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Lake Okonoka Habitat Restoration Herpetological Monitoring Report

August 2015



Prepared For:
SmithGroupJJR
201 Depot Street, Floor 2
Ann Arbor, MI 48104

Prepared By:
Herpetological Resource and Management, LLC
P.O. Box 110
Chelsea, MI 48118

Suggested Citation: Herpetological Resource and Management. 2015. Lake Okonoka Habitat Restoration Herpetological Monitoring Report. Herpetological Resource and Management. Chelsea, MI. 47 pp+appendices.

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Executive Summary

In 2015 Herpetological Resource and Management, LLC (HRM) conducted surveys for reptiles and amphibians (herpetofauna) at Lake Okonoka in Belle Isle park. The lake is proposed for a restoration project to improve the overall habitat quality and ecosystem functionality. The project will evaluate the lake's connection to Blue Heron Lagoon and assess the feasibility of connecting Lake Okonoka to the Detroit River. The goal of HRM's surveys was to determine the richness and spatial distribution of herpetofauna within the project area and to provide site recommendations for restoring the habitat in and around Lake Okonoka as well as improving overall habitat connectivity within this area of Belle Isle. The results of these pre-restoration surveys will be used to help guide habitat restoration and better evaluate its success on Belle Isle.

A total of sixteen species of herpetofauna were observed during the 2015 pre-restoration study including five species of amphibians and eleven species of reptiles. Based on previous surveys conducted by HRM dating back to 2004, a total of seventeen species and subspecies of herpetofauna are known to occur on Belle Isle. Among these are three state-listed species: Eastern Fox Snake (*Pantherophis gloydi*), (Threatened), Blanding's Turtle (*Emydoidea blandingii*) (Special Concern) and Eastern Box Turtle (*Terrapene carolina carolina*) (Special Concern, under review for elevation to Threatened). The Eastern Box Turtle observed during 2015 surveys was recently deceased and may have been released from captivity. Also present are Butler's Garter Snake (*Thamnophis butleri*), Northern Leopard Frog

(*Rana pipians*) and Mudpuppy (*Necturus maculosus maculosus*), all of which are listed as Species of Greatest Conservation Need by the State of Michigan.

Recently restored natural areas on Belle Isle have been shown to support several of the above-listed rare species and additional efforts to improve local habitat will likely increase the use of the island by both rare and sensitive as well as common amphibians and reptiles. Recommendations made in this report describe the restoration, construction and management of appropriate habitat for herpetofauna species present on the island. This includes the management of invasive species, restoration of habitat to lakeplain prairie, addition of basking structures, creation of reptile hibernacula and nesting sites, and overall proper use of the Best Management Practices for amphibians and reptiles during and after the restoration effort.

Based on our previous and current work HRM strongly recommends the incorporation of wildlife corridors to improve the connectivity between Lake Okonoka, Blue Heron Lagoon, and the Detroit River. Significant road related mortality of wildlife has been noted for several years and has increased as adjacent habitats have improved. Creation of multiple wildlife passages and corridors to provide contiguous habitat on the island for herpetofauna will substantially limit road mortality..

Objective

This study provides an assessment of the distribution, species richness, and relative abundance of amphibians and reptiles within and around Lake Okonoka, as well as adjacent natural areas on Belle Isle; to help guide restoration measures to benefit these sensitive and declining species. The pre-restoration results are intended to help guide the project design team in determining how to maximize the effectiveness of the restoration for fish and wildlife communities, while minimize impacts to rare or sensitive species, and address habitat fragmentation and high road-related mortality.

Introduction

In 2015 Herpetological Resource and Management, LLC (HRM) was contracted by SmithGroupJJR (SGJJR) to conduct a baseline survey for reptiles and amphibians (herpetofauna) on portions of Belle Isle Park in Detroit, Michigan, focusing on Lake Okonoka (LO) and adjacent habitats. This work is part of a larger restoration project initiated by Friends of the Detroit River to improve wildlife habitat on Belle Isle as part of the Area of Concern (AOC) delisting process. Previous restoration efforts have been successful at the Blue Heron Lagoon (BHL) and the South Fishing Pier (SFP). Goals of this phase include creating hydrologic connectivity between LO and the Detroit River and improving connectivity between BHL and LO, expanding on previous restoration work conducted in BHL. In addition, habitat restoration and enhancements will be conducted within and adjacent to LO to increase habitat functionality. The results of amphibian and reptile monitoring will be used to help guide the restoration process and identify opportunities to restore critical wildlife habitat.

Amphibians and reptiles are recognized as key bioindicators, or gauges of environmental health. These groups of animals are highly sensitive to environmental pollutants and habitat disturbances. Their presence, represented age classes, spatial distribution, and relative abundance can be important tools in identifying the need for habitat restoration projects and evaluating their success, in addition to assessing overall ecosystem health (Guilfoyle 2010; Mifsud 2014). Because of their effectiveness as bioindicators, amphibians and reptiles were used as a metric to assess the effectiveness and success of the restoration at BHL and SFP. As such the same metric will be applied to LO. HRM assessed the pre-restoration amphibian and reptile communities within LO during the spring and summer of 2015. This report reflects the results of these pre-restoration surveys as well as recommendations regarding proposed restoration efforts and the overall conservation of herpetofauna on Belle Isle.

Site Location and Description

The project area is located on the east end of Belle Isle, an island situated in the Detroit River in Wayne County, Michigan. Lake Okonoka is a 24 acre, shallow lake with a mud bottom and several small islands at its center (Photos 1-4). It is connected to Lake Tacoma on the west end of Belle Isle by Nashua Canal (Photo 5). To the east, LO connects to Blue Heron Lagoon, a 41 acre lake with a rocky bottom and emergent vegetation (Photos 6-7) under Lakeside Road via a culvert. The southern shoreline where the location for hydraulic connection to the Detroit River is proposed, is separated from the river by a road and adjacent beach. (Photo 8).

Natural communities surrounding LO as classified by the Michigan Natural Features Inventory include Emergent and Submergent Marsh (Photos 9,10) (Kost, Albert et al. 2007). A majority of surrounding habitat includes an unclassifiable community, mowed lawn as well as two roads with periodically high traffic. Strand/Lakeside Drive wraps around the lake on its southern and eastern edge, while Woodside Drive traverses along the northern edge (Photo 11). To the north of LO is a 200 acre wet-mesic flatwood forest and one of the largest contiguous natural areas in urban Detroit (Heslinga and McDowell 2013). Small islands in the center of LO contain habitat that may be classified as wet-mesic flatwood; however, it appears to be largely second growth and highly disturbed. Garbage and other debris is abundant along the edge of the lake and it is not uncommon to observe animals among the floating refuse (Photo 12, 13). The lake's water quality is poor being in a eutrophic state and supporting numerous invasive plant species with the most prevalent species including Eurasian milfoil (*Myriophyllum spicatum*), common buckthorn (*Rhamnus cathartica*), and common reed (*Phragmites australis australis*). The lake shoreline is actively maintained and lacks structures along its edges such as woody debris that provide important habitat components for herpetofauna as well as other fish and wildlife. Currently the lake primarily serves as a recreational fishing site and due to this, overall habitat conditions around LO is not suitable for a majority of herpetofauna species. Historically, this area and associated natural communities would have supported a rich assemblage of herpetofauna and with restoration, enough habitat remains to support many if not most of these species today.

Methods

Herpetofaunal Surveys

Herpetofaunal surveys were conducted on May 7, June 24, and July 31, 2015 during optimal weather conditions by teams of three to five biologists trained in the identification of herpetofauna. Time-constrained ground searches and defined transect surveys as well as aural (listening) surveys were performed to investigate all aquatic and terrestrial habitats for evidence of reptiles and amphibians. Techniques employed by surveyors included direct detection of herpetofauna through visual encounters or identification of calling frogs and toads, inspection of potential basking and nesting areas (Photo 14), as well as turning over natural and artificial cover objects (logs, boards, debris, etc.). No voucher samples were collected, but photographs were taken when possible. All survey activities were in accordance with HRM's Scientific Collector's and Threatened and Endangered Species permits issued by the State of Michigan.

Data Collection

Each positively identified amphibian and reptile was recorded in the database. The following data were collected for each record: (1) species, (2) gender of each individual (when possible), (3) behavior of each individual, and (4) reproductive condition of each individual (if it can be determined). Observation locations were recorded using Tier II spatial accuracy standards. Trimble® Geo XT and Juno SB GPS Units were used during HRM's surveys and observations were mapped using ArcMap® software.

Results

A total of sixteen species of herpetofauna were observed by HRM in 2015 including five species of amphibian and eleven species of reptile (Figure 1). Within the targeted study area surrounding Lake Okonoka, HRM recorded the presence of ten herpetofauna species (Table 1). These included four frogs and toads: Eastern American Toad (*Bufo americanus americanus*), Bullfrog (*Rana catesbeiana*) (Photo 12), Green Frog (*Rana clamitans melanota*) (Photo 13) and Northern Leopard Frog (*Rana pipiens*) (Photo 15); one snake: Northern Water Snake (*Nerodia sipedon sipedon*) (Photo 16); and five turtles: Midland Painted Turtle (*Chrysemys picta marginata*), Northern Map Turtle (*Graptemys geographica*), Red-eared Slider (*Trachemys scripta elegans*), Yellow-Bellied Slider (*Trachemys scripta scripta*), and Eastern Box Turtle (*Terrapene carolina carolina*) (Photo 17).

Supplemental post-restoration surveys of the area surrounding the Blue Heron Lagoon resulted in the observation of five additional reptile species including, Eastern Snapping Turtle (*Chelydra serpentina serpentina*), Butler's Garter Snake (*Thamnophis butleri*) (Photo 18), Eastern Fox Snake (*Pantherophis gloydi*) (Photo 19), Eastern Garter Snake (*Thamnophis sirtalis sirtalis*), and Northern Brown Snake (*Storeria dekayi dekayi*). Species not recorded at BHL that were observed at LO include Eastern American Toad, Red-eared Slider, Yellow-bellied Slider, and Eastern Box Turtle. Just north of the assessment area, HRM observed one Blanding's Turtle (*Emydoidea blandingii*) dead on the road within an area of bottomland forest (Photo 20). Surveys conducted by HRM in May 2015 at Belle Isle for a separate project resulted in the observation of one additional species of amphibian, the Mudpuppy (*Necturus maculosus maculosus*).

In previous years, HRM has conducted a series of other surveys at Belle Isle targeting both LO and BHL as well as surrounding areas. During these surveys a total of seventeen species and subspecies have been recorded (Table 1, Figure 2) including one not observed in 2015, the Gray Treefrog (*Hyla chrysoscelis* or *H. versicolor*) (Mifsud 2004).

Discussion

In 2015, HRM observed a moderately high diversity of herpetofauna including several protected, rare, and sensitive species during surveys on Belle Isle. In total, five of the species observed are listed by Michigan Department of Natural Resources (MDNR) as Species of Greatest Conservation Need (SGCN). Favorable weather coupled with the presence of restored habitat adjacent to the LO study area likely contributed to the higher detection rate of species. While a similar number of herpetofauna species were observed between both Lake Okonoka and Blue Heron Lagoon, the previously restored BHL appears to support a higher number of rare and sensitive species. These findings support not only the value of restoration efforts conducted thus far on Belle Isle, but also the need for further measures to be taken in other areas such as LO. Overall, LO is a degraded, eutrophic system with poor water quality that lacks sufficient habitat features to support multiple life states of several herpetofaunal species known to occur on the island. A majority of observed species were either generalists or only observed in adult life stages indicating significant opportunities for overall habitat improvement and enhancement.

Within the BHL assessment area, rare and declining species observed include the Eastern Fox Snake and Butler's Garter Snake. The Eastern Fox Snake is listed as Threatened

in Michigan where its small range is restricted to Great Lakes wetlands in the southeastern Lower Peninsula. This species is known to travel long distances both terrestrially as well as aquatically and are well adapted for swimming. The Eastern Fox Snake is recognized to occur throughout Belle Isle beyond those observed at BHL and will likely occur at LO if suitable habitat is established. Butler's Garter Snake are a Species of Greatest Conservation Need in the state and are also proposed for elevation to Special Concern by the Michigan Amphibian and Reptile Technical Advisory Committee (ARTAC) (Herpetological Resource and Management 2014). In close proximity to the Belle Isle, this species is listed as Endangered in Canada as is the Eastern Fox Snake. If LO is restored to contain quality habitat suitable to support herpetofauna it is highly likely that Butler's Garter Snakes will utilize the area as they are known nearby at BHL.

Within the LO assessment area and in close proximity to BHL, one deceased Eastern Box Turtle was recorded. This species is listed as State Special Concern and is currently being proposed for elevation to State Threatened (Herpetological Resource and Management 2014). It appeared that this individual was killed by a lawn mower or similar equipment shortly before HRM's survey in late June. Due to a lack of recent observations of this species, it is probable that the turtle was released from captivity. However, Eastern Box Turtles historically occurred in the area and enough suitable habitat may remain to support a small wild population. Further assessments are warranted and habitat features to support this species and other herpetofauna with similar habitat requirements should be incorporated. For example, Northern Leopard Frogs, which are listed as a Species of Greatest Conservation Need (SGCN) and also seasonally dependent on grassland areas were found

throughout the LO assessment area. The observed individuals were limited to adults, however, the LO has the potential to support breeding habitat post restoration.

In May 2015 as part of a separate research project, HRM recorded the presence of Mudpuppies along the shoreline of Belle Isle. These aquatic salamanders are declining throughout the state and currently designated as SGCN and proposed for elevation to Special Concern (Herpetological Resource and Management 2014). Historically this species has been found in the waters near the South Fishing Pier and even within LO itself. This species relies on large flat structures for refugia, and breeding and nursery habitat. The previous restoration of BHL included the addition of Mudpuppy structures and post-restoration data has shown the area to be successful with multiple observations of the species within the structures. Enhancing the current connection to BHL from LO and adding appropriate habitat structures will likely allow Mudpuppies to disperse and utilize LO. Additionally the enhancements along the southern shoreline of Belle Isle to create a fish nursery could also be beneficial to Mudpuppy populations as well.

Just outside of the study area; however in close proximity, HRM recorded the presence of Blanding's Turtle, which is listed as Special Concern in the state and experiencing population declines. Furthermore, Blanding's Turtle is currently being evaluated for potential federal protection (U.S. Fish and Wildlife Service 2015). This individual was found deceased in the road, not an uncommon site for the species which suffers wide spread road mortality (Congdon and Keinath 2006; Jones and Sievert 2012). Blanding's Turtles are known to travel up to a mile to reach seasonal habitats for foraging, breeding, as well as nesting. For more detailed descriptions of these rare and sensitive

species, please consult the animal summaries provided in this report following the Recommendations section.

As with many natural areas located in public parks, Belle Isle supports introduced, non-native wildlife and two species of non-native turtles are known to currently inhabit LO. The Yellow-bellied Slider is a subspecies from the southeastern United States commonly kept as a pet and is not native to Michigan (Ernst and Lovich 2009). Red-eared Sliders are native to western Michigan but are not currently believed to have native populations in southeast Michigan (Harding 1997). Both the Red-eared and Yellow-bellied Sliders observed on Belle Isle likely represent released pets that may have formed naturally reproducing populations. It is the opinion of HRM that these species do not pose a threat to restoration or overall ecosystem function. Both species are known to consume aquatic vegetation including Eurasian Milfoil which may serve to help reduce this noxious invasive from the restoration area.

It is the recommendation of HRM that habitat restoration within and surrounding LO be conducted to support and promote viable populations of herpetofauna on the island. Restoration should begin with the control of invasive plant species and the encouragement of new native growth. Emphasis should be placed on aquatic vegetation as multiple invasive species were noted including *Phragmites* and Eurasian Milfoil (Photo 21). Additionally consideration should be given to restore the northern lawn to lakeplain prairie or similar communities incorporating seasonal wet meadow habitat in low areas, which would benefit many of the rare species found on the island (Photo 22). Recreational use areas should be clearly delineated to limit the public's impact on these newly restored habitats and the animals

moving back into them (Photo 23). If fishing is proposed for LO, HRM recommends that this be limited to the south side of the lake where fishing already occurs. Allowing this area to return to more natural conditions will also reduce the need for mowing, which can negatively affect herpetofauna by causing injury and/or mortality (Mitchell 1988; Durbian 2006; Humbert, Ghazoul et al. 2009). In areas that will require continued mowing, timing of activities and height of vegetation should be assessed to limit the potential impacts on herpetofauna.

Along with overarching habitat improvement and restoration there are several specific habitat features that would greatly benefit amphibians and reptiles and likely increase the overall density and richness of herpetofauna around LO. Restoration must take into account the various breeding strategies that amphibians and reptiles have adapted to accommodate the multiple life stages of these species. Breeding and nesting sites should be put in place around the lake including sandy-vegetation free areas for turtle nesting and woody debris with fine branching in the water for amphibian cover and egg deposition (Photo 24 and 25). Basking sites and cover for snake species can be created by placing additional woody debris around the lake (Photo 26). The addition of riprap materials can also provide critical basking and refugia habitat for snakes. These types of structures are often overlooked as suitable habitat for wildlife; however, some species including Eastern Fox Snakes rely heavily on rocky shorelines and telemetry studies have shown they will spend up to 80% of their time in these areas (Kucher and Seldon 2009). Surveys conducted by HRM at Belle Isle and other sites that contain Eastern Fox Snake supports this as well. Hibernacula can also be put in place to encourage snakes to remain around the lake (Photo 27). Eastern Fox Snakes located on the restored peninsula in BHL are likely using the

hibernacula created during previous restoration and constructing a hibernacula near LO would benefit this population of snakes.

Due to Belle Isle being a public natural area and being located within an urban city there herpetofauna on the island are being negatively impacted from subsidized predators. Identified as primary predators of several wildlife species, raccoons are known to have large impacts on herpetofaunal communities and in particular turtle populations (Harding 1997; Steen and Gibbs 2004; Burke, Schneider et al. 2005). Raccoons often destroy most, if not all, turtle nests in areas of high raccoon densities and it is not uncommon for these locations to experience 100% turtle nest mortality (Harding 1997; Geller 2012; Herpetological Resource and Management 2012; Holman 2012). Song birds and waterfowl are also common targets of Raccoons, with their nests and fledglings are also predated. These mortality rates exceed the normal rate of loss and are biologically significant. The impacts from such mortality can lead to population declines and possible long-term population or even species extirpation. There are direct or indirect management option available to mitigate the effects of these predators on Belle Isle (Photo 28 and 29). Specific options are discussed below in the recommendations section.

One of the main objectives of this project phase is restoring LO's hydraulic connectivity to the Detroit River and BHL. Restoring this connectivity between various habitats on the island presents an ideal opportunity for creating wildlife corridors that can facilitate the movement of animals across the landscape as well as reducing road mortality. Specifically, enhancing the connection between LO and BHL is an excellent opportunity to install a culvert or span bridge in conjunction with a wildlife barrier fence that allows for

terrestrial crossings and prevents animals from entering the road in an area where high numbers of fatalities are known (Photo 30).

Amphibians and reptiles on Belle Isle currently face a significant threat of road related injury and mortality due to the presence of multiple roads, particularly, Woodside Drive and Lakeside Drive, which run between natural habitats. These roads and areas with associated curbs present potentially fatal barriers to herpetofauna travelling between the bottomland wetland complex to the west and BHL to the east and LO to the south. Results from a spring survey conducted by HRM in 2012 included, numerous deceased amphibians and reptiles on the roadway, many of which were attempting to reach breeding habitats (Photo 31 and 32). Reports from park staff indicate that this is a common sight during spring migration. These mortalities are likely appreciably influencing the rate of colonization, recruitment, and habitat use within the eastern portion of Belle Isle where LO and BHL are located. The high number of deceased individuals observed over the years during Belle Isle surveys clearly indicates that Lakeside Drive poses a fatal threat to local herpetofauna and a key island wildlife sink. This will become even more evident and problematic as habitat quality improves on both sides of the road and more individuals seek to cross it (Photo 33). It is highly recommended that efforts be made to improve connectivity and reduce road-related mortality by including placement of wildlife crossing signs, creation of wildlife culverts, widening of the watercourse crossing, and consideration of seasonally closing the road during heavy wildlife migrations. Permanently closing and removing Woodside Road is recommended or alternatively converting it to a walking path and emergency vehicle access is strongly recommended (Photo 34).

Newly constructed aquatic connections can create opportunities for supplementing additional habitat for herpetofauna species and should be considered whenever possible. Installing riprap along shorelines can provide critical habitat for many snake species seeking basking sites or refugia (Photo 35). Care should be taken to ensure that the proper size and arrangement of riprap is used to ensure its optimal use as well as accounting for the safety of smaller species that can become trapped in riprap, such as hatchling turtles. Mudpuppies should be considered an important target species for any aquatic habitat restoration project and special efforts should be made to protect and improve its habitat when designing any restoration (Photo 36). Initial phases of this project including the restoration of BHL were beneficial for this species and the restoration of LO will likely create additional opportunities for dispersal and habitat use for the species throughout the island. The needs of this species should be considered when constructing and enhancing the south shore as the proposed fish nursery area could also serve as Mudpuppy habitat. Near-shore areas that contain rip-rap should be maintained and additional similar materials should be installed whenever possible to encourage use of the area by Eastern Fox Snake.

Many species of amphibians and reptiles are generally declining throughout their Michigan range and extensive efforts to conserve and protect critical habitat to promote the long-term health of populations in the state are needed. With at least five currently observed species within the Belle Isle study area that are identified as SGCN, the restoration of LO is warranted and could greatly improve the success of rare and sensitive species on the island. Restoration plans should closely evaluate the specific habitat requirements of focal species and implement these features into restoration designs. Long-term monitoring of the area after restoration efforts are complete are strongly encouraged to evaluate wildlife response

and overall restoration success. Few species were identified directly along the shores of LO, and restoring this area to creating contiguous high quality habitat in conjunction with Blue Heron Lagoon, the South Fishing Pier and the Belle Isle forest is needed. The restoration efforts conducted at this site are crucial to the overall ecosystem health and long-term success of this area. Listed below are specific recommendations that if implemented would likely improve overall habitat quality and functionality for herpetofauna on Belle Isle.

Recommendations

Many of the following recommendations have been developed utilizing the Michigan Amphibian and Reptile Best Management Practices manual, a Michigan-focused guide that provides specific recommendations for protecting, preserving, and restoring the herpetofauna of Michigan (Mifsud 2014). Incorporating Best Management Practices (BMPs) during the initial planning phases of work can help protect amphibians, reptiles, and other wildlife through the lifecycle of a project. Based on HRM's knowledge of Belle Isle's herpetofauna and experience in design and creation of reptile and amphibian habitat, as well as using sound data and peer reviewed scientific literature the following recommendations are provided to improve or retain desirable habitat features for reptiles and amphibians. A priority recommendation that is key to any restoration project is the long-term monitoring of the site after work is complete to evaluate the overall success. Due to behaviors and natural history of amphibians and reptiles, multi-year monitoring is strongly suggested to accurately reflect the long-term results of wildlife response.

Habitat Recommendations

- *Non-Native Turtles.* Several species of turtles not native to Michigan have been observed on Belle Isle, including the Yellow-bellied Slider and the Red-eared Slider. As Belle Isle is a popular park with easy access to the water, release of pets may be common. Educational signs can help prevent releases of pet fish or reptiles, reducing the chances for the introduction of diseases or invasive species. Currently there is no known threat to the native species or ecosystem from the two observed non-native species and no recommendations are being made to remove them at this time.
- *Aquatic Vegetation.* Several species of invasive wetland vegetation were observed along the shoreline of the lake. Invasives tend to overrun native species and create monocultures that do not adequately fulfill the habitat needs of most wildlife. Removal of invasive vegetation would allow improved colonization by native species and have positive impacts on the overall wildlife community and ecosystem function. Additionally, limited submergent or emergent vegetation is present around many portions of the shoreline. Improving the density and diversity of native aquatic vegetation should greatly improve the function of these areas for herpetofauna (Photo 21).
- *Grassland Buffer.* Restoring lakeplain prairie (similar to the existing restoration to the north of BLH) on the north side of LO will benefit resident snakes and various frog species, as well as small mammals, birds, invertebrates, and other wildlife (Photo 22). Lakeplain prairie and other Great Lakes coastal communities historically occurred in this area and is ideal habitat for the threatened Eastern Fox Snake. Reducing the

amount of lawn, especially in places where it is rarely used recreationally, can also save on maintenance costs and increase the aesthetic appeal.

- *Create Seasonal Wetland Habitat:* Evidence of seasonally inundated wet areas around LO were observed during 2015 surveys. Promoting the sustained presence of water on the landscape would increase local amphibian breeding habitat. Ceasing mowing activities and allowing the field to grow fallow would not only help in preserving such wetlands but also provide habitat for recently metamorphosed frogs and toads utilizing those pools.
- *Designate Recreational Use Areas:* Lake Okonoka is a popular recreational fishing site and the majority of individuals fishing were observed on the southern shoreline of the lake (Photo 23). This area also contains habitat that would require more extensive efforts to restore it to suitable conditions for wildlife. Therefore, in order to maintain recreational opportunities for locals while allowing other areas to undergo restoration undisturbed, designating the southern shoreline of LO for fishing while restricting the northern areas to such activities should be considered. Interpretive signage can be beneficial in educating the public to the restoration project and will also engage them as certain areas begin to develop more natural conditions. Additionally, signage can be used to educate anglers about catching herpetofauna on fishing hooks, such as turtles or Mudpuppies.
- *Mowing.* Care should be taken if mowing near LO continues in order to reduce wildlife mortality. Herpetofauna, including several rare species, are particularly susceptible to this threat as they readily use tall grass or the edges of mowed areas,

and are slow to escape from mowers. The Eastern Box Turtle observed in 2015 had shell damage consistent with being hit by mower blades. Eastern Fox Snakes (and other snakes as well) prefer to bask hidden in short grass and will even take cover in old grass clippings. To reduce the impact of mowing on herpetofauna communities mowing less frequently and adjusting mower decks higher (>6") in areas known to have herpetofauna can help reduce injury and mortality. Alternatively, if the presence of herpetofauna is not compatible with the use of a landscape area, consistently mowing grass short (<2") can discourage the movement of herpetofauna into mowed areas and will reduce mower related mortality. Mowing outside of the active season is preferred.

- *Turtle Basking Structures.* There is a lack of large woody debris such as fallen trees throughout a majority of LO (Photo 25). Adding debris would work to improve the overall habitat quality in a several ways. First, the woody debris would act as basking structures for the various turtle species which are found in the lake. Basking structures are a limiting factor controlling the presence and density of some turtles. Secondly, these woody structures would also serve as a critical habitat feature for amphibians to have to deposit their eggs on or near in the spring time bolstering populations around the lake. In addition to providing herpetofaunal habitat, woody debris also provides shelter for fish and habitat for aquatic macroinvertebrates.
- *Reptile Nesting Habitat.* Many reptiles lay shelled eggs and typically require well-drained, moist soils on a south-facing slope (Photo 24). Nesting areas include sandy or loose, friable soils and can typically be made by actively removing vegetation from

some areas and supplementing the soil with additional sand or mulch. Nesting typically occurs on south facing slopes to warm the nest to an appropriate temperatures for incubation. Snake nesting sites can include mulch piles or leaf litter or other warm decomposing organic materials that the snakes can enter and deposit eggs. Segments of shoreline along LO should be actively managed to provide this habitat feature.

- *Snake Habitat.* Restoration efforts may create areas of riprap along both LO and the hydrologic connection to the Detroit River which can serve as potential snake habitat (Photo 35). The size and arrangement of the riprap should be carefully considered as using the wrong design can lead to the habitat not being used or even result in increased mortality of some wildlife. Incorporating some areas where riprap is filled in to allow for better migration between habitats by turtles and other organisms is advised. Placement of brush piles will also aid in providing smaller snake species with refugia.
- *Reptile Hibernacula.* During winter months, reptiles seek out locations that are suitable for hibernation. For snakes this includes, holes, burrows, crevices and any other form of sufficient cover. Larger structures known as hibernacula are often used simultaneously by numerous snakes and other wildlife species (Photo 27). Constructing hibernacula can help increase local populations of snakes including the Eastern Fox Snake. When constructing hibernacula care should be taken in order to make sure they are constructed in a way that will allow snakes to use them. Restoration can also help to create better overwintering sites for the many turtle species found on Belle Isle as well. Hibernation for many of the species on Belle Isle

occurs underwater requiring waters deep enough that they don't entirely freeze.

Some also require or would utilize woody debris like fallen trees in the water to hide under during the winter as well.

- *Predator Control.* A growing threat for herpetofauna is the presence of dense subsidized predator populations. Predators such as raccoons can have a disproportionate effect on herpetofauna populations when the predators population exceeds natural levels. Indirect methods of mitigating this threat include the use of predator excluder devices, which can be designed to protect both single nests as well as entire nesting areas (Photos 28 and 29). Additionally, education and outreach on the island can help eliminate some of the causes for increased predators. Eliminating the excess of available food by encouraging visitors to not feed wildlife and not to throw away food waste except in covered garbage cans is one of the first steps that can be taken. Alternatively more direct approaches can include trapping and lethal control of dense populations.
- *Mudpuppy Habitat.* Care should be taken during the construction and restoration of LO to ensure that minimal negative impacts occur to local Mudpuppy habitat. Efforts should be made as well to improve the current available habitat. As an example, in the field north of LO there is a large area of concrete where an old swing set stood (Photo 36). This concrete can be removed and installed in the LO and the Detroit River as Mudpuppy habitat. Mudpuppies are known to occur around Belle Isle and within BHL as well. By connecting LO with the Detroit River and improving connectivity to BHL Mudpuppies could seasonally utilize LO helping this declining species.

Road Corridors.

The best opportunity for most amphibians and reptiles to cross a road is typically through culverts or under bridges. A majority of culvert systems are designed with the primary objective of allowing water passage while preventing scour that might degrade the road or crossing structure and the resulting designs are usually inadequate for allowing wildlife passage (Andrews, Nanjappa et al. 2015). Creating wildlife corridors under Lakeside Drive and Woodside Drive would allow herpetofauna and other vertebrates to travel between habitats underneath Belle Isle's main roads and, if designed correctly, could significantly reduce the number of road mortalities (Figure 3-4, Photo 30). To ensure the effectiveness of wildlife corridors, several key aspects must be considered including structure type, size, and ability to attract wildlife, and are reflected in the following recommendations in addition to other important measures that should be considered.

- *Temporary or Permanent Road Closings.* Temporary road closures during times of the year when wildlife activity is at a peak such as spring breeding and migration has been shown to dramatically reduce road related mortalities. However, in cases of seldom used roads such as Woodside Drive the permanent closure and removal is recommended. Removing this road would eliminate the threat faced by herpetofauna and other wildlife moving from the wet-mesic flatwood forest south to the restored LO. Road removals are usually not feasible elsewhere and this represents a unique opportunity to permanently reconnect existing fragmented habitats

- *Crossing Structure Design.* Bridges are typically the preferred choice for animal passage but if a culvert is necessary open-bottom arch culverts are preferred followed by box culverts, elliptical culverts and circular culverts in descending order of preference.
- *Size of structure.* Corridors should be made so that they are oversized. This is particularly important when creating crossings with culverts as small structures are less likely to be found and used by species seeking to cross the road. Larger culverts and crossings are also more likely to have natural lighting which is another important factor to encourage use by wildlife.
- *Mimic Natural Habitat.* Crossing structures should also be designed to mimic natural conditions as they are more likely to be used by wildlife if they closely resemble the surrounding habitat. Using the appropriate substrate and having sources of cover inside the crossing to provide shelter are perhaps the most critical characteristics of crossings targeting small animals such as amphibians and reptiles.
- *Barrier Fences and Wildlife Direction.* Consideration should also be given as to whether some form of barrier is needed to direct species into the crossing. For example, culverts commonly have wing walls in order to prevent erosion but these can also act as a funnel to direct species into the culvert. Additionally barriers to direct species to the crossing also help reduce the number of individuals that stray into the road. These structures can be critical on a corridor enhanced roadway as studies have found that success of connectivity structures was reliant upon the success of exclusion structures and entire mitigation systems have been compromised through no taking this component of the corridor into account.

- *Wildlife Friendly Curbs.* Another measure that has been shown to reduce road mortality is the installation of wildlife friendly curbs . Vertical curbs can hinder the movement of species once they have gained access to the road and rolled curbs can decrease the likelihood of animals becoming trapped in the path of a moving vehicle(Figure 5) (Andrews, Nanjappa et al. 2015). Incorporating road signage indicating wildlife crossing areas is also encouraged to alert visitors to the island of possible high volume crossing areas. This is particularly important now that both sides of the road will contain restored habitat, increasing the likelihood of crossings.

Conclusion

Previous restoration efforts have increased the quality and quantity of available habitat on Belle Isle suitable for supporting amphibians and reptiles. LO represents an excellent opportunity to continue this effort and increase the amount of functional and contiguous wildlife habitat on Belle Isle. Currently, habitat quality around LO is relatively low. However the diverse herpetofauna known to occur in and adjacent to LO is encouraging. Efforts should be made to ensure the restoration efforts best maximize the functionality of the target landscape for all species but especially those under state protection. Improving connectivity between the habitats is also highly recommended as this will be a critical component to the long-term viability of this area and will result in a reduction of the potential for mortality of several rare and protected species including the Eastern Fox Snake and Blanding’s Turtle. Continued long-term monitoring is also highly recommended as this area serves as an exceptional demonstration site for the success of habitat restoration.

Tables

Belle Isle Reptile and Amphibian Diversity (Lake Okonoka and Blue Heron Lagoon)					
Common Name	Species Name	(2004-2014)	2015	Observed at LO	Potential Unobserved Species
<i>Salamanders</i>					
Mudpuppy	<i>Necturus maculosus maculosus</i>	X	X		
<i>Frogs and Toads</i>					
Bullfrog	<i>Rana catesbeiana</i>	X	X	X	
Eastern American Toad	<i>Bufo americanus americanus</i>	X	X	X	
Gray Treefrog	<i>Hyla chrysoscelis/versicolor</i>	X			
Green Frog	<i>Rana clamitans melanota</i>	X	X	X	
Northern Leopard Frog	<i>Rana pipiens</i>	X	X	X	
<i>Snakes</i>					
Butler's Garter Snake	<i>Thamnophis butleri</i>	X	X		
Eastern Fox Snake	<i>Pantherophis gloydi</i>	X	X		
Eastern Garter Snake	<i>Thamnophis sirtalis sirtalis</i>	X	X		
Northern Brown Snake	<i>Storeria dekayi dekayi</i>	X	X		
Northern Red-Bellied Snake	<i>Storeria occipitomaculata occipitomaculata</i>				X
Northern Water Snake	<i>Nerodia sipedon sipedon</i>	X	X	X	
<i>Turtles</i>					
Blanding's Turtle	<i>Emydoidea blandingii</i>	X	X		
Eastern Musk Turtle	<i>Sternotherus odoratus</i>				X
Midland Painted Turtle	<i>Chrysemys picta marginata</i>	X	X	X	
Northern Map Turtle	<i>Graptemys geographica</i>	X	X	X	
Eastern Snapping Turtle	<i>Chelydra serpentina serpentina</i>	X	X		
Red-eared Slider	<i>Trachemys scripta elegans</i>	X	X	X	
Yellow-bellied Slider	<i>Trachemys scripta scripta</i>	X	X	X	
Eastern Box Turtle	<i>Terrepene carolina carolina</i>		X	X	

Table 1. Amphibian and reptile diversity in 2015, 2004-2014, and potential species not seen yet for eastern Belle Isle.

Figures

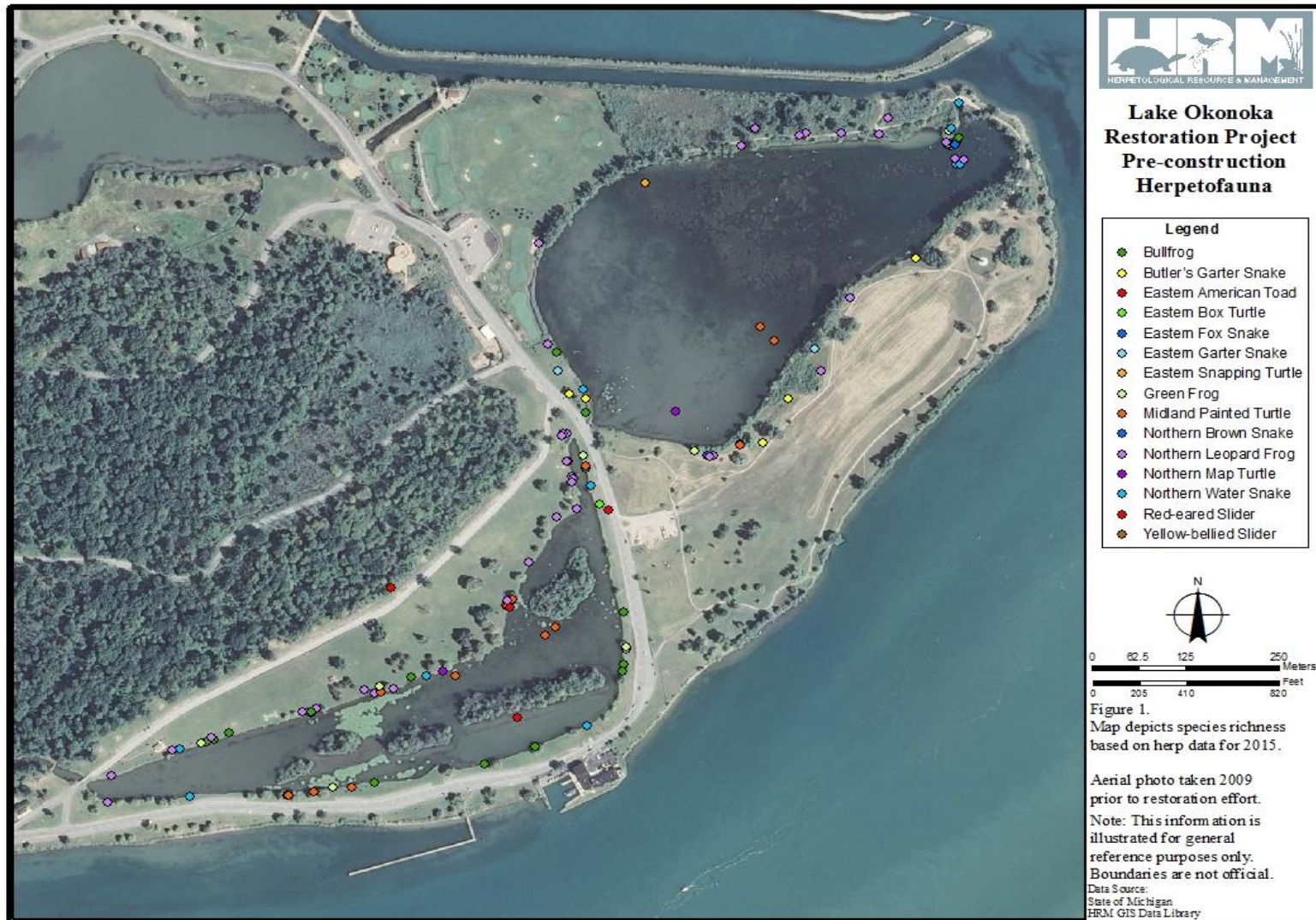


Figure 1. Map depicting amphibian and reptile diversity through 2015.



Figure 2. Map depicting historic amphibian and reptile diversity for Eastern end of Belle Isle.

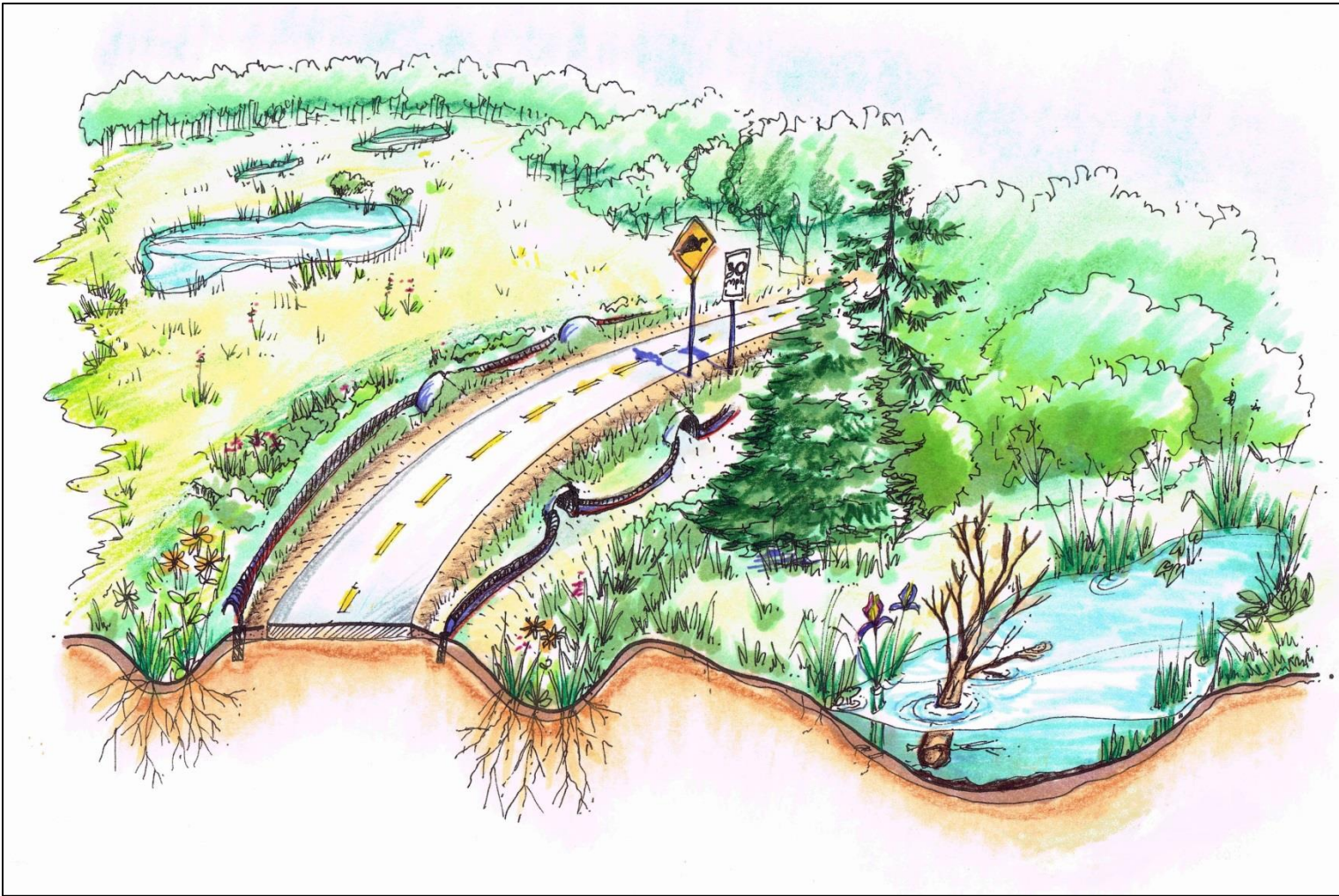


Figure 3. Conceptual drawing depicting a landscape modified to incorporate wildlife needs including, low or non-existent curbs, crossing structures and associated barrier fencing, no mow and vegetative buffer zones, and wildlife crossing signs. (Source: Michigan Amphibian and Reptile Best Management Practices manual).

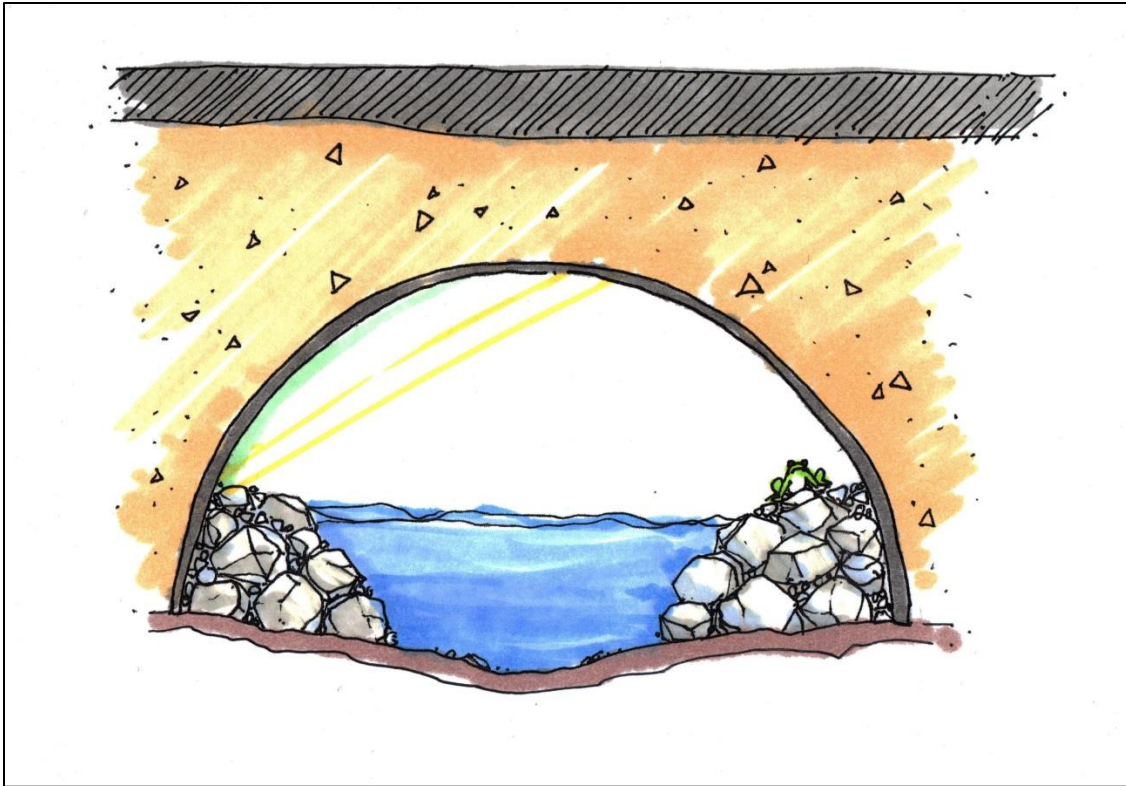


Figure 4. Crossing structures can be installed at hydraulic connection points to facilitate movement of both aquatic and terrestrial herpetofauna species. (Source: Michigan Amphibian and Reptile Best Management Practices manual).

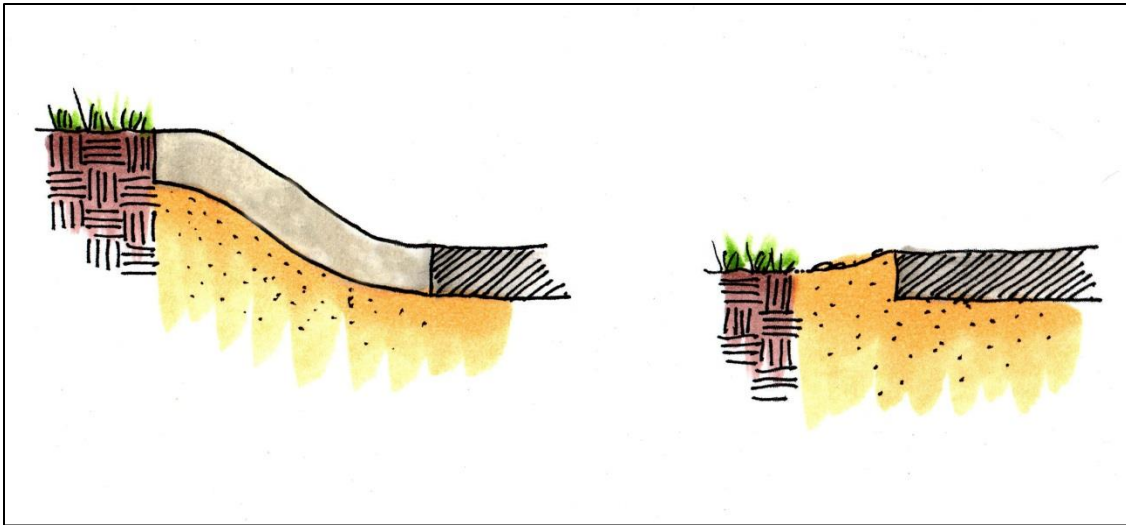


Figure 5. Eliminating curbs or installing those with gentle slopes can reduce rates of road mortality. (Source: Michigan Amphibian and Reptile Best Management Practices manual).

Photos



Photo 1. Lake Okonoka facing north towards Woodside Drive and Nashua Canal.



Photo 2. Westernmost shoreline of LO.



Photo 3. Southern shoreline of LO facing east.



Photo 4. Forested island located in the center of LO.



Photo 5. View north from the Woodside Drive bridge over Nashua Canal.



Photo 6. Current hydraulic connection between LO and the Blue Heron Lagoon.



Photo 7. Adjacent to LO is the Blue Heron Lagoon and recently restored connection to the Detroit River.



Photo 8. Southern shoreline of LO where connection to the Detroit River is approximately proposed.



Photo 9. Shoreline along the north shore of LO with limited emergent vegetation that is seasonally mowed.



Photo 10. Northwestern shoreline of LO before crossing the Woodside Bridge with higher densities of emergent vegetation.



Photo 11. LO facing east with mowed lawn-dominated shoreline adjacent to a high traffic roadway.



Photo 12. A female bullfrog found on one of the few flats created by emergent vegetation.



Photo 13. Green frog found along the banks of LO.



Photo 14. HRM staff conducting visual surveys of the aquatic habitat by scanning potential basking locations with binoculars.



Photo 15. Northern Leopard Frog in emergent vegetation along the north side of LO.



Photo 16. Northern Water Snake in some emergent vegetation along LO.



Photo 17. Deceased Eastern Box Turtle found along eastern shore of LO.



Photo 18. A gravid female Butler's Garter Snake taking refuge in an old tree trunk.



Photo 19. Eastern Fox Snake observed using restored habitat along BLH.



Photo 20. Blanding's Turtle observed dead in the road north of the assessment areas.



Photo 21. *Phragmites* growing alongside LO should be eliminated before it spreads.



Photo 22. Currently managed the northern lawn should be restored to lakeplain prairie and include seasonal wetland habitat.



Photo 23. Leaving the southern shore of LO open to recreational fishing while restricting the northern shore for habitat would balance recreational uses of this area.



Photo 24. Example of a turtle nesting site. Sandy areas that are managed to maintain no vegetation are ideal nesting locations for species like turtles.

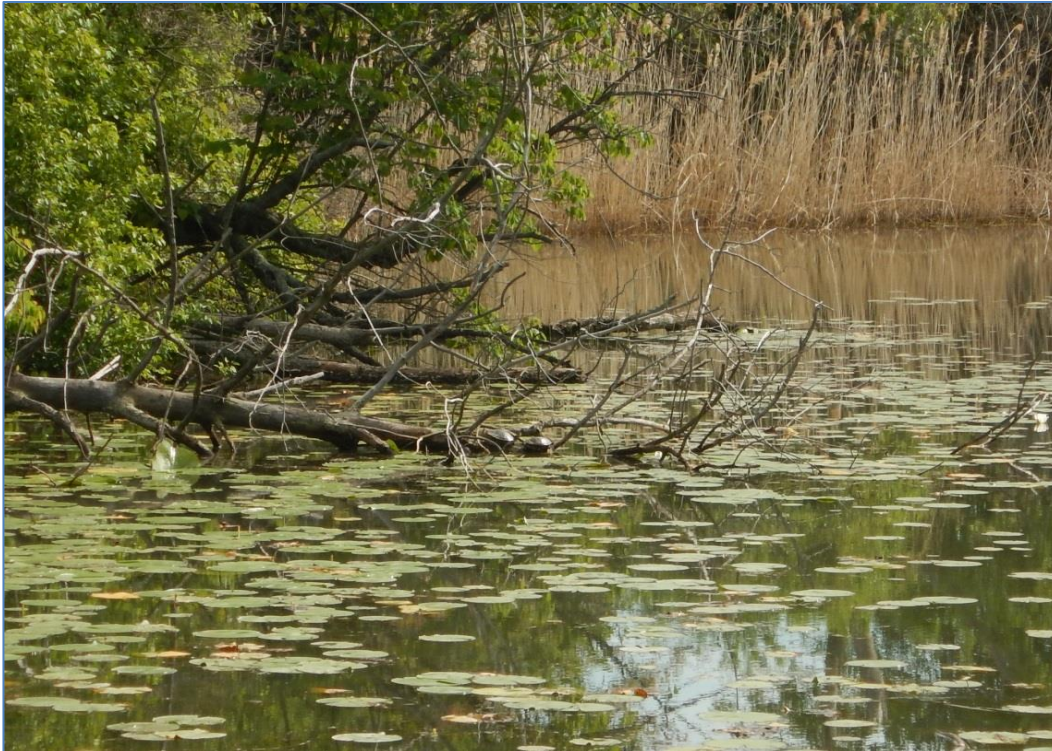


Photo 25. Basking opportunities are limited throughout LO. Felling trees on site is a simple way to create this critical habitat feature.



Photo 26. Herpetofauna seek cover in areas of emergent vegetation like this portion of the LO north shoreline. Providing woody debris for cover is advised.



Photo. 27 An example of a hibernaculum. These types of structures can also provide reptile nesting sites and uses for other wildlife species



Photo 28. Example of a single nest predator excluder device for known turtle nests.



Photo 29. Example of a full nesting site predator excluder device to reduce turtle nest mortalities.



Photo 30. Creating crossing structures such as this one can provide passage for both aquatic and terrestrial species while minimizing risk of road mortality.



Photo 31. Road mortality is fairly common on Belle Isle with many animals forced to cross busy roadways in search of various habitats.



Photo 32. Curbs can act as barriers to herpetofauna. Installing rolled curbs or eliminating them all together can help prevent roadside mortalities.



Photo 33. Temporally high volumes of traffic pose a fatal threat to herpetofauna seeking to cross Lakeside Drive from BHL to LO.



Photo 34. The removal of Woodside Drive could permanently reconnect existing fragmented habitats.

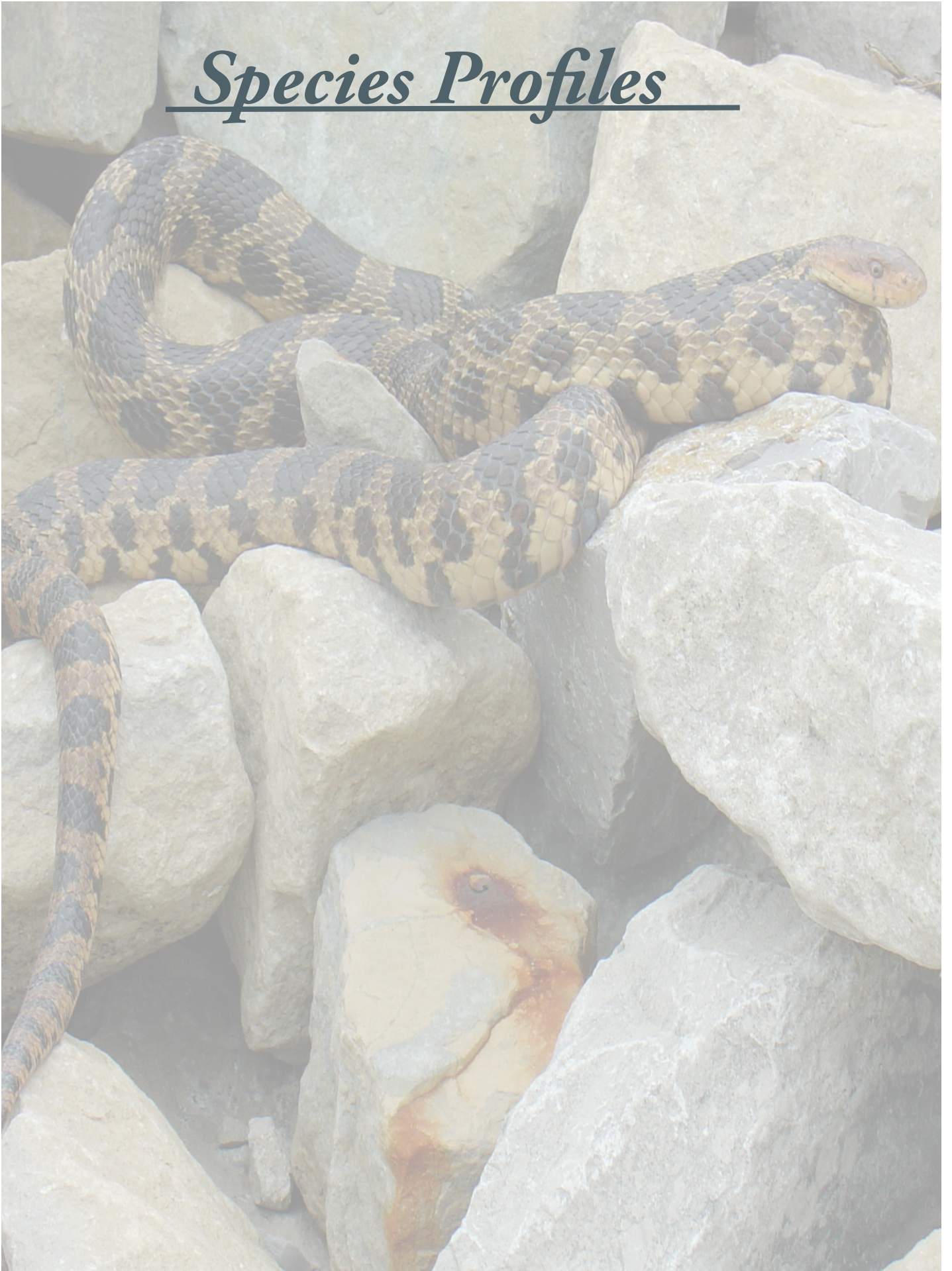


Photo 35. Supplementing aquatic crossings and other shoreline areas with riprap material such as at the Nashua Canal bridge can provide important snake habitat.



Photo 36. Unwanted on-site materials such as this old concrete base can be utilized to supplement Mudpuppy habitat or as materials for reptile hibernacula.

Species Profiles



Salamanders

Mudpuppy



Mudpuppies are large, entirely aquatic salamanders that are proposed for Special Concern status in Michigan which would afford it protection under the MDNR Fisheries Order 223.13. They are easily recognized by their large size (up to 1.5 feet long) and external gills just behind the head (Harding 1997). Small Mudpuppies might resemble the larvae of other salamanders, but have only four toes on each foot instead of five. In Michigan, this species is the only amphibian that normally inhabits the open water of large lakes and rivers, spending most of its time hiding under flat rocks. They are highly carnivorous and are often caught by fishermen, even in winter. Because of their unique appearance and unjustified reputation as predators of game fish, they are often killed when captured, even though they are harmless. Mudpuppies breed in fall, entering shallow water as the temperatures cool, but do not nest until the following spring. Females require moderately shallow water with plenty of large, flat rocks on the bottom beneath which they can deposit their eggs. Mudpuppies are the obligate host species for the larvae of the Salamander Mussel (*Simpsonaias ambigua*), a state Endangered species (Clark-Eagle, Hay-Chmielewski et al. 2005). This species is also potentially important in helping control invasive species. They have been recorded eating invasive round gobies (*Apollonia melanostomus*) and invasive mussels making them an important species in maintaining healthy aquatic habitats. Mudpuppies are declining throughout the Great Lakes region including the Detroit River. Despite their overall rarity, this species occurs throughout Belle Isle which serves as a critical nursery and breeding site for this rare species. Removal of submerged rocky shoreline habitat can significantly impact local populations.

Frogs and Toads

Northern Leopard Frog



The Northern Leopard Frog is listed as a Species of Greatest Conservation Need in Michigan. Once fairly common, populations of this frog suffered serious declines in the 60's and 70's and now can be uncommon in much of its range. The Northern Leopard Frog prefer habitats that are open and may consist of marshes, bogs, edges of water bodies, fields, meadows and even lawns. Northern Leopard Frogs feed primarily on invertebrates but full grown adults are known to eat small frogs such as Spring Peepers. A large variety of predators including humans feed upon all life stages of Leopard Frogs. During the spring, these frogs transition to shallow water for breeding but then disperse to dry land for the remainder of the summer. As with other amphibians, pollutants in the water have a negative effect on this species but the leopard frog tends to be particularly sensitive. The leopard frog is also sensitive to changes in the pH of water and generally does not do well in acidified waters. This frog also faces pressure from human collection for science and bait. Overall, it is believed though that the Northern Leopard Frog has to potential to recover from its reduced populations if the proper habitat is available(Harding 1997).

Turtles

Blanding's Turtle



In Michigan, the Blanding's Turtle is listed as a Species of Special Concern. While stable in some parts of Michigan, this species is listed as Threatened and Endangered in other portions of the range, and it is currently being considered for federal protection. The Belle Isle population is relatively small and this species' natural history traits do not support annual mortality exceeding 4% for adults (Congdon, Dunham et al. 1993). This species requires a mosaic of wetland habitats for their survival. For much of the year, they prefer open water areas with structures such as logs or stumps to bask. Females require well drained soils, usually with southern exposure, for nesting and will travel long distances to locate a suitable nesting location. Hibernation occurs within ponds where the animals burrow into the mud below the frost line. The Blanding's Turtle has a life span of approximately 80 years, and does not reach sexual maturity until around 20 years of age. Adults have no natural predators, but hatchling and juvenile turtles suffer very high mortality rates. Annual nest predation by predators, especially raccoons, is often 100%. For this reason, it may take one adult female decades to produce enough turtles to replace herself and her mate and thus maintain a stable population. Due to their very low reproductive rate, it is extremely important to maintain ample nesting areas as well as floating leaved and shrub swamp wetland to shelter young Blanding's Turtles (Harding 1997; Carl H. Ernst 2009).

Eastern Box Turtle



The Eastern Box Turtle is listed in Michigan as a Species of Special Concern and is currently proposed for elevation to Threatened (Herpetological Resource and Management 2014). These turtles are primarily terrestrial, favoring wooded areas consisting of deciduous or mixed trees with sandy soils but can also be found utilizing nearby open habitat like fields and marshes. Critical to their habitat is some form of access to water from any of a variety of sources including streams, ponds, and bogs etc. Diurnal, these turtles generally have periods of activity in the morning or after a rainstorm but spend most of the summer buried in leaf litter or when temperatures are high near their source of water. During the winter box turtles hibernate by burrowing into the ground ranging from shallow to much deeper burrows. These turtles have relatively small ranges and have an omnivorous diet consisting of plants, berries, invertebrates, and some small vertebrates. Major predators include raccoons, skunks, foxes and other mid-sized carnivores however, roadside mortalities of these animals is an even larger threat. These long lived animals (40-50 years in the wild, occasionally to 100 years) can take up to 10 years to reach sexual maturity and because of the high mortality rates of young box turtles it can take some time for adults to replace themselves in the population. The largest threats facing the Eastern Box Turtle come from humans, including habitat destruction, road mortality, and collection for the pet trade (Harding 1997).

Snakes

Butler's Garter Snake



In Michigan, the Butler's Garter Snake is listed as a Species of Greatest Conservation Need and is proposed for elevation to Special Concern (Herpetological Resource and Management 2014). In Canada, the species is listed as Endangered. Ranging from 15 to 29 inches these yellow/orange striped snakes are found on the eastern half of the state. The Butler's Garter Snake requires wet grassy habitat including meadows prairies, water body shores, or old fields and is commonly found under debris in these locations outside of its mating season, which occurs in early spring. Movements of this species tend to be restricted to the vicinity of water and patterns of movement parallel the margins of marsh habitat. Butler's Garter Snakes are rarely observed in woods and wooded areas likely act as a barrier. The primary prey source for these snakes are earthworms, which they typically hunt for in fairly small ranges of less than 1 hectare. Being a relatively small snake the Butler's Garter Snake faces predation by many species. The largest growing threat to this snake is the increasing development of urban and suburban lands. The species relies on the open fields which are most likely to be developed and are often found basking on gravel roads and walking or bicycle trails (Harding 1997; COSEWIC 2010).

Eastern Fox Snake



Eastern Fox Snakes (Photo 86) have a small range restricted to areas along and adjacent to the shores of Lake Huron and Lake Erie. They are a State Threatened species in Michigan, and are listed as Endangered in Canada. Fox Snakes require grassland habitat that is rarely mowed or burned, and often prefer to take shelter and overwinter in adjacent riprap or similar habitat. Although they spend much of their time in uplands feeding on small mammals, they are very strong swimmers, and it is not uncommon for them to use waterways to travel significant distances. Despite their size, these snakes are often preyed upon by large raptors and medium sized mammals. In the fall, Fox Snakes enter hibernacula, which sometimes include communal sites, and do not emerge until mid-April or May. Breeding occurs in spring, and eggs are laid in June or July, hatching about two months later. Fox Snakes are often senselessly killed because they are mistaken for Copperheads (*Agkistrodon contortrix*), a U.S. species not present in Michigan, because of the orange head, or for rattlesnakes because they will vibrate their tail against dry vegetation when threatened, producing a loud buzz (Harding 1997). This species is also uniquely vulnerable to habitat loss because of its restriction to a thin strip of shoreline where it must compete with intense road development (COSEWIC 2008).

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