Southeastern Fishes Council
Annual Meeting Program
November 8-9, 2012
New Orleans, Louisiana

Thursday, 8 November

8:00 - Welcome
Hank Bart, Tulane University

8:15 - Keynote Address: The Many Facets of Royal D. Suttkus
Robert C. Cashner, Emeritus Vice Chancellor for Research, UNO

9:00 - Did Royal Suttkus coin the term biodiversity?
David Etnier

9:20 - Seining along the Western front
Glenn Clemmer and Jim Williams

The research and collections of R.D. Suttkus from the western United States are perhaps less familiar than his well-documented work in the east. His collections in the west spanned three decades, from the mid-1960s into the 1990s, and represent an important contribution to natural history and ichthyology. His emphasis was always on fishes, but he also made extensive collections of mammals, reptiles, amphibians, and plants. While he made collections throughout the western United States, much of his effort was concentrated in the Grand Canyon of Arizona during the 1970s into the early 1980s. He made several collecting trips down the Grand Canyon which further ignited his interest in the cyprinid genus *Gila*. He made significant discoveries while working in the Grand Canyon including the rediscovery of the Humpback Chub, *Gila cypha*. His work on *Gila* continued until his death in 2009.

9:40 - Suttkus superlatives
Henry L. Bart, Jr.

Royal Dallas Suttkus was a man of many accomplishments. He described 34 fish species as new to science, 30 of them from the freshwaters of the southeastern U.S. His species descriptions are among the most thorough in the profession because of the large numbers of specimens he examined. He is best known for his prowess collecting in the field. He made 10,060 collections while affiliated with Tulane University (1950-2005), the first on 6 October 1950 and his last collection on 6 August 2005. He made a number of other collections (as many as 1,855) while a graduate student at Cornell University. He had a hand in collecting 5.6 million of the 7.4 million specimens in the Royal D. Suttkus Fish Collection. He believed in collecting large series of specimens. When he encountered a large population of any species, he sampled it abundantly. The largest lot in the RDS Fish Collection collected by Suttkus (*Pimephales vigilax*) contains 11,369 specimens. The collection contains over a million specimens (7,936 lots) of a single species, the blacktail shiner, *Cyprinella venusta*. This presentation pays tribute to R.D. Suttkus by highlighting the many superlatives of his field collecting and his studies of southeastern fishes.

10:00 – 10:30 Morning Break

10:30 - Extinction attributes of missing north American freshwater fishes
Noel M. Burkhead, Howard L. Jelks, and Stephen J. Walsh

North America is here defined as Canada, the United States, and Mexico. Since 1900, North America has lost 39 species and 18 subspecies of freshwater fishes, and since 1898, three unique populations of freshwater fishes, comparable to IUCN's "Regionally Extinct" category, disappeared from the continent. Modern extinctions of freshwater fishes from 1900 to 2012 are 863 times greater than the background extinction rate–1 extinction/3 million years–reported in the paleontological literature. Human activities are linked to *all* modern fish extinctions in North America and probably worldwide. The primary causes of extinction are habitat loss and introduction of nonindigenous fishes. Of the 53 families of freshwater and diadromous fish families occurring in North America, 14 families have extinct taxa or extirpated populations, but these families collectively represent 85% of the continental ichthyodiversity. The families with the proportionally highest numbers of imperiled and extinct taxa are the Cyprinodontidae, Gasterosteidae, Goodeidae, and Atherinopsidae. Most extinct fishes are from moderate or small genera with 15 or fewer species. Two monotypic genera are extinct: the Stumptooth Minnow *Stypodon signifer* and the Catarina Pupfish *Megupsilon aporus*. Restricted geographic occurrence is the most prominent shared attribute of extinct fishes—70% were narrow or localized endemics and 96% were drainage endemics. Because human activities caused fish extinctions, there is little correlation between extinction and centers of faunal richness or endemism. Two interrelated patterns of extinct fishes are evident: 1, the juxtaposition of narrow and localized endemic fishes with human activities, and 2, the duration and intensity of human activities in drainages or ecoregions having endemic fishes.

10:45 - Morphological systematics and biogeography of the *Pteronotropis hypselopterus* species complex: a tribute to Royal D. Suttkus
Brady A. Porter

Royal D. Suttkus launched his doctoral training in ichthyology with the cyprinid group *Pteronotropis* under the guidance of Dr. Edward Raney at Cornell University. Early in his career Suttkus revised the taxonomy of the group and described *P. signipinnis* and *P. euryzonus* as new species. After retiring from a long and distinguished career as a Professor of Biology at Tulane University, he returned to the these fishes, providing further insight into the group by resurrecting *P. grandipinnis* (Jordan, 1877) and *P. stonei* (Fowler, 1921) from synonymy with *P. hypselopterus* and describing *P. merlini* in honor of his brother. He was close to publishing on a few final taxonomic revisions and new species when Hurricane Katrina devastated his home in Ocean Springs, MS; destroying his field notes, morphological data and slides. We re-measured and scored morphometric characters on the numerous archived lots spread across various museums and collected additional specimens from Georgia and Florida in an attempt to finally publish all aspects of his 1951 dissertation. With his passing in 2009, I now carry the torch for the final revisions and species descriptions of this group which will be published posthumously. This talk will focus on the morphology, coloration, geographic distribution and larval behavior of the cryptic forms of the *P. hypselopterus* species complex.

11:00 - Diversity within the weeds: morphological and molecular variation within *Notropis texanus***
Marisa Stachowski, Blake Matherne, Mollie F. Cashner, and Kyle R. Piller

The Weed Shiner, *Notropis texanus*, has a fairly widespread distribution that ranges from the Mississippi drainage system in Minnesota and Wisconsin down to the Gulf Coast, spanning east-west from the Nueces River in Texas to the Coastal Plain drainage of the Suwannee River in Georgia and the Florida panhandle. A previous study examined morphological variation

across the range of *N. texanus* as part of a larger, more comprehensive study of the *N. texanus* species group. The results from this study noted variability in several morphological characters including interocular and premandibular canals, body circumference scales and intensity of anal fin ray pigmentation; however much of the variation was attributed to clinal variation and no taxonomic changes were proposed. We utilized information from this study as a guide to more comprehensively examine a set of potentially informative morphological characters, including pigmentation and meristic characters, as well as examining mitochondrial variation across the range of *N. texanus*. The results indicate significant variation in several morphological characters as well as mitochondrial DNA suggesting that *N. texanus* may be more diverse than currently recognized. The taxonomic implications of these results, as well as the elucidation of the position of the morphological/molecular break will be presented.

11:15 - Gulf coastal plain vicariance and speciation within the *Cottogaster* (*Percina copelandi* sp. clade)
Mark A. Dugo, Brian R. Kreiser, William T. Slack, and Paul B. Tchounwou

The subgenus *Cottogaster* (*Percina*) includes the channel darter (*Percina copelandi*), the pearl darter (*Percina aurora*), and the coal darter (*Percina brevicauda*). The *Cottogaster* is experiencing extirpation and population declines throughout their range. *Percina copelandi* is widely disjunct in the Mississippi Basin, with populations occurring both east and west of the Mississippi Valley. *Percina aurora* is historically known from the Pearl and Pascagoula River drainages of the Gulf coastal plain, and *P. brevicauda* is endemic to the Mobile Basin. We have added mtDNA ND2 (999 base pairs) and nuclear S7 (529 base pairs) gene sequences to our original mtDNA cyt *b* (1140 base pairs) phylogeny of the *Cottogaster*. The combined dataset (2668 base pairs) supports the monophyly of the *Cottogaster*, however the utility of S7 for resolving intraspecific patterns was limited. The combined mtDNA phylogeny of ND2 and cyt *b* strongly suggests that *P. copelandi* is polyphyletic, recovering two distinct clades for populations sampled. The first clade consisted of populations east of the Mississippi River, plus northern populations west of the Mississippi River (i.e. Arkansas River drainage). The second major clade represented the two most southern drainages sampled west of the Mississippi River (i.e. the Ouachita and Red river drainage), sharing genetic affinity with the sister species pair, *P. aurora* and *P. brevicauda*. This phylogeny best explained the genetic variation for *P. copelandi*, with 80.3%, compared to a model that split *P. copelandi* into groups east and west of the Mississippi River (31.2%). Overall, these data indicate the greatest diversity occurs in the southern distribution of the *Cottogaster*, whereas speciation is tied to vicariant events associated with sea level fluctuations along the Gulf coastal plain theatre. Future directions are to follow-up with morphological datasets, to describe and characterize the patterns of variation observed in *P. copelandi*.

11:30 - Assessing the impact of low head dams and life-history on fine scale genetic structure of etheostomatine darters**
David Camak and Kyle Piller

Anthropogenic modifications to aquatic habitats, such as dams, can fragment lotic systems, disrupt fluvial continuity and modify flow patterns. Such structures could negatively impact riverine ecology and potentially act as barriers to gene flow. Although previous studies have examined potential negative effects of aquatic barriers on population structure and gene flow, most have focused on large species of fish that are highly vagile and have low habitat specificity. In addition, past studies have shown there is often a correlation between life history characteristics and gene flow in fish.This study will test the influence of dams and life-history variation on fine-scale genetic structure of Etheostomatine darters (*Ammocrypta beanii*, *Etheostoma swaini*, and *Percina nigrofasciata*) in the Pearl River basin. Individuals of all three species also were analyzed from three control sites (no dams) in the neighboring Lake Pontchartrain basin (Tangipahoa River system). A minimum of thirty specimens were sampled

from a total of twelve sites across both basins. Our data suggests that the dams impacted the spatial genetic structure of each species differently. There was no real genetic differentiation among populations of *A. beanii*, a main channel, highly vagile species, above and below the two low head dams, whereas *E. swaini* and *P. nigrofasciata* displayed large and moderate amounts of genetic structure, respectively, across this same area. The data suggests that life-history may play a greater role than the dams in shaping fine-scale genetic structure for these species. The implications of these results and a comprehensive summary of this data will be presented.

11:45 - Occurrence and predicted dispersal of bighead carp (*Hypophthalmichthys nobilis*) in the Mississippi River system: development of a heuristic tool
Martin T. OConnell, Ann M. U. OConnell, and Valerie A. Barko

Bighead carp (*Hypophthalmichthys nobilis*) have become established within the Mississippi River system (MRS) and pose a serious threat to native fishes and aquatic ecosystems throughout North America. Determining their dispersal dynamics will be a key management tool for controlling their expansion. To better understand how bighead carp have spread through the MRS, we developed a simple diffusion model to be used as a heuristic tool to generate insights regarding dispersion patterns. With this model, we generated and compared four possible dispersal scenarios for bighead carp based on likely points of introduction. For each of these, we calculated Cohen's kappa and sensitivity (measures of predictive success) to determine which dispersal scenarios were the most accurate in predicting bighead carp occurrence pattern after 30 years. We found significant agreement between the actual and predicted distributions of carp after 30 years of expansion for all four dispersal scenarios (Cohen's kappa: range = 0.136–0.426, $p < 0.05$). The single introduction scenario (in the Arkansas River) had the lowest agreement with the occurrence data (Cohen's kappa = 0.136, sensitivity = 32%) compared with the scenarios representing multiple points of carp introduction: introductions in the Arkansas and Missouri rivers (Cohen's kappa = 0.370, sensitivity = 71%), introductions in the Arkansas and lower Ohio rivers (Cohen's kappa = 0.391, sensitivity = 68%), and introductions in all three river locations (Cohen's kappa = 0.426, sensitivity = 85%). The triple introduction scenario also had the highest sensitivity (sensitivity = 66%) basis: Arkansas River only (sensitivity = 25%), Arkansas and Missouri rivers (sensitivity = 39%), and Arkansas and lower Ohio rivers (sensitivity = 46%). These results suggest expanding bighead carp populations in the MRS began from multiple origins rather than a single introduction. The dispersal scenarios also suggest bighead carp are more widely dispersed than current occurrence data indicate.

12:00 – 1:30 Lunch Break

1:30 - Demographic history and population structure of *Notropis suttkusi* in southeastern Oklahoma**
M.R. Schwemm, A.A. Echelle, and R.A. Van Den Bussche

Recent phylogeographic analyses have shown that the Rocky Shiner *Notropis suttkusi* of southeastern Oklahoma and southwestern Arkansas represents a distinct clade of the widespread *N. rubellus* complex. Here, we present results from a population genetic analysis using complete sequences of the mitochondrial cytochrome b gene from five populations throughout the species' range. Results show large numbers of weakly divergent haplotypes (60 in 178 fish; <1.1% divergence). Haplotype diversity was low (0.12) in the population examined from Muddy Boggy River (McGee Creek), high in Blue River (0.74) and unusually high in the populations from the Kiamichi, Little, and Glover rivers (0.93-0.97). Instances of high haplotype diversity were due to large numbers of private haplotypes. This suggests that populations in different streams are isolated and demographically independent. This is significant for the conservation of the species as water projects are proposed for the region. Additionally, patterns of nucleotide divergence indicate contrasting demographic patterns among Red River

tributaries. Results from mismatch distributions show that the population from Blue River has been stable in population size, while other tributaries indicate a pattern of late Pleistocene expansion. These patterns suggest the possibility that eastern Red River tributaries dispersed from Blue River.

1:45 - A phylogeny of *rhinichthys* (Cypriniformes: Cyprinidae) using COI**
C. Keith Ray and Jonathan W. Armbruster

The molecular revolution in North American ichthyology has seen the super analysis of some molecular phylogenies, with respect to certain groups of fishes, however, the Riffle Daces, *Rhinichthys*, seem to have been overlooked in all the rush. With seven to ten valid species and roughly 40 synonyms, this trans- North American genus is in need of taxonomic revision, yet only one complete morphological phylogeny exists for the genus to serve as a basis for evaluating evolutionary hypotheses. In this study, we examine 112 partial cytochrome oxidase subunit I (COI) sequences obtained from Genbank to produce phylogenetic hypotheses. Both maximum parsimony and maximum likelihood analyses reveal well-supported monophyletic groups that seem to break along biogeographic regions. Four major species groups were recovered and were congruent in both analyses: *R. cobitis*, *R. atratulus* group, *R. cataractae* group, and the *R. osculus* group. With the exception of *R. cataractae*, all species were recovered as monophyletic. Analysis of genetic distances within and between species revealed low distances within groups (0- 1.6%), but high genetic distances between groups (0.7- 16%). We discuss the potential resolution of taxonomic issues based on the results of this study and the potential biogeographic phenomena that lead to these distributions.

2:00 - Evolution of two reproductive traits in E*theostoma* (Etheostomatini): providing new insight to darter phylogenetics**
Zachary P. Martin and Larry M. Page

Darters (Etheostomatini) are known to vary greatly in morphological and behavioral reproductive traits. Given recent taxa rich hypotheses of percid relationships, it is possible to examine these reproductive traits in an evolutionary context. Variation in genital papilla morphology in 129 species of Etheostoma along with two outgroup taxa (Ammocrypta vivax and Percina maculata) is described using 19 discrete morphological characters and grouped into as many as 16 categories. In addition, the four originally described spawning behavior categories are reexamined and modified into nine behavioral guilds based on the preferred mode of oviposition: burying, diving, clumping, rock-attaching, macrophyte-attaching, algae-attaching, alpha-clustering, beta-clustering, and gamma-clustering. Distributions of the morphological traits and spawning behaviors are mapped on phylogenies to predict their evolutionary histories as well as test hypothesized relationships and provide information on unresolved phylogenetic positions such as that of Allohistium. Also, previously undescribed morphological synapomorphies are identified in subgenera such as Catonotus and Boleosoma. Finally, the parsimonious reconstruction of spawning behaviors allows predictions about spawning behaviors employed by species for which spawning has never been observed.

2:15 - Correlating genetic diversity and habitat preference in three species of Missouri darters**
Kerstin L. Edberg and Robert M. Wood

A cornerstone of the life history paradigm surrounding North American darters is the widely held, yet scarcely tested, assumption that these fishes have a high degree of site fidelity to their preferred habitats and do not move great distances from those sites. Reduced levels of gene flow have been documented for many darters at large spatial scales, but very few studies have attempted to determine the fine-scale population dynamics of darter species and what role habitat preferences play in the observed patterns of genetic diversity and population

subdivision. The purpose of this study is to determine whether the range of habitats inhabited by three co-occurring species of Missouri darters, *Etheostoma flabellare, E. blennioides*, and *E. erythrozonum*, is correlated with the amount of gene flow and genetic diversity found within these species. Preliminary results for 8 microsatellite loci will be explored in the context of the overall paradigm of movement within darters at large.

2:30 - Invasive Pike Killfish (*Belonesox*) in Florida: what's the source?**
Liz Marchio and Kyle Piller

Belonesox belizanus (Teleostei: Poeciliidae) is a wide-spread livebearing species that occurs on the Atlantic Slope from southern Mexico to northern Costa Rica. Previous work noted morphological variation within the species, and recognized two subspecies: *B. b. belizanus* and *B. b. maxillosus*. *Belonesox* was introduced into southern Florida in 1957, has become invasive, and can easily be found in drainage ditches and canals throughout the area. The source population of the invasive population is unclear. We used 1122 bp of cyt b and 617 bp of S7-1 and geometric morphometric and gonopodial analyses to conduct a range-wide study of variation within *Belonesox* to examine the distinctiveness of the subspecies and to determine the source of the Florida populations. Bayesian phylogenetic and haplotype analyses indicated that *B. b. maxillosus* is not distinctive from other northern populations of *Belonesox*. Similar outcomes resulted from geometric morphometric and gonopodial analyses. Our results indicate that the Florida populations are from the northern portion of the natural range. Interestingly, a distinct phylogeographic break is evident near the Rio Grande in southern Belize. One clade is comprised of the putative *B. b. maxillosus* and all populations sampled north of the Rio Grande, including Florida. The other clade is comprised of the Rio Grande and all populations south of the Rio Grande.

2:45 – 3:15 Afternoon Break

3:15 - Life history of the Brook Silverside, *Labidesthes sicculus*, in the Mobile Basin, Alabama**
Matthew S. Piteo and Phillip M. Harris

Little is known about the life history of *Labidesthes sicculus* in the Mobile Basin, which represents the subspecies *L. s. vanhyningi*. Because of its widespread distribution and high local abundance, there is currently little conservation concern for *L. sicculus*. However, recent studies suggest that *L. s. vanhyningi* may represent a unique lineage that deserves its own conservation consideration. Of particular concern is the recent invasion of the Tennessee-Tombigbee Waterway by *Menidia beryllina*, another silverside fish shown to replace *Labidesthes sicculus* in freshwater environments. It is therefore important to understand the life history of *L. s. vanhyningi* so that stakeholders will be more informed when making conservation decisions. *Labidesthes* were collected at boat ramps in Lake Tuscaloosa reservoir (North River, Black Warrior River drainage) on a monthly basis from September 2011 to September 2012. Abundance ranged from 49 specimens in 2 hours of sampling in September 2011 to over 100 individuals in one seine haul in December. Length-frequency histograms were generated to define size classes and estimate annual growth of these size classes. Preliminary results from length-frequency data indicated that from January to August 2012 most individuals ranged from 30-50 mm standard length (SL). The emergence of juveniles (20-23 mm SL) in May suggested spawning occurred a month earlier than reported for an Indiana *L. sicculus* population from the Wabash/Ohio River drainage. A dietary analysis will be conducted on each monthly collection from a subset of individuals representing each size class. Gonadosomatic indexes (GSI) will be calculated and ova will be weighed, counted and measured to determine reproductive investment of this species. Dietary and GSI data will be compared and contrasted to populations of Brook Silversides in other river drainages. These life history data will provide much needed

information about Mobile Basin *Labidesthes*, should conservation concerns arise for this unique lineage.

3:30 - Reproductive-based patterns of movement in *Fundulus olivaceus***
Scott Clark and Jake Schaefer

The movement of animals throughout a landscape is an important mechanism regulating a host of ecological and evolutionary processes operating at different spatial and temporal scales. Identifying potential ecological drivers that promote movement behavior may lend valuable insight into many of these processes (e.g. assemblage composition, metapopulation dynamics, etc.) which are strongly influenced by the movement of individuals within and between populations. Although movement patterns of stream fishes have been well documented, the ecological factors influencing such patterns are to a much lesser extent understood. Using passive integrated transponder (PIT) technology, we assessed the movement patterns of the blackspotted topminnow (*Fundulus olivaceus*) in a mesocosm setting, manipulating trial population densities and operational sex ratios across spawning and non-spawning portions of the year. Experimental trials were ran over 24 hour periods, using initial starting densities of 4 (low) and 12 (high) individuals, across three levels of sex ratio (3:1, 1:1, 1:3; male:female). Per capita rates of movement during the spawning season were found to be significantly higher in low density treatments, presumably due to increased search for potential mates. Across all treatments, males exhibited significantly higher rates of movement compared to females, consistent with the sexual asymmetry of reproductive investment, and furthermore, this trend was exacerbated as operational sex ratio became more female biased. These results suggest that local population structure may facilitate differential patterns of movement, thereby directly influencing the rate and magnitude at which movement-based processes operate across populations.

3:45 - Life history of the Diamond Darter, *Crystallaria cincotta***
Crystal Ruble, Patrick Rakes, J.R. Shute, and Stuart Welsh

The diamond darter, a candidate species for listing under ESA, occurs within the lower Elk River, WV. Little is known about the reproductive biology of this species, so we conducted a captive propagation study during 2008-2012. Three diamond darters (including two juveniles) collected during fall 2008 did not spawn during spring 2009. Two diamond darter males were collected in fall 2009 and added to the existing three. Spawning occurred with these five individuals in spring 2010 and 2011. During fall 2011, 12 diamond darters were collected from Elk River and added to two remaining diamond darters, giving a total breeding group of five males and nine females. Breeding in 2012 was mid-March through June. Males were very territorial of spawning sites. Spawns were quick vibrations of males and females into the substrate. Eggs were buried in fine sand in relatively swift clean depositional areas. Temperatures during breeding time ranged from 55^{o}F to 74^{o}F. Egg size was 1.8 - 1.9 mm. Embryo development ranged from 7 - 11 day until hatch, and the embryo size at hatch was 7.8 - 8.0 mm total length. Eggs were harvested by gravel siphoning, secondly larvae were passively collected. Larvae were transferred to a black, shallow, oval rearing tub. Larval yolk sac absorption took 5 - 10 days. Larvae were 10.8 - 11.0 mm total length when yolk sac was fully absorbed. Larvae were provided brine shrimp *Artemia sp.*, *Ceriodaphnia dubia* neonates, marine rotifers, and powdered foods ranging in size from 50-400 microns. Although food density was high, larvae were not observed to have food in their gut. Larvae were observed cannibalizing other larvae. There was 100% mortality of larvae for three consecutive years, the oldest larvae was 11 days.

4:00 - Niche position and competitive exclusion in stream fish communities: a geometric morphometric approach**
Luke M. Bower and Kyle R. Piller

The connection between ecology and morphology has long intrigued ecologists, and investigation of this relationship has given ecologists insight into the factors that influence assemblage structuring of fish communities. Stream fish co-occur in similar habitats, but often forage on different prey items or utilize slightly different microhabitats, thereby allowing them to co-exist. Slight differences in morphology may optimize stream fish for certain microhabitats. By examining these differences in morphology, it is possible to predict the niche position of stream fish. Niche-partitioning has presumably allowed for high species richness in stream fishes communities in the southeastern United States. The purpose of this study was to take an eco-morphological approach to examine the degree of seasonal niche overlap fishes and to test the utility of body shape as a predictor of niche position among stream of the Tickfaw River (Lake Pontchartrain Basin) in southeastern Louisiana. To accomplish this, point sample collections were made throughout the year and ecological (habitat and trophic) and body shape (geometric morphometric) data were collected for each specimen of fish. Multivariate analyses were performed to examine relationships and differences between stream fish species body shape and niche position. Results indicate that the niche of several species shifted seasonally, likely the results of changes in reproductive habitat, food items, or competition with other congenerics. Within a stream fish community, body shape was shown to be an indicator of basic niche position for stream fish species.

4:15 - Trade-offs and synergies between fish production and other ecosystem services in response to flow regime in the nation's largest river swamp – the Atchafalaya River basin, Louisiana**
Micah G. Bennett, Kelley Fritz, Anne Hayden-Lesmeister, Justin Kozak, and Aaron Nickolotsky

Ecosystem services are the fundamental benefits that living ecological communities provide to humans. Freshwater ecosystems provide many such services and are highly managed and controlled in much of the United States. Thus, management decisions affect the multitude of services freshwater systems provide, yet this dynamic is complex and often cryptic. Some ecosystem services are complimentary and may respond similarly to a management action while others may have divergent responses. Understanding this dichotomy is crucial to adaptive and collaborative ecosystem management. The Atchafalaya River Basin in Louisiana is the nation's largest river swamp, the largest distributary of the Mississippi River, and the principal floodway of the Mississippi River and Tributaries Project. Enclosed by a levee system and containing many canals and diversions, the highly managed system is optimized for flood control and receives approximately 30% of the combined annual flow from the Mississippi and Red rivers through the Old River Control Structure. While there is interest in altering this mandated flow regime, the many stakeholders and services in the Basin make this decision complex. Using existing data on land cover, inundation levels, and ecological properties, we develop models relating ecosystem services including fish and crayfish production, denitrification, navigation, oyster production, and delta-building to aspects of flow regime. This information will allow managers and policy-makers to visualize complementarities and trade-offs among these services. Knowledge of these relationships will allow policy-makers to better understand the impacts of management decisions on ecosystem services and therefore potentially improve stakeholder cooperation in the Atchafalaya Basin. This ecosystem services tool could serve as a model for an adaptive management approach in large, complex ecosystems and provide hypotheses for initial steps toward such management actions.

4:30 – 6:00 Southeastern Fishes Council Business Meeting
7:00 Poster Session/Social

Friday, 9 November

8:30 - Phylogeography and genetic structure of a genetically distinct population of *Lepomis megalotis* in Cuatro Cianegas, Mexico**
Lyndon M. Coghill, C. Darrin Hulsey, and Steven G. Johnson

Cuatro Ciénegas, an aquatic oasis located in the Mexican Chihuahuan desert, exhibits the highest level of endemism in the continental United States. Cuatro Ciénegas is located in an extremely arid region and virtually all of the endemic fish and other species are found within the more than 200 permanent pools, rivers and lakes within the valley. Despite all being located in a Mexican National Protected Area, little is known about the evolutionary distinctiveness of even some of the fish species in Cuatro Ciénegas. We conducted a phylogeographic study on mitochondrial DNA haplotypes on the centarchid fish *Lepomis megalotis* to determine if the populations found within the valley were evolutionarily distinct from the populations outside of the valley and to determine if their were evolutionarily significant units (ESUs) within the basin. The genetic divergence of *L. megalotis* in the valley suggests they occur naturally both within and directly outside the valley. Based on the amount of mitochondrial and nuclear gene divergence among populations of *L. megalotis* our results suggest individuals within the valley are a unique evolutionary entity compared to other *L. megalotis* populations. Significant sequence divergence was also discovered between *L. megalotis* populations separated by the Sierra de San Marcos bisecting the valley. These results support previous studies that suggest the two lobes of the valley deserve independent consideration during management decisions.

8:45 - Diet and feeding-related morphometrics of the Blackstripe Topminnow *Fundulus notatus* and the Blackspotted Topminnow *Fundulus olivaceus* in syntopic and allotopic populations**
Charles M. Champagne, Jake F. Schaefer, Brian R. Krieser, and Dave Duvernell

The *Fundulus notatus* species complex consists of three described species: *F. notatus , F. olivaceus and F. euryzonus*. Both *F. notatus* and *F. olivaceus* have broad overlapping ranges with many populations being found within and outside of contact zones. Contact zones are generally found in mid-reaches with *F. olivaceus* dominating headwaters and *F. notatus* in larger rivers downstream. Both species share similar ecological niches so the mechanism allowing for stable coexistence in contact zones is unknown. The purpose of this study was to examine variability in diet and feeding morphology of *F. notatus* and *F. olivaceus* in syntopic and allotopic populations across three drainages. Both *Fundulus* species were sampled in Pascagoula River, Pearl River and Neches River contact zones in the summer of 2008. Fish were genotyped and feeding-related morphometrics were taken (standard length, body width, body depth, head length, head width, head depth, interorbital distance, preorbital length, orbit length, postorbital length, gape width, gape height, maxillary length, and dentary length). Morphometric analyses were conducted to determine if there were ontogenetic shifts or sexual dimorphisms in allotopic and syntopic populations. Analyses were also conducted to determine if there were differences among species and syntopic-allotopic populations. Digestive tracts of *F. notatus* and *F. olivaceus* were examined to determine prey items. There were significant differences in feeding-related morphometrics between age classes, sexes, and syntopic and allotopic populations for both *Fundulus* . There were also significant differences in diets of various groups of *F. notatus* and *F. olivaceus* .

9:00 - Examining community level variables of fishes in relation to natural gas development**
Jessie J. Green, Ginny L. Adams, and Reid Adams

The emerging use of natural gas extraction by hydraulic fracturing is a new and understudied

anthropogenic disturbance to aquatic ecosystems. In the Fayetteville Shale of central Arkansas, hydraulic fracturing has increased extensively over the last eight years, with over 4,000 gas wells currently in existence. Potential disturbances associated with gas extraction are siltation from pad, road, and pipeline construction, along with improper disposal of production water. Siltation of streams can alter substrates vital for successful reproduction in fishes and habitat for macroinvertebrates. In spring 2012, we sampled 13 sites throughout the Fayetteville Shale within the Boston Mountain and Arkansas Valley ecoregions. To address study concerns that confounded previous data, sites were selected based on similar catchment areas, and stream size and encompassed a gradient of gas well densities (0 to 3.26 wells/km^2). Fishes were sampled quantitatively using backpack electrofishing and three-pass depletion at multiple riffle-pool units per site. We examined fish species richness, fish density, percent sensitive taxa, percent darters, and percent Green Sunfish *Lepomis cyanellus* in relation to increasing gas well density. All pairwise correlations, except fish species richness and fish density, were significantly related to gas well density at $\alpha = 0.05$. Proportional abundance of sensitive taxa ranged from 19.5 to 63.0% and was negatively correlated with gas well density ($r= -0.86$, $p=0.03$). Proportional abundance of darters ranged from 6.1 to 63.0% and was negatively correlated to gas well density ($r= -0.76$, $p<0.01$). Proportional abundance of *L. cyanellus* ranged from 1.31 to 23.57% and was positively correlated with gas well density ($r= 0.66$, $p=0.01$). Our preliminary results suggest a negative response in some community level variables to natural gas development. Addressing confounding effects of catchment size and gas well density gradients allows more insight into potential impacts of natural gas development.

9:15 - Refining methods to catch and evaluate size structure of an imperiled population of Alligator Gar in Arkansas**

Chris Naus, Reid Adams, and Lindsey Lewis

Alligator gar (*Atractosteus spatula*) historically ranged throughout most of the southeastern United States, from Florida to Illinois. However, human impacts (e.g. dams and overharvest) have led to drastic reductions in both their range and populations. The status of alligator gar in Arkansas is currently listed as imperiled (Nature Serve), meaning the species faces a serious threat of extinction in most or all of its range within Arkansas. In 2007, a population of alligator gar was discovered in the Fourche LaFave River, a tributary of the Arkansas River. From 2007-2011 seven sampling trips to an overwintering location with annual site affinity yielded 47 unique individuals caught and tagged. Captured fish ranged in size from 147-223 centimeters, with an average size of 182.35 cm (SD±19.62 n=47). Based off documented spawning in 2007 and published length at age data we believed our previous sampling method excluded smaller individuals. During the winter of 2011/12 an effort was made to determine if small individuals were not being captured by the multifilament gillnet array of 10.16 and 12.7 cm mesh used from 2007-2011 by adding 7.62 cm inch mess gillnets to the array. Sixteen individuals including 15 unique individuals were caught, size ranged from 96-212 cm, with an average of 142.19 cm (SD±36.71 n=16). Of those caught, 9 were smaller than any fish caught in prior years and 5 of those were caught using 7.62 cm mesh nets. With the addition of smaller mesh gillnets we will be able to generate a more accurate population size structure of alligator gar in the Fourche LaFave River,AR.

9:30 - Explosive diversification coinciding with a benthic to pelagic shift in eastern North American cyprinids**

Phillip Hollingsworth Jr, Andrew Simons, James Fordyce, and Darrin Hulsey

Evolution along a benthic to pelagic (or bottom to mid-water) habitat axis is ubiquitous in fish inhabiting relatively depauparate, lentic environments. However, the importance of this axis to diversification for fishes living in the lotic environments that dominate aquatic ecosystems in eastern North America is unclear. Transitions between benthic and pelagic habitats in riverine ecosystems could commonly represent a shift into a novel adaptive zone that leads to

exceptional lineage diversification. In this study, we generated the most thoroughly taxonomically sampled phylogenies to date for North America's most speciose endemic clade of fishes, the open posterior myodome (OPM) cyprinids. Using these phylogenies, we estimated divergence times within this clade and traced the history of benthic and pelagic habitat transitions across the tree. Then, we asked whether a major historical shift from benthic to pelagic habitats lead to a burst of lineage diversification within this clade. Our results suggest that a historical shift from benthic to pelagic habitats coincided with a burst of speciation in the hyper-diverse and generally pelagic OPM shiner clade. Diversification along a benthic/pelagic habitat axis could link micro- and macroevolutionary processes across both lentic and lotic freshwater ecosystems.

9:45 - Patterns of phylogenetic organization in darter riffle communities**
Aaron D. Geheber

Factors contributing to community organization (i.e. biotic and environmental interactions) have received much attention in the past, however the potential underlying role that phylogenetic relatedness plays in such interactions has often been overlooked. Because phylogenetically closely related species are more likely to be ecologically similar than are phylogenetically distanced species, ecological determinants of community composition should be reflected in phylogenetic patterns. The aim of this study was to assess the underlying effects of genetic relatedness on darter riffle community organization in order to better understand the mechanisms by which communities are assembled. Darter communities are especially interesting systems for this type of study due to the potential for interspecific interactions at small geographic scales (i.e. High species richness at small spatial scales). Because of the high concentration of closely related species, competition is a plausible expectation. Darter riffle communities in the Duck River (Tennessee) were sampled using standardized methods. A maximum likelihood phylogenetic hypothesis based on multiple genes was generated for the regional species pool of the family Percidae. Phylocom version 4.2 was used to calculate mean phylogenetic distance (MPD) and mean nearest phylogenetic taxon distance (MNTD) within all samples, and MPD and MNTD between samples. Results suggest that communities are non-randomly organized with respect to ancestral relationships. Additionally, the spatial scale at which communities are examined is an important indicator of community organization processes. Implications for community organization processes and the roles of competition and environmental filtering at differing spatial scales will be further discussed.

10:00 – 10:30 Morning Break

10:30 - Where have all the Slackwater Darters gone? Using environmental DNA for detection of rare species
Alexis M. Janosik and Carol E. Johnston

Environmental DNA (eDNA) in aquatic systems is material left in the water by species that can be detected by genetic markers. These species-specific markers can be used for detection of aquatic organisms, often when sampling has not produced specimens. This technique is particularly useful for the detection of rare species, especially when their presence is temporally or spatially variable. A positive detection using the eDNA technique may highlight areas for more concentrated sampling, or for habitat protection. We chose Slackwater Darter as a model for the development of this technique for imperiled species in the Southeast. This species is notoriously difficult to find during the non-breeding season, and can be missed at breeding sites if the timing of sampling is off. Furthermore, this species is in serious decline, and habitat protection and restoration measures are in process. Correctly targeting critical habitats for the species is crucial, and detection is a necessary component in this process. Our results from non-breeding sites identified Slackwater Darter at six of 11 sites using eDNA, while traditional

sampling recovered specimens from only two of these sites. Two of the sites where a positive DNA signature was recovered, Limestone Creek and Lindsay Creek, are streams where Slackwater Darter was thought extirpated. Our future work is aimed at sampling breeding sites this winter, but our preliminary results already suggest that this technique is a useful management tool for this species.

10:45 - Genetic assessment of Lake Sturgeon for reintroduction into the upper Tennessee River

Ashantye Williams and Gregory Moyer

Lake sturgeon is considered an endangered species in Tennessee and many populations have suffered from overfishing, construction of dams, destruction of habitats, and others. Since 1998, the Tennessee River Lake sturgeon Reintroduction Working Group (TRLSRWG) has been working towards the goal of restoring lake sturgeon. In the Tennessee River system TRLSRWG developed a plan in 2007 in an attempt to guide any restoration efforts. The plan called for the marking or tagging of all individuals to track success of restoration. Conventional tags for long-lived species are prone to failure because of battery life, tissue regeneration or loss of external tag. Furthermore marking techniques using conventional methods can be expensive and time consuming because each generation a large number of marks and marking efforts would be required. As such our study provided an initial assessment of genetic diversity for the genetic monitoring of reintroduced fish. Our objectives were comparison of genetic diversity between hatchery and wild stock and evaluation of molecular tags for monitoring hatchery returns. Eleven microsatellite loci were used to assess molecular tags and estimate genetic diversity of these species. General population genetic parameters such as average observed number of alleles and heterozygosity for hatchery (4.25 and 0.493) and wild (4.889 and 0.490) indicated no difference in genetic diversity between broodstock and the wild. Our results emphasized the importance of integrating genetic information in reintroduction programs in an effort to evaluate the programs' stocking success in the river system.

11:00 - Evaluation of the Tennessee Lake Sturgeon (*Acipenser fulvescens*) reintroduction and management plan

Kathlina Alford, Mark Cantrell, Carlos Echevarria, Anna George, Jason Henegar, Bernie Kuhajda, Dave Matthews, and Greg Moyer

Lake Sturgeon (*Acipenser fulvescens*) historically were not uncommon in the Tennessee River but became extirpated due to constructed dams altering riverine habitat and blocking movement, overharvesting, and poor water quality. In 1998 a Lake Sturgeon Working Group and Management Plan was created, and several agencies began working to restore this species to the Tennessee River based on improved water quality due to the Clean Water Act and TVA's Reservoir Release Improvement Program. This fish can once again be found in the river due to reintroduction of propagated Lake Sturgeon from eggs provided by the Wisconsin DNR from wild fish each year. Because Lake Sturgeon are long lived, do not spawn until 12-25 years old, and females only spawn every 4-9 years, it is anticipated that restoration will be a 20+ year endeavor. Therefore it is important to update management plans regularly and assess productivity and success of the project. Currently the working group is updating the 2006 Tennessee Lake Sturgeon Management Plan to include new data, standardized collection and genetics procedures, and expanded management area. After 13 years of stocking, expected effective population size (Ne) is estimated at 251, putting the program on track to reach its goal of an Ne of 500 by the year 2021. Because Lake Sturgeon are moving far outside of the original management unit (extreme upper Tennessee and lower Holston and French Broad rivers), the boundaries of the management area were extended to encompass the entire Tennessee River drainage. The Cumberland River has also been added to the management plan due to recent reintroduction efforts. Promoting additional education and outreach on the restoration of the Lake Sturgeon was added to the plan. The new Tennessee Lake Sturgeon Management Plan is

expected to be approved at the 2013 meeting of all of the project partners.

11:15 - Management and regulatory implications of streamside recreation to listed fishes in Citico Creek (Cherokee National Forest, Monroe County, TN)

Peggy Shute, Ken McDonald, J. R. Shute, and Pat Rakes

Before 1997, dispersed camping in the Cherokee National Forest (CNF) along the Citico Creek corridor within the range of the federally threatened yellowfin madtom and federally endangered smoky madtom and Citico darter was unrestricted. These fishes spawning periods coincide with periods of high water-based recreation use. In 1984, stream access and associated rock dam construction was identified as potentially resulting in deleterious impacts to these fishes. Moving rocks to build dams could crush eggs, expose darter eggs attached to the undersides of the rocks to predators or desiccation, result in loss of entire madtom nests (not attached to rocks) as current sweeps them away when cover rocks were moved, reduce available spawning substrate or cover with rocks being incorporated into dams, and alter upstream and downstream flow and depth. In 1997, the Forest Service followed recommendations to prohibit camping in sensitive areas by restricting camping to designated sites within the range of the three fishes. Although the three fish populations appear to have remained relatively stable in recent years, rock dam building persists, with 10 to 12 dams consistently being constructed near campsites. In response to recent Forest Service proposals that could result in higher visitation along this sensitive stream corridor, we analyzed detection probabilities for all three species throughout their ranges in Citico Creek based on 1989-2011 data, especially in relation to designated campsites considered more likely to be affected by dam building. Likelihood of detecting young-of-year (YOY) of all three fishes was higher following camping restrictions in 1997, and with increasing distance from campsites. Site-specific decreased YOY survivorship related to rock dam building is indicated; this facilitates endangered species analyses of projects that might result in increased water-based recreation.

11:30 - Freshwater information network: utilizing underutilized distributional data for aquatic conservation

Evan R Collins, Bernard R Kuhajda, and Anna L George

While the Southeastern U.S. is known for its diverse aquatic fauna, it is also unfortunately recognized as an area where these species are at severe risk. Therefore, conservation is now at the forefront of most ichthyological work in the Southeast. Meaningful conservation actions require data that are capable of integrating distribution and diversity across varying spatial and temporal scales. However, these data are scattered throughout a number of databases, academic institutions, government agencies, and personal libraries. Collating, organizing, and sharing this plethora of data will facilitate coordinated conservation and restoration programs by interested stakeholders (researchers, managers, and citizen scientists). As part of the SFC initiative to draft conservation plans for imperiled fishes in the Southeast, 61 fish species were identified as most at risk in the Mobile Basin and the Cumberland/Tennessee River drainage. For each species we compiled museum data in the form of accessioned specimens, field identifications from researcher's field notes, and gray literature from agency status reports. We currently have gathered over 70,000 museum records from 27 institutions and are incorporating field-identified records and data from status surveys. Records were georeferenced using the Global Biodiversity Information Facility "Guide to Best Practices for Georeferencing" protocol. Detailed distribution maps were created from the databases, with collection dates noted by color coding as pre-1980, 1980-1999, and 2000-present. Negative data were included when surveys were specifically looking for the species in its known range. Map drafts were reviewed by experts on each species to determine accuracy and find missing records. Questionable records were removed from maps and stored in a separate database. These records form the basis for a dynamic database, the Freshwater Information Network (FIN), which can be continually updated to reflect best available science for rapid dissemination.

11:45 - Comparing river condition to successful hatching of Alabama Shad (A*losa alabamae*) in northern Gulf of Mexico drainages
Paul.F. Mickle[1], Jake F. Schaefer[1], Susan.B. Adams[2], Brian R. Kreiser[1], and Todd Slack[3]

In recent years, the Alabama shad (*Alosa alabamae*) has experienced dramatic declines and extirpations from portions of its native range. Habitat degradation and barriers to migration are considered contributing factors to range contraction. To identify conditions of successful spawning, timing of successful hatch windows were compared to river temperature and discharge among two northern Gulf of Mexico drainages (Apalachicola and Pascagoula rivers). Sampling during 2005-2009 yielded 399 juvenile A. alabamae of which 182 were aged from sagittal otolith ring counts. Logistic regression revealed that the presence of successful spawning was influenced by large regime shifts of increasing temperature within a specific range (1927 $^{\circ}$C). However, this timing also requires a synced absolute high discharge volume (X>5290 m^3/s Apalachicola R., 3380 m^3/s Pascagoula R.). Timing of successful hatch windows differed between drainages but not between years within each drainage. Documenting and identifying the river conditions during successful reproduction can provide important information for river management of this threatened species.

12:00 – 1:30 Lunch Break

1:30 - From holding on high water: Gulf Sturgeon movement in the Yellow River
Bill Tate, Jeff Van Vrancken, Channing St. Aubin, and Mike Nunley

The Gulf of Mexico sturgeon (Gulf sturgeon) is a federally threatened, anadromous sub-species of the Atlantic sturgeon inhabiting the rivers of the northern Gulf Coast. In spring, sturgeon migrate into coastal rivers, travelling greater than 100 km inland to spawning sites then returning to lower reaches of these rivers (<60km) where they reside in deeper pools and other “holding” areas until fall when they return to the marine environments to feed. Until recently, the temporal and spatial patterning of Gulf sturgeon were poorly understood but recent advances in acoustic telemetry have provided effective methods to passively observe Gulf sturgeon movements. We deployed stationary Vemco VR2W receivers at 5km intervals in the lower 60km of the Yellow River as well as an additional series of receivers in the upper river near known and suspected spawning sites. Individual fish, surgically implanted with coded acoustic transmitters, were monitored to determine sturgeon habitat utilization within the river. Of the nearly 80 fish tagged in the Yellow River, 15 were recorded at the spawning sites in the upper river (> rkm 95). During low river stages, sturgeon tended to be less active, with fish activity increasing during higher stages. Some fish were observed to travel more than 20 km/day during flood events, travelling to the upriver spawning sites as late as mid-June. Timing of migration out of the river also appeared to be associated with river stage. Our data indicate that rain events and river discharge are factors influencing Gulf sturgeon behavior in the Yellow River, particularly during drought years. Tracking of Gulf sturgeon in the Yellow River enables military mission planners to develop avoidance/mitigation zones will be important components in recovery and management programs for Gulf of Mexico and other sturgeons worldwide.

1:45 - Variation in contact zone dynamics between two species of topminnows, *Fundulus notatus* and *F. olivaceus*, across isolated drainage systems
David Duvernell, Jake Schaefer and Brian Kreiser

Understanding how evolutionary and ecological processes create and maintain the diversity of organisms is the fundamental goal of evolutionary biology. The best systems for studying ecological and genetic interactions between species are ones in which the conditions have been replicated naturally and in which environments take on predictable linear gradients. Two species in the *Fundulus notatus* species complex (*F. olivaceus* and *F. notatus*) are widely distributed

from south central Texas to the panhandle of Florida and as far north as central Missouri and southern Illinois. Throughout this broad range, *F. olivaceus* typically occurs in headwaters and *F. notatus* downstream in larger streams and rivers. Multiple basins throughout this broad region contain populations of both species, which form independent hybrid zones along this river continuum. These hybrid zones are typically centered around tributary-river confluences that feature abrupt shifts in stream habitat. We present data of an ecological and genetic assessment of ten replicate *Fundulus* hybrid zones. Within each zone, we assessed patterns of coexistence, reproductive isolation, measures of fitness and life history traits. These data were used to addresses hypotheses regarding hybridization and rates of coexistence, strength of ecological gradients, and phenotypic similarity.

2:00 - The effect of reservoirs on gene flow in stream fishes revisited: analysis of two species from the Tallapoosa River system in

Brook L. Fluker, Bernard R. Kuhajda, and Phillip M. Harris

It is hypothesized that river impoundments (reservoirs) impede natural migration in stream fishes, resulting in spatially and genetically fragmented populations. Our previous work utilized microsatellite (m) DNA loci to examine the effect Martin Reservoir (Tallapoosa River, Mobile Basin) on genetic structure, migration, and gene flow of two species with putatively differing migration capabilities, the Tallapoosa Darter (*Etheostoma tallapoosae*) and Tallapoosa Shiner (*Cyprinella gibbsi*). For both species, analysis of mDNA revealed genetic discontinuities between neighboring tributaries that have been fragmented by reservoir construction. This finding was in stark contrast to the high degree of genetic continuity, for both species, between control tributaries in a natural river setting. Microsatellite based estimates of genetic diversity and migration were differentially affected in the two species indicating that stream fishes with relatively high dispersal abilities can be equally or more susceptible to reservoir fragmentation when compared to species with putatively low dispersal abilities. In the current study, we analyzed mitochondrial (mt) DNA variation from the same samples to evaluate whether genetic structure observed from the mDNA data set could be attributed to historical signatures of genetic structure or represent recent, fragmentation-induced genetic structure. Results from mtDNA revealed no significant genetic structure within reservoir or river groups, indicating a lack of historical genetic structure (i.e. prior to reservoir construction). The mtDNA data bolster our previous conclusion that reservoir fragmentation influences genetic patterns and processes in stream fishes. Further, small-stream species can experience genetic impacts from reservoir fragmentation over a relatively short time period (approximately 85 years). These findings are particularly relevant to conservation strategies for small-stream inhabitants of the southeastern United States, where hydroelectric and recreational reservoirs restrict connectivity in aquatic systems.

2:15 - A predictive model for estimating fish habitat in upland and lowland southeastern USA streams

Michael H. Doosey, Justin G. Mann, and Henry L. Bart Jr.

The availability of suitable habitat for aquatic species is critical to successful management and conservation programs. However, collection of habitat data over large geographic areas is costly and labor intensive. We construct a model to predict stream width and other habitat parameters important to fish in lowland and upland streams across the southeastern USA. We use a dataset of fish diversity and habitat characteristics (e.g. width, depth, flow) collected at 45 sites in 13 basins across the region. GIS data (e.g. basin area, stream length, gradient, etc.) from various sources was used to identify environmental layers predictive of stream habitat. Knowledge of aspects of local stream conditions that are not routinely measured in fish sampling is important for estimating fish habitat availability and enables of wide range of new uses of historical fish collection data. We aim to use models developed in this study to predict presence of flows, depths and benthic habitat types (e.g. sand or gravel) critical for species of

conservation concern.

2:30 - Beyond multi-district litigation and megapetitions: developing an effective approach to conserving candidate, petitioned, and other at-risk species in the Southeast
Robert Tawes and Gabrielle Horner

Since 2010, the U.S. Fish and Wildlife Service (FWS) has been petitioned to list over 400 species in the southeastern U.S., including 48 freshwater fishes, as threatened or endangered species under the Federal Endangered Species Act (ESA). Through settlements with environmental groups in 2011, FWS has also committed to make proposed or final listing determinations on 251 candidates for ESA protection and several other species, including an additional eight southeastern fishes, by 2016. The Southeast Region of FWS and its partners are implementing an effective, sustainable, and science-based strategy to address the conservation needs of these species. The five step strategy includes species categorization, identification of possible conservation actions, development of partnerships with varied stakeholders, collection of biological and threat data, and promotion of conservation through outreach and education. Through this strategy we hope to address threats to as many target species as possible, hopefully precluding the need for ESA protection. This presentation will outline this strategy, focus on progress to date, and discuss planned activities that will benefit imperiled fishes and other wildlife.

2:45 – 3:15 Afternoon Break

3:15 - *Nothonotus* 9.0: three decades of *Nothonotus* (Percidae) phylogeny estimation
Benjamin P. Keck

The *Nothonotus* darters comprise at least 22 species occurring in drainages throughout much of eastern North America. The first phylogenetic treatment to include most species of *Nothonotus* was Page's 1981 estimation of darter relationships. Subsequent studies focused on or including *Nothonotus* have added new data including morphology, allozymes, mitochondrial DNA sequences, and nuclear DNA sequences. The accumulation of more data and progress in analytical methods have improved our understanding of relationships among many of the *Nothonotus*, but several biogeographically important relationships remain unresolved and introgression is an issue. I will briefly review previous hypotheses and discuss insights into these relationships based on a phylogeny estimated from 14 nuclear exon loci.

3:30 - Unexpected genetic divergence among populations of the Brighteye Darter, *Etheostoma lynceum*
Ray C. Schmidt, Michael H. Doosey , and Henry L. Bart Jr.

Previous studies on the variation of the wide ranging banded darter *(Etheostoma zonale*) identified subspecies and geographic races based on morphological characters. Subsequently, *E. lynceum* was recognized as a distinct species based on its allopatric distribution and modal differences of several meristic characters. The brighteye darter occurs in eastern tributaries of the Mississippi River from the Obion River south to Tunica Bayou, and eastward across the Lake Pontchartrain, Pearl River, and Pascagoula river drainages. We examined genetic variation across these populations and detected significant divergences across lower Mississippi River tributaries and eastern Gulf drainages. The genetic results are interpreted with respect to previously published and newly gathered morphological data.

3:45 - Distribution and life history of a new species of minnow (*Chrosomus* sp. *cf. saylori*) in the upper Clinch River watershed, Virginia
Shannon White and Donald Orth

In 1999, a new species of minnow, Clinch dace (Chrosomus sp. cf. saylori), was discovered in the Tennessee drainage of Virginia. The species is listed as a Federal Species of Concern and on Virginia's Wildlife Action Plan as Tier II- Very High Conservation Need because of potential threats from habitat degradation, high population fragmentation, and a largely unknown distribution. Consequently, a management plan for Clinch dace is of utmost importance, but more information regarding species distribution and life history is required before such a plan can be implemented. In 2011 and 2012, we sampled over 60 headwater streams in the upper Clinch River watershed, Virginia and, combined with previous sampling records, over 200 locations have now been assessed for Clinch dace presence. From this, we conclude that Clinch dace are restricted to only eight small tributaries to the Clinch River. Multivariate analysis of habitat correlates indicated that Clinch dace are found in small streams with gravel substrate, low gradient, and forested watersheds. Reproduction was witness in May 2012 and a nest association with central stoneroller (Campostoma anomalum) was observed. Gonad weights were measured for 63 individuals, and indicated that spawning lasts from May-July and that sexual maturity is not achieved until age two. Eggs were counted in all mature females (n=12), and the average number of mature ova per female was 267.3. The oldest age, as determined by otolith analysis, in our sample was two. Together, this information indicates that Clinch dace are narrowly distributed and populations are small, fragmented, and of question viability. Delayed maturation and low egg count also makes the reproductive potential of Clinch dace lower than other Chrosomus species. Given this, further conservation efforts for Clinch dace are warranted, and should focus on conservation of critical habitat and protection of streams during summer spawning.

4:00 - Habitat use of the diamond darter
Stuart Welsh, Dustin Smith, and Nate Taylor

The diamond darter (*Crystallaria cincotta*) is currently a candidate for listing under the U.S. Endangered Species Act. The only known extant population exists in the lower 37 km of Elk River, WV. Our understanding of diamond darter habitat use was previously somewhat limited, in part, because few individuals have been observed during sampling. The low number of previous observations may reflect small population size or a low detection rate by conventional sampling gears. For this study, we quantified microhabitat use of diamond darters based on measurements of water depth, water velocity, and percent substrate composition. Using spotlights at nighttime, we observed a total of 82 diamond darters at 10 of 11 sampling sites within the lower 37 km of Elk River. Diamond darters were located primarily in glide habitats, characterized by relatively shallow depths (< 1 m), moderate to low water velocities (often < 0.5 m/s), and a smooth water surface. Microhabitat use (mean ± SE, and range) of diamond darters was estimated for depth (0.47 ± 0.02 m, 0.15 – 1.07 m), average velocity (0.27 ± 0.01 m/s, 0.13 – 0.48 m/s), and bottom velocity (0.15 ± 0.01 m/s, 0.06 – 0.31 m/s). Substrate used (mean ± SE) by diamond darters was predominantly sand intermixed with lesser amounts of gravel and cobble; % sand (52.1 ± 1.6), % small gravel (12.2 ± 0.78), % large gravel (14.2 ± 0.83), % cobble (19.8 ± 0.96), and % boulder (1.6 ± 0.36). Data on microhabitat use will aid conservation and management efforts for this species. Spotlight searches for diamond darters should be considered for study designs of population estimation and long-term monitoring. Also, spotlight searches should be used for sampling efforts in other drainages with historic records of diamond darters.

4:15 - An update on the *Cyprinella* bioacoustics project
Catherine T. Phillips and Carol E. Johnston

The widely distributed and large genus *Cyprinella* provides an ideal model to examine the evolution of acoustic signal structure. In our survey of sound production across the genus, we have identified several derived call characteristics. We aim to describe sound production across

the phylogeny to examine divergence in temporal and spectral characteristics for multiple contexts (courtship and agonistic) among species. Evolution of temporal and spectral signal variables may occur at varying rates within and among species and, like genetic and morphological characters, can be used to create and test phylogenetic hypotheses. Preliminary data for species examined will be reviewed with possible patterns among species examined. Although sound production in *Cyprinella* was discovered over 50 years ago, all aspects of this sensory modality are poorly studied. An understanding of signal variation and evolution will provide a roadmap for the development of future hypotheses in this group, and has been our objective for the past few years. We have documented sound production in 20 species within the clade. Our investigation has included species from both the 'western' and 'eastern' clades of *Cyprinella*, as well as several sister species. Our work to date has identified unique signal components and ancestral character states. Our work will allow our group as well as other researchers to identify relevant research questions on aspects of character displacement, sexual selection and other topics.

4:30 - Closing Remarks, Announcement of Student Awards

Poster Session – Thursday, 8 November

1 - Conservation leadership in action: using summer camps to engage teens in aquatic conservation at the Tennessee Aquarium
Ashford S. Rosenberg, Thaddeus M. Taylor, Anna L. George

Research by The Ocean Project indicates that youth between ages 12 and 25 are more educated on environmental issues and more likely to make positive conservation decisions than any other age group. In addition, adults look to tweens and teens to make better environmental decisions for the household. While the Tennessee Aquarium has been successful at reaching K-5 schoolchildren in our educational programming, we recently started increasing outreach to teens in order to increase our impact on this influential demographic. New outreach programs and an Our Blue Planet speaker series specifically for regional high school students emphasize the connection between everyday choices and aquatic conservation. In addition to traditional education programs, the Aquarium began a residential summer camp for high school students, the Conservation Leadership in Action Week, led by aquatic scientists. During this week in July 2012, campers explored the southeastern conservation community and learned how to become an environmental leader. Campers experienced field trips to rivers, forests, and farms, and also focused on designing conservation projects for their own schools and neighborhoods. Projects varied widely from recycling programs, to fundraisers, to water quality monitoring. Some of these students will form the basis for a new Conservation Science Club that meets regularly at the Aquarium. By creating programs that meet the specific needs of teens and tweens, the Aquarium hopes to empower this growing generation of leaders for freshwater conservation.

2 - Fish and mussel assemblage patterns in the Chipola River, Florida, and Spring Creek, Georgia
Stephen J. Walsh, Howard L. Jelks, Nathan A. Johnson and Zachary P. Martin

WaterSMART (Sustain and Manage America's Resources for Tomorrow) is a U.S. Department of the Interior program focused on developing a sustainable water strategy to ensure stable, secure supplies for future generations . As part of this program, we are working with other USGS investigators to assess environmental flows and ecological metrics of fish and mussel populations in headwater tributaries of the Apalachicola-Chattahoochee-Flint river basin. We have commenced semiannual sampling at nine fixed sites in the Chipola River (Apalachicola River tributary, Florida) and four sites in Spring Creek (Flint River tributary, Georgia). These

sites are vulnerable to reduced flows or complete dewatering as a result of altered hydrology through drought, surface-water diversion, and ground-water withdrawals. The study objective is to evaluate persistence, recruitment, and colonization of various species with abiotic parameters (e.g., discharge, water quality, habitat variables). Preliminary data are insufficient to determine trends, but basic assemblage structure was characterized. For all sites combined, 39 fish species representing 23 genera of 13 families were collected in spring 2012. Numerically dominant species (7-21% relative abundance), in diminishing order, were: *Notropis harperi*, *Pteronotropis grandipinnis*, *Percina nigrofasciata*, *Aphredoderus sayanus*, *Etheostoma edwini*, and *Notropis texanus*. A weak correlation was noted between increased flow and greater fish species richness. Quantitative sampling of live mussels yielded 13 species of 9 genera, dominated by *Elliptio pullata* (relative abundance = 34%), *Toxolasma paulum* (31%), and *Villosa vibex* (11%). We found live *Medionidus penicillatus* in the Chipola River drainage (2 sites), live *Pleurobema pyriforme* in the Chipola River (3 sites) and Spring Creek (1 site) drainages, and valves of two dead *Hamiota subangulata* in the Chipola River (1 site) and Spring Creek (1 site) drainages; all three are federally endangered species.

3 - Occurrence of *Etheostoma fusiforme* in the York River basin of Virginia

Werner Wieland

The swamp darter, *Etheostoma fusiforme* is known to be common throughout the Coastal Plain from Maine to Florida and along the Gulf of Mexico to the Mississippi River. Yet it is absent from Coastal Plain streams of the York and Rappahannock river basins of Virginia. Absence from these river basins in Virginia is peculiar in that it occurs in the Piankatank River drainage which lies between the Rappahannock and York river basins. Change in sea level due to melting of continental glaciers has been offered as a possible explanation for the observed distribution of this species. In 1997 a single specimen of the swamp darter was discovered in a collection from a tributary in the upper York River basin. Additional collections were made throughout the Mattaponi River basin at 12 locations over a period of seven years. In addition to the specimens taken in Feb. 1997 more individuals were capture in Apr. 2000. Of the latter specimens one was a female ripe with eggs. Four additional specimens were taken at a second location. Both localities lie within the Coastal Plain physiographic province. It is possible that additional populations exist within the York R. basin and the apparent absence of this species may be attributable to its rare occurrence and /or the difficulty of collecting in Coastal Plain streams. However, both sites are located immediately below ponds and it is also possible that these occurrences are a result of bait bucket introductions into these ponds. The presence of a gravid female would indicate an established population.

4 - The Mississippi Museum of Natural Science ichthyology collection: 1933-2012

Matt E. Roberts

The Mississippi Museum of Natural Science (MMNS) operates as a Division of the Mississippi Department of Wildlife, Fisheries and Parks (MDWFP) and was designated by the State Legislature in 1971 as “the official state natural science museum”. The Museum began in 1933 as the State Wildlife Museum under the direction of Ms. Fannye A. Cook. From 1936 to 1941 a state-wide Plant and Animal Survey was conducted as a joint federal and state WPA (Works Progress Administration) project under the technical supervision of Ms. Cook. These collections are the foundation of present biological collections. Collections from the WPA survey resulted in approximately 9,800 total cataloged lots of fishes. Today the Ichthyology Collection at the Museum consists of over 62,000 cataloged lots comprised of whole voucher specimens, osteological material, and tissue samples suitable for genetic analyses. The Ichthyology Collection is the largest collection housed at MMNS. It contains representative fish material from marine, estuarine, and freshwater habitats from 29 states and 4 countries with the earliest material dating back to 1888. Presently, holdings represent 735 taxa (35 orders, 95

families). Holdings of particular interest include one lot of type material (paratype, *Etheostoma boschungi*) and substantial holdings (ca. 1300 lots of 42 species) of both federally and state listed endangered species or regionally recognized species of concern. Researchers will also be interested in material generated from surveys conducted in the Tombigbee River drainage before (1951-1983, ca. 7844 lots of 103 species), and after (2002-2010, ca. 2467 lots of 91 species), construction of the Tennessee-Tombigbee Waterway. Services provided by MMNS to researchers include: material loans, database access, mapping, publications, visiting researcher accommodation, specimen identification and archival.

5 - An assay of spawning seasonality based on gonadal somatic index in the native North American cyprinid, *Notropis photogenis***

Stefanie Greenleaf, Kelly Hodgskins, Bruce Stallsmith

Previous studies suggest that northern-based sexually mature *Notropis photogenis* (*NP*) begin spawning in June. Our study suggests that *Notropis photogenis* found in the Flint River of northern Alabama spawn February to March with a peak Gonadal Somatic Index (GSI) value in March. Reproductive effort coincides with a minimum daily water temperature of 12°C. *NP*'s with a length of 55mm or greater were selected for GSI calculations. Specimens were collected at three different sites in the Flint River. A total of 174 *NP*'s were divided into three groups based on reproductive status: 90 females, 49 males, and 33 juveniles (<55mm). The 33 juvenile were excluded from GSI calculations due to under-development of gonadal tissue. The primary focus of this study was GSI values among female *NP*'s. Quantifications were based on length measurements, gross weight, gonadal mass, and gonadal mass index. Spawning of Cyprinids is temperature dependent and starts with elevation in water temperature. Data show that the temperature threshold for this study is 12°C, which was observed during fish collection in February 2012. Elevated female GSI levels of 4.6 were observed in November 2011. By February 2012, these GSI values elevated to 11.0 and peaked to 16.5 in March 2012. A dramatic decline to 1.9 GSI was observed for April 2012. The same trend was observed in male specimens. In relationship to spawning times of other Cyprinids studied from the Flint River, it was found that *Notropis photogenis* is the first in the synchrony of spawning. This result is significant because it indicates a biological niche for a species not thought to be native to this region. Further research on ovarian egg development and population age structure is currently being conducted.

6 - The effect of hydraulic fracturing on the life history of the Slender Madtom (*Noturus exilis*) in central Arkansas streams**

Page Vick, Chelsey Sherwood, Jessie Green, and Ginny Adams [1]

Natural gas development has increased by 65% since 1998 due to hydraulic fracturing or "fracking" and over 4,000 gas wells currently exist in the Fayetteville Shale region of central Arkansas. Activities associated with natural gas development, including pad and road construction, may result in increased sedimentation with resultant impacts to benthic fishes. Previous research on *Etheostoma whipplei* showed a decline in Year 1 age class in relation to gas well density. Slender madtoms (*Noturus exilis*) represent a native benthic species that requires clean interstitial spaces for habitat and reproduction. *Noturus exilis* were collected from 11 sites within the Fayetteville Shale across a gradient of gas well densities to examine age class structure and compare life history characteristics. Gas well density ranged from 0 to 3.26 well/km^2. Collections occurred in 2011 (May and June) and 2012 (March through May) and encompassed the spawning period (late April to early June). Individuals were collected using a backpack electrofisher with multiple pass depletion and placed in 10% formalin for further examination. Gonads were examined for reproductive stage and gonadosomatic index (GSI=ovary mass/total mass x 100) to compare reproductive development among sites. Male:female ratio, female size at first reproduction and percent of Age 1 individuals will also be

examined in relation to gas well density and results discussed. Understanding population level metrics in relation to gas well disturbance may provide a more detailed understanding of mechanisms driving change compared to coarse community data.

7 - Data needed for conservation status assessments of petitioned aquatic species in the southeast

Stephanie Chance, Chris Davidson, Beau Dudley, Michael Floyd, Robin Goodloe, Alice Lawrence, Sarah McRae, Jeff Powell, Eric Prowell, and Sandra Pursifull

In 2010, the Center for Biological Diversity (CBD) petitioned the US Fish and Wildlife Service (Service) to list 404 aquatic and riparian species in the Southeast. Of particular interest to the Southeastern Fishes Council, the petition included 43 species of fishes. After our initial review, the Service determined that the petition presented substantial scientific or commercial information indicating that federal listing may be warranted for 374 of the 404 petitioned species. Therefore, the Service will be initiating status reviews to determine if listing is warranted for these species. To ensure that the status reviews are comprehensive, the Service is soliciting scientific and commercial data and other information regarding the status of and threats facing these species throughout their ranges. Data on distribution and abundance, genetics, ongoing conservation efforts, and species habitat needs and/or threats are needed. All information will be evaluated by the Service to perform threats assessments and five factor analyses necessary to determine if federal listing is warranted for these species. A summary of the petition's major taxonomic groups is provided. A detailed list of fish species is provided for each Ecological Services Field Office with the lead biologist's contact information. Species lists for other taxonomic groups or additional information about the petition can be obtained by contacting the authors or by visiting http://www.fws.gov/southeast/news/2011/11-063.html.

8 - Identification of Striped Bass spawning sites in the Chattahoochee River above West Point and Walter George Reservoirs, GA**

Bill Davin, Warren Stiles, and Reid Popple

Gulf-strain striped bass (*Morone saxatilis*) are an important game fish that has been stocked into main-stem reservoirs in the Chattahoochee River, GA. Naturally an anadromous species, successful spawning events in land-locked striped bass populations are rare and require long stretches of free flowing river. The Chattahoochee flows from northeast Georgia to Lake Seminole with many reservoirs along its length. The longest free-flowing stretch of the river is located between Morgan Falls Dam and West Point Reservoir (125km). Striped bass have been stocked into West Point Reservoir since 2005 and Walter George Reservoir since 1996 with the hope of natural reproduction. Eggs were sampled with a Wisconsin-style drift net at three points above West Point Reservoir and one point above George Reservoir. The harvested eggs were stained, identified and the striped bass eggs staged to provide an approximate spawning time. Of 447 eggs collected, 20% (N=86) are believed to be striped bass eggs. Striped Bass eggs were collected above both of the reservoirs, with the majority (N=72) coming from the Chattahoochee River above West Point Reservoir , however, the concentrations of eggs in the samples were low (0.02 to 0.8 eggs /m^3). Due to low river velocities during the 2012 spawning period (less than the 0.3m/s needed to suspend the eggs and larval fish), it is unlikely that the 2012 spawning events on the Chattahoochee were successful.

9 - Morphological diversification and flow-induced plasticity in *Cyprinella venusta*

Nathan R. Franssen, Laura K. Stewart, and Jake Schaefer

Gene by environment interactions during an organism's development may have profound effects on the phenotype expressed. Anthropogenic alterations often impose drastic effects on stream ecosystems (e.g., reservoir construction), altering the habitat of fishes that occupy

these environments. Impoundments facilitate dramatic changes to stream habitats, causing native fishes to face sudden shifts in flow regimes. Evaluating the degree of phenotypic divergence between reservoir and stream populations and levels of phenotypic plasticity will provide valuable insights into the effects of these man-made impoundments on native stream fishes. A number of previous studies have indicated morphological differentiation between stream and reservoir populations across a number of taxa. For instance, *Cyprinella venusta* inhabiting reservoirs tend to be deeper bodied and have smaller heads compared to that of *C. venusta* populations in stream habitats. We conducted a mesocosm experiment to assess intraspecific morphological diversification and flow-induced plasticity in *C. venusta*, collected from stream and reservoir habitats within the Yazoo River drainage (MS). Individuals from both habitats were exposed to either lotic and lentic conditions within the mesocosm experiment. We predicted that differences between habitats would generate selective pressures resulting in morphological divergence between conspecific populations and phenotypes would be plastic in response to stream flow. We reared offspring from all treatment combinations to adult sizes, and assessed body morphology of the offspring using geometric morphometrics.

10 - Isolated wetlands as refuges for species of concern in south Georgia

David Bechler, Brett Albanese, Josh Salter, and Charles Wright

Over the past 12 years, we have carried out a series of surveys involving rivers, barrow pits and wetlands throughout the Suwannee and Aucilla drainages in South Georgia. Currently, we are working with the Georgia DNR to assess the status of the blackbanded sunfish, the Gulf Coast pygmy sunfish, and several species in the family Fundulidae. In this presentation, we examine the influence of severe droughts on current fish distributions. Most notably we discuss the drought of 2011 and its impact on the potential distribution of fish in the Aucilla and Alapaha rivers. Our data suggest that wetlands such as Carolina bays and other lentic habitats may be important refuges for species of concern during droughts. We recommend a greater emphasis on these habitats in future surveys, monitoring, and conservation efforts.

11 - Migratory phenology of young yellow-phase American Eels at Norrell Lock and Dam, Arkansas River navigation system

Casey Cox, Reid Adams, Ginny Adams, Lindsey Lewis, and Jeff Quinn

Other than records of incidental catch and fish length, few life history and population data exist for the American eel (*Anguilla rostrata*) in rivers of the Mississippi River basin, especially the Arkansas River. It has been hypothesized the American eel has experienced a drastic decline in the Arkansas River from its historical population sizes. The species life history complexities leave it vulnerable to anthropogenic alteration of riverine habitat (e.g. construction of locks and dams) and potential fluctuations of ocean currents in the Gulf of Mexico. One of our objectives is to describe the migratory phenology of yellow-phase eels in the Arkansas River Navigation System. A concrete sill below Norrell Lock and Dam, the first obstacle fishes migrating upstream from the Gulf of Mexico encounter in the Arkansas River Navigation System, was sampled by backpack electrofishing from 22 March 2012 to present. Seventeen yellow-phase eels (mean length = 470mm, ± 79mm) were collected below Norrell dam over a 44 day period (7 April: 9, 20 April: 4, 21 April: 1, 5 May: 1, 20 May: 2). During this period water temperature ranged from 22-27° C. The presence of eels below Norrell dam for a limited period and within a certain temperature range possibly indicates that migratory eels are seeking entry into the Arkansas River. In addition, seven yellow-phase eels (mean length = 721mm, ± 98mm) were collected during 22-23 March 2012 from the main channel by boat electrofishing and donations from commercial fishermen (minimum distance 700 meters below dam) and were significantly larger than eels collected in the sill below Norrell dam. Future goals are to investigate pathways into the system used by migrating eels, determine the need for a passage structure, and examine differences in life history traits of resident eels inhabiting free-flowing and

fragmented sections of the river.

12 - Assessing fish community structure in the Flint River watershed of North Alabama
Helen Czech, Heather Howell, Allison Bohlman

The Flint River Watershed, primarily found in Madison Co. Alabama, is located in the most rapidly urbanizing region of the state. Land in the watershed is being converted from forested and agricultural lands into suburban and urban areas as the population grows. In 2009 we initiated a study examining the effects of urbanization and drought on fish abundance in the Flint River. Between 2009 and 2011 we collected data on fish abundance at ten sites within the watershed. Sampling sites included 7 headwater tributaries, 2 main stem sites and 1 lower main stem tributary. Stream habitat and surrounding land use types were classified using GIS and standard field protocols. Streams were sampled yearly using a back-pack electrofisher. All fishes collected were identified to species. Across the three years we sampled over 18,500 fish. On average, 45 species per year were encountered. The Largescale Stoneroller, *Campostoma oligolepus*, was the most abundant fish sampled in 60% of streams in 2009 and was the most abundant fish in 50% of streams in 2010 and 2011. Cyprinids dominated all streams except for the lower main stem tributary, which was dominated by *Gambusia* sp. and two headwater streams which were dominated by Centrarchids and *Cottus carolinae*. One headwater stream was less diverse when compared to the other headwater streams and consistently had the smallest catch. We examined the relationship of fish community structure to land use and stream habitat characteristics using canonical correspondence analysis (CCA). Preliminary analysis suggests stream substrate composition, woody debris and zones of deposition are important factors influencing fish community structure. Several streams experienced morphological and hydrological changes of both man-made and natural origins, including natural damming and a man-made gravel ford, over the three year span of the study that may have affected the fish community structure of the streams.

13 - Life history trait convergence in two species of the *Fundulus notatus* species complex**
Jared Harris, Jake Schaefer

Divergent traits are very common among closely related species. They are often the result of adaptation due to different environments being occupied by the closely related species. However, in this particular case, convergent traits may be present between closely related species that have evolved independently in similar, but separate environments. Two sister species, Fundulus notatus and F. olivaceus, are usually distributed along a habitat gradient throughout their large distribution, with the former occupying large river or downstream habitat and the latter occupying headwater or upstream habitat. The key to studying convergence in this system is that there are at least three known drainages where this distribution pattern is reversed. This arrangement provides a unique opportunity to test for convergence of life history traits between these species. The prediction is that the life history phenotypes of the populations from the reversed drainages will converge on the populations of the opposite species from the normally distributed drainages. Populations of both species from six drainages (three normal drainages, three reversed drainages) were collected to test for evidence of convergence. Data analyzed was egg mass, egg diameter, GSI, and a measure of condition. A comparison between the normally distributed drainages and the reversed drainages may provide evidence for the convergence of life history phenotypes.

14 - Species-specific relationships between *Pimephales* body shape and discharge regime**
James C. Cureton II

Flowing water is a strong selection pressure on intra- and inter-specific body shape in aquatic

vertebrates. The development of a recent theoretical model laid the foundation for understanding the relationship between water velocity and body shape: fishes in high flow habitats have streamlined bodies relative to conspecifics in low flow habitats. In this study, I tested these theoretical predictions in three closely related species, each of which can tolerate a unique range of water velocities. Specifically, I asked whether the three species exhibit a similar response across a subset of water discharges all species occupy (0-2000 m3/s) as well as the unique water discharges each species inhabits (P. notatus: 0-10000 m3/s; P. vigilax: 0-30000 m3/s; *P. promelas*: 0-2000 m3/s). To answer this question, I used geometric morphometrics to assess body shape variation of Pimephales notatus, *P. vigilax*, and *P. promelas* from 41 collections from the Sam Noble Museum of Natural History. Analysis of body shape across 0-2000 m3/s showed that *P. vigilax* and *P. notatus* matched theoretical predictions. In contrast, *P. promelas* – a "backwater" species – showed no strong trends in body shape across discharge regimes. Intriguingly, when populations from sites with a discharge greater than 2000 m3/s were included, body shape of P. notatus and P. vigilax seemed to be asymptotic – that is, body shape was no more streamlined at 30,000 m3/s than at 10,000 m3/s. Understanding this asymptotic curve and determining if it is represents an evolutionary constraint on body shape will provide insight into intra- and inter-specific body shape evolution. In-depth analysis of the body shape-streamflow relationship within and across species will enhance the precision as well as generality of this theoretical body shape-streamflow model.

15 - Three years of fish surveys in Aldridge Creek, an urban stream in North Alabama**

Heather Howell, Helen Czech, Allison Bohlman

Aldridge Creek is a main-stem tributary of the impounded Tennessee River in North Alabama. The watershed of Aldridge Creek is dominated by an increasingly urban landscape. While much of Aldridge Creek's Channel is surrounded by a greenway, the stream shows many impacts of urbanization. Trees are not planted in the greenway; in fact, they are removed. High runoff from increased impervious surface and channel straightening have resulted in channel downcutting and in-stream erosion. The substrate is a mixture of eroded compacted clay, mud, and gravel. Fertilizer applied, to surrounding lawns runs off into the stream, loading it with nutrients. Pesticides are apllied to the riverbanks inside the channel. Fish kills have been observed by the author in this stream. However this stream remains an important resource to the community. The greenway provides recreation opportunities. The stream teems with gamefish. The stream also has a variety of fish species and a large number of fish. Despite its impairment, Aldridge Creek shows that it has ecological value worth conserving, improving, and appreciating.

16 - Museums as Lazarus: effectiveness of extraction and microsatellite amplification on formalin-fixed specimens

Mollie F. Cashner, Erica Lemons, and Kyle Piller

Museums hold a wealth of information, however funding and appreciation for their maintenance has been on a precipitous decline in the last decade. A number of prominent ichthyological collections have been relegated to satellite campuses to make room for biological pursuits which are perceived as being more relevant and cutting-edge. The advance of molecular techniques may be, in part, to blame for the loss of appreciation of natural history collections, but they may be the vehicle for salvation . Sequencing DNA from museum specimens has been the holy grail of museumophiles for a number of years, but has been met with repeated disappointment. Formalin-fixation and the aquatic storage of specimens results in damaged DNA (acidification cuts fragments, formalin binds to DNA) making it difficult to obtain samples which can be sequenced. Microsatellites, small fragments of DNA, may be the answer to this dilemma. Following a protocol with an extended wash period (to remove bonded formalin) and a modified phenol-chloroform DNA extraction, we examine the potential to generate

microsatellite data from formalin-fixed, aqueous-stored specimens of *Ammocrypta beanii*. The results of our tests and the efficacy of this approach will be presented.

17 - Shape shifters: a look at fish body shape plasticity though geometric morphometrics**

Luke M. Bower and Kyle R. Piller

Ontogenetic processes are believed to give rise to species disparity and phenotypic variation, which can lead to unique phenotypes between or within populations. Phenotypic plasticity provides an excellent opportunity for ecologists to study spatial phenotypic variation as well as phenotypic disparity of ecologically different species. Body shape has been shown to be an excellent surrogate for the ecology of fish species. By examining the disparity in body shape, it may be possible to understand how some species are able to take advantage of more resources and different flow regimes and habitats than others. In order to determine if species' body shapes may differ across drainage basins, geometric morphometrics was used to examine body shape variation of four species across three drainage basins in southeastern Louisiana, including the Pearl, Pascagoula, and Lake Pontchartrain basins. Multivariate analyses were performed to examine body shape differences among basins. The results indicate body shape differences among drainages for Longear Sunfish, but no other significant pattern was found for other species. The second purpose of this study was to determine if generalist species have greater body shape disparity than specialist species. To accomplish this, the disparity in body shape was compared across five ecologically different species from three families. Generalists did not have a higher disparity when compared to specialists across families, although more derived species had a higher body shape disparity. This is likely due to the strong phylogenetic influence on body shape.

18 - Reintroduction of the federally endangered Boulder Darter, *Etheostoma wapiti*, and the threatened Spotfin Chub, *Erimonax monachus*, into shoal creek using captive propagation

Rebecca A. Xiques, Patrick L. Rakes, J. R. Shute, Missy A. Petty, Crystal L. Ruble, and Jessica B. Hendricks

The federally endangered boulder darter (*Etheostoma wapiti*) and threatened spotfin chub (*Erimonax monachus*) were reintroduced into Shoal Creek using captive propagation and continued monitoring. Neither species has been found in Shoal Creek since the 1880s. Conservation Fisheries, Inc. (CFI) collected adult boulder darters from the Elk River and spotfin chub adults from the Emory River to utilize as broodstock. From 2005-2012 CFI reintroduced 4,832 boulder darters at 5 sites. In 2011, four different age classes of boulder darters were observed in Shoal Creek, all of which included wild spawned individuals. Propagated boulder darters can be distinguished by VIE tag. A total of 17,113 spotfin chubs were reintroduced from 2007-2012 at 7 sites. Propagated individuals of spotfin chub were observed in snorkel surveys in 2010 and 2011 including three young of the year in 2011, marking the first observed spotfin chub wild reproduction in over a century. Spotfin chubs are not tagged, so only observations of young of the year can be confirmed as wild spawned. In 2012, both the spotfin chub and boulder darter were observed in Shoal Creek in Alabama, demonstrating significant dispersal.

19 - Quantitative microscopic analysis of scale morphology in North American darters (Percidae: Etheostomatinae)

Eva Grebe, Sarah Lundin-Schiller, and Rebecca Blanton Johansen

The utility of fish scales in systematic ichthyology has been recognized since Agassiz classified fishes into four major groups based on scale morphology and composition. With improved microscopy and associated technology, recent studies have found informative variation in the microstructure of fish scales across a variety of taxonomic levels, highlighting the potential role

of these characters in phylogenetic studies and discerning species boundaries. Despite a long history of research on the species-rich North American darter clade (Percidae: Etheostomatinae), variation in darter scale morphology, specifically scale microstructure, has not been thoroughly described, limiting the potential use of such data in systematic research. Two previous studies examined scale morphology of darters, but focused on a limited number of species, relatively few characters, or explored variation in the context of older hypotheses of diversity and phylogeny. This study expanded on previous work by using confocal microscopy to describe variation in scale microstructure, including characters not previously quantified, for all darter lineages under the current hypotheses of diversity and phylogeny. Variation among closely related species of a clade also was examined to determine the potential utility of scale characteristics in species-level taxonomic studies. Variation in several structures, such as scale shape and number of ctenii and radii, was noted among species and higher-level clades. Preliminary analyses suggest these characters may prove valuable in both taxonomic and phylogenetic studies, enhancing our understanding of the evolution of this diverse group of fishes.

20 - Geometric morphometrics of *Notropis longirostris*

Carla C. Stout and Jonathan W. Armbruster

Notropis longirostris, the longnose shiner, is found throughout the southeastern region of the United States. Current studies question whether populations within the drainages represent enough genetic difference to separate this group into multiple species. Preliminary genetic analyses have found distinctions between western and eastern drainages, the Apalachicola drainage and eastern drainages, and the Altamaha drainage and Apalachicola drainages (M. Raley, pers. comm.).The purpose of this study was to determine if geometric morphometrics using principal component analysis (PCA) and canonical variates analysis (CVA) could support these preliminary genetic findings. PCA was used to see if drainages represent distinct morphospaces, and CVA used the drainages as a priori groupings to find what morphological features best separate them in hopes that these features could be useful for identification purposes. Results show remarkably little morphological variation, and the overlap in mophospace shows that the drainages do not hold distinct morphotypes. Even with CVA, which did separate some of the groups, the morphological features that drive the separation are very small. These features include slight changes in mouth position and depth of the caudal peduncle. This trend remained in all the groupings for analysis. Because genetic variation has been found (M. Raley, pers. comm.), this could indicate evidence of one or more cryptic species or that stabilizing selection is driving the morphology of this group while the genes are becoming more and more divergent across these populations.

21 - Morphological variation in the Fantail Darter, *Etheostoma flabellare*, from the Cumberland and Tennessee River drainages**

Aaron Ross and Rebecca Blanton Johansen

The widely distributed Fantail Darter, *Etheostoma flabellare* (Percidae), has been recognized as a complex of distinct, but undescribed species. Recent taxonomic studies have focused on Atlantic Slope populations and resulted in elevation of one distinct form, *E. brevispinum*, from drainages of North Carolina, South Carolina, and Virginia. Although variation in genes and morphology among other populations has been previously noted and other taxa have been historically recognized, species boundaries, if present, have not been clearly defined for Tennessee and Cumberland River systems. To better elucidate potential species boundaries inferred by morphological diagnosability, standard meristic counts were taken from multiple specimens and two populations each of the tributary systems of the Tennessee and Cumberland River systems. Although preliminary, Clinch River and Little River (Tennessee River) populations consistently had higher scale and pore counts than other Tennessee River systems examined. Within the Cumberland River, little variation was observed among

tributaries, but several characters varied consistently from those of the Tennessee River. Observed patterns of variation in morphology will be compared to patterns of genetic variation to further elucidate diversity in this species complex.

22 - Filling the gap: a survey of the Rutherford Fork of the Obion River provides new localities for 20 species**

Kristen Pilcher and Rebecca Blanton Johansen

In the mid 20th century the Obion River in northwest Tennessee was largely channelized for agricultural purposes. The Rutherford Fork of the Obion River, adjacent to Milan Army Ammunitions Plant (MLAAP), received additional impacts from wastewater discharges containing heavy metals. In 1987 MLAAP was placed on the Environmental Protection Agency's National Priority List and remediation began shortly thereafter. Austin Peay State University has been involved in long-term monitoring of aquatic communities of MLAAP. However, studies have focused on macroinvertebrates and herpetofuana. Review of the distribution of fishes reported from the Obion River revealed a seemingly depauperate fish fauna for Rutherford Fork. The purpose of this study was to determine whether species common elsewhere in the Obion River system or region were absent from the Rutherford Fork, possibly due to extirpation associated with previous impacts, or if the lack of species records reflected few collection efforts in this tributary, and also to increase the knowledge of the overall health of the aquatic communities on and near MLAAP. Results of this survey showed that species diversity of the Rutherford Fork is considerably higher than previously reported. A total of 29 different species from 8 sites on the Rutherford Fork were collected. Of these, 20 species from 7 families, including intolerant taxa such as darters (Percidae) and madtoms (Ictaluridae), were not previously reported from the system, resulting in range extensions or new localities for these species. Future work will examine habitat parameters associated with the occurrence of intolerant benthic fishes to further evaluate factors influencing their distribution in the Rutherford Fork.

23 - Evaluation of the southern-most population of the federally endangered Pallid sturgeon, *Scaphirhynchus albus*: using an increased multi-locus dataset of microsatellites**

Krista Boysen and Robert M. Wood

Microsatellite markers have been widely used in molecular studies on *Scaphirhynchus* species (McQuown et al., 2000; Ray et al., 2007; Schrey and Heist, 2007; Schrey et al., 2009). Published data sets comprised of 13 and 16 microsatellite loci (Ray et al., 2007; Heist and Schrey et al., 2011, respectively) used on samples throughout the range, which produced no diagnostic species-specific markers. In addition to the lack of genetic distinction between *S. albus* and *S. platorynchus*, in the southern-most end of the range morphological identification is also problematic due to pronounced similarity in many morphometric and meristic characters (Murphy et al., 2007). The current study seeks to characterize *S. albus* at the extreme southern end of its distribution. During a recovery effort behind a water diversion structure known as the Bonnet Carre Spillway (12 miles west of New Orleans), entrained samples (N=26) were collected, while non-entrained samples (N=49) were collected in the Mississippi River from river mile 310 south (approximately 58 miles north of Baton Rouge, LA). Given the known limitations of the 13 locus and 16 locus data sets, an increased number of loci (N=20) were used to determine if additional species resolution could be determined for this population. Samples were analyzed with the program Structure with and without a priori designations (Pritchard, et al., 2000) to determine the most likely number of populations (ΔK) (Evanno et al., 2005). To further characterize these sturgeon a variety of standard population genetic statistics were estimated from the genetic data. These include: effective population size (Ne) following Waples and England (2011), total alleles per locus, unique alleles per locus, observed heterozogosity (Ho), expected heterozogosity (He), and conformance to Hardy-Weinberg

Equilibrium.

24 - Infrequent visitors? The common occurrence of the Striped Mullet (*Mugil cephalus*) in the lower Arkansas River**

Garrett Grimes, Lindsey Lewis, Reid Adams, and Ginny Adams

The striped mullet (*Mugil cephalus*) is a commercially and ecologically important species of fish that can be found in the coastal waters of the southwestern and eastern United States and in the Gulf of Mexico. Although striped mullet spawn and primarily live in saltwater, they can migrate into freshwater, and are known to travel into Arkansas from the Gulf of Mexico by way of the Mississippi River. However, striped mullet in Arkansas are historically regarded as rare, infrequent visitors and a curiosity. In contrast, a large population of striped mullet has been observed occurring in Arkansas at a significant distance from the Gulf of Mexico (~940 km) in the lower Arkansas River. Investigative sampling into this population was conducted using boat electrofishing during the months of November 2009, June and September 2010, January 2011, and July 2012. The total length (TL) for striped mullet (N=144) ranged between 297 and 590 mm. Of the 144 fish sampled 115 were above maturation length (TL > 350 mm). During each sampling trip, striped mullet were seemingly abundant in the areas sampled. This repeated observed abundance suggests a large, permanent population. The presence of a permanent population would confound the previous records of mullet being a rare catch, and a seasonal visitor. It is unknown why the striped mullet found in the lower Arkansas River have migrated such a large distance from saltwater, and what role the freshwater habitat has in their life history. The data presented provide a preliminary assessment for a large-scale project investigating life history characteristics and population dynamics of striped mullet in the lower Arkansas River.

25 - Captive propagation of the Gilt Darter, *Percina evides*, for restoration of an extirpated population in New York state

Patrick L. Rakes, J. R. Shute, Crystal L. Ruble, Melissa A. Petty, Jessica B. Hendricks, Rebecca A. Xiques, Doug M. Carlson, John R. Foster, Brent C. Lehman, and Tyler Davis

The gilt darter (*Percina evides*) was extirpated from New York reaches of the Allegheny River over seventy years ago due to water quality degradation and loss of habitat by the construction of the Allegheny Reservoir. Due to habitat improvements in New York's Allegheny watershed, it now appears that there are suitable areas to support this species. However, natural restoration of gilt darters in the New York reaches of the Allegheny River cannot occur because the Kinzua Dam and the extensive Allegheny Reservoir behind it prevents northern Allegheny River populations of gilt darter from moving upstream into New York State. In 2008, through the combined efforts of US Fish & Wildlife Service, New York State Department of Environmental Conservation, New York State Museum, Pennsylvania Fish and Boat Commission, the State University of New York at Cobleskill, and Conservation Fisheries, Inc. (CFI), a project was initiated to demonstrate the feasibility of utilizing hatchery reared fish to restore gilt darters to the New York reaches of the Allegheny River. Techniques developed with this project could be applicable to other areas such as Illinois, Iowa and Ohio, where gilt darters have also become extirpated. Efforts were initiated in the fall of 2008 with twenty-five subadult gilt darters collected from the Allegheny River near Warren PA, just downstream of the Kinzua Dam. The fish were shipped to CFI where they were quarantined and conditioned by manipulating water temperatures, day length, and feeding to mimic natural conditions as closely as possible. Details of husbandry, breeding tank set-ups, egg and larval collection techniques, and larval rearing methods are described along with refinements over the several years of the project. No spawning occurred in the first year, 2009, and additional broodstock was acquired in the fall. In spring 2010 territorial and courtship behaviors were observed and the first evidence of spawning was the collection of 4 larvae on April 7. These were all successfully reared, but no further larvae were collected. Additional broodstock was collected in late 2010 and 70 of the

largest, oldest individuals were utilized for 2011 breeding efforts. Beginning 17 April 136 larvae were collected by passive capture, and 113 eggs and larvae were collected by gravel siphoning the substrate. A total of 65 juveniles were produced. Following breeding tank modifications, in 2012 more than 1200 eggs and larvae were siphon-collected and more than 1200 larvae passively collected between 20 March and 25 June. More than 1700 fry were produced, ultimately yielding more than 1450 juveniles shipped to SUNY for further grow out between April and July. The primary driver for the final year's success appeared to be the age of the female breeders with at least three-year-old fish required for substantial egg production.

26 - *Fundulus* as a model for assessing differential toxicological response

Mark A. Dugo, Paul B. Tchounwou, William T. Slack, and Brian R. Kreiser

A major task of toxicological research is the ability to translate findings with ecological relevance. Toxicological studies are frequently conducted using single species models that challenge the extrapolation to "real world" settings. Both, physiological tolerance and environmental parameters, such as salinity, can alter the toxicity of xenobiotic substances. There are over 30 species of *Fundulus* whose patterns of ecological diversity provide an opportunity to assess differential toxicological response among closely related species (i.e. Phylogenetic Toxicology). In addition to the variation of salinity tolerance classically described among Fundulids, our combined phylogenetic analysis using cytochrome b DNA sequence data and field collections targeting members of the *F. nottii* species complex, have verified the taxonomic validity of *F. dispar* and *F. blairae*, and determined that their distributions are strongly obligated to the floodplain habitats, compared to ubiquitous backwater areas commonplace among other members of the complex. This ecological resolution provides a robust comparative signal to test for differential xenobiotic toxicity among closely related species. The cytochrome p450 (CYP) enzyme system is a well-established marker of xenobiotic toxicity, particularly for polycyclic aromatic hydrocarbons (PAHs). The flavin-containing monooxygenase (FMO) enzyme system is much less studied, although it has been reported to function in both osmoregulation and detoxification. While the CYP enzyme system is a well-established marker of toxicity in the mummichog, *F. heteroclitus*, the FMO system remains unexplored among *Fundulus*. Objectives of our current research are to expose select *Fundulus* species with the PAH, 3-Methylcholanthrene to: 1) assess differential toxicities among four species of the *F. nottii* species complex treated in freshwater conditions; 2) assess differential toxicities among three estuarine species (*F. grandis*, *F. jenkinsi*, and *F. pulvereus*), each treated at two different salinities (10ppt, and 20ppt); 3) to determine the utility of the FMO enzyme system as a marker of toxicity among *Fundulus* species.

27 - Overview of the collection of fishes at the LSU Museum of Natural Science

Caleb D. McMahan and Prosanta Chakrabarty

The LSU Museum of Natural Science is located on the campus of Louisiana State University in Baton Rouge, Louisiana. The museum is comprised of the following sections: Ichthyology, Herpetology, Mammalogy, Ornithology, Anthropology/Archaeology, and Genetic Resources. The collection of fishes contains some 16,000 lots comprising over 400,000 specimens. In addition to specimens, in recent years the tissue collection of fishes has been growing exponentially, as well. In addition to the southern United States, we have specimens of fishes in our collection from around the world. We have large collections of specimens from Hawaii, Mexico, and South America. Modest representation of specimens from Europe and Africa are also housed in the collection. Recent expeditions have focused on collecting fishes in Asia (Taiwan and Vietnam) and Central America (Costa Rica, Panama, El Salvador, Nicaragua, and Honduras). The purpose of this poster is to provide an overview of the material (specimens and tissue samples) in the collection of fishes at the LSU Museum of Natural Science, including recent growth and collecting expeditions.

28 - Ecological niche modeling of rare fish and mussel species in east Texas
Marsha G. Williams, Ashley Dunithan, Josh Banta, Lance R. Williams, and Neil B. Ford

Recently, the Texas Parks and Wildlife Department listed 6 species of mussels that occur in east Texas as threatened. The U.S. Fish and Wildlife Service is considering some of these species for federal listing. Ten species of fish that occur in east Texas rivers are also listed as threatened or species of concern. In 2008, we began intensively surveying for these species in five east Texas rivers. Many of these rivers were completely lacking historical data. We have been using ecological niche modeling (using Maxent software) to predict the current distribution of these species across their native range. Field validation of our models is ongoing. The final models will be an important landuse planning tool for state and federal agencies charged with managing these rare species.

29 - Differences in critical swim performance among stocks of Bighead Carp (*Hypopthalmichthys nobilis*)
Collin E. Beachum, Jan Hoover, and Amanda Johnson

Researchers use hatchery reared fish in laboratory investigations to make inferences about wild populations. We set out to answer two questions. Does swim performance differ among hatchery two hatchery stocks? What morphological measures are the best predictors of critical swim speed (Ucrit)? Two groups of hatchery fish with different source stocks were used in Ucrit assays using a Blazka type swim tunnel. The fish were photographed and used in geometric morphometric analyses which describe shape. Structural measurements (total length, dorsal fin height and width, peduncle depth, caudal fin surface area, anal fin length and width, pelvic fin length and width, pectoral fin length) were taken from freshly dead specimens. Ucrit does differ between the two hatchery populations. Mixed-effect regression models were constructed and compared (a null model and combinations of shape and structural measurements). Multi-model inference was able to attribute Ucrit differences to a combination of measured structures and body shape. This work is could be used for designing effective barriers to prevent further encroachment of Bighead carp (Hypophthalmichthys nobilis) into native habitats and may be suggestive of rapid evolution or hybridization in this species.

30 - Analysis of an introduced species in shape space**
Paul Wieczorek

Members of the genus Cyprinella in the Mobile Basin were examined using geometric morphometrics to determine where the introduced species *Cyprinella lutrensis* falls out in shape space. The morphology of the species in the genus can be possibly used as a predictive value to determine if *C. lutrensis* will be competing with any of the remaining species within the clade since morphology directly influences feeding behaviors. If there is overlap within shape space between *C. lutrensis* and another species, competition may occur between the species for similar food resources. The other species included in the data set are *C. caerulea*, *C. callistia*, *C. gibbsi*, *C. trichroistia*, *C. venusta*, and *C. whipplei*. Because there are conservation concerns with C. caerulea and there is overlap in ranges in the Coosa River, this study may be of conservation importance.

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