Harry and Laura Nohr Chapter of Trout Unlimited

Scott Ladd Memorial Internship Report (2005-2006)

The Upper Blue River

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Abstract -The impacts of reach scale restoration practices on macroinvertebrates, habitat and fish were studied on the upper Blue River watershed in southwestern Wisconsin. Field surveys were consistently taken for three consecutive years at five sites; upstream, downstream and at specific restoration sites. Unrestored sites held a higher possibility of recruitment with larger numbers of juvenile trout than restored sites. Restored reaches held the highest number of large fish among all five sites. Even while continuing an active restoration practice it may be possible, under certain circumstances for a lotic system to recover faster than expected.

INTRODUCTION

Reach scale modification of southwestern Wisconsin streams has been a common occurrence for more than 3 decades (Wagner et al. 2003). While techniques have been modified throughout the years, rehabilitation has remained a consistent goal. In little under 30 years there has been a widely accepted change in reach scale modification, focusing on more proactive bank enhancement projects (Wagner et al. 2003). Reach scale modifications influence a magnitude of factors including; geomorphology, biology and ecology; however, effects of reach scale restoration are not well documented, due to minimal active monitoring of restoration sites (Kershner 1997, Bash et al. 2002). Further active pre and post restoration monitoring would be beneficial in evaluating restoration practices.

This study examined the effects of reach scale restoration on habitat, fish and macroinvertebrates on the upper Blue River of southwest Wisconsin over a three year period. Restoration on the upper Blue River is being conducted by the Nohr Chapter of Trout Unlimited, with the expectation of producing greater biodiversity and more extensive trout habitat.

The main objective in this study was to determine if un-restored reaches differed from restored reaches in habitat, fish, and macroinvertebrates over a three year period. If differences were noticeable, the secondary objective was to determine the magnitude of those differences. We hypothesized that restored reaches would hold a greater diversity and abundance of macroinvertebrates and fish than un-restored reaches. In addition we expected to see differences in habitat from restored reaches to un-restored reaches. In particular, we hypothesized that restoration would change substrate deposition, substrate size, erosion, channel structure and percentage of riparian cover.

METHODS

Study Areas:

The upper Blue River

The upper Blue River (43°00.087N, 90°25.583W) is located 32km north of Platteville in the township of Montfort WI, flowing west-northwest, eventually draining into the Wisconsin River (Kuykendall et al. 2005). The stream is undergoing continuous restoration projects (i.e. dredging, habitat structure, rip-rap removal, bank restoration, fording) that began in the spring of 2004. This area has been studied for two years prior to 2006. In 2004 and 2005 the study area consisted of approximately 3600 meters of stream; in 2006 approximately 1200 meters of sampling sites were added.

Approximately 4800 meters spanned five different properties (Landowners: Carpenter, Sime, Addison, Wolenec, Zoha) approximately 500 meters upstream of the Bluff Rd bridge continuing upstream past the Country Highway I bridge for approximately 4300 meters (Fig. 1). Within each of the five properties, 400 meter sampling sites were selected. The Carpenter and Sime properties were un-restored at the time of sampling and selected for construction in the summer of 2007. During the time of sampling, active restoration was occurring downstream of the Carpenter site. Addison property was un-restored at the time of sampling. The Wolenec property had previous reach scale restoration in the summer of 2004. The Zoha property under went restoration through spring and early summer of 2006.

Sampling:

All data collection in 2006 occurred before the end of August which was consistent from previous Scott Ladd Internship sampling periods in 2004 and 2005 (interns Amanda Lederer and Brad Kuykendall respectively). . All three properties were also sampled in June of 2004 prior to any restoration activity and again in August after the completion of restoration on the Wolenec

property. Each study site remained the same each year and were divided into 12 transects that spanned the width of the stream.

Habitat

Habitat surveys on all five study sites were done using Wisconsin Department of Natural Resources protocols. Measurements were taken for: river width, river depth, bank erosion, coverage, substrate composition (including macrophytes), fine substrate depth/embeddedness, dissolved oxygen, pH, water temperature, and water conductivity. Estimated percentages were taken when measuring coverage, embeddedness and substrate composition.

Macroinvertebrates

Six randomly selected transects were selected at each site and one macroinvertebrate sample was taken at each transect. Samples were taken in-channel and were orientated left, center and right along the channel width for the first three samples, and in the opposite arrangement for the following three samples. The samples were collected with a 250µm mesh Surber sample and preserved in 75% ethanol. All macroinvertebrates were identified down to family or genera.

Fish

Fish sampling was done using an electro-shocking backpack at three randomly selected transects in each site. At each of the 3 transects, fish were sampled 30m immediately upstream resulting in 90m of total stream area surveyed at each site. All fish were counted and identified down to species. Brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*) and white suckers (*Catostomus commersonii*) were measured for total lengths. All fish were released.

Analyses

Average values for habitat, macroinvertebrate and fish were compared among all five sites on the Upper Blue River. Among-site and between-year comparisons were made using data from 2004 (both pre and post Wolenec restoration), 2005 (1 yr post Wolenec restoration) and 2006 (both 1st and 2nd year post Wolenec restoration and immediately after restoration on Zoha). One-way ANOVA and paired-t tests were used to determine significance at the 0.05 level.

RESULTS

The Blue River

Habitat

Over the three year period the restored sites Wolenec (ANOVA, p-value <0.05) and Zoha (ANOVA, p-value <0.05) had no significant change in river widths (Fig. 2). We also observed no significant change in substrate depth from 2005 to 2006 on both the Addison (ANOVA, p-value <0.05) and Zoha site (ANOVA, p-value <0.05). Gravel composition was dramatically altered with significant decreases observed on all three sites for all three years; Addison (ANOVA, p-value <0.001), Wolenec (ANOVA, p-value <0.001) and Zoha (ANOVA, p-value <0.001). Sand composition between 2005 and 2006, decreased significantly only on the Zoha site (ANOVA, p-value <0.05). Significant increase in silt substrate from 2005 to 2006 was observed on two of the three sites, the un-restored Addison site (ANOVA, p-value <0.001) and the Zoha site (ANOVA, p-value <0.001) restored in late 2005 through early 2006 (Fig. 4). Significant changes in percent of coverage were observed between 2005 and 2006 on two of the three sites, Addison (ANOVA, p-value <0.05) and Zoha (ANOVA, p-value <0.001) .

In 2006 we observed an increase of 10.45 meters of total erosion on the Addison site from 2005, a decrease of 2.15 meters of total erosion on the Wolenec site and also a 9.10 meter decrease in total erosion on the Zoha site. Percent macrophyte growth from 2005 to 2006

increased on both the Addison (+5.29%) and Wolenec (+11.3%) site and decreased on the Zoha site (-0.04%) (Fig. 4).

Habitat Carpenter and Sime

In late summer of 2006 we recorded 41.80 meters of total erosion for the Carpenter site and 10.50 meters of erosion for the Sime site. Average macrophyte growth measured 24.38% of the substrate composition on the Carpenter site and 39.79% at the Sime site. Average stream widths were 5.22 meters for the Carpenter site and 6.35 meters for Sime. Average depths were 0.30m for Carpenter and 0.35m for Sime. The Sime site in 2006 had 0% average composition of gravel substrate; the Carpenter site had a gravel substrate composition of 10.73%. The Sime site of 2006 had an average substrate composition of 6.04% cobble, 26.46% sand and 6.88% silt. The Carpenter site in 2006 had an average substrate composition of 25.73% cobble, 15.42% sand and 17.81% silt (Fig. 5).

Macroinvertebrates

Thirty four macroinvertebrate taxanomic groups were identified in 2006, chironomid midges and gastropods were the most abundant among all three sites. There was significant difference between the taxanomic groups on all sites between the years of 2005 and 2006 (ANOVA, p-value <0.05) as well as 2004 and 2006 (ANOVA, p-value <0.05).

Macroinvertebrate abundance decreased from 2004 by 2337 individuals sampled. An increase of 1082 individuals was observed from 2005 to 2006. In 2006 we observed little to no change in macroinvertebrate abundance from 2005. The Wolenec property of 2006 had an increase of 597 individuals. We sampled an increase of 515 individuals within the Zoha site (Fig. 6).

Macroinvertebrates Carpenter and Sime

In late summer 2006, 21 macroinvertebrate taxanomic groups were sampled on the Carpenter site, the Sime site had 19 families identified in 2006. The Carpenter site had a greater abundance of macroinvertebrates with 479; the Sime site had 418 sampled individuals. The Diptera family Chironomidae was the most abundant between the two sites with 322 sampled individuals. The Gastropod *Physiidae sp*. had the second greatest abundance within the two sites with 133 sampled individuals. Collectively the Carpenter and Sime sites held more individuals belonging to the order of Ephemeroptera than the Addison, Wolenec and Zoha properties combined. There were 86 members of Ephemeroptera collected between the Carpenter and Sime site. Within the Addison, Wolenec and Zoha properties there were 59 collected members of Ephemeroptera. Similarly we observed 48 individuals of the order Coleoptera within the Carpenter and Sime Sites, and only 19 individuals of this order within the other three sites in the sample area. The majority of Coleoptera collected belong to the Elimidae family (Riffle Beetles) composing 66 of the 67 individuals sampled, the additional member Coleoptera belonged to the terrestrial *Curclio sp*. The only 4 identified individuals within the order Odonata (Dragon and Damselflies) were sampled on the Carpenter and Sime sites.

Fish

In 2006 24 fish species were identified, with an increase of 13 species from 2005 and an increase of one species from 2004. Three species of fish were identified on 2006 that were not present in the 2005 study, these include Common Shiner (*Luxilus cornutus)*, Johnny Darter (*Etheostoma nigrum*) and Creek Chub (*Semotilus atromaculatus*), with 3, 1 and 3 individuals sampled respectively. The Brook Stickleback (*Culaea inconstans*) was the only fish species sampled in 2006 that was absent in 2004. The Longnose Dace (*Rhinichthys cataractae*) and the Hornyheaded Creek Chub (*Nocomis biguttatus*) were sampled in 2004 but were absent in 2006.

Brown Trout (*Salmo trutta*), Mottled Sclupin (*Cottus bairdi*), Slimy Sculpin (*Cottus cognatus*) and White Sucker (*Catostomus commersoni*) were the most abundant in 2004, 2005 and 2006. There was no significant differences in fish abundance between 2006 and 2005 (ANOVA, p-value >0.05). Significant differences in fish richness on the Addison, Wolenec and Zoha were observed between 2005 and 2006 (ANOVA, p-value <0.05) (Fig. 7). There were no significant differences in fish richness between 2004 and 2006 (ANOVA, p-value >0.05).

Brown trout numbers of 2006 increased from 2005 by 42 individuals within the Addison, Carpenter and Zoha sites. The 2006 numbers also show an increase of 35 individuals from the 2004 study. Between 2005 and 2006 the Addison site experienced the greatest increase in trout with an additional 43 individuals, the Zoha site increased by 10 brown trout, and Wolenec decreased by 11 individuals (Fig. 8). The Addison site had the greatest change in brown trout between the lengths of 1-199mm with a 68.78% increase from the previous year (Fig. 9). The Wolenec site between 2005 and 2006 had a decrease of 6 brown trout in between the lengths of 1-199mm; Wolenec also experienced an increase of 12.77% of fish 300-450mm in length (Fig. 10). The Zoha site between 2005 and 2006 had an increase of 9 brown trout between the lengths of 300-450mm (Fig. 11).

Fish Carpenter and Sime

In late summer of 2006 the Sime site had an abundance of 43 brown trout. The Carpenter site had an abundance of 31 brown trout. The Carpenter site had 12 individuals between the lengths of 200-299mm and 3 individuals between the lengths of 300-450mm. The Sime site had 18 individuals between the lengths of 200-299mm and 3 individuals between the lengths of 300-450mm. Similar size distributions were observed on both the Sime and Carpenter sites (Fig. 12).

DISCUSSION

We observed variability among sites in habitat, macroinvertebrates, and fish in a three year period on five sites that differed in time since their restoration. Our findings continue to support the idea that stream restoration activities affect all aspects of that system, (Allan 1975, Gorman and Karr 1978, Schlosser 1982, Minshall 1984, Gore et al. 1998, Meffe and Sheldon 1998). Our evidence supported the hypothesis that restored reaches would be affected differently than un-restored reaches; although, we also found evidence that some stream characteristics remained stable through the restoration process.

Upper Blue River

Two external events that occurred in 2005 could have influenced some of the stream's characteristics. In the summer of 2005 there were 2 stocking events of over 20,000 brown trout fingerlings. The summer of 2005 also had a low base flow due to a low water year. In 2006 water conditions returned to the previous averages. Also there were no known incidents of stocking in the 2006 year.

Time since restoration is an essential consideration when analyzing the upper Blue River watershed. Severe human involvement in natural systems can cause longer than normal watershed rebound (Moerke et al. 2004). Restored and un-restored reaches of the upper Blue River were distinguishable by a few select variables. The Wolenec and Zoha properties had the least amount of coverage in the five study sites. These two sites were the only two restored sites in the study, suggesting that restoration practices reduce riparian coverage. In all three sites we observed an increase in silt deposition from both 2005 and 2006. With the increased silt deposition macrophyte growth seems to flourish, there were no significant decreases in macrophyte coverage from 2005 to 2006. We observed dramatic reduction in erosion for both restored sites. In contrast there was a large increase in erosion on the Addison property (un-

restored). This data suggests effective restoration practices for short term goals, such as bank stabilization.

Sustained deposition by the advent of increased macrophytes will change habitat diversity and thus has changed macroinvertebrate community structure. The greater amount of silt deposition on all three sites appears to have increased the abundance of bivalves and gastropods in 2006 from 2004 and 2005. Abundance of macroinvertebrates was increased from 2005 to 2006, but was dramatically reduced from 2004. This fluctuation in macroinvertebrate abundance was in spite of an increase in diversity. These observations could be occurring for a multitude of reasons. The decrease in abundance we observed in 2005 from 2004 could be a response to a different sampling method (absence of a neoprene glove). The increase in diversity from 2005 to 2006 shows promise of a two year natural rebound by invertebrate communities in response to human restoration. Another piece of evidence for increasing invertebrate populations after restoration could be the increase of invertebrate abundance through all three sites from 2005 to 2006.

The brown trout population of the upper Blue River had some major changes occur with restoration in 2006. We observed that the Addison property held the greatest amount of fingerling sized brown trout (yearlings). This may suggest that un-restored stream reaches become a probable area for juvenile development or possibly recruitment. The Wolenec property immediately upstream from Addison, has displayed approximately the same size distribution for the last three years of this study. This finding suggests that restored habitat on the Wolenec property is conducive to adolescent fish (two to three years old). We observed large amounts of adult fish dominating the Zoha site, no fish smaller than 250mm were observed. Predation pressure by cannibalism could be a major factor for the disappearance of juvenile trout

in this reach; this finding may also suggest a possible reason for the migration of smaller fish down stream to the Addison property. Overall we observed an increase in fish abundance; this increase could be in response to a few different factors. The increase in invertebrate abundance from 2005 to 2006 could have also influenced the systems carry capacity in relation to brown trout population. Mottled sculpins and Common Shiners experienced the greatest decrease in abundance in 2006 from 2005; this could be due in part to the loss of cobble and gravel substrate which both species are adapted to inhabit.

Carpenter and Sime 2006

The Carpenter and Sime properties were added in the year of this report. These two sites do not have any previous data and cannot be described with the previous 3 sites. Average depths of these two sites are comparable to the sites of Addison, Wolenec and Zoha. The Carpenter site of 2006 has the lowest depth reading between the two sites as well as all five sites. Invertebrate abundance of the Carpenter and Sime sites are similar to the other 3 sites in 2006. The Carpenter site did have a higher invertebrate abundance than that of the Sime site, possibly due to more hospitable substrate composition. Sizes of Brown Trout on the Carpenter property were more evenly distributed than the other four sites, as well as a lower abundance. This could be due to higher numbers of larger fish in the Carpenter property causing an increased predation pressure.

CONCLUSIONS

The five study sites give us better insight on the ability of lotic systems to adapt to human restoration practices. From the collective data of these five sites, we can deduce a few general conclusions on how different lotic systems are affected by a human restoration effort. These include (but are not limited to): size of the specific system in question, how the riparian land is used, and the amount of time needed for recovery (Kuykendall et al. 2005). The upper Blue

River is a large tributary to the Wisconsin River. Large watersheds have a greater possibility of separate variables affecting the systems ability to react to external pressures, therefore scale of restoration must be taken into affect (Feist et al. 2003). Different watersheds are managed and used in an array of ways; usage on a system can influence the ability of that system to recover. Ecological principles that govern environments, operate on a large time scale, effects can be observed immediately or in the long term. Depending on a multitude of variables an ecological system may take years to respond to an external pressure. The recovery of a system after human rehabilitation can be incomplete and/or take much longer than natural disturbances (Niemi et al. 1990, Detenbeck et al. 1992). With the advent of more anthropogenic affects on the environment, it is essential to continue a proactive approach in the monitoring of reach scale restoration activities.

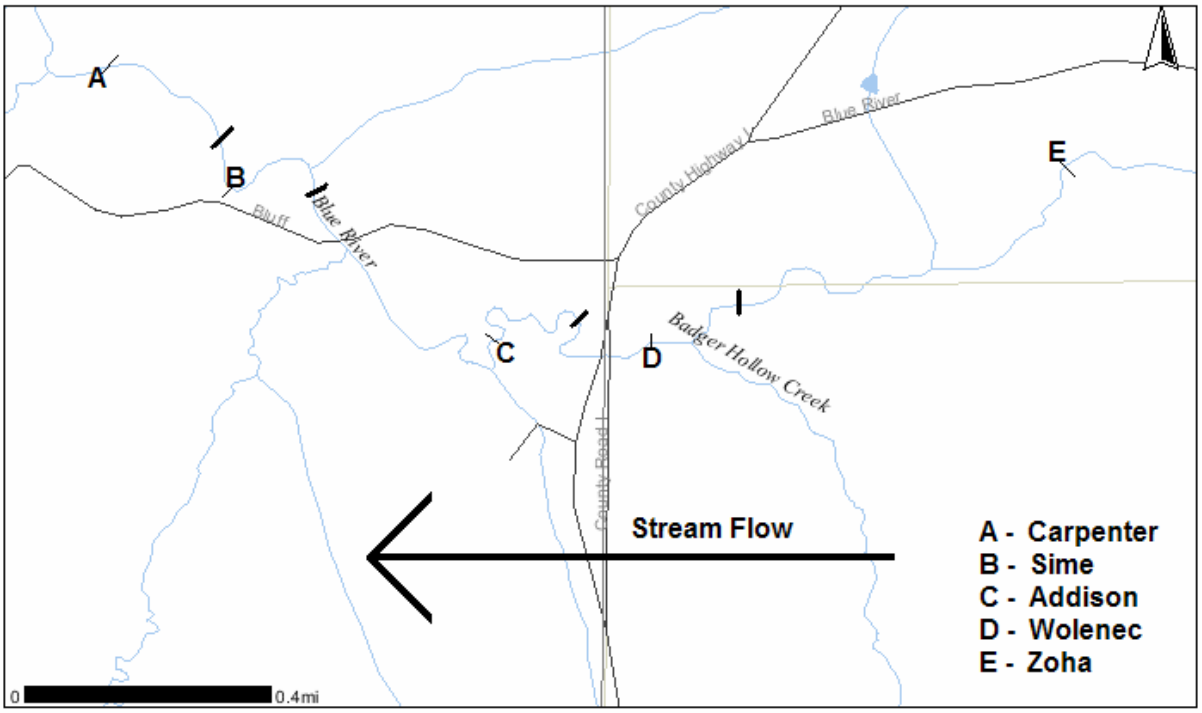

Figure 1 – Map of the upper Blue River watershed included in the study. Sites included in the study are marked with upper case letters their end points are marked with black lines, a large arrow marks the general stream flow. (From the WDNR surface water data viewer).

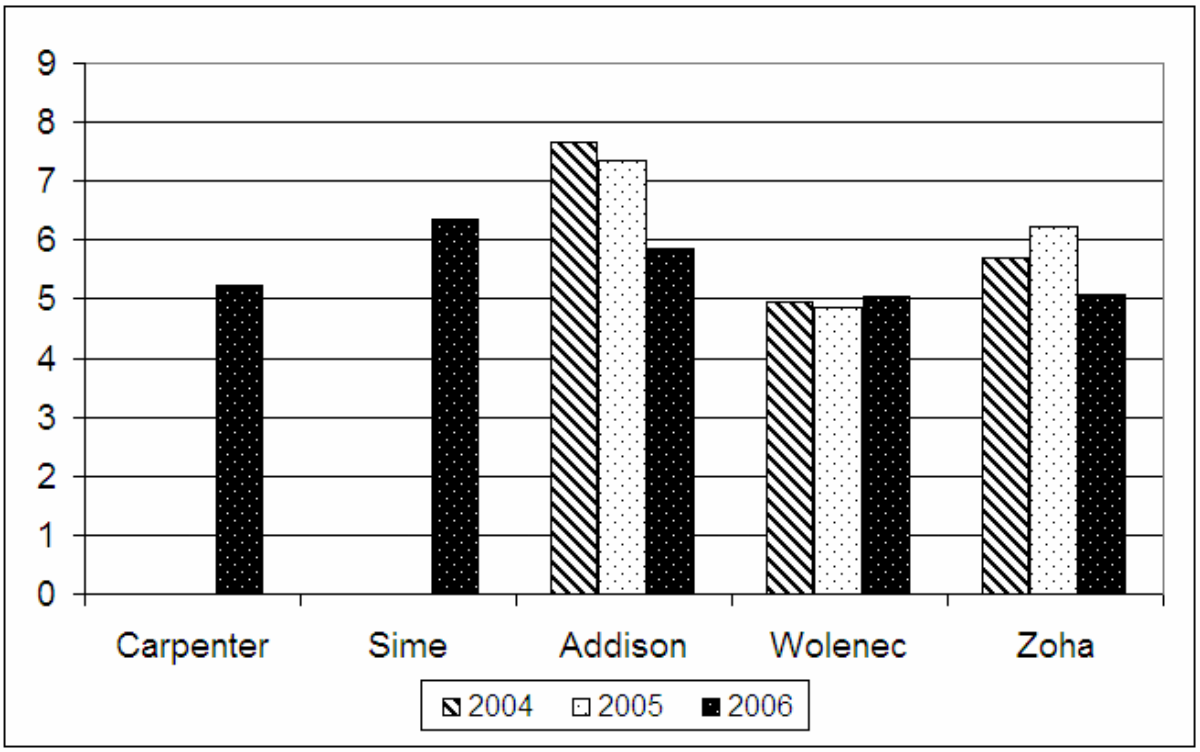

Figure 2 – Graph showing the trend in average river width for all five sites in all three years of the study. Data for the average width is represented in meters on the ordinate axis, site names are listed on the x-axis.

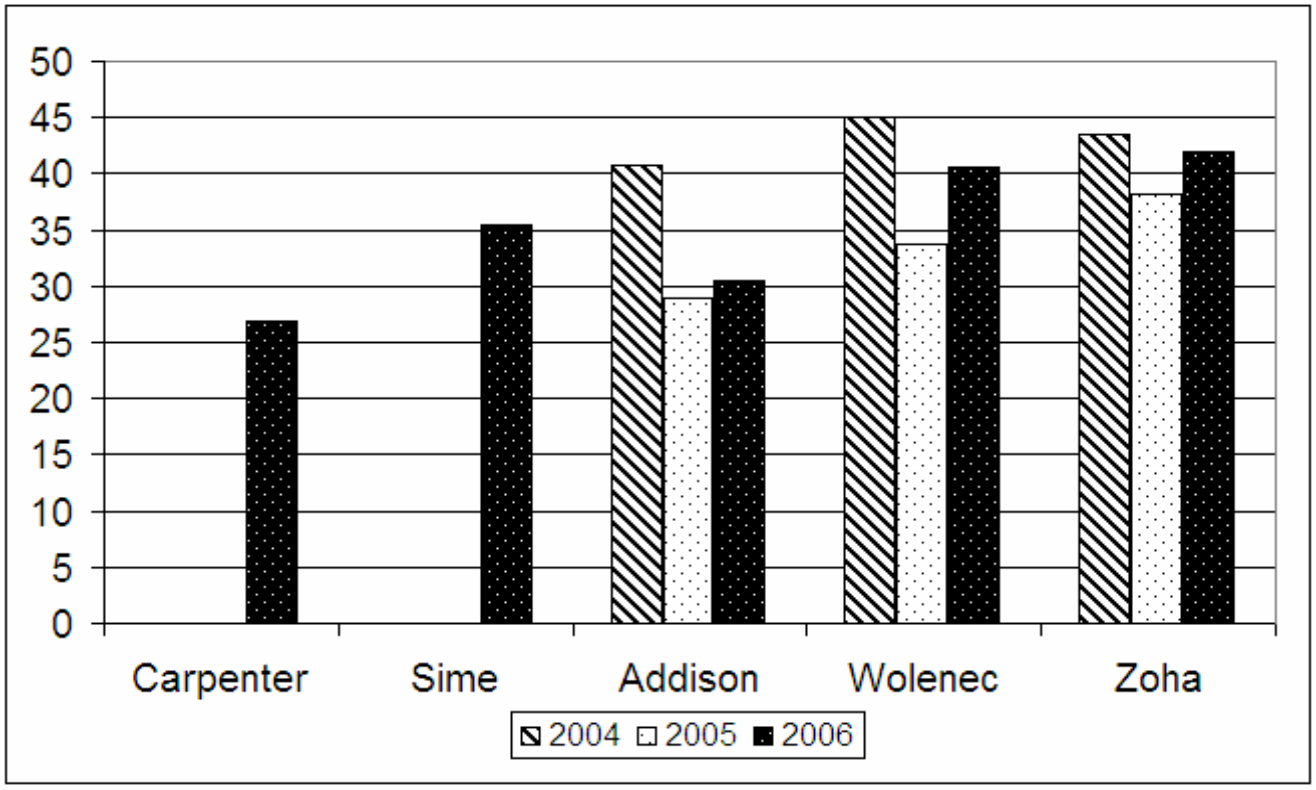

Figure 3 – Graph showing the trend in average river depth for all five sites in all three years of the study. Data for the average depth is represented in centimeters on the ordinate axis, site names are listed on the x-axis.

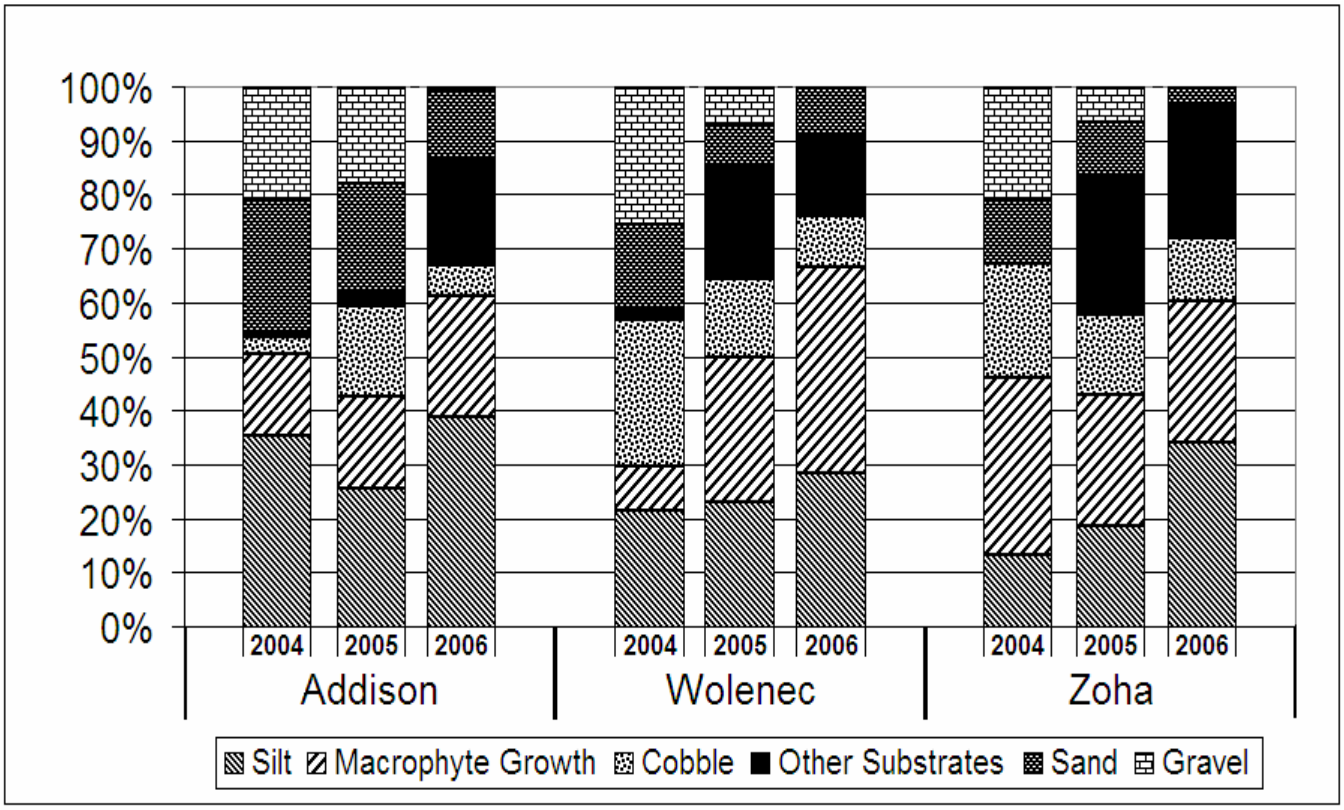

Figure 4 – Graph showing the composition of substrates on each of the three sites included in the three year study.

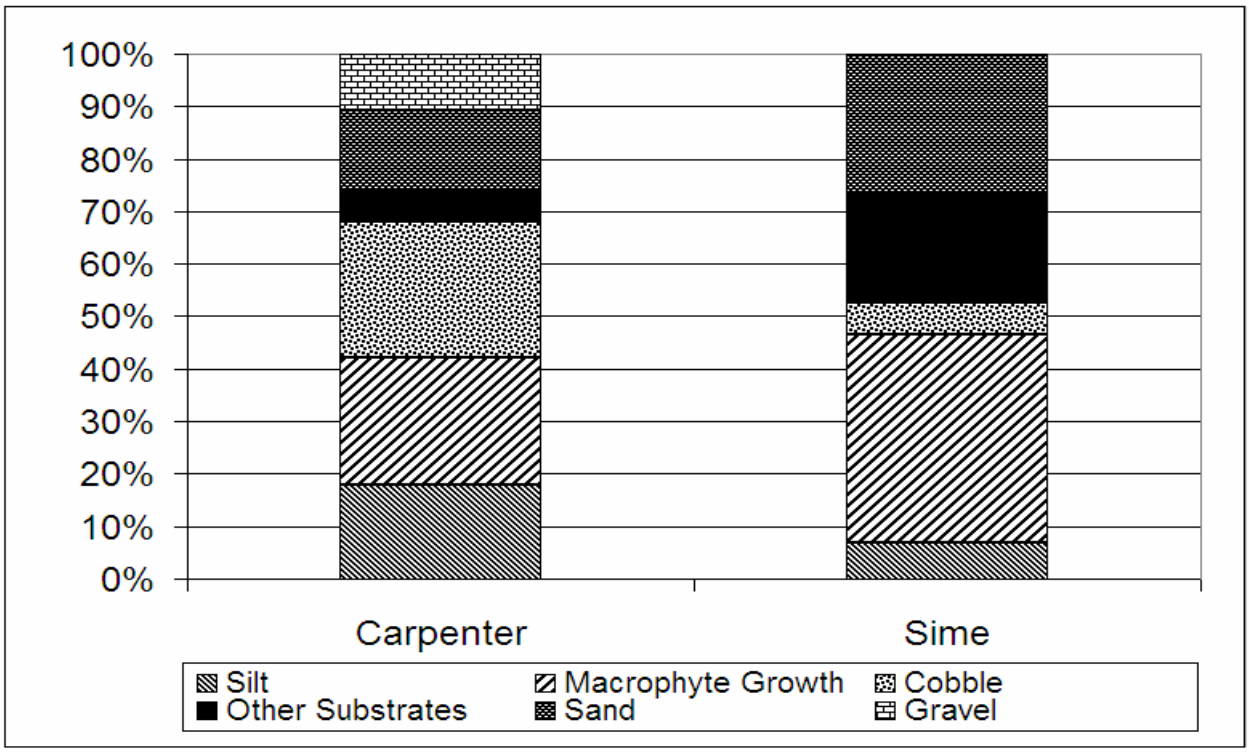

Figure 5 – Graph of substrate composition in the summer of 2006 on the Carpenter and Sime sites.

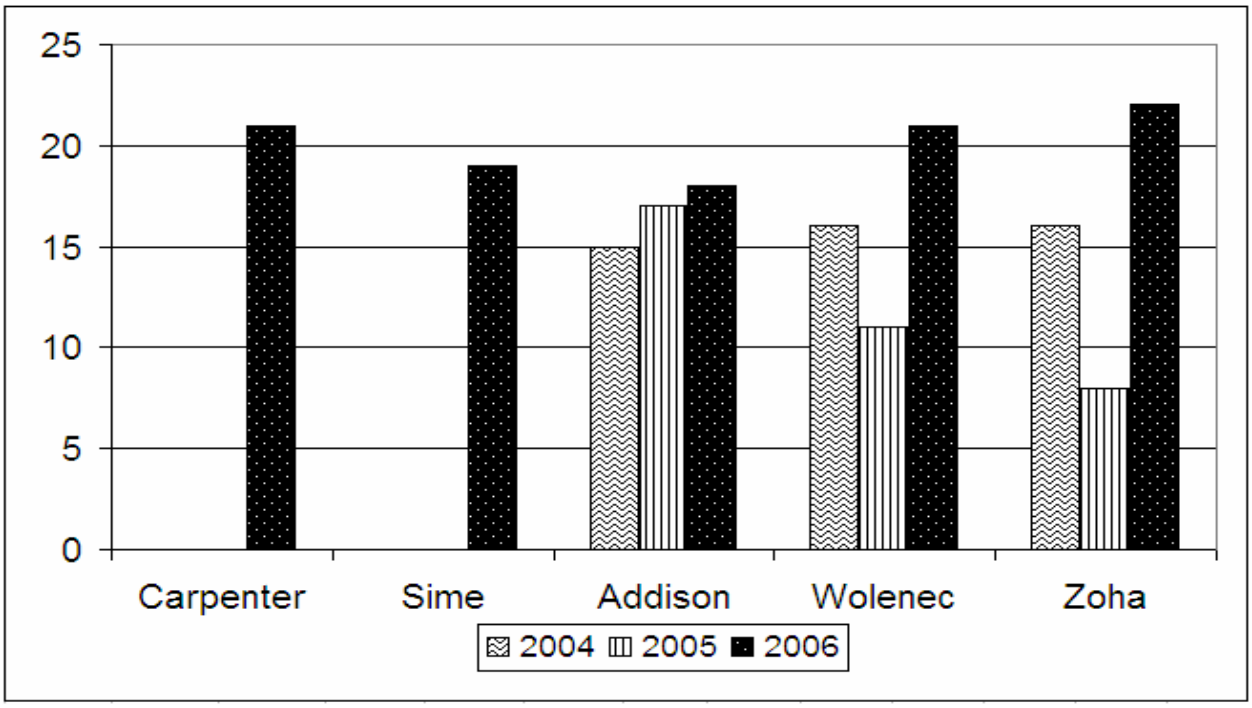

Figure 6 – Graph of macroinvertebrate diversity over a three year period. The ordinate axis is numbered for different taxonomic groups found at each site. Sampling began on the Carpenter and Sime sites in 2006.

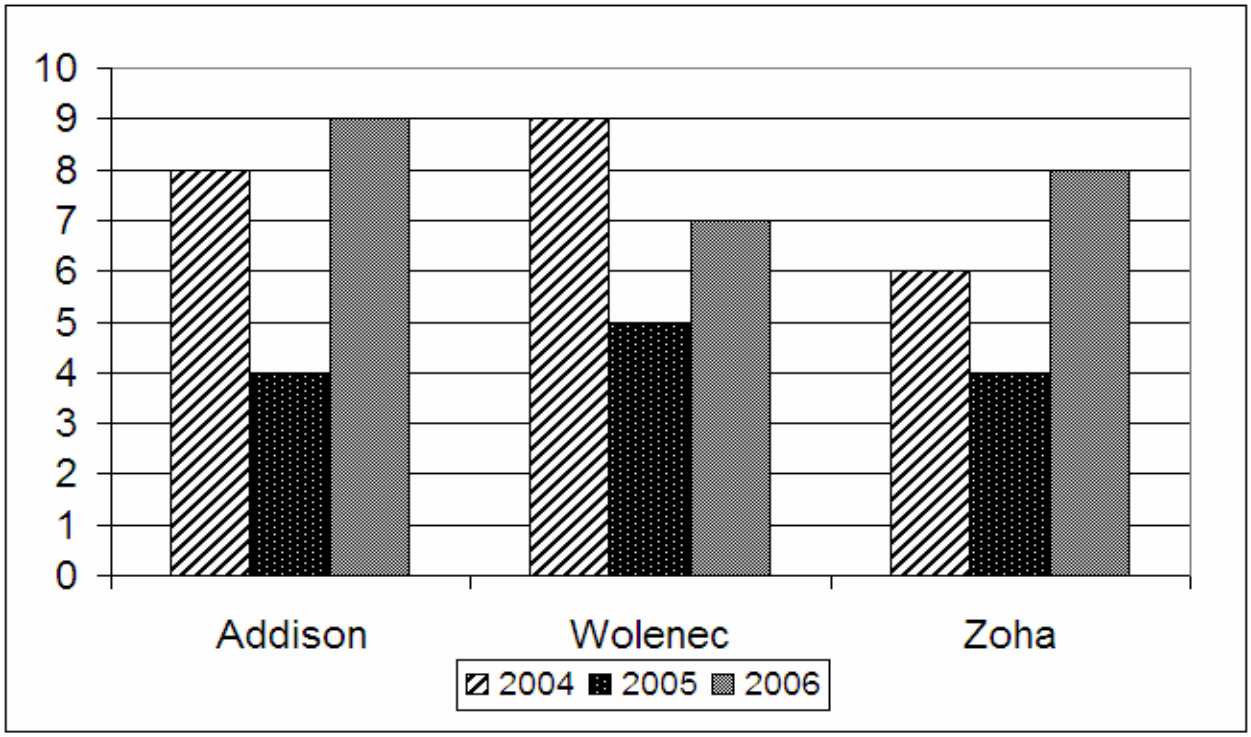

Figure 7 – Graph of the number of different taxonomic groups of fishes sampled at each site for the three years of the study.

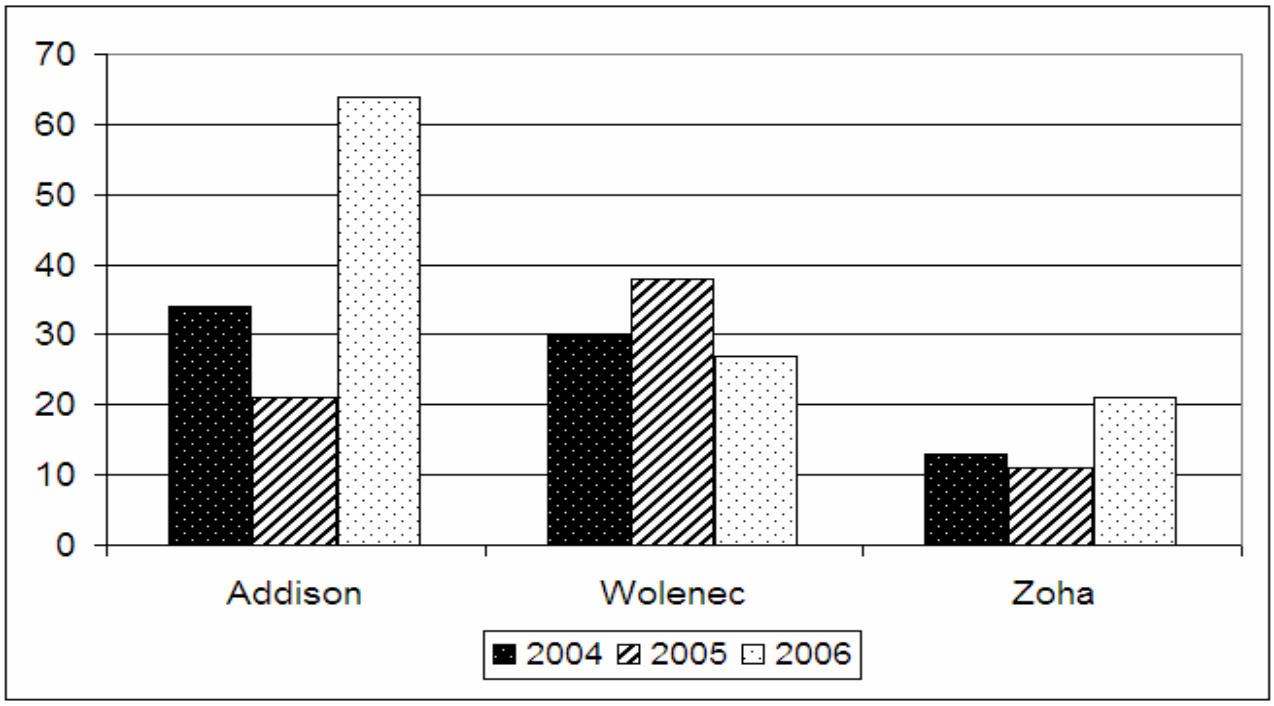

Figure 8 – Graph of brown trout (*Salmo trutta*) abundance, number of individuals is on the ordinate axis. Site names are labeled on the x-axis, color pattern denotes the time of each survey.

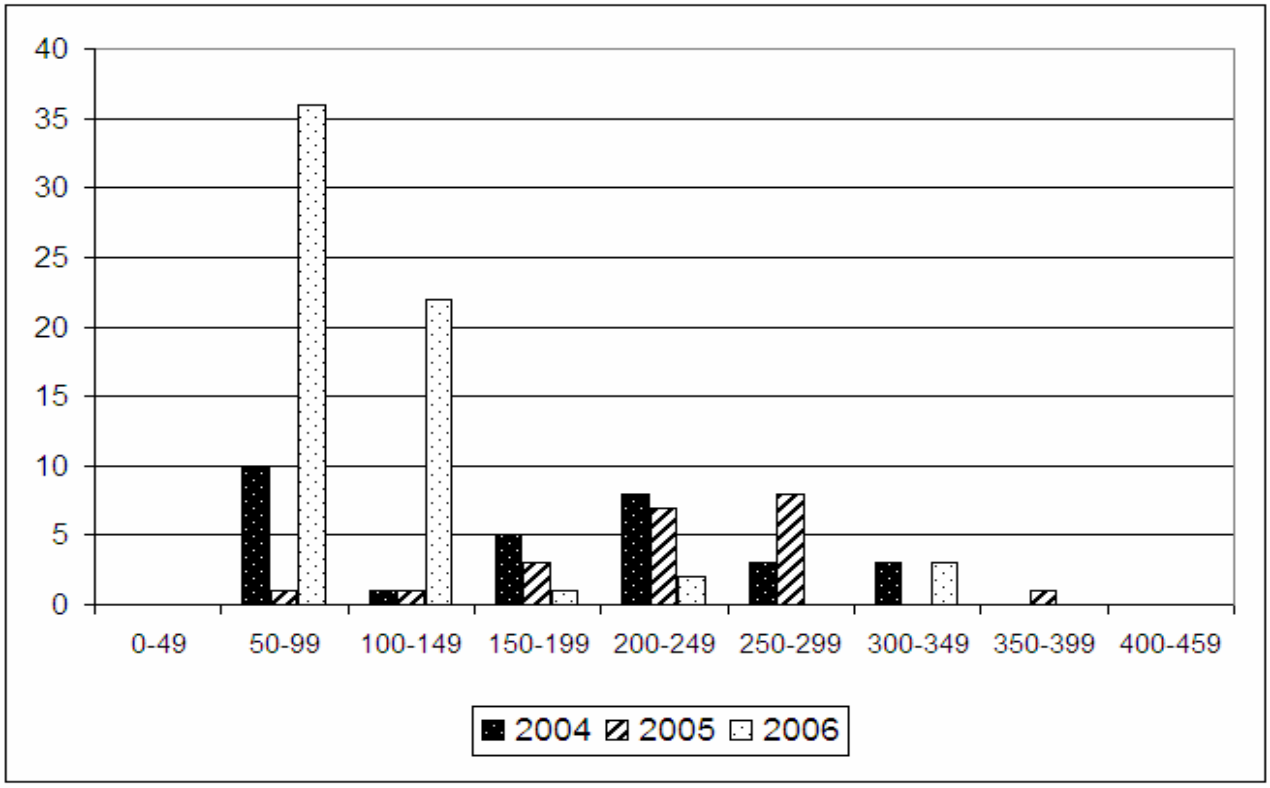

Figure 9 – Graph of brown trout (*Salmo trutta*) size distribution on the Addison property over the three year study. Number of individuals is on the ordinate axis, year of each survey is denoted by color pattern.

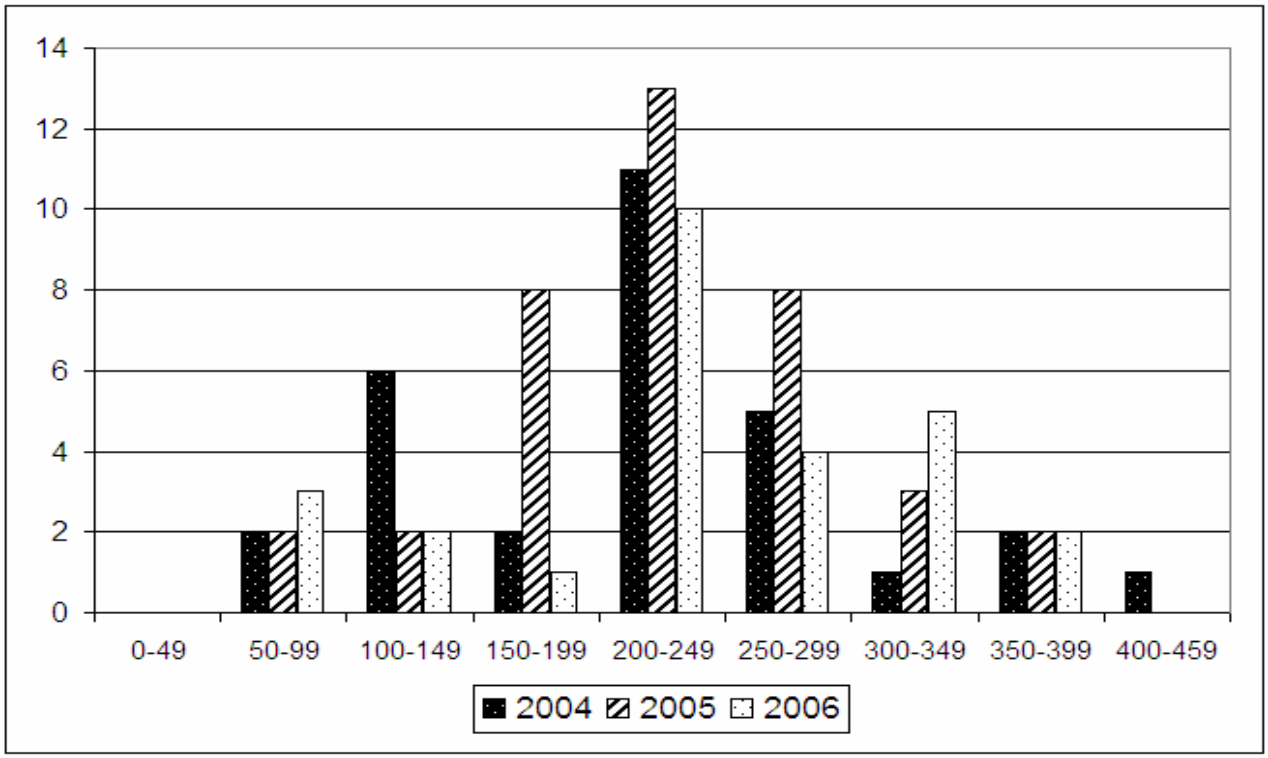

Figure 10 – Graph of brown trout (*Salmo trutta*) size distribution on the Wolenec property over the three year study. Number of individuals is on the ordinate axis, year of each survey is denoted by color pattern.

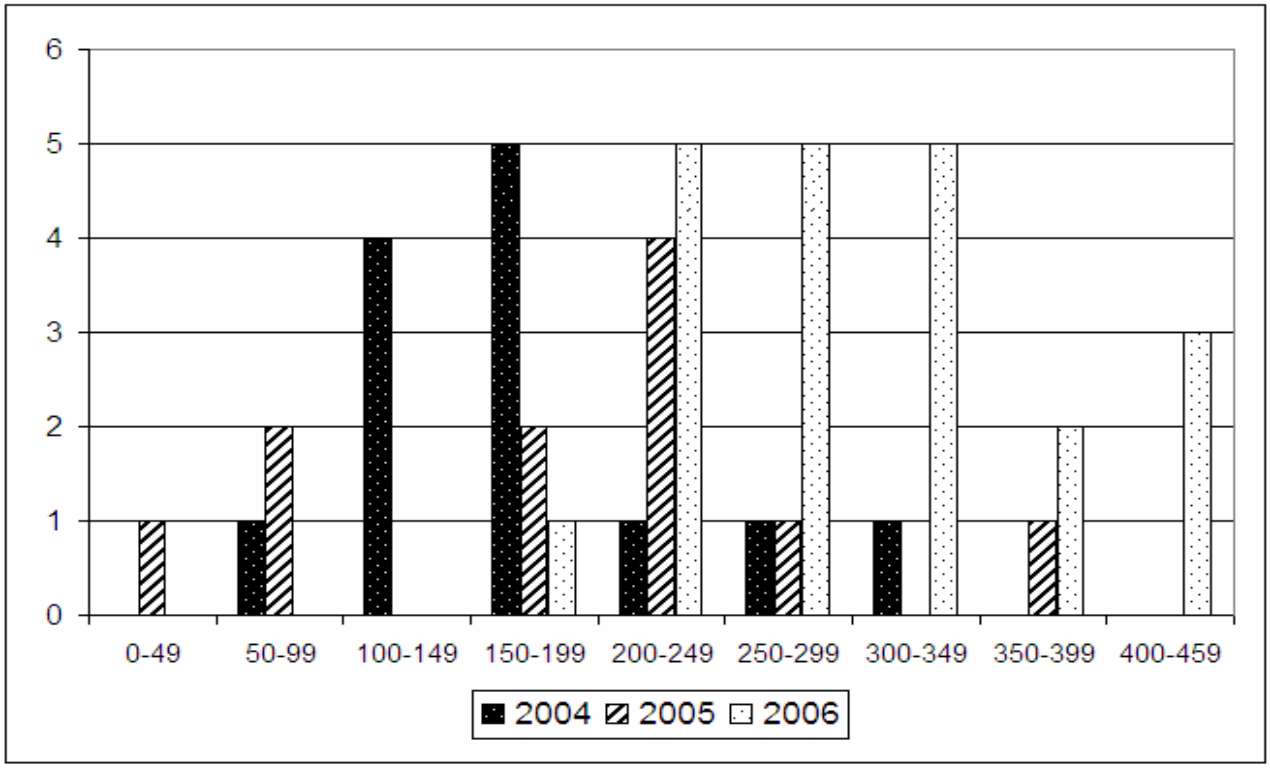

Figure 11 - Graph of brown trout (*Salmo trutta*) size distribution on the Zoha property over the three year study. Number of individuals is on the ordinate axis, year of each survey is denoted by color pattern.

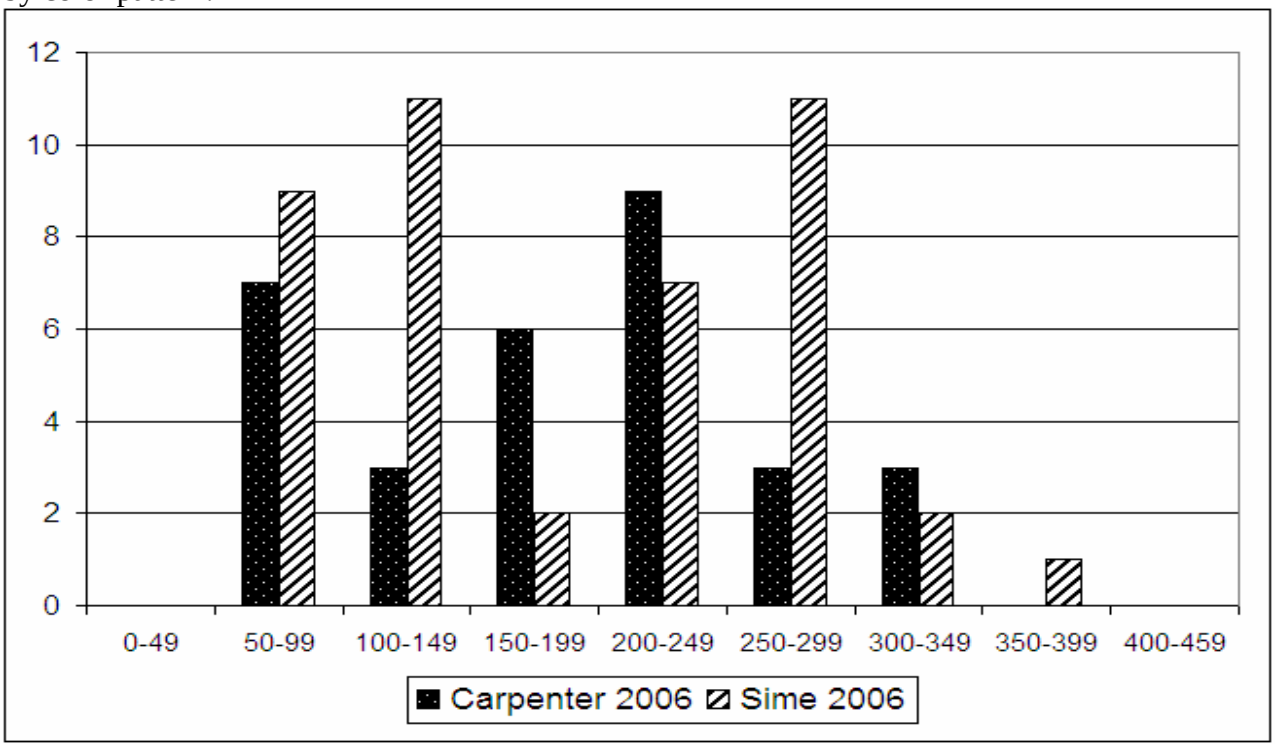

Figure 12 – Graph showing the brown trout (*Salmo trutta*) size distribution on the Carpenter and Sime sites for the summer of 2006. Numbers of individuals are displayed on the ordinate axis and size range in millimeters is displayed on the x-axis.

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