

# **Reptile and Amphibian Community Assessment and Evaluation for the Beaver Island Archipelago**

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## Executive Summary

In 2013 Herpetological Resource and Management, LLC (HRM) was contracted by Conservation Resource Alliance (CRA) to conduct amphibian and reptile assessments within the Beaver Island Archipelago. This area has been identified as a hub of biodiversity among Great Lakes islands (Hatt, 1948; Placyk Jr and Gillingham, 2002). The primary objectives of these surveys are to establish a baseline of current species presence and to evaluate available habitat for herpetofauna on the archipelago, specifically in areas where invasive species are present and spreading. The results of these surveys are intended to assist in guiding restoration actions to be taken in the Beaver Island Archipelago as well as helping to evaluate the success of future restoration efforts conducted within the study area.

Surveys were conducted during the last week of July in 2013. Eight different sites were surveyed in the Archipelago, seven of which were located on Beaver Island and one that was located on Garden Island. Weather conditions limited HRM's ability to conduct additional surveys on the islands adjacent to Beaver Island. The sites on Beaver Island included Barney's Lake Nature Preserve, Petritz Nature Preserve, Little Sand Bay Nature Preserve, Egg Lake, Johnny Martin's Trail, Gull Harbor Nature Preserve and Lake Geneserath. On Garden Island the surveys transected through part of Northcutt Bay as well as Garden Island Harbor.

During the course of these surveys seventeen species of herpetofauna were observed including nine amphibians and eight reptiles. This represented seventeen of twenty one species known to occur on the islands. Of these seventeen species observed, four species (Northern Leopard Frog, Blue-spotted Salamander, Northern Ring-necked Snake and the Smooth Green Snake) are designated as Species of Greatest Conservation Need by the Michigan Department of Natural Resources. Surveys did not identify any Bullfrog on the island; it is believed that this species

has been extirpated. The identification of where these species occur and which habitats could support them will assist in the efforts to best manage and restore the Beaver Island Archipelago.

Management recommendations for the islands include invasive species control, reducing populations of subsidized predators, as well as improving existing habitat with structures like nesting grounds, basking structures, hibernacula, and cover objects. Invasive species represent one of the largest threats to the Beaver Island Archipelago. Management of these species would ensure that proper habitat would be available for not only herpetofauna but all species on the islands. There are various invasive species on the islands and the methods to dealing with them vary from controlled burns on dense areas of reed canary grass, to volunteers pulling less dense invasives. Also due to their introduction in the 1960's and subsequent population explosion, raccoon populations on the islands need to be monitored to ensure that they do not reach levels in which they are detrimentally affecting the herpetofauna populations on the islands. Finally, additional effort should be made to assess the status of Bullfrog on the island and evaluate the causes of decline and potential for reintroduction.

## **Objective**

This study will provide a baseline assessment of habitat quality within the Beaver Island Archipelago through the use of amphibian and reptile presence. The findings of this report should provide qualitative and quantitative data to assist in the restoration actions taken in removing invasive plant species as well as improving overall habitat conditions.

## **Introduction**

Due in part to their high sensitivity to environmental pollutants, amphibians and reptiles are recognized as key bioindicators, gauges of environmental health, and indicators of habitat

disturbance. Consequently, assessment of herpetofauna abundance and species richness within an area can reveal much about the health of the ecosystem and can point to habitat quality concerns that may not be detected by water quality or floristic assessments (Cooperrider et al., 1986; Guilfoyle, 2010; Welsh and Droege, 2001). Overall amphibian and reptile presence, represented age classes, spatial distribution, and relative abundance can be important tools in identifying the need for, and success of, habitat restoration projects.

The Beaver Island Archipelago has been identified as an important area of biodiversity within the Great Lakes. The islands are not only home to many rare species of herpetofauna but also support endangered plants and birds. Invasive species represent a significant threat to the Beaver Island Archipelago particularly invasive plants species that have the potential to drastically change habitats and outcompete native species. Raccoons, a species introduced to the archipelago in the 1960's, also have been documented to inflict considerable damage on herpetofauna populations, especially turtles (HRM, 2012). Because of this, restoration and management must be conducted on the islands to keep raccoon populations in check.

In 2013 Herpetological Resource and Management, LLC (HRM) was contracted by the Conservation Resource Alliance (CRA) to conduct reptile and amphibian surveys within the Beaver Island Archipelago. HRM will conduct additional assessments through 2015 to determine herpetofauna populations on Beaver Island as well as many of the outlying islands, including High Island, Garden Island, Hog Island, Squaw Island, Trout Island and Whiskey Island. The presence of amphibians and reptiles will be used as important factors in determining the proper course of restoration to take to improve overall habitat conditions in the Beaver Island Archipelago. Historical data will also be included in an effort to provide more comprehensive spatial data as well as comparison between pre and post restoration conditions on the islands.

## Site Locations and Descriptions

The project area consists of parcels in the Beaver Island Archipelago (Map 1). In 2013 eight different sites were surveyed, seven of which were on Beaver Island and one on Garden Island. The lack of surveys conducted in 2013 on other outer islands was due to inclement weather conditions in the archipelago not being favorable to reach the islands.

The Beaver Island Archipelago is a grouping of islands located in the northern portion of Lake Michigan near the city of Charlevoix. Geologically the islands are made up of primarily limestone and sand stone (Hatt, 1948). Many limestone reefs reach near the surface of the waters surrounding the islands within the archipelago. The islands have a diverse range of habitat including Great Lakes coastal marsh, lakes, cedar swamp, ridge-swale complex, upland forest, grassland, and old field. Because of this diverse amount of habitat, the islands can support a relatively large variety of flora and fauna. Within Beaver Island, one town named St. James is present though houses and cottages are present throughout the island.

### Beaver Island Parcels:

#### *Barney's Lake Nature Preserve*

Barney's Lake Nature Preserve is a one hundred and twenty acre parcel located in the northern half of Beaver Island and is accessed off Barney's Lake Road which bisects the property (Map 1). The preserve is owned by the Little Traverse Conservancy and encompasses a wide variety of habitat communities (Photos 9-14). The property encircles a forty-five acre lake that is surrounded by high quality bog, marsh and cedar swamp. Barney's Lake Nature Preserve also supports old field as well as high quality upland forest. The eastern portion of the preserve where

the old homestead was located contains a large pond with emergent marsh and tall sedges surrounding it (Photo 14).

#### *Petritz Nature Preserve*

Located in the Northern most portion of Beaver Island the George and Althea Petritz Nature Preserve owned by the Little Traverse Conservancy is a 27 acre parcel (Map 3). The parcel consists of hilly topography with predominately mixed conifers and hardwood forest that transition to sand beach and coastal marsh along Lake Michigan (Photos 1-4). The sand beach adjacent to the coastal marsh supported two species of federally protected plants, the Lake Huron Tansy (*Tanacetum huronense*), and Pitcher's Thistle (*Cirsium pitcheri*).

#### *Gull Harbor Nature Preserve*

Gull Harbor Nature Preserve is located off of Gull Harbor Drive in the Northeast portion of Beaver Island just southeast from Petritz Nature Preserve (Map 3). Gull Harbor Nature Preserve owned by the Michigan Department of Natural Resources (MDNR) is divided by Gull Harbor Drive which is seasonally inundated connecting the site to Lake Michigan. This parcel supports a coastal marsh, cedar swamp, mixed upland forest as well as a pond (5-8). The pond is the remaining evidence of the historic use of the site as a gravel pit.

#### *Egg Lake*

Egg Lake encompasses both privately owned land and land owned by the MDNR. Egg Lake is an acidic lake that includes a high quality bog surrounding the entirety of its shores (Map 5). The bog (Photo 21) supports a wide range of plants ranging from cranberry (*Vaccinium macrocarpon*), highbush blueberry (*Vaccinium corymbosum*), and sedges to carnivorous plants such as pitcher plant (*Sarracenia purpurea*) (Photo 21) and sundew (*Drosera rotundifolia*). Parts of this parcel include upland deciduous

forest as well as a coniferous plantation that transitions into cedar swamp. Old field habitat is present that is remnant of the homestead once located on the parcel. Similar old field habitat is also present due to the recent clearing of woodland to make room for a motel which was never built (Photo 20). There is a significant band of reed canary grass (*Phalaris arundinacea*) in between the field which was cleared for the motel and the bog.

### *Johnny Martin's Trail*

Johnny Martin's Trail is a narrow gravel road and trail that leads through both state land (MDNR) and private property. The trail is accessed off of East Side Drive (Map 4). This site consists of a mosaic of upland and wetland habitats including mixed coniferous/deciduous forests dominated by hemlock and aspen. Ridge-swale complex is abundant with black ash (Photo 24). Johnny Martin's Trail also contains a gravel pit which is actively used for materials as well as by locals as a dump and firing range (Photo 25-26).

### *Lake Geneserath*

The largest and deepest lake on the island, Lake Geneserath is four hundred and eighty nine acres in area and reaches up to fifty feet in depth (Map 7). The lake is surrounded on one side by state land managed by the MDNR while the other is owned by private residents. The sight surveyed consists of the south side of the lake and associated emergent marsh and shrub wetland edge (Photo 35). This habitat transitions into cedar swamp and a second growth aspen-paper birch and mixed coniferous forest (Photo 37). The upland woods support a very dense understory of red maple throughout large portions of the surveyed area. Ephemeral streams were present as well as vernal pools. A portion of this site is also actively used as a public camp ground.

### *Little Sand Bay Nature Preserve*



Located along the coast of Lake Michigan on the eastern side of Beaver Island, Little Sand Bay Nature Preserve is a sixty acre parcel owned by the Little Traverse Conservancy (Map 6). This site is made up of several community types (15-19). Closest to the lake, the nature preserve consists of coastal marsh and long linear inundated swales. The marsh transitions into a thick cedar swamp. Within the swamp are several small streams as well as a pond on the south end. On the west side of the cedar swamp the landscape transitions into a field with portions dominated by juniper. This field also contains some old orchard trees, gravel pits, as well as a historical farm house.

## **Garden Island**

Garden Island is state owned and is the second largest island in the Beaver Island Archipelago. Located 1.25 miles north off of the coast of Beaver Island, Garden Island is 4,990 acres (Map 8). The island is a mix of coastal marsh, coniferous forest, and mixed second growth coniferous/deciduous forest consisting of Aspen and Hemlock (Photos 31 and 34). The island once supported a few homesteads, native tribes and continues to serve as a native burial site (Hatt, 1948). The southernmost lake located on the east end of the island that was surveyed supports a fringe of fen dominated species including two species of sundew, pitchers plant, various sedges and shrubby cinquefoil (*Pentaphraguloides floribunda*). Lake levels are noticeably low with abundant coastal marsh and exposed lake bed present. An area which previously supported wetland hydrology was dominated by shrubby cinquefoil and patches of red-osier dogwood (*Cornus sericea*) (Photo 29). Pitcher's thistle (*Cirsium pitcheri*) a federally protected species of plant was also observed on Garden Island.

## Methods

### *Herpetofaunal Surveys*

Transect surveys through various habitats using visual detection as well as aural surveys were conducted during seasonally appropriate weather conditions in July of 2013. During these surveys HRM and CRA staff trained in the identification of amphibians and reptiles performed meandering transects through the properties surveying in both aquatic and terrestrial habitats. These habitats were searched for all life stages of amphibians and reptiles and evaluated as potential habitat. Various techniques were employed by the surveyors due to the diverse habitat used by herpetofauna. These techniques included direct detection of target taxa, turning over of fallen material on the ground which may be used as cover by many species, visual identification of possible nesting and basking spots, dip netting, aural identification of species calling, as well as enhanced visual detection through use of binoculars. During the course of the surveys no vouchers were taken, however, photographs were taken when possible to document site conditions and species observed. 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 could be determined). Observation locations were recorded using Tier II spatial accuracy standards. Juno SB GPS Units were used during HRM's surveys and observations were mapped using ArcMap®.

## Results

Seventeen species of herpetofauna (eight species of reptiles and nine species of amphibians) were observed in the Beaver Island Archipelago in 2013. Amphibians observed were the Blue-spotted Salamander (*Ambystoma laterale*), Eastern Newt (*Notophthalmus viridescens*), Red-backed Salamander (*Plethodon cinereus*), Eastern American Toad (*Bufo americanus americanus*), Northern Spring Peeper (*Pseudacris crucifer crucifer*), Gray Treefrog (*Hyla chrysoscelis/versicolor*), Green Frog (*Rana clamitans melanota*), Northern Leopard Frog (*Rana pipiens*), and Wood Frog (*Rana sylvatica*). Observed reptiles were Northern Red-bellied Snake (*Storeria occipitomaculata occipitomaculata*), Eastern Garter Snake (*Thamnophis sirtalis sirtalis*), Smooth Green Snake (*Opheodrys vernalis*), Eastern Milk Snake (*Lampropeltis triangulum triangulum*), Northern Water Snake (*Nerodia sipedon sipedon*), Northern Ring-necked Snake (*Diadophis punctatus edwardsii*), Eastern Snapping Turtle (*Chelydra serpentina serpentina*), Midland Painted Turtle (*Chrysemys picta marginata*). For the purposes of this report, *Hyla chrysoscelis* and *H. versicolor* were combined and listed as Gray Treefrog. The Eastern Newts found were most likely of the subspecies Central Newt (*Notophthalmus viridescens louisianensis*).

### Beaver Island

#### *Barney's Lake Nature Preserve*

During 2013, thirteen species of herpetofauna were observed at Barney's Lake Nature preserve including six species of amphibians and seven species of reptiles (Table 2, Map 2). The observed species were Northern Leopard Frog, Green Frog (Photo 11), Eastern American Toad, Northern Spring Peeper, Red-backed Salamander, Eastern Newt, Eastern Garter Snake, Eastern Milk Snake (Photo 10), Northern Water Snake (Photo 11), Northern Red-bellied Snake, Northern Ring-necked Snake, Smooth Green Snake, and Eastern Snapping Turtle. Invasive species included

spotted knapweed (*Centaurea maculosa*), multiflora rose (*Rosa multiflora*), reed canary grass (*Phalaris arundinacea*), and the common reed (*Phragmites australis*). None of these invasives were abundant at this site. Based on the available habitat types and quality an additional seven species of herpetofauna may occur within Barney's Lake Nature Preserve. Although not observed in this survey, Gray Treefrog, Bull Frog (*Rana catesbeiana*), Wood Frog, Blue-spotted Salamander, Spotted Salamander, Ribbon Snake and Midland Painted Turtle may be present. The Eastern Newts observed were found in the eft stage signifying high quality habitat and successful recruitment of this species. Though habitat is suitable and this species was known to occur on Beaver Island, the Bull Frog has not been reported on the island in over 20 years and may be extirpated.

#### *Petriz Nature Preserve*

One species of herpetofauna was observed at Petriz Nature Preserve (Table 2, Map 3). The observed species was the Red-backed Salamander (Photo 4). Although this was the only species found within the site, a high density of individuals was observed which is indicative of high quality habitat (Harding, 1997). Invasive species included spotted knapweed and sweet clover (*Melilotus officinalis*). Both of which were found along the lakeshore portion of the parcel. This site is home to the federally protected Pitcher's Thistle and Lake Huron Tansy. Based on the quality and type of habitat available eight additional species of amphibians and reptiles may occur within Petriz Nature Preserve. In the wooded area Eastern American Toads, Ring-necked snakes, and Garter snakes may occur. Transitioning into the forests edge Northern Red-bellied snake, Smooth Green Snake and Eastern Garter Snake may be found. Leopard Frogs, Eastern Newts, Eastern Garter Snakes, Red-bellied snake, and Eastern Snapping Turtle would likely occur in the coastal marsh.

### *Gull Harbor Nature Preserve*

During surveys five species of herpetofauna were observed at Gull Harbor Nature Preserve, including three reptiles and two amphibians (Table 2, Map 3). The species found were Eastern American Toad, Green Frog, Northern Water Snake, Eastern Garter Snake and Northern Ring-necked Snake (Photo 8). Invasive species observed at this site included sweet clover, reed canary grass, spotted knapweed, and zebra mussels (*Dreissena polymorpha*). Based on the observations made at Gull Harbor the nature area has the potential to support an additional eight species. These species are Mudpuppy (*Necturus maculosus maculosus*), Eastern Newt, Blue-spotted Salamander, Leopard Frog, Wood Frog, Northern Spring Peeper, Gray Treefrog, Midland Painted Turtle and Eastern Snapping Turtle. Mudpuppy would be most likely found just offshore using flat limestone pieces in the water.

### *Egg Lake*

At Egg Lake four species of reptiles and amphibians were observed including one amphibian and three reptiles (Table 2, Map 5). The species observed were Green Frog, Northern Water Snake, Eastern Garter Snake, and Northern Ring-necked snake. Invasive species observed were spotted knapweed, reed canary grass, sweet clover, Jerusalem artichoke (*Helianthus tuberosus*) and other agronomic weeds. Based on the variety of habitat types and quality there are an additional eleven species of herpetofauna that may use this site. These species are the Northern Leopard Frog, Gray Treefrog, Eastern American Toad, Northern Spring Peeper, Wood Frog, Red-backed Salamander, Eastern Newt, Northern Ribbon Snake, Smooth Green snake, Eastern Milk Snake, and Northern Red-bellied snake. Additional species would most likely be observed during a spring survey of this site due to the presence of high quality amphibian breeding habitat.

### *Johnny Martin's Trail*

Twelve species of herpetofauna were observed at Johnny Martin's Trail in 2013 including eight species of amphibians and four species of reptiles (Table 2, Map 4)). The species observed were Eastern American Toad (Photo 23), Green Frog, Northern Spring Peeper, Gray Treefrog, Wood Frog, Red-backed Salamander, Blue-spotted Salamander, Eastern Newt (Photo 28), Eastern Garter Snake, Northern Red-bellied Snake (Photo 27), Eastern Snapping Turtle and Midland Painted Turtle. Invasive species included spotted knapweed and reed canary grass. Based on the available habitat an additional seven species of herpetofauna may use Johnny Martin's Trail. These species include Northern Leopard Frog, Spotted Salamander, Northern Ribbon Snake, Smooth Green Snake, Eastern Milk Snake, Northern Ring-necked Snake, and Northern Water Snake. The ridge-swailes and gravel pit were biologically significant breeding grounds for multiple species of amphibians and also acted as nurseries for juvenile turtles.

### *Lake Geneserath*

In 2013, seven species of herpetofauna were observed at Lake Geneserath including five species of amphibians and two species of reptiles (Table 2, Map 7). These species included Eastern American Toad, Northern Spring Peeper, Green Frog (Photo 38), Red-backed Salamander, Eastern Newt, Northern Water Snake, and Eastern Garter Snake (Photo 36). Based on available habitat the following ten species of herpetofauna may be found at Lake Geneserath including Bullfrog, Wood Frog, Gray Treefrog, Blue-spotted Salamander, Spotted Salamander, Ribbon Snake, Ring-necked Snake, Red-bellied Snake, Eastern Snapping Turtle, and Midland Painted Turtle. The Eastern Newt found here was found in the eft stage signifying high quality woods. Though habitat is suitable and this species was known to occur on Beaver Island, the Bull Frog is reported as being extirpated on the island.



### *Little Sand Bay Nature Preserve*

Ten species of reptiles and amphibians were observed at Little Sand Bay Nature Preserve in 2013 including five species of amphibians and five species of reptiles (Table 2, Map 6). These species were Green Frog, Eastern American Toad, Northern Leopard Frog, Red-backed Salamander, Eastern Newt, Eastern Garter Snake, Smooth Green Snake (Photo 17), Northern Water Snake, Midland Painted Turtle, and Eastern Snapping Turtle. Invasive species at this site included spotted knapweed, *Phragmites*, bull thistle, Canada thistle and reed canary grass. Several federally protected species of plants were observed too including Lake Huron Tansy, and Michigan Monkey Flower (*Mimulus michiganensis*). Based on available habitat there are an additional nine species of herpetofauna that may occur at Little Sand Bay Nature Preserve. These species are Wood Frog, Spring Peeper, Bull Frog, Blue-salamander, Ribbon Snake, Northern Ring-necked Snake, Northern Red-bellied Snake, and Eastern Milk Snake. The Smooth Green Snake observed on this parcel was a dead gravid female.

### **Garden Island**

Eight species of herpetofauna were observed on Garden Island in 2013 (Table 2, Map 8). Of these eight species three were amphibians and five were reptiles. The species observed were Green Frog, Eastern American Toad, Red-backed Salamander (Photo 32), Northern Water Snake (Photo 33), Eastern Garter Snake, Northern Ring-necked Snake, Northern Red-bellied Snake, and Midland Painted Turtle (Photo 30). Invasive species appear to be limited and localized in the area surveyed. Though limited, reed canary grass and spotted knapweed are both present on the island. Based on the available habitat and its quality there are an additional ten species of herpetofauna that could likely occur on Garden Island. Wood Frog, Northern Leopard Frog, Northern Spring Peeper, Gray Treefrog, Blue-spotted Salamander, Eastern Newt, Eastern Milk Snake, Northern Ribbon

Snake, Smooth Green Snake, and Eastern Snapping Turtle are all possible species. An observation of a female Red-backed Salamander guarding her eggs was observed demonstrating successful reproduction by this species on the island.

## **Discussion**

The Beaver Island Archipelago historically is home to twenty-one different species of herpetofauna eleven of which are amphibians and nine of which are reptiles. During the course of surveys conducted in July seventeen of these species were observed. The only four species that were historically observed but were not observed during 2013 surveys are the Bullfrog, Spotted Salamander, Northern Pickerel Frog, and Northern Ribbon Snake. Pickerel Frogs have not been recorded from any previous surveys of the islands and the sole historical observation is being reviewed to determine if the species may have been misidentified. Many of the herpetofauna species encountered throughout the sample areas were observed at various life stages indicating that these sites appear to support critical habitat able to sustain reproductively viable populations. Many observed female snakes were found gravid. Although nest predation is known to be high in many parts of Beaver Island, juveniles of both Midland Painted Turtle and Eastern Snapping Turtle were observed. Metamorph amphibians were found in great abundance in wetlands at Johnny Martin's Trail and along the coastal wetlands of Little Sand Bay Nature Preserve. Eastern Newts were found in three life stages on Beaver Island as a metamorph, eft, and adult. There were also many observations made of herpetofauna demonstrating rare and unusual physical characteristics such as appearance and size. Eastern Garter Snakes were found demonstrating high morphological variability with several forms from bright orange morphs, bright electric yellow morphs, and turquoise morphs as well. Eastern Garter Snakes and Eastern American Toads were found at extremely large sizes. Eastern American Toads were found at sizes larger than the average human

fist (see species summary Eastern American Toad for more information) and a close to three foot long Eastern Garter Snake was observed at Barney's Lake. Larger garter snakes are increasingly rare in Michigan and presence implies older individuals.

An important observation can be made in particular from two of the sites that were surveyed. Johnny Martin's Trail as well as Gull Harbor Nature Preserve both have portions within the parcels that have been either severely impacted by humans in the past or in the case of the gravel pit off of Johnny Martin's Trail is being actively impacted. These areas can serve as biologically significant zones as critical habitats and can be generated from construction activities. For Johnny Martin's Trail the creation of multiple water bodies was biologically significant and spatially demonstrated the degree of utilization. The ponds that occurred in these two gravel pits were not only used by many different species of herpetofauna but also had high densities of herpetofauna using them. Even the smallest of ponds at the gravel pit off of Johnny Martin's Trail which was less than four inches deep provided habitat for juvenile snapping turtles, Eastern Newts, and frog metamorphs. Care should be taken at these sites particularly at the gravel pit near Johnny Martin's Trail, to ensure that these sites are properly managed in order to provide improved habitat for the herpetofauna that were observed using them. These sites can also serve as reference sites for how similar sites, such as gravel pits, may be transformed into critical habitat for herpetofauna.

While surveying Beaver Island there were no observations made for Bullfrog. This species has historically occurred on the island however while talking to local individuals who are capable of recognizing the species, HRM employees were informed that the Bullfrog has not been seen on the island for many years. Because it is believed that the species may have been extirpated, follow up and looking into why this species is no longer observed on the island is recommended. If the

conditions appear right and the habitat seems suitable this may be a species that could be reintroduced to the islands to its historic range.

In recent years, populations of herpetofauna have declined in Michigan and throughout the world (Graeter et al., 2008; Harding, 1997; Holman, 2012). There are many factors implicated in population declines including climate change, disease, altered hydrologic regimes, illegal collection, road mortality, and habitat loss. The most significant drivers of amphibian and reptile population declines in Michigan are likely habitat loss, fragmentation, and degradation. Because the islands are secluded they represent a significant biological refuge for the species found on them. By limiting these potential threats the herpetofauna on the islands can thrive and uncommon characteristics of the same herpetofauna found on the mainland may continue to be observed. However, if the threats that available habitat on these islands face are not addressed these species may not continue to thrive. Invasive species will need to be continually monitored to ensure that they do not take over a habitat that is a refuge for herpetofauna species

## Recommendations

Recommendations are provided for each area surveyed as well as overall recommendations. The recommendations for sites surveyed can also be used as a reference when considering restoration measures for other parcels not assessed by HRM that are proposed for restoration.. The following recommendations are for the overall Beaver Island Archipelago.

- *Subsidized Predators.* During HRM's surveys, several predated turtle nests were observed. Monitoring the raccoon population in the archipelago is strongly encouraged and possibly implementing a density management plan for this species. Raccoons are notorious turtle

nest predators and can severely impact the number of successful nests destroying upwards of 100% of nests annually (Harding, 1997; HRM, 2012).

- *Invasive Control.* Invasive plant species in the archipelago should be continually monitored and managed. Not only do these plants threaten the herpetofauna populations but other populations can be impacted too such as the rare and protected plants found on the islands. Timing and techniques used to conduct invasive control can help to reduce impacts directly to herpetofauna. Regardless of which technique is the most suitable for management goals, care should be taken to conduct management activities in a manner and at times that are sensitive to the habitat requirements and life cycle of on-site herpetofauna species.
- *Bullfrog Population Assessment.* Bullfrogs were not observed during the surveys conducted in 2013 and have been reported by others as being absent for many years on known sites. Because of this, a targeted assessment focused on determining the status of this species on the island and potential cause of its decline is warranted. If extirpated, this species would likely serve as a good candidate for reintroduction.
- *Outreach and Training.* It has been anecdotally documented on multiple occasions that snakes are persecuted by some residents on the island. Educating the public about the role and importance of amphibians and reptiles on the landscape is an important component in restoring and preserving healthy ecosystems. In addition to demonstrating the value these species have, citizens can also help in monitoring species and collecting critical data through contributions to projects like the Michigan Herp Atlas administered by HRM. Conducting a training workshop on amphibians and reptiles will not only aid in the understanding of these taxa but also engage likely volunteers in contributing observations.

### *Barney's Lake Nature Preserve*

- *Basking Structures.* The lake was greatly lacking in sufficient basking structures. Basking opportunities are a limiting factor controlling the presence and density of some herpetofauna. These structures also provide important cover for fish species. Placing additional woody debris sporadically along the shore will increase habitat use by turtle and snake species and improve overall habitat restoration.
- *Woody Debris.* In the grassland field across from the lake, placement of additional woody debris to provide cover for herpetofauna species is encouraged. This habitat provides critical microhabitat and microclimate zones that are necessary for nesting, foraging, shelter, and shedding.
- *Road Crossing.* This parcel is bisected by a road dividing the property. Roads are known wildlife sinks and can fragment landscapes. Incorporating wildlife crossing signs to reduce potential road related mortality of the amphibians and reptiles is suggested. These signs can also educate the public about wildlife in the area.

### *Petritz Nature Preserve*

- *Woody Debris.* Adding some woody debris to the coastal marsh and beach area of Petritz Nature Preserve would provide important cover for various species of herpetofauna that use this area. It will also provide critical nesting sites for various species that nest in these logs.

### *Gull Harbor Nature Preserve*

- *Road Crossing.* Due to the road that bisects this parcel a wildlife crossing sign is advised to reduce road related fatalities of the amphibians and reptiles which seasonally or temporally utilize both sides of the road.



- *Woody Debris.* The addition of woody debris in this area would provide additional cover to herpetofauna species such as snakes.

### *Egg Lake*

- *Native Community Restoration.* The establishment of native shrubs and herbaceous vegetation to the recently created old field habitat at Egg Lake along with invasive control would allow this site to provide a more diverse habitat and likely support a richer assemblage of wildlife including amphibians and reptiles.
- *Public Walk.* Because of the sensitivity of ecosystems such as the bog, limiting public access or providing a board walk with rails would help to protect not only the herpetofauna species that use the bog but would also protect many of the sensitive plant species that live in the bog as well.
- *Hibernacula.* Available overwintering sites were lacking at this location. Creating such structure allows for greater use of herpetofauna within this area. Utilizing existing material to create overwinter site would be beneficial to species found in the area. There is sufficient onsite debris and rock left over from the old homestead that could be utilized in creating structures. An old well would also serve as a likely start point for a simple overwintering site for onsite herpetofauna.
- *Forest Stand Improvement Cut.* Selectively removing unwanted trees to open canopy or improve site conditions for target habitat communities can be beneficial for various species. The felled trees can act as cover for species of Salamanders as well as being used to provide cover in the old field habitat.

### *Johnny Martin's Trail*

- *Trash Removal.* There is a large amount of trash and debris found near and around the gravel pit located off of the trail. The removal of this trash would make the habitat overall more natural and potentially less hazardous to the herpetofauna species there. It would also discourage continued dumping at this location.
- *Creation of Additional Ponds.* Due to the incredible amount of herpetofauna species that were observed using the pools of water in the gravel pit. The construction of additional ponds would likely provide increased critical breeding and nursery habitat and would promote herpetofauna use of this area.
- *Re-contouring of Slopes.* The bank slopes of the ponds in the gravel pit are generally too steep for herpetofaunal use in many areas. Re-contouring these slopes to a grade that would allow easier access to and from the pools would greatly benefit herpetofaunal species which may use the ponds.
- *Basking Structures.* The addition of basking logs to the existing ponds and to any future created ponds would further encourage the use of the site by herpetofauna species such as the Midland Painted Turtle. These structures also provide necessary cover for a number of other species.
- *Woody Debris.* Adding woody debris and brush piles around the gravel pit would provide essential cover for snakes and some salamander species. The brush piles, if properly designed, could also function as hibernacula for the snakes providing additional functional habitat for them.

### *Lake Geneserath*

- *Nesting Beach.* Lake Geneserath has inadequate nesting opportunity for turtles. The addition of turtle nesting grounds would likely greatly benefit turtles trying to use Lake Geneserath and would also bolster the population of turtles in the lake.
- *Basking Structures.* The lake lacks sufficient basking structures. Basking opportunities are a limiting factor controlling the presence and density of some herpetofauna. These structures would also likely provide cover for fish and other aquatic organisms. Placing additional woody debris sporadically along the shore will increase habitat use by turtle and snake species and improve overall habitat restoration.

### *Little Sand Bay Nature Preserve*

- *Woody Debris.* The addition of woody debris along the coastal and grassland areas would provide critical cover for various species of herpetofauna as well as nesting substrate for some snake species..
- *Basking Structures.* The pond located at the southeastern portion of Little Sand Bay had turtles utilizing the habitat however the pond is lacking any basking structure. The addition of basking structures would likely increase the use of the pond by turtle species.

## **Garden Island**

Additional surveys will provide more insight into what recommendations are needed at Garden Island. Due to the small area covered in the one day that surveys were able to be conducted on Garden Island there is no way to accurately determine the state of the entire island. However, the overall recommendations of controlling subsidized predators and invasive plant monitoring and control are applicable to this site.

## Conclusion

The benefits of habitat restoration to the Beaver Island Archipelago would be significant in improving habitat for amphibians, reptiles, and other wildlife. Wildlife areas with limited human disturbances will become exceedingly more important in the future and these islands will likely serve as a refuge for herpetofauna species and for rare traits of those species in the future. Perhaps the largest threat to the island is invasive plant species. By addressing this threat early before species such as *Phragmites* and reed canary grass take over habitats and severely degrade them, less harm will come to the habitats. By ensuring that habitats necessary to support herpetofauna populations are not lost these sites will continue to serve as high quality critical areas for amphibians and reptiles. Additional actions may be taken to improve the overall habitat condition at sites as well. Providing cover, basking opportunities, and other structures used by herpetofauna will help increase the use of sites by herpetofauna. Many of the actions that can be taken are simple and effective. Overall, the habitat on Beaver Island and Garden Island appears to be relatively well suited to the needs of the herpetofauna species found on the island. Continued monitoring and assessment of the amphibians and reptiles of the archipelago will help demonstrate the current status and distribution of these species and better solidify their critical role as indicators of ecosystem health.

## Tables

Table 1. Weather Data for transect surveys.

Site	Date	Start Time	Start Temp (°F)	Start Humidity (%)	Start Wind Speed (mph)	Start Cloud Cover	End Time	End Temp (°F)	End Humidity (%)	End Wind Speed (mph)	End Cloud Cover	Total Hours*
Petritz Nature Preserve	7/27/2013	9:45	59.8	79	0	Cloudy	12:14	60	79	0	Partly Cloudy	9.93
Gull Harbor Nature Preserve	7/27/2013	12:43	65	69.5	2	Mostly Cloudy	3:05	64.5	69	1.5	Mostly Cloudy	11.83
Barney's Lake Nature Preserve	7/28/2013	9:40	60	73	0.8	Partly Cloudy	1:00	59	78	1.7	Cloudy Light Rain	16.67
Barney's Lake Nature Preserve	7/31/2013	10:45	73	76	2.1	Partly Cloudy	2:45	80	63	1.8	Partly Cloudy	16
Egg Lake	7/29/2013	9:12	59	81	1.1	Cloudy	11:10	66	74	2	Partly Cloudy	9.83
Johnny Martin's Trail	7/29/2013	1:30	69	66	0.6	Partly Cloudy	5:57	74	58	0.6	Mostly Sunny	22.25
Lake Geneserath	7/31/2013	3:21	69	76	5.4	Partly Cloudy	5:36	71	77	2.6	Partly Cloudy	9.00
Little Sand Bay Nature Area	7/28/2013	2:10	60	78.5	1.8	Cloudy Scattered Rain	4:50	62	81	1.6	Cloudy Scattered Rain	13.33
Garden Island	7/30/2013	10:15	68	69	4	Partly Cloudy	3:28	67	72	10	Partly Cloudy	26.08

\*Total Hours=Time on site x Number of Observers

Table 2. Observed species by location during 2013 surveys.

Herpetofauna Species	Petritz Nature Preserve	Gull Harbor Nature Preserve	Barney's Lake Nature Preserve	Little Sand Bay Nature Preserve
Pickerel Frog ( <i>Rana palustris</i> )	X			
Eastern American Toad ( <i>Bufo americanus americanus</i> )		X	X	X
Gray Tree Frog ( <i>Hyla chrysoscelis/versicolor</i> )				
Northern Spring Peeper ( <i>Pseudacris crucifer crucifer</i> )			X	
Bullfrog ( <i>Rana catesbeiana</i> )				X
Northern Green Frog ( <i>Rana clamitans melanota</i> )		X	X	
Northern Leopard Frog ( <i>Rana pipiens</i> )			X	X
Wood Frog ( <i>Rana sylvatica</i> )				
Eastern Newt ( <i>Notophthalmus viridescens viridescens</i> )			X	X
Red-backed Salamander ( <i>Plethodon cinereus</i> )			X	X
Spotted Salamander ( <i>A. maculatum</i> )				
Blue-spotted Salamander ( <i>Ambystoma laterale</i> )				
Ring-necked Snake ( <i>Diadophis punctatus</i> )		X	X	
Northern Water Snake ( <i>Nerodia sipedon sipedon</i> )		X	X	
Northern Red-bellied Snake ( <i>Storeria o. occipitomaculata</i> )			X	
Northern Ribbon Snake ( <i>Thamnophis sauritus septentrionalis</i> )				X
Eastern Garter Snake ( <i>Thamnophis sirtalis sirtalis</i> )		X	X	X
Smooth Green Snake ( <i>Opheodrys vernalis</i> )			X	X
Eastern Milk Snake ( <i>Lampropeltis triangulum triangulum</i> )			X	
Snapping Turtle ( <i>Chelydra serpentina serpentina</i> )			X	X
Midland Painted Turtle ( <i>Chrysemys picta marginata</i> )				X
Amphibian Totals	1	2	6	5
Reptile Totals	0	3	7	5
Total	1	5	13	10





Table 2. Continued.

Herpetofauna Species	Egg Lake	Johnny Martin's Trail	Lake Geneserath	Garden Island
Pickerel Frog ( <i>Rana palustris</i> )				
Eastern American Toad ( <i>Bufo americanus americanus</i> )		X	X	X
Gray Tree Frog ( <i>Hyla chrysoscelis/versicolor</i> )		X		
Northern Spring Peeper ( <i>Pseudacris crucifer crucifer</i> )		X	X	
Bullfrog ( <i>Rana catesbeiana</i> )				
Northern Green Frog ( <i>Rana clamitans melanota</i> )	X	X	X	X
Northern Leopard Frog ( <i>Rana pipiens</i> )				
Wood Frog ( <i>Rana sylvatica</i> )		X		
Eastern Newt ( <i>Notophthalmus viridescens viridescens</i> )		X	X	
Red-backed Salamander ( <i>Plethodon cinereus</i> )		X	X	X
Spotted Salamander ( <i>A. maculatum</i> )				
Blue-spotted Salamander ( <i>Ambystoma laterale</i> )		X		
Ring-necked Snake ( <i>Diadophis punctatus</i> )	X			X
Northern Water Snake ( <i>Nerodia sipedon sipedon</i> )	X		X	X
Northern Red-bellied Snake ( <i>Storeria o. occipitomaculata</i> )		X		X
Northern Ribbon Snake ( <i>Thamnophis sauritus septentrionalis</i> )				
Eastern Garter Snake ( <i>Thamnophis sirtalis sirtalis</i> )	X	X	X	
Smooth Green Snake ( <i>Opheodrys vernalis</i> )				X
Eastern Milk Snake ( <i>Lampropeltis triangulum triangulum</i> )				
Snapping Turtle ( <i>Chelydra serpentina serpentina</i> )		X		
Midland Painted Turtle ( <i>Chrysemys picta marginata</i> )		X		X
Amphibian Totals	1	8	5	3
Reptile Totals	3	4	2	5
Total	4	12	7	8



Table 3. Historic observations on Beaver Island Archipelago

Herpetofauna Species	Beaver Island	Garden Island	High Island	Hog Island
Pickereel Frog ( <i>Rana palustris</i> )			X	
Eastern American Toad ( <i>Bufo americanus americanus</i> )	X	X	X	X
Gray Tree Frog ( <i>Hyla chrysoscelis/versicolor</i> )	X			
Northern Spring Peeper ( <i>Pseudacris crucifer crucifer</i> )	X	X		
Bullfrog ( <i>Rana catesbeiana</i> )	X			
Northern Green Frog ( <i>Rana clamitans melanota</i> )	X	X	X	
Northern Leopard Frog ( <i>Rana pipiens</i> )	X	X		
Wood Frog ( <i>Rana sylvatica</i> )	X			
Eastern Newt ( <i>Notophthalmus viridescens viridescens</i> )	X	X	X	X
Red-backed Salamander ( <i>Plethodon cinereus</i> )	X	X	X	X
Spotted Salamander ( <i>A. maculatum</i> )	X			
Blue-spotted Salamander ( <i>Ambystoma laterale</i> )	X	X	X	
Ring-necked Snake ( <i>Diadophis punctatus</i> )	X	X		
Northern Water Snake ( <i>Nerodia sipedon sipedon</i> )	X	X	X	X
Northern Red-bellied Snake ( <i>Storeria o. occipitomaculata</i> )	X	X	X	
Northern Ribbon Snake ( <i>Thamnophis sauritus septentrionalis</i> )	X			
Eastern Garter Snake ( <i>Thamnophis sirtalis sirtalis</i> )	X	X	X	X
Smooth Green Snake ( <i>Opheodrys vernalis</i> )	X			
Eastern Milk Snake ( <i>Lampropeltis triangulum triangulum</i> )	X	X	X	
Snapping Turtle ( <i>Chelydra serpentina serpentina</i> )	X	X		
Midland Painted Turtle ( <i>Chrysemys picta marginata</i> )	X	X	X	
Amphibian Totals	11	7	6	3
Reptile Totals	9	7	5	2
Total	20	14	11	5



Table 3. Continued.

Herpetofauna Species	Whiskey Island	Trout Island	Squaw Island
Pickerel Frog ( <i>Rana palustris</i> )			
Eastern American Toad ( <i>Bufo americanus americanus</i> )	X	X	X
Gray Tree Frog ( <i>Hyla chrysoscelis/versicolor</i> )		X	
Northern Spring Peeper ( <i>Pseudacris crucifer crucifer</i> )		X	
Bullfrog ( <i>Rana catesbeiana</i> )			
Northern Green Frog ( <i>Rana clamitans melanota</i> )			
Northern Leopard Frog ( <i>Rana pipiens</i> )			
Wood Frog ( <i>Rana sylvatica</i> )			
Eastern Newt ( <i>Notophthalmus viridescens viridescens</i> )			X
Red-backed Salamander ( <i>Plethodon cinereus</i> )			
Spotted Salamander ( <i>A. maculatum</i> )			
Blue-spotted Salamander ( <i>Ambystoma laterale</i> )		X	
Ring-necked Snake ( <i>Diadophis punctatus</i> )			
Northern Water Snake ( <i>Nerodia sipedon sipedon</i> )	X		X
Northern Red-bellied Snake ( <i>Storeria o. occipitomaculata</i> )	X		X
Northern Ribbon Snake ( <i>Thamnophis sauritus septentrionalis</i> )			
Eastern Garter Snake ( <i>Thamnophis sirtalis sirtalis</i> )	X	X	X
Smooth Green Snake ( <i>Opheodrys vernalis</i> )			
Eastern Milk Snake ( <i>Lampropeltis triangulum triangulum</i> )	X		
Snapping Turtle ( <i>Chelydra serpentina serpentina</i> )			
Midland Painted Turtle ( <i>Chrysemys picta marginata</i> )			
Amphibian Totals	1	4	2
Reptile Totals	3	1	3
Total	4	5	5

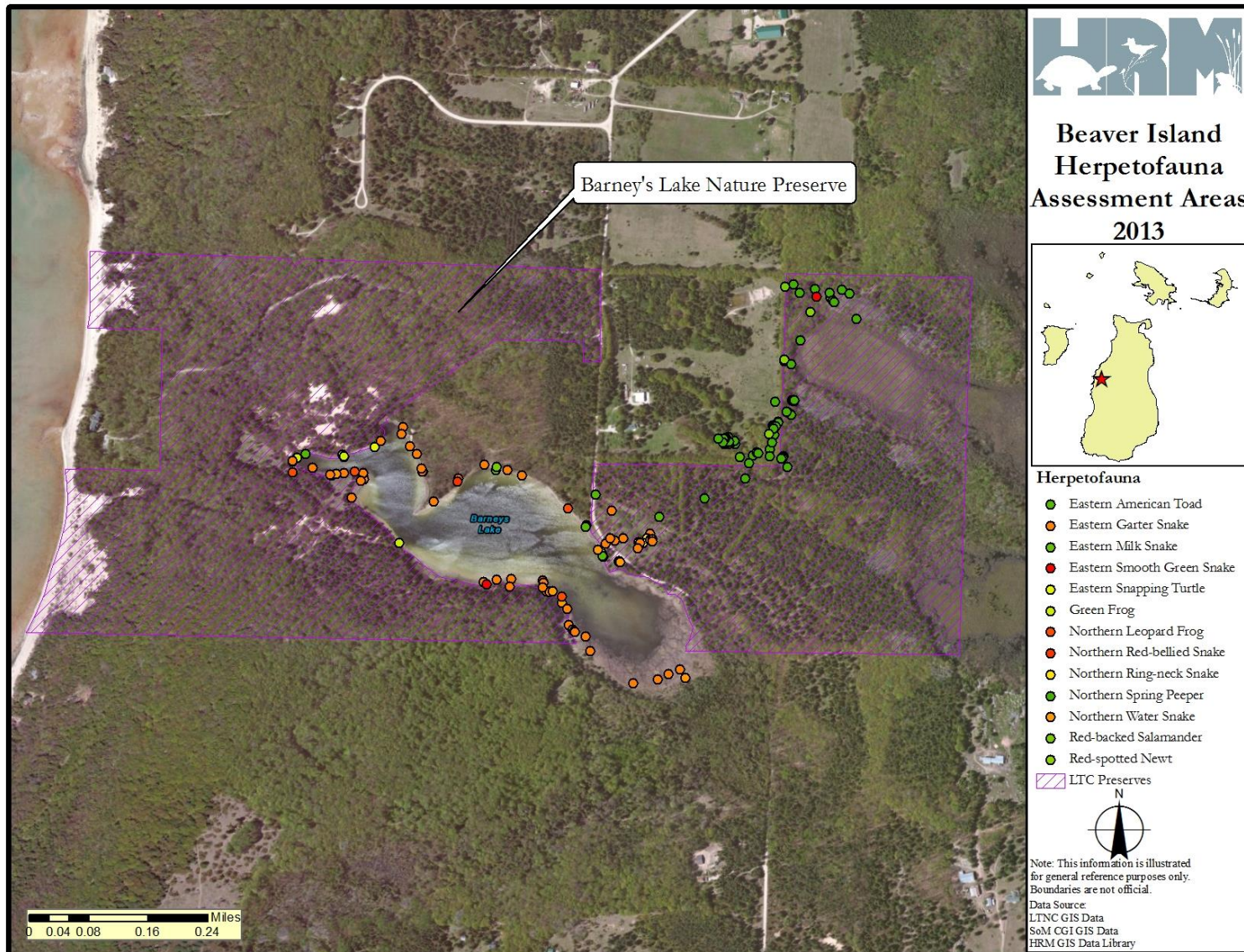
## Figures

Map 1. Beaver Island Archipelago.



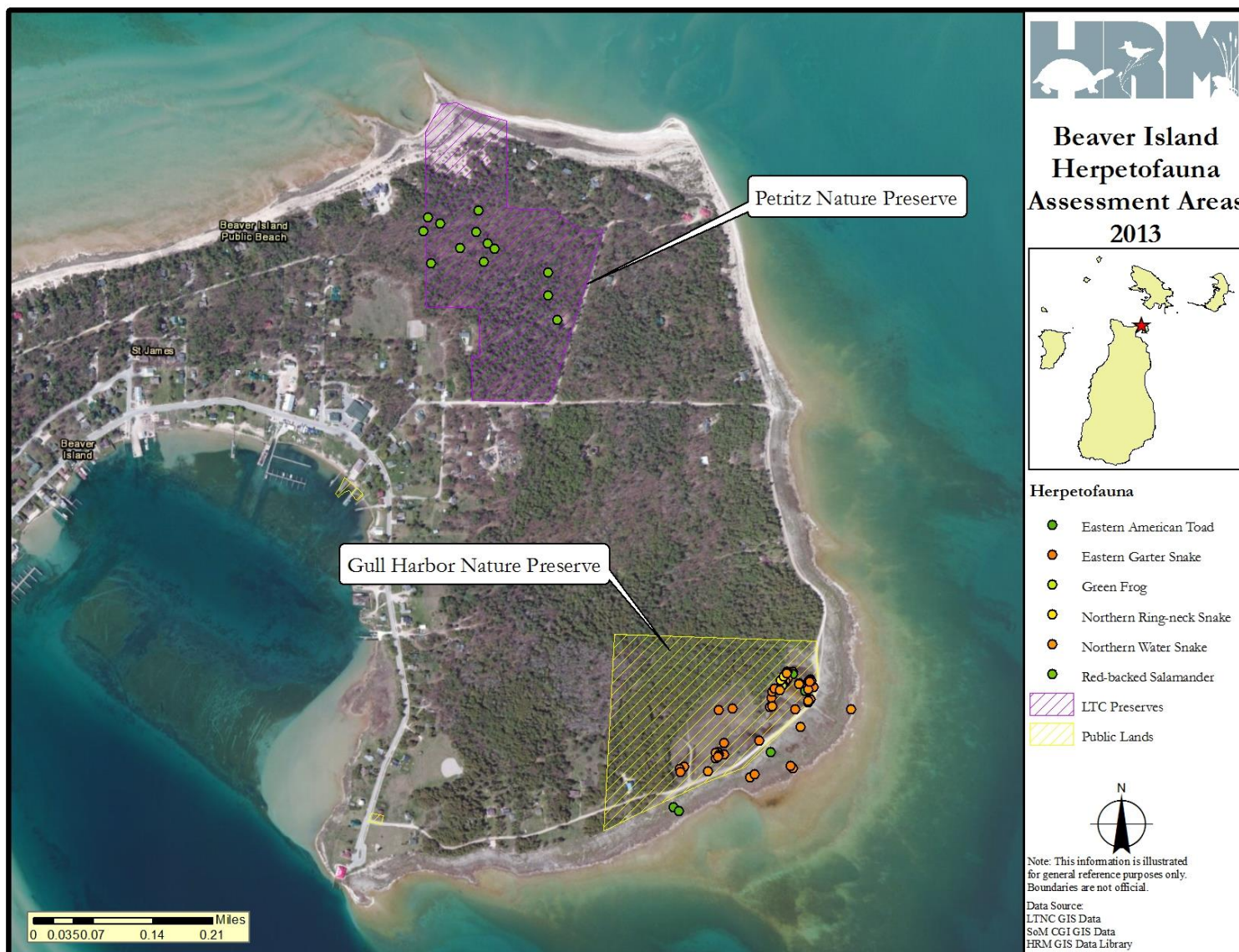


Map 2. Amphibian and reptile data observed at Barney's Lake Nature Preserve.



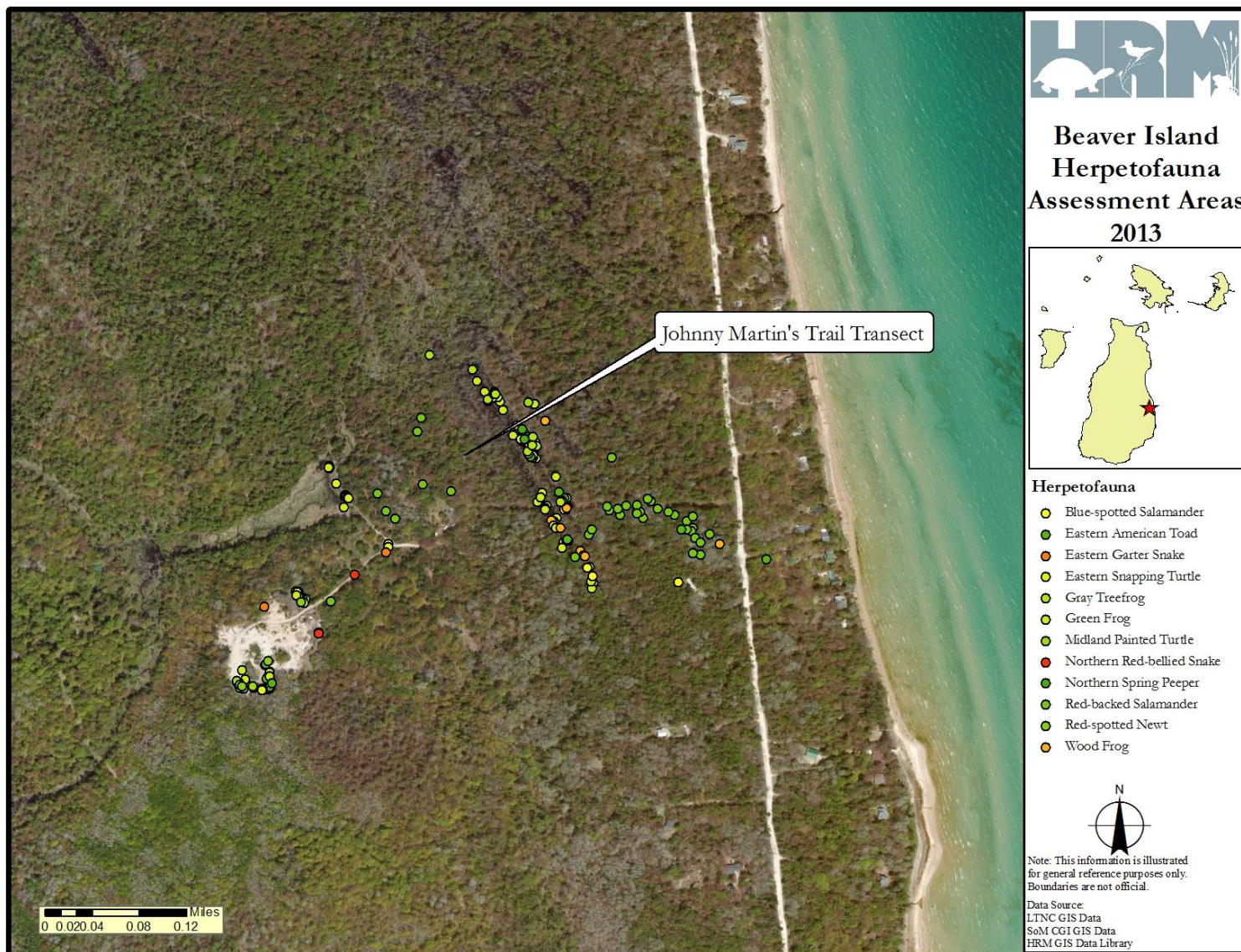


Map 3. Amphibian and reptile observations made at Petritz Nature Preserve and Gull Harbor Nature Preserve.





Map 4. Amphibian and reptile observations made at Johnny Martin's Trail.



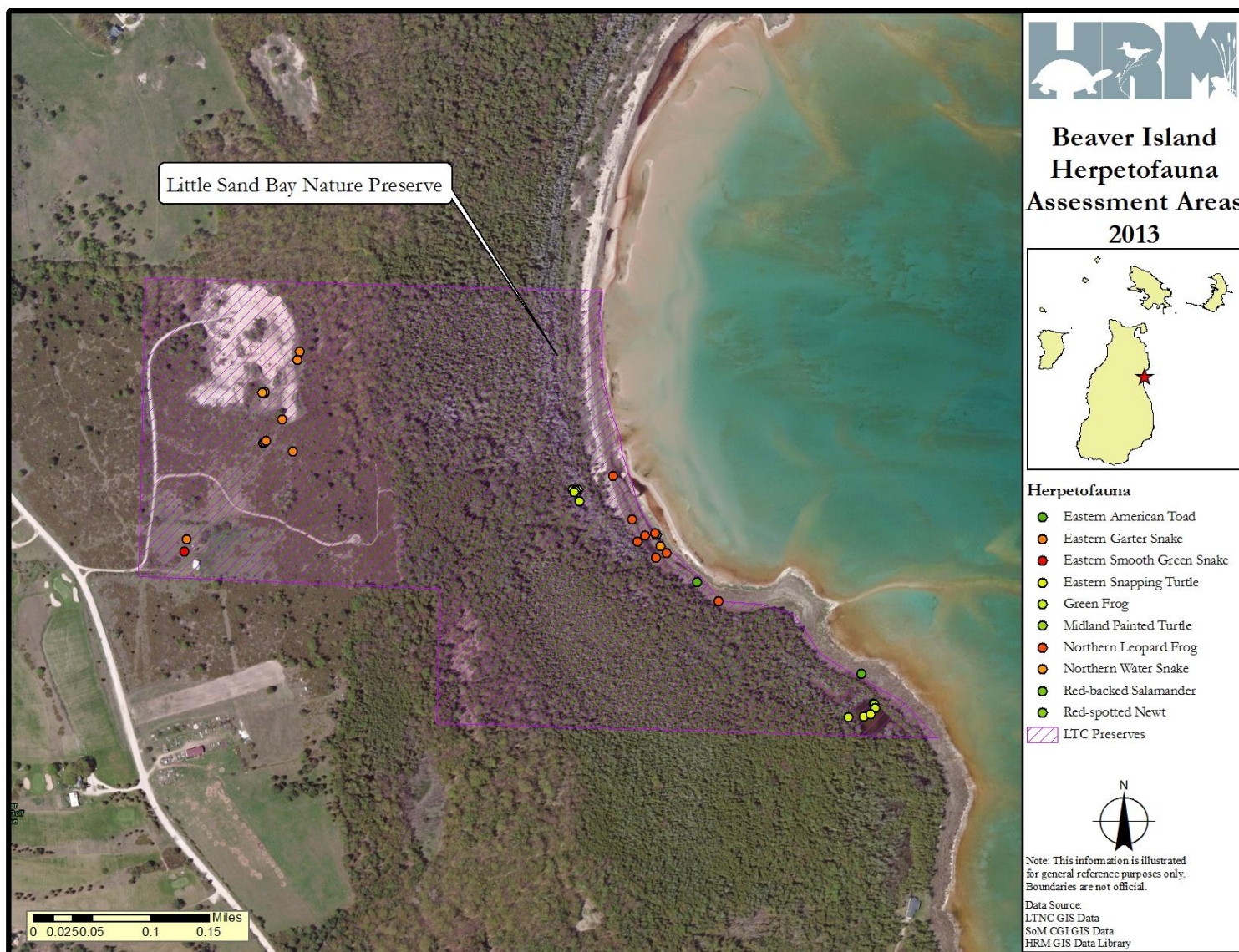


Map 5. Amphibian and reptile observations made at Egg Lake Natural Area



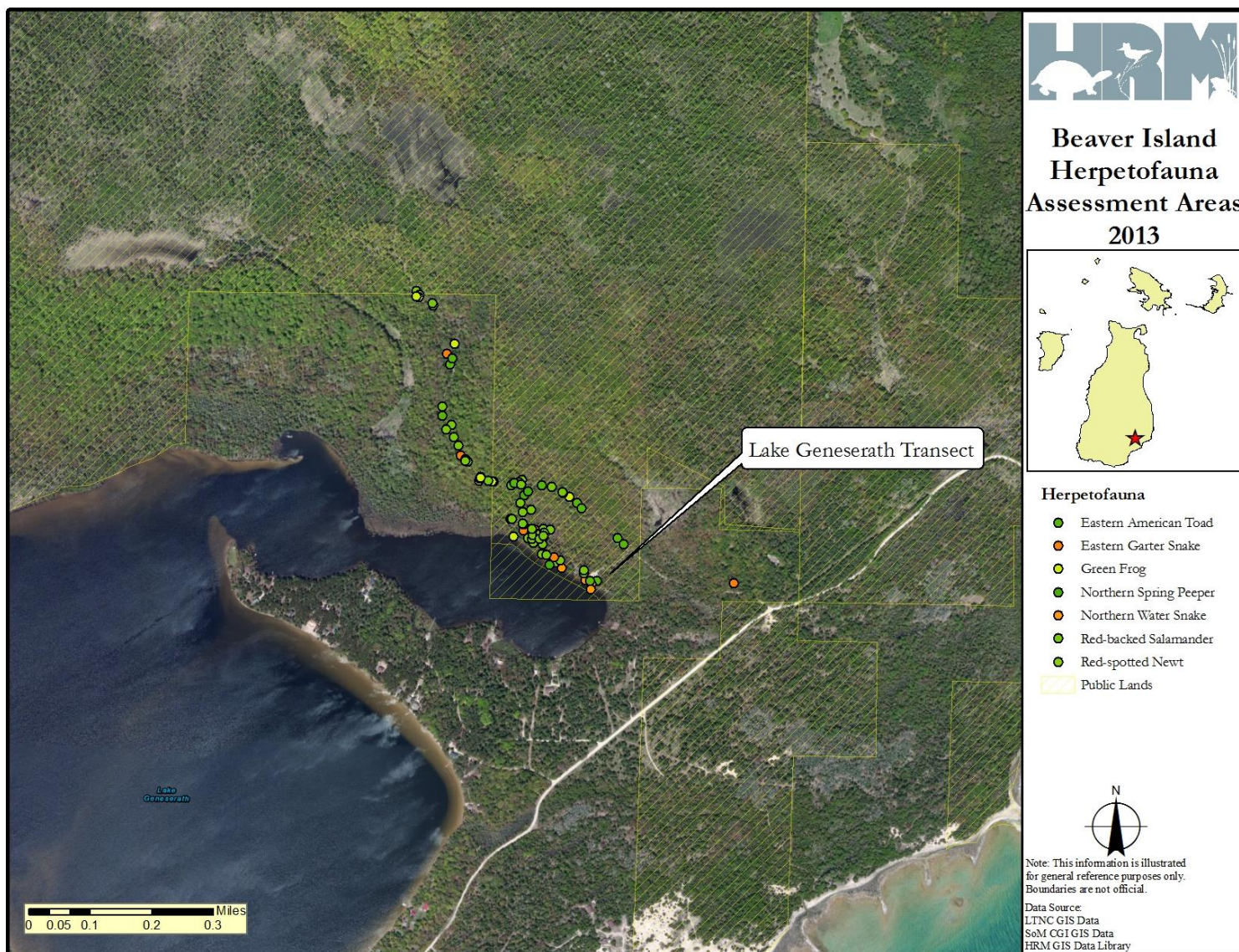


Map 6. Amphibian and reptile observations made at Litte Sand Bay Nature Preserve.



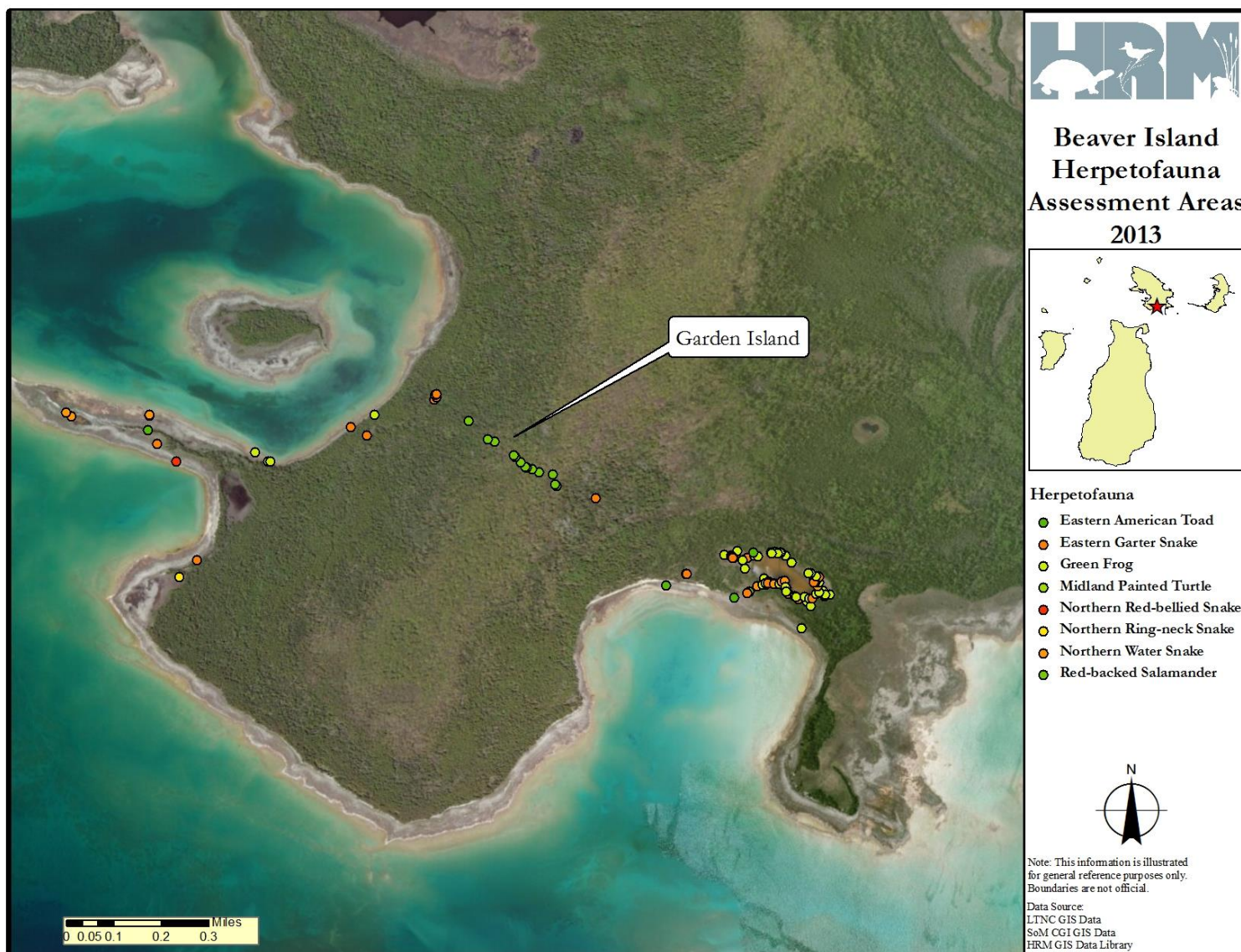


Map 7. Amphibian and reptile observations made at Lake Geneserath.





Map 8. Amphibian and reptile observations made at Garden Island.





## Photos



Photo 1. Upland forest at Petritz Nature Preserve.



Photo 2. Transition of upland forest into coastal marsh at Petritz Nature Preserve.





Photo 3. Coastal marsh at Petritz Nature Preserve.



Photo 4. Red-backed Salamander found at Petritz Nature Preserve under woody debris.



Photo 5. Old Gravel pit that now acts as a pond at Gull Harbor Nature Preserve



Photo 6. Coastal marsh at Gull Harbor Nature Preserve.





Photo 7. Open field at Gull Harbor Nature Preserve. Snakes used this area to help shed.



Photo 8. Northern Ring-necked snake found inside a rotting log at Gull Harbor Nature Preserve.





Photo 9. Barney's Lake at Barney's Lake nature preserve



Photo 10. Eastern Milk Snake found at Barney's Lake Nature Preserve





Photo 11. A Northern Water Snake consuming a Green Frog metamorph at Barney's Lake.



Photo 12. Old Field Habitat at Barney's Lake Nature Preserve





Photo 13. Upland forest habitat at Barney's Lake Nature Preserve.



Photo 14. Bog attached to eastern portion of Barney's Lake Nature Preserve.





Photo 15. Gravel pit located at Little Sand Bay Nature Preserve.



Photo 16. Juniper plains located at Little Sand Bay Nature Preserve which provide excellent snake habitat.



Photo 17. Dead gravid female Smooth Grass Snake found at Little Sand Bay Nature Preserve.



Photo 18. Coastal marsh at Little Sand Bay Nature Preserve





Photo 19. Stream that bisects the cedar swamp at Little Sand Bay Nature Preserve.



Photo 20. Old field habitat located at Egg Lake that was recently cleared for potential development.





Photo 21. The bog at Egg Lake.



Photo 21. Pitcher plant found in the bog at Egg Lake.





Photo 23. A very large Eastern American Toad found near Johnny Martin's Trail.



Photo 24. One of the many pools found in the ridge swale system at Johnny Martin's Trail





Photo 25. Pond at gravel pit near Johnny Martin Trail. Note the steep grade of sides and debris.



Photo 26. Gravel pit at Johnny Martin's Trail.





Photo 27. Two Red-bellied snakes demonstrating two different color morphs.



Photo 28. A male, a female, and a metamorph Eastern Newt.



Photo 29. The small lake/bog surveyed on Garden Island.



Photo 30. A male Midland Painted Turtle found on Garden Island





Photo 31. Upland Forest on Garden Island.



Photo 32. A female Red-backed Salamander guarding her eggs inside a log.





Photo 33. Two Northern Water Snakes demonstrating two different color morphs.



Photo 34. Coastal marsh on Garden Island.



Photo 35. Shrubby marsh along Lake Geneserath's edge.



Photo 36. An Eastern Garter Snake demonstrating a brilliant orange color morph.





Photo 37. Upland forest at Lake Geneserath.

## Appendix

### *Herpetofauna Species Summaries*

#### Eastern Newt

The Eastern Newt can be locally abundant if the proper habitat is available. These salamanders require permanent ponds with aquatic vegetation as the adults and larvae are entirely aquatic. What is unique about these salamanders is that they have an intermediate juvenile form in between the larvae and adult phases that is entirely terrestrial known as the eft form. Efts will inhabit only high quality forests with proper cover such as rotting logs to live in and under. In Michigan there are two subspecies of the Eastern Newt which are the Red-spotted Newt and the Central Newt. Red-spotted Newts are found primarily in the western portions of Michigan while Central Newts are found in eastern and northern ranges of Michigan. Eastern Newts are extremely sensitive to changes in habitat and will suffer when pollution is introduced or deforestation occurs (Harding, 1997).

#### Eastern American Toad

The Eastern American Toad is an amphibian that can tolerate a relatively large range of habitats including woodlands, grasslands, marshes, and agricultural and suburban areas. Although it can be relatively common in some areas, it has undergone noticeable decline in Michigan in recent years. Declines in populations can occur from the loss of breeding habitat, disease, and fragmentation of habitat. The American Toad spends most of its time under cover or buried in moist soil. It has an adaptable diet and will feed on any insects that are available. American Toads inhabiting Lake Michigan islands including the Beaver Island Archipelago have been observed to reach very large sizes. This trait has also been observed by the author on Detroit River islands (unpublished data). The cause of these large island toads is currently unknown (Harding, 1997).

### Northern Ring-necked Snake

The Northern Ring-necked Snake is a small snake that will rarely exceed a foot and a half in length. They prefer moist shaded woodlands but will also be found in fringe habitat between woodlands and other habitats. This snake is commonly found below or inside rotting logs which makes accurate accounts of local populations very difficult to attain. Northern Ring-necked snakes typically are found in colonies and entire populations can be heavily affected even by small disturbances to their preferred habitat (Harding, 1997).

### Smooth Green Snake

Smooth Green Snakes also known as Eastern Smooth Green Snakes range from about a foot long to just over two feet long. This snake prefers to inhabit moist grassy places like marshes, meadows, lake edges etc. These snakes are commonly found under cover objects including logs, flat rocks, and debris such as boards and tar paper. This snake's diet is primarily insects and they tend to specialize on grasshoppers and crickets. This species has decreasing numbers and in some cases extirpation in the Great Lakes Basin. The largest threat to the Smooth Green Snake is agriculture as it not only destroys habitat used by the Smooth Green Snake but it also employs the use of pesticides which kill off the main source of food (Harding, 1997).



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