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| **2015 TNAFS Meeting Schedule** | | |
| **February 19th** |  |  |
| 1:00 |  | Welcome & general information - Travis Scott |
| 1:20 | \*1 | Thomas Johnson, Assessment of Southern Appalachian Brook Trout Propagation for Restoring Tennessee Populations |
| 1:40 | 2 | Cole Harty, Evaluation of catfish populations and development of standardized sampling protocols in Tennessee reservoirs |
| 2:00 | \*3 | Shawn Settle, Conservation status and habitat use of Noturus gladiator and other Coastal Plain madtom catfishes |
| 2:20 | 4 | Brian Alford, Associations between fish assemblages and agricultural land use in the Nolichucky River watershed |
| 2:40 | 5 | Joshua Perkin, Multi-scale prioritization of dam removals to benefit stream biodiversity in Tennessee |
| 3:00 |  | Break |
| 3:20 | \*6 | Zachary Wolf, Conservation status of the Tennessee-endemic Egg-mimic Darter (Etheostoma pseudovulatum) |
| 3:40 | \*7 | Daniel Walker, Substrate Characteristics and Potential Contaminant Exposure Risk of Lake Sturgeon Habitat in the Upper Tennessee River |
| 4:00 | 8 | Bernie Kuhajda, Status of and threats to the Laurel Dace, Chrosomus saylori, endemic to Walden Ridge, Tennessee |
| 4:20 | 9 | Don Hubbs (will send abstract week of 1/26/25) |
| 4:40 |  | Closing Remarks, Instructions for Banquet |
| 5:00 |  | Dismissal |
|  |  |  |
| 7:00 | Banquet, Auction, Awards, Poster Session | |
|  | Posters |  |
|  | 1 | Amelia Atwell, Relationships Between Benthic Macroinvertebrate Assemblages, Stream Habitat, and Catchment Landscape Features in the Lookout Creek System (Tennessee River Drainage) |
|  | 2 | Paul Ayers, Kayak-based videomapping river systems for determining habitat distribution and large-scale aquatic population monitoring |
|  | 3 | Mark Schorr, Spatiotemporal patterns in the distribution and abundance of the introduced Redbreast Sunfish (Lepomis auritus) and native Longear Sunfish (L. megalotis; Centrarchidae) in reservoirs of the Tennessee River drainage |
| **February 20th** |  |  |
| 8:30 |  | Good morning welcome & announcements - Travis Scott |
| 8:40 | 10 | Paul Ayers, Underwater videomapping development and evolution |
| 9:00 | 11 | Brett Connell, Application of the High Definition Stream Survey on the Paint Rock Creek and Bear Creek watersheds |
| 9:20 | 12 | Jim Parham (will send abstract week of 1/26/15) |
| 9:40 | 13 | Hope Klug, Overcoming Evolutionary History: Conditioning the Barrens Topminnow to Escape an Evolutionary Trap |
| 10:00 | 14 | Josh Ennen, The where and why of North American turtles: An explanation of species richness patterns |
|  |  |  |
| 10:40 |  | Break |
| 11:00 |  | Business Meeting |
| 12:00 |  | Dismissal |
| **\*** | **consideration for best student presentation** | |

**ABSTRACTS**

Oral Presentations:

\*indicates a competitor for the Best Student Paper Award.

Brian Alford, jalfor12@utk.edu, 865-974-8752

Associations between fish assemblages and agricultural land use in the Nolichucky River watershed

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The Nolichucky River is one of the most critically important “hot spots” for North American biodiversity in the U.S. However, agricultural land use has intensified since 2006 with vegetable “truck crops”, primarily tomatoes, flourishing in the region. Pesticide treatments during the growing season have caused runoff-related fish kills. Our study explores relationships between agricultural landscapes and the structure of fish assemblage and biotic integrity in the watershed. During July-October 2014, we surveyed 10 sites (4 tributaries, 6 main stem) using Tennessee Valley Authority (TVA) protocols, specifically backpack electrofishing (riffle-run habitats) and seine hauls (pools). Fish sampling and water quality measurements were conducted at sites classified as least impacted (n=4), moderately impacted (n=2), and most impacted (n=4) by agriculture. Thus far, 43 species (5,279) have been documented from 199 riffle-run habitats, while 39 species (1,206 individuals) were sampled from 106 pools. Cluster analysis and Sum F tests revealed that fish assemblages were statistically different based on our site impairment classifications. Results of indicator species analysis (ISA) suggested that, for riffle-run habitats, *Nothonotus acuticeps*, *Nothonotus camurum*, *Etheostoma blennioides* and *Etheostoma simoterum* were strong indicators (Indicator values > 25; *P* < 0.01) of the least impacted condition from the warmer, main stem sites. *Cottus bairdi* and *Notropis rubricroceus* were strong indicators of the least impacted condition in cooler, higher-elevation tributary sites. For moderately impacted sites, *Nocomis micropogon* and *Notropis volucellus* were adequate indicatorss. Meanwhile, species indicative of heavily impacted sites were *Nothonotus rufilineatus* and *Cottus carolinae*. For pool habitats, least impacted indicator species included only *Notropis telescopus*, while *Moxostoma breviceps* was an indicator of moderately impacted sites*. Luxilus* *coccogenis* was indicative of most impacted sites. We continue to assess agricultural impacts on health and condition of aquatic biota, including benthic macroinvertebrate assemblages and fish physiology (e.g., intersex condition, parasite load, sensory system development).

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Underwater videomapping development and evolution

Ayers, P.1

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The need to develop GIS-compatible large-scale maps of aquatic habitat in river systems led to the development of GPS-based underwater videomapping systems. The river mapping system is kayak-mounted with georeferenced above and under water cameras, depth sounder, width sensors and underwater lasers. GIS maps of river characteristics - substrate (modified Wentworth scale), embeddedness (EPA classification), depth, width and river characteristic (pool, riffle, run) were developed. River thalweg profile rugosity and sinuosity were also determined using depth sensors and GPS respectively. Every linear foot of river can be mapped at a rate of 10 miles per day. The system provides a GIS-based georeferenced database for river and stream inventory. A technique to define optimum habitat locations and habitat suitability indices for aquatic species was developed and implemented. The underwater videomapping system has evolved over the past 10 years and has been used to map 100’s of miles of river habitat in Tennessee.

Complemented with a GPS-based snorkel videomapping system (GSVMS) and a Sneak Peek under-structure video exploration technique, site-specific fish population monitoring provide video documented georeferenced information regarding population, size, species distribution, location, and habitat. GIS-based video tours of the above and below water river features, providing virtual tours within ArcGIS and Google Earth will be demonstrated.

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Application of the High Definition Stream Survey on the Paint Rock Creek and Bear Creek

watersheds

Connell, B.1 and J. Parham2

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Understanding the quality and distribution of stream habitat is important to managing stream biota. Traditional stream habitat survey methods are often spatially-limited, time-consuming, expensive, and collect limited data. The novel HDSS approach was created to integrate GPS, streambank video, and depth sensors to gather continuous geo-referenced data on both streambanks in a single pass. Data gathered can be used to assess habitat and locate areas that contribute to poor stream conditions. Two recent surveys of Bear Creek and the Paint Rock River provide an example of the HDSS application. Using the HDSS, 63 continuous miles of river in the Bear Creek Watershed were surveyed in 4 days and 53 continuous miles of the Paint Rock River and its tributaries were surveyed in 3 days. Each GPS point had associated Bank Condition and habitat scores and was used to develop geo-referenced video and GIS habitat quality maps. The survey results can be used in three ways. 1) As a tool for monitoring the results of previous restoration activities; 2) a tool to prioritize future restoration efforts and action areas; and 3) baseline characterization of river bank conditions in 2014 for future review.

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The where and why of North American turtles: An explanation of species richness patterns

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Species richness is not uniformly distributed across the landscape, and these patterns are often associated with environmental gradients. In this study, we examine species richness patterns within North America turtles and use 14 abiotic variables (8 climatic, 2 topographical, 2 stream variables, as well as latitude and longitude) to construct regression models fitted to spatial data that predict species richness for all turtles (n = 84), freshwater aquatic and semiaquatic turtles (n = 75), turtles in the family Emydidae (n = 43), and those in the Kinosternidae (n = 21). Overall, species richness was positively related to maximum temperature of the warmest month (K), precipitation of the wettest month (mm), total stream length (km), and temperature seasonality. Species richness of aquatic and semiaquatic turtles was positively related with precipitation of the wettest month, total stream length, and temperature seasonality. Emydid species richness was only related (positively) to precipitation of the wettest month. Interestingly, only kinosternid richness was related (negatively) with latitude. Also, species richness within kinosternid was positively related to precipitation of the wettest month and total stream length.Given current and projected climate trends, especially alterations of temperature and precipitation patterns, species richness of North American turtles could be impacted.

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Evaluation of catfish populations and development of standardized sampling protocols in Tennessee reservoirs

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Catfish are important components of the sport and commercial fisheries in several Tennessee reservoirs. In recent surveys, catfish were the second most pursued recreational species in the state behind black bass and accounted for nearly 5 million days of fishing. Sport fishing effort directed at catfish exceeded 30% of all fishing pressure in Kentucky Lake, when more than 330,000 Blue Catfish *Ictalurus furcatus* and Channel Catfish *I. punctatus* were harvested. Catfish in Tennessee have received scant attention due to the fact that catfish were not classified as a sport fish (and Sport Fish Restoration Funds were not available to study and manage them) until 2007. The lack of knowledge regarding catfish populations in Tennessee reservoirs and how to effectively sample them presents many research opportunities. Objectives of this three-year research project are to (1) develop unbiased catfish sampling protocols for the use of trotlines, low-frequency electrofishing, tandem hoop nets, or a combination of these three approaches; (2) assemble a statewide database on commercial and recreational harvest of catfish species and examine historical trends in terms of yield; (3) mathematically model the response of catfish populations to different management scenarios; and (4) assess the potential for growth and recruitment overfishing in Tennessee reservoirs. In a pilot study during the summer of 2014, tandem hoop nets were deployed in Kentucky Lake (24 tandem series), Chickamauga Lake (16 tandem series), and Fort Loudoun Lake (16 tandem series) and over 450 Channel Catfish were collected. Sampling during 2015 will encompass several seasons and include all gears of interest (i.e., tandem hoop nets, low-frequency electrofishing, and trotlines).

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Lower Duck River Mussel Inventory

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The Duck River flows 290 miles through several major ecoregions before entering the impounded main stem Tennessee River at Sycamore Landing, Tennessee, adjacent to the Tennessee National Wildlife Refuge. The aquatic biodiversity of the Duck River has been described as surpassing that of all European rivers combined, and as possibly the most biologically diverse river in all of North America (Littschwager 2012, Stein et al. 2000). The Duck River contains nearly a quarter of the nation’s 300 native freshwater mussel species (Parmalee and Bogan 1998, Schilling and Williams 2002). The status of the aquatic community in the lower portion of the Duck River has historically received little attention by aquatic biologists. Schilling and Williams (2002) performed cursory surveys at 13 sites on the lower Duck River, yet they reported several previously undocumented species, including federally listed species. They suggested the unique mussel assemblage in the lower Duck River has been inadequately surveyed, and its importance in the conservation and recovery of imperiled species should be elevated. TWRA obtained a USFWS National Wildlife Refuge Southeast Region Inventory and Monitoring grant to conduct an inventory of the freshwater mussels inhabiting the lower 24 miles of the Duck River and Kentucky Reservoir adjacent to the Tennessee National Wildlife Refuge’s Duck River Unit. Timed visual and tactical search techniques of appropriate habitats have been completed at 7 of 10 project sites documenting a Unionid fauna of at least 33 species.

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Assessment of Southern Appalachian Brook Trout Propagation for Restoring Tennessee Populations

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Brook Trout *Salvelinus fontinalis* are the only salmonid native to Tennessee and currently only inhabit one-fourth of their historic range. Populations initially declined as a result of habitat degradation. However, current threats include interspecific competition with non-native salmonids, climate change, stream acidification, and loss of riparian vegetation. Management practices typically involve translocation to restore extirpated populations. Captive propagation and stocking of fingerlings is an additional restoration tool that is being explored. During fall 2013, wild broodstock were collected from two streams, Sycamore Creek and Left Prong Hampton Creek, by backpack electrofishing. Broodstock collected in 2012 were held over for grow-out at two hatcheries, Tennessee Wildlife Resources Agency’s (TWRA) Tellico Trout Hatchery (TTH) and Tennessee Aquarium Conservation Institute (TNACI). All broodstock were artificially spawned, and gamete production for wild versus hold-over broodstock was compared. Holdover broodstock from 2012 were larger and produced more gametes than did 2013 wild broodstock. After fertilization, eggs were divided into thirds and distributed to three hatchery facilities, each with a unique water source: surface water (TTH), municipal recirculation (TNACI) and spring water (TWRA’s Erwin Trout Hatchery: ETH). Once progeny reared at each hatchery reached the fingerling stage, they were double marked using visible implant elastomer (VIE) and coded wire tags (CWT) and stocked into their respective source streams. Post-stocking performance of hatchery reared fingerlings was evaluated by comparing growth of hatchery cohorts between source streams and among propagation facilities. Insufficient fingerling production at ETH resulted in omission of this cohort so comparisons only include TTH and TNACI. To date, fingerlings reared at TNACI are larger and are persisting in greater number than fingerlings reared at TTH. However, condition factor (K) for TTH fingerlings is higher.

Note: This project has not been completed and is a work in progress.

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Overcoming Evolutionary History: Conditioning the Barrens Topminnow to Escape an Evolutionary Trap

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The increasing emergence of evolutionary traps is a pressing conservation concern. An evolutionary trap occurs when past selection pressures shaped cue-response systems that were once adaptive for an organism but no longer are. Once in an evolutionary trap, an organism displays an inappropriate (i.e. sub-optimal with respect to fitness) response to novel ecological conditions due to the lack of evolutionary history with those conditions**.** Evolutionary traps are increasing in prevalence due to climate change, invasive species, and anthropogenic activities such as agriculture, harvesting, and ecotourism. Surprisingly, we know relatively little about how to effectively rescue organisms from evolutionary traps. In this study, we demonstrate that conditioning can potentially be used to rescue organisms from evolutionary traps. The Barrens Topminnow (*Fundulus julisia*; BTM) is a fish species in an evolutionary trap initiated by the introduction of the non-native Western Mosquitofish, *Gambusia affinis*. The BTM has no evolutionary history with which to base an effective anti-predator response to Western Mosquitofish. As such, Western Mosquitofish predate upon BTMs and have, in part, led to the BTM becoming endangered. In this study, we conditioned BTM to avoid predation by Western Mosquitofish. We found that conditioning altered the BTM behavioral response to Western Mosquitofish relative to unconditioned fish. Additionally, we assessed the survival effects of conditioning by releasing conditioned and unconditioned BTMs into their natural habitat. Significantly more conditioned than unconditioned fish were recaptured, suggesting higher survival of conditioned fish. This study illustrates that conditioning can potentially be used to rescue organisms from evolutionary traps.

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Status of and threats to the Laurel Dace, *Chrosomus saylori*, endemic to Walden Ridge, Tennessee

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The Laurel Dace, *Chrosomus saylori*, is a federally endangered species endemic to small headwater streams along Walden Ridge in Bledsoe, Cumberland, and Rhea counties, Tennessee. It is historically known from only eight streams in the Soddy (1), Sale (3), Piney (3), and Grassy Cove (1) creek systems within the Tennessee River drainage. Preliminary genetic data suggests two genetically distinct groups, a southern population (Soddy and Sale Creek systems) and a northern population (Piney Creek system); Grassy Cove Creek genetics are unknown. Three populations are likely extirpated (Laurel Branch, Cupp Creek, and Grassy Cove Creek) and Laurel Dace have not been observed in the Soddy Creek system since 2004. All known localities were sampled in 2013 and 2014 to assess population persistence and site occupancy. Current distribution of possibly introduced Tennessee Dace, *Chrosomus tennesseensis*, in the Piney Creek system was also assessed during survey work because this closely related congener could compromise the viability of northern populations of Laurel Dace. Results indicate that the southern population of Laurel Dace is restricted to a single pool in Horn Branch, with heavy siltation and poor water quality from agriculture (tomatoes) the likely cause of extirpation in other creeks. The northern population of Laurel Dace (Piney Creek system) appears to be in relatively good shape, with high numbers of individuals in Bumbee and Moccasin creeks, but siltation and instream modifications for road crossings restrict distribution. The third creek in this system, Youngs Creek, has few Laurel Dace and is impacted by heavy siltation and poor water quality from agriculture (tomatoes). Tennessee Dace are abundant in Duskin Creek, which is located downstream of Laurel Dace populations, but to date have not been observed in the Piney Creek mainstem upstream of Duskin Creek.

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Integrating High Definition Habitat and Fish Surveys: More Data with Less Effort Results in Better Project Success

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Documenting habitat availability, species’ use, and overall habitat suitability is fundamental to developing appropriate responses to many management issues. However, most decisions are based on descriptions of short (several 100m) stream segments which are hoped to characterize the whole stream. By using a new multi-attribute stream survey technique that integrates GPS, video, and other sensors, it is now feasible to survey several miles of stream in a single day with data collected approximately every meter. This new approach can rapidly and cost-effectively transform data-poor stream reaches into multi-attribute, high-resolution maps of instream habitat, streambank, and water-quality conditions. The multi-attribute habitat surveys can be combined with geo-referenced underwater video surveys to document fish occurrence, behavior, and habitat use. These combined outputs allow resource managers to move from statistical assumptions about the “average condition” based on a few sample locations to a census of conditions with highly accurate, site-specific data available. All data collected are georeferenced and can be classified in GIS software to support multiple management objectives. An overview of the process of field data collection, data management, classification, mapping, and analysis will be shown from a number of recent studies. These projects address issues associated with instream flow documentation, understanding mitigation needs, and assessing habitat distribution for fish species. These case studies show the range of data collected and its utility in GIS mapping, fish habitat identification, and overall stream health applications.

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Multi-scale prioritization of dam removals to benefit stream biodiversity in Tennessee

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The Tennessee River basin supports exceptionally high freshwater biodiversity, including a number of rare or narrowly distributed fish species. However, the basin now contains >700 large and small dams that provide freshwater ecosystem goods and services but also fragment longitudinal habitat connectivity. We used barrier occurrence data from multiple sources including a new barrier documentation tool developed in collaboration with the Southeast Aquatic Resources Partnership to document the distribution of dams across 67 10-digit hydrologic unit codes (HUCs) in Tennessee. We then applied an enhanced version of the Dendritic Connectivity Index that simultaneously accounts for the connectivity, type, and quality of habitats distributed throughout stream networks. This framework allows for prioritizing barriers for removal or mitigation at two scales: an ecologically relevant scale controlled by natural resource managers (i.e., within 10-digit HUCS) as well as across a broad region spanning multiple management jurisdictions (i.e., all 67 10-digit HUCS in southeast Tennessee). We illustrate the utility of this framework by prioritizing barriers that might feasibly be removed, including small dams without impoundments or with impoundments characterized by surface areas <200 hectares, to benefit freshwater biodiversity (fishes, mussels, amphibians). Our approach is useful for freshwater resource managers charged with rescuing declining biodiversity while maintaining freshwater infrastructure that is critical to human water security or flood control.

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Conservation status and habitat use of *Noturus gladiator* and other Coastal Plain madtom catfishes

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Compared to other regions, the Coastal Plain of west Tennessee has been understudied with respect to aquatic fauna. Unfortunately, this area has been heavily impacted by agriculture practices, which have contributed to large-scale changes in flow and habitat complexity of river systems. Benthic fishes, such as madtoms (Ictaluridae: *Noturus*), are particularly sensitive to such disturbances. Several species of madtoms occur in these streams, including *N. gladiator*, which is a candidate for federal protection. To assess the status of this species and to better understand habitat requirements and potential impacts of anthropogenic activities on this and other madtoms, historical localities of *N. gladiator* were surveyed and reach-scale and kick-scale habitat measurements were taken. A total of 26 *N. gladiator* were found at only 4 of 16 historical localities sampled. Other more common and abundant species of madtoms collected and examined included *N. hildebrandi*, *N.* *phaeus*, and *N. miurus*. For all madtoms, presence was significantly and positively correlated with overall habitat quality scores and with availability of cover in the reach. At the kick-scale, madtom presence was significantly and positively correlated with woody debris, which likely serves as diurnal cover for all species. Other kick-scale features, such as the erosional or depositional condition or position in the stream channel (e.g, lateral, mid-channel), were significantly correlated with species presence, but varied among species. For example, *N. hildebrandi* were typically found in mid-channel riffles, whereas *N. miurus* were found in lateral position, depositional areas. This variation suggests that although madtom species require woody debris cover, cover patches are partitioned among species based on other microhabitat variables. These results support the need for conservation actions that improve or maintain riparian zones and natural flow regimes to enhance overall habitat complexity and ensure Coastal Plain streams continue to support a diverse catfish fauna.

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Substrate Characteristics and Potential Contaminant Exposure Risk of Lake Sturgeon Habitat in the Upper Tennessee River

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One of the goals established by the Southeastern Lake Sturgeon Working Group for restoring the Lake Sturgeon (*Acipenser fulvescens*) to its historic range in the Tennessee River system is to describe the habitat utilization of reintroduced Lake Sturgeon at a microhabitat scale and determine the availability and quality of habitat for these fish in the Tennessee River system. During June and July 2014, we located acoustic-tagged Lake Sturgeon in Fort Loudoun and Watts Bar reservoirs and collected substrate samples from their estimated locations. We collected sediment associated with locations of 20 sub-adults that varied in size, age, and gender. We created substrate profiles to describe the microhabitats for each fish location, and compared the profiles between reservoirs and among Lake Sturgeon size classes. The habitat utilized by Lake Sturgeon was dominated by clay and silt particles (<63 µm diameter; 71% of total dry mass sample). ANCOVA testing did not support significant differences in the habitat among size classes, likely due to the predominance of fine particles in all habitats. Additionally, we collected samples from five locations across an area of known Lake Sturgeon use for contaminant testing and tested for heavy metal and trace element content. The most prevalent trace elements detected (>200 mg/kg) were iron, aluminum, calcium, magnesium, manganese, potassium, and total organic carbon. Contaminants potentially harmful to Lake Sturgeon (mercury, cadmium, iron, copper, chromium, arsenic, strontium) were also detected. The presence of these heavy metals and trace elements generally correlated with the amount of clay in the substrate sample, suggesting that the majority of summer habitat utilized by Lake Sturgeon in the Upper Tennessee River system may increase their risk for exposure and bioaccumulation of harmful contaminants. Future research will further characterize Lake Sturgeon habitat and investigate the distribution of harmful contaminants.

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Conservation status of the Tennessee-endemic Egg-mimic Darter (*Etheostoma pseudovulatum*)

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Restricted to two counties within the Duck River watershed of Tennessee, *Etheostoma pseudovulatum* is recognized as a state endangered species and has been petitioned for federal listing. Despite this, little is known about the species including its current abundance and distribution. The most recent status survey (1995) found *E. pseudovulatum* in five tributaries to the Duck River and deemed the overall population stable but threatened by growing disturbances in its range, with the risk of extirpation highest in the three smallest tributaries. The goal of this study was to evaluate the current conservation status of the species by: describing current distribution, estimating abundance, and describing general habitat use. At all historical localities, a closed 75-meter reach was sampled using standard seining techniques. Abundance estimates were calculated using the Petersen Method for a subset of localities. Reach-scale and kick-scale habitat variables were measured and analyzed for correlation with *E. pseudovulatum* presence. *Etheostoma* *pseudovulatum* was present at all 25 historical localities sampled, including Little Piney Creek from which it was not observed in the 1995 survey. Abundance estimates ranged from 5 to 258 individuals for each of the localities sampled. *Etheostoma pseudovulatum* were found to prefer pools, undercut banks, leaf/woody debris, lower flows, and deeper depths. This habitat use is similar to that described for other closely-related darter species. Overall, the species was locally abundant and appears stable, however it remains susceptible to local extirpation especially in the three smallest tributaries where populations are small and potentially isolated. Future management efforts should target these smaller tributaries.

Posters:

To be displayed during the Banquet February 19, 2015

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Relationships Between Benthic Macroinvertebrate Assemblages, Stream Habitat, and Catchment Landscape Features in the Lookout Creek System (Tennessee River Drainage)

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We examined relationships of catchment land-use features with lotic habitat (instream, riparian) and benthic macroinvertebrate assemblages (family richness) at eight tributary sites in the Lookout Creek system (Tennessee River drainage). The Lookout Creek watershed (485 km²; Tennessee River drainage) encompasses parts of northern Alabama (DeKalb County) and Georgia (Dade and Walker County), and southeastern Tennessee (Hamilton and Marion County). Study reaches (all in northwestern Georgia) were approximately 35 times the mean stream width and represented different tributaries in the Ridge and Valley ecoregion; however, portions of the upper catchments of certain sites fell within the Southwestern Appalachians. Study catchments yielded land-use results ranging from: 60.3% to 86.2% forested; 0.7% to 20.5% agricultural; and 2% to 32.3% urbanized. Benthic macroinvertebrate assemblages at the sites exhibited family richness values ranging from: 6 to11 EPT (Ephemeroptera, Plecoptera, and Trichoptera) families, 1 to 7 intolerant families, and 19 to 30 total families. Landscape-stream relationships were analyzed using Spearman’s rank correlation procedure (P < 0.05). Family richness indices (EPT, intolerant, total) were directly correlated with pebble size in the streambed and inversely correlated with catchment housing density and inadequate riparian habitat. Total family richness was directly related to pool abundance. Agricultural land use in the catchment was inversely correlated with stream width and large woody debris. These relationships reflect the sensitivity of macroinvertebrates assemblages to catchment and habitat changes.

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Kayak-based videomapping river systems for determining habitat distribution and large-scale aquatic population monitoring

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The need to develop GIS-compatible large-scale maps of river systems led to the design of a kayak-mounted GPS-based river videomapping system. The river mapping system is kayak-mounted with georeferenced under and above water cameras, depth sounder, width sensors and underwater lasers. GIS maps of streambank characteristics (pool, riffle, run), substrate (modified Wentworth scale), embeddedness (EPA classification), depth, width and river characteristic (pool, riffle, run) were developed. River profile rugosity and sinuosity can be determined. The system was used to map every foot of river on over 200 river miles in Tennessee River System, including National Park Service and Forest Service streams. The system provides a georeferenced database for river and stream inventory. A technique to define optimum habitat locations for endangered fish and mussel species was implemented. Habitat suitability indexes algorithm for endangered fish species were also developed. GIS-based video tours of the above and below water river features, providing virtual tours within ArcGIS and Google Earth will be demonstrated.

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Spatiotemporal patterns in the distribution and abundance of the introduced Redbreast Sunfish (*Lepomis auritus*) and native Longear Sunfish (*L. megalotis*; Centrarchidae) in reservoirs of the Tennessee River drainage

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The Redbreast Sunfish (*Lepomis auritus*) was introduced in the Tennessee River drainage (TRD) in the 1940s by intentional stocking. Our study objective was to characterize temporal patterns in population abundances of *Lepomis auritus* and *L. megalotis* in mainstem reservoirs on the Tennessee River based on multiyear analyses of historical (cove rotenone) and contemporary (shoreline electrofishing) datasets. Data were analyzed using longitudinal regression to assess sunfish population trends (species vs. time) within ecoregion-reservoir-specific river sections (overall alpha = 0.05, with sequential Bonferroni adjustment). Historical rotenone data (1947-1997) suggest two major points of *L. auritus* entry into the TRD in the 1950s: (1) Fort Loudon (1953)-Watts Bar (1957) in the upper reaches and (2) Wilson-Wheeler-Guntersville (1950 in each) in the middle reaches. Populations of *L. auritus* exhibited increasing trends in the Chickamauga-Nickajack and Guntersville sections (Ridge and Valley-Southwestern Appalachians), but such patterns were not observed in the other mainstem river sections. Populations of *L. megalotis* have remained robust in the Wilson-Wheeler and Pickwick-Kentucky sections (Interior Plateau-Southeastern Plains), but have declined in Chickamauga-Nickajack and Guntersville sections where *L. auritus* was found in high or increasing numbers. Contemporary electrofishing data (1993-2012) suggest that *L. auritus* has surpassed *L. megalotis* in mean abundance in the Nickajack-Chickamauga section. Patterns of change observed in *L. auritus* were not observed in other native *Lepomis* species.