OHIO'S HABITATS

The purpose of Ohio's State Wildlife Action Plan (SWAP) is to provide tactical direction for conserving wildlife diversity in Ohio. A rich diversity of wild animals is a valuable ecological, social, and economic asset for Ohio. Wildlife populations have been stressed by a number of factors such as invasive species, chemicals in the environment, and climate variability to name a few. However, in Ohio habitat quantity and quality are unquestionably the principal factors influencing the status of Ohio's wildlife species. Consequently, Ohio's SWAP is focused on habitats from an organizational standpoint, and habitats serve as the glasses through which conservation threats and actions – which affect wildlife species – are viewed.

The majority of conservation actions, in order to benefit the most species, will be aimed at maintaining and improving their associated habitats. Implementation of habitat-based conservation actions is key to sustaining wildlife diversity in Ohio. Success of habitat-based conservation actions will be reflected in the condition of the fish and wildlife that inhabit them.

Like most other states, there is no single statewide comprehensive habitat classification system for Ohio. Ohio's SWAP draws from a number of habitat data sources to classify and categorize the diversity of habitat types across the state. Fifteen habitat categories form the basis for Ohio's SWAP – and these are based on Ohio's pre-settlement habitat, habitat information from the ODNR Division of Natural Areas and Preserves Natural Heritage Database Program, and expert opinions. The habitat categories are somewhat broad, and often include several sub-habitat categories (e.g., Wetlands includes natural marshes, diked marshes, vernal pools, bogs, and fens). Arguments can be made for and against using broad versus very specific habitat categories. Our feeling was that there was more utility in using broad categories, and that the more specific sub-categories could be adequately addressed within the threats/actions under each broad habitat category.

There are limitations to the habitat classification/categorization system that Ohio has chosen to use in this Action Plan. Information in the habitat chapters should be interpreted and used with these limitations in mind. These limitations stem primarily from the fact that it is not possible to fit a very complex and dynamic natural environment into a very structured systematic classification system. In a sense, this would be analogous to creating a quantitative classification system to fit qualitative data. The interface between habitat boundaries is often not clearly delineated. Habitat boundaries change over time. Habitats often tend to bleed into one and other – and "hybridize" to a degree. The quality of habitat data varies – and often does not accurately reflect the true spatial extent and/or configuration of individual habitats. The natural world simply does not lend itself to fine scale mapping/classification, especially on a protracted temporal scale. The habitat information and maps in this Action Plan are intended to be used as a general guide for the types and distribution of habitats in Ohio.

Habitat Categories

Fifteen habitat categories provide the foundation for Ohio's SWAP. Split between terrestrial (7), aquatic (7), and one habitat type that encompasses both, they represent the breadth of Ohio's ecosystems – albeit on a relatively broad scale. The categories chosen are a reflection of the state of habitat data available today. Finer scale habitat types within these larger categories are acknowledged and addressed within the conservation threats and actions for each of the following categories:

Terrestrial Habitats
Grasslands - Prairies, Pastures/Hayfields, Old Fields
Forests - Composition (oak-hickory, beech, etc.), Growth Stage (early successional through mature)
Wetlands - Marshes (Natural, Diked), Vernal Pools, Bogs, Fens
Caves & Mines
Oak Savannas
Lake Erie Islands
Boreal Communities

Artificial/Man-made Environments (Agricultural Fields, Skyscrapers, Bridges/Overpasses, Human Structures (boat docks, lowhead dams, etc.), Urban/Suburban Homes/Yards, Barns & Other Rural Structures)

Aquatic Habitats
Lake Erie
Lake Erie Tributaries
Ohio River
Ohio River Tributaries
Headwater and Small Inland Streams
Man-made Lakes and Ponds
Natural Lakes

Grasslands, Forests, Wetlands – The focus will be to identify strategies that will guide the Division on restoration, maintenance, and enhancement of these habitats and the diversity of wildlife species that occupy them. Emphasis will be on providing adequate quality and quantities of each of these habitat types to meet these goals. The management strategies for these habitats will be statewide in nature, leaving site-specific (Conservation Opportunity Area) initiatives to be addressed by individual tactical plans.

Caves & Mines, Oak Savannas, Lake Erie Islands, Boreal Communities – At the time of European settlement, Ohio's landscape was primarily a vast expanse of forest, with a few large grassland and wetland areas. Also scattered throughout the state, in smaller amounts, were other significant habitats – Ohio's primary examples of these include Lake Erie islands, oak savannas, the boreal (snowbelt) community, and both natural and man-made caves/mines. While most of our native wildlife needs will be addressed through the major terrestrial habitat programs (grasslands, forests, wetlands), some species (including several listed species) are dependent upon these very specialized habitat types that are not addressed by the major habitat programs. These habitat types generally occur in relatively small quantities and relatively isolated areas. They are capable of supporting types of wildlife with highly specialized habitat requirements or species at the fringe of their wider U.S. range – for example snowshoe hares were only found in boreal communities in northeastern Ohio. These habitats must be protected, and in some cases enhanced to ensure survival of several wildlife species. Management strategies will focus on providing adequate amounts of these habitats, and the focus will be much narrower in scope compared to the other terrestrial habitat programs.

Artificial/Man-made Environments (this habitat category contains both aquatic and terrestrial components)
Ohio is the 34th largest, 7th most populous, and 10th most densely populated state – consequently very little of this state has not been altered to some degree. The most significant alteration in terms of scale is the conversion of wetlands, grasslands, and forests to agriculture. Urban/suburban development is also extensive, and the amount of man-made infrastructure is significant. While the extensive alteration (and sometimes loss) of natural habitats has extirpated a number of species, many others have adapted and taken advantage of the food, shelter, and breeding habitat that man-made environments provide. Many species of wildlife feed in grain fields, peregrine falcons nest on skyscrapers, barn owls nest in old barns, bats utilize mines as hibernacula and bridge expansion joints/seams as roosting sites, and fish use docks, piers, and bridge abutments for cover and feeding areas – just to name a few. Management strategies for this habitat category will revolve around ways to make existing and future development more wildlife

friendly. Many opportunities exist to enhance man-made structures which simulate natural habitats for a variety of wildlife species.

Lake Erie, Lake Erie Tributaries – The Lake Erie program addresses Ohio's 2.24 million acre portion of Lake Erie. The lake's tributaries will be addressed separately for the purposes of this Action Plan, but are clearly an important component of the lake ecosystem, and affected by lake-related management strategies. Lake Erie's tributaries are important habitats for a number of lake species. The interjurisdictional nature of the lake (4 states and Ontario share this resource) complicates management, and necessitates constant communication and cooperation among partners. Lake Erie and its tributaries contain a diverse mix of economically important species (walleye, yellow perch, smallmouth bass), as well as rare species (lake sturgeon, popeye shiner, cisco, burbot). Invasive species and water quality issues affect our management ability on the lake more so than on most other aquatic ecosystems around the state.

Ohio River, Ohio River Tributaries – The southern boundary of Ohio includes 451 miles of the Ohio River. The Ohio River program will cover the mainstem and tributary embayments. Ohio River tributaries will be addressed separately, but clearly have a large influence on the river itself. Ohio River tributaries drain huge watersheds, impacting river water quality and flow. While the Ohio River is an extremely modified system due to the numerous dams, hydropower, and navigation systems, it contains many wildlife populations of economic, social, and ecological significance. Like Lake Erie, the interjurisdictional nature of the Ohio River (West Virginia and Kentucky share the river adjacent to Ohio) complicates management efforts and necessitates good working relationships with our partner states.

Headwater and Small Inland Streams – This program focuses on the inland streams that combine to create the primary tributaries to Lake Erie and the Ohio River. These are important habitats for a diverse assemblage of aquatic species, especially species that need good water quality and stream gradient to survive. A number of listed fish, mussels, crayfish, and aquatic insects are dependent upon these types of habitats. While primarily an aquatic wildlife habitat program, management strategies may also benefit species of terrestrial wildlife due to the importance of riparian corridor habitat. The strategies for this program will be statewide in nature, leaving site-specific (Conservation Opportunity Watersheds) initiatives to be addressed by individual tactical plans.

Man-made Lakes & Ponds - Between Lake Erie and the Ohio River, Ohio's numerous lakes and ponds support diverse populations of aquatic wildlife. These waters range from small farm ponds and borrow pits to large reservoirs. While functioning as important habitats for aquatic species, many were created for multiple purposes, some of which are incompatible with wildlife management. On-stream lakes are affected by, and in turn affect the stream they impound. Lake water quality may be compromised by silt and excess nutrients delivered by inflowing streams, and excessive withdrawal of water could exacerbate the downstream hydrologic alteration caused by the dam. Dam operation (timing, frequency, duration, and magnitude of water releases) also affects downstream hydrology and habitat.

Natural Lakes - The majority of Ohio's natural lakes formed in the aftermath of the most recent ice age. A few are post-glacial in origin, created from cutoff stream oxbows. There are 110 natural lakes in Ohio larger than five acres, covering a total surface area of 4,658 acres. These lakes occur in 21 of Ohio's 88 counties. Many of Ohio's natural lakes have been altered to some degree by human activities. Some lakes have been enlarged by the addition of levees or dikes, and some have had outlet control structures installed, or outlet streams enlarged, to allow for controlling of lake levels (Black 1991). While not a significant habitat on an acreage basis, several listed fish species occur in natural lakes (blacknose shiner, western banded killifish, Iowa darter, pirate perch).

Conservation Threats/Actions Related to Habitat Categories

The tables following this section contain a summary of conservation threat impacts among Ohio's terrestrial and aquatic habitat categories. As suggested in AFWA's Best Practices for SWAPs guide, we used the definitions and hierarchical classification in Salafsky et al. (2008) *A Standard Lexicon for Biodiversity Conservation: Unified Classifications of Threats and Actions* to describe and to categorize

threats and actions. Adopting a consistent framework for threats and conservation actions will help ensure consistency across SWAPs and will facilitate the identification of shared threats across states.

Threat impact scores (Tables 1 & 3) were calculated using the IUCN Threats Calculator, with scores based on estimates of the scope, severity, and timing for applicable individual threats to the species or ecosystem (Master et al.2012). See the Habitat Categories Template section for a more detailed description.

Conservation action priority ranks (Tables 2 and 4) were determined using the seven ranking criteria developed by the Georgia Department of Natural Resources – Wildlife Resources Division (Georgia DNR 2005) where rating reflects the relative contribution or significance of a conservation action for each criterion. Internal species/habitat experts assessed the contribution of each conservation action for each of these criteria and assigned scores. The resulting point totals were used to sort the conservation actions into categories by priority. See the Habitat Categories Template section for a more detailed description.

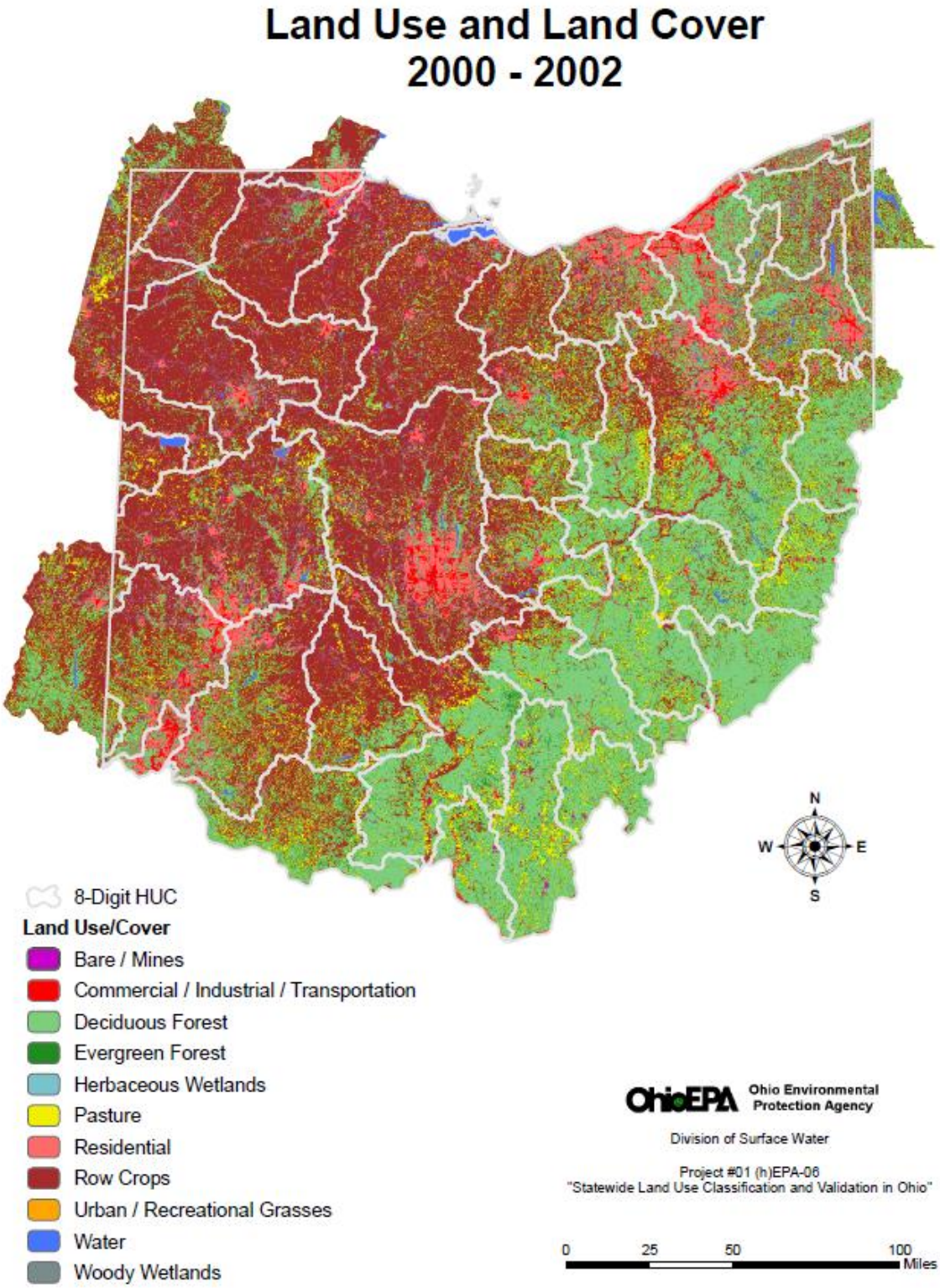


Figure 1. Ohio's State Wildlife Action Plan **terrestrial habitat** categories (*note: this figure is being used as a placeholder until a map with the correct habitat categories is developed*).

Table 1. Direct threats impact by habitat category for each **terrestrial habitat**, and overall threat impact for all terrestrial habitats combined.

DIRECT THREATS FOR 1st & 2nd LEVEL OF CLASSIFICATION*	THREAT IMPACT BY HABITAT CATEGORY								OVERALL THREAT IMPACT
	FOREST	GRASSLAND	WETLAND	LAKE ERIE ISLANDS	OAK SAVANNAS	BOREAL COMMUNITY	CAVES And MINES	ARTIFICIAL/ MAN-MADE ENVIRONMENTS	ALL HABITAT CATEGORIES
Residential & Commercial Development	medium	low	high	high	high	medium	medium	very high	high
housing and urban areas	high	low	high	high	high	high	medium	very high	high
commercial & industrial areas	low	low	medium	high	high	low	medium	very high	high
tourism & recreation areas	low	not a threat	low	high	low	low	medium	medium	medium
Agriculture & Aquaculture	low	medium	low	medium	low	low	negligible	high	medium
annual & perennial non-timber crops	negligible	very high	medium	high	low	low	negligible	very high	high
wood & pulp plantations	low	not a threat	negligible	negligible	medium	low	negligible	negligible	low
livestock farming & ranching	low	low	low	low	low	low	negligible	not a threat	low
marine & freshwater aquaculture	negligible	negligible	low	negligible	negligible	negligible	negligible	negligible	negligible
Energy Production & Mining	high	low	medium	low	low	low	medium	high	medium
oil & gas drilling	high	low	low	negligible	low	medium	low	high	medium
mining & quarrying	high	low	low	medium	medium	low	high	low	medium
renewable energy	low	low	medium	negligible	low	low	negligible	medium	low
Transportation & Service Corridors	low	negligible	high	high	low	medium	low	low	medium
roads & railroads	medium	negligible	high	high	medium	medium	negligible	low	medium
utility & service lines	medium	negligible	high	medium	low	medium	low	low	medium
shipping lanes	negligible	negligible	medium	negligible	negligible	negligible	negligible	negligible	negligible
flight paths	negligible	negligible	low	medium	negligible	negligible	negligible	negligible	low
Biological Resource Use	low	negligible	medium	low	low	low	low	low	low
hunting & collecting terrestrial animals	negligible	not a threat	low	low	low	negligible	low	negligible	low
gathering terrestrial plants	low	negligible	low	negligible	low	negligible	negligible	medium	low
logging & wood harvesting	medium	negligible	medium	negligible	low	low	negligible	negligible	low
fishing & harvesting aquatic resources	negligible	negligible	medium	negligible	negligible	negligible	low	negligible	negligible
Human Intrusions & Disturbance	low	low	medium	high	low	low	medium	low	medium
recreational activities	medium	negligible	medium	high	medium	low	medium	low	medium
war, civil unrest & military exercises	low	negligible	negligible	negligible	negligible	low	negligible	negligible	negligible
work & other activities	low	medium	medium	low	low	low	low	low	low
Natural System Modifications	low	low	medium	low	low	low	medium	medium	low
fire & fire suppression	low	negligible	low	negligible	medium	low	low	medium	low
dams & water management/use	low	negligible	medium	negligible	negligible	low	low	medium	low
other ecosystem modifications	low	low	low	low	low	low	medium	medium	low
Invasive & Other Problematic Species & Genes	medium	high	medium	high	medium	high	medium	medium	high
invasive non-native/alien species	high	medium	high	high	high	very high	high	high	high
problematic native species	low	high	low	medium	low	high	medium	medium	medium
introduced genetic material	low	low	medium	negligible	low	low	negligible	negligible	low
Pollution	low	low	medium	low	low	low	low	low	low
household sewage & urban wastewater	low	negligible	low	low	low	low	negligible	low	low
industrial & military effluents	low	negligible	low	low	low	low	high	low	low
agricultural & forestry effluents	low	medium	high	negligible	low	low	low	low	low
garbage & solid waste	low	negligible	low	low	low	low	low	low	low
air-borne pollutants	low	not a threat	low	negligible	negligible	medium	negligible	low	low
excess energy	low	negligible	low	negligible	negligible	low	negligible	low	low

Table 1. continued

Geological Events	low	negligible	low	low	negligible	low	low	negligible	low
volcanoes	negligible	negligible	negligible	negligible	negligible	negligible	negligible	negligible	negligible
earthquakes/tsunamis	low	negligible	low	negligible	negligible	low	medium	negligible	low
avalanches/landslides	low	negligible	low	low	negligible	low	low	negligible	low
Climate Change & Severe Weather	low	negligible	high	low	medium	medium	negligible	high	medium
habitat shifting & alteration	low	negligible	high	low	medium	high	negligible	high	medium
droughts	low	negligible	high	negligible	high	low	negligible	very high	medium
temperature extremes	low	negligible	medium	low	medium	low	negligible	medium	low
storms & flooding	low	negligible	high	low	low	low	low	high	medium
OVERALL THREAT IMPACT FOR EACH HABITAT	medium	low	high	high	medium	medium	medium	high	

*for each category, 1st level threats in **bold**, 2nd level threats in *italics*

Table 2. Conservation actions by habitat category for each **terrestrial habitat**, and overall action benefits for all terrestrial habitats combined.

ACTIONS FOR 1st & 2nd LEVEL OF CLASSIFICATION*	ACTION BY HABITAT CATEGORY								OVERALL ACTION BENEFIT
	FOREST	GRASSLAND	WETLAND	LAKE ERIE ISLANDS	OAK SAVANNAS	BOREAL COMMUNITY	CAVES and MINES	ARTIFICIAL/ MAN-MADE ENVIRONMENTS	ALL HABITAT CATEGORIES
Land/water Protection	high	high	high	medium	medium	high	high	high	high
site/area protection	high	high	high	medium	high	high	high	high	high
resource & habitat protection	medium	high	medium	medium	low	high	high	high	high
Land/water Management	high	medium	medium	medium	medium	high	high	medium	high
site/area management	medium	medium	low	low	low	medium	high	medium	medium
invasive/problematic species control	high	medium	high	high	medium	high	high	medium	high
habitat & natural process restoration	high	high	medium	medium	medium	high	high	low	high
Species Management	high	medium	high	medium	medium	high	medium	medium	high
species management	high	medium	high	high	medium	high	low	medium	high
species recovery	high	medium	high	low	medium	high	high	medium	high
species reintroduction	medium	medium	medium	low	medium	low	low	low	medium
ex situ conservation	medium	medium	low	low	low	medium	medium	low	medium
Education & Awareness	high	medium	medium	high	low	medium	high	high	high
formal education	high	medium	medium	high	low	high	high	high	high
training	high	high	medium	high	low	medium	high	medium	high
awareness & communications	low	medium	medium	high	low	low	high	high	medium
Law & Policy	high	medium	medium	medium	low	medium	medium	high	medium
legislation	high	high	medium	medium	low	low	high	high	high
policies & regulations	high	medium	medium	medium	low	medium	medium	high	medium
private sector standards & codes	medium	medium	medium	high	medium	medium	medium	medium	medium
compliance & enforcement	medium	medium	medium	low	low	medium	medium	medium	medium
Livelihood, Economic, & Other Incentives	low	medium	medium	low	low	medium	medium	medium	medium
linked enterprises & livelihood alternatives	low	high	medium	low	low	high	low	low	medium
substitution	low	medium	low	low	low	low	low	low	low
market forces	medium	medium	high	low	low	low	medium	medium	medium
conservation payments	medium	high	medium	low	low	high	high	medium	medium
nonmonetary values	low	low	low	low	low	low	high	medium	low
External Capacity Building	medium	high	medium	low	medium	high	high	high	high
institutional & civil society development	medium	high	medium	low	medium	medium	high	high	medium
alliance & partnership development	medium	high	medium	low	medium	high	high	high	high
conservation finance	high	high	medium	medium	medium	high	high	medium	high
OVERALL ACTION BENEFIT FOR EACH HABITAT	medium	high	medium	low	low	medium	high	medium	

*for each category, 1st level threats in **bold**, 2nd level threats in *italics*

Figure 2. Ohio's State Wildlife Action Plan **aquatic habitat** categories (*note: this figure is being used as a placeholder until a map with the correct habitat categories is developed*).

Table 3. Direct threats impact by habitat category for each **aquatic habitat**, and overall threat impact for all aquatic habitats combined.

DIRECT THREATS FOR 1st & 2nd LEVEL OF CLASSIFICATION*	THREAT IMPACT BY HABITAT CATEGORY							OVERALL THREAT IMPACT
	LAKE ERIE	LAKE ERIE TRIBUTARIES	OHIO RIVER	OHIO RIVER TRIBUTARIES	HEADWATER & SMALL INLAND STREAMS	MAN-MADE LAKES & PONDS	NATURAL LAKES	ALL HABITAT CATEGORIES
Residential & Commercial Development	medium	medium	low	medium	high	low	high	medium
housing & urban areas	medium	medium	low	medium	high	low	very high	high
commercial & industrial areas	medium	low	low	low	medium	low	low	medium
tourism & recreation areas	low	low	low	low	not a threat	low	low	low
Agriculture & Aquaculture	medium	medium	low	medium	high	low	medium	medium
annual & perennial non-timber crops	high	high	low	high	high	low	medium	high
wood & pulp plantations	negligible	negligible	low	low	negligible	low	low	low
livestock farming & ranching	low	low	low	low	low	low	medium	low
marine & freshwater aquaculture	negligible	negligible	negligible	negligible	negligible	negligible	negligible	negligible
Energy Production & Mining	low	low	low	low	high	medium	low	medium
oil & gas drilling	negligible	low	low	low	high	medium	low	medium
mining & quarrying	negligible	low	low	low	low	negligible	low	low
renewable energy	low	low	low	low	negligible	negligible	negligible	low
Transportation & Service Corridors	medium	medium	medium	low	medium	low	low	medium
roads & railroads	low	low	low	low	high	low	low	medium
utility & service lines	negligible	low	low	low	low	low	low	low
shipping lanes	medium	medium	medium	negligible	negligible	low	negligible	low
flight paths	negligible	negligible	negligible	negligible	negligible	negligible	negligible	negligible
Biological Resource Use	low	low	low	low	low	low	low	low
hunting & collecting terrestrial animals	negligible	negligible	negligible	negligible	negligible	negligible	negligible	negligible
gathering terrestrial plants	negligible	negligible	negligible	negligible	negligible	negligible	negligible	negligible
logging & wood harvesting	negligible	negligible	low	low	high	negligible	low	medium
fishing & harvesting aquatic resources	low	low	low	low	negligible	low	negligible	low
Human Intrusions & Disturbance	low	low	low	low	low	medium	low	low
recreational activities	low	low	low	low	negligible	medium	negligible	low
war, civil unrest & military exercises	negligible	negligible	negligible	negligible	negligible	negligible	negligible	negligible
work & other activities	negligible	negligible	low	negligible	low	negligible	low	low
Natural System Modifications	low	medium	high	medium	high	high	medium	high
fire & fire suppression	negligible	negligible	negligible	negligible	negligible	negligible	negligible	negligible
dams & water management/use	low	medium	high	medium	high	high	medium	high
other ecosystem modifications	low	medium	low	medium	low	low	high	medium
Invasive & Other Problematic Species & Genes	high	high	high	high	low	medium	high	high
invasive non-native/alien species	high	high	high	high	low	medium	high	high
problematic native species	low	low	low	low	negligible	low	low	low
introduced genetic material	negligible	negligible	low	low	negligible	low	negligible	low
Pollution	high	high	high	high	medium	medium	high	very high
household sewage & urban wastewater	high	high	high	high	low	low	high	high
industrial & military effluents	low	medium	medium	medium	low	low	low	medium
agricultural & forestry effluents	very high	very high	high	very high	high	high	high	very high
garbage & solid waste	low	low	low	low	low	low	low	low
air-borne pollutants	low	low	low	low	low	low	low	low
excess energy	negligible	negligible	low	negligible	negligible	negligible	negligible	negligible

Table 3. continued

Geological Events	negligible	negligible	negligible	negligible	negligible	negligible	negligible	negligible
volcanoes	negligible	negligible	negligible	negligible	negligible	negligible	negligible	negligible
earthquakes/tsunamis	negligible	negligible	negligible	negligible	negligible	negligible	negligible	negligible
avalanches/landslides	negligible	negligible	negligible	negligible	negligible	negligible	negligible	negligible
Climate Change & Severe Weather	low	low	low	low	medium	low	high	medium
habitat shifting & alteration	low	low	low	low	high	low	very high	medium
droughts	low	low	low	low	low	low	low	low
temperature extremes	low	low	low	low	low	low	negligible	low
storms & flooding	medium	medium	medium	medium	low	low	negligible	medium
OVERALL THREAT IMPACT FOR EACH HABITAT CATEGORY	medium	medium	medium	medium	high	low	high	

*for each category, 1st level threats in **bold**, 2nd level threats in *italics*

Table 4. Conservation actions by habitat category for each **aquatic habitat**, and overall action benefits for all aquatic habitats combined.

ACTIONS FOR 1st & 2nd LEVEL OF CLASSIFICATION*	ACTION BY HABITAT CATEGORY							OVERALL ACTION PRIORITY
	LAKE ERIE	LAKE ERIE TRIBUTARIES	OHIO RIVER	OHIO RIVER TRIBUTARIES	HEADWATER & SMALL INLAND STREAMS	MAN-MADE LAKES & PONDS	NATURAL LAKES	ALL HABITAT CATEGORIES
Land/water Protection	medium	medium	high	medium	high	high	high	high
site/area protection	low	low	medium	low	high	medium	high	medium
resource & habitat protection	medium	high	high	high	high	high	high	high
Land/water Management	high	high	high	high	medium	medium	medium	high
site/area management	medium	low	low	low	low	low	medium	low
invasive/problematic species control	high	high	high	high	low	medium	medium	high
habitat & natural process restoration	high	high	high	high	high	high	high	high
Species Management	low	low	low	low	medium	low	medium	low
species management	low	low	medium	medium	low	low	low	low
species recovery	medium	medium	low	low	low	low	medium	medium
species reintroduction	low	low	low	low	medium	low	medium	low
ex situ conservation	low	low	low	low	medium	low	medium	low
Education & Awareness	medium	high	medium	high	high	medium	high	high
formal education	low	low	low	low	high	low	medium	medium
training	high	high	high	high	high	medium	high	high
awareness & communications	medium	high	medium	high	medium	medium	medium	medium
Law & Policy	high	high	medium	high	high	medium	medium	high
legislation	high	high	medium	high	high	medium	medium	high
policies & regulations	high	high	medium	high	medium	medium	medium	high
private sector standards & codes	low	low	low	low	high	medium	low	low
compliance & enforcement	medium	medium	low	medium	medium	medium	low	medium
Livelihood, Economic, & Other Incentives	medium	medium	medium	medium	medium	medium	low	medium
linked enterprises & livelihood alternatives	low	low	low	low	low	low	low	low
substitution	low	low	low	low	low	low	low	low
market forces	medium	high	medium	high	low	medium	low	medium
conservation payments	medium	high	medium	high	medium	medium	low	medium
nonmonetary values	low	low	low	low	high	low	low	low
External Capacity Building	medium	medium	medium	medium	high	medium	medium	medium
institutional & civil society development	medium	medium	low	medium	medium	medium	medium	medium
alliance & partnership development	high	high	high	high	medium	high	low	high
conservation finance	low	low	low	low	high	low	medium	low
OVERALL HABITAT PRIORITY FOR ALL ACTIONS COMBINED	medium	high	medium	high	high	medium	medium	

*for each category, 1st level threats in **bold**, 2nd level threats in *italics*

THE HABITAT CATEGORIES TEMPLATE

This section describes the information contained within each habitat category, and how that information is organized. The following template is used to describe all of Ohio's terrestrial and aquatic habitats:

Statewide Habitat Distribution Map

The maps indicate statewide habitat distribution based upon the best information available. Given the statewide scale, the accuracy of these maps is compromised relative to habitat boundaries, and the locations of isolated habitat fragments. The maps are simply intended to give the viewer a qualitative representation of the distribution of each habitat category, and are not meant to be used for any kind of quantitative habitat analysis.

Habitat Status

This section contains a brief assessment of the current condition, condition trend, size, statewide scale relative to other habitats, and general distribution for each habitat category. The total area in acres and/or miles for each habitat is estimated from the best GIS data available.

Habitat Description

A historical perspective on how the habitat has changed over time is presented here. Habitat condition and distribution is characterized using the best and most current information available. Effects of an increasing population, changing land use practices, industrialization and urbanization are presented and discussed. Present day ownership of each habitat, benefits to wildlife, as well as current issues are also discussed.

Associated SGCN

Each habitat chapter contains a list of SGCN associated with that particular habitat. These habitat associations are not exclusive, but represent the most important and highly used habitats for the species on each list. Species lists are grouped by taxa (mammals, birds, fish, reptiles, etc.), and the order of species within each taxa reflects conservation status rank, as described in Chapter 4 – Species of Greatest Conservation Need.

Conservation Threats Table

For each habitat/species assessment there is a table illustrating the results using the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system. With this system, threats are characterized by determining the scope, severity, and timing of each. Subsequently, threat "impact" scores were calculated using the IUCN Threats Calculator, with scores based on estimates of the scope, severity, and timing for applicable individual threats to the species or ecosystem (Master et al. 2012). The threat classification system is described in detail by Salafsky et al. (2008).

The direct threats classification uses a hierarchical approach with 3 different levels. Each first level threat category is sub-divided into several second level categories, and these in turn are divided into third level categories. The classifications are comprehensive and exclusive for the first and second levels – consequently we limited our threat analysis to first and second level categories. For each threat level identified, the scope, severity, timing, and impact were determined.

Direct threats are in general limited to human activities – with the exception of geological events, climate change, and severe weather. The rationale for these exceptions is that when humans put pressure on species and ecosystems, the effects of natural events can be more detrimental than they would otherwise be (Salafsky et al. 2008).

Conservation Actions Table

For each habitat/species assessment there is a table illustrating the results using the IUCN-CMP classification of conservation actions described by Salafsky et al. (2008). The conservation actions classification uses a hierarchical approach with 3 different levels. Each first level action category is sub-divided into several second level categories, and these in turn are divided into third level categories. The classifications are comprehensive and exclusive for the first and second levels – consequently we limited our conservation action analysis to first and second level categories.

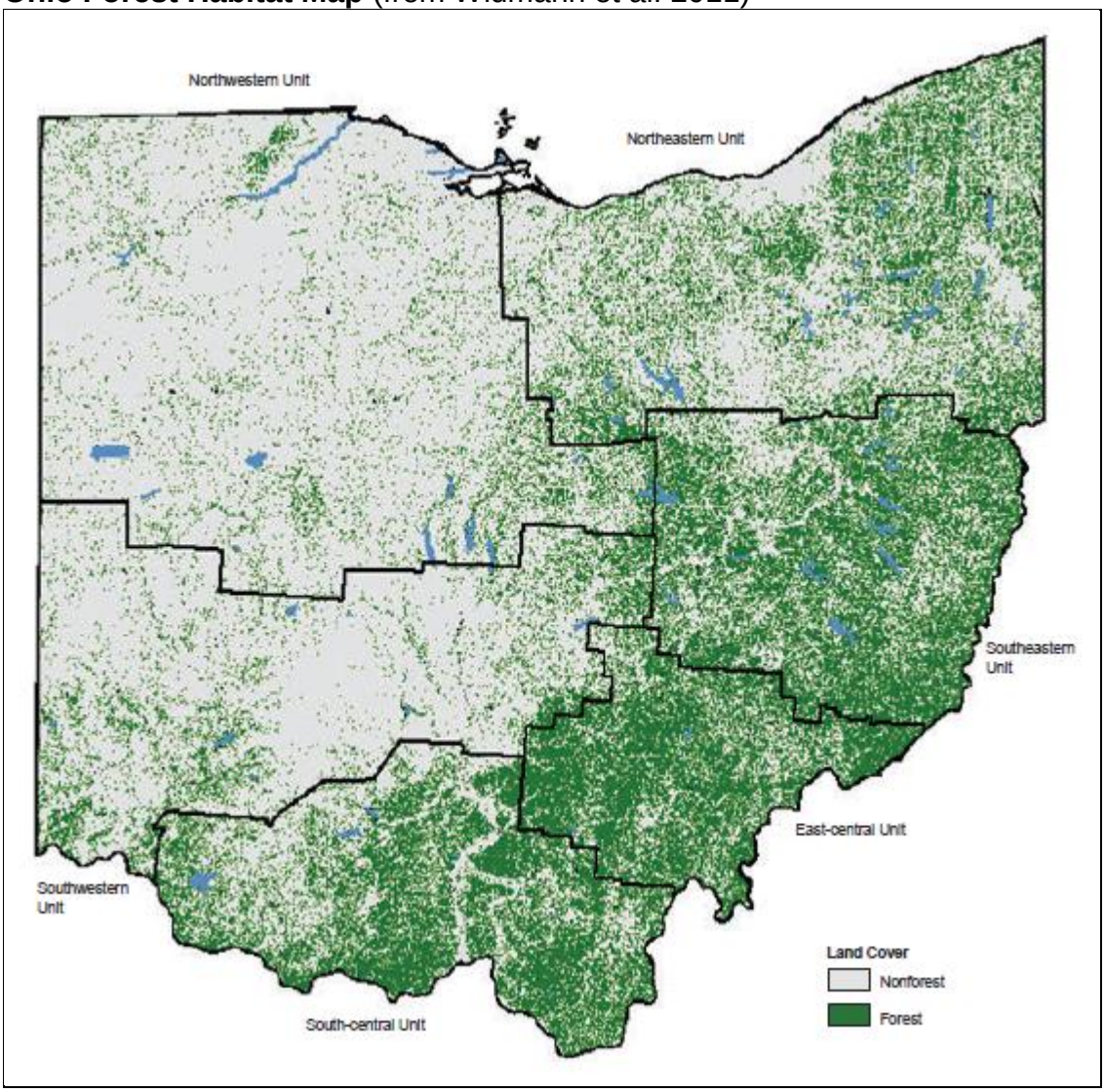
Conservation action priority ranks were then determined using the seven ranking criteria (see bullets below) developed by the Georgia Department of Natural Resources (Georgia DNR 2005) where rating reflects the relative contribution or significance of a conservation action for each criterion. Internal species/habitat experts assessed the contribution of each conservation action for each of these criteria and assigned scores (1-3 points for each). The resulting point totals were used to sort the conservation actions into three categories: high priority (17-21 points), medium priority (12-16 points), and low priority (7-11 points).

Each conservation action in the table was evaluated and assigned a priority score using the following criteria:

- Benefits for High Priority Species/Habitats
- Addresses Un(der)funded Needs
- Importance to Ongoing Local Efforts
- Timeliness or Urgency
- Connections with Other Conservation Actions
- Building Public Support for Wildlife Conservation
- Probability of Success

Forest Habitat

Ohio Forest Habitat Map (from Widmann et al. 2011)



STATUS
Since 2006, forest land has increased by 2.1 percent in Ohio. Currently, forestland comprises about 31 percent of the State's land area (approx. 8.1 million acres). Forestlands are not uniformly distributed across the state. Forest cover in glaciated, western counties averages less than 15 percent, whereas counties in unglaciated southeastern Ohio average 67 percent forest cover. Overall Ohio's forests are maturing and trees continue to shift to larger diameter size classes. By volume, red maple, yellow poplar and sugar maple dominate. Fourteen percent of Ohio's forestland acreage is in public ownership, with the remaining 86% privately owned (Widmann et al. 2011).

DESCRIPTION
Forest habitat is classified by composition (ex., oak-hickory, beech), and growth stage (early successional through mature) for management purposes.

The Ohio landscape has undergone dramatic changes since the late 1700s, when nearly 95 percent of the state was forested. Massive deforestation occurred throughout Ohio during settlement as land was cleared and swamps were drained for farmland. Forest cover was reduced to a low of 12 percent in Ohio by 1942. This destruction of forest habitat, along with unregulated hunting, resulted in the extirpation of many native animals from Ohio including the gray wolf, elk, mountain lion, and the extinction of the passenger pigeon.

Since the 1940s, Ohio's forestlands have more than doubled in area due to the reversion of unproductive and abandoned farmland and pastures back to forests. The steady increase in forest habitat in recent decades has been the major factor leading to the successful reintroduction, return, or resurgence of many forest-dependent wildlife species such as white-tailed deer, wild turkey, beaver, and bobcat.

The vast majority of forestlands are owned by private landowners in Ohio. Forest fragmentation and development pressures present an increasing threat as private woodland owners choose to sell forestland to developers. Few landowners have management plans for their forests and many do not know where to turn for technical advice. Increasing the capacity and delivery of forest habitat technical guidance will be an important goal to increase the amount of private forestland that is being sustainably managed in Ohio.

Acorns are an important food source for many forest wildlife species. Numerous studies have linked the abundance of acorn mast crops to body condition, winter survival, and reproductive success of wildlife (McShea and Healy 2002). However, an emerging shift in tree species composition has become apparent in Ohio's forests. Although oak-hickory is still the dominant forest type and provides an important wildlife food resource in Ohio, an analysis of tree species composition by diameter class reveals a lack of oak and hickory, and a predominance of shade-tolerant species such as red maple, in smaller tree diameter classes (Widmann et al. 2009). The virtual absence of oak regeneration has been attributed to fire suppression and silvicultural practices that favor shade tolerant species and inhibit oak establishment.

Early-successional habitat important to many forest wildlife species is declining as Ohio's forests are maturing. Since 1968, acreage in the seedling/sapling size class (trees < 5 inches d.b.h.) has declined by 73% from 3.7 to 1.0 million acres, whereas acreage in the sawtimber size class (trees $\geq$11 inches d.b.h.) more than doubled from 1.9 to 4.8 million acres (Widmann et al. 2009). As of 2006, the age/size class distribution of Ohio's forestland habitat was 12% seedling/sapling, 24% pole timber, and 63% saw timber (Widmann et al. 2009). The ruffed grouse has declined dramatically since the early 1980s due to loss of early-successional habitat. Furthermore, several bird species that use early-successional forest habitats including the American woodcock, prairie warbler, and blue-winger warbler have been identified as species of highest conservation priority by the Appalachian Mountains Joint Venture.

The Forest Habitat chapter addresses the major issues facing forestlands in Ohio. Increasing the capacity and delivery of forest habitat technical guidance will be an important goal to increase/improve the amount of private forestland being managed. Maintaining oak-hickory forest types and providing a sustainable balance of forest age classes, including early-successional habitats, on publicly-owned lands will be critical to provide habitat for diverse and abundant wildlife populations. Implementation of the Forest Habitat conservation actions in this section will foster healthy forest ecosystems, create/maintain opportunities for forest wildlife recreation, and improve public awareness, understanding, and appreciation of Ohio's forest wildlife on both public and private lands.

ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

Ohio's forestland historically supported 100 avian species, 30 species of mammals, 48 species of reptiles and amphibians, 58 species of lepidopterans, and numerous other invertebrates. This wide assemblage of native fauna is dependent on forest habitat for survival and reproduction. Each species has unique habitat requirements. Some species can survive and reproduce only in the earliest stages of forest succession, whereas others need mature forest with large, tall trees. Some species require a broken forest with a good interspersion of age classes, whereas others need large expanses of unbroken mature forest with little or no edge.

The following species have been identified as Forest habitat species of greatest conservation need (conservation status rank in parentheses):

Amphibians

Northern Spring Salamander (1)	*Gyrinophilus porphyriticus porphyriticus*
Streamside Salamander (2)	*Ambystoma barbouri*
Kentucky Spring Salamander (3)	*Gyrinophilus porphyriticus duryi*
Smallmouth Salamander (4)	*Ambystoma texanum*
Mud Salamander (5)	*Pseudotriton montanus*
Green Salamander (6)	*Aneides aeneus*
Jefferson Salamander (7)	*Ambystoma jeffersonianum*
Northern Red Salamander (7)	*Pseudotriton ruber ruber*
Eastern Tiger Salamander (9)	*Ambystoma tigrinum tigrinum*
Marbled Salamander (10)	*Ambystoma opacum*
Four-toed Salamander (11)	*Hemidactylium scutatum*
N. Ravine Salamander (12)	*Plethodon richmondi*
Longtailed Salamander (13)	*Eurycea longicauda longicauda*
Eastern Spadefoot (15)	*Scaphiopus holbrookii*
Northern Dusky Salamander (17)	*Desmognathus fuscus fuscus*
Red-spotted Newt (20)	*Notophthalmus viridescens viridescens*
Western Chorus Frog (20)	*Pseudacris triseriata triseriata*
Wood Frog (22)	*Rana sylvatica*
Cope's Gray Treefrog (24)	*Hyla chrysoscelis*
Gray Treefrog (24)	*Hyla versicolor*
Mountain Dusky Salamander (24)	*Desmognathus ochrophaeus*
Pickerel Frog (24)	*Rana palustris*
Northern Slimy Salamander (28)	*Plethodon glutinosus*
Spotted Salamander (28)	*Ambystoma maculatum*
N. Two-lined Salamander (32)	*Eurycea bislineata*
S. Two-lined Salamander (32)	*Eurycea cirrigera*
Northern Spring Peeper (34)	*Pseudacris crucifer crucifer*
Redback Salamander (34)	*Plethodon cinereus*

Birds

Cerulean Warbler (1)	*Dendroica cerulea*
Blue-winged Warbler (10)	*Vermivora pinus*
Sharp-shinned Hawk (10)	*Accipiter striatus*
Worm-eating Warbler (10)	*Helmitheros vermivorus*
Black-billed Cuckoo (24)	*Coccyzus erythropthalmus*
Red-headed Woodpecker (24)	*Melanerpes erythrocephalus*
Whip-poor-will (24)	*Antrostomus vociferus*
American Woodcock (24)	*Scolopax minor*
Wood Thrush (24)	*Hylocichla mustelina*
Prairie Warbler (24)	*Setophaga discolor*
Acadian Flycatcher (36)	*Empidonax virescens*
Wood Duck (36)	*Aix sponsa*
Yellow-billed Cuckoo (36)	*Coccyzus americanus*
Great Crested Flycatcher (36)	*Myiarchus crinitus*
Bell's Vireo (36)	*Vireo bellii*
Yellow-throated Vireo (36)	*Vireo flavifrons*
Blue-gray Gnatcatcher (36)	*Polioptila caerulea*
Veery (36)	*Catharus fuscescens*
Black-and-white Warbler (36)	*Mniotilta varia*
American Redstart (36)	*Setophaga ruticilla*
Black Vulture (52)	*Coragyps atratus*
Bald Eagle (52)	*Haliaeetus leucocephalus*

Red-shouldered Hawk (52)	*Buteo lineatus*
Broad-winged Hawk (52)	*Buteo platypterus*
Northern Saw-whet Owl (52)	*Aegolius acadicus*
Chuck-will's-widow (52)	*Antrostomus carolinensis*
Yellow-bellied Sapsucker (52)	*Sphyrapicus varius*
Pileated Woodpecker (52)	*Dryocopus pileatus*
Blue-headed Vireo (52)	*Vireo solitarius*
Golden-crowned Kinglet (52)	*Regulus satrapa*
Hermit Thrush (52)	*Catharus guttatus*
Chestnut-sided Warbler (52)	*Setophaga pensylvanica*
Black-throated Green Warbler (52)	*Setophaga virens*
Blackburnian Warbler (52)	*Setophaga fusca*
Yellow-throated Warbler (52)	*Setophaga dominica*
Pine Warbler (52)	*Setophaga pinus*
Northern Parula (52)	*Setophaga americana*
Hooded Warbler (52)	*Setophaga citrina*
Canada Warbler (52)	*Cardellina canadensis*
Summer Tanager (52)	*Piranga rubra*
Eastern Towhee (52)	*Pipilo erythrophthalmus*
Rose-breasted Grosbeak (52)	*Pheucticus ludovicianus*
Blue Grosbeak (52)	*Passerina caerulea*
Rusty Blackbird (52)	*Euphagus carolinus*
Ruffed Grouse (52)	*Bonasa umbellus*
Eastern Screech-Owl (52)	*Megascops asio*
Northern Flicker (52)	*Colaptes auratus*
Eastern Wood-Pewee (52)	*Contopus virens*
Willow Flycatcher (52)	*Empidonax traillii*
Brown Thrasher (52)	*Toxostoma rufum*
Yellow-breasted Chat (52)	*Icteria virens*
Scarlet Tanager (52)	*Piranga olivacea*
Indigo Bunting (52)	*Passerina cyanea*
Orchard Oriole (52)	*Icterus spurius*
Wild Turkey (112)	*Meleagris gallopavo*
Turkey Vulture (112)	*Cathartes aura*
Cooper's Hawk (112)	*Accipiter cooperii*
Mourning Dove (112)	*Zenaida macroura*
Great Horned Owl (112)	*Bubo virginianus*
Barred Owl (112)	*Strix varia*
Red-bellied Woodpecker (112)	*Melanerpes carolinus*
Downy Woodpecker (112)	*Picoides pubescens*
Hairy Woodpecker (112)	*Picoides villosus*
Eastern Phoebe (112)	*Sayornis phoebe*
White-eyed Vireo (112)	*Vireo griseus*
Warbling Vireo (112)	*Vireo gilvus*
Red-eyed Vireo (112)	*Vireo olivaceus*
Carolina Chickadee (112)	*Poecile carolinensis*
Black-capped Chickadee (112)	*Poecile atricapillus*
Tufted Titmouse (112)	*Baeolophus bicolor*
White-breasted Nuthatch (112)	*Sitta carolinensis*
Carolina Wren (112)	*Thryothorus ludovicianus*
American Robin (112)	*Turdus migratorius*
Gray Catbird (112)	*Dumetella carolinensis*
Northern Mockingbird (112)	*Mimus polyglottos*
Cedar Waxwing (112)	*Bombycilla cedrorum*
Yellow Warbler (112)	*Setophaga petechia*
Ovenbird (112)	*Seiurus aurocapilla*

Kentucky Warbler (112)	*Geothlypis formosa*
Baltimore Oriole (112)	*Icterus galbula*
Mississippi Kite (112)	*Ictinia mississippiensis*
Long-eared Owl (112)	*Asio otus*
Alder Flycatcher (112)	*Empidonax alnorum*
Least Flycatcher (112)	*Empidonax minimus*
Red-breasted Nuthatch (112)	*Sitta canadensis*
Brown Creeper (112)	*Certhia americana*
Winter Wren (112)	*Troglodytes hiemalis*
Nashville Warbler (112)	*Oreothlypis ruficapilla*
Magnolia Warbler (112)	*Setophaga magnolia*
Black-throated Blue Warbler (112)	*Setophaga caerulescens*
Northern Waterthrush (112)	*Parkesia noveboracensis*
Mourning Warbler (112)	*Geothlypis philadelphia*
Dark-eyed Junco (112)	*Junco hyemalis*
Purple Finch (112)	*Haemorhous purpureus*
Pine Siskin (112)	*Spinus pinus*
Common Raven (112)	*Corvus corax*

<u>Butterflies and Skippers</u>

Mitchell's Satyr (1)	*Neonympha mitchellii*
Grizzled Skipper (3)	*Pyrgus centaureae wyandot*
Olympia Marble (4)	*Euchloe olympia*
Gold-banded Skipper (5)	*Autochton cellus*
Confused Cloudy Wing (6)	*Thorybes confusis*
Duke's Skipper (6)	*Euphyes dukesi*
Diana Fritillary (9)	*Speyeria diana*
Mottled Dusky Wing (9)	*Erynnis martialis*
Cobweb Skipper (14)	*Hesperia metea*
Silvery Blue (22)	*Glaucopsyche lygdamus*
Atlantis Fritillary (23)	*Speyeria atlantis*
Gray Comma (23)	*Polygonia progne*
Zebra Swallowtail (25)	*Eurytides marcellus*
Dusky Azure (26)	*Celastrina nigra*
Northern Oak Hairstreak (27)	*Fixsenia favonius ontario*
Falcate Orange Tip (28)	*Anthocharis midea annickae*
Eastern Pine Elfin (28)	*Incisalia niphon*
Northern Metalmark (28)	*Calephelis borealis*
Early Hairstreak (31)	*Erora laeta*
Edward's Hairstreak (33)	*Satyrium edwardsii*
White M Hairstreak (34)	*Parrhasius m-album*
Compton Tortoise Shell (34)	*Nymphalis l-album*
Goatweed Butterfly (37)	*Anaea andria*
Hayhurst’s Scalloped Sootywing (37)	*Staphylus hayhurstii*
Hickory Hairstreak (39)	*Satyrium caryaevorum*
Leonard's Skipper (41)	*Hesperia leonardus*
West Virginia White (45)	*Pieris virginiensis*
Brown Elfin (45)	*Incisalia augustinus croesoides*
Appalachian Blue (45)	*Celastrina negelectamajor*
Pepper & Salt Skipper (45)	*Amblyscirtes hegon*
Striped Hairstreak (50)	*Satyrium liparops strigosum*
Spring Azure (52)	*Celastrina ladon*
Pipe-vine Swallowtail (53)	*Battus philenor*
Aphrodite Fritillary (53)	*Speyeria aphrodite*
Appalachian Eyed Brown (53)	*Satyrodes appalachia*
Southern Cloudy Wing (53)	*Thorybes bathyllus*

Northern Cloudy Wing (53)	*Thorybes pylades*
Sleepy Dusky Wing (53)	*Erynnis brizo*
Hobomok Skipper (53)	*Poanes hobomok*
Zabulon Skipper (53)	*Poanes zabulon*
Giant Swallowtail (66)	*Papilio cresphontes*
Red-banded Hairstreak (66)	*Calycopis cecrops*
American Snout (66)	*Libytheana carinenta bachmanii*
Silvery Checkerspot (66)	*Chlosyne nycteis*
Milbert's Tortoise Shell (66)	*Aglais milberti*
Northern Pearly Eye (66)	*Enodia anthedon*
Gemmed Satyr (66)	*Cyllopsis gemma*
Carolina Satyr (66)	*Hermeuptychia sosybius*
Hoary Edge Skipper (66)	*Achalarus lyciades*
Horace's Dusky Wing (66)	*Erynnis horatius*
Crossline Skipper (66)	*Polites origenes*
Roadside Skipper (66)	*Amblyscirtes vialis*
Harvester (82)	*Feniseca tarquinius*
Monarch (82)	*Danaus plexippus*
Coral Hairstreak (85)	*Satyrium titus*
Banded Hairstreak (85)	*Satyrium calanus falacer*
Henry's Elfin (89)	*Incisalia henrici*
Mourning Cloak (89)	*Nymphalis antiopa*
Tawny Emperor (89)	*Asterocampa clyton*
Little Wood Satyr (89)	*Megisto cymela*
Dreamy Dusky Wing (89)	*Erynnis icelus*
Juvenal's Dusky Wing (89)	*Erynnis juvenalis*
Eastern Tailed Blue (104)	*Everes comyntas*
Tiger Swallowtail (106)	*Papilio glaucus*
Spicebush Swallowtail (106)	*Papilio troilus*
Question Mark (106)	*Polygonia interrogationis*
Hop Merchant (Comma) (106)	*Polygonia comma*
Red Admiral (106)	*Vanessa atalanta rubria*
Red-spotted Purple (106)	*Limenitis arthemis astyanax*
Hackberry Butterfly (106)	*Asterocampa celtis*
Northern Broken Dash Skipper (106)	*Wallengrenia egeremet*
Summer Azure (119)	*Celastrina neglecta*
Gray Hairstreak (123)	*Strymon melinus humuli*
Great Spangled Fritillary (130)	*Speyeria cybele*

<u>Invertebrates</u>

American Burying Beetle	*Nicrophorus americanus*

<u>Mammals</u>

Eastern Small-footed Bat (1)	*Myotis subulatus leibii*
Northern Long-eared Bat (2)	*Myotis septentrionalis*
Rafinesque's Big-eared Bat (3)	*Corynorhinus rafinesquii*
Silver-haired Bat (4)	*Lasionycteris noctivagans*
Evening Bat (5)	*Nycticeius humeralis*
Red Bat (6)	*Lasiurus borealis*
Indiana Bat (7)	*Myotis sodalis*
Tri-colored bat (7)	*Perimyotis subflavus*
Hoary Bat (9)	*Lasiurus cinereus*
Southern Flying Squirrel (9)	*Glaucomys volans*
Little Brown Bat (14)	*Myotis lucifugus*
Big Brown Bat (14)	*Eptesicus fuscus*
Thirteen-lined Ground Squirrel (16)	*Spermophilus tridecemlineatus*

Pine Vole (19)	*Microtus pinetorum*
Smoky Shrew (19)	*Sorex fumeus*
Hairy-tailed Mole (22)	*Parascalops breweri*
Allegheny Woodrat (24)	*Neotoma magister*
Eastern Chipmunk (25)	*Tamias striatus*
Bobcat (25)	*Felis rufus*
Black Bear (28)	*Ursus americanus*
Long-tailed Weasel (30)	*Mustela frenata*
Red Squirrel (30)	*Tamiasciurus hudsonicus*
Masked Shrew (33)	*Sorex cinereus*
White-footed Mouse (36)	*Peromyscus leucopus*
Gray Fox (36)	*Urocyon cinereoargenteus*
Gray Squirrel (42)	*Sciurus carolinensis*
Fox Squirrel (45)	*Sciurus niger*
Red Fox (53)	*Vulpes vulpes*
White-tailed Deer (54)	*Odocoileus virginianus*

Reptiles

Shortheaded Garter Snake (1)	*Thamnophis brachystoma*
Eastern Smooth Earth Snake (2)	*Virginia valeriae valeriae*
Rough Green Snake (3)	*Opheodrys aestivus*
Eastern Hognose Snake (6)	*Heterodon platirhinos*
Broadhead Skink (12)	*Eumeces laticeps*
Eastern Box Turtle (13)	*Terrapene carolina carolina*
Black Kingsnake (13)	*Lampropeltis getula nigra*
Northern Copperhead (17)	*Agkistrodon contortrix mokasen*
Timber Rattlesnake (18)	*Crotalus horridus horridus*
Copperbelly Water Snake (22)	*Nerodia erythrogaster neglecta*
Northern Ringneck Snake (24)	*Diadophis punctatus edwardsii*
Eastern Worm Snake (25)	*Carphophis amoenus amoenus*
Midwest Worm Snake (25)	*Carphophis amoenus helenae*
Eastern Milk Snake (28)	*Lampropeltis triangulum triangulum*
Northern Redbelly Snake (29)	*Storeria occipitomaculata occipitomaculata*
Little Brown Skink (30)	*Scincella lateralis*
Black Rat Snake (31)	*Elaphe obsoleta obsolete*
Five-lined Skink (34)	*Eumeces fasciatus*
Northern Fence Lizard (37)	*Sceloporus undulatus hyacinthinus*
Northern Brown Snake (43)	*Storeria dekayi dekayi*

FOREST CONSERVATION OPPORTUNITY AREAS

The Division of Wildlife's approach to enhancing and maintaining the highest level of terrestrial wildlife diversity in the state is to use a conservation opportunity area concept to sustain viable populations of as many native species of wildlife as possible. The idea is to concentrate efforts and resources to provide all the necessary habitat requirements in a few, relatively large landscapes of major habitat types, along with the remnants of several unique habitats, for species that are of limited distribution or have low populations.

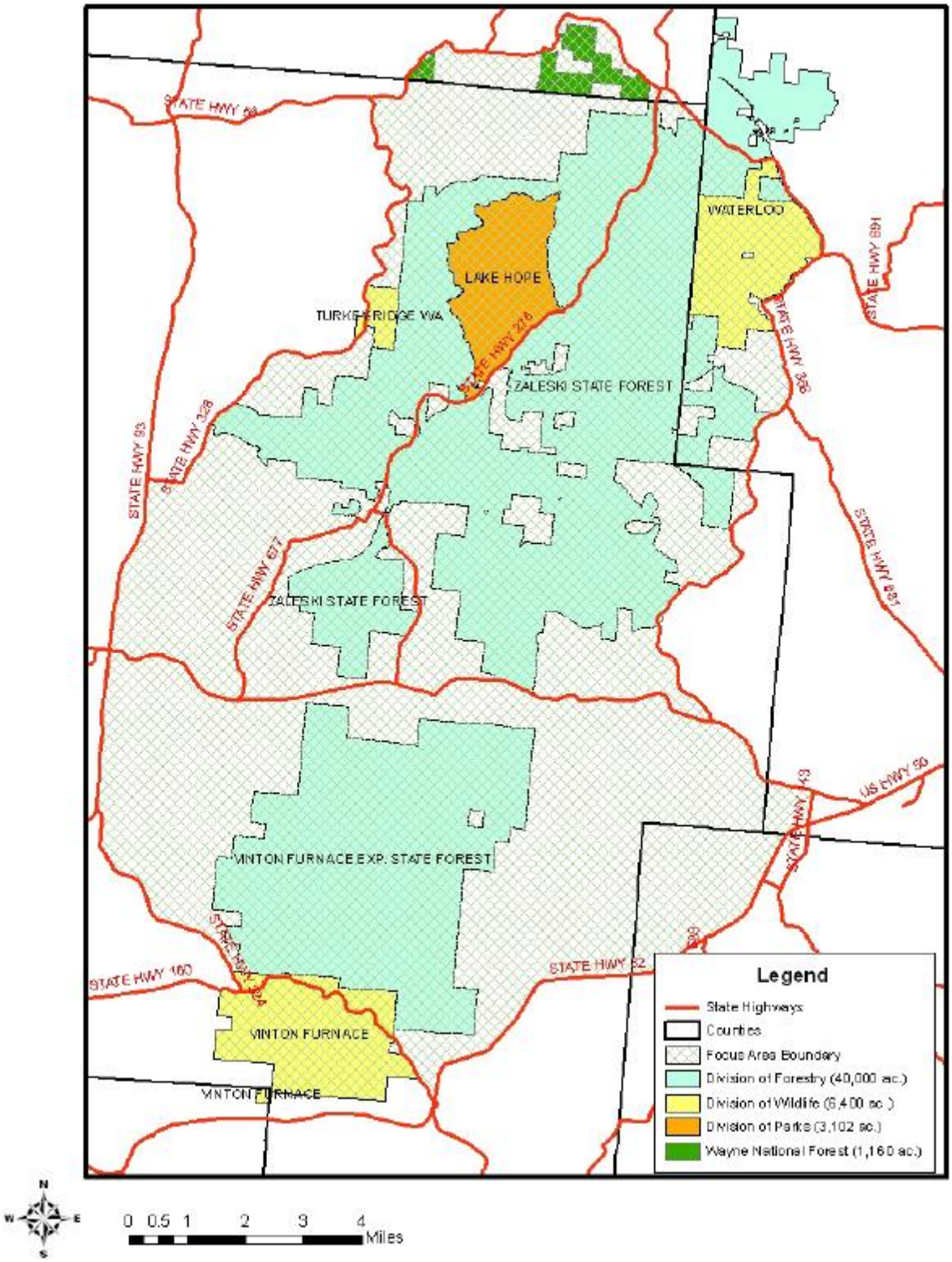
In the Division's last strategic plan, two forest conservation opportunity areas were identified - the Appalachian Foothills and Tecumseh Forest Conservation Opportunity Areas, both of sufficient size (>60,000 acres) to maintain viable populations of most native forest dependent wildlife species, except black bears. Important partnerships were developed and great strides were made to inventory forest resources and discuss cooperative management of forest conservation opportunity areas during the last several years. The next steps will require development of specific habitat objectives to benefit priority wildlife species as identified in state, federal, and regional conservation plans, and conducting a coordinated monitoring protocol to determine the success of these efforts.

Appalachian Foothills Forest Conservation Opportunity Area

The Appalachian Foothills Conservation Opportunity Area, primarily located in Vinton and Athens counties, includes the Zaleski State Forest (28,604 ac.), Vinton Furnace State Experimental Forest (12,089 ac.), Waterloo (2,635 ac.), Turkey Ridge Wildlife Area (377 ac.), Vinton Furnace Wildlife Area (3,405 ac.), Lake Hope State Park (2,635 ac.), and surrounding private lands (Figure T-1). Current habitat conditions on inholdings and adjacent privately-owned properties within the focus area landscape will be identified with satellite imagery and considered along with public lands as forest management plans are developed within the conservation opportunity area. Private lands of strategic conservation value within the area will be identified and prioritized for acquisition and/or conservation easements.

The Appalachian Foothills Conservation Opportunity Area landscape is primarily an oak-hickory forest type, and contains a heterogeneous composition of forest species referred to as the Central Upland Hardwoods. Mixed oak species are located on upper slopes and ridges, with mixed mesophytic trees of more tolerant and later climax species located in the hollows and low areas. Principal species include red, white, and black oak, red and sugar maple, various hickories, beech, yellow poplar, ash, and occasional walnut and scattered other species. Plantations of conifers are common throughout the area. Principal species include white, red, and shortleaf pine.

Figure T-1. Appalachian Foothills Forest Conservation Opportunity Area

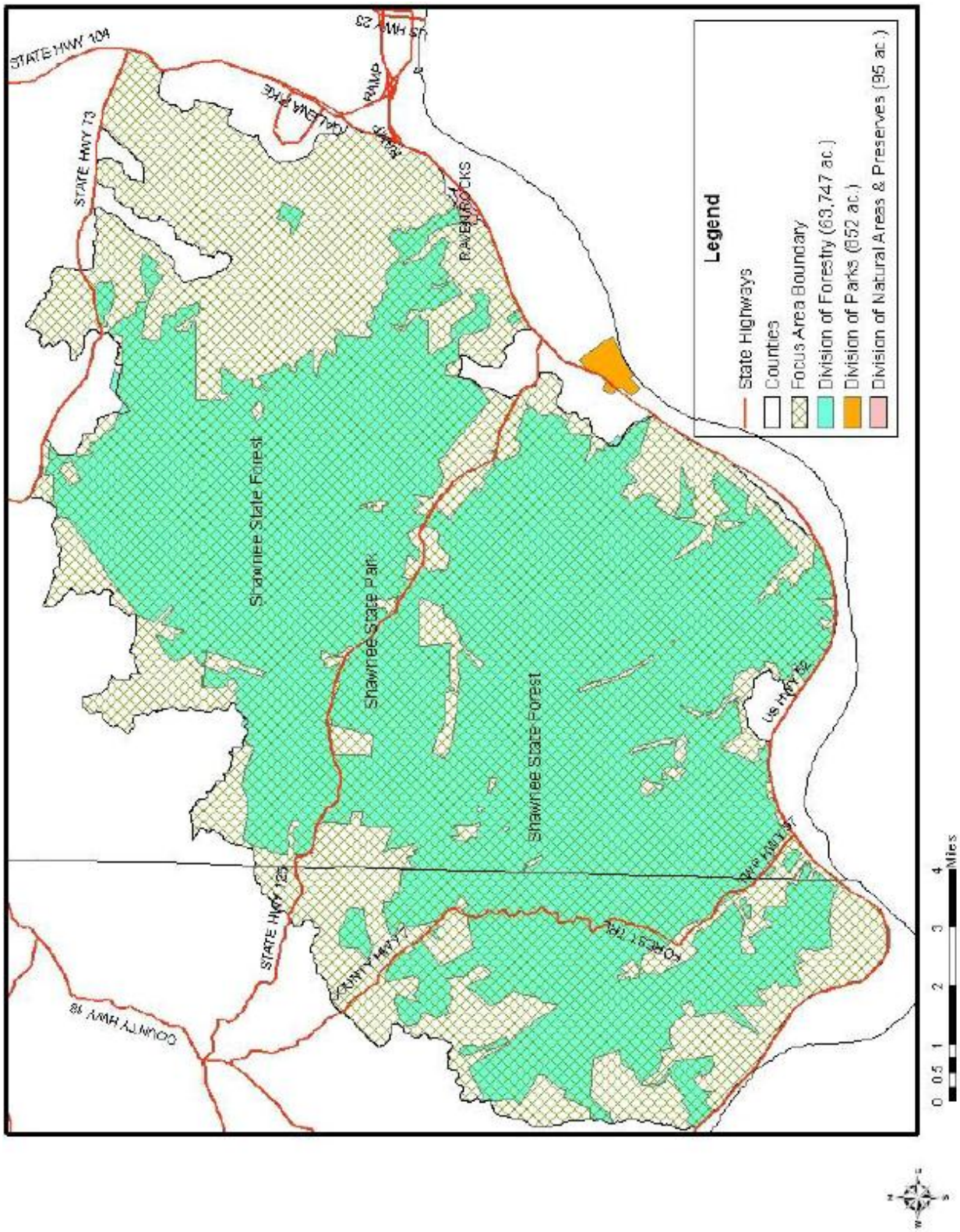


Tecumseh Forest Conservation Opportunity Area

The Tecumseh Forest Conservation Opportunity Area, located in Scioto and Adams counties, includes Shawnee State Forest (63,747 ac.), Shawnee State Park (852 ac.), Raven Rock State Nature Preserve (95 ac.), and surrounding private lands (Figure T-2 – the boundaries of this area are currently being revised). Current habitat conditions on inholdings and adjacent privately-owned properties within the area landscape will be identified with satellite imagery and considered along with public lands as forest management plans are developed within the conservation opportunity area. Private lands of strategic conservation value within the area will be identified and prioritized for acquisition and/or conservation easements.

The Tecumseh Forest Conservation Opportunity Area is part of the overall Central Hardwood Region and contains two major forest types: mixed-mesophytic and oak-hickory, as well as small stands of other forest types spread throughout the forest. The relatively narrow ridges and steep upper slopes typical of the region support trees of the oak-hickory forest type with the occasional stands of native pine. The main hardwood species include scarlet, chestnut, white, black, and northern red oaks, pignut, shagbark and mockernut hickories, and sassafras. Native conifers include Pitch, Virginia, and shortleaf pines. Depending upon the aspect, many sites support mixed-mesophytic hardwood species such as chestnut, white, black, and northern red oaks, red and sugar maple, basswood, yellow-poplar, yellow buckeye, blackgum, white ash, beech, red elm, hackberry, aspen, and several species of hickory. The coves, depending on site class and aspect, support high quality hardwoods such as yellow poplar, black walnut, white ash, black cherry, and red oak.

Figure T-2. Tecumseh Forest Conservation Opportunity Area



CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Forest habitat. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		medium
A	Changing land ownership patterns are increasing fragmentation, parcelization, and urbanization of forestlands	housing & urban areas commercial & industrial areas	high low
B	Habitat destruction, fragmentation, altered hydrology from commercial development	commercial & industrial areas	low
C	Habitat destruction, fragmentation, altered hydrology from urban/suburban development	housing & urban areas	high
II	**agriculture and aquaculture**		low
A	Loss of forest habitat because of conversion to agriculture	annual & perennial non-timber crops livestock farming & ranching	negligible low
B	Loss of forest habitat due to increase in intensity of agricultural practices – conversion of fencerows and other imbedded forest habitat	annual & perennial non-timber crops	negligible
III	**energy production and mining**		high
A	Mining, oil and gas extraction - can directly damage and destroy forest habitat, and indirectly have negative impacts by altering hydrology and causing chemical contamination	oil & gas drilling mining & quarrying	high high
IV	**transportation and service corridors**		low
A	Roads and utilities can destroy and fragment forest habitat, and alter hydrology	roads & railroads utility & service lines	medium medium
V	**biological resource use**		low
A	Logging and timber harvest can destroy and/or alter forest habitat	logging & wood harvesting	medium
VI	**human intrusions and disturbance**		low
A	Incompatible recreational activities	recreational activities	medium
B	Creation of recreational facilities can alter/destroy forest habitat	recreational activities	medium
VII	**natural system modifications**		low
A	Our ability to manage/protect forestlands is limited because nearly 73% of forest land is owned by private landowners in Ohio	other ecosystem modifications	low
B	Increased opposition to prescribed burning in forestlands	fire & fire supression	low
C	Lack of forest inventory data, and a database system to analyze that data limits our ability to manage	other ecosystem modifications	low
D	Our ability to manage forestlands is limited by available staff and funding	other ecosystem modifications	low
E	Forest tree species composition is shifting in Ohio from oaks and hickories – important wildlife habitat – to less desirable species such as red maple	other ecosystem modifications	low

F	Wildlife species dependent on early-successional habitats have declined as Ohio forests have matured into older age classes.	other ecosystem modifications	low
G	Incompatible forestry practices that result in changes to species composition, changes in habitat structural complexity, changes in hydrology – and resulting impacts to wildlife normally associated with these habitats	other ecosystem modifications	low
H	Our ability to address habitat objectives in some forests stands (management by selective cutting) may be limited because there may be no market for the timber	other ecosystem modifications	low
I	Lack of forestland associated species data limits our ability to manage	other ecosystem modifications	low
VIII	**invasive and other problematic species and genes**		medium
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	high
B	Introduction and/or spread of nuisance plants and animals	problematic native species	low
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	high low
IX	**pollution**		low
A	Urban effluent	household sewage & urban wastewater industrial & military effluents garbage & solid waste air-borne pollutants	low low low low
B	Agriculture effluent	agricultural & forestry effluents	low
X	**geological events**		low
---	none	---	---
XI	**climate change and severe weather**		low
A	Climate change could effect plant species composition, which in turn could affect wildlife species	habitat shifting & alteration droughts temperature extremes storms & flooding	low low low low

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Forest habitat. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		high	
1	Protect forest lands through strategic acquisitions, easements, and partnerships	resource & habitat protection	med	I, II, III, IV, V, VI
2	Annually identify and prioritize properties within the existing Forest Conservation Opportunity Areas for strategic acquisitions, conservation easements, management agreements, or partnerships	site/area protection	high	I, II, VII-D
3	Use State Wildlife Grant funds for potential acquisitions	resource & habitat protection	med	I, II, III, IV, V, VI
4	Site new recreational facilities such as golf courses and ball fields on already disturbed land whenever possible	resource & habitat protection	med	VI-B
II	**LAND/WATER MANAGEMENT**		high	
1	Manage Forest Conservation Opportunity Areas to provide appropriate habitat to sustain viable populations of all forest dependent wildlife species native to Ohio	site/area management	med	VII-E,F VIII, IX
2	Develop a forest wildlife monitoring protocol	habitat & natural process restoration	high	VII-C,I
3	Assure that wildlife/habitat interests are considerations in all forestry practices	habitat & natural process restoration	high	V, VII-G
4	Develop habitat objectives for Forest Conservation Opportunity Areas based on Habitat Suitability Index (HSI) modeling results for forest wildlife species of highest conservation priority	site/area management	med	VII-C,I
5	Support research on wildlife species for which knowledge of habitat requirements and/or population status is incomplete	habitat & natural process restoration	high	VII-C,I
6	Conduct annual wildlife population monitoring of priority species within Forest Conservation Opportunity Areas to evaluate wildlife population status in response to forest management strategies	site/area management	med	VII-C,E,F,G,I
7	Annually hire a research technician and seasonals to conduct wildlife population surveys in Forest Conservation Opportunity Areas	site/area management	med	VII-D,I
8	Obtain information on habitat requirements and HSI models for all native forest wildlife species that occur in Forest Conservation Opportunity Areas	site/area management	med	VII-C,I
9	Collect and evaluate data from legitimate citizen scientist-based monitoring surveys, such as the Ohio Lepidopterist Society's Long-term Butterfly Monitoring Program, the Breeding Bird Survey, and the Frog and Toad Call Survey, through 2020	habitat & natural process restoration	high	VII-C,D,I

10	Create a Division of Wildlife/Division of Forestry jointly-funded forest habitat biologist position to conduct Forest Conservation Opportunity Area habitat modeling, and to provide wildlife habitat consultations to agencies and partners	site/area management	med	VII-D,G,I
11	Assign lower priority to potential Forest Conservation Opportunity Area acquisitions in which mineral or timber rights have been severed from surface rights	habitat & natural process restoration	high	I, II, III
12	Work with the National Resource Conservation Service to increase the number and the promotion of forest habitat management practices eligible for cost-share funding in WHIP, CSP, HFRP, and EQIP programs	habitat & natural process restoration	high	VII-A
13	Develop forest management plans to maintain, restore, or regenerate oak-hickory forest types totaling 10,000 acres on at least 5 different wildlife areas by 2016	site/area management	med	VII-E
14	Train additional wildlife management staff in oak ecology and silvicultural methods	habitat & natural process restoration	high	VII-E,F
15	Collaborate with the Division of Forestry to accomplish appropriately-timed burns on forestlands to promote oak regeneration	habitat & natural process restoration	high	VII-B,E,F
16	Seek technical assistance from Division of Forestry land management foresters when implementing silvicultural techniques to promote oak regeneration	habitat & natural process restoration	high	VII-D,E
17	Obtain forest inventory data to develop stand maps and silvicultural prescriptions to maintain and regenerate oak species	habitat & natural process restoration	high	VII-C,E
18	Contract with a forest consulting firm to obtain forest stand inventory data for all wildlife areas with >500 contiguous acres of forestland	habitat & natural process restoration	high	VII-C,D
19	Collaborate with Division of Forestry (DOF) to reduce inventory costs and acquire data that are compatible with the DOF's Genus database management system	habitat & natural process restoration	high	VII-C,D
20	Use forest inventory to identify and protect large blocks of mature forest, streamside management zones, and unique/rare habitats	habitat & natural process restoration	high	I, II, III, IV, V, VI
21	Use annual timber sale revenue to pay for inventory and data management costs	habitat & natural process restoration	high	VII-C,D
22	Obtain current timber inventory data to model wildlife habitat quality in Forest Conservation Opportunity Areas	site/area management	med	VII-C
23	Update and improve the accuracy of landcover data in Ohio by using advanced GIS modelling to determine habitat distribution and quality	habitat & natural process restoration	high	VII-C
24	Develop a database management system to store, access, map, and analyze forest inventory data	habitat & natural process restoration	high	VII-C,I
25	Obtain forest stand inventory data to assess current age composition of forest landscapes in unglaciated Ohio	habitat & natural process restoration	high	VII-C

26	Develop plans to manage invasive species on forest management and reclamation projects	invasive/ problematic species control	high	VIII
27	Treat invasive plant species as an integral component of forest management plans on wildlife areas	invasive/ problematic species control	high	VIII
28	Establish an early-detection rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	high	VIII
29	Promote forest restoration/reclamation on lands impacted by surface mines or other disturbances	habitat & natural process restoration	high	I, II, III
30	Annually review and provide wildlife habitat recommendations for all 21 Division of Forestry State Forest Management Plans and applicable Wayne National Forest management projects	site/area management	med	V, VI, VII-G
31	Identify 5 early-successional management units totaling at least 5,000 acres on Wildlife Areas outside of Forest Conservation Opportunity Areas	site/area management	med	VII-F
32	Develop management plans and create at least 500 acres of habitat on 5 early-successional management units on Wildlife Areas outside of Forest Conservation Opportunity Areas	site/area management	med	VII-F
33	Partner with the Wildlife Management Institute to secure additional funds to achieve early-successional forest habitat objectives	habitat & natural process restoration	high	VII-D,F
34	Actively market and offer timber sales to achieve early-successional forest habitat objectives	habitat & natural process restoration	high	VII-D,H
35	Work towards a sustainable balance of early, mid, and late-successional habitats within forested landscapes in unglaciated Ohio	habitat & natural process restoration	high	VII-E,F
36	Identify ecosystem or population-level threats through research, surveillance, monitoring, and inventory	habitat & natural process restoration	high	I, II, III, IV, V, VI, VIII, IX, XI
37	Develop compatible recreational activities criteria that can be used to evaluate impacts to habitat/species from recreational activities	habitat & natural process restoration	high	VI
III	**SPECIES MANAGEMENT**		high	
1	Reintroduce and restore forestland species where appropriate	species reintroduction	med	I, II, VII-F,G,I
2	Develop species-specific conservation plans as needs are identified to clearly define the actions the Division will/or will not implement concerning the state-listed species	species management	high	VII-F,G,I
3	Identify, design, and conduct appropriate species-specific surveys, inventories, or monitoring projects to determine species distribution and abundance	species management	high	VII-C,F,G,I
4	Develop a feral hog management plan designed to minimize introductions and control expansion	species management	high	VIII-B
5	Continue to support research and develop plans for restoration of American chestnut on surface mine reclamation areas	species reintroduction	med	I, II, VII-E

IV	EDUCATION AND AWARENESS		high	
1	Increase the amount and delivery of technical assistance to non-industrial private forest landowners in Ohio	awareness & communications	low	VII-A
2	Enhance forest wildlife habitat technical guidance by providing assistance to landowners through partnerships and education	training	high	VII-A
3	Target forest landowners for technical services through a variety of media based on enrollment in Forest Tax Law or similar programs	awareness & communications	low	VII-A
4	Inform forest landowners about services available to them and who to contact for management guidance or to obtain professionally designed management plans	awareness & communications	low	VII-A
5	Develop and coordinate an advertising campaign for forest wildlife management advice similar to Call Before You Cut program	awareness & communications	low	V-A VII-A,G
6	Publish a comprehensive forest wildlife habitat management technical guide for private landowners and forest practitioners	awareness & communications	low	V-A VII-A,G
7	Partner with The Ohio State University – Extension and the Terrestrial Wildlife Ecology Laboratory to reduce costs and increase distribution of a forest wildlife habitat management technical publication	awareness & communications	low	V-A VII-A,G
8	Revise and incorporate existing Division of Wildlife woodland habitat management factsheets and OSU-extension bulletins into a comprehensive forest wildlife habitat management technical publication	awareness & communications	low	V-A VII-A,G
9	Provide guidance to landowners for eradication/control of invasive and nuisance species	awareness & communications	low	VII-A VIII-A,B
10	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communications	low	VIII-A,B
11	Provide forest wildlife habitat management practices training to Division of Forestry service foresters, Soil and Water Conservation District wildlife specialists, and National Research Conservation Service biologists every 2 years	training	high	V-A VII-G
12	Conduct additional forest habitat field days in conjunction with OSU-Extension, Farm Science Review, Woodland Owner groups, and Wildlife Conservation NGOs	training	high	V-A VII-A,G
13	Develop additional wildlife habitat interpretation/educational materials for the Division of Forestry's forest management driving tours and/or demonstration areas at Mohican-Memorial State Forest, Zaleski State Forest, and the Vinton Furnace State Experimental Forest	awareness & communications	low	V-A VII-A,G
14	Synthesize research results from the Ohio State University's Terrestrial Wildlife Ecology Laboratory's forest wildlife research projects into practical management guidelines	awareness & communications	low	V-A VII-C,D,G
15	Provide additional training to wildlife management staff to increase knowledge of forestry practices	training	high	VII-D,G

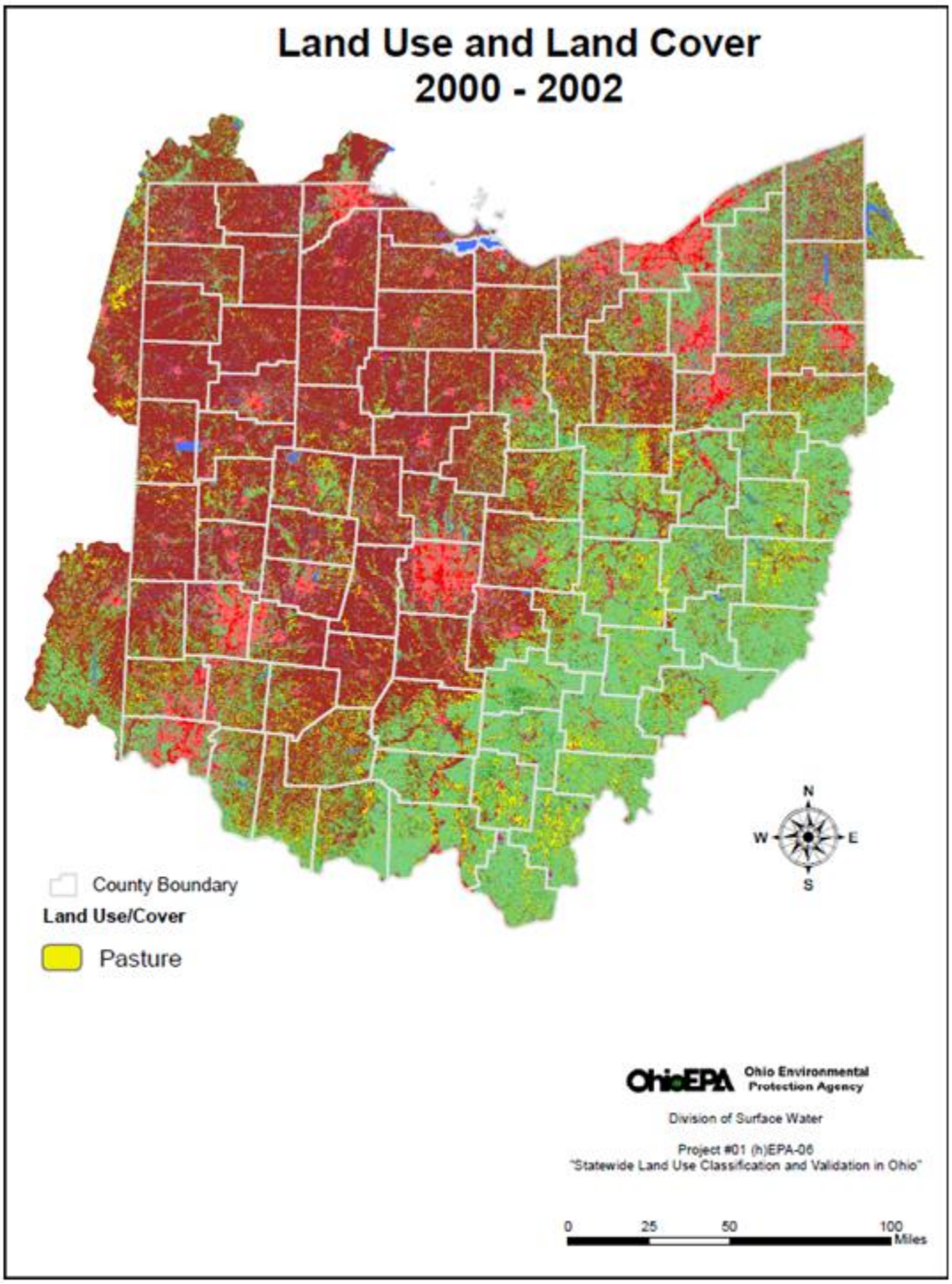
16	Maintain a corps of Division of Wildlife-trained partners and volunteers to assist, lead, and promote special programs	training	high	V-A VII-A,G
17	Educate landowners, maintenance staff, municipalities, etc. on ways to reduce impacts to adjacent forest habitat	awareness & communications	low	I, II VII-A
18	Resolve the issue of various, and often conflicting, sources of forest management technical information are available through multiple outlets, agencies, and organizations	awareness & communications	low	VII-A
V	**LAW AND POLICY**		high	
1	Balance the needs of fish and wildlife with the needs of people by mitigating incompatible ecosystem uses	policies & regulations	high	I, II, III, IV, V, VI
2	Participate in the policy-making process at Federal level to influence conservation programs	policies & regulations	high	VII-A,G
3	Support legislation promoting eco-friendly energy development and use	legislation policies & regulations	high high	III-A
4	Encourage the preservation of habitat connectivity in all land use planning	policies & regulations private sector standards & codes	high med	I, IV
5	Create incentives (laws, policies) to prevent loss and/or minimize impacts to forest lands due to development	policies & regulations	high	I, II, IV
6	Develop regulations to deter introduction of invasive/nuisance species	legislation policies & regulations	high high	VIII
7	Develop and implement a risk-assessment system in the approval process for bringing live animals/plants into Ohio, or moving them within the state	legislation policies & regulations	high high	VIII
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		low	
1	Support the creation of incentives for the protection and restoration of forest habitat	linked enterprises & livelihood alternatives substitution market forces conservation payments non-monetary values	low low med med med	I, II, III, IV, VII-A

2	Support incentives that encourage landowners to maintain/preserve existing forest habitat on agricultural lands	market forces conservation payments non-monetary values	med med low	II
3	Support incentives for private landowners to practice forest management that focuses on preserving native habitat and wildlife species	conservation payments non-monetary values	med low	VII-A
4	Support creation of incentives to incorporate wildlife habitat into recreational facilities such as parks and golf courses	market forces conservation payments non-monetary values	med med low	VI-B
5	Develop incentives for private landowners to eradicate/control invasive plant species	conservation payments non-monetary values	med low	VII-A VIII
VII	**EXTERNAL CAPACITY BUILDING**		med	
1	Create partnerships among research scientists and other key partners to plan coordinated wildlife monitoring and implement this protocol across ownership boundaries within Forest Conservation Opportunity Areas	alliance & partnership development	med	VII-C,D,I
2	Support and actively participate in an Ohio Prescribed Fire Council	alliance & partnership development	med	VII-B
3	Help create and support partnerships of conservation-minded groups to protect and manage forest habitat	alliance & partnership development	med	I, II, V-A, VII-C,D
4	Support legitimate citizen scientist-based monitoring efforts of wildlife species and habitats	institutional & civil society development	med	VII-C,D,I
5	Create a multiagency invasive species prevention and control group that would be responsible for all invasive species issues	alliance & partnership development	med	VIII
6	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, causeway, and utilities design, construction, and maintenance	alliance & partnership development	med	IV

*refers to the Forest Habitat Conservation Threats table

Grassland Habitat

Ohio Grassland Habitat (this map is a placeholder)



STATUS

Fair and declining. Never a very abundant habitat in terms of acreage, grassland habitat is second only to wetlands in terms of habitat loss in Ohio. Ohio's grasslands are threatened primarily by conversion to urban/suburban development and agriculture, and to a lesser degree by reversion to forestland. Since the federal government required ethanol to be blended with motor fuels, significant acres of grasslands have been lost – including many of those created by the Conservation Reserve Program. The absence of periodic fires (except in intensively managed grassland areas) to retard succession is also responsible for the loss of some of Ohio's grasslands.

DESCRIPTION

Grassland ecosystems, which include prairies, pastures, hayfields, meadows, and old fields, are highly valued by Ohioans for their rich diversity of plant and wildlife resources. Historic grasslands in Ohio, such as native prairies and wet meadows, comprised only 2.5%, or 1,000 square miles of Ohio's landscape before European settlement. Grassland-dependent wildlife was likely not as abundant as during later, post-settlement times. European settlement resulted in broad changes to Ohio's landscape as forests were cleared for agriculture. Grassland habitats, including native grass pasture, hayfields, and small grain fields, increased as a consequence of this activity, and resulted in population and range expansions of grassland-associated wildlife. These wildlife populations are still valued today, including those of northern bobwhite quail, various grassland songbirds, the American badger, and the introduced ring-necked pheasant. After World War II, a growing human population and changes in agricultural practices (including the introduction of cool season, exotic pasture grasses) and agricultural economics decreased or degraded the grassland habitats available to wildlife in Ohio. The dominance of row crops such as corn or soybeans in agricultural systems, the prevalence of larger equipment, and decreased reliance on diversified agricultural operations meant less need for fence field dividers, small pastures, and other areas that once supported diverse wildlife populations. Suburban development, and in some areas, forest regeneration, have further contributed to Ohio's loss of grassland habitats.

Identifying Current Ohio Grasslands

Dramatic population declines of many grassland bird species, including northern bobwhite quail, ring-necked pheasant, Henslow's sparrow, bobolink, eastern meadowlark, upland sandpiper, and others have resulted because of reductions in the amount of Ohio's grassland habitats during the last 50 years. Some species like the northern bobwhite and the barn owl have not only experienced population declines but also range contractions and are no longer present in many areas of Ohio. Other grassland bird species like the field sparrow and red-winged blackbird that are perceived to be common have experienced population declines in Ohio and throughout the Midwest.

Grassland-dependent birds and other wildlife are attracted to a variety of habitat features, including tract size, vegetation height and density, availability of shrub cover, and amount of edge, among others. Whereas much effort has been made to identify the distribution and cover types of wetland and forest habitats, similar information is generally lacking for grassland ecosystems throughout Ohio. Grassland habitats are an early successional state and ephemeral on the landscape over the timeframe in which they may be mapped and catalogued (i.e. National Land Cover Database). In addition, grassland habitats that provide sufficient structure and resources for wildlife are often difficult to distinguish from pastured and hayed lands that might offer suitable conditions for only a few species. Nonetheless, knowledge about the distribution and types of grasslands available throughout Ohio can be important in understanding how wildlife populations are distributed, what habitat conditions need to be improved to reverse declines among priority populations, and to identify the grassland types and locations that may be under the greatest threat of conversion to other cover types.

Prioritizing Grassland Management Efforts

Providing grassland resources of sufficient quality for Ohio's upland and priority grassland species is a challenge given continued growth in Ohio's human population, changes in agricultural practices, and the resulting alterations to Ohio's landscape. The primary goal for grassland management on private and public lands should be to reverse declines in wildlife populations associated with these habitats. The approach taken in this grassland chapter is to promote intensive management on select critical grassland areas while maintaining no net loss of grassland habitats on DOW-managed properties and private lands,

and preserving large (>50 acres) grassland mosaics wherever possible for the benefit of priority grassland wildlife. Under this approach, intensive management would occur at 1) private and public lands within conservation opportunity areas based on the Partners In Flight model for avian conservation for grassland-dependent wildlife, 2) priority areas that contain expansive grassland tracts to support populations of area-sensitive birds of regional importance, and 3) private and public lands within priority areas designed to benefit northern bobwhite or ring-necked pheasant populations.

ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

Grassland wildlife populations are influenced primarily by habitat and weather factors. Habitat quality, also, can be directly impacted by weather conditions. Much of the annual variation shown by small game populations, for example, can be the result of weather conditions during critical periods (i.e., nesting, brood-rearing, and winter). Long-term trends, however, tend to be tied more directly to habitat quality, quantity, and distribution.

Weather, then, is of primary importance in interpreting annual fluctuations in grassland wildlife populations. Severe winter weather, consisting of prolonged periods of deep snow or ice and colder than normal temperatures, tends to result in higher than normal overwinter mortality and, thus, reduced brood stock in the spring. Cold, wet periods in the spring and early summer can impact survival of young wildlife by chilling eggs or young animals or flooding nests. Extended periods of drought can affect vegetation growth and, thus, cover quality. Drought can also make insects and seeds less available as food for growing wildlife. Land-use and technological changes are of primary importance in explaining long-term population trends for grassland species. An increasing human population with the resultant increase in urbanization and residential and commercial development yields fewer acres for wildlife. Likewise, modern farming's emphasis on more efficient and larger equipment and increased reliance on chemicals reduces the quantity and quality of available habitat. On the other hand, federal farm policy that idles agricultural land and requires herbaceous cover crops can improve habitat conditions for farmland wildlife.

Most of Ohio is in private ownership, and, thus, habitat management on public lands is of little value in terms of impacting grassland wildlife populations at the state level. However, land-use practices that benefit grassland wildlife can result from regional or federal government programs and policies. For example, the Conservation Reserve Program (CRP) created by the 1985 Farm Bill and continued by the 1990, 1996, and 2002 bills idled more than 300,000 acres of cropland in Ohio. Most of this acreage now supports a cover crop of grasses, legumes, and wild forbs. To the extent that this acreage is not disturbed during the nesting season, these areas provide moderate to good quality nesting cover for many grassland birds. Pheasants, in particular, showed a numerical response to the availability of additional safe nesting cover resulting from this federal program in its early years. This program has changed focus over time, particularly in the 1996 bill, but continues to provide habitat for grassland nesting species.

Wildlife species that live in grasslands are well adapted to the distinctive habitat that grasslands provide. The grassland species assemblage includes grazing animals that feed on the grasses (deer, rabbits), burrowing animals that avoid predators by spending a significant portion of their lives below ground (mice, voles, groundhogs), and specialized grassland predators (hawks, owls, coyotes, snakes). Grasslands are also home many species of birds – neotropical migrants, short distance migrants, and resident species – that use them as breeding habitat. Species such as the upland sandpiper, ring-necked pheasant, northern harrier, common barn-owl, short-eared owl, horned lark, bobolink, eastern meadowlark, vesper sparrow, savannah sparrow, grasshopper sparrow, Henslow's sparrow, Le conte's sparrow, dickcissel, and sedge wren utilize grassland habitats in Ohio for breeding. Unfortunately, owing to the disappearance and fragmentation of grasslands, grassland birds have declined more than any other group of birds.

The following species have been identified as grassland species of greatest conservation need (conservation status rank in parentheses):

<u>Amphibians</u>

Marbled Salamander (10)	*Ambystoma opacum*
Mountain Chorus Frog (18)	*Pseudacris brachyphona*

Western Chorus Frog (20)	*Pseudacris triseriata triseriata*
Gray Treefrog (24)	*Hyla versicolor*
Northern Leopard Frog (28)	*Rana pipiens*

Birds

Henslow's Sparrow (1)	*Ammodramus henslowii*
Northern Bobwhite (3)	*Colinus virginianus*
Sedge Wren (3)	*Cistothorus platensis*
Northern Harrier (5)	*Circus cyaneus*
Upland Sandpiper (10)	*Bartramia longicauda*
Bobolink (10)	*Dolichonyx oryzivorus*
Loggerhead Shrike (24)	*Lanius ludovicianus*
Blue-winged Teal (24)	*Anas discors*
Barn Owl (24)	*Tyto alba*
Prairie Warbler (24)	*Setophaga discolor*
Lark Sparrow (36)	*Chondestes grammacus*
Wilson's Phalarope (36)	*Phalaropus tricolor*
Short-eared Owl (36)	*Asio flammeus*
Vesper Sparrow (36)	*Pooecetes gramineus*
Eastern Meadowlark (36)	*Sturnella magna*
Sandhill Crane (52)	*Grus canadensis*
Northern Shoveler (52)	*Anas clypeata*
Northern Pintail (52)	*Anas acuta*
Green-winged Teal (52)	*Anas crecca*
Ring-necked Pheasant (52)	*Phasianus colchicus*
Purple Martin (52)	*Progne subis*
Savannah Sparrow (52)	*Passerculus sandwichensis*
Grasshopper Sparrow (52)	*Ammodramus savannarum*
Dickcissel (52)	*Spiza americana*
Western Meadowlark (52)	*Sturnella neglecta*
Mallard (52)	*Anas platyrhynchos*
Killdeer (52)	*Charadrius vociferus*
Canada Goose (112)	*Branta canadensis*
Red-tailed Hawk (112)	*Buteo jamaicensis*
American Kestrel (112)	*Falco sparverius*
Mourning Dove (112)	*Zenaida macroura*
Eastern Kingbird (112)	*Tyrannus tyrannus*
Horned Lark (112)	*Eremophila alpestris*
Eastern Bluebird (112)	*Sialia sialis*
Common Yellowthroat (112)	*Geothlypis trichas*
Field Sparrow (112)	*Spizella pusilla*
Red-winged Blackbird (112)	*Agelaius phoeniceus*
Brown-headed Cowbird (112)	*Molothrus ater*
American Goldfinch (112)	*Spinus tristis*
Cattle Egret (112)	*Bubulcus ibis*
Merlin (112)	*Falco columbarius*
Clay-colored Sparrow (112)	*Spizella pallida*

Butterflies and Skippers

Olympia Marble (4)	*Euchloe olympia*
Mottled Dusky Wing (9)	*Erynnis martialis*
Regal Fritillary (11)	*Speyeria idalia*
Harris Checkerspot (11)	*Chlosyne harrisii liggetti*
Cobweb Skipper (14)	*Hesperia metea*
Silver-bordered Fritillary (19)	*Boloria selene myrina*
Northern Oak Hairstreak (27)	*Fixsenia favonius ontario*

Edward's Hairstreak (33)	*Satyrium edwardsii*
Goatweed Butterfly (37)	*Anaea andria*
Dog Face (41)	*Colias cesonia*
Leonard's Skipper (41)	*Hesperia leonardus*
Indian Skipper (41)	*Hesperia sassacus*
Long Dash Skipper (41)	*Polites mystic*
Striped Hairstreak (50)	*Satyrium liparops strigosum*
Dainty Sulphur (51)	*Nathalis iole*
Spring Azure (52)	*Celastrina ladon*
Black Swallowtail (53)	*Papilio polyxenes*
Cloudless Sulphur (53)	*Phoebis sennae eubule*
Olive Hairstreak (53)	*Mitoura grynea*
Gulf Fritillary (53)	*Agraulis vanillae*
Aphrodite Fritillary (53)	*Speyeria aphrodite*
Southern Cloudy Wing (53)	*Thorybes bathyllus*
Northern Cloudy Wing (53)	*Thorybes pylades*
Swarthy Skipper (53)	*Nastra lherminier*
Giant Swallowtail (66)	*Papilio cresphontes*
Bronze Copper (66)	*Lycaena hyllus*
Variegated Fritillary (66)	*Euptoieta claudia*
Milbert's Tortoise Shell (66)	*Aglais milberti*
Crossline Skipper (66)	*Polites origenes*
Delaware Skipper (66)	*Atrytone logan*
Roadside Skipper (66)	*Amblyscirtes vialis*
Ocola Skipper (66)	*Panoquina ocola*
Checkered White (82)	*Pontia protodice*
Monarch (82)	*Danaus plexippus*
Coral Hairstreak (85)	*Satyrium titus*
Little Yellow Sulphur (87)	*Eurema lisa*
Sleepy Orange (87)	*Eurema nicippe*
Cabbage Butterfly (89)	*Pieris rapae*
Painted Lady (89)	*Vanessa cardui*
Buckeye (89)	*Junonia coenia*
Common Wood Nymph (89)	*Cercyonis pegala alope*
Checkered Skipper (89)	*Pyrgus communis*
European Skipper (89)	*Thymelicus lineola*
Fiery Skipper (89)	*Hylephila phyleus*
Little Glassywing Skipper (89)	*Pompeius verna*
Sachem Skipper (89)	*Atalopedes campestris*
Eastern Tailed Blue (104)	*Everes comyntas*
Tiger Swallowtail (106)	*Papilio glaucus*
Red Admiral (106)	*Vanessa atalanta rubria*
Viceroy (106)	*Limenitis archippus*
Common Sooty Wing (106)	*Pholisora catullus*
Peck's Skipper (106)	*Polites peckius*
Tawny-edged Skipper (106)	*Polites themistocles*
Northern Broken Dash Skipper (106)	*Wallengrenia egeremet*
Dun Skipper (106)	*Euphyes vestris metacomet*
Summer Azure (119)	*Celastrina neglecta*
Meadow Fritillary (120)	*Boloria bellona*
Wild Indigo Dusky Wing (120)	*Erynnis baptisiae*
Least Skipper (120)	*Ancyloxpha numitor*
Clouded Sulphur (123)	*Colias philodice*
Orange Sulphur (123)	*Colias eurytheme*
American Copper (123)	*Lycaena phlaeas americana*
Gray Hairstreak (123)	*Strymon melinus humuli*

American Painted Lady (123)	*Vanessa virginiensis*
Great Spangled Fritillary (130)	*Speyeria cybele*

Mammals

Pygmy Shrew (11)	*Sorex hoyi*
Least Shrew (12)	*Cryptotis parva*
Badger (16)	*Taxidea taxus*
Eastern Harvest Mouse (19)	*Reithrodontomys humulis*
Southern Bog Lemming (32)	*Synaptomys cooperi*
Eastern Mole (34)	*Scalopus aquaticus*
Deer Mouse (36)	*Peromyscus maniculatus*
Prairie Vole (36)	*Microtus ochrogaster*
Short-tailed Shrew (36)	*Blarina brevicauda*
Meadow Vole (44)	*Microtus pennsylvanicus*

Reptiles

Kirtland's Snake (5)	*Clonophis kirtlandii*
Butler's Garter Snake (8)	*Thamnophis butleri*
Black Racer (8)	*Coluber constrictor constrictor*
Blue Racer (8)	*Coluber constrictor flaviventrus*
Smooth Green Snake (8)	*Liochlorophis vernalis*
Eastern Ribbon Snake (13)	*Thamnophis sauritus sauritus*
Northern Ribbon Snake (13)	*Thamnophis sauritus septentrionalis*
Plains Garter Snake (44)	*Thamnophis radix radix*

GRASSLAND CONSERVATION OPPORTUNITY AREAS

The Division of Wildlife's approach to enhancing and maintaining the highest level of terrestrial wildlife diversity in the state is to use a conservation opportunity area concept to sustain viable populations of as many native species of wildlife as possible. The idea is to concentrate efforts and resources to provide all the necessary habitat requirements in a few, relatively large units of the major habitat types, along with the remnants of several unique habitats, for species that are of limited distribution or have low populations. Grassland conservation opportunity areas were designed to consider the needs of Ohio's grassland-dependent birds, although wildlife populations of other taxa are also expected to benefit. Several of these birds (e.g., upland sandpiper, Henslow's sparrow, bobolink, and savannah sparrow) are highly sensitive to habitat fragmentation and the size of the grassland tract. It is unlikely that many of these species would consistently nest in an area of <250 acres of contiguous grassland habitat. Further, although the exact number of pairs needed for a minimum viable population for each of these species is unknown, this number can be reasonably estimated at 200 breeding pairs. The most sensitive of these species is unlikely to nest at a density higher than 1 pair per 25 acres of suitable habitat in a large grassland complex. Thus, a conservation opportunity area should contain at least 5,000 acres of suitable, undisturbed grassland habitat to have a reasonable likelihood of supporting viable populations of Ohio's grassland-dependent birds (i.e., 200 pairs x 25 acres per pair = 5,000 acres of grass).

Outside of reclaimed mined lands, the Ohio landscape is unlikely to support such a vast sea of grassland habitat given current land ownership patterns and land-use practices. An approach suggested by Partners in Flight (PIF) and others may have merit under these conditions. This approach would allow the 5,000 acres of grass to occur within a 12,500-acre conservation opportunity area centered on a 2,500-acre block of grassland habitat (core area). The 10,000 acres surrounding the core would need to be at least 25% grassland habitat with 50% or more of the grassland tracts at least 250 acres in size. Based on the above, a 12,500-acre grassland conservation opportunity area is likely able to provide all the habitat requirements necessary to support viable populations of Ohio's highly area-sensitive birds and other grassland-dependent species native to the region. Species excluded from this include the northern harrier, short-eared owl, and extirpated greater prairie-chicken due to their extreme area requirements, estimated to equal or exceed 30,000 acres of grassland habitat. This concept also precludes any reintroduction attempt for greater prairie-chickens in the foreseeable future since sufficient habitat is

unlikely to be created to support such an effort. We believe it is simply impractical and unrealistic to attempt to provide such a vast grassland complex in Ohio. The landscapes surrounding Lake LaSuAn Wildlife Area (Williams Co.) and Big Island and Killdeer Plains Wildlife Areas (Marion and Wyandot Co's.) currently offer the best opportunities to utilize this management approach. These 3 sites have been identified by the Audubon Society as Important Bird Areas.

Habitats for Area-sensitive Species: Bird Priority Areas

Ideally, concentrating management on individual 5,000 acre tracts of habitat likely provides the best opportunity for maintaining populations of area-sensitive birds. Former surface-mined lands that have been planted in herbaceous cover (primarily grasses) as part of the reclamation process provide unique opportunities for management of grassland-dependent wildlife that are not available throughout the rest of Ohio's landscape. Currently, Woodbury Wildlife Area (Coshocton Co.), Tri-Valley Wildlife Area (Muskingum Co.), Egypt Valley Wildlife Area (Belmont Co.), and Crown City Wildlife Area (Gallia Co.) are the only Division of Wildlife properties containing large tracts of contiguous grasslands that are suited to this management approach as Bird Priority Areas. Populations of Henslow's sparrows have been documented on these 4 sites and have been present in high enough densities that these locations are likely regionally and nationally important. Being under public ownership and management, these sites can offer long-term conservation protection for these populations. Grassland habitats that are similar in type and expanse to the above 4 wildlife areas, created through surface-mine reclamation at The Wilds property in Noble County, have already been recognized by the Audubon Society as an Important Bird Area.

Killdeer Plains/Big Island Grassland Conservation Opportunity Areas

The Killdeer Plains and Big Island Wildlife Areas currently exhibit some of the best examples of the grassland wildlife habitat that existed in western Ohio prior to European settlement. The Killdeer Plains Wildlife Area is located primarily in Wyandot County, and the Big Island Wildlife Area is located in Marion County, approximately 12 miles to the south of Killdeer (Figure T-3). The majority of land adjacent to and between these 2 Wildlife Areas is in private ownership, characterized by large farms in continuous row crop production.

These 2 Wildlife Areas are part of the Sandusky Plains, historically known as one of the largest prairies that existed in Ohio. Prior to European settlement of this area, the Sandusky Plains was comprised of islands of open grassland prairie that covered over 80,000 acres in portions of Crawford, Marion and Wyandot Counties. Intensive agricultural development of the area did not begin until the late 1800s because of poor drainage of the land. With the advent of modern drainage equipment in the early 1900s, most of these prairies were converted to small grains, pasture and small fields of row crops. Further changes in agricultural technologies in the 1950s resulted in a shift from small grains, pasture and hayfields to predominantly row crops, larger farm and field sizes, and increased fall plowing. This extensive loss of native prairie, pasture and small grains has led to a significant decline in grassland-dependent wildlife species throughout both areas, with grassland nesting birds showing the greatest declines.

The Killdeer Plains and Big Island Wildlife Areas are both owned and managed by the Division of Wildlife, and comprise nearly 13,000 acres of public land, with grassland acreage totaling 4,300 acres. Because of the 12 mile distance between these 2 wildlife areas, a separate Grassland Conservation Opportunity Area has been centered on each. Efforts will be made to link the Killdeer Plains and Big Island Conservation Opportunity Areas with smaller grassland patches and corridors resulting in a large grassland complex with 2 core areas.

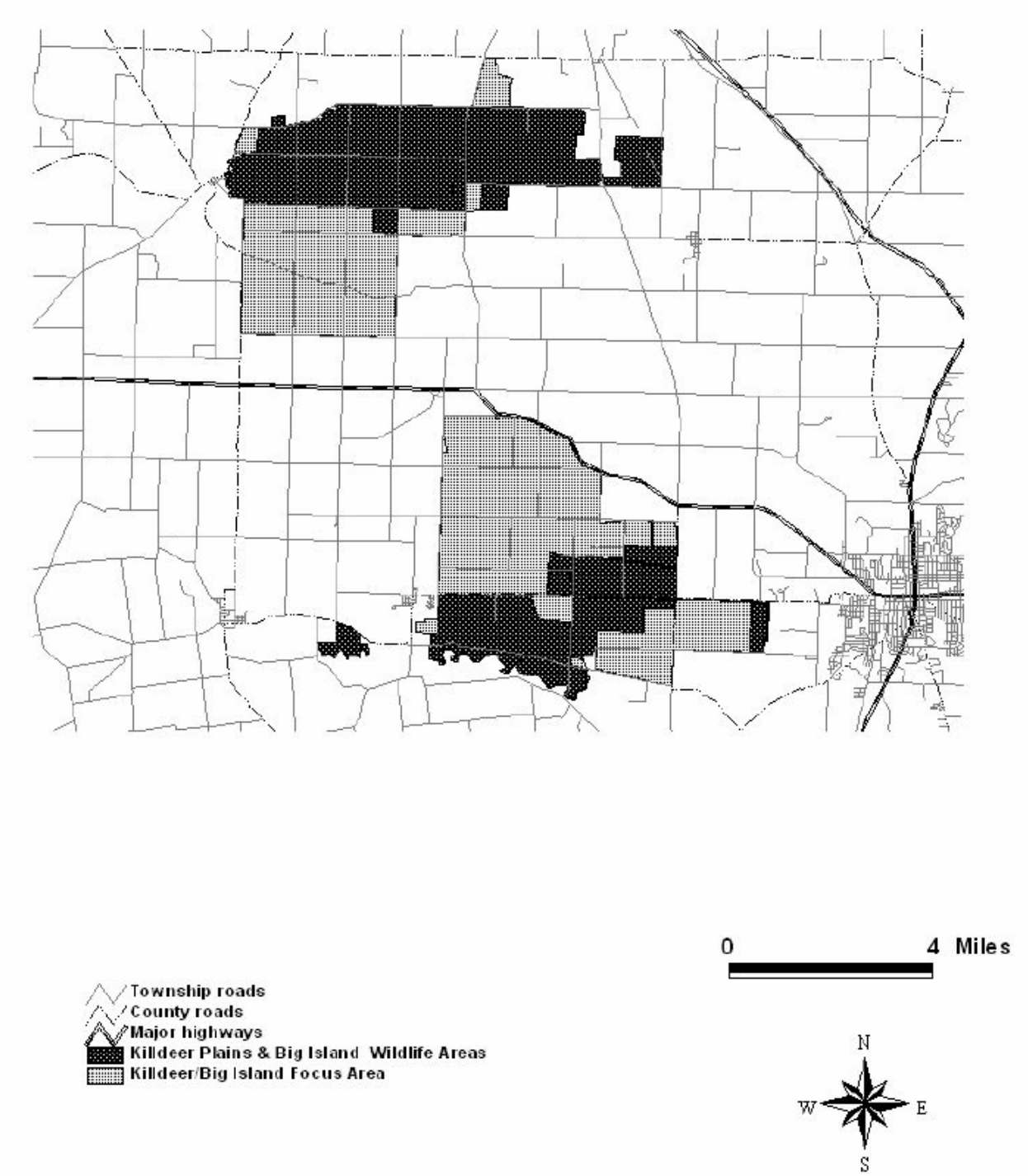
Killdeer Plains Conservation Opportunity Area

This area consists of 13,404 acres, with private land accounting for 5,395 acres, or 40%. Approximately 61% of the area consists of agricultural land, 21% wetland, and 18% woodland. Currently 2,493 acres of the agricultural land in the conservation opportunity area is established in grassland habitat, with the vast majority of this grassland located on the wildlife area. As of 2002, approximately 371 acres of grassland currently occur on private lands within the conservation opportunity area.

Big Island Conservation Opportunity Area

This area consists of 13,541 acres, with private land accounting for 8,532 acres, or 63%. Approximately 80% of the area consists of agricultural land, 7% wetland, and 13% woodland. As of 2002, 2,445 acres of the agricultural land in the conservation opportunity area is established in grassland habitat, with the vast majority of this grassland located on the wildlife area. Approximately 253 acres of grassland currently occur on private lands within the conservation opportunity area.

Figure T-3. Killdeer Plains/Big Island Grassland Conservation Opportunity Areas



Lake LaSuAn Grassland Conservation Opportunity Area

The Lake LaSuAn Grassland Conservation Opportunity Area, located in Williams County, is an important breeding, foraging and/or migration area for numerous grassland-dependent wildlife species. Lake LaSuAn Wildlife Area is included in the Conservation Opportunity Area (Figure T-4). The Wildlife Area is 2,430 acres, of which approximately 1,073 acres are in cool and warm-season grasses. The majority of land adjacent to the wildlife area is in private ownership, characterized by row crops, CRP fields and woodlots. Private land comprises about 85% of the Conservation Opportunity Area. This area is home to the majority of Ohio's endangered copperbelly water snake population.

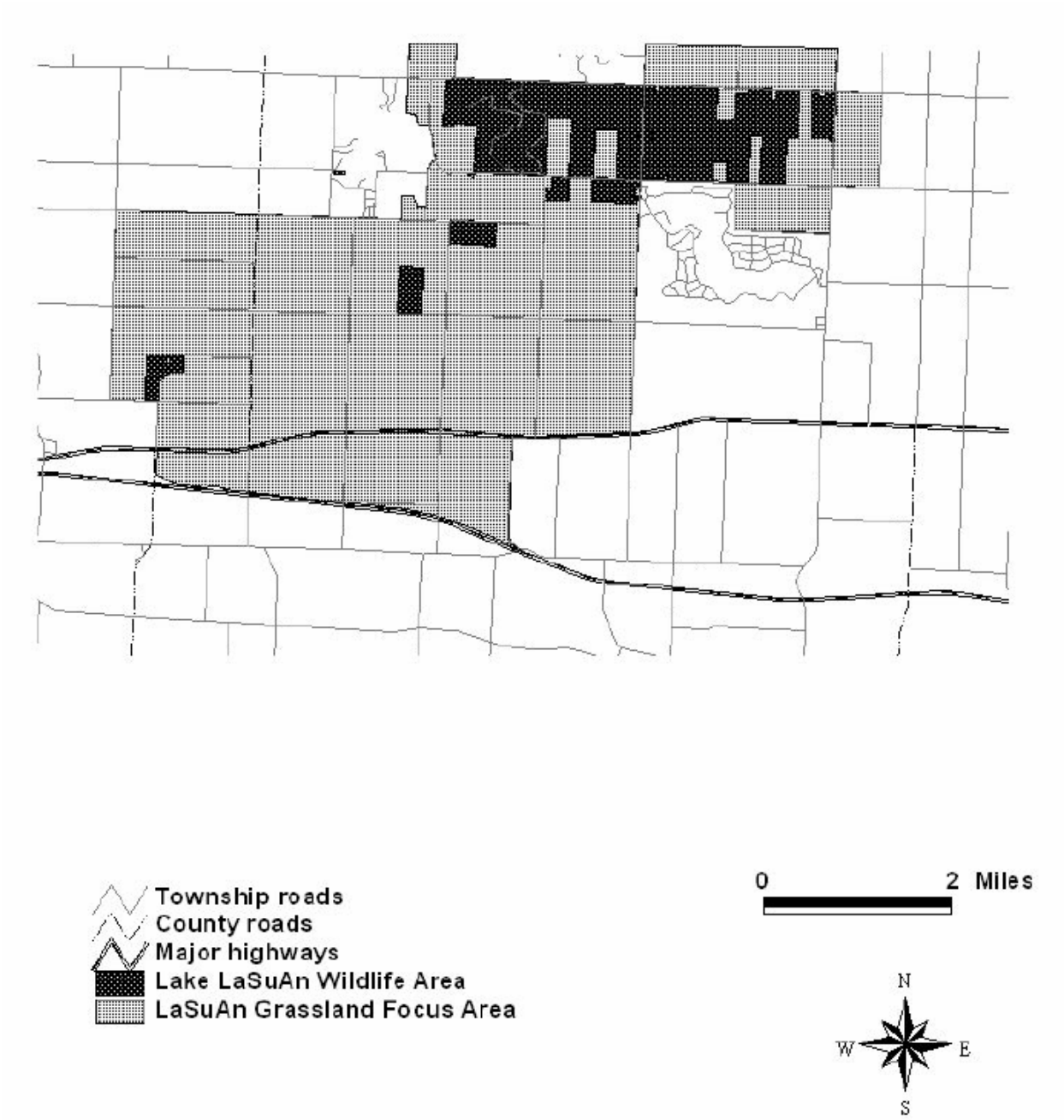
The Lake LaSuAn Conservation Opportunity Area is situated on the Wabash end moraine deposited during the Wisconsin glaciation. At the time of European settlement, the Lake LaSuAn Focus Area was a beech-maple hardwood forest with scattered poorly-drained wooded wetlands. Post-European settlement resulted in a dramatic decrease in forested acres as the land was cleared for agriculture. Further changes in agricultural technologies in the 1950s resulted in a shift from small fields supporting a variety of crops, hayfields, pastures and single family livestock operations to predominantly row crops, larger farm and field sizes, and increased fall plowing which greatly reduced grassland habitat in the region. Implementation of the 1985 USDA Farm Bill resulted in Williams County leading Ohio in Conservation Reserve Program set-aside acres.

The Lake LaSuAn Conservation Opportunity Area is in a very rural area of northwestern Ohio with little development. The area is characterized by gentle rolling hills carved out by many creeks and rivers. The soils in the area formed mainly in stratified, water-deposited material. Most of the soils within the area are classified as highly erodible and offer an opportunity to reduce the efforts of erosion within the St. Joseph River watershed through grassland management on both private and public lands.

This Conservation Opportunity Area consists of 14,500 acres. Once habitat work is accomplished, the area is expected to provide all habitat requirements necessary to support a viable population of Ohio's area-sensitive grassland bird species, and is thus likely to support viable populations of all other native grassland species, with the exception of northern harriers, short-eared owls, and prairie chickens (extirpated).

To meet the minimum habitat requirements, at least 5,800 acres of undisturbed grassland will need to be provided within the Conservation Opportunity Area, including a 2,500 acre core area. Lake LaSuAn Wildlife Area currently does not meet the core area requirement of 2,500 acres of grassland habitat. LaSuAn currently has about 800 acres of warm-season and cool-season grasses planted; an additional 550 acres of grassland can be planted in the next 10 years. Private land within the Conservation Opportunity Area is comprised of row-crop agriculture and a limited amount of pasture (250 acres) and hay crop (100 acres). There are also at least 3,400 acres enrolled in the Conservation Reserve Program on private lands in the area. These acreage figures suggest that the biggest challenge in the area may be creating a spatial arrangement of grassland habitats that produces a core area.

Figure T-4. Lake LaSuAn Grassland Conservation Opportunity Area



CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Grassland habitat. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		low
A	Large tracts of grassland habitats, and the wildlife species dependent upon them, have declined in Ohio because of changes in land ownership patterns	housing & urban areas	low
B	Habitat destruction, fragmentation, altered hydrology from commercial development	commercial & industrial areas	low
C	Habitat destruction, fragmentation, altered hydrology from urban/suburban development	housing & urban areas	low
II	**agriculture and aquaculture**		medium
A	Loss of grassland habitat because of conversion to agriculture	annual & perennial non-timber crops livestock farming & ranching	very high low
B	Loss of grassland habitat due to increase in intensity of agricultural practices – conversion of fencerows and other imbedded grassland habitat	annual & perennial non-timber crops	very high
C	It is unlikely that we will meet habitat objectives within the Big Island/Killdeer Plains Conservation Opportunity Area because of the amount of land (>10,000 acres) owned by corporate farming operations in the area	annual & perennial non-timber crops	very high
III	**energy production and mining**		low
A	Mining, oil and gas extraction - can directly damage and destroy grassland habitat, and indirectly have negative impacts by altering hydrology and causing chemical contamination	oil & gas drilling mining & quarrying	low low
B	Wind turbines can negatively impact birds and bats that utilize grassland habitat	renewable energy	low
IV	**transportation and service corridors**		negligible
A	Roads and utilities can destroy and fragment grassland habitat, and alter hydrology	roads & railroads utility & service lines	negligible negligible
V	**biological resource use**		negligible
A	Biofuels could threaten grassland habitat	gathering terrestrial plants	negligible
VI	**human intrusions and disturbance**		low
A	Incompatible recreational activities	recreational activities	negligible
B	Creation of recreational facilities can alter/destroy grassland habitat	recreational activities	negligible
VII	**natural system modifications**		low
A	Losing grassland habitat – or missing out on opportunities to create additional grassland acreage – because financial benefits of some conservation programs may be insufficient to encourage private landowner enrollment	other ecosystem modifications	low
B	Lack of periodic burning resulting in habitat cover change and impacts to grassland wildlife species	fire & fire supression	negligible

C	Lack of grassland inventory data, and a database system to analyze that data limits our ability to manage	other ecosystem modifications	low
D	Our ability to manage grasslands is limited by available staff and funding	other ecosystem modifications	low
E	Habitat program availability generally relies on the political climate and funds made available through the Farm Bill	other ecosystem modifications	low
F	Lack of private landowner participation in available habitat programs in critical areas	other ecosystem modifications	low
G	Habitat destruction, fragmentation, altered hydrology due to proximity of development	other ecosystem modifications	low
H	The Division of Wildlife has no regulatory authority over federal conservation programs, and so has limited influence over the quality of habitats established under the Conservation Reserve Program (CRP)	other ecosystem modifications	low
I	Lack of grassland associated species data limits our ability to manage	other ecosystem modifications	low
VIII	**invasive and other problematic species and genes**		high
A	Introduction and/or spread of invasive plants and animals	invasive non-native alien species	medium
B	Introduction and/or spread of nuisance plants and animals	problematic native species	high
C	Introduction and spread of diseases (plants and animals)	invasive non-native alien species problematic native species	medium high
IX	**pollution**		low
A	Urban effluent	household sewage & urban wastewater industrial & military effluents garbage & solid waste	negligible negligible negligible
B	Agriculture effluent	agricultural & forestry effluents	medium
X	**geological events**		negligible
---	none	---	---
XI	**climate change and severe weather**		negligible
A	Climate change could effect plant species composition, which in turn could affect wildlife species	habitat shifting & alteration droughts temperature extremes storms & flooding	negligible negligible negligible negligible

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Grassland habitat. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		high	
1	Protect grasslands through strategic acquisitions, easements, and partnerships	resource & habitat protection	high	I, II, III, IV, V, VI
2	Use State Wildlife Grant funds for potential acquisitions	resource & habitat protection	high	I, II, III, IV, V, VI
3	Obtain through purchase or permanent easement sufficient acreage to meet core area requirements (2,500 acres of managed grasslands) at Killdeer Plains, Big Island, and Lake LaSuAn Conservation Opportunity Areas	site/area protection	high	II-C
4	Obtain through purchase or permanent easement 1,000 acres of land to serve as a link between Big Island and Killdeer Plains Conservation Opportunity Areas	site/area protection	high	II-C
5	Strive for no net loss of large grassland tracts on DOW-managed and private lands to benefit area-sensitive species	resource & habitat protection	high	I, II, VII-A
6	Site new recreational facilities such as golf courses and ball fields, on already disturbed land	resource & habitat protection	high	VI-B
II	**LAND/WATER MANAGEMENT**		med	
1	Manage Grassland Conservation Opportunity Areas to provide appropriate habitat to sustain viable populations of all grassland dependent wildlife species native to Ohio	site/area management	med	VII-B,G VIII, IX
2	Inventory the distribution and quantity of grassland habitats and priority grassland wildlife species	habitat & natural process restoration	high	VII-C,I
3	Conduct research on species-habitat relationships within grassland conservation opportunity areas to help direct management decisions	site/area management	med	VII-C,I
4	Investigate alternative management strategies to promote diverse stands of grassland habitat compatible with multiple wildlife species	habitat & natural process restoration	high	VII-C,I
5	Make use of existing data, including National Land Cover Database (NLCD), National Agricultural Statistics Service (NASS), North American Breeding Bird Survey (BBS), the Second Ohio Breeding Bird Atlas, DOW surveys, and others to develop best estimates of grassland availability and bird distribution in Ohio	habitat & natural process restoration	high	VII-C,I
6	By 2016, develop statewide grassland habitat goals required to stabilize grassland wildlife populations	habitat & natural process restoration	high	VII-C,I

7	Review and summarize relevant literature since Swanson (1996) and Herkert (1993) papers about grassland bird habitat use	habitat & natural process restoration	high	VII-C,I
8	Obtain information on habitat requirements and HSI models for all native grassland wildlife species that occur in Grassland Conservation Opportunity Areas	site/area management	med	VII-C,I
9	Collect and evaluate data from legitimate citizen scientist-based monitoring surveys, such as the Ohio Lepidopterist Society's Long-term Butterfly Monitoring Program, the Breeding Bird Survey, and the Frog and Toad Call Survey, through 2020	habitat & natural process restoration	high	VII-C,D,I
10	Identify gaps in knowledge relative to wildlife populations and grasslands, and address through research	habitat & natural process restoration	high	VII-C,I
11	Annually manage 2,500 acres of diverse grasslands as habitat cores within Killdeer Plains, Big Island, and Lake LaSuAn Grassland Conservation Opportunity Areas	site/area management	med	II-C
12	Establish and maintain large grassland mosaics (at least 250 acres) on Big Island, Killdeer Plains, and Lake LaSuAn Grassland Conservation Opportunity Areas	site/area management	med	II-C
13	Within Grassland Conservation Area boundaries, promote managed grasslands on private lands with a goal of establishing 2,500 acres of grassland around each conservation opportunity area core by 2020 - of these grassland acres, 50% should be in tracts of at least 250 acres in size	site/area management	med	VII-A,E,F,H
14	Designate 4 Bird Priority Areas for area-sensitive bird populations of regional significance at Woodbury, Tri-Valley, Crown City, and Egypt Valley Wildlife Areas	site/area management	med	I-A, VII-I
15	On each Bird Priority Area, annually manage multiple fields of continuous grassland habitats that are >250 acres to provide a diverse mosaic of large (e.g. >5,000 acres) grassland habitat	site/area management	med	I-A, VII-I
16	Establish staffing/funding levels commensurate with the amount of management activities at grassland conservation opportunity areas	site/area management	med	VII-D
17	Prevent introduction and control the spread of harmful species through legislation, regulation, policy, management practices, education, and partnerships	invasive/ problematic species control	med	VIII
18	Investigate methods of invasive species management appropriate to the spatial scale of wildlife area grasslands on former strip-mined lands	invasive/ problematic species control	med	VIII
19	Establish an early-detection rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	med	VIII
20	Identify collaborative partners (The Wilds, USFS, AEP, etc.) that manage similar habitats to exchange information on management strategies and possibly cost-share on equipment or other management expenses	habitat & natural process restoration	high	VII-C,D,I

21	Work with conservation partners like the USDA Farm Services Agency to make use of geospatial data about grassland habitats restored or established through federal programs	habitat & natural process restoration	high	VII-C
22	Incorporate habitat and population estimates for priority species identified within the Ohio Bird Conservation Initiative All-Bird Plan and other regional and Joint Venture plans	habitat & natural process restoration	high	VII-I
23	Use grasslands established through reclamation efforts on former strip-mined lands as opportunities to manage large (e.g., >5,000 acre) tracts of grassland habitats for area-sensitive species	habitat & natural process restoration	high	VII-A,E,F,H,I
24	Annually maintain grassland parcels of >75 acres on DOW managed areas that are outside of grassland conservation opportunity areas, area-sensitive bird priority areas, or gamebird priority areas	habitat & natural process restoration	high	VII-A,E,F,H
25	On private lands outside of gamebird priority areas and grassland conservation opportunity areas, promote grassland tracts ≥50 acres for the benefit of area-sensitive grassland wildlife species	habitat & natural process restoration	high	VII-A,E,F,H,I
26	Research alternative grassland habitats that would not be affected by farm commodity prices (ex. - wind turbine fields, solar panel fields, livestock haying/grazing operations, new urban development design, roadsides, carbon sequestration fields, corporate facility landscaping, well fields, urban green space, etc)	habitat & natural process restoration	high	VII-C
27	Update and improve the accuracy of landcover data in Ohio by using advanced GIS modelling to determine habitat distribution and quality	habitat & natural process restoration	high	VII-C
28	Determine Ohio-specific population and trend estimates for wildlife species to aid our ability to identify appropriate habitat objectives	habitat & natural process restoration	high	VII-C,I
29	Determine the importance of native warm season vs. exotic cool season grass management relative to avian community structure, species density, and population demographics	habitat & natural process restoration	high	VII-C,I
30	Develop habitat programs where the DOW establishes rules for participation and sets standards for habitat quality - identify target townships and market aggressively to landowners	habitat & natural process restoration	high	VII-A,E,F,H
31	Increase management efficiency by increasing communication among wildlife area managers regarding common solutions to management issues - use management plans and GIS tools to help identify common solutions and prioritize management activities	habitat & natural process restoration	high	VII-D
32	Identify ecosystem or population-level threats through research, surveillance, monitoring, and inventory	habitat & natural process restoration	high	I, II, III, IV, V, VI, VIII, IX, XI
33	Develop compatible recreational activities criteria that can be used to evaluate impacts to habitat/species from recreational activities	habitat & natural process restoration	high	VI

34	Develop ways to encourage mega-farm, hobby farm, and rural estate owners to participate in habitat programs	habitat & natural process restoration	high	VII-A,F
III	**SPECIES MANAGEMENT**		med	
1	Reintroduce and restore grassland species where appropriate	species reintroduction	med	I, II, VII-B,G
2	Develop species-specific conservation plans as needs are identified to clearly define the actions the Division will/or will not implement concerning the state-listed species	species management	med	VII-I
3	Identify, design, and conduct appropriate species-specific surveys, inventories, or monitoring projects to determine species distribution and abundance	species management	med	VII-C,I
4	Develop a feral hog management plan designed to minimize introductions and control expansion	species management	med	VIII-B
IV	**EDUCATION AND AWARENESS**		med	
1	Educate private landowners about participation in habitat programs relative to the enrollment process (particularly when multiple agencies/offices are involved), rental equipment available, vendors available to do habitat work, and local program administration	awareness & communications	med	VII-A,F
2	Provide workshops or training opportunities to learn management techniques and exchange ideas	training	high	VII-D
3	Provide education/information about grassland habitats and wildlife, and opportunities for establishment on private lands; provide technical assistance to landowners for habitat establishment and maintenance	awareness & communications	med	VII-A,F
4	Educate USDA Farm Service Agency staff about upland bird management and habitat needs as it relates to CRP and mid-contract management	training	high	VII-H
5	Educate and inform the public and other agency personnel on the importance and necessity for prescribed burning as a safe and effective tool for grassland habitat management	awareness & communications	med	VII-B
6	Provide technical assistance to public and private landowners concerning the use of prescribed burning as a safe and effective management tool	awareness & communications	med	VII-B
7	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communications	med	VIII-A,B
8	Provide guidance to landowners for eradication/control of invasive and nuisance species	awareness & communications	med	VIII-A,B
9	Maintain a corps of Division of Wildlife-trained partners and volunteers to assist, lead, and promote special programs	training	high	VII-A,F
10	Educate landowners, maintenance staff, municipalities, etc. on ways to reduce impacts to adjacent grassland habitat	awareness & communications	med	I, II, VII-G

V	**LAW AND POLICY**		med	
1	Balance the needs of fish and wildlife with the needs of people by mitigating incompatible ecosystem uses	policies & regulations	med	I, II, III, IV, V, VI
2	Participate in the policy-making process at Federal level to influence conservation programs	policies & regulations	med	VII-A,E,H
3	Encourage the preservation of habitat connectivity in all land use planning	policies & regulations private sector standards & codes	med med	I, IV
4	Create incentives (laws, policies) to prevent loss and/or minimize impacts to grasslands due to development	policies & regulations	med	I, II, IV
5	Support legislation promoting eco-friendly energy development and use	legislation policies & regulations	high med	III-A,B
6	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	high med	VIII
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		med	
1	Provide incentives for grassland establishment on private lands, especially within priority areas or where large tracts could benefit declining wildlife populations - work with private lands conservation partners (NGO's and agencies) to develop funding opportunities	conservation payments non-monetary values	high low	VII-A,E,F
2	Engage in research to understand social and economic influences on landowner decisions to participate in habitat programs, and use information to influence where and how programs are marketed	conservation payments non-monetary values	high low	VII-A,F
3	Support incentives that encourage landowners to maintain/preserve existing grassland habitat on agricultural lands	market forces conservation payments non-monetary values	med high low	II

4	Support the creation of incentives for the protection and restoration of grassland habitat	linked enterprises & livelihood alternatives substitution market forces conservation payments non-monetary values	high med med high low	I, II, III, IV, VII-A
5	Support creation of incentives to incorporate wildlife habitat into recreational facilities such as parks and golf courses	market forces conservation payments non-monetary values	med high low	VI-B
6	Develop incentives for private landowners to eradicate/control invasive plant species	conservation payments non-monetary values	high low	VIII
VII	**EXTERNAL CAPACITY BUILDING**		high	
1	Provide collaborative support to Pheasants Forever Farm Bill biologists in Ohio	alliance & partnership development	high	VII-D
2	Work with cooperating conservation agencies to streamline the enrollment process for new landowners in CRP or similar programs	alliance & partnership development	high	VII-A,F,H
3	Investigate alternative uses or markets for biomass produced by invasive plants on reclaimed strip-mined lands to recover some management costs - seek alternative funding sources (WHIP, USFWS) for woody species management	conservation finance	high	VII-D
4	Create a multiagency invasive species prevention and control group that would be responsible for all invasive species issues	alliance & partnership development	high	VIII
5	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, causeway, and utilities design, construction, and maintenance	alliance & partnership development	high	IV
6	Support and actively participate in an Ohio Prescribed Fire Council	alliance & partnership development	high	VII-B
7	Help create and support partnerships of conservation-minded groups to protect and manage forest habitat	alliance & partnership development	high	I, II, VII-D
8	Support legitimate citizen scientist-based monitoring efforts of wildlife species and habitats	institutional & civil society development	high	VII-C,D

*refers to the Grassland Habitat Conservation Threats table

Wetland Habitat

Ohio Wetland Habitat (U.S. Fish and Wildlife Service)

STATUS
Depleted but relatively stable. Ohio contains an estimated 880,000 wetland acres based on a recent USFWS National Wetland Inventory (NWI) update. Major wetland classification types within the NWI include wet-woods (35%), shrub swamps (9%), and marshes (11%). Ohio's wetlands have experienced losses unlike any other habitat type in the state. While "no net loss" programs have generally checked overall losses, fragmentation continues to threaten Ohio's wetland habitat. Mitigation wetlands isolated from other wetland complexes significantly contribute to fragmentation. Most of Ohio's wetlands are in private ownership, but the majority of consistently high quality wetlands are managed by the Division of Wildlife, the U.S. Fish and Wildlife Service, and several private hunting clubs. The Division has stepped up wetland protection, restoration, and enhancement efforts throughout Ohio under the North American Waterfowl Management Plan, the National Shorebird Plan, and the All-Bird Conservation Initiative.

DESCRIPTION
Before European settlement, Ohio's wetlands covered 18.9% (5 million acres) of the state. The majority of these wetlands were swamp forest, 3 million acres of which were covered by the Great Black Swamp in northwest Ohio. This massive swamp was approximately 120 miles long and 40 miles wide. As settlers moved west, they drained the wetlands for timber and farming, thus eliminating over 90% of the original wetlands.

Today, Ohio has a diversity of wetland types within its borders. The conservation threats and actions contained within this section apply to all of the wetland types listed below:

- Marsh – a shallow wetland that is subject to frequent or continuous flooding and is characterized by aquatic vegetation such as cattail, arrowhead, and sedges
- Swamp – a wetland fed primarily by surface water (stream, river) and is dominated by trees and shrubs
- Bog – wetland containing spongy peat deposits and is characterized by evergreen trees, sphagnum moss, and acidic water
- Fen – wetland fed by mineral rich groundwater covered with grasses, sedges, willow, and birch trees and containing alkaline or neutral water
- Vernal pools – shallow temporary wetlands that fill annually from rain and/or snow, dry out every year or every other year, and do not have a population of predatory fish

The wetland habitats that remain in Ohio are stressed by a number of factors, reducing our ability to maintain the quality and quantity of wetland acreage. The three primary issues impacting Ohio's wetlands are habitat loss, fragmentation, and aquatic invasive species.

Wetland habitat loss
Ohio ranks second only to California in percentage of wetland loss since 1780. Ohio's population density per square mile is 9th among all U.S. states, despite the fact that the rate of population growth is slower than most of the nation. Nevertheless, the rate of land converted to urban and commercial use happens at a much faster rate than population growth would indicate. Ohio has seen a decrease in population in core metropolitan areas and a dramatic increase in low-density housing in "exurban" areas. This development pattern puts further expansion and redevelopment in conflict with wetland habitats.

Since the early 1980s, federal and state programs have slowed the loss of wetlands, and several agricultural/conservation programs now exist which provide incentives to restore wetlands. Wetland mitigation also serves to keep wetlands on the map, but compared to the original wetland, the quality, function, and location of mitigated wetlands are oftentimes less than equivalent.

An evaluation of vegetation and wildlife responses to newly constructed wetlands needs to be conducted to ensure that mitigated wetlands are functionally equivalent to the original wetlands they replace. The quantity and quality of Ohio's wetlands must be maintained because a decline in either will decrease the suitability of this critical habitat to support sustainable wildlife populations.

The Upper Mississippi River and Great Lakes Region Joint Venture created habitat objectives for each state in the Joint Venture. Ohio has about 110,000 acres of emergent marsh according to the NWI – however, the JV habitat objectives require 133,000 acres for migrating birds and 118,000 for breeding birds. Restoration of marshes as well as maintenance of existing wetlands is paramount if the habitat objectives are to be met.

Fragmentation of remaining wetlands
Land use changes continue to fragment Ohio's remaining wetland habitat thus reducing the state's overall ecological capacity. Consequently, many of Ohio's remaining wetlands are small, isolated habitats surrounded by suburbia or farm fields. That isolation decreases habitat suitability for many wildlife species. To counter the fragmentation of the state's remaining wetland habitat, the Division must prioritize landscape-level ecology within concentrated focus areas. The majority of remaining wetlands in the state are in private ownership, which places a premium on the Division to develop strategies for technical assistance and education.

Aquatic invasive species
The biodiversity of wetlands have been impacted by invasive plants and animals more than other habitat types. Several non-native invasive plant species in particular, are a focus of management/control efforts:

- Common Reed (*Phragmites australis*)
- Purple loosestrife (*Lythrum salicaria*)
- Reed canary grass (*Phalaris arundinacea*)
- Eurasian watermilfoil (*Myriophyllum spicatum)*
- Flowering rush (*Butomus umbellatus)*

Wetland Bioassessment Program Update (from the Ohio EPA 2014 Integrated Report)
Numerous grants from U.S. EPA over many years have funded work that is advancing the science of wetland assessment methodologies in Ohio. Published work includes an amphibian index of biotic integrity (AmphIBI) for wetlands, a vegetation index of biotic integrity (VIBI) for wetlands, and a comparison of natural and mitigation (constructed) wetlands. A number of wetland reports are available on the Division of Surface Water web page (http://www.epa.ohio.gov/dsw/wetlands/WetlandEcologySection_reports.aspx) including (1) an assessment of the condition of wetlands in the Cuyahoga River watershed, (2) a study on the condition and functions of urban wetlands, (3) a comparison of the ecological condition of 25 randomly selected mitigation wetlands from around the state with results from Ohio's natural wetlands, and (4) the development of a GIS tool to identify potential vernal pool habitat restoration areas.

Studies currently in progress include (1) an in-depth analysis of the relationship between stream and wetland condition and function in the Big Run Scioto River watershed, (2) incorporating wetland information with data from other surface water resources to develop a total maximum daily load analysis of a watershed, and (3) assessment of the ecological condition of 50 randomly selected natural wetlands located across Ohio in order to generate a "scorecard" of wetland condition. These studies will add to data collected as part of U.S. EPA's National Wetland Condition Assessment conducted across the United States in 2011. Future research will include a detailed study of hydrologic functioning within natural and constructed wetlands, and continued investigations of various taxonomic groups (e.g., birds, bryophytes, algae, etc.) to determine their potential use in new and improved wetland assessment techniques.

Ohio EPA Wetland Protection Program
Ohio's Wetland Water Quality Standards (OAC 3745-1-50 to -54) contain definitions, beneficial use designations, narrative criteria and antidegradation provisions that guide Ohio EPA's review of projects in which applicants are seeking authorization to discharge dredged or fill material into wetlands. Ohio Administrative Code 3745-1-53 gives all wetlands the "wetland" designated beneficial aquatic life use. However, wetlands are further defined as Category 1, 2, or 3 based on the wetland's relative functions and values, sensitivity to disturbance, rarity, and potential to be adequately compensated for by wetland mitigation.

Category 1, 2, and 3 wetlands demonstrate minimal, moderate and superior wetland functions, respectively. Category 1 wetlands are typified by low species diversity, a predominance of non-native species, no significant habitat or wildlife use, and limited potential to achieve beneficial wetland functions. Category 2 wetlands are dominated by native species but generally without the presence of, or habitat for rare, threatened or endangered species. Additionally, these wetlands may be degraded, but have reasonable potential for re-establishing lost wetland functions. Category 3 wetlands typically possess high levels of diversity, a high proportion of native species, high functional values, and may contain the presence of, or habitat for rare, threatened and endangered species. Wetlands that are scarce, either regionally or statewide, form a subcategory of Category 3 wetlands for which, when allowable, short-term disturbances may be authorized.

The rigor of the Antidegradation Review conducted under 3745-1-50 through 54 is based on the category of the wetlands proposed to be impacted. Category 1 wetlands are classified as Limited Quality Waters and may be impacted after examining avoidance and minimization measures and determining that no significant impacts to water quality will result from the impacts. Category 2 and 3 wetlands are classified as General High Quality Waters, and may be impacted only after a formal examination of alternatives and a determination that the lowering of water quality is necessary to accommodate social and economic development. In addition, an applicant must demonstrate that “public need” is achieved in order to receive authorization to impact Category 3 wetlands. Compensatory mitigation ratios are based on wetland category, vegetation class, and proximity of the mitigation to the impact site.

ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

Ohio's wetland wildlife is a varied resource consisting of both resident and migratory species. Estimates suggest that <25% of Ohio’s original wetland habitat remains today. It’s not surprising that over half of Ohio's threatened and endangered species are dependent on wetlands as crucial habitat. Ohio's wetlands are an essential part of the life cycle of migratory birds which travel through the state each spring and fall between their wintering and nesting grounds. Monitoring populations of wetland wildlife, particularly migratory birds and furbearers, is a complex year-round task that involves the cooperation of many states and countries throughout North America. Participation by the Ohio Division of Wildlife (Division) in the Mississippi Flyway Council, Association of Fish and Wildlife Agencies, Midwest Furbearers Group, Partners-In-Flight, and other conservation groups and initiatives ensures wise monitoring and conservation of wetland wildlife.

Wetland wildlife populations are affected by many factors including habitat quality and quantity, weather, and the actions of humans. For migratory birds these factors may occur far from Ohio, but they have a major impact on the abundance of wetland wildlife species that frequent our state. Ohio’s wetlands were once part of a very complex ecosystem covering millions of acres. An important result of settlement was the “taming” of wetlands through extensive subsurface drains and ditches. Road building also altered the course of water forever. Today, wetland management is an art and science of manipulating water levels to simulate the natural drying and flooding that once occurred in Ohio’s wetlands. These manipulations entail mimicking natural drought and rainfall conditions to simulate these natural cycles. Drawdowns expose mudflats to heat and oxygen which stimulates the germination of seeds and growth of emergent vegetation. Shallow flooding attracts shorebirds that later give way to waterfowl and waders as water levels rise. The end result is an ecosystem that is one of the most productive available for a wide variety of wildlife.

The following species have been identified as wetland species of greatest conservation need (conservation status rank in parentheses):

<u>Amphibians</u>

Mud Salamander (5)	*Pseudotriton montanus*
Jefferson Salamander (7)	*Ambystoma jeffersonianum*
Eastern Tiger Salamander (9)	*Ambystoma tigrinum tigrinum*
Four-toed Salamander (11)	*Hemidactylium scutatum*
Eastern Spadefoot (15)	*Scaphiopus holbrookii*
Red-spotted Newt (20)	*Notophthalmus viridescens viridescens*

Pickerel Frog (24)	*Rana palustris*
Northern Leopard Frog (28)	*Rana pipiens*
Northern Slimy Salamander (28)	*Plethodon glutinosus*
N. Two-lined Salamander (32)	*Eurycea bislineata*
Northern Spring Peeper (34)	*Pseudacris crucifer crucifer*
Redback Salamander (34)	*Plethodon cinereus*
Blanchard's Cricket Frog (36)	*Acris crepitans blanchardi*

<u>Birds</u>

Sedge Wren (3)	*Cistothorus platensis*
King Rail (5)	*Rallus elegans*
Marsh Wren (5)	*Cistothorus palustris*
Northern Harrier (5)	*Circus cyaneus*
Sora Rail (5)	*Porzana carolina*
Virginia Rail (5)	*Rallus limicola*
American Black Duck (10)	*Anas rubripes*
American Bittern (10)	*Botaurus lentiginosus*
Black Tern (10)	*Chlidonias niger*
Black-crowned Night-Heron (10)	*Nycticorax nycticorax*
Common Gallinule (10)	*Gallinula galeata*
Common Tern (10)	*Sterna hirundo*
Great Egret (10)	*Ardea alba*
Least Bittern (10)	*Ixobrychus exilis*
Prothonotary Warbler (10)	*Protonotaria citrea*
Blue-winged Teal (24)	*Anas discors*
Snowy Egret (24)	*Egretta thula*
Trumpeter Swan (24)	*Cygnus buccinator*
Great Blue Heron (36)	*Ardea herodias*
Short-eared Owl (36)	*Asio flammeus*
Wilson's Phalarope (36)	*Phalaropus tricolor*
Wood Duck (36)	*Aix sponsa*
American Coot (52)	*Fulica americana*
Bald Eagle (52)	*Haliaeetus leucocephalus*
Belted Kingfisher (52)	*Megaceryle alcyon*
Canada Goose (52)	*Branta canadensis*
Canvasback (52)	*Aythya valisineria*
Green-winged Teal (52)	*Anas crecca*
Herring Gull (52)	*Larus argentatus*
Hooded Merganser (52)	*Lophodytes cucullatus*
Little Blue Heron (52)	*Egretta caerulea*
Mallard (52)	*Anas platyrhynchos*
Northern Shoveler (52)	*Anas clypeata*
Northern Pintail (52)	*Anas acuta*
Pied-billed Grebe (52)	*Podilymbus podiceps*
Rusty Blackbird (52)	*Euphagus carolinus*
Sandhill Crane (52)	*Grus canadensis*
Spotted Sandpiper (52)	*Actitis macularius*
Swamp Sparrow (52)	*Melospiza georgiana*
Willow Flycatcher (52)	*Empidonax traillii*
Wilson’s Snipe (52)	*Gallinago delicata*
Yellow-crowned Night-Heron (52)	*Nyctanassa violacea*
Alder Flycatcher (112)	*Empidonax alnorum*
American Wigeon (112)	*Anas americana*
Black-necked Stilt (112)	*Himantopus mexicanus*
Cattle Egret (112)	*Bubulcus ibis*
Common Yellowthroat (112)	*Geothlypis trichas*

Common Moorhen (112)	*Gallinula chloropus*
Gadwall (112)	*Anas strepera*
Green Heron (112)	*Butorides virescens*
Osprey (112)	*Pandion haliaetus*
Purple Gallinule (112)	*Porphyrio martinicus*
Red-winged Blackbird (112)	*Agelaius phoeniceus*
Redhead (112)	*Aythya americana*
Ring-billed Gull (112)	*Larus delawarensis*
Ruddy Duck (112)	*Oxyura jamaicensis*
Yellow-headed Blackbird (112)	*Xanthocephalus xanthocephalus*
Yellow Warbler (112)	*Setophaga petechia*

Butterflies and Skippers

Mitchell's Satyr (1)	*Neonympha mitchellii*
Swamp Metalmark (6)	*Calephelis mutica*
Confused Cloudy Wing (6)	*Thorybes confusis*
Duke's Skipper (6)	*Euphyes dukesi*
Harris Checkerspot (11)	*Chlosyne harrisii liggetti*
Two-spotted Skipper (11)	*Euphyes bimacula*
Mulberry Wing Skipper (14)	*Poanes massasoit*
Broad-winged Skipper (14)	*Poanes viator viator*
Silver-bordered Fritillary (19)	*Boloria selene myrina*
Dion Skipper (20)	*Euphyes dion*
Black Dash Skipper (21)	*Euphyes conspicua*
Gray Comma (23)	*Polygonia progne*
Baltimore Checkerspot (32)	*Euphydryas phaeton*
Eyed Brown (34)	*Satyrodes eurydice*
Acadian Hairstreak (39)	*Satyrium acadicum*
Purplish Copper (45)	*Lycaena helloides*
Brown Elfin (45)	*Incisalia augustinus croesoides*
Delaware Skipper (66)	*Atrytone logan*
Harvester (82)	*Feniseca tarquinius*
Viceroy (106)	*Limenitis archippus*
Dun Skipper (106)	*Euphyes vestris metacomet*

Invertebrates

Noctuid Moth	*Photedes enervata*
Noctuid Moth	*Spartiniphaga inops*

Mammals

Ermine (16)	*Mustela erminea*
Star-nosed Mole (25)	*Condylura cristata*
Southern Bog Lemming (32)	*Synaptomys cooperi*
River Otter (42)	*Lutra canadensis*
Beaver (45)	*Castor canadensis*
Mink (45)	*Mustela vison*
Muskrat (49)	*Ondatra zibethicus*

Reptiles

Spotted Turtle (4)	*Clemmys guttata*
Kirtland's Snake (5)	*Clonophis kirtlandii*
Eastern Ribbon Snake (13)	*Thamnophis sauritus sauritus*
Northern Ribbon Snake (13)	*Thamnophis sauritus septentrionalis*
Common Map Turtle (19)	*Graptemys geographica*
Blanding's Turtle (22)	*Emydoidea blandingii*
Copperbelly Water Snake (22)	*Nerodia erythrogaster neglecta*

Eastern Massasauga (27)	*Sistrurus catenatus catenatus*
Eastern Fox Snake (33)	*Elaphe vulpina gloydi*
Common Musk Turtle (34)	*Sternotherus odoratus*
Midland Painted Turtle (40)	*Chrysemys picta marginata*
Northern Water Snake (40)	*Nerodia sipedon sipedon*
Northern Brown Snake (43)	*Storeria dekayi dekayi*

WETLAND CONSERVATION OPPORTUNITY AREAS

The Division of Wildlife's approach to enhancing and maintaining the highest level of terrestrial wildlife diversity in the state is to use a "conservation opportunity area" concept to sustain viable populations of as many native species of wildlife as possible. The idea is to concentrate efforts and resources to provide all the necessary habitat requirements in a few, relatively large units of the major habitat types, along with the remnants of several unique habitats, for species that are of limited distribution or have low populations.

Lake Erie Marsh Conservation Opportunity Area

The Lake Erie Marsh Conservation Opportunity Area (Figure T-5) lies along the Western Basin of Lake Erie. It stretches from the eastern edge of Maumee Bay along the Lake Erie shoreline and ends just west of the City of Sandusky in Sandusky Bay. The Lake Erie Marsh Conservation Opportunity Area is situated in a rapidly developing area of the Great Lakes. Development in the form of marinas, condominiums, and support industries continues to occur. Many small wetlands have succumbed to this development, and larger marsh complexes have been encroached upon. The area is also heavily farmed, with many wetlands converted for agricultural production. The current threat to remaining and restorable wetlands is high.

The region is an important staging area for migrant songbirds as they rest before the passage around or over Lake Erie in the spring. Lake Erie represents the largest migration barrier to many of these species after they cross the Gulf of Mexico. The western Lake Erie shoreline supports one of the most dramatic buildups of neotropical migrants in North America during spring migration.

Wetlands of the Lower Great Lakes are one of the six original continental areas designated as a "priority habitat range" in the North American Waterfowl Management Plan. The Lake Erie marshes are at the crossroads of the Mississippi and Atlantic flyways, and they annually attract hundreds of thousands of migrating waterfowl. The Lake Erie marshes are also the most important migration staging area on the continent for black ducks. This high concentration of black ducks in the marshes represents nearly 17 percent of the continental black duck population. Although predominantly utilized by waterfowl during migration, several species also nest within the region including mallards, blue-winged teal, wood ducks, trumpeter swans and Canada geese.

The Lake Erie Marsh Conservation Opportunity Area includes the Ottawa National Wildlife Refuge (9,000 acres) and several Division of Wildlife-owned properties (Pipe Creek, Pickerel Creek, Willow Point, Little Portage, Toussaint Creek, Metzger Marsh, Magee Marsh, Mallard Club) that total 9,758 acres. Publicly-managed lands constitute 41% of the total wetland acreage within this area.

Figure T-5. Lake Erie Marsh Conservation Opportunity Area

conservation opportunity area boundaries ------

Killbuck Marsh Conservation Opportunity Area

The Killbuck Marsh Conservation Opportunity Area (Figure T-6) in east-central Ohio extends through the Killbuck Creek Valley and through portions of Wayne, Holmes, and Coshocton counties. Killbuck Creek is the central natural feature within the area. Over 40 miles of Killbuck Creek are included within the Conservation Opportunity Area. The creek's low gradient creates many acres of productive, emergent wetlands. The town of Millersburg lies between the two halves of the Conservation Opportunity Area (2.4 stream miles) in a location where past channelization and a narrow valley floor have resulted in reduced wetland habitat. However, from an area south of Millersburg to the confluence of the Killbuck and Walhonding River in Coshocton County, the stream gradient and wetland habitat are similar in nature to the northern portion of the Conservation Opportunity Area, and contain extensive wetlands.

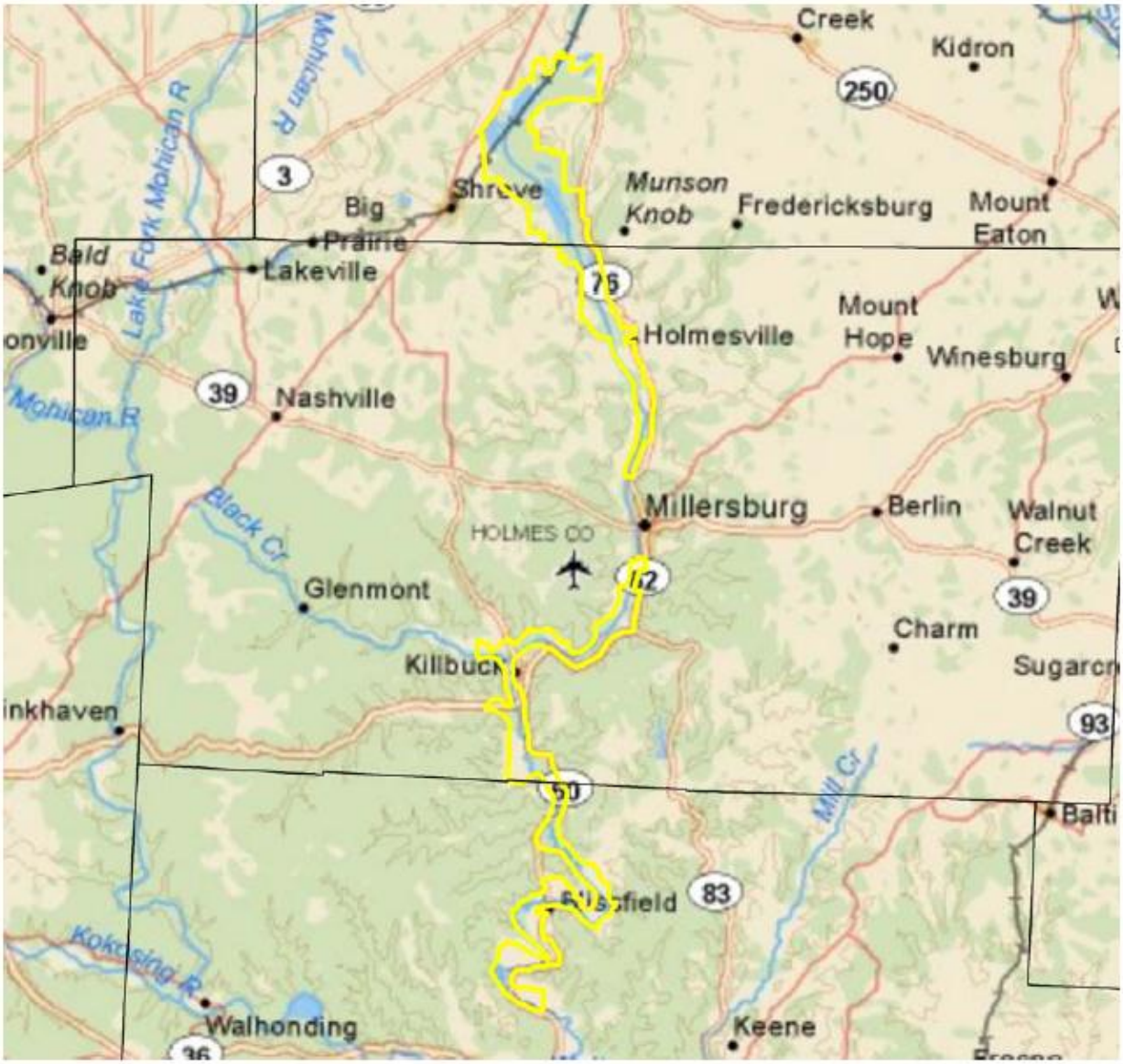
Inland wetlands like those in the Killbuck Conservation Opportunity Area are important staging areas for thousands of waterfowl during spring and fall migration. As many as 23 species of ducks have been identified using the area. Shorebirds and a variety of other wildlife and listed species also depend heavily on these inland wetlands.

In 1988, the first recorded Ohio nesting attempt of the state endangered sandhill crane in more than 60 years was documented nearby at Funk Bottoms Wildlife Area. Sandhills now nest regularly at both the Killbuck Conservation Opportunity Area and Funk Bottoms Wildlife Area. The first recorded nesting of bald eagles in the Killbuck Marsh Conservation Opportunity Area occurred in 2000. In 1991, Killbuck Marsh Wildlife Area was the site for a successful reintroduction of river otters, which have subsequently expanded into adjoining watersheds.

Trumpeter swans were reintroduced in the Killbuck marshes in 1997 to re-establish this endangered species, and two nesting attempts were documented in 2000. Additionally, sightings of the eastern massasauga rattlesnake (currently a candidate species for federal endangered status) are known to have occurred in the Killbuck Valley.

The Killbuck Marsh Wildlife Area in north central Holmes County represents the largest remaining inland marsh in Ohio. This 5,500 acre wetland complex is composed of a wide variety of habitats, including seasonally flooded bottomland hardwoods, shrub-scrub swamps, emergent marshes, shallow ponds with submergent vegetation, and wet meadows. Restoration of diked wetlands such as the Wright Marsh (350 acres in 1990) and the Moore Marsh (50 acres in 1991) have added to the diversity of habitats. Presently 5,650 acres of Division of Wildlife-owned lands (38% of total acreage) are located within the Killbuck Marsh Conservation Opportunity Area.

Figure T-6. Killbuck Marsh Conservation Opportunity Area



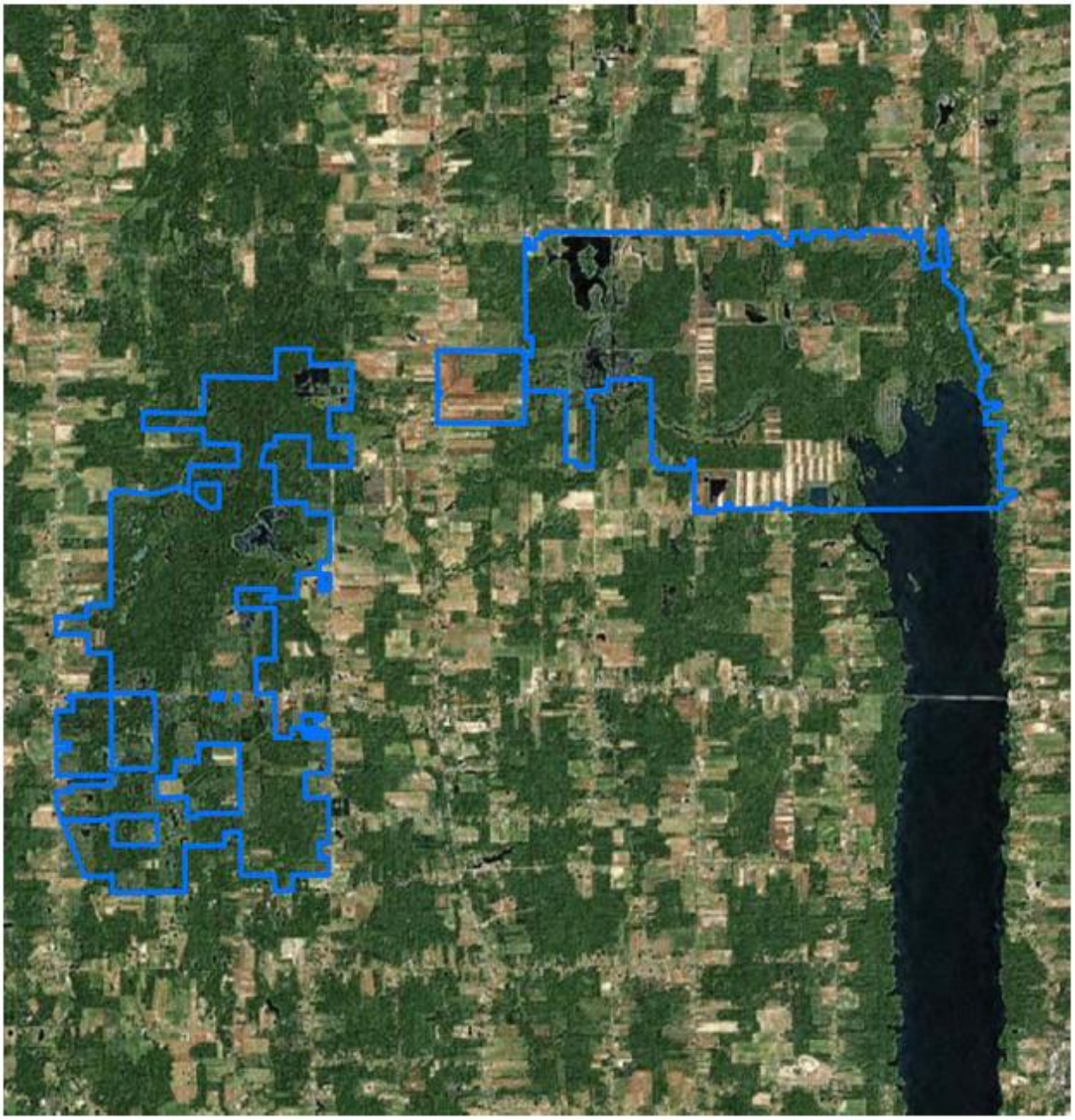
conservation opportunity area boundaries

Grand River/Mosquito Creek Conservation Opportunity Area
Approximately 43% of Ohio's human population is located in northeast Ohio, with over 3 million people living within 35 miles of the Grand River/Mosquito Creek Conservation Opportunity Area (Figure T-7). Despite this concentration of human activity, productive wetland systems still exist in Northeast Ohio. Together, the Grand River and Mosquito Creek Wildlife Areas comprise 86% of this 16,028 acre Conservation Opportunity Area. Current habitat conditions within the area are characterized by numerous beaver swamps, riparian wetlands, bottomland forests, vernal pools, and adjacent agricultural lands. Topography in the area is extremely flat and the soils are poorly drained.

The western portion of this Conservation Opportunity Area consists primarily of the Grand River Wildlife Area (over 7,400 acres), which was established in 1956 and is located at the southern end of the Grand River Lowlands. The "Lowlands" are recognized as a distinct physiographic region that developed from the ancestral lakebed of a finger lake that once stretched from northern Trumbull County through the western half of Ashtabula County. The Grand River itself has been identified as having the highest diversity of fish and mussels of any river of its size in the Lake Erie drainage. Due to the quality and quantity of the wetland habitat in the vicinity, the Grand River was selected as the first release site for river otters when restoration efforts were initiated in 1986.

The eastern portion of this Conservation Opportunity Area is comprised primarily of Mosquito Creek Wildlife Area (over 9,000 acres) which lies within Ohio's portion of the Ohio River drainage basin. The Mosquito Creek Reservoir Project was authorized in 1938 to provide flood control and a water supply for industry downstream. Full operation of the reservoir by the U.S. Army Corps of Engineers was initiated in 1944. The Ohio Division of Wildlife was granted a license by the Secretary of the Army in 1946 for fish and wildlife management on the over 9,000 acres of land and water north of State Route 88. The federal land was used as a public hunting area from 1946 to 1962. The state of Ohio established a land acquisition unit adjacent to the federal land in 1956.

Figure T-7. Grand River/Mosquito Creek Conservation Opportunity Area



conservation opportunity area boundaries ------

CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Wetland habitat. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		high
A	Wetlands in Ohio have become highly fragmented due to development	housing & urban areas commercial & industrial areas	high medium
B	Habitat destruction and altered hydrology from commercial development	commercial & industrial areas	medium
C	Habitat destruction and altered hydrology from urban/suburban development	housing & urban areas	high
D	Wetland construction/restoration far from other wetlands (fragmentation) as a result of mitigation from development	housing & urban areas commercial & industrial areas	high medium
E	No authority to control private land uses and development related to federal and state programs supporting wetland restoration	housing & urban areas	high
II	**agriculture and aquaculture**		low
A	Loss of wetland habitat because of conversion to agriculture	annual & perennial non-timber crops livestock farming & ranching	medium low
B	Loss of wetland habitat due to increase in intensity of agricultural practices – conversion of imbedded wetland habitat	annual & perennial non-timber crops	medium
III	**energy production and mining**		medium
A	Oil and gas extraction - can directly damage and destroy wetland habitat, and indirectly have negative impacts by altering hydrology and causing chemical contamination	oil & gas drilling mining & quarrying	low low
B	Wind turbines can negatively impact birds and bats that utilize wetland habitat	renewable energy	medium
IV	**transportation and service corridors**		high
A	Roads and utilities can destroy and fragment wetland habitat, and alter hydrology	roads & railroads utility & service lines	high high
V	**biological resource use**		medium
---	none	---	---
VI	**human intrusions and disturbance**		medium
A	Incompatible recreational activities	recreational activities	medium
B	Creation of recreational facilities can alter/destroy wetland habitat	recreational activities	medium
VII	**natural system modifications**		medium
A	Wetlands could be converted (drained) to CRP as 30 year Wetland Reserve Program (WRP) contracts expire and the landowner no longer receives payment	dams & water management/use	medium

B	Insufficient funds available to build/maintain wetland habitat on private lands – resulting in lack of management and subsequent habitat degradation	dams & water management/use	medium
C	Lack of wetland inventory data, and a database system to analyze that data limits our ability to manage	other ecosystem modifications	low
D	Our ability to manage wetlands is limited by available staff and funding	other ecosystem modifications	low
E	Landowners do not want to cede development rights to the state related to federal and state programs supporting wetland restoration	other ecosystem modifications	low
F	Construction costs associated with restoring private land wetlands continues to rise resulting in fewer wetland acres restored for the price	other ecosystem modifications	low
G	Habitat destruction, fragmentation, altered hydrology due to proximity of development	other ecosystem modifications	low
H	Aging wetland infrastructures can affect the quantity and the quality of wetlands	dams & water management/use	medium
I	Altered hydrologic regimes due to ditching and diking, water control structures, etc	dams & water management/use	medium
J	Lack of wetland associated species data limits our ability to manage	other ecosystem modifications	low
VIII	**invasive and other problematic species and genes**		medium
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	high
B	Introduction and/or spread of nuisance plants and animals	problematic native species	low
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	high low
D	Landowners not aware of which species of vegetation to control, and how to control them	invasive non-native/alien species problematic native species	high low
E	Lack of accessibility and cost of herbicides for non-licensed landowners for control of vegetation	invasive non-native/alien species problematic native species	high low
IX	**pollution**		medium
A	Urban effluent	household sewage & urban wastewater industrial & military effluents garbage & solid waste air-borne pollutants	low low low low
B	Agriculture effluent	agricultural & forestry effluents	high

X	**geological events**		low
---	none	---	---
XI	**climate change and severe weather**		high
A	Climate change could effect plant species composition, which in turn could affect wildlife species	habitat shifting & alteration droughts temperature extremes storms & flooding	high high medium high

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Wetland habitat. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		high	
1	Protect wetlands through strategic acquisitions, easements, and partnerships	resource & habitat protection	med	I, II, III, IV, V, VI
2	Use State Wildlife Grant funds for potential acquisitions	resource & habitat protection	med	I, II, III, IV, V, VI
3	Annually identify and prioritize properties within the existing Wetland Conservation Opportunity Areas for strategic acquisitions, conservation easements, management agreements, or partnerships	site/area protection	high	I, II, VII-A, D
4	Work with land conservation partners to secure conservation easements and other protection for wetlands coming out of federal contracts	resource & habitat protection	med	VII-A,D
5	Site new recreational facilities such as golf courses and ball fields on already disturbed land	resource & habitat protection	med	VI-B
II	**LAND/WATER MANAGEMENT**		med	
1	Manage Wetland Conservation Opportunity Areas to provide appropriate habitat to sustain viable populations of all wetland dependent wildlife species native to Ohio	site/area management	low	I, II, VIII, IX
2	Maintain 400,000 acres of privately owned, high quality wetlands in Ohio through 2020, as indexed by the private lands database and Conservation Reserve Program (CRP) acreages	habitat & natural process restoration	med	VII-A,B,E,F,H,I
3	Develop and maintain 28,500 acres of Division-owned wetlands in the wetland conservation opportunity areas as Category III wetlands (as defined by the Army Corps of Engineers) by 2020	site/area management	low	I, II, IX

4	Restore/enhance 600 acres of wetlands in District 1, 1,650 acres in District 2, 450 acres in District 3, and 300 acres in District 5 by 2020, with 3,200 acres of the restorations occurring within the three wetland conservation opportunity areas	site/area management habitat & natural process restoration	low med	I-D
5	Assess the quality of wetlands in the wetland conservation opportunity areas	site/area management	low	VII-C
6	Assure that publicly owned wetlands in wetland conservation opportunity areas are high quality	site/area management	low	VII-G,H,I
7	Prioritize restoration/maintenance of Division-managed wetlands at greatest risk	habitat & natural process restoration	med	VII-C
8	Work with fisheries biologists to integrate fisheries considerations when restoring wetlands	habitat & natural process restoration	med	VII-G,H,I
9	Conduct aerial surveys of wetlands in selected areas during the summer and autumn - assess the percentage cover of emergent and floating leafed vegetation	habitat & natural process restoration	med	VII-C
10	Assess the quality of privately owned wetlands that have been restored with federal and/or state assistance by 2020	habitat & natural process restoration	med	VII-C
11	Randomly sample restored wetlands to determine their contribution to wildlife habitat	habitat & natural process restoration	med	VII-C,J
12	Use research and monitoring data to increase understanding of how land-use changes impact the watersheds of coastal wetlands	habitat & natural process restoration	med	VII-C,G
13	Conduct biological surveys on Division-managed wetlands within each conservation opportunity area in 2015 and 2020	site/area management	low	VII-C,J
14	Develop a survey technique that adequately captures all aspects of the quality of a wetland	habitat & natural process restoration	med	VII-C,J
15	Obtain information on habitat requirements and HSI models for all native wetland wildlife species that occur in Wetland Conservation Opportunity Areas	site/area management	low	VII-C,J
16	Evaluate and update management plans for priority species on Division-managed properties in wetland conservation opportunity areas	site/area management	low	VII-C,J
17	Incorporate all wetland conservation opportunity areas into statewide marshbird monitoring protocol	site/area management	low	VII-C,J
18	Include private wetlands on the marshbird monitoring protocol	habitat & natural process restoration	med	VII-C,J
19	Focus efforts on monitoring the priority species listed in the Upper Mississippi River and Great Lakes Region Joint Venture Implementation Plan	habitat & natural process restoration	med	VII-C,J
20	Encourage wetland owners to record wildlife use of their particular wetlands, and integrate the data into a database to track wildlife use of wetland types across the state	habitat & natural process restoration	med	VII-C,D,J

21	Collect and evaluate data from legitimate citizen scientist-based monitoring surveys, such as the Ohio Lepidopterist Society's Long-term Butterfly Monitoring Program, the Breeding Bird Survey, and the Frog and Toad Call Survey, through 2020	habitat & natural process restoration	med	VII-C,J
22	Update and improve the accuracy of landcover data in Ohio by using advanced GIS modelling to determine habitat distribution and quality	habitat & natural process restoration	med	VII-C
23	Prevent introduction and control the spread of harmful species through legislation, regulation, policy, management practices, education, and partnerships	invasive/ problematic species control	high	VIII
24	Establish an early-detection rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	high	VIII-A,B
25	Stop or reduce the spread of wetland invasive vegetation in the three wetland conservation opportunity areas	invasive/ problematic species control site/area management	high low	VIII-A,B
26	Annually control 1,000 to 1,500 acres of wetlands containing invasive species on public land with an emphasis in the conservation opportunity areas	invasive/ problematic species control site/area management	high low	VIII-A,B
27	Utilize aerial spray for invasive species control/eradication in larger problem areas	invasive/ problematic species control	high	VIII-A,B
28	Use seasonal water level management to control invasive species	invasive/ problematic species control	high	VIII-A,B
29	Develop a standardized monitoring program to recognize potential threats from invasive species	invasive/ problematic species control	high	VIII
30	Assist with control of invasive vegetation on 500 acres of private wetlands annually through 2020	invasive/ problematic species control	high	VII-B, VIII-A,B,D,E
31	Use GIS to annually map the extent of invasive plants on selected wetlands, beginning with the wetland conservation opportunity areas	invasive/ problematic species control	high	VII-C, VIII-A,B
32	Increase and maintain adequate Division staffing in core areas for management of invasive species	invasive/ problematic species control	high	VII-D, VIII
33	Increase Division private lands biologist staffing in core wetland areas to work with landowners during CRP mid-contract management checks to insure they are utilizing proper wetland management techniques (*Guidelines for Management of Ohio's Wetland Habitat*)	habitat & natural process restoration	med	VII-D
34	Maintain the private lands biologist program on regional basis	habitat & natural process restoration	med	VII-D

35	Increase Division staffing within the three Wetland Conservation Opportunity Areas	site/area management	low	VII-D
36	Annually budget funding for conservation opportunity areas capital projects on a rotating basis to maintain water control structures on highest priority wetlands	site/area management	low	VII-H
37	Identify ecosystem or population-level threats through research, surveillance, monitoring, and inventory	habitat & natural process restoration	med	I, II, III, IV, V, VI, VIII, IX, XI
38	Develop compatible recreational activities criteria that can be used to evaluate impacts to habitat/species from recreational activities	habitat & natural process restoration	med	VI
39	Develop ways to encourage mega-farm, hobby farm, and rural estate owners to participate in habitat programs	habitat & natural process restoration	med	VII-A,B,E,F
III	**SPECIES MANAGEMENT**		high	
1	Reintroduce and restore wetland species where appropriate	species reintroduction	med	I, II
2	Develop species-specific conservation plans as needs are identified to clearly define the actions the Division will/or will not implement concerning the state-listed species	species management	high	VII-J
3	Identify, design, and conduct appropriate species-specific surveys, inventories, or monitoring projects to determine species distribution and abundance	species management	high	VII-C,J
4	Identify the causes for the decline of the black-crowned night heron populations and develop a recovery plan by 2016	species recovery	high	VII-C,J
IV	**EDUCATION AND AWARENESS**		med	
1	Offer wetland management technical assistance to NRCS by providing long-term management plans to landowners enrolled within WRP	awareness & communications	med	VII-A,B
2	Make 40 substantive contacts relating to federal and state programs supporting wetland restoration each year	awareness & communications	med	I-E VII-B,E,F
3	Educate landowners about the importance of land stewardship and the value of wetlands on private lands - and inform them of best management practices for their wetland habitats	awareness & communications	med	VII-A,B,E,F
4	Provide guidance to landowners for eradication/control of invasive and nuisance species	awareness & communications	med	VIII-A,B,D,E
5	Conduct restoration and conservation demonstrations to transfer management capacity to benefit coastal wetland management	training	med	VII-D
6	Maintain a corps of Division of Wildlife-trained partners and volunteers to assist, lead, and promote special programs	training	med	VII-D
7	Educate landowners, maintenance staff, municipalities, etc. on ways to reduce impacts to adjacent wetland habitat	awareness & communications	med	I, II, VII-G
8	Deliver science-based training and information that supports wetland stewardship to decision-makers	training	med	I, II, VII-G
9	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communications	med	VIII-A,B

V	**LAW AND POLICY**		med	
1	Balance the needs of fish and wildlife with the needs of people by mitigating incompatible ecosystem uses	policies & regulations	med	I, II, III, IV, V, VI
2	Participate in the policy-making process at Federal level to influence conservation programs	policies & regulations	med	I-E, VII-A,B,E,F
3	Create an interagency team to explore streamlining the permitting process for wetland restoration projects	policies & regulations	med	VII-E,F
4	Foster legislative support for private lands wetland conservation to continue the wetlands financial incentives in future Farm Bill titles and editions	legislation	med	VII-A,B
5	Encourage the preservation of habitat connectivity in all land use planning	policies & regulations private sector standards & codes	med med	I, IV
6	Create incentives (laws, policies) to prevent loss and/or minimize impacts to wetlands due to development	policies & regulations	med	I, II, IV
7	Support legislation promoting eco-friendly energy development and use	legislation policies & regulations	med med	III
8	Develop regulations to deter introduction of invasive/nuisance species	legislation policies & regulations	med med	VIII-A,B,C
9	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	med med	VIII-A,B,C
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		med	
1	Explore tying eligibility for grant money, loans, and cost-share programs to nutrient loading levels for agriculture – the lower the nutrient levels in their effluent, the more money they would be eligible for	conservation payments	med	IX-B
2	Create incentives for vegetated buffers along all waterways to reduce nutrient loads and sediment	market forces conservation payments non-monetary values	high med low	IX-B
3	Support incentives that encourage landowners to maintain/preserve existing wetland habitat on agricultural lands	market forces conservation payments non-monetary values	high med low	II

4	Engage in research to understand social and economic influences on landowner decisions to participate in habitat programs, and use information to influence where and how programs are marketed	conservation payments non-monetary values	med low	VII-A,B,E,F
5	Create incentives to promote land use that incorporates wetland habitat friendly planning	linked enterprises & livelihood alternatives market forces conservation payments non-monetary values	med high med low	I, II, III, IV
6	Create incentives for controlled wetland owners to improve water control structures and subsequently improve habitat conditions for fish and wildlife	conservation payments non-monetary values	med low	VII-B,H
7	Support creation of incentives to incorporate wildlife habitat into recreational facilities such as parks and golf courses	market forces conservation payments non-monetary values	high med low	VI-B
8	Develop incentives for private landowners to eradicate/control invasive plant species	conservation payments non-monetary values	med low	VIII
9	Seek Federal grant money to assist with chemical applications to control invasive species	conservation payments	med	VIII-D,E
10	Seek competitive grant funding to support wetland restoration/maintenance efforts	conservation payments	med	VII-B,D,E,F
11	Increase funding for projects which don't meet the Farm Bill requirements	conservation payments	med	VII-A,B,E,F
12	Maintain state matching grants for created wetlands	conservation payments	med	VII-A,B,E,F
13	Support creation of incentives for landowners to build wetlands	market forces conservation payments non-monetary values	high med low	VII-B
VII	**EXTERNAL CAPACITY BUILDING**		med	
1	Utilize partnerships with university research programs to evaluate the most cost-effective technique to determine wetland quality	alliance & partnership development	med	VII-C,D

2	Maintain partnerships with US Fish and Wildlife Service (USFWS), Ducks Unlimited (DU), Farm Service Administration (FSA), National Resource Conservation Service (NRCS), and Ohio Soil and Water Conservation Districts (SWCD)	alliance & partnership development	med	VII-C,D
3	Encourage partnerships of conservation minded groups to protect and manage wetland habitat	alliance & partnership development	med	I, II, VII-D
4	Support legitimate citizen scientist-based monitoring efforts of wildlife species and habitats	institutional & civil society development	med	VII-C,D,J
5	Create a multiagency invasive species prevention and control group that would be responsible for all invasive species issues	alliance & partnership development	med	VIII-A,B,C
6	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, causeway, and utilities design, construction, and maintenance	alliance & partnership development	med	IV
7	Facilitate the development of cooperative weed management areas	alliance & partnership development	med	VII-D

*refers to Wetlands Habitat Conservation Threats table

Lake Erie Islands

Ohio Lake Erie Islands Habitat Map (Wikipedia)

STATUS
Lake Erie island habitat varies based upon the level of human development and disturbance. Some islands – particularly North, South, and Middle Bass, and Kelleys – have year round residents, influxes of tourists during the summer, and considerable development supporting the tourism industry. Other islands have no development, and are only occasionally visited by people. Development on populated islands, and habitat destruction from colonies of cormorants on un- or lesser populated islands continue to impact island habitat.

DESCRIPTION
The Lake Erie Islands constitute an archipelago of 22 islands lying between the Canadian and American shores of the western basin of Lake Erie (Figure T-8). Ohio has jurisdiction over 13 of the islands (Kelleys, North Bass, Middle Bass, South Bass, Green, Rattlesnake, Sugar, Gibralter, Ballast, Starve, West Sister, Mouse, Johnson's) which range in size from the 1.2-acre Starve Island with 0.186 miles of shoreline, to the 2,824-acre Kelleys Island which has 11.6 miles of shoreline. Twenty-seven percent (1,616 ac) of the 5,892 acres comprising the four largest islands (Kelleys, South Bass, Middle Bass and North Bass) is owned by the Ohio Department of Natural Resources, U.S. Fish and Wildlife Service, and conservation-minded non-governmental organizations.

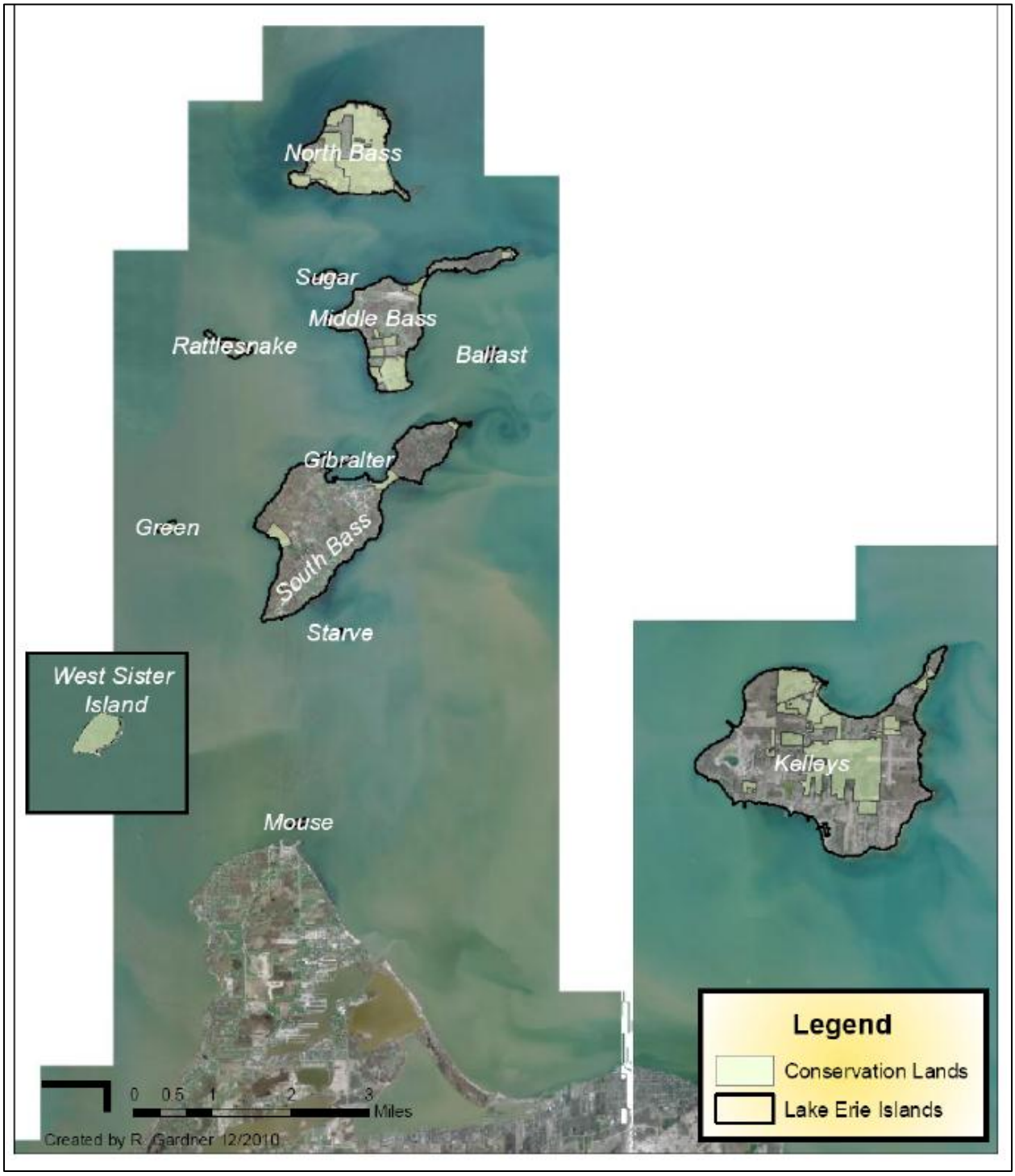
The Lake Erie islands, although distinct from the neighboring mainland in climate and topography, are considered to be vegetatively indistinguishable from the surrounding mainland. Shoreline characteristics

vary from island to island but consist of beaches of sand, gravel/small stones, loose rocks, alvars, and sheer cliffs – all with varying amounts of vegetative cover.

The conversion of the Lake Erie islands' landscape has been dramatic. Island forests were cleared for agricultural endeavors, and limestone quarrying was an important industry through the 1800s. Since the early 1900s, the islands have been developed at a quickening pace as summertime residences, and to meet the needs of the growing tourism industry. Today, nearly a million tourists visit the islands each summer to camp, bike, boat, sail, fish, and sightsee. Human disturbance, habitat degradation and destruction, coupled with shoreline alteration and development are the most serious threats to island-dependent wildlife. The Lake Erie water snake's population will need to be monitored through 2016 (and beyond) to ensure long-term sustainability.

Data is needed to quantify impacts to colonial waterbirds and other avian communities affected by vegetation changes resulting from roosting/nesting cormorants. Cormorants also compete with these birds for nest sites. Information is needed to determine if the cormorant management plan is effective. On Lake Erie islands, cormorants nest primarily in trees in close proximity to other colonial-nesting species. Habitat alteration and competition is a potential problem given the lack of alternative nesting sites for colonial waterbirds. Consequently, conservation of nesting sites should be the emphasis of management activities for these waterbirds. Finally, fluctuating water levels in the lake, shoreline erosion, pollution/contaminants, and the impacts of aquatic invasive species on the prey base are also unknown factors which may be detrimental to island-dependent wildlife.

Figure T-8. Lake Erie Islands Habitat and Conservation Lands



ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

The Lake Erie islands historically have been an important staging and stopover location for a variety of migratory avian species. In addition, West Sister Island currently supports a significant percentage of all the herons and egrets nesting in the U.S. Great Lakes. The islands also support the largest colony of snowy egrets, the only little blue heron colony, and the largest colonies of great blue herons, great egrets, and black-crowned night-herons found within the Great Lakes. The entire population of the Lake Erie water snake is restricted to 8 Lake Erie islands. The snake's population declined through the 1990s resulting in the species being listed as federally threatened in 1999 and state endangered in 2000. Today, with enough protected habitat to sustain a viable population, abundant prey in the form of the round goby, and a significant reduction in direct mortality from people through intensive public outreach efforts, the snake population appears secure and growing throughout its range. In 2011 the snake was removed from the list of federally threatened species, and downlisted to state threatened in 2012.

The following species have been identified as Lake Erie Islands species of greatest conservation need (conservation status rank in parentheses):

<u>Birds</u>

Black Tern (10)	*Childonias niger*
Black-crowned Night Heron (10)	*Nycticorax nycticorax*
Great Egret (10)	*Casmerodius albus*
Snowy Egret (24)	*Egretta thula*
Great Blue Heron (36)	*Ardea herodias*
Herring Gull (52)	*Larus argentatus*
Little Blue Heron (52)	*Egretta caerulea*
Cattle Egret (112)	*Bubulcus ibis*
Gadwall (112)	*Anas strepera*
Ring-billed Gull (112)	*Larus delawarensis*

<u>Reptiles</u>

Lake Erie Water Snake (40)	*Nerodia sipedon insularum*

CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Lake Erie Islands habitat. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		high
A	Habitat destruction, fragmentation, altered hydrology from tourism-related development	tourism & recreation areas	high
B	Habitat destruction, fragmentation, altered hydrology from residential development	housing & urban areas	high
C	The market value of undeveloped land on the Lake Erie Islands is exceptionally, high making land acquisition for protection purposes problematic	housing & urban areas tourism & recreation areas	high high
II	**agriculture and aquaculture**		medium
A	Loss of island habitat because of conversion to agriculture (primarily vinyards)	annual & perennial non-timber crops	high

III	**energy production and mining**		low
A	Mining (primarily quarrying) can directly damage and destroy island habitat, and indirectly have negative impacts by altering hydrology	mining & quarrying	medium
B	Wind turbines can negatively impact birds and bats that utilize island habitat	renewable energy	negligible
IV	**transportation and service corridors**		high
A	Roads and utilities can destroy and fragment island habitat, and alter hydrology	roads & railroads utility & service lines	high medium
V	**biological resource use**		low
A	Killing of Lake Erie watersnakes	hunting & collecting terrestrial animals	low
VI	**human intrusions and disturbance**		high
A	Incompatible recreational activities	recreational activities	high
B	Creation of recreational facilities can alter/destroy island habitat	recreational activities	high
VII	**natural system modifications**		low
A	Fluctuating water levels in Lake Erie and shoreline erosion can negatively impact island-dependent wildlife	other ecosystem modifications	low
B	The use of chemical controls for the control/eradication of the gypsy moth and mosquitoes is known to negatively impact non-target lepidopteran and amphibians	other ecosystem modifications	low
C	Habitat destruction, fragmentation, altered hydrology due to proximity to development	other ecosystem modifications	low
D	Our ability to manage island habitat is limited by available staff and funding	other ecosystem modifications	low
E	The amount of land in private/corporate ownership on the islands limits our ability to manage	other ecosystem modifications	low
F	Lack of island habitat inventory data, and a database to analyze that data limits our ability to manage	other ecosystem modifications	low
G	Lack of island associated species data limits our ability to manage	other ecosystem modifications	low
VIII	**invasive and other problematic species and genes**		high
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	high
B	Introduction and/or spread of nuisance plants and animals	problematic native species	medium
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	high medium
D	Colonial waterbirds and other avian communities are impacted by vegetation changes and nest site competition resulting from roosting/nesting cormorants	problematic native species	medium

IX	**pollution**		low
A	Urban effluent	household sewage & urban wastewater industrial & military effluents garbage & solid waste air-borne pollutants	low low low negligible
B	Agriculture effluent	agricultural & forestry effluents	negligible
X	**geological events**		low
---	none	---	---
XI	**climate change and severe weather**		low
A	Climate change could effect plant species composition, which in turn could affect wildlife species	habitat shifting & alteration droughts temperature extremes storms & flooding	low negligible low low
B	Lake levels impacts on shoreline species due to climate change	habitat shifting & alteration storms & flooding	low low

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Lake Erie Islands habitat. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		med	
1	Protect island habitat through strategic acquisitions, easements, and partnerships	resource & habitat protection	med	I, II, III, IV, V, VI
2	Use State Wildlife Grant funds for potential acquisitions	resource & habitat protection	med	I, II, III, IV, V, VI
3	Establish permanent buffer areas around island habitats to ensure their long-term viability	resource & habitat protection	med	I, II, III, IV, VI
4	Conserve and connect island habitats through acquisition, conservation easements, land donations, and other innovative strategies together with conservation-minded NGO partners and federal, state, and local governments	resource & habitat protection	med	I, II, III, IV, VI
5	Develop new and build on existing relationships with Land Trusts purchasing lands and conservation easements	resource & habitat protection	med	I, II, III, IV, VI

6	Add 100 acres of protected lands on the Lake Erie islands through conservation easement or purchase by 2016	site/area protection	med	I, II, III, IV, VI, VII-C,E
7	Site new recreational facilities such as golf courses and ball fields on already disturbed land	resource & habitat protection	med	VI-B
II	**LAND/WATER MANAGEMENT**		med	
1	Identify, investigate, and conduct research on the causes of habitat loss or impairment and develop strategies to minimize further habitat loss	habitat & natural process restoration	med	I, II, III, IV, VI, VII-C
2	Develop a list and prioritize research needs associated with habitat loss or impairment	habitat & natural process restoration	med	I, II, III, IV, VI, VII-C
3	Identify, protect, restore, and enhance 100 acres of island habitats that will support viable populations of the wildlife species dependent upon these habitats on public and private lands by 2016	site/area management	low	I, II, III, IV, V, VI, VII-B,C, VIII, IX
4	Identify and implement strategies to minimize the effects of residential development adjacent to existing protected/preserved habitats	habitat & natural process restoration	med	I, IV, VI, VII-C
5	Design and implement surveys to determine the status and distribution of wildlife species associated with island habitats - evaluate the success of habitat restoration, enhancement, and management measures being implemented	habitat & natural process restoration	med	VII-F,G
6	Continue to research habitat requirements for the suite of wildlife associated with Lake Erie Island habitats	habitat & natural process restoration	med	VII-F,G
7	Assemble and/or develop GIS-based data layers and associated tables of known island habitats, including publicly-owned or conservation-minded NGO managed lands, and make it available for public-land managers and conservation-minded NGOs	habitat & natural process restoration	med	VII-F
8	Develop a comprehensive baseline inventory of historic versus current distribution and abundance of island habitats	habitat & natural process restoration	med	VII-F
9	Identify, design, and conduct appropriate habitat-based projects to evaluate the quality, quantity, connectivity, and distribution of “undeveloped/natural” Lake Erie Island habitat	habitat & natural process restoration	med	VII-F
10	Develop a management plan for colonial waterbirds on the Lake Erie islands	habitat & natural process restoration	med	VIII-B,D
11	Determine the effectiveness of habitat manipulation on Lake Erie islands to enhance colonial waterbird habitat	habitat & natural process restoration	med	VIII-B,D
12	Collect and evaluate data from legitimate citizen scientist-based monitoring surveys, such as the Ohio Lepidopterist Society’s Long-term Butterfly Monitoring Program, the Breeding Bird Survey, and the Frog and Toad Call Survey, through 2020	habitat & natural process restoration	med	VII-D,G
13	Prevent introduction and control the spread of harmful species through legislation, regulation, policy, management practices, education, and partnerships	invasive/ problematic species control	high	VIII

14	Implement strategies identified in the Wildlife Stewardship Tactical Plan to avoid, minimize or eliminate the adverse impacts of non-native and/or problematic species in island habitats	invasive/ problematic species control	high	VIII
15	Establish an early-detection rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	high	VIII-A,B,C
16	Implement strategies identified in the Wildlife Stewardship Tactical Plan to avoid, minimize or eradicate diseases in wildlife associated with island habitats	invasive/ problematic species control	high	VIII-C
17	Identify ecosystem or population-level threats through research, surveillance, monitoring, and inventory	habitat & natural process restoration	med	I, II, III, IV, V, VI, VIII, IX, XI
18	Develop compatible recreational activities criteria that can be used to evaluate impacts to habitat/species from recreational activities	habitat & natural process restoration	med	VI
III	**SPECIES MANAGEMENT**		med	
1	Reintroduce and restore Lake Erie Island species where appropriate	species reintroduction	low	I, II, VII-C
2	Develop species-specific conservation plans as needs are identified to clearly define the actions the Division will/or will not implement concerning the state-listed species	species management	high	VII-G
3	By 2016, develop and implement recovery/conservation plans for the state-listed species dependent upon island habitats starting with the Blanding's turtle	species recovery	low	VII-G
4	Identify, design, and conduct appropriate species-specific surveys, inventories, or monitoring projects to determine species distribution and abundance	species management	high	VII-G
5	Biannually meet with appropriate department personnel to ensure compliance with the Lake Erie Watersnake Management Plan for island properties owned or managed by ODNR	species management	high	V
6	Continue Lake Erie watersnake population surveys through 2016 as designed in the post-delisting monitoring protocol	species management	high	V
7	Continue to implement the cormorant management plan through 2020 and revise its content as needed	species management	high	VIII-D
8	Identify the causes for the decline of the black-crowned night heron populations and develop a recovery plan by 2016	species recovery	low	VII-G
IV	**EDUCATION AND AWARENESS**		high	
1	Promote the value of island habitat/species conservation by developing and distributing new publications, educational materials, website information, and digital presentations	awareness & communications	high	I, II, III, IV, V, VI, VII-C,E
2	Provide technical assistance to private landowners who wish to protect, restore and/or enhance island habitats	awareness & communications	high	VII-E
3	Provide guidance to landowners for eradication/control of invasive and nuisance species	awareness & communications	high	VII-E, VIII

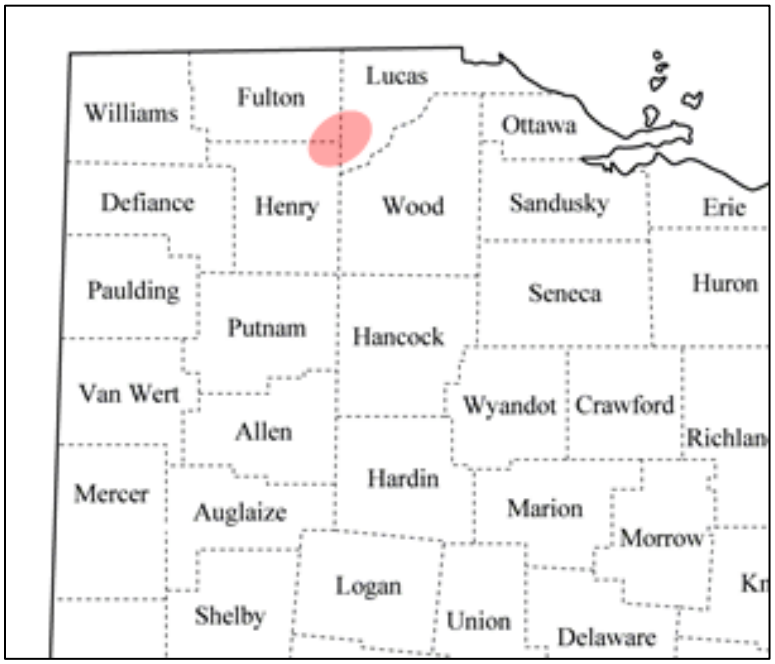
4	Continue to provide technical assistance to Lake Erie island shoreline residents and businesses to ensure open rock cribs are used in the construction of new or refurbished docks	awareness & communications	high	VI-B, VII-C
5	Provide technical guidance on coastal development plans as relates to fish and wildlife interests	awareness & communications	high	I, IV, VI, VII-C
6	Provide technical assistance to public land managers and NGOs to ensure island habitats under their management continue to be protected, restored and/or enhanced	awareness & communications	high	VII-D,E
7	Maintain a corps of Division of Wildlife-trained partners and volunteers to assist, lead, and promote special programs	training	high	V, VI, VII-D
8	Utilize the Ohio Wildlife Legacy Stamp as a tool to illustrate the value of Ohioans in wildlife conservation and to convey the connection between wildlife, people, and habitat	awareness & communications	high	V, VI, VII-E
9	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communications	high	VIII-A,B,C
V	**LAW AND POLICY**		med	
1	Balance the needs of fish and wildlife with the needs of people by mitigating incompatible ecosystem uses	policies & regulations	med	I, II, III, IV, V, VI
2	Participate in the policy-making process at Federal level to influence conservation programs	policies & regulations	med	I, II, III, IV
3	Encourage the preservation of habitat connectivity in all land use planning	policies & regulations private sector standards & codes	med high	I, IV
4	Create incentives (laws, policies) to prevent loss and/or minimize impacts to island habitats due to development	policies & regulations	med	I, II, IV
5	Support legislation promoting eco-friendly energy development and use	legislation policies & regulations	med med	III
6	Develop regulations to deter introduction of invasive/nuisance species	legislation policies & regulations	med med	VIII-A,B,C
7	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	med med	VIII-A,B,C
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		low	
1	Support incentives that encourage landowners to maintain/preserve existing island habitat on their properties	market forces conservation payments non-monetary values	low low low	I, VII-E

2	Support the creation of incentives for the protection and restoration of island habitat	linked enterprises & livelihood alternatives substitution market forces conservation payments non-monetary values	low low low low low	I, II, III, IV, VII-E
3	Support creation of incentives to incorporate wildlife habitat into recreational facilities such as parks and golf courses	market forces conservation payments non-monetary values	low low low	VI-B
4	Develop incentives for private landowners to eradicate/control invasive plant species	conservation payments non-monetary values	low low	VII-E, VIII-A,B,C
VII	**EXTERNAL CAPACITY BUILDING**		low	
1	Actively promote and engage in partnerships to conserve and enhance island habitats and the species dependent upon them	alliance & partnership development	low	I, II, V-A, VII-D
2	Support legitimate citizen scientist-based monitoring efforts of wildlife species and habitats	institutional & civil society development	low	VII-D
3	Develop new and strengthen existing partnerships with the Lake Erie Island Chapter of the Black Swamp Conservancy and Land Trust organizations working on the Lake Erie islands	alliance & partnership development	low	VII-D
4	Create a multiagency invasive species prevention and control group that would be responsible for all invasive species issues	alliance & partnership development	low	VIII
5	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, causeway, and utilities design, construction, and maintenance	alliance & partnership development	low	IV

*refers to the Lake Erie Islands Habitat Conservation Threats table

Oak Savannas

Ohio Oak Savanna Habitat



STATUS
The oak savanna was once one of the most common vegetation types in the Midwest. However, since the middle of the 19th century declines due primarily to settlement and loss of the normal fire regime have led this habitat to be listed as globally imperiled. Oak savannas are one of the rarest plant communities today. Most remaining oak savannas, including those in Ohio, are small and fragmented.

DESCRIPTION
Ohio's Oak Savannas lay a region in the northwestern portion of the state, along a sandy belt of soil known as the Oak Openings (Figure T-9). This area is 22 miles long, 6 miles wide, and encompasses 130 to 140 square miles in parts of Henry, Fulton, and Lucas counties. These oak savannas are upland, dry areas dominated by drought-resistant prairie plants such as little bluestem, lupine, and widely-spaced oak trees with a park-like appearance. This community is often interspersed with areas of poor drainage that support wetlands.

In 1859, Lucas County Commissioners led the effort to develop an extensive network of drainage ditches throughout the county to drain the wet prairies and make the land available to agriculture. The water table was lowered and the oak savannas and wet prairies were converted to pastures and farms. Draining the wet areas of the Oak Openings enabled farms and homes to exist in areas that were formerly wetlands. Over the years, numerous farms in the area were abandoned for the more fertile soils found in the nearby Black Swamp region. During the 1930s, farmed-out areas were planted in pines to keep sand from blowing across roads and against houses.

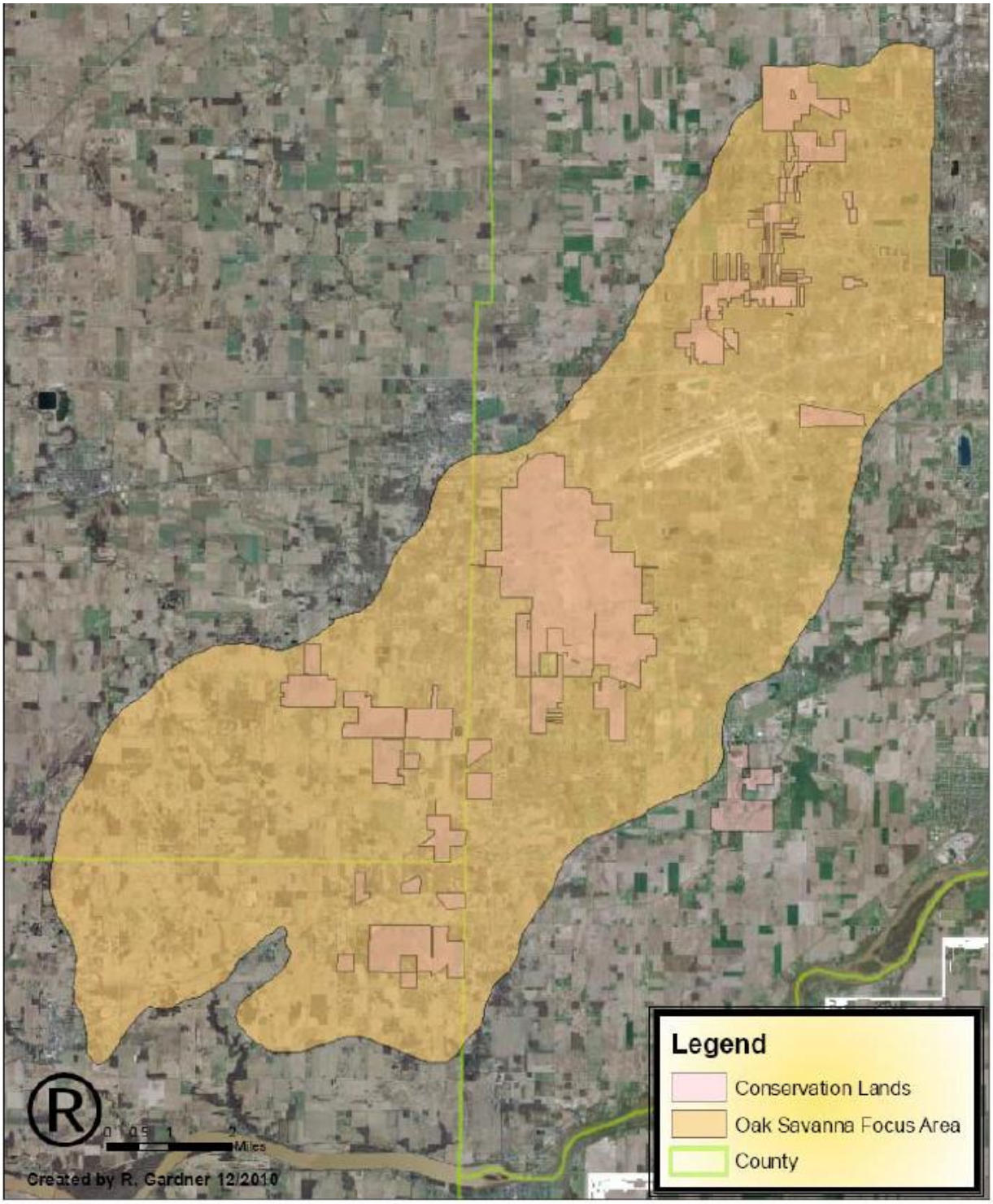
The Oak Openings Region Green Ribbon Initiative consists of a number of local partners intent on conserving habitat by creating a biological/recreational corridor of preserved lands. This initiative has identified 6,000 acres of high-quality green space running through the area. Within this green space, approximately 1,000 acres of oak savanna habitat is actively maintained by the ODNR and The Nature Conservancy. Remnant oak savannas, wet prairies, and sand dunes are also scattered throughout an

additional 8,300 acres owned by the Division of Forestry and the Toledo Metroparks. Remnant oak savanna plant communities still exist on many residential properties throughout the region.

Periodic fires which once sustained the oak savanna plant community by retarding succession, now only occur in intensively managed areas. Invasive plant species also change the composition and structure of the plant community, making restoration more difficult. In addition, the use of chemical controls (e.g., demilin, and Bt) for the eradication of the gypsy moth is known to impact non-target lepidopteran species. This could be very problematic for lepidopterans with distributions limited to the Oak Openings.

It is difficult to quantify the minimum habitat necessary to sustain viable populations of the oak savanna wildlife. Efforts should be made to enhance, restore, and connect fragmented oak savanna habitat in the largest block of protected lands possible. Habitat should be maintained in a mosaic of open prairie grass areas with native lupines and nectaring plants (95%) interspersed with widely scattered oaks (3%) and small wetlands (2%).

Figure T-9. Oak Savanna Habitat and Conservation Lands



ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

Oak savannas provide a variety of habitats for many species of wildlife. Oak trees provide habitat as well as food for birds, rodents, deer, turkey, and a host other species. The diversity of ground vegetation (grasses, forbs) also supports numerous wildlife species that utilize this habitat for food and cover.

A self-sustaining population of the Karner blue butterfly has been successfully reintroduced in this habitat in the Oak Openings region. Efforts continue to expand the Karner's distribution to suitable habitat within its historic range. Habitat specificity for the Eastern Persius dusky wing butterfly and the frosted elfin butterfly is being researched. The distribution and abundance of the blue-spotted salamander also need to be determined so that sound management practices can be implemented to conserve a viable population within the Oak Savanna area.

The following species have been identified as Oak Savanna species of greatest conservation need (conservation status rank in parentheses):

<u>Amphibians</u>

Blue-spotted Salamander (19)	*Ambystoma laterale*
Spotted Salamander (28)	*Ambystoma maculatum*

<u>Birds</u>

Lark Sparrow (36)	*Chondestes grammacus*
Chestnut-sided Warbler (52)	*Dendroica pensylvanica*
Mississippi Kite (112)	*Ictinia mississippiensis*
Mourning Warbler (112)	*Oporornis philadelphia*
Golden-winged Warbler (EX)	*Vermivora chrysoptera*

<u>Butterflies</u>

Persius Dusky Wing Butterfly (2)	*Erynnis persius*
Dusted Skipper (17)	*Atryonopsis hianna*
Frosted Elfin Butterfly (18)	*Incisalia irus*
Edward's Hairstreak (33)	*Satyrium edwardsii*
Indian Skipper (41)	*Hesperia sassacus*
Coral Hairstreak (85)	*Satyrium titus*
Karner Blue Butterfly (104)	*Lycaeides melissa samuelis*
American Copper (123)	*Lycaena phlaeas americana*

<u>Reptiles</u>

Eastern Hognose Snake (6)	*Heterodon platirhinos*

CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Oak Savanna habitat. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		high
A	Habitat destruction, fragmentation, altered hydrology from commercial development	commercial & industrial areas	high
B	Habitat destruction, fragmentation, altered hydrology from urban/suburban development	housing & urban areas	high
C	The market value of undeveloped land in the Oak Openings Region is exceptionally high, making land acquisition for protection purposes problematic	commercial & industrial areas housing & urban areas	high high

II	**agriculture and aquaculture**		low
A	Loss of Oak Savanna habitat because of conversion to agriculture	annual & perennial non-timber crops wood & pulp plantations livestock farming & ranching	low medium low
B	Loss of oak savanna habitat due to increase in intensity of agricultural practices – conversion of imbedded oak savanna habitat	annual & perennial non-timber crops	low
III	**energy production and mining**		low
A	Mining, oil and gas extraction - can directly damage and destroy habitat, and indirectly have negative impacts by altering hydrology and causing chemical contamination	oil & gas drilling mining & quarrying	low medium
B	Wind turbines can negatively impact birds and bats that utilize Oak Savanna habitat	renewable energy	low
IV	**transportation and service corridors**		low
A	Roads and utilities can destroy and fragment Oak Savanna habitat, and alter hydrology	roads & railroads utility & service lines	medium low
V	**biological resource use**		low
---	none	---	---
VI	**human intrusions and disturbance**		low
A	Incompatible recreational activities	recreational activities	medium
B	Creation of recreational facilities can alter/destroy island habitat	recreational activities	medium
VII	**natural system modifications**		low
A	Periodic fires which once sustained the oak savanna plant community by retarding succession only occur in intensively managed areas	fire & fire supression	medium
B	The use of chemical controls for the control/eradication of the gypsy moth and mosquitoes is known to negatively impact non-target lepidopteran and amphibians	other ecosystem modifications	low
C	Habitat destruction, fragmentation, altered hydrology due to proximity to development	other ecosystem modifications	low
D	Our ability to manage Oak Savanna habitat is limited by available staff and funding	other ecosystem modifications	low
E	While remnant oak savanna plant communities still exist on many residential properties, larger, intact oak savanna habitat is limited and few areas are connected leaving isolated oak savanna habitat scattered throughout the region	other ecosystem modifications	low
F	Less than 2% of the complex of dunes and swales that supported the sedge meadows, tallgrass prairies, barrens, and oak savannas remain	other ecosystem modifications	low
G	Lack of oak savanna inventory data, and a database system to analyze that datalimits our ability to manage	other ecosystem modifications	low
H	Lack of oak savanna associated species data limits our ability to manage	other ecosystem modifications	low

VIII	**invasive and other problematic species and genes**		medium
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	high
B	Introduction and/or spread of nuisance plants and animals	problematic native species	low
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	high low
IX	**pollution**		low
A	Urban effluent	household sewage & urban wastewater industrial & military effluents garbage & solid waste air-borne pollutants	low low low negligible
B	Agriculture effluent	agricultural & forestry effluents	low
X	**geological events**		negligible
---	none	---	---
XI	**climate change and severe weather**		medium
A	Climate change could effect plant species composition, which in turn could affect wildlife species	habitat shifting & alteration droughts temperature extremes storms & flooding	medium high medium low

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Oak Savanna habitat. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		med	
1	Protect oak savanna habitat through strategic acquisitions, easements, and partnerships – with special emphasis on the Oak Openings region	resource & habitat protection	low	I, II, III, IV, V, VI
2	Use State Wildlife Grant funds for potential acquisitions	resource & habitat protection	low	I, II, III, IV, V, VI
3	Establish permanent buffer areas around oak savanna habitats to ensure their long-term viability	resource & habitat protection	low	I, II, III, IV, VI

4	Conserve and connect oak savanna habitats through acquisition, conservation easements, land donations, and other innovative strategies together with conservation-minded NGO partners and federal, state, and local governments	resource & habitat protection	low	I, II, III, IV, VI
5	Develop new and build on existing relationships with Land Trusts purchasing lands and conservation easements	resource & habitat protection	low	I, II, III, IV, VI
6	Add 250 acres of protected lands within the Oak Openings region through purchase or conservation easement by 2016	site/area protection	high	I, II, III, IV, VI-C,E
7	Site new recreational facilities such as golf courses and ball fields on already disturbed land	resource & habitat protection	low	VI-B
II	**LAND/WATER MANAGEMENT**		med	
1	Identify, investigate, and conduct research on the causes of habitat loss or impairment and develop strategies to minimize further habitat loss	habitat & natural process restoration	med	I, II, III, IV, VI, VII-C
2	Develop a list and prioritize research needs associated with habitat loss or impairment	habitat & natural process restoration	med	I, II, III, IV, VI, VII-C
3	Identify, protect, restore, and enhance 100 acres of oak savanna habitat that will support viable populations of the wildlife species dependent upon this habitat on public and private lands by 2016	site/area management	low	I, II, III, IV, V, VI, VII-B,C, VIII, IX
4	Identify and implement strategies to minimize the effects of residential development adjacent to existing protected/preserved unique habitats by 2016 beginning in the Oak Openings region	site/area management	low	I, IV, VI, VII-C
5	Design and implement surveys to determine the status and distribution of wildlife species associated with oak savanna habitats - evaluate the success of habitat restoration, enhancement, and management measures being implemented	habitat & natural process restoration	med	VII-G,H
6	Continue to research habitat requirements for the suite of wildlife associated with oak savanna habitats	habitat & natural process restoration	med	VII-G,H
7	Conduct research on the elements and complexity of the symbiotic relationship among wildlife species associated with oak savannas	habitat & natural process restoration	med	VII-H
8	Assemble and/or develop GIS-based data layers and associated tables of oak savanna habitats, including publicly-owned or conservation-minded NGO managed lands, and make it available for public-land managers and conservation-minded NGOs	habitat & natural process restoration	med	VII-G
9	Develop a comprehensive baseline inventory of historic versus current distribution and abundance of oak savanna habitats	habitat & natural process restoration	med	VII-G
10	Identify, design, and conduct appropriate habitat-based projects to evaluate the quality, quantity, connectivity, and distribution of “undeveloped/natural” oak savanna habitat	habitat & natural process restoration	med	VII-G

11	Identify and prioritize corridors to connect fragmented parcels of unique habitat to allow for wildlife movement between areas beginning in the Oak Savanna Conservation Opportunity Area	site/area management	low	I, II, VII-E,G
12	Collect and evaluate data from legitimate citizen scientist-based monitoring surveys, such as the Ohio Lepidopterist Society's Long-term Butterfly Monitoring Program, the Breeding Bird Survey, and the Frog and Toad Call Survey, through 2020	habitat & natural process restoration	med	VII-D,H
13	Prevent introduction and control the spread of harmful species through legislation, regulation, policy, management practices, education, and partnerships	invasive/ problematic species control	med	VIII
14	Implement strategies identified in the Wildlife Stewardship Tactical Plan to avoid, minimize or eliminate the adverse impacts of non-native and/or problematic species in oak savanna habitats	invasive/ problematic species control	med	VIII
15	Establish an early-detection rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	med	VIII
16	Implement strategies identified in the Wildlife Stewardship Tactical Plan to avoid, minimize or eradicate diseases in wildlife associated with island habitats	invasive/ problematic species control	med	VIII-C
17	Identify ecosystem or population-level threats through research, surveillance, monitoring, and inventory	habitat & natural process restoration	med	I, II, III, IV, V, VI, VIII, IX, XI
18	Develop compatible recreational activities criteria that can be used to evaluate impacts to habitat/species from recreational activities	habitat & natural process restoration	med	VI
19	Contact local government agencies within the Oak Openings Region to encourage them to stop spraying insecticides that adversely impact the lepidopteran and amphibians associated with oak savanna habitat	site/area management	low	VII-B
III	**SPECIES MANAGEMENT**		med	
1	Reintroduce and restore oak savanna species where appropriate	species reintroduction	med	I, II, VII-C
2	Develop species-specific conservation plans as needs are identified to clearly define the actions the Division will/or will not implement concerning the state-listed species	species management	med	VII-H
3	By 2016, develop and implement recovery/conservation plans for the state-listed species dependent upon oak savanna habitats starting with the blue-spotted salamander and endangered butterflies	species recovery	med	VII-H
4	Continue reintroduction and monitoring efforts for the Karner blue butterfly until viable, self-sustaining populations have been restored or through 2020	species reintroduction	med	VII-H
5	Identify, design, and conduct appropriate species-specific surveys, inventories, or monitoring projects to determine species distribution and abundance	species management	med	VII-G,H
6	Develop a feral hog management plan designed to minimize introductions and control expansion	species management	med	VIII-B

IV	**EDUCATION AND AWARENESS**		low	
1	Promote the value of oak savanna habitat/species conservation by developing and distributing new publications, educational materials, website information, and digital presentations	awareness & communications	low	I, II, III, IV, V, VI, VII-C
2	Provide technical assistance to private landowners who wish to protect, restore and/or enhance oak savanna habitats	awareness & communications	low	VII-E
3	Provide guidance to landowners for eradication/control of invasive and nuisance species	awareness & communications	low	VII-E, VIII
4	Provide technical assistance to public land managers and NGOs to ensure island habitats under their management continue to be protected, restored and/or enhanced	awareness & communications	low	VII-D,E
5	Continue to educate and inform the public and other agency personnel on the importance and necessity for prescribed burning as a safe and effective tool for oak savanna habitat management	awareness & communications	low	VII-A,E
6	Provide technical assistance to public and private landowners concerning the use of prescribed burning as a safe and effective management tool	awareness & communications	low	VII-A,E
7	Support efforts to identify, develop, and distribute appropriate informational and educational materials concerning the value of prescribed burning as a safe and effective tool for oak savanna habitat management to local residents, grassroots conservation groups, and local government agencies	awareness & communications	low	VII-A,D,E
8	Maintain a corps of Division of Wildlife-trained partners and volunteers to assist, lead, and promote special programs	training	low	V, VI, VII-D
9	Utilize the Ohio Wildlife Legacy Stamp as a tool to illustrate the value of Ohioans in wildlife conservation and to convey the connection between wildlife, people, and habitat	awareness & communications	low	V, VI, VII-E
10	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communications	low	VIII
V	**LAW AND POLICY**		low	
1	Balance the needs of fish and wildlife with the needs of people by mitigating incompatible ecosystem uses	policies & regulations	low	I, II, III, IV, V, VI
2	Participate in the policy-making process at Federal level to influence conservation programs	policies & regulations	low	VII-E,F
3	Encourage the preservation of habitat connectivity in all land use planning	policies & regulations private sector standards & codes	low med	I, IV
4	Create incentives (laws, policies) to prevent loss and/or minimize impacts to oak savanna habitat due to development	policies & regulations	low	I, II, IV
5	Support legislation promoting eco-friendly energy development and use	legislation policies & regulations	low low	III

6	Develop regulations to deter introduction of invasive/nuisance species	legislation policies & regulations	low low	VIII
7	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	low low	VIII
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		low	
1	Support incentives that encourage landowners to maintain/preserve existing oak savanna habitat on their properties	market forces conservation payments non-monetary values	low low low	I, VII-E
2	Support the creation of incentives for the protection and restoration of oak savanna habitat	linked enterprises & livelihood alternatives substitution market forces conservation payments non-monetary values	low low low low low	I, II, III, IV, VII-E
3	Support creation of incentives to incorporate wildlife habitat into recreational facilities such as parks and golf courses	market forces conservation payments non-monetary values	low low low	VI-B
4	Develop incentives for private landowners to eradicate/control invasive plant species	conservation payments non-monetary values	low low	VII-E, VIII
5	Engage in research to understand social and economic influences on landowner decisions to participate in habitat programs, and use information to influence where and how programs are marketed	conservation payments non-monetary values	low low	VII-E
VII	**EXTERNAL CAPACITY BUILDING**		med	
1	Actively promote and engage in partnerships to conserve and enhance oak savanna habitats and the species dependent upon them	alliance & partnership development	med	I, II, VII-D
2	Support legitimate citizen scientist-based monitoring efforts of wildlife species and habitats	institutional & civil society development	med	VII-D,G,H

3	Develop new and strengthen existing partnerships with Land Trust organizations working in the Oak Openings region	alliance & partnership development	med	VII-D
4	Create a multiagency invasive species prevention and control group that would be responsible for all invasive species issues	alliance & partnership development	med	VIII
5	Support partner organizations utilizing prescribed burning and other techniques to restore and enhance oak savannas	alliance & partnership development	med	VII-A,D
6	Become an active participant in the Green Ribbon Initiative in the Oak Openings region	alliance & partnership development	med	VII-D
7	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, causeway, and utilities design, construction, and maintenance	alliance & partnership development	med	IV
8	Beginning in the Toledo area, identify local planners and initiate dialogue promoting the value of oak savanna habitat conservation in local planning and zoning decisions	alliance & partnership development	med	I, II, III, IV

*refers to the Oak Savanna Habitat Conservation Threats table

Boreal Community

Ohio Boreal Community Habitat

STATUS

The extensive boreal forest which extends from Alaska through Canada and into the northeast United States was never a dominant habitat type in Ohio. What boreal community did occur in Ohio was restricted to the northeast part of the state. Extensive logging that occurred from the time of settlement through the early part of the 20th century reduced the amount of boreal habitat in Ohio. Boreal habitat

remaining today faces additional threats from the population density and accompanying development in this part of the state.

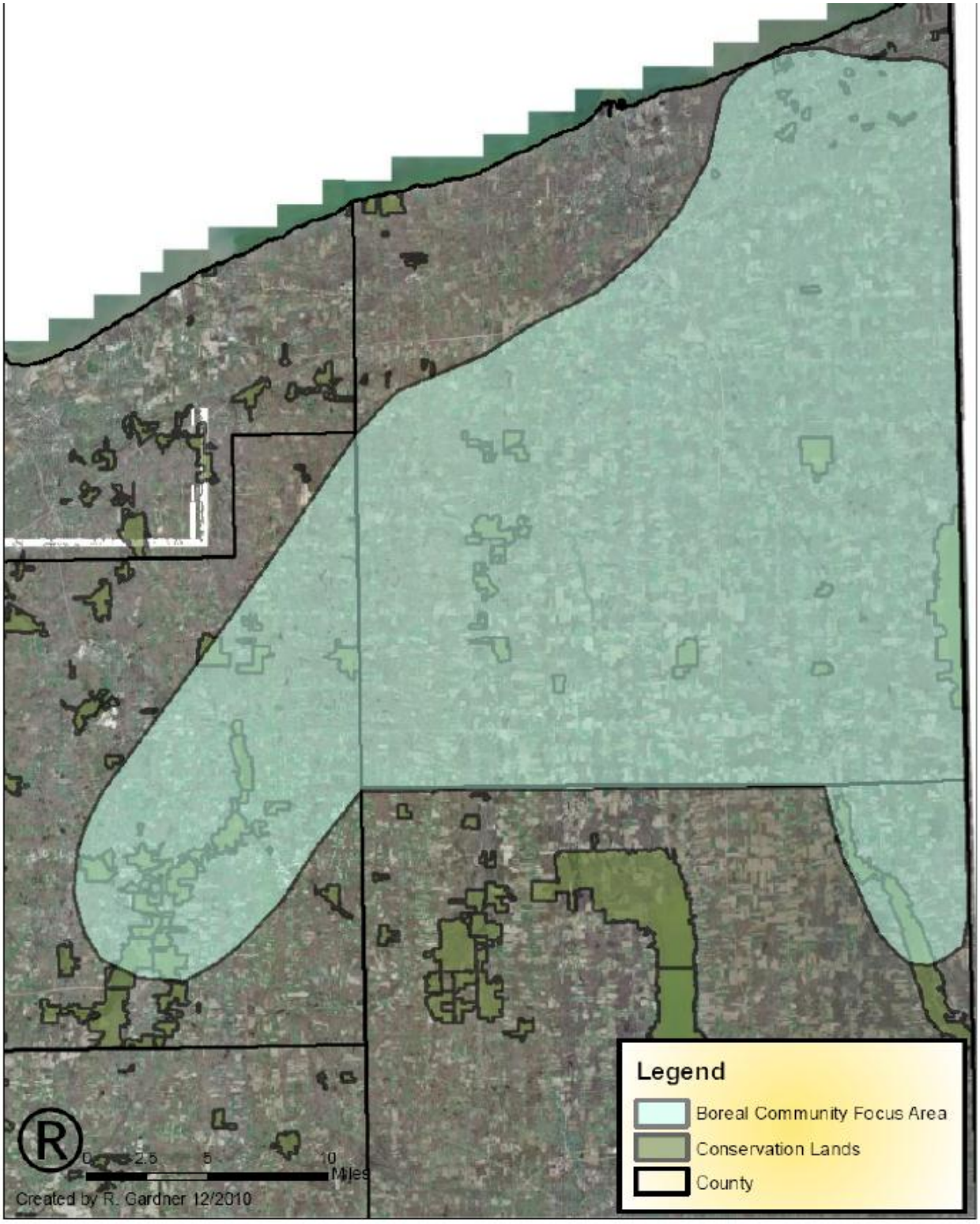
DESCRIPTION

Boreal communities are peatlands (e.g., hemlock-hardwood swamps and other boggy swamps, bogs, and fens) generally thought of as areas which occur in northern regions of the United States and Canada. However, both boreal flora and fauna occur in the snowbelt region of extreme Northeastern Ohio. The Boreal Community Area (Figure T-10) includes portions of Ashtabula County, the eastern 1/3 of Geauga County, and the northern 1/3 of Trumbull County where the average annual snowfall exceeds 60 inches.

Boreal communities once covered thousands of acres in the snowbelt region, but since European settlement, these lands have been drained or flooded. Many existing boreal communities are degraded by human impacts and invasive species. Hemlock swamps are very rare in Ohio, occurring only in the snowbelt region. Bogs and fens are not limited to this region, however numerous boreal species only occur or have been reported to occur in this region's bogs and fens. Some of the region's best examples of boreal communities (e.g., the Pymatuning Bog in Eastern Andover Township, Ashtabula County) existed into the 1930s but were drained and burned for conversion to agricultural fields, pastures, and other land uses. Based on field surveys conducted through 2009, roughly a few dozen examples of boreal communities still exist in the region. These remaining boreal communities are threatened by an increasing abundance of invasive species and incompatible land uses.

Approximately 43% of the state's human population resides in northeastern Ohio. Losses of boreal habitat can be attributed primarily to agriculture, but also to recreation, water level changes, mining, and development. Many boreal areas have been destroyed, fragmented, and isolated as a result of commercial, industrial, and residential development. As a result of wetland regulations, active non-profit conservation organizations, and state agencies – a number of boreal communities have been protected, and opportunities exist to conserve additional areas. All remaining quality boreal communities should be protected and managed for the wildlife dependent upon them.

Figure T-10. Boreal Community Habitat and Conservation Lands



ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

Four boreal-dependent wildlife species have been extirpated (fisher, lynx, porcupine, and snowshoe hare). The fisher and lynx probably were never common in Ohio and it is not likely that restoration efforts for either of these species would be successful. The porcupine, which was extirpated by 1900, was once common in extreme northeastern and northwestern Ohio. Since 2005, public observations of porcupines have increased in northeastern and eastern Ohio. A survey to determine the status of porcupines in the state would be appropriate. Snowshoe hares were extirpated from Ohio by 1940 but have been reintroduced starting in 2000 in eastern Geauga County. Designated as state-listed Species of Concern, little is known about the current distribution and abundance of the ermine, southern red-backed vole, and woodland jumping mouse. Surveys need to be initiated to assess their status and distribution.

The following species have been identified as Boreal Community species of greatest conservation need (conservation status rank in parentheses):

<u>Amphibians</u>

Four-toed Salamander (11)	*Hemidactylium scutatum*

<u>Birds</u>

Black-throated Blue Warbler (112)	*Setophaga caerulescens*
Dark-eyed Junco (112)	*Junco hyemalis*
Northern Waterthrush (112)	*Parkesia noveboracensis*
Winter Wren (112)	*Troglodytes hiemalis*

<u>Mammals</u>

Southern Red-backed Vole (13)	*Myodes gapperi*
Ermine (16)	*Mustela ermine*
Woodland Jumping Mouse (22)	*Napaeozapus insignis*
Snowshoe Hare (56)	*Lepus americanus*

<u>Reptiles</u>

Spotted Turtle (4)	*Clemmys guttata*

CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Boreal Community habitat. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		medium
A	Habitat destruction, fragmentation, altered hydrology from commercial development	commercial & industrial areas	low
B	Habitat destruction, fragmentation, altered hydrology from urban/suburban development	housing & urban areas	high
C	The market value of undeveloped land in the Boreal Community region is exceptionally high, making land acquisition for protection purposes problematic	commercial & industrial areas housing & urban areas	low high

II	**agriculture and aquaculture**		low
A	Loss of Boreal habitat because of conversion to agriculture	annual & perennial non-timber crops wood & pulp plantations livestock farming & ranching	low low low
B	Loss of Boreal habitat due to increase in intensity of agricultural practices – conversion of imbedded boreal habitat	annual & perennial non-timber crops	low
III	**energy production and mining**		low
A	Mining, oil and gas extraction - can directly damage and destroy habitat, and indirectly have negative impacts by altering hydrology and causing chemical contamination	oil & gas drilling mining & quarrying	medium low
IV	**transportation and service corridors**		medium
A	Roads and utilities can destroy and fragment Boreal habitat, and alter hydrology	roads & railroads utility & service lines	medium medium
V	**biological resource use**		low
A	Logging and timber harvest can destroy/damage habitat	logging & wood harvesting	low
VI	**human intrusions and disturbance**		low
A	Incompatible recreational activities	recreational activities	low
B	Creation of recreational facilities can alter/destroy island habitat	recreational activities	low
VII	**natural system modifications**		low
A	The use of chemical controls for the control/eradication of the gypsy moth and mosquitoes is known to negatively impact non-target lepidopteran and amphibians	other ecosystem modifications	low
B	Habitat destruction, fragmentation, altered hydrology due to proximity to development	other ecosystem modifications	low
C	Our ability to manage boreal habitat is limited by available staff and funding	other ecosystem modifications	low
D	Lack of boreal habitat inventory data, and a database system to analyze that data limits our ability to manage	other ecosystem modifications	low
E	Lack of boreal habitat associated species data limits our ability to manage	other ecosystem modifications	low
VIII	**invasive and other problematic species and genes**		high
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	very high
B	Introduction and/or spread of nuisance plants and animals	problematic native species	high
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	very high high

IX	**pollution**		low
A	Urban effluent	household sewage & urban wastewater industrial & military effluents garbage & solid waste air-borne pollutants	low low low medium
B	Agriculture effluent	agricultural & forestry effluents	low
X	**geological events**		low
---	none	---	---
XI	**climate change and severe weather**		medium
A	Climate change could effect plant species composition, which in turn could affect wildlife species	habitat shifting & alteration droughts temperature extremes storms & flooding	high low low low

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Boreal Community habitat. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		high	
1	Protect boreal community habitat through strategic acquisitions, easements, and partnerships	resource & habitat protection	high	I, II, III, IV, V, VI
2	Use State Wildlife Grant funds for potential acquisitions	resource & habitat protection	high	I, II, III, IV, V, VI
3	Establish permanent buffer areas around boreal community habitats to ensure their long-term viability	resource & habitat protection	high	I, II, III, IV, VI
4	Conserve and connect boreal habitats through acquisition, conservation easements, land donations, and other innovative strategies together with conservation-minded NGO partners and federal, state, and local governments	resource & habitat protection	high	I, II, III, IV, VI
5	Develop new and build on existing relationships with Land Trusts purchasing lands and conservation easements	resource & habitat protection	high	I, II, III, IV, VI
6	Add 100 acres of protected lands within the boreal community region through purchase or conservation easement by 2016	site/area protection	high	I, II, III, IV, VI, VII-B

7	Site new recreational facilities such as golf courses and ball fields on already disturbed land	resource & habitat protection	high	VI-B
II	**LAND/WATER MANAGEMENT**		high	
1	Identify, investigate, and conduct research on the causes of habitat loss or impairment and develop strategies to minimize further habitat loss	habitat & natural process restoration	high	I, II, III, IV, VI, VII-B
2	Develop a list and prioritize research needs associated with habitat loss or impairment	habitat & natural process restoration	high	I, II, III, IV, VI, VII-B
3	Identify, protect, restore, and enhance 100 acres of boreal habitat that will support viable populations of the wildlife species dependent upon this habitat on public and private lands by 2016	site/area management	med	I, II, III, IV, VI, VII-A,B, VIII, IX
4	Identify and implement strategies to minimize the effects of residential development adjacent to existing protected/preserved unique habitats	habitat & natural process restoration	high	I, IV, VI, VII-B
5	Design and implement surveys to determine the status and distribution of wildlife species associated with boreal community habitats - evaluate the success of habitat restoration, enhancement, and management measures being implemented	habitat & natural process restoration	high	VII-D,E
6	Continue to research habitat requirements for the suite of wildlife associated with boreal habitats	habitat & natural process restoration	high	VII-D,E
7	Conduct research on the distribution and abundance of wildlife species associated with boreal communities	habitat & natural process restoration	high	VII-D,E
8	Assemble and/or develop GIS-based data layers and associated tables of boreal community habitats, including publicly-owned or conservation-minded NGO managed lands, and make it available for public-land managers and conservation-minded NGOs	habitat & natural process restoration	high	VII-D
9	Develop a comprehensive baseline inventory of historic versus current distribution and abundance of boreal community habitats	habitat & natural process restoration	high	VII-D
10	Identify, design, and conduct appropriate habitat-based projects to evaluate the quality, quantity, connectivity, and distribution of “undeveloped/natural” boreal community habitat	habitat & natural process restoration	high	VII-D
11	Identify and prioritize corridors to connect fragmented parcels of boreal habitat to allow for wildlife movement between areas	habitat & natural process restoration	high	I, II, VII-B,D
12	Collect and evaluate data from legitimate citizen scientist-based monitoring surveys, such as the Ohio Lepidopterist Society’s Long-term Butterfly Monitoring Program, the Breeding Bird Survey, and the Frog and Toad Call Survey, through 2020	habitat & natural process restoration	high	VII-C,D,E
13	Prevent introduction and control the spread of harmful species through legislation, regulation, policy, management practices, education, and partnerships	invasive/ problematic species control	high	VIII

14	Implement strategies identified in the Wildlife Stewardship Tactical Plan to avoid, minimize or eliminate the adverse impacts of non-native and/or problematic species in boreal community habitats	invasive/ problematic species control	high	VIII
15	Establish an early-detection rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	high	VIII
16	Implement strategies identified in the Wildlife Stewardship Tactical Plan to avoid, minimize or eradicate diseases in wildlife associated with boreal community habitats	invasive/ problematic species control	high	VIII-C
17	Identify ecosystem or population-level threats through research, surveillance, monitoring, and inventory	habitat & natural process restoration	high	I, II, III, IV, V, VI, VIII, IX, XI
18	Develop compatible recreational activities criteria that can be used to evaluate impacts to habitat/species from recreational activities	habitat & natural process restoration	high	VI
III	**SPECIES MANAGEMENT**		high	
1	Reintroduce and restore boreal community species where appropriate	species reintro	low	I, II, VII-C
2	Develop species-specific conservation plans as needs are identified to clearly define the actions the Division will/or will not implement concerning the state-listed species	species management	high	VII-E
3	Initiate surveys to determine the current distribution and abundance of the ermine, southern red-backed vole, and woodland jumping mouse	species management	high	VII-E
4	Continue reintroduction and monitoring efforts for the snowshoe hare until viable, self-sustaining populations have been restored or through 2020	species reintro	low	VII-E
5	Identify, design, and conduct appropriate species-specific surveys, inventories, or monitoring projects to determine species distribution and abundance	species management	high	VII-E
6	Develop a feral hog management plan designed to minimize introductions and control expansion	species management	high	VIII-B
IV	**EDUCATION AND AWARENESS**		med	
1	Promote the value of oak savanna habitat/species conservation by developing and distributing new publications, educational materials, website information, and digital presentations	awareness & communications	low	I, II, III, IV, V, VI, VII-B
2	Provide technical assistance to private landowners who wish to protect, restore and/or enhance boreal habitats	awareness & communications	low	I, II
3	Provide guidance to landowners for eradication/control of invasive and nuisance species	awareness & communications	low	VIII
4	Provide technical assistance to public land managers and NGOs to ensure boreal habitats under their management continue to be protected, restored and/or enhanced	awareness & communications	low	VII-B
5	Maintain a corps of Division of Wildlife-trained partners and volunteers to assist, lead, and promote special programs	training	med	VII-B

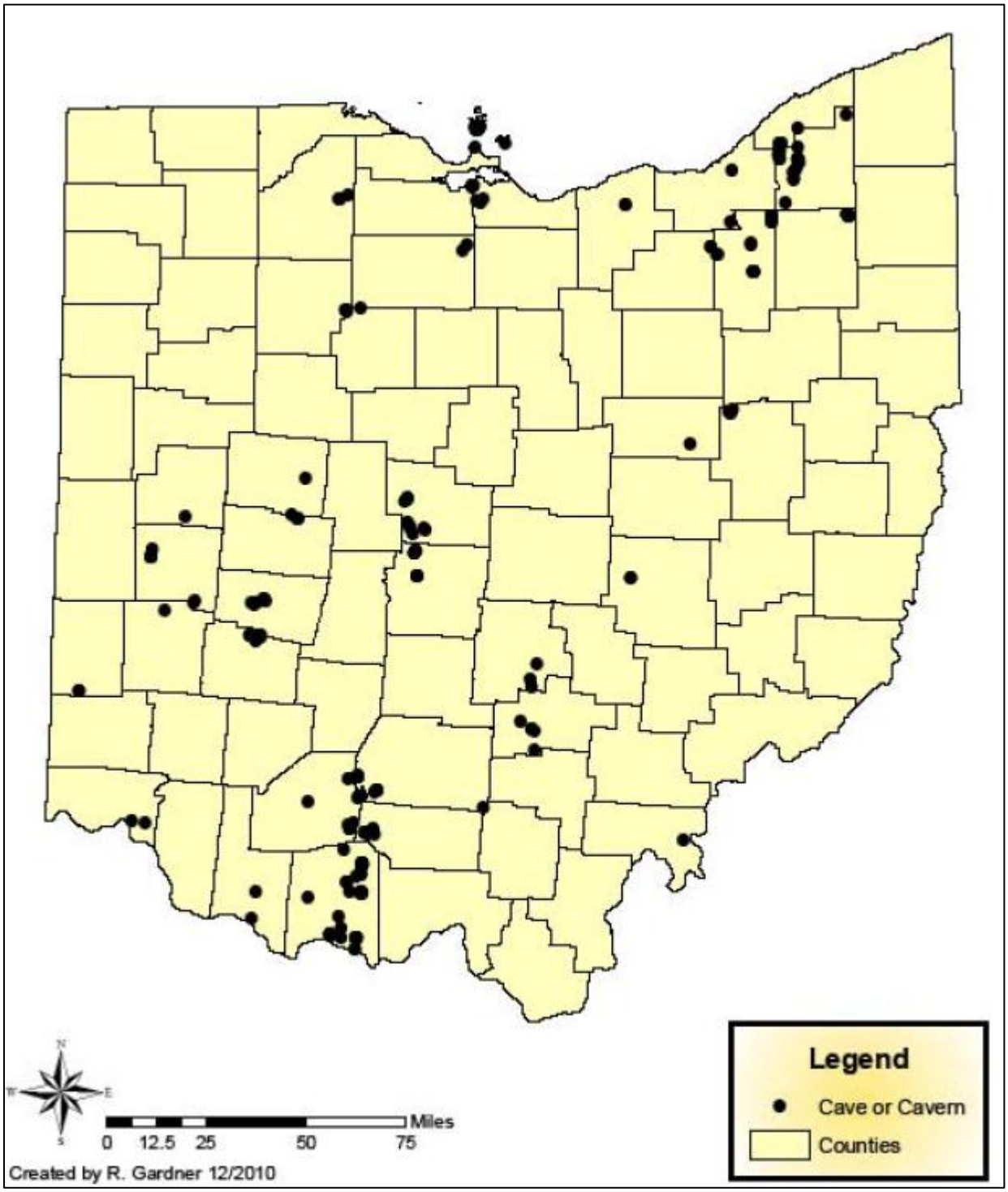
6	Utilize the Ohio Wildlife Legacy Stamp as a tool to illustrate the value of Ohioans in wildlife conservation and to convey the connection between wildlife, people, and habitat	awareness & communications	low	VI, VII-B
7	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communications	low	VIII
V	**LAW AND POLICY**		med	
1	Balance the needs of fish and wildlife with the needs of people by mitigating incompatible ecosystem uses	policies & regulations	med	I, II, III, IV, V, VI
2	Participate in the policy-making process at Federal level to influence conservation programs	policies & regulations	med	I, II, III, IV
3	Encourage the preservation of habitat connectivity in all land use planning	policies & regulations private sector standards & codes	med med	I, IV
4	Create incentives (laws, policies) to prevent loss and/or minimize impacts to boreal habitat due to development	policies & regulations	med	I, II, III, IV
5	Support legislation promoting eco-friendly energy development and use	legislation policies & regulations	low med	III
6	Develop regulations to deter introduction of invasive/nuisance species	legislation policies & regulations	low med	VIII
7	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	low med	VIII
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		med	
1	Support incentives that encourage landowners to maintain/preserve existing boreal habitat on their properties	market forces conservation payments non-monetary values	low high low	I

2	Support the creation of incentives for the protection and restoration of boreal community habitat	linked enterprises & livelihood alternatives substitution market forces conservation payments non-monetary values	high low low high low	I, II, III, IV
3	Support creation of incentives to incorporate wildlife habitat into recreational facilities such as parks and golf courses	market forces conservation payments non-monetary values	low high low	VI-B
4	Develop incentives for private landowners to eradicate/control invasive plant species	conservation payments non-monetary values	high low	VIII
VII	**EXTERNAL CAPACITY BUILDING**		high	
1	Actively promote and engage in partnerships to conserve and enhance boreal community habitats and the species dependent upon them	alliance & partnership development	high	I, II, VII-C
2	Support legitimate citizen scientist-based monitoring efforts of wildlife species and habitats	institutional & civil society development	med	VII-C
3	Create a multiagency invasive species prevention and control group that would be responsible for all invasive species issues	alliance & partnership development	high	VIII
4	Work with partners in northeast Ohio to restore and/or enhance hydrologic regime of boreal communities	alliance & partnership development	high	VII-C
5	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, causeway, and utilities design, construction, and maintenance	alliance & partnership development	high	IV
6	Develop new and strengthen existing partnerships with Land Trust organizations working in Boreal Communities	institutional & civil society development	med	VII-C

*refers to the Boreal Community Habitat Conservation Threats table

Caves & Mines

Ohio Caves



STATUS

In 2007 the ODNR Division of Natural Areas, in partnership with Wittenberg University, initiated a multi-year survey of Ohio's cave resources. In total, the cave survey identified 400 caves – 211 in carbonate bedrock and 189 in non-carbonate bedrock. Caves that have formed in limestone and dolomite bedrock are located in western Ohio. Non-carbonate caves, including rock shelters and recesses, are the common cave type in eastern Ohio. Although Ohio's caves may be few in number and relatively small compared to other states, they are fragile ecosystems that have important geological, biological, and archaeological values.

DESCRIPTION

Approximately 300 caves span Ohio in a 40-mile-wide track of land aligned north-south from the Lake Erie islands to Adams County. A 3-year survey of the plant and animal species associated with Ohio caves was initiated in 2007 by the Division of Natural Areas and Preserves and gathered considerable data. In addition to naturally formed caves, there are 4,000+ recorded inactive underground mines resulting from mineral extraction. Of the 4,000+ recorded mines, less than 20% are believed to have external entrances which are still open. Both natural caves and man-made mines provide critical habitat for wildlife. The features common to most caves include total darkness, relative permanence (in contrast to more ephemeral environments like a forest), and relatively constant environmental conditions (temperature, humidity, air flow). Two equally important features are caves' long history of isolation and their individuality.

To secure populations of most of the cave-dependent wildlife, it is estimated that a minimum of 25% of all caves or quality mines should be protected. This can be accomplished by installing bat-friendly gates in all high quality mine entries and conserving natural buffer zones (a minimum of 200 acres) around cave or mine entries known to support hibernating bats.

Human disturbance including but not limited to recreational vehicle use, caving, commercialization, and vandalism pose a serious threat to unique habitat-dependent wildlife. Sealing and improper gating reduces or eliminates the availability of mines to wildlife. Properly designed and installed gating can provide secure environments for cave-dependent wildlife, while eliminating human disturbance. Opportunities may exist to provide quality hibernacula for Indiana bats by enhancing internal features of man-made mines to simulate the humidity, airflow, and micro-habitat required by these bats. The feasibility of enhancing these mine features needs to be researched. Additional surveys and research are needed to adequately assess the population status of cave dwelling bat species. The impacts of White-nose Syndrome must be assessed and monitored. All Ohio bats are insectivores and are known to feed over a variety of habitats including riparian corridors, forests, grasslands, and agricultural fields. In addition to protecting caves and mines, adjacent lands must be conserved to ensure adequate amounts of quality foraging habitat exist near cave entrances.

ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

The 2007 Division of Natural Areas survey placed special emphasis on the identification of all living organisms found within each cave. Typical cave fauna discovered include types of planaria, spiders, isopods, beetles, pseudoscorpions, and bats. In total, 261 species of invertebrates and invertebrates were found to utilize Ohio's caves. Twenty of these species are considered obligate cavernicoles – meaning they are entirely dependent upon the cave environment.

The following species have been identified as Caves and Mines species of greatest conservation need (conservation status rank in parentheses):

<u>Amphibians</u>

Cave Salamander (15)	*Eurycea lucifuga*

<u>Birds</u>

Black Vulture (52)	*Coragyps atratus*
Turkey Vulture (112)	*Cathartes aura*

Invertebrates

Kramer's Cave Beetle	*Pseudanophthalmus krameri*
Ohio Cave Beetle	*Pseudanophthalmus ohioensis*

Mammals

Eastern Small-footed Bat (1)	*Myotis subulatus leibii*
Northern Long-eared Bat (2)	*Myotis septentrionalis*
Rafinesque's Big-eared Bat (3)	*Corynorhinus rafinesquii*
Indiana Bat (7)	*Myotis sodalis*
Tri-colored Bat (7)	*Perimyotis subflavus*
Little Brown Bat (14)	*Myotis lucifugus*
Big Brown Bat (14)	*Eptesicus fuscus*
Allegheny Woodrat (24)	*Neotoma magister*

CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Caves and Mines habitat. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		medium
---	none	---	---
II	**agriculture and aquaculture**		negligible
---	none	---	---
III	**energy production and mining**		medium
A	Mining, oil and gas extraction - can directly damage and destroy habitat, and indirectly have negative impacts by altering hydrology and causing chemical contamination	oil & gas drilling mining & quarrying	low high
IV	**transportation and service corridors**		low
---	none	---	---
V	**biological resource use**		low
---	none	---	---
VI	**human intrusions and disturbance**		medium
A	Incompatible recreational activities	recreational activities	medium
B	The spread of pathogens from cave to cave by humans could seriously impact cave-dependent wildlife	recreational activities work & other activities	medium low
C	Disturbance of bat hibernacula	recreational activities work & other activities	medium low
VII	**natural system modifications**		medium
A	Sealing and improper gating mine entrances eliminates or reduces the availability of underground mines to wildlife	other ecosystem modifications	medium
B	Disturbance of foraging habitat near cave entrances can compromise bats' ability to store adequate fat reserves prior to entering a hibernaculum, and to find food upon spring emergence	other ecosystem modifications	medium
C	Our ability to manage cave and mine habitat is limited by available staff and funding	other ecosystem modifications	medium
D	Lack of cave and mine inventory data, and a database to analyze that data limits our ability to manage	other ecosystem modifications	medium

E	Lack of cave and mine associated species data limits our ability to manage	other ecosystem modifications	medium
VIII	**invasive and other problematic species and genes**		medium
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	high
B	Introduction and/or spread of nuisance plants and animals	problematic native species	medium
C	Introduction and spread of diseases (especially white-nose syndrome)	invasive non-native/alien species problematic native species	high medium
IX	**pollution**		low
A	Most caves have not been mapped and their connectivity to the surface remains unclear. As a result the potential for cave degradation from non-point source pollution is unknown but likely to occur	household sewage & urban wastewater industrial & military effluents agricultural & forestry effluents	negligible high low
X	**geological events**		low
---	none	---	---
XI	**climate change and severe weather**		negligible
---	none	---	---

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Caves and Mines habitat. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		high	
1	Protect cave and mine habitat through strategic acquisitions, easements, and partnerships	resource & habitat protection	high	III, VI, VII, VIII, IX
2	Use State Wildlife Grant funds for potential acquisitions	resource & habitat protection	high	III, VI, VII, VIII, IX
3	Establish permanent buffer areas around cave and mine habitats to ensure their long-term viability	resource & habitat protection	high	III, VI, VII, VIII, IX
4	Develop new and build on existing relationships with Land Trusts purchasing lands and conservation easements	resource & habitat protection	high	III, VI, VII, VIII, IX
II	**LAND/WATER MANAGEMENT**		high	
1	Identify, investigate, and conduct research on the causes of habitat loss or impairment and develop strategies to minimize further habitat loss	habitat & natural process restoration	high	III, VI, VII-B
2	Develop a list and prioritize research needs associated with habitat loss or impairment	habitat & natural process restoration	high	III, VI, VII-B

3	Identify and implement strategies to minimize the effects of residential development adjacent to existing protected/preserved habitats	habitat & natural process restoration	high	VI, VII-B
4	Design and implement surveys to determine the status and distribution of wildlife species associated with mine and cave habitats - evaluate the success of habitat restoration, enhancement, and management measures being implemented	habitat & natural process restoration	high	VII-D,E
5	Continue to research habitat requirements for the suite of wildlife associated with cave and mine habitats	habitat & natural process restoration	high	VII-D,E
6	Conduct research on the distribution and abundance of wildlife species associated with cave and mine habitats	habitat & natural process restoration	high	VII-D,E
7	Develop and implement recovery/conservation plans for the state-listed species dependent upon cave and mine habitats	habitat & natural process restoration	high	VII-E
8	Assemble and/or develop GIS-based data layers and associated tables of cave and mine habitats, including publicly-owned or conservation-minded NGO managed lands, and make it available for public-land managers and conservation-minded NGOs	habitat & natural process restoration	high	VII-D
9	Develop a comprehensive baseline inventory of historic versus current distribution and abundance of cave and mine habitats	habitat & natural process restoration	high	VII-D
10	Continue locating and protecting, with bat-friendly gates, mines and caves serving as hibernation sites for Indiana Myotis and other species	habitat & natural process restoration	high	VI
11	Support the mapping of caves, as feasible, to ensure their conservation and the long-term viability of cave-dependent wildlife	habitat & natural process restoration	high	VII-D
12	Evaluate the feasibility of creating suitable hibernacula zones for Indiana myotis by enhancing internal features of the Preble Mine in areas of the mine currently unoccupied by bats by 2016	site/area management	high	VI
13	Continue biannual surveys of all bat species in the Preble County underground mine to assess population size and evaluate health and condition	site/area management	high	VI
14	Prevent introduction and control the spread of harmful species through legislation, regulation, policy, management practices, education, and partnerships	invasive/ problematic species control	high	VIII
15	Implement strategies identified in the Wildlife Stewardship Tactical Plan to avoid, minimize or eliminate the adverse impacts of non-native and/or problematic species in cave and mine habitats	invasive/ problematic species control	high	VIII
16	Establish an early-detection rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	high	VIII
17	Implement strategies identified in the Wildlife Stewardship Tactical Plan to avoid, minimize or eradicate diseases in wildlife associated with cave and mine habitats	invasive/ problematic species control	high	VI-B, VIII-C
18	Identify ecosystem or population-level threats through research, surveillance, monitoring, and inventory	habitat & natural process restoration	high	III, VI, VII, VIII, IX

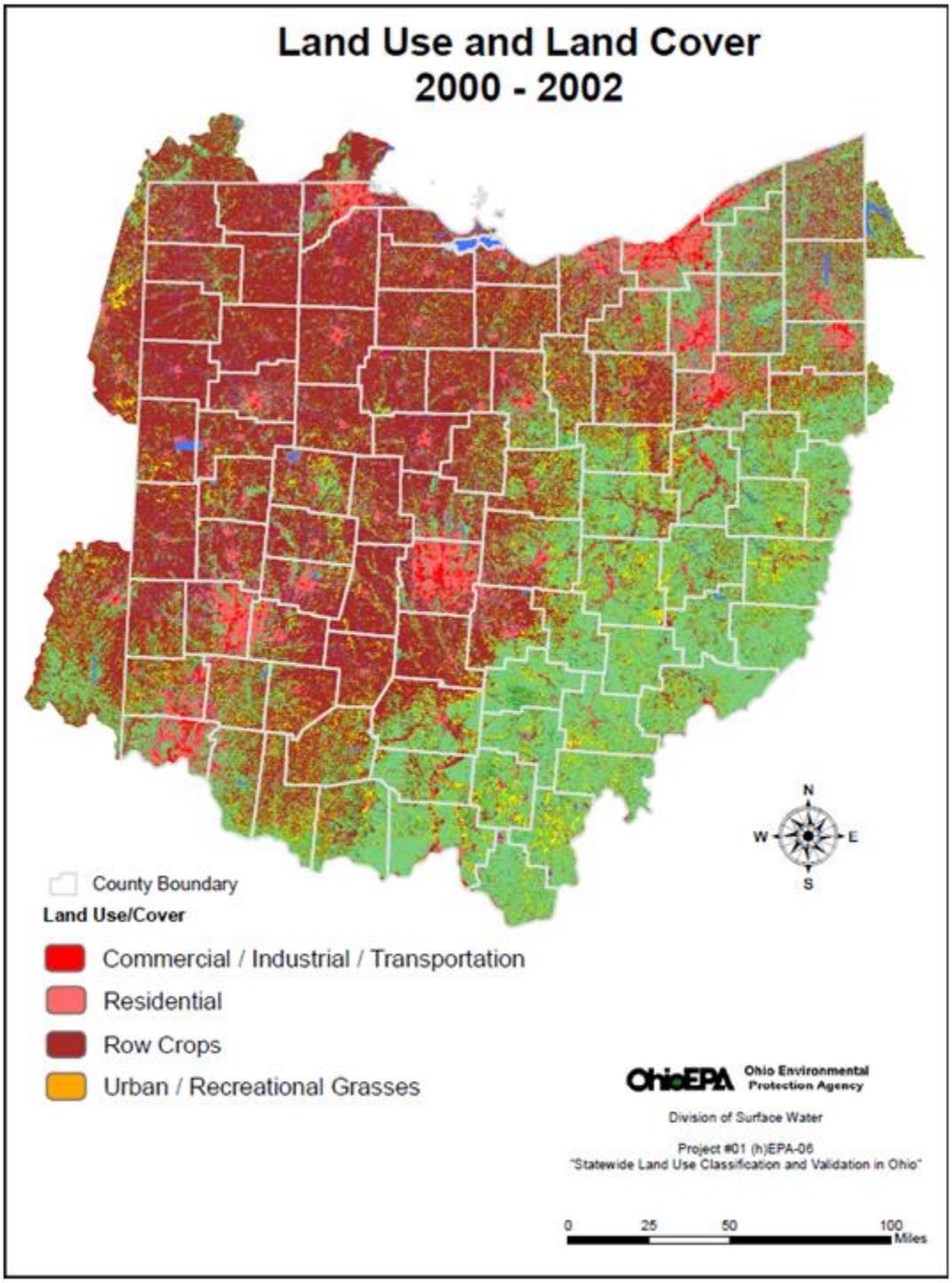
19	Develop compatible recreational activities criteria that can be used to evaluate impacts to habitat/species from recreational activities	habitat & natural process restoration	high	VI
III	**SPECIES MANAGEMENT**		med	
1	Develop species-specific conservation plans as needs are identified to clearly define the actions the Division will/or will not implement concerning the state-listed species	species management	low	VII-E
2	Annually revise and distribute the ODNR Indiana Bat Management Strategy	species management	low	VI, VII
3	Identify, design, and conduct appropriate species-specific surveys, inventories, or monitoring projects to determine species distribution and abundance	species management	low	VII-E
IV	**EDUCATION AND AWARENESS**		high	
1	Promote the value of cave and mine habitat/species conservation by developing and distributing new publications, educational materials, website information, and digital presentations	awareness & communications	high	VI, VII
2	Provide technical assistance to public land managers and NGOs to ensure cave and mine habitats under their management continue to be protected, restored and/or enhanced	awareness & communications	high	VII-C
3	Maintain a corps of Division of Wildlife-trained partners and volunteers to assist, lead, and promote special programs	training	high	VII-C
4	Utilize the Ohio Wildlife Legacy Stamp as a tool to illustrate the value of Ohioans in wildlife conservation and to convey the connection between wildlife, people, and habitat	awareness & communications	high	VI, VII
V	**LAW AND POLICY**		med	
1	Balance the needs of fish and wildlife with the needs of people by mitigating incompatible ecosystem uses	policies & regulations	med	III, VI, VII
2	Participate in the policy-making process at Federal level to influence conservation programs	policies & regulations	med	III, IX
3	Create incentives (laws, policies) to prevent loss and/or minimize impacts to cave and mine habitat due to development	policies & regulations	med	VII-B
4	Support legislation promoting eco-friendly energy development and use	legislation policies & regulations	high med	III, IX
5	Develop regulations to deter introduction of invasive/nuisance species	legislation policies & regulations	high med	VIII
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		med	
1	Support incentives that encourage landowners to maintain/preserve existing cave and mine habitat on their properties	market forces conservation payments non-monetary values	med high high	VII-C

VII	**EXTERNAL CAPACITY BUILDING**		high	
1	Actively promote and engage in partnerships to conserve and enhance cave and mine habitats and the species dependent upon them	alliance & partnership development	high	VII-C
2	Meet routinely with state and federal agency personnel to ensure bat-friendly gating is used when sealing entries to abandoned underground mines with known or potential use by bats	alliance & partnership development	high	VI, VII-A
3	Support legitimate citizen scientist-based monitoring efforts of wildlife species and habitats	institutional & civil society development	high	VII-C,D,E

*refers to the Caves and Mines Habitat Conservation Threats table

Artificial/man-made Environments

Ohio Artificial/man-made Environments



STATUS

Ohio's population growth is currently relatively static, and urban areas seem to reflect this in terms of growth. As far as developed areas are concerned, suburban areas show the most growth. Residential neighborhoods, condominium complexes, townhouses/apartments, and the like are responsible for the majority of recent development. The number of acres in agriculture has decreased by about 10%, and the number of farms has decreased by about 13% in the last 30 years (USDA 2012). During this time, the number of farms under 1000 acres have decreased, while farms over 1000 acres have increased.

DESCRIPTION

Artificial/man-made Environments are primarily divided between areas of human development of varying intensity (urban a suburban areas) and agriculture. In both cases, natural habitats have been replaced artificial environments, and the species that occupied these natural habitats have been replaced by a substantially reduced assemblage of tolerant/adaptable species. These environments create an ecosystem of their own with altered hydrology, climate, plant and animal communities, and a host of other development-induced characteristics.

Urban/suburban environments are a complex mixture of above ground structures (buildings, bridges, towers, power lines & supports) and altered surfaces (roads, parking lots, lawns). Some of the artificial environments in this category offer significant opportunities for wildlife conservation. With proper planning, wildlife habitat can be included in parks, golf courses, airport properties, cemeteries, and residential areas. Areas of intense development (cities) offer fewer opportunities, but still have structures that can mimic natural habitats that are utilized by certain wildlife species (ex., peregrine falcons nesting on tall buildings, bats roosting in bridge expansion joints).

Agricultural lands convert diverse natural communities into large areas of relative monoculture. Large acreages may be planted in row crops (primarily corn and soybeans) or other field crops such as wheat and hay, or may exist as pastures, orchards, or vineyards. Available wildlife habitat often varies by season. At the peak of the growing season, structural complexity in agricultural fields is at its maximum, and food and shelter are readily available for a number of wildlife species adapted to such conditions. After harvest and through the winter months, available habitat is at a minimum and large expanses of land may offer little to wildlife species in terms of food or shelter. Applications of fertilizers, herbicides, and pesticides can have far reaching effects to agricultural land ecosystems, and the natural ecosystems that surround them. Opportunities to include wildlife habitat on agricultural lands are numerous and varied.

A third but much smaller category of artificial environments are man-made structures placed into aquatic habitats. Structures such as docks, piers, bridge supports, breakwaters, marinas, and rip-rapped shorelines often increase structural complexity in aquatic systems. By increasing complexity, these structures can actually add habitat, and there can be community benefits resulting from these artificial habitats in aquatic systems. However, many of these structures replace significant amounts of natural habitat, cause habitat degradation and affect water quality during their construction, and can result in changes to natural water and animal movements (dams).

ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

In an evolutionary sense, artificial environments have not existed long enough to have developed their own suite of associated species. Over time however, a number of terrestrial and aquatic species have demonstrated the ability to adapt very well to these environments. While none of these species would be considered to call artificial environments "home", many are able to make use of different aspects that these artificial habitats offer, and some spend their entire life (and have for generations) living in these artificial environments. Species such as deer, coyote, raccoon, opossum, groundhog, cardinals, and robins have developed urban/suburban populations. These species are able to find the necessary food and cover to survive/reproduce, and are highly tolerant of human activity.

In agricultural areas, a number of wildlife species live in or adjacent to crop fields, and utilize crops as a primary food source. Agricultural fields create edge habitat, and some species that require a patchwork of habitat types and the edge-effect they create have flourished in agricultural areas. Ohio's countryside today supports more whitetail deer than did the same land before settlers arrived. Grain fields can be

important food stops for migrating birds and waterfowl. In general however, agricultural lands support a much less diverse species assemblage than the habitats they replaced, despite the fact that some well adapted species (deer) have prospered in these areas.

Species found in artificial environments are there because of their ability to adapt. Artificial environments are not "preferred habitat" for any wildlife species, and there are not species that are dependent upon artificial habitats for their survival. Opportunistic/adaptable species over time have simply taken advantage of an unoccupied niche that provides enough of life's necessities for them to survive. Consequently, we do not feel that a list of species of greatest conservation need is appropriate for artificial man-made environments.

CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Artificial/man-made Environments. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		very high
A	Loss of agricultural land to residential development	housing & urban areas	very high
B	Loss of agricultural land to commercial development	commercial & industrial areas	very high
II	**agriculture and aquaculture**		high
---	none	---	---
III	**energy production and mining**		high
A	Energy extraction, production, and mining can directly damage and destroy habitat, and indirectly have negative impacts by altering hydrology and causing chemical contamination	oil & gas drilling mining & quarrying renewable energy	high low medium
IV	**transportation and service corridors**		low
A	Roads and associated traffic in urban/suburban areas impact wildlife movement and cause mortality	roads & railroads	low
B	Power lines are a source of wildlife mortality	utility & service lines	low
V	**biological resource use**		low
---	none	---	---
VI	**human intrusions and disturbance**		low
A	Incompatible recreational activities	recreational activities	low
B	Human activities in urban/suburban areas	work & other activities	low
VII	**natural system modifications**		medium
A	Incompatible wildlife management strategies - managed to control/reduce wildlife species	other ecosystem modifications	medium
B	Agricultural lands are managed to focus on a particular crop, resulting in reduced habitat diversity	other ecosystem modifications	medium
C	Artificial environments cause altered hydrology, water quality, species composition/community structure	other ecosystem modifications	medium
D	Lack of artificial/man-made environment associated species data limits our ability to manage	other ecosystem modifications	medium
E	Our ability to manage artificial/man-made environments is limited by available staff and funding	other ecosystem modifications	medium
VIII	**invasive and other problematic species and genes**		medium
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	high

B	Introduction and/or spread of nuisance plants and animals	problematic native species	medium
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	high medium
IX	**pollution**		low
A	Herbicides, pesticides, fertilizers, chemicals, solid waste, other toxic substances	household sewage & urban wastewater industrial & military effluents agricultural & forestry effluents garbage & solid waste air-borne pollutants	low low low low low
B	Light pollution in urban/suburban areas	excess energy	low
C	Noise pollution in urban/suburban areas	excess energy	low
X	**geological events**		negligible
---	none	---	---
XI	**climate change and severe weather**		high
A	Climate change could impact habitats, water quality, and species	habitat shifting & alteration droughts temperature extremes storms & flooding	high very high medium high

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Artificial Man-made Environments. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		high	
1	Use acquisitions, conservation easements, etc. to protect key habitats/species	resource & habitat protection	high	IV, VI, VII-C, IX
2	Use State Wildlife Grant funds for potential acquisitions	resource & habitat protection	high	IV, VI, VII-C, IX
3	Create parks, open spaces, greenways	site/area protection	high	IV, VII-C, IX
4	Develop new and build on existing relationships with Land Trusts purchasing lands and conservation easements	resource & habitat protection	high	IV, VI, VII-C, IX

II	**LAND/WATER MANAGEMENT**		med	
1	Identify, investigate, and conduct research on the causes of habitat loss or impairment and develop strategies to minimize further habitat loss	habitat & natural process restoration	low	I, III, IV, VII-C
2	Develop a list and prioritize research needs associated with habitat loss or impairment	habitat & natural process restoration	low	I, III, IV, VII-C
3	Minimize effects of lighting, noise, activity on wildlife	habitat & natural process restoration	low	VI-B, IX-B,C
4	Design and implement surveys to determine the status and distribution of wildlife species associated with Artificial/man-made Environments - evaluate the success of habitat restoration, enhancement, and management measures being implemented	habitat & natural process restoration	low	VII-D
5	Continue to research habitat requirements for the suite of wildlife associated with Artificial/man-made Environments	habitat & natural process restoration	low	VII-D
6	Develop and implement recovery/conservation plans for the state-listed species that utilize Artificial/man-made Environments	habitat & natural process restoration	low	VII-D
7	Include wildlife/habitat in land use planning	habitat & natural process restoration	low	I, IV, VII-C, IX
8	Restore hydrology by removing obsolete water control structures	habitat & natural process restoration	low	VII-C
9	Prevent introduction and control the spread of harmful species through legislation, regulation, policy, management practices, education, and partnerships	invasive/ problematic species control	med	VIII
10	Implement strategies identified in the Wildlife Stewardship Tactical Plan to avoid, minimize or eliminate the adverse impacts of non-native and/or problematic species in Artificial/man-made Environments	invasive/ problematic species control	med	VIII
11	Establish an early-detection rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	med	VIII
12	Implement strategies identified in the Wildlife Stewardship Tactical Plan to avoid, minimize or eradicate diseases in wildlife associated with artificial man-made environments	invasive/ problematic species control	med	VIII-C
13	Identify ecosystem or population-level threats through research, surveillance, monitoring, and inventory	habitat & natural process restoration	low	I, III, IV, VI, VII, VIII, IX, XI
14	Develop compatible recreational activities criteria that can be used to evaluate impacts to habitat/species from recreational activities	habitat & natural process restoration	low	VI-A
III	**SPECIES MANAGEMENT**		med	
1	Develop species-specific conservation plans as needs are identified to clearly define the actions the Division will/or will not implement concerning the state-listed species	species management	med	VII-D

2	Identify, design, and conduct appropriate species-specific surveys, inventories, or monitoring projects to determine species distribution and abundance	species management	med	VII-D
IV	**EDUCATION AND AWARENESS**		high	
1	Educate landowners, homeowners, city maintenance personnel, etc. on the proper use of chemicals – pesticides, herbicides	awareness & communications	high	IX
2	Educate landowners, homeowners, maintenance personnel, etc. on identification and control of invasive and nuisance species	awareness & communications	high	VIII
3	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communications	high	VIII
4	Educate planners, developers, homeowners, farmers, policy makers, etc. on ways to benefit wildlife/habitat	awareness & communications	high	I, III, IV, VI, VII, IX
5	Promote the value of habitat/species conservation by developing and distributing new publications, educational materials, website information, and digital presentations	awareness & communications	high	IV, VI, VII, VIII, IX
6	Maintain a corps of Division of Wildlife-trained partners and volunteers to assist, lead, and promote special programs	training	med	VII-E
7	Utilize the Ohio Wildlife Legacy Stamp as a tool to illustrate the value of Ohioans in wildlife conservation and to convey the connection between wildlife, people, and habitat	awareness & communications	high	IV, VI, VII, VIII, IX
V	**LAW AND POLICY**		high	
1	Balance the needs of fish and wildlife with the needs of people by mitigating incompatible ecosystem uses	policies & regulations	high	I, III, IV, VI, VII-B, C, IX
2	Participate in the policy-making process at Federal level to influence conservation programs	policies & regulations	high	I, III, IV, IX
3	Create incentives to prevent loss and/or minimize impacts to existing wildlife habitat	policies & regulations private sector standards & codes	high med	I, III, IV, VI, VII-B, C, IX
4	Develop regulations to deter introduction of invasive/nuisance species	legislation policies & regulations	high high	VIII
5	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	high high	VIII
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		med	
1	Provide economic incentives for wildlife friendly development in urban/suburban areas	market forces conservation payments non-monetary values	med med med	I, IV, VI, VII-C, IX

2	Provide incentives for habitat restoration in agricultural areas	linked enterprises & livelihood alternatives market forces conservation payments non-monetary values	low med med med	VII-B, IX
3	Develop incentives for landowners to eradicate/control invasive plant species	conservation payments non-monetary values	med med	VIII
4	Promote land use practices that minimize the need for hardened shorelines	market forces conservation payments non-monetary values	med med med	VII-C
VII	**EXTERNAL CAPACITY BUILDING**		high	
1	Create a coalition of outdoor enthusiast groups (garden clubs etc) to volunteer for green projects in urban/suburban areas	institutional & civil society development	high	VII-E
2	Create a coalition of farmers and rural landowners interested in wildlife/habitat - and facilitate projects for them	institutional & civil society development	high	VII-B
3	Create a multiagency invasive species prevention and control group that would be responsible for all invasive species issues	alliance & partnership development	high	VIII
4	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, causeway, and utilities design, construction, and maintenance	alliance & partnership development	high	IV

*refers to the Artificial Man-made Environments Habitat Conservation Threats table

Lake Erie

Ohio waters of Lake Erie (Google maps)

STATUS

The current condition of Lake Erie is best described as stressed. Lake Erie is subjected to more stress from urbanization, industrialization, and agriculture than any other Great Lake. About one-third of the total population of the Great Lakes basin resides within the Lake Erie watershed. Not surprising given the fact that the Lake Erie basin supports the largest population, it surpasses all the other Great Lakes in the amount of effluent received from sewage treatment plants (Lake Erie LaMP 2000). Lake Erie is the Great Lake most subjected to sediment loading. Intensive agricultural development, particularly in southwest Ontario and northwest Ohio, contributes huge sediment loads to the lake. The Lake Erie Basin also receives the most phosphorus of any Great Lake, and 44 percent of the total for the entire Great Lakes (NRCS 2011). Invasive species have entered Lake Erie in numbers via the Welland Canal, ballast water from commercial shipping, and intentional introductions.

DESCRIPTION

The Lake Erie habitat category applies to the 2.3 million acres of Ohio waters in Lake Erie, the 312 miles of Ohio shoreline, and Ohio's Lake Erie tributaries up to the first impediment to fish passage. The Ohio waters of Lake Erie account for about 90 percent of Ohio's water area by acres.

Lake Erie is the second smallest (by area) of the Great Lakes, smallest by volume, shallowest, and the most biologically productive. Multiple jurisdictions share the lake including the states of New York, Pennsylvania, Ohio, Michigan, and the Canadian Province of Ontario. Lake Erie is divided into three basins - the western basin is very shallow with an average depth of 24 ft., the central basin is deeper with the average depth of 60 ft., and the eastern basin is the deepest of the three with an average depth of 82 ft. Eighty percent of Lake Erie's total inflow comes from the Detroit River, and the Niagara River is the main outflow from the lake (Lake Erie LaMP 2000). The water volume of the western basin is approximately one-fifth of Lake Erie, but it drains about 65 percent of the Lake Erie watershed (Ohio EPA

2010c). Unlike the central and eastern basins, the western basin rarely thermally stratifies (Lake Erie LaMP 2011).

Lake Erie has undergone significant physical, chemical, and biological changes over time. These changes have primarily been a result of human influence on the lake itself, and in the basin. Overfishing, pollution, and habitat destruction began to take a toll in the late 1800s. Lake Erie was the first of the Great Lakes to experience problems with eutrophication. Its shallow basin made it the warmest and most biologically productive of the Great Lakes, however by the 1950's nutrient inputs finally pushed the trophic status of the lake to the point where algal blooms and turbidity reduced water quality and impacted aquatic species (Lake Erie LaMP 2000).

The Clean Water Act of 1972 started Lake Erie on the road to recovery relative to nutrient inputs, and by the 1990s the lake had essentially achieved the phosphorus levels established under the Great Lakes Water Quality Agreement as those needed to eliminate the effects of eutrophication. However, the models used to determine the maximum allowable annual phosphorus load did not account for the influence of such a major ecosystem disrupter as the zebra mussel. Attempting to manage the lake system by simply managing phosphorus inputs appears no longer workable, at least until more is understood about the internal dynamics of phosphorus cycling in the lake (Lake Erie LaMP 2000).

Recent summers on Lake Erie have been characterized by blue-green algal blooms similar to those seen in the 1960's. Water quality data shows increases in total, particulate, and dissolved reactive phosphorous loading since the mid 1990's. The summers of 2010 and 2011 brought massive algal blooms to Lake Erie. The Ohio Lake Erie Phosphorus Task Force concluded that while there are multiple contributors of phosphorus into Lake Erie, agriculture is the leading source due to the majority of the land use in agriculture (about 80%) in the Maumee River watershed (Ohio Lake Erie Phosphorus Task Force II Final Report 2013). Phosphorus delivered to rivers and streams in the Lake Erie Basin from cultivated cropland represented 61% of the total phosphorus load from all sources. Because of its location, high discharges, and high loads and concentrations of total and dissolved phosphorus, the Maumee River watershed is the primary driver of algal blooms in the Western Basin of Lake Erie (NRCS 2011). While agricultural practices have been identified as the primary culprit, the effects of other nutrient sources, climate change, and invasive species on nutrient cycling cannot be discounted (Lake Erie LaMP 2000).

Lake Erie has been the unfortunate recipient of many aquatic invasive species over the past century. Most of the major introductions prior to 1980 were fishes that entered the lake through the Welland Shipping Canal, such as the sea lamprey, alewife, and white perch. Other non-native fishes (rainbow smelt and common carp) were intentionally introduced. All of these species now have naturalized reproducing populations in Lake Erie. After 1980, the most important introductions of invasive species have occurred through ballast-water discharge from commercial freighters, including zebra and quagga mussels, the round and tubenose goby, spiny and fishhook water fleas, the bloody red shrimp, and a unique strain of viral hemorrhagic septicemia, all of which persist in Lake Erie today. The potential introduction of Asian carp into Lake Erie is the newest invasive species threat. The long-term impacts of invasive species on native fauna are highly uncertain, but are clearly not beneficial. Control programs have been implemented only for sea lamprey.

Changes in land use, development, and the construction of various shore structures have significantly altered the original habitat available along the Lake Erie shoreline. Many of the wetlands have been drained, filled, or altered so they no longer function naturally. Shore structures associated with development or built to protect shore property from high water levels have inhibited the natural flow of beach building materials along the shoreline, and consequently the natural habitat (Lake Erie LaMP 2000). From 2011-2013, Ohio EPA assessed nearshore fish communities from sites spread along Ohio's Lake Erie shoreline, including the islands. In general, areas assessed showed significant impairment due primarily to tributary loadings of nutrients and sediment, exacerbated by trophic disruptions caused by the proliferation of exotic species, algal blooms, and shoreline habitat modifications. Of the 38 sites sampled, only 13 percent of fish community collections were assessed as fully attaining the designated EWH aquatic life use, 34 percent were assessed as partially attaining, and the remaining 53 percent were in non-attainment (Ohio EPA 2014a).

Land use practices and nutrient loading are the primary human activities affecting the future state of the Lake Erie ecosystem. Land use practices affect habitat, influence hydrology and sediment runoff, and contribute to inputs of nutrients and contaminants. Other issues of concern are the continued introduction of invasive species, the effects of climate change, and understanding the role and impacts of phosphorus management in the Lake Erie system (Lake Erie LaMP 2000).

The major priority for future sustainability of Lake Erie fish populations lies in the protection, enhancement, and restoration of critical habitat, especially spawning and nursery habitats that are created in large part by hydrological processes in the watershed and nearshore environments (Davies et al. 2005). As these processes were disrupted or degraded over the past century by human activities, native fish stocks/species (e.g., lake sturgeon, lake trout, sauger, blue-pike, lake herring), as well as other aquatic species (mussels, crayfish, invertebrates) were lost or suffered significant population declines. Healthy habitats will help buffer impacts to native species from severe weather patterns, such as storms or extended droughts, and potentially improve resiliency of the fish community against the impacts of invasive species.

ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

Lake Erie has a long history of natural and anthropogenic changes. The forests, grasslands, and wetlands that once comprised the Lake Erie watershed are largely gone. Urban, industrial, and agricultural lands now dominate the landscape. Tributary streams and rivers have experienced major changes in their hydrology owing to dams, channelization, tiling of agricultural fields, and an increase in hard surfaces that speed overland flow of water. The lake's shorelines have been hardened and coastal wetlands drowned. River mouths have been dredged and turned into ports, at a loss of important estuarine habitat. Exotic species have been intentionally and unintentionally introduced.

All of these events have altered the lake's physical and chemical environment and produced changes in the aquatic community composition and abundance. Recent history indicates significant eutrophication throughout most of the 20th century, followed by a period of water quality improvement due to nutrient reductions/establishment of zebra mussels, and again followed by increasing phosphorous levels that today are causing severe blooms of diatoms and blue-green algae.

The Lake Erie species assemblage has, and will continue to shift with the physical and chemical environment of the lake. As the human influence on the lake is reduced, we can expect species composition and numbers reflective of what Lake Erie once was. At the other end of the scale, the deleterious effects of present day land-use will manifest themselves in an aquatic community able to tolerate the conditions. The most highly ranked species in terms of conservation need will always be the species on the fringe of tolerance relative to the existing physical and chemical environment in the lake.

The following species have been identified as Lake Erie species of greatest conservation need (conservation status rank in parentheses):

<u>FISH</u>

Spoonhead Sculpin (14)	*Cottus ricei*
Lake Sturgeon (17)	*Acipenser fulvescens*
Blacknose Shiner (22)	*Notropis heterolepis*
Mottled Sculpin (24)	*Cottus bairdi*
Silver Lamprey (26)	*Ichthyomyzon unicuspis*
Eastern Sand Darter (29)	*Ammocrypta pellucida*
Western Banded Killifish (30)	*Fundulus diaphanus menona*
Cisco (33)	*Coregonus artedi*
Burbot (36)	*Lota lota*
Silver Chub (36)	*Macrhybopsis storeriana*
Iowa Darter (38)	*Etheostoma exile*
Channel Darter (44)	*Percina copelandi*
Spotted Gar (45)	*Lepisosteus oculatus*
Longnose Sucker (47)	*Catostomus catostomus*

Black Redhorse (48)	*Moxostoma duquesnei*
Mooneye (50)	*Hiodon tergisus*
Lake Whitefish (57)	*Coregonus clupeaformis*
River Darter (58)	*Percina shumardi*
Brindled Madtom (70)	*Noturus miurus*
Longnose Dace (74)	*Rhinichthys cataractae*
Bowfin (76)	*Amia calva*
Spotted Sucker (76)	*Minytrema melanops*
Stonecat Madtom (78)	*Noturus flavus*
Bigmouth Buffalo (80)	*Ictiobus cyprinellus*
Tadpole Madtom (80)	*Noturus gyrinus*
Longnose Gar (83)	*Lepisosteus osseus*
Fantail Darter (89)	*Etheostoma flabellare*
Golden Redhorse (89)	*Moxostoma erythrurum*
Mimic Shiner (94)	*Notropis volucellus*
Greenside Darter (95)	*Etheostoma blennioides*
Spottail Shiner (97)	*Notropis hudsonius*
Lake Trout (99)	*Salvelinus namaycush*
Trout Perch (102)	*Percopsis omiscomaycus*
Johnny Darter (106)	*Etheostoma nigrum*
Brook Silverside (107)	*Labidesthes sicculus*
Quillback Carpsucker (107)	*Carpiodes cyprinus*
Chinook Salmon (111)	*Oncorhynchus tshawytscha*
Coho Salmon (111)	*Oncorhynchus kisutch*
Pink Salmon (111)	*Oncorhynchus gorbuscha*
Spotfin Shiner (114)	*Cyprinella spiloptera*
Shorthead Redhorse (115)	*Moxostoma macrolepidotum*
Logperch Darter (116)	*Percina caprodes*
Northern Hogsucker (119)	*Hypentelium nigricans*
Brown Bullhead (120)	*Ameiurus nebulosus*
Yellow Bullhead (120)	*Ameiurus natalis*
Sand Shiner (124)	*Notropis stramineus*
Emerald Shiner (127)	*Notropis atherinoides*
Striped Shiner (127)	*Luxilus chrysocephalus*
Golden Shiner (129)	*Notemigonus crysoleucas*
Black Bullhead (130)	*Ameiurus melas*
Pugnose Shiner (131)	*Notropis anogenus*
Creek Chub (132)	*Semotilus atromaculatus*
Freshwater Drum (132)	*Aplodinotus grunniens*
Bluntnose Minnow (135)	*Pimephales notatus*
Rock Bass (135)	*Ambloplites rupestris*
White Sucker (137)	*Catostomus commersoni*
Fathead Minnow (139)	*Pimephales promelas*
Sauger (143)	*Sander canadense*
Northern Pike (145)	*Esox lucius*
Rainbow Smelt (146)	*Osmerus mordax*
Green Sunfish (147)	*Lepomis cyanellus*
Blackchin Shiner (148)	*Notropis heterodon*
Orangespotted Sunfish (148)	*Lepomis humilis*
Rainbow Trout (150)	*Oncorhynchus mykiss*
Smallmouth Bass (151)	*Micropterus dolomieu*
Channel Catfish (153)	*Ictalurus punctatus*
Walleye (154)	*Sander vitreus*
White Bass (155)	*Morone chrysops*
Gizzard Shad (157)	*Dorosoma cepedianum*
Bluegill Sunfish (159)	*Lepomis macrochirus*

Largemouth Bass (160)	*Micropterus salmoides*
Black Crappie (161)	*Pomoxis nigromaculatus*
Yellow Perch (162)	*Perca flavescens*
White Crappie (163)	*Pomoxis annularis*
Brown Trout (164)	*Salmo trutta*

CRAYFISH

Northern Clearwater Crayfish (4)	*Orconectes propinquus*
Big Water Crayfish (7)	*Cambarus robustus*
Red Swamp Crayfish (13)	*Procambarus clarkii*
Rusty Crayfish (18)	*Orconectes rusticus*

MUSSELS

Eastern Pondmussel (8)	*Ligumia nasuta*
Slippershell Mussel (16)	*Alasmidonta viridis*
Rayed Bean (21)	*Villosa fabalis*
Creek Heelsplitter (23)	*Lasmigona compressa*
Pondhorn (23)	*Uniomerus tetralasmus*
Threeridge (40)	*Amblema plicata*
Round Hickorynut (42)	*Obovaria subrotunda*
Kidneyshell (48)	*Ptychobranchus fasciolaris*
Northern Riffleshell (48)	*Epioblasma torulosa rangiana*
Rainbowshell (50)	*Villosa iris*
Round Pigtoe (50)	*Pleurobema sintoxia*
Elktoe (52)	*Alasmidonta marginata*
Deertoe (53)	*Truncilla truncata*
Fawnsfoot (53)	*Truncilla donaciformis*
Threehorn Wartyback (55)	*Obliquaria reflexa*
Cylindrical Papershell (56)	*Anodontiodes ferussacianus*
Fluted Shell (58)	*Lasmigona costata*
Creeper (60)	*Strophitus undulatus*
Lilliput (61)	*Toxolasma parvum*
Spike (61)	*Elliptio dilatata*
Wabash Pigtoe (61)	*Fusconaia flava*
Paper Pondshell (66)	*Utterbackia imbecillis*
Fragile Papershell (71)	*Leptodea fragilis*
Plain Pocketbook (72)	*Lampsilis cardium*
Mapleleaf (73)	*Quadrula quadrula*
Pimpleback (74)	*Quadrula pustulosa*
White Heelsplitter (74)	*Lasmigona complanata*
Fatmucket (77)	*Lampsilis radiata*
Giant Floater (77)	*Pyganodon grandis*
Pink Heelsplitter (79)	*Potamilus alatus*

CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Lake Erie. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		medium
A	Coastal development and its effect on nearshore habitat and species	housing & urban areas commercial & industrial areas tourism & recreation areas	medium medium low
B	Hydrological effects caused by hard surfaces such as roof tops, roads, parking lots, etc.	housing & urban areas commercial & industrial areas tourism & recreation areas	medium medium low
C	The market value of undeveloped land on the Lake Erie shoreline is exceptionally high, making land acquisition for protection purposes problematic	housing & urban areas commercial & industrial areas tourism & recreation areas	medium medium low
II	**agriculture and aquaculture**		medium
A	Watershed conversion to agriculture alters hydrology	annual & perennial non-timber crops livestock farming & ranching	high low
III	**energy production and mining**		low
A	Oil and gas extraction - can physically damage and destroy habitat, and cause negative impacts from chemical contamination	oil & gas drilling	negligible
B	Wind turbines can negatively impact birds and bats that utilize lake habitat	renewable energy	low
IV	**transportation and service corridors**		medium
A	Dredging/modification shipping lanes causes habitat loss, water quality impacts	shipping lanes	medium
B	Coastal development such as roads, bridges, causeways, utilities, etc. - impact shoreline/nearshore habitats	roads & railroads utility & service lines	low negligible
V	**biological resource use**		low
A	Fishing pressure and fishing gear impacts from recreational and commercial fishing	fishing & harvesting aquatic resources	low
VI	**human intrusions and disturbance**		low
A	Incompatible recreational activities	recreational activities	low
B	Creation of recreational facilities can alter/destroy nearshore habitat	recreational activities	low

C	Vessel impacts to fragile habitats and water quality	recreational activities work & other activities	low negligible
VII	**natural system modifications**		low
A	Loss of wetland function as spawning and nursery habitat due to wetlands being isolated from the lake by dikes/levees	dams & water management/use	low
B	Hardened shoreline structures such as dikes, seawalls, breakwaters, causeways, etc. that do not allow the shoreline to move naturally with fluctuating water levels	other ecosystem modifications	low
C	Natural sediment transport is disrupted by shoreline development	other ecosystem modifications	low
D	Some species populations have been reduced to levels below what is necessary to recover on their own	other ecosystem modifications	low
VIII	**invasive and other problematic species and genes**		high
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	high
B	Introduction and/or spread of nuisance plants and animals	problematic native species	low
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	high low
IX	**pollution**		high
A	Urban effluent carries a variety of substances that impact water quality and aquatic species	household sewage & urban wastewater industrial & military effluents garbage & solid waste air-borne pollutants	high low low low
B	Agricultural effluent from row crops as well as confined animal operations impacts water quality and aquatic species	agricultural & forestry effluents	very high
C	Harmful algal blooms affect water quality, aquatic species, and can be toxic to terrestrial species	agricultural & forestry effluents	very high
D	Industrial spills impact water quality and aquatic species	industrial & military effluents	low
X	**geological events**		negligible
---	none	---	---
XI	**climate change and severe weather**		low
A	Climate change could impact habitats, water quality, and species	habitat shifting & alteration droughts temperature extremes storms & flooding	low low low medium

B	Climate change induced fluctuating lake levels could impact nearshore species and habitats	droughts temperature extremes storms & flooding	low low medium

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Lake Erie habitat. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		med	
1	Protect coastal properties through acquisition, partnerships, conservation easements, etc.	site/area protection resource & habitat protection	low med	I, II, III-A, IV-B, VI-B, VII-A,B,C, XI-B
2	Quantify and map critical habitat areas in Cleveland Harbor for future protection	site/area protection	low	I-A, IV-A,B, VI-B,C, VII-B,C,
II	**LAND/WATER MANAGEMENT**		high	
1	Use physical enhancements in areas such as Maumee and Sandusky rivers and bays where human activities have permanently altered the natural hydrology	habitat & natural process restoration	high	I-A,B, II, IV, VI-B,C, VII-A,B, XI
2	Work to restore natural hydrological connections and flow regimes in tributary/near-shore areas	habitat & natural process restoration	high	I-A,B, IV-B, VI-B, VII-A,B,C, XI
3	Develop standardized nearshore monitoring programs for habitats and species	site/area management	med	I-A, III-B, IV-B, VI-B,C, VII-A,B,C, VIII-A,B, XI
4	Improve our understanding of the effects of manageable actions (e.g., dredging, energy generation, barriers to fish access, nutrient loading) and unmanageable/environmental factors (e.g., weather, climate change, land use practices, invasive species, etc.) on the Lake Erie ecosystem	habitat & natural process restoration	high	I-A,B, II, III, IV, V, VI, VII, VIII, IX, XI
5	Identify critical habitat areas (through research, literature, data mining) to help delineate management options for their protection/enhancement	site/area management habitat & natural process restoration	med high	I-A,B, II, III, IV, V, VI, VII, VIII-A, XI
6	Identify upland uses for dredge material and end open lake dumping of dredge spoil	habitat & natural process restoration	high	IV-A
7	Use lowest impact techniques and timing for dredging activities	habitat & natural process restoration	high	IV-A

8	Create and use wetlands for stormwater treatment	habitat & natural process restoration	high	I-A, IX-A
9	Establish an early-detection/rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	high	VIII-A,B
10	Continue to work with federal and state Great Lakes partners to prevent the introduction of Asian Carp	invasive/ problematic species control	high	VIII-A
11	Develop a way to quantify habitat impacts caused by development so that they can be mitigated for	habitat & natural process restoration	high	I-A, III-A, IV, VI-B, VII-A,B,C
12	Develop a process for coordinating disparate data sources of distribution and abundance of aquatic SGCN	habitat & natural process restoration	high	I-A, III-B, IV-A,B, VI-B, XI
13	Review existing species and habitat data to identify data gaps and needs for additional surveys, research, and management actions	habitat & natural process restoration	high	I, II, III, IV, V, VI, VII, VIII, IX, XI
14	Conduct comprehensive surveys of freshwater mussels	habitat & natural process restoration	high	IV-A,B, VI-B,C, XI
III	**SPECIES MANAGEMENT**		low	
1	Determine if lake sturgeon sightings reported by the public can be used to monitor relative abundance	species management species recovery	low med	VII-D
2	Monitor the status of lake sturgeon through reported sightings from sport and commercial fisheries, fish assessment surveys, and the general public to assist with restoration efforts	species management species recovery	low med	VII-D
3	Assess population status, habitat suitability, and probability for restoration of lake sturgeon spawning stocks in Ohio tributaries	species management species recovery	low med	VII-D
4	Develop a restoration strategy for sauger in the Maumee and Sandusky Rivers	species reintroduction	low	VII-D
5	Assess spawning and nursery habitat suitability for lake trout at natural reefs in Ohio waters of the western and central basins of Lake Erie	species reintroduction	low	VII-D
IV	**EDUCATION AND AWARENESS**		medium	
1	Educate waterfront landowners and commercial pesticide/herbicide applicators on responsible chemical use, and the negative impacts to wildlife from toxic chemicals	training	high	I-A,C, IX-A
2	Promote conservation easements along shoreline habitat	training awareness & communic-ations	high med	I, II, IV-B, VI-B, VII-A,B,C, XI
3	Provide technical guidance on coastal development plans as relates to fish and wildlife interests	training	high	I, IV-B, VI-B, VII-A,B,C, XI
4	Support the Ohio Clean Lakes Initiative - educating and training farmers and other interested parties on agricultural nutrient management and stewardship	training	high	II, IX-B,C

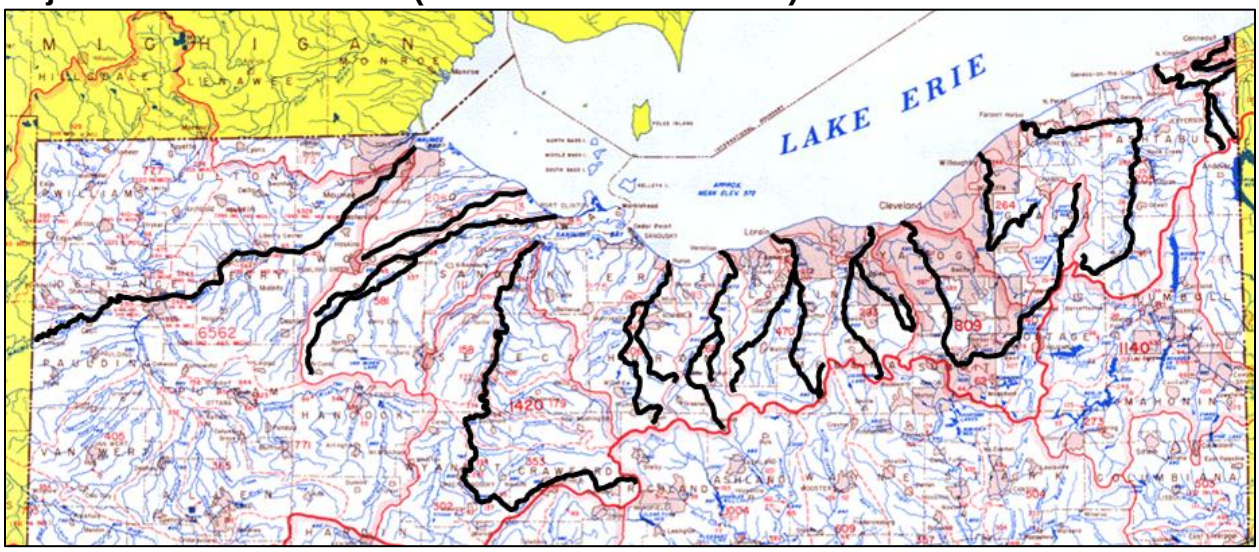
5	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communic-ations	med	VIII
V	**LAW AND POLICY**		high	
1	Support legislation promoting eco-friendly energy development and use	legislation	high	III
2	Find innovative ways to mandate the inclusion of fish and wildlife interests in development plans	policies & regulations private sector standards & codes	high low	I, IV-B, VI-B, VII, XI
3	Increase enforcement of stormwater regulations	compliance & enforcement	med	I-B, IX-A
4	Support the ban on oil and gas drilling in Lake Erie	legislation policies & regulations	high high	III-A
5	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	high high	VIII
6	Support more stringent ballast water regulations to stop the introduction of invasive species	legislation policies & regulations	high high	VIII
7	Support legislation aimed at preventing Asian carp from entering the Great Lakes	legislation	high	VIII-A
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		med	
1	Explore tying eligibility for grant money, loans, and cost-share programs to nutrient loading levels for agriculture – the lower the nutrient levels in their effluent, the more money they would be eligible for	market forces conservation payments	med med	IX-B,C, XI
2	Create incentives for vegetated buffers along all waterways to reduce nutrient loads and sediment	market forces conservation payments	med med	I-B, IX-A,B,C, IX-A
3	Create incentives to promote eco-friendly energy development and use	market forces conservation payments non-monetary values	med med low	III
4	Support the creation of incentives to protect coastal habitat	market forces conservation payments	med med	I-A,C, IV-B, VI-B, VII-A,B,C, XI
5	Support clean marina and clean vessel programs	market forces conservation payments	med med	VI-C

6	Develop incentives for municipalities to use stormwater management systems that minimize negative impacts to aquatic habitats	market forces conservation payments	med med	I-A, IX-A
7	Support incentives for development plans involving water frontage that take into account wildlife and habitat needs	market forces conservation payments non-monetary values	med med low	I, IV-B, VI-B, VII-A,B,C, XI
VII	**EXTERNAL CAPACITY BUILDING**		med	
1	Work with ODA and OEPA to minimize nutrients in runoff, and develop BMPs for pesticide/herbicide use	alliance & partnership development	high	IX
2	Create an interagency spill response team – update contacts and training on a regular basis	alliance & partnership development	high	IX-D
3	Consider creating a multiagency invasive species prevention and control group that would handle all invasive species issues	alliance & partnership development	high	VIII
4	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, and causeway design, construction, and maintenance	alliance & partnership development	high	IV-B
5	Use interagency partnerships to augment data used to assess population status, habitat suitability, and probability for restoration of lake sturgeon spawning stocks in Ohio tributaries	alliance & partnership development	high	VII-D
6	Work with scientific community partners to understand longer-term trends in unmanageable environmental factors and their impacts on aquatic communities	institutional & civil society development alliance & partnership development	med high	XI
7	Through partnerships with the U.S. and Ohio EPA, U.S. Dept. Agriculture, and the U.S. Army Corps, implement actions on manageable biotic and abiotic factors affecting Lake Erie, such as phosphorus regulation and dredging activities	alliance & partnership development	high	I-B, II, IV-A, IX-A,B
8	Use existing, and develop new partnerships with watershed managers, property owners, and funding/regulatory groups, etc. to affect land use practices in the Lake Erie basin	alliance & partnership development	high	I-B, II, IX-A,B,C, XI-A
9	Increase personnel and expertise available for SGCN surveys/research through partnerships with other government agencies, universities, and conservation-minded NGO's	institutional & civil society development alliance & partnership development	med high	I, II, III, IV, V, VI, VII, VIII, IX, XI

*refers to the Lake Erie Habitat Conservation Threats table

Lake Erie Tributaries

Major Lake Erie tributaries (ODNR Division of Water)



STATUS
Stable to improving. Ohio Environmental Protection Agency (Ohio EPA) surveys indicate general improvement in the physical habitat, water quality, and biological communities of most of the streams in the Lake Erie watershed. Ohio's large rivers continue to show improvement as tracked over the last 20 years. The "100% full attainment by 2020" aquatic life goal statistic remains steady at 89.2% full attainment. Taken collectively since the 1980s, the quality of aquatic life in all of Ohio's large rivers has shown a remarkable improvement. Then, only 21% of the large rivers met water quality standards, increasing to 62% in the 1990s, to 89% today. Areas not meeting the standards have decreased from 79% in the 1980s to 38% in the 1990s to 11% today (Ohio EPA 2014a).

DESCRIPTION
In the upper third of Ohio, Lake Erie tributaries drain north across the 11,714 square mile Lake Erie watershed. The four largest tributaries include the Maumee River (drains 6,608 square miles), the Sandusky River (drains 1,420 square miles), the Cuyahoga River (drains 809 square miles), and the Grand River (drains 712 square miles). Tributary physical attributes, water quality, habitat, and biological communities tend to follow a west to east gradient across northern Ohio. This gradient results from geographical differences as well as changes in land use practices in the watersheds. The trend is from relatively flat watersheds dominated by agriculture in the west, to watersheds with more relief dominated by forests and urban/suburban land use in the east. Streams across this gradient reflect the impacts and impairments that result from land uses within the watershed.

Along Ohio's portion of the Lake Erie shoreline, 56 different streams empty directly into Lake Erie. From west to east, those tributary streams are: Halfway Creek, Ottawa River, Maumee River, Duck Creek, Swan Creek, Otter Creek, Wolf Creek, Cedar Creek, Crane Creek, Turtle Creek, Toussaint River, Lacarpe Creek, Portage River, Muddy Creek, Sandusky River, South Creek, Raccoon Creek, Pickerel Creek, Little Pickerel Creek, Cold Creek, Mills Creek, Pipe Creek, Plum Brook, Sawmill Creek, Huron River, Old Woman Creek, Cranberry Creek, Chapel Creek, Sugar Creek, Darby Creek, Sherod Creek, Vermilion River, Brownhelm Creek, Quarry Creek, Beaver Creek, Martin Run, Black River, Porter Creek, Cahoon Creek, Rocky River, Cuyahoga River, Doan Brook, Ninemile Creek, Euclid Creek, Chagrin River, Marsh Creek, Grand River, McKinley Creek, Big Creek, Wheeler Creek, Cowles Creek, Indian Creek, Red Brook, Ashtabula River, Conneaut Creek, and Turkey Creek (ODNR 2001).

Significant tributaries (watersheds >100 square miles) flowing directly into Lake Erie include the Ottawa River, Maumee River, Toussaint River, Portage River, Sandusky River, Huron River, Vermilion River, Black River, Rocky River, Cuyahoga River, Chagrin River, Grand River, Ashtabula River, and Conneaut Creek. A brief description of the habitat, water quality, and biological communities for each of these tributaries follows.

Ottawa River

The following information was assembled from *Biological and Water Quality Study of the Ottawa River Lower Nine Miles* (Ohio EPA 2007b) and *Biological and Water Quality Study of the Ottawa River and Principal Tributaries, 2010* (Ohio EPA 2013a).

The Ottawa River watershed is located in northwestern Ohio and drains into Maumee Bay in Lucas County. The 221 square mile watershed of the Ottawa River spans both sides of the Michigan-Ohio border. The western portion of the watershed is primarily crop land, while the eastern portion is almost entirely urban development. The watershed occupies two distinct ecoregions - the Eastern Corn Belt Plain (ECBP) and the Huron-Erie Lake Plains (HELP). The transition to the HELP ecoregion from the ECBP ecoregion occurs approximately at RM 17.5 on the Ottawa River mainstem.

The leading cause and source of aquatic life use impairments in the upper Ottawa River mainstem is nutrient enrichment/eutrophication from nonpoint source inputs (tile discharged to modified tributaries or surface runoff). In lower reaches of the Ottawa, the main causes of impairment are nutrient enrichment and organic enrichment from urban sewer overflow inputs, and municipal and industrial discharges. Recent surveys by the Ohio EPA however, indicate that pollution abatement efforts to date have yielded water quality improvements, and indicate that the Ottawa River has entered a phase of strong environmental recovery.

As measured by the Qualitative Habitat Evaluation Index (QHEI), the quality of near and in-stream macrohabitat throughout most of the Ottawa River appeared capable of supporting diverse, functionally organized, and well-structured assemblages of aquatic organisms, consistent with its respective ecoregional ECBP and HELP benchmarks. Most areas contain a complement of positive channel, substrate and riparian features at least minimally compatible with the river‘s Warm Water Habitat (WWH) aquatic life-use designation. However, conditions are not uniform, and the Ottawa River mainstem consists of a patchwork of high to moderate quality free-flowing reaches found largely within the rural portions of the ECBP, and lower quality channel with modified and/or impounded segments within the HELP ecoregion and the greater Lima area.

The river exists in a relatively natural or unmodified state upstream from Lima. Macrohabitat quality and resulting QHEI scores fall sharply as the Ottawa River enters the greater Lima area. Habitat quality metrics point to a predominance of modified features including historic channel modification, impoundment, and sedimentation. Progressing downstream into the heart of urban/industrial Lima, the Ottawa River enters a series of five dam pools contained within an approximately three mile river reach. Leaving the urban center of Lima, the Ottawa River is again free flowing and continues so for approximately ten river miles. Habitat metrics indicate WWH potential through this stretch, despite ample evidence of past channel modification. Before entering the lake plain proper (HELP ecoregion), the Ottawa River flows through approximately nine miles of lacustrine deposits contained in the ECBP ecoregion where stream gradient drops precipitously in comparison to upstream reaches. Habitat metrics reflect the change in topography and associated steam characteristics, but despite reduced stream power and diminished macrohabitat quality, most QHEI values remained within the WWH range. The lower 17 miles of the Ottawa River are contained within the HELP ecoregion. Gradients are further reduced through this segment and are typically half of that observed within the free-flowing reaches within the ECBP ecoregion. The increase in the level of sedimentation and diminishing channel form and function (through the loss of stream power) resulted in reduced QHEI scores for this stretch of river.

Ohio EPA surveys from 2010 indicated that about 76% (linear stream miles) of the mainstem were found to support an assemblage of fish at least minimally consistent with Warm Water Habitat (WWH) biocriteria. The remaining 24.3% failed to support WWH assemblages; however, the magnitude of the

departure was not great, as community performance below the fair range was not observed. Compared against historical results, common stations in nearly every instance supported richer communities and a greater number of environmentally sensitive taxa in 2010.

Fifty fish species and four hybrids were collected from the Ottawa River during 2010 Ohio EPA surveys. Numerically predominant species were bluntnose minnow (33.7%), greenside darter/longear sunfish (~7.0%), white sucker/redfin shiner (~5.0%), and central stoneroller/spotfin shiner/bluegill sunfish (~4%). In terms of relative biomass, dominant species were common carp (25.3%), white sucker (17.6%), golden redhorse (8.5%), smallmouth bass (6.2%), and rock bass/channel catfish (5.2%). Over a quarter of the community, measured in terms of numerical abundance and biomass, was concentrated in two highly tolerant and ecological generalist species - bluntnose minnow and common carp, respectively. Nearly 47% of all fish and 51% of total fish biomass collected from the mainstem were pollution tolerant taxa. State listed species included only the greater redhorse. Other intolerant, rare, declining or otherwise ecologically significant species included mimic shiner and stonecat madtom.

The macroinvertebrate community in the Ottawa River mainstem was also assessed in the 2010 survey. Twenty-one of 26 Ottawa River mainstem survey sample sites (81%) attained the designated WWH aquatic life-use criterion. During this survey, the Ottawa River reach upstream from Lima and the lower 28.8 river miles of the Ottawa River mainstem met the WWH macroinvertebrate ecoregional biological performance criteria. The Invertebrate Community Index (ICI) scores attaining WWH status from the 2010 survey ranged from good to exceptional.

Maumee River

The following information was assembled from *Total Maximum Daily Loads for the Maumee River (lower) Tributaries and Lake Erie Tributaries Watershed* (Ohio EPA 2012e) and *Western Lake Erie Basin Study Upper Maumee Watershed Assessment* (U.S. Army Corps of Engineers 2009), except where otherwise noted.

The Maumee River is the largest tributary in the Great Lakes basin, draining all or part of 17 Ohio counties, five Indiana counties, and two Michigan counties. The entire watershed covers 8,316 square miles. The mainstem of the Maumee River is approximately 130 miles in length, the downstream 105 miles of which lie in Ohio. The Maumee drains a total of 5,024 square miles in Ohio before it empties into Lake Erie (Maumee Bay) at Toledo (Maumee RAP 2006).

The watershed is predominantly comprised of cultivated crops with some urban development, hay and pasture lands, and forest. The watershed covers a combination of Huron-Erie Lake Plain and Indiana and Ohio Till Plain ecoregions. The topography ranges from gently sloping glacial till plain to nearly level broad lake plains with some beach ridges and lower moraines. The gradient of the Maumee averages between 1-5 feet per mile throughout its length.

The 43-mile portion of the Maumee River extending from the Indiana/Ohio border to the Ohio Route 24 bridge (RM 68) near Defiance is designated as a State Scenic River. An additional 53 mile segment is designated as a State Recreational River from about RM 68 to RM 15. These two designated areas have special restrictions on development, permitted discharge, etc. within them. The lower 22.8 miles of the Maumee River is included in the Maumee River Area of Concern (Maumee RAP 2006).

The entire length of the Maumee River (in Ohio) has not been completely assessed since 1997. Ohio EPA surveys from the 1990's revealed that only about half of mainstem sites sampled met WWH aquatic life-use criteria. Agricultural practices, stream channelization, and urbanization contributed to the loss and/or degredation of many landscape features that once attenuated flows, provided detention, and retained sediment. In general, negative impacts from agriculture are more prevalent in the upper Maumee River, while the effects of urbanization manifest themselves more so in the lower portion of the river.

Of note for the lower portion of the Maumee River is the fact that it supports a significant spring run of spawning walleyes and serves as important spawning habitat for a number of Lake Erie species. A more

detailed discussion of the Maumee River watershed is provided in the Conservation Opportunity Watersheds section.

Toussaint River

The following information was assembled from *Biological and Water Quality Study of the Toussaint River and Rusha Creek Basins* (Ohio EPA 2005a) and *Total Maximum Daily Loads for the Toussaint River Watershed* (Ohio EPA 2006d).

The Toussaint River is a tributary to western Lake Erie, draining 143 square miles in Wood, Ottawa, and Sandusky counties.The mainstem of the river is 37 miles long and empties into Lake Erie in Ottawa County. Upstream from its confluence with Packer Creek, the Toussaint has historically been considered a creek. The Toussaint widens as it reaches lake elevation where the riverine habitat is affected by the intrusion of water levels from Lake Erie.

The watershed is located entirely in the Huron-Erie Lake Plains (HELP) ecoregion. The HELP ecoregion is a broad, fertile, nearly flat plain. Most of the area has been cleared and artificially drained for agricultural crop production. Stream habitat and water quality have been degraded by channelization and agricultural activities. Landcover data from 2003 show the watershed contains mixed row crops/open space/yards (56%), cultivated crop land (9%), forest (12%), developed land (11%), and grassland (8%).

Habitat (QHEI) scores for the Toussaint watershed indicate that the majority of very poor habitat areas are found in small tributary streams. Agricultural practices, including riparian cover removal, channelization, and dredging, as well as nutrient enrichment and siltation, have resulted in a degradation of available habitat to instream biological communities. Habitat quality modestly improves as drainage area increases, but in general, the highly modified conditions present throughout the majority of the watershed have resulted in a reduction in diversity and numbers of aquatic species.

2003 surveys of the resident fish community by the Ohio EPA produced a total of 18,076 fish, consisting of 46 species and 7 hybrids. No endangered or threatened species were collected during the sampling effort, though five moderately intolerant species, including smallmouth bass, brook silverside, sand shiner, logperch darter and greenside darter, were collected. Numerically predominant were tolerant fish species including bluntnose minnow (18.6%), fathead minnow (13.1%), and stoneroller minnow (10.6%). Species that dominated in biomass included common carp (52.9%), creek chub (7.5%) and largemouth bass (3.8%).

A total of 208 separate macroinvertebrate taxa were collected in the Toussaint watershed during 2003 sampling. Moderately intolerant or sensitive taxa comprised 27% of the total taxa collected. Pollution-tolerant taxa comprised approximately 22% of the total taxa collected. The lotic stream sites on Toussaint Creek mostly achieved the macroinvertebrate WWH biocriteria. Farther downstream, the lacustrine sites on the Toussaint River did not achieve minimum lacustrine performance expectations.

Portage River

The following information was assembled from *Biological and Water Quality Study of the Portage River Basin, Select Lake Erie Tributaries, and Select Maumee River Tributaries, 2006 - 2008* (Ohio EPA 2010a) and *Total Maximum Daily Loads for the Portage River Watershed* (Ohio EPA 2011c).

The Portage River is located in northwest Ohio, extending from headwaters near Findlay and Fostoria and emptying into Lake Erie at Port Clinton in Ottawa County. The watershed drains 585 square miles and encompasses parts of Wood, Hancock, Ottawa, Sandusky, and Seneca counties. The Portage River is fed by four major tributaries, the North Branch, the Middle Branch, the South Branch and the East Branch. The lower 30 miles of river is characterized by a single channel that meanders to Lake Erie, with its final reach from Oak Harbor to Port Clinton essentially an estuary controlled by Lake Erie. The majority of the watershed is located in the Huron-Erie Lake Plain (HELP) Ecoregion. The most upstream portion of the East Branch Portage River lies within the Eastern Corn Belt Plains (ECBP) ecoregion.

There is little topographic relief in the watershed. The overall stream gradient averages less than three feet per mile. Drainage practices (primarily drainage ditches) which faciliatated agricultural activities led to alteration of the landscape. Row crop agriculture is by far the dominant land use accounting for over 76% of the total Portage River watershed area. Developed land amounts to about 11% of the total. Forest and wetlands constitute 5.5% and 2.3% of the total, respectively.

Ohio EPA sampling indicated forty percent of the sites on the Portage River mainstem did not meet standards for aquatic life uses. The tributary streams showed slightly lower quality with a 47% overall impairment rate. Within all of the study area, most of the water quality impairments could be linked to nonpoint sources such as fertilizer and manure runoff, sedimentation from agricultural crop production, and failing home sewage systems. Agricultural practices such as the habitat alteration, channelization/maintenance of streams and ditches, and the drainage of farm fields through subsurface tiles caused habitat and flow alteration impairments. The average habitat (QHEI) score for the watershed was towards the low end of the “fair” range. This low average score reflects the low habitat quality throughout the study area which is a direct result of extensive channel modifications.

A total of 96,207 fish representing 66 species were collected from the study area between June 2006 and October 2008. Three very sensitive species were collected, though twelve tolerant species, often in high numbers, were also collected throughout the study area. Portage River mainstem sites sampled during 2008 achieved the applicable Warmwater Habitat (WWH) fish biocriteria at 64% of the locations evaluated.

Macroinvertebrate communities reflected habitat and water quality throughout the watershed. In less impacted areas of the Portage River and tributaries, macroinvertebrate communities were evaluated as good to exceptional in terms of number of individuals and taxa. In more heavily impacted areas – generally tributary headwaters and the lacustrine area of the lower Portage – communities did not meet WWH status. Macroinvertebrate communities in these areas were characterized by lower numbers of individuals, reduced diversity, and dominated by pollution tolerant species.

Thirteen species of freshwater mussels (Unionidae) were collected live or fresh-dead from the Portage River watershed. State listed species collected in this watershed were *Truncilla donaciformis* (Fawnsfoot-Threatened Species) from the Portage River, *Truncilla truncata* (Deertoe-Species of Concern) from the Portage River and Middle Branch Portage River, and *Uniomerus tetralasmus* (Pondhorn-Threatened Species) from the North Branch Portage River. The collection of *Uniomerus tetralasmus* during this study was the first time that species was recorded in the Portage River watershed.

Sandusky River

The following information was assembled from *Biological and Water Quality Study of the Sandusky River and Selected Tributaries 2001* (Ohio EPA 2003b), *Biological and Water Quality Study of the Lower Sandusky River Watershed 2009* (Ohio EPA 2011a), and *Total Maximum Daily Loads for the Sandusky River (lower) and Bay Tributaries Watershed* (Ohio EPA 2014b).

The Sandusky River drains 1,850 square miles from 12 counties in northwest Ohio before emptying into Lake Erie at Sandusky Bay. The Sandusky River mainstem is 133 miles long. The upper two-thirds of the river are relatively flat, characterized by broken ridges which are representative of end moraines deposited by glaciers. The northern one-third is flat to gently rolling and is characterized by shorelines from ancient lakes formed as glaciers receded. The Sandusky basin straddles the Eastern Corn Belt Plains (ECBP) ecoregion and Huron/Erie Lake Plain (HELP) ecoregion. Land use in the watershed is approximately 75% row crops, 10% developed land, 9% forest, 3% grassland/pasture/hay, and 2% wetlands. Approximately 70 miles of the Sandusky River between Upper Sandusky and Fremont is designated as a state scenic river.

The Sandusky basin, like other watersheds in north-central and northwest Ohio, is dominated by agricultural land use, including both cultivated row crops and pasture land for livestock grazing. Agricultural drain tiles were installed in the Sandusky basin to lower the water table for crop production and channels and ditches were installed to efficiently route water. Both practices significantly affect the

hydrology of the region and affect the water quality of the streams due to rapid delivery of excess nutrients. This area, along with other agricultural areas in northwestern Ohio, represents some of the most intensively tile-drained crop land in the United States.

The lower portion of the Sandusky River mainstem and small direct tributaries to Sandusky Bay and Lake Erie are lacustrine, meaning that waters from the streams and Lake Erie mix within an estuary. These lacustrine areas are slack water that can ebb and flow as lake seiches affect water levels, and are generally located between the farthest downstream riffle of the tributary and Lake Erie proper.

Ohio EPA sampled 21 sites on the upper Sandusky mainstem during 2001. Habitat, as reflected by QHEI scores generally met the Warmwater Habitat (WWH) minimum criteria at all sites. In terms of WWH aquatic life use, 66% of sites met minimal aquatic life use criteria, 24% were in partial attainment, and the remaining 10% did not meet minimum WWH criteria. Index of Biotic Integrity (IBI) scores met WWH criteria for fish communities at 71% of sites, and Modified Index of Well-being (MIwb) scores indicated healthy fish communities at 57% of sites. Macroinvertebrate communities achieved the minimum ICI scores for WWH at 85% of sites sampled. Health of biotic communities generally improved in a downstream direction on this section of the Sandusky mainstem.

Impediments to full attainment of designated aquatic life uses within the assessment area can be largely attributed to agricultural practices within the watershed. Sedimentation and substrate embeddedness were the most common impacts where aquatic life use attainment was not fully met. The channelizing of streams, removal of riparian trees and field tiling to facilitate drainage have reduced the volume of water present during dry weather periods.

On the lower Sandusky River mainstem, the free-flowing reaches generally had good habitat and water quality. Of 18 sites sampled on the lower mainstem – 66% were in full attainment of WWH aquatic life use criteria, 6% were in partial attainment, and 28% were in non-attainment. The Sandusky River mainstem from Tymochtee Creek to Wolf Creek is impaired by sedimentation. Sources are individually permitted point sources, storm water from developed land, failing home septic systems, and agriculture. Model results indicate that the dominant source of sediment load is cultivated cropland (96%). The Sandusky mainstem from Wolf Creek to the mouth is impaired by sedimentation/siltation, nutrient/eutrophication, substrate embeddedness, and direct habitat alteration. The sources of pollutant loads are individually permitted point sources, storm water from developed land, failing home septic systems, and agriculture. Again, model results indicate that the dominant source of loading is cultivated cropland: 95% of total phosphorus loads, ~69% of nitrate/nitrite loads, and ~93% of sediment loads.

A more detailed discussion of the Sandusky River watershed is provided in the Conservation Opportunity Watersheds section.

Huron River

The following information was assembled from *Total Maximum Daily Loads for the Huron River Watershed* (Ohio EPA 2005b) except where otherwise noted.

The Huron River watershed is located on the south shore of Lake Erie between Toledo and Cleveland, in Huron, Erie, Seneca, Richland and Crawford counties. The Huron River is 59.7 miles long and drains 403 square miles. Land cover is primarily agricultural with approximately 74% cropland, 15% woodland, and 3-11% urban and other land uses.

Headwaters of the Huron River gather along the Fort Wayne and Defiance Moraines. The West Branch and East Branch of the Huron River flow relatively close to each other throughout much of the basin. From the confluence of West Branch and East Branch just west of Milan, the Huron River flows about 14 stream miles across the Lake Plain to its mouth in Lake Erie at Huron (Shiefer 2002).

The Huron River watershed spans the Eastern Corn Belt Plains (ECBP) and the Erie-Ontario Drift and Lake Plain (EODLP) ecoregions. The ECBP ecoregion is a rich agricultural area that covers approximately 70% of the watershed. Extensive grain and livestock production occurs in this ecoregion.

The turbid, low gradient streams in the ECBP ecoregion generally do not support exceptional fish communities. The EODLP ecoregion is a nearly level coastal strip of lacustrine deposits, and urban and industrial land use is more prevalent in this region of the Huron River watershed.

Despite the increase in conservation tillage practices on agricultural lands in recent years, the Huron River remains as having among the highest suspended sediment yields in the state of Ohio, and the second highest in the Lake Erie Basin. Many small streams have been channelized to assist drainage in the level, poorly drained soils of Huron and Seneca counties. With the exception of municipal sources, biological and water quality impairment in the Huron basin was most often associated with agricultural land use. The most common causes of impairment in these areas are siltation, channelization, and/or nutrient enrichment.

Despite past water quality issues, a 2002 Ohio EPA biological and water quality survey of the Huron River watershed found significant improvement in portions of the basin, particularly in the East and West Branches. Excluding the lacustrine segment, the Huron River mainstem and most of the East Branch and the West Branch are now in full attainment of Warmwater Habitat (WWH) aquatic life-use criteria. Approximately 80% of the over 80 free-flowing river miles in the mainstem and major branches met WWH criteria in 2002. With the exception of a few stream segments, fish and macroinvertebrate community performance was generally in the good to exceptional ranges. Not coincidentally, areas of high biological performance also tended to have intact physical habitats and riparian corridors. Based on QHEI habitat scores, attaining segments in the mainstem and major branches had good to exceptional physical habitat quality.

Vermilion River

The following information was assembled from *Biological and Water Quality Study of the Vermilion River, Old Woman Creek, Chappel Creek, Sugar Creek, and Select Lake Erie Tributaries 2002* (Ohio EPA 2004a), and *Total Maximum Daily Loads for the Vermilion River Watershed* (Ohio EPA 2005c).

The Vermilion River is 66.9 miles long and drains 269 square miles in north-central Ohio as it flows through Ashland, Erie, Huron, Lorain and Richland counties before emptying into Lake Erie at Vermilion. The predominant land cover within the Vermilion River basin is agriculture (72.8%) and forest (25.3%), with wetlands, open water, and urban areas accounting for the remaining 1.9%.

The upper portion of Vermilion River and its tributaries originate in the Erie-Ontario Drift and Lake Plain (EODLP) ecoregion consisting of low rolling hills and end moraines blanketed with low line drift and lacustrine deposits. The mid-section of the watershed in Erie, Huron and Lorain counties flows through the Eastern Corn Belt Plains (ECPB) ecoregion which is characterized by rolling till plains and end moraines. The lower portion of the watershed is located in the EODLP ecoregion, characterized by nearly level coastal lacustrine land with beach ridges and swales.

In a 2002 assessment by the Ohio EPA, habitat in the Vermilion mainstem and branches generally met Warmwater Habitat (WWH) criteria based upon QHEI scores. Sampling locations in the Vermilion mainstem and upper branches achieved minimum WWH criteria at 83% and 87% of sites, respectively. In the Vermilion watershed, most of the sites not meeting the QHEI habitat targets have drainage areas less than 30 square miles. QHEI scores tended to increase with drainage area for stream segments in the watershed. Primary causes of impairment were excess nutrients, siltation, and habitat and flow alteration. Similar to other watersheds in northwestern and north central Ohio, agriculture's influence on headwater and smaller tributary streams is reflected in the causes of impairment. The biological communities present in the headwater streams typically do not meet WWH criteria due to the historical and current habitat alterations, channelization, and nutrient enrichment.

A total of 26,103 fish, comprising 57 species and 4 hybrids were collected throughout the Vermilion basin during the 2002 Ohio EPA study. No endangered or threatened species were collected, though several intolerant species including the black redhorse, river chub, bigeye chub, silver shiner, rosyface shiner, mimic shiner and stonecat madtom were collected. Numerically predominant fish species included bluntnose minnows (18.2%), creek chub (15%), and stoneroller minnow (10.9%). Species that dominated

in biomass included common carp (32.5%), rock bass (10.9%), golden redhorse (8.7%), and white sucker (8.5%).

The fish community index for the upper Vermilion River ranged between very good and fair – the index improved in a downstream direction as sinuosity and stream cover improved. The fish community index for the middle portion of the Vermilion ranged between good and excellent. The higher quality fish assemblage found here was due to more natural stream conditions which offered diverse substrates, increased sinuosity, and high quality stream cover. The fish community index for the lower Vermilion ranged between good and excellent at sites outside of the lacustrine area. The lacustrine site index was fair to poor due to high percentage of exotic species and tolerant species. The lacustrine portion of the mainstem has exhibited poor biological performance from both fish and macroinvertebrate communities over time. The lacustrine area acts as a sink for silt and nutrients generated from upstream agricultural and development activities. In addition, the mouth of the mainstem is maintained for navigational purposes for both commercial and recreational use.

Uppermost sites on the Vermilion River reflected an improving trend in the condition of the macroinvertebrate community with increasing drainage area. Macroinvertebrate communities sampled in the majority of sites in the lotic portion of the Vermilion met WWH criteria. Impounded areas of the Vermilion supported lower diversity of macroinvertebrate fauna. Lacustrine sites also supported limited macroinvertebrate fauna. About half of the upstream tributaries in the watershed supported macroinvertebrate communities with indexes of marginally good to good. In the lower portion of the watershed about two-thirds of the macroinvertebrate communities met WWH criteria.

Black River

The following information was assembled from *Biological and Water Quality Study of The Black River Basin* (1999b), and *Total Maximum Daily Loads for the Black River Watershed* (Ohio EPA 2008) except where otherwise noted.

The Black River drains a 470 square mile watershed in Ashland, Huron, Medina, Cuyahoga and Lorain counties before emptying into Lake Erie in the City of Lorain. The East and West branches are about 42 and 30 miles long, respectively. The Black River watershed lies entirely within the Erie-Ontario Drift and Lake Plain (EODLP) ecoregion. The EODLP ecoregion is characterized by gently rolling plains from previous glaciation, unconsolidated glacial deposits, sandstone and shale bedrock, and glacial end moraines.

Headwaters of the Black River gather along the Defiance Moraine. The two main branches of the river, East Branch and West Branch, join at Elyria. From the confluence of East Branch and West Branch, the Black River flows about 16 stream miles to its mouth in Lake Erie at Lorain (Shiefer 2002).

Prominent land cover in the Black River watershed is 44% cropland, 25% forest, 18% residential/urban development, and 8% pasture. The subbasins of the greater Black River watershed exhibit distinctly different characters. The Black River mainstem area is urban and industrial in nature. In the French Creek sub-basin and the eastern areas of the northern East Branch, rapid suburban development is altering the formerly agricultural landscape. The southern regions of the watershed remain predominantly rural and agricultural, although extensive development has occurred in and around the Lodi area.

Because of a legacy of environmental impacts to water and habitat quality, the Black River was designated as a Great Lakes Area of Concern (AOC) and a remedial action plan (RAP) has been in place. Unique and diverse communities of fish, mussels and aquatic insects live in the streams of the Black River watershed, but recent studies confirm degraded water quality and stream habitat. In the agricultural upper watershed areas, the modification of stream channels (for drainage improvement), failing home sewage treatment facilities, and row crop/livestock production have resulted in habitat degradation, sedimentation, and high nutrient and pathogen loadings. In the Black River mainstem, major municipal and industrial discharges, combined sewer overflows, and urban runoff result in high nutrient and organic loads, poor habitat quality, siltation, and low dissolved oxygen concentrations. Among the most visible threats to the Black River today is the conversion of farm, forest and stream bank acreage to

suburban and commercial uses. Portions of the Black River watershed are experiencing unprecedented development. Ohio EPA studies of the overall watershed showed that 37% of sampled sites were meeting water quality goals, 30% were partially meeting the goals, and 38% were not meeting goals.

The free flowing reach of the Black River mainstem contains excellent habitat. The sinuous free flowing river combined with glacial tills and woody debris provide for habitat complexity, heterogeneity of the substrates, and good channel development. Habitat in the East Branch of the Black River is impacted by agriculture and encroachment into riparian areas – but despite these impacts, the habitat was sufficient to support warmwater communities. Habitat (QHEI) scores for West Branch sites were low.

Fish communities in the free flowing portion of the Black River mainstem have improved over time. The number of darter and sucker species, while improving slightly compared to previous surveys, remained below expectations. The absence of intolerant species, and the low numbers of darter and sucker species is a legacy of prior point source pollution, and an indication of continued watershed-scale habitat impairment. Nearly all sites sampled in the Black River lacustrine area remain in the poor to very poor range of Index of Biotic Integrity (IBI) scores. Some slight improvement was observed in the stream segment associated with contaminated sediment removal (from USS/Kobe outfalls), but IBI scores are still poor. This area as well as the rest of the lacustrine area remains strongly influenced by nutrient enrichment derived from point sources and nonpoint pollution. Within a mile of Lake Erie, the influx of cleaner water low in nutrients from the lake has created conditions more favorable to healthy fish communities. Nearer the lake, fish communities remain poor in response to habitat loss in the navigation channel. The Black River from approximately river mile 2.8 to Lake Erie is periodically dredged to support its use as a navigation channel. Vertical sheet piling and cement sea walls provide little habitat for fish.

As with the Black River mainstem, the legacy of nonpoint pollution and habitat degradation in the East Branch was evident in the absence of intolerant fish species, and low numbers of darter and sucker species. Habitat and water quality issues also limited fish communities in the West Branch. Macroinvertebrate communities in the Black River upstream from the Lake Erie lacustrine area were in the good to exceptional range in the 1997 study, but communities in the lacustrine area (below RM 5.6) scored below lacustrine criteria. In the East Branch, macroinvertebrate communities were very good to exceptional at all sites sampled.

Rocky River

The following information was assembled from *Biological and Water Quality Study of the Rocky River and Selected Tributaries* (Ohio EPA 1999c), and *Total Maximum Daily Loads for the Rocky River Basin* (Ohio EPA 2001) except where otherwise noted.

The Rocky River watershed drains a total of 265 square miles in all or parts of Cuyahoga, Summit, Medina, and Lorain Counties in northeastern Ohio. The Rocky empties into Lake Erie on the west side of Cleveland. Land cover within the watershed is primarily a mix of forest (44%), agriculture (40%), and urban areas (14%). The northern portion of the watershed is predominantly urban, while the southern half is dominated by forest and agriculture.

The Rocky River gathers headwaters in the hilly moraines that cross through Medina County into southern parts of Cuyahoga County. West Branch of the Rocky River originates south of Medina in the Wabash Moraine and flows through the Defiance Moraine along a northward course. East Branch of the Rocky River originates along the distal side of the Defiance Moraine in southern Cuyahoga County and flows southward to the Fort Wayne Moraine where it reverses course and flows back northward through the Defiance Moraine to its confluence with West Branch just north of Berea. From the confluence of East Branch and West Branch, the Rocky River flows about 12 stream miles to its mouth in Lake Erie on the west side of Cleveland (Shiefer 2002).

The watershed is located in the Erie-Ontario Drift and Lake Plain (EODLP) ecoregion. The EODLP ecoregion is characterized by northern hardwood vegetation (maple, birch, beech, hemlock) and glacial plains interspersed with high remnant beach ridges, drumlins, glacial till ridges, till plains, and outwash terraces. The Rocky River basin is a flat plateau with extremely narrow and dissected canyons.

The mainstem of the Rocky River is protected by the Cleveland Metroparks for almost its entire length. However, the area surrounding the metropark is heavily urbanized. For much of its mainstem, the Rocky River is fairly shallow and free flowing with good velocity and a fractured bedrock substrate. The mouth of the river has been modified to accommodate boating – Rocky River Harbor consists of the lower 4,200 feet of Rocky River.

Based on the performance of the biological communities, 71% of the surveyed reach of the Rocky River mainstem, including the lacustrine zone (the portion influenced by Lake Erie) were in partial attainment of the designated aquatic life use. The remaining 29% was in non-attainment. Attainment status, where both fish and invertebrates were sampled, was largely determined by the performance of the fish assemblage. While the macroinvertebrates at least marginally achieved ecoregional criteria, one or both fish indices (IBI and MIwb) performed at a fair to poor level throughout the mainstem.

The East and West branches of the Rocky River were assessed in 1997. Full attainment of Warmwater Habitat (WWH) aquatic life use was achieved for 66% of the East Branch and 70% of the West Branch. The remaining surveyed stretches of both branches partially met the designated aquatic life use. Departure from the WWH biocriteria was driven solely by fair fish community performance in both branches, as the macroinvertebrate community consistently exceeded ecoregional criteria. The North Branch of the Rocky River supported diverse biological communities, including good numbers of pollution sensitive taxa, and was found to be in full attainment of the WWH aquatic life use.

More recent studies of the Rocky mainstem and East Branch (Northeast Ohio Regional Sewer District 2012, 2013) indicated that habitat (QHEI scores), fish community (MIwb and IBI scores), and the macroinvertebrate community (ICI scores) met warmwater habitat aquatic life use criteria. Data collected was minimal compared to the previously referenced Ohio EPA studies, but suggests improvement in the water quality, habitat, and biological communities of the Rocky River in recent years.

Cuyahoga River

The following information was assembled from *Total Maximum Daily Loads for the Middle Cuyahoga River* (Ohio EPA 2000), *Total Maximum Daily Loads for the Lower Cuyahoga River* (Ohio EPA 2003a), and *Total Maximum Daily Loads for the Upper Cuyahoga River* (2004b).

The Cuyahoga River is 84.9 miles long and drains 813 square miles in Geauga, Portage, Summit and Cuyahoga counties before emptying into Lake Erie at Cleveland. The river is one of the few rivers in the world that changes flow direction and creates a u-shaped watershed. The basin is situated within the Erie-Ontario Drift and Lake Plain (EODLP) ecoregion, characterized by glacial formations that can have a significant local relief of up to 300 feet and exhibits a mosaic of cropland, pasture, woodland, and urban areas. Land use patterns vary greatly from the upper basin that is primarily forest/agricultural/rural, to the lower basin which is among the most densely populated and industrialized urban areas in the state. The Cuyahoga River, from the Ohio Edison Dam to the mouth and the nearshore area has been identified as an Area of Concern (AOC) by the International Joint Commission.

Upper River

The upper Cuyahoga River flows through Geauga and Portage counties. This portion of the watershed is predominately rural in nature with significant amounts of wetlands. Based on Ohio EPA's monitoring, a number of water bodies within this watershed appear on Ohio's list of impaired waters. The Ohio EPA identified the upper Cuyahoga River watershed as a priority impaired water in 2002. The primary causes of impairment in the upper Cuyahoga River watershed are hydromodification, nutrient enrichment, low dissolved oxygen, and habitat degradation.

Among mainstem stations evaluated within the upper Cuyahoga River, only 33% were found to support an assemblage of fish fully attaining the Warmwater Habitat (WWH) aquatic life use designation. The majority of the stream reaches in this segment were characterized by low stream gradient, historic channel modification, hydromodification, and influences from extensive natural wetland complexes. Fish and macroinvertebrate communities were in non and partial attainment of WWH in the upper reaches of

the mainstem downstream from East Branch reservoir. The stream reaches upstream from East Branch reservoir were found to be fully attaining Ohio's WWH biocriteria.

Much of the West Branch of the Cuyahoga is a low gradient swamp-marsh influenced stream with attendant habitat limitations, and consequently the fish community is limited by the habitat. Despite these limitations, excellent habitat features are present owing to light development in the watershed, and as a result, biological community health throughout most of the West Branch was quite good.

Middle River
The middle Cuyahoga River watershed covers portions of Portage, Summit and Stark Counties. The middle Cuyahoga River mainstem has been identified as a priority impaired water on Ohio's list of impaired waters. Biological and chemical stream surveys from 1989 through 1998 indicated that habitat alteration, excessive nutrient levels, and low dissolved oxygen were the primary causes of impairment in this stream segment. Index of Biotic Integrity (IBI) scores decrease downstream from Lake Rockwell relative to the free-flowing reach upstream primarily because the river is impounded, causing habitat loss and resulting in an increase in the relative abundance of tolerant fishes. Modified Index of Well-being (MIwb) scores also decreased in the reach downstream from Lake Rockwell. Consequently, neither fish index met the respective WWH criterion. The invertebrate community, being less dependent on habitat, was found to be in better condition than the fish community.

Lower River
The Lower Cuyahoga River watershed flows through Summit and Cuyahoga counties before emptying into Lake Erie. Historical pollution has occurred in this section of the river as a result of heavy industrial and urban centers located between the cities of Akron and Cleveland. Based on Ohio EPA's monitoring of the Lower Cuyahoga River watershed, a number of streams appear on Ohio's list of impaired waters. Organic enrichment, nutrients, bacteria, flow alteration, toxicity, and degraded habitats are cited as the primary causes of impairment. Physical habitat attributes in most of the mainstem and tributaries are generally of high quality and typically include natural stream channels, coarse substrates and wooded riparian corridors.

Biological impairment in the Cuyahoga River downstream from Akron was manifest most strongly in the fish. Fish communities were poor or very poor at nearly all sites between Akron and Cleveland. Both fish and macroinvertebrate communities were in the fair to very poor ranges downstream from the Akron. In contrast to the fish communities, macroinvertebrates gradually improved and reached very good to exceptional quality upstream from Cleveland. Biological community health declined below Akron but year 2000 results showed significant improvement over past surveys.

Sampling downstream from Tinkers Creek found the first Full attainment of WWH ever recorded by Ohio EPA in the Cuyahoga River downstream from Akron. Full attainment is believed to extend downstream to the confluence with Mill Creek. Downstream of Mill Creek the fish communities declined to the poor range. Fish improved to fair downstream from Southerly resulting in partial attainment.

The lower section of the Cuyahoga River contains a navigation channel. Ohio EPA sampling indicates that adult fish are able to utilize the navigation channel for passage upstream to suitable habitat. Cumulative loadings and flows from steel plant outfalls make it one of the largest point source discharges in the Cuyahoga River basin. Poor and very poor biological communities coincide with the lack of suitable habitat, low dissolved oxygen, and chronically elevated ammonia and zinc levels between the steel plant and Lake Erie.

A more detailed discussion of the Cuyahoga River watershed is provided in the Conservation Opportunity Watersheds section.

Chagrin River
The following information was assembled from *Biological and Water Quality Study of the Chagrin River and Selected Tributaries 2003-04* (Ohio EPA 2006b), and *Total Maximum Daily Loads for the Chagrin River Watershed* (Ohio EPA 2007d).

The Chagrin River watershed is located in northeast Ohio, flowing through Portage, Geauga, Cuyahoga, and Lake Counties on its way to Lake Erie. The Chagrin River watershed is located in the Erie-Ontario Drift and Lake Plain (EODLP), which is formerly glaciated and characterized by low rounded hills, scattered end moraines, kettles, and areas of wetlands. The resulting soils and geologic deposits contribute to the high quality and varied habitats of the watershed. The Main Branch of the Chagrin River begins as the Upper Main Branch above Bass Lake in Geauga County, and flows over 49 miles before entering Lake Erie in the City of Eastlake, comprising a drainage area of 267 square miles.

The Chagrin River is deeply entrenched over the lower 25 miles of its length and flows on bedrock in narrow valleys through much of the watershed. The southern portion of the watershed is a mixture of urban development, agricultural land uses, and forest. The southern and western portions of the watershed are predominantly comprised of urban development. Primary land cover in the basin is forest 65.4%, commercial/industrial/residential 21.2%, crops 7.6%, pasture/urban/recreational grasses 3.2%, and wetlands 1.2%.

The Aurora Branch, East Branch, and Chagrin mainstem are included in the State of Ohio Scenic River system. Seventy-one miles of streams in the watershed are designated as a Scenic Rivers. Stream impacts are generally noted in the tributary streams, while the main stem is generally meets aquatic life-use designation. Although the watershed is experiencing significant development pressure from Cleveland's population migration to outlying suburbs, the majority of the river retains its riparian forest cover. The river valley offers a diversity of terrestrial and aquatic plant communities, wildlife, unique rock outcroppings, and extensive headwater wetlands.

Overall, habitat quality in the Chagrin River watershed is very good. Of the sites assessed, only 7.1% failed to meet the QHEI Warmwater Habitat (WWH) score minimum. However, the Ohio EPA identified the Chagrin River as a priority impaired water on the 2004 and 2006 lists of impaired waters. Studies show that organic enrichment, nutrients, flow alteration, and degraded habitats are the primary causes of impairment. Stream surveys conducted in 2003 and 2004 found impairments for some biological communities.

Upper River

The upper reaches of the Chagrin River do not completely meet applicable biocriteria. Fish communities in the upstream-most (upper 7.5 miles) sampling locations were all degraded by direct channelization, and by removal of riparian habitat. Macroinvertebrate communities also show signs of impact, but most sites sampled met WWH biological criteria. The river recovers to full attainment downstream of the headwaters, and maintains full attainment to downstream from the Aurora Branch confluence. Several sites in this area demonstrate exceptional biological communities. The section between Dewdale Creek and the Aurora Branch contained a very good to exceptional macroinvertebrate community.

The Aurora Branch shows impairments of both fish and macroinvertebrate indices. The fish community showed an elevated relative abundance of pollution tolerant species and omnivores. The stream generally recovers to full attainment farther downstream. Ninety-three percent of macroinvertebrate samples collected in the Aurora Branch of the Chagrin River met their aquatic performance expectations. The Aurora Branch and its tributaries, despite having the highest combined intensity of agricultural and residential land use in the basin, generally had good to excellent habitat. Approximately two-thirds of the tributaries sampled in this part of the Chagrin basin are designated Cold Water Habitat (CWH). Where habitat is intact and stable, brook trout reintroductions have been successful in a number of small tributaries in the upper Chagrin and Aurora Branch subwatersheds.

Lower River

The entire lower mainstem of the Chagrin River is in full attainment of its life-use biocriteria. Habitat quality in the mainstem of the Chagrin River downstream from the confluence with the Aurora Branch is good to excellent, and possesses all the necessary attributes to fully support a diverse and robust fish community. Overall, the lower mainstem macroinvertebrate community quality was generally very good with Invertebrate Community Index (ICI) scores ranging from good to exceptional.

The East Branch Chagrin River, due to habitat and flow alterations declined in the upstream reaches and did not meet its designated CWH aquatic life use in the lower mainstem. The East Branch is unique among Ohio streams in that it harbors a strong population of longnose dace, a coolwater/coldwater fish species with the southern limit of its distribution in Northeast Ohio. Most sites sampled in the East Branch and its tributaries harbored fish communities that met numeric water quality standards for biological integrity. The strong population of longnose dace and the presence of numerous young-of-the-year steelhead trout in the mainstem and tributaries indicate that the East Branch continues to maintain its coldwater character. The macroinvertebrate community in the East Branch was rated exceptional in upstream areas, with a very good macroinvertebrate community present downstream. There are several small cold-water tributaries to the Chagrin River that serve as some of the few remaining streams supporting naturally reproducing brook trout in Ohio.

A more detailed discussion of the Chagrin River watershed is provided in the Conservation Opportunity Watersheds section.

Grand River

The following information was assembled from *Biological and Water Quality Study of the Grand River Basin 2003-2004* (Ohio EPA 2006c), Biological *and Water Quality Study of the Grand River Basin* (Ohio EPA 2009a), *Total Maximum Daily Loads for the Grand River (lower) Watershed* (Ohio EPA 2012c), and *Total Maximum Daily Loads for the Grand River (upper) Watershed* (Ohio EPA 2013b).

The Grand River is located in northeastern Ohio and drains a total of 707 square miles as it flows through all or part of Ashtabula, Geauga, Lake, Portage, and Trumbull counties. The watershed is a mixture of forest, agricultural land (crops, pasture, hay), and urban land. The Grand River basin is contained within the Erie-Ontario Drift and Lake Plain (EODLP) ecoregion. Portions of the 102.7 mile long Grand River have Wild and Scenic River designations.

Upper River

The upper Grand River flows through Ashtabula, Geauga, Portage and Trumbull counties and drains 418 square miles. Land cover in the upper Grand River watershed is dominated by forest (41.5%), cultivated crops and pasture lands (36.1%), and wetlands (8.9%). A large complex of wetlands is located near the center of the watershed, and forest and agricultural lands are spread throughout the watershed. Developed land (6.3%) is primarily located in the northern portion of the upper watershed.

The condition of biological communities in the upper Grand River basin is governed principally by post-glacial physiography. The dominant feature of the basin is the glacial lake-plain and lacustrine deposits which have essentially resulted in three classes of streams: lowland streams, upland headwaters, and the Grand River mainstem. Because the lowland streams are sluggish and have fine-grained substrates, they cannot in all cases be reasonably expected to support biological communities typical of the ecoregion. At the other extreme, some of the headwaters drain areas where bedrock is very close to the surface, and consequently, flow is not sustained through the summer because the shallow soil horizon does not store water. Apart from these natural limitations, some of the sites evaluated in the upper watershed were impacted by pollution or loss of habitat.

Non and partial attainment of aquatic life-use criteria in the watershed tended to result from natural conditions (flow or habitat), excess nutrients, and organic enrichment. Sixty-three percent of sites assessed within the watershed by the Ohio EPA fully attained water quality standards, 23% partially attained, and 14% were in non-attainment. Overall habitat QHEI scores ranged from fair to excellent in the headwaters of the Grand River subwatershed. Where the topography is flat, and the substrates are composed primarily of lacustrine silts and clays, habitat quality was generally poor and not conducive to stream faunas typical of the ecoregion. The headwaters on the western side tend to have high gradients, and possess the energy to form well-developed channels through coarse substrates. Typically, the faunas in these headwaters were not limited by habitat quality.

Within the headwaters area, the Grand River transitions rapidly from a small upland coldwater stream, to a large lowland swamp stream. Near the northern subwatershed boundary, the river begins to support a fauna typical of larger streams and rivers including redhorse suckers and walleye. Fish communities were sampled at several locations along the Grand River mainstem. Headwater sites above RM 88.5 did not meet applicable standards, but fish communities met criteria for Warmwater Habitat (WWH) from RM 88.5 downstream to RM 48.6. Northern brook lamprey ammocoetes and sand darters were found in the Grand River near RM 88.5. Starting at RM 44.5 the Grand River is designated Exceptional Warmwater Habitat (EWH). Functionally, the fish community at the site represents one of the closest approximations Ohio has to an intact, lowland, large river fish fauna. No other river in Ohio has native, naturally reproducing populations of muskellunge, northern pike and walleye occurring together.

Macroinvertebrate communities collected from the three most upstream stations on the Grand River (above RM 94.3) were performing at an exceptional level with high diversity and sensitive taxa. The remaining Grand River sites were located in a lowland area with low gradient (glacial Grand River Lake lacustrine deposits). Macroinvertebrate communities at these stations were performing at good to exceptional levels, with generally lower diversity and sensitive taxa.

Lower River

The lower Grand River flows through Lake, Ashtabula and Geauga counties and drains 287 square miles. The river empties into Lake Erie at Painesville. The Grand River downstream from Mill Creek transitions from a low-gradient swamp stream to a higher-gradient bedrock stream. Land use in the lower Grand River watershed transitions from urban/suburban on the western edge to rural and agricultural in the eastern two-thirds. The watershed is a mixture of forest (43%), agricultural land (29%), and urban land (16%).

The character and physical habitat of the Grand River changes abruptly near RM 44.5 where the river makes its westward turn toward Lake County and its eventual union with Lake Erie. Upstream from RM 44.5 the river flows through the lacustrine deposits of a former glacial lake. There, the river is a classic swamp-wetland type stream with low gradient (<1 ft/mi), fine sediments (typically small gravels to clay), and few riffles. Consequently, large woody debris, rootwads, rootmats, undercut banks and deep pools characterize the habitat. The fish fauna in this reach very much resembles a swamp-stream association: trout-perch, silver redhorse, sunfish and blackside darters are common. The wetland environs also provide spawning habitat for the Great Lakes muskellunge and northern pike. A native population of walleye exists as well. In short, the habitat in this reach of the Grand River supports one of the few intact type-locality faunal assemblages found anywhere in Ohio.

Downstream from RM 44.5 the gradient increases and the river flows in a series of pools, glides, runs, and riffles through a shale gorge. Long stretches of shallow bedrock alternate with aggregations of glacial till to form glides and riffles, and deeper pools exist where the river erodes former depositional areas. Water quality in the river is protected by the shale gorge that the river flows through and the scouring flows that formed it – the steep bluffs and regular flooding generally preclude development within the floodplain. Habitat quality in this reach of the river is among the best anywhere in Ohio.

In 2003 and 2004, the Ohio EPA evaluated the biological health and water quality of the lower Grand River watershed. The results of that survey show that the Grand River and its tributaries continue to harbor a rich and diverse biological assemblage containing many rare and threatened species, and several state endangered species. Fish communities in the Grand River have an exceptionally high degree of biological integrity. This is evident in the consistently high Index of Biotic Integrity (IBI) scores along the length of the mainstem and in the unusually high percent composition of pollution intolerant species. The population of Great Lakes muskellunge subspecies (*Esox masquinongy masquinongy*) in the Grand River may well be a truly endemic strain. As it stands, it is the last naturally reproducing muskellunge population found in any of Ohio's Lake Erie tributaries.

Aquatic life in the Grand River is fully attaining standards for EWH from RM 42.2 to RM 5.2, and is fully meeting standards for WWH downstream from there. The entire free-flowing Grand River mainstem sampled in this study from RM 44.0 to 6.1 was supporting exceptional macroinvertebrate communities.

High numbers of sensitive taxa and sensitive taxa diversity existed throughout this reach. In addition, three lacusturine stations scored high on the lacustrine Invertebrate Community Index (ICI). The free flowing lower Grand River has maintained exceptional macroinvertebrate communities since the late 1980s. ICI scores and sensitive taxa diversity in 2004 were as high or higher than previous years.

Twenty-three sensitive taxa (excluding freshwater mussels) found in this assessment unit are noteworthy because they are not commonly collected in statewide collections. In addition to these, the state listed Species of Concern crayfish *Orconectes propinquus* (Great Lakes Crayfish) was collected at 19 of the 35 stations in this assessment unit. Seventeen species of freshwater mussels (Unionidae) were collected from the lower Grand River. In total, this study found two state Endangered species, three state Threatened species, and four state Species of Concern to be present in the lower Grand River basin. This assessment unit had an unusually high number of uncommonly collected sensitive taxa and state listed species, which is an indication of the exceptional resource quality in the lower Grand River basin.

A more detailed discussion of the Grand River watershed is provided in the Conservation Opportunity Watersheds section.

Ashtabula River

The following information was assembled from *Biological and Water Quality Study of The Grand and Ashtabula River Basins including Arcola Creek, Cowles Creek and Conneaut Creek* (Ohio EPA 1997), *Biological Study of the Lower Ashtabula River and Conneaut Creek* (Ohio EPA 2006a), and *Fish Community Aquatic Life Use Attainment Study Upper Mainstem Ashtabula River, 2007* (Ohio EPA 2007c).

The Ashtabula River is a tributary to Lake Erie that drains an area of about 137 square miles. The majority of the watershed is contained within Ashtabula County in Ohio, with 8.91 square miles located in Pennsylvania. The mainstem of the Ashtabula River is 27.55 miles long, beginning at the confluence of the East and West Branches, and discharging into Lake Erie in the City of Ashtabula. The lacustrine portion (where water levels vary with the elevation of Lake Erie) of the Ashtabula River extends to river mile 2.5. The Ashtabula River mainstem has an average gradient of 11.6 feet per mile. The Ashtabula River watershed is located within the Erie-Ontario Drift and Lake Plain ecoregion (EODLP).

The southern portion of the watershed is a mixture of agricultural land and forest. The northern portion of the watershed includes some urban development near the Lake Erie shoreline. The Ashtabula River is designated a State Scenic River and has 46 continuous designated river miles on three stream segments including the mainstem (25 miles), East Branch (12 miles), and West Branch (9 miles).

Upper River

Habitat quality as assessed by the Qualitative Habitat Evaluation Index (QHEI) was found to be more than suitable to support the Warmwater Habitat (WWH) aquatic life use throughout the monitored reach. Land cover within the study area is dominated by forest and mixed agricultural uses. The riparian corridor along the Ashtabula River within the study area was almost completely forested.

Fish community assessments were conducted in 2007 along the upper reaches of the Ashtabula River mainstem in Ashtabula County to determine the attainment status for the WWH aquatic life use. Survey results for both the Index of Biotic Integrity (IBI) and the Modified Index of Well-being (MIwb) were in Full attainment of the ecoregional criteria for the fish community. A total of 24 fish species were collected during the survey. Most notable among the species collected were the northern bigeye chub and the northern mimic shiner. Both are listed as declining fish species in Ohio. Healthy populations of both species were found at all three sampling locations. In addition, all three sites supported robust populations of rock bass and smallmouth bass. The presence of larval sea lamprey in the Ashtabula River study area indicates that the river is breeding habitat for this invasive species. The 2007 survey of the upper portion of the Ashtabula River did not include an assessment of macroinvertebrate communities.

Lower River
The lower Ashtabula River empties into Lake Erie at Ashtabula, where the mouth and immediate upstream area have been modified to accommodate commercial shipping. The bottom sediments, bank soils, and biota of Ashtabula tributary Fields Brook (approximately RM 1.6) have been severely contaminated by unregulated discharges of hazardous substances. Hazardous substances have migrated downstream from Fields Brook to the Ashtabula River and Harbor, contaminating bottom sediments, fish, and wildlife. The lower two miles of the Ashtabula River and its outer harbor were designated an Area of Concern due to severe pollution problems by U.S. EPA in 1988.

Fish and macroinvertebrate communities were sampled in the lacustrine areas of the Ashtabula River during 2003 and 2005 by the Ohio EPA and U.S. Fish and Wildlife Service. Partial attainment of the interim lacustrine Index of Biotic Integrity (IBI) and Modified Index of Well-being (MIwb) biocriteria for fish was noted in the Ashtabula River at RM 1.3 during 2005. Lacustrine IBI scores were in the fair to good range, and MIwb scores were reflective of fair to good conditions. Fish species considered moderately to highly intolerant of pollution were collected in this lacustrine area – these included included silver redhorse, black redhorse, golden redhorse, smallmouth bass, brook silverside, and logperch.

In the lower Ashtabula River, the macroinvertebrate community was exceptional to good at the upstream sites, but in the vicinity of Fields Brook the macroinvertebrate community was poor to very poor. The macroinvertebrate community improved downstream and returned to good condition at the most downstream sampling location. The macroinvertebrate community is impaired within the area where Fields Brook flow mixes with the Ashtabula River.

Conneaut Creek
The following information was assembled from *Biological and Water Quality Study of The Grand and Ashtabula River Basins including Arcola Creek, Cowles Creek and Conneaut Creek* (Ohio EPA 1997), and *Biological Study of the Lower Ashtabula River and Conneaut Creek* (Ohio EPA 2006a).

The Conneaut Creek basin drains an area of 38 square miles in extreme northeast Ohio. The entire watershed, including the portion in Ohio, encompasses about 190 square miles. The Conneaut Creek mainstem originates south of Conneautville in Crawford County, Pennsylvania. In general Conneaut Creek flows in a northwesterly direction to the town of Conneaut where it enters Lake Erie. The mainstem is 56.8 miles in length, (22.3 in miles in Ohio). The Conneaut Creek mainstem has an average gradient of 11.3 feet per mile. All principal tributaries to Conneaut Creek are located in Pennsylvania.

The lower portion of the watershed is a mixture of urban development and forest. The upper portion of the watershed is predominantly comprised of forest, with some hay and pasture lands and cultivated crops. The Conneaut Creek watershed is situated within the Erie-Ontario Drift and Lake Plain ecoregion. The Ohio portion of Conneaut Creek is designated a State Wild and Scenic River.

The lacustrine area (estuary) is impacted from urbanized municipal and industrial activities. Major coal handling operations have resulted in layers of coal dust in the substrate. There are no marinas in Conneaut Creek harbor, however, the west shore has been bulkheaded and embankment reshaping has occurred along the eastern embankment. Most of the banks of Conneaut Creek in the lower two miles have been extensively modified with rip-rap and sheet piling. Undisturbed shorelines exist upstream from RM 2.0.

In the lacustrine zone, predominant bottom substrates included sand, muck, hardpan, and cobble, with lesser amounts of boulder, gravel, bedrock, and silt. Aquatic vegetation included pond lilies, wild celery, waterweed, cattail, Eurasian milfoil, and algae mats. Conneaut Creek lacustrine fish communities were in the fair to good range during 2003 and 2005. Modified Index of Well-being scores were fully attaining the interim lacustrine biocriterion during 2003 and 2005. Interim lacustrine Index of Biotic Integrity (IBI) results revealed attainment of the biocriteria during 2005. Conneaut Creek biological monitoring documented full attainment of the interim Lacustrine Invertebrate Community Index (LICI) biocriterion at all macroinvertebrate sampling locations during 2003. LICI scores were reflective of good to exceptional biological conditions.

Upstream, excellent habitat quality was noted at all sites evaluated. Fractured bedrock and glacial tills provided substrates with a variety of sizes and high complexity, and channel development was excellent. Riffles were free of embedding silt, and silt in the slower channels was confined to depositional areas. Wide mature riparian vegetation covered the undeveloped flood plain, providing woody debris for in-stream cover. Upstream fish communities in Conneaut Creek met Exceptional Warmwater Habitat (EWH) criteria at all sampling locations. Fish species considered moderately to highly intolerant of pollution collected in Conneaut Creek included silver redhorse, black redhorse, golden redhorse, shorthead redhorse, northern hog sucker, rosyface shiner, and smallmouth bass. Upstream macroinvertebrate communities were consistently in the exceptional range at all sampling locations. Invertebrate Community Index (ICI) scores, and mayfly/stonefly/caddisfly taxa richness were consistently among the highest in the survey. Conneaut Creek has consistently been among the highest quality streams in the state of Ohio with regards to macroinvertebrate community performance.

ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

The characteristics of Ohio's Lake Erie tributaries change significantly from west to east, and with them the associated aquatic communities. Western tributary species tend to be more tolerant of degraded conditions, low stream gradient and velocity, turbidity, and compromised habitat. Eastern tributary aquatic communities contain species that require better habitat and water quality. All of Ohio's Lake Erie tributaries are utilized by a number of lake fish species at certain times of the year. Several of the western tributaries experience significant spring spawning runs, and a number of eastern tributaries are used by steelhead during the cold weather months. Overall, generalist species are found across the entire gradient of tributaries, and species less tolerant of human disturbance tend to be more abundant in eastern tributaries.

The following species have been identified as Lake Erie Tributary species of greatest conservation need (conservation status rank in parentheses):

<u>FISH</u>

Popeye Shiner (3)	*Notropis ariommus*
American Eel (5)	*Anguilla rostrata*
Lake Sturgeon (17)	*Acipenser fulvescens*
Blacknose Shiner (22)	*Notropis heterolepis*
Silver Lamprey (26)	*Ichthyomyzon unicuspis*
Eastern Sand Darter (29)	*Ammocrypta pellucida*
Western Banded Killifish (30)	*Fundulus diaphanus menona*
Silver Chub (36)	*Macrhybopsis storeriana*
Iowa Darter (38)	*Etheostoma exile*
Bigeye Chub (42)	*Hybopsis amblops*
Channel Darter (44)	*Percina copelandi*
Spotted Gar (45)	*Lepisosteus oculatus*
Black Redhorse (48)	*Moxostoma duquesnei*
Mooneye (50)	*Hiodon tergisus*
Silver Redhorse (52)	*Moxostoma anisurum*
Greater Redhorse (55)	*Moxostoma valenciennesi*
River Darter (61)	*Percina shumardi*
Brindled Madtom (70)	*Noturus miurus*
Longnose Dace (74)	*Rhinichthys cataractae*
Bowfin (76)	*Amia calva*
Spotted Sucker (76)	*Minytrema melanops*
Stonecat Madtom (78)	*Noturus flavus*
Bigmouth Buffalo (80)	*Ictiobus cyprinellus*
Tadpole Madtom (80)	*Noturus gyrinus*
Longnose Gar (83)	*Lepisosteus osseus*
Silver Shiner (83)	*Notropis photogenis*
Fantail Darter (89)	*Etheostoma flabellare*
Golden Redhorse (89)	*Moxostoma erythrurum*

Longear Sunfish (91)	*Lepomis megalotis*
Mimic Shiner (94)	*Notropis volucellus*
Greenside Darter (95)	*Etheostoma blennioides*
Spottail Shiner (97)	*Notropis hudsonius*
Rainbow Darter (100)	*Etheostoma caeruleum*
Trout Perch (102)	*Percopsis omiscomaycus*
Blackside Darter (103)	*Percina maculata*
Rosyface Shiner (103)	*Notropis rubellus*
Johnny Darter (106)	*Etheostoma nigrum*
Quillback Carpsucker (107)	*Carpiodes cyprinus*
Redfin Shiner (107)	*Lythrurus umbratilis*
Chinook Salmon (111)	*Oncorhynchus tshawytscha*
Coho Salmon (111)	*Oncorhynchus kisutch*
Pink Salmon (111)	*Oncorhynchus gorbuscha*
Spotfin Shiner (114)	*Cyprinella spiloptera*
Shorthead Redhorse (115)	*Moxostoma macrolepidotum*
Logperch Darter (116)	*Percina caprodes*
Silverjaw Minnow (117)	*Notropis buccatus*
Northern Hogsucker (119)	*Hypentelium nigricans*
Brown Bullhead (120)	*Ameiurus nebulosus*
Central Stoneroller (120)	*Campostoma anomalum*
Yellow Bullhead (120)	*Ameiurus natalis*
Sand Shiner (124)	*Notropis stramineus*
Emerald Shiner (127)	*Notropis atherinoides*
Striped Shiner (127)	*Luxilus chrysocephalus*
Golden Shiner (129)	*Notemigonus crysoleucas*
Black Bullhead (130)	*Ameiurus melas*
Pugnose Shiner (131)	*Notropis anogenus*
Creek Chub (132)	*Semotilus atromaculatus*
Freshwater Drum (132)	*Aplodinotus grunniens*
Bluntnose Minnow (135)	*Pimephales notatus*
Rock Bass (135)	*Ambloplites rupestris*
Suckermouth Minnow (137)	*Phenacobius mirabilis*
White Sucker (137)	*Catostomus commersoni*
Fathead Minnow (139)	*Pimephales promelas*
Flathead Catfish (141)	*Pylodictis olivaris*
Warmouth (142)	*Lepomis gulosus*
Sauger (143)	*Sander canadense*
Northern Pike (145)	*Esox lucius*
Green Sunfish (147)	*Lepomis cyanellus*
Blackchin Shiner (148)	*Notropis heterodon*
Orangespotted Sunfish (148)	*Lepomis humilis*
Rainbow Trout (150)	*Oncorhynchus mykiss*
Smallmouth Bass (151)	*Micropterus dolomieu*
Channel Catfish (153)	*Ictalurus punctatus*
Walleye (154)	*Sander vitreus*
White Bass (155)	*Morone chrysops*
Gizzard Shad (157)	*Dorosoma cepedianum*
Bluegill Sunfish (159)	*Lepomis macrochirus*
Largemouth Bass (160)	*Micropterus salmoides*
Black Crappie (161)	*Pomoxis nigromaculatus*
Yellow Perch (162)	*Perca flavescens*
White Crappie (163)	*Pomoxis annularis*
Brown Trout (164)	*Salmo trutta*

CRAYFISH

Northern Clearwater Crayfish (4)	*Orconectes propinquus*
Sanborn's Crayfish (6)	*Orconectes sanbornii*
Big Water Crayfish (7)	*Cambarus robustus*
Paintedhand Mudbug (8)	*Cambarus polychromatus*
Little Brown Mudbug (9)	*Cambarus thomai*
Papershell Crayfish (13)	*Orconectes immunis*
Virile Crayfish (13)	*Orconectes virilis*
Appalachian Brook Crayfish (16)	*Cambarus bartonii cavatus*
White River Crayfish (17)	*Procambarus acutus*
Rusty Crayfish (18)	*Orconectes rusticus*

MUSSELS

Snuffbox (5)	*Epioblasma triquetra*
Eastern Pondmussel (8)	*Ligumia nasuta*
Purple Lilliput (15)	*Toxolasma lividum*
Slippershell Mussel (16)	*Alasmidonta viridis*
Rayed Bean (21)	*Villosa fabalis*
Creek Heelsplitter (23)	*Lasmigona compressa*
Rabbitsfoot (25)	*Quadrula cylindrica*
Salamander Mussel (25)	*Simpsonaias ambigua*
Clubshell (35)	*Pleurobema clava*
Purple Wartyback (37)	*Cyclonaias tuberculata*
Threeridge (40)	*Amblema plicata*
Round Hickorynut (42)	*Obovaria subrotunda*
Black Sandshell (47)	*Ligumia recta*
Kidneyshell (48)	*Ptychobranchus fasciolaris*
Northern Riffleshell (48)	*Epioblasma torulosa rangiana*
Rainbowshell (50)	*Villosa iris*
Round Pigtoe (50)	*Pleurobema sintoxia*
Elktoe (52)	*Alasmidonta marginata*
Deertoe (53)	*Truncilla truncata*
Fawnsfoot (53)	*Truncilla donaciformis*
Threehorn Wartyback (55)	*Obliquaria reflexa*
Cylindrical Papershell (56)	*Anodontiodes ferussacianus*
Fluted Shell (58)	*Lasmigona costata*
Creeper (60)	*Strophitus undulatus*
Lilliput (61)	*Toxolasma parvum*
Spike (61)	*Elliptio dilatata*
Wabash Pigtoe (61)	*Fusconaia flava*
Mucket (64)	*Actinonaias ligamentina carinate*
Paper Pondshell (66)	*Utterbackia imbecillis*
Wavyrayed Lampmussel (68)	*Lampsilis fasciola*
Fragile Papershell (71)	*Leptodea fragilis*
Plain Pocketbook (72)	*Lampsilis cardium*
Mapleleaf (73)	*Quadrula quadrula*
Pimpleback (74)	*Quadrula pustulosa*
White Heelsplitter (74)	*Lasmigona complanata*
Fatmucket (77)	*Lampsilis radiata*
Giant Floater (77)	*Pyganodon grandis*
Pink Heelsplitter (79)	*Potamilus alatus*
Eastern Elliptio (EX)	*Elliptio complanata*
Eastern Floater (EX)	*Pyganodon cataracta*

AMPHIBIANS

Mudpuppy (14)	*Necturus maculosus maculosus*

REPTILES

Rough Green Snake (3)	*Opheodrys aestivus*
Midland Smooth Softshell (7)	*Apalone mutica mutica*
Common Map Turtle (19)	*Graptemys geographica*
Ouachita Map Turtle (19)	*Graptemys ouachitensis*
Queen Snake (19)	*Regina septemvittata*
Red-eared Slider (31)	*Trachemys scripta elegans*
Common Musk Turtle (34)	*Sternotherus odoratus*
Eastern Spiny Softshell (36)	*Apalone spinifera spinifera*
Midland Painted Turtle (40)	*Chrysemys picta marginata*
Northern Water Snake (40)	*Nerodia sipedon sipedon*

CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Lake Erie Tributaries. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		medium
A	Watershed conversion to urban/commercial development alters hydrology	housing & urban areas commercial & industrial areas	medium low
B	Riparian development and its negative effect on habitat and species	housing & urban areas commercial & industrial areas tourism & recreation areas	medium low low
C	Increasing land prices limit our ability to protect riparian corridors	housing & urban areas commercial & industrial areas tourism & recreation areas	medium low low
II	**agriculture and aquaculture**		medium
A	Loss of riparian corridor to agriculture	annual & perennial non-timber crops livestock farming & ranching	high low
B	Watershed conversion to agriculture alters hydrology	annual & perennial non-timber crops livestock farming & ranching	high low

III	**energy production and mining**		low
A	Oil and gas extraction - can have negative impacts by causing chemical contamination	oil & gas drilling	low
B	Hydropower facilities disrupt stream connectivity and kill aquatic species	renewable energy	low
C	Water withdrawal for fracking can alter hydrology	oil & gas drilling	low
D	Sand/gravel operations destroy habitat	mining & quarrying	low
IV	**transportation and service corridors**		medium
A	Channel modification, dredging river mouths - causes habitat loss, water quality impacts	shipping lanes	medium
B	Roads, bridges, causeways, utilities, impact shoreline/nearshore habitats	roads & railroads utility & service lines	low low
V	**biological resource use**		low
A	Fishing pressure and fishing gear impacts	fishing & harvesting aquatic resources	low
VI	**human intrusions and disturbance**		low
A	Incompatible recreational activities	recreational activities	low
B	Creation of recreational facilities can alter/destroy nearshore habitat	recreational activities	low
C	Vessel impacts to nearshore habitats and water quality	recreational activities work & other activities	low negligible
VII	**natural system modifications**		medium
A	Dams cause habitat loss, sedimentation, decreased water quality, reduced biodiversity, and reduce movement of aquatic species and species abundance	dams & water management/use	medium
B	Conflicting water control management objectives of controlling agencies (DOW – USACOE)	dams & water management/use	medium
C	Some species' populations have been reduced to levels below what is necessary to recover on their own	other ecosystem modifications	medium
VIII	**invasive and other problematic species and genes**		high
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	high
B	Introduction and/or spread of nuisance plants and animals	problematic native species	low
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	high low
IX	**pollution**		high
A	Urban effluent carries a variety of substances that impact water quality and aquatic species	household sewage & urban wastewater industrial & military effluents garbage & solid waste air-borne pollutants	high medium low low
B	Agricultural effluent from row crops as well as confined animal operations impacts water quality and aquatic species	agricultural & forestry effluents	very high

C	Harmful algal blooms affect water quality, aquatic species, and can be toxic to terrestrial species	agricultural & forestry effluents	very high
D	Industrial spills impact water quality and aquatic species	industrial & military effluents	medium
X	**geological events**		negligible
---	none	---	---
XI	**climate change and severe weather**		low
A	Climate change could impact habitats, water quality, and species	habitat shifting & alteration droughts temperature extremes storms & flooding	low low low medium

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Lake Erie Tributaries habitat. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		med	
1	Protect riparian corridors through acquisition, partnerships, conservation easements, etc.	site/area protection resource & habitat protection	low high	I, II, IV-B, VI-B
2	Quantify and map critical habitat areas in the Cuyahoga River for future protection	site/area protection	low	I-A, IV-A,B, VI-B,C, VII-C
II	**LAND/WATER MANAGEMENT**		high	
1	Develop GIS tools to archive and monitor the status of protected lands in conservation opportunity watersheds	site/area management	low	XI
2	Work with OEPA, ODOT, USACE, and other government agencies to focus mitigation activities on riparian habitats in conservation opportunity watersheds	habitat & natural process restoration	high	I-A, II-A, IV-B, VI-B, XI
3	Work with landowners to develop and implement habitat improvement projects on private lands	habitat & natural process restoration	high	I, II, XI
4	Remove dams to restore stream connectivity and improve water quality	habitat & natural process restoration	high	VII-A, XI
5	Develop criteria for prioritizing candidate dams for removal – give extra emphasis to dams in conservation opportunity watersheds	habitat & natural process restoration	high	III-B, VII
6	Research fish passage improvements for dams that are not candidates for removal	habitat & natural process restoration	high	III-B, VII

7	Identify and prioritize restoration projects (channel restoration, floodplain and backwater reconnection, etc.) in conservation opportunity watersheds	habitat & natural process restoration	high	I-A,B, II, IV, VII-B, XI
8	Complete one geomorphological restoration project in each conservation opportunity watershed every 5 years	habitat & natural process restoration	high	I-A,B, II, IV, VII, XI
9	Develop model stream protection guidelines aimed at slowing the overland flow of water into streams	habitat & natural process restoration	high	I-A, II-B, IX-A,B
10	Use lowest impact techniques and timing for dredging activities	habitat & natural process restoration	high	III-D, IV-A, VII-B
11	Create and use wetlands for stormwater treatment	habitat & natural process restoration	high	I-A, IX-A
12	Establish an early-detection/rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	high	VIII-A,B
13	Develop ways to control invasive plant species in flowing waters	invasive/ problematic species control	high	VIII-A,B
14	Develop a process for coordinating disparate data sources of distribution and abundance of aquatic SGCN with special emphasis on conservation opportunity watersheds	habitat & natural process restoration	high	I-B, III-B,D, IV-A,B, VI-B, VII-A, XI
15	Review existing species and habitat data to identify data gaps and needs for additional surveys, research, and management actions	habitat & natural process restoration	high	I, II, III, IV, V, VI, VII, VIII, IX, XI
16	Conduct comprehensive surveys of freshwater mussels in all conservation opportunity watersheds	habitat & natural process restoration	high	I-B, III-C,D, IV-A,B, VI-B, VII, XI
17	Conduct watershed studies to identify and prioritize restoration opportunities	habitat & natural process restoration	high	I-B, II-A, IV-A, VI-B, VII, XI
18	Stabilize severely eroding streambanks with bio-engineering techniques	habitat & natural process restoration	high	I-A,B, II, VI-C
19	Reconnect stream channels with natural floodplains	habitat & natural process restoration	high	I-A,B, II, IV, VII-B, XI
20	Restore/stabilize riparian habitat by planting native grasses, shrubs, and trees	habitat & natural process restoration	high	I-B, II-A, IV-B
III	**SPECIES MANAGEMENT**		low	
1	Assess population status, habitat suitability, and probability for restoration of lake sturgeon spawning stocks in Ohio tributaries to Lake Erie	species management species recovery	low med	VII-C
2	Develop a restoration strategy for sauger in the Maumee and Sandusky Rivers	species reintroduction	low	VII-C
IV	**EDUCATION AND AWARENESS**		high	
1	Educate waterfront landowners and commercial pesticide/herbicide applicators on responsible chemical use, and the negative impacts to wildlife from toxic chemicals	training	high	I-B,C, IX-A

2	Promote conservation easements to protect riparian habitat	training awareness & communic-ations	high high	I, II, IV-B, VI-B, XI
3	Conduct shoreline protection/stabilization workshops	training	high	I-B, II-A, IV-B, VI-B
4	Provide technical guidance on shoreline development plans as relates to fish and wildlife interests	training	high	I, IV-B, VI-B, XI
5	Support the Ohio Clean Lakes Initiative - educating and training farmers and other interested parties on agricultural nutrient management and stewardship	training	high	II, IX-B,C
6	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communic-ations	high	VIII
7	Provide training to road construction/maintenance personnel for runoff/sediment control	training	high	I-B, IV-B, VI-B
8	Educate the public and legislators on the benefits of dam removals	training awareness & communic-ations	high high	VII-A
9	Provide training in geomorphological, fluvial, and in-stream flow processes for DOW personnel	training	high	III-B,C,D, IV, VI-B, VII-A,B
10	Develop and provide streams/watersheds educational materials for landowners, schools, public officials, and the general public	training awareness & communic-ations	high high	I, II, IX-A,B, XI
11	Create and implement demonstration projects aimed at reducing urban effluent – such as rain gardens, bioretention, etc.	training awareness & communic-ations	high high	I-A,B, IX-A
12	Conduct outreach for landowners on private land management, conservation practices, and water quality	training awareness & communic-ations	high high	I, II, IX-A,B
V	**LAW AND POLICY**		high	
1	Support legislation promoting eco-friendly energy development and use	legislation	high	III-A,B,C
2	Find innovative ways to mandate the inclusion of fish and wildlife interests in development plans	policies & regulations private sector standards & codes	high low	I, III-B,C,D, IV-B, VI-B, VII-C, XI
3	Support the creation of additional and/or increased enforcement of stormwater regulations	policies & regulations compliance & enforcement	high med	I-A, IX-A

4	Support sewage sludge/animal manure disposal standards to regulate application rates and timing	policies & regulations	high	IX-A,B,C
5	Support the use of buffers between development and tributary shorelines	policies & regulations private sector standards & codes	high low	I-A,B, IV-B, IX-A
6	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	high high	VIII
7	Support more stringent ballast water regulations to stop the introduction of invasive species	legislation policies & regulations	high high	VIII
8	Encourage and support minimum flow regulations that protect downstream aquatic habitats	policies & regulations	high	III-B, VII-A,B, IX-A,B
9	Support increased regulation of home sewage treatment systems	compliance & enforcement	med	IX-A
10	Promote riparian protection ordinances that prevent floodplain encroachment and riparian habitat removal	policies & regulations private sector standards & codes	high low	I, II, IV-B, VI-B
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		med	
1	Explore tying eligibility for grant money, loans, and cost-share programs to nutrient loading levels for agriculture – the lower the nutrient levels in their effluent, the more money they would be eligible for	market forces conservation payments	high high	IX-B,C, XI
2	Create incentives for vegetated buffers along all waterways to reduce nutrient loads and sediment	market forces conservation payments	high high	I, II, IX-A,B,C, XI
3	Create incentives to promote eco-friendly energy development and use	market forces conservation payments non-monetary values	high high low	III-A,B,C
4	Support the creation of incentives to protect riparian habitat	market forces conservation payments	high high	I, II, IV-B, VI-B, XI
5	Support clean marina and clean vessel programs	market forces conservation payments	high high	VI-C

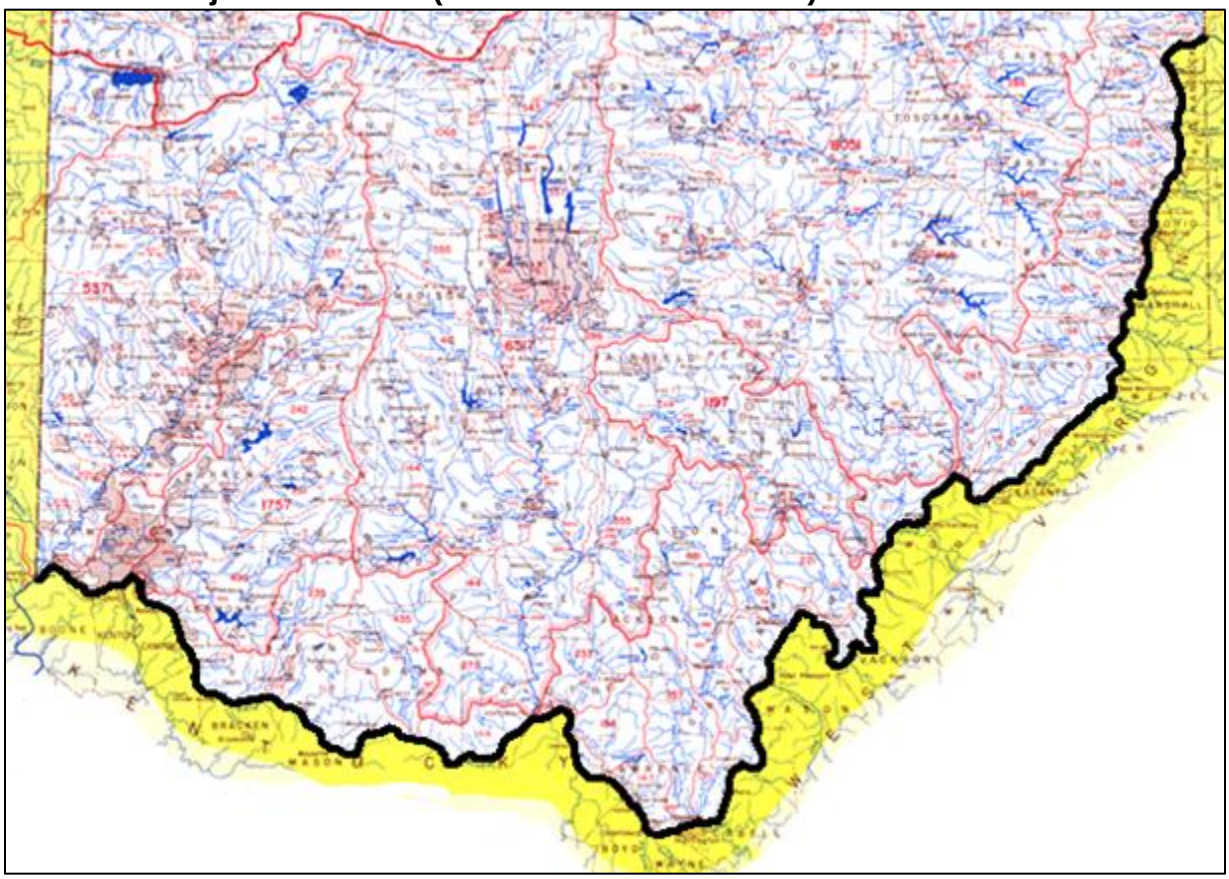
6	Develop incentives for municipalities to use stormwater management systems that minimize negative impacts to aquatic habitats	market forces conservation payments	high high	I-A, IX-A
7	Support incentives for development plans involving water frontage that take into account wildlife and habitat needs	market forces conservation payments non-monetary values	high high low	I, IV-B, VI-B, XI
8	Support payments to offset losses (revenue from crops) resulting from implementation of conservation practices aimed at reducing sediment loads	conservation payments	high	IX-B,C
9	Create incentives to encourage the use of conservation tillage – especially in impaired watersheds	market forces conservation payments	high high	IX-B,C
10	Support incentives for conservation farming practices – including nutrient management plans and livestock waste management plans	market forces conservation payments	high high	IX-B,C
11	Encourage the use of cover crops for idle agricultural fields	market forces conservation payments	high high	IX-B,C
12	Promote drainage water management such as grassed waterways, 2-stage channels, and over-wide ditches	market forces conservation payments	high high	II, IX-B,C
13	Promote waterway conservation livestock practices such as exclusion fencing, livestock crossings, alternative water supplies, livestock access lanes	market forces conservation payments	high high	II-A, IX-B,C
VII	**EXTERNAL CAPACITY BUILDING**		med	
1	Work with ODA and OEPA to minimize nutrients in runoff, and develop BMPs for pesticide/herbicide use	alliance & partnership development	high	IX
2	Create an interagency spill response team – update contacts and training on a regular basis	alliance & partnership development	high	IX-D
3	Consider creating a multiagency invasive species prevention and control group that would handle all invasive species issues	alliance & partnership development	high	VIII
4	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, and causeway design, construction, and maintenance	alliance & partnership development	high	IV-B
5	Create a multi-agency dam removal task force	alliance & partnership development	high	VII
6	Use inter-agency cooperation to influence watershed health	alliance & partnership development	high	I, II, IX, XI

7	Pursue partnerships with local, state, and federal agencies to secure funding for projects benefitting streams and watersheds	alliance & partnership development conservation finance	high low	I, II, III, IV, VI, VII, VIII, IX, XI
8	Work with OEPA to encourage the reuse of point source discharge water	alliance & partnership development	high	IX-A
9	Work with OEPA and municipalities to eliminate CSO's and SSO's – especially in impaired watersheds	alliance & partnership development	high	I-A, IX-A
10	Work with OEPA to encourage completion of TMDL studies for all streams in the Lake Erie drainage	alliance & partnership development	high	IX-A,B,C
11	Work with OEPA and local watershed groups to remediate contaminated sediments, and restore habitat in conjunction with remediation	alliance & partnership development	high	I-B, IX-A
12	Work with regulatory agencies and local watershed groups on programs to restore natural stream and flood plain function	alliance & partnership development	high	I-A,B, II, IV, VII-A,B, XI
13	Encourage/facilitate the establishment of watershed groups & watershed coordinator to promote watershed improvement activities	institutional & civil society development	med	I, II, IX, XI
14	Develop partnerships with land trusts, watershed and conservation groups, and government agencies to guide acquisition and protection activities in each conservation opportunity watershed	institutional & civil society development alliance & partnership development	med high	I, II, III, IV, VI, XI
15	Increase personnel and expertise available for SGCN surveys and research through partnerships with other government agencies and, universities, and conservation-minded NGO's	institutional & civil society development alliance & partnership development	med high	I, II, III, IV, V, VI, VII, VIII, IX, XI

*refers to the Lake Erie Tributaries Habitat Conservation Threats table

Ohio River

Ohio River adjacent to Ohio (ODNR Division of Water)



STATUS
Generally good, and stable. All pools adjacent to Ohio met aquatic life-use designations. Water quality has improved over time, although industrial spills continue to occur. The percentage of pollution tolerant fishes has declined over time. Despite dams, hydropower facilities, and commercial navigation, the river supports a tremendous diversity of terrestrial and aquatic species – although this species assemblage has changed significantly since the river was modified to facilitate commercial navigation.

DESCRIPTION
The Ohio River is formed in Pittsburgh, Pennsylvania by the confluence of the Allegheny and Monongahela rivers and flows 981 miles to Cairo, Illinois where it enters the Mississippi River. The river forms the entire 451-mile southern boundary between Ohio and West Virginia/Kentucky. Adjacent to Ohio, the river comprises 91,300 surface acres of water. The U.S. Army Corps of Engineers began modifying the Ohio River to improve navigation in 1824 by dredging sandbars and removing snags. The first lock and dam was completed in 1885 about five miles below Pittsburgh, and 12 more were built in 1910. Channelization of the river was completed in 1929 with 50 lock and dam structures in operation. This system was later replaced by a high rise system of 20 dams. Nine navigational projects (locks and dams) are in operation today along the stretch of the Ohio River adjacent to Ohio (http://watercraft.ohiodnr.gov/ohioriver).

The nine locks and dams located on the 451-mile section of the Ohio River adjacent to Ohio are (from east to west): New Cumberland, Pike Island, Hannibal (hydro), Willow Island (hydro), Belleville, Racine

(hydro), RC Byrd, Greenup (hydro), and Meldahl. These locks and dams divide the river into a series of pools that provide adequate navigation depths and allow freight to be transported the length of the river. Freight on the river is primarily coal, aggregrates, and grain moved by barges.

This habitat chapter refers to the 451 miles of the Ohio River mainstem along Ohio's southern border, and its tributaries to the first riffle or dam. The Ohio River is an extremely altered system, due to the numerous dams, hydropower facilities, and commercial navigation. In spite of these perturbations, the river supports many unique wildlife populations, e.g., freshwater mussels, tiger beetles, paddlefish, waterfowl, ospreys and bald eagles. The Ohio River contains a diverse fish community that includes over 150 different species.

Shared ownership of the Ohio River with Kentucky along the Ohio-Kentucky border, and ownership of the Ohio River by West Virginia along the Ohio-West Virginia border, creates opportunities for cooperative management as well as unique inter-jurisdictional challenges. Fisheries management is conducted under the context of the Ohio River Fisheries Management Team, which is composed of natural resource personnel from the six states bordering the river. Shared jurisdiction necessitated cooperative management and led to the development of a Memorandum of Understanding among natural resource agencies that manage fisheries in Pennsylvania, West Virginia, Ohio, Kentucky, Indiana, and Illinois.

The following water quality, habitat, and biological assessment of the Ohio River comes from the Ohio River Valley Water Sanitation Commission (ORSANCO 2012). Ohio River pool assessments are from http://www.orsanco.org/biological-programs-55/10-mainpages/orsanco-programs/115-biological-surveys – and additional information can be found at www.orsanco.org.

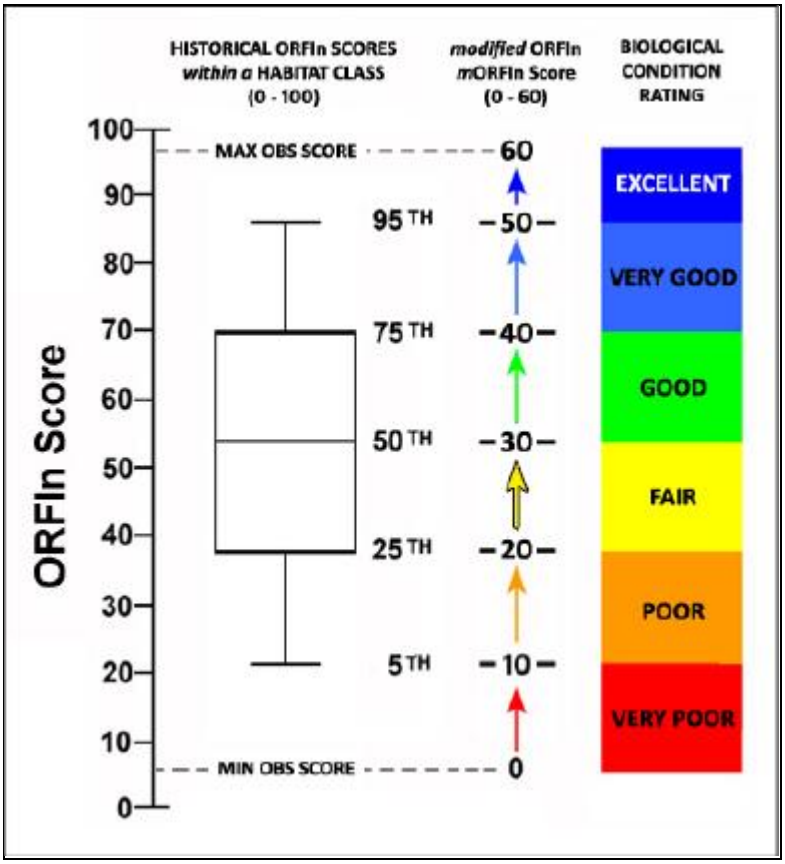
ORSANCO is a water pollution control agency established in 1948 by an interstate Compact. The eight member states - Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia - pledge to cooperate in the control of water pollution within the Ohio River Basin. ORSANCO coordinates activities and facilitates an exchange of information and technology among federal agencies and the water pollution control and natural resource agencies of the member states.

Maintaining the biological integrity of the Ohio River through the protection of aquatic life and habitat is a goal of both the Compact and the Clean Water Act. Chemical and physical parameters are monitored to assess pollution levels in the river. In addition, the effects of pollution on aquatic life monitored using biological assessment tools. Monitoring biological communities can reveal stressors, such as pollution or habitat degradation, which may not be detected by chemical or physical measurements.

Since 2004, aquatic life has been assessed on a pool-by-pool basis. For aquatic life assessments, the river has been divided into independent Assessment Units (AUs) based on the pools created by high-lift dams. These AUs are sampled each year on a rotating basis, such that complete coverage of the river every five years is achieved. ORSANCO evaluates biological condition using an index specifically designed for the Ohio River, the ORFIn, which has been updated recently and is now referred to as the *modified* Ohio River Fish Index (*m*ORFIn). The *m*ORFIn combines various attributes of the fish community to assign a score to the river based on biological characteristics.

The *m*ORFIn is comprised of metrics which serve as surrogate measures of more complicated processes. Examples of metrics include number of species, number of pollution tolerant individuals, and percent of top piscivores in the fish community. A *m*ORFIn score is calculated for each site by comparing observed ORFIn values to statistical thresholds in historical ORFIn scores within each habitat class. ORSANCO uses three distinct habitat classes in performing habitat assessments - designated as Class A, B, and C. Each class has a different expectation on the ORFIn scale, depending on the habitat composition. Habitat A sites contain coarse substrates such as boulders and cobble, provide the most cover and food, and therefore score the highest. Habitat C sites contain smaller substrates such as sand, are less attractive to fish, and usually score at the lower end of the ORFIn scale. Habitat B sites have a combination of sand, cobble, and other substrates.

ORFIn scores decrease significantly at locations influenced heavily by human activity and are higher at less-impacted sites. Higher scores indicate a more desirable fish community that is reflective of improved water quality. Biological condition ratings are then assigned to a pool based on the average *m*ORFIn score. Attainment is assessed as either “fully supporting” indicating no impairment, “partially supporting” meaning the segment is impaired due to violations of chemical water quality criteria for the protection of aquatic life or biological data, or “not supporting” meaning biological and water quality data indicate impairment. A description of *m*ORFIn scores and how they relate to biological condition ratings is shown in the figure below:



A brief synopsis of ORSANCO Ohio River pool descriptions and assessments (moving in a downstream direction from east to west) follows:

New Cumberland Pool (2011 data)

The New Cumberland pool is 22.7 miles long, averages 1439 feet wide and 22 feet deep, and has an average gradient of 0.2 feet per mile. The upper 9 miles of the pool flow within the state of Pennsylvania, while the remaining 13.7 miles are bordered by Ohio and West Virginia. The pool lies 31.7 miles downstream of the City of Pittsburgh in a portion of the Ohio River heavily influenced by industry. The pool receives water primarily from Little Beaver Creek and Yellow Creek. The pool's watershed is primarily forested (>65%), with some agriculture and urban influences. In unmodified sections of the pool the shoreline consists of coarse substrates. Cobble/gravel/sand make up over 75% of the bottom substrate. ORSANCO sampling indicated the following families dominated the fish species composition of the pool: Cyprinids 48.5%, Clupeids 22.6%, Centrarchids 8.6%, Catostomids 8.4%, Ictalurids 4.5%.

New Cumberland Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: C – equal mix of coarse and fines

Notable Measures: relatively high percentage of coarse shoreline

Biological Measures

Total No. of Fish Species: 39

Average No. of Individuals: 149

Dominant Family (*minus herring/shad)*: Minnows/Carp

Dominant Species (*minus shad/shiners*): golden redhorse

Threatened & Endangered Species: mooneye, silver chub (PA)

Rare Ohio River Mainstem Species: channel darter

Notable Catch: abundant game fishes (sm. bass and bluegill)

Assessment Results

Highest scoring ORFIn metric (*minus DELTs*): % Non-natives

Lowest scoring ORFIn metric: % Piscivores

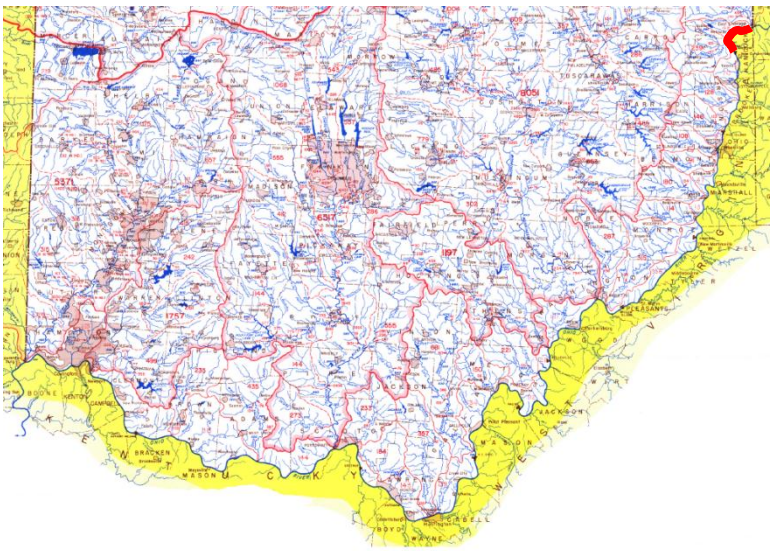
Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 9

Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 6

Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Fair

New Cumberland Pool



Pike Island Pool (2012 data)

The Pike Island pool is 29.8 miles long, averages 1338 feet wide and 19 feet deep, and has an average gradient of 0.4 feet per mile. The pool is located in a portion of the Ohio River heavily influenced by industry, with significant barge activity. The pool receives water primarily from Buffalo Creek (WV) and Short Creek. The pool's watershed is primarily forested (>64%), with some agriculture and urban influences. The shorelines of this pool support a moderate degree of aquatic vegetation, and littoral zones are dominated by invasive species (Hydrilla spp.). Boulder/cobble/gravel/sand make up about 75% of the bottom substrate. ORSANCO sampling indicated the following families dominated the fish species composition of the pool: Clupeids 62.8%, Cyprinids 18.6%, Centrarchids 8.5%, Catostomids 3.1%.

Pike Island Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: C - equal mix of coarse and fines

Notable Measures: abundant aquatic vegetation (15 of 15 sites)

Biological Measures

Total No. of Fish Species: 42

Average No. of Individuals: 137

Dominant Family (*minus herring/shad)*: Minnows/Carp

Dominant Species (*minus shad/shiners*): smallmouth bass

Species of Concern: river redhorse (OH)

Rare Ohio River Mainstem Species: rainbow darter

Notable Catch: northern pike

Assessment Results

Highest scoring ORFIn metric (*minus DELTs*): % Non-natives

Lowest scoring ORFIn metric: Great River Species

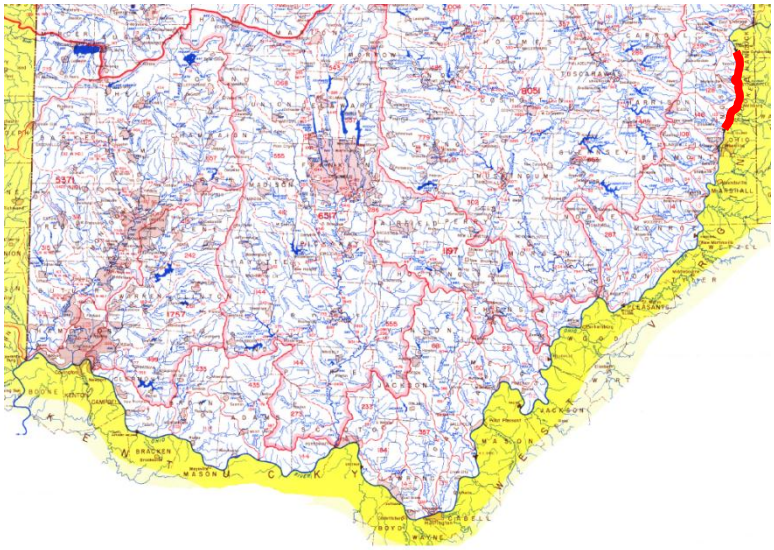
Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 12

Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 3

Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Good

Pike Island Pool



Hannibal Pool (2013 data)

The Hannibal pool is 42.2 miles long, averages 1133 feet wide and 21 feet deep, and has an average gradient of 0.5 feet per mile. The pool is located in a portion of the Ohio River heavily influenced by industry with significant barge activity. The pool receives water primarily from Wheeling Creek (OH), Wheeling Creek (WV), McMahon Creek, Grave Creek (WV), Captina Creek, Fish Creek (WV), and Sunfish Creek. The pool's watershed is primarily forested (>64%), with some agriculture and urban influences. The shorelines of this pool support a moderate degree of aquatic vegetation, and littoral zones are dominated by invasive species (Hydrilla spp.). Boulder/cobble/gravel/sand make up about 65% of the bottom substrate. ORSANCO sampling indicated the following families dominated the fish species composition of the pool: Centrarchids 44.3%, Catostomids 18.6%, Cyprinids 16.4%, Percids 9.1%, Ictalurids 4.3%.

Hannibal Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: C - equal mix of coarse and fines

Notable Measures: Above average flows and poor water clarity were observed during the sampling period

Biological Measures

Total No. of Fish Species: 48

Average No. of Individuals: 169

Dominant Family (*minus herring/shad)*: Sunfishes/Black Bass

Dominant Species (*minus shad/shiners*): bluegill

Species of Concern (WV): highfin carpsucker

Rare Ohio River Mainstem Species: greenside darter

Notable Catch: river darter & channel darter (threatened in OH)

Assessment Results

Highest scoring ORFIn metric (*minus DELTs*): % Non-natives

Lowest scoring ORFIn metric (*minus GR Species*): % Lithophils

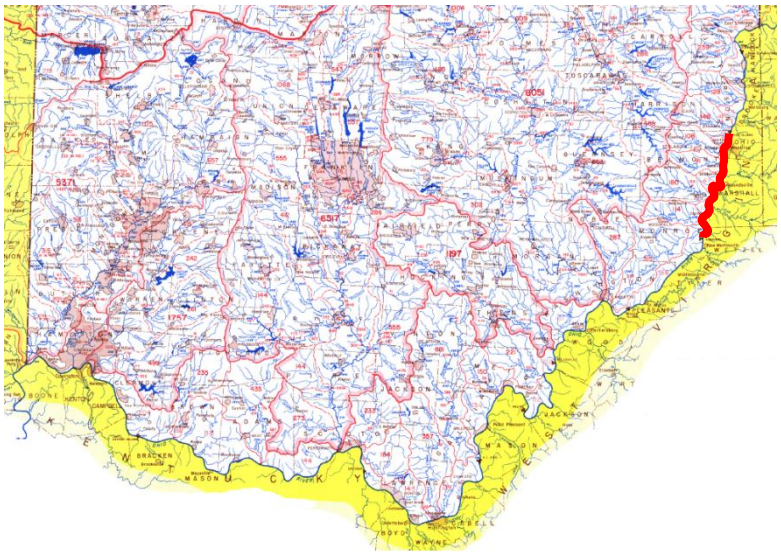
Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 13

Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 2

Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Good

Hannibal Pool



Willow Island Pool (2011 data)

The Willow Island pool is 35.3 miles long, averages 1194 feet wide and 21 feet deep, and has an average gradient of 0.6 feet per mile. The pool receives water primarily from Fishing Creek (WV), Middle Island Creek (WV), and the Little Muskingum River. The pool's watershed is primarily forested (>65%), with some agriculture and urban influences. Almost the entire Ohio shoreline is federally protected national forest (Wayne National Forest). Boulder/cobble/gravel/sand make up about 54% of the bottom substrate. ORSANCO sampling indicated the following families dominated the fish species composition of the pool: Cyprinids 42.3%, Centrarchids 27.3%, Clupeids 9.4%, Catostomids 4.4%.

Willow Island Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: D - shallow sand/fines

Notable Measures: abundant inshore structure and vegetation

Biological Measures

Total No. of Fish Species: 48

Average No. of Individuals: 182

Dominant Family (*minus herring/shad)*: Minnows/Carp

Dominant Species (*minus shad/shiners*): bluegill

Endangered Species: banded killifish (OH)

Rare Ohio River Mainstem Species: yellow bullhead

Notable Catch: abundant game fishes (bass and bluegill)

Assessment Results

Highest scoring ORFIn metric (*minus DELTs*): Centrarchid score

Lowest scoring ORFIn metric: % Lithophils

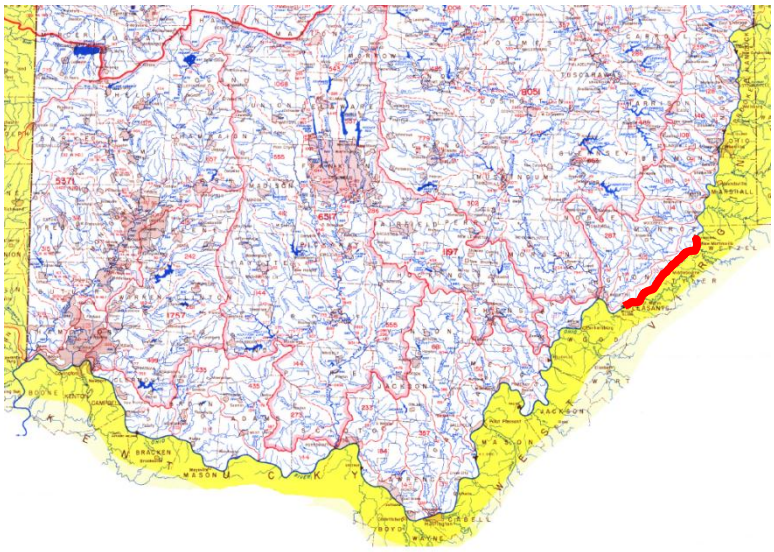
Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 13

Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 2

Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Fair

Willow Island Pool



Belleville Pool (2009 data)

The Belleville pool is 42.2 miles long, averages 1327 feet wide and 24 feet deep, and has an average gradient of 0.5 feet per mile. The pool is located in a portion of the basin moderately influenced by industry and barge activity. The pool receives water primarily from Duck Creek, Muskingum River, Little Kanawha River (WV), Little Hocking River, and the Hocking River. The pool's watershed is primarily forested (>65%), with some agriculture and urban influences. The pool has multiple islands scattered throughout its reach. Boulder/cobble/gravel/sand make up about 77% of the bottom substrate. ORSANCO sampling indicated the following families dominated the fish species composition of the pool: Cyprinids 46.7%, Centrarchids 17.3%, Clupeids 12.3%, Catostomids 10.4%, Percids 5.3%.

Belleville Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: C - mix of coarse and fine substrates

Notable Measures: rocky shorelines were still to be found, woody debris and aquatic vegetation were both very common

Biological Measures

Total No. of Fish Species: 52

Average No. of Individuals: 167

Dominant Family (*minus herring/shad)*: Minnows/Carp

Dominant Species (*minus shad/shiners*): mimic shiner

Threatened/Endangered: Ohio lamprey (E) & river darter (T)

Rare Ohio River Mainstem Species: rainbow darter

Notable Catch: muskellunge and large flathead catfish

Assessment Results

Highest scoring ORFIn metric (*minus DELTs*): % Non-Natives

Lowest scoring ORFIn metric: % Piscivores & Great River Species

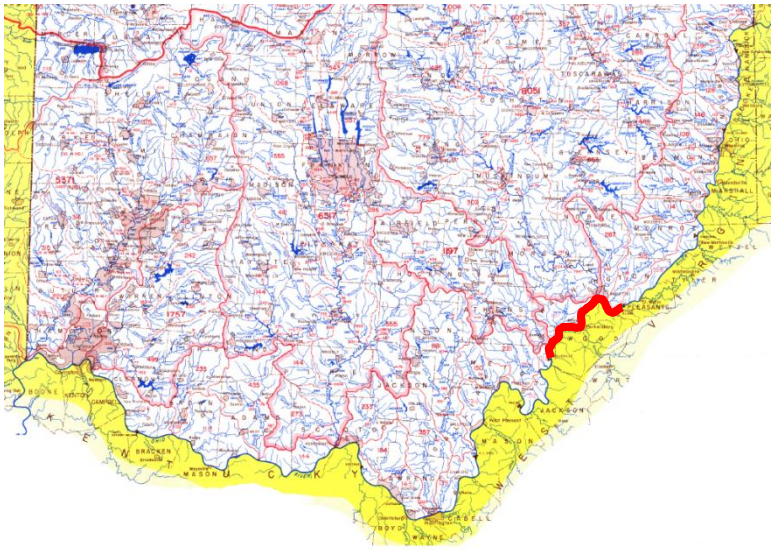
Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 14

Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 1

Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Good

Belleville Pool



Racine Pool (2010 data)

The Racine pool is 33.6 miles long, averages 1275 feet wide and 24 feet deep, and has an average gradient of 0.5 feet per mile. The pool is located in a relatively undeveloped portion of the basin with little influence of industry. The pool receives water primarily from the Shade River, Shady Creek (WV), and Mill Creek (WV). The pool's watershed is primarily forested (>65%), with some agriculture and residential influences. The shoreline conditions are conducive to the growth of aquatic vegetation, which is found in large quantities throughout the pool. Boulder/cobble/gravel/sand make up about 65% of the bottom substrate. ORSANCO sampling indicated the following families dominated the fish species composition of the pool: Clupeids 35.1%, Cyprinids 17.9%, Centrarchids 14.9%, Sciaenids 8.5%, Serranids 8.4%.

Racine Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: D - shallow sand/fines

Notable Measures: aquatic vegetation found at 100% of sites

Biological Measures

Total No. of Fish Species: 42

Average No. of Individuals: 97

Dominant Family (*minus herring/shad)*: Minnows/Carp

Dominant Species (*minus gizzard shad)*: bluegill sunfish

Threatened & Endangered: banded killifish (OH)

Rare Ohio River Mainstem Species: yellow bullhead

Notable Catch: spotted sucker

Assessment Results

Highest scoring ORFIn metric: Centrarchid species

Lowest scoring ORFIn metric: Great River species

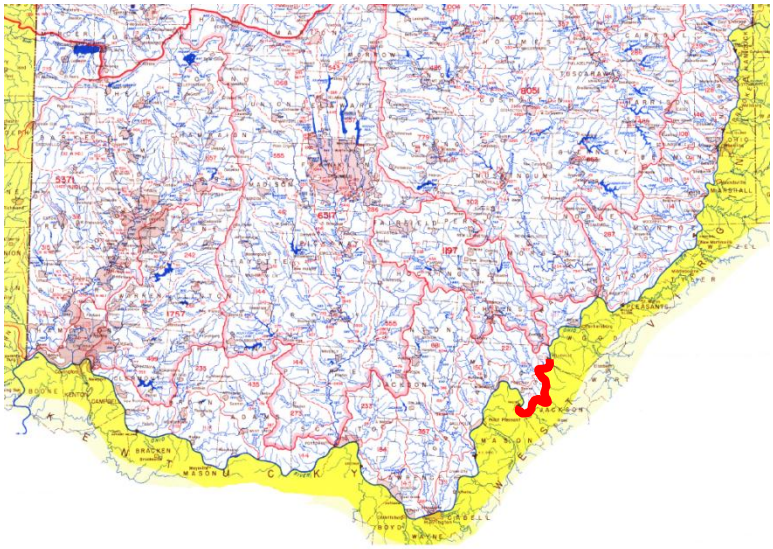
Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 8

Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 7

Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Fair

Racine Pool



R.C. Byrd Pool (2013 data)

The R. C. Byrd pool is 41.7 miles long, averages 1154 feet wide and 26 feet deep, and has an average gradient of 0.6 feet per mile. The pool is located in a portion of the basin heavily influenced by industry, with significant barge activity. The pool receives water primarily from Leading Creek, Kanawha River (WV), and Raccoon Creek. The pool's watershed is primarily forested (>65%), with some agriculture and residential influences. Littoral zones are dominated by invasive aquatic vegetation species (Hydrilla spp.). Boulder/cobble/gravel/sand make up about 57% of the bottom substrate. ORSANCO sampling indicated the following families dominated the fish species composition of the pool:, Cyprinids 41.2%, Centrarchids 20.4%, Catostomids 8.1%, Clupeids 8.0%, Ictalurids 7.0%.

R. C. Byrd Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: C - equal mix of coarse and fines

Notable Measures: The lowest performing sites were found downstream of the confluence of the Kanawha River

Biological Measures

Total No. of Fish Species: 33

Average No. of Individuals: 121

Dominant Family (*minus herring/shad*): Minnows/Carp

Dominant Species (*minus shad/shiners*): bluegill

Species of Concern: highfin carpsucker (WV) & river redhorse (OH)

Rare Ohio River Mainstem Species: spottail shiner

Notable Catch: striped bass (common in reservoirs & lower OH R.)

Assessment Results

Highest scoring ORFIn metric (*minus DELTs*): % Tolerants

Lowest scoring ORFIn metric (*minus GR Species*): CPUE

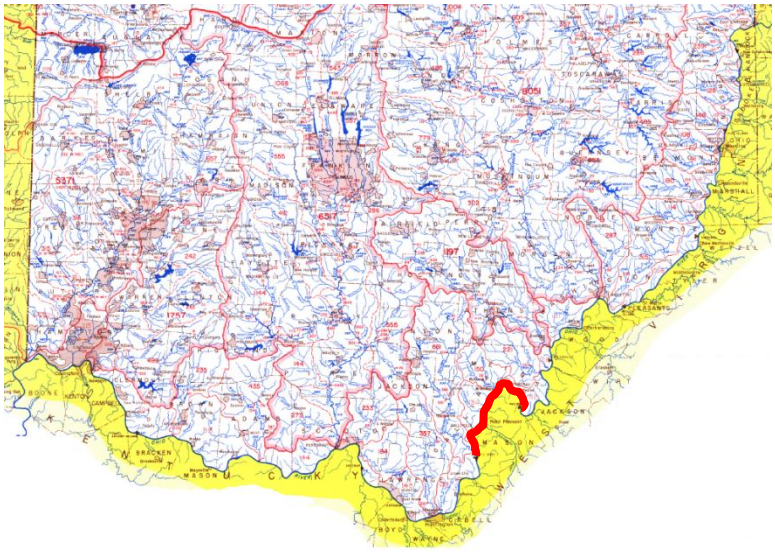
Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 10

Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 5

Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Good

R.C. Byrd Pool



Greenup Pool (2011 data)

The Greenup pool is 61.8 miles long, averages 1111 feet wide and 26 feet deep, and has an average gradient of 0.4 feet per mile. The pool is located in a portion of the basin heavily influenced by industry, with significant barge activity. The pool receives water primarily from the Guyandotte River (WV), Symmes Creek, Twelvepole Creek (WV), Big Sandy River (WV) and Little Sandy River (KY). The pool's watershed is primarily forested (>65%), with some agriculture and urban influences. Boulder/cobble/gravel/sand make up about 67% of the bottom substrate. ORSANCO sampling indicated the following families dominated the fish species composition of the pool: Cyprinids 59.4%, Centrarchids 13.6%, Ictalurids 7.5%, Sciaenids 7.4%, Catostomids 4.5%.

Greenup Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: C – equal mix of coarse and fines

Notable Measures: relatively high percentage of barge traffic

Biological Measures

Total No. of Fish Species: 47

Average No. of Individuals: 183

Dominant Family (*minus herring/shad)*: Minnows/Carp

Dominant Species (*minus shad/shiners*): bluegill

Species of Concern: river redhorse (OH), black buffalo (KY)

Rare Ohio River Mainstem Species: bowfin

Notable Catch: river redhorse, numerous catfish and basses

Assessment Results

Highest scoring ORFIn metric (*minus DELTs*): % Tolerants

Lowest scoring ORFIn metric: % Lithophils

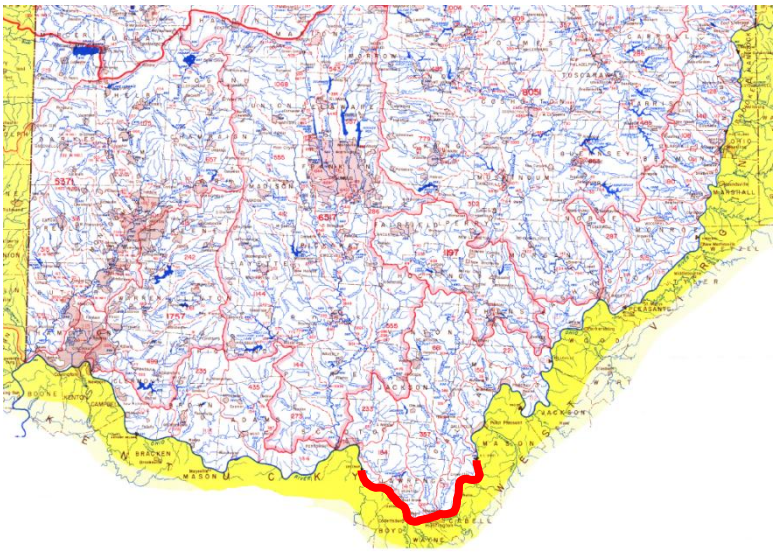
Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 15

Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 0

Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Good

Greenup Pool



Meldahl Pool (2012 data)

The Meldahl pool is 95.2 miles long, averages 1603 feet wide and 23 feet deep, and has an average gradient of 0.3 feet per mile. The pool receives water primarily from Pine Creek, Little Scioto River, Tygarts Creek, Scioto River, Kinniconnick Creek, Ohio Brush Creek, Eagle Creek, and Whiteoak Creek. The shorelines support a moderate degree of aquatic vegetation. The pool's watershed is primarily forested (>65%), with significant agricultural influence. Historically, Meldahl is consistently rated as one of the better pools on the Ohio River. Boulder/cobble/gravel/sand make up about 72% of the bottom substrate. ORSANCO sampling indicated the following families dominated the fish species composition of the pool: Clupeids 79%, Cyprinids 11.8%, Sciaenids 3.1%, Centrarchids 2.3%, Catostomids 1.4%.

Meldahl Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: E - deep sand/fines

Notable Measures: high occurance of woody structure

Biological Measures

Total No. of Fish Species: 41

Average No. of Individuals: 191

Dominant Family (*minus herring/shad)*: Minnows/Carp

Dominant Species (*minus shad/shiners*): freshwater drum

Threatened and Endangered Species: channel darter (T)

Rare Ohio River Mainstem Species: slenderhead darter

Notable Catch: walleye (more common upstream)

Assessment Results

Highest scoring ORFIn metric (*minus DELTs*): % Non-natives

Lowest scoring ORFIn metric: % Lithophils

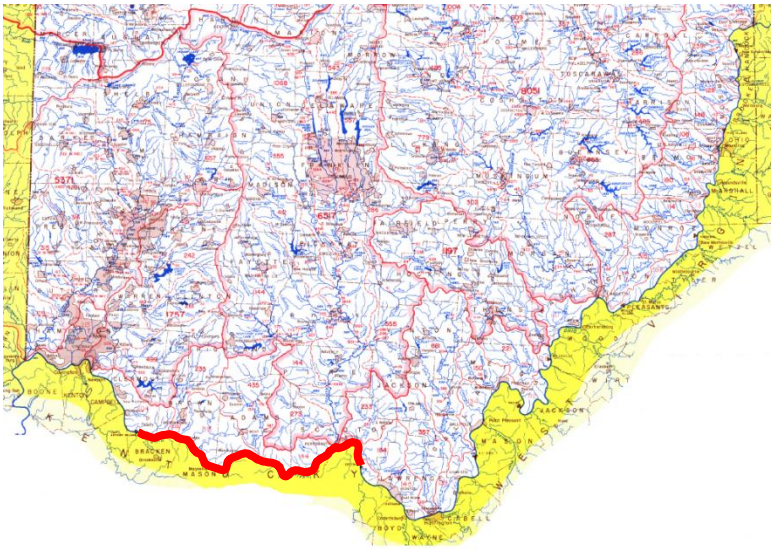
Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 14

Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 1

Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Good

Meldahl Pool



Markland Pool (2009)

The Markland pool is 95.3 miles long, averages 1594 feet wide and 31 feet deep, and has an average gradient of 0.4 feet per mile. The lower 39 miles of the pool are bordered by Indiana and Kentucky. The pool is located in a portion of the basin heavily influenced by industry, with significant barge activity. The pool receives water primarily from the Little Miami River (OH), Great Miami River (OH), and Licking River (KY) – as well as several smaller tributaries. The pool's watershed is primarily forested (>50%), with significant agriculture and urban influence. Boulder/cobble/gravel/sand make up about 58% of the bottom substrate. ORSANCO sampling indicated the following families dominated the fish species composition of the pool: Cyprinids 21.6%, Sciaenids 18.4%, Centrarchids 17.1%, Catostomids 15.4%, Percids 13.7%.

Markland Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: D - shallow sand/fines

Notable Measures: some degree of woody cover was observed at each of the 15 sites

Biological Measures

Total No. of Fish Species: 45

Average No. of Individuals: 207

Dominant Family (*minus herring/shad*): Drum

Dominant Species (*minus shad/shiners*): freshwater drum

Species of Concern (OH): black buffalo

Rare Ohio River Mainstem Species: warmouth

Notable Catch: river darter & channel darter (threatened in OH)

Assessment Results

Highest scoring ORFIn metric (*minus DELTs*): % Tolerants

Lowest scoring ORFIn metric (*minus GR Species*): CPUE (i.e. total catch)

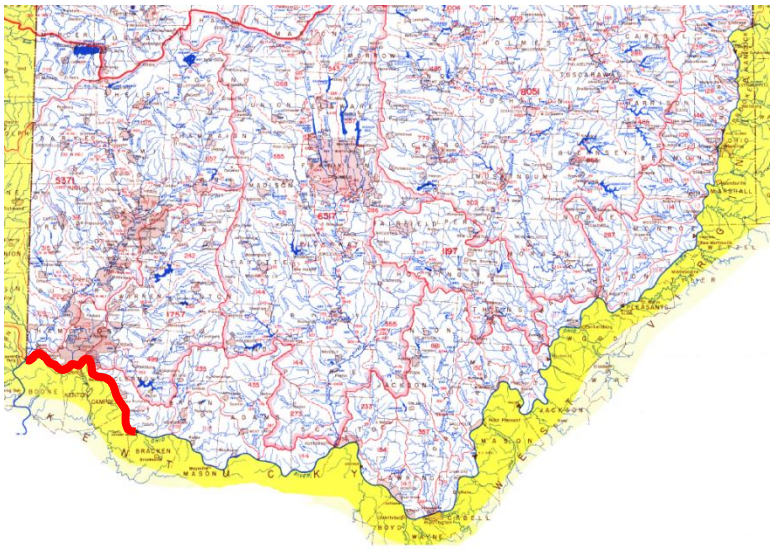
Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 15

Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 0

Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Very Good

Markland Pool



ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

Considering that the Ohio River today bears no resemblance to the river that existed in pre-settlement days, the river still supports tremendous numbers and diversity of aquatic species. The riffles, pools, and runs that were the Ohio River are long gone – covered by water of adequate depth to support commercial navigation. A number of aquatic species that existed in the pre-dams Ohio are also gone. Today the river has more in common with large southern reservoirs than it does with the free flowing stream that it once was. The species found in the river today are a reflection of that. Improved water quality in recent years has been mirrored by a shift in the species assemblage – in the direction of species characteristic of better quality lakes/streams. Owing to the reduction in gradient in a downstream direction, the lower pools of the Ohio are longer, wider, warmer, and generally contain softer substrates than their upstream counterparts. As the physical and chemical environment of the river changes, shifts in species composition and abundance are apparent.

The following species have been identified as Ohio River species of greatest conservation need (conservation status rank in parentheses):

<u>FISH</u>

Diamond Darter (2)	*Crystallaria cincotta*
American Eel (5)	*Anguilla rostrata*
Gilt Darter (6)	*Percina evides*
Paddlefish (9)	*Polyodon spathula*
Shoal Chub (11)	*Macrhybopsis hyostoma*
Ohio Lamprey (13)	*Ichthyomyzon bdellium*
Alligator Gar (15)	*Lepisosteus spatula*
Lake Sturgeon (17)	*Acipenser fulvescens*
Blue Sucker (18)	*Cycleptus elongatus*
Shovelnose Sturgeon (19)	*Scaphirhynchus platorynchus*
Bluebreast Darter (25)	*Etheostoma camurum*
Eastern Sand Darter (29)	*Ammocrypta pellucida*
Silver Chub (36)	*Macrhybopsis storeriana*
Goldeye (39)	*Hiodon alosoides*
Channel Darter (44)	*Percina copelandi*
Black Redhorse (48)	*Moxostoma duquesnei*
Mooneye (50)	*Hiodon tergisus*
Silver Redhorse (52)	*Moxostoma anisurum*
Black Buffalo (56)	*Ictiobus niger*
Dusky Darter (58)	*Percina sciera*
Shortnose Gar (60)	*Lepisosteus platostomus*
River Darter (61)	*Percina shumardi*
Mississippi Silvery Minnow (62)	*Hybognathus nuchalis*
River Redhorse (63)	*Moxostoma carinatum*
Smallmouth Redhorse (63)	*Moxostoma breviceps*
Slenderhead Darter (68)	*Percina phoxocephala*
Channel Shiner (70)	*Notropis volucellus wickliffi*
Highfin Carpsucker (72)	*Carpiodes velifer*
Blue Catfish (73)	*Ictalurus furcatus*
Bowfin (76)	*Amia calva*
Spotted Sucker (76)	*Minytrema melanops*
River Carpsucker (79)	*Carpiodes carpio*
Bigmouth Buffalo (80)	*Ictiobus cyprinellus*
River Shiner (80)	*Notropis blennius*
Ghost Shiner (83)	*Notropis buchanani*
Longnose Gar (83)	*Lepisosteus osseus*
Threadfin Shad (87)	*Dorosoma petenense*
Smallmouth Buffalo (88)	*Ictiobus bubalus*
Fantail Darter (89)	*Etheostoma flabellare*

Golden Redhorse (89)	*Moxostoma erythrurum*
Longear Sunfish (91)	*Lepomis megalotis*
River Chub (93)	*Nocomis micropogon*
Greenside Darter (95)	*Etheostoma blennioides*
Skipjack Herring (96)	*Alosa chrysochloris*
Bullhead Minnow (97)	*Pimephales vigilax*
Spottail Shiner (97)	*Notropis hudsonius*
Banded Darter (100)	*Etheostoma zonale*
Rainbow Darter (100)	*Etheostoma caeruleum*
Trout Perch (102)	*Percopsis omiscomaycus*
Blackside Darter (103)	*Percina maculata*
Johnny Darter (106)	*Etheostoma nigrum*
Quillback Carpsucker (107)	*Carpiodes cyprinus*
Brook Silverside (107)	*Labidesthes sicculus*
Spotfin Shiner (114)	*Cyprinella spiloptera*
Shorthead Redhorse (115)	*Moxostoma macrolepidotum*
Logperch Darter (116)	*Percina caprodes*
Northern Hogsucker (119)	*Hypentelium nigricans*
Brown Bullhead (120)	*Ameiurus nebulosus*
Central Stoneroller (120)	*Campostoma anomalum*
Yellow Bullhead (120)	*Ameiurus natalis*
Sand Shiner (124)	*Notropis stramineus*
Emerald Shiner (127)	*Notropis atherinoides*
Striped Shiner (127)	*Luxilus chrysocephalus*
Golden Shiner (129)	*Notemigonus crysoleucas*
Black Bullhead (130)	*Ameiurus melas*
Creek Chub (132)	*Semotilus atromaculatus*
Freshwater Drum (132)	*Aplodinotus grunniens*
White Catfish (132)	*Ictalurus catus*
Bluntnose Minnow (135)	*Pimephales notatus*
Rock Bass (135)	*Ambloplites rupestris*
White Sucker (137)	*Catostomus commersoni*
Fathead Minnow (139)	*Pimephales promelas*
Flathead Catfish (139)	*Pylodictis olivaris*
Pumpkinseed Sunfish (139)	*Lepomis gibbosus*
Warmouth (142)	*Lepomis gulosus*
Sauger (143)	*Sander canadense*
Spotted Bass (144)	*Micropterus punctulatus*
Northern Pike (145)	*Esox lucius*
Green Sunfish (147)	*Lepomis cyanellus*
Orangespotted Sunfish (148)	*Lepomis humilis*
Smallmouth Bass (151)	*Micropterus dolomieu*
Ohio Muskellunge (152)	*Esox masquinongy ohioensis*
Channel Catfish (153)	*Ictalurus punctatus*
Walleye (154)	*Sander vitreus*
White Bass (155)	*Morone chrysops*
Striped Bass (156)	*Morone saxatilis*
Gizzard Shad (157)	*Dorosoma cepedianum*
Redear Sunfish (158)	*Lepomis microlophus*
Bluegill Sunfish (159)	*Lepomis macrochirus*
Largemouth Bass (160)	*Micropterus salmoides*
Black Crappie (161)	*Pomoxis nigromaculatus*
Yellow Perch (162)	*Perca flavescens*
White Crappie (163)	*Pomoxis annularis*
Crystal Darter (EX)	*Ammocrypta asprella*

CRAYFISH

Rusty Crayfish (18)	*Orconectes rusticus*

MUSSELS

White Wartyback (1)	*Plethobasus cicatricosus*
Pink Mucket (3)	*Lampsilis abrupta*
Long Solid (6)	*Fusconaia subrotunda*
Ebonyshell (8)	*Fusconaia ebena*
Elephantear (8)	*Elliptio crassidens*
Pyramid Pigtoe (8)	*Pleurobema rubrum*
Orange-foot Pimpleback (12)	*Plethobasus cooperianus*
Ohio Pigtoe (13)	*Pleurobema cordatum*
Sheepnose (13)	*Plethobasus cyphyus*
Monkeyface (16)	*Quadrula metanevra*
Slippershell Mussel (16)	*Alasmidonta viridis*
Ring Pink (18)	*Obovaria retusa*
Scaleshell (18)	*Leptodea leptodon*
Winged Mapleleaf (18)	*Quadrula fragosa*
Butterfly (21)	*Ellipsaria lineolata*
Fanshell (25)	*Cyprogenia stegaria*
Wartyback (25)	*Quadrula nodulata*
Rough Pigtoe (35)	*Pleurobema plenum*
Yellow Sandshell (37)	*Lampsilis teres*
Spectaclecase (39)	*Cumberlandia monodonta*
Threeridge (40)	*Amblema plicata*
Washboard (40)	*Megalonaias nervosa*
Cracking Pearlymussel (42)	*Hemistena lata*
Pocketbook (42)	*Lampsilis ovata*
Northern Riffleshell (48)	*Epioblasma torulosa rangiana*
Round Pigtoe (50)	*Pleurobema sintoxia*
Elktoe (52)	*Alasmidonta marginata*
Deertoe (53)	*Truncilla truncata*
Fawnsfoot (53)	*Truncilla donaciformis*
Threehorn Wartyback (55)	*Obliquaria reflexa*
Fat Pocketbook (56)	*Potamilus capax*
Flat Floater (59)	*Anodonta suborbiculata*
Creeper (60)	*Strophitus undulatus*
Lilliput (61)	*Toxolasma parvum*
Spike (61)	*Elliptio dilatata*
Wabash Pigtoe (61)	*Fusconaia flava*
Mucket (64)	*Actinonaias ligamentina ligamentina*
Mucket (64)	*Actinonaias ligamentina carinate*
Pistolgrip (66)	*Quadrula verrucosa*
Wavyrayed Lampmussel (68)	*Lampsilis fasciola*
Hickorynut (69)	*Obovaria olivaria*
Rock-pocketbook (69)	*Arcidens confragosus*
Fragile Papershell (71)	*Leptodea fragilis*
Plain Pocketbook (72)	*Lampsilis cardium*
Mapleleaf (73)	*Quadrula quadrula*
Pimpleback (74)	*Quadrula pustulosa*
Pink Papershell (74)	*Potamilus ohiensis*
White Heelsplitter (74)	*Lasmigona complanata*
Fatmucket (77)	*Lampsilis radiata*
Giant Floater (77)	*Pyganodon grandis*
Pink Heelsplitter (79)	*Potamilus alatus*

CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact the Ohio River. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		low
A	Watershed conversion to urban/commercial development alters hydrology	housing & urban areas commercial & industrial areas	low low
B	Shoreline development and its negative effect on habitat and species	housing & urban areas commercial & industrial areas tourism & recreation areas	low low low
C	Increasing land prices limit our ability to protect riparian corridors	housing & urban areas commercial & industrial areas tourism & recreation areas	low low low
II	**agriculture and aquaculture**		low
A	Loss of riparian corridor to agriculture	annual & perennial non-timber crops livestock farming & ranching	low low
B	Watershed conversion to agriculture alters hydrology	annual & perennial non-timber crops livestock farming & ranching	low low
III	**energy production and mining**		low
A	Oil and gas extraction - can have negative impacts by causing chemical contamination	oil & gas drilling	low
B	Hydropower facilities disrupt stream connectivity and kill aquatic species	renewable energy	low
C	Sand/gravel operations destroy habitat	mining & quarrying	low
IV	**transportation and service corridors**		medium
A	Channel modification, dredging shipping lanes - causes habitat loss, water quality impacts	shipping lanes	medium
B	Roads, bridges, causeways, utilities, impact shoreline/nearshore habitats	roads & railroads utilities & service lines	low low
C	Barge traffic impacts water quality, nearshore habitat, and aquatic species	shipping lanes	medium
V	**biological resource use**		low
A	Fishing pressure and fishing gear impacts from recreational and commercial fishing	fishing & harvesting aquatic resources	low

B	Exploitation of Ohio listed species by sport/commercial fisheries in other Ohio River states	fishing & harvesting aquatic resources	low
VI	**human intrusions and disturbance**		low
A	Incompatible recreational activities	recreational activities	low
B	Creation of recreational facilities can alter/destroy nearshore habitat	recreational activities	low
C	Creation of commercial facilities can alter/destroy nearshore habitat	work & other activities	low
D	Vessel impacts to nearshore habitats and water quality	recreational activities work & other activities	low low
VII	**natural system modifications**		high
A	The interjurisdictional nature, conflicting priorities, overlapping regulatory responsibilities and limited Ohio ownership complicates management	other ecosystem modifications	low
B	Dam operations can affect movement of aquatic species, impact water quality, and impact habitat (through changing water levels)	dams & water management/use	high
C	Conflicting water control management objectives of controlling agencies (DOW – USACOE)	dams & water management/use	high
D	Some species' polulations have been reduced to levels below what is necessary to recover on their own	other ecosystem modifications	low
VIII	**invasive and other problematic species and genes**		high
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	high
B	Introduction and/or spread of nuisance plants and animals	problematic native species	low
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	high low
D	Possible genetic contamination of native fish stocks from introduced hybrid fishes	introduced genetic material	low
IX	**pollution**		high
A	Urban effluent carries a variety of substances that impact water quality and aquatic species	household sewage & urban wastewater industrial & military effluents garbage & solid waste air-borne pollutants	high medium low low
B	Agricultural effluent from row crops as well as confined animal operations impacts water quality and aquatic species	Agricultural & forestry effluents	high
C	Industrial spills impact water quality and aquatic species	industrial & military effluents	medium
X	**geological events**		negligible
---	none	---	---

XI	**climate change and severe weather**		low
A	Climate change could impact habitats, water quality, and species	habitat shifting & alteration droughts temperature extremes storms & flooding	low low low medium

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Ohio River habitat. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		high	
1	Protect shoreline habitats through acquisition, partnerships, conservation easements, etc.	site/area protection resource & habitat protection	med high	I, II, IV-B, VI-B,C, XI
II	**LAND/WATER MANAGEMENT**		high	
1	Increase habitat diversity in the Ohio River (construct riffles and “T” dikes, dredge embayments, connect backwaters to the mainstem, build islands and wetlands, etc.)	habitat & natural process restoration	high	III-C, IV, V, VI-B,C,D, VII, XI
2	Work with USACOE to minimize negative impacts to fish and wildlife species from dam operations	habitat & natural process restoration	high	III-B, VII-B,C
3	Use lowest impact techniques and timing for dredging activities	habitat & natural process restoration	high	III-C, IV-A, VII-A
4	Work with the USACOE on upland disposal sites for dredge material, or develop innovative ways to create habitat	habitat & natural process restoration	high	IV-A
5	Create and use wetlands for stormwater treatment	habitat & natural process restoration	high	I-A, IX-A
6	Establish an early-detection/rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	high	VIII-A,B
7	Develop a process for coordinating disparate data sources of distribution and abundance of aquatic SGCN with special emphasis on conservation opportunity watersheds	habitat & natural process restoration	high	I-B, III-B,C, IV, V-B, VI-B, C, VII-B, XI
8	Review existing species and habitat data to identify data gaps and needs for additional surveys, research, and management actions	habitat & natural process restoration	high	I, II, III, IV, V, VI, VII, VIII, IX, XI

9	Conduct comprehensive surveys of freshwater mussels	habitat & natural process restoration	high	I-B, III-C, IV, VI-B,C,D, VII, XI
10	Compile Ohio River hydrological/limnological datasets and assess the potential these data may have to explain variations in Ohio River fish populations	habitat & natural process restoration	high	V, VII-B,D, VIII-D
11	Evaluate the efficacy of alternative sampling gears for providing accurate and precise estimates of population metrics for important fishes	habitat & natural process restoration	high	V, VII-D, VIII-D
III	**SPECIES MANAGEMENT**		low	
1	Determine the genetic structure of Ohio River *Sander* spp. populations	species management	med	VIII-D
2	Monitor for the presence of Asian carp in pools adjacent to Ohio	species management	med	VIII-A
IV	**EDUCATION AND AWARENESS**		med	
1	Educate waterfront landowners and commercial pesticide/herbicide applicators on responsible chemical use, and the negative impacts to wildlife from toxic chemicals	training	high	I-B,C, IX-A
2	Promote conservation easements along important shoreline habitat (backwaters, embayments, etc.)	training awareness & communic-ations	high med	I, II, IV-B, VI-B,C, XI
3	Provide technical guidance on shoreline development plans as relates to fish and wildlife interests	training	high	I, IV-B, VI-B,C, XI
4	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communic-ations	med	VIII-A,B,C
5	Provide training to road construction/maintenance personnel for runoff/sediment control	training	high	I-B, IV-B, VI-B,C
V	**LAW AND POLICY**		med	
1	Support legislation promoting eco-friendly energy development and use	legislation	med	III-A,B
2	Find innovative ways to mandate the inclusion of fish and wildlife interests in development plans	policies & regulations private sector standards & codes	med low	I, III-B,C, IV-B, VI-B,C, VII-D, XI
3	Support the creation of additional and/or increase enforcement of stormwater regulations	compliance & enforcement	low	I-A, IX-A
4	Support the use of buffers between development and tributary shorelines	policies & regulations private sector standards & codes	med low	I-A,B, IV-B, IX-A
5	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	med med	VIII

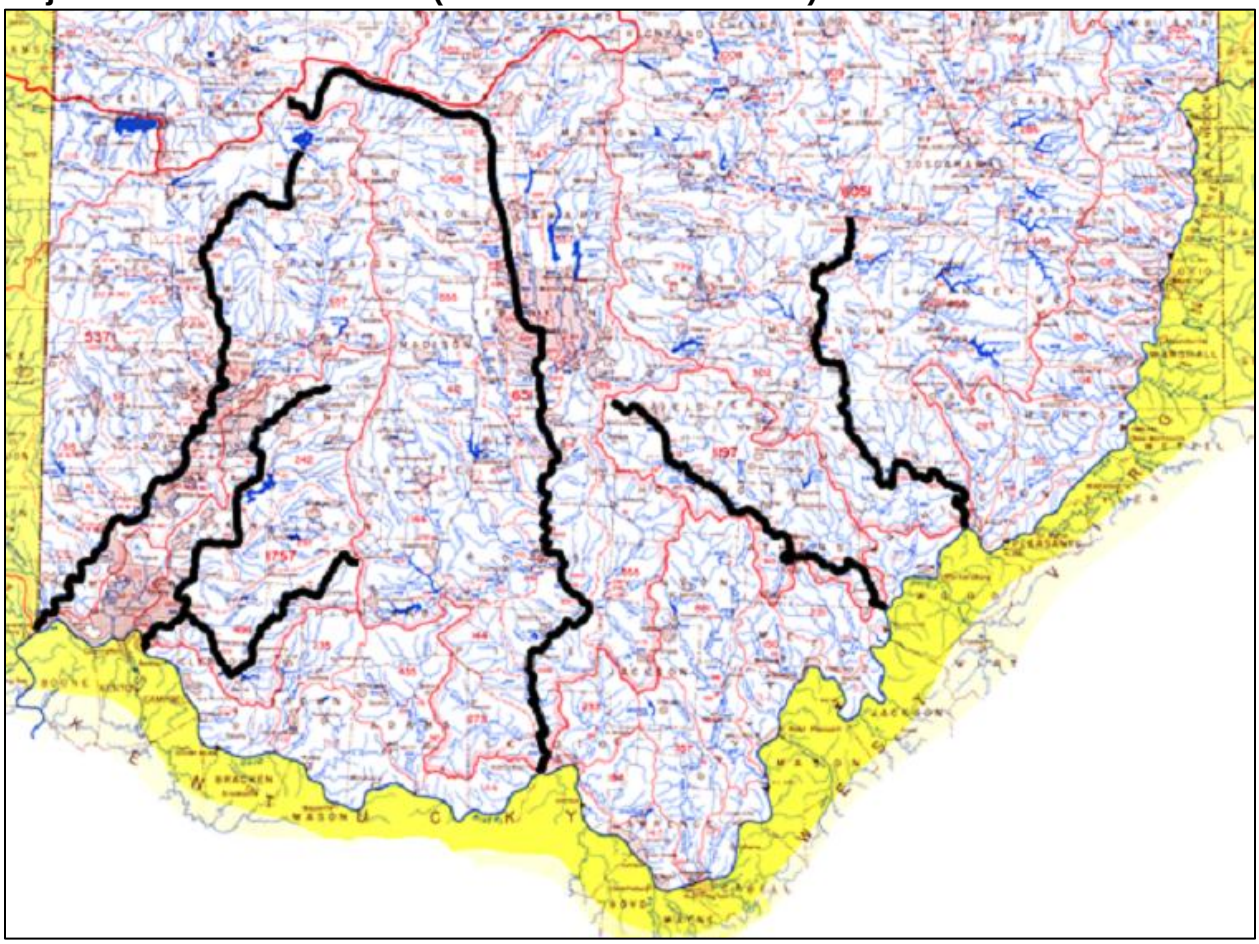
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		med	
1	Explore tying eligibility for grant money, loans, and cost-share programs to nutrient loading levels for agriculture – the lower the nutrient levels in their effluent, the more money they would be eligible for	market forces conservation payments	med med	IX-B,C, XI
2	Create incentives for vegetated buffers along all waterways to reduce nutrient loads and sediment	market forces conservation payments	med med	I, II, IX-A,B,C, XI
3	Create incentives to promote eco-friendly energy development and use	market forces conservation payments non-monetary values	med med low	III-A,B
4	Support the creation of incentives to protect shoreline habitat	market forces conservation payments	med med	I, II, IV-B, VI-B,C, XI
5	Support clean marina and clean vessel programs	market forces conservation payments	med med	VI-D
6	Develop incentives for municipalities to use stormwater management systems that minimize negative impacts to aquatic habitats	market forces conservation payments	med med	I-A, IX-A
7	Support incentives for development plans involving water frontage that take into account wildlife and habitat needs	market forces conservation payments non-monetary values	med med low	I, IV-B, VI-B,C, XI
VII	**EXTERNAL CAPACITY BUILDING**		med	
1	Work with ODA and OEPA to minimize nutrients in runoff, and develop BMPs for pesticide/herbicide use	alliance & partnership development	high	IX
2	Create an interagency spill response team – update contacts and training on a regular basis	alliance & partnership development	high	IX-C
3	Consider creating a multiagency invasive species prevention and control group that would handle all invasive species issues	alliance & partnership development	high	VIII-A,B,C
4	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, and causeway design, construction, and maintenance	alliance & partnership development	high	IV-B
5	Improve inter-jurisdictional relationships within the Ohio River Fisheries Management Team – share data and data gathering	alliance & partnership development	high	I-B, III-B, IV, V, VI, VII, VIII, IX-C, XI

6	Use inter-agency cooperation to influence watershed health, reduce in-stream habitat degradation, and implement projects to improve habitats	alliance & partnership development	high	I, II, III-C, IV, VI-B,C,D, VII-D, IX, XI
7	Collaborate on interjurisdictional management strategies that benefit the resource and constituents, unify regulations, and meet statutory responsibilities	alliance & partnership development	high	VII-A,C
8	Develop or improve reciprocal agreements with Kentucky and West Virginia for fish and wildlife management and wildlife law enforcement	alliance & partnership development	high	VII-A
9	Work with OEPA to encourage completion of TMDL studies for all streams in the Ohio River drainage	alliance & partnership development	high	IX-A,B
10	Encourage/facilitate the establishment of watershed groups and watershed coordinator to promote watershed improvement activities	institutional & civil society development alliance & partnership development	low high	I, II, IX, XI
11	Increase personnel and expertise available for SGCN surveys and research through partnerships with other government agencies and, universities, and conservation-minded NGO's	institutional & civil society development alliance & partnership development	low high	I, II, III, IV, V, VI, VII, VIII, IX, XI

*refers to the Ohio River Habitat Conservation Threats table

Ohio River Tributaries

Major Ohio River tributaries (ODNR Division of Water)



STATUS
Stable to improving. Ohio Environmental Protection Agency (Ohio EPA) surveys indicate general improvement in the physical habitat, water quality, and biological communities of most of the streams in the Ohio River watershed. Ohio's large rivers continue to show improvement as tracked over the last 20 years. The "100% full attainment by 2020" aquatic life goal statistic remains steady at 89.2% full attainment. Taken collectively since the 1980s, the quality of aquatic life in all of Ohio's large rivers has shown a remarkable improvement. Then, only 21% of the large rivers met water quality standards, increasing to 62% in the 1990s, to 89% today. Areas not meeting the standards have decreased from 79% in the 1980s to 38% in the 1990s to 11% today (Ohio EPA 2014a).

DESCRIPTION
In the southern two-thirds of Ohio, tributaries drain south across the 34,361 square mile Ohio River watershed. The five largest tributaries include the Muskingum River (drains 8051 square miles), the Scioto River (drains 6517 square miles), the Great Miami River (drains 5371 square miles), the Little Miami River (drains 1757 square miles), and the Hocking River (drains 1197 square miles). Tributary physical attributes, water quality, habitat, and biological communities tend to follow a west to east gradient across southern Ohio. This gradient results from geographical differences as well as changes in land use practices in the watersheds. The trend is for relief in watersheds to increase from west to east as a result of past glaciation. In the western third of Ohio, the upper reaches of tributary watersheds tend to

be relatively flat, with stream gradients increasing as they enter the Ohio River valley. Land use in this part of the state is dominated by urban/suburban development and agriculture. In the unglatiated eastern two-thirds of Ohio, relief is greater, watersheds are smaller, and stream gradients higher. The predominant land cover in this part of the state is forest, and agriculture is the dominant land use. Streams across this gradient reflect the impacts and impairments that result from land uses within the watershed.

Along Ohio's portion of the Ohio River shoreline, 204 different streams empty directly into the Ohio River. From west to east, those tributary streams are: Great Miami River, Muddy Creek, Rapid Run, Mill Creek, Little Miami River, Fivemile Creek, Eightmile Creek, Tenmile Creek, Pond Run, Twelvemile Creek, Little Indian Creek, Boat Run, Indian Creek, Little Indian Creek, Ray Run, Maple Creek, Bear Creek, Crooked Run, Ryan Run, Bullskin Creek, Moon Hollow Run, Miranda Run, Hog Run, Whiteoak Creek, Straight Creek, Levanna Branch, Cornick Run, Redoak Creek, Eagle Creek, Threemile Creek, Fishing Gut Creek, Little Threemile Creek, Buzzardroost Creek, Elk Run, McClelland Run, Isaacs Creek, Island Creek, Lindsey Creek, Donaldson Run, Cummings Creek, Upper Sister Creek, Spring Run, Ohio Brush Creek, Alex Run, Smokey Creek, Stout Run, Long Lick Run, Wikoff Run, Sulphur Creek, Little Sulphur Creek, Gilpen Run, McCall Run, Rock Run, Lower Twin Creek, Upper Twin Creek, Moore Run, Spencer Run, McAtee Run, Old Pond Run, Pond Run, Nace Run, Turkey Creek, Carey Run, Slab Run, Scioto River, Munn Run, Little Scioto River, Pine Creek, Patton Run, Ginat Creek, Gervais Run, Norman Run, Osburn Run, Storms Creek, Ice Creek, Lick Creek, Salliday Creek, Buffalo Creek, Symmes Creek, Indian Guyan Creek, Paddy Creek, Twomile Creek, Federal Creek, Stillhouse Branch, Swan Creek, Hildebrand Run, Teens Run, Burrels Run, Raccoon Creek, Sardis Run, Long Run, Clark Run, Evans Run, Chickamauga Creek, Mill Creek, George Creek, Campaign Creek, Kyger Creek, Stores Run, Leading Creek, Forest Run, Jesse Run, Bowman Run, Wolf Run, Dunham Run, Tupper Run, Johns Run, Mill Run, Tanner Run, Toms Run, Oldtown Creek, Granny Run, Silver Creek, Savers Run, Groundhog Creek, Dry Run, Locks Run, Wells Run, DeWitt Run, Long Run, Shade River, Guyan Run, Forked Run, Little Forked Run, Sugarcamp Run, Indian Run, Hocking River, Swan Run, Dunfee Run, Sawyer Run, Little Hocking River, Davis Creek, Congress Run, Crooked Run, Mile Run, Muskingum River, Duck Creek, Little Muskingum River, Sheets Run, Allen Run, Bells Run, Newell Run, Danas Run, Reynolds Run, Davis Run, Reas Run, Leith Run, Sheets Run, Collins Run, Mill Creek, Jims Run, Miller Run, Deadhorse Run, Parker Run, Barnes Run, Narrows Run, Patton Run, Pool Run, Havely Run, Texas Creek, Bares Run, Fisher Run, Ueltsch Run, Narrows Run, Litman Run, Muhleman Run, Opossum Creek, Bishop Creek, Sunfish Creek, Gardner Run, Stillhouse Run, Blair Run, Big Run, Captina Creek, Little Captina Creek, Pipe Creek, Big Run, Wegee Creek, McMahon Creek, Indian Run, Whiskey Run, Moore Run, Wheeling Creek, Glenns Run, Patton Run, Deep Run, Short Creek, Little Rush Run, Rush Run, Salt Run, Tarrs Run, Cross Creek, Wells Run, Wills Creek, Island Creek, Croxton Run, Jeremy Run, Goose Run, Brimstone Run, Yellow Creek, McQueen Run, Little Yellow Creek, Wells Run, California Hollow (ODNR 2001).

A brief description of the habitat, water quality, and biological communities for each of the five largest tributaries to the Ohio River follows.

Great Miami River

The following information was assembled from *Total Maximum Daily Loads for the Great Miami River (upper) Watershed* (Ohio EPA 2012d) except where otherwise noted.

The Great Miami River watershed is located in southwestern Ohio and drains a total of 3,802 square miles as it flows through all or part of 15 counties. The river's headwaters begin near Indian Lake, and the Great Miami flows 170 miles in a southweaterly direction before it empties into the Ohio River west of Cincinnati. Most of the Great Miami River Watershed lies within the Eastern Corn Belt Plains Ecoregion which is characterized by rolling till plains with local moraines. Extreme southern portions of the watershed lie within the Northern Bluegrass Ecoregion characterized by more rugged and deeply dissected terrain (Miami Conservancy District 2012).

In general, the northern portion of the watershed is more agricultural while the southern portion is more urban and suburban developed land. Land cover in the upper Great Miami River watershed is comprised of 71% cultivated crops, 8% pasture/hay, 9% forest and 9% developed land. Land cover in the middle

section of the watershed is dominated by cultivated crops (65%) and developed land (20%), with an additional 8% forest and 5% pasture/hay. Land cover in the lower portion of the watershed is dominated by developed urban and residential land (nearly 40%), agricultural land (28%) and forest (19%).

In 2008, Ohio EPA sampled 78 sites on streams in the upper Great Miami River watershed. Overall the watershed met criteria for aquatic life use at 64% of sites, partially met at 26%, and did not meet aquatic life use criteria at 10% of the sites. The causes of impairments included habitat alteration, excess nutrients, silt, flow alteration, organic enrichment, low dissolved oxygen, excess dissolved solids, and bacteria. In the 2008 survey, 79% of sites evaluated for habitat quality had experienced some form of channelization and 62% were still negatively influenced by channelization. Eighteen percent of sites have recovered from historical modification, and only 21% of site channels were considered natural and unmodified.

Bacteriological impairment was pervasive throughout the upper watershed. Primary Contact Recreation criteria were exceeded at 73% of sites. Row crop agriculture was a suspected source of contamination at all of the impaired sites. Normal row crop agricultural activity may also include manure application to farm fields – and portions of the Great Miami basin drain some of the highest manure-producing counties in the state. Biosolids from the larger local municipal wastewater treatment plants are also spread on area fields near the facilities. The lower watershed shows similar causes of impairment, although due to the increasingly urban nature of the watershed in this area, sources of impairment shift to a variety of runoff and discharges from municipalities.

A more detailed discussion of the Great Miami River watershed is provided in the Conservation Opportunity Watersheds section.

Little Miami River

The following information was assembled from *Total Maximum Daily Loads for the Upper Little Miami River* (Ohio EPA 2002), and *Lower Little Miami River Watershed Draft TMDL Report* (Ohio EPA 2010b).

The Little Miami River watershed is located in southwestern Ohio and drains a total of 1,758 square miles as it flows through all or part of 11 counties. The 110-mile-long river joins the Ohio River in Hamilton County on the east side of Cincinnati. The eastern portion of the watershed is predominantly comprised of cultivated crops with pockets of forest and pasture/hay lands. The western portion of the watershed is a mixture of forest, pasture/hay lands and urban development. The majority of the watershed is located within the Eastern Corn Belt Plains ecoregion, which is characterized by level to gently sloping land. Designated a State and National Scenic River, the Little Miami River mainstem contains some of Ohio's most scenic and diverse riverine habitat.

Upper River

The upper Little Miami River watershed covers portions of six counties and drains approximately 657 square miles. The topography of this northern section has been influenced by glaciation which left distinctive land forms and thick deposits of silt, sand, and gravel.

The habitat quality in the upper Little Miami watershed ranges from poor to excellent. For the mainstem, detailed results from Ohio EPA studies show that two patterns are apparent. First, the headwaters upstream from Clifton possess a greater number of human derived habitat attributes than natural attributes. Row crop agriculture strongly influences this part of the basin. Habitat attributes associated with impaired biological performance included sparse cover, no sinuosity, and channelization. The other pattern evident is that the riffles are at least moderately embedded with fine gravel, sand and silt. These two patterns are related – the practices resulting in modified habitat attributes in the headwaters and tributaries result in the bedload of sediment that infiltrates the riffles throughout the mainstem. Two other pervasive sources of sediment loads affecting the mainstem are eroding banks, especially where the riparian buffers have been removed, and suburban development. Downstream from Clifton, the habitat is capable of supporting Exceptional Warmwater Habitat (EWH) communities, with the habitat characterized by natural features derived from a free flowing channel interacting with glacial till and a mature riparian corridor.

Lower River
The lower Little Miami River watershed covers portions of 5 counties and drains about 1100 square miles. Land cover in the watershed is predominantly agriculture (40% cropland, 11% pasture) and forest (30%). About 17% of the watershed is developed or urban land, mostly in the southern portion when current land development is most rapid.

In 2007, the Ohio EPA collected biological, chemical, and physical data in the lower watershed. The mainstem of the Little Miami River showed exceptional quality, as twenty-four of twenty-five locations achieved the State's highest standards for aquatic life. The smaller tributary streams met goals for aquatic communities at 57% of the sites, partially met at 35%, and dis not meet at 12% of the sites. The reason for not meeting aquatic life goals at over half of the impaired sites was low stream flow due to an unusually dry year. The other impaired sites were most impacted by wastewater discharges, where nutrients and organic substances are the pollutants of concern. An excessive amount of fine sediment on the streambed was a problem at some survey sites. This was likely the result of surface or stream bank erosion in cropland areas due to exposed soil, changes in hydrology, and ditch maintenance.

The following information was assembled from *Biological and Water Quality Study of Little Miami River and Tributaries 2012* (Midwest Biodiversity Institute 2013).

Seventeen Little Miami R. mainstem sites were evaluated under the Warmwater Habitat (WWH) suite of uses and biocriteria. Of these, 24% were in full attainment of EWH biocriteria, and the remaining 76% were in partial attainment. The 2012 results represent a decline in attainment status compared to the most recent 2007 Ohio EPA results. The decline was the result of the failure of the fish Index of Biotic Integrity (IBI) to meet the EWH biocriterion. The reduction in the quality of the fish assemblage was substantial and widespread. A total of eight fish species that were present in 2007 were missing in 2012, and 16 additional species exhibited marked declines in distribution and abundance. Fifteen of these 24 species are classified as highly intolerant to pollution. Seven species increased in distribution and abundance and four of these are classified as moderately to highly tolerant of pollution.

Eleven mainstem sites on the East Fork of the Little Miami River were evaluated under the WWH suite of uses and biocriteria. Of these, 1 site was in full attainment of the EWH use and the remaining 10 in partial attainment. Causes of impairment included flow fluctuations, low dissolved oxygen, organic enrichment, habitat modifications, and siltation.

A number of sites on tributaries to the Little Miami River were also evaluated. In general, the majority of sites either did not meet the warmwater habitat aquatic life use criteria, or only partially attained it. The partial and non-attainment of WWH was mostly due to poor quality fish assemblages, and at some locations, poor quality macroinvertebrate assemblages also. The water quality in these tributary streams was typical of watersheds with a high degree of urban development, and urban effluents were the primary source of causes of impairment.

A more detailed discussion of the Little Miami River watershed is provided in the Conservation Opportunity Watersheds section.

Ohio Brush Creek
The following information was assembled from *Biological and Water Quality Study of Ohio Brush Creek and Selected Tributaries 2007* (Ohio EPA 2011b).

Ohio Brush Creek is a moderate sized Ohio River tributary in south central Ohio, draining 435 square miles in portions of 5 counties before it empties into the Ohio River in Adams County just downstream of the town of Rome. The average mainstem gradient is 8.7 ft./mile. The West Fork is the only significant Ohio Brush tributary. Smaller tributaries are numerous, with gradients frequently exceeding 40 ft./mile. These steep gradients are a result of the high relative relief of the uplands.

Ohio Brush Creek watershed is located in the Interior Plateau (IP) Ecoregion. Land cover in the IP varies with topography, but is primarily livestock, pasture, cropland, and forest. Most of the basin is sparsely populated, and within the heart of the watershed (Adams County) land use is roughly split between agriculture and forest. Due to a diverse geology creating diverse habitat types, Adams County supports some of the highest numbers of State listed species in Ohio.

By and large, the channel configuration of the Ohio Brush Creek mainstem is in a natural state, displaying adequate sinuosity and development. Dominant substrates are coarse, consisting of a mixture of native limestone, dolomite, shale, sandstone, and tills. Riparian areas at most sites are vegetated, more often wooded, attenuating sunlight and providing in-stream structure in the form of woody debris and rootwad formations. As measured by the Qualitative Habitat Evaluation Index, the quality of near and in-stream macrohabitat through the length of Ohio Brush Creek appeared capable of supporting diverse, functionally organized, and well-structured assemblages of aquatic organisms, consistent with its existing Exceptional Warmwater Habitat aquatic life use.

Surface flow or stream discharge of Ohio Brush Creek fluctuates widely. Runoff is rapid in the hill county and peak flows generally follow shortly after heavy precipitation. In contrast, during extended dry periods, surface flows often go intermittent or very low, due to a paucity of sustained ground water input. The latter was directly observed during the 2007 Ohio EPA survey which coincided with an extreme drought.

Of the 152 aggregate linear stream miles of the Ohio Brush Creek watershed assessed in 2007, 59.9% were found to fully support existing and recommended aquatic life uses. Partial attainment was indicated for 38.1%, and non-attainment for the remaining 2.0%. By far the leading associated cause and source of the aquatic life use impairments throughout the basin was the significant reduction, diminution and at times elimination of surface flow, due to an extreme drought experienced throughout south-central Ohio in 2007. Nearly all (98.4%) of the impaired stream miles had as their primary cause and source of impairment “low flow” resulting from a prolonged regional drought. Although other stressors were identified for many waterbodies, nearly all of these factors had as their antecedent, diminished surface flow due to an exceptionally dry summer.

The effects of the drought on the fish and macroinvertebrate indices were largely the cause of the low attainment percentages. It is uncommon to find such a high percentage of impaired river miles within a rural and relatively undeveloped watershed, as that observed for Ohio Brush Creek in 2007. The vast majority of fish stations were found to support a diverse and well organized assemblage of fish, showing high species richness and a good representation of sensitive taxa. In contrast, the performance of macroinvertebrates at the same locations typically performed no better than fair, and in almost every instance were the organism group driving attainment status.

A more detailed discussion of the Ohio Brush Creek watershed is provided in the Conservation Opportunity Watersheds section beginning on page xx.

Scioto River

The following information was assembled from *Biological and Water Quality Study of the Middle Scioto River and Select Tributaries, 2010* (Ohio EPA 2012a), *Biological and Water Quality Study of the Upper Scioto River Watershed 2009 & 2011* (Ohio EPA 2012b), and *Ohio 2014 Integrated Water Quality Monitoring and Assessment Report* (Ohio EPA 2014a).

The Scioto River watershed is located in central and south central Ohio and drains a total of 6,513 square miles in all or part of 31 counties. The Scioto River flows into the Ohio River at Portsmouth in Scioto County. The main stem of the Scioto River is over 236 miles long and has an average gradient of 2.3 feet per mile. The watershed is located in the Eastern Corn Belt Plains (ECBP) ecoregion. The northern portion of the watershed is predominantly comprised of cultivated crops with some areas of substantial urban development. The southern portion of the watershed is primarily comprised of forest with pockets of agricultural lands.

Upper River
The upper Scioto River watershed is located in the northwestern portion of central Ohio. The predominant land cover in this part watershed is cultivated crops at 80%. Other relatively common land cover types include developed land (8%), forest (6%) and pasture/hay (4%).

In 2009, 23 streams in the upper Scioto River watershed were assessed by the Ohio EPA. Scioto River mainstem habitat quality was highly variable and ranged from very poor to excellent. The average Qualitative Habitat Evaluation Index (QHEI) score for the upper Scioto River mainstem reflected overall good habitat quality. However, for more than sixteen miles the mainstem is severely modified from channelization, and habitats scored in the poor to fair range. Excellent physical habitat was scored outside of this reach, which helped increase the diversity and biological recruitment potential in the fish communities. High quality tributaries were rarely encountered in the upper Scioto River basin and a majority of samples reflected degraded or marginal quality. As a result of widespread impairment encountered in the upper Scioto basin, high quality biological communities were rarely found.

Fish sampling was conducted during the upper Scioto River watershed assessment in 2009 and 2011. The upper Scioto River headwater site was the only biologically exceptional fish community sampled and had five darter species in the community. The Scioto River downstream of Kenton scored very good, while 40% of mainstem sites scored good and the other 47% were found to have only marginally good or fair quality fish communities.

Macroinvertebrates were sampled at 14 locations along the upper Scioto River mainstem in 2009. Scioto River mainstem sites achieved the applicable Warmwater Habitat (WWH) macroinvertebrate biocriterion at all sites evaluated. The average Invertebrate Community Index (ICI) score was generally reflective of good to very good biological quality. Communities maintained good to exceptional quality from Kenton to the Little Scioto River confluence.

Throughout the study area, channelization and nutrient enrichment associated with agriculture were considered the most common and widespread stressors at these lower quality sites. For macroinvertebrates, the negative effects of these activities were manifest in low total taxa, low sensitive taxa richness, and a predominance of facultative, nutrient and silt tolerant populations. These mostly facultative populations included a number of flatworms, blackflies, midges and riffle beetles, along with several common varieties of baetid mayflies and net-spinning caddisflies.

Middle River
The middle Scioto River watershed is located in central Ohio. Forty-five percent of the basin is developed to some degree (ranging from high to low density development) while cropland by itself accounts for another forty percent of the area. Forest and pastureland account for an additional six and five percent respectively. The middle Scioto River mainstem has a designated aquatic life use of WWH throughout the study area, except for the 2.5 miles impounded by the Greenlawn Avenue dam. In addition, two stretches of the middle Scioto River are impounded by reservoirs: O'Shaugnessy Reservoir (6.6 miles) and Griggs Reservoir (5.9 miles).

Nearly half of the sites within the middle Scioto River basin did not meet the biological integrity goal, as only 58% were in full attainment of the WWH aquatic life use designation. The remaining sites were in partial (19%) or non-attainment (19%) of WWH criteria. Full attainment of a reduced-goal aquatic life use was achieved at the remaining 4%. While 84.6% of the Scioto River mainstem from the Little Scioto River to Big Darby Creek were in full attainment of the designated aquatic life use, organic enrichment downstream of Columbus contributed to 8.1% of partial attainment in the lower reach of the river.

Excellent stream habitat was noted at 39% of sites sampled, good stream habitat was recorded at another 39% of sites, fair habitat was noted at 18% of locations, and poor habitat accounted for the remaining 4%. The average QHEI score for the watershed reflected generally good habitat quality throughout the study area. The Scioto River mainstem had excellent to good habitat quality at 88% of sampling locations. Two sites scored within the fair range as a result of impounded conditions caused by dams.

A total of 82 species of fish were collected from the study area between June 2009 and September 2010. Fourteen very sensitive species were collected, reflecting the overall integrity of the middle Scioto River basin. Scioto River mainstem sites sampled achieved the applicable WWH biocriteria at all sites with this aquatic life use designation. Exceptional fish communities were recorded at all but two sites sampled.

The macroinvertebrate communities from 18 locations in the middle Scioto River and 20 locations in tributaries to the middle Scioto River watershed were sampled in 2009 and 2010. The middle Scioto River mainstem achieved the WWH macroinvertebrate biocriterion at 78% of sites sampled. The average ICI score for the Scioto River mainstem was reflective of overall good biological quality. The four sites that did not meet WWH criteria were impacted by either dams or by the influence urban/suburban effluent.

Lower River
The lower Scioto River watershed is located in south central Ohio. Predominant land cover in this part of the watershed includes forest (47%), cultivated crops (26%) and pasture/hay (13%). Approximately 7.5% of the watershed is developed land. The lower Scioto River from the confluence of Big Darby Creek to the mouth at the Ohio River (101 miles) was in 100% attainment of aquatic life use.

A more detailed discussion of the Scioto River watershed is provided in the Conservation Opportunity Watersheds section.

Hocking River
The following information was assembled from *Total Maximum Daily Loads for the Hocking River Watershed* (Ohio EPA 2009b).

The Hocking River watershed, including Sunday and Monday creeks, is located in southeastern Ohio and drains a total of 1,196 square miles in all or part of seven counties. The Hocking River mainstem is over 102 miles long, emptying into the Ohio River at Hockingport. The northern portion of the watershed is predominantly comprised of cultivated crops. The southern portion of the watershed is predominantly forest, with some hay and pasture lands, and pockets of urban development. Overall, land cover in the watershed is predominantly forest (62%) and agricultural lands (27%). About 9% of the watershed is developed or urban land.

The Hocking River watershed is located within parts of the three different ecoregions: the Eastern Corn Belt Plains (ECBP), the Erie-Ontario Lake Plains (EOLP), and the Western Allegheny Plateau (WAP). The ECBP ecoregion consists primarily of rolling till plains with local end moraines. Corn, soybean, and livestock production is widespread. The EOLP ecoregion is characterized by low lime drift overlying rolling to level terrain with scattered end moraines and kettles. The WAP has a more rugged, unglaciated terrain with local relief up to 500 feet. The underlying strata of the WAP contain significant coal, oil, and gas deposits. Extraction of coal, oil, and gas has had and continues to have a major effect on the ecology of the region. Steep slopes in the region limit crop and cattle production to valley floors that reduces riparian corridors and concentrates animal wastes near the stream.

Ohio EPA conducted a comprehensive physical, chemical, and biological survey in portions of the Hocking River watershed from 2003 to 2005. Aquatic life uses were fully met at nearly 70% of sampling sites throughout the watershed. Just over 20% of the sites sampled were found to be in partial attainment where one or two of the three biological indices (habitat, fish, invertebrates) were met. About 10% of the sites failed to meet any of the biological criteria. The Upper Rush Creek assessment unit is severely impacted by acid mine drainage (AMD) along the mainstem of Rush Creek and some of its small tributaries. These streams are essentially devoid of fish and macroinvertebrates. Due to the overwhelming impact from the AMD, some streams and stream segments are designated as limited resource waters. Primary sources of non-attainment in the watershed were excess nutrients/organic enrichment, sedimentation, habitat alteration, and acid mine drainage.

Based upon Qualitative Habitat Evaluation Index (QHEI) scores, the Hocking River mainstem had good to excellent habitat quality at 66% of sampling locations. In general, habitat quality improved in a downstream direction. Habitat scores in tributary streams were good to excellent in areas not impacted by

agriculture or mine drainage. Impacted stream sampling sites generally did not meet Warmwater Habitat (WWH) criteria.

Fish communities met WWH or Exceptional Warmwater Habitat (EWH) criteria at about 70% of sites sampled on the Hocking mainstem. Community scores improved in a downstream direction. Fish community scores in tributary streams usually met WWH or EWH unless impacted by mine drainage. Macroinvertebrate communities met WWH criteria or better at about 90% of Hocking mainstem sites. Macroinvertebrate communities from tributary streams were rated moderately good or better at about 80% of sites sampled.

Muskingum River

The following information was assembled from *2006 Biological and Water Quality Study of the Muskingum River* (Ohio EPA 2007a).

Located in eastern Ohio, the Muskingum River drains the largest watershed in the state, encompassing 8,051 square miles in all or part of 27 counties. The mainstem is 112 miles long and enters the Ohio River near Marietta. The Muskingum River is located in the Western Allegheny Plateau (WAP) ecoregion. The northern portion of the watershed is a mixture of urban development, agricultural land, and forest. The southern portion of the watershed is predominantly comprised of forest, with some hay and pasture lands and pockets of urban development.

Ten locks and dams are currently located on the mainstem of the lower 85 miles of the Muskingum River. This system of dams and locks, built to allow commercial use of the river, was one of the earliest slack water systems in the United States. The Muskingum River is no longer used for commercial navigation. Today, recreational boaters use the river, with more than 5,800 boats “locking through” the river’s navigation system annually.

Biological sampling in the Muskingum River during 2006 demonstrated that the entire length of river is fully attaining the Warmwater Habitat (WWH) aquatic life-use designation. Surveys of the fish and macroinvertebrate communities of the Muskingum River revealed healthy populations of numerous pollution sensitive species, along with localized populations of rare, threatened, and endangered species. Most of the free-flowing and tailwater sites supported exceptional biological communities, and chemical water testing results were generally reflective of good water quality.

A total of 65 species of fish were collected from the Muskingum River during 2006 surveys. Muskingum River fish communities at 93% of sampling locations achieved the WWH biocriterion. Index of Biotic Integrity (IBI) scores and Modified Index of Well-being scores were all within the marginally good to exceptional range. An evaluation of fish communities by habitat type (free-flowing upper section, tailwaters, and impounded sections) reveals that the free-flowing and tailwater sites were largely reflective of very good to exceptional conditions, and at or approaching Exceptional Warmwater Habitat (EWH) levels of biological integrity. Physical habitat features at the free-flowing and tailwater sections were adequate for supporting the EWH aquatic life-use designation.

Ohio threatened (T), or species of concern (SC) fish collected during this survey included blue sucker (T), mountain madtom (T), river redhorse (SC), and eastern sand darter (SC). Fish species collected which are intolerant of water pollution included mooneye, blue sucker, river redhorse, bigeye chub, streamline chub, silver shiner, rosyface shiner, mimic shiner, stonecat madtom, mountain madtom, slenderhead darter, eastern sand darter, banded darter, variegate darter, and bluebreast darter. River redhorse and mimic shiner, two species intolerant of water pollution, were recorded at a number of sampling sites on the Muskingum River. Mimic shiners were recorded from impounded and freeflowing (including tailwater) sites, with fish collected from 22 of 28 sampling locations. River redhorse, a fish species which prefers moderate to swift water habitat, were recorded from 15 of 16 free-flowing sites.

Macroinvertebrate sampling results from 2006 indicate that all sampled sites were in full attainment of the WWH biocriterion. A more detailed discussion of the Muskingum River watershed is provided in the Conservation Opportunity Watersheds section.

ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

The physical and chemical characteristics of Ohio River tributaries change as you move from unglaciated eastern Ohio and transition to the glaciated western part of the state. Changes in gradient and land cover drive changes in stream characteristics from east to west. The eastern portion of the Ohio River watershed is predominantly comprised of forest with some areas of crops, pasture, and hay lands. The central portion of the watershed is a more even mixture of crops, pasture and hay lands, and forest. The western portion of the watershed is primarily comprised of urban development and agriculture. The aquatic communities of Ohio River tributaries are a reflection of the glaciated versus unglaciated differences in the watershed.

The following species have been identified as Ohio River Tributary species of greatest conservation need (conservation status rank in parentheses):

<u>FISH</u>

Diamond Darter (2)	*Crystallaria cincotta*
American Eel (5)	*Anguilla rostrata*
Paddlefish (9)	*Polyodon spathula*
Shoal Chub (11)	*Macrhybopsis hyostoma*
Ohio Lamprey (13)	*Ichthyomyzon bdellium*
Alligator Gar (15)	*Lepisosteus spatula*
Lake Sturgeon (17)	*Acipenser fulvescens*
Blue Sucker (18)	*Cycleptus elongatus*
Shovelnose Sturgeon (19)	*Scaphirhynchus platorynchus*
Tippecanoe Darter (20)	*Etheostoma tippecanoe*
Bluebreast Darter (25)	*Etheostoma camurum*
Eastern Sand Darter (29)	*Ammocrypta pellucida*
Gravel Chub (32)	*Erimystax x-punctatus*
Silver Chub (36)	*Macrhybopsis storeriana*
Goldeye (39)	*Hiodon alosoides*
Streamline Chub (41)	*Erimystax dissimilis*
Bigeye Chub (42)	*Hybopsis amblops*
Channel Darter (44)	*Percina copelandi*
Black Redhorse (48)	*Moxostoma duquesnei*
Mooneye (50)	*Hiodon tergisus*
Silver Redhorse (52)	*Moxostoma anisurum*
Variegate Darter (53)	*Etheostoma variatum*
Black Buffalo (56)	*Ictiobus niger*
Dusky Darter (58)	*Percina sciera*
Shortnose Gar (60)	*Lepisosteus platostomus*
River Darter (61)	*Percina shumardi*
Mississippi Silvery Minnow (62)	*Hybognathus nuchalis*
River Redhorse (63)	*Moxostoma carinatum*
Smallmouth Redhorse (63)	*Moxostoma breviceps*
Scarlet Shiner (68)	*Lythrurus fasciolaris*
Slenderhead Darter (68)	*Percina phoxocephala*
Brindled Madtom (70)	*Noturus miurus*
Channel Shiner (70)	*Notropis volucellus wickliffi*
Highfin Carpsucker (72)	*Carpiodes velifer*
Blue Catfish (73)	*Ictalurus furcatus*
Orangethroat Darter (74)	*Etheostoma spectabile*
Bowfin (76)	*Amia calva*
Spotted Sucker (76)	*Minytrema melanops*
Stonecat Madtom (78)	*Noturus flavus*
River Carpsucker (79)	*Carpiodes carpio*
Bigmouth Buffalo (80)	*Ictiobus cyprinellus*
River Shiner (80)	*Notropis blennius*

Tadpole Madtom (80)	*Noturus gyrinus*
Ghost Shiner (83)	*Notropis buchanani*
Longnose Gar (83)	*Lepisosteus osseus*
Silver Shiner (83)	*Notropis photogenis*
Threadfin Shad (87)	*Dorosoma petenense*
Smallmouth Buffalo (88)	*Ictiobus bubalus*
Fantail Darter (89)	*Etheostoma flabellare*
Golden Redhorse (89)	*Moxostoma erythrurum*
Longear Sunfish (91)	*Lepomis megalotis*
Steelcolor Shiner (91)	*Cyprinella whipplei*
Mimic Shiner (94)	*Notropis volucellus*
Greenside Darter (95)	*Etheostoma blennioides*
Skipjack Herring (96)	*Alosa chrysochloris*
Bullhead Minnow (97)	*Pimephales vigilax*
Banded Darter (100)	*Etheostoma zonale*
Rainbow Darter (100)	*Etheostoma caeruleum*
Trout Perch (102)	*Percopsis omiscomaycus*
Blackside Darter (103)	*Percina maculata*
Rosyface Shiner (103)	*Notropis rubellus*
Johnny Darter (106)	*Etheostoma nigrum*
Quillback Carpsucker (107)	*Carpiodes cyprinus*
Redfin Shiner (107)	*Lythrurus umbratilis*
Spotfin Shiner (114)	*Cyprinella spiloptera*
Shorthead Redhorse (115)	*Moxostoma macrolepidotum*
Logperch Darter (116)	*Percina caprodes*
Silverjaw Minnow (117)	*Notropis buccatus*
Northern Hogsucker (119)	*Hypentelium nigricans*
Brown Bullhead (120)	*Ameiurus nebulosus*
Central Stoneroller (120)	*Campostoma anomalum*
Yellow Bullhead (120)	*Ameiurus natalis*
Northern Studfish (124)	*Fundulus catenatus*
Sand Shiner (124)	*Notropis stramineus*
Emerald Shiner (127)	*Notropis atherinoides*
Striped Shiner (127)	*Luxilus chrysocephalus*
Golden Shiner (129)	*Notemigonus crysoleucas*
Black Bullhead (130)	*Ameiurus melas*
Creek Chub (132)	*Semotilus atromaculatus*
Freshwater Drum (132)	*Aplodinotus grunniens*
Bluntnose Minnow (135)	*Pimephales notatus*
Rock Bass (135)	*Ambloplites rupestris*
Suckermouth Minnow (137)	*Phenacobius mirabilis*
White Sucker (137)	*Catostomus commersoni*
Fathead Minnow (139)	*Pimephales promelas*
Flathead Catfish (141)	*Pylodictis olivaris*
Warmouth (142)	*Lepomis gulosus*
Sauger (143)	*Sander canadense*
Spotted Bass (144)	*Micropterus punctulatus*
Green Sunfish (147)	*Lepomis cyanellus*
Orangespotted Sunfish (148)	*Lepomis humilis*
Smallmouth Bass (151)	*Micropterus dolomieu*
Ohio Muskellunge (152)	*Esox masquinongy ohioensis*
Channel Catfish (153)	*Ictalurus punctatus*
White Bass (155)	*Morone chrysops*
Gizzard Shad (157)	*Dorosoma cepedianum*
Bluegill Sunfish (159)	*Lepomis macrochirus*
Largemouth Bass (160)	*Micropterus salmoides*

Black Crappie (161)	*Pomoxis nigromaculatus*
White Crappie (163)	*Pomoxis annularis*
Speckled Chub (likely EX)	*Macrhybopsis aestivalis*

CRAYFISH

Teays River Crayfish (1)	*Cambarus sciotensis*
Norwood River Crayfish (2)	*Orconectes raymondi*
Sanborn's Crayfish (6)	*Orconectes sanbornii*
Big Water Crayfish (7)	*Cambarus robustus*
Paintedhand Mudbug (8)	*Cambarus polychromatus*
Little Brown Mudbug (9)	*Cambarus thomai*
Spiney Stream Crayfish (11)	*Orconectes cristavarius*
Papershell Crayfish (13)	*Orconectes immunis*
Red Swamp Crayfish (13)	*Procambarus clarkii*
Virile Crayfish (13)	*Orconectes virilis*
Appalachian Brook Crayfish (16)	*Cambarus bartonii cavatus*
White River Crayfish (17)	*Procambarus acutus*
Rusty Crayfish (18)	*Orconectes rusticus*
Rock Crawfish (19)	*Cambarus carinirostris*
Sloan's Crayfish (20)	*Orconectes sloanii*
Allegheny Crayfish (21)	*Orconectes obscurus*

MUSSELS

White Wartyback (1)	*Plethobasus cicatricosus*
Snuffbox (5)	*Epioblasma triquetra*
Long Solid (6)	*Fusconaia subrotunda*
Ebonyshell (8)	*Fusconaia ebena*
Elephantear (8)	*Elliptio crassidens*
Pyramid Pigtoe (8)	*Pleurobema rubrum*
Orange-foot Pimpleback (12)	*Plethobasus cooperianus*
Ohio Pigtoe (13)	*Pleurobema cordatum*
Sheepnose (13)	*Plethobasus cyphyus*
Monkeyface (16)	*Quadrula metanevra*
Slippershell Mussel (16)	*Alasmidonta viridis*
Ring Pink (18)	*Obovaria retusa*
Scaleshell (18)	*Leptodea leptodon*
Winged Mapleleaf (18)	*Quadrula fragosa*
Butterfly (21)	*Ellipsaria lineolata*
Rayed Bean (21)	*Villosa fabalis*
Creek Heelsplitter (23)	*Lasmigona compressa*
Pondhorn (23)	*Uniomerus tetralasmus*
Fanshell (25)	*Cyprogenia stegaria*
Rabbitsfoot (25)	*Quadrula cylindrica*
Salamander Mussel (25)	*Simpsonaias ambigua*
Wartyback (25)	*Quadrula nodulata*
Clubshell (35)	*Pleurobema clava*
Rough Pigtoe (35)	*Pleurobema plenum*
Purple Wartyback (37)	*Cyclonaias tuberculata*
Yellow Sandshell (37)	*Lampsilis teres*
Spectaclecase (39)	*Cumberlandia monodonta*
Threeridge (40)	*Amblema plicata*
Washboard (40)	*Megalonaias nervosa*
Cracking Pearlymussel (42)	*Hemistena lata*
Pocketbook (42)	*Lampsilis ovata*
Round Hickorynut (42)	*Obovaria subrotunda*
Black Sandshell (47)	*Ligumia recta*

Kidneyshell (48)	*Ptychobranchus fasciolaris*
Northern Riffleshell (48)	*Epioblasma torulosa rangiana*
Rainbowshell (50)	*Villosa iris*
Round Pigtoe (50)	*Pleurobema sintoxia*
Elktoe (52)	*Alasmidonta marginata*
Deertoe (53)	*Truncilla truncata*
Fawnsfoot (53)	*Truncilla donaciformis*
Threehorn Wartyback (55)	*Obliquaria reflexa*
Cylindrical Papershell (56)	*Anodontiodes ferussacianus*
Fat Pocketbook (56)	*Potamilus capax*
Fluted Shell (58)	*Lasmigona costata*
Flat Floater (59)	*Anodonta suborbiculata*
Creeper (60)	*Strophitus undulatus*
Lilliput (61)	*Toxolasma parvum*
Spike (61)	*Elliptio dilatata*
Wabash Pigtoe (61)	*Fusconaia flava*
Mucket (64)	*Actinonaias ligamentina ligamentina*
Mucket (64)	*Actinonaias ligamentina carinate*
Paper Pondshell (66)	*Utterbackia imbecillis*
Pistolgrip (66)	*Quadrula verrucosa*
Wavyrayed Lampmussel (68)	*Lampsilis fasciola*
Hickorynut (69)	*Obovaria olivaria*
Fragile Papershell (71)	*Leptodea fragilis*
Plain Pocketbook (72)	*Lampsilis cardium*
Mapleleaf (73)	*Quadrula quadrula*
Pimpleback (74)	*Quadrula pustulosa*
Pink Papershell (74)	*Potamilus ohiensis*
White Heelsplitter (74)	*Lasmigona complanata*
Fatmucket (77)	*Lampsilis radiata*
Giant Floater (77)	*Pyganodon grandis*
Pink Heelsplitter (79)	*Potamilus alatus*
Eastern Elliptio (EX)	*Elliptio complanata*

AMPHIBIANS

Mudpuppy (14)	*Necturus maculosus maculosus*

REPTILES

Rough Green Snake (3)	*Opheodrys aestivus*
Midland Smooth Softshell (7)	*Apalone mutica mutica*
Common Map Turtle (19)	*Graptemys geographica*
Ouachita Map Turtle (19)	*Graptemys ouachitensis*
Queen Snake (19)	*Regina septemvittata*
Red-eared Slider (31)	*Trachemys scripta elegans*
Common Musk Turtle (34)	*Sternotherus odoratus*
Eastern Spiny Softshell (36)	*Apalone spinifera spinifera*
Midland Painted Turtle (40)	*Chrysemys picta marginata*
Northern Water Snake (40)	*Nerodia sipedon sipedon*

CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Ohio River Tributaries. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		medium
A	Watershed conversion to urban/commercial development alters hydrology	housing & urban areas commercial & industrial areas	medium low
B	Shoreline development and its effect on habitat and species	housing and urban areas commercial & industrial areas tourism & recreation areas	medium low low
C	Increasing land prices limits our ability to protect riparian corridors	housing and urban areas commercial & industrial areas tourism & recreation areas	medium low low
II	**agriculture and aquaculture**		medium
A	Loss of riparian corridor to agriculture	annual & perennial non-timber crops livestock farming & ranching	high low
B	Watershed conversion to agriculture alters hydrology	annual & perennial non-timber crops livestock farming & ranching	high low
III	**energy production and mining**		low
A	Oil and gas extraction - can have negative impacts by causing chemical contamination	oil & gas drilling	low
B	Hydropower facilities disrupt stream connectivity and kill aquatic species	renewable energy	low
C	Water withdrawal for fracking alters hydrology	oil & gas drilling	low
D	Instream sand/gravel operations destroy habitat	mining & quarrying	low
E	Coal mining can result in acid mine drainage	mining & quarrying	low
IV	**transportation and service corridors**		low
A	Channel modification/dredging causes habitat loss, water quality impacts	shipping lanes	negligible
B	Roads, bridges, causeways, utilities, impact shoreline/nearshore habitats	roads & railroads utility & service lines	low low

V	**biological resource use**		low
A	Fishing pressure and fishing gear impacts	fishing & harvesting aquatic resources	low
VI	**human intrusions and disturbance**		low
A	Incompatible recreational activities	recreational activities	low
B	Creation of recreational facilities can alter/destroy nearshore habitat	recreational activities	low
C	Vessel impacts to nearshore habitats and water quality	recreational activities work & other activities	low negligible
VII	**natural system modifications**		medium
A	Dams cause habitat loss, sedimentation, decreased water quality, reduced biodiversity, and reduce movement of aquatic species and species abundance	dams & water management/use	medium
B	Conflicting water control management objectives of controlling agencies (DOW – USACOE)	dams & water management/use	medium
VIII	**invasive and other problematic species and genes**		high
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	high
B	Introduction and/or spread of nuisance plants and animals	problematic native species	low
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	high low
D	Possible genetic contamination of native fish stocks from introduced hybrid fishes	introduced genetic material	low
IX	**pollution**		high
A	Urban effluent carries a variety of substances that impact water quality and aquatic species	household sewage & urban wastewater industrial & military effluents garbage & solid waste air-borne pollutants	high medium low low
B	Agricultural effluent from row crops as well as confined animal operations impacts water quality and aquatic species	agricultural & forestry effluents	very high
C	Industrial spills impact water quality and aquatic species	industrial & military effluents	medium
X	**geological events**		negligible
---	none	---	---
XI	**climate change and severe weather**		low
A	Climate change could impact habitats, water quality, and species	habitat shifting & alteration droughts temperature extremes storms & flooding	low low low medium

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Ohio River Tributaries habitat. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		med	
1	Protect riparian corridors through acquisition, partnerships, conservation easements, etc.	site/area protection resource & habitat protection	low high	I, II, IV-B, VI-B
II	**LAND/WATER MANAGEMENT**		high	
1	Develop GIS tools to archive and monitor the status of protected lands in conservation opportunity watersheds	site/area management	low	XI
2	Work with OEPA, ODOT, USACE, and other government agencies to focus mitigation activities on riparian habitats in conservation opportunity watersheds	habitat & natural process restoration	high	I-A, II-A, IV-B, VI-B, XI
3	Work with landowners to develop and implement habitat improvement projects on private lands	habitat & natural process restoration	high	I, II, XI
4	Remove dams to restore stream connectivity and improve water quality	habitat & natural process restoration	high	VII-A, XI
5	Develop criteria for prioritizing candidate dams for removal – give extra emphasis to dams in conservation opportunity watersheds	habitat & natural process restoration	high	III-B, VII
6	Research fish passage improvements for dams that are not candidates for removal	habitat & natural process restoration	high	III-B, VII
7	Identify and prioritize restoration projects (channel restoration, floodplain and backwater reconnection, etc.) in conservation opportunity watersheds	habitat & natural process restoration	high	I-A,B, II, IV, VII-B, XI
8	Complete one geomorphological restoration project in each conservation opportunity watershed every 5 years	habitat & natural process restoration	high	I-A,B, II, IV, VII, XI
9	Develop model stream protection guidelines aimed at slowing the overland flow of water into streams	habitat & natural process restoration	high	I-A, II-B, IX-A,B
10	Use lowest impact techniques and timing for dredging activities	habitat & natural process restoration	high	III-D, IV-A, VII-B
11	Create and use wetlands for stormwater treatment	habitat & natural process restoration	high	I-A, IX-A
12	Establish an early-detection/rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	high	VIII-A,B

13	Develop ways to control invasive plant species in flowing waters	invasive/ problematic species control	high	VIII-A,B
14	Develop a process for coordinating disparate data sources of distribution and abundance of aquatic SGCN with special emphasis on conservation opportunity watersheds	habitat & natural process restoration	high	I-B, III-B,D, IV-A,B, VI-B, VII-A, XI
15	Review existing species and habitat data to identify data gaps and needs for additional surveys, research, and management actions	habitat & natural process restoration	high	I, II, III, IV, V, VI, VII, VIII, IX, XI
16	Conduct comprehensive surveys of freshwater mussels in all conservation opportunity watersheds	habitat & natural process restoration	high	I-B, III-C,D, IV-A,B, VI-B, VII, XI
17	Conduct watershed studies to identify and prioritize restoration opportunities	habitat & natural process restoration	high	I-B, II-A, III-E, IV-A, VI-B, VII, XI
18	Stabilize severely eroding streambanks with bio-engineering techniques	habitat & natural process restoration	high	I-A,B, II, VI-C
19	Reconnect stream channels with natural floodplains	habitat & natural process restoration	high	I-A,B, II, IV, VII-B, XI
20	Restore/stabilize riparian habitat by planting native grasses, shrubs, and trees	habitat & natural process restoration	high	I-B, II-A, IV-B
21	Use treatment techniques to control the pH of effluent on abandoned mine lands	habitat & natural process restoration	high	III-E
III	**SPECIES MANAGEMENT**		low	
1	Monitor for the presence of Asian carp in the lower portions of large tributaries	species management	med	VIII-A
IV	**EDUCATION AND AWARENESS**		high	
1	Educate waterfront landowners and commercial pesticide/herbicide applicators on responsible chemical use, and the negative impacts to wildlife from toxic chemicals	training	high	I-B,C, IX-A
2	Promote conservation easements to protect riparian habitat	training awareness & communic-ations	high high	I, II, IV-B, VI-B, XI
3	Conduct shoreline protection/stabilization workshops	training	high	I-B, II-A, IV-B, VI-B
4	Provide technical guidance on shoreline development plans as relates to fish and wildlife interests	training	high	I, IV-B, VI-B, XI
5	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communic-ations	high	VIII
6	Provide training to road construction/maintenance personnel for runoff/ sediment control	training	high	I-B, IV-B, VI-B
7	Educate the public and legislators on the benefits of dam removals	training awareness & communic-ations	high high	VII-A

8	Provide training in geomorphological, fluvial, and in-stream flow processes for DOW personnel	training	high	III-B,C,D, IV, VI-B, VII-A,B
9	Develop and provide streams/watersheds educational materials for landowners, schools, public officials, and the general public	training awareness & communic-ations	high high	I, II, IX-A,B, XI
10	Create and implement demonstration projects aimed at reducing urban effluent – such as rain gardens, bioretention, etc.	training awareness & communic-ations	high high	I-A,B, IX-A
11	Conduct outreach for landowners on private land management, conservation practices, and water quality	training awareness & communic-ations	high high	I, II, IX-A,B
V	**LAW AND POLICY**		high	
1	Support legislation promoting eco-friendly energy development and use	legislation	high	III-A,B,C,E
2	Find innovative ways to mandate the inclusion of fish and wildlife interests in development plans	policies & regulations private sector standards & codes	high low	I, III-B,C,D,E, IV-B, VI-B, XI
3	Support the creation of additional and/or increased enforcement of stormwater regulations	policies & regulations compliance & enforcement	high med	I-A, IX-A
4	Support the use of buffers between development and tributary shorelines	policies & regulations private sector standards & codes	high low	I-A,B, IV-B, IX-A
5	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	high high	VIII
6	Support sewage sludge/animal manure disposal standards to regulate application rates and timing	policies & regulations	high	IX-A,B
7	Encourage and support minimum flow regulations that protect downstream aquatic habitats	policies & regulations	high	III-B, VII-A,B, IX-A,B
8	Support increased regulation of home sewage treatment systems	compliance & enforcement	med	IX-A
9	Promote riparian protection ordinances that prevent floodplain encroachment and riparian habitat removal	policies & regulations private sector standards & codes	high low	I, II, IV-B, VI-B

VI	LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES		med	
1	Explore tying eligibility for grant money, loans, and cost-share programs to nutrient loading levels for agriculture – the lower the nutrient levels in their effluent, the more money they would be eligible for	market forces conservation payments	high high	IX-B, XI
2	Create incentives for vegetated buffers along all waterways to reduce nutrient loads and sediment	market forces conservation payments	high high	I, II, IX-A,B, XI
3	Create incentives to promote eco-friendly energy development and use	market forces conservation payments non-monetary values	high high low	III-A,B,C,E
4	Support the creation of incentives to protect riparian habitat	market forces conservation payments	high high	I, II, IV-B, VI-B, XI
5	Support clean marina and clean vessel programs	market forces conservation payments	high high	VI-C
6	Develop incentives for municipalities to use stormwater management systems that minimize negative impacts to aquatic habitats	market forces conservation payments	high high	I-A, IX-A
7	Support incentives for development plans involving water frontage that take into account wildlife and habitat needs	market forces conservation payments non-monetary values	high high low	I, IV-B, VI-B, XI
8	Support payments to offset losses (revenue from crops) resulting from implementation of conservation practices aimed at reducing sediment loads	conservation payments	high	IX-B
9	Create incentives to encourage the use of conservation tillage – especially in impaired watersheds	market forces conservation payments	high high	IX-B
10	Support incentives for conservation farming practices – including nutrient management plans and livestock waste management plans	market forces conservation payments	high high	IX-B
11	Encourage the use of cover crops for idle agricultural fields	market forces conservation payments	high high	IX-B
12	Promote drainage water management such as grassed waterways, 2-stage channels, and over-wide ditches	market forces conservation payments	high high	II, IX-B

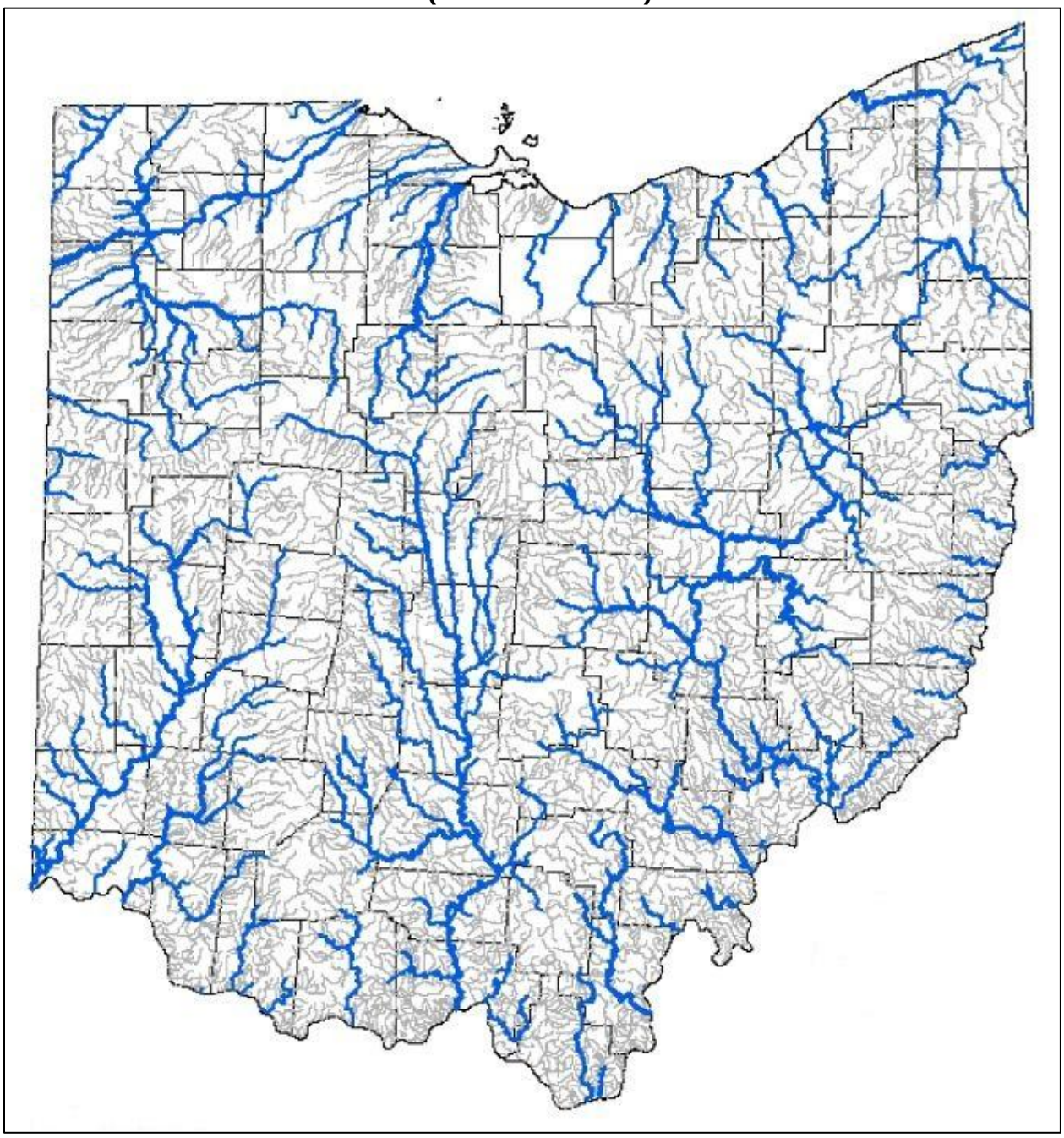
13	Promote waterway conservation livestock practices such as exclusion fencing, livestock crossings, alternative water supplies, livestock access lanes	market forces conservation payments	high high	II-A, IX-B
VII	**EXTERNAL CAPACITY BUILDING**		med	
1	Work with ODA and OEPA to minimize nutrients in runoff, and develop BMPs for pesticide/herbicide use	alliance & partnership development	high	IX
2	Create an interagency spill response team – update contacts and training on a regular basis	alliance & partnership development	high	IX-C
3	Consider creating a multiagency invasive species prevention and control group that would handle all invasive species issues	alliance & partnership development	high	VIII
4	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, and causeway design, construction, and maintenance	alliance & partnership development	high	IV-B
5	Create a multi-agency dam removal task force	alliance & partnership development	high	VII
6	Use inter-agency cooperation to influence watershed health	alliance & partnership development	high	I, II, IX, XI
7	Pursue partnerships with local, state, and federal agencies to secure funding for projects benefitting streams and watersheds	alliance & partnership development conservation finance	high low	I, II, III, IV, VI, VII, VIII, IX, XI
8	Work with OEPA to encourage the reuse of point source discharge water	alliance & partnership development	high	IX-A
9	Work with OEPA and municipalities to eliminate CSO's and SSO's – especially in impaired watersheds	alliance & partnership development	high	I-A, IX-A
10	Work with OEPA to encourage completion of TMDL studies for all streams in the Ohio River drainage	alliance & partnership development	high	IX-A,B
11	Work with OEPA and local watershed groups to remediate contaminated sediments and restore habitat in conjunction with remediation	alliance & partnership development	high	I-B, IX-A
12	Work with regulatory agencies and local watershed groups on programs to restore natural stream and flood plain function	alliance & partnership development	high	I-A,B, II, IV, VII-A,B, XI
13	Encourage/facilitate the establishment of watershed groups & watershed coordinator to promote watershed improvement activities	institutional & civil society development	med	I, II, IX, XI
14	Develop partnerships with land trusts, watershed and conservation groups, and government agencies to guide acquisition and protection activities in each conservation opportunity watershed	alliance & partnership development	high	I, II, III, IV, VI, XI

15	Increase personnel and expertise available for SGCN surveys and research through partnerships with other government agencies, universities, and conservation-minded NGO's	institutional & civil society development alliance & partnership development	med high	I, II, III, IV, V, VI, VII, VIII, IX, XI

*refers to the Ohio River Tributaries Habitat Conservation Threats table

Headwater and Small Inland Streams

Ohio Headwater/Inland Streams* (Ohio EPA 2014a)



***Streams in gray are named streams with <50 sq. mi. drainages – these are the streams represented in the Headwater & Small Inland Streams habitat category.**

STATUS

Improving. State and federal legislation have created water quality standards, new technologies, stricter enforcement, and successful permitting and monitoring programs. Point source pollution has been significantly reduced and the quality of many streams has markedly improved as a result. Biological

communities in these streams generally show improvement commensurate with improvements to habitat and water quality.

In general, the percent of stream miles in attainment of their aquatic life use designations tends to increase from north to south in Ohio. Recent data indicates that unhealthy fish and aquatic insect populations are more common for smaller streams. For headwater streams (<20 sq. mi. drainage), 54% of sites sampled during 2003-2012 were in full attainment of their aquatic life use designation, compared to moderate sized streams (20-50 sq. mi. drainage) at 60%, and principal streams (50-500 sq. mi. drainage) at 67%. The larger the drainage area (and usually the larger the stream), the more likely the stream is to be healthy. This phenomenon correlates well with the most widespread causes associated with the aquatic life impairment in these watersheds. Habitat alteration and non-point source pollution remain issues today – new abatement efforts are increasingly focused on nonpoint sources such as runoff from urban and agricultural lands (Ohio EPA 2014a).

DESCRIPTION

Ohio rivers and streams represent more than 60,000 mi of flowing waters. Fifteen of the 3,300 named streams in Ohio have watersheds larger than 1,000 square miles (Sanders 2000). In the upper one-third of Ohio these streams drain north across the 11,714 square mile Lake Erie watershed, whereas in the lower two-thirds of Ohio they drain south across the 34,361 square mile Ohio River watershed. This aquatic habitat chapter focuses on the inland tributary streams that combine to form direct tributaries to Lake Erie and the Ohio River.

Approximately 28,900 miles of the over 58,000 miles of stream channels digitally mapped in Ohio are headwater streams. However, the digital maps currently available for Ohio do not include the smallest of headwater channels. Results of a special study of primary headwater streams (drainage areas less than 1 sq. mi.) place the estimate of primary headwaters between 146,000 to almost 250,000 miles. Some of these primary headwater streams are in fact perennial habitats for aquatic life, and supply base flow to larger streams (Ohio EPA 2014a).

More than 75% of the streams in Ohio are first- or second-order streams - small headwater streams with drainage areas of less than 5 square miles (see the table from Ward et al. (2008) below). Many of the headwater streams in the Midwest region of the United States are constructed agricultural ditches or are natural streams that have been straightened and deepened to facilitate the removal of excess water from agricultural fields.

Stream Order	Drainage Area (square miles)	Total Length (miles)	Percentage of stream miles	Cumulative % of stream mi.
1	0.2 – 1.0	67,530	51.5	51.5
2	1.0 – 4.7	33,138	25.3	76.8
3	4.7 – 23	15,963	12.2	89.0
4	23 – 109	7803	6.0	95.0
5	109 – 518	3810	2.9	97.9
6	518 – 2460	1861	1.4	99.3
7	2460 – 11,700	908	0.7	100.0

Ohio's generally low gradient landscape results in the majority of headwater streams being Rosgen type C and E streams. Type C streams are slightly entrenched, meandering systems characterized by well-developed floodplains with riffle-pool bed forms that are typically wider than they are deep. Type E streams have a low width-to-depth ratio and exhibit a wide range of sinuosity with well developed floodplains. Less than 10 percent of Ohio's first and second order streams are of the Rosgen type A or B – typically steep, entrenched, confined channels found in narrow valleys of rolling hill landforms with channel beds consisting of a series of rapids and cascades with irregular scour pools (think mountain streams/brooks) (Ward et al. 2008).

The Importance of Headwater Streams and Their Protection

As discussed in *Association between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams* (Ohio EPA 1999a), headwater streams represent a significant source of assimilative capacity for the protection of downstream reaches. The aggregate condition of headwater streams is correlated with the quality of water and aquatic life resources in larger streams, and reflects the integrity of the watershed as a whole. Headwaters represent the primary interface between the landscape and aquatic ecosystems, and are the initial entry points for energy and nutrients into lotic ecosystems. The form, manner, and rate at which nutrients are delivered to headwaters and eventually transported downstream profoundly affect the ecological integrity of the larger streams and rivers. While headwater streams are proportionally smaller in terms of physical size and volume, their sheer numbers imply importance in cumulative terms for downstream water bodies.

For watersheds, most impairment is related to modification of the landscape – and these impairments have the greatest impact on smaller streams. The top five aquatic life impairment causes for the period 2003 through 2012 are: siltation/sedimentation, excess nutrients, habitat modification, hydromodification, and organic enrichment/dissolved oxygen. Most of the impaired watershed units with current data had at least one of these causes contributing to impairment and many had two or more of the top five causes listed (Ohio EPA 2014a).

Headwater stream protection approaches should be focused on the improved management of riparian zones in attempts to reduce sediment and nutrient delivery (*i.e.*, encouraging sediment and nutrient interception, processing, and storage within the riparian areas of headwater streams). Vegetated riparian buffers are a vital functional component of the stream ecosystem and are instrumental in the detention, removal and assimilation of nutrients from or by the water column. The riparian zone is essentially a component of instream habitat. It contributes food and nutrients in forms that desirable aquatic assemblages are adapted for, and contributes to the habitat heterogeneity by influencing channel morphology via large woody debris and bank stabilization (Ohio EPA 1999a).

Illustrating the importance of the riparian zone to headwater stream ecology is the fact that biological community performance in headwaters and wadable streams has been found to be highest (based upon Index of Biotic Integrity [IBI] or Invertebrate Community Index [ICI] values) where total phosphorous (TP) concentrations are lowest. The quality of the riparian corridor influences TP levels in the stream by its ability to detain, remove, and assimilate P before it enters the stream. The lowest TP concentrations were also associated with the highest quality stream habitats (based upon Qualitative Habitat Evaluation Index [QHEI] scores). The correlation of low TP with high quality lotic habitat is thought to be the result of TP being sequestered by the well-organized, diverse, and trophically dynamic aquatic assemblages that are typically associated with high quality habitat (Ohio EPA 1999a).

Excess nutrients can have negative effects by altering trophic dynamics, increasing algal production, increasing turbidity, decreasing dissolved oxygen (D.O.) concentrations, and increasing daily fluctuations in D.O. and pH. Changes caused by excessive nutrient concentrations result in shifts in species composition away from functional assemblages of intolerant species, benthic insectivores and top carnivores (*e.g.,* darters, insectivorous minnows, redhorse, sunfish, and black basses) typical of high quality warmwater streams, towards less desirable assemblages of tolerant species, niche generalists, omnivores, and detritivores (*e.g.,* creek chub, bluntnose minnow, white sucker, carp, green sunfish) typical of degraded warmwater streams (Ohio EPA 1999a).

Since more than 88 percent of Ohio is privately or locally owned, the well-being of Ohio's streams and watersheds is very dependent upon the attitudes and conservation stewardship of landowners and local communities. Increasingly, community-based watershed groups and partnerships comprised of many stakeholders are collectively working to protect and restore their local streams and watersheds. As water resources become increasingly important, it will be the willingness of private landowners and these groups to practice voluntary conservation on private and local lands that will determine the need for future regulations related to the health of streams and watersheds throughout Ohio (Sanders 2000).

ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

With more than 1,200 species, aquatic insects are the largest group of Ohio stream wildlife. An amazing number of fish – over 160 species – have also been recorded from Ohio streams. Ohio's least impacted streams are characterized free-flowing diverse aquatic habitats, forested riparian corridors, islands, associated wetlands, unregulated flow regimes, and sparsely populated watersheds. These streams contain diverse and abundant biological assemblages that include pollution-sensitive, rare, and endangered species (Sanders 2000). Headwater and small inland streams however, are very succeptible to natural and anthropogenic influences due to their small size. In many of Ohio's watersheds, biological communities improve as stream size increases. Size can buffer the impacts of issues such as variable flows, pollution, land-use practices, and climate. Headwater and small inland streams are fragile systems who's aquatic species assemblages can be severly impacted by events that would have little effect upon larger systems. At any point in time, the aquatic community present in a small inland stream may be a reflection of the condition/activities in the watershed, a recent event that negatively impacted the stream (e.g., chemical spill), or both.

The following species have been identified as Headwater and Small Inland Streams species of greatest conservation need (conservation status rank in parentheses):

<u>FISH</u>

Scioto Madtom (1)	*Noturus trautmani*
Longhead Darter (4)	*Percina macrocephala*
Western Tonguetied Minnow (7)	*Exoglossum laurae*
Spotted Darter (8)	*Etheostoma maculatum*
Northern Madtom (10)	*Noturus stigmosus*
Bigeye Shiner (12)	*Notropis boops*
Ohio Lamprey (13)	*Ichthyomyzon bdellium*
Mountain Brook Lamprey (16)	*Ichthyomyzon greeleyi*
Tippecanoe Darter (20)	*Etheostoma tippecanoe*
Mountain Madtom (21)	*Noturus eleutherus*
Blacknose Shiner (22)	*Notropis heterolepis*
Northern Brook Lamprey (23)	*Ichthyomyzon fossor*
Mottled Sculpin (24)	*Cottus bairdi*
Bluebreast Darter (25)	*Etheostoma camurum*
Silver Lamprey (26)	*Ichthyomyzon unicuspis*
Pugnose Minnow (27)	*Opsopoeodus emiliae*
American Brook Lamprey (28)	*Lampetra appendix*
Eastern Sand Darter (29)	*Ammocrypta pellucida*
Western Banded Killifish (30)	*Fundulus diaphanus menona*
Redside Dace (31)	*Clinostomus elongatus*
Gravel Chub (32)	*Erimystax x-punctatus*
Least Darter (33)	*Etheostoma microperca*
Least Brook Lamprey (35)	*Lampetra aepyptera*
Iowa Darter (38)	*Etheostoma exile*
Rosyside Dace (39)	*Clinostomus funduloides*
Streamline Chub (41)	*Erimystax dissimilis*
Bigeye Chub (42)	*Hybopsis amblops*
Central Mudminnow (43)	*Umbra limi*
Lake Chubsucker (46)	*Erimyzon sucetta*
Bigmouth Shiner (48)	*Notropis dorsalis*
Black Redhorse (48)	*Moxostoma duquesnei*
Pirate Perch (51)	*Aphredoderus sayanus*
Silver Redhorse (52)	*Moxostoma anisurum*
Variegate Darter (53)	*Etheostoma variatum*
Southern Redbelly Dace (54)	*Phoxinus erythrogaster*
Greater Redhorse (55)	*Moxostoma valenciennesi*
Creek Chubsucker (58)	*Erimyzon claviformis*

Dusky Darter (58)	*Percina sciera*
Smallmouth Redhorse (63)	*Moxostoma breviceps*
Grass Pickerel (65)	*Esox americanus vermiculatus*
Brook Stickleback (66)	*Culaea inconstans*
Hornyhead Chub (67)	*Nocomis biguttatus*
Scarlet Shiner (68)	*Lythrurus fasciolaris*
Slenderhead Darter (68)	*Percina phoxocephala*
Brindled Madtom (70)	*Noturus miurus*
Highfin Carpsucker (72)	*Carpiodes velifer*
Longnose Dace (74)	*Rhinichthys cataractae*
Orangethroat Darter (74)	*Etheostoma spectabile*
Spotted Sucker (76)	*Minytrema melanops*
Stonecat Madtom (78)	*Noturus flavus*
Tadpole Madtom (80)	*Noturus gyrinus*
Ghost Shiner (83)	*Notropis buchanani*
Longnose Gar (83)	*Lepisosteus osseus*
Silver Shiner (83)	*Notropis photogenis*
Blackstriped Topminnow (86)	*Fundulus notatus*
Fantail Darter (89)	*Etheostoma flabellare*
Golden Redhorse (89)	*Moxostoma erythrurum*
Longear Sunfish (91)	*Lepomis megalotis*
Steelcolor Shiner (91)	*Cyprinella whipplei*
River Chub (93)	*Nocomis micropogon*
Mimic Shiner (94)	*Notropis volucellus*
Greenside Darter (95)	*Etheostoma blennioides*
Bullhead Minnow (97)	*Pimephales vigilax*
Banded Darter (100)	*Etheostoma zonale*
Rainbow Darter (100)	*Etheostoma caeruleum*
Trout Perch (102)	*Percopsis omiscomaycus*
Blackside Darter (103)	*Percina maculata*
Common Shiner (103)	*Luxilus cornutus*
Rosyface Shiner (103)	*Notropis rubellus*
Johnny Darter (106)	*Etheostoma nigrum*
Brook Silverside (107)	*Labidesthes sicculus*
Chain Pickerel (107)	*Esox niger*
Quillback Carpsucker (107)	*Carpiodes cyprinus*
Redfin Shiner (107)	*Lythrurus umbratilis*
Spotfin Shiner (114)	*Cyprinella spiloptera*
Logperch Darter (116)	*Percina caprodes*
Mosquitofish (117)	*Gambusia affinis*
Silverjaw Minnow (117)	*Notropis buccatus*
Northern Hogsucker (119)	*Hypentelium nigricans*
Brown Bullhead (120)	*Ameiurus nebulosus*
Central Stoneroller (120)	*Campostoma anomalum*
Yellow Bullhead (120)	*Ameiurus natalis*
Brook Trout (123)	*Salvelinus fontinalis*
Northern Studfish (124)	*Fundulus catenatus*
Sand Shiner (124)	*Notropis stramineus*
Western Blacknose Dace (124)	*Rhinichthys atratulus*
Emerald Shiner (127)	*Notropis atherinoides*
Striped Shiner (127)	*Luxilus chrysocephalus*
Golden Shiner (129)	*Notemigonus crysoleucas*
Black Bullhead (130)	*Ameiurus melas*
Creek Chub (132)	*Semotilus atromaculatus*
Bluntnose Minnow (135)	*Pimephales notatus*
Rock Bass (135)	*Ambloplites rupestris*

Suckermouth Minnow (137)	*Phenacobius mirabilis*
White Sucker (137)	*Catostomus commersoni*
Fathead Minnow (139)	*Pimephales promelas*
Flathead Catfish (141)	*Pylodictis olivaris*
Northern Pike (145)	*Esox lucius*
Green Sunfish (147)	*Lepomis cyanellus*
Orangespotted Sunfish (148)	*Lepomis humilis*
Rainbow Trout (150)	*Oncorhynchus mykiss*
Smallmouth Bass (151)	*Micropterus dolomieu*
Ohio Muskellunge (152)	*Esox masquinongy ohioensis*
Channel Catfish (153)	*Ictalurus punctatus*
White Bass (155)	*Morone chrysops*
Gizzard Shad (157)	*Dorosoma cepedianum*
Brown Trout (164)	*Salmo trutta*
Speckled Chub (likely EX)	*Macrhybopsis aestivalis*

<u>CRAYFISH</u>

Devil Crayfish (3)	*Cambarus diogenes*
Northern Clearwater Crayfish (4)	*Orconectes propinquus*
Sanborn's Crayfish (6)	*Orconectes sanbornii*
Paintedhand Mudbug (8)	*Cambarus polychromatus*
Little Brown Mudbug (9)	*Cambarus thomai*
Ortman's Mudbug (10)	*Cambarus ortmanni*
Spiney Stream Crayfish (11)	*Orconectes cristavarius*
Cave Spring Crayfish (12)	*Cambarus tenebrosus*
Papershell Crayfish (13)	*Orconectes immunis*
Virile Crayfish (13)	*Orconectes virilis*
Appalachian Brook Crayfish (16)	*Cambarus bartonii cavatus*
White River Crayfish (17)	*Procambarus acutus*
Rock Crawfish (19)	*Cambarus carinirostris*
Sloan's Crayfish (20)	*Orconectes sloanii*

<u>MUSSELS</u>

White Catspaw (2)	*Epioblasma obliquata perobliqa*
Purple Catspaw (3)	*Epioblasma obliquata obliquata*
Little Spectaclecase (7)	*Villosa lienosa*
Purple Lilliput (15)	*Toxolasma lividum*
Slippershell Mussel (16)	*Alasmidonta viridis*
Rayed Bean (21)	*Villosa fabalis*
Creek Heelsplitter (23)	*Lasmigona compressa*
Rabbitsfoot (25)	*Quadrula cylindrica*
Salamander Mussel (25)	*Simpsonaias ambigua*
Clubshell (35)	*Pleurobema clava*
Purple Wartyback (37)	*Cyclonaias tuberculata*
Threeridge (40)	*Amblema plicata*
Round Hickorynut (42)	*Obovaria subrotunda*
Black Sandshell (47)	*Ligumia recta*
Kidneyshell (48)	*Ptychobranchus fasciolaris*
Rainbowshell (50)	*Villosa iris*
Round Pigtoe (50)	*Pleurobema sintoxia*
Cylindrical Papershell (56)	*Anodontiodes ferussacianus*
Fluted Shell (58)	*Lasmigona costata*
Creeper (60)	*Strophitus undulatus*
Lilliput (61)	*Toxolasma parvum*
Spike (61)	*Elliptio dilatata*
Wabash Pigtoe (61)	*Fusconaia flava*

Paper Pondshell (66)	*Utterbackia imbecillis*
Pistolgrip (66)	*Quadrula verrucosa*
Wavyrayed Lampmussel (68)	*Lampsilis fasciola*
Plain Pocketbook (72)	*Lampsilis cardium*
White Heelsplitter (74)	*Lasmigona complanata*
Fatmucket (77)	*Lampsilis radiata*
Giant Floater (77)	*Pyganodon grandis*

AMPHIBIANS

Mudpuppy (14)	*Necturus maculosus maculosus*

REPTILES

Rough Green Snake (3)	*Opheodrys aestivus*
Midland Smooth Softshell (7)	*Apalone mutica mutica*
Common Map Turtle (19)	*Graptemys geographica*
Ouachita Map Turtle (19)	*Graptemys ouachitensis*
Queen Snake (19)	*Regina septemvittata*
Red-eared Slider (31)	*Trachemys scripta elegans*
Common Musk Turtle (34)	*Sternotherus odoratus*
Eastern Spiny Softshell (36)	*Apalone spinifera spinifera*
Midland Painted Turtle (40)	*Chrysemys picta marginata*
Northern Water Snake (40)	*Nerodia sipedon sipedon*

CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Headwater and Small Inland Streams. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		high
A	Watershed conversion to urban/commercial development alters hydrology	housing & urban areas commercial & industrial areas	high medium
B	Shoreline development and its effect on habitat and species	housing & urban areas commercial & industrial areas	high medium
C	Increasing land prices limit our ability to protect riparian corridors	housing & urban areas commercial & industrial areas	high medium
II	**agriculture and aquaculture**		high
A	Loss of riparian corridor to agriculture	annual & perennial non-timber crops livestock farming & ranching	high low
B	Watershed conversion to agriculture alters hydrology	annual & perennial non-timber crops livestock farming & ranching	high low

III	**energy production and mining**		high
A	Oil and gas extraction - can have negative impacts by causing chemical contamination	oil & gas drilling	high
B	Water withdrawal for fracking alters hydrology	oil & gas drilling	high
C	Coal mining can result in acid mine drainage	mining & quarrying	low
IV	**transportation and service corridors**		medium
A	Roads/bridges/causeways and utilities can destroy habitat, alter hydrology	roads & railroads utility & service lines	high low
V	**biological resource use**		low
A	Fishing pressure and fishing gear impacts	fishing & harvesting aquatic resources	negligible
B	Removal of trees from streambanks and the watershed impacts water quality	logging & wood harvesting	high
VI	**human intrusions and disturbance**		low
A	Incompatible recreational activities	recreational activities	negligible
VII	**natural system modifications**		high
A	Forestry practices can negatively impact water quality	other ecosystem modifications	low
B	Altering channel morphology to facilitate agriculture impacts habitat and species	dams & water management/use	high
C	Dams cause habitat loss, sedimentation, decreased water quality, reduced biodiversity, and reduce movement of aquatic species and species abundance	dams & water management/use	high
VIII	**invasive and other problematic species and genes**		low
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	low
B	Introduction and/or spread of nuisance plants and animals	problematic native species	negligible
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	low negligible
IX	**pollution**		medium
A	Urban effluent carries a variety of substances that impact water quality & aquatic species	household sewage & urban wastewater industrial & military effluents garbage & solid waste air-borne pollutants	low low low low
B	Agricultural effluent from row crops as well as confined animal operations impacts water quality & aquatic species	agricultural & forestry effluents	high
C	Pesticides/herbicides from waterfront property owners impacts water quality	household sewage & urban wastewater	low
D	Mine drainage negatively impacts water quality and reduces species & species abundance	industrial & military effluents	low
X	**geological events**		negligible
---	none	---	---

XI	**climate change and severe weather**		medium
A	Climate change could impact habitats, water quality, and species	habitat shifting & alteration droughts temperature extremes storms & flooding	high low low low

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Headwater and Small Inland Streams habitat. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		high	
1	Protect riparian corridors through acquisition, partnerships, conservation easements, etc.	site/area protection resource & habitat protection	high high	I, II, IV, V-B, VII-B
II	**LAND/WATER MANAGEMENT**		med	
1	Develop GIS tools to archive and monitor the status of protected lands in conservation opportunity watersheds	site/area management	low	XI
2	Work with OEPA, ODOT, USACE, and other government agencies to focus mitigation activities on riparian habitats in conservation opportunity watersheds	habitat & natural process restoration	high	I-A, II-A, IV, XI
3	Work with landowners to develop and implement habitat improvement projects on private lands	habitat & natural process restoration	high	I, II, IX-C, XI
4	Remove dams to restore stream connectivity and improve water quality	habitat & natural process restoration	high	VII-C, XI
5	Develop criteria for prioritizing candidate dams for removal – give extra emphasis to dams in conservation opportunity watersheds	habitat & natural process restoration	high	VII-C
6	Research fish passage improvements for dams that are not candidates for removal	habitat & natural process restoration	high	VII-C
7	Identify and prioritize restoration projects (channel restoration, floodplain and backwater reconnection, etc.) in conservation opportunity watersheds	habitat & natural process restoration	high	I-A,B, II, IV, VII-B, XI
8	Complete one geomorphological restoration project in each conservation opportunity watershed every 5 years	habitat & natural process restoration	high	I-A,B, II, IV, VII-B,C, XI
9	Develop model stream protection guidelines aimed at slowing the overland flow of water into streams	habitat & natural process restoration	high	I-A, II-B, IX-A,B

10	Sample fish assemblages and assess aquatic habitat in currently non-assessed tributaries	site/area management	low	I, II, III, IV, V, VI, VII, VIII, IX, XI
11	Create and use wetlands for stormwater treatment	habitat & natural process restoration	high	I-A, IX-A
12	Establish an early-detection/rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	low	VIII-A,B
13	Develop ways to control invasive plant species in flowing waters	invasive/ problematic species control	low	VIII-A,B
14	Develop a process for coordinating disparate data sources of distribution and abundance of aquatic SGCN with special emphasis on conservation opportunity watersheds	habitat & natural process restoration	high	I-B, IV, VII-B,C, XI
15	Review existing species and habitat data to identify data gaps and needs for additional surveys, research, and management actions	habitat & natural process restoration	high	I, II, III, IV, V, VI, VII, VIII, IX, XI
16	Conduct comprehensive surveys of freshwater mussels in all conservation opportunity watersheds	habitat & natural process restoration	high	I-B, III-B,C, IV, VII, XI
17	Expand the DOW livestock exclusion fencing program to SWCDs in all counties in conservation opportunity watersheds	habitat & natural process restoration	high	II-A, VII-B, IX-B
18	Conduct watershed studies to identify and prioritize restoration opportunities	habitat & natural process restoration	high	I-B, II-A, III-C, IV, V-B, VII, XI
19	Reconnect stream channels with natural floodplains	habitat & natural process restoration	high	I-A,B, II, IV, VII-B, XI
20	Restore/stabilize riparian habitat by planting native grasses, shrubs, and trees	habitat & natural process restoration	high	I-B, II-A, V-B, VII-B
21	Use treatment techniques to control the pH of effluent on abandoned mine lands	habitat & natural process restoration	high	III-C
III	**SPECIES MANAGEMENT**		med	
---	none	---	---	---
IV	**EDUCATION AND AWARENESS**		high	
1	Educate waterfront landowners and commercial pesticide/herbicide applicators on responsible chemical use, and the negative impacts to wildlife from toxic chemicals	training	high	I-B,C, IX-A
2	Promote conservation easements to protect riparian habitat	training awareness & communic-ations	high med	I, II, IV, V-B, IX, XI
3	Conduct shoreline protection/stabilization workshops	training	high	I-B, II-A, IV, V-B, XI
4	Provide technical guidance on shoreline development plans as relates to fish and wildlife interests	training	high	I, IV, XI

5	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communic-ations	med	VIII
6	Provide training to road construction/maintenance personnel for runoff/sediment control	training	high	I-B, IV
7	Educate the public and legislators on the benefits of dam removals	training awareness & communic-ations	high med	VII-C
8	Conduct stream-related demonstrations or presentations to schools, watershed groups, and the general public	training	high	I, II, IX-A,B,C, XI
9	Provide training in geomorphological, fluvial, and in-stream flow processes for DOW personnel	training	high	III-B, IV, V-B, VII-B,C
10	Develop and provide streams/watersheds educational materials for landowners, schools, public officials, and the general public	training awareness & communic-ations	high med	I, II, IX-A,B,C, XI
V	**LAW AND POLICY**		high	
1	Support legislation promoting eco-friendly energy development and use	legislation	high	III
2	Find innovative ways to mandate the inclusion of fish and wildlife interests in development plans	policies & regulations private sector standards & codes	med high	I, III-B,C, IV, IX-A, XI
3	Support the creation of additional and/or increased enforcement of stormwater regulations	policies & regulations compliance & enforcement	med med	I-A, IX-A
4	Support groundwater protection efforts	policies & regulations	med	III-B, VII-C, IX
5	Support the use of buffers between development and stream shorelines	policies & regulations private sector standards & codes	med high	I-A,B, IV, IX-A
6	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	high med	VIII
7	Support sewage sludge/animal manure disposal standards to regulate application rates and timing	policies & regulations	med	IX-A,B
8	Encourage and support minimum flow regulations that protect downstream aquatic habitats	policies & regulations	med	III-B, VII-C, IX

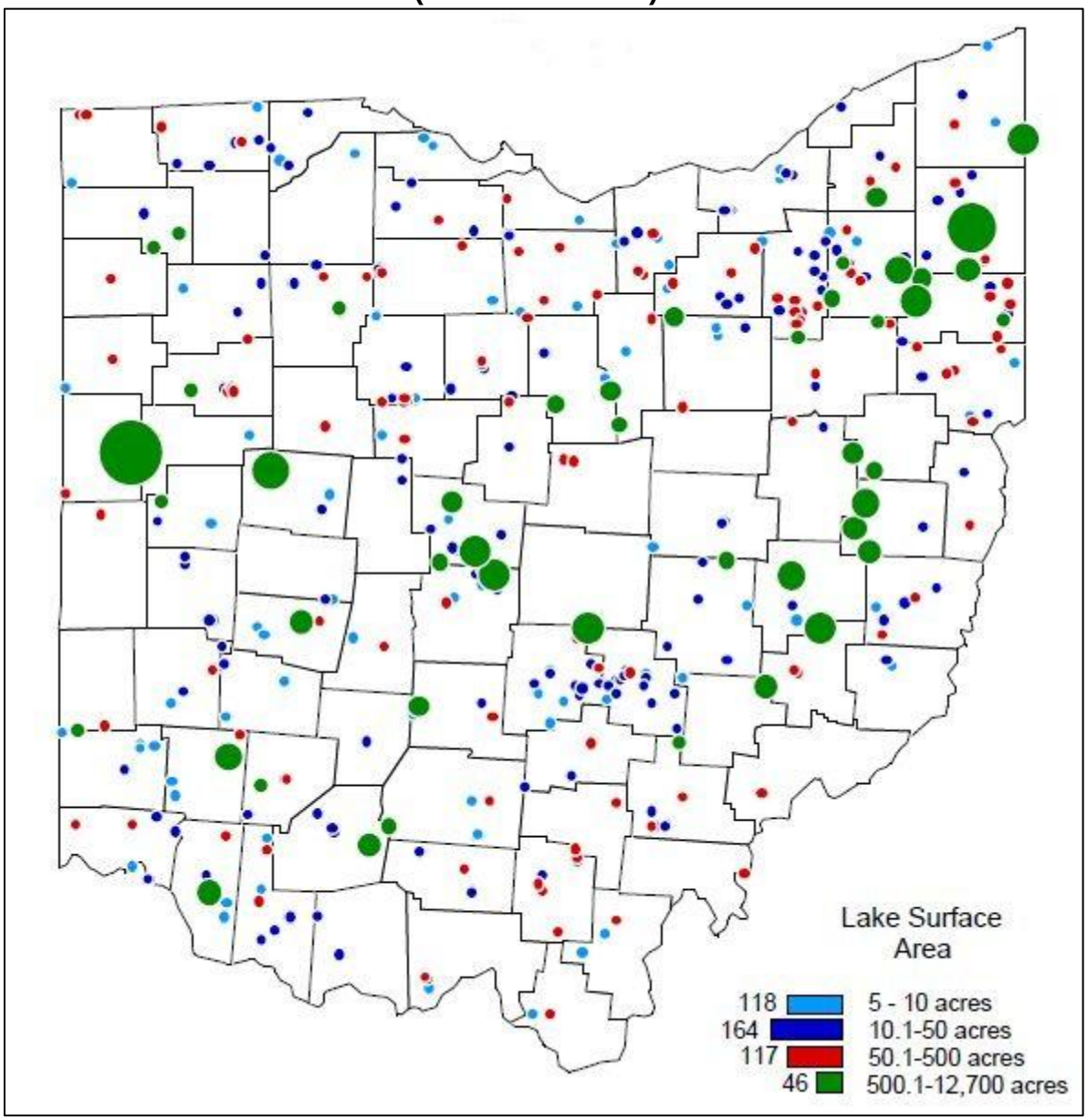
9	Promote riparian protection ordinances that prevent floodplain encroachment and riparian habitat removal	policies & regulations private sector standards & codes	med high	I, II, IV, V-B, VII-A,B
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		med	
1	Explore tying eligibility for grant money, loans, and cost-share programs to nutrient loading levels for agriculture – the lower the nutrient levels in their effluent, the more money they would be eligible for	conservation payments	med	IX-B, XI
2	Create incentives for vegetated buffers along all waterways to reduce nutrient loads and sediment	market forces conservation payments	low med	I, II, V-B, VII-A,B, IX-A,B, XI
3	Create incentives to promote eco-friendly energy development and use	market forces conservation payments non-monetary values	low med high	III
4	Support the creation of incentives to protect riparian habitat	market forces conservation payments	low med	I, II, IV, V-B, VII-A,B, XI
5	Create/support programs that encourage buffers between development and inland streams	market forces conservation payments	low med	I-A,B, IV, IX-A
6	Develop incentives for municipalities to use stormwater management systems that minimize negative impacts to aquatic habitats	market forces conservation payments	low med	I-A, IX-A
7	Support payments to offset losses (revenue from crops) resulting from implementation of conservation practices aimed at reducing sediment loads	conservation payments	med	IX-B
8	Create incentives to encourage the use of conservation tillage – especially in impaired watersheds	market forces conservation payments	low med	IX-B
9	Support incentives for conservation farming practices – including nutrient management plans and livestock waste management plans	market forces conservation payments	low med	IX-B
10	Encourage the use of cover crops for idle agricultural fields	market forces conservation payments	low med	IX-B
11	Promote drainage water management such as grassed waterways, 2-stage channels, and over-wide ditches	market forces conservation payments	low med	II, VII-B, IX-B

12	Promote waterway conservation livestock practices such as exclusion fencing, livestock crossings, alternative water supplies, livestock access lanes	market forces conservation payments	low med	II-A, IX-B
VII	**EXTERNAL CAPACITY BUILDING**		high	
1	Work with ODA and OEPA to minimize nutrients in runoff, and develop BMPs for pesticide/herbicide use	alliance & partnership development	med	IX
2	Create an interagency spill response team – update contacts and training on a regular basis	alliance & partnership development	med	IX-A,B
3	Consider creating a multiagency invasive species prevention and control group that would handle all invasive species issues	alliance & partnership development	med	VIII
4	Develop a multi-agency group to design wildlife/habitat friendly stream crossings	alliance & partnership development	med	I-B, II-A, IV, VI
5	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, and causeway design, construction, and maintenance	alliance & partnership development	med	IV
6	Create a multi-agency dam removal task force	alliance & partnership development	med	VII-C
7	Use inter-agency cooperation to influence watershed health	alliance & partnership development	med	I, II, V-B, VII-A,B, IX, XI
8	Attend and actively collaborate with watershed partnerships	institutional & civil society development alliance & partnership development	med med	I, II, III, IV, V-B, VI, VII, VIII, IX, XI
9	Pursue partnerships with local, state, and federal agencies to secure funding for projects benefitting streams and watersheds	alliance & partnership development conservation finance	med high	I, II, III, IV, V-B, VII, VIII, IX, XI
10	Develop partnerships with land trusts, watershed and conservation groups, and government agencies to guide acquisition and protection activities in each conservation opportunity watershed	alliance & partnership development	med	I, II, III, IV, V-B, VII-A,B, XI
11	Increase personnel and expertise available for SGCN surveys and research through partnerships with other government agencies, universities, and conservation-minded NGO's	institutional & civil society development alliance & partnership development	med med	I, II, III, IV, V, VI, VII, VIII, IX, XI

*refers to the Headwater and Small Inland Streams Habitat Conservation Threats table

Man-made Lakes and Ponds

Ohio's Public Lakes >5 acres (Davic et al. 1996)



STATUS

Assessment data for this habitat category is limited and lagging behind assessment of rivers and streams. Inputs from the surrounding watershed as well as tributary streams affect habitat and water quality of lentic systems. Ohio's largest lakes/reservoirs are heavily influenced by sedimentation, nutrient enrichment, and turbidity. Canal lakes are extremely productive systems, but due to degraded habitat and water quality, are dominated by tolerant species. Overall, ponds provide the best combination of water quality and habitat primarily because of the landcover in their smaller drainage areas.

DESCRIPTION

Ohio is estimated to have 2,293 lakes and reservoirs >5 acres, totaling 142,006 acres (ODNR 1980). Considering smaller waters, the US Environmental Protection Agency (EPA) estimated that Ohio has 5,130 lakes, reservoirs and ponds totaling 188,461 acres, whereas the ODNR estimated over 50,000 water bodies totaling 200,000 acres during this same time. Numerous small ponds counted by the ODNR were not identified by the US EPA due to differences in methods (Davic et al. 1996). The most recent estimate of all inland lentic waters, regardless of size, is over 52,000 ponds, lakes, and reservoirs statewide (Miami University 2005). Maintaining a current inventory of lakes, reservoirs, and ponds is challenging, as new waters are periodically constructed, while others are occasionally "decommissioned" by draining or breaching the dam.

Of Ohio's 446 public lakes, 279 (62.6%) are dammed impoundments, 86 (19.3%) are upground reservoirs, 57 (12.7%) are dug-out lakes, and 24 (5.4%) are natural glacial lakes. Three lakes are more than 5000 acres: Grand Lake St. Marys at 12,700 acres, Mosquito Creek Reservoir at 7,850 acres, and Indian Lake at 5,104 acres (Pymatuning Lake is 14,658 acres, but the majority lies in Pennsylvania). An additional 27 lakes range between 1,000 and 5,000 acres. Together, the 30 lakes larger than 1000 acres represent 84,336 (71%) of the total acres of inland public lake water in Ohio. A large number of public lakes (282) are from 5 to 50 acres in size, but these lakes collectively represent only 3.9 % (4,657 acres) of the total acres of public water (Davic et al. 1996). All of these waters have become important multi-use resources and provide important habitat for a number of aquatic and terrestrial species.

Ohio reservoirs are generally shallow (median depth 13.5 feet), and fertile. Ohio's deepest reservoirs are East Fork and Caesar Creek, with maximum depths of nearly 121 feet, but all other reservoirs have maximum depths of less than 72 feet. Sixty percent of Ohio reservoirs are eutrophic, 19% are mesotrophic, 17% are hypereutrophic, and less than 5% are oligotrophic based on Carlson Trophic State Indicators (Davic et al. 1996). The range of productivity can vary greatly statewide depending upon landcover in the watershed. Knoll et al. (2003) found ranges of phosphorus from 27-153 ug/l, and chlorophyll-a from 5-56 ug/l in 12 tributary reservoirs with watersheds that spanned a gradient of 29% to 89% agricultural land use. Trophic state values do not differ substantially statewide by lake type except for lower values in upground reservoirs, that because of their morphology, control runoff. Another pattern that emerges is the distribution of low trophic state scores in the relatively nutrient poor Western Allegheny Plateau ecoregion and the higher scores in the intensively farmed Huron Erie Lake Plain. This pattern matches that observed for streams and rivers in Ohio (Davic et al. 1996).

Land cover across Ohio is 59% agricultural, 31% forest, 6% urban, and 3% wetland, with the balance in other cover types, but reservoir watersheds are predominately agriculture (64%) with very little urban use (3%) (Renwick and Andereck 2005). Agricultural land use can cause significant soil erosion and sedimentation, resulting in increased nitrogen and phosphorus loading, reduced storage capacity, and shortened reservoir life expectancy. Renwick and Andereck (2005) found reservoir sedimentation rates in 68 Ohio reservoirs to be highly variable, ranging from 2.4-23.8 yd^3/ac/y – values typical in Midwestern reservoirs. Extensive sedimentation often occurs in reservoirs with rapid exchange of water volume resulting from large watershed area to reservoir storage volume ratios. Ohio reservoirs with high watershed area to reservoir volume ratios can completely exchange total reservoir volume in less than three weeks (e.g. Dillon, Delaware, O'Shaughnessy, Paint Creek, Charles Mill, and Stonelick reservoirs). However, the median time to complete replacement of volume is 155 days (ODNR unpublished data). Throughout the Midwest, sedimentation rates have been reduced through improved agricultural practices (Renwick and Andereck 2005; Renwick et al. 2005), suggesting that land management may be more important than land use in addressing sedimentation.

Of the 136 public lakes/ponds/reservoirs assessed by the Ohio EPA relative to aquatic life use attainment, 93 (68%) fully met, 30 (22%) partially met, and 13 (10%) did not meet designated life-use criteria. Major and moderate sources of non-attainment are primarily nonpoint in origin. Agricultural nonpoint sources are by far having the greatest influence with major and moderate effects on over 12,000 acres and threatening over 28,000 more. Other significant nonpoint sources with major and moderate magnitude impacts include hydromodification (> 4,000 acres), construction (>2,000 acres), urban runoff (>1,000 acres) and septic systems (1,400 acres). Point sources (all categories) have major or moderate

impacts on greater than 7,000 acres of Ohio lakes. These sources of impact mirror those in Ohio rivers and streams (i.e., the predominance of nonpoint sources) and support a movement toward a watershed approach to water resource restoration in Ohio (Davic et al. 1996).

Most (probably all) Ohio lakes/reservoirs/ponds have been altered due to management and/or restoration activities. Primary alterations result from activities that (1) affect the biological community (fish stocking, nuisance fish removal, aquatic plant and algae control), and/or (2) influence productivity (nutrient addition or nutrient reduction), and alter physical habitat (dredging, shoreline alteration, drawdowns, artificial structure additions).

ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

The water bodies that comprise this habitat category were for the most part not constructed with aquatic species in mind. Man-made reservoirs/lakes/ponds serve a number of purposes, with water supply and flood control topping the list. Recreational opportunities vary with the size of the water body, but are rarely the primary intended purpose. Consequently, little to no regard for aquatic habitat goes into the construction and subsequent management of these waters. What habitat exists is to a large degree influenced by the watershed to surface acres ratio of a given body of water. On-stream impoundments in particular tend to serve as settling basins for sediment transported by source streams. The result after several years of existence is a homogenization of habitats from silt/sediment deposition. In addition, fluctuating water levels negatively impact littoral habitats and aquatic species throughout the year.

Despite the issues described above, a number of aquatic species survive and flourish in these systems. While species diversity is not extremely high, and threatened/rare species are not usually represented, these waters still provide significant habitat for a number of warm and cool water species. Man-made reservoirs/lakes/ponds are the primary habitat for sunfish species (Centrarchidae), and constitute a significant portion of habitat for catfishes (Ictaluridae), minnows (Cyprinidae), suckers (Catostomidae), a handful of mussel species, and the mudpuppy.

The following species have been identified as Man-made Lakes and Ponds species of greatest conservation need (conservation status rank in parentheses):

<u>FISH</u>

Lake Chubsucker (46)	*Erimyzon sucetta*
Blue Catfish (73)	*Ictalurus furcatus*
Spotted Sucker (76)	*Minytrema melanops*
Bigmouth Buffalo (80)	*Ictiobus cyprinellus*
Longnose Gar (83)	*Lepisosteus osseus*
Blackstriped Topminnow (86)	*Fundulus notatus*
Golden Redhorse (89)	*Moxostoma erythrurum*
Brook Silverside (107)	*Labidesthes sicculus*
Chain Pickerel (107)	*Esox niger*
Quillback Carpsucker (107)	*Carpiodes cyprinus*
Logperch Darter (116)	*Percina caprodes*
Brown Bullhead (120)	*Ameiurus nebulosus*
Yellow Bullhead (120)	*Ameiurus natalis*
Golden Shiner (129)	*Notemigonus crysoleucas*
Black Bullhead (130)	*Ameiurus melas*
Rock Bass (135)	*Ambloplites rupestris*
White Sucker (137)	*Catostomus commersoni*
Fathead Minnow (139)	*Pimephales promelas*
Pumpkinseed Sunfish (139)	*Lepomis gibbosus*
Flathead Catfish (141)	*Pylodictis olivaris*
Warmouth (142)	*Lepomis gulosus*
Spotted Bass (144)	*Micropterus punctulatus*
Northern Pike (145)	*Esox lucius*
Green Sunfish (147)	*Lepomis cyanellus*

Orangespotted Sunfish (148)	*Lepomis humilis*
Smallmouth Bass (151)	*Micropterus dolomieu*
Channel Catfish (153)	*Ictalurus punctatus*
Walleye (154)	*Sander vitreus*
White Bass (155)	*Morone chrysops*
Gizzard Shad (157)	*Dorosoma cepedianum*
Redear Sunfish (158)	*Lepomis microlophus*
Bluegill Sunfish (159)	*Lepomis macrochirus*
Largemouth Bass (160)	*Micropterus salmoides*
Black Crappie (161)	*Pomoxis nigromaculatus*
Yellow Perch (162)	*Perca flavescens*
White Crappie (163)	*Pomoxis annularis*

CRAYFISH

Rusty Crayfish (18)	*Orconectes rusticus*

MUSSELS

Lilliput (61)	*Toxolasma parvum*
Paper Pondshell (66)	*Utterbackia imbecillis*
Fragile Papershell (71)	*Leptodea fragilis*
Fatmucket (77)	*Lampsilis radiata*
Giant Floater (77)	*Pyganodon grandis*

AMPHIBIANS

Mudpuppy (14)	*Necturus maculosus maculosus*

CONSERVATION THREATS

The following threats negatively impact or have the potential to negatively impact Man-made Lakes and Ponds. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		low
A	Watershed conversion to urban/commercial development alters hydrology	housing & urban areas commercial & industrial areas	low low
B	Waterfront development and its effect on nearshore habitat and species	housing & urban areas tourism & recreation areas	low low
C	Increasing land prices limit our ability to protect riparian corridors - which affects water quality and habitat in lakes	housing & urban areas commercial & industrial areas	low low
II	**agriculture and aquaculture**		low
A	Loss of riparian corridor to agriculture - which affects water quality and habitat	annual & perennial non-timber crops livestock farming & ranching	low low

B	Watershed conversion to agriculture alters hydrology	annual & perennial non-timber crops livestock farming & ranching	low low
III	**energy production and mining**		medium
A	Oil and gas extraction - can have negative impacts by causing chemical contamination	oil & gas drilling	medium
B	Water withdrawal for fracking alters hydrology	oil & gas drilling	medium
IV	**transportation and service corridors**		low
A	Roads/bridges/causeways and utilities can destroy habitat, alter hydrology	roads & railroads utility & service lines	low low
B	Dredging to accommodate recreational watercraft can destroy habitat and affect water quality	shipping lanes	low
V	**biological resource use**		low
A	Fishing pressure and fishing gear impacts	fishing & harvesting aquatic resources	low
VI	**human intrusions and disturbance**		medium
A	Incompatible recreational activities	recreational activities	medium
B	Creation of recreational facilities can alter/destroy nearshore habitat	recreational activities	medium
C	Negative impacts of recreational watercraft on water quality and nearshore habitat	recreational activities	medium
VII	**natural system modifications**		high
A	Aging of reservoirs and the sediment they have collected destroys habitat and reduces species diversity and abundance	dams & water management/use	high
B	Dam operations affect habitat and species by changing water levels	dams & water management/use	high
C	Conflicting water control management objectives of controlling agencies (DOW – USACOE)	dams & water management/use	high
D	Seasonal hypolimnetic hypoxia and anoxia in many Ohio lakes and reservoirs substantially reduces deepwater habitat available to aquatic species	other ecosystem modifications	low
E	Chemical treatments applied to upground reservoirs to reduce algal production, for the purpose of maintaining the quality of municipal drinking water, can retard the production of the zooplankton needed to support the feeding of fish early life stages	other ecosystem modifications	low
VIII	**invasive and other problematic species and genes**		medium
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	medium
B	Introduction and/or spread of nuisance plants and animals	problematic native species	low
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	medium low

IX	**pollution**		medium
A	Urban effluent carries a variety of substances that impact water quality and aquatic species	household sewage & urban wastewater industrial & military effluents garbage & solid waste air-borne pollutants	low low low low
B	Agricultural effluent from row crops as well as confined animal operations impacts water quality and aquatic species	agricultural & forestry effluents	high
C	Pesticides/herbicides from waterfront property owners impact water quality	household sewage & urban wastewater	low
D	Harmful algal blooms affect water quality, aquatic species, and can be toxic to terrestrial species	agricultural & forestry effluents	high
X	**geological events**		negligible
---	none	---	---
XI	**climate change and severe weather**		low
A	Climate change could impact habitats, water quality, and species	habitat shifting & alteration droughts temperature extremes storms & flooding	low low low low

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Man-made Lakes and Ponds. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		high	
1	Protect shoreline habitat and upstream riparian habitat through acquisition, partnerships, conservation easements, etc.	site/area protection resource & habitat protection	med high	I, II, IV-A, VI-B
II	**LAND/WATER MANAGEMENT**		med	
1	Determine the effect that spatial and temporal variations in water temperature and dissolved oxygen have on the quantity and quality of habitat	site/area management	low	VII-B,C,D
2	Evaluate the affect of common water level management practices and control structure type on in-lake habitat	site/area management	low	VII-B,C,D
3	Identify the watershed characteristics that have the strongest influence on the quality of lake and reservoir habitats	habitat & natural process restoration	high	I-A, II-B, VII-A, IX

4	Develop a protocol for the collection and analysis of physical habitat data using high-frequency side scan sonar	habitat & natural process restoration	high	IV-B, VI-C, VII-A
5	Support and encourage efforts by the Ohio EPA and other agencies to assess the overall condition of Ohio's lakes	habitat & natural process restoration	high	I, II, III, IV, V, VI, VII, VIII, IX, XI
6	Establish an early-detection/rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	med	VIII-A,B
7	Annually collect lower trophic data to understand watershed impacts on fish communities, and how changes in land use may influence lake/reservoir productivity	habitat & natural process restoration	high	I-A, II-B, VII-A, IX
8	Research how hydrologic pulsing influences aquatic species, as well as reservoir productivity	site/area management	low	VII-B,C
9	Research how reservoir aging affects productivity and influences abundance and condition of aquatic species	habitat & natural process restoration	high	VII-A
10	Complete development of a reservoir classification system that improves our understanding of the physical, chemical, and biological characteristics of reservoirs in a way that allows us to better manage aquatic species	habitat & natural process restoration	high	I, II, III, IV, V, VI, VII, VIII, IX, XI
11	Create and use wetlands for stormwater treatment	habitat & natural process restoration	high	I-A, IX-A
12	Develop compatible recreational activities criteria that can be used to evaluate impacts to habitat/species from recreational activities	site/area management	low	VI
13	Develop a process for coordinating disparate data sources of distribution and abundance of aquatic SGCN with special emphasis on conservation opportunity watersheds	habitat & natural process restoration	high	I-B, IV, VI-B, VII-A,B,C, XI
14	Review existing species and habitat data to identify data gaps and needs for additional surveys, research, and management actions	habitat & natural process restoration	high	I, II, III, IV, V, VI, VII, VIII, IX, XI
15	Conduct comprehensive surveys of freshwater mussels in all conservation opportunity watersheds	habitat & natural process restoration	high	I-B, III-B, IV, VII-A,B,C,D, XI
III	**SPECIES MANAGEMENT**		low	
---	none	---	---	---
IV	**EDUCATION AND AWARENESS**		med	
1	Educate waterfront landowners and commercial pesticide/herbicide applicators on responsible chemical use, and the negative impacts to wildlife from toxic chemicals	training	med	I-B,C, IX-A,C
2	Promote conservation easements to protect riparian habitat of inlet streams	training awareness & communic-ations	med med	I, II, IV-A, VI-B, VII-A,D, IX, XI
3	Provide technical guidance on shoreline development plans as relates to fish and wildlife interests	training	med	I, IV-A, VI-B, XI

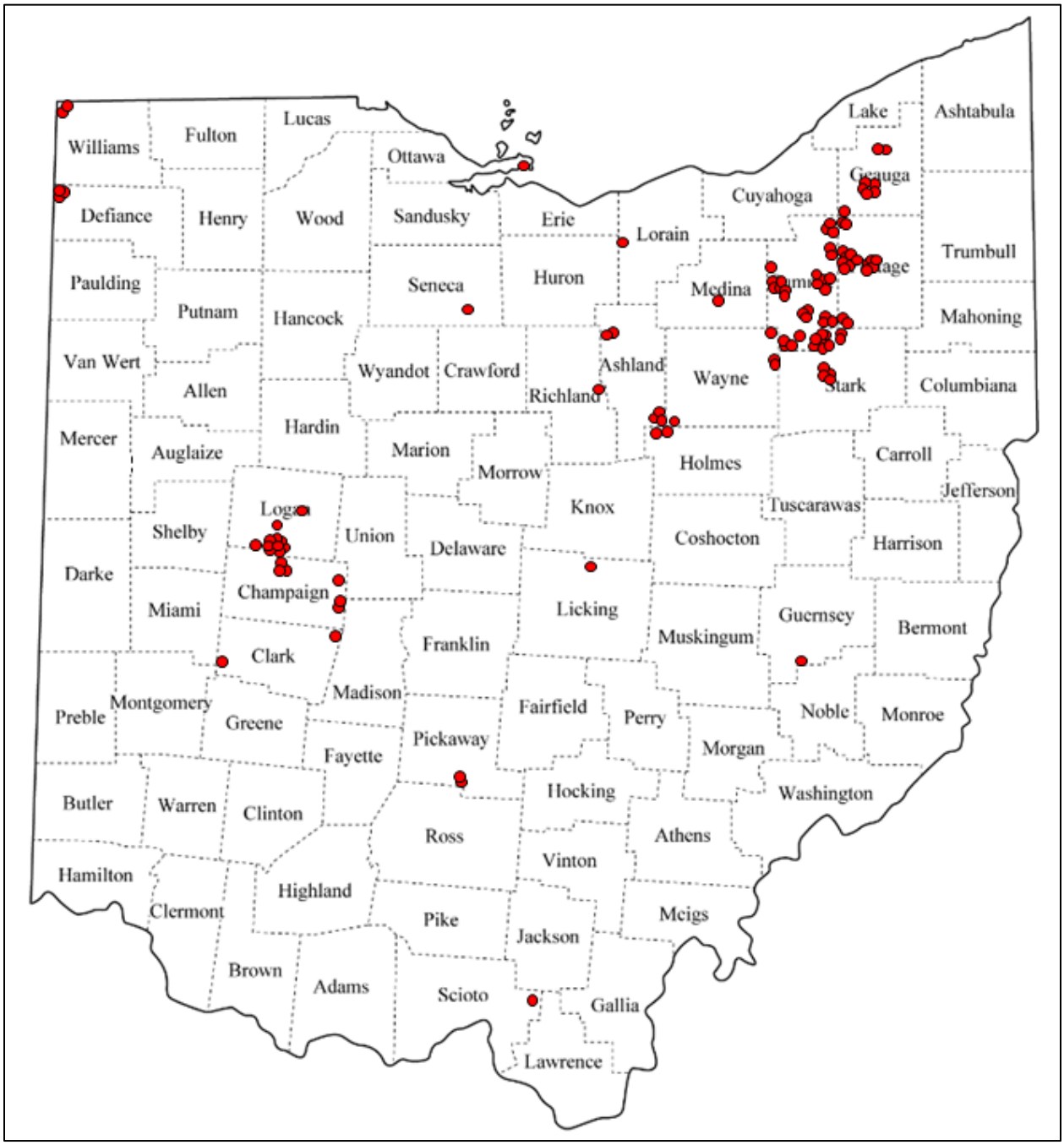
4	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communic-ations	med	VIII
5	Provide training to road construction/maintenance personnel for runoff/sediment control	training	med	I-B, IV-A
6	Educate boaters about the negative impacts power boats can have on aquatic habitats	training awareness & communic-ations	med med	VI-A,C
V	**LAW AND POLICY**		med	
1	Support legislation promoting eco-friendly energy development and use	legislation	med	III
2	Find innovative ways to mandate the inclusion of fish and wildlife interests in development plans	policies & regulations private sector standards & codes	med med	I, III, IV, VI-B, IX-A, XI
3	Support the creation of additional and/or increased enforcement of stormwater regulations	policies & regulations compliance & enforcement	med med	I-A, IX-A
4	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	med med	VIII
5	Encourage and support minimum flow regulations that protect downstream aquatic habitats	policies & regulations	med	III-B, VII-C, IX
6	Support increased regulation of home sewage treatment systems	compliance & enforcement	med	IX-A
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		med	
1	Explore tying eligibility for grant money, loans, and cost-share programs to nutrient loading levels for agriculture – the lower the nutrient levels in their effluent, the more money they would be eligible for	market forces conservation payments	med med	IX-B, XI
2	Create incentives for vegetated buffers along all waterways to reduce nutrient loads and sediment	market forces conservation payments	med med	I, II, VII-A,D, IX, XI
3	Create incentives to promote eco-friendly energy development and use	market forces conservation payments non-monetary values	med med low	III
4	Support the creation of incentives to protect shoreline habitat	market forces conservation payments	med med	I, II, IV-A, VI, XI

5	Develop incentives for municipalities to use stormwater management systems that minimize negative impacts to aquatic habitats	market forces conservation payments	med med	I-A, IX-A
6	Support incentives for development plans involving water frontage that take into account wildlife and habitat needs	market forces conservation payments non-monetary values	med med low	I-B, IV-A, VI-B, IX-A,C
7	Support clean marina and clean vessel programs	market forces conservation payments	med med	VI-C
VII	**EXTERNAL CAPACITY BUILDING**		med	
1	Work with ODA and OEPA to minimize nutrients in runoff, and develop BMPs for pesticide/herbicide use	alliance & partnership development	high	IX
2	Consider creating a multiagency invasive species prevention and control group that would handle all invasive species issues	alliance & partnership development	high	VIII
3	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, and causeway design, construction, and maintenance	alliance & partnership development	high	IV-A
4	Through interagency coordination work to establish an inland lake monitoring program to collect baseline and long-term chemical, physical, and biological data for all of Ohio's public lakes	alliance & partnership development	high	I, II, III, IV, V, VI, VII, VIII, IX, XI
5	Use inter-agency cooperation to influence watershed health	alliance & partnership development	high	I, II, VII-A,D, IX, XI
6	Attend and actively collaborate with watershed partnerships	institutional & civil society development alliance & partnership development	med high	I, II, III, IV-A, VI-A,B, VII-A,D, IX, XI
7	Work with controlling authorities (i.e., US Army Corps of Engineers) to develop water management plans that are conducive to sustaining reservoir aquatic species populations and habitats	alliance & partnership development	high	IV-B, VI, VII-B,C,D
8	Increase personnel and expertise available for SGCN surveys and research through partnerships with other government agencies, universities, and conservation-minded NGO's	institutional & civil society development alliance & partnership development	med high	I, II, III, IV, V, VI, VII, VIII, IX, XI

*refers to the Man-made Lakes and Ponds Habitat Conservation Threats table

Natural Lakes

Ohio's Natural Lakes >5 acres



STATUS
Generally good, although much like man-made lakes and ponds, assessment data is limited. Aquatic life use data available for natural lakes indicated a high degree of attainment.

DESCRIPTION
The following information was assembled from *Natural Lakes in Ohio* (Black 1991).

There are 110 natural lakes in Ohio larger than five acres, covering a total surface area of 4,658 acres. These lakes occur in 21 of Ohio's 88 counties. Summit County has the most natural lakes with 34, followed by Portage County with 16, and Geauga County with 9.

Many (probably most) of Ohio's natural lakes have been altered to some degree by human activities. Some lakes have been drained, others completely inundated by manmade reservoirs. Some lakes have been enlarged by the addition of levees or dikes. Some lakes have had outlet control structures installed or outlet streams enlarged, thereby controlling lake levels. The vast majority of Ohio's natural lakes formed in the aftermath of the most recent ice age. A few are post-glacial in origin, created from cutoff stream oxbows.

The 20 largest natural lakes in Ohio are:
1. Aurora Pond, Portage County 345 acres
2. Chippewa Lake, Medina County 324 acres
3. Turkeyfoot Lake, Summit County 318 acres
4. Wingfoot Lake, Portage County 262 acres
5. Congress Lake, Stark County 200 acres
6. Springfield Lake, Summit County 200 acres
7. Lake Hodgson, Portage County 190 acres
8. Lake Pippen, Portage County 143 acres
9. Meyers Lake, Stark County 134 acres
10. Bass Lake, Geauga County 128 acres
11. Odell Lake, Holmes County 107 acres
12. Punderson Lake, Geauga County 101 acres
13. Summit Lake, Summit County 100 acres
14. Nettle Lake, Williams County 94 acres
15. West Twin Lake, Portage County 91 acres
16. Silver Lake, Summit County 91 acres
17. Sandy Lake, Portage County 90 acres
18. Sippo Lake, Stark County 88 acres
19. Muzzy Lake, Portage County 82 acres
20. Lake Nesmith, Summit County 80 acres

ASSOCIATED SPECIES OF GREATEST CONSERVATION NEED

While natural lakes do not constitute a large portion of Ohio’s aquatic habitats, either numerically or from an acreage standpoint, they are home to some of Ohio’s rare species. State listed (endangered) western banded killifish, Iowa darters, and pirate perch for example, have been found in natural lakes – primarily in the northern part of the state.

The following species have been identified as Natural Lakes species of greatest conservation need (conservation status rank in parentheses):

<u>FISH</u>

Blacknose Shiner (22)	*Notropis heterolepis*
Western Banded Killifish (30)	*Fundulus diaphanus menona*
Iowa Darter (38)	*Etheostoma exile*
Pirate Perch (51)	*Aphredoderus sayanus*
Brook Silverside (107)	*Labidesthes sicculus*
Mosquitofish (117)	*Gambusia affinis*
Rock Bass (135)	*Ambloplites rupestris*
Warmouth (142)	*Lepomis gulosus*
Green Sunfish (147)	*Lepomis cyanellus*
Orangespotted Sunfish (148)	*Lepomis humilis*
Smallmouth Bass (151)	*Micropterus dolomieu*
Bluegill Sunfish (159)	*Lepomis macrochirus*
Largemouth Bass (160)	*Micropterus salmoides*

Black Crappie (161) *Pomoxis nigromaculatus*
White Crappie (163) *Pomoxis annularis*

CONSERVATION THREATS
The following threats negatively impact or have the potential to negatively impact Natural Lakes. Threat categories/classification from Salafsky et al. (2008), and threat impact rank calculations from Master et al. (2012).

ID	threats	2nd level threat classification(s)	threat impact rank
I	**residential and commercial development**		high
A	Watershed conversion to urban/commercial development alters hydrology	housing & urban areas commercial & industrial areas	very high low
B	Waterfront development and its effect on nearshore habitat and species	housing & urban areas tourism & recreation areas	very high low
C	Increasing land prices limit our ability to protect riparian corridors - which affects water quality and habitat in lakes	housing & urban areas commercial & industrial areas	very high low
II	**agriculture and aquaculture**		medium
A	Loss of riparian corridor to agriculture - which affects water quality and habitat	annual & perennial non-timber crops livestock farming & ranching	medium medium
B	Watershed conversion to agriculture alters hydrology	annual & perennial non-timber crops livestock farming & ranching	medium medium
III	**energy production and mining**		low
A	Oil and gas extraction - can have negative impacts by causing chemical contamination	oil & gas drilling	low
B	Water withdrawal for fracking alters hydrology	oil & gas drilling	low
IV	**transportation and service corridors**		low
A	Roads/bridges/causeways and utilities can destroy habitat, alter hydrology	roads & railroads utility & service lines	low low
V	**biological resource use**		low
A	Fishing pressure and fishing gear impacts	fishing & harvesting aquatic resources	negligible
VI	**human intrusions and disturbance**		low
A	Incompatible recreational activities	recreational activities	negligible
B	Creation of recreational facilities can alter/destroy nearshore habitat	recreational activities	negligible
C	Negative impacts of recreational watercraft on water quality and nearshore habitat	recreational activities	negligible

VII	**natural system modifications**		medium
A	Seasonal hypolimnetic hypoxia and anoxia can substantially reduce deepwater habitat available to aquatic species	other ecosystem modifications	high
VIII	**invasive and other problematic species and genes**		high
A	Introduction and/or spread of invasive plants and animals	invasive non-native/alien species	high
B	Introduction and/or spread of nuisance plants and animals	problematic native species	low
C	Introduction and spread of diseases (plants and animals)	invasive non-native/alien species problematic native species	high low
IX	**pollution**		high
A	Urban effluent carries a variety of substances that impact water quality and aquatic species	household sewage & urban wastewater industrial & military effluents garbage & solid waste air-borne pollutants	high low low low
B	Agricultural effluent from row crops as well as confined animal operations impacts water quality and aquatic species	agricultural & forestry effluents	high
C	Pesticides/herbicides from waterfront property owners impact water quality	household sewage & urban wastewater	high
D	Harmful algal blooms affect water quality, aquatic species, and can be toxic to terrestrial species	agricultural & forestry effluents	high
X	**geological events**		negligible
---	none	---	---
XI	**climate change and severe weather**		high
A	Climate change could impact habitats, water quality, and species	habitat shifting & alteration droughts temperature extremes storms & flooding	very high low negligible negligible

CONSERVATION ACTIONS

The following actions will help abate or have the potential to help abate threats to Natural Lakes. Action categories/classification from Salafsky et al. (2008), and action priority rank calculations from Georgia DNR (2005).

ID	actions	2nd level action classification(s)	action priority rank	threat(s) addressed*
I	**LAND/WATER PROTECTION**		high	
1	Protect shoreline habitat and upstream riparian habitat through acquisition, partnerships, conservation easements, etc.	site/area protection resource & habitat protection	high high	I, II, IV, VI-B
II	**LAND/WATER MANAGEMENT**		med	
1	Develop a process for coordinating disparate data sources of distribution and abundance of aquatic SGCN with special emphasis on conservation opportunity watersheds	habitat & natural process restoration	high	I-B, IV, VI-B, VII, XI
2	Review existing species and habitat data to identify data gaps and needs for additional surveys, research, and management actions	habitat & natural process restoration	high	I, II, III, IV, V, VI, VII, VIII, IX, XI
3	Conduct comprehensive surveys of freshwater mussels in all conservation opportunity watersheds	habitat & natural process restoration	high	I-B, III-B, IV, VII, XI
4	Establish an early-detection rapid-response system for dealing with invasive and nuisance species	invasive/ problematic species control	med	VIII
5	Annually collect lower trophic data to understand watershed impacts on fish communities, and how changes in land use may influence lake/reservoir productivity	habitat & natural process restoration	high	I-A, II-B, VII, IX
6	Create and use wetlands for stormwater treatment	habitat & natural process restoration	high	I-A, IX-A
7	Develop compatible recreational activities criteria that can be used to evaluate impacts to habitat/species from recreational activities	site/area management	med	VI
8	Support and encourage efforts by the Ohio EPA and other agencies to assess the overall condition of Ohio's lakes	habitat & natural process restoration	high	I, II, III, IV, V, VI, VII, VIII, IX, XI
III	**SPECIES MANAGEMENT**		med	
---	none	---	---	---
IV	**EDUCATION AND AWARENESS**		high	
1	Educate waterfront landowners and commercial pesticide/herbicide applicators on responsible chemical use, and the negative impacts to wildlife from toxic chemicals	training	high	I-B,C, IX-A,C
2	Promote conservation easements along shoreline habitat and riparian habitat of inlet streams	training awareness & communic-ations	high med	I, II, IV, VI-B, VII, IX, XI

3	Educate the public about the negative effects of exotic and nuisance animals – encourage responsible disposal of unwanted animals	awareness & communic-ations	med	VIII
4	Provide training to road construction/maintenance personnel for runoff/sediment control	training	high	I-B, IV
5	Educate boaters about the negative impacts power boats can have on aquatic habitats	training awareness & communic-ations	high med	VI-A,C
V	**LAW AND POLICY**		med	
1	Support legislation promoting eco-friendly energy development and use	legislation	med	III
2	Find innovative ways to mandate the inclusion of fish and wildlife interests in development plans	policies & regulations private sector standards & codes	med low	I, III, IV, VI-B, IX-A, XI
3	Support the creation of additional and/or increased enforcement of stormwater regulations	policies & regulations compliance & enforcement	med low	I-A, IX-A
4	Develop and implement a risk-assessment system in the approval process for importing or moving live animals and plants	legislation policies & regulations	med med	VIII
VI	**LIVLIHOOD, ECONOMIC AND OTHER INCENTIVES**		low	
1	Explore tying eligibility for grant money, loans, and cost-share programs to nutrient loading levels for agriculture – the lower the nutrient levels in their effluent, the more money they would be eligible for	market forces conservation payments	low low	IX-B, XI
2	Create incentives for vegetated buffers along all waterways to reduce nutrient loads and sediment	market forces conservation payments	low low	I, II, VII, IX, XI
3	Create incentives to promote eco-friendly energy development and use	market forces conservation payments non-monetary incentives	low low low	III
4	Support the creation of incentives to protect shoreline habitat	market forces conservation payments	low low	I, II, IV, VI, XI
5	Develop incentives for municipalities to use stormwater management systems that minimize negative impacts to aquatic habitats	market forces conservation payments	low low	I-A, IX-A

6	Support incentives for development plans involving water frontage that take into account wildlife and habitat needs	market forces conservation payments non-monetary values	low low low	I-B, IV, VI-B, IX-A,C
VII	**EXTERNAL CAPACITY BUILDING**		med	
1	Work with ODA and OEPA to minimize nutrients in runoff, and develop BMPs for pesticide/herbicide use	alliance & partnership development	low	IX
2	Consider creating a multiagency invasive species prevention and control group that would handle all invasive species issues	alliance & partnership development	low	VIII
3	Through interagency coordination, work to assure that wildlife interests are taken into consideration in road, bridge, and causeway design, construction, and maintenance	alliance & partnership development	low	IV
4	Use inter-agency cooperation to influence watershed health	alliance & partnership development	low	I, II, VII, IX, XI
5	Attend and actively collaborate with watershed partnerships	institutional & civil society development alliance & partnership development	med low	I, II, III, IV, VI-A,B, VII, IX, XI
6	Increase personnel and expertise available for SGCN surveys and research through partnerships with other government agencies, universities, and conservation-minded NGO's	institutional & civil society development alliance & partnership development	med low	I, II, III, IV, V, VI, VII, VIII, IX, XI

*refers to the Natural Lakes Habitat Conservation Threats table

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