) and shoreline (Central Michigan University Biological Station, CMUBS) sites provided habitats to spring migrating birds. Although some bird species were found at both sites, more species of Neotropical migrants were found at the CMUBS site; over half of these species were wood warblers. In addition, birds that have been identified as species of concern were documented, with more species of concern found at the shoreline location. Although, on average, a higher percentage of individual Neotropical migrants, when compared to the total number of birds, were encountered at the Miller's Marsh site on each census date, about half of these birds were Least Flycatchers. The Least Flycatchers, however, is considered to have declining populations in eastern North America (DeGraaf & Rappole 1995), so documenting a breeding population on Beaver Island is an important find.

The CMUBS site had a greater diversity of Neotropical migrants, even though they were a smaller percentage of all birds encountered. In addition, as spring migration proceeded, new migrant species were more likely encountered at the CMUBS shoreline site. The CMUBS site offered greater vegetation complexity and diversity as compared to the inland location. This may have provided more accessible cover for migrants, as well as greater food availability. In fact, the reason Neotropical migrant foraging behavior was not recorded at inland sites is that species found at the shoreline were difficult



to locate inland. When they were located, they were moving quickly and could not be observed foraging for more than a few seconds before moving on, if they were foraging at all. As such, more research is needed before the importance and quality of stopover sites can be determined.

Conclusions and Recommendations

Birds were abundant at both inland and shoreline locations on Beaver Island during spring migration. By far, greater diversity in all bird types (long- and short-distance migrants, as well as resident birds) were found at the shoreline site. Comparing migrants' use of shoreline and inland habitats during migration, and beginning to describe these sites, has begun to provide information that should allow for better conservation and management plans. In addition, ascertaining stopover use of habitats on the smaller, uninhabited islands may provide further insight on how human-impacted lands (like those on Beaver Island) influence the migration and behavior of migrant birds. Data collected during 2006 serves as preliminary information to aid in designing future studies on stopover sites in the Beaver Archipelago.

Location: Beaver Island area

Year(s): 2006

Partners: Michigan Department of Natural Resources – Wildlife Division, Non-Game Wildlife Fund

Bats – Project Summaries



The Bat Community along Black Creek, Lenawee County, with Emphasis on the Evening Bat and Indiana Bat

*Dr. Allen Kurta, Rachel Bricklin, Olivia Munzer, Joshua Stumpf
Eastern Michigan University – Department of Biology*

Michigan has nine species of bats, seven of which are species of greatest conservation need. Black Creek is an important area for bats because eight species of bats have been found to use this area: big brown bat (*Eptesicus fuscus*), little brown bats (*Myotis lucifugus*), northern bats (*Myotis septentrionalis*), Indiana bats (*Myotis sodalis*), evening bats (*Nycticeius humeralis*), red bats (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and silver-haired bat (*Lasionycteris noctivagans*). This area also harbors one of two sites in Michigan that have all three bat species of *Myotis* that live in the state. Much is still unknown about these secretive species. This study was the first to examine the ecology and behavior of a northern population of evening bats and the first multi-year study of a single colony of evening bats anywhere in their range.

Movements and distributions

Mist nets were used to learn more about the seasonal patterns and timing of migration and reproduction of bats. The big brown bat was found to be a year-round resident in the Black Creek area. While other species appear in the area starting in May and typically are gone by mid-September; the Indiana bat and evening bat appear to migrate south earlier in August. Most (56–74%) adults collected during this study were females. For most species of bats, males and females typically spend the summer apart and come together again in early fall when courtship and mating are initiated.

Before 2004, evening bats were thought not to be residents of Michigan. This study demonstrated that there is indeed a resident and reproducing colony in Michigan; the northernmost on the continent.

The distance that individual evening bats traveled overnight between roosts ranged from 18 to 3,041 m, with a mean of 547 ± 102 (SE) m/switch. Distance that individual Indiana bats traveled overnight between roosts ranged from 35 to 2,746 m, with a mean of 886 ± 344 m/switch. Northern bats had the largest roosting home range, extending from the River Raisin, west along Black Creek, with many roosts along the Grinnell Drain and Bear Creek. Movement patterns of radiotracked animals suggested that three separate colonies may exist. Distance that individual northern bats traveled overnight between roosts ranged from 10 to 738 m, with a mean of $201 \pm$



27 m/switch. With one exception, little brown bats did not change between roost sites, indicating the existence of multiple colonies.

Habitat

Evening, Indiana, and northern bats were often found roosting in green ash trees (*Fraxinus pennsylvanica*); a typical roost was larger in diameter, taller, and grew in areas with lower density and greater basal area of trees than in randomly chosen sites. Most bats roosted in areas of mature bottomland forest along the river. Evening bats mainly used crevices and cavities (73%) and under exfoliating bark (27%), whereas northern bats mainly roosted under exfoliating bark (82%) and in cavities and crevices (16%) less often. No evening bat ever roosted in isolated woodlots away from the river. Indiana bats

consistently roosted under exfoliating bark. Little brown bats typically occupied barns, as well as a concrete bridge over the River Raisin. This is the first report of reproductive females of any species of bat in Michigan using a bridge as a day roost.

Diet

The diet of evening bats included 14 orders of insects and two orders of arachnids. Four orders—Coleoptera (beetles), Diptera (flies), Hymenoptera (wasps, bees, ants), Hemiptera (aphids, planthoppers)—comprised 85% of the volume of the diet.

Recommendations

The evening bat is in the process of being listed as state-threatened in Michigan, which will give it legal protection. As with the Indiana bat, surveys for evening bats might be required in response to potential construction projects, and/or tree-cutting may be restricted to the time that evening bats are not in Michigan to prevent indirect take. This project's data tentatively suggests that a no-cut period of 1 May to 31 August may be sufficient for this species.

Location: Black Creek, Lenawee County

Year(s): 2006-2008

Partners: Michigan Department of Natural Resources – Wildlife Division

Monitoring and Protecting Bat Populations in the Upper Peninsula of Michigan

Steven Smith, Dr. Allen Kurta, Bill Scullon

S.M. Smith Co., Eastern Michigan University, Michigan Department of Natural Resources – Wildlife Division

Artificial habitats can be important for species of greatest conservation need. In Michigan, four species of bats, silverhaired bat (*Lasionycteris noctivagans*), northern bat (*Myotis septentrionalis*), Indiana bat (*Myotis sodalis*), and eastern pipistrelle (*Pipistrellus subflavus*), use abandoned mines for winter hibernacula. Populations fluctuate due to changing water levels, mine closures, human persecution, deforestation, outward spread of light sources, reduced insect numbers, and other factors. However, mine closures to address human safety concerns may still have the largest overall impacts on bat populations. This project identified mines and installed exclusion gates at sites important for bats. Bat-friendly mine exclusion gates are needed to maintain hibernacula while providing for human safety. Data was collected on mine use by bats, as well as habitat parameters.

Results

A large population of bats, more than 2,200, were found in the Lafayette mine in Porcupine Mountains State Park; this is the tenth largest population known in Michigan. Two new locations for the eastern pipistrelles were found, including the westernmost capture site for the species in Michigan. In 2007, the largest known wintering population of eastern pipistrelles was found in the Vulcan Tourist Mine site in Dickinson County. Minimum estimated populations of 14,000+ bats were surveyed in this underground abandoned iron mine complex. The majority of the bats hibernating here are little browns, but there are significant numbers of big brown bats, northern long-eared bats, along with eastern pipistrelles. This is most likely within the top five known hibernacula in Michigan, perhaps even ranking higher.

Accomplishments:

2005: 15 mine sites were visited, as well as 4 adits (a horizontal passage entering a mine; it may end blindly or connect with drifts and shafts) in Dickinson, Ontonagon, Gogebic or Iron counties. Species of bats and estimates of population size for each mine were recorded. Temp, depths, humidity, type, maps, and other info were also collected for each mine.

2006: Three mine sites were surveyed in Gogebic County with a total population of 75 bats. The South Bluff Adit East in Ontonagon County was surveyed and contained 2,391 bats making it the number 10 site in Michigan. It also contained 8 pipistrelle, which is the most found in a mine in the Upper Peninsula. The Nassau mine in Ontonagon County, which was gated in 2005, was surveyed and found to have a population of 4,633 bats, making it the number 6 population in Michigan. Two new adits were located and surveyed in the Keweenaw that contained 80 bats. GPS coordinates were taken on mines for which there were none taken previously. One gate was installed.

2007: No work was conducted due to funding constraints.



2008: 1 gate was installed at the Vulcan mine site in cooperation with Natural Resources Conservation Service; 2 monitoring trips were accomplished.

Recommendations

- Continue to survey mines in Michigan. Priority areas are: Gogebic County, Iron County, Marquette County, and some mines in Ontonagon, Houghton, or Keweenaw County.
- Continue to educate local communities and gain local support through renewed efforts at publicizing the bat surveys in Michigan.
- Establish long-term population monitoring in mines. Suitable mines for long-term monitoring include: the Belt, South Lake, and Mead Mine. Long-term monitoring will also allow for early detection of white-nose syndrome.
- Continue to install bat friendly exclusion gates and evaluate their affects on bat populations.

White-nose syndrome

Monitoring will prove key to detecting white-nose syndrome in Michigan. White-nose syndrome was first documented in bats in New York in the winter of 2006-2007, and now it appears to be spreading across the country. White-nose syndrome is spread through bat-to-bat contact and by humans visiting caves and mines.

Location: Upper Peninsula

Year(s): 2005-2008

Partners: Mine Inspectors and Owners

Terrestrial Research – Project Summaries



Refining Wildlife-Habitat Models for Land Use Decision Support: Merging MIGAP Models and IFMAP Inventory Data

Lance Roberts, Erica Mize, Dr. Brian Maurer, and Michael Donovan

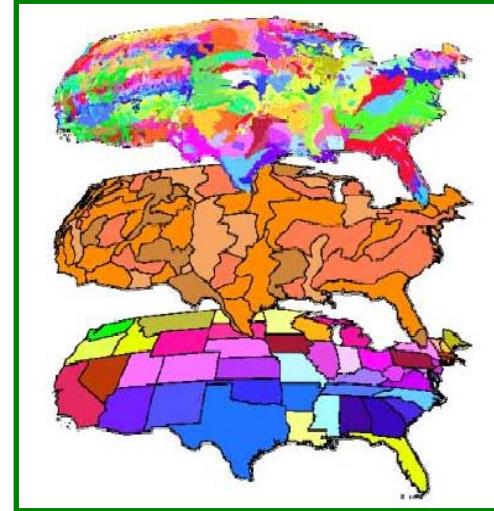
Michigan State University – Department of Fisheries and Wildlife, Michigan Department of Natural Resources – Wildlife Division

Wildlife-habitat models are a necessary component of ecosystem management and play a critical role in determining conservation priorities and making land management decisions. Previous wildlife-habitat modeling efforts in Michigan include the Michigan Gap Analysis Project – MIGAP (Donovan et al. 2004), a statewide project that provides an overview of the distribution of Michigan's terrestrial vertebrate and land cover diversity. The models produced by MIGAP use broad habitat classifications defined by MIWILD (Doepker et al. 2001), a detailed habitat use database for Michigan wildlife, to generate a statewide ecosystem-level inventory of potential wildlife habitat for all species of terrestrial vertebrates in Michigan. The MIGAP models are very useful in making strategic management decisions at an ecosystem level, but are not suitable for tactical-level wildlife-habitat management because of their coarse scale.

This project worked to refine these existing wildlife-habitat models to include stand-level vegetation information collected as part of the Integrated Forest Monitoring, Assessment, and Prescription (IFMAP) program. The two objectives of this study were to: 1) assess the utility of a forest resource inventory database for use in monitoring wildlife habitat, and 2) determine the influence of vegetation classifications on wildlife habitat model performance.

Results

The results of this study suggest that forest resource databases like IFMAP can be as useful as intensive plot-scale field samples in monitoring wildlife habitat, and suggest that a wildlife habitat resource module could be successfully implemented into forest resource decision support tools. This would make it possible to track changes in wildlife habitat resources that result from each timber resource management action. Further it was found that the resolution at which these vegetation measurements were recorded (small plot measurements vs. entire stand summaries) is less vital to model accuracy than is the addition of detailed vegetation characteristics (i.e., vegetation structure and composition vs. land cover types). Those species that show a large difference in accuracy between stand- and plot-scale models belong to the mixed/edge habitat guild. The majority of forest and other habitat guild birds have a small difference in accuracy between their plot- and stand-scale models.



When comparing the IFMAP model against two models, 1) a statically fit set using the first as training data and 2) an unsupervised clustering routine, there appears to be declining levels of agreement with increasing number of classes. Yet despite this, the accuracy of bird habitat models increased with higher levels (more classes) of each classification, indicating that number of classes does in fact increase the ability of statistical wildlife habitat models to fit sample data. However, there were significant differences between classifications (within each level) that indicate the quality and format of the classification can also influence wildlife habitat model performance. These results show that the IFMAP habitat classification system is as useful as, or better than, an *a posteriori* statistical clustering classification for modeling habitat associations of a large suite of bird species. The detail of the forested habitat classes (at level-3 or above) appears to be adequate for describing habitat types used by a set of bird species in the Midwest. The IFMAP classification system led to higher accuracy at every level of the classification and resulted in nearly every species showing more accurate models than with either the predicted or cluster analysis classification.

Location: Lower Peninsula of Michigan

Year(s): 2005-2008

Grassland Ecology and Management and Wildlife-Habitat Relationships: An Analysis

Nicole Lamp, Adria Van Loan, Dr. Kelly Millenbah, Dr. Henry Campa III
Michigan State University – Department of Fisheries and Wildlife

Native grasslands in North America have declined dramatically since European settlement, leaving as little as one-tenth of one percent of the historic area remaining in some states and provinces (Samson and Knopf 1994). In the American Midwest, prairies have declined by 83-99% since settlement (Noss et al. 1995). It is unknown exactly how much native prairie existed in Michigan prior to settlement, but 39 known prairies have been identified (covering approximately 2.3 million acres), most of which occurred in the Southern Lower Peninsula (Sargent and Carter 1999). Nationwide, the introduction and expansion of agriculture has been one of the primary factors contributing to the decline of these native grasslands (Best et al. 1997). Grasslands provide unique habitats for many plant and animal communities, and the loss of these areas has significant implications for the communities inhabiting them.

This project conducted a review of grassland ecology and management and grassland wildlife-habitat relationships, with particular emphasis on Michigan. This synthesis encompasses information up to August 2004. Topics covered include:

Grassland Management Techniques And Their Effects On Vegetation And Wildlife: grazing, tilling, burning, mowing, and haying, haying vs. burning, effects of management techniques on wildlife in Michigan;

Set-aside Programs: Conservation Reserve and Conservation Reserve Enhancement Programs (CRP/CREP), Wildlife Habitat Incentive Program (WHIP) and Grassland Reserve Program (GRP);

Vegetation Types and Establishment Methods: cool-season grasses, value of natives to wildlife, warm-season grasses,



monocultures vs. mixtures, establishment methods, native vs. non-native genotypes;

Issues of scale and landscape composition: scale: habitat size, shape, and edge; landscape composition;

Priority research needs in Michigan

Much of the information in this review is from studies outside of Michigan. As such, grassland research in Michigan is needed to ensure the results elsewhere are applicable to Michigan.

Location: Statewide

Year(s): 2005

Partners: Michigan Department of Natural Resources – Wildlife Division

Comparisons of Coarse Woody Debris in Northern Michigan Forests by Sampling Methods and Stand Type

Michael Monfils, Christopher Weber, Michael Kost, Dr. Patrick W. Brown
Michigan Natural Features Inventory

Forest management has increasingly focused on maintaining biodiversity and sustainability. Coarse woody debris (CWD) on the forest floor is a large contributor to biodiversity within Michigan forests. Coarse woody debris influences forest soil nutrient cycling (Fisk et al. 2002, Laiho and Prescott 2004) and provides a suitable seed bed for hemlock regeneration (Ward and McCormick 1982, Goodman and Lancaster 1990, O'Hanlon-Manners and Kotanen 2004). Due to its influence on forest structure at the ground, understory, and overstory levels, CWD is an essential component of mammal, bird, amphibian, arthropod, and microbial habitats (Harmon 1986, Bull et al. 1997, Burris and Haney 2005, Crow et al. 2002). Large-diameter CWD and tip-up mounds created by natural disturbances are a crucial structural component for forest biodiversity and are largely missing from managed landscapes (Goodburn and Lorimer 1998, Tyrell et al. 1998, McGee et al. 1999, Crow et al. 2002).

Measuring levels of CWD is an important step in assessing the sustainability of forest management practices. Several methods of sampling CWD exist, and the Department uses one method as part of their forest compartment inventory process (Integrated Forest Monitoring, Assessment, and Prescription [IFMAP] stage two). However, the method used during stage two inventories has not been compared with other sampling methods to determine which protocol provides the most accurate and efficient means of measuring CWD. Some methods have shown different levels of accuracy based on stand type and age and the CWD parameter of interest (Bate et al. 2004). We compared four commonly used methods of measuring CWD to evaluate their utility in future IFMAP stage two inventories.

More study is needed to assess the range of variation of CWD parameters in managed and unmanaged forests of the region to aid the evaluation of management practices and decision making. Hagan and Grove (1999) suggested that to determine how much coarse woody debris is enough in managed forests, several questions need to be answered: 1) What is the natural range of CWD in our forests types? 2) How do managed stands compare with natural regimes of CWD? and 3) Are silvicultural methods diminishing the amounts of CWD over time? To help address these questions, this study compared levels of CWD among three forest types in northern Michigan: managed aspen, managed northern hardwood, and unmanaged northern



hardwood. Levels of CWD were estimated in the three forest types across a range of age classes and management histories.

Methods comparisons

The circuit line-intercept (CLI) methodology used by the Department produced similar estimates to random strip-plot (RSP) sampling for the three CWD variables measured: density, length, and volume. This study did not measure the time required to implement each

method, but CLI sampling was substantially easier to set up and conduct in the field and appeared to be the most time efficient. All four methods produced comparable results across the three stand types.

Stand type comparisons

Greater mean CWD density, length, and volume, and snag basal area and DBH were observed in unmanaged northern hardwood stands compared to managed northern hardwood and aspen forest in Michigan. Mean CWD density for unmanaged northern hardwoods was similar to previous studies (Tyrrell et al. 1998), while volume estimates in this study varied from those reported by other researchers in the Great Lakes region and northeastern United States (Tyrrell and Crow 1994, Goodburn and Lorimer 1998, Hale et al. 1999). This study recorded lower CWD density and volume estimates for managed hardwood forests than those of other studies (Goodburn and Lorimer 1998, Hale et al. 1999, McGee et al. 1999).

Aspen age-class comparisons

Sampling of aspen stands within four age classes indicated that CWD and snag variables varied with stand age. Although CWD variables tended to increase with increasing age, estimates of density, length, and volume were statistically similar among the 40-, 60-, and 80-year age classes. Differences in CWD parameters generally occurred between the 20-year age class and all other age classes. Low amounts of CWD in the youngest age group (20 yrs) suggests that residue from final harvest in aspen has limited residency time in these stands. Our results also suggest that CWD may have built up enough by the 40-year age class to be similar to later age classes.

Location: Statewide

Year(s): 2005-2007

Partners: Michigan Department of Natural Resources – Wildlife Division, Michigan State University

Southern Michigan DNR Lands Integrated Inventory Project

Jeffrey Lee, Michael Kost
Michigan Natural Features Inventory

To responsibly manage Michigan's natural resources, staff require thorough knowledge of both the landscape features and natural features on state lands. This project helps facilitate the implementation of the Wildlife Action Plan by completing an integrated inventory on state lands in southern Michigan.

The primary goal of this project is to delineate forested and non-forested stands in management areas to be incorporated into the Integrated Forest Monitoring, Assessment, and Prescription (IFMAP) system. This was accomplished by: 1) delineating non-forested and forested stands prior to field work using aerial photos in ArcGIS; 2) verifying and adjusting stand boundaries in the field while recording specified inventory data for non-forested and forested stands; 3) transferring the final pre-inventory layer to the Stage 1 non-forested and forested stand layers in the IFMAP GDSE; and suggesting improvements in the protocol for future inventory work. The IFMAP Stage 1 inventory is a good preliminary process for identifying potential high quality natural areas.

Accomplishments

2009: Waterloo Game Unit at Waterloo Recreation Area – 330 stands were established within the 5,621 acres; common non-forested stands were sedge- and grass-dominated wet meadows and shrub-carr. Common forested communities included oak-hickory, black oak with white oak, mixed deciduous uplands (usually with a strong black cherry component), and lowland maple. Little oak regeneration was seen. Invasive species were noted.

2009: Crane Pond, Three Rivers, and Fabius State Game Areas – Surveys for exemplary natural communities and rare animals were conducted; 35 new element occurrences were documented and 19 were updated. New records included Cerulean Warbler (*Dendroica cerulea*), Least Bittern (*Ixobrychus exilis*), and Blanchard's cricket frog (*Acris crepitans blanchardi*).

2010: Barry State Game Area – 958 stands were established within the 15,686 acres; Oak-hickory forest is a common community type in the uplands. Numerous wetlands occur throughout the management area, and several prairie fens and bogs were noted during the Stage 1 inventory. Herpetiles, especially turtles, were frequently encountered.

2010: Gratiot-Saginaw State Game Area – 185 stands were established within the 5,125 acres; pin oak flats and young aspen-red maple communities are most common in these settings. Large fields dominated by willows, meadowweet, goldenrods, and mixed grasses are abundant. Buttonbush-



dominated wetlands (i.e., inundated shrub swamps) are also common in many of the impoundments.

2010: Port Huron State Game Area – 248 stands were established within the 6,690 acres; more northern species, such as eastern hemlock, are common in some areas, and numerous element occurrences (e.g., Hooded Warbler, *Wilsonia citrina*; Red-shouldered Hawk, *Buteo lineatus*; Osprey, *Pandion haliaetus*; and painted trillium, *Trillium undulatum*), and a possible new county record of chinkapin oak (*Quercus muehlenbergii*) were documented.

2010: Holly Recreation Area – 179 stands were established within the 2,655 acres; Young forests of mixed-mesophytic species are common, and a proximal urban interface makes invasive species proliferation especially problematic. Invasive plants such as autumn olive (*Elaeagnus umbellata*), Eurasian honeysuckle (*Lonicera sp.*), buckthorn (*Rhamnus sp.*), multiflora rose (*Rosa multiflora*), and black swallowwort (*Cynanchum sp.*) form impenetrable thickets in some places.

Location: Waterloo Recreation Area, Barry State Game Area, Gratiot-Saginaw State Game Area, Port Huron State Game Area, Holly Recreation Area

Year(s): 2009-2010

Partners: Michigan Department of Natural Resources – Wildlife Division

Systematic Evaluation of Oak Regeneration in Lower Michigan

Jeffrey Lee, Michael Kost
Michigan Natural Features Inventory

Oak species (*Quercus* spp.) provide a critical wildlife resource throughout their range (Rodewald 2003). Historically oak ecosystems were maintained by periodic fires, which created open canopy conditions suitable for the establishment and recruitment of shade-intolerant oak seedlings and saplings. Decades of fire suppression have resulted in the closure of oak canopies and the invasion of the understory and canopy by shade-tolerant species (Curtis 1959). Many oak-dominated forests in both southern and northern Michigan and throughout the northeast now support an understory dominated by red maple (*Acer rubrum*), a shade-tolerant species that has the ability to dominate forest canopies in the future (Lorimer 1984, Host et al. 1987, Abrams 1992, Abrams 1998). As oaks begin to reach senescence and mesophytic species such as red maple and black cherry (*Prunus serotina*) assume dominance, the impacts will reverberate throughout populations of wildlife that depend on resources of oak forests.

Management attempts for oak regeneration have met with mixed levels of success and no comprehensive study has been produced to document the effectiveness of various methods across ecoregional gradients. Comparisons of management strategies among ecoregions, glacial landforms, soils, and landscape settings will provide land managers and planners with critical information for establishing regionally appropriate oak management guidelines.

To document the current composition and abundance of dry and dry-mesic oak forests in the Lower Peninsula of Michigan, 105 sites were sampled, roughly evenly distributed between northern and southern regions on 4 major landforms: ice-contact terrain, moraine, outwash, and lake plain. These sites also represented varying management histories including recently unmanaged, cut (clearcut, shelterwood, selection, thinning), and burned.

Forest structure

The current overstory of many upland forests of Lower Michigan is dominated by oak species, however, a conspicuous lack of oak regeneration is seen in many forested oak ecosystems. Oak regeneration was found to vary between broad regional ecosystems (i.e., south and north regions of the Lower Peninsula) and among finer-scale landforms within each region (i.e., ice-contact terrain, moraine, outwash, and lake plain). At the regional level, oak regeneration was greater in the north region than south region, presumably because of its generally lower soil moisture and nutrient concentrations, which limit the growth of many oak competitors, and higher management intensity.

However, red maple regeneration in both regions was equal to or greater than that of oak regeneration, suggesting the need for understory control of red maple. At the landform level, oak

regeneration was generally best on outwash and sand lake plain landforms. The competitive advantage of red maple, in the absence of fire, on ice contact and moraine landforms was not as pronounced or realized on the drier outwash and lake plain landforms. Oak regeneration appears to be negatively related to deer abundance in the south region, but did not show a consistent pattern among oak species in the north region. Red maple regeneration did not appear to be affected by any level of deer abundance in either region, which may provide it with a competitive advantage over oak where deer numbers are high.

Systematic evaluation of management

Upon this evaluation, activities that will help ensure successful oak regeneration include reducing overstory basal area, increasing light availability in the understory, and limiting competition, especially from red maple, black cherry, and sassafras. This study has shown that great variation exists among forested oak ecosystems of Lower Michigan, and management for oak regeneration will benefit from a firm understanding of these differences at the site level.

The effect of active management, especially those activities that consisted of clearcuts, shelterwood cuts, or combined cut and burned treatments on outwash or lake plain landforms, generally stimulated oak regeneration through clonal sprouting. However, the likelihood of sustaining a population of oak advanced regeneration was observed to be dependent on controlling understory competition and limiting overstory shading, specifically from red maple. These factors, in turn, were intimately related to landform-mediated differences of soil moisture and nutrient concentrations.

Conclusions

Factors that promoted oak regeneration included 1) low soil exchangeable cation concentration, 2) low overstory basal area, 3) low understory basal area, especially red maple, 4) low groundcover coverage, 5) low shrub abundance, 6) high oak seedling abundance, 7) occurrence on outwash or lake plain landforms, and 8) presence of sandy subsurface soil horizons (i.e., well drained soils). Less effort is required to encourage oak regeneration when the conditions listed above are satisfied.

Location: Lower Peninsula

Year(s): 2006-2008

Partners: Michigan Department of Natural Resources – Wildlife and Forest Management Divisions, U.S. Forest Service, University of Michigan, volunteers

Invasive Plant Framework Implementation

*Phyllis Higman
Michigan Natural Features Inventory*

Michigan's Wildlife Action Plan identifies invasive species as one of the highest priority threats to wildlife and landscape features in the state. *Meeting the challenge of invasive plants: a framework for action* to address invasive species impacts in Michigan was developed in 2009. This project works to implement that framework. Below are the accomplishments in relation to the goals stated in the framework.

Accomplishments for Goal 1: Leadership and Coordination
2009 – Worked closely to build support for and continue the development of the Midwest Invasive Species Information Network (MISIN); created a list of priority treatment sites to target funding from the Restoration Recovery stimulus funds; worked with partners to procure additional funding to implement framework.

2010 – Assisted in prioritizing sites for stimulus funding for on-the-ground management; piloted invasive species contractor training on significant natural features of the coastal zone; worked with partners to procure additional funding to implement framework.

Accomplishments for Goal 2: Assessment and Research
2010 – Gathered distribution data from many sources for uploading into MISIN; completed static maps of priority invasive plant species.

Accomplishments for Goal 4: Early Detection and Rapid Response

2010 – Provided start-up training for the Rapid Response Invasive Plant Intervention Team for Upper Peninsula (RRIP-IT-UP); worked with pilot rapid response team to address high priority species and initiate documentation and monitoring protocols; developed early detection-rapid response prototype for *phragmites* in northern Michigan to serve as model.

Accomplishments for Goal 5: Control, Management, and Restoration

2009 – Drafted summaries of best control practices for 14 priority species; assisted with the implementation of a pilot strike team through the identification of outlier infestations of high priority invasive plants such as swallow-wort in northern lower Michigan.

2010 – Best control practices were completed and posted on the invasive species node of the Michigan Natural Features Inventory (MNFI) website; supported the release of biocontrol for spotted knapweed; supported the development and use of ordinances requiring the treatment of *phragmites* in the coastal zone;

Accomplishments for Goal 6: Education and Outreach

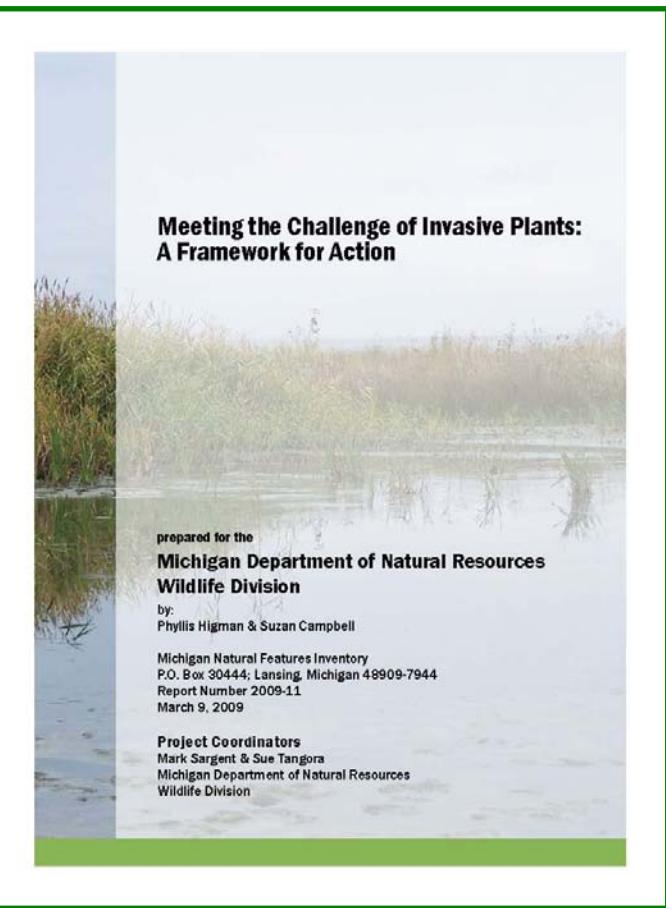
2009 – *The invasive plant challenge – a framework for action* was presented to and approved by the Wildlife Division management team and disseminated to staff; conducted 5 field-based workshops and 7 formal outreach presentations.

2010 – Distributed over 700 terrestrial invasive field guides; developed aquatic invasive species field guide; invasive species node of the MNFI website updated; identification training modules for 10 priority invasive plant species and mapping protocols were developed for the MISIN; conducted 5 workshops and 4 formal outreach presentations.

Location: Statewide

Year(s): 2009-2010

Partners: Michigan Department of Natural Resources – Wildlife Division, Michigan Department of Environmental Quality, Michigan State University, and many other partners



Development of a Monitoring Framework for Michigan's Wildlife Action Plan

Michael Kost

Michigan Natural Features Inventory

The aim of this project was to develop a monitoring framework for effectively assessing the status and condition of landscape features and species of greatest conservation need (SGCN) identified as high priorities for the Wildlife Action Plan (WAP). This effort was envisioned as a four-year project with the convening of a multi-agency partner team during the first year, development of a draft monitoring framework, expert review, limited field testing in years two and three, and completion of a monitoring framework in the fourth year of the project. However, due to budget cutbacks, funding was only provided for the first year at a reduced level.

Four meetings were held with staff from Michigan Natural Features Inventory, Michigan Department of Natural Resources – Wildlife Division, and Michigan State University – Fisheries and Wildlife Department to discuss project goals and develop a conceptual framework for monitoring the status and trends of SGCN and landscape features in the WAP. Select team members were assigned to develop a list of current monitoring programs for each terrestrial SGCN and landscape feature. Both SGCN and landscape features were categorized by the current level of available data; categories included inventory, surveillance, and monitoring. Definitions were developed for each of these categories and for several other related terms of reference.

Definitions developed for this project include:

Inventory: an intensive or extensive effort to determine location or condition of resources, including the presence, class, distribution, and status of plants, animals, and abiotic components.

Surveillance: collection of time-series information that is not hypothesis-driven or in the absence of a management context.

Monitoring: collection of specific information for management purposes in response to hypotheses derived from assessment and management activities.

Assessment: the identification of the status of, and threats to, a resource as a basis for the collection of more specific information through monitoring activities.

A status and trends program should involve inventory, surveillance, assessment, and reporting. The identification of research needs was within the scope of this project. To explore developing a framework for a status and trends program for SGCN and landscape features, the group discussed two approaches, one using an ecosystem representation model and the other based on species.

For the 285 terrestrial SGCN reviewed, the current level of survey effort is as follows: 171 have inventory; 110 have surveillance; and 4 have monitoring efforts. For the 171 species listed in the inventory category, no consistent and regular data collection effort currently exists to reliably assess their population status statewide. The 110 species within the surveillance category includes all birds, frogs, and toads, three mammals (snowshoe hare, lynx, least weasel), and two butterflies (Mitchell's satyr and Poweshiek skipperling). Several ongoing programs collect annual data on the presence and absence of birds, frogs and toads. Some of these efforts include the Breeding Bird Survey, Christmas Bird Count, Marsh Monitoring Program, and Frog and Toad Survey. The surveillance category for mammals included data from annual hunter surveys, which provides a consistent source for assessing status and trends. The four species included in the monitoring category were moose, grey wolf, American marten, and Karner blue butterfly. These species are actively studied and monitored by the Wildlife Division. Information being collected on all landscape features is best described as inventory. Although monitoring is being carried out at a few select sites, none of the landscape features are consistently surveyed or monitored across their range within the state. The final report includes meeting notes, a glossary, and tables showing type of data collected for species and landscape features.

Location: Statewide

Year(s): 2009

Partners: Michigan Department of Natural Resources – Wildlife Division, Michigan State University

Evaluating the potential for biological control of garlic mustard in Michigan

Dr. Doug Landis
Michigan State University – Department of Entomology

Non-indigenous invasive plants pose a major threat to natural communities worldwide. Biological control of weeds via selected introduction of their natural enemies can affect control over large spatial areas but also risk non-target effects. To maximize effectiveness while minimizing risk, weed bio-control programs should introduce the minimum number of host-specific natural enemies necessary to control an invasive non-indigenous plant.

This study used elasticity analysis of a matrix model to help inform bio-control agent selection for garlic mustard (*Alliaria petiolata* (M. Bieb.) Cavara and Grande). The Eurasian biennial garlic mustard is considered one of the most problematic invaders of temperate forests in North America. Four weevil species in the genus *Ceutorhynchus* (Coleoptera: Curculionidae) are currently considered potential bio-control agents. These species attack rosettes (*C. scrobicollis*), stems (*C. roberti*, *C. alliariae*), and seeds (*C. constrictus*) of garlic mustard. Elasticity analyses using garlic mustard demographic parameters from North America indicated that changes in the rosette-to-flowering-plant transition and changes in fecundity consistently had the greatest impact on population growth rate. These results suggest that attack by the rosette-feeder *C. scrobicollis*, which reduces overwintering survival, and seed or stem feeders that reduce seed output should be particularly effective. Model outcomes differed greatly as garlic mustard demographic parameters were varied within ranges observed in North America, indicating that successful control of garlic mustard populations may occur under some, but not all, conditions.

Using these a priori analyses it was predicted that: (1) rosette mortality and reduction of seed output will be the most important factors determining garlic mustard demography; (2) the root-crown feeder *C. scrobicollis* will have the most significant impact on garlic mustard demography; (3) releases of single control agents are unlikely to control garlic mustard across its full range of demographic variability; (4) combinations of agents that simultaneously reduce rosette survival and seed production will be required to suppress the



most vigorous garlic mustard populations. These predictions can be tested using established long-term monitoring sites coupled with a designed release program. If demographic models can successfully predict bio-control agent impact on invasive plant populations, a continued dialogue and collaboration between empirical and theoretical approaches may be the key to the development of successful bio-control tactics for plant invaders in the future.

Accomplishments:

2006: Conducted herbicide treatments at six sites in the following counties: Cass, Lenawee, Clinton, Kent, Ottawa, and Shiawassee. Damage assessments were made on garlic mustard at all sampling areas (4 at each site).

Location: Statewide

Year(s): 2005-2006

Partners: Michigan State University – Department of Crop and Soil Science, Cornell University – Department of Natural Resources, CABI Bioscience Switzerland Centre, U.S. Department of Agriculture, Michigan Department of Natural Resources – Wildlife Division

Three Year Assessment of a GIS-Based Patch Analysis to Identify Priority Conservation Areas in Michigan

Edward Schools, Dr. Brian Klatt, Bradford Slaughter, Michael Penskar, Dr. Joelle Gehring
Michigan Natural Features Inventory

Land managers continue to face steep challenges in obtaining sufficient fiscal and staff resources to carry out conservation and management activities. These challenges highlight the need for scientifically sound information that will assist in deciding where to direct resources. This study represents an initial assessment after three years of a planned 10 – 20 year effort to develop a GIS model and a corresponding field methodology for identifying and verifying high priority conservation areas. The goal of the effort was to improve the ability of the Michigan Department of Natural Resources to identify terrestrial areas of high ecological value.

Methods

A vegetation patch analysis was developed and subsequently field sampling was conducted throughout Newaygo County and its vicinity. Patches of vegetation were scored based on their area, core area, and proximity to similar vegetation types. Field sampling was employed to test the efficacy of the vegetation patch analysis, as well as the effectiveness and applicability of metrics developed to assess the diversity and quality of a patch's flora (vascular plant species), natural community structure, and avian community assemblage. Field sampling was conducted in 2006, 2007, and 2008 in selected patch types, with detailed statistical analyses conducted for a single patch type, upland deciduous forest, to evaluate the efficacy of the vegetation patch model and the effectiveness and applicability of the floristic, ecological, and avian metrics and derived indices. All field sampling took place on public lands.

Results

A total of 19 metrics were collected in the field or derived from field data. The analysis included eight metrics to assess ecological community structure, six metrics to assess floristic quality, and five metrics to assess avian community structure. Fifty-four upland deciduous sample cells had at least one set of metrics assessed and 39 sample cells had the complete suite of metrics assessed. Using the Fisher-Jenks natural breaks algorithm, test cells were assigned to a high, moderate, or low category based on the patch analysis score of the vegetation patch containing the cell. A discriminant function analysis was used to determine which of the metrics could be used to determine the membership of a test cell in the high, moderate, or low category. Two metrics, the presence of interior bird species and the presence of red maple (*Acer rubrum*) were determined to be predictors of membership in a high, moderate, or low category. With presence of interior bird species being a positive indicator for high quality patches and the presence and abundance of red maple being an indicator of low quality patches. Further analysis of the red maple metric indicates that its usefulness as an indicator metric may have

been compromised by proximity of upland forest test cells to wetlands.

Discussion and recommendations

While the patch model presented here appears to work well for predicting high quality upland deciduous forest habitat (based on the presence of interior bird species), it is not known whether the model will be as applicable to other community groups and is unlikely to work as well for small patch size communities. In addition, there is no evidence to indicate that the model is predicting high quality forest patches for other taxa or a wider suite of ecological functions. Thus, future efforts may be better focused on developing coarse grain approaches to a priori identification of high biodiversity areas, rather than on identifying community-specific areas. The coarse-grain effort should be ultimately followed by community-specific and species-specific modeling to address fine-grained issues of rare communities and species.

In general, future modeling and testing efforts should include the following aspects:

- Assuring grain appropriateness of metrics used to test models
- Increase the robustness of the models by incorporating factors other than patch measures (e.g., soils, topography, aspect, etc.)
- Produce specific models for the ecosystem function of interest instead of expecting one model to represent a wide range of functions
- Thorough consideration of metric selection and experimental design as part of the model development and testing regime
- Test and calibrate the metrics to the community type or model being tested
- Use a four-point rule instead of an eight point rule to define patch connectedness, or use hexagon shaped planning units, in the patch model
- Evaluation of correlation between metrics, along with removal of redundancy and selection of cost effective quantitative variables as metrics
- Include additional animal taxa as metrics
- Sample geographic areas rather than a single community type
- Include private lands in the sampling effort

Location: Statewide

Year(s): 2008-2010

Partners: Michigan Department of Natural Resources – Wildlife Division, Michigan State University

Aquatic Research – Project Summaries



Monitoring the Status and Trends of Ecological Indicators in Michigan Streams, Rivers, and Lakes

Todd Wills, Dr. Kevin Wehrly

Michigan Department of Natural Resources – Fisheries Division

Michigan's streams and lakes are valuable, productive, and sustainable resources. Studies suggest that relatively frequent sampling is needed to describe variation and trends in fish populations at spatial and temporal scales pertinent to fishery managers. Hence, spatially and temporally extensive sampling is needed to effectively protect and manage Michigan streams and lakes. The Status and Trends Program began in 2002. This effort incorporates standardized sampling methods in an effort to collect and evaluate data from a state-wide perspective. These data include fisheries information from electrofishing, habitat measurements, and water quality sampling that are used to monitor statewide status and trends of streams and lakes as well as to evaluate stocking and other management activities in streams and lakes. The objectives of this program are to:

1. characterize fish community structure and the abundance, presence, and distribution of fish populations across the state;
2. quantify the baseline and describe long-term trends in fish community structure and fish population abundance across the state; and
3. identify appropriate spatial scales for describing regional trends in fish community structure and fish population abundance.

2006 Accomplishments

Streams – 10 random- and 22 fixed-site surveys for fish populations, physical habitats, and water temperature were conducted. Methodologies were standardized and published in the Fisheries Division's Survey Manual (Wills et al. 2006).

Lakes – 23 lakes were surveyed for fish populations, zooplankton, nutrients, alkalinity, chlorophyll, dissolved oxygen, temperature, and shoreline condition. Zooplankton samples from 2005 were processed. New shoreline assessment methods were developed and implemented. Two training sessions were held to train survey crews.

2007 Accomplishments

Streams – 14 random- and 18 fixed-site surveys for fish populations, physical habitats, and water temperature were conducted.



Lakes – 41 lakes were surveyed for fish populations, zooplankton, nutrients, alkalinity, chlorophyll, dissolved oxygen, temperature, and shoreline condition. Zooplankton samples from 2006 were processed.

2008 Accomplishments

Streams – 18 random- and 22 fixed-site surveys for fish populations. Physical habitat data were collected at 15 of the 18 random sites and at 16 of the 22 fixed sites. New sampling protocols for habitat sampling in non-wadable rivers were developed and added to the standard survey manual.

Lakes – 30 lakes were surveyed for fish populations, zooplankton, nutrients, alkalinity, chlorophyll, dissolved oxygen, temperature, and shoreline condition. Zooplankton samples from 2007 were processed.

Location: Statewide

Year(s): 2006-2008

Exploration of Classifying Lakes into Natural Communities in Michigan

Amy Derosier, Dr. Reuben Goforth
Michigan Natural Features Inventory



Protecting aquatic biological diversity in Michigan depends heavily on our ability to protect representative and unique habitats or ecosystems. Currently, terrestrial and wetland natural communities are tracked in the state's natural heritage database, which aids in conserving high quality natural communities through environmental review and other venues. However, we do not yet have fully aquatic natural communities defined or described. In the past, Michigan Natural Features Inventory has been involved in lake classification work based on physicochemical variables (Pringle 1983), but currently almost no lakes are incorporated into the heritage database. To preserve the full breadth of Michigan's biodiversity, representative habitats or ecosystems need to be described and located for aquatic systems.

Small lakes provide a variety of services towards the conservation of biodiversity. They are likely to reflect extremes of certain key environmental variables, such as pH and alkalinity, providing unique ecosystems and communities. Small lakes have been shown to act as refugia for native species susceptible to declines from human alterations (e.g., Mwanja 2001). Michigan has a variety of species that are at the edge of their range. These "edge of range" populations have the potential to be genetically different than the central populations and are therefore important for maintaining and conserving the genetic diversity of species and providing opportunities for evolutionary processes (Lescia and Allendorf 1995, Nielson, Scott, and Aycrigg 2001).

There is some recent evidence to show that small lakes, especially small isolated lakes contribute disproportionately to biodiversity (Scheffer et al. 2006) often 'containing specialized flora and fauna which are not represented in other habitats' (Bratton 1990, Williams et al. 1998, Williams et al. 2003). Ponds and small lakes are often dominated by vegetation and this can lead to a higher diversity in many animal groups, including use of small lakes by bird species.

This project summarizes lake natural community classifications from nine states. It also provides the results of field work conducted in fifty-four of Michigan's ponds and small lakes. Lakes were sampled for water quality, habitat, zooplankton, macrophytes, macroinvertebrates, and some for fish. Work is still needed to complete the zooplankton and macroinvertebrate work.

Further, the report proposes a draft framework for lake element occurrence (EO) specifications, draft lake EO rank specifications, and proposes draft pond and small lake natural community types. These community types are hierarchical and based on ecological drainage units, landscape-level types, and natural communities based on field data. This work is just a start to better understanding ponds and small lakes in Michigan.

Location: Statewide
Year(s): 2005-2008

Partners: Michigan Department of Natural Resources – Wildlife and Fisheries Divisions, Michigan State University

Incorporating Aquatic Ecological Classification Units as Elements of Biodiversity in the Biotics Database

Dr. Reuben Goforth, Amy Derosier, Peter Badra

Michigan Natural Features Inventory

There exists a relatively long history of classifying and tracking terrestrial and wetland natural communities as elements of biodiversity in the state's natural heritage database, and many relationships between terrestrial fauna and flora and these systems-level ecological units have been established. This has significantly aided efforts to conserve high quality natural communities, and it has also provided a means for predicting occurrences of listed taxa that has helped to prioritize survey, monitoring, and conservation efforts. Aquatic systems-level elements remain undeveloped to date. This lack of development and tracking of comparable aquatic ecological units therefore reflects a significant gap in management for Michigan's biodiversity. Tracking aquatic ecological and community units provides a vehicle for much more effective habitat conservation to help keep common species common and rare species viable.

This project: 1) proposes a draft hierarchical framework and EO specifications for riverine natural communities; 2) proposes draft natural community types for the finest level of the framework; 3) proposes draft criteria for ranking riverine natural communities; and 4) provides field survey results collected at potentially high-quality river reaches. In addition, future efforts needed to complete this work are described.

The proposed framework has three levels. The highest level are Ecological Drainage Units, which creates a regional framework based on watersheds. This is the over-arching framework that considers climate, physiography, and zoogeographic history. The intermediate level are Aquatic Ecosystem Types, which would be used to capture processes such as nutrient and energy dynamics and hydrologic regimes. The size of these intermediate units would likely range from 100 to 600 mi². The finest level would be based on river valley segments or VSECs (Seelbach et al. 1997). These have been defined in Michigan and are stretches of river based on parameters such as surficial geology, catchment slope, valley width, channel sinuosity, and groundwater input. Mean lengths for VSECs range from 6 to 12 km. Our proposed river natural community types for the finest level – VSECs are based on size, water temperature, and gradient. Our proposed EO rank specifications are based on five factors of condition and three factors of landscape context. Condition is based on in-stream cover, water temperature, substrate quality, stream bank erosion, and exotic species. Landscape context is based on composition of riparian areas, level of impervious surfaces in watershed, and number of dams in watershed. We performed field surveys at 24 sites in the Lower Peninsula of Michigan to begin detailing site-specific



habitat and species data for the Level 3 riverine natural community. Using this data we were able to test the proposed draft of EO rank specifications.

Final report includes:

- aquatic conservation units used in other states;
- proposed draft framework for EO specifications – three-level hierarchical framework: 1. ecological drainage unites, 2. aquatic ecosystem types, 3. river valley segments;
- proposed draft EO rank specifications; and
- field survey results.

Location: Statewide

Year(s): 2005-2007

Partners: Michigan Department of Natural Resources – Wildlife and Fisheries Divisions

Project References

Conservation Tools

Endangered Species Assessment Tool:

<http://www.mcgi.state.mi.us/esa/>

Biological Rarity Index and Probability Mapping Tool:

<http://web4.msue.msu.edu/mnfi/data/rarityindex.cfm>

Digital Water Atlas:

<http://ifrgis.snrre.umich.edu/projects/DWA/dwa.shtml>

Michigan Conservation Gazetteer

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Wildlife Division Report No. 3532 • February, 2012



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