# The Sandra Miller Bellrose Stream and Wetland Restoration Monitoring Summary

**Overview**

This report summarizes monitoring activities for a Natural Resource Damage Assessment (NRDA) restoration project. For more information about the NRDA program please visit our website at: http://www.dnr.illinois.gov/programs/NRDA/Pages/default.aspx. Monitoring of NRDA restoration projects is a critical component of the overall process. Monitoring allows us to examine how well the project is functioning, which helps us determine whether additional work needs to take place at the site; a form of adaptive management. Monitoring also helps us understand overall project performance, which will help us make more informed choices with future projects. For more information about the NRDA monitoring program go to: http://www.dnr.illinois.gov/programs/NRDA/Pages/NaturalResourceRestorationMonitoringProgram.aspx.

**Project Description**

The Sandra Miller Bellrose Nature Preserve, located in Logan County Illinois, is in the Salt Creek basin, north of Lincoln (Fig 1). The Site is approximately 106-acres and is privately owned (Lerczak 2000). The preserve consists of a 0.8-mile segment of Sugar Creek plus adjacent woodlands and fields on both sides (Fig 2). NRDA funds were used as cost share with other State and Federal programs (Fig 2) to conduct instream (Fig 3) and wetland (Fig 4) restoration projects. Other restoration measures taking place at the site, funded by other programs, include forest (Fig 5) and grassland (Fig 6) enhancement projects. These projects combine to create 400 acres that are permanently protected and restored in and around the nature preserve (Fig 2). All projects were implemented in the fall of 2007. For more detailed information regarding the NRDA funded restoration efforts (stream and wetland) you can review the NRDA Restoration Plan located on the web at: http://www.dnr.illinois.gov/programs/NRDA/Pages/WilliamsPipeline.aspx (Phase I Restoration Plan).

**Overall Monitoring Plan**

The objective of the instream restoration project was to increase the habitat for aquatic wildlife, such as smallmouth bass and mussels, and aquatic insect species, such as pollution intolerant and high quality indicator species. For the wetland project, the objective was to increase wetland habitat for wetland birds, aquatic and terrestrial insects, and amphibians and reptiles. For the grassland and forest projects, the objective was to improve the habitat's natural quality. To assess whether or not these projects are achieving their desired goals, monitoring has been conducted both before and after restoration action. This monitoring report will focus on the NRDA funded projects, which included the instream and wetland restoration efforts. Table 1 illustrates the various types of surveys conducted as well as the year completed. Table 1 also indicates the projected plans for monitoring the projects for a 10 year time period. In many cases it takes decades for the true benefits of restoration actions to be realized, therefore, monitoring will continue for as many years post restoration as possible. More details regarding the instream and wetland restoration efforts as well as the specific surveys conducted for monitoring purposes are described below.

**Instream Restoration Monitoring Summary**

The purpose of the instream project is to enhance habitat for aquatic life within Sugar Creek by adding a variety of habitat structures (boulder clusters, longitudinal habitat stone, and secured brush). Stone Toe Protection was also constructed to stabilize an eroding streambank. Monitoring surveys conducted for the instream restoration project include: habitat, aquatic insect, smallmouth bass, and mussel surveys.



**Boulder Clusters:** A cluster of rocks (3 - 6 ft in diameter) that generate flow turbulence and create scour holes on the downstream side of the clusters to create additional fish habitat. The clusters also increase the dissolved oxygen content of the water, providing essential oxygen to aquatic life. The rocks themselves provide habitat for small fish and aquatic insects.

**Longitudinal Habitat Stone:** An elongated formation of 3-12 inch diameter rocks creates scour development and escape/spawning habitat for fish. The rocks themselves provide habitat for small fish and aquatic insects.





**Stone Toe Protection:** A series of 3-12 inch diameter rocks placed along the base of the streambank to stabilize the bank, limiting erosion; thereby reducing sedimentation and increasing overall water quality of the stream. The rocks themselves provide habitat for small fish and aquatic insects.

A.) <u>Habitat Survey</u>:

Along with water quantity and quality, available instream habitat is a major determining factor for determining whether a stream reach is suitable for the presence of aquatic life.  For instance, the presence of stream cover such as, but not limited to, boulders, overhanging vegetation, and root wads, should provide good habitat for fish and aquatic insects; and diverse substrate of cobble, gravel, and sand, should provide good habitat for aquatic life including mussels.  If a stream consists of mostly sand or muck substrate with little to no instream cover then a lower quality and likely lower quantity aquatic life will be present.  The importance of habitat is why many instream restoration efforts focus on providing structures such as secured brush and rock formations, which among other things increase depth of pools near the structures.

To assess the habitat changes pre and post restoration two types of habitat assessments were utilized:  the Qualitative Stream Habitat Assessment Procedure (SHAP) and Qualitative Habitat Evaluation Index (QHEI).  The QHEI is calculated from six scores, which are visual assessments of the quality of substrate, in-stream cover, channel morphology, bank and riparian zone, pools and glides, and riffles and runs.  QHEI scores greater than 60 suggest high habitat quality and scores below 45 suggest poor habitat quality.  The SHAP was completed to provide a secondary means of assessing the habitat within the project reach.  A total of fifteen metrics are scored, the metrics include the characterization of:  the bottom and pool substrate, deposition, pool quality and variability, instream and canopy cover, bank vegetation, channel alteration and sinuosity, and hydrologic diversity.  The scores are totaled and compared to absolute scores by which to determine if the stream reach can be characterized as having excellent (171-208), good (119-156), fair (67-104), or poor (15-52) habitat (Table 2).

The 2008, 2009, and 2012 habitat surveys were all very similar to the 2007 survey prior to restoration work, which indicates a good to high quality stream (Table 2 and 3).  Due to the instream enhancements there was an increase in instream cover and pool variability, which would indicate an increase in habitat for fish including an improvement of general stream conditions such as adequate temperature and varied depths.  The habitat surveys increase was small, approximately a 2-9% increase for the QHEI and a range of a 7% increase to a 3% decrease for the SHAP (Table 3; Figs 7-8).  This variability is most likely due to a difference in the scorer's rankings versus an actual ecological impact.  With the large channel size there likely was not enough habitat structures put in the stream reach for there to be a detectable impact to the physical structure of the stream.

However, flow and depth measurements collected around the instream structures indicate the structures should be providing flow refugia and habitat for multiple age classes of fish (Figs 9-12).  For example, the boulders are creating slower water on the downstream end of the structure, which provides a good spot for adult fish to rest and wait for food.  The longitudinal habitat structures are providing interstitial spaces for insects and smaller fish species.  And the log jams are providing a complex of various flow types which should be benefiting both adult and juvenile fish. [pers. communication B. Metzke July 2015]  The increased turbulence around the structures should also be aerating the water, increasing the dissolved oxygen, which is beneficial for the various aquatic life.

B.) <u>Aquatic Insect Survey</u>:

Aquatic insects are important to monitor for the following reasons:  they are good ecological indicators of localized conditions because many aquatic insects have limited migration patterns or a sessile mode of life; sensitive life stages will respond quickly to stress;

and aquatic insects serve as a primary food source for fish, therefore, the number and type of aquatic insects present may be an indicator of the abundance and diversity of fish able to thrive in the stream system.

To assess the aquatic insect community pre and post restoration, the Environmental Protection Agency's Multi-Habitat 20-Jab Method was followed. Different types of aquatic insect habitat such as, riffles, undercut banks, and rootwads were sampled in approximate proportion to their presence in the stream reach. Sampling involved using a D-net to jab the habitat, allowing sticks, leaves, sediment, etc. to fall into the net. Riffle kicks were also utilized, which consist of standing at a riffle looking downstream, with the D-net facing upstream, kicking the substrate thereby dislodging loose material into the net. After each sample, the debris (including leaf litter, sticks, and sediment) collected in the nets were examined for aquatic insects. If live specimens were found they were picked and placed into a jar for preservation. The remaining debris was washed and deposited into a mesh bucket, which was later complied into a separate jar for further examination in a lab. The samples were covered in preservative and stored for later laboratory sorting and identification. Following the 20-Jab Method, approximately 250 aquatic insects are identified to the genus level. A macroinvertebrate Index for Biotic Integrity (mIBI) was then calculated based on the following metrics: Coleoptera Taxa, Ephemeroptera Taxa, Total Taxa, Intolerant Taxa, Hilsenhoff Biotic Index[1], Percent Scrapers, and Percent EPT.

A lower quantity and quality of aquatic insects were collected in 2009 (mIBI=57.9) and 2012 (mIBI=59.6) as compared to the 2007 (mIBI=79.4) pre restoration sample (Table 4). The low mIBI score in 2009 is most likely attributed to extreme flood events (Figure 13). It is uncertain as to why the 2012 score remained low, potentially because populations were still attempting to rebound from past year declines. Another theory is with the fish population rebounding in 2012, the fish could have preyed on the aquatic insects, reducing their numbers. Overall, the post restoration results still indicate this reach is a good quality stream (Table 5). Additional conclusions may be realized with future monitoring data.

   C.) <u>Smallmouth Bass Fish Survey</u>:
Fish are good ecological organisms to use for long-term monitoring and broad habitat conditions because they are relatively long-lived and mobile. The fishery goals of the instream restoration project was to increase available fish habitat, with a focus on smallmouth bass, such as an increase in habitat for adults, spawning habitat, and habitat for juveniles. Illinois Department of Natural Resources (IDNR) professional fishery staff conducted fish surveys with an AC boat electrofisher to monitor the fish changes pre and post restoration.

Samples show a declining overall catch rate that went from 22.2 fish per hour in 2006 and 53 fish per hour in 2007 (pre restoration) to 18.8 fish per hour in 2008 and 5.7 fish per hour in 2009 (post restoration)(Carney 2009). Very similar post restoration results were observed in 2010. However, in 2012 there was a rebound in the population similar to the year's pre restoration.

The most plausible explanation for the low smallmouth bass numbers 2008-2010 were unusually high rainfall amounts during the spring spawning months and the summer sampling season (Figure 13). High stream flows affect both the overall stream health (high erosion,

---

[1] The Hilsenhoff Biotic Index is calculated based on the number of organisms times the taxa's tolerance rating (pollution tolerance ratings range from 0 to 11; zero is assigned to taxa found only in unaltered streams of high water quality, and a rating of 11 is assigned to taxa known to occur in severely polluted or disturbed streams).

decrease in water quality, and decrease in aquatic life survivability) as well as decreases sampling effectiveness.

The 2012 sample, during a lower water period, is indication of the fish population rebounding:

- there was a return of juveniles in the 2012 sample;
- the fishery staff documented that young smallmouth bass continue to be found around the rock structures that were constructed;
- three fish over 300 mm and one fish over 400mm were netted (the fish over 400mm is the largest smallmouth bass fish observed in the stream reach since the monitoring began in 2006).

The fish sampling results illustrate a declining overall catch rate in post restoration years as compared to pre restoration. However, there is too much annual variability to detect a difference (Fig 14). The explanation for the decrease could be high spring flows, which could have impacted the smallmouth bass recruitment for those years. The decrease could also be a natural cycle of population changes. Or there could be some short term environmental impacts in the area. Additionally, the lower smallmouth bass captured post restoration could be attributed to decreased sampling effectiveness as a result of the structures. For example, since there is an increase in habitat for fish, they could be avoiding the electrofishing, hiding in pools and in the rock structures, this is especially true for the smaller fish. This theory is supported in Brian Metzke's evaluation that the post restoration results indicate a shift from more juveniles collected pre restoration as compared to adults and post restoration the opposite is true, more adults are being collected as compared to juveniles (Fig 14). According to the velocity and depth evaluations around the structures flow refugia, deeper pools, and a complex of habitat should be providing good habitat for fish. Therefore, even though the post restoration fish samples so far have not captured a significant change in smallmouth bass in the restoration reach, future sampling will continue to be conducted to assess long term biological changes and overall project success.

   D.) Mussel Survey:

Freshwater mussels can be used as a good biological indicator of overall environmental health because they are very sensitive to the various forms of stream pollution. Freshwater mussels are also dependent on species-specific host fish during their reproduction cycle.

Two forms of mussel surveys have been utilized to monitor the population pre and post restoration: the typical sampling method involving a timed four hour grubbing session, and a more intensive transect/quadrat method. The four hour timed grubbing session involves, for example, four people in the stream for 1 hour conducting visual walking searches and grubbing on hands in knees for mussels buried in the substrate. The transect/quadrant method involved establishing 3-4 transects perpendicular to the streambank, equally spaced throughout the reach. A one meter area across the entire transect (downstream side) was grubbed for mussels similar to how a four person hour grubbing session is conducted: skimming the top of the surface and digging with your hands a little ways into the substrate, trying to feel for mussels. Afterwards, quadrat searches were conducted. The number of quadrats were dependent on the width of the stream at each particular transect. The quadrats were evenly spaced. A one meter area was surveyed on the downstream side of the transect by excavating sediment into a bucket with a trowel or small hand shovel. After the substrate was collected in the bucket the contents were poured into a sieve and the material was examined for mussels. All mussels collected via the
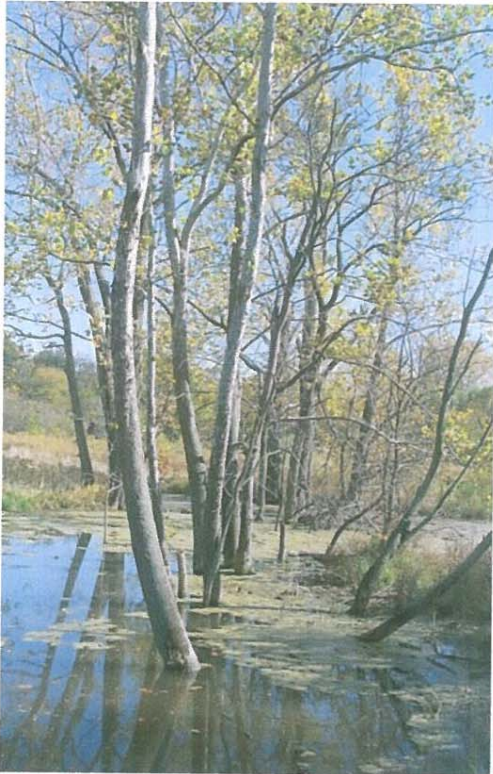
grubbing session and transect/quadrat method were identified to species with the number of individuals recorded by species.  After recording relevant information, in some cases the length of the mussel and its overall condition, the mussels were returned to the stream.

A pre restoration mussel survey was conducted in 2007.  High water levels (non-wadeable stream conditions) did not allow for mussel surveys to occur in 2008 and 2009.  In 2010, the first post restoration survey was conducted, and a second post restoration survey was conducted in 2012.  Comparative results were found in the 2007 and 2010 surveys:  throughout both methods (transect/quadrat survey and four-hour timed search) 136 individuals of 11 species were collected in 2007 and in 2010, 138 individuals of 11 species were collected (Fig 15 & 17).  In 2012, the number of collected mussels doubled, and the species diversity increased by one (2012 survey = 288 individuals of 12 different species; Fig 17).  There were only two species differing from 2007 to 2010:  in 2007 a Fawnsfoot and Fatmucket were collected, which were not collected in the 2010 sample; however, in 2010 a Squawfoot and a Yellow sandshell were collected, which were not collected in the 2007 survey.  In 2012 a Creeper and Pink heelsplitter were collected, which were not collected in previous surveys.  Missing from the 2012 survey as compared to the two previous surveys were Fatmucket, Fawnsfoot, and Squawfoot.  No juvenile mussels were collected in the 2007 sample, whereas a Pistolgrip juvenile was collected in 2010 (Fig 16), and a Fragile papershell and Creeper or Squawfoot juveniles were collected in 2012.

These results indicate an overall increase in mussel abundance in the restoration reach, including an increase in juvenile mussels, which is a very good sign as to the overall quality of the stream reach.  Since mussels rely on host fish to disperse their larvae, an increase in mussel abundance may be an indication that fish abundance and diversity has increased in the restoration reach.  Examples of host fish for the mussels listed above include (but are not limited to): largemouth bass, flathead catfish, creek chubs, gars, sunfish, bluegill, crappie, and drums.  The mussel community will continue to be sampled and analyzed over a longer period of time to determine changes in stream conditions and overall project success.

## Wetland Restoration Monitoring Summary

The purpose of the wetland project is to provide adequate wetland habitat for aquatic and terrestrial wildlife, as well as increase the stream's water quality. Monitoring surveys conducted for the wetland restoration project include: vegetation/hydrological and insect surveys along with bird, herp, and other wildlife observation.





**Wetland 2** is located just north of Wetland 1 and is characterized as an emergent, semi-flooded basin. This small ( ≈0.15 acres) wetland was created as the result of borrow activities for wetlands 1 and 3, and maintains a dense, diverse mix of emergent plant zones.

**Wetland 1** is approximately 0.48 acres and is characterized as a partially forested, permanently flooded, shallow-water basin. Water levels are controlled by a small earthen embankment along the northwest corner of the site. Flood tolerant trees such as Sycamore partially shade the central portion of the wetland; however, the littoral margins along the southern half of the wetland receive full sunlight and are composed of dense stands of emergent species



**Wetland 3** is the largest and the most diverse sample site and can be characterized as a hemi-marsh. This wetland is approximately 2.48 acres and maintains permanently flooded conditions as a result of significant ground water input. A small earthen berm along the southern boundary helps maintain water levels. This hemi-marsh is dominated by a mix of submerged aquatic species, open water and emergent vegetation.

Pictures and legends quoted from b. LaGesse 2010.

A.) <u>Vegetation/Hydrological Survey</u>:

The wetland vegetation has a direct effect on the type of wildlife that will utilize the wetland, and in turn the wetland's hydrology is largely responsible for the vegetation present, therefore both vegetation and hydrology are important to evaluate. A transect/plot method was employed to track changes at the site over time, to determine how the vegetation community is responding to the restoration activities. Basic hydrology observations, such as water holding capacity, were recorded to assist in the management decisions of the wetland restoration effort.

For the vegetation/hydrological monitoring component a 2010 vegetation assessment was compared to a 2008 baseline assessment and a 2007 Landowner Incentive Program (LIP) survey. In the 2008 survey, 56 plant species were sampled. This included 7 tree/vine species, 22 grass/sedge species, and 27 forbs (LaGesse 2008). The 2008 survey added 46 new plant species to the LIP 2007 survey (LaGesse 2008). In the 2010 survey, 52 plant species were sampled, which added 22 new plant species to the LIP 2007 survey and the 2008 vegetative survey (a. LaGesse 2010). Therefore, the vegetation at the wetland sites is becoming more diverse over time.

The information gained from these surveys has helped in proper management of the wetlands, such as: a wetland failing to maintain appropriate hydrological levels led to the removal of an open tile line; observations of scattered clumps of reed canary grass led to recommendations for controlling the invasive species (i.e. herbicide applications); and beaver, mink, and muskrat activity reducing the stability of the berm and blocking the water control structure, potentially compromising the ability of the wetland to maintain open water, led to the recommendation to manage their activity (i.e. capture and relocate).

Overall, the vegetation at the wetlands is still developing and is being managed for higher quality species. Once better vegetation is established, more insects will be in the area, which will also attract more wetland wildlife such as birds and herps. Therefore, more results will be realized with future monitoring efforts.

B.) <u>Insect Survey</u>:

Insects are an integral component to the health, balance, and sustainability of aquatic systems including wetlands. For example, insects play an important role in the food web of wetland systems, providing the link to energy transfer from plants to water birds and other higher level animals. Furthermore, insects possess a wide variety of life histories and physiological requirements, making them one of the best organisms to use in biomonitoring. (LaGesse 2012)

Insect monitoring was conducted to document and track the presence/absence of various macroinvertebrate species in the fall of 2008, spring 2009, spring/summer/fall 2010, and spring 2012. In an effort to yield the most productive results, sampling was conducted in preferred habitats when present. Such habitats include, but are not limited to, shoreline zones with emergent vegetation, aquatic macrophyte beds consisting of floating and/or submerged plants, woody debris, root mats, and leaf litter. Also, sampling was conducted in a maximum 1 meter depth of water. Sampling involved using a 600 micron mesh D-frame dip net to "sweep" or "jab" several different complexes of the bank zone habitats and within bottom zone sediments representative of the dominant substrate. Sweeps included both the open water and stems of the dominant emergent and woody vegetation. Each major plant zone was sampled to capture the spatial variance represented by the various benthic habitats within each wetland. After several rounds of sweeps the contents of the nets were placed into a white shallow sorting pan and late instar stages insects were picked and placed into a vessel containing 95% ethanol. Samples were

field picked for approximately 30 minutes or until 150-300 organisms were picked.  Upon arrival at the laboratory, samples were further processed, sorted and prepared for identification.  Low magnification dissecting microscopes and the highly effective Intel Plug & Play QX3 microscope were used to aid in identifying the specimens from each wetland site to the lowest possible taxonomic grouping using multiple peer review taxonomic keys. (LaGesse 2012)

According to the 2010 LaGesse Report (b.), sample results were excellent.  Invertebrate abundance and diversity was the highest since sampling was first initiated during 2008.  Comparison of the sampling results from 2008, 2009, and 2010 indicates diversity increased dramatically.  Generally, all the species collected in 2008 and 2009 were present within 2010; however many new species were collected for the first time.  Sample results from 2010 showed that numerous species not present in 2008 or 2009 became well established during 2010.  Several new species of dragonflies, damselflies, and mayflies were present in all sampling sites for the first time.  Additionally, large predatory Hemipterans, such as water scorpions and creeping water bugs were also collected for the first time within the restored wetland sites indicating the maturation of vegetative species has led to greater invertebrate abundances and complexity within the food webs.  Wetland 3 maintained the highest diversity of species with a total of 28 invertebrates collected over the three sampling periods; however, both wetland 1 and 2 were also productive as each site produced over 20 species.  (b. LaGesse 2010)

For the 2012 survey, drought conditions significantly reduced water levels in the wetlands.  Therefore, only one survey was conducted in late spring 2012.  Due to lack of water within the wetlands surveys were not performed in the summer or fall of 2012.  According to the LaGesse 2012 report, sample results were fair to good.  Invertebrate diversity was similar compared to 2010; however, the effort to find some of the invertebrates was much more difficult than 2010.  Total invertebrate densities were similar to results in 2008, the first year after restoration, when the abundance of intolerant species was very low.  Some species such as the mayflies and dragonflies were only represented by one individual captured during the sampling, while chironomids were abundant in every sample.  Predatory Hemipterans, extremely abundant in 2010, had nearly disappeared from the restored wetland sites in 2012 indicating their ability to disperse from habitats when conditions deteriorate.  No new species were found in 2012.  As typical of previous years, Wetland 3 maintained the highest diversity of species totaling 18 invertebrate species collected during the one sample period; Wetland 1 was less productive and contained only 12 species.  The presence of fish within all three wetland sites has altered the community structure in the previous sampling years; however, no species of fish were collected in 2012.  The lack of fish should allow insect recolonization to occur quickly once water returns.

In summary, the insect response to drought in the restored wetlands was negative.  As the wetland site dried, previously productive habitats were reduced in size and number making competition for available resources high, leading to an abundance of tolerant species and very few intolerant desirable species.  The effect of drought and the drying of wetland habitats significantly reduced the overall species evenness (abundance of intolerant species) in 2012.  If normal precipitation patterns return, it is anticipated that the aquatic invertebrate populations will recover and the relative abundance of intolerant species will rebound.  Future sampling efforts will help us better understand the biotic changes taking place at the wetland restoration sites over time.  (LaGesse 2012)

In terms of future management recommendations, the presence of fish will continue to alter the macroinvertebrate composition within all three wetland sites. Therefore, winter time water level management to eliminate fish would positively benefit macroinvertebrate abundances

(b. LaGesse 2010 and LaGesse 2012).  Leaf litter is also limiting the abundance of species within wetland 1.  Similar to the fish management, leaf litter can be managed by drawing down the water during the winter months, which would help facilitate aerobic breakdown of the leaf litter. This management would likely increase macroinvertebrate abundance and overall functionality of wetland 1 (b. LaGesse 2010 and LaGesse 2012).

     C.)  <u>Bird, Herp, and Other Wildlife Observations</u>:

     The landowners of the Sandra Miller Bellrose Nature Preserve participate in the annual [Audubon Society bird count](#).  The entire 400 acres of the preserve, which includes all 4 restoration/enhancement projects, is included in the area they walk and record their bird observations.  The landowners have been actively participating in these surveys since 2003. Therefore, we have a pretty good historical background of what birds have been seen on site, which we can compare to the surveys being conducted after restoration activity.  There have been some notable increases in certain species abundance as well as some new species observed on site.  For example, there has been an increase in the number of Kingbirds, Bank & Tree Swallows, Cow Birds, Gold Finch, Robins, and Grosebeaks after restoration activity.  Also, the following species have been seen on the site for the first time since the projects have been implemented:  Common Nighthawk, Blackburnian Warbler, Carolina and Sedge Wrens, Worm-eating Warbler, Tanager, Tree Sparrow, Killdeer, North Rough-Winged Swallow, Belted Kingfisher, Cliff Swallow, Purple Finch, and Green Heron.  Overall the average abundance of birds observed on site increased (387 to 425) after restoration activity.  However, the diversity has remained the same with an average of 57 different species observed per year (Table 6). Hopefully over time there will be an increase in both diversity and abundance of birds visiting the site as well as an increase in wetland specific birds utilizing the wetland habitat.

     The landowners are also noting their observations of herps and other wildlife utilizing the site.  For example, they have witnessed squirrels, raccoons, deer, turkeys, grey foxes, an occasional red fox, a bobcat, and coyote.  For herps they have seen a tree frog, leopard and bull frogs, brown snakes, one orange and blue ribbon snake, and possibly an Eastern Massasauga (Swamp Rattlesnake) which is an endangered species in Illinois.  The landowners will continue to record the wildlife they observe on site and hopefully over time we will see an increase in the different types of wildlife utilizing the various restored/enhanced habitat types.

**Conclusions**

The instream and wetland restoration project has been monitored for five years post restoration with a few surveys being conducted a year or two prior to the restoration implementation. For the instream restoration project the habitat has remained the same, indicating the instream restoration efforts have had no major impacts, positive or negative, to the overall structure of the stream reach. However, specific parameters such as, instream cover and pool variability have increased post restoration, which would indicate an increase in habitat for fish including an improvement of general stream conditions such as adequate temperature and varied depths. The aquatic insect samples declined after restoration during a year with increased precipitation, and therefore high water levels, which likely negatively impacted the insect's spring emergence. Water levels also remained high during the summer sampling season, which likely negatively impacted sampling quality. However, the mIBI values still indicate the stream reach is good to high quality. A decline was also observed in the smallmouth bass population post restoration in the years of high water levels during both the spring spawning season and the summer sampling season. However, the 2012 smallmouth bass survey, during a low water level year, indicated a rebound in the population by a return of juveniles as well as larger fish, netting the largest smallmouth bass fish observed in the stream reach since monitoring began. Another potential limitation regarding the monitoring results is the decreased searcher efficiency as a result of the cover provided by the instream structures. Hopefully, both the aquatic insect community and smallmouth bass populations will show substantial improvements in future sampling efforts. The abundance of mussels collected increased post restoration, which is an indication of a healthier stream system with potentially more host fish present. All four of these ecological parameters: habitat, aquatic insects, smallmouth bass, and mussels will continue to be sampled and analyzed over a longer period of time to determine changes in stream conditions and overall project success.

Initially, the wetland monitoring results indicated an increase in the diversity and abundance of the aquatic insects and vegetation in and around the restored wetlands. However, similar to how floods affected the instream restoration results, drought conditions in 2012 resulted in significant changes to the wetland basins. Drier basins likely resulted in reduced species diversity, including fewer intolerant desirable species. Various wildlife continue to be observed across the site, recorded by the landowners. For example, the abundance of birds has increased post restoration, with the species diversity remaining the same at 57 species observed during an annual bird count. Overall, the vegetation at the wetlands is still developing and is being managed for higher quality species. Once better vegetation is established, more insects will likely be in the area, which will also attract more wetland wildlife such as birds and herps. More positive results are anticipated with future monitoring efforts.

This multi-faceted monitoring approach illustrates the type of information that can be collected when adequate funds and resources are available. Monitoring funds from the settlement are available to carry out one more round of sampling for the instream and wetland projects, in year 2017. This additional data will help assess the trend of the ecological parameters at the restoration site over a 10-year timeframe. Longer-term monitoring is preferred, but may not be a fiscally available option. Watershed changes including the impacts of a restoration effort can take many decades to properly assess and evaluate. This monitoring protocol is intended to generate practical information for evaluating project development and to implement mid-course corrections when necessary. Therefore, the Contaminant Assessment Section staff, who implements actions under the state's NRDA program, will learn from the

results to make their best efforts to improve the system they are trying to restore.  Natural ecosystem disturbances that range from high water levels to droughts will continue to occur and have impacts on the restoration efforts, sometimes limiting the wildlife benefits.

Overall, this project is a great example of the partnerships formed between both multi-units of government and private landowners to conserve and monitor critical habitat.  The project would not have been possible without the dedication and participation of the landowners.  The landowners' participation did not stop as the property owners of this project.  They have an integral part in the monitoring taking place at their site including recording their wildlife observations, such as conducting annual bird surveys.  The landowners' commitment to conservation and monitoring is an example of a driving force behind the success of many restoration projects taking place in Illinois.

**References**

Carney, Doug. 2009. Smallmouth Bass Assessment in Sugar Creek, Bellrose Nature
        Preserve, Logan County, IL. Illinois Department of Natural Resources Memorandum. p.
        1-5.

LaGesse, Vern. 2008. Bellrose Wetland Restoration Project. Logan County, Illinois. 2008
        Vegetative Baseline Survey.  LaGesse and Associates Report prepared for IDNR.

a.  LaGesse, Vern. 2010. Bellrose Wetland Restoration Project. Logan County, Illinois. 2010
        Vegetative Survey.  LaGesse and Associates Report prepared for IDNR.

b. LaGesse, Vern. 2010. Bellrose Wetland Restoration Project. Logan County, Illinois. Aquatic
        Macroinvertebrate Sampling Results Summary Report 2010. LaGesse and Associates
        Report prepared for IDNR.

LaGesse, Vern. 2012. Bellrose Wetland Restoration Project. Logan County, Illinois. Aquatic
        Macroinvertebrate Sampling Results Summary Report 2012. LaGesse and Associates
        Report prepared for IDNR.

Lerczak, Tom. 2000. Proposal for Dedication of Sandra Miller Bellrose Nature Preserve as an
        Illinois Nature Preserve. Illinois Nature Preserves Commission. INPC 169 Item 15. p. 1.

Metzke, Brian. 2015. Evaluation of an Agency-Driven Stream Restoration Presentation.

*For copies of these reports or other raw data, please contact Jessica Riney with the Contaminant Assessment Section at ph.:  217-524-0125 or email:  [jessica.riney@illinois.gov](mailto:jessica.riney@illinois.gov)*


**Acknowledgements**

Table 1.  Monitoring conducted and planned for the NRDA funded restoration projects at the Bellrose Nature Preserve.

| Bellrose Monitoring Funds | | | | | | | |
|---|---|---|---|---|---|---|---|
| Calendar Years: | 2006 | 2007 | 2008 | 2009 | 2010 | 2012 | 2017 |
| | Pre Rest | Pre Rest | 1st year | 2nd year | 3rd year | 5th year | 10th year |
| Instream: | | | | | | | |
| Habitat Survey | | ✓ | | ✓ | ✓ | ✓ | to be completed |
| Aquatic Insect Survey | | ✓ | | ✓ | | ✓ | to be completed |
| Smallmouth Bass Survey | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | to be completed |
| Mussel Survey | | ✓ | | | ✓ | ✓ | to be completed |
| Wetlands: | | | | | | | |
| Vegetation Survey with Hydrological Observations | | | ✓ | | ✓ | ✓ | to be completed |
| Insect Survey | | | ✓ | ✓ | ✓ | ✓ | to be completed |
| Herp Survey | | | ✓ | ✓ | ✓ | ✓ | to be completed |
| Bird Survey | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | to be completed |

Table 2.  Stream Habitat Assessment Procedures
Absolute Values as of March 8, 1996.

| Absolute scores | Max | Min |
|---|---|---|
| Excellent | 208 | 171 |
| Good | 156 | 119 |
| Fair | 104 | 67 |
| Poor | 52 | 15 |

Table 3. Bellrose Pre and post-restoration habitat survey data 2007-2012.

| | Year | QHEI Scores | Percent Change | SHAP Scores | Percent Change |
|---|---|---|---|---|---|
| **Pre-Restoration** | 2007 | 72.5 | | 140 | |
| Post-Restoration | 2008 | 79 | +8.9% | 151 | +7.8% |
| | 2009 | 79.5 | +9.6% | 144 | +2.8% |
| | 2012 | 74.5 | +2.7% | 135 | -3.5% |

Table 4. Bellrose Pre and Post instream restoration aquatic insect data.

| Metric | 2007 Standardized Score | 2009 Standardized Score | 2012 Standardized Score |
|---|---|---|---|
| Coleoptera Taxa | 80 | 60 | 80 |
| Ephemeroptera Taxa | 50 | 50 | 30 |
| Total Taxa | 80.6 | 44 | 46 |
| Intolerant Taxa | 100 | 75 | 62.5 |
| Hilsenhoff Biotic Index | 95.5 | 97 | 100 |
| Percent Scrapers | 100 | 21 | 69 |
| Percent EPT | 49.4 | 58 | 30 |
| **Total Score** | 555.5 | 405 | 417.5 |
| **mIBI Score** | **79.4** | **57.9** | **59.6** |

Table 5. Macroinvertebrate IBI quality thresholds.

| Index Score | | |
|---|---|---|
| **Lower Boundary** | **Upper boundary** | **Narrative Description** |
| **73.2** | **100** | **Exceptional** |
| **52.4** | **73.1** | **Good** |
| 26.2 | 52.3 | Fair |
| 0 | 26.1 | Poor |

Table 6. Number of species and bird abundance at the Bellrose Nature preserve as observed by the landowners from 2003 – 2007 (pre restoration) to 2008 – 2014 (post restoration) during the annual Audubon Society bird count.

| Bellrose Bird List | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pre Restoration | | | | | Post Restoration | | | | |
| Year survey Conducted: | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2012 | 2014 |
| # of Species | 58 | 51 | 58 | 61 | 57 | 49 | 55 | 58 | 62 | 60 |
| Average # of Species | 57 | | | | | 57 | | | | |
| Total Abundance | 390 | 275 | 397 | 431 | 443 | 378 | 402 | 482 | 421 | 444 |
| Average Abundance | 387 | | | | | 425 | | | | |

# Watershed Location
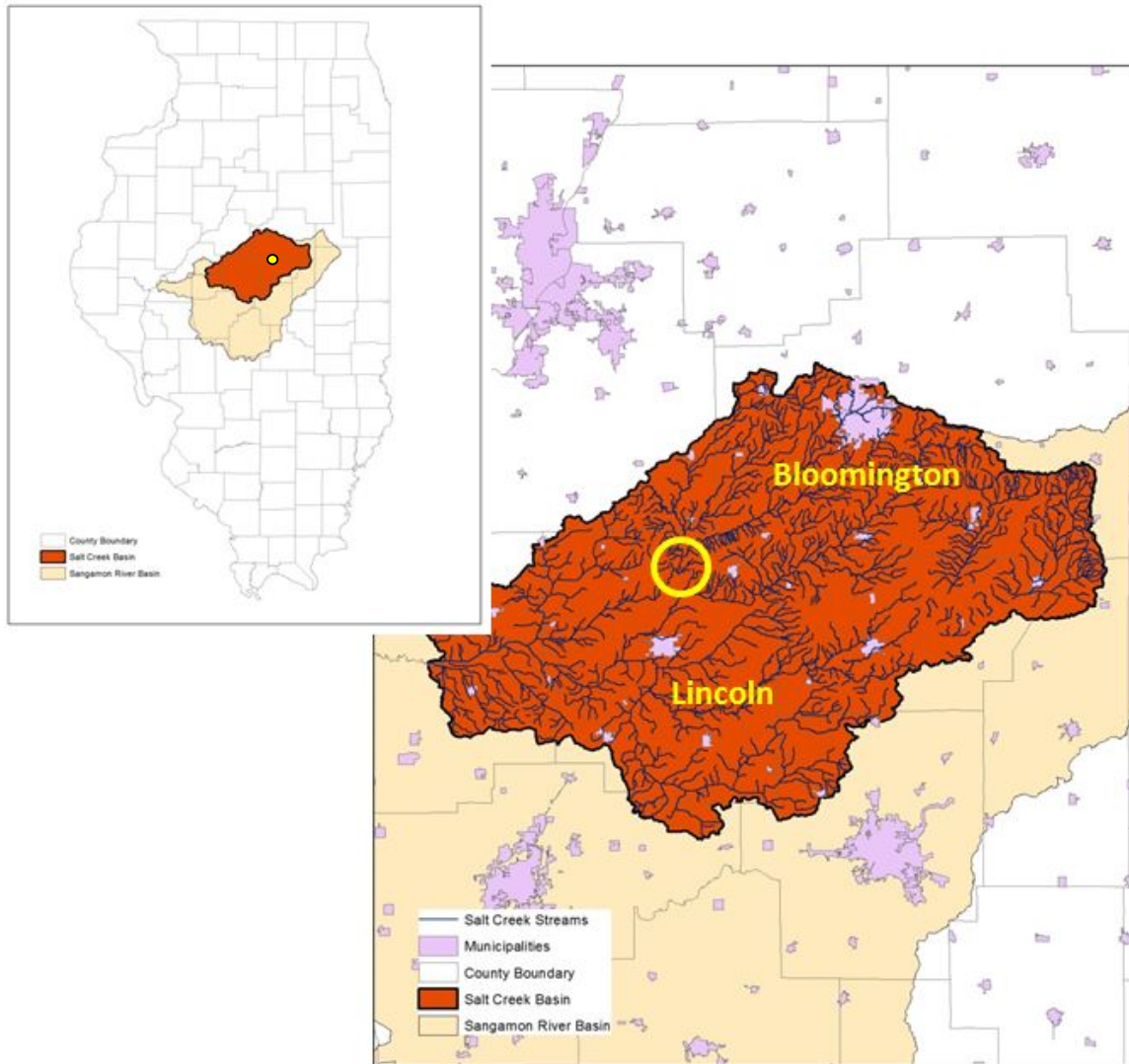
Figure 1.  The Sandra Miller Bellrose Nature Preserve is located in Logan County Illinois in the Salt Creek basin.  [Provided by Metzke 2015]

Sugar Creek
Stream Project (NRDA+CREP Enhancement cost-share funds)
Forest Enhancement (C2000 and LIP funds)
Grassland and Reforestation (CRP and CREP cost-share funds)
Wetland Restoration (NRDA and CREP Enhancement cost-share funds)
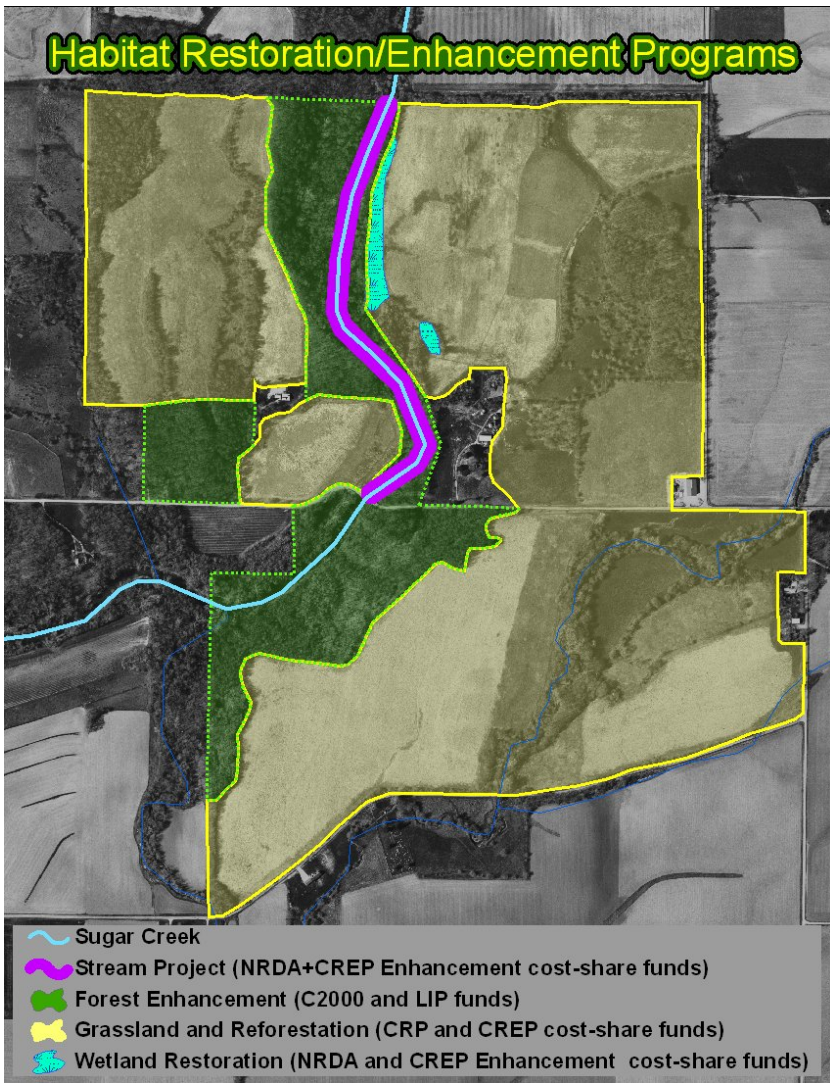
Figure 2.  Digital Ortho map of the Sandra Miller Bellrose Nature Preserve (area in green) and implemented restoration projects.  This map was obtained from IDNR's Office Resource Conservation.



Figure 4.  Wetland Restoration Project (photo credit:  IDNR's Contaminant Assessment Section).



Figure 5.  Forest Enhancement Project (photo credit:  IDNR's Contaminant Assessment Section).



Figure 3.  Instream Restoration Longitudinal Stone Habitat Structure (photo credit:  IDNR's Contaminant Assessment Section).



Figure 6.  Grassland Enhancement Project (photo credit:  IDNR's Contaminant Assessment Section).

18
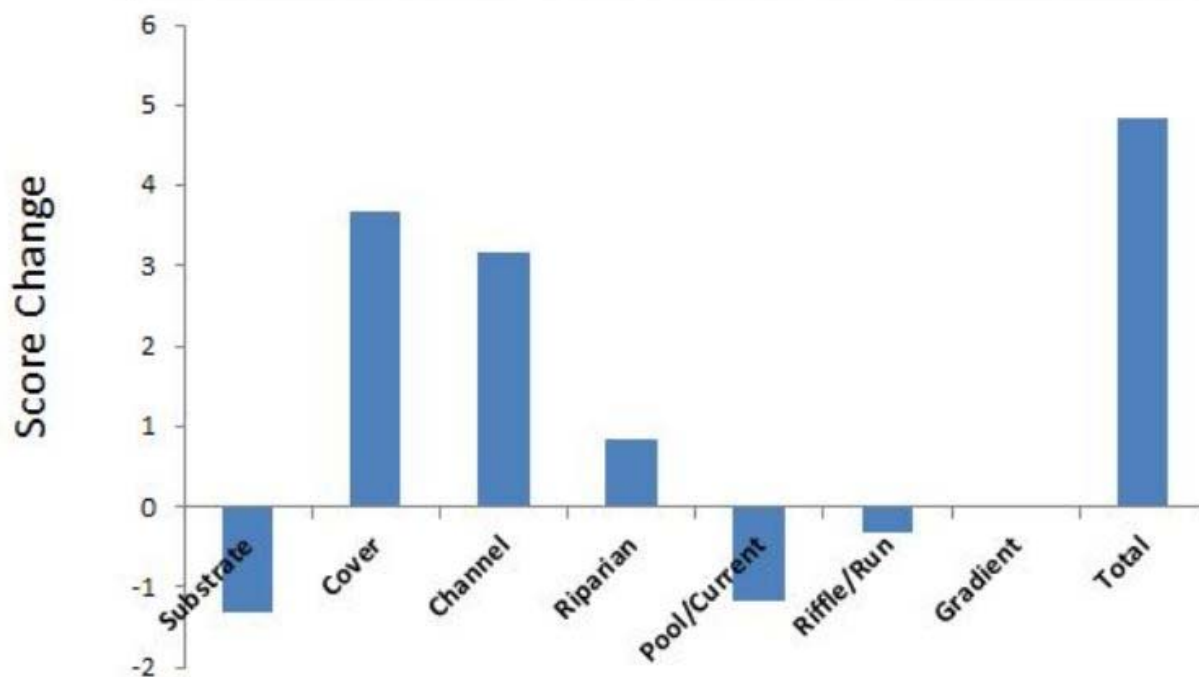
Figure 7. Post restoration score change from pre restoration values for various categories using the Qualitative Habitat Evaluation Index [graphic provided by Metzke 2015].
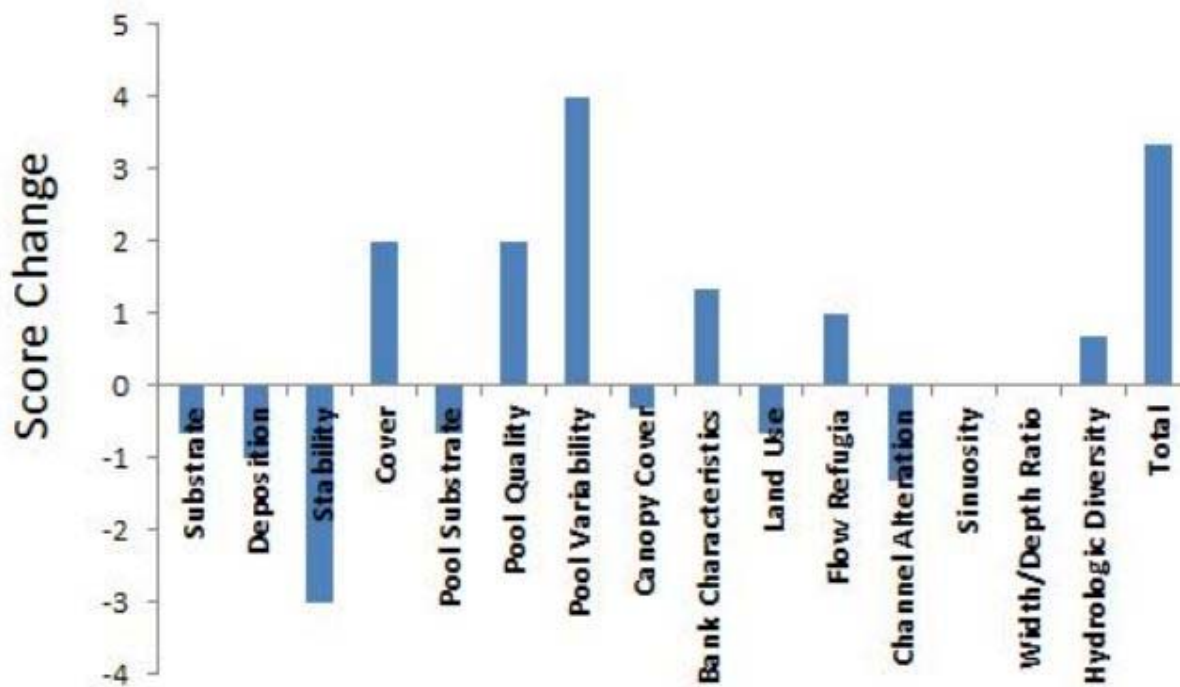


Figure 8. Post restoration score change from pre restoration values for various categories using the Qualitative Stream Habitat Assessment Procedure [graphic provided by Metzke 2015].
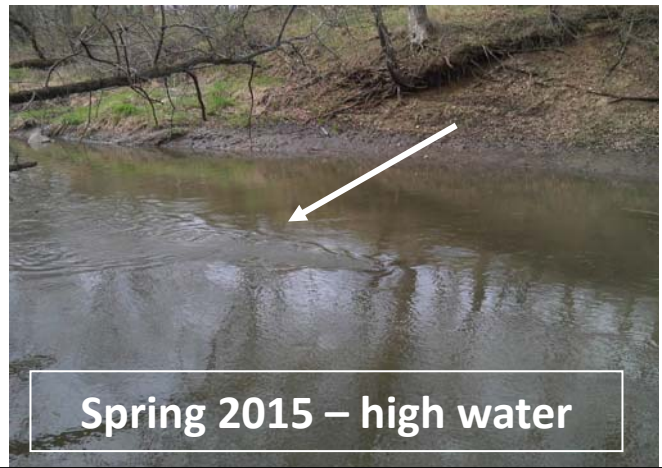
Figure 9. Boulder clusters immediately post implementation (left) and during high water flow (right). Increased turbulence is observable over the boulder cluster during high water levels (white arrow). Photos courtesy of IDNR and Illinois Natural History Survey staff.
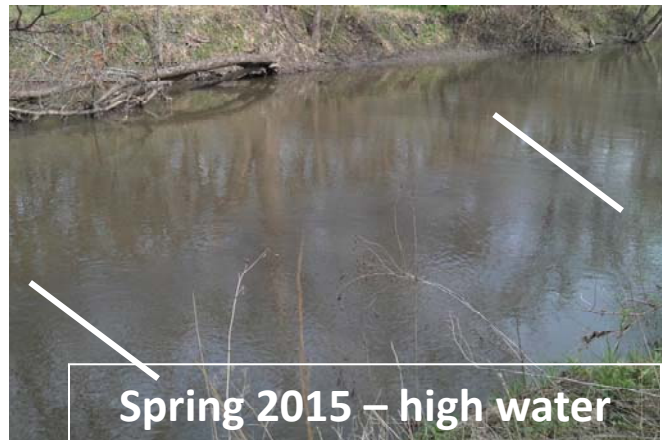


Figure 10. Longitudinal Habitat Structures immediately post implementation (left) and during high water flow (right). Increased turbulence is observable over the rock structure during high water levels (white lines). Photos courtesy of IDNR and Illinois Natural History Survey staff.
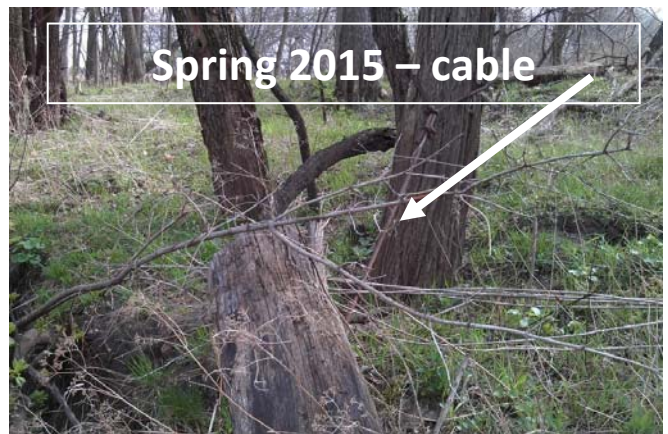


Figure 11. A Log Cluster, which provides a diverse complex of habitat. The woody debris is cabled to a tree along the streambank to secure it in place. Photos courtesy of Illinois Natural History Survey staff.

# Velocity Evaluation

**Boulder clusters**
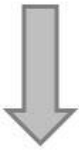
Flow Direction
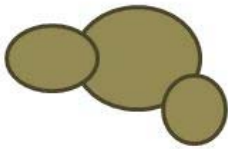
0.45m/s

0.13m/s

**Longitudinal structures**

Flow Direction

0.40m/s
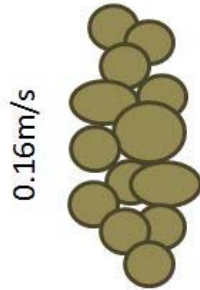
0.16m/s

0.41m/s

0.09m/s

**Secured logs**

Flow Direction

0.45m/s

0.36m/s
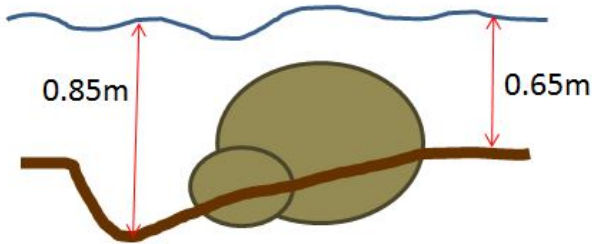
0.14m/s    0.20m/s

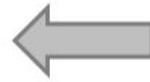# Depth Evaluation
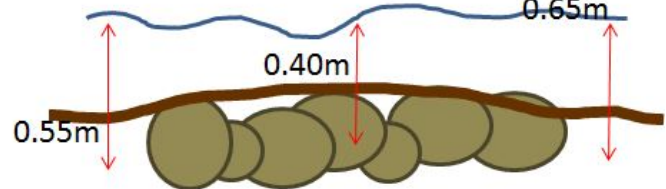
**Boulder clusters**

Flow Direction

0.85m

0.65m

**Longitudinal structures**

Flow Direction

0.65m

0.40m

0.55m

Figure 12.  As a result of the velocity and depth evaluation it appears the structures should be providing flow refugia and habitat for multiple age classes [graphic provided by Metzke 2015].
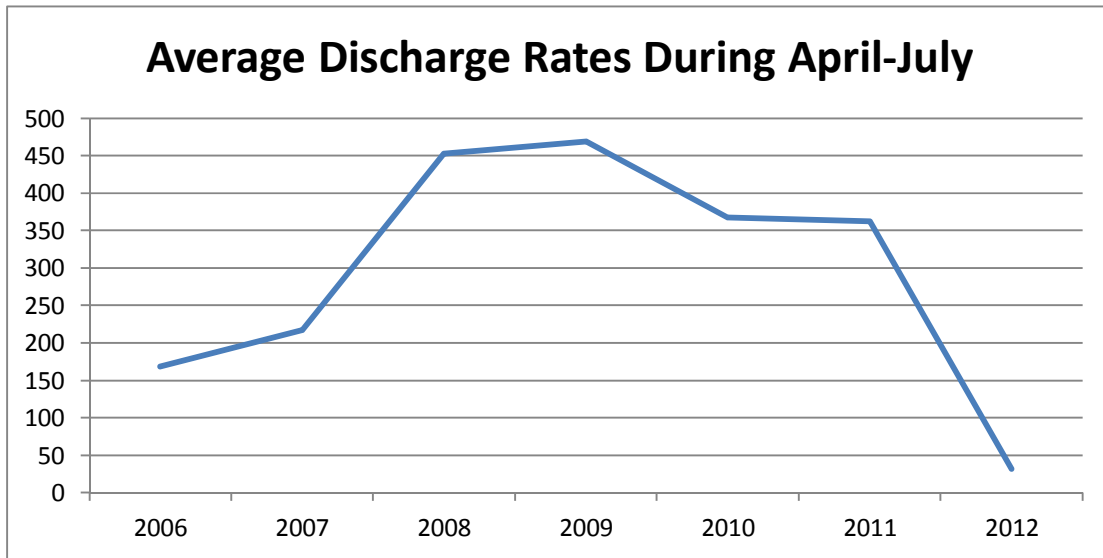
**Average Discharge Rates During April-July**

Figure 13. Average discharge from April-July in the years 2006-2012 at USGS Gage 05580000—Kickapoo Creek at Waynesville, IL (nearest stream gauge to the Bellrose project area; the results are an indication of high regional flows in 2008-2011 as compared to other years).

**Smallmouth bass abundance**

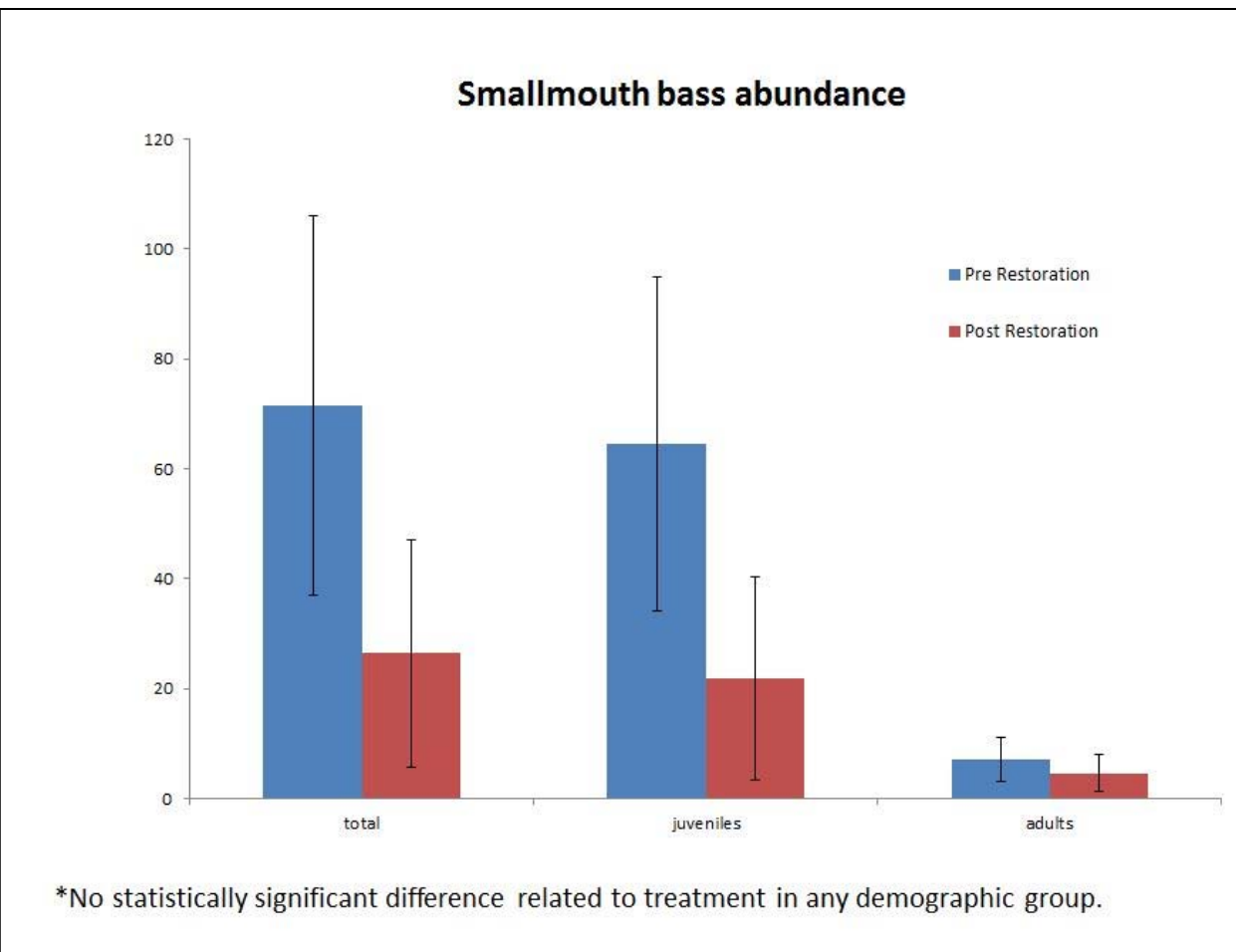*No statistically significant difference related to treatment in any demographic group.

Figure 14. Smallmouth bass abundance in both juveniles and adults pre versus post restoration [graphic provided by Metzke July 2015].

Figure 15. A group of Mussels collected at one of the three transects during the August 2010 Bellrose mussel survey.



Figure 16. Juvenile (top of picture) and adult (bottom of picture) Pistolgrip mussels; collected during the August 2010 Bellrose mussel survey.
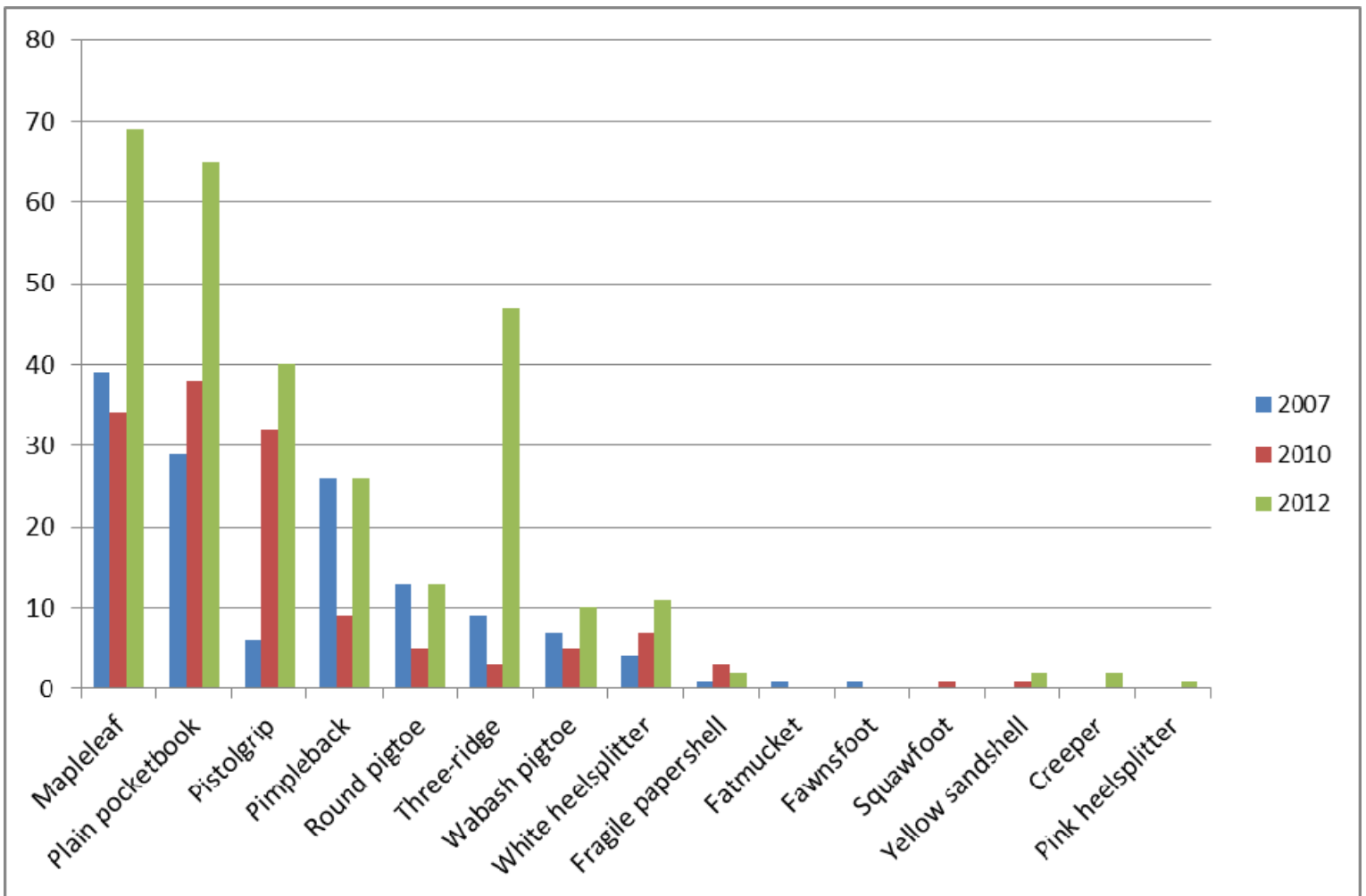


Figure 17. Summary of live mussels collected at the Bellrose Instream restoration reach; pre restoration (2007) and post restoration (2010 and 2012).