Harry and Laura Nohr Chapter of Trout Unlimited

Scott Ladd Memorial Internship Report (2009-2010)

The Blue River and Bronson Creek

Jennie Franks (2009 Intern); Robert Burken III (2009 Research Technician)
Kristopher Wright (Advisor)
Biology Department
University of Wisconsin-Platteville

Abstract-This study examined the effects of restoration on the Blue River conducted by the Nohr Chapter of Trout Unlimited. The restoration efforts were intended to produce, greater biodiversity and more suitable trout habitat. Sampling was conducted from May to July of 2009 at seven sites on the Blue River and Bronson Creek. Average values for habitat, aquatic invertebrates, and fish were compared among all seven sites on the Blue River and Bronson Creek. As expected, some differences did exist among restored and unrestored sites within the Blue River; however, there were observed characteristics that did not distinguish restored from unrestored sites. Factors which may influence restoration activities and compromise the effects of restoration are discussed. Continuing research is needed to determine the long-term effects and impacts of stream restoration.

Introduction

The Driftless Area has struggled with anthropogenic challenges such as land use practices and large scale erosion throughout the decades. Consequently, efforts to improve farming practices and restore the natural character of the land have been occurring since the 1930s (Trout Unlimited, 2005). Natural Resources Conservation Service (NRCS) was one of the initial agencies to attempt managing and restoring agricultural lands by implementing restoration projects to reverse previous land, channel, and wetland alterations. Within the agency, soil conservation geologists and landscape architects produced a Federal manual, "Stream Corridor Restoration "emphasizing the use of vegetation rather than structural works for stream corridor restoration (NRCS, 2010). The manual set a basis for stream restoration projects in the Midwest and the Driftless Area. In 2006, a cooperative conservation effort involving Wisconsin, Illinois, Iowa, and Minnesota was initiated with a goal to restore waterways within the Driftless Area (Hoffmann, 2006). The conservation effort included cutting back the eroded stream banks, stabilizing, and reseeding the area with native prairie grasses. (Hoffmann, 2006).

The Blue River is a prime example of the conservation efforts within the Driftless Area. It was one of the first local scale sites to be restored within the Driftless Area (Trout Unlimited, 2005). Starting in 2004 with the Wolenec site, Trout Unlimited, Wisconsin Department of Natural Resources, the Iowa County Land Conservation Department, and others have worked together to restore sections of the stream. The overall goal was to enhance recreational usage and tourism as well as be ecologically sound and still support the agricultural sector of the

Driftless Area (Trout Unlimited, 2005). A secondary goal was to make the Driftless Area an example of restoration for further watersheds, streams, and rivers to be restored (Trout Unlimited, 2005).

This study examined the effects of restoration on the Blue River conducted by the Nohr Chapter of Trout Unlimited, with the expectation of producing greater biodiversity and more suitable trout habitat. The main objective of this study was to determine if restored sites improved habitat, macroinvertebrates, and trout populations compared to unrestored sites. In addition, three sites that have been surveyed since 2004 were compared to examine changes over time.

Methods

Sampling was conducted from May to July of 2009 on the Blue River and Bronson Creek. The surveys focused on three different areas, habitat, fish, and macroinvertebrates. Sampling locations on the Blue River had an average length of 209m; Bronson had a length of 83m. Each site was evenly divided into 12 transects; transect-to- transect length was determined using WI DNR Protocols.

Study Area:

Bronson Creek

Bronson Creek is a small tributary that feeds into the Blue River between Addison and Simplot study areas of the Blue. Sampling was done along Vavricka Road (N43° 00.375' W90°26.740') (Figure 1). The study site runs through a moderately grazed cow pasture. In 2001

Bronson had some rip rap management done. In 2005, 500 brown trout (*Salma trutta*) fingerlings had been stocked. The survey conducted was prior to restoration which began in the late summer of 2009.

Blue River

The study sites stretch across six properties; three of which can be accessed at Hwy I, North of Montfort (Addison, Wolenec, and Zoha). The remaining three sites are northwest and downstream of the first three sites (Winkers, Kite, and Simplot). The downstream sites may be accessed from Snowbottom Road, off of Hwy I, north of Montfort (Figure 1).

Upstream*:* Wolenec's riparian and stream habitat was restored in 2004 and Zoha's habitat was restored in 2005. Wolenec (N43° 00.089' W 90° 25.554') and Zoha (N 43° 00.224' W 90° 24.999') consist of low topography and moderately grazed pasture with minimal tree cover. Addison (N43° 00.103' W90° 25.970'), downstream of Wolenec, is unrestored. The Addison site had high amounts of tree cover and riparian vegetation. Wolenec and Zoha can be publically accessed; Addison is private and public access is restricted.

Downstream: Simplot (N43° 00.807' W90° 26.879'), Kite (N43° 00.916' W90° 27.179'), and Winkers (N43° 01.240' W90° 27.365') have not been restored. Simplot and Kite consist of low topography and are moderately grazed pastures. Winkers had high amounts of tree cover and riparian vegetation. The Simplot site included a small standing pond; tadpoles and turtles were seen at the time of the study. Kite consisted of large boulders (greater than 256mm) that were also found in Zoha and Simplot sampling sites.

Sampling:

Habitat surveys used for the Blue River sites and Bronson Creek were consistent with the WIDNR Habitat Survey Protocol. Measurements taken from four points within each transect are as follows: stream width, stream depth and embeddedness, flow discharge and substrate composition. Stream depth, width, and bank erosion were measured by using a yard stick and measuring tape. Bank erosion was measured on both banks of each transect. Measurements taken from one point in each transect included: pH, dissolved oxygen, water temperature, tree cover, and macrophyte growth. Discharge was measured at one location per site (average flow multiplied by the cross section width) and water velocity was measured with a flow meter. Tree cover, macrophyte growth, and substrate composition were estimated in percent.

Aquatic invertebrates were collected from six randomly selected transects within each site. Samples were collected within in-channel positions altering from left, center, and right orientations. All thirty samples were collected using a 250 µm mesh Surber sampler. The first five samples of macroinvertebrates at each site were sorted in the field with a given time period of ten minutes for each sample. The entire-sixth sample was retained for processing in the lab. All samples were preserved in 75% ethanol and taken back to the lab to separate, identify, and enumerate the macroinvertebrates. All inverts were identified by either the family or genius level.

Fish were surveyed using a backpack electro-fisher and the entire selected site was shocked. All fish were counted and identified down to the species level. Total lengths of brown trout (*Salma trutta*), rainbow trout (*Oncorhynchus mykiss*), and brook trout (*Salvelinus fontinalis*) were measured in millimeters. All fish were released near or at the capture location.

Analysis:

Average values for habitat, aquatic invertebrates, and fish were compared among all seven sites on the Blue River and Bronson Creek. Among-site and among-year comparisons were made using data from previous surveys from 2004 (pre and post Wolenec restoration), 2005(one year post Wolenec restoration), 2006 (both 1st and 2nd year post Wolenec restoration and post Zoha restoration), and surveys conducted on Addison (unrestored, downstream from Wolenec & Zoha.

Results

Bronson Creek

The average stream width was 2.37m (±0.43 STD) with an average depth of 0.22m (±0.13 STD). Bronson had an average bank erosion of 0.25m (±0.24 STD). The majority of the stream was composed of sand and gravel (Table 1). Average macrophyte growth was 16.67% (±19.6 STD). Stream discharge was calculated at 0.0690 m^3/sec; dissolved oxygen levels averaged at 9.94mg/l (±0.21 STD) and pH was 7.18 (±0.10 STD). Bronson macroinvertebrates were collected from either a glide or riffle type of water movement. Total amount of individual aquatic macroinvertebrates was 345 with 12 different taxa identified. Amphipods, baetid mayflies, hydropsychid caddisflies, and chironomid midges were the most abundant. Within the Bronson Creek site 33 brown trout were measured and identified; the majority of which were

50-99mm. Bronson was the only site where brook trout was identified within this study, with a length of 225mm. Beside trout, mottled sculpin (*Cottus bairdii*) was the only other fish species that was identified.

2009 Blue River Habitat

Overall, the surveyed portion of the Blue River in 2009 had an average stream width of 7.2m (± 1.14 STD), an average depth of 0.4m (± 0.06 STD), an average dissolved oxygen level of 11.74mg/l (±2.02 STD), an average pH level of 7.35 (± 0.44 STD), and a flow of 0.3618m^3/sec (±0.12 STD). Macrophyte growth was observed in all Blue River sites; Wolenec had the most growth and Addison had the least (Table 1). Macrophyte growth at Addison, Simplot, Kite, and Winkers was relatively low averaging less than 10% (Table 1). The Zoha property had a high amount of macrophyte growth but was less than Wolenec's growth by 15% (Table 1). Underneath the macrophyte growth, the 2009 Blue River sampling sites were largely composed of gravel, cobble, and sand (Table 1). The average amount of fine substrates for the Blue River was 11% (±9.76 STD). Boulders (≥30 cm diameter) were only identified in Zoha, Simplot, and Kite (Table 1). Bedrock was not observed or identified within the Blue River sites; all sites contained large rock with the exception of Addison and Kite. Along the meanders, bank erosion was present within all sites; however, average bank erosion at any site never exceeded 1m (Table 1). Addison and Winkers had the most tree cover present, whereas, Wolenec and Zoha had no measurable tree cover (Table 1).

Wolenec, Zoha, and Addison Habitat 2004-2009

Within a five year period, Zoha has maintained a stable percent of macrophyte growth whereas, macrophytes have steadily increased in Wolenec and decreased in Addison since 2004

(Figure 2). While Zoha's gravel composition increased and the cobble composition decreased. Addison's composition of gravel decreased and cobble increased (Figure 3). Both Addison and Zoha saw a decline in the amount of fines from 2004-2009 (Figure 3). In contrast, both cobble and gravel substrates have decreased in Wolenec and the amount of fines stayed relatively the same over time (Figure 3).

2009 Blue River Macroinvertebrates

A total of 22 different taxa were identified within the Blue River sampling sites. The most abundant taxa identified were Chironomidae (midges) with 1,468 individuals counted. Other abundant invertebrates included: *Baetidae baetis* (mayflies)*, Hydropsychidae hydropsyche* (caddisflies)*, Tipulidae anatocha* (craneflies), and amphipods. (Figure 4). Among all of the sampling sites, total abundance ranged from 117-1064 inverts identified and collected. Winkers had the most abundant macroinvertebrates and Addison had the least abundant (Figure 5). Winkers had the highest macroinvertebrate diversity with 15 different taxa identified and Addison with the lowest at 8 different invertebrate taxa.

2009 Blue River Fish

A total of ten fish species were identified within the sampled sites of 2009. Mottled sculpin, brown trout, and white sucker (*Catostomus commersoni*) were the most abundant from all of the sampling sites (Figure 6). Brown trout average length ranged from 128-200mm (±34.1 STD) in all Blue River sites. Rainbows were found in Wolenec, Kite and Winkers with an average length ranging from 129-340mm (±108.7 STD). Wolenec had the highest amount of brown trout, followed by Addison (Figure 7). With the exception of Zoha, there is a declining trend of total brown trout going downstream (Figure 7). Winkers, the most downstream site, had only 4 trout collected and two of which were rainbows.

Wolenec, Zoha, and Addison Fish 2004-2009

Within all three sites, the total amount of trout (*Salmo trutta, Oncorhynchus mykiss*, and *Salvelinus fontinalis)* fluctuated from 2004 to 2009 (Figure 8). Wolenec had a dramatic increase from 2006 to 2009 in total trout numbers (Figure 8). Zoha consistently had the fewest trout among the three sites but has kept a relatively stable number of trout within the five year period (Figure 8). Addison's trout numbers have varied and have been inversely consistent with Wolenec's trends; when Addison experienced a decline in numbers, Wolenec saw an increase and vice versa (Figure 8).

Discussion

Bronson Creek

The survey conducted on Bronson was an initial survey and will be used as pre-restoration data. The Nohr Trout Unlimited Chapter's goal for Bronson is to reduce the sediment load entering into the Blue River and also to enhance the cold water flow into the main channel of the Blue to provide additional spawning habitat (Trout Unlimited, 2009). Stream and riparian improvement work was initiated after the survey.

Blue River

Habitat quality has been found elsewhere to be dramatically improved in a restored stream area compared to an unrestored area (Phillips, 2003). As expected, differences did exist among restored and unrestored sites within the Blue River; however, there also were many observed characteristics that did not differ among restored and unrestored sites or were not associated with any restoration patterns.

There were limited differences in fish communities between restored and unrestored sites. In general upstream sites (Zoha, Wolenec, and Addison) had the highest numbers of trout; however, the unrestored downstream sites (Simplot, Kite and Winkers) had the greatest overall diversity of fish. Indeed, Zoha (a restored site and furthest upstream) only had evidence of two fish species (brown trout and mottled sculpin) in 2009. Variability in brown trout populations over time at Zoha, Wolenec, (both restored), and Addison (unrestored) make it increasingly difficult to distinguish between restored (Wolenec and Zoha) and unrestored (Addison) areas. Fish stockings within the five year period from 2004-2009 could have impacted the increase in trout populations within the upstream sites, particularly the dramatic increase in Wolenec observed from 2006-2009. However, Zoha did not seem to have had any significant change in trout abundance and trout actually decreased in Addison over the same time period. It should be noted that the observed size distribution of trout indicates that wild reproduction has been occurring in the Blue River. Fingerlings must be 5-6in (127mm-152mm) in length in order to be stocked (Outdoors Kentucky, 2010) and so any trout measured below that is considered to be wild. Another possible explanation for the high abundance of trout in the upstream sites, Addison and Wolenec, could be the movement of browns into more ideal thermal and habitat conditions.

According to the Fish and Wildlife Service, brown trout prefer a silt-free rocky substrate with abundant instream cover, well vegetated habitat, and low to moderate gradient areas in suitable, high gradient river systems (Raleigh et al., 1986). Cover, such as boulders and undercut banks, is extremely important for brown trout more than any other trout species (Adams et al., 2008), and fine sediments are a limiting factor to brown trout survival and productivity rates (Adams et al., 2008). Nevertheless, there were no obvious differences in habitat among the Blue River sites that would indicate significant differences in fish communities between restored and unrestored sites. Average substrate compositions were typically variable within each Blue River sampling site, but most sites were composed of sand, gravel, and cobble substrates. In 2009, most boulders were observed in Zoha (restored), Simplot (unrestored), and Kite (unrestored) sites. Restored Wolenec had the highest amount of fines and unrestored Simplot had the lowest amount; gravels and cobbles were fairly evenly distributed among the sites. From 2004 to 2009, fine substrates declined in Addison (unrestored) and Zoha (restored) and stayed relatively the same in Wolenec.

Submerged macrophytes affect stream structure and are important for the composition and abundance of macroinvertebrates and fish (Fjorback et al., 2002). However, too much macrophyte growth can impact a water system and exert stress on dissolved oxygen levels within the water column during plant decomposition (Utah Division of Water Quality, 2010). In 2009, high macrophyte growth was found within the restored sites (Zoha and Wolenec) compared to the unrestored sites. A reason for this difference is likely due to the absence of canopy cover over the restored sites. Over time since 2004, macrophyte growth in Wolenec has increased from an initial 8% growth presence to 43%. Since 2005, unrestored Addison has consistently had few macrophytes than either Wolenec or Zoha. The high amounts of macrophyte growth in the restored areas could impact instream communities by physically restricting flow and lowering dissolved oxygen levels via nighttime respiration and decomposition of trapped organic sediments.

Macroinvertebrate taxa richness stayed relatively the same between restored and unrestored sites and also between upstream and downstream sites. Total abundance however, varied and did not show a clear pattern between the sampling sites. Addison had the lowest abundance and Winkers had the highest abundance; both sites are unrestored and have high percentages of canopy cover. These differences could be due to the habitat type in which the inverts were identified from. Micro-habitat type varied from which macroinvertebrates were collected from. The aquatic insects were taken from a pool, riffle, or glide type of water movement. Addison only had inverts taken from a glide type of water movement due to the random selection of sampling (Figure 9). Zoha and Wolenec were the only two sites that had invert samples collected from a pool (Figure 9). Most of the inverts were taken from a glide or riffle type of water movement (Figure 9). Aquatic invertebrate abundance tends to be higher in riffle habitat (Gregory, 2005). This could be affecting the macroinvertebrate numbers between restored and unrestored sites.

In comparing Winkers and Wolenec sampling sites for 2009 there was unexpected differences between each other and further research should be conducted to determine what is occurring. Winkers is an unrestored site and the most downstream site in relation to the other samplings sites. Winkers had extremely low fish abundance compared to the other Blue River sites with only 4 brown trout. However, Winkers had the highest invertebrate abundance. Also, Winkers had a high percentage of tree cover in relation to the other sites and very low macrophyte growth. Percent fines are low and the gravel and cobble ratio percentages are very similar in range with the other sites. At the other end of the spectrum, Wolenec, the first restored site of the Blue and upstream of Winkers had the highest fish abundance with a total of 72 brown trout. Invertebrate abundance was neither low nor high. Wolenec has zero percent tree cover and the highest percent of macrophyte growth in comparison to the other sampling sites. Also, Wolenec has the highest amount of fines. Based on favorable trout habitat (Raleigh et al., 1986), Winkers should be a suitable habitat for browns and other species of trout. Though, with many systems too much of a particular factor can have negative impacts; too much tree cover can restrict productivity which could be a possible cause for the low numbers in Winkers. Another difference within the two sites is that Wolenec has been restored and has been stocked with brown trout fingerlings.

It is difficult to distinguish clear patterns between restored and unrestored sites due to inconsistent results over time. Surveys did not return clear distinctions possibly indicating other variables should be measured, for example water chemistry. However, fish and invertebrates are indicators of water quality and stream habitat. Therefore results of fish and invertebrate surveys should illustrate if differences exist between restored and unrestored sites. Larger factors may be occurring that need to be taken into consideration. For example, riparian cover was found inconsistent between restored and unrestored sites; this factor could be putting pressure on the restored sites to make them less successful than what had been originally thought. Riparian cover provides shade, food, and a suitable habitat for fish; without this cover, food and suitable habitat will be lacking creating less than ideal conditions. Also, land use practices; farming and grazing within the sites will continue to occur to minimize adverse affects for the farmer and the agricultural sector. As agricultural land use continues on the landscape surrounding the stream, the impacts could compromise the final goal of the restoration project. Another factor that should be taken into consideration is that what happens upstream will eventually affect the habitat downstream. This could be a reason for the declining trend of trout populations from upstream sites to downstream sites.

Differences and similarities among restored and unrestored sites and over time are present from the 2009 survey. Restoration does affect the stream and a longer time frame could show the distinctions between restored and unrestored more clearly than a short time frame. We also must recognize that our data were collected on relatively small or local scale restoration projects.

Conclusion

In determining if restoration has had an impact on the Blue River, there is no black and white difference. Restored ecological systems take significant amounts of time to recover and may take several years to reach a fully functioning level. Restoration has good objectives and ideals but those objectives don't always meet the finished goal of a project depending on outside factors such as land use practices and natural disturbances. Continued research needs to be conducted in order to analyze further long-term effects and impacts of stream restoration. It is essential to continue with a proactive approach in monitoring restoration activities to gain a better understanding of effects on lotic systems from anthropogenic practices and structures.

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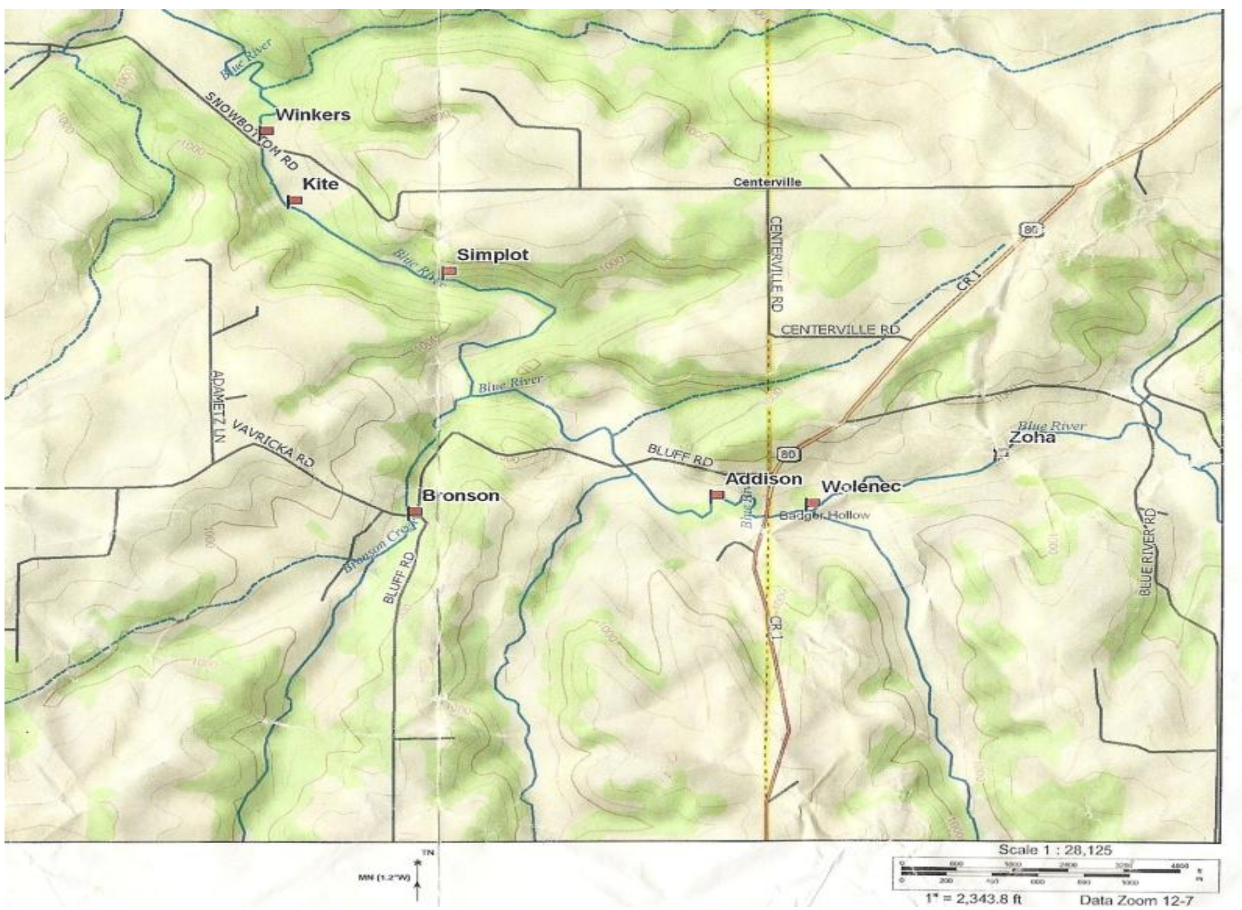


Figure 1. A topographic map of a section of the upper Blue River watershed, north of Montfort, WI. Research sites included in the study are marked with red flags and site names are identified by property owners. Stream flow is moving northwest.

Table 1. Averages of each Blue River site's habitat assessment survey from 2009.

Site	Date	Width (m)	Cover (%)	Depth (m)	Embededness (m)	Erosion Left (m)	Erosion Right (m)	Gravel (%)	Cobble (%)	Sand (%)
Zoha	6/2/09	6.02	0.00	0.46	0.49	0.00	0.12	23.13	7.50	13.96
Wolenec	6/2/09	5.60	0.00	0.48	0.54	0.00	0.31	25.63	23.02	13.13
Addison	6/3/09	8.18	42.92	0.37	0.41	0.58	0.33	18.09	26.60	39.15
Simplot	6/10/09	8.38	17.50	0.34	0.35	0.00	0.62	36.67	32.29	14.38
Kite	6/10/09	7.19	12.50	0.36	0.40	0.23	0.82	37.92	10.00	41.46
Winkers	6/4/09	7.63	35.42	0.46	0.51	0.29	0.29	33.33	11.04	37.50
Bronson	6/3/09	2.37	0.83	0.22	0.28	0.22	0.28	26.81	15.42	48.33

(cont.)

Site	Date	Large Rock (%)	Fine (%)	Boulder (%)	Bedrock (%)	Macrophyte Growth (%)	Discharge (m^3/s)	D.O. (mg/l)	pH	
Zoha	6/2/09	39.38	13.96	2.08	0.00	27.50	0.3309	8.77	7.46	
Wolenec	6/2/09	11.67	26.56	0.00	0.00	42.50	0.3471	9.94	7.18	
Addison	6/3/09	0.00	16.17	0.00	0.00	5.00	0.2864	12.38	7.58	
Simplot	6/10/09	11.49	1.46	4.17	0.00	4.17	0.2382	14.08	6.91	
Kite	6/10/09	0.00	2.50	6.25	0.00	7.50	0.3713	11.90	6.93	
Winkers	6/4/09	10.21	5.42	0.00	0.00	5.83	0.5967	13.36	8.04	
Bronson	6/3/09	5.00	3.96	0.00	0.00	16.67	0.0690	9.40	7.88	

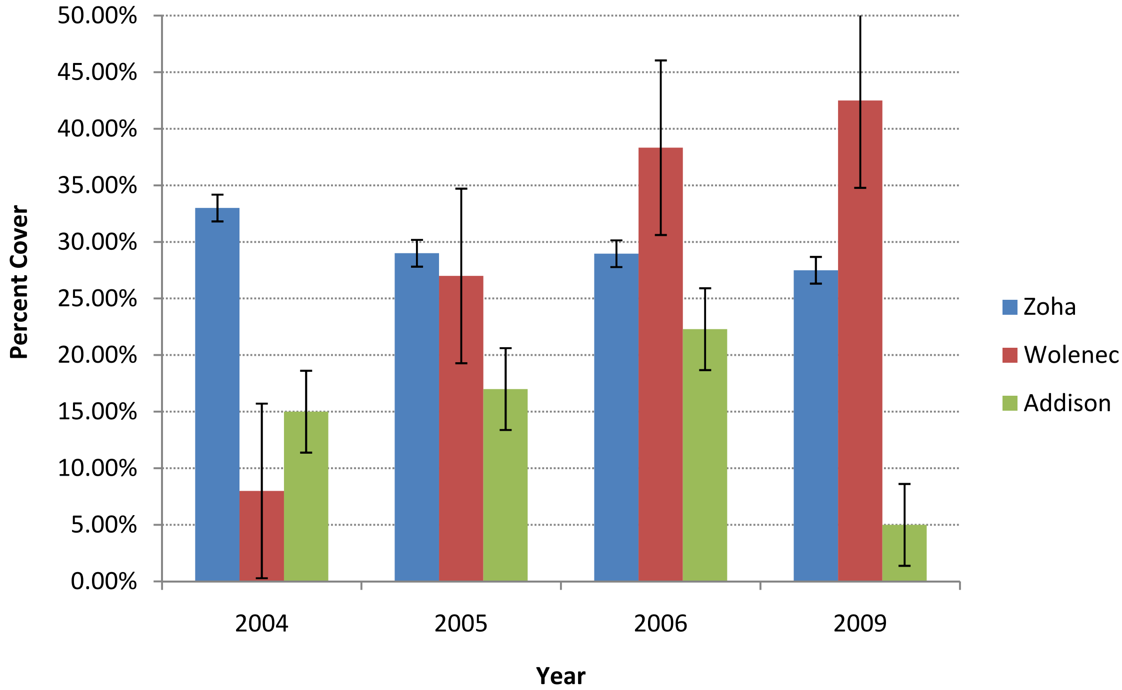
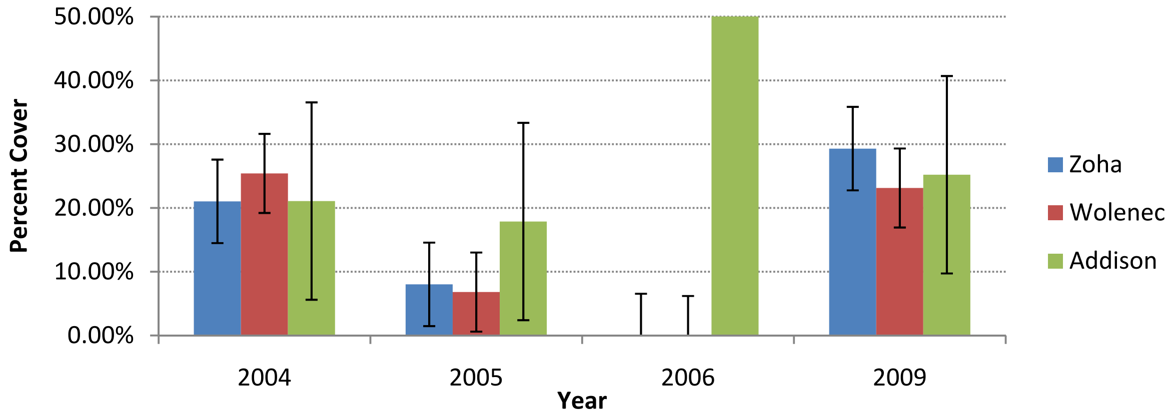
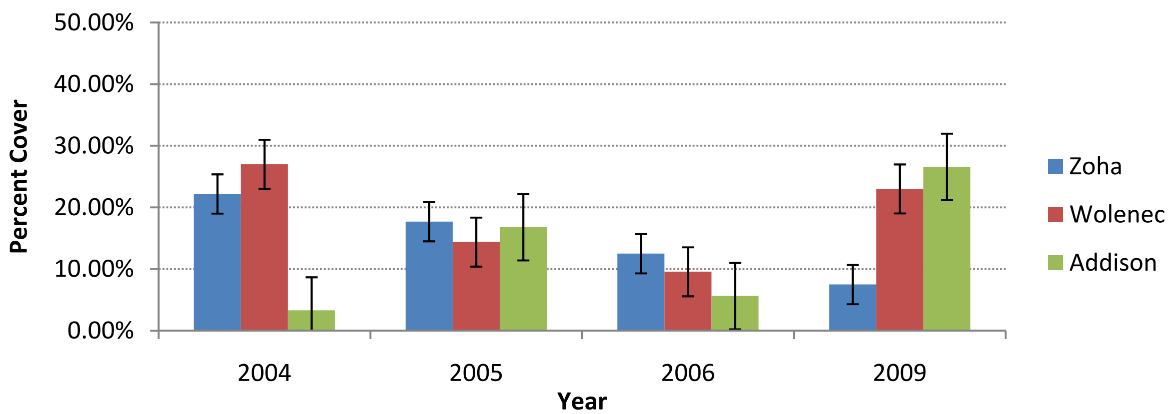


Figure 2. Average macrophyte growth measured in percent cover (± STD) from the upstream Blue River sampling sites 2004-2009. Note: No data were collected from these sites in 2007 and 2008.

A. Gravel



B. Cobble



C. Fines

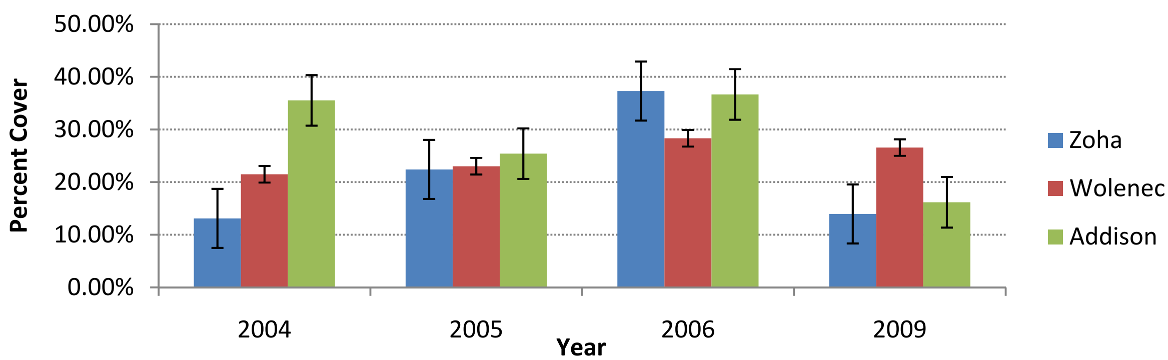


Figure 3. Comparisons of average proportions (± STD) of gravel (A), cobble (B), and fine(C) substrates from the upstream Blue River sampling sites 2004-2009.

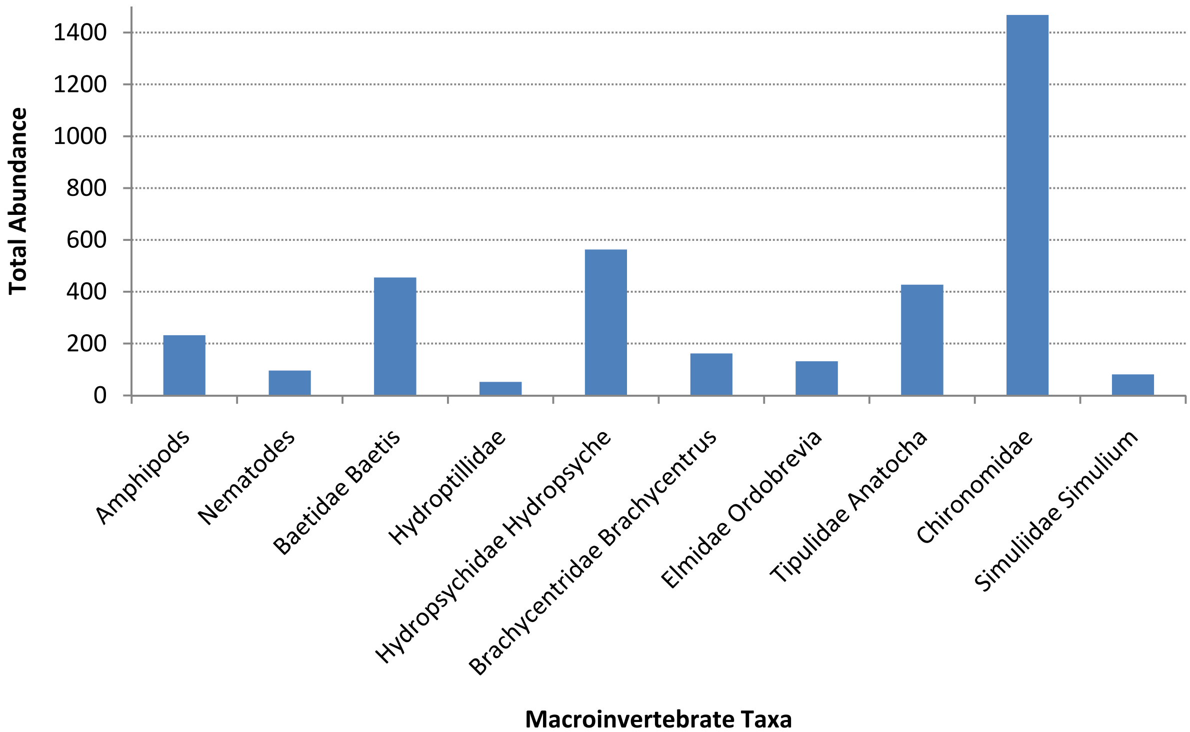


Figure 4. Abundance of the ten most common taxa of aquatic macroinvertebrates collected within all of the Blue River sampling sites in 2009.

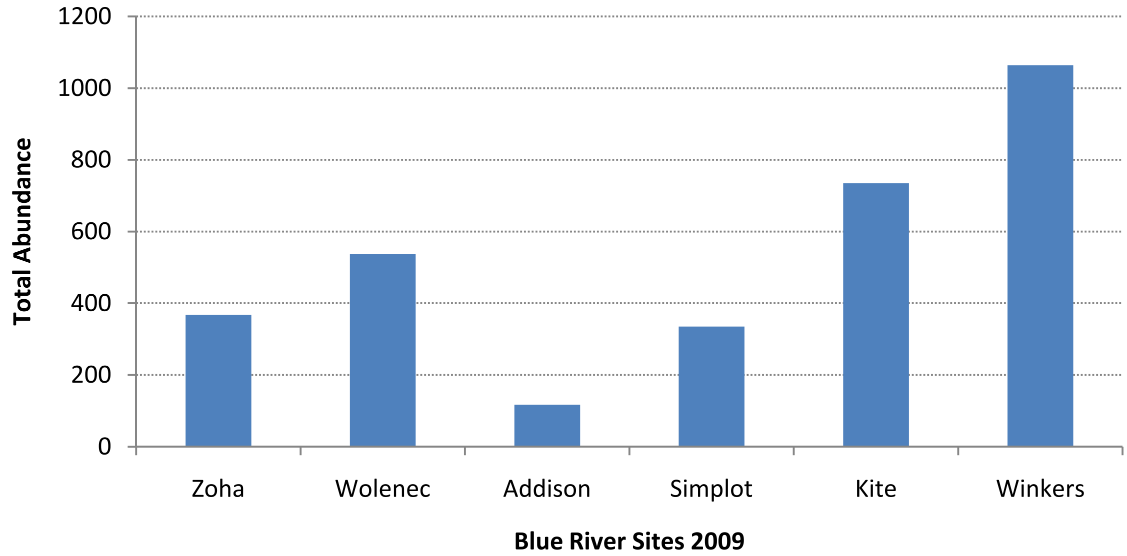


Figure 5. Total abundance of aquatic macroinvertebrates collected within the Blue River sampling sites of 2009.

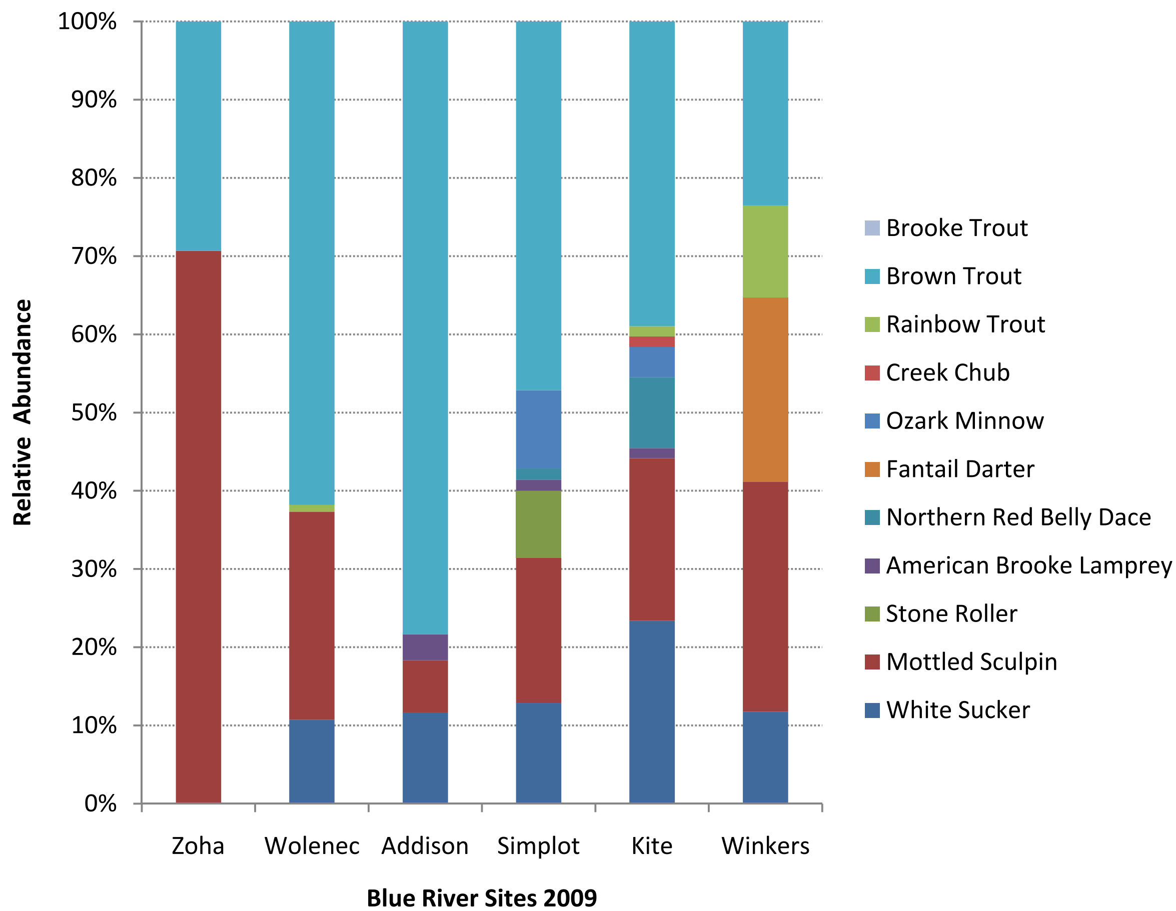


Figure 6. Relative abundance of fish identified in the Blue River sample sites in the 2009 survey.

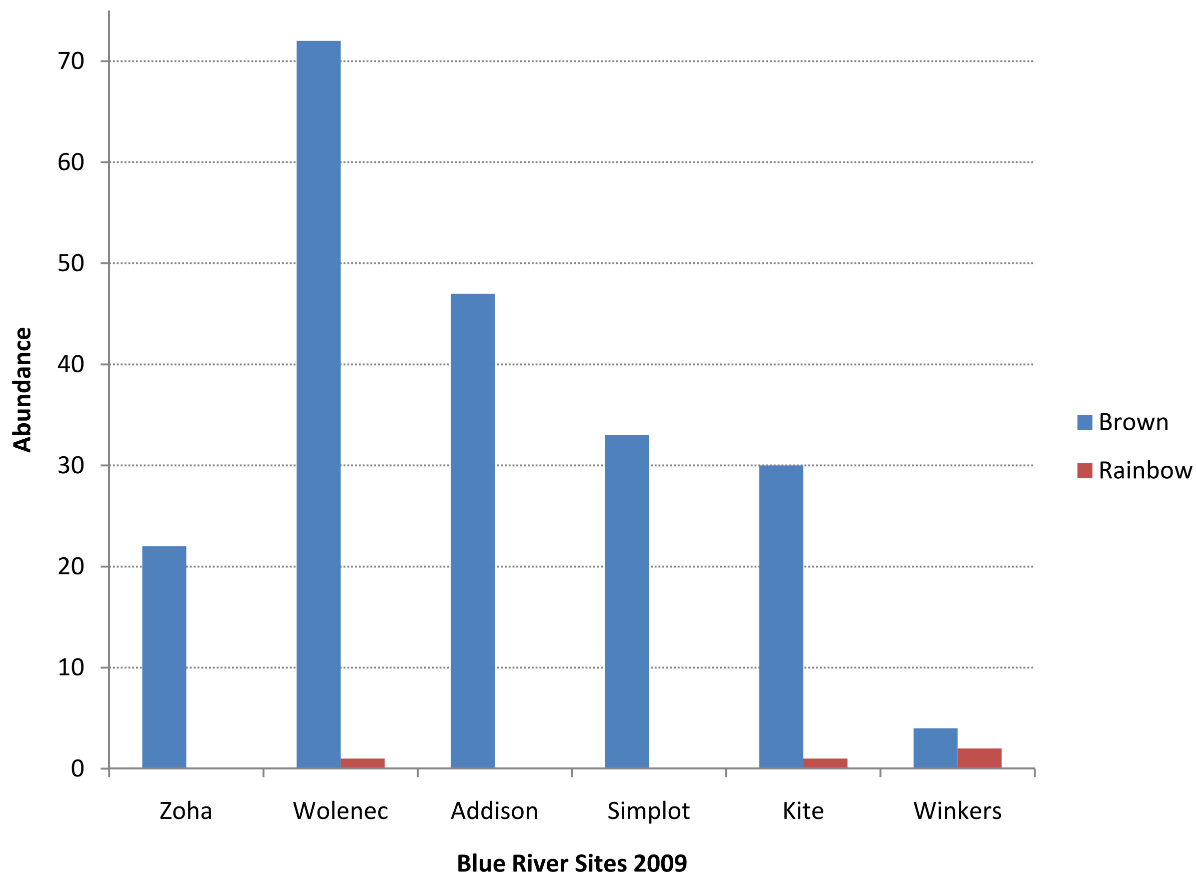


Figure 7. Total brown and rainbow trout (*Salma trutta* & *Oncorhynchus mykiss*) surveyed from the Blue River sample sites in 2009.

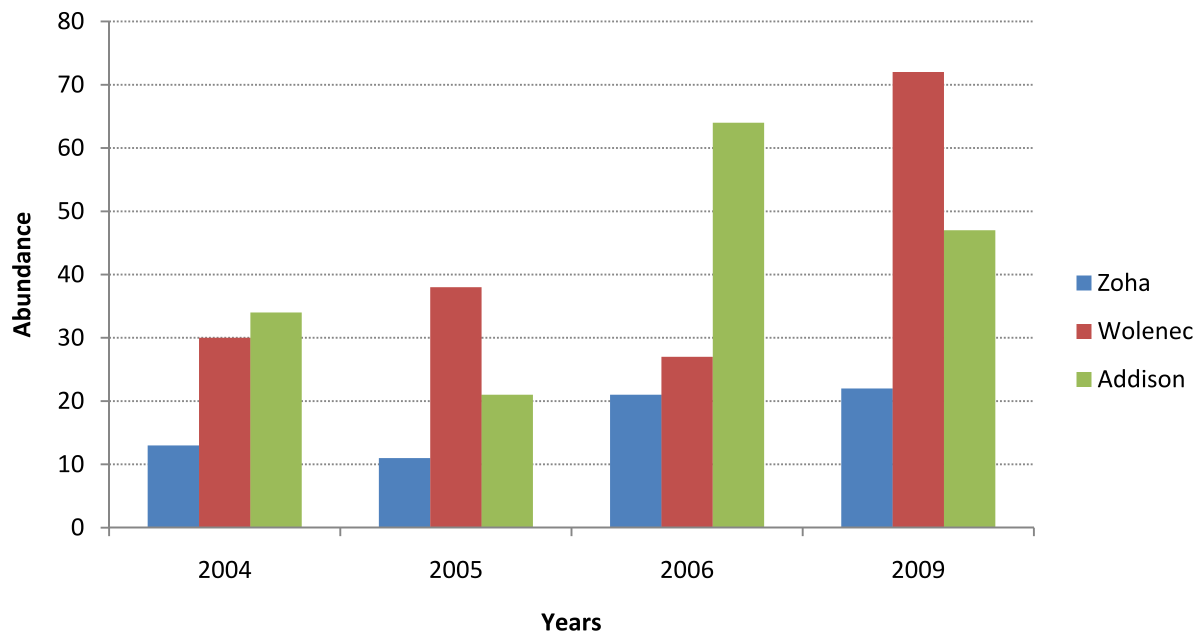


Figure 8. The total amount of trout (*Salmo trutta*, *Oncorhynchus mykiss, and Salvelinus fontinalis*) collected within the restored sample sites of the Blue River from 2004 to 2009. Note: no sampling was done on these sites during 2007 and 2008.

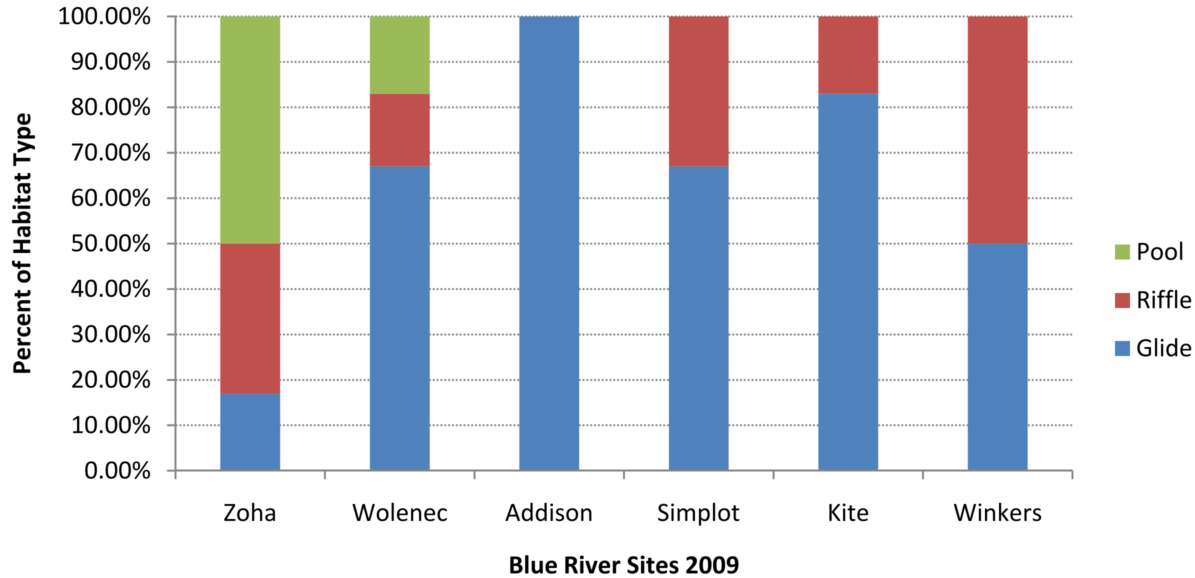


Figure 9. Proportions of micro-habitat types where macroinvertebrate samples were collected within each of the Blue River sampling sites of 2009.

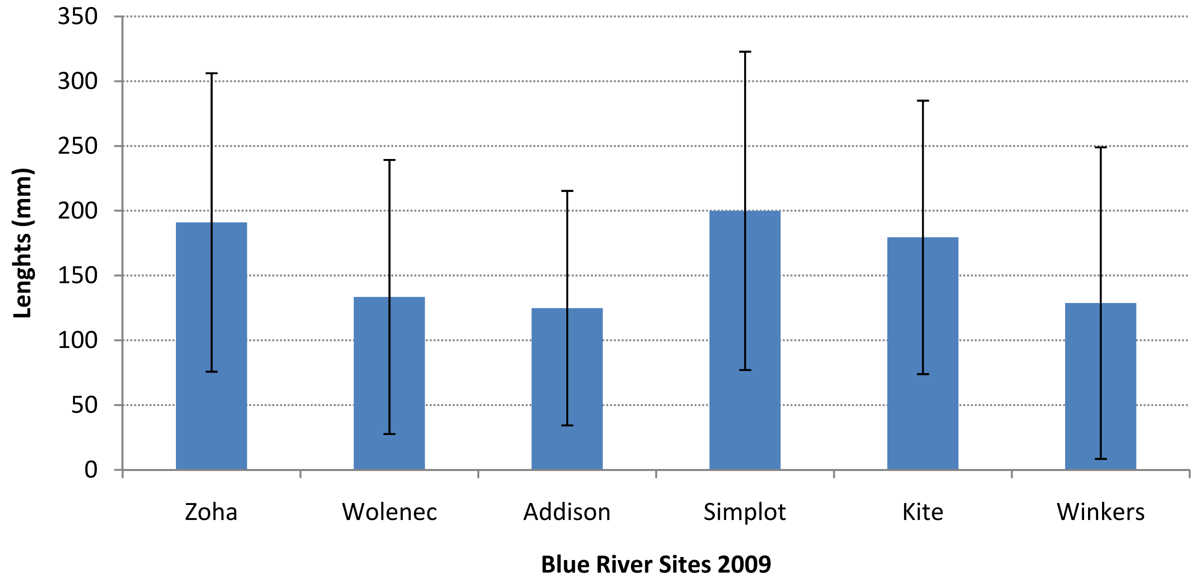


Figure 10. Average lengths (± STD) of brown trout (*Salma trutta*) observed from the Blue River sites in 2009.