FINAL PERFORMANCE REPORT

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Determining Factors Affecting the Distribution of Endangered Fish and Crayfish Species with Emphasis on the Ozark Region in Northeastern Oklahoma

Oklahoma Department of Wildlife Conservation

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Grant Title: Determining Factors Affecting the Distribution of Endangered Fish and Crayfish Species with Emphasis on the Ozark Region in Northeastern Oklahoma

Grant Period: 1 June 2011 – 30 May 2014

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OBJECTIVES

1. Establish multiple sampling sites throughout each river drainage of focus by using historic collection localities and field reconnaissance. (Grand-Neosho, Illinois, and Spavinaw). Quantify the composition of fish and crayfish communities (including the presence of invasive species) and assess basic habitat properties including the physical environment, nutrient levels that are indicative of anthropogenic activities, and basic properties of aquatic insect communities that serve as environmental indicators.

2. Generate a GIS database of fish and crayfish distributions that could be used to identify significant landscape-level risks to these species (e.g. river access points, highway overpasses, permitted wastewater inputs).

3. Determine historic ranges of tier-listed species by using the GIS database of fish distributions. By comparing historic data with results from current surveys, we will identify distribution trends in tier-listed species.

4. Use GIS-based analyses of each species' environmental niche using ecological niche modeling techniques. Identify landscape level properties that determine historic and current niches of tier-listed species.

NEED

Freshwater habitats are among the most imperiled ecosystems in North America and are threatened particularly by overexploitation, water pollution, flow modification, habitat degradation, and the presence of invasive species (Dudgeon et al. 2006). While most conservation studies focus on freshwater mussels, large bodied fishes, and other higher vertebrates, monitoring populations of small-bodied fish species and invertebrates (particularly crayfish; Taylor et al. 1996) in determining factors affecting their distribution and conservation status has received comparatively little attention, despite the fact that they contribute to a large proportion of endangered species in North America (Ricciardi and Rasmussen 1999, Strayer 2006, Jelks et al. 2008). The proposed project aims to elucidate factors determining the distributional trends in small-bodied fishes and crayfishes in three river drainages of northeastern

Oklahoma by combining extensive field sampling and comparisons of present and historic distribution with on site habitat assessments and ecological niche modeling.

The Oklahoma Comprehensive Wildlife Conservation Strategy (OCWCS) indicates that small rivers (Spring and Illinois Rivers), gravel bottom streams (Spavinaw Creek), and large rivers (Grand-Neosho River) in the Ozark Region represent very high and moderate priority conservation landscapes (page: 51 and 277 respectively). These habitats historically and currently support two Tier 1, eight Tier 2, and three Tier 3 fish species along with two crayfish species, Neosho midget crayfish (*Orconectes macrus*) and midget crayfish (*O. nana*, Tier 1), that are listed as species of greatest conservation need (see Table 1). However, a lack of general data on the composition of fish and crayfish assemblages as well as a thorough understanding of the environmental requirements of imperiled species in these habitats represents a significant impediment for conservation planning and implementation. The majority of the imperiled species are characterized by having low abundance and declining trends in their populations (OCWCS), and the actual status of the number of individuals, long-term population trends, and suitable habitat availability in these rivers and creeks are currently unknown.

Previous studies have analyzed fish community composition in northeastern Oklahoma (e.g., Felley and Hill 1983, Dauwalter et al. 2008), but only few studies have specifically targeted the the natural history and conservation of endangered fish and crayfish species. Fish communities in communities in the area were recently sampled to identify hosts of endangered freshwater mussels in the Neosho River (Bidwell et al. 2009). In terms of endangered fishes, the best-studied species is the Neosho madtom (*Noturus pacidus*), a small catfish with specific habitat habitat requirements in large rivers (Bulger and Edds 2001). In contrast, crayfish communities – communities – even though much less complex – remain poorly understood. A notable exception exception is a study by Jones and Bergey (2007) that surveyed the imperiled *Orconectes saxatilis saxatilis* in southeastern Oklahoma resulting in concrete knowledge about habitats, population population densities, distribution, and conservation threats and considerations.

We assessed the population biology and conservation status of small-bodied fish and crayfish in the northeastern portion of Oklahoma through field surveys to determine the distribution and habitat requirements of the listed species that occur in small streams associated with the Grand-Neosho and Illinois Rivers, as well as Spavinaw Creek. By surveying their current distribution and abundance, identifying historic ranges based on museum records and previously published survey data, and using a geographic information system (GIS) to characterize landscape use and features, we generated a list of environmental factors that are needed for a species to occur. Based on the results, we tried to identify high priority areas for conservation.

APPROACH

Field surveys

Potential fish and crayfish habitats in the river drainages were first identified through the use of records in museum collections, past survey data, and peer-review literature. Field assessment was then used to verify and establish multiple sampling sites in each of the river drainages. Fish and crayfish surveys were conducted using back-pack electrofishing. Tier

listed fish species caught were identified and counted. Up to 100 individuals per species and site were weighed and measured to the nearest 1 mm standard length. Crayfish were also identified and counted for abundance. All species were released at the original collection location.

To characterize environmental conditions at each habitat, we used the rapid bioassessment protocols (Barbour et al. 1999). Basic water chemistry and nutrient level data (temperature, dissolved oxygen, pH, conductivity, alkalinity, hardness, total nitrogen, total phosphorus, nitrate, and ortho-phosphorus) were also collected. At each sampling site, three replicate benthic macroinvertebrate samples were collected with a D-frame kicknet (400 μm mesh size). The samples were individually placed in clean 500 ml polyethylene containers and preserved with 70% ethanol. Sorting and identification of specimens was conducted at Oklahoma State University. All taxa were identified to the lowest practical taxonomic unit (usually genus) using the keys provided by Merritt et al. (2008). Descriptive metrics for macroinvertebrate samples include taxa richness, abundance, Shannon diversity index, % Ephemeroptera-Plecoptera-Trichoptera index, and biotic index as described by MDNR (2005).

Environmental variables were compared between sites where a particular species is present or absent using multivariate statistics. These comparisons were used to identify specific variables characterizing habitats of tier-listed fish and crayfish. Knowledge of specific habitat requirements of imperiled species will directly benefit conservation efforts, as conservation priorities and habitat restoration can focus on parameters relevant for the species of concern.

GIS database

To generate a GIS database of past and current distributions of tier-listed fish and crayfishes, we performed an extensive search of museum collections at institutions housing major collections of Oklahoman fishes. If not already accomplished, records were geo-referenced based on locality information. The database includes entries on species names, latitude and longitude of collection locations, description of collection sites, and the collection dates. Database entries were then integrated with detailed maps using ARC-GIS and Google Earth (KML file) to provide a tool to analyze past and present distributions. The files used to generate the maps will be provided to Oklahoma Department of Wildlife Conservation for their use in aiding future projects and management plans.

Environmental niche modeling

To complement our data on habitat requirement of tier-listed fish and crayfish, we used ecological niche modeling (Peterson and Vieglais 2001, Elith et al. 2006, Elith and Leathwick 2009) to identify landscape level variables that determine the range of each species. To do so, we used locality point data of past and present collection sites for each species as assembled in the GIS database. Raster coverage's for 21 environmental variables were adapted for climatological (Worldclim project) and hydrological (USGS hydro1k project) metrics. Data layers were downloaded or projected at 30 arc-seconds (~1 km^2) resolution. Some of the variables in these datasets have been used successfully in previous

studies on freshwater fish species employing ecological niche modeling (e.g., Dominguez-Dominguez et al. 2006, Chen et al. 2007, Costa and Schlupp 2010).

Environmental niche models (ENMs) were constructed for each species using the program Maxent v.3.3.2 (Phillips et al. 2006). Maxent uses environmental variables from localities in which a species has been documented previously (i.e., training data) to build a predictive model of where else the species may occur due to similar environmental conditions, hence identifying potentially suitable habitat even where the species does not presently occur. Results also include an analysis of each variable's relative contribution to the model and can be used to assess which variables are most important in predicting the species' distribution and might be potentially important when considering specific conservation measures. To quantify potential differences between historic and current distributions and to indentify environmental conditions that lead to declines of tier-listed species, niche overlap between historic and current occurrence locations will be calculated using the program ENMTools (Warren et al. 2008, 2010). ENMTools uses the ENMs for past and current distributions of a species and calculates the degree of niche overlap. As noted in the yearly report for the 2012-2013 sampling timeframe, there were a few species where historical data was lacking and we were unable to run distribution models comparing historic and current distributions. We were able to run historic and current distribution comparisons for eight of the thirteen species and no significant differences were detected in their historic and current distributions. Based on these results we ran future climate change models for a select group of tier-listed species (objective 4 and see below).

Climate change modeling

GIS-based climatic layers including minimum and maximum temperature and precipitation averages from 1950 - 2000 (hereafter "current") were obtained from the data portal of the Research Program on Climate Change, Agriculture and Food Security of the Consultative Group on International Agriculture Research (Jones et al. 2009). To investigate the potential distributions of fish species under different climate change scenarios, we downloaded the predicted climate data for the time periods of 2021 - 2040 (hereafter 2030), 2041 - 2060 (hereafter 2050), and 2071 - 2090 (hereafter 2080) down-scaled from MICRO 3.2 General Circulation Model (GCM), which represents one of the GCMs used in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (Solomon et al. 2007). We used the A1B, A2, and B1 emission scenarios included in the IPCC Special Report on Emission Scenarios. The A1B scenario represents current trends in which human energy use continues to increase (with a balance between fossil and non-fossil fuel sources), but CO_2 emissions are stabilized to some extent by technological advances and public awareness. An estimated CO_2 concentration of 850 ppm and temperature increase of 2.8 °C was used. The A2 scenario focuses on regional economic development and slower changes towards technological advances relative to other scenarios. It is characterized by an increase of CO_2 concentrations to 1250 ppm and of temperature by 3.4 °C in 2100. In the B1 scenario, human population growth declines around 2050 and the focus is on environmental protection and social equity. Cleaner technology is implemented, and CO_2 concentrations increase to 600 ppm and temperature rises by 1.8 °C, the lowest increases of any scenario (IPCC 2007).

Therefore, the degree of predicted climate change varies between scenarios, with B1 < A1B < A2.

Current and future temperature and precipitation variables were used to calculate 19 "bioclimatic" variables for current, 2030, 2050, and 2080 periods representing quarterly and monthly climate seasonality and extremes (Hijmans et al. 2005). Bioclimatic variables were generated in ArcInfo using available AML code (http://www.worldclim.org/bioclim). All environmental variable layers had a 1 km^2 resolution and were masked to the extent of our study area which was the Ozark Plateau ecoregion (including parts of Arkansas, Kansas, and Missouri). We ran the models using Maxent niche modeling as described above.

STATISTICAL ANALYSES

Water Quality

Summary statistics for temperature (°C), specific conductivity (SpC), dissolved oxygen (mg/L), pH, turbidity (NTU), hardness, alkalinity, nitrogen, and phosphorous were generated for each sample site. We used an ANOVA to compare the average values for each parameter between the drainages. If significant differences were detected, all multiple pair-wise comparisons were further evaluated using Tukey's HSD test ($\alpha = 0.05$).

Fish Surveys

For fish surveys, taxa lists were compiled indicating abundance of each species collected at each sampling location. Summary statistics including total abundance, richness, Shannon-diversity index and catch per unit effort (CPUE) were generated for each sampling site. Additionally, to compare the summary statistics generated among the three drainages, analysis of variance (ANOVA) was used, treating the sampling locations as replicates for each year separately, and also comparing between years with all drainages combined. If significant differences were detected, all multiple pair-wise comparisons were further evaluated using Tukey's HSD test ($\alpha = 0.05$).

Crayfish Surveys

Crayfish abundance surveys were only conducted in 2013 due to severe drought conditions in 2012. Due to the restricted ranges of *Orconectes macrus* and *O. nana*, and low sample sizes per site, we only present locality information and descriptive statistics below.

Invertebrate Surveys

For invertebrate surveys, taxa lists were compiled to summarize the abundance of each species collected at each sampling location. Summary statistics including total abundance, richness, Shannon-diversity index, IBI, and %EPT were generated for each sampling site. Additionally, to compare the summary statistics generated among the three drainages, analysis of variance (ANOVA) was used, treating the sampling locations as replicates for each year separately and also comparing between years with all drainages combined. If significant differences were detected, all multiple pair-wise comparisons were further evaluated using Tukey's HSD test ($\alpha = 0.05$).

Habitat Surveys

Habitat surveys were used to compare overall stream habitat quality between the drainages. We used an ANOVA to compare the habitat assessment scores between the drainages. If significant differences were detected, all multiple pair-wise comparisons were further evaluated using Tukey's HSD test ($\alpha = 0.05$). Additionally, we ran discriminant function analyses using environmental data collected at each site to test whether the presence or absence of tier-listed fish species could be predicted based on environmental variables and to identify variables driving the patterns.

Future climate change ecological niche modeling

We visually analyzed potential changes in species distributions for the selected tier-listed fish species and similar non-tier-listed species for the three emission scenarios and three future time frames.

RESULTS AND DISCUSSION

SAMPLING SITES

In 2012 we sampled a total of 46 sites throughout the Neosho, Spavinaw, and Illinois drainages (Table 2). We sampled locations on the west and east side of Grand Lake to ensure that the focal tier-listed species did not occur in the tributaries on the west side. Since we did not collect any of the targeted fish and crayfish species in the western tributaries, we only re-sampled sites located east of Grand Lake along with the locations in the Spavinaw and Illinois drainages for a total of 37 sampling sites in 2013 (Table 3; Figure 1). We excluded sites along the western side of Grand Lake for all analyses, as we did not collect any tier-listed species from those sites. Furthermore, we did not collect any invasive fish or crayfish species at any of our sampling sites.

DRAINAGE WATER CHEMISTRY

Basic water chemistry was collected at each of the sampling locations for each year and a summary can be found in Table 4 for 2012 and Table 5 for 2013. As water quality data were only collected once per year at each sampling site, the values provide a 'snap-shot' of the water conditions across the drainages and sites.

In 2012 only two parameters were significantly different among the drainages, DO ($P < 0.001$) and alkalinity ($P = 0.019$; Table 6). Tukey's HSD indicated that DO in Spavinaw drainage was significantly lower than the Neosho and Illinois drainages. The estimated marginal mean of DO in the Spavinaw drainage was 5.75 mg/L, while it was 7.06 and 7.99 mg/L in the Neosho and Illinois drainages respectively. As the Spavinaw drainage in smaller relative to the Neosho and Illinois, and Oklahoma was still under severe drought conditions in 2012, there was less discharge in this drainage, and combined with high temperatures, this is likely the cause of the lower DO values. We did not witness any fish kills in the Spavinaw drainage during our field sampling. As water quality parameters were only taken once per site, reduced DO concentrations may not have been consistent throughout the year.

Tukey's HSD also indicated that the significant difference observed for alkalinity was driven by differences between the Spavinaw and Neosho drainages. The estimated marginal means for Spavinaw was 109.778 and 73.385 for the Neosho. These differences are not likely biologically relevant because drainages did not differ significantly in pH ($P > 0.050$). The

Spavinaw drainage likely has a higher ability to buffer acidic waters than the other two drainages which may be driven by sites in Beaty Creek that had some of the highest alkalinity values (Table 4), and are mostly exposed limestone (personal observation).

In 2013, temperature ($P = 0.001$), DO ($P = 0.003$), and ortho-phosphorus concentrations ($P = 0.030$) significantly varied among drainages, while the remainder of the water quality parameters were all not significantly different among the drainages (Table 6). The Neosho drainage had the lowest average temperature and the highest DO values compared to the Spavinaw and Illinois drainages. As temperature and DO have an inverse relationship, these results are not unexpected. The DO values for the drainages were 9.009 mg/L for Neosho, 8.029 mg/L for Illinois, and 7.878 mg/L for Spavinaw. All of these values indicate that the DO in these drainages during the 2013 field season were well within the ranges expected for sustaining a healthy biota and are not a concern. Tukey's HSD indicated that the differences in ortho-phosphorus were driven by the Neosho and Illinois drainages, where the Neosho was 0.028 mg/L and the Illinois was 0.079 mg/L. Although these are significantly different, they are both low and not of concern for eutrophication and excess nutrient purposes.

FISH SURVEYS

OVERVIEW

We collected a total of 44 species of fish totaling 9206 individuals during the two years of sampling effort, which included five of the thirteen tier-listed fish species: Cardinal shiner (*Luxilus cardinalis*), Ozark minnow (*Notropis nubilus*), Redspot chub (*Nocomis asper*), Sunburst darter (*Etheostoma mihileze*), and the Southern brook lamprey (*Ichthyomyzon gagei*). Overall we found no significant differences between the drainages for abundance, species richness, Shannon-Diversity Index, and CPUE during the sampling conducted in 2012 and 2013 (all *P*-values > 0.050; Table 7). However, all metrics were significantly different ($P < 0.006$) between the two years, with 2012 sampling yielding higher values than 2013. As Oklahoma was still under severe drought conditions in 2012, there was less water in all of the drainages, concentrating the fish into smaller areas. This likely made sampling more effective, such that we ultimately collected more individuals and more species.

TIER-LISTED SPECIES

The Cardinal shiner was one of the most abundant fish species in the Ozark Highlands and we collected a total of 950 individuals at 33 out of the 37 sites (89%), including all three focal drainages. At one site (Spavinaw Creek between Eucha Lake and Spavinaw Lake), we could visually see this species but were unable to collect any specimens due to the depth of water and diminished ability to electrofish. Cardinal shiners showed positive length to weight relationships in all three focal drainages (Figure 2).

We collected 150 Ozark minnows at 11 of the 37 sites (30%) sampled from the Neosho and Illinois River drainages. These results are similar to surveys by the Oklahoma Water Resources Board, which conducted intensive surveys within the Illinois River drainage in 2007 and 2008 and collected 828 individuals 21 out of the 32 times they sampled. However, we did not collect any Ozark minnows within the Spavinaw drainage (9 sites sampled). The tributaries and upper portions of the Spavinaw drainage may contain Ozark minnows, but further surveys will be required to determine this. Overall, Ozark minnows prefer faster

moving, deeper runs within the systems they inhabit. Ozark minnows collected from the Neosho and Illinois River drainages had positive length to weight relationships (Figure 3).

We collected 58 individual Redspot chubs at 13 of the 37 (35%) sites we sampled, and this species was present in all three drainages. Redspot chubs strictly inhabit clear streams with low silt loads and is restricted to the Ozark Highlands with one exception; they also inhabit the Blue River in south central Oklahoma (Miller and Robison 2004). The majority of the Redspot chubs collected were over the limit of our scale but for the individuals that we were able to measure, positive length to weight relationships were observed (Figure 4).

We collected 135 individual Sunburst darters in 24 of the 37 (65%) sites sampled, and this species was present in all three drainages. The Sunburst darter was designated a distinct species and separated out from the Stippled darter (*Etheostoma punctulatum*) based on morphological and genetic data (Mayden 2010). With this designation, the Sunburst darter only occurs in drainages that flow into the Neosho and Illinois Rivers, making the majority of its distribution located within the political boundaries of Oklahoma. All previous *E. punctulatum* identifications in Oklahoma should now be referred to as *E. mihileze*. Length to weight relationships for the Sunburst darter were positive for all focal drainages (Figure 5).

We only collected 1 Southern brook lamprey from one sampling location (Baron Fork at Camp Egan) during the two years of sampling. The Southern brook lamprey is rare in these drainages. The Oklahoma Water Resources Board only collected 4 individuals in 3 of their 32 sampling efforts in 2007 and 2008, all coming from the Baron Fork. Additionally, we collected two Chestnut lampreys (*Ichthyomyzon castaneus*) from the Baron Fork at the same locations as the Southern brook lamprey. The Chestnut lamprey is also rare in Oklahoma and it is recommended that this species be added to the tier-listed species for Oklahoma.

For each tier-listed species, we also tested whether sites where a species was present differed in environmental conditions from sites where a species was absent by using discriminant function analyses (DFA). Except for the Southern brook lamprey, all DFAs were non-significant ($P > 0.13$) and did not allow us to make inferences about environmental factors driving the presence or absence of species. The presence of the Southern brook lamprey as associated primarily with higher depths, the presence of sand, and a high EPT index, but negatively associated with the presence of boulder and CPOM. These results should be interpreted cautiously, because of the small sample size of sites with this species being present.

Based on our field sampling efforts and intensive database searches for tier-listed fish species, we have compiled all occurrence records in excel database that can be imported into any mapping program (e.g., ArcGIS) and used for further examination of landscape variables and potential threats to tier-listed species. Additionally, we have created a KML file that is compatible with Google Earth for users that do not have access to other mapping programs.

CRAYFISH SURVEYS

The dominant crayfish species in northeast Oklahoma and Ozark Highlands was the Ringed crayfish (*Orconectes neglectus neglectus*), followed by Meek's short-pointed crayfish

(*Orconectes meeki brevis*). The Neosho midget crayfish (*Orconectes macrus*) occurred in the Neosho and Spavinaw drainages and the Midget crayfish (*Orconectes nana*) in the upper Illinois drainage (Table 8). Within Oklahoma, *O. macrus* is constrained to the Neosho-Grand River and Spavinaw Creek drainages north of Ft. Gibson Lake, while *Orconectes nana* is distributed only in the upper Illinois River drainage north of Tenkiller Lake (Figure 6); i.e., they are closely related species with largely allopatric distributions.

Orconectes macrus was collected in Sycamore Creek and Warren Branch on northern end of Grand Lake south to Cloud Creek (Spavinaw drainage), as well as Spring Creek and Little Saline Creek (Neosho drainage) with abundances ranging from 1 to 9 specimens collected during our standardized sampling. One female *Orconectes macrus* carrying 5 eggs was collected in April from Spring Creek at Rocky Ford State Park. We collected a total of 41 individual *O. macrus*, with 17 from the Spavinaw drainage and 24 from the Neosho drainage.

Orconectes nana abundances ranged between 1 and 8 individuals collected during our sampling efforts (Table 8). In general, we collected more *Orconectes nana* in smaller streams and tributaries than in the larger streams, as highlighted by 8 individuals being collected in Peacheater Creek and two unnamed tributaries to the Illinois River and Flint Creek (Table 8). This observation could potentially be a product of our sampling efforts, as we did not sample the main stem Illinois or other deeper, faster moving waters. We collected a total of 35 *O. nana* from the upper Illinois drainage. Both *O. macrus* and *O. nana* prefer faster moving riffle areas relative to runs or pools. Overall, both species were not sampled in large abundances throughout our sampling region.

INVERTEBRATE SURVEYS

At each sampling location, three replicate kick-net samples were taken from different riffles, and the invertebrates were identified and enumerated. In 2012, no significant differences were observed in total abundance, species richness, biotic index, % EPT, or Shannon-Diversity between the drainages ($P > 0.050$; Table 9). Total abundance ranged from 15 to 619 individuals per site and species richness varied from 12 to 26 taxa per site. A summary metric that combines the abundance of invertebrates in the Ephemeroptera, Plecoptera, and Trichoptera (EPT) orders is commonly used in macroinvertebrate surveys, since these groups tend to include taxa that are more sensitive to habitat degradation (Merritt et al. 2008). The EPT comprised between 25 and 67 percent at any given site, while the Shannon diversity index ranged from 1.17 to 2.79. The average biotic index for sites from 2012 sampling ranged from 3.21 to 5.76. Using the EPT taxa to predict water quality indicated that 54% of the sites had very good to excellent, 38% had good, and 8% (Buffalo Creek and Spavinaw Creek near Arkansas border) had fair water quality.

In 2013, statistically significant differences were found between drainages in species richness, biotic index, and Shannon-Diversity ($P < 0.013$), but not for species abundance or % EPT (Table 9). Significant differences in species richness were driven by the Neosho River drainage and Spavinaw Creek, where Spavinaw Creek had a fewer species than the Neosho River drainage. The differences observed in the Biotic Index and Shannon-Diversity Index were driven by Spavinaw Creek that had lower values than both the Illinois and Neosho drainages. The total abundance ranged from 19 to 1519 individuals per site, and

species richness varyied between 11 and 29 taxa per site. The EPT comprised between 13.3 and 63.6 % at any given site, while Shannon-Diversity index ranged from 1.28 to 3.18. The average biotic index for sites sampled in 2013 varied from 2.84 to 7.82. Using the EPT taxa to predict water quality indicated that 38% of the sites had very good to excellent, 38% had good, and 24% (Pumpkin Hollow, Sager Creek, Tyner Creek, Brush Creek, Buffalo Creek, Fourteen Mile Creek, Honey Creek, and Whitewater Creek) had fair to poor water quality. The lower percentages of very good to excellent water quality observed in 2013 may have been caused sampling bias, where more rare EPT taxa were spread out due to higher water levels.

CLIMATE CHANGE MODELING

Ecological niche modeling was performed for all tier-listed fish species in the Ozark Plateau ecoregion based on the current data availability. We ran niche overlap and background tests for fish collection locations pre- and post 1975 (i.e., historic vs. current distributions). These two analyses examined the potential distributions of the fish species based on the Maxent algorithm and allowed testing whether and how distributions of individual species differed between the two time periods. As mentioned in the methods sections, all of the models' performance were excellent based on examination of AUC values (Table 10), but none of the tier-listed species exhibited significant differences in their distributions pre- and post 1975 (Schoener's D; Table 10). This may suggests that the fish populations in this region have not been impacted to the point that distributional shifts estimated by ENM are detectable, but at times spotty collection records particularly for this historical time period may have contributed to the non-significant results. The current and potential distributions of each species examined are shown in Figure 7. White represents areas that are highly suitable for the species and black represents unsuitable habitat based on the bioclimatic variables used in the models.

We also investigated potential effects of climate change on the distribution of select species. We purposely focused on species occupying different niches within each creek: *Etheostoma mihileze* (benthic species), *Notropis nubilus* (mid-water column species), and *Fundulus sciadicus* (water-surface species). Additionally, we compared these tier-listed species to similar, but more widespread species with overlapping distributions. By doing this, we were able to compare and contrast tier-listed species with more narrow ranges to more widespread species to test if the potential climate change impacted the tier-listed species disproportionately.

For the benthic species, *Etheostoma flaballare* (widespread) and *E. mihileze* (narrow range) showed very similar patterns of distributions (Figures 8 and 9). In 2030, all emission scenarios still indicate suitable environmental conditions in the Ozark Highlands. In 2050, the A1B scenario (the second harshest of the three scenarios) suggests large truncations in the suitable environmental conditions with very few suitable areas available. The A2 scenario (harshest conditions) has less area available than 2030 but still projects the majority of the Ozark Highlands as suitable. The B2 (best scenario relatively) has less area available than suggested in 2030, but suggests that the distribution becomes more fragmented. This could potentially result in isolated populations, which may or may not be large enough to sustain themselves. By 2080, all of the scenarios project virtually no suitable conditions in the Ozark

Highlands of Oklahoma. Since *E. mihileze* was elevated to species status and has a very restricted distribution (see Mayden 2010 and above), the species may be vulnerable to extinction because the models consistently indicate a drastic reduction of suitable conditions for this species.

The mid-water column species *Notropis boops* (widespread) and *N. nubilus* (narrow range) showed different distributions across emission scenarios and years (Figures 10 and 11). In 2030, all of the emission scenarios indicated that suitable environmental conditions exist throughout the Ozark Highlands for both *Notropis* species. In 2050, suitable conditions are predicted in the Ozark Highlands for *N. nubilus*, but conditions were spotty and patterns were shifting to the southeast portion of Oklahoma for *N. boops*. By 2080, models indicated that there were no suitable conditions for *N. boops* for any of the emission scenarios in the Ozark Highlands, but suitable conditions existed in the southern half of their known range south of Lake Tenkiller in the lower Illinois River drainage. For *N. nubilus*, small isolated patches along the Oklahoma/ Arkansas border in the upper Illinois drainage were observed for the A1B and A2 emission scenarios, while the B2 (best scenario relatively) indicated that suitable environmental conditions existed throughout the Ozark Highlands in Oklahoma.

Finally, climate models for the top-water column species *Fundulus notatus* (widespread) and *F. sciadicus* (narrow range) indicated opposing results (Figures 12 and 13). For the widespread *F. notatus*, models indicated that all emission scenarios for all years (2030, 2050, 2080) contained suitable environmental conditions throughout its current range. The outlook for *F. sciadicus* was more faint, as models ran for all emission scenarios and year suggest suitable environmental conditions have all but disappeared by the year 2030 and completely vanished by 2050. We did not collect any specimens during our sampling efforts in 2012 an 2013, although we consciously sampled streams and sites with previous records of *F. sciadicus*.

VI. Conclusions and Recommendations

We collected five tier-listed fish species and two tier-listed crayfish species within the Ozark Highlands. Of the five fish species collected, no changes are recommended for the statuses of the Cardinal shiner, Ozark minnow, Redspot chub, and Sunburst darter. We recommend that all documents referring to the Stippled darter be updated to reflect the current taxonomy. Given that the formerly widespread Stippled darter now represents three different species with more narrow distributions, the Sunburst darter (which has the majority of its distribution in Oklahoma) should be monitored closely in the future. We also recommend that the status of the Southern brook lamprey be down-graded to "Low" instead of "Medium". We suggest this based on the low numbers (only 1 individual from 37 sites) collected during our sampling effort and previous efforts conducted by the Oklahoma Water Resources Board. The trend is still unknown for this species, and more targeted monitoring is required in the future. Furthermore, we suggest the addition of the Chestnut lamprey to the species of greatest conservation need. During all of our sampling efforts, we collected two individuals from the Baron Fork. We suggest listing this species as a Tier 1 species with the label of "Low" for the status and "Unknown" for the trend. The Chestnut lamprey is rare within the state of Oklahoma based on Miller and Robison (2004).

During our sampling efforts we discovered *O. nana* at multiple sites from which the species was previously unknown. The current status and trend for *O. nana* is listed as "Unknown". We suggest moving to the status to "Medium", as we collected this species throughout the Upper Illinois River and change the trend to "Stable". Currently, the Baron Fork and Upper Illinois watersheds are part of the scenic rivers program, and the protection these rivers receive should continue to help protect the tier-listed species that inhabit them. *Orconectes macrus* has not been officially added to the list of species in need to conservation. We suggest adding *O. macrus* to the list as a Tier 1 species with a status of "Medium" and trend of "Stable" as we collected this species throughout the Grand-Neosho River and Spavinaw Creek drainages. *Orconectes macru*s and *O. nana* occupy the same types of habitats within their respective drainages. They are usually found in swift moving riffle areas within systems that contain water the majority of the year. Furthermore, we suggest adding *Orconectes meeki brevis* to the list of species in need of conservation as Tier 2 species. *Orconectes m. brevis* was collected in the Upper Illinois River and Grand-Neosho River drainages, with the majority collected from the Upper Illinois River drainage. This species only occurs within the Northeast region of Oklahoma. We suggest listing *Orconectes m. brevis* as "Abundant" and "Stable".

We did not detect any distributional changes for the tier-listed species based on historical and current species locations. For future research and funding purposes, we suggest more focused efforts on the eight tier-listed fish species we did not collect during our sampling efforts, which are primarily found in larger streams and rivers. Additionally, the practicality and usefulness of creating stated designated "scenic rivers" with the Spavinaw Creek drainage (e.g., Beaty Creek) and Neosho River drainage (e.g., Spring Creek) to protect these watersheds should be evaluated as these two creeks held multiple tier-listed fish and crayfish species.

VII. SIGNIFICANT DEVIATIONS

There are no significant deviations to report.

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DATE 14 July 2014

APPROVED BY

Fisheries Division Administration
Oklahoma Department of Wildlife Conservation

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Figure 1. Sampling locations in the Ozark Highland ecoregion during 2013 for tier-listed fish and crayfish species.

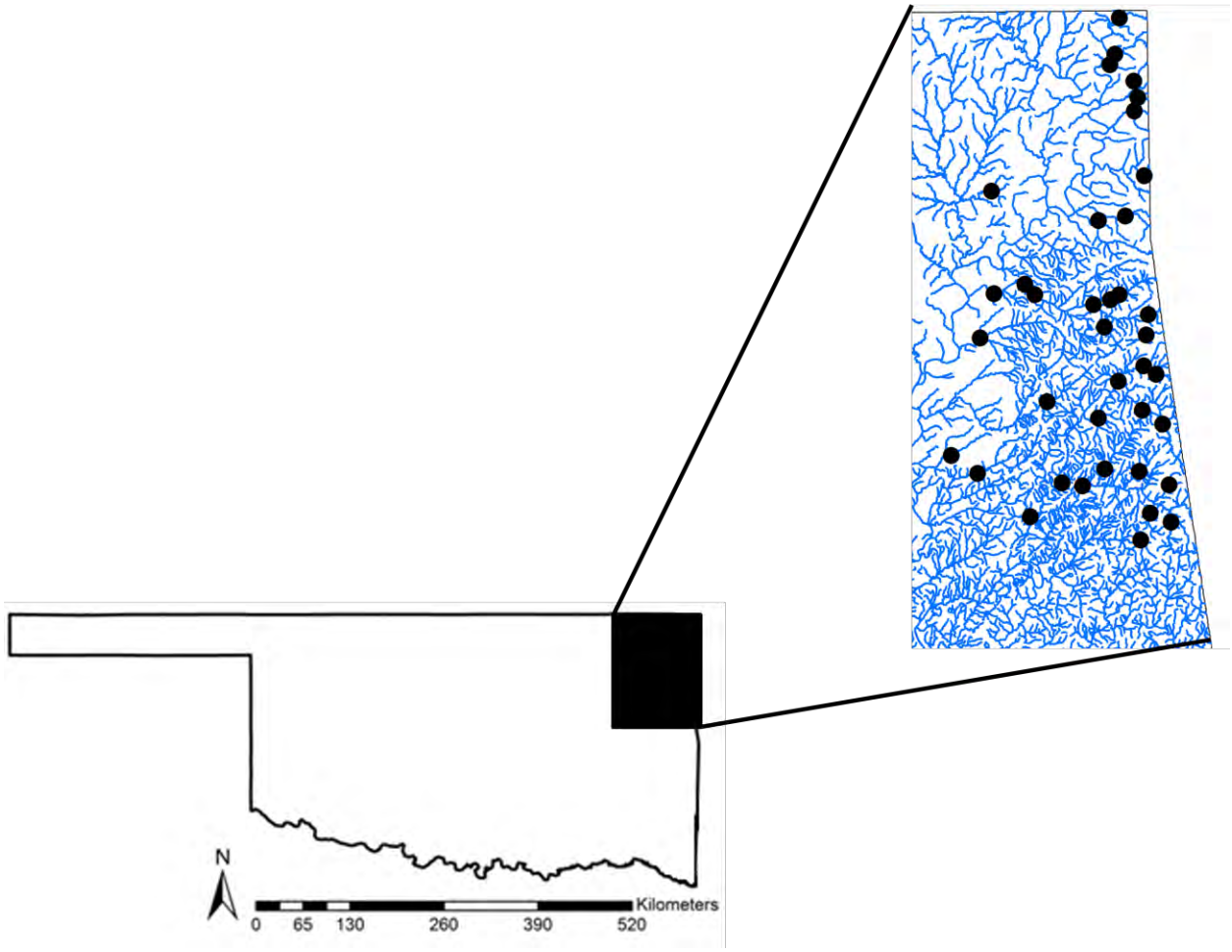


Figure 2. Length and weight scatter plot for the Cardinal shiner in each of the focal drainages.

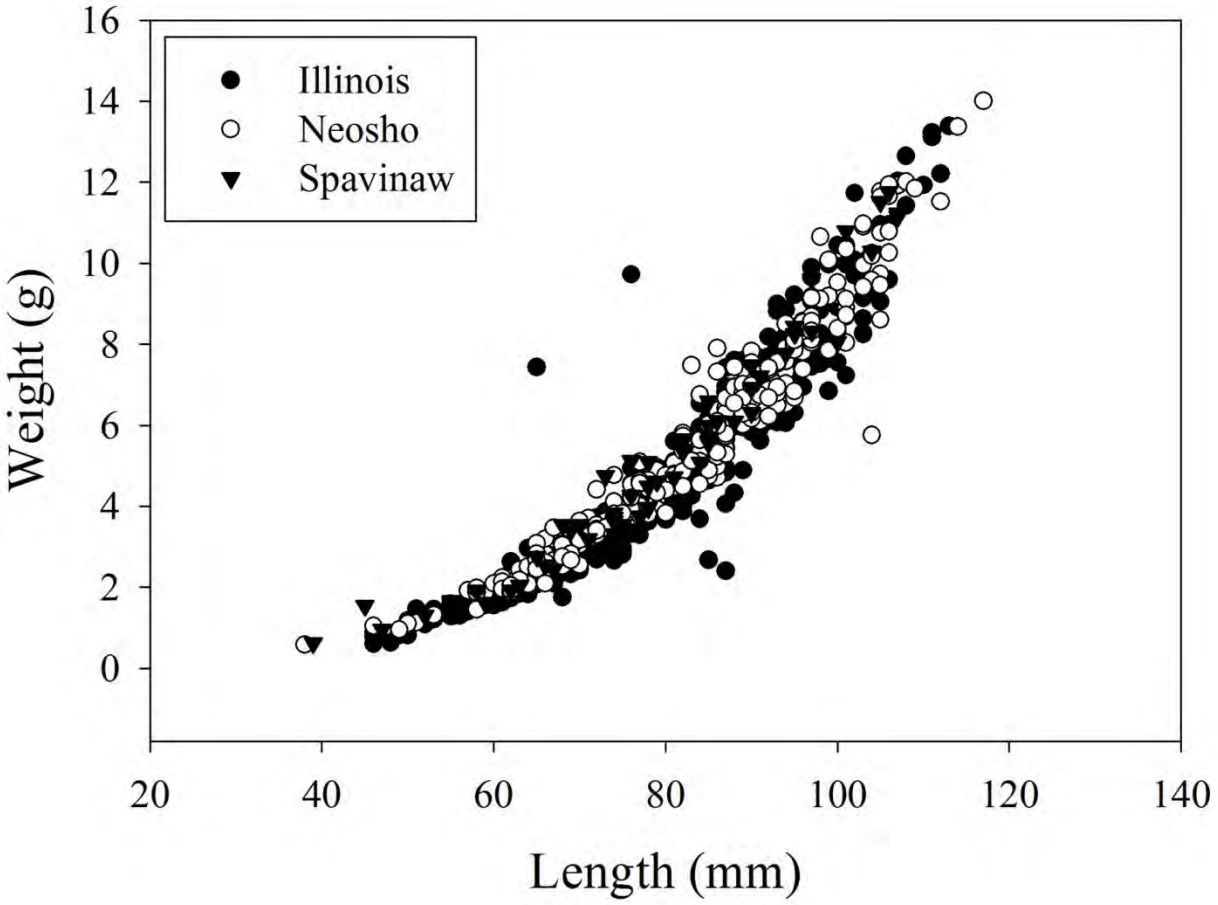


Figure 3. Length and weight scatter plot for the Ozark minnow in each of the focal drainages.

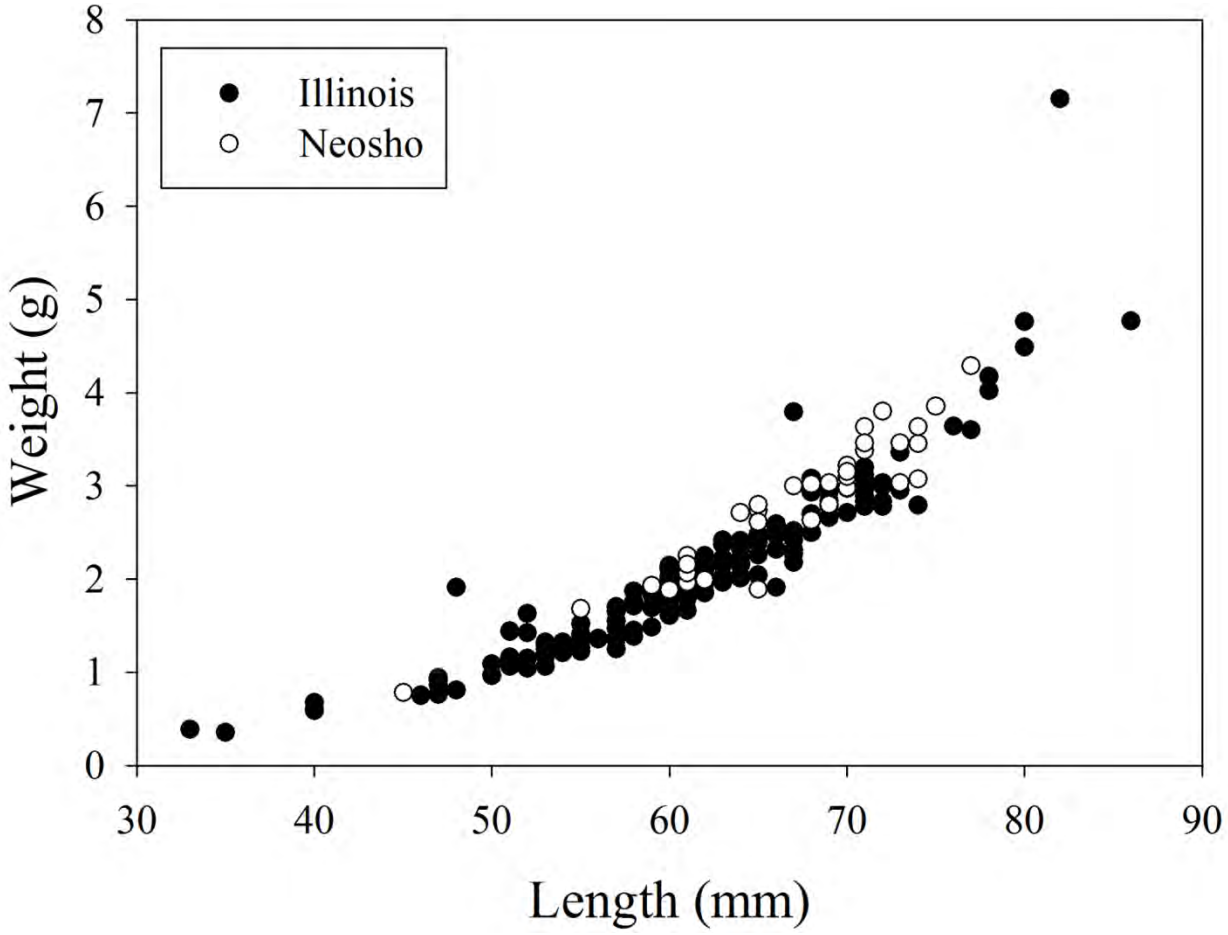


Figure 4. Length and weight scatter plot for the Redspot chub combined across all drainages.

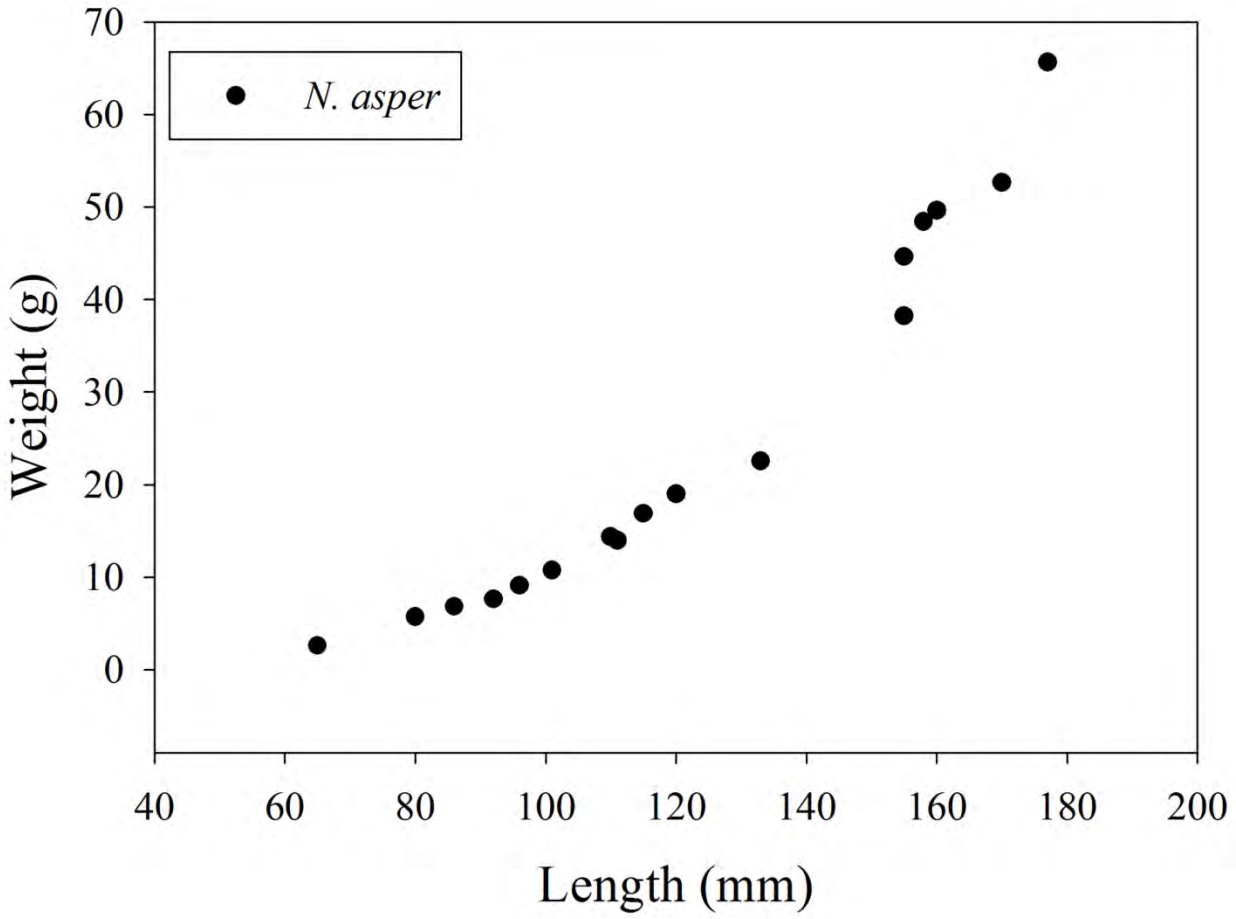


Figure 5. Length and weight scatter plot for the Sunburst darter in each of the focal drainages.

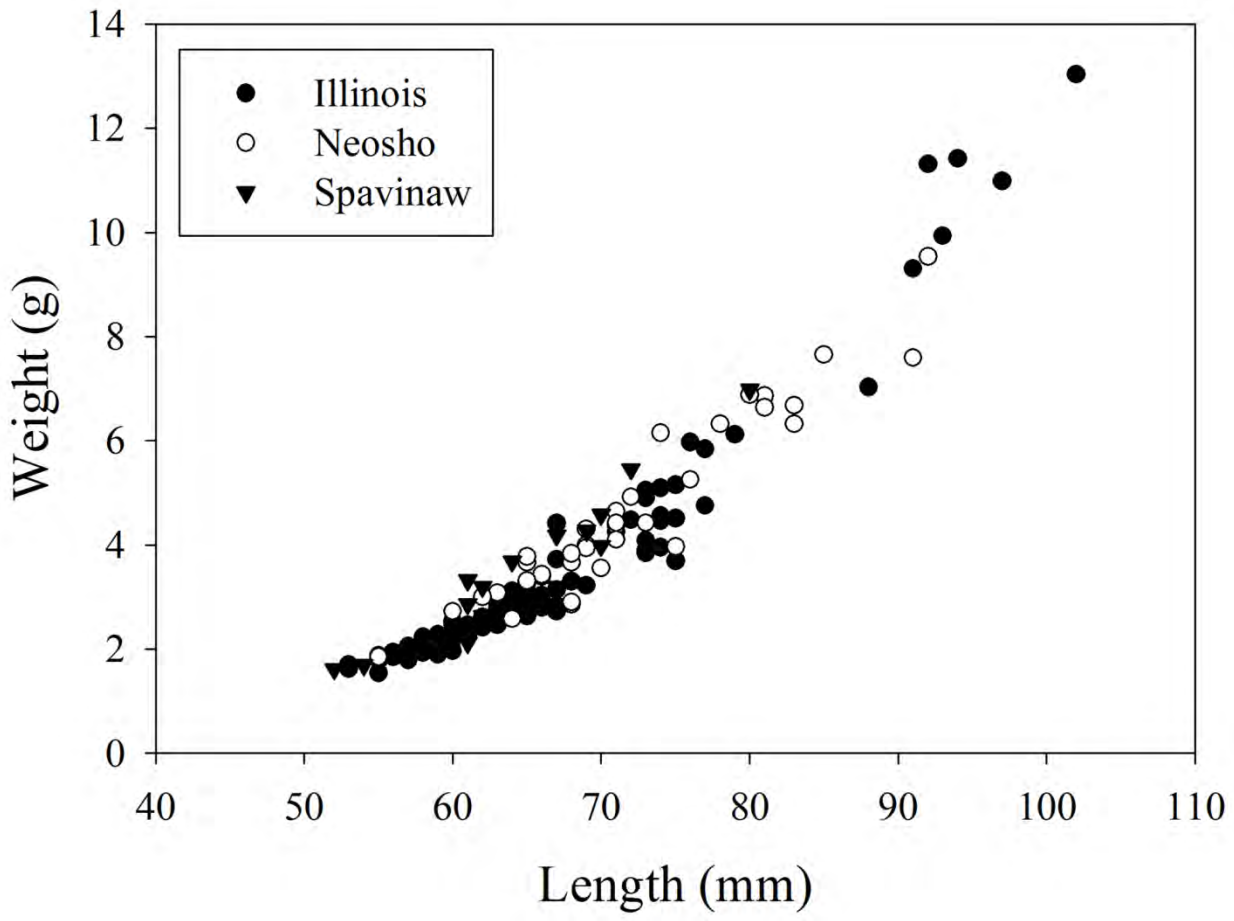


Figure 6. Locations of *Orconectes macrus* and *Orconectes nana* in the focal drainages of northeastern Oklahoma. Triangles represent collection localities of *O. macrus* and circles of *O. nana*.

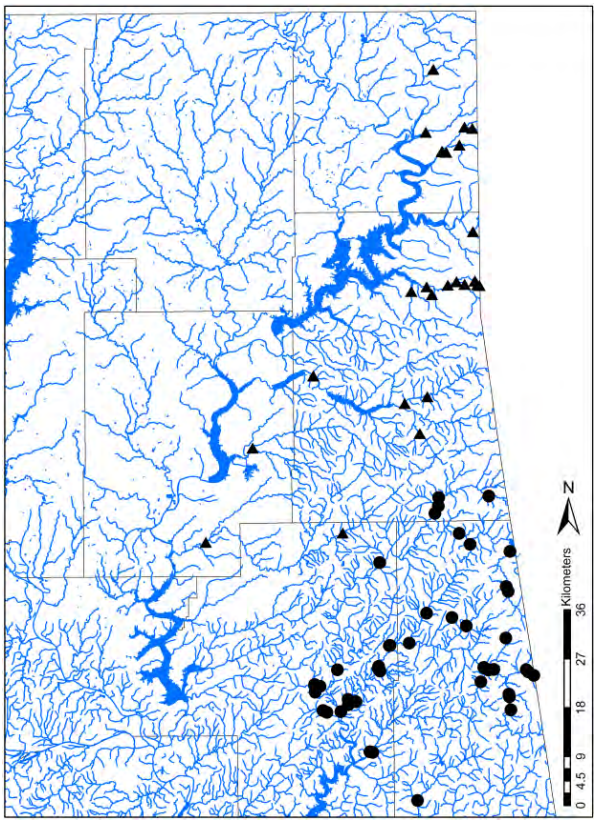
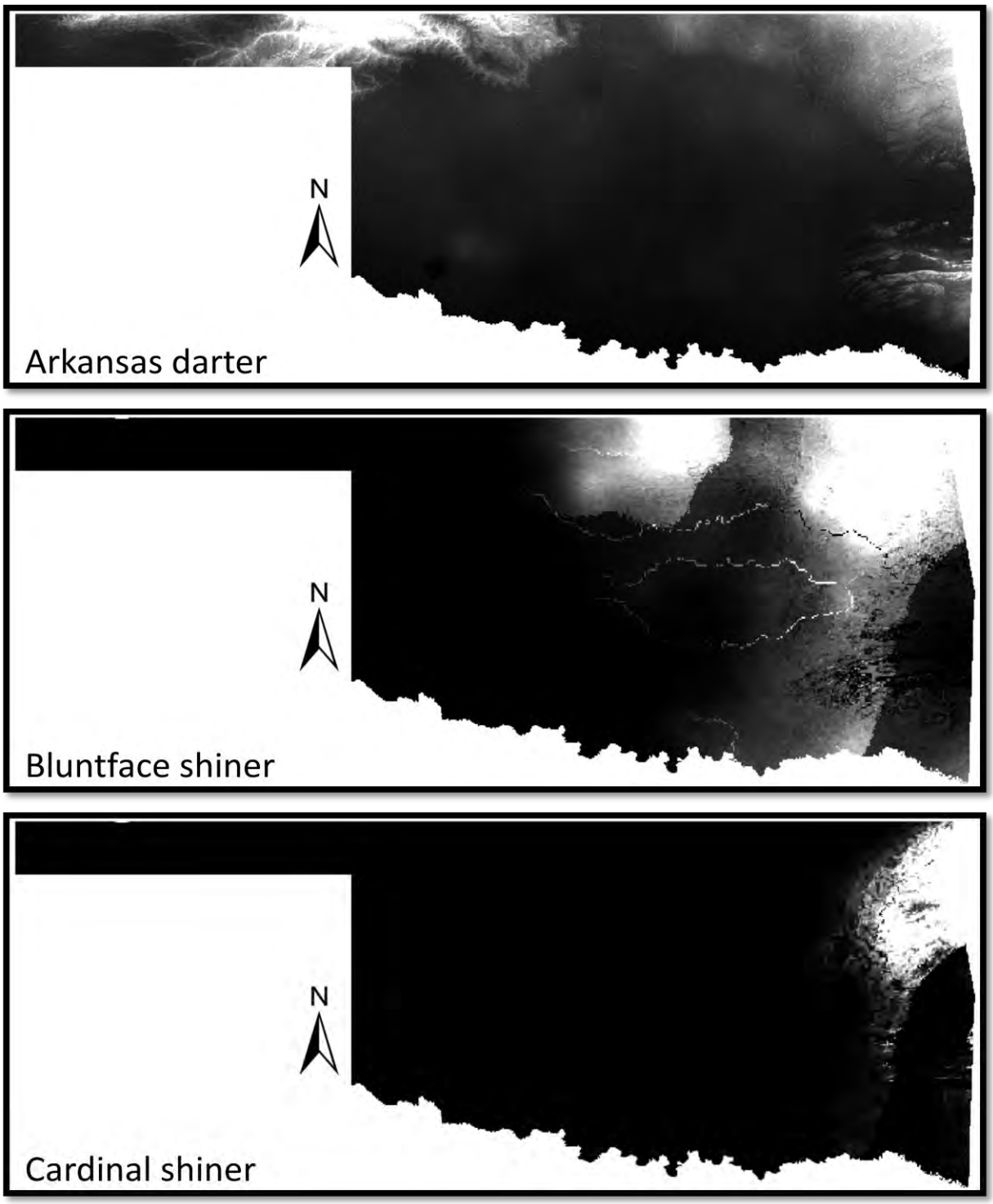


Figure 7. Current and potential distributions of each tier-listed species based on the Maxent algorithm. White represents suitable areas and black represents areas that are not suitable for the species' based on the bioclimatic variables used in the model.

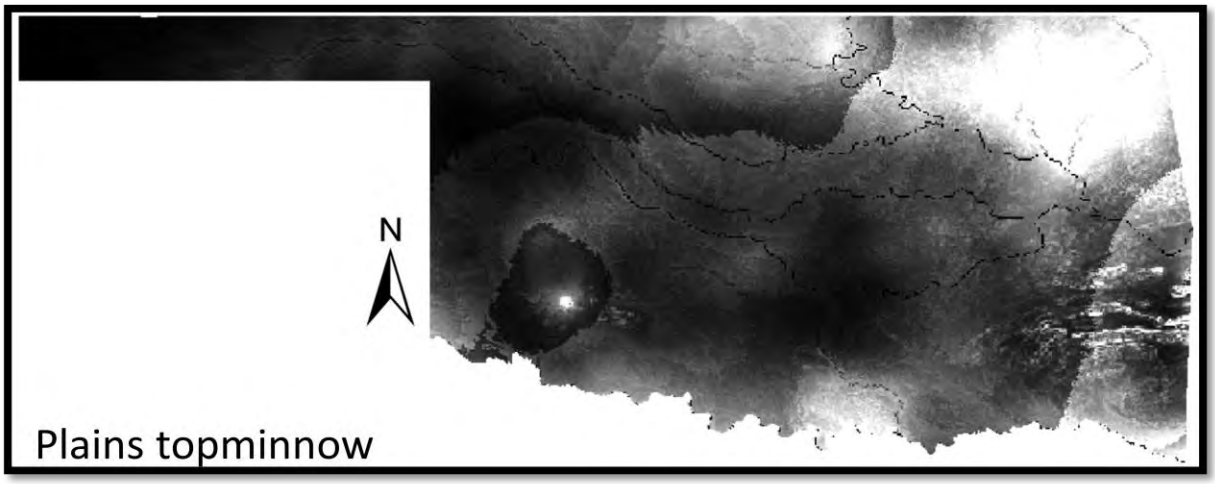



N
Ozark minnow


N
Neosho madtom


N
Southern brook lamprey


N
Plains minnow


N
Plains topminnow


N
Redspot chub


N
River darter


N
Spotfin shiner


N
Sunburst darter


N
Wedgespot shiner

Figure 8. Current and future potential distribution of *Etheostoma flaballare* based on different climate change scenarios. White represents suitable areas and black represents areas that are not suitable for the species based on the bioclimatic variables used in the model.

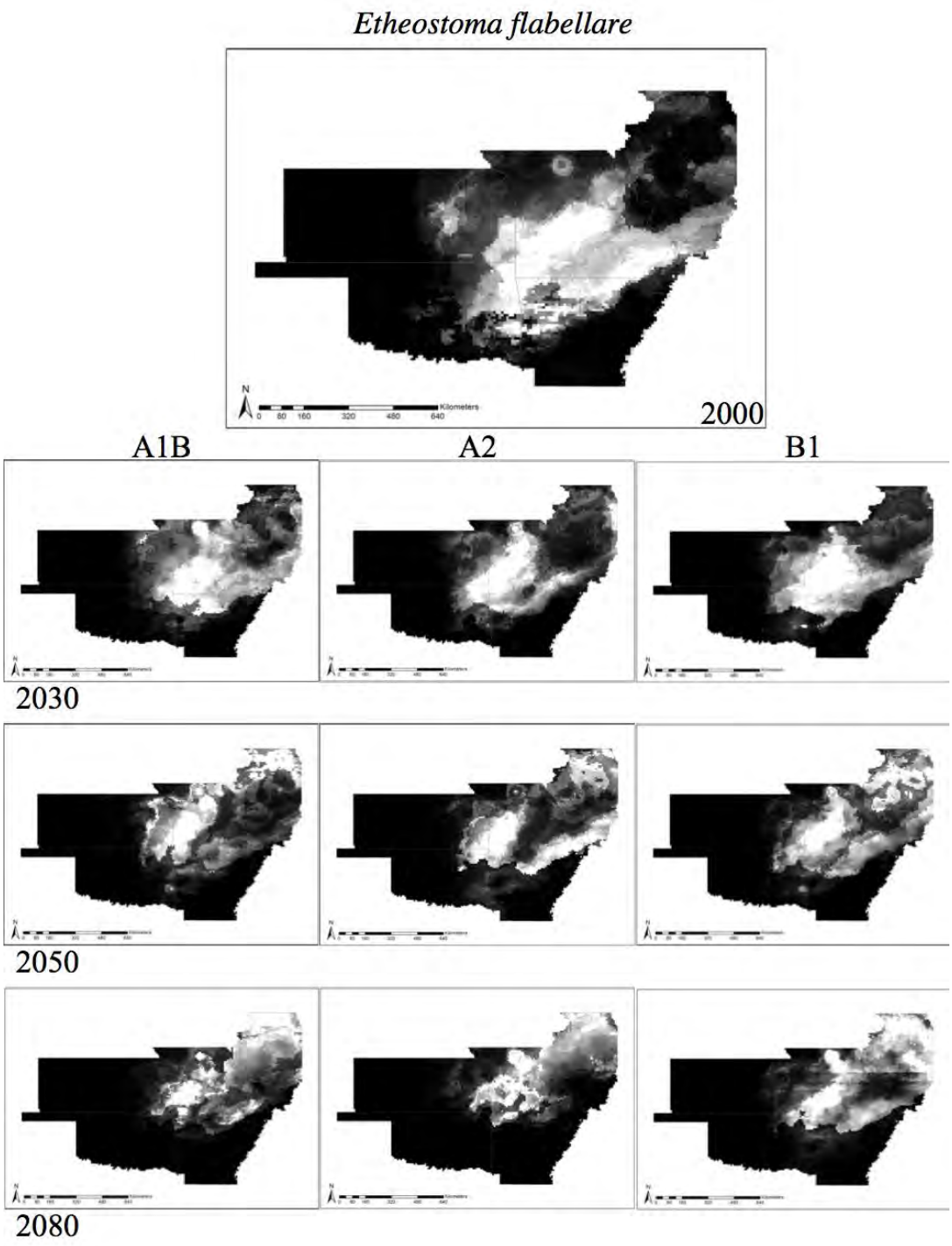


Figure 9. Current and future potential distribution of *Etheostoma mihileze* based on different climate change scenarios. White represents suitable areas and black represents areas that are not suitable for the species based on the bioclimatic variables used in the model.

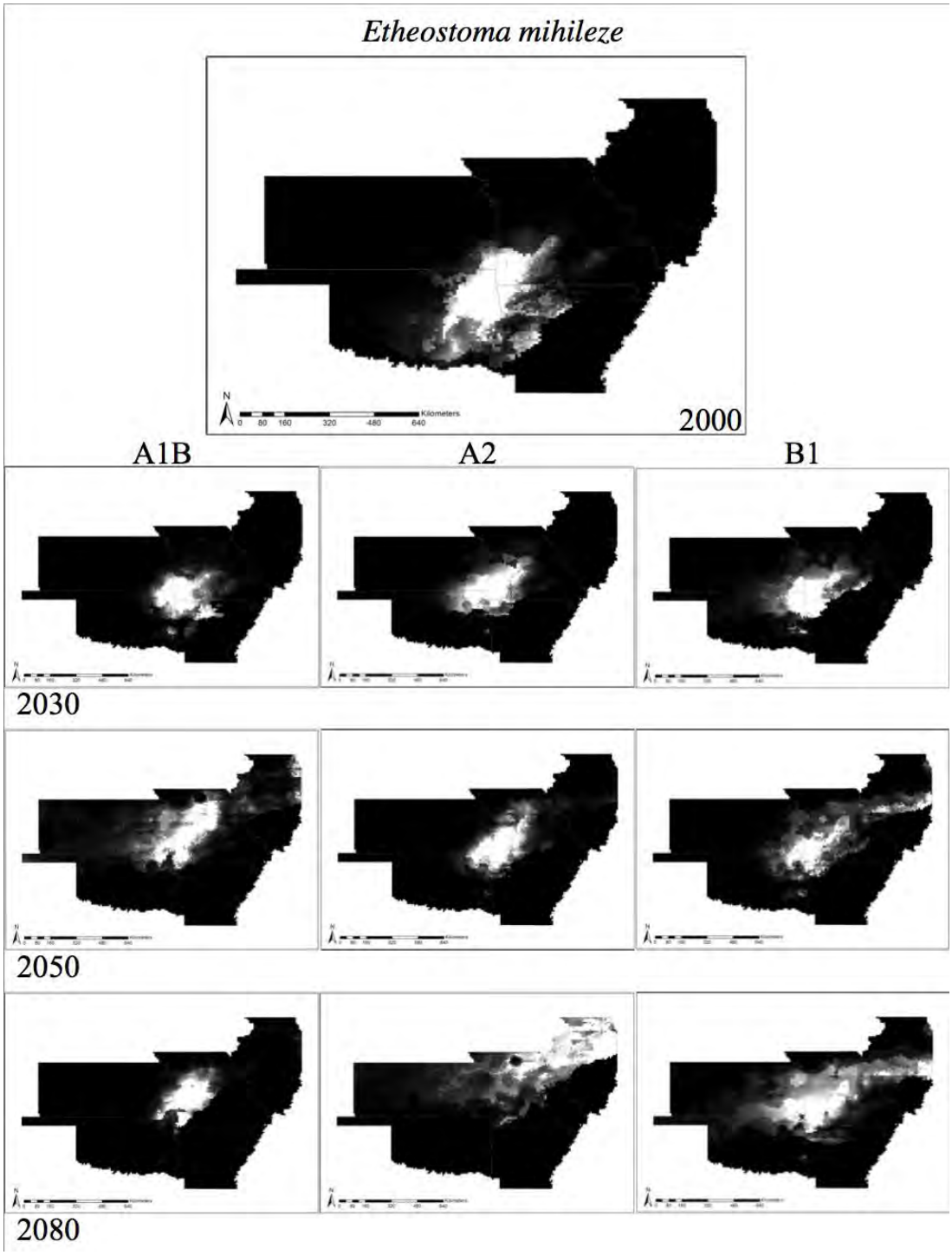


Figure 10. Current and future potential distribution of *Notropis boops* based on climate change scenarios. White represents suitable areas and black represents areas that are not suitable for the species based on the bioclimatic variables used in the model.

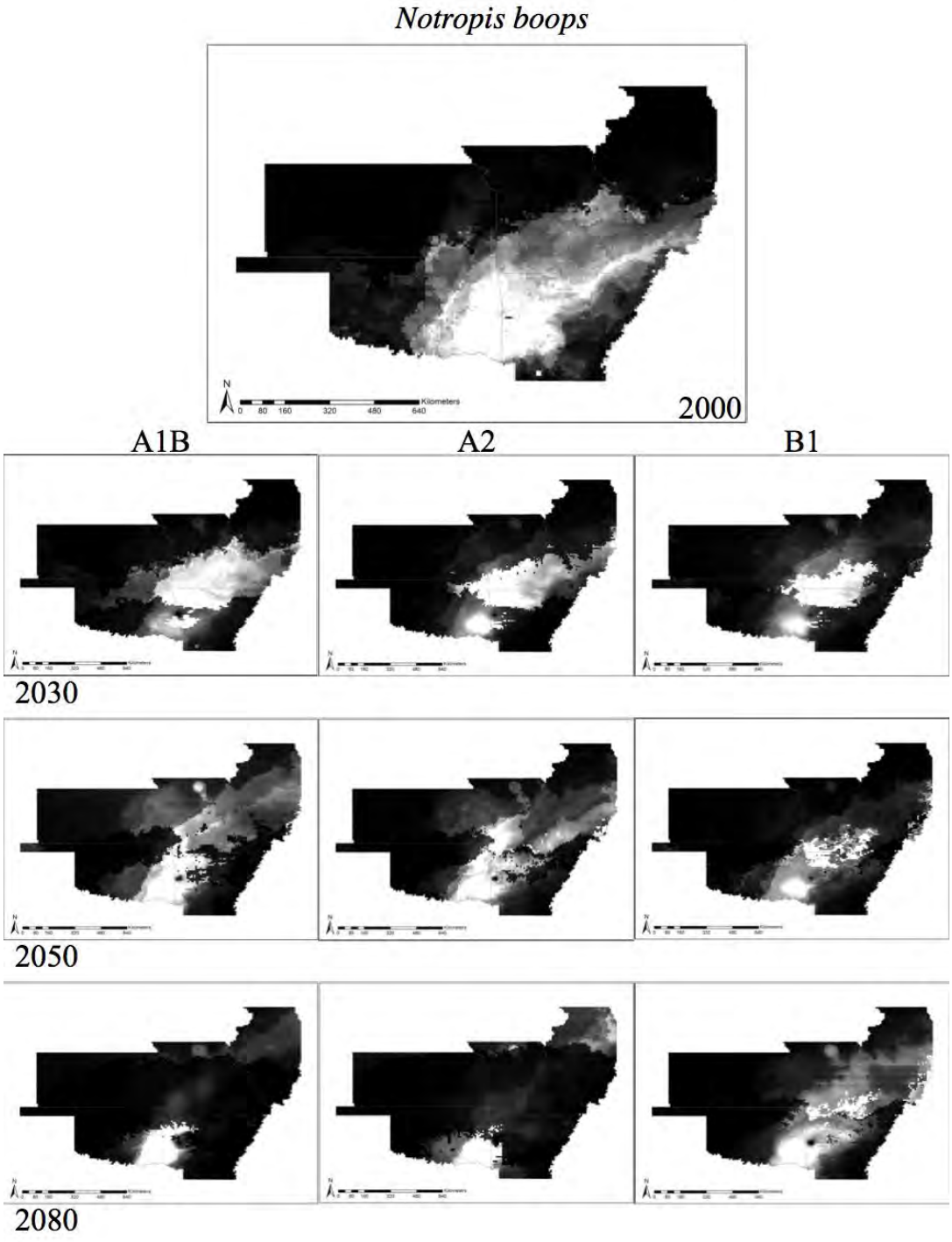


Figure 11. Current and future potential distribution of *Notropis nubilus* based on climate change scenarios. White represents suitable areas and black represents areas that are not suitable for the species based on the bioclimatic variables used in the model.

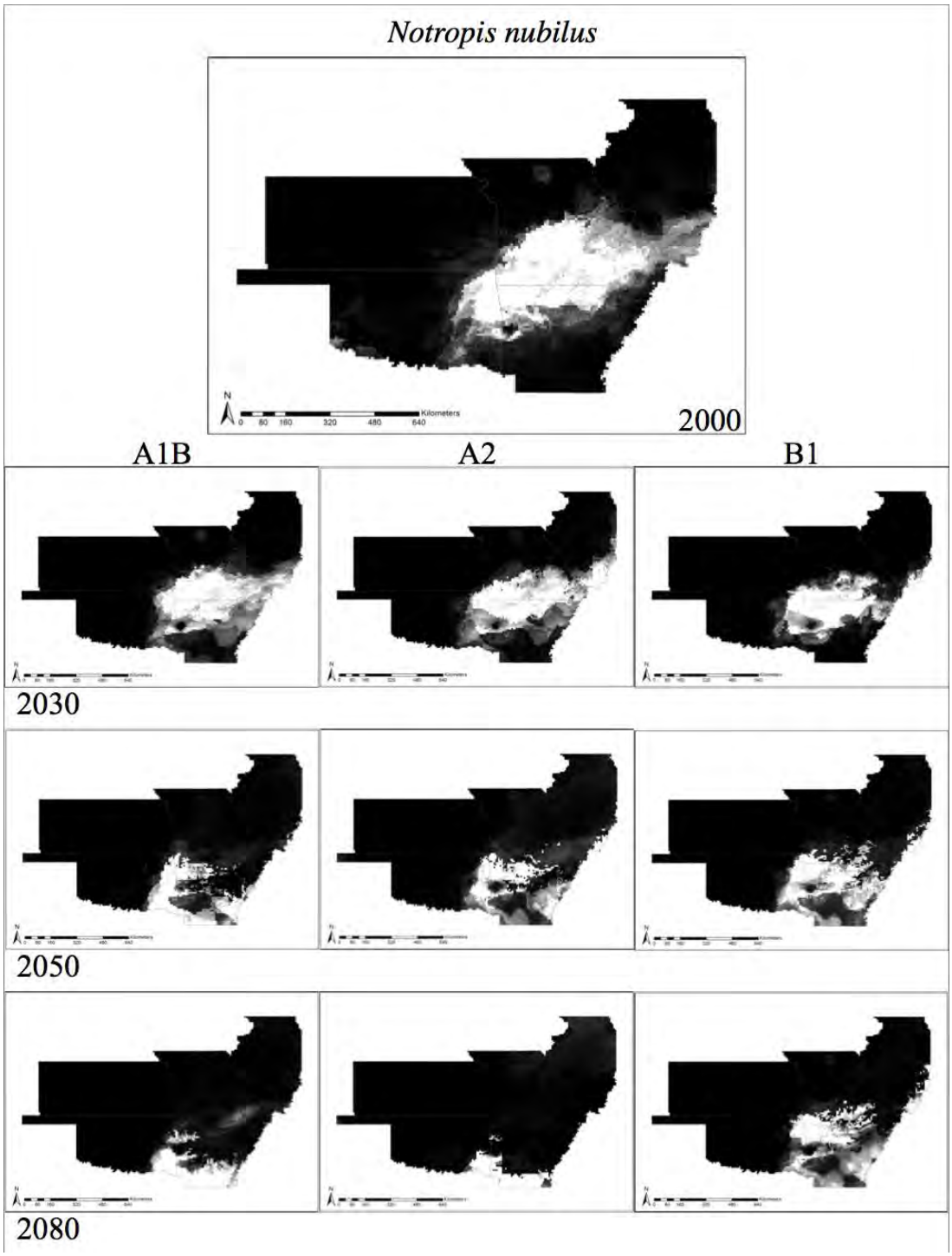


Figure 12. Current and future potential distribution of *Fundulus notatus* based on climate-change scenarios. White represents suitable areas and black represents areas that are not suitable for the species based on the bioclimatic variables used in the model.

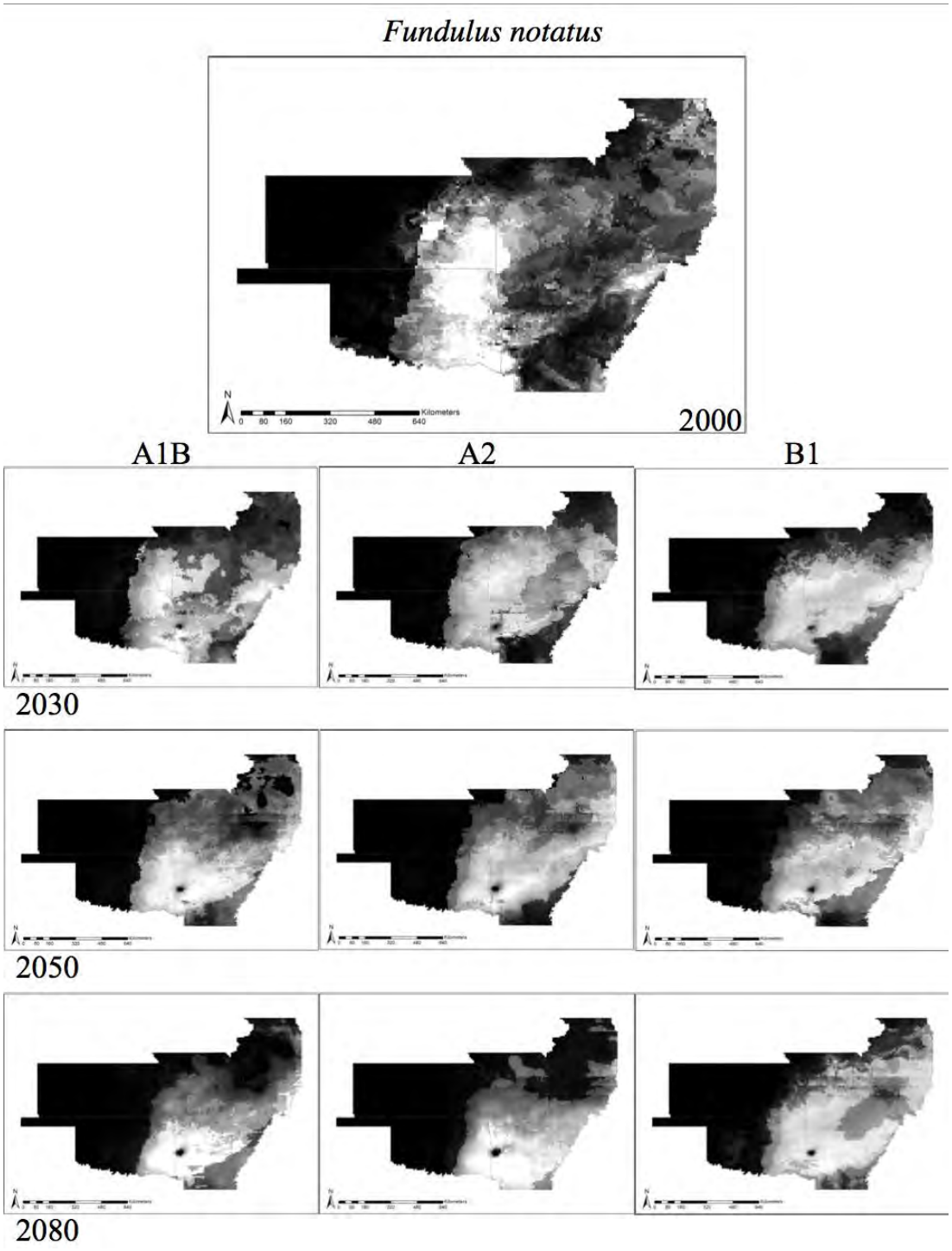


Figure 13. Current and future potential distribution of *Fundulus sciadicus* based on climate change scenarios. White represents suitable areas and black represents areas that are not suitable for the species based on the bioclimatic variables used in the model.

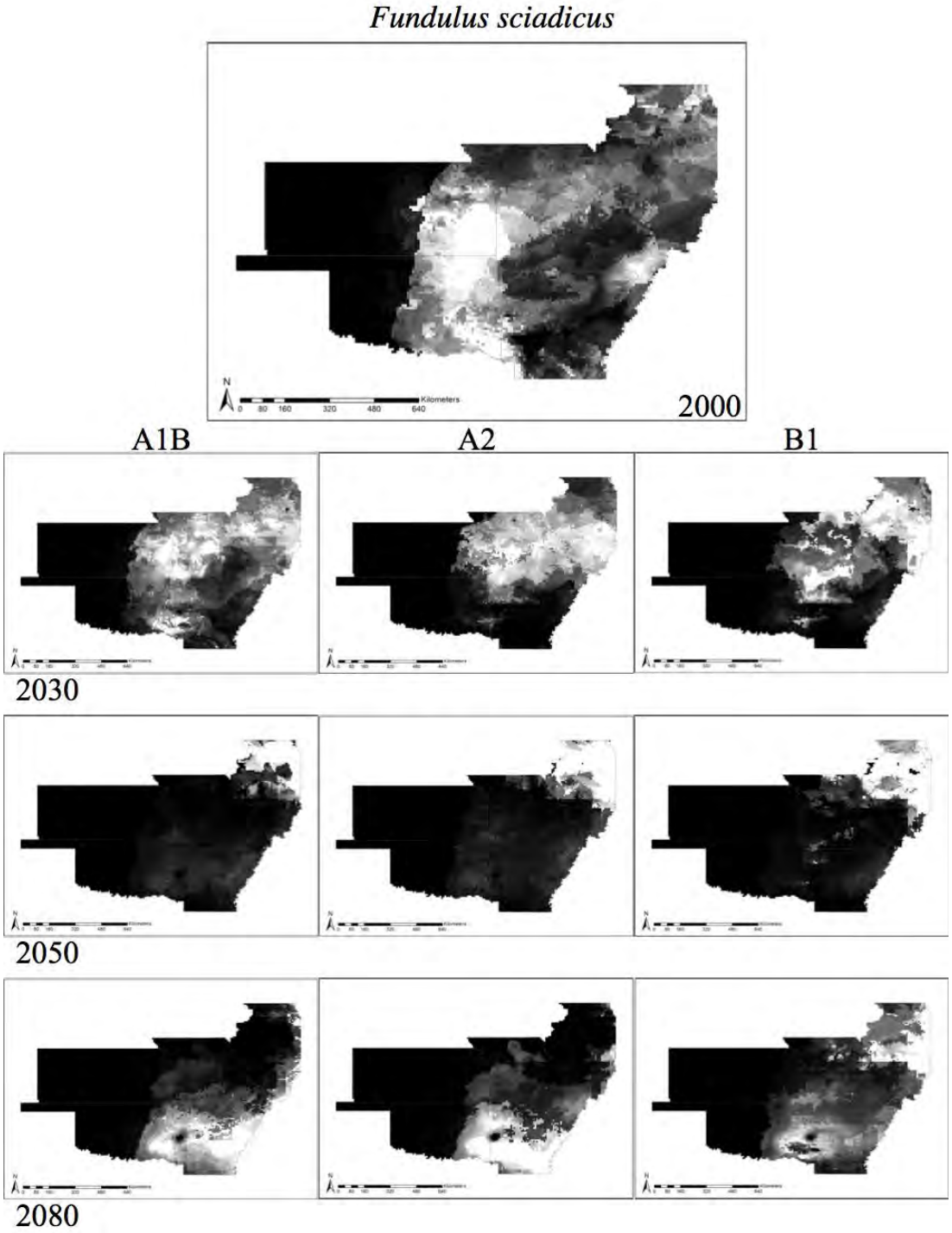


Table 1. Tier-listed fish and crayfish species occurring in northeastern Oklahoma and the Ozark Highland ecoregion following the Oklahoma Comprehensive Wildlife Conservation Strategy. Note that Oklahoman populations of the Stippled darter have recently been described as a distinct species: *E. mihileze* (see text).

Species	**Name**	**Tier**
Arkansas darter	*Etheostoma cragini*	I
Bluntface shiner	*Cyprinella camura*	II
Cardinal shiner	*Luxilus cardinalis*	II
Neosho madtom	*Noturus placidus*	I
Ozark minnow	*Notropis nubilus*	II
Plains minnow	*Hybognathus placitus*	III
Plains topminnow	*Fundulus sciadicus*	II
Redspot chub	*Nocomis asper*	II
River darter	*Percina shumardi*	III
Southern brook lamprey	*Ichthyomyzon gagei*	II
Spotfin shiner	*Cyprinella spiloptera*	III
Stippled darter	*Etheostoma punctulatum*	II
Wedgespot shiner	*Notropis greenei*	II
Midget Crayfish	*Orconectes nana*	I
Neosho Midget Crayfish	*Orconectes macrus*	N/A

Table 2. Sampling locations visited in 2012. Locations sampled on the west side of Grand Lake are in bold font.

Site #	Stream Name	Drainage	Latitude	Longitude
RM12-021	Ballard Creek	Illinois	36.09138	-94.58956
RM12-016	Baron Fork	Illinois	35.95843	-94.81205
RM12-017	Caney Creek	Illinois	35.83789	-94.65479
RM12-018	Evansville Creek	Illinois	35.87596	-94.57000
RM12-014	Flint Creek	Illinois	36.22004	-94.63982
RM12-022	Peacheater Creek	Illinois	35.98862	-94.65512
RM12-019	Peavine Creek	Illinois	35.89667	-94.62730
RM12-024	Pumpkin Hollow	Illinois	35.96589	-94.86789
RM12-015	Ross Branch	Illinois	35.89271	-94.9565
RM12-013	Sager Creek	Illinois	36.20124	-94.60518
RM12-020	Shell Branch	Illinois	35.95813	-94.57475
RM12-002	Tributary to Flint Creek	Illinois	36.18657	-94.70946
RM12-025	Tributary to Illinois River	Illinois	36.10606	-94.76579
RM12-026	Tributary to Illinois River	Illinois	36.12270	-94.64512
RM12-023	Tyner Creek	Illinois	35.99514	-94.75010
RM12-032	Brush Creek	Neosho-Grand	36.77839	-94.65563
RM12-031	Buffalo Creek	Neosho-Grand	36.63608	-94.62994
RM12-044	Clear Creek	Neosho-Grand	36.02794	-95.17210
RM12-010	**Cow Creek**	**Neosho-Grand**	**36.89293**	**-94.98137**
RM12-012	**Elm Creek**	**Neosho-Grand**	**36.92170**	**-94.91767**
RM12-027	Five Mile Creek	Neosho-Grand	36.98299	-94.69307
RM12-029	Flint Branch	Neosho-Grand	36.88017	-94.72110
RM12-045	Fourteen Mile Creek	Neosho-Grand	35.98857	-95.10065
RM12-030	Honey Creek	Neosho-Grand	36.54886	-94.68359
RM12-007	**Horse Creek**	**Neosho-Grand**	**36.68264**	**-94.92727**
RM12-006	**Little Cabin Creek**	**Neosho-Grand**	**36.59801**	**-95.13909**
RM12-011	**Little Elm Creek**	**Neosho-Grand**	**36.88517**	**-94.82369**
RM12-042	Little Saline Creek	Neosho-Grand	36.28513	-95.08994
RM12-008	**Locust Creek**	**Neosho-Grand**	**36.60636**	**-95.05352**
RM12-034	Lost Creek	Neosho-Grand	36.84374	-94.65531
RM12-005	**Mustang Creek**	**Neosho-Grand**	**36.52480**	**-95.08723**
RM12-001	Spring Creek	Neosho-Grand	36.14394	-94.90664
RM12-043	Spring Creek	Neosho-Grand	36.13083	-95.18826
RM12-033	Sycamore Creek	Neosho-Grand	36.80793	-94.64468
RM12-028	Warren Branch	Neosho-Grand	36.90317	-94.70763
RM12-009	Whitewater Creek	Neosho-Grand	36.53923	-94.75930
RM12-003	Beaty Creek	Spavinaw	36.35522	-94.77576
RM12-037	Beaty Creek	Spavinaw	36.37594	-94.70393
RM12-038	Beaty Creek	Spavinaw	36.36610	-94.72894
RM12-035	Cloud Creek	Spavinaw	36.30595	-94.74545
RM12-036	Spavinaw Creek	Spavinaw	36.33155	-94.62527
RM12-039	Spavinaw Creek	Spavinaw	36.37832	-94.93682
RM12-040	Spavinaw Creek	Spavinaw	36.40200	-94.96382
RM12-041	Spavinaw Creek	Spavinaw	36.38228	-95.05000
RM12-004	Tributary to Spavinaw Creek	Spavinaw	36.28687	-94.63087

Table 3. Sampling locations visited in 2013.

Site #	Stream Name	Drainage	Latitude	Longitude
RM13-032	Ballard Creek	Illinois	36.09138	-94.58956
RM13-042	Baron Fork	Illinois	35.95843	-94.81205
RM13-035	Caney Creek	Illinois	35.83789	-94.65479
RM13-036	Evansville Creek	Illinois	35.87596	-94.57
RM13-029	Flint Creek	Illinois	36.22004	-94.63982
RM13-039	Peacheater Creek	Illinois	35.98862	-94.65512
RM13-037	Peavine Creek	Illinois	35.89667	-94.6273
RM13-033	Pumpkin Hollow	Illinois	35.96589	-94.86789
RM13-034	Ross Branch	Illinois	35.89271	-94.9565
RM13-030	Sager Creek	Illinois	36.20124	-94.60518
RM13-038	Shell Branch	Illinois	35.95813	-94.57475
RM13-028	Tributary to Flint Creek	Illinois	36.18657	-94.70946
RM13-031	Tributary to Illinois River, Chance Rd	Illinois	36.10606	-94.76579
RM13-041	Tributary to Illinois River, N of Chewey	Illinois	36.1227	-94.64512
RM13-040	Tyner Creek	Illinois	35.99514	-94.7501
RM13-015	Brush Creek	Neosho	36.77839	-94.65563
RM13-016	Buffalo Creek	Neosho	36.63608	-94.62994
RM13-027	Clear Creek	Neosho	36.02794	-95.1721
RM13-010	Five Mile Creek	Neosho	36.98299	-94.69307
RM13-012	Flint Branch	Neosho	36.88017	-94.7211
RM13-026	Fourteen Mile Creek	Neosho	35.98857	-95.10065
RM13-017	Honey Creek	Neosho	36.54886	-94.68359
RM13-025	Little Saline Creek	Neosho	36.28513	-95.08994
RM13-013	Lost Creek	Neosho	36.84374	-94.65531
RM13-043	Spring Creek	Neosho	36.14394	-94.90664
RM13-014	Sycamore Creek	Neosho	36.80793	-94.64468
RM13-011	Warren Branch	Neosho	36.90317	-94.70763
RM13-018	Whitewater Creek	Neosho	36.53923	-94.7593
RM13-024	Beaty Creek 1	Spavinaw	36.35522	-94.77576
RM13-023	Beaty Creek 2	Spavinaw	36.37594	-94.70393
RM13-022	Beaty Creek 3	Spavinaw	36.3661	-94.72894
RM13-021	Cloud Creek	Spavinaw	36.30595	-94.74545
RM13-019	Spavinaw Creek	Spavinaw	36.33155	-94.62527
RM13-046	Spavinaw Creek between lakes	Spavinaw	36.37832	-94.93682
RM13-045	Tailwaters of Eucha Lake	Spavinaw	36.402	-94.96382
RM13-044	Tailwaters of Spavinaw Lake	Spavinaw	36.38228	-95.05
RM13-020	Tributary to Spavinaw Creek	Spavinaw	36.28687	-94.63087

Table 4. Water quality parameters measured for each site in 2012.

Site #	Name	Drainage	Temperature (°C)	SpC (µS/cm)	DO (mg/L)	pH	Turbidity (NTU)	Hardness	Alkalinity	NH_4	NO_3	Ortho-P
RM12-021	Ballard Creek	Illinois	22.01	257	9.49	7.68	129	114	106	0.0961	1.3210	0.0364
RM12-016	Baron Fork	Illinois	23.02	204	8.29	7.34	102	100	86	0.0100	0.7388	0.0237
RM12-017	Caney Creek	Illinois	16.43	324	7.55	7.21	162	132	118	0.0270	3.4670	0.2217
RM12-018	Evansville Creek	Illinois	19.98	227	7.46	6.94	113	124	114	0.0100	0.4791	0.0268
RM12-014	Flint Creek	Illinois	18.58	317	9.82	7.23	158	120	112	0.0234	2.0000	0.0564
RM12-022	Peacheater Creek	Illinois	20.07	178	7.11	6.76	89	74	58	0.0312	2.2010	0.1104
RM12-019	Peavine Creek	Illinois	17.79	250	7.54	7.16	125	120	114	0.0011	0.9190	0.0303
RM12-024	Pumpkin Hollow	Illinois	19.18	148	5.32	6.23	74	76	68	0.0288	0.4492	0.0269
RM12-015	Ross Branch	Illinois	24.28	272	9.89	8.15	136	126	114	0.0383	1.1950	0.0379
RM12-013	Sager Creek	Illinois	18.72	449	8.00	7.20	225	150	132	0.0100	2.2230	0.1737
RM12-020	Shell Branch	Illinois	18.53	378	7.55	7.23	189	164	146	0.0054	1.9230	0.0654
RM12-002	Tributary to Flint Creek	Illinois	18.70	205	8.05	7.03	103	116	72	0.0146	0.1960	0.0230
RM12-025	Tributary to Illinois River N of Chewey	Illinois	16.87	181	8.08	7.11	91	110	80	0.0129	1.5030	0.0230
RM12-026	Tributary to Illinois River, Chance Rd	Illinois	17.78	177	8.52	6.85	88	80	68	0.0016	2.4870	0.0341
RM12-023	Tyner Creek	Illinois	20.00	190	6.56	6.89	95	82	76	0.1393	1.9710	0.0526
RM12-032	Brush Creek	Neosho	19.17	271	8.02	7.34	135	118	92	0.0151	2.3820	0.0201
RM12-031	Buffalo Creek	Neosho	17.89	281	5.42	7.09	140	128	124	0.0100	1.7240	0.0319
RM12-044	Clear Creek	Neosho	18.55	174	7.00	6.26	87	88	76	0.0100	0.4803	0.0286
RM12-027	Five Mile Creek	Neosho	20.35	250	6.74	7.20	125	74	34	0.0784	0.3640	0.0404
RM12-029	Flint Branch	Neosho	20.28	301	8.40	7.65	151	56	28	0.0170	0.3746	0.0257
RM12-045	Fourteen Mile Creek	Neosho	25.62	184	5.73	6.67	92	78	76	0.0200	0.3150	0.0526
RM12-030	Honey Creek	Neosho	21.21	593	6.76	7.15	296	90	56	0.0145	2.3660	0.0475
RM12-042	Little Saline Creek	Neosho	20.91	200	6.61	6.48	100	98	96	0.0439	0.5564	0.0447
RM12-034	Lost Creek	Neosho	20.93	243	6.11	6.43	121	126	92	0.0179	2.6310	0.0365
RM12-001	Spring Creek at Rocky Ford	Neosho	24.01	233	7.57	6.94	116	96	108	0.2122	0.4095	0.0531
RM12-033	Sycamore Creek	Neosho	18.67	275	7.98	7.25	137	62	30	0.0100	2.9330	0.0506
RM12-028	Warren Branch	Neosho	18.16	261	8.36	6.99	131	70	22	0.0169	1.3700	0.0295
RM12-009	Whitewater Creek	Neosho	ND	ND	ND	ND	ND	130	120	0.0117	1.1170	0.0246
RM12-003	Beaty Creek 1	Spavinaw	21.96	258	6.55	6.85	129	116	114	0.0189	2.2440	0.0667
RM12-038	Beaty Creek 2	Spavinaw	19.78	258	6.21	6.68	129	118	120	0.0128	2.5130	0.0617
RM12-037	Beaty Creek 3	Spavinaw	20.29	267	5.10	6.58	134	136	120	0.0202	2.6540	0.0740
RM12-035	Cloud Creek	Spavinaw	17.78	147	6.58	6.65	73	66	60	0.0100	2.1480	0.0664
RM12-036	Spavinaw Creek	Spavinaw	20.21	334	7.29	6.83	167	150	142	0.0215	3.9260	0.0488
RM12-040	Spavinaw Creek between lakes	Spavinaw	24.49	198	4.50	6.67	99	92	106	0.0264	0.6447	0.0144
RM12-039	Tailwaters of Eucha Lake	Spavinaw	24.53	192	5.66	6.96	96	92	108	0.0959	0.6044	0.0960
RM12-041	Tailwaters of Spavinaw Lake	Spavinaw	27.12	357	5.97	7.11	178	98	92	0.1869	0.0266	0.0359
RM12-004	Tributary to Spavinaw Creek	Spavinaw	19.82	306	3.89	ND	153	134	126	ND	ND	0.0830

Table 5. Water quality parameters measured for each site in 2013.

Site #	Name	Drainage	Temperature (°C)	SpC (µS/cm)	DO (mg/L)	pH	Turbidity (NTU)	Hardness	Alkalinity	NH_4	NO_3	Ortho-P
RM13-032	Ballard Creek	Illinois	24.04	284	7.51	8.18	142	124	222	0.0321	2.3200	0.0600
RM13-042	Baron Fork	Illinois	23.48	212	7.86	8.12	106	94	205	0.1582	1.0530	0.0506
RM13-035	Caney Creek	Illinois	19.37	322	7.77	7.89	161	134	149	0.0238	3.5150	0.2826
RM13-036	Evansville Creek	Illinois	23.19	232	7.38	7.79	116	116	130	0.0445	0.6809	0.0415
RM13-029	Flint Creek	Illinois	21.52	317	8.40	8.21	159	124	227	0.0318	2.0220	0.0776
RM13-039	Peacheater Creek	Illinois	20.37	179	8.39	7.75	89	86	128	0.0312	3.2700	0.0617
RM13-037	Peavine Creek	Illinois	18.49	269	7.11	7.45	134	130	78	0.0212	1.3420	0.1007
RM13-033	Pumpkin Hollow	Illinois	18.44	142	8.67	8.13	71	80	207	0.0302	0.2760	0.0199
RM13-034	Ross Branch	Illinois	23.59	291	8.64	8.15	145	140	215	0.0223	1.5430	0.0596
RM13-030	Sager Creek	Illinois	22.27	400	8.40	8.21	200	158	227	0.1054	4.0430	0.1864
RM13-038	Shell Branch	Illinois	20.21	342	6.49	7.91	171	150	152	0.0310	4.2220	0.1485
RM13-028	Tributary to Flint Creek	Illinois	18.69	194	7.80	7.69	97	94	115	0.0296	0.4169	0.0202
RM13-041	Tributary to Illinois River N of Chewey	Illinois	21.65	188	8.56	7.97	94	84	174	0.0360	2.4830	0.0219
RM13-031	Tributary to Illinois River, Chance Rd	Illinois	21.09	181	7.34	7.96	91	90	172	0.0448	2.7350	0.0310
RM13-040	Tyner Creek	Illinois	19.69	185	10.11	8.71	92	86	126	0.0295	2.2300	0.0301
RM13-015	Brush Creek	Neosho	15.61	252	10.5	8.10	126	116	200	0.0354	3.0300	0.0185
RM13-016	Buffalo Creek	Neosho	14.48	268	9.1	8.07	134	120	198	0.0308	2.2840	0.0235
RM13-027	Clear Creek	Neosho	16.29	134	8	7.46	67	58	90	0.0347	0.9328	0.0245
RM13-010	Five Mile Creek	Neosho	12.68	231	9.5	8.18	116	96	223	0.0216	0.4403	0.0159
RM13-012	Flint Branch	Neosho	13.10	286	9.3	8.34	143	136	269	0.0261	0.4882	0.0169
RM13-026	Fourteen Mile Creek	Neosho	20.01	155	8	7.68	78	70	110	0.0318	0.7983	0.0381
RM13-017	Honey Creek	Neosho	14.86	392	8.7	8.15	196	114	215	0.0285	3.0220	0.0247
RM13-025	Little Saline Creek	Neosho	16.24	171	8.5	7.95	86	78	175	0.0276	1.1620	0.0180
RM13-013	Lost Creek	Neosho	15.00	219	9.5	7.94	109	96	178	0.0416	3.0170	0.0417
RM13-043	Spring Creek	Neosho	24.00	237	8.11	8.28	119	104	240	0.1358	0.6018	0.0584
RM13-014	Sycamore Creek	Neosho	12.54	230	9.4	7.82	115	116	167	0.0157	2.9620	0.0306
RM13-011	Warren Branch	Neosho	14.06	196	10	7.89	98	80	150	0.0161	1.1580	0.0234
RM13-024	Beaty Creek 1	Spavinaw	15.74	230	7.5	7.33	115	104	70	0.0167	3.4660	0.0664
RM13-023	Beaty Creek 2	Spavinaw	17.35	233	6.8	7.72	117	114	125	0.0515	3.8420	0.0717
RM13-022	Beaty Creek 3	Spavinaw	17.93	240	7.5	7.49	120	112	80	0.0408	4.5630	0.0672
RM13-021	Cloud Creek	Spavinaw	16.23	125	7.7	7.82	62	64	135	0.0362	1.6680	0.0444
RM13-019	Spavinaw Creek	Spavinaw	15.01	247	7.8	7.95	123	112	175	0.0266	4.0070	0.0592
RM13-046	Spavinaw Creek b/w Lakes	Spavinaw	26.19	216	8.62	7.69	102	110	119	0.0328	0.9282	0.0247
RM13-045	Tail waters of Eucha Lake	Spavinaw	25.73	197	7.13	8.03	98	94	180	0.1341	0.8750	0.0163
RM13-044	Tail waters of Spavinaw Lake	Spavinaw	27.03	184	7.03	8.17	92	80	220	0.1553	0.2916	0.0211
RM13-020	Tributary to Spavinaw Creek	Spavinaw	15.26	256	7.8	7.80	128	120	130	0.0312	3.7970	0.0495
RM13-018	Whitewater Creek	Spavinaw	16.24	240	9.3	8.36	120	140	287	0.0228	2.2930	0.0194

Table 6. Results of analyses of variance testing for among drainage differences in the different water quality parameters measured in 2012 and 2013. Bold indicates significant values ($P < 0.05$).

2012	***df***	***F***	***P* - value**
Temperature	2,36	2.493	0.098
Specific Conductivity	2,36	0.263	0.77
Dissolved Oxygen	2,36	10.938	**<0.001**
pH	2,36	2.196	0.128
Turbidity	2,36	0.475	0.626
Hardness	2,36	2.155	0.132
Alkalinity	2,36	4.455	**0.019**
NH4	2,36	1.198	0.549
NO3	2,36	0.672	0.518
Ortho-Phosphorous	2,36	1.541	0.229

2013	***df***	***F***	***P* - value**
Temperature	2,36	8.316	**0.001**
Specific Conductivity	2,36	0.776	0.468
Dissolved Oxygen	2,36	6.875	**0.003**
pH	2,36	1.213	0.310
Turbidity	2,36	0.826	0.447
Hardness	2,36	1.135	0.333
Alkalinity	2,36	0.989	0.382
NH4	2,36	1.753	0.416
NO3	2,36	1.365	0.269
Ortho-Phosphorous	2,36	3.989	**0.030**

Table 7. Results of analyses of variance testing for among drainage and year differences in fish abundance and diversity metrics for fish collected in 2012 and 2013. Bold indicates significant values ($P < 0.05$).

2012	***df***	***F***	***P* - value**
Abundance	2,36	0.370	0.693
Richness	2,36	0.155	0.857
Shannon-Diversity Index	2,36	1.304	0.285
Catch per Unit Effort (CPUE)	2,36	0.370	0.693

2013	***df***	***F***	***P* - value**
Abundance	2,36	1.157	0.326
Richness	2,36	0.951	0.396
Shannon-Diversity Index	2,36	0.781	0.466
Catch per Unit Effort (CPUE)	2,36	1.157	0.326

Between Years	***df***	***F***	***P* - value**
Abundance	1, 73	16.727	**0.001**
Richness	1, 73	7.933	**0.006**
Shannon-Diversity Index	1, 73	23.215	**0.001**
Catch per Unit Effort (CPUE)	1, 73	16.727	**0.001**

Table 8. Breakdown of the number of individuals collected for different crayfish species at each sampling site (summed across both years of sampling).

Stream Name	Drainage	*Orconectes neglectus*	*Orconectes macrus*	*Orconectes nana*	*Orconectes meeki brevis*	*Orconectes nais*
Ballard Creek	Illinois	50	0	0	80	0
Baron Fork	Illinois	37	0	4	5	0
Caney Creek	Illinois	10	0	0	6	0
Evansville Creek	Illinois	50	0	0	2	0
Flint Creek	Illinois	1	0	0	0	0
Peacheater Creek	Illinois	6	0	8	17	0
Peavine Creek	Illinois	100	0	2	3	0
Pumpkin Hollow	Illinois	0	0	0	15	0
Ross Branch	Illinois	27	0	4	12	0
Sager Creek	Illinois	5	0	0	1	0
Shell Branch	Illinois	11	0	0	18	0
Tributary to Flint Creek	Illinois	13	0	8	3	0
Tributary to Illinois River, Chance Rd	Illinois	2	0	8	13	0
Tributary to Illinois River, N of Chewey	Illinois	3	0	0	7	0
Tyner Creek	Illinois	0	0	1	3	0
Brush Creek	Neosho	24	1	0	0	0
Buffalo Creek	Neosho	2	2	0	0	0
Clear Creek	Neosho	41	0	0	0	0
Five Mile Creek	Neosho	44	0	0	0	0
Flint Branch	Neosho	8	0	0	0	0
Fourteen Mile Creek	Neosho	6	0	0	1	0
Honey Creek	Neosho	133	2	0	0	0
Little Saline Creek	Neosho	95	2	0	0	0
Lost Creek	Neosho	7	0	0	0	11
Spring Creek at Rocky Ford	Neosho	74	6	0	0	0
Spring Creek near Hwy 82	Neosho	12	2	0	0	0
Sycamore Creek	Neosho	252	1	0	1	0
Warren Branch	Neosho	41	6	0	0	0
Whitewater Creek	Neosho	57	2	0	0	0
Beaty Creek 1	Spavinaw	22	3	0	1	0
Beaty Creek 2	Spavinaw	11	9	0	2	0
Beaty Creek 3	Spavinaw	129	4	0	2	0
Cloud Creek	Spavinaw	42	0	0	0	0
Spavinaw Creek	Spavinaw	27	0	0	9	0
Spavinaw Creek between lakes	Spavinaw	13	0	0	0	0
Tailwaters of Eucha Lake	Spavinaw	1	0	0	0	0
Tailwaters of Spavinaw Lake	Spavinaw	1	0	0	0	1
Tributary to Spavinaw Creek	Spavinaw	26	1	0	0	0

Table 9. Results of analyses of variance testing for among drainage and year differences in macroinvertebrates abundance and diversity metrics for macroinvertebrates collected in 2012 and 2013. Bold indicates significant values ($P < 0.05$).

2012	***df***	***F***	***P* - value**
Abundance	2,35	1.133	0.334
Richness	2,35	0.818	0.450
Index of Biological Integrity	2,35	2.617	0.088
% Ephemeroptera-Plecoptera-Tricoptera	2,35	0.074	0.929
Shannon-Diversity Index	2,35	0.144	0.866

2013	***df***	***F***	***P* - value**
Abundance	2,36	1.952	0.158
Richness	2,36	5.568	**0.008**
Index of Biological Integrity	2,36	8.318	**0.001**
% Ephemeroptera-Plecoptera-Tricoptera	2,36	2.774	0.077
Shannon-Diversity Index	2,36	4.963	**0.013**

Between Years	***df***	***F***	***P* - value**
Abundance	1,72	0.881	0.351
Richness	1,72	3.282	0.740
Index of Biological Integrity	1,72	9.059	**0.004**
% Ephemeroptera-Plecoptera-Tricoptera	1,72	0.271	0.604
Shannon-Diversity Index	1,72	2.833	0.097

Table 10. Area under the curve (AUC) values and Schoener's D statistic from the ecological niche modeling of all tier-listed spcies. All models had high AUC values indicating that the 'model fit' was excellent. Schoener's D statistic measures the significance of niche overlap between an individual's distribution from two different time periods (i.e., pre- and post 1975; <0.05 equals significantly different from each time period). (-) represents species that did not have enough data points from one time period to make statistical comparisons.

Species Model	AUC Value	Schoener's D
Arkansas darter	0.877	-
Bluntface shiner	0.923	0.261
Cardinal shiner	0.969	-
Neosho madtom	0.999	-
Ozark minnow	0.992	0.146
Plains minnow	0.903	0.638
Plains topminnow	0.997	-
Redspot chub	0.934	0.281
River darter	0.965	0.240
Southern brook lamprey	0.955	0.245
Spotfin shiner	0.989	-
Sunburst darter	0.990	0.117
Wedgespot shiner	0.966	0.290

Appendix A

Raw data for fish and macroinvertebrates collected in 2012

Fish collected in 2012.

Specie Name	RM12-001	RM12-002	RM12-003	RM12-004	RM12-005	RM12-006
Phoxinus erythrogaster		1		43		
Noturus exilis	5	11	5	2		
Cottus carolinae	26	5	20	39		
Semolitus atromaculatus			1	10		
Etheostoma flabellare	14	24	25		23	
Etheostoma spectabile	6	24	2	5	41	
Etheostoma whipplei					10	
Luxilus cardinalis	15	85	1	15		
Notropis nubilus						
Campostoma anomalum	6	22	8	33	200	
Lepomis macrochirus	1		8	3	22	25
Ambloplites rupestris			5			
Ameiurus natalis	2				1	
Ameiurus melas						
Percina caprodes						
Etheostoma mihileze	9	39	9	1		
Nocomis asper	11		5			
Etheostoma blennioides		2				
Lepomis megalotis	1					3
Ictalurus punctatus						
Pomoxis nigromaculatus						
Lepomis humilis						
Lepomis microlophus			1			
Lepomis cyanellus	1	1		6		
Lepomis gulosus						
Lepomis macrochirus x cyanellus						
Micropterus salmoides					2	
Micropterus dolumeiu						
Micropterus punctulatus						
Etheostoma zonale						
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus		2				
Gambusia affinis		1				3
Fundulus catenatus			5			
Notropis boops					4	
Lepisosteus oculatus						1
Fundulus notatus						
Pimephales notatus						
Cyprinella lutrensis						
Hypentelium nigricans						
Moxostoma erythrurum						
Dorosoma cepedianum						

Specie Name	RM12-007	RM12-008	RM12-009	RM12-010	RM12-011	RM12-012
Phoxinus erythrogaster						
Noturus exilis						
Cottus carolinae			37			
Semolitus atromaculatus						
Etheostoma flabellare			5			
Etheostoma spectabile	2		31			
Etheostoma whipplei						
Luxilus cardinalis			3			
Notropis nubilus			1			
Campostoma anomalum			4			
Lepomis macrochirus	23	14	10		12	25
Ambloplites rupestris	1					
Ameiurus natalis	1					2
Ameiurus melas						
Percina caprodes						
Etheostoma mihileze			2			
Nocomis asper						
Etheostoma blennioides						
Lepomis megalotis	1	1			3	7
Ictalurus punctatus						
Pomoxis nigromaculatus						
Lepomis humilis		1				
Lepomis microlophus	4					
Lepomis cyanellus	4		5	1	7	
Lepomis gulosus					3	7
Lepomis macrochirus x cyanellus						
Micropterus salmoides						
Micropterus dolumeiu						
Micropterus punctulatus						
Etheostoma zonale						
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus						
Gambusia affinis	1	2	1			
Fundulus catenatus						
Notropis boops			1			
Lepisosteus oculatus						
Fundulus notatus	3				1	2
Pimephales notatus				1		
Cyprinella lutrensis				8		
Hypentelium nigricans						
Moxostoma erythrurum						
Dorosoma cepedianum						

Specie Name	RM12-013	RM12-014	RM12-015	RM12-016	RM12-017	RM12-018
Phoxinus erythrogaster					84	
Noturus exilis	1		12	10		6
Cottus carolinae	3	4	2	13		6
Semolitus atromaculatus						
Etheostoma flabellare			1			
Etheostoma spectabile	41	9	13	28	41	25
Etheostoma whipplei						
Luxilus cardinalis	20	19	50	18		42
Notropis nubilus		13	1	66		
Campostoma anomalum	73	79	45	5	114	62
Lepomis macrochirus	6		5	2		
Ambloplites rupestris						1
Ameiurus natalis	1					
Ameiurus melas						
Percina caprodes		2	2			
Etheostoma mihileze		3	3	2		
Nocomis asper	1		14			1
Etheostoma blennioides		17		7		25
Lepomis megalotis	1	4	12	3		
Ictalurus punctatus						
Pomoxis nigromaculatus						
Lepomis humilis						
Lepomis microlophus						
Lepomis cyanellus	1		1		28	1
Lepomis gulosus			3	1		
Lepomis macrochirus x cyanellus						
Micropterus salmoides						
Micropterus dolumeiu	2	2				
Micropterus punctulatus						
Etheostoma zonale				12		
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus						
Gambusia affinis					7	1
Fundulus catenatus						
Notropis boops				1		
Lepisosteus oculatus						
Fundulus notatus						
Pimephales notatus				1		
Cyprinella lutrensis						
Hypentelium nigricans						1
Moxostoma erythrurum						
Dorosoma cepedianum						

Specie Name	RM12-019	RM12-020	RM12-021	RM12-022	RM12-023	RM12-024
Phoxinus erythrogaster	2	4		59	7	
Noturus exilis	2		9	3	13	
Cottus carolinae	10	5	20	22	8	
Semolitus atromaculatus	1	1			4	
Etheostoma flabellare	19	20		2	37	
Etheostoma spectabile	28	9	29	12	7	
Etheostoma whipplei						
Luxilus cardinalis	6	4	15	22	10	
Notropis nubilus						
Campostoma anomalum	4	51	10	87	7	93
Lepomis macrochirus		11				
Ambloplites rupestris			1			
Ameiurus natalis						
Ameiurus melas		1				
Percina caprodes						
Etheostoma mihileze		2				
Nocomis asper					2	
Etheostoma blennioides			9			
Lepomis megalotis			17			
Ictalurus punctatus						
Pomoxis nigromaculatus						
Lepomis humilis						
Lepomis microlophus						
Lepomis cyanellus		13	5		1	5
Lepomis gulosus						
Lepomis macrochirus x cyanellus						
Micropterus salmoides						1
Micropterus dolumeiu		3	2			
Micropterus punctulatus						
Etheostoma zonale			1			
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus						
Gambusia affinis						
Fundulus catenatus						
Notropis boops						
Lepisosteus oculatus						
Fundulus notatus						
Pimephales notatus						
Cyprinella lutrensis						
Hypentelium nigricans						
Moxostoma erythrurum						
Dorosoma cepedianum						

Specie Name	RM12-025	RM12-026	RM12-027	RM12-028	RM12-029	RM12-030
Phoxinus erythrogaster	5			3		
Noturus exilis	3	2	7	1		7
Cottus carolinae	14	7	11	11	22	13
Semolitus atromaculatus	4	1		1		
Etheostoma flabellare	20	40	56	41	4	9
Etheostoma spectabile	5	6	3	5	14	4
Etheostoma whipplei						
Luxilus cardinalis	78	67	7	10	1	1
Notropis nubilus				1		
Campostoma anomalum	45	114	25	230	17	1
Lepomis macrochirus	1	1	3		3	9
Ambloplites rupestris						2
Ameiurus natalis				1		
Ameiurus melas				2		
Percina caprodes						
Etheostoma mihileze		3	1	1		6
Nocomis asper	3			2		
Etheostoma blennioides						
Lepomis megalotis					1	
Ictalurus punctatus						
Pomoxis nigromaculatus						
Lepomis humilis						
Lepomis microlophus						
Lepomis cyanellus	8		1	2	5	3
Lepomis gulosus	1					
Lepomis macrochirus x cyanellus						
Micropterus salmoides						
Micropterus dolumeiu			5			
Micropterus punctulatus						
Etheostoma zonale						
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus			14			
Gambusia affinis		4				1
Fundulus catenatus						6
Notropis boops						
Lepisosteus oculatus						
Fundulus notatus						
Pimephales notatus						
Cyprinella lutrensis						
Hypentelium nigricans						
Moxostoma erythrurum		1				
Dorosoma cepedianum						

Specie Name	RM12-031	RM12-032	RM12-033	RM12-034	RM12-035	RM12-036
Phoxinus erythrogaster		2		22	222	7
Noturus exilis	2		2			
Cottus carolinae	72	3	9	2	99	26
Semolitus atromaculatus					2	
Etheostoma flabellare		62	24	18	40	10
Etheostoma spectabile	58	8	11	27	1	8
Etheostoma whipplei						
Luxilus cardinalis	1	58	8		23	3
Notropis nubilus	2					
Campostoma anomalum	76	241	39	22	1	10
Lepomis macrochirus	1				1	
Ambloplites rupestris	1		1			
Ameiurus natalis						
Ameiurus melas						
Percina caprodes						
Etheostoma mihileze	1		1	2		
Nocomis asper						1
Etheostoma blennioides	1					
Lepomis megalotis	2					
Ictalurus punctatus						
Pomoxis nigromaculatus						
Lepomis humilis						
Lepomis microlophus						
Lepomis cyanellus			1			
Lepomis gulosus						
Lepomis macrochirus x cyanellus						
Micropterus salmoides						
Micropterus dolumeiu						
Micropterus punctulatus						
Etheostoma zonale						
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus						
Gambusia affinis						
Fundulus catenatus						
Notropis boops						
Lepisosteus oculatus						
Fundulus notatus						
Pimephales notatus						
Cyprinella lutrensis						
Hypentelium nigricans						
Moxostoma erythrurum						
Dorosoma cepedianum						

Specie Name	RM12-037	RM12-038	RM12-039	RM12-040	RM12-041	RM12-042
Phoxinus erythrogaster						27
Noturus exilis	2	3		22		
Cottus carolinae	45	16		1		1
Semolitus atromaculatus						
Etheostoma flabellare	51	30				21
Etheostoma spectabile	1	19		10	4	7
Etheostoma whipplei						
Luxilus cardinalis	6	6			7	4
Notropis nubilus						
Campostoma anomalum	1	8		4	4	25
Lepomis macrochirus			4	27	37	
Ambloplites rupestris	1					
Ameiurus natalis			2		1	
Ameiurus melas						
Percina caprodes				15	3	
Etheostoma mihileze						3
Nocomis asper	2					
Etheostoma blennioides					5	
Lepomis megalotis			1	14	27	
Ictalurus punctatus					1	
Pomoxis nigromaculatus					7	
Lepomis humilis						
Lepomis microlophus					4	
Lepomis cyanellus			9	3	6	
Lepomis gulosus					2	
Lepomis macrochirus x cyanellus					42	
Micropterus salmoides			1		1	
Micropterus dolumeiu						1
Micropterus punctulatus			1	1		
Etheostoma zonale			26	6		
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus						
Gambusia affinis						2
Fundulus catenatus						
Notropis boops						
Lepisosteus oculatus						
Fundulus notatus						
Pimephales notatus						
Cyprinella lutrensis						
Hypentelium nigricans						
Moxostoma erythrurum						
Dorosoma cepedianum				1		

Specie Name	RM12-043	RM12-044	RM12-045
Phoxinus erythrogaster		8	
Noturus exilis	9		9
Cottus carolinae	20	46	
Semolitus atromaculatus	1		1
Etheostoma flabellare	34	23	
Etheostoma spectabile	6	8	4
Etheostoma whipplei			1
Luxilus cardinalis	8	26	28
Notropis nubilus	10		5
Campostoma anomalum	22	24	93
Lepomis macrochirus			
Ambloplites rupestris	1	1	
Ameiurus natalis	1		
Ameiurus melas			
Percina caprodes			
Etheostoma mihileze	1	3	
Nocomis asper	1	4	
Etheostoma blennioides	2		
Lepomis megalotis	1		
Ictalurus punctatus			
Pomoxis nigromaculatus			
Lepomis humilis			
Lepomis microlophus			
Lepomis cyanellus			
Lepomis gulosus			
Lepomis macrochirus x cyanellus			
Micropterus salmoides			
Micropterus dolumeiu	1		
Micropterus punctulatus			
Etheostoma zonale			
Pomoxis annularis			
Labidesthes sicculus			
Pimephales promelas			
Fundulus olivaceus			
Gambusia affinis			
Fundulus catenatus			
Notropis boops			
Lepisosteus oculatus			
Fundulus notatus			
Pimephales notatus			
Cyprinella lutrensis			
Hypentelium nigricans			
Moxostoma erythrurum			
Dorosoma cepedianum			

Macroinvertebrates collected in 2012.

Order	Family	Genus	RM12-001	RM12-002	RM12-003	RM12-004	RM12-005	RM12-006
Coleoptera	Amphizoidae	Amphizoa				1		
	Dytiscidae	Hydroponinae						
	Elmidae	Ordobrevia						
	Elmidae	Optioservus	3	3	86	14	62	1
	Elmidae	Stenelmis	4		24	2	6	
	Georyssidae	Georyssus						
	Gyrinidae	Dineutus				1		1
	Gyrinidae	Gyrinus						
	Haliplidae	Peltodytes						
	Hydrophilidae	Berosus				2		
	Hydrophilidae	Tropisternus						
	Melyridae							
	Psepheniidae	Ectopria				1		
	Psepheniidae	Psephenus	26	63	236	5	4	
Diptera	Anthericidae							
	Axymyiidae							
	Ceratopogonidae							
	Chaoboridae	Chaoborus						
	Chironomidae	Chironominae				5		1
	Chironomidae	Orthocladius						
	Chironomidae	Procladius				1		
	Chironomidae	Tanypodinae		11	5	17	34	11
	Culcidae	Anopheles						
	Dixidae							
	Muscidae	Limnophora		2				
	Sciomyzidae							
	Simuliidae	Simulium	1	2		1	9	1
	Syrphyidae							
	Tabanidae	Chrysops						
	Tabanidae	Tabanus	1	1				
	Tipulidae	Antocha		1				
	Tipulidae	Hexatoma				1		
	Tipulidae	Limonia						
	Tipulidae	Tipula	1					
	Tipulidae							1
Ephemeroptera	Baetidae	Baetis	51	18	15	111	4	
	Caenidae	Caenis			12			
	Ephemeridae	Ephemera						
	Ephemerellidae	Ephemerella		16				
	Heptageniidae	Heptagenia	38		30	44	9	
	Heptageniidae	Stenoema		2				
	Insonychiidae	Isonychia	2	1	1	1		
	Leptohyphiidae	Tricorythodes			8			
	Leptophlebiidae	Paraleptaphlebia				17	5	
	Potamathidae	Anthopotamus						
Hemiptera	Corixidae	Cyinatia						
	Corixidae	Micronecta						

	Veliidae	Rhagovelia						
Hymenoptera								
	Scelionidae	Tiphyodytes						
Lepodoptera	Crambidae	Petrophila						
Megaloptera	Corydalidae	Chauliodes						
	Corydalidae	Corydalus	1					
Neuroptera	Sisyridae	Sisyra	1	1				
Odonata	Calopterygidae	Calopteryx						
	Coenogrionidae	Agia						
	Coenogrionidae	Amphiagrion						
	Gomphiidae	Ampylla				1		
	Gomphiidae	Gompus	2					
	Protoneuridae	Protoneua						
Plecoptera	Choroperlidae	Alloperla		1		15		
	Choroperlidae	Sweltsa		1				
	Leuctridae	Zealeuetra	2	1				
	Perlidae	Agnetina		1			2	
	Perlidae	Claasenia					9	1
	Perlidae	Hansonoperla						
	Perlidae	Neoperla		1	36	28	27	1
	Perlidae	Palinella	25	169				
	Perlodidae	Isoperla			2			
Tricoptera	Economidae	Austrotinodes						
	Helicopsychiidae	Helicopsyche						
	Hydropsychidae	Hydropsyche	242	29	152	84	57	
	Philopotamidae	Chimarra	4		1	4	1	
	Polycentropidae	Neuroclipsis						
	Polycentropidae	Polycentropus					1	
	Polycentropidae							
	Sericostomatidae	Agarodes			12			
Amphipoda								
Gastropoda							1	1
Isopoda					1	28	3	
Oligochaete							6	
Planaria								

Order	Family	Genus	RM12-007	RM12-008	RM12-009	RM12-010	RM12-011	RM12-012
Coleoptera	Amphizoidae	Amphizoa						
	Dytiscidae	Hydroponinae					1	1
	Elmidae	Ordobrevia						
	Elmidae	Optioservus	6		4			
	Elmidae	Stenelmis		3	1			
	Georyssidae	Georyssus						
	Gyrinidae	Dineutus				1		1
	Gyrinidae	Gyrinus						
	Haliplidae	Peltodytes		1				
	Hydrophilidae	Berosus						
	Hydrophilidae	Tropisternus		1				
	Melyridae							
	Psepheniidae	Ectopria						
	Psepheniidae	Psephenus			4			
Diptera	Anthericidae							
	Axymyiidae						1	
	Ceratopogonidae						1	
	Chaoboridae	Chaoborus				1		
	Chironomidae	Chironominae		21	3	4	1	1
	Chironomidae	Orthocladius						
	Chironomidae	Procladius						
	Chironomidae	Tanypodinae	1	1	2	1	1	1
	Culcidae	Anopheles					2	
	Dixidae			1			2	1
	Muscidae	Limnophora						
	Sciomyzidae			1				
	Simuliidae	Simulium	132	103	1			
	Syrphyidae							
	Tabanidae	Chrysops				1		
	Tabanidae	Tabanus						
	Tipulidae	Antocha						
	Tipulidae	Hexatoma						
	Tipulidae	Limonia						
	Tipulidae	Tipula						
	Tipulidae			2	1	1		
Ephemeroptera	Baetidae	Baetis		1	3		3	
	Caenidae	Caenis	1	1			2	
	Ephemeridae	Ephemera						
	Ephemerellidae	Ephemerella						
	Heptageniidae	Heptagenia			14			
	Heptageniidae	Stenoema						
	Insonychiidae	Isonychia			1			
	Leptohyphiidae	Tricorythodes			1			
	Leptophlebiidae	Paraleptaphlebia						
	Potamathidae	Anthopotamus						
Hemiptera	Corixidae	Cyinatia		1			1	
	Corixidae	Micronecta						
	Veliidae	Rhagovelia						
Hymenoptera								
	Scelionidae	Tiphyodytes						

Lepodoptera	Crambidae	Petrophila						
Megaloptera	Corydalidae	Chauliodes						
	Corydalidae	Corydalus						
Neuroptera	Sisyridae	Sisyra						
Odonata	Calopterygidae	Calopteryx						
	Coenogrionidae	Agia						
	Coenogrionidae	Amphiagrion		1				
	Gomphiidae	Ampylla						
	Gomphiidae	Gompus						
	Protoneuridae	Protoneua					1	
Plecoptera	Choroperlidae	Alloperla			5			
	Choroperlidae	Sweltsa						
	Leuctridae	Zealeuetra						
	Perlidae	Agnetina						
	Perlidae	Claasenia		1	1			
	Perlidae	Hansonoperla						
	Perlidae	Neoperla		1		1		
	Perlidae	Palinella						
	Perlodidae	Isoperla						
Tricoptera	Economidae	Austrotinodes						
	Helicopsychiidae	Helicopsyche						
	Hydropsychidae	Hydropsyche	2	4	1	1		
	Philopotamidae	Chimarra						
	Polycentropidae	Neuroclipsis						
	Polycentropidae	Polycentropus						
	Polycentropidae							
	Sericostomatidae	Agarodes						
Amphipoda					1			
Gastropoda				6		1		
Isopoda			1		16	1	8	
Oligochaete			10	1		4	1	
Planaria								

Order	Family	Genus	RM12-013	RM12-014	RM12-015	RM12-016	RM12-017	RM12-018
Coleoptera	Amphizoidae	Amphizoa						
	Dytiscidae	Hydroponinae						
	Elmidae	Ordobrevia		9	2		17	1
	Elmidae	Optioservus	105	60	15	14	22	10
	Elmidae	Stenelmis	8	5		6	5	3
	Georyssidae	Georyssus						
	Gyrinidae	Dineutus						
	Gyrinidae	Gyrinus		1				
	Haliplidae	Peltodytes						
	Hydrophilidae	Berosus				1		
	Hydrophilidae	Tropisternus						
	Melyridae				1			
	Psepheniidae	Ectopria	1				1	
	Psepheniidae	Psephenus	21	18	51	3	5	3
Diptera	Anthericidae					4		
	Axymyiidae							
	Ceratopogonidae							
	Chaoboridae	Chaoborus						
	Chironomidae	Chironominae	1	2	2	24	5	1
	Chironomidae	Orthocladius						
	Chironomidae	Procladius				1		
	Chironomidae	Tanypodinae	1		1	3	16	3
	Culcidae	Anopheles						
	Dixidae							
	Muscidae	Limnophora						
	Sciomyzidae							
	Simuliidae	Simulium		1	8	34		
	Syrphyidae							
	Tabanidae	Chrysops						1
	Tabanidae	Tabanus						
	Tipulidae	Antocha						
	Tipulidae	Hexatoma				1		
	Tipulidae	Limonia						
	Tipulidae	Tipula				1		
	Tipulidae		5			5		
Ephemeroptera	Baetidae	Baetis	15	22	19	142	7	16
	Caenidae	Caenis		1		15	1	38
	Ephemeridae	Ephemera		1				
	Ephemerellidae	Ephemerella						
	Heptageniidae	Heptagenia	9	14	4	5	1	68
	Heptageniidae	Stenoema		6				
	Insonychiidae	Isonychia	1	1		1		3
	Leptohyphiidae	Tricorythodes		30		28		4
	Leptophlebiidae	Paraleptaphlebia				4		
	Potamathidae	Anthopotamus						
Hemiptera	Corixidae	Cyinatia						
	Corixidae	Micronecta						
	Veliidae	Rhagovelia						
Hymenoptera								
	Scelionidae	Tiphyodytes						

Lepodoptera	Crambidae	Petrophila						
Megaloptera	Corydalidae	Chauliodes						
	Corydalidae	Corydalus						1
Neuroptera	Sisyridae	Sisyra						
Odonata	Calopterygidae	Calopteryx		1				
	Coenogrionidae	Agia					1	
	Coenogrionidae	Amphiagrion	5	1			1	2
	Gomphiidae	Ampylla		1			2	1
	Gomphiidae	Gompus						
	Protoneuridae	Protoneua						
Plecoptera	Choroperlidae	Alloperla						
	Choroperlidae	Sweltsa						
	Leuctridae	Zealeuetra						
	Perlidae	Agnetina		2				
	Perlidae	Claasenia		1				
	Perlidae	Hansonoperla	1					
	Perlidae	Neoperla	1	6		14		57
	Perlidae	Palinella				1		
	Perlodidae	Isoperla						
Tricoptera	Economidae	Austrotinodes						
	Helicopsychiidae	Helicopsyche						
	Hydropsychidae	Hydropsyche	14	65	54	201	18	8
	Philopotamidae	Chimarra			17	2		
	Polycentropidae	Neuroclipsis						
	Polycentropidae	Polycentropus						
	Polycentropidae							
	Sericostomatidae	Agarodes		1		1		1
Amphipoda								
Gastropoda				1	1			
Isopoda			1	1				
Oligochaete					1		1	
Planaria							3	

Order	Family	Genus	RM12-019	RM12-020	RM12-021	RM12-022	RM12-023	RM12-024
Coleoptera	Amphizoidae	Amphizoa						
	Dytiscidae	Hydroponinae			1			
	Elmidae	Ordobrevia	25		10	2	1	
	Elmidae	Optioservus	35	1	20	6	1	
	Elmidae	Stenelmis	3	1	3	1	2	
	Georyssidae	Georyssus						
	Gyrinidae	Dineutus						
	Gyrinidae	Gyrinus						
	Haliplidae	Peltodytes						
	Hydrophilidae	Berosus						
	Hydrophilidae	Tropisternus						
	Melyridae							
	Psepheniidae	Ectopria						
	Psepheniidae	Psephenus	18	1	38	14	9	
Diptera	Anthericidae							
	Axymyiidae							
	Ceratopogonidae							
	Chaoboridae	Chaoborus						
	Chironomidae	Chironominae		1	6	3	2	
	Chironomidae	Orthocladius						
	Chironomidae	Procladius	1	1		2	1	
	Chironomidae	Tanypodinae	3		2	7	5	
	Culcidae	Anopheles						
	Dixidae							
	Muscidae	Limnophora						
	Sciomyzidae							
	Simuliidae	Simulium				7		
	Syrphyidae							
	Tabanidae	Chrysops	1		1	4	3	
	Tabanidae	Tabanus						
	Tipulidae	Antocha						
	Tipulidae	Hexatoma	1				1	
	Tipulidae	Limonia				1	1	
	Tipulidae	Tipula	1					
	Tipulidae		1					
Ephemeroptera	Baetidae	Baetis	7	17	29	125	3	
	Caenidae	Caenis			5			
	Ephemeridae	Ephemera						
	Ephemerellidae	Ephemerella						
	Heptageniidae	Heptagenia	22	5	49	5	9	
	Heptageniidae	Stenoema						
	Insonychiidae	Isonychia	2		7		1	
	Leptohyphiidae	Tricorythodes				79	20	
	Leptophlebiidae	Paraleptaphlebia						
	Potamathidae	Anthopotamus						
Hemiptera	Corixidae	Cyinatia						
	Corixidae	Micronecta						
	Veliidae	Rhagovelia						
Hymenoptera								
	Scelionidae	Tiphyodytes						

Lepodoptera	Crambidae	Petrophila			1			
Megaloptera	Corydalidae	Chauliodes						
	Corydalidae	Corydalus	2		1	1		
Neuroptera	Sisyridae	Sisyra						
Odonata	Calopterygidae	Calopteryx						
	Coenogrionidae	Agia						
	Coenogrionidae	Amphiagrion	1		6			
	Gomphiidae	Ampylla	11	1	1	2		
	Gomphiidae	Gompus						
	Protoneuridae	Protoneua						
Plecoptera	Choroperlidae	Alloperla					6	
	Choroperlidae	Sweltsa						
	Leuctridae	Zealeuetra						
	Perlidae	Agnetina	2		1			
	Perlidae	Claasenia				1		
	Perlidae	Hansonoperla						
	Perlidae	Neoperla	21		34	5	2	
	Perlidae	Palinella						
	Perlodidae	Isoperla						
Tricoptera	Economidae	Austrotinodes						
	Helicopsychiidae	Helicopsyche						
	Hydropsychidae	Hydropsyche	101	11	55	249	68	
	Philopotamidae	Chimarra		1		1		
	Polycentropidae	Neuroclipsis	1		1			
	Polycentropidae	Polycentropus						
	Polycentropidae							
	Sericostomatidae	Agarodes	1		1	1		
Amphipoda								
Gastropoda			2	1			1	
Isopoda			1	6			1	
Oligochaete				4	1		2	
Planaria			2	13				

Order	Family	Genus	RM12-025	RM12-026	RM12-027	RM12-028	RM12-029	RM12-030
Coleoptera	Amphizoidae	Amphizoa				1		
	Dytiscidae	Hydroponinae					1	
	Elmidae	Ordobrevia		5		2		1
	Elmidae	Optioservus	24	15	2	48	4	2
	Elmidae	Stenelmis	1	4	2	19	5	1
	Georyssidae	Georyssus						
	Gyrinidae	Dineutus		1				
	Gyrinidae	Gyrinus						
	Haliplidae	Peltodytes						
	Hydrophilidae	Berosus						
	Hydrophilidae	Tropisternus						
	Melyridae							
	Psepheniidae	Ectopria						1
	Psepheniidae	Psephenus	65	23	11	9	1	14
Diptera	Anthericidae							1
	Axymyiidae							
	Ceratopogonidae							
	Chaoboridae	Chaoborus						
	Chironomidae	Chironominae	24		1	6	42	1
	Chironomidae	Orthocladius						
	Chironomidae	Procladius	1					
	Chironomidae	Tanypodinae	35	1	1	5	9	
	Culcidae	Anopheles						
	Dixidae							
	Muscidae	Limnophora						
	Sciomyzidae							
	Simuliidae	Simulium	4			10	8	1
	Syrphyidae							
	Tabanidae	Chrysops	3		2		1	1
	Tabanidae	Tabanus						
	Tipulidae	Antocha						
	Tipulidae	Hexatoma				1		
	Tipulidae	Limonia						
	Tipulidae	Tipula	1				1	1
	Tipulidae				1			
Ephemeroptera	Baetidae	Baetis	3	4	44	35	31	10
	Caenidae	Caenis	1		7			
	Ephemeridae	Ephemera						
	Ephemerellidae	Ephemerella						
	Heptageniidae	Heptagenia	15	7	4	21	21	10
	Heptageniidae	Stenoema						
	Insonychiidae	Isonychia	1		7	37	15	1
	Leptohyphiidae	Tricorythodes	1	8	11	1		
	Leptophlebiidae	Paraleptaphlebia				2	3	
	Potamathidae	Anthopotamus						
Hemiptera	Corixidae	Cyinatia						
	Corixidae	Micronecta						
	Veliidae	Rhagovelia						
Hymenoptera							1	
	Scelionidae	Tiphyodytes						

Lepodoptera	Crambidae	Petrophila						
Megaloptera	Corydalidae	Chauliodes						
	Corydalidae	Corydalus	1	5	2			2
Neuroptera	Sisyridae	Sisyra						
Odonata	Calopterygidae	Calopteryx						
	Coenogrionidae	Agia						
	Coenogrionidae	Amphiagrion	1		4	1		1
	Gomphiidae	Ampylla	2		1			4
	Gomphiidae	Gompus						
	Protoneuridae	Protoneua						
Plecoptera	Choroperlidae	Alloperla	13		1			
	Choroperlidae	Sweltsa						
	Leuctridae	Zealeuetra						
	Perlidae	Agnetina	2	1	4	1	1	2
	Perlidae	Claasenia	1	1				
	Perlidae	Hansonoperla						
	Perlidae	Neoperla	5	1	17	6	22	12
	Perlidae	Palinella						
	Perlodidae	Isoperla						
Tricoptera	Economidae	Austrotinodes						
	Helicopsychiidae	Helicopsyche		1		1		1
	Hydropsychidae	Hydropsyche	199	51	141	11	183	73
	Philopotamidae	Chimarra	37	1	1	2	79	1
	Polycentropidae	Neuroclipsis	1					
	Polycentropidae	Polycentropus						
	Polycentropidae							
	Sericostomatidae	Agarodes			2			
Amphipoda								
Gastropoda			1					1
Isopoda			1	25	11	34	11	29
Oligochaete								3
Planaria								

Order	Family	Genus	RM12-031	RM12-032	RM12-033	RM12-034	RM12-035	RM12-036
Coleoptera	Amphizoidae	Amphizoa					1	
	Dytiscidae	Hydroponinae						
	Elmidae	Ordobrevia						
	Elmidae	Optioservus	5	7	3	13	5	1
	Elmidae	Stenelmis	7		6	2		2
	Georyssidae	Georyssus						
	Gyrinidae	Dineutus						
	Gyrinidae	Gyrinus						
	Haliplidae	Peltodytes						
	Hydrophilidae	Berosus						
	Hydrophilidae	Tropisternus						1
	Melyridae							
	Psepheniidae	Ectopria		1				
	Psepheniidae	Psephenus		3			34	
Diptera	Anthericidae							
	Axymyiidae							
	Ceratopogonidae							
	Chaoboridae	Chaoborus						
	Chironomidae	Chironominae	1	35	1	14		1
	Chironomidae	Orthocladius						1
	Chironomidae	Procladius	1		2	3		
	Chironomidae	Tanypodinae	1	27	21	8	2	
	Culcidae	Anopheles						
	Dixidae							
	Muscidae	Limnophora		1				
	Sciomyzidae							
	Simuliidae	Simulium	1	1		1		
	Syrphyidae							1
	Tabanidae	Chrysops		1		4	1	
	Tabanidae	Tabanus						
	Tipulidae	Antocha						
	Tipulidae	Hexatoma			1			
	Tipulidae	Limonia						
	Tipulidae	Tipula						
	Tipulidae				1		1	
Ephemeroptera	Baetidae	Baetis	543	42	10	107	3	
	Caenidae	Caenis					1	
	Ephemeridae	Ephemera						
	Ephemerellidae	Ephemerella						
	Heptageniidae	Heptagenia	6	8	12	9	10	
	Heptageniidae	Stenoema						
	Insonychiidae	Isonychia			3			
	Leptohyphiidae	Tricorythodes	5	78	4		23	
	Leptophlebiidae	Paraleptaphlebia		1		48		
	Potamathidae	Anthopotamus						
Hemiptera	Corixidae	Cyinatia						
	Corixidae	Micronecta						
	Veliidae	Rhagovelia						
Hymenoptera								
	Scelionidae	Tiphyodytes						1

Lepodoptera	Crambidae	Petrophila						
Megaloptera	Corydalidae	Chauliodes			1			
	Corydalidae	Corydalus						
Neuroptera	Sisyridae	Sisyra						
Odonata	Calopterygidae	Calopteryx						
	Coenogrionidae	Agia						
	Coenogrionidae	Amphiagrion	1				1	
	Gomphiidae	Ampylla		2			1	
	Gomphiidae	Gompus						
	Protoneuridae	Protoneua						
Plecoptera	Choroperlidae	Alloperla						
	Choroperlidae	Sweltsa						
	Leuctridae	Zealeuetra						
	Perlidae	Agnetina	1					
	Perlidae	Claasenia						
	Perlidae	Hansonoperla						
	Perlidae	Neoperla	18	3		5	2	
	Perlidae	Palinella						
	Perlodidae	Isoperla				2		
Tricoptera	Economidae	Austrotinodes						1
	Helicopsychiidae	Helicopsyche						1
	Hydropsychidae	Hydropsyche	8	24	109	10	86	
	Philopotamidae	Chimarra		13	4	1		
	Polycentropidae	Neuroclipsis						
	Polycentropidae	Polycentropus						1
	Polycentropidae							3
	Sericostomatidae	Agarodes	1					
Amphipoda								
Gastropoda								
Isopoda			2	11	4	2	7	1
Oligochaete			1	2	1	1	1	
Planaria				6			1	

Order	Family	Genus	RM12-037	RM12-038	RM12-039	RM12-040	RM12-041	RM12-042
Coleoptera	Amphizoidae	Amphizoa	3			1		
	Dytiscidae	Hydroponinae						
	Elmidae	Ordobrevia		20				
	Elmidae	Optioservus	23	35	20	116	20	1
	Elmidae	Stenelmis	19	3	9	5	1	1
	Georyssidae	Georyssus					1	
	Gyrinidae	Dineutus						
	Gyrinidae	Gyrinus						
	Haliplidae	Peltodytes						
	Hydrophilidae	Berosus					1	
	Hydrophilidae	Tropisternus						
	Melyridae							
	Psepheniidae	Ectopria						
	Psepheniidae	Psephenus	97	23				20
Diptera	Anthericidae							
	Axymyiidae							
	Ceratopogonidae							
	Chaoboridae	Chaoborus						
	Chironomidae	Chironominae	10	1	3	44	24	
	Chironomidae	Orthocladius						
	Chironomidae	Procladius				1	1	1
	Chironomidae	Tanypodinae	6	2	3	70	11	8
	Culcidae	Anopheles						
	Dixidae							
	Muscidae	Limnophora	1			1		
	Sciomyzidae							
	Simuliidae	Simulium			23		2	
	Syrphyidae							
	Tabanidae	Chrysops	1	1		1		
	Tabanidae	Tabanus						
	Tipulidae	Antocha						
	Tipulidae	Hexatoma						
	Tipulidae	Limonia						
	Tipulidae	Tipula						
	Tipulidae				2	5	6	1
Ephemeroptera	Baetidae	Baetis	3	18	2	47	3	30
	Caenidae	Caenis	3	1				
	Ephemeridae	Ephemera						
	Ephemerellidae	Ephemerella						
	Heptageniidae	Heptagenia	12	19	14	8	30	15
	Heptageniidae	Stenoema						
	Insonychiidae	Isonychia	3					
	Leptohyphiidae	Tricorythodes	59	38	74	52	194	33
	Leptophlebiidae	Paraleptaphlebia	3	1				1
	Potamathidae	Anthopotamus				13		
Hemiptera	Corixidae	Cyinatia						
	Corixidae	Micronecta						
	Veliidae	Rhagovelia						
Hymenoptera								
	Scelionidae	Tiphyodytes						

Lepodoptera	Crambidae	Petrophila						
Megaloptera	Corydalidae	Chauliodes						
	Corydalidae	Corydalus	1	1	1	1	2	
Neuroptera	Sisyridae	Sisyra						
Odonata	Calopterygidae	Calopteryx						
	Coenogrionidae	Agia						
	Coenogrionidae	Amphiagrion	1	1	1			
	Gomphiidae	Ampylla	2	1				1
	Gomphiidae	Gompus						
	Protoneuridae	Protoneua						
Plecoptera	Choroperlidae	Alloperla	8	1				
	Choroperlidae	Sweltsa						
	Leuctridae	Zealeuetra						
	Perlidae	Agnetina	3	1				
	Perlidae	Claasenia						
	Perlidae	Hansonoperla						
	Perlidae	Neoperla	35	5		8	1	8
	Perlidae	Palinella						
	Perlodidae	Isoperla						
Tricoptera	Economidae	Austrotinodes						
	Helicopsychiidae	Helicopsyche		5				1
	Hydropsychidae	Hydropsyche	148	58	84	141	181	17
	Philopotamidae	Chimarra	5			2		
	Polycentropidae	Neuroclipsis						
	Polycentropidae	Polycentropus						
	Polycentropidae							
	Sericostomatidae	Agarodes		1			1	
Amphipoda								
Gastropoda				1	3			
Isopoda			1					1
Oligochaete				1	16			
Planaria					1			

Order	Family	Genus	RM12-043	RM12-044	RM12-045
Coleoptera	Amphizoidae	Amphizoa	1		
	Dytiscidae	Hydroponinae			
	Elmidae	Ordobrevia		3	
	Elmidae	Optioservus	6	17	2
	Elmidae	Stenelmis	10	3	2
	Georyssidae	Georyssus			
	Gyrinidae	Dineutus			
	Gyrinidae	Gyrinus			
	Haliplidae	Peltodytes			
	Hydrophilidae	Berosus			
	Hydrophilidae	Tropisternus			
	Melyridae				
	Psepheniidae	Ectopria	1		
	Psepheniidae	Psephenus	7	8	6
Diptera	Anthericidae				
	Axymyiidae				
	Ceratopogonidae				
	Chaoboridae	Chaoborus			
	Chironomidae	Chironominae	1	1	1
	Chironomidae	Orthocladius			
	Chironomidae	Procladius	1	1	
	Chironomidae	Tanypodinae	1	7	1
	Culcidae	Anopheles			
	Dixidae				
	Muscidae	Limnophora			
	Sciomyzidae				
	Simuliidae	Simulium		2	1
	Syrphyidae				
	Tabanidae	Chrysops			
	Tabanidae	Tabanus			
	Tipulidae	Antocha			
	Tipulidae	Hexatoma			
	Tipulidae	Limonia			
	Tipulidae	Tipula			
	Tipulidae				
Ephemeroptera	Baetidae	Baetis	34	15	71
	Caenidae	Caenis	1		1
	Ephemeridae	Ephemera			
	Ephemerellidae	Ephemerella			
	Heptageniidae	Heptagenia	8	1	24
	Heptageniidae	Stenoema			
	Insonychiidae	Isonychia	1		28
	Leptohyphiidae	Tricorythodes	1	14	
	Leptophlebiidae	Paraleptaphlebia	2		
	Potamathidae	Anthopotamus			
Hemiptera	Corixidae	Cyinatia			
	Corixidae	Micronecta		1	
	Veliidae	Rhagovelia		1	
Hymenoptera					
	Scelionidae	Tiphyodytes			

Lepodoptera	Crambidae	Petrophila			
Megaloptera	Corydalidae	Chauliodes			
	Corydalidae	Corydalus			2
Neuroptera	Sisyridae	Sisyra			
Odonata	Calopterygidae	Calopteryx			
	Coenogrionidae	Agia			
	Coenogrionidae	Amphiagrion	1		1
	Gomphiidae	Ampylla		1	
	Gomphiidae	Gompus			
	Protoneuridae	Protoneua			
Plecoptera	Choroperlidae	Alloperla			
	Choroperlidae	Sweltsa			
	Leuctridae	Zealeuetra			
	Perlidae	Agnetina			1
	Perlidae	Claasenia			
	Perlidae	Hansonoperla			
	Perlidae	Neoperla	5	5	8
	Perlidae	Palinella			
	Perlodidae	Isoperla			
Tricoptera	Economidae	Austrotinodes			
	Helicopsychiidae	Helicopsyche	3	1	
	Hydropsychidae	Hydropsyche	16	7	17
	Philopotamidae	Chimarra		3	4
	Polycentropidae	Neuroclipsis			
	Polycentropidae	Polycentropus			
	Polycentropidae				
	Sericostomatidae	Agarodes	1		
Amphipoda					
Gastropoda			1		1
Isopoda			1	1	
Oligochaete			1		
Planaria					

Appendix B

Raw data for fish and macroinvertebrates collected in 2013

Fish collected in 2013

Specie Name	RM13-010	RM13-011	RM13-012	RM13-013	RM13-014	RM13-015
Phoxinus erythrogaster				7	7	
Noturus exilis	10	3			5	1
Cottus carolinae	2	4	8	11	4	12
Semolitus atromaculatus						3
Etheostoma flabellare	35	20	1	9	24	64
Etheostoma spectabile		5	20	3	6	
Etheostoma whipplei						
Luxilus cardinalis	1	21	5		23	38
Notropis nubilus					1	
Campostoma anomalum	30		17	22	7	13
Lepomis macrochirus			10			
Ambloplites rupestris	1		1			
Ameiurus natalis						
Ameiurus melas			3	1		
Percina caprodes						
Etheostoma mihileze				8		
Nocomis asper	2					
Etheostoma blennioides						
Lepomis megalotis						
Ictalurus punctatus						
Pomoxis nigromaculatus						
Lepomis humilis						
Lepomis microlophus						
Lepomis cyanellus	2		8			
Lepomis gulosus						
Lepomis macrochirus x cyanellus				3		
Micropterus salmoides						
Micropterus dolumeiu	5				1	
Micropterus punctulatus						
Etheostoma zonale						
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus						
Gambusia affinis	3					
Fundulus catenatus	13				1	
Notropis boops						
Lepisosteus oculatus						
Fundulus notatus		1				
Pimephales notatus			1			
Cyprinella lutrensis						
Hypentelium nigricans						
Moxostoma erythrurum						
Dorosoma cepedianum						

Specie Name	RM13-016	RM13-017	RM13-018	RM13-019	RM13-020	RM13-021
Phoxinus erythrogaster				7	131	32
Noturus exilis	8	3			1	
Cottus carolinae	1	10	2	27	20	18
Semolitus atromaculatus			14		3	3
Etheostoma flabellare	3	3		1	2	9
Etheostoma spectabile	1	1	9	1	7	
Etheostoma whipplei						
Luxilus cardinalis		1	2	2	11	4
Notropis nubilus			2			
Campostoma anomalum			1		5	5
Lepomis macrochirus	4	2				
Ambloplites rupestris		1		1		
Ameiurus natalis						
Ameiurus melas			1		1	
Percina caprodes						
Etheostoma mihileze	1	4				
Nocomis asper						
Etheostoma blennioides						
Lepomis megalotis		2				
Ictalurus punctatus						
Pomoxis nigromaculatus						
Lepomis humilis						
Lepomis microlophus			1			
Lepomis cyanellus		3	14	1	18	
Lepomis gulosus						
Lepomis macrochirus x cyanellus						
Micropterus salmoides						
Micropterus dolumeiu						
Micropterus punctulatus						
Etheostoma zonale						
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus						
Gambusia affinis			2			
Fundulus catenatus						
Notropis boops						
Lepisosteus oculatus						
Fundulus notatus						
Pimephales notatus						
Cyprinella lutrensis						
Hypentelium nigricans						
Moxostoma erythrurum						
Dorosoma cepedianum						

Specie Name	RM13-022	RM13-023	RM13-024	RM13-025	RM13-026	RM13-027
Phoxinus erythrogaster				1		55
Noturus exilis	1	3	14		3	1
Cottus carolinae	22	9	35			22
Semolitus atromaculatus	2			1		6
Etheostoma flabellare	10	15	17	26		27
Etheostoma spectabile		1	4	26		
Etheostoma whipplei						
Luxilus cardinalis	6	1	2	7	4	
Notropis nubilus						
Campostoma anomalum	1		1	3	2	1
Lepomis macrochirus						
Ambloplites rupestris						
Ameiurus natalis						
Ameiurus melas						
Percina caprodes						
Etheostoma mihileze			4		2	
Nocomis asper						
Etheostoma blennioides						
Lepomis megalotis						
Ictalurus punctatus						
Pomoxis nigromaculatus						
Lepomis humilis						
Lepomis microlophus						
Lepomis cyanellus	1				1	
Lepomis gulosus						
Lepomis macrochirus x cyanellus						
Micropterus salmoides						
Micropterus dolumeiu						
Micropterus punctulatus						
Etheostoma zonale						
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus						
Gambusia affinis						
Fundulus catenatus						
Notropis boops						
Lepisosteus oculatus						
Fundulus notatus						
Pimephales notatus						
Cyprinella lutrensis						
Hypentelium nigricans						
Moxostoma erythrurum						
Dorosoma cepedianum						

Specie Name	RM13-028	RM13-029	RM13-030	RM13-031	RM13-032	RM13-033
Phoxinus erythrogaster	3					
Noturus exilis	26	1		6	1	
Cottus carolinae	8	1	3	4	3	2
Semolitus atromaculatus		2				
Etheostoma flabellare	11			37		
Etheostoma spectabile	8	3	3	9	2	1
Etheostoma whipplei						
Luxilus cardinalis	21	11	2	17	2	4
Notropis nubilus	8	40				
Campostoma anomalum	54	14		11		12
Lepomis macrochirus			33		3	
Ambloplites rupestris	1					
Ameiurus natalis			2			
Ameiurus melas						
Percina caprodes						
Etheostoma mihileze	10		1	2		
Nocomis asper	2		2			
Etheostoma blennioides	1	1				
Lepomis megalotis		26	4		3	
Ictalurus punctatus						
Pomoxis nigromaculatus						
Lepomis humilis						
Lepomis microlophus						
Lepomis cyanellus						1
Lepomis gulosus						
Lepomis macrochirus x cyanellus						
Micropterus salmoides						
Micropterus dolumeiu			4		3	
Micropterus punctulatus						
Etheostoma zonale						
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus		1				
Gambusia affinis						
Fundulus catenatus						
Notropis boops	1					
Lepisosteus oculatus						
Fundulus notatus						
Pimephales notatus						
Cyprinella lutrensis						
Hypentelium nigricans			1			
Moxostoma erythrurum						
Dorosoma cepedianum						

Specie Name	RM13-034	RM13-035	RM13-036	RM13-037	RM13-038	RM13-039
Phoxinus erythrogaster		70			14	12
Noturus exilis	13				11	12
Cottus carolinae	4		3	19	7	17
Semolitus atromaculatus		19		11	3	
Etheostoma flabellare				7	4	2
Etheostoma spectabile	7	86	22	9	9	16
Etheostoma whipplei						
Luxilus cardinalis	27		5	8	17	13
Notropis nubilus			9			
Campostoma anomalum	30	41	2	15	10	17
Lepomis macrochirus	7		7	3	1	
Ambloplites rupestris						
Ameiurus natalis						
Ameiurus melas						
Percina caprodes						
Etheostoma mihileze				6	3	1
Nocomis asper	1					
Etheostoma blennioides						
Lepomis megalotis	12					
Ictalurus punctatus						
Pomoxis nigromaculatus						
Lepomis humilis						
Lepomis microlophus				2		
Lepomis cyanellus	6	12	4	24	2	
Lepomis gulosus						
Lepomis macrochirus x cyanellus						
Micropterus salmoides						
Micropterus dolumeiu			5			
Micropterus punctulatus						
Etheostoma zonale						
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus						
Gambusia affinis		4	1		1	
Fundulus catenatus						
Notropis boops						
Lepisosteus oculatus						
Fundulus notatus						
Pimephales notatus						
Cyprinella lutrensis						
Hypentelium nigricans						
Moxostoma erythrurum						
Dorosoma cepedianum						

Specie Name	RM13-040	RM13-041	RM13-042	RM13-043	RM13-044	RM13-045
Phoxinus erythrogaster	3					
Noturus exilis	1	7	14	8		
Cottus carolinae	2	23	6	29		
Semolitus atromaculatus	2					
Etheostoma flabellare	2	26		1		
Etheostoma spectabile	2	8	19	1	12	
Etheostoma whipplei						
Luxilus cardinalis	3	19	4	10		
Notropis nubilus	1					
Campostoma anomalum	16	4	208	2	16	1
Lepomis macrochirus					1	2
Ambloplites rupestris						
Ameiurus natalis					1	
Ameiurus melas						
Percina caprodes						1
Etheostoma mihileze		1		1		
Nocomis asper				5		
Etheostoma blennioides			1		14	2
Lepomis megalotis					2	
Ictalurus punctatus						1
Pomoxis nigromaculatus						
Lepomis humilis						
Lepomis microlophus		1			6	
Lepomis cyanellus		2			13	
Lepomis gulosus					3	
Lepomis macrochirus x cyanellus						
Micropterus salmoides					1	4
Micropterus dolumeiu						
Micropterus punctulatus						
Etheostoma zonale					1	
Pomoxis annularis						
Labidesthes sicculus						
Pimephales promelas						
Fundulus olivaceus				1		
Gambusia affinis						
Fundulus catenatus						
Notropis boops					1	
Lepisosteus oculatus						
Fundulus notatus						1
Pimephales notatus						
Cyprinella lutrensis						
Hypentelium nigricans						
Moxostoma erythrurum						
Dorosoma cepedianum						

Specie Name	RM13-046
Phoxinus erythrogaster	
Noturus exilis	
Cottus carolinae	
Semolitus atromaculatus	
Etheostoma flabellare	
Etheostoma spectabile	
Etheostoma whipplei	
Luxilus cardinalis	
Notropis nubilus	
Campostoma anomalum	102
Lepomis macrochirus	10
Ambloplites rupestris	
Ameiurus natalis	
Ameiurus melas	1
Percina caprodes	50
Etheostoma mihileze	
Nocomis asper	
Etheostoma blennioides	
Lepomis megalotis	
Ictalurus punctatus	
Pomoxis nigromaculatus	
Lepomis humilis	
Lepomis microlophus	
Lepomis cyanellus	1
Lepomis gulosus	
Lepomis macrochirus x cyanellus	
Micropterus salmoides	15
Micropterus dolumeiu	
Micropterus punctulatus	
Etheostoma zonale	
Pomoxis annularis	
Labidesthes sicculus	
Pimephales promelas	
Fundulus olivaceus	
Gambusia affinis	
Fundulus catenatus	
Notropis boops	
Lepisosteus oculatus	
Fundulus notatus	
Pimephales notatus	
Cyprinella lutrensis	
Hypentelium nigricans	
Moxostoma erythrurum	
Dorosoma cepedianum	

Macroinvertebrates collected in 2013.

Order	Family	Genus	RM13-010	RM13-011	RM13-012	RM13-013	RM13-014	RM13-015
Coleoptera	Amphizoidae	Amphizoa						
	Dytiscidae	Stictotarsus					2	
	Elmidae	Ordobrevia					1	2
	Elmidae	Optioservus	1	14	5	1	14	30
	Elmidae	Stenelmis	1	6	1	1	4	3
	Georyssidae	Georyssus				1		
	Hydrophilidae	Berosus						
	Hydrophilidae	Tropisternus				1		
	Psepheniidae	Ectopria						1
	Psepheniidae	Psephenus	16	10	1		10	41
Diptera	Anthericidae							
	Axymyiidae							
	Ceratopogonidae		1					
	Chironomidae	Chironominae	6	43	18	20	121	4
	Chironomidae	Orthocladius						
	Chironomidae	Procladius	1	4	2	4	3	
	Chironomidae	Tanypodinae	2	4	3		16	2
	Muscidae	Limnophora						
	Simuliidae	Simulium		1	4	4	12	5
	Tabanidae	Chrysops	1					
	Thaumaleidae	Androposopa						
	Tipulidae	Hexatoma					1	
	Tipulidae	Limonia						
	Tipulidae	Tipula			1		1	
	Tipulidae			1	1	1	1	
Ephemeroptera	Baetidae	Baetis	17	53	42	92	115	26
	Caenidae	Caenis			7		1	1
	Ephemerellidae	Ephemerella						
	Heptageniidae	Heptagenia	10	59	19	4	7	17
	Heptageniidae	Maccaffertium						
	Heptageniidae	Stenoema						
	Insonychiidae	Isonychia	5	3	1		3	1
	Leptohyphidae	Leptohyphes						
	Leptohyphidae	Tricorythodes						24
	Leptophlebiidae	Paraleptaphlebia	1	28	4		10	1
	Potamathidae	Anthopotamus						
Lepodoptera	Crambidae	Petrophila						
Megaloptera	Corydalidae	Corydalus	5					1
	Corydalidae	Nigronia					1	
Odonata	Coenogrionidae	Amphiagrion	1	2				
	Aeshnidae	Aeshnidae					1	
	Cordulidae	Neurocordulia						
	Gomphidae	Ampylla		1			1	2
	Protoneuridae	Protoneua						
Plecoptera	Choroperlidae	Alloperla	1	1			7	
	Leuctridae	Leuctra		2	1	1	1	
	Perlidae	Agnetina	4	2			3	2

	Perlidae	Claasenia						
	Perlidae	Neoperla	10	13	12	2	14	7
	Perlodidae	Isoperla				1		
Tricoptera	Economidae	Austrotinodes			1			
	Glossosamatidae	Glossossoma			1			1
	Helicopsychiidae	Helicopsyche	3	5	2		4	5
	Hydropsychidae	Hydropsyche	1	6			9	12
	Limnephilidae	Dicosmoecus			1			
	Philopotamidae	Chimarra	1	7	1		2	2
	Polycentropidae	Neuroclipsis						
	Polycentropidae	Polycentropus						
	Phryganeidae	Agryphia						
	Sericostomatidae	Agarodes						
Amphipoda						13		1
Gastropoda			11	24	1	1	8	26
Hirunea								
Isopoda			11	34	41	1367	6	258
Oligochaete			1		1	1	1	1
Planaria				13	1			

Order	Family	Genus	RM13-016	RM13-017	RM13-018	RM13-019	RM13-020	RM13-021
Coleoptera	Amphizoidae	Amphizoa						
	Dytiscidae	Stictotarsus			1			
	Elmidae	Ordobrevia						1
	Elmidae	Optioservus	1	2	1	1	1	1
	Elmidae	Stenelmis	1	1	1		1	
	Georyssidae	Georyssus						
	Hydrophilidae	Berosus	1					
	Hydrophilidae	Tropisternus						
	Psepheniidae	Ectopria	1	1				
	Psepheniidae	Psephenus	5	10	3	1	1	
Diptera	Anthericidae							
	Axymyiidae							
	Ceratopogonidae						1	1
	Chironomidae	Chironominae	2	2	4	3	18	15
	Chironomidae	Orthocladius						2
	Chironomidae	Procladius	1		1	1	4	1
	Chironomidae	Tanypodinae	1	2			2	
	Muscidae	Limnophora						
	Simuliidae	Simulium		1			1	3
	Tabanidae	Chrysops						
	Thaumaleidae	Androposopa						
	Tipulidae	Hexatoma						
	Tipulidae	Limonia						
	Tipulidae	Tipula			1			
	Tipulidae							
Ephemeroptera	Baetidae	Baetis	80	52	65	2	32	8
	Caenidae	Caenis		1		1		
	Ephemerellidae	Ephemerella		1				1
	Heptageniidae	Heptagenia	4	13	11	8	53	8
	Heptageniidae	Maccaffertium						
	Heptageniidae	Stenoema						
	Insonychiidae	Isonychia	1		3	1	1	
	Leptohyphidae	Leptohyphes						
	Leptohyphidae	Tricorythodes	5	4		1		1
	Leptophlebiidae	Paraleptaphlebia					1	
	Potamathidae	Anthopotamus						
Lepodoptera	Crambidae	Petrophila						
Megaloptera	Corydalidae	Corydalus		2	1	1		
	Corydalidae	Nigronia						
Odonata	Coenogrionidae	Amphiagrion	1	1				
	Aeshnidae	Aeshnidae						
	Cordulidae	Neurocordulia						
	Gomphidae	Ampylla		1				
	Protoneuridae	Protoneua		1				
Plecoptera	Choroperlidae	Alloperla	4		10		8	1
	Leuctridae	Leuctra	3					
	Perlidae	Agnetina		2		1	1	
	Perlidae	Claasenia						
	Perlidae	Neoperla	2	7	4		7	1
	Perlodidae	Isoperla	1			1	12	1

Tricoptera	Economidae	Austrotinodes						
	Glossosamatidae	Glossossoma						
	Helicopsychiidae	Helicopsyche		3			2	3
	Hydropsychidae	Hydropsyche		3	1		1	1
	Limnephilidae	Dicosmoecus						
	Philopotamidae	Chimarra		4				
	Polycentropidae	Neuroclipsis						
	Polycentropidae	Polycentropus	1	1				
	Phryganeidae	Agryphia						
	Sericostomatidae	Agarodes		1				
Amphipoda			10		4		1	
Gastropoda			5	3	5			1
Hirunea			1					
Isopoda			98	30	65	2	3	6
Oligochaete			1	1	1			
Planaria				1				

Order	Family	Genus	RM13-022	RM13-023	RM13-024	RM13-025	RM13-026	RM13-027
Coleoptera	Amphizoidae	Amphizoa						
	Dytiscidae	Stictotarsus						
	Elmidae	Ordobrevia				1		
	Elmidae	Optioservus	1	3		1	2	1
	Elmidae	Stenelmis	1	1			1	1
	Georyssidae	Georyssus						
	Hydrophilidae	Berosus						
	Hydrophilidae	Tropisternus						
	Psepheniidae	Ectopria						
	Psepheniidae	Psephenus	6	7	1	5	1	1
Diptera	Anthericidae							
	Axymyiidae							
	Ceratopogonidae					1	1	
	Chironomidae	Chironominae	2	2	1	26	20	64
	Chironomidae	Orthocladius				1		11
	Chironomidae	Procladius			1	7	2	1
	Chironomidae	Tanypodinae		1		1		1
	Muscidae	Limnophora						
	Simuliidae	Simulium		1		4	6	5
	Tabanidae	Chrysops						
	Thaumaleidae	Androposopa						
	Tipulidae	Hexatoma						
	Tipulidae	Limonia						
	Tipulidae	Tipula						
	Tipulidae							
Ephemeroptera	Baetidae	Baetis	7	6	1	25	23	63
	Caenidae	Caenis	1					
	Ephemerellidae	Ephemerella		1	1	1		2
	Heptageniidae	Heptagenia	41	40	8	18		17
	Heptageniidae	Maccaffertium						
	Heptageniidae	Stenoema						
	Insonychiidae	Isonychia	1	3	1	2	1	1
	Leptohyphidae	Leptohyphes						
	Leptohyphidae	Tricorythodes						
	Leptophlebiidae	Paraleptaphlebia		1	1	1		
	Potamathidae	Anthopotamus						
Lepodoptera	Crambidae	Petrophila						
Megaloptera	Corydalidae	Corydalus	1					
	Corydalidae	Nigronia						
Odonata	Coenogrionidae	Amphiagrion						
	Aeshnidae	Aeshnidae						
	Cordulidae	Neurocordulia						
	Gomphidae	Ampylla				1		
	Protoneuridae	Protoneua						
Plecoptera	Choroperlidae	Alloperla	1	3	2	4		2
	Leuctridae	Leuctra						
	Perlidae	Agnetina	1	1		1		
	Perlidae	Claasenia						1
	Perlidae	Neoperla	2	1	1	5	3	6
	Perlodidae	Isoperla	1	1	1			7

Tricoptera	Economidae	Austrotinodes						
	Glossosamatidae	Glossossoma						
	Helicopsychiidae	Helicopsyche	2	1				
	Hydropsychidae	Hydropsyche	1	1		2	1	1
	Limnephilidae	Dicosmoecus						
	Philopotamidae	Chimarra	1					
	Polycentropidae	Neuroclipsis						
	Polycentropidae	Polycentropus						
	Phryganeidae	Agryphia						
	Sericostomatidae	Agarodes					1	
Amphipoda				1	1	1		
Gastropoda			1	1		3		1
Hirunea			1				1	
Isopoda			1	1			1	9
Oligochaete							1	1
Planaria								1

Order	Family	Genus	RM13-028	RM13-029	RM13-030	RM13-031	RM13-032	RM13-033
Coleoptera	Amphizoidae	Amphizoa						
	Dytiscidae	Stictotarsus						
	Elmidae	Ordobrevia		1				
	Elmidae	Optioservus	1	3	28	1	9	
	Elmidae	Stenelmis	1	2	4	12	2	
	Georyssidae	Georyssus						
	Hydrophilidae	Berosus						
	Hydrophilidae	Tropisternus						
	Psepheniidae	Ectopria						
	Psepheniidae	Psephenus	6	1	2	1	13	
Diptera	Anthericidae							
	Axymyiidae							
	Ceratopogonidae							
	Chironomidae	Chironominae	35	3	89	54	5	19
	Chironomidae	Orthocladius	1					3
	Chironomidae	Procladius	1		1	3	1	2
	Chironomidae	Tanypodinae	1	2	1	1	6	4
	Muscidae	Limnophora						
	Simuliidae	Simulium	1	7	23	1		2
	Tabanidae	Chrysops						
	Thaumaleidae	Androposopa						
	Tipulidae	Hexatoma						
	Tipulidae	Limonia						
	Tipulidae	Tipula						
	Tipulidae							
Ephemeroptera	Baetidae	Baetis	38	16	96	4	119	21
	Caenidae	Caenis					5	
	Ephemerellidae	Ephemerella	1					
	Heptageniidae	Heptagenia	3	1	1	59	26	3
	Heptageniidae	Maccaffertium	1				1	
	Heptageniidae	Stenoema						
	Insonychiidae	Isonychia				14	1	
	Leptohyphidae	Leptohyphes		1				
	Leptohyphidae	Tricorythodes	3	5				
	Leptophlebiidae	Paraleptaphlebia	1				5	
	Potamathidae	Anthopotamus						
Lepodoptera	Crambidae	Petrophila				6		
Megaloptera	Corydalidae	Corydalus				5	1	
	Corydalidae	Nigronia				6	1	
Odonata	Coenogrionidae	Amphiagrion		1	1			
	Aeshnidae	Aeshnidae						
	Cordulidae	Neurocordulia		1				
	Gomphidae	Ampylla		1		1	1	
	Protoneuridae	Protoneua			1			
Plecoptera	Choroperlidae	Alloperla	1			4		
	Leuctridae	Leuctra						
	Perlidae	Agnetina						
	Perlidae	Claasenia						
	Perlidae	Neoperla	1			5	9	
	Perlodidae	Isoperla						

Tricoptera	Economidae	Austrotinodes						
	Glossosamatidae	Glossossoma	1	1				
	Helicopsychiidae	Helicopsyche	1			3	2	
	Hydropsychidae	Hydropsyche	34	3		118	18	1
	Limnephilidae	Dicosmoecus						
	Philopotamidae	Chimarra	5			89	1	
	Polycentropidae	Neuroclipsis						
	Polycentropidae	Polycentropus				1		
	Phryganeidae	Agryphia						
	Sericostomatidae	Agarodes	1					
Amphipoda			1					5
Gastropoda			1	2	26	1	7	11
Hirunea					5			
Isopoda			3	1		3	1	13
Oligochaete				1	1			3
Planaria				1	12		2	

Order	Family	Genus	RM13-034	RM13-035	RM13-036	RM13-037	RM13-038	RM13-039
Coleoptera	Amphizoidae	Amphizoa						
	Dytiscidae	Stictotarsus						
	Elmidae	Ordobrevia	1			1	1	5
	Elmidae	Optioservus	29	2	2	3	1	5
	Elmidae	Stenelmis	1	4	27	1	1	1
	Georyssidae	Georyssus						1
	Hydrophilidae	Berosus						
	Hydrophilidae	Tropisternus						
	Psepheniidae	Ectopria		1				
	Psepheniidae	Psephenus	19		1	6	9	4
Diptera	Anthericidae							
	Axymyiidae							
	Ceratopogonidae							
	Chironomidae	Chironominae	13	7	3	5	13	72
	Chironomidae	Orthocladius						2
	Chironomidae	Procladius				3		2
	Chironomidae	Tanypodinae	3	2	2	7	4	9
	Muscidae	Limnophora						
	Simuliidae	Simulium	1	1	1	1	7	19
	Tabanidae	Chrysops						
	Thaumaleidae	Androposopa						
	Tipulidae	Hexatoma			1			
	Tipulidae	Limonia						
	Tipulidae	Tipula						
	Tipulidae							
Ephemeroptera	Baetidae	Baetis	40	32	140	57	12	129
	Caenidae	Caenis			11		3	1
	Ephemerellidae	Ephemerella						3
	Heptageniidae	Heptagenia	6	7	17	9	11	5
	Heptageniidae	Maccaffertium		3			1	
	Heptageniidae	Stenoema						
	Insonychiidae	Isonychia			4		1	3
	Leptohyphidae	Leptohyphes						
	Leptohyphidae	Tricorythodes			4	6	1	12
	Leptophlebiidae	Paraleptaphlebia			1	1	7	1
	Potamathidae	Anthopotamus						
Lepodoptera	Crambidae	Petrophila						
Megaloptera	Corydalidae	Corydalus	1				1	
	Corydalidae	Nigronia				1	1	1
Odonata	Coenogrionidae	Amphiagrion		1		1	1	
	Aeshnidae	Aeshnidae						
	Cordulidae	Neurocordulia						
	Gomphidae	Ampylla	1					
	Protoneuridae	Protoneua						
Plecoptera	Choroperlidae	Alloperla				1	1	1
	Leuctridae	Leuctra						
	Perlidae	Agnetina				1		
	Perlidae	Claasenia						
	Perlidae	Neoperla			8	7	1	2
	Perlodidae	Isoperla						

Tricoptera	Economidae	Austrotinodes						
	Glossosamatidae	Glossossoma						1
	Helicopsychiidae	Helicopsyche		2	1	4		
	Hydropsychidae	Hydropsyche	13	45	40	61	41	56
	Limnephilidae	Dicosmoecus						
	Philopotamidae	Chimarra	24		4	2	3	13
	Polycentropidae	Neuroclipsis						
	Polycentropidae	Polycentropus			1			
	Phryganeidae	Agryphia						
	Sericostomatidae	Agarodes			1			
Amphipoda				1		2	3	
Gastropoda			3	19		3	3	
Hirunea			1	2				
Isopoda						9		1
Oligochaete				2		1		
Planaria			14	2				

Order	Family	Genus	RM13-040	RM13-041	RM13-042	RM13-043	RM13-044	RM13-045
Coleoptera	Amphizoidae	Amphizoa						
	Dytiscidae	Stictotarsus						
	Elmidae	Ordobrevia		1		4		
	Elmidae	Optioservus		7	18	7		49
	Elmidae	Stenelmis	1		45	5	3	26
	Georyssidae	Georyssus	1					
	Hydrophilidae	Berosus						
	Hydrophilidae	Tropisternus						
	Psepheniidae	Ectopria						
	Psepheniidae	Psephenus	1	17	1	2		
Diptera	Anthericidae							
	Axymyiidae							
	Ceratopogonidae						2	
	Chironomidae	Chironominae	17	5	10	2	25	8
	Chironomidae	Orthocladius			1		1	2
	Chironomidae	Procladius	1			1		
	Chironomidae	Tanypodinae	8	18		2	2	1
	Muscidae	Limnophora						
	Simuliidae	Simulium	23	10	29	6	17	3
	Tabanidae	Chrysops			1			
	Thaumaleidae	Androposopa						1
	Tipulidae	Hexatoma			2			
	Tipulidae	Limonia						
	Tipulidae	Tipula						
	Tipulidae						1	
Ephemeroptera	Baetidae	Baetis	57	28	294	56	1	
	Caenidae	Caenis		5	8	1		5
	Ephemerellidae	Ephemerella				1		
	Heptageniidae	Heptagenia	3	3	32	27	1	
	Heptageniidae	Maccaffertium						
	Heptageniidae	Stenoema			7			
	Insonychiidae	Isonychia			26	3		
	Leptohyphidae	Leptohyphes						10
	Leptohyphidae	Tricorythodes	7	5		1	16	12
	Leptophlebiidae	Paraleptaphlebia	1	1				
	Potamathidae	Anthopotamus						
Lepodoptera	Crambidae	Petrophila						2
Megaloptera	Corydalidae	Corydalus			1	1		
	Corydalidae	Nigronia			9	3		
Odonata	Coenogrionidae	Amphiagrion		1			1	1
	Aeshnidae	Aeshnidae						
	Cordulidae	Neurocordulia						
	Gomphidae	Ampylla				1		
	Protoneuridae	Protoneua						
Plecoptera	Choroperlidae	Alloperla		8		1		
	Leuctridae	Leuctra						
	Perlidae	Agnetina						
	Perlidae	Claasenia						
	Perlidae	Neoperla		7	4	9		
	Perlodidae	Isoperla				1		

Tricoptera	Economidae	Austrotinodes						1
	Glossosamatidae	Glossossoma						
	Helicopsychiidae	Helicopsyche		4				
	Hydropsychidae	Hydropsyche	4	81	55	93	70	88
	Limnephilidae	Dicosmoecus						
	Philopotamidae	Chimarra		24	3	2		
	Polycentropidae	Neuroclipsis						
	Polycentropidae	Polycentropus	1			1		1
	Phryganeidae	Agryphia				1		
	Sericostomatidae	Agarodes			1			2
Amphipoda			6					
Gastropoda			7			1	4	8
Hirunea						1	1	3
Isopoda			1	6				
Oligochaete				1				
Planaria							3	

Order	Family	Genus	RM13-046
Coleoptera	Amphizoidae	Amphizoa	
	Dytiscidae	Stictotarsus	
	Elmidae	Ordobrevia	
	Elmidae	Optioservus	41
	Elmidae	Stenelmis	41
	Georyssidae	Georyssus	
	Hydrophilidae	Berosus	
	Hydrophilidae	Tropisternus	
	Psepheniidae	Ectopria	
	Psepheniidae	Psephenus	
Diptera	Anthericidae		
	Axymyiidae		
	Ceratopogonidae		
	Chironomidae	Chironominae	11
	Chironomidae	Orthocladius	
	Chironomidae	Procladius	1
	Chironomidae	Tanypodinae	14
	Muscidae	Limnophora	
	Simuliidae	Simulium	1
	Tabanidae	Chrysops	
	Thaumaleidae	Androposopa	
	Tipulidae	Hexatoma	
	Tipulidae	Limonia	
	Tipulidae	Tipula	
	Tipulidae		
Ephemeroptera	Baetidae	Baetis	1
	Caenidae	Caenis	1
	Ephemerellidae	Ephemerella	
	Heptageniidae	Heptagenia	38
	Heptageniidae	Maccaffertium	
	Heptageniidae	Stenoema	10
	Insonychiidae	Isonychia	
	Leptohyphidae	Leptohyphes	
	Leptohyphidae	Tricorythodes	23
	Leptophlebiidae	Paraleptaphlebia	6
	Potamathidae	Anthopotamus	4
Lepodoptera	Crambidae	Petrophila	
Megaloptera	Corydalidae	Corydalus	1
	Corydalidae	Nigronia	
Odonata	Coenogrionidae	Amphiagrion	
	Aeshnidae	Aeshnidae	
	Cordulidae	Neurocordulia	
	Gomphidae	Ampylla	
	Protoneuridae	Protoneua	
Plecoptera	Choroperlidae	Alloperla	
	Leuctridae	Leuctra	
	Perlidae	Agnetina	
	Perlidae	Claasenia	
	Perlidae	Neoperla	10
	Perlodidae	Isoperla	

Tricoptera	Economidae	Austrotinodes	
	Glossosamatidae	Glossossoma	
	Helicopsychiidae	Helicopsyche	15
	Hydropsychidae	Hydropsyche	55
	Limnephilidae	Dicosmoecus	
	Philopotamidae	Chimarra	
	Polycentropidae	Neuroclipsis	
	Polycentropidae	Polycentropus	
	Phryganeidae	Agryphia	
	Sericostomatidae	Agarodes	6
Amphipoda			
Gastropoda			
Hirunea			
Isopoda			
Oligochaete			
Planaria			