Table of Contents

Executive Summary ............................................................................................................ 1
Introduction ......................................................................................................................... 2
Site Location and Description ............................................................................................. 3
Methods ............................................................................................................................... 3
Results ................................................................................................................................. 4
Discussion ........................................................................................................................... 4
Conclusion .......................................................................................................................... 7
Tables .................................................................................................................................. 8
Maps .................................................................................................................................... 9
Photos ................................................................................................................................ 11
References ......................................................................................................................... 32
Executive Summary

In 2016, Herpetological Resource and Management, LLC (HRM) was contracted by Conservation Resource Alliance to assess a portion of the Boardman River associated with a dam removal project. Objectives of this project were to document the presence, relative abundance, and distribution of amphibians and reptiles and establish baseline data for future comparison to post-restoration diversity and distribution.

The study was conducted over eight days in May and July of 2016. Sampling was conducted upstream of, and within, the Boardman impoundment continued downstream to Sabin Dam. Surveys included aquatic, riparian and terrestrial habitats incorporating a variety of sampling techniques to accurately record species diversity and distribution.

Important findings from this project included:

- A total of 14 species of herpetofauna including six amphibians and eight reptiles were documented within the project area.
- Based on a review of historic data and current site conditions, an additional 16 species of herpetofauna may occur along the project corridor including the state protected Wood Turtle (*Glyptemys insculpta*).
- The most commonly observed herpetofauna included generalist species capable of surviving in a range of conditions. Several more sensitive species were also observed in lower numbers.
- HRM identified several opportunities for additional restoration measures including the incorporation of nesting sites, basking structures, and woody debris.

The Boardman River and associated habitats are currently fragmented by the Boardman and Sabin dams, limiting the ability of fish and wildlife to effectively disperse through the area. Removing these dams and allowing the river to return to a natural state will likely increase the dispersal of fish and wildlife through the project area. These major restoration activities in addition to general habitat improvement measures will likely benefit the viability and genetic diversity of herpetofauna populations throughout. Preliminary herpetofauna inventory conducted in 2016 provides baseline data that post-restoration species diversity and spatial distribution can be compared with. This study will provide valuable information that can be utilized for similar dam removal projects in the future.
Introduction

Amphibian and reptiles (collectively known as herpetofauna) are considered key bioindicators. These animals are highly sensitive to habitat disturbances and environmental pollutants (Cooperrider, Boyd et al. 1986; Welsh and Droge 2001; Guilfoyle 2010). In Michigan, more than 60% of herpetofauna species are listed as Species of Greatest Conservation Need (SGCN) with habitat loss and degradation considered as some of the major contributing factors of population declines (Harding 1997; Holman 2012). Protection and restoration of critical habitats are among the key components to effective management and conservation of these species.

Complex riverine systems throughout the Great Lakes region provide critical habitat to a range of herpetofauna and other wildlife species. Centuries of anthropogenic activities have resulted in the loss of approximately 50% of these and other wetland habitats in the United States (Dahl 1990). Within Michigan, there are 36,000 miles of rivers with over 2,500 dams located throughout. Most of these structures were built decades ago with many no longer functioning and in a state of disrepair (Michigan Department of Natural Resources and Michigan Department of Environmental Quality 2004). When working properly, dams provide a range of socio-economic benefits including transportation, hydroelectricity, irrigation, and recreational uses. Unfortunately, they have also been shown to disrupt important natural ecological processes and impact native wildlife and fisheries resources. Dams create physical barriers to amphibian and reptile movements and as a result serve to fragment populations, which can lead to decreased genetic diversity and overall lower population fitness (Poff 2002; Moll and Moll 2004; Bennett, Keevil et al. 2010; Mifsud 2014). The physical barriers created by dams also alter hydrologic and thermal conditions that impact breeding, nesting, basking, and hibernation opportunities of riverine herpetofauna, altering their spatial distribution (Lind, Welsh Jr et al. 1996; Ashton, Bettaso et al. 2011; Bettaso 2013). Largely due to these detrimental effects, the removal of dams from both large and small river systems has become an emerging trend in the field of restoration ecology; however studies investigating the ecological responses of a river to dam removal are still limited.

A project was initiated in northern Michigan in a phased approach to remove or modify several dam structures along the Boardman River. The aging structures were determined to be no longer economically feasible to produce hydropower. The removal of three dams and modification of one was decided to allow the system to return to a more natural state as a free-flowing cold water river. In 2016, Herpetological Resource and Management, LLC (HRM) was contracted by Conservation Resource and Alliance (CRA) to conduct herpetofauna surveys along portions of the stream associated with removal of the Boardman and Sabin Dams. Information obtained from these surveys including the presence, relative abundance, and distribution of amphibians and reptiles within the project area will provide critical baseline data to evaluate initial changes in species composition and distribution following restoration.
Site Location and Description

The Boardman River is a state designated “natural river” located in Grand Traverse and Kalkaska Counties in Northwest Lower Michigan (Photos 1, 2). It includes 160 miles of river and tributary streams. It is one of Michigan’s top ten fisheries and downstream from the project area it supports Great Lakes migratory fish species including salmon, steelhead, and brown trout (The Boardman River Dams Project 2016). The portion of the Boardman River included in this project area extends for approximately 3 river miles (pre-restoration) and lies entirely within Grand Traverse County. Areas assessed included the Boardman Dam and Keystone Pond as well as Sabin Dam and Sabin Pond (Map 1, Photos 3-5). The Boardman River is characterized as a cold water stream and contains a sandy bottom with rocky substrate and sandy banks with several stretches of steeply sloped banks (Photo 6). Natural communities present within the riparian and upland areas assessed include, mixed coniferous and deciduous forest, alder thicket, forested wetlands, upland grassland, emergent marsh, wet meadow, seeps, and barrens (Photos 7-11).

Methods

Herpetofauna surveys were conducted over eight days in May and July 2016 by teams of four to five biologists trained in the identification of amphibian and reptile species. Two sampling events (spring and summer) were conducted to improve herpetofauna detection and better understand seasonal activity and spatial distribution. A historical review of species data for the project area was compiled to help guide sample locations. Multiple methods were employed to assess the several habitats and microhabitats that herpetofauna occupy. HRM crews performed meandering transects through both aquatic and terrestrial habitats associated with the Boardman Dam and Sabin Dam (Photos 12, 13). These areas were searched for all life stages of herpetofauna and evaluated for potential habitat. Aquatic surveys involved the use of watercrafts to assess open water and adjacent wetlands and ground searches were used to inventory terrestrial habitats. Various survey techniques including visual observation, aural identification of species calling, identification of potential nesting and basking spots, and turning over cover materials were utilized to assess the diversity and distribution of resident herpetofauna. 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.

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 Trimble® Juno SB GPS Units, which record the location to U.S. Environmental Protection Agency (EPA) Tier II National Geospatial Data Spatial Standards, and mapped using ArcMap® software. Geo-referenced sample locations were also provided for replication of work and eventual comparison to post-restoration conditions.
Results

Ongoing research into the genetics, physiology, behavior, and fossil history of amphibians and reptiles has led to debates about their proper classification. Some biologists have proposed the splitting of established genera like Rana (typical frogs) and Bufo (“true toads”) into the newer genera, Lithobates and Anaxyrus, respectively (Harding 1997). Some suggestions have included using the newly proposed groupings as subgenera, allowing recognition of the new divisions while maintaining name stability. For the purposes of this report, this system will be followed for the genus of toad Bufo (Anaxyrus). The genus of “typical frogs” will not include subgenera based on a recent publication which supports the placement of all North American ranid frogs in the genus Rana (Yuan, Zhou et al. 2016).

A total of 14 species of herpetofauna were observed during HRM’s 2016 initial assessments (Table 1). Six amphibian species documented include: Eastern American Toad (Bufo [Anaxyrus] americanus americanus) (Photo 14), Gray Treefrog (Hyla versicolor/chrysoselis), Green Frog (Rana clamitans) (Photo 15), Northern Leopard Frog (Rana pipiens) (Photo 16), Northern Spring Peeper (Pseudacris crucifer crucifer), and Red-backed Salamander (Plethodon cinereus) (Photo 17). Eight reptile species documented include: Eastern Garter Snake (Thamnophis sirtalis sirtalis) (Photo 18), Eastern Hog-nosed Snake (Heterodon platirhinos) (Photo 19), Eastern Milk Snake (Lampropeltis triangulum triangulum) (Photo 20), Northern Brown Snake (Storeria dekayi dekayi) (Photo 21), Northern Water Snake (Nerodia sipedon sipedon) (Photo 22), Eastern Snapping Turtle (Chelydra serpentina serpentina) (Photo 23), Midland Painted Turtle (Chrysemys picta marginata) (Photo 24), and Northern Map Turtle (Graptemys geographica) (Photo 25).

Based on a review of historic data and current site conditions, an additional 16 species of herpetofauna may occur along the project corridor including six amphibians and ten reptiles (Table 1). These species include: Bullfrog (Rana catesbeiana), Pickerel Frog (Rana palustris), Western Chorus Frog (Pseudacris triseriata), Wood Frog (Rana sylvatica), Mudpuppy (Necturus maculosus), Red-spotted Newt (Notophthalmus viridescens), Blue Racer (Coluber constrictor foxi), Eastern Smooth Green Snake (Opheodrys vernalis), Northern Red-bellied Snake (Storeria occipitomaculata occipitomaculata), Northern Ribbon Snake (Thamnophis sauritus septentrionalis), Northern Ring-necked Snake (Diadophis punctatus edwardsii), Blanding’s Turtle (Emydoidea blandingii), Eastern Box Turtle (Terrapene carolina carolina), Red-eared Slider (Trachemys scripta elegans), Wood Turtle (Glyptemys insculpta), and Five-lined Skink (Eumeces fasciatus).

Discussion

HRM conducted surveys during optimal conditions in May and July 2016 to assess the species diversity and spatial distribution of amphibians and reptiles within the Boardman River project area. Both spring and summer assessments were conducted to capture trends in seasonal habitat use and presence of multiple age classes. Herpetofauna typically utilize a mosaic of different habitat types and will seasonally migrate between wetland and upland areas to meet various breeding, nesting, and foraging needs. Herpetofauna are also active at different times of the year which necessitates multiple sampling events. Conducting multiple surveys provided greater opportunity for more accurate depiction the species community composition and spatial distribution in the project area.
Northwestern Michigan supports a wealth of herpetofaunal biodiversity with a number of species known to occur within along the Boardman River. A total of fourteen species of amphibians and reptiles were recorded during 2016 pre-restoration assessments. Of the observed species several are characterized as generalists and relatively tolerant of degraded habitat conditions. The most commonly observed herpetofauna were Green Frog, Eastern American Toad, and Midland Painted Turtle. These species can thrive in a range of high quality habitats and persist in sub-optimal conditions. Other species that are more sensitive to disturbed environmental conditions including Northern Leopard Frogs were observed; however in much lower numbers. The assessment area contains a complex range of wetland and riparian habitats that can support a diverse assemblage of amphibians and reptiles (Photo 26). The multiple dams present along this portion of the river have fragmented these natural communities and likely limited the movement of animals across the landscape (Photos 27, 28). This limited ability for herpetofauna to disperse between habitats may be a large contributing factor for the relatively low diversity of species observed by HRM during 2016 assessments. Lowering of the water levels within the project area in preparation for dam removal had been initiated at the time of surveys and may have also impacted HRM’s findings.

Based on habitat, known species distribution, historic data, and species natural history, at least 16 species not observed in 2016 may occur in the project area. Ten of these are listed as Species of Greatest Conservation Need (SGCN) by the Michigan Wildlife Action Plan (Pickerel Frog, Mudpuppy, Blue-spotted Salamander, Eastern Smooth Green Snake, Northern Ribbon Snake, Northern Ring-necked Snake, Five-lined Skink, Blanding’s Turtle, Eastern Box Turtle, and Wood Turtle). The removal of several dams and overall restoration of the site will benefit these rare and sensitive species, particularly Wood Turtles. This species prefers fast moving, cold water associated streams and populations have been noted to be declining throughout their range, including in Michigan (Harding 1997; Herpetological Resource and Management 2014; Mifsud 2014). Based on correspondence with staff from the Boardman River Nature Center and a member of the Grand Traverse Band of Ottawa and Chippewa Indians, Wood Turtles are known to occur within this stretch of the river and upstream of the project area. Importantly, this species has been observed as recently as 2015. Restoration efforts should place emphasis on creating habitat that is suitable for supporting this long-lived, declining species.

It is the opinion of HRM that the overall health of Boardman River will greatly benefit from the proposed major restoration activities and herpetofauna will respond positively. Some portions of the assessment area however, contain high quality habitat that will provide more value if left undisturbed. Directly downstream from the Boardman Dam, a small backwater segment of the river includes abundant woody debris and ideal substrate for supporting riverine herpetofauna, making it a preferred landscape for sensitive target species such as Wood Turtles to occupy (Photo 29). Numerous fresh water mussels were also observed in this area indicating good water quality and a presence of stable food sources for several herpetofauna species. Maintaining this small backwater area in its current condition is strongly recommended. Other habitats that will benefit if left intact or enhanced include isolated wetlands in the riparian zone directly adjacent to the Boardman (Photo 30). Following the dam removals, there will likely be an appreciable shift in habitat types and lentic wetlands with slower moving water will become more limited. When possible, these
existing communities within the riparian zone should be maintained to provide habitat for wetland dependent wildlife that do not typically occupy fast moving riverine systems. Stretches of Eastern Box Turtle habitat with suitable food sources were observed in the floodplain adjacent to the river (Photo 31). Preserving these areas when possible will provide seasonal habitat for this state protected reptile as well as several other species of herpetofauna that would use this community.

While conducting herpetofaunal surveys, HRM identified opportunities for general habitat improvements targeting rare species such as Wood Turtles as well as other reptiles and amphibians. Portions of the river have very steep banks with little to no vegetation present and large gravel substrate. These conditions are not suitable for most herpetofauna and it particularly limits turtle nesting opportunities. While Wood Turtles do rely on sparsely vegetated riverine banks for nesting habitat, they prefer sandy substrates and moderate slopes. As part of proposed restoration and river channel countering, incorporating nesting beaches with shallow gradient is preferred. Areas that currently support appropriate conditions should also be protected to prevent future erosion and soil loss (Photo 32). Stretches of the river upstream of the assessment area supported faster flowing water compared to other portions. This area may act as a travel corridor for herpetofauna but many species including Wood Turtles will not typically inhabit faster flowing habitats like this (Photo 33). Placing efforts on ensuring areas with slower flowing water are present following restoration is recommended. Previously installed erosion control measures including reinforced banks were documented at multiple locations (Photo 34). These methods of control severely limit the ability of herpetofauna, particularly turtles from accessing nearby terrestrial habitats. Modifying these structures to include wildlife passageways would allow easier movement of amphibians, reptiles, and other wildlife. Nesting opportunities can also be supplemented within the floodplain areas by clearing or thinning vegetation such as pine stands to create open areas with loose, sandy soils that a variety of turtles and other egg laying herpetofauna may use (Photo 35). Nesting success can also be enhanced through the protection of nests from mesopredators, including raccoons which can have a disproportionate effect on herpetofauna populations when the predator’s populations exceed natural levels. Multiple predated nests were observed during 2016 surveys (Photo 36). Indirect mitigation measures can include the use of predator excluder devices, which can be designed to protect both single nests as well as entire nesting areas (Photo 37). Measures aimed at controlling predator populations including public involvement and limiting access to trash cans and other resources can also be an effective tool for enhancing turtle nesting success.

Emergent aquatic vegetation was limited in several portions of the assessment area (Photo 38). Herpetofauna rely on this type of vegetation for cover and refugia from predators and the elements, food sources, and amphibian breeding. A majority of the observations made by HRM were located in protected “coves” within the river and impoundments where ample wetland vegetation and cover were present. Following restoration activities, encouraging the growth of native aquatic vegetation within the river will be beneficial. Enhancing and encouraging submergent aquatic vegetation in the river channel is also recommended as this provides value to aquatic invertebrates, fish, herpetofauna, and other wildlife. Several beds of submergent vegetation were observed and should be protected as part of restoration activities.
Another important habitat feature absent within portions of the river includes basking structures. Logs and other material suitable for providing thermoregulation opportunities were very limited and a number of amphibians and reptiles observed displaying basking behavior were forced to use algal mats (Photo 39). Appropriate basking structures were particularly lacking in Keystone Pond. During initial assessments HRM observed large piles of woody material near a construction area at the Boardman Dam with signage indicating its later use for habitat restoration. Using this material in the project area to provide additional opportunities for basking and cover would increase the habitat suitability for amphibians and reptiles (Photos 40, 41). Placing additional woody debris within the riparian areas would also benefit species that typically inhabit terrestrial communities. Studies have shown that basking sites are a limiting factor for density and distribution of reptiles particularly turtles. Increasing basking opportunities along with proposed restoration measures will likely increase the abundance and distribution of Northern Map Turtles and provide more suitable habitat for Wood Turtles and other turtle species known to occur within the project area.

Over the last several decades, the scientific community has learned much about the adverse effects dams have on the overall health of a river system. As a result, dam removal has become a new focal point of many stream restorations. Dam removal studies are fairly limited and there is a wide range of potential outcomes based on the project. The Boardman River dam removal project and associated monitoring will provide valuable information that can be utilized for similar projects in the future. Additionally, preliminary herpetofauna inventory conducted in 2016 provides baseline data for comparison to post-restoration species diversity and spatial distribution.

Because of herpetofauna natural history and often cryptic nature, evaluating responses to habitat restoration in a short period of time can be difficult and often does not depict the true extent of a project’s success. Long-term monitoring over several years of amphibians and reptiles along the Boardman River is strongly encouraged to better assess species recovery and response to dam removal and restoration.

**Conclusion**

HRM’s pre-restoration surveys of the Boardman River project area resulted in the documentation of 14 species of amphibians and reptiles. Natural communities present along the project area appear suitable for supporting an even greater diversity of herpetofauna. The river and associated habitats are currently fragmented by the Boardman and Sabin dams, limiting the ability of fish and wildlife to effectively disperse through the area. Removing these dams and allowing the river to return to a natural state will likely increase the dispersal of fish and wildlife through the project area. These major restoration activities in addition to general habitat improvement measures including creating basking and nesting will likely benefit the viability and genetic diversity of herpetofauna populations throughout.
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<th>Scientific Name</th>
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<th>Current (2016)</th>
<th>Potential</th>
<th>Conservation Status**</th>
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Table 1. Herpetofauna known to historically occur near the project area, observed by HRM in 2016, and that may occur based on current conditions. *Historic records represent observations in close proximity to the project area. **Based on 2015 Michigan Wildlife Action Plan (Derosier, Hanshue et al. 2015) (SGCN=Species of Greatest Conservation Need, SC= Special Concern)
Maps

Map 1. Boardman River project area including adjacent public conservation and recreation lands.
Map 2. Boardman River 2016 observed herpetofauna.
Photos

Photo 1. Portion of the Boardman River assessment area.

Photo 2. Portion of the Boardman River including Keystone Pond.
Photo 3. The Boardman Dam located on Keystone Pond.

Photo 4. South facing view of Keystone Pond near the Boardman Dam.
Photo 5. Sabin Pond and Sabin Dam at the northern extent of the project area.

Photo 6. Steeply sloped banks along the Boardman River.
Photo 7. Upland forest located adjacent to the Boardman River.

Photo 8. Forested wetland adjacent to the Boardman River.
Photo 9. Wet meadow located within the project area.

Photo 10. Emergent marsh located in a portion of the Boardman River.
Photo 11. Old field habitat in the riparian zone of the Boardman River.

Photo 12. HRM staff conducting aquatic herpetofaunal surveys.
Photo 13. HRM assessing portions of the project area undergoing construction while conducting terrestrial surveys.

Photo 14. Eastern American Toad observed during 2016 pre-restoration surveys.
Photo 15. Green Frog was one of the most commonly observed species during 2016 pre-restoration surveys.

Photo 16. Northern Leopard Frog observed during 2016 pre-restoration surveys in old field habitat.
Photo 17. Red-backed Salamander observed during 2016 pre-restoration surveys.

Photo 18. Eastern Garter Snake observed during 2016 pre-restoration surveys.
Photo 19. Eastern Hog-nosed Snake observed in old field habitat during 2016 pre-restoration surveys.

Photo 20. Eastern Milk Snake observed in woody debris during 2016 pre-restoration surveys.
Photo 21. Deceased Northern Brown Snake observed on a trail during 2016 pre-restoration surveys.

Photo 22. Northern Water Snake observed under cover in wet meadow habitat during 2016 pre-restoration surveys.
Photo 23. Eastern Snapping Turtle observed during 2016 pre-restoration surveys.

Photo 24. Midland Painted Turtle observed basking during 2016 pre-restoration surveys.
Photo 25. Northern Map Turtle observed during 2016 surveys.

Photo 26. Boardman River project area includes a mosaic of habitat types, capable of supporting diverse assemblages of herpetofauna.
Photo 27. The northern extent of Keystone pond is fragmented by the Boardman Dam, making dispersal of wildlife difficult.

Photo 28. The downstream portion of the Sabin Dam contains swift rapids and numerous obstacles that make movement difficult for a range of aquatic wildlife.
Photo 29. The backwater portion of the river downstream from Boardman Dam supports high quality habitat including woody debris and submergent aquatic vegetation in its current condition.

Photo 30. A small isolated pond in the riparian zone of the Boardman River provides ideal habitat for species that do not occupy fast moving riverine systems.
Photo 31. Wet meadow and old field habitats adjacent to the Boardman River provide ideal habitat for multiple potential species, including Eastern Box Turtle.

Photo 32. Portions of the Boardman River that provide nesting habitat should be maintained.
Photo 33. Portions of the river with fast flowing water provide less habitat functionality for many herpetofauna, including Wood Turtles.

Photo 34. Intensive bank stabilization measures as seen above form a barrier for animals attempting to move between the river and adjacent uplands.
Photo 35. Additional nesting areas can be created through the removal of vegetation like a portion of this pine stand.

Photo 37. Example of a predator excluder structure that can increase turtle nesting success at in a natural area with high predator populations.

Photo 38. Aquatic vegetation that herpetofauna use for important sources of cover was lacking in portions of the project area.
Photo 39. Many amphibians and reptiles were observed floating on vegetation and algal mats, likely due to the lack of sufficient basking structures.

Photo 40. Felling trees on site or repurposing existing trees can provide ideal basking structures.
Photo 41. Construction activities conducted have provided a surplus supply of woody debris that should be distributed among both aquatic and terrestrial habitats.
References


Michigan Department of Natural Resources and Michigan Department of Environmental Quality (2004). Dam Removal Guidelines for Owners.


