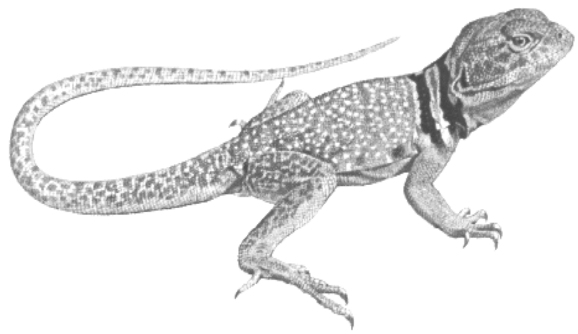

The Glade

Newsletter of the Missouri Chapter of The Society for Conservation Biology

Volume 16 Number 1 July 2014

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SPECIAL ISSUE FEATURING STUDENT RESEARCH

This issue features articles written by past winners of our annual Student Poster Competition. Each year, during the Missouri Natural Resources Conference, the Missouri Chapter gives cash awards and complimentary memberships in the Society for Conservation Biology to two students. See page 24 for details on entering the March, 2014 poster contest.

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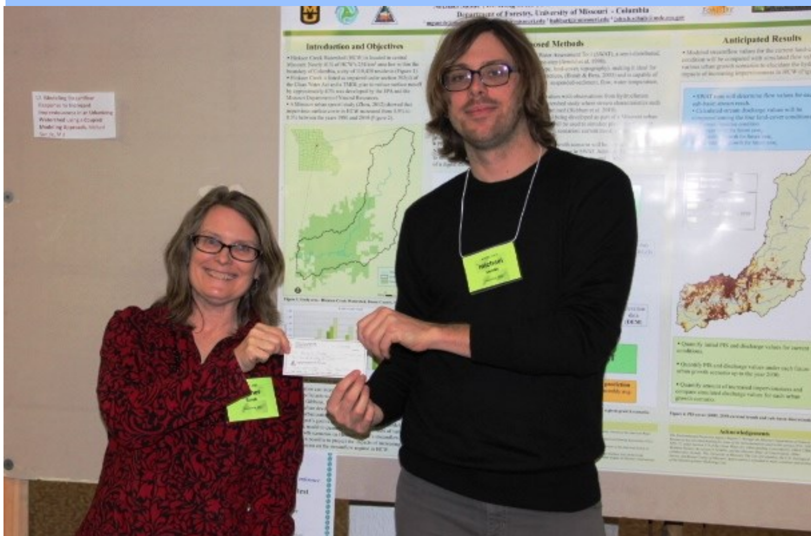
VISIT OUR NEW WEBSITE: MOSCB.WEEBLY.COM

NEWS AND NOTES: MNRC 2013



2013 Student Poster Contest Winners

Ninth Annual Student Poster Contest first place winner Michael Sunde (top left photo) and second place winner Ashley Schulz (bottom left photo) are presented their prizes by outgoing MOSCB President Esther Stroh, accompanied by incoming MOSCB President Stephanie Schuttler at the 2013 Missouri Natural Resources Conference on January 30th. Read about Michael's and Ashley's research in this issue.

2013 Silent Auction

Items donated by friends of MOSCB covered two tables at MNRC this year (above and left photos). Stephanie Schuttler and Esther Stroh mind the booth while auction donor and MOSCB member Nels Holmgren shops. Income from the silent auction supports our annual the student poster contest and other MOSCB activities. This year we earned over $800.

ICCB 2013:
Connecting Systems, Disciplines and Stakeholders

Stephanie Schuttler

The Society for Conservation Biology will host the 26th International Congress for Conservation Biology July 21-25 in Baltimore, Maryland. I am excited to be presenting both for the Missouri Chapter on our successes and activities and also on my original research on the social structure of African forest elephants. This year's theme, Connecting Systems, Disciplines and Stakeholders, is representative of the fact that humans are an essential component in conservation. I first learned this lesson when I was a study abroad student at the School for Field Studies' Center for Wildlife Management in Kenya. This program incorporated not only an ecology and wildlife component, but also a societal one. As large African megafauna cannot be contained in fragmented national parks, it is essential to involve, embrace, and allow benefits to the local community in conservation efforts.

There are plenty of interesting and engaging symposia, but one I am most looking forward to attending is "Detecting, Understanding and Deterring Conservation Crime." This is a pressing and crucial issue given the rampant rise in poaching over the past few years. Species especially at risk include elephants and rhinos, which are still relentlessly poached for their tusks and horns. Conservation criminology is an important and emerging field as the nature of poaching events has extended beyond individuals in the local community to international, well-organized criminal organizations. For example, in the recent mass slaughter of 26 forest elephants at world heritage Dzanga-Ndoki National Park in the Central African Republic, strong evidence points to Sudan's army and Central Reserve police. This symposium will highlight recent innovations in detecting and deterring conservation crimes, and highlight future directions and guidance on collaborative approaches to deter conservation crime.

Two plenary talks I am excited about involve the communication of science and the involvement of the public through citizen science. "The Rocket Model for Effective Communications" is a talk about preparing scientists to communicate with the public, especially journalists. This issue is also crucial in conservation. Science literacy in the United States continues to decline and issues such as climate change become politicized while the results of studies are lost. The session ends with a demonstration of the "rocket model;" a mock TV interview on scientific integrity with former SCB Executive Director Dr. Alan Thornhill. I am looking forward to learning how to improve my communication skills and sharing them with the scientific community.

ICCB Program Available for Download

The ICCB Program is available for download. See the complete scientific program and schedule of events here.

ICCB (continued)

Finally, John Fitzpatrick and Caren Cooper will lead the plenary "Humans as Biological Sensors, Democratization of Science, and Our New Relationship with the Earth." This plenary talk focuses on the role of citizen science in conservation research. As the Internet and technology have allowed this type of outreach to expand, more and more scientists are using citizens to contribute in the data collection process. This plenary will provide successes from eBird, an online checklist for the birding community and one of the world's largest observational database on a non-human organism. In March of 2012, more than 3.1 million bird observations were recorded in eBird across North America! The potential of citizen science is huge for research, communication, and outreach and will certainly be a tool for scientists today and in the future. I look forward to these talks, in addition to the opportunities to connect with thousands of conservation professionals from across the world.

MOSCB President Stephanie Schuttler will attend ICCB 2013 in Baltimore and represent MOSCB. Read her blog posts about ICCB here.

About the Author

Stephanie Schuttler is MOSCB President and a postdoctoral fellow in the Department of Fisheries & Wildlife at the University of Missouri in Columbia. Her research interests include conservation biology, animal behavior, and molecular ecology. Contact her at schuttlers@missouri.edu

Stephanie will present a poster about MOSCB at a special session on SCB Chapters at the conference. You can view our chapter poster online here.

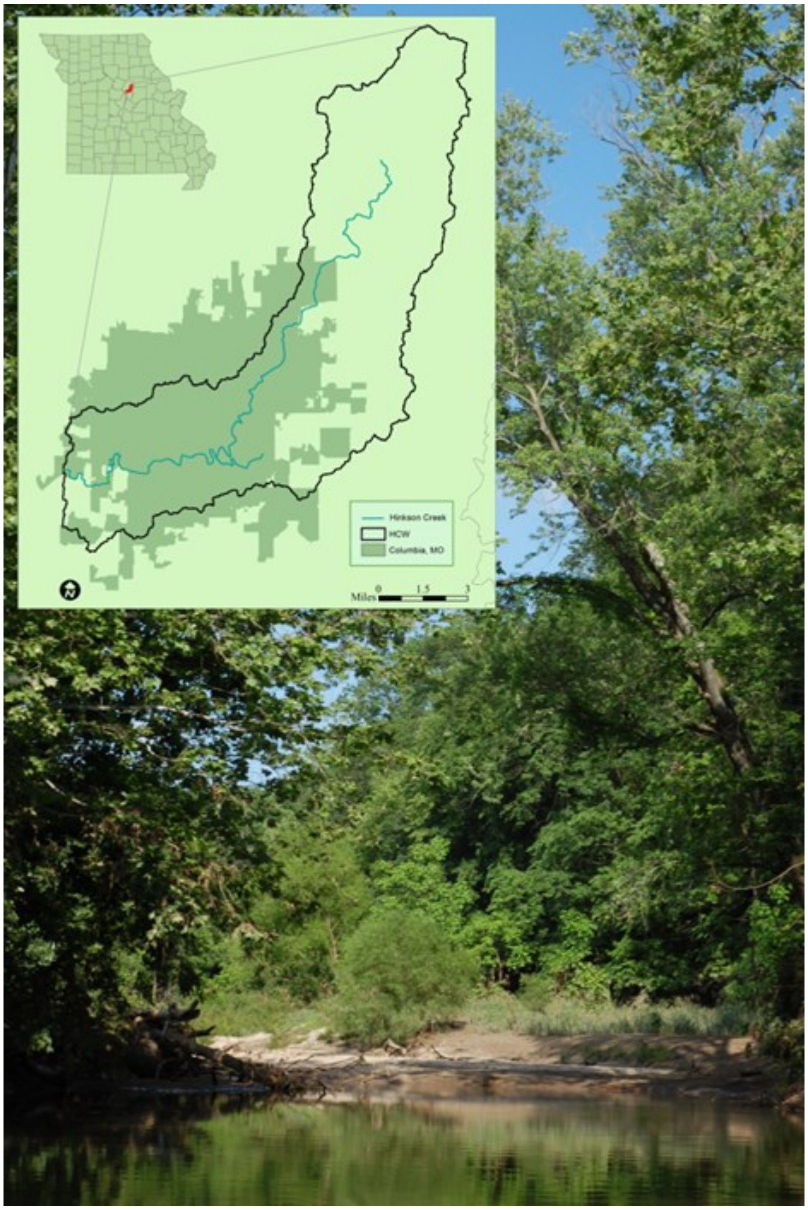
Get Ready for MNRC 2014!

The Missouri Chapter of the Society for Conservation Biology will hold its annual membership meeting and host its 10th Annual Student Poster Competition February 5-7, 2014 during the Missouri Natural Resources Conference at Tan-Tar-A Resort in Osage Beach, Missouri. The MNRC call for papers and posters is now open; abstracts are due October 16th. All students whose poster abstracts are accepted are encouraged to enter the contest. Details on page 24.

MOSCB Board of Directors will meet August 8 to discuss possible workshop topics for MNRC. If you have a suggestion for a topic, send a note to schuttlers@missouri.edu.

Projecting Streamflow Response to Increased Imperviousness in an Urbanizing Watershed Using a Coupled Modeling Approach

Michael Sunde

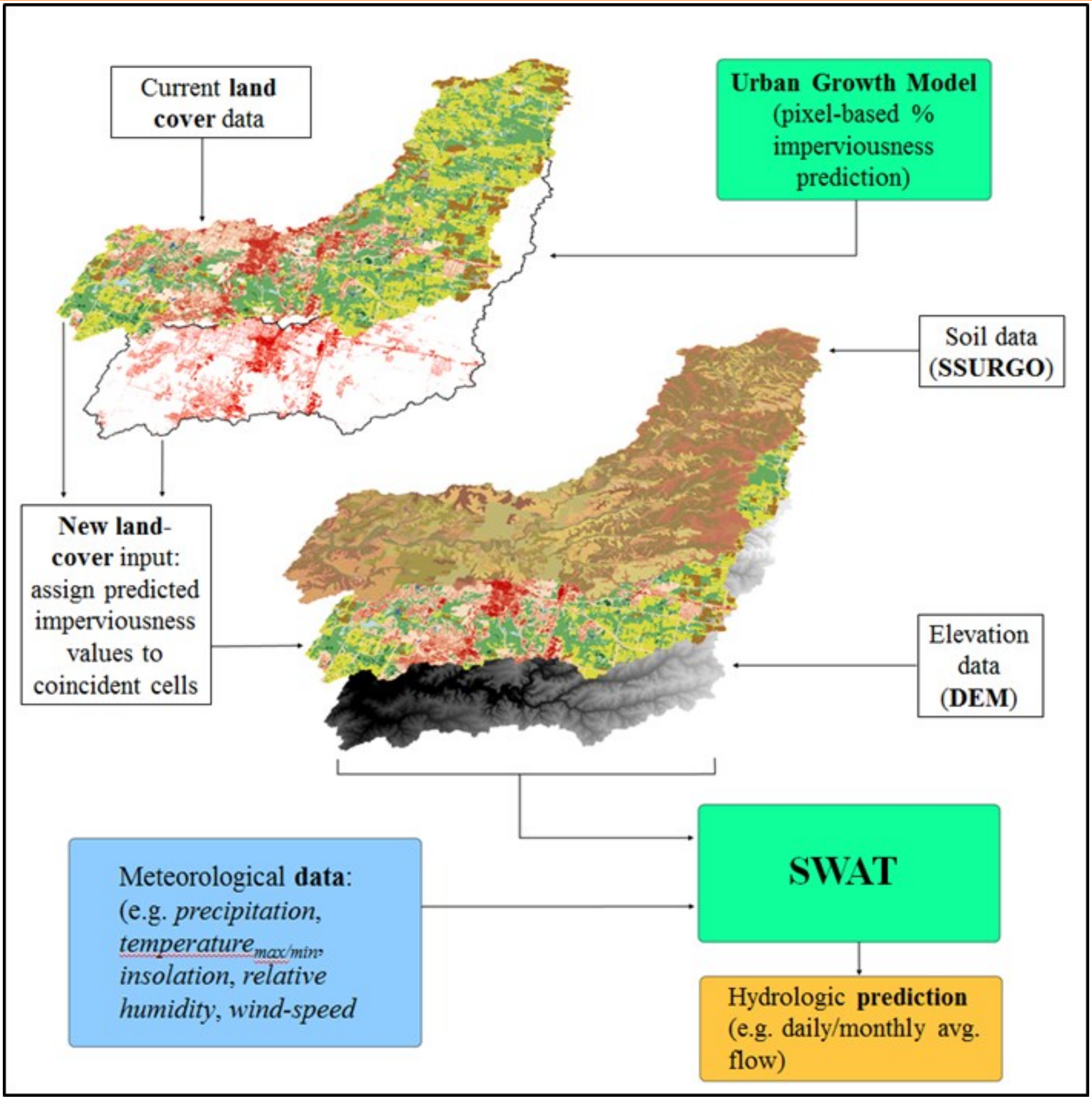


Hinkson Creek, Columbia, MO.

The build-up of impervious surfaces in urbanizing watersheds prevents the infiltration of precipitation into the soil profile and leads to increased runoff, which can alter streamflow volume and timing. Additionally, runoff from impervious surfaces serves as a transport mechanism for urban pollutants such as oil, heavy metals, pharmaceutical effluent, and particulates to nearby streams, negatively impacting aquatic biodiversity, and other beneficial water resource uses. Understanding how streams in urbanizing watersheds will respond to future urban development is crucial for assessing potential flood-risks and developing urban growth and natural resource management policies that preserve the integrity of water resources.

Hinkson Creek Watershed (HCW) encapsulates roughly half of the city of Columbia, Missouri, a town of 110,000 residents. Two segments of the creek have been listed as impaired under section 303(d) of the Clean Water Act and a plan to reduce surface runoff was developed by the EPA and the Missouri Department of Natural Resources. The amount of impervious surface area in HCW has increased by about 9% since 1980 and rapid growth in the area continues to generate more impervious surface coverage. In fact, the latest census showed that the population of Columbia increased by nearly 30% since 2000.

The goal of this study is to couple a hydrologic model, the Soil Water Assessment Tool (SWAT), with an urban growth model, the Imperviousness Change Analysis Tool (ICAT), to simulate possible changes to streamflow that might arise due to new impervious surface growth in HCW. In order to achieve this, ICAT will be used to simulate impervious surface coverage in HCW for three different urban growth scenarios: current trend, controlled, and uncontrolled growth.



Integrated modeling approach for projecting future streamflow impacts.

Impervious surface growth for each scenario will be projected up to the year 2030, and output from the urban growth model will be overlaid with current land cover data to produce new land cover inputs for use in SWAT (Figure above). Hydrologic simulations will then be run and changes to Hinkson Creek's streamflow will be contrasted using predictions based on HCW's current land cover and land cover for the three urban growth scenarios.

Streamflow Response (continued)

The results of this study will help to quantify the potential future effects of different urban growth paradigms on streamflow in HCW, thus providing practicable information for urban planners, land managers, and other decision makers. In addition, this coupled modeling study will provide a useful watershed management tool that can be used by others to assess the effects of urbanization in similar watersheds.

Acknowledgments
Special thanks to Dr. Hong He and Dr. Jason Hubbart.

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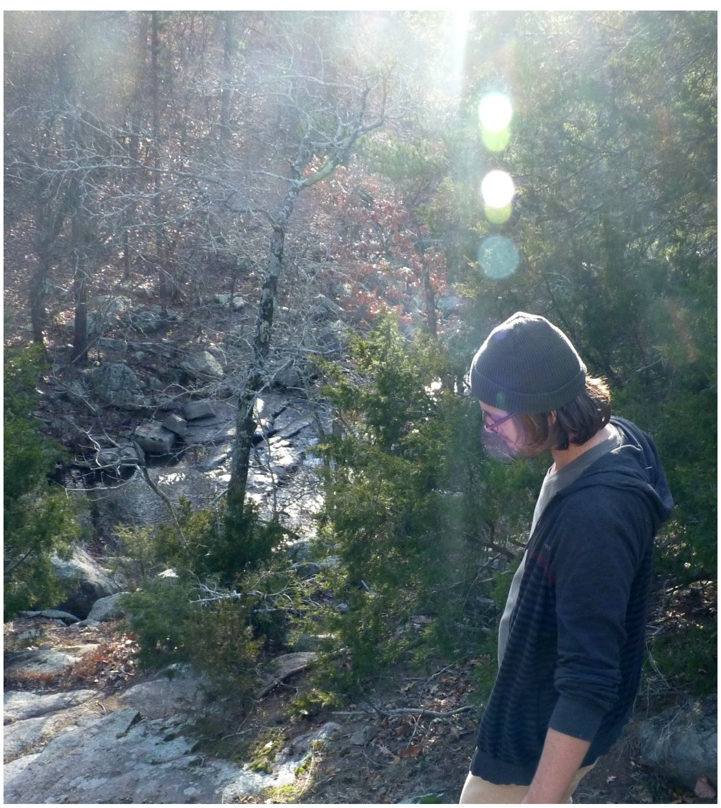

About the Author

Michael Sunde began pursuing a M.S. in Forestry at MU in late 2010, and switched to the PhD program in 2012. His research involves assessing the future hydrologic impacts of urbanization and climatic variations at the watershed scale. He spends his spare time taking photos, bicycling, backpacking, and exploring nature in Missouri and elsewhere. This article is based on the work he presented as a poster at MNRC 2013. Michael's poster won first place in the MOSCB Annual Student Poster Contest.

EFFECTS OF PRESCRIBED FIRE ON INSECT DIVERSITY IN THE MISSOURI OZARKS

Ashley N. Schulz, Lizzie Wright and Rose Marie Muzika

INTRODUCTION

Wildfires have long played a role in the development of many of the Missouri Ozark forest and woodland ecosystems. Before European settlement, Native Americans regularly burned the areas of Eastern America to facilitate hunting or to encourage grass growth for grazing (Pyne, 1982; Cutter and Guyette 1994). Following the mid-19th century, settlers of European descent began to establish agriculture-based communities within the area of the Missouri Ozarks. As a result of the change in land use and the new communities that were being established, fire suppression and prevention became important in the early 20th century (Guyette et al. 2002). This method of land management did not change until the mid-late 20th century when researchers determined that fires were a naturally occurring disturbance in the Ozark forests. Subsequently, prescribed burning became a forest management technique that many resource foresters within the Missouri Ozarks, as well as other parts of North America, still implement today.

Since prescribed burning has become such a popular forest management technique, some researchers have become interested in how this technique has been affecting ecologically important communities of ground-dwelling arthropods that are food sources for larger animals, decomposers of organic material, soil aerators and bio-indicators of a healthy ecosystem. Studies have been completed in various locations throughout North America including Kentucky, Mississippi and areas of the Northern Boreal Forest and Canada. Although this is just a small sample of what research efforts have accomplished, there has been very little research associated with the relationship between arthropods and prescribed fire in the lower Midwest, more specifically in the Missouri Ozarks where prescribed burning is frequently used to control fuel loads, reduce the amount of invasive species, manage ecosystems for wildlife and maintain the understory aesthetics of forests and woodlands. For an area that has such a rich ecological history, it is important to fill in all of the research gaps to create a more complete picture and to ensure that there is a better understanding of the processes involved in the complex ecosystems that occur in the Missouri Ozarks.

Pitfall trap used to capture insects in the study.

In order to test how prescribed fire affects insect abundance and diversity, we used an oak-hickory-pine site within Little Black Conservation Area (LBCA; Ripley County, MO) that had been burned in March 2012. During the burn, three unburned islands (manmade refugia) were left in the area for this study. Arthropod sampling took place four months after the burn in July 2012. For the study we used nine plots located within the area of the burned site. Three of the plots were set up as island plots, three were burn plots and three were control plots. Each of these nine plots contained three pitfall traps containing propylene glycol ($C3H8O2$) for a total of twenty-seven samples within the entire sampling area of LBCA. The traps remained in the area for one week (seven days) in July 2012. After collection, the pitfall traps were brought back to the lab to be processed. All of the arthropods were identified to class and anything within the class Insecta was identified to family/subfamily.

Once all of the pitfall traps were processed, the data was entered into Microsoft Excel and organized by treatment type (i.e.: unburned island, burn plot, control plot), as well as by each insect order, family and general arthropod class. In order to compare the diversity of each treatment type, we used Shannon's Index of Diversity to calculate the diversity (H), equitability (EH) and family richness (S) for each treatment type, where:

$$H = -\sum_{j=l}^{S} p_i \ln p_i \qquad E_H = \frac{H}{\ln S} \qquad S = \text{number of families}$$

RESULTS

In total, 2,433 individual arthropods were collected and categorized into five classes: Arachnida, Chilopoda, Diplopoda, Insecta and Nematoda. The average abundance of two classes (Arachnida [n=26]; and Insecta [n=278]) within each treatment type is given in Figure 2 along with the average total number of arthropods (Arachnida, Chilopoda, Diplopoda, Insecta and Nemtoda). Arachnids were more abundant in the control plot although, overall, the island plot had the greatest abundance of arthropods and, more importantly, a greater abundance of insects. Arthropods in the class Insecta composed over 90% of the specimen biomass (2,211 individuals). The Insecta collected spanned 12 orders and 43 families with little consistency within treatment type (Figure 3).

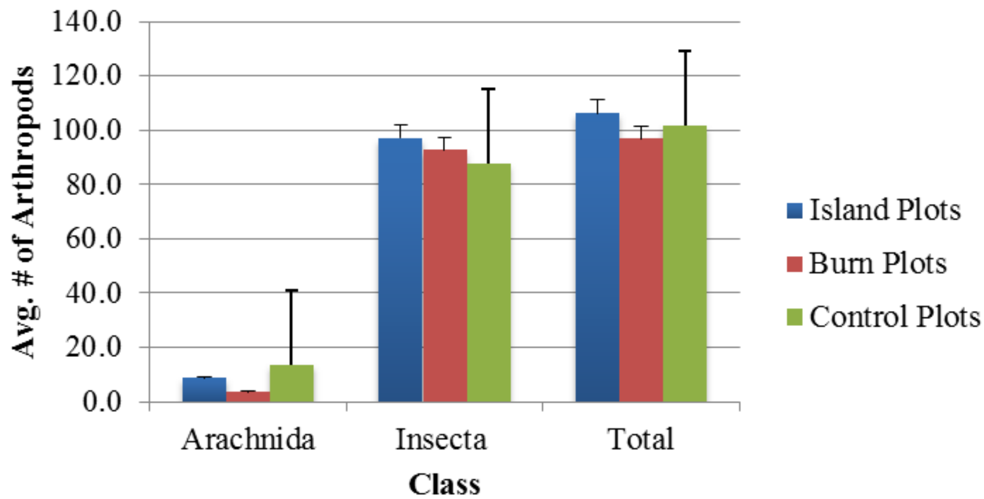

Figure 2. Average abundance of arachnids, insects and total number of arthropods found within each treatment type. Total number of arthropods includes Arachnida and Insecta plus Diplopoda, Chilopoda and Nematoda.

Most of the orders that dominated the control treatment (Figure 3b, 3c), such as Blattodea (cockroaches), Collembola (springtails), Orthoptera (crickets) and Psocoptera (booklice), have very limited to no flight capabilities. Orders that dominated the burn treatment, such as Hemiptera (seed bugs), Neuroptera (antlions), and Diptera (flies), generally have well developed wings and, as a result, can evade the dangers of the fire and repopulate more rapidly post-burn. Moreover, they may be dispersing to the more favorable habitat. Specimens that were more abundant in the island plots included Microcoryphia (jumping bristletails), Thysanoptera (thrips), Lepidoptera (moths) and Coleoptera (beetles). Some of these orders (Microcoryphia and Thysanoptera) were associated with the unburned islands than the other treatment types, most notably the burn treatment, since, like the control treatment organisms, these two groups cannot fly and evade fire as easily as other insect organisms.

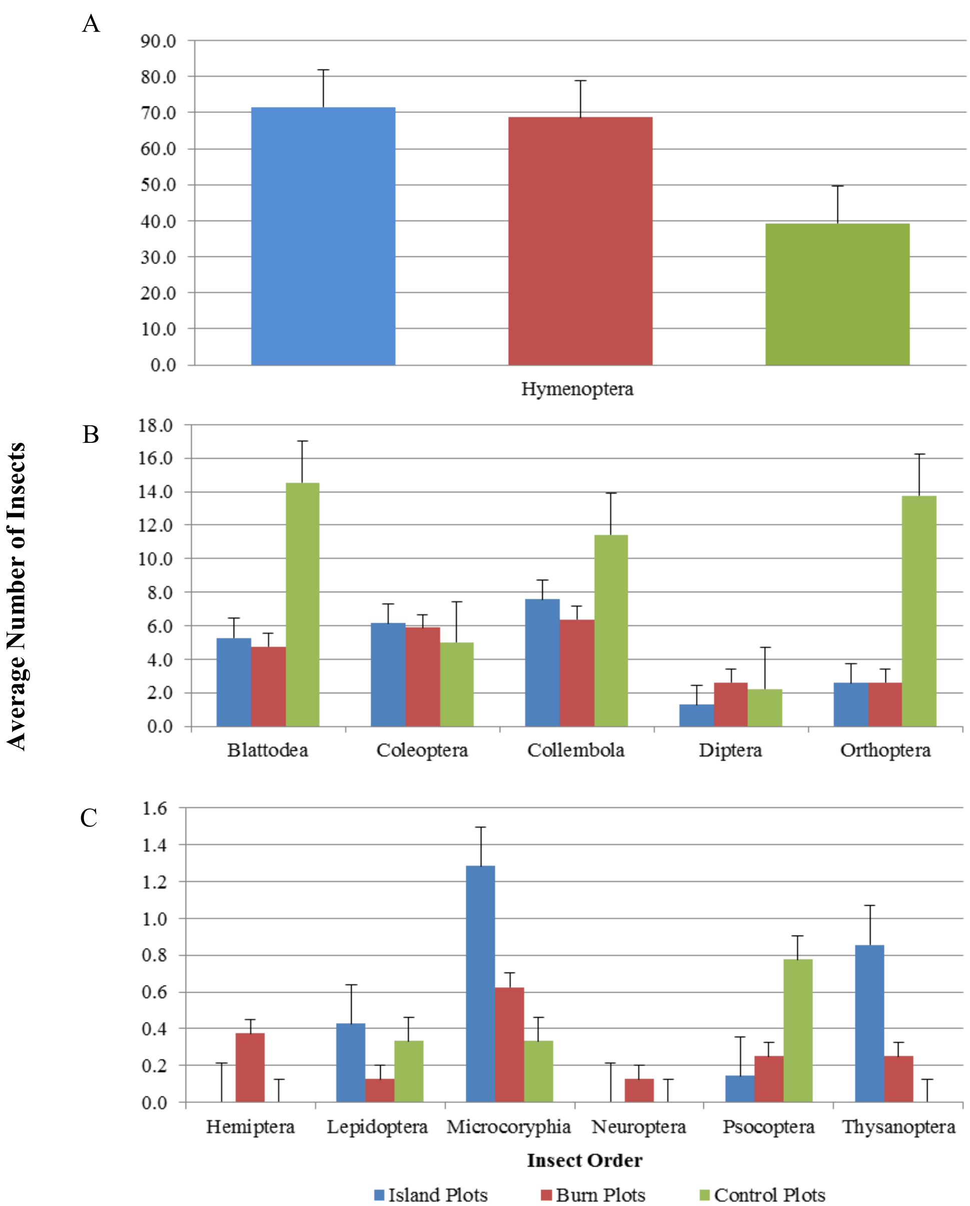

Figure 3. Average number of insects found per Order within each treatment type.

About 64% of the total insects collected were composed of Hymenoptera (ants and wasps) primarily in the family Formicidae (subfamilies Myrmicinae and Formicinae). Overall, the Hymenopterans were more abundant in the island plot, but also had the second highest association with the burn plot. Although most ants (other than the queen) do not have flight capabilities, they build colonies belowground and, as a result, can easily evade the low intensity fires being administered every three to five years.

DISCUSSION

Overall, the island treatment had the greatest abundance of arthropods (Figure 2, 3) and richness (Table 1) of insects, while the control plot had the greatest diversity and equitability (evenness, Table 1). Based on the results of our research and the research of others that indicate that unburned areas (e.g., island and control treatments) have the greatest diversity and abundance of organisms, we propose that unburned islands (manmade or natural) be implemented into management plans to promote shelter for the flightless insects. Since complete suppression of fire is not ideal due to the risk of wildfire and the negative effects suppression has on plant regeneration, we feel that including islands would provide a compromise treatment that would promote both insect and plant biodiversity. Villa-Castillo and Wagner (2002) suggest that, over time, the unburned islands will help repopulate the burned areas and more species may be observed in burned than unburned areas as the vegetation responds years after the fire, further promoting the use of fire, but also supporting the use of unburned refugia within the burn area.

Table 1. A comparison of the diversity, equitability (evenness) and richness for the overall island, burn and control treatments. Equitability assumes a value between 0 and 1 with 1 being complete evenness.

Value	Island Treatment	Burn Treatment	Control Treatment
Diversity (H)	1.368	1.258	1.912
Equitability (E_H)	0.398	0.37	0.58
Richness (S)	31	30	27

CONCLUSION

As the results of other studies demonstrate, different levels of disturbance (burning vs. no burning) can have varying effects on insect diversity and abundance. If our management objective is to preserve wildlife and plant biodiversity in forested areas, it is essential that we understand how different forms of biomass removal can affect insect diversity and abundance (Catling et al. 2010), since insects are one of the basic building blocks for healthy forest ecosystems.

The results of this study must be used with caution, in part because of the co-occurring summer 2012 drought and that potential influence on insect activity. Despite this, the research can serve as a base line for related projects in the future. The Missouri Ozark Highlands remains a highly diverse area of the country that has many opportunities for research projects. Future related projects should sample pre- and post-burn, as well as during years without drought to get a comparative data set. Other projects could include different sized islands to determine which size works best for the low-moderate intensity fires that are frequently seen in the Ozarks. Sampling methods could also include belowground litter bags in addition to pitfall samples to evaluate belowground diversity.

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About the Author

Ashley Schulz recently graduated from the University of Missouri-Columbia with a Bachelor of Science in Forestry. She plans to pursue her Master of Science and Ph.D. in Forestry with emphases in forest ecology, entomology and pathology; so that one day, she can achieve her dream to become a forest health researcher and professor at a land grant university. This article is based on the work she presented as a poster at MNRC. Ashley's poster won second place in the 2013 MOSCB Annual Student Poster Contest.

Seasonal Microhabitat Selection of Adult Niangua Darters

Jake D.A. Faulkner & Craig P. Paukert

INTRODUCTION

Habitat degradation is a main driver in reduction of native stream fish abundance and diversity. Specifically, alterations to flow patterns, water chemistry, and/or channel shape often challenge the longevity of biotic communities within streams (Riccardi & Rasmussen, 1999). In order to retain these imperiled fishes, managers must understand species' habitat requirements and how these are influenced by habitat and/or ecosystem changes (Schlosser & Angermeier, 1995).

The Niangua darter, *Etheostoma nianguae*, is a relatively large (6-9 cm TL), slender darter endemic to north-flowing streams of the Osage River basin in south-central Missouri, U.S.A. (Pflieger 1978). Federally listed in 1985, the Niangua darter is imperiled by low densities, limited distribution, and numerous threats: reservoir construction, destruction of stream habitat, degrading water quality, and introduction of non-native species (USFWS, 1989). Currently eight of ten known populations remain, however population level trends are largely uncertain (Novinger & Decoske, 2010; Figure 1). Previous research has examined habitat preferences during summer months but we have no knowledge of habitat association during cooler months (Mattingly & Galat, 2002). Our objective was to determine seasonal variation in microhabitat selection by Niangua darters.

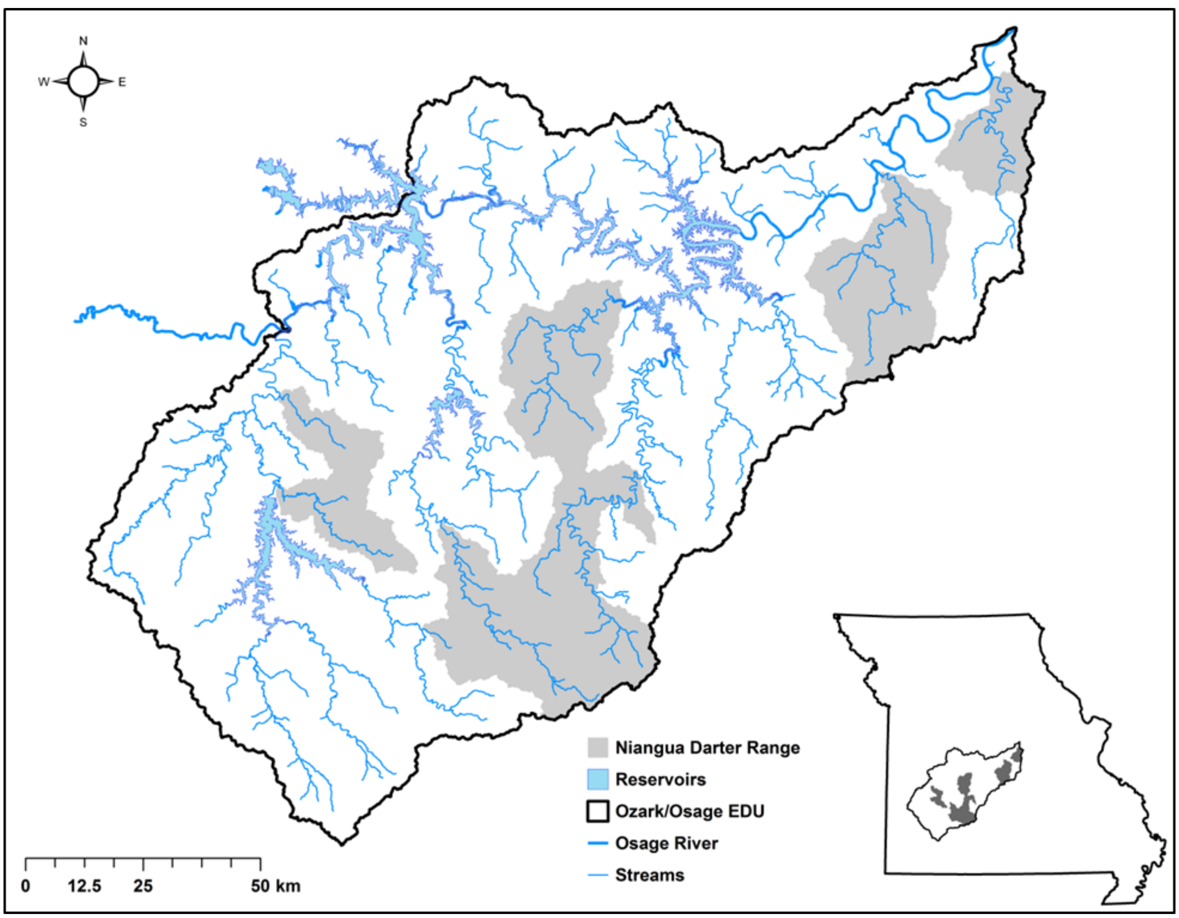

Figure 1: Current range of Niangua darters (Novinger & Decoske 2010).

METHODS

We located Niangua darters in three stream reaches (~500 m), two on the Little Niangua River and one on Starks Creek. We located Niangua darters within each of the three reaches every other month between July 2011 and May 2012 using snorkeling. Each reach was snorkeled by a single observer in an upstream zigzag progression at approximately 2-3 m min^{-1}. In areas too shallow to snorkel, the observer visually scanned the stream with the aid of polarized sunglasses while walking slowly upstream. Upon sighting a Niangua darter, the observer visually designated its size class and marked its exact location with a weighted fluorescent marker. The size of each individual was classified as juvenile [age 0; < 60 mm total length (TL)] or adult (age 1-4; > 60 mm TL; Pflieger, 1978; Mattingly & Galat, 2002). After snorkeling the length of the reach, we returned to these locations within 6 h to measure microhabitat variables.

At each marked location where we found a Niangua darter (hereafter, location), we measured six variables that we hypothesized to influence Niangua darter selection. Habitat type was visually classified into hydraulic habitat units modified after Arend (1999); high gradient riffle, low gradient riffle, shallow run, deep run, shallow pool, and deep pool. Depth (cm) and water velocity (m s-1) at 0.6 depth (hereafter velocity) was measured using a top-setting wading rod and flow meter. Dominant substrate was visually classified based on modified Wentworth (1922) size categories: fines (< 2 mm), gravel (2-15 mm), pebble (16-63 mm), cobble (64-256 mm), boulder (> 256 mm), and bedrock. Embeddedness was visually classified among four percentage ranges, representing the percent to which larger particles were saturated by fine sediments (Platts et al., 1983). To examine the importance of cover, we centered a 0.25 m^2 circle on each location and counted the number of cover items within the circle. Cover was defined as any physical structure with a surface axis ≥ 15 cm, capable of concealing an adult Niangua darter.

Niangua darter. Photo by Jake Faulkner.

To examine selection we randomly sampled three locations, within 100 m upstream or downstream, for every used location. We believed that this represented the area that was available to the individual (hereafter choice set), as previous research showed most individuals moved less than 100 m in a 12-month period (C. McCleary, unpubl. data).

We used discrete choice analysis to determine variation in Niangua darter habitat selection among seasons. The discrete choice model is similar to logistic regression; however, each used location is compared only to its affiliated choice set (Cooper & Millspaugh, 1999). Due to small samples sizes, we were limited to examining only univariate models for each of the six variables (Tables 1 and 2).

We fit models separately for each combination of stream and season (hereafter, model-set) using PROC MDC in SAS ©. We used Akaike's Information Criterion corrected for small sample size (AICc) and Akaike weights (wi) to rank each model (Burnham & Anderson, 2002).

RESULTS

We collected a total of 196 adult Niangua darter locations across all reaches (498.2 ± 5.8 m) in spring, summer and fall (Table 1). In all model-sets, depth was most important for microhabitat selection of adult Niangua darters, based on AICc ranking (Table 2). For the Little Niangua River, spring and Starks Creek, fall model-sets, embeddedness and habitat type, respectively, were also important for microhabitat selection of adult Niangua darters.

Table 1: Number of adult locations for each reach and month sampled between July 2011 and May 2012.

	Jan.	Mar.	May	July	Sept.	Nov.
Little Niangua River (upper)	0	4	7	8	8	0
Little Niangua River (lower)	0	13	22	15	16	5
Starks Creek	0	10	34	21	26	7

Table 2: A priori seasonal microhabitat selection models for adult Niangua darters.
Variables: Depth (cm; DEP), water velocity, (ms^{-1}, VEL), number of cover items (CD), high gradient riffle (HGR), low gradient riffle (LGR), deep run (DR), shallow run (SR), shallow pool (SP), gravel (2-15 mm; GR), pebble (16-63 mm; PE), cobble (64-256 mm; CO), boulder (> 256 mm; BO), bedrock (BE), four percentage ranges, (0-100%, E1-E4).

Models
$= \beta_1(DEP) + \beta_2(DEP^2)$
$= \beta_1(VEL) + \beta_2(VEL^2)$
$= \beta_1[\log_{10}(CD)]$
$= \beta_1(HGR) + \beta_2(LGR) + \beta_3(DR) + \beta_4(SR) + \beta_5(SP)$
$= \beta_1(GR) + \beta_2(PE) + \beta_3(CO) + \beta_4(BO) + \beta_5(BE)$
$= \beta_1(E1) + \beta_2(E2) + \beta_3(E3) + \beta_4(E4)$

During spring, adult Niangua darters on average used locations with depths of 42.70 ± 3.47 cm (range = 20-131) in the Little Niangua River compared to 52.82 ± 5.93 cm (range = 12-131) in Starks Creek. For the Little Niangua River, embeddedness was also important for resource selection of adult Niangua darters during spring. Substrates that were 26-50% embedded were eight times as likely to be selected compared to 75-100% embedded substrates.

During summer, adult Niangua darters on average used locations with depths of 23.13 ± 1.43 cm (range = 12-40) in the Little Niangua River compared to 49.67 ± 2.62 cm (range = 18-79) in Starks Creek. During fall, adult Niangua darters on average used locations with depths of 39.17 ± 1.69 cm (range = 21-69) in the Little Niangua River compared to 58.82 ± 4.45 cm (range = 15-125) in Starks Creek. For Starks Creek, habitat type was also important for resource selection of adult Niangua darters with most individuals using deep pool habitats. Non-convergence of this model prevented calculation of odds ratios but does indicate a strong influence of habitat type on Niangua darter selection during fall in Stark Creek.

DISCUSSION

Water depth was most important for microhabitat selection of adult Niangua darters in the Little Niangua River and Starks Creek in spring, summer, and fall. Depth selection for lotic species is likely a tradeoff among numerous factors, and for Niangua darters may be largely determined by energetics, biotic interaction, and reproduction. Doisy & Rabeni (2001) found that benthic invertebrate richness and density significantly decreased with depth. Therefore in summer, when energy requirements are likely greatest, Niangua darters selected relatively shallower depths with greater prey availability. However given their large body size, Niangua darters may have avoided extremely shallow depths to evade wading predators (Power, 1987). During cooler months, when energy requirement are low, Niangua darters selected relatively deeper depths, but may have avoided the deepest habitats due to risk of piscivorous predation (Power, 1987). During spring and fall, adult Niangua darters selected similar depths; however, in fall, the range of selected depths was narrower than in spring. Wider ranges of depths in spring may be attributed to a disparity in spawning behavior as some but not all individuals may have been selecting microhabitats suitable for spawning.

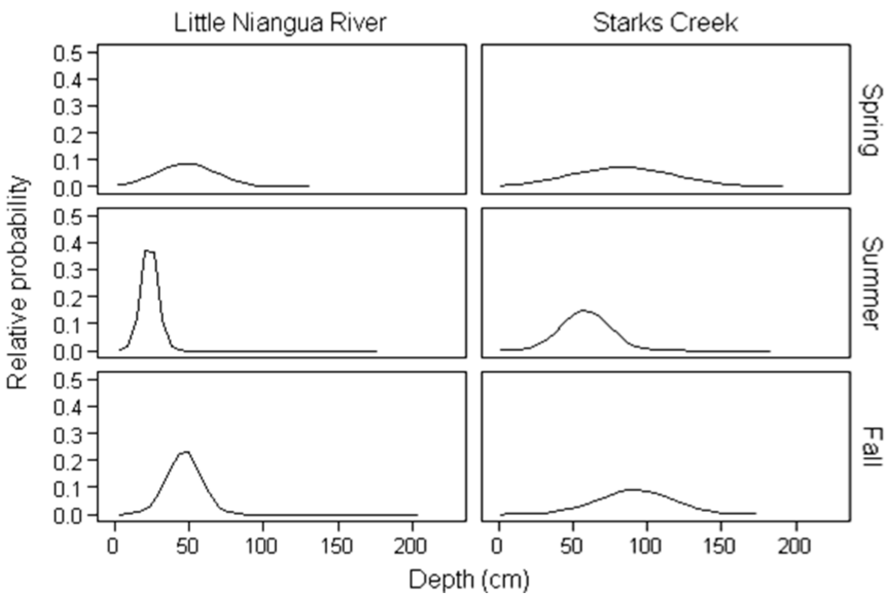

Figure 2. Resource selection functions of top-ranked models indicating the relative probability of selection across the range of depths used and available to adult Niangua darters in studied reaches of the Little Niangua River and Starks Creek, MO, U.S.A, 2011-2012.

Embeddedness was also important for microhabitat selection of adult Niangua darters in Little Niangua River during spring. Selection for less embedded substrate during spring could indicate selection for spawning locations as Niangua darters are lithophilous spawners, requiring a clean gravel substrate for spawning. However results were inconsistent between streams as embeddedness was not important for Niangua darters in Starks Creek. This may be attributable to asynchronous reproduction between streams as discrete water temperature measurements prior to sampling were cooler in Starks Creek during spring. The lack of importance of embeddedness in Starks Creek during spring could also be attributed to differences in habitat between streams; however, embeddedness of available substrates was not substantially different.

Habitat type was also important for microhabitat selection of adult Niangua darters during fall in Starks Creek but not in L. Niangua River. Niangua darters in Starks Creek selected pool habitat in fall whereas individuals in the L. Niangua River showed no strong selection for any one habitat type, which is likely due to differences in habitat between streams during fall. Starks Creek is a much smaller stream and thus in late summer and fall riffle and runs become very shallow and not favorable for Niangua darters. This disparity in depths among habitat types was not as pronounced in the L. Niangua River and explains why habitat type was not a top model for L. Niangua River in fall.

Although we now have a better understanding of microhabitat use during spring, summer, and fall, we were unable to document winter habitat of Niangua darters. We do not suspect that detection was influenced by effort and/or sampling conditions during winter as collected metrics (visibility, effort, etc.) were not significantly different across seasons, with only water temperature varying substantially. It is possible that Niangua darters migrated out of the sampled reaches during winter, but given their sedentary nature, that doesn't seem plausible. Alternatively, Niangua darters may be utilizing some subsurface refuge where we were unable to detect them. In an attempt to discover winter habitat of Niangua darters, we non-systematically sampled reaches, disturbing the substrate (~ top six inches) and excavating boulders multiple times after the initial sample; however, no additional Niangua darters were found. More research is needed to determine winter habitat use by Niangua darters.

CONSERVATION IMPLICATIONS

Understanding how habitat requirements of imperiled fishes such as the Niangua darter may vary temporally will allow managers to better predict the future distribution of species and proactively protect and restore current and future habitat. Proactively protecting and restoring habitat will likely increase the resilience of systems and the probability of persistence of species. For species of concern, understanding habitat requirements may aid recovery efforts by providing crucial information for locating suitable habitat which may support remnant undiscovered populations or may be potential sites for translocation (Griffith et al. 1989).

Management to maintain or improve depth variability and limit sediment input in streams occupied by Niangua darters should provide two very important aspects of habitat for the species. This includes but is not limited to: erosion reduction, maintaining or expanding riparian corridors, and/or limiting instream disturbances (gravel mining, excavation, vegetation removal, and vehicle traffic). Some of these practices are already in place but could benefit from expansion.

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ABOUT THE AUTHOR

Jake Faulkner received his bachelor's degree in Fisheries & Wildlife from the University of Missouri-Columbia in 2008. During and after his time there, he held various positions with the Missouri Department of Conservation. Currently Jake is finishing his master's research under Dr. Craig Paukert and is employed as an Ecologist with the U.S. Geological Survey at the Columbia Environmental Research Center. In his spare time, he enjoys time with family and friends and partaking in numerous outdoor activities. This article is based on the work he presented as a poster at MNRC 2012. Jake's poster won second place in that year's MOSCB Annual Student Poster Contest.

A Terrestrial Snail Survey of LaBarque Creek Watershed

Nels J. Holmberg, Ronald D. Oesch and John Vogel

Abstract

A terrestrial snail survey of the LaBarque Creek Watershed was carried out by a team of volunteers from 2008-2011. Volunteers spent over 534 hours conducting the survey and recorded 6,368 shells from 53 species, which comprises 43.4% of Missouri's 122 known species. The most common and abundant species found during the survey included *Inflectarius inflectus* (Shagreen snail), *Euchemotrema fraternum* (Upland Pillsnail), and *Anguispira kochi* (Banded Tigersnail). Dolomite glades had the highest snail diversity and abundance.

Introduction

The LaBarque Creek Watershed covers approximately 13 square miles of wooded hills and valleys in northern Jefferson County, Missouri. Due to minimal development in the area, it has flourished into a haven of plant and wildlife seen in very few areas in the state. The watershed has 89% deciduous forest cover. The Missouri Department of Conservation (MDC) designated the watershed as a "Conservation Opportunity Area" opening doors for beneficial support, partnerships and grants. To date, numerous conservation organizations have taken an interest in preservation of the watershed.

Labarque Creek Conservation Area. Photo by FredlyFish4.

LaBarque Creek Watershed lies in the Outer Ozark Border of the Ozark Highlands of northeastern Missouri (Nigh and Schroeder, 2002). These 8,365 acres consist of St. Peters sandstone bluffs, bowls, waterfalls and glades, with hills capped by dolomite and chert. They contain at least 16 communities described in The Terrestrial Natural Communities of Missouri (Nelson, 2005).

Previous surveys in the watershed for fish (53 species), vascular plants (770 species), and bryophytes (177 species) demonstrated that the watershed is highly diverse across multiple taxa. Snails are a diverse group in the Ozark Highlands of Missouri (Oesch, et. al. 2013) but were hitherto poorly known from the LaBarque watershed. Our survey was designed to fill this gap and supplement studies of other taxa.

Methods

Volunteers were assembled from the Webster Groves Nature Study Society, Missouri Native Plant Society, Missouri Master Naturalists (Confluence, Great Rivers & Mirimiguoa Chapters), Stream Team 4123, Shaw Institute for Field Training, Friends of LaBarque Creek, and other private citizens. Volunteers collected at pre-selected sites by picking shells off bare soil, sifting through the leaf litter, scraping soil out of small rock overhangs, and looking under rocks and logs. All shells were identified by Ron Oesch, author of Missouri Naiades: A Guide to the Mussels of Missouri (In Press).

Results

Our crew surveyed at 66 sites on 13 properties in the LaBarque Creek Watershed from March 2008 through April 2011. A total of 534 hours were spent on the survey, spread over 39 days, totaling 198 volunteer days. A total of 12 of the 16 community types were sampled and 6,368 shells have been identified to date (Appendix). An average of 11.9 snails per hour, or 96.5 snails per site (range 1-402) were collected. We found a total of 53 species, with *Inflectarius inflectus*, the Shagreen snail, being the most frequently collected snail (939 shells, or 14.75% of the total). No state-listed snails were found, although 4 species are represented by only one specimen each. The most species-rich community type was the dolomite glade.

Discussion

While sandstone substrate dominates the watershed and is responsible for its scenic character and much of its impressive diversity, surveys in these areas showed they are not good habitat for snails. Many of the hills in the watershed have small chert caps, which also supported few snails.

Gastrocopta armifera, one of the snails found in the survey.

We observed that snails track calcium in the environment, mainly available in the dolomite communities, as calcium is needed to build shells. This is reflected in the snails/hour data for these areas. High in the watershed (Don Robinson State Park), dolomite areas are small and near the hill tops. Snails/hour collection rates averaged 6.2 in the high watershed sites. For sites lower in the watershed (LaBarque Creek Conservation Area), dolomite areas are more common, but still limited. Snails/hour collection rates averaged 13.0 for sites located in this vicinity. When compared to the lowest areas in the watershed (Young Conservation Area), where there are large bands of dolomite extending almost down to the creek, snails/hour collection rates averaged 15.4. The highest snails/hour rate (38.4) was for the Hwy FF road cut, where there is extensive dolomite glade habitat available. The other rich site (Brown property, 26.4) was fueled by a log pile at the edge of a small clearing. On a micro scale, we noted that we hit pockets of abundance or scarcity for unknown reasons. Two species were found to be dolomite glade specialists; *Pupoides albilabris* (white-lip dagger), and *Rabdotus dealbatus* (whitewashed dealbatus), although the *Pupoides* was also found in a fescue field.

LaBarque Creek Snails (cont'd)

Our study added additional knowledge to understanding biodiversity patterns in this unique watershed. In addition, this survey illustrates the success of a significant scientific survey accomplished by a partnership between a snail species specialist and a group of dedicated volunteers!

Acknowledgments
We would like to acknowledge Bob Coffing for his assistance with organizing this survey and arranging permission to access survey sites on private lands. In addition, we would like to acknowledge the residents of the LaBarque Creek Watershed for their continued support of scientific research and public land protection.

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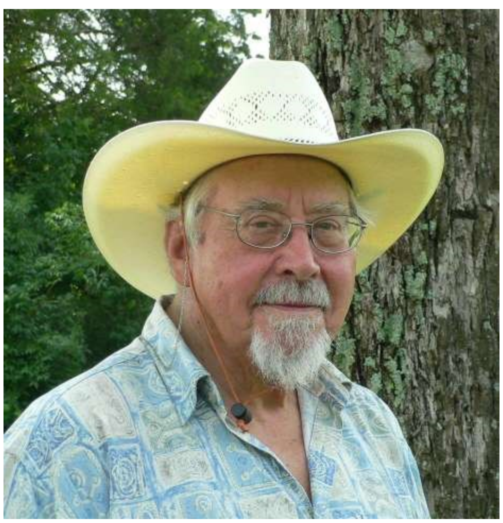

About the Authors

Ronald Dean Oesch (1930-2012, top left) received his Master's degrees from University of Central Missouri with a thesis on vertebrate paleontology. He spent over forty years studying the Mollusca of Missouri, resulting in three books: Missouri Naiades (1984, 1995), Missouri Aquatic Snails (1997, with Wu and Gordon), and Land Snails of Missouri (with Watrous and Barnhart, forthcoming).

Nels Holmberg (bottom left) received a MS in Biochemistry from Oklahoma State University in 1966 and a MS in Biology (Ecology, Evolution and Systematics) from University of Missouri, St. Louis in 2001. He does vascular plant and bryophyte surveys for numerous state and private organizations. He and his wife Sandra operate a sheep farm near Krakow, MO.

John Vogel is Wildlife Biologist for the Missouri Department of Conservation at the St. Louis Regional Office.

Labarque Creek Watershed Snail Survey			
Number	**% of Total**	**Species**	**Common Name**
939	14.75%	*Inflectarius inflectus*	Shagreen
780	12.25%	*Euchemotrema fraternum*	Upland pillsnail
746	11.71%	*Anguispira kochi*	Banded Tigersnail
548	8.61%	*Haplotrema concavum*	Gray-foot Lancefoot
440	6.91%	*Anguispira alternata*	Flamed Tigersnail
367	5.76%	*Glyphyalinia indentata*	Carved Glyph
267	4.19%	*Neohelix alleni*	Western whitelip
250	3.93%	*Mesodon zaletus*	Toothed Globe
221	3.47%	*Daedalochila dorfeuilliana*	Oakwood Liptooth
169	2.65%	*Gastrocopta armifera*	Armed Snaggletooth
160	2.51%	*Mesomphix friabilis*	Brittle Button
153	2.40%	*Mesodon thyroidus*	White-lip Globe
147	2.31%	*Strobilops labyrinthica*	Maze Pinecone
131	2.06%	*Striatura meridonalis*	Median Striate
118	1.85%	*Discus patulus*	Domed Disc
92	1.44%	*Rabdotus dealbatus*	Whitewashed dealbatus
82	1.29%	*Gastrocopta contracta*	Bark Snaggletooth
67	1.05%	*Helicodiscus parallelus*	Compound Coil
66	1.04%	*Nesovitrea electrina*	Amber Glass
65	1.02%	*Hawaii minuscula*	Minute Gem
61	0.96%	*Zonitoides arboreus*	Quick Gloss
54	0.85%	*Paravitrea significans*	Domed Supercoil
45	0.71%	*Punctum minutissimum*	Small Spot
41	0.64%	*Daedalochila leporina*	Gulf Coast Liptooth
40	0.63%	*Euconulus trochulus*	Silk Hive
39	0.61%	*Strobilops aenea*	Bronze Pinecone
36	0.57%	*Pupoides albilabris*	White-lip Dagger
27	0.42%	*Gastrocopta pentodon*	Comb Snaggletooth
24	0.38%	*Gastrocopta corticaria*	Bottleneck Snaggletooth
21	0.33%	*Euchemotrema leai aliciae*	Alice's Pillsnail
21	0.33%	*Vallonia pulchella*	Lovely Vallonia
19	0.30%	*Triodopsis discoidea*	Rivercliff Threetooth
18	0.28%	*Mesomphix capnodes*	Dusty Button
16	0.25%	*Carychium exile*	Ice thorn snail
16	0.25%	*Catinella vermeta*	Suboval Ambersnial
15	0.24%	*Guppya sterki*	Sterki's granule
15	0.24%	*Helicodiscus notius*	Tight Coil
8	0.13%	*Xolotrema fosteri*	Bladetooth Wedge
7	0.11%	*Physa cf. gyrina*	a snail
6	0.09%	*Gastrocopta procera*	Wing Snaggletooth
5	0.08%	*Mesodon clausus*	Yellow Globelet
5	0.08%	*Vertigo meramecensis*	Bluff Vertigo
4	0.06%	*Euchemotrema leai leai*	A Pillsnail
3	0.05%	*Gastrocopta tappaniana*	White Snaggletooth
2	0.03%	*Deroceras reticulatum*	Gray fieldslug
2	0.03%	*Euconulus dentatus*	Toothed Hive
2	0.03%	*Phylomycus carolinianus*	Carolina mantle slug
2	0.03%	*Ventridens ligera*	Globose Dome
2	0.03%	*Vertigo tridentata*	Honey vertigo
1	0.02%	*Pallifera marmorea*	marbled mantleslug
1	0.02%	*Potamilus lapidaria*	Slender Walker
1	0.02%	*Punctum vitreum*	Glass Spot
1	0.02%	*Vallonia excentrica*	Eccentric vallonia
6368			

President's Corner

Stephanie Schuttler

One event I am most eager to attend at the International Congress for Conservation Biology is the Society for Conservation Biology's chapter meeting. At this meeting, I will be presenting and sharing the Missouri Chapter's history and successes to other state and international chapters. I am excited for two reasons; I am really proud of the accomplishments of our chapter, and I am excited to learn from other chapters.

The Missouri Chapter is one of the longest running chapters in SCB. One of our biggest accomplishments is the publication of *The Glade*. Since 1998, we have had 15 volumes published, with contributions from students, conservation professionals, and professors. That is truly incredible and an accomplishment to be proud of. Additionally, MOSCB has been represented at the Missouri Natural Resources Conference annually, and has hosted a workshop almost every year.

We are starting to become more engaged in policy, and recently submitted comments to the Missouri Department of Conservation on a proposed amendment to allow the sale of an aggressive crayfish, the virile crayfish, as bait in the state of Missouri. (You can read this letter here: moscb.weebly.com/uploads/1/8/6/9/18697076/moscb_crayfish_recommendation.pdf). As president, one of my goals for the chapter is to increase communication among chapter members. We have launched a new website (moscb.weebly.com/), have a Twitter account (twitter.com/MissouriSCB) and a Facebook group page (facebook.com/groups/529344250432364/). In addition to *The Glade*, we also have a blog on the MOSCB website featuring posts from different individuals in Missouri on pertinent conservation issues. We encourage you to contribute, and if you are interested in writing an article for the blog, please contact me at MissouriSCB@gmail.com. As we embark on our 16th year, I am proud of our chapter's achievements and excited to grow this chapter with you.

Editor's Corner

Esther Stroh

I am pleased to present our MOSCB membership and friends with Volume 16, Number 1 of *The Glade*. This issue was emailed to 216 individuals. To subscribe, unsubscribe or update your email address, send a note to estroh@usgs.gov with a subject line mentioning *The Glade*.

I have been a member of MOSCB since 1998, and I have served in the past as MOSCB President, Treasurer, and Secretary. As editor of *The Glade*, I hope to feature a wide variety of topics representative of our membership. This issue features articles written by past winners of our annual student poster contest. See page 24 for information on entering our 2014 contest.

I invite submissions of original research, essays, and opinion pieces on Missouri biological diversity: its history, value, maintenance, loss, or restoration. If you wish to submit an article, please contact me at estroh@usgs.gov. Volume 16 Issue 2 deadline for submissions is November 30, 2013.

You can find digital copies of this issue and all back issues of *The Glade* at moscb.weebly.com/the-glade-archives.html

Society for Conservation Biology

A global community of conservation professionals

The Missouri Chapter of the Society for Conservation Biology

is pleased to announce the Tenth Annual

Student Poster Competition

At the Missouri Natural Resources Conference
6:30 – 8:30 p.m. Wednesday, February 5, 2014

The Missouri Chapter of the Society for Conservation Biology encourages and recognizes quality student research that has explicit conservation applications. For the past nine years, we have sponsored a student poster competition at the Missouri Natural Resources Conference (MNRC).

The competition is open to all undergraduates, graduate students, or recent graduates whose posters are accepted for MNRC 2014. **The student must be the first author and the designer of the poster.**

Judges will rate each poster during the Wednesday evening poster session. Posters will be evaluated on research quality, presentation quality, and **conservation relevance**. **The poster should explicitly state the conservation applications of the research.**

First Place: $250 cash to support your studies and research

Second Place: A one-year membership in the Society for Conservation Biology, including online access to the journals *Conservation Biology* and *Conservation Letters*. ($90 value)

Both students will be invited to write an article for our chapter newsletter *The Glade*.

Abstracts are due to MNRC October 16th. To enter the Student Poster Competition, send your MNRC-accepted abstract, school affiliation, email address and telephone number **by January 17th, 2014** to Amy Buechler, amy.buechler@mdc.mo.gov.

For more information contact Amy at 573-751-4115

MOSCB Financial Report

Checking account 2011 year-end balance (12/31/11): $264.53
Debits: 2012 student poster contest and MNRC exhibit space: $644.00
Credits: Dividends, dues, 2012 silent auction, and transfers from savings: $1111.09
Checking account 2012 year-end balance (12/31/12): $731.62

Savings Account 2011 year-end balance (12/31/11) : $1153.31
Debits: Transfer to savings: $730.00; Credits: Dividends: $3.64
Savings account 2012 year-end balance (12/31/12): $426.95

2012 combined year-end balance: $1,158.57
(*Condensed from MOSCB CFO Annual Report submitted January 30, 2013*)

Ozark glade. Photo by Matthew Struckhoff.

MOSCB Board of Directors

The following individuals were elected at our annual membership meeting on January 30, 2013 at Tan-Tar-A Resort in Osage Beach, Missouri:

President: Stephanie Schuttler
Vice President: Gopala Borchelt
Treasurer: Amy Buechler
Secretary: Jill Dewitt
Chair of Conservation Committee/Glade Editor: Esther Stroh

Terms of office are from April 1, 2013 to March 31, 2014. Elections for 2014 will be held at the MOSCB annual membership meeting, February 5, 2014 at the Missouri Natural Resources Conference.

SOCIETY FOR CONSERVATION BIOLOGY AND THE MISSOURI CHAPTER

The Society for Conservation Biology (SCB) is an international professional organization of more than 5000 resource managers, educators, government and private conservation workers, and students. We promote the scientific study of phenomena that affect the maintenance, loss, and restoration of biological diversity. www.conbio.org

The Missouri Chapter of SCB was established in 1998. We promote communication among conservation biologists throughout Missouri. Annual membership in the Missouri Chapter is $5.00, and includes electronic delivery of *The Glade.*

DO YO LIKE *THE GLADE*? SUPPORT MOSCB!

Annual membership in the Missouri Chapter is just $5.00. Please send a check payable to MOSCB to Amy Buechler, Treasurer, MOSCB, c/o MDC, PO Box 180, Jefferson City, MO 65102. Contact Amy with questions: amy.buechler@mdc.mo.gov, 573-751-4115.

ARE YOU A *VOTING* MEMBER OF MOSCB?

In order to be a *voting* member of the Missouri Chapter, you must join the larger Society for Conservation Biology (SCB). Join now: http://www.conbio.org/membership/become-a-member. Annual dues are $80 for working professionals and $20 for students/retirees. Voting members can serve as and elect MOSCB officers and vote on MOSCB policy positions.

Old cedar (*Juniperis virginiana*). Photo by Esther Stroh.