CHAPTER 1
INTRODUCTION

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1.1 Background to Study

The Buffalo River is a recovering riparian system. Its history of heavy industrial discharge resulted in poor water quality and badly contaminated sediments. The river was considered biologically dead as recently as the early 1970's (Buffalo Courier Express, 1974) and it was designated as a Great Lakes Area of Concern (AOC) in the mid-1980's (New York State Department of Environmental Conservation (NYSDEC), 1989). Impaired beneficial uses include degradation of benthos, fish tumors, loss of fish and wildlife habitat, degradation of fish and wildlife populations, the tainting of fish and wildlife flavor, and the presence of bird or animal deformities or reproductive problems. Combined sewer overflows and upstream pollutant inputs remain concerns, but historical sediment contamination and poor habitat opportunities persist as the major obstacles to recovery.

This project is part of a unique collaborative effort to plan and fund sediment remediation for the restoration of aquatic habitat within the AOC. The Buffalo District U.S. Army Corps of Engineers (USACE) (2003) recently completed its Sediment Reconnaissance Study of the Buffalo River, a first step in determining whether targeted environmental dredging would improve aquatic conditions. Subsequently, the USACE (2004) agreed to pursue a full Feasibility Study of sediment cleanup options. The Feasibility Study will be conducted over the period 2005-2008 and is subject to a 50% non-federal match. The Buffalo River Partnership, organized by the Friends of the Buffalo Niagara Rivers (now Buffalo Niagara Riverkeeper) and other nonprofit organizations, has taken the lead in raising the non-federal matching funds, and in particular, the NYSDEC will do an intensive sampling and analysis of bed sediment in select areas of the river in 2005-06.

While signs of biological recovery have been documented within the AOC (e.g. Buffalo Courier Express, 1974; Diggins and Snyder, 2003), much of the shoreline's natural cover and vegetation has been removed and bank slopes have been altered or eliminated. Habitat restoration efforts could greatly speed recovery. Therefore, the objective of this study was to document the biological, water quality, and use characteristics of 10 promising habitat restoration sites located between Michigan Avenue and the river's confluence with Cazenovia Creek. These data are valuable in their own right as a direct measure and update of biotic and limnological information for the river. The study also developed a characterization matrix for each of the 10 candidate sites. This matrix was designed to serve as guidance for stakeholders and decision makers, allowing them to quickly view comprehensive assessments of the potential for effective habitat restoration (including the need for sediment removal and/or immobilization).

1.2 The Buffalo River Watershed and Area of Concern

The Buffalo River drains an area of 1,155 km^2 (447 mi^2) and Cayuga, Buffalo, and Cazenovia creeks are the three major tributaries within the watershed (Figure 1.1). The Buffalo River watershed occupies two physiographic regions. The northern and western portion of the watershed is within the Erie-Ontario Lake Plain Province, while the southern part of the watershed is within the Alleghany Plateau Province. The Erie-Ontario Province formerly was a glacial lake bed and therefore has limited relief. The watershed consists primarily of 21 different soil series, but the majority of soils texturally are a silt loam (U.S. Department of Agriculture, 1986). The slopes of these soil units range between nearly level and 0.50, while the drainage classification ranges from very poorly drained to excessively drained (U.S. Department of Agriculture, 1986).

The climate of the Buffalo area is classified under the Koppen system as humid continental with a mild summer (Dfb) (Gabler et al., 1997). Annual total precipitation at the Buffalo Airport averages 98 cm (38.6 in), with February being the driest month (5.9 cm (2.32 in) of precipitation) and August being the wettest month (10.6 cm (4.17 in) of precipitation). The lowest monthly mean flow recorded at U.S. Geological Survey (USGS) gauge stations on each of the tributaries (Figure 1.1) typically occurs in July and August when evapotranspiration is highest (Cayuga Cr. - 0.70 m^3s^{-1} (24.6 cfs); Buffalo Cr. - 1.30 m^3s^{-1} (45.8 cfs); and Cazenovia Cr. - 1.35 m^3 s^{-1} (47.8 cfs)). Highest monthly mean flow on the three tributaries typically occurs in March (Cayuga Cr. – 9.68 m^3s^{-1} (342 cfs); Buffalo Cr. – 14.0 m^3s^{-1} (495 cfs); and Cazenovia Cr. – 15.6 m^3s^{-1} (551 cfs)) as the result of snowmelt and spring rainfall.

Simple summation of the daily mean flow at the three gauge stations cannot provide an accurate approximation of the inflow to the top of the AOC (Figure 1.1) because the USGS gauges do not represent the entire contributing area for the three tributaries. Meredith and Rumer (1987) used a proportional-area approximation to account for the ungauged portions of the watershed in calculating inflow to the top of the AOC:

$$Q_T = Q_G \bullet \left(\frac{A_T}{A_G} \right) \qquad [1.1]$$

where: Q_T = daily flow from the tributary to the top of the AOC (cfs or m^3s^{-1})
Q_G = daily flow at the gauge on the tributary (cfs or m^3s^{-1})
A_T = total drainage area at the mouth of the tributary (mi^2 or km^2)
A_G = drainage area upstream of the gauge (mi^2 or km^2)

The drainage areas upstream of the Buffalo, Cayuga, and Cazenovia creek gauges are 144, 94.9, and 134 mi^2 (372.1, 245.2, 346.2 km^2), respectively. The total drainage areas for Buffalo, Cayuga, and Cazenovia creeks are 146.2, 124.4, and 135.4 mi^2 (377.8, 321.4, 349.9 km^2), respectively (Meredith and Rumer, 1987). The flow adjustment approach represented by equation 1.1 was used in this study to estimate daily mean flow to the top of the AOC.

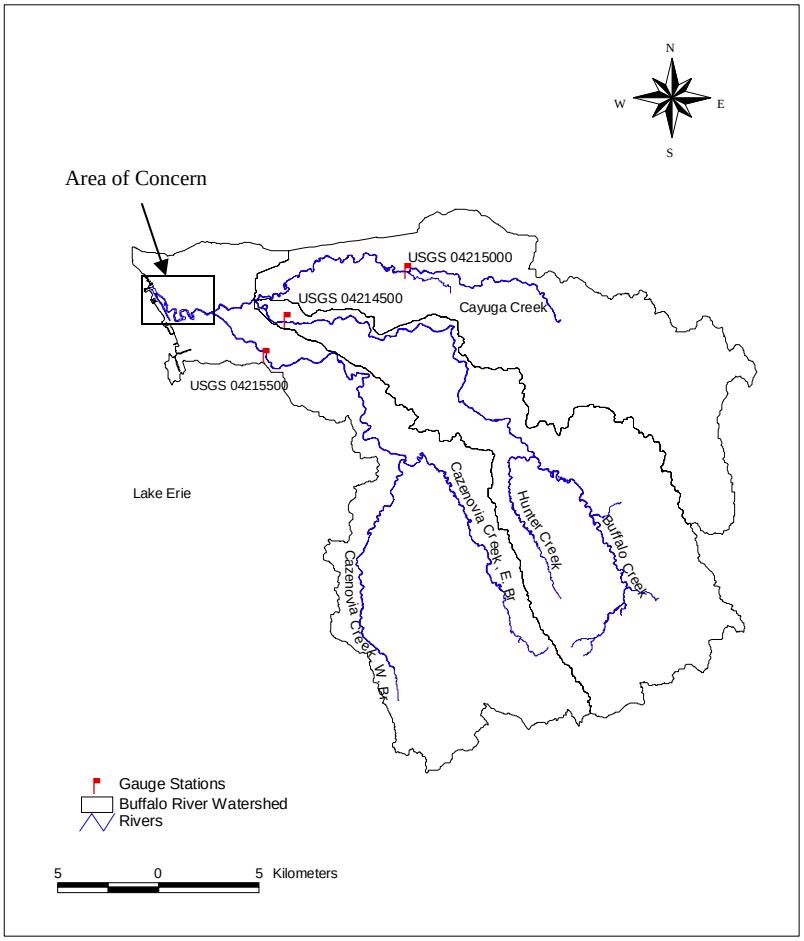

Figure 1.1 Buffalo River Watershed and USGS gauging stations

Land use within the watershed varies. Much of the upper portion of the watershed is characterized by woods and farmland, but prior to joining the Buffalo River the creeks also pass through several small communities and receive industrial, commercial, residential, and municipal discharges (Irvine and Pettibone, 1996). The lower Buffalo River historically has been highly urbanized and industrialized (Sauer, 1979; Rossi, 1995) and this appears to be principally why only the lower 9.6 km (6 mi) of the river was designated an AOC by the International Joint Commission. The change in the industrial composition of the AOC between 1929 and 1990 was documented and mapped by Irvine et al. (2003).

Much of the Buffalo River AOC is designated as a navigable channel and is maintained at a minimum depth of 7m (22 ft) by the Buffalo District USACE. This dredged reach is wider and deeper than the tributaries, but the bed slope is shallower. As a result of the changes in the hydraulic geometry, flow velocities within most of the AOC typically are less than those of the tributaries, producing local shoaling areas as sediment

deposits. The Buffalo River Improvement Corporation (BRIC) was created in 1967 to supply industries along the Buffalo River with water for cooling and processing purposes. The water is pumped from Lake Erie and ultimately augments flows in the Buffalo River. The design operation of the BRIC system is 2.18 $m^3 s^{-1}$ (77 cfs) and during its early years of operation often contributed 90% of the total river flow in the drier summer months (Sauer, 1979). This flow augmentation helped to improve the water quality of the river at the time. As industry has declined along the river, so too has the BRIC pumping rate. Pumping rates in the early part of this decade averaged 0.66 $m^3 s^{-1}$ (23 cfs).

1.3 Habitat Assessment Sites and Study Approach

In consultation with the Friends of the Buffalo Niagara Rivers (now Buffalo Niagara Riverkeeper) and stakeholders (which included a boat tour of the AOC), and considering past research efforts (e.g. NYSDEC, 1993; Kozuchowski et al., 1994; Diggins and Stewart, 1998; Diggins and Snyder, 2003; U.S. Fish and Wildlife Service, undated; Irvine et al., 2003; 2005; 2005b) 10 promising habitat restoration sites were identified for study. The locations of these sites are shown in Figure 1.2 and a photo of each site is presented in Appendix 1.1. At each site, sampling was conducted for benthic organisms (identified to genus or species level and chironomid larvae deformity assessment), extent and species composition of submerged macrophytes, extent of shading, juvenile and adult fish species composition, conventional water quality parameters (pH, dissolved oxygen, temperature, turbidity, conductivity), anthropogenic use of the water (e.g. recreational activities), and adjacent property ownership. The specific approaches and results of the individual sampling efforts are presented in Chapters 2 through 6. The results subsequently are considered in a holistic way in Chapter 7 through the use of a site characterization matrix, with the intent of identifying the most promising sites for remediation work.

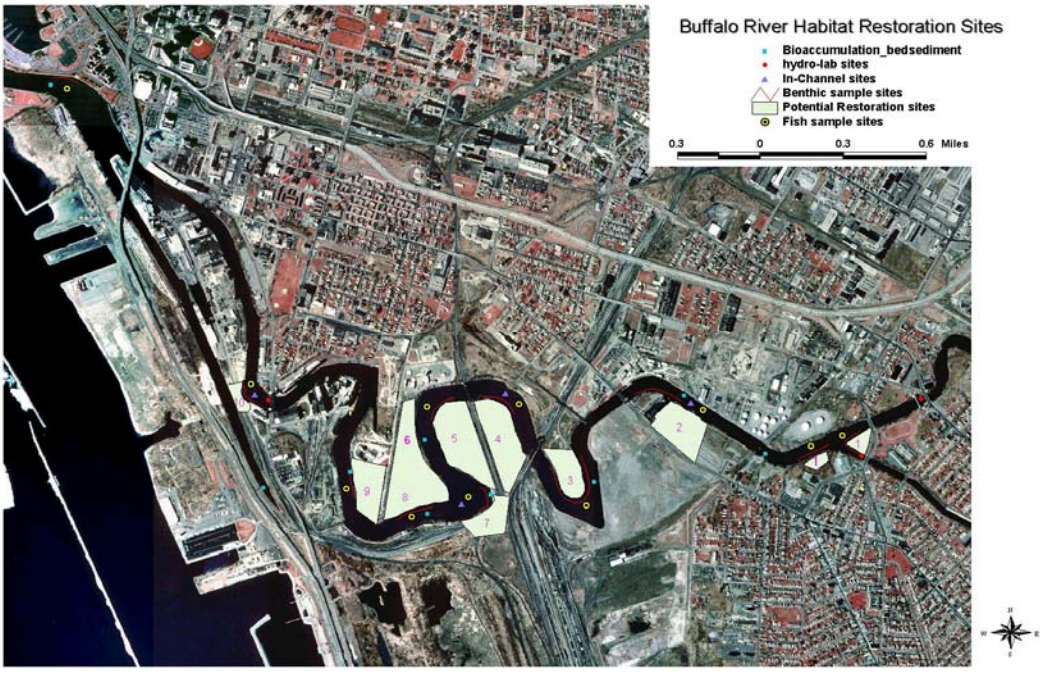

Figure 1.2 Study sample sites

1.4 References

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APPENDIX 1.1
HABITAT ASSESSMENT SITES

Site 1

Site 2

Site 3

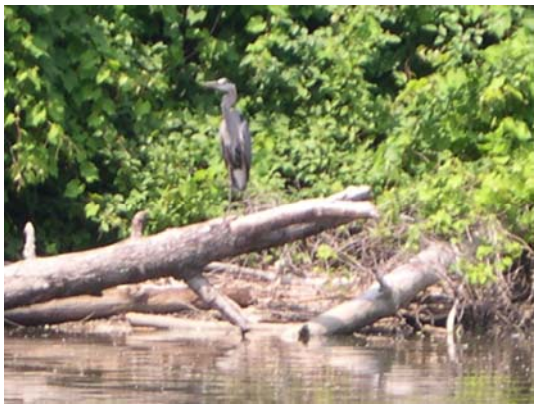
Site 3 (Continued)

Site 4

Site 5

Site 6

Site 6 (continued)



Site 6 (continued)

Site 7

Site 7 (Continued)

Site 8

Site 8 (Continued)

Site 9

Site 9 (Continued)

Site 10

Site 10 (Continued)