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Oral Presentation

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Population ecology of the Grotto Sculpin in cave and resurgence streams in Perry County, Missouri.

The Grotto Sculpin, endemic to caves in Perry County, was listed as a federal candidate species in 2002 and assigned a priority number of 2, indicating an imminent threat to the species exists. Due to the unstable nature of the cave environment in Perry County, Missouri, it was imperative to obtain baseline data on the population ecology of Grotto Sculpin and factors influencing their ability to repopulate caves in response to a catastrophic event (e.g., a contaminant spill). The objective of this study was to examine population ecology and habitat use of the Grotto Sculpin in two cave populations and their primary resurgence stream. Cave sites were divided into 10 m increments and individual fish were tagged using unique tags at four to six week intervals beginning August 2005. Presence of adult Grotto Sculpin remained fairly consistent among sampling dates for the two cave locations. However, in resurgence streams, there was a marked decline of adults in late winter (January-March) with a peak in abundance of young-of-year in May corresponding to presence of larval sculpin drifting from resurgence springs. The late winter decline of adults may correspond to a movement of adult fish to underground environment for reproduction. Approximately 90% of individuals in cave populations moved less than 50 meters between sampling intervals. A fish kill was observed in the upstream portion of one of the cave sites and in the two years subsequent to the fish kill only fifteen to twenty individuals were observed, with little upstream movement of tagged individuals into the affected region of the cave. Based on our data, the relatively sedentary nature of the Grotto Sculpin may limit their ability to recolonize habitats. Population estimates and habitat use for each sampling site will also be discussed.

Oral Presentation

An overview of Georgia's Nongame Aquatic Conservation Program

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Working with our partners in other agencies, universities, and conservation groups, our mission is to meet monitoring, research, and conservation needs for Georgia's rich aquatic fauna. Our database contains records for over 1700 populations of rare fishes and is supplemented through data sharing agreements with the Georgia DNR Stream Survey Team and the UGA Museum of Natural History. This database is the backbone of our monitoring program and is used extensively for conservation planning and environmental review. Most of our funding comes through Section 6, the State Wildlife Grant, and license plate sales. Current projects include an atlas of Georgia's freshwater fishes, fish monitoring projects in the Coosa Basin, mussel monitoring projects in the Altamaha and Flint Basins, an Altamaha mussel genetics project, dragonfly surveys, and several anadromous fisheries projects. In addition, following the first significant update of our state protected species list since 1992, we are developing new species accounts for our protected animals book. Admittedly, we have been more successful at monitoring and research than actual on the ground conservation. We are currently focusing land acquisition and other conservation efforts in the Raccoon Creek watershed, which is part of the larger Etowah system. With additional capacity, we hope to target additional high priority watersheds in the near future.

Oral Presentation (student competition)

Systematics of the *Etheostoma rufilineatum* species group (Teleostei: Percidae) based on both mitochondrial (Cytochrome b) and nuclear (S7 intron) loci

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The redline darter, *Etheostoma rufilineatum,* belongs to the darter subgenus *Nothonotus,* which currently contains 20 recognized species, six of which are listed as vulnerable or near threatened status. The phylogenetic position of *E. rufilineatum* within *Nothonotus* is not consistent in the most recently published phylogenies for the group and has confounded attempts at erecting a stable classification for *Nothonotus*. We found that the phylogenetic position of this taxon using mtDNA characters is dependent upon where specimens are geographically located; however, this is not the case with the nuclear phylogeny. Distinct geographic differences in coloration patterns have also been discovered within several populations of *E. rufilineatum* distributed throughout the Tennessee, Cumberland, and Duck River systems. In particular, up to four color classes of males exist within the Hiwassee River drainage. Additionally, individuals found in populations from Bear Creek (Marion, AL) and the West Fork Clarks River (Graves, KY) exhibit smaller sizes in relation to remaining individuals of this species and may represent a miniaturized clade. Genetic variation based on both the complete mtDNA gene cytochrome *b* (1140 bp) and nuclear intron S7 (540 bp) of individuals from populations within these drainages, as well as from individuals across the entire range of *E. rufilineatum* will be presented and discussed.

Oral Presentation

Life History Attributes and Status of the Frecklebelly Madtom (*Noturus munitus*) in the Mobile Basin

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The Frecklebelly Madtom, *Noturus munitus*, is a diminutive boldy-patterned catfish [maximum standard length 75 mm (ca. 3 in.)] with a disjunct distribution across the southeastern United States, found in large rivers and tributaries of the Mobile Basin and Pearl River drainage. *N. munitus* has declined since extensive river modification began in the 1960s throughout its range and is likely extirpated from the Alabama River. We collected 225 specimens of *N. munitus* from a gravel island on the Coastal Plain in the Cahaba River in Alabama from May 2005 to March 2007 to examine life history characteristics. Adult madtoms were associated with fast flow over large gravel at depths of 0.5 – 1 m. Young-of-year and juvenile madtoms were found from June to August mostly at water depths of 0.4 - 0.5 m. Length frequency data indicated four size (age) classes with most individuals in the 1+ class. Analysis of gonads indicated a reproductive season from May to August, with collection of young-of-the-year in late June through August supporting a mid- to late summer spawn. Analysis of stomach contents revealed a similar diet to other *Noturus* species dominated in volume and proportion by larvae of baetid mayflies, hydropsychid caddisflies, and Simuliidae. Some seasonal and sex differences in diet were apparent. Based on current data, *N. munitus* is one of the most highly fecund madtoms of the subgenus *Rabida* based on relative fecundity. Fewer males were found in riffles during summer and no young individuals were found outside summer, indicating potential sex and size differences in habitat use. In the absence of difficult-to-collect data on seasonal movement and habitat use, sex ratio and catch data can be used to infer seasonal changes in habitat use and timing and location of nesting sites. A survey of 13 major tributaries to the Cahaba, Alabama and Tombigbee rivers yielded only one specimen of *N. munitus* in a large Cahaba River tributary despite the presence of typically associated species, emphasizing the importance large-rive gravel habitat. In addition, the Frecklebelly was not found at several sites at which it has been taken previously, representative of the general decline of the species due to habitat modification. Conservation and protection of *N. munitus* and other imperiled aquatic fauna will depend on knowledge of ecology and life history and the ability of scientists to promote conservation and sustainability of aquatic ecosystems.

Oral Presentation

Current Status of Federally Listed, Endangered and Threatened Fishes

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The USFWS Southeast Region has 322 listed species for which it has lead responsibility to recover working collaboratively with partners. 32 of these species are endangered or threatened fishes. Additionally, the southeast has 7 federal candidate fish species to monitor. Mussels, snails, crayfish, amphibians, and reptiles also are heavily represented on the Federal list of endangered and threatened species and candidate list. Over 90% of southeastern listed species have recovery plans. Many of which have been in place for a couple of decades and are being implemented with the help of Federal, State, local agencies, universities, non-profit organizations, private landowners, and general concerned partners across the Southeast. Imperiled aquatic species continue to face numerous threats especially due to habitat destruction, fragmentation and modification. With many agencies and organizations facing reduced budgets and increasing needs for up-to-date information on imperiled aquatic species, partnerships within the conservation community will be vital to achieve conservation of native fish.

Oral Presentation

Morphological variation in the Duskytail Darter, *Etheostoma percnurum*: implications for taxonomy and conservation

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The federally endangered Duskytail Darter, *Etheostoma percnurum*, is comprised of four extant populations in the upper Cumberland and Tennessee rivers. The species' highly disjunct distribution suggests that populations have likely been genetically isolated for thousands of generations. Differences in morphology and behavior of populations have been documented. These features imply that *E. percnurum* may constitute several currently unrecognized evolutionary lineages. A detailed examination of geographic variation in morphological traits among disjunct populations revealed diagnostic characteristics that support the recognition of *E. percnurum* as a species complex. These results have important implications for the conservation of *E. percnurum* lineages and habitats. Additionally, these findings can inform re-stocking strategies that are designed to bolster population numbers and re-establish extirpated populations.

Oral presentation

Prezygotic and postzygotic reproductive isolation between introduced red shiner and native blacktail shiner (Cyprinidae: *Cyprinella*)

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Biological invasions involving hybridization can lead to rapid displacement and loss of native species. Timely management that aids or reinforces pre- and postzygotic isolation could be effective for preventing hybridization and curtailing the loss of native species. Such strategies should account for how isolating mechanisms vary across species interactions and environments. Here we present a study of prezygotic and postzygotic reproductive isolation between non-native red shiner (*Cyprinella lutrensis*) and blacktail shiner (*C. venusta stigmatura*) from the Coosa River basin where a hybrid swarm is rapidly expanding. We conducted conservative no-choice spawning trials to measure mating preferences and raised broods generated from con- and heterospecific crosses to assay hybrid viability through early juvenile development. Females of both species were significantly more responsive to conspecific versus heterospecific mates, although blacktail shiner females responded more often to heterospecific mates than did red shiner females. Heterospecific crosses resulted in lower fertilization and egg hatching rates, but we found no other evidence of inviability. Rather, we found comparatively low larval mortality of hybrids, which is suggestive of heterosis. Considering that prior studies link high water turbidity to the formation of *C. lutrensis x C. venusta* hybrid swarms, these findings suggest that a water quality improvement plan to reduce turbidity could strengthen sexual isolation and prevent further hybridization between introduced red shiner and native blacktail shiner in the Coosa River basin.

Oral Presentation

Status of Imperiled Freshwater Fishes of North America: Report of the American Fisheries Society's Endangered Species Committee

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The AFS Endangered Species Committee is revising its list of imperiled freshwater and diadromous fishes of North America; the last revision was in 1989. An updated list is timely due to: changes in conservation trends for individual taxa; systematic and nomenclatural revisions; discovery and description of new taxa; application of molecular and other tools; conceptual changes of biodiversity; and impetus to provide natural resource managers, the public, and other stakeholders with current, science-based information on the taxonomy, distribution, and conservation status of imperiled fishes. Nominate species, infraspecific taxa (nominate and undescribed subspecies; discrete populations of nominate species), and undescribed taxa are recognized. Status categories and percent of total number of taxa are: endangered (36%), threatened (25%), vulnerable (31%), and extinct (8%). Provisional estimates indicate that nearly 750 taxa representing 132 genera and 35 families are imperiled; the significant increase from 364 taxa in the 1989 list represents both changes in conservation status and increases in documented biodiversity. Cyprinidae (25%), Percidae (14%), and Salmonidae (11%) have the most listed taxa. About half of the salmonids on the list represent unique populations, whereas about two-thirds of cyprinids and percids are described species. The number of taxa regarded as extinct increased by 19 from the 40 reported in 1989. A map of 80 freshwater ecoregions based on natural drainage units was developed in collaboration with the World Wildlife Fund, U.S. Geological Survey, and Commission on Environmental Cooperation. About 75% of listed taxa are confined to a single ecoregion and approximately 10% are found in three ecoregions or more. The Tennessee, Mobile, and Lerma-Chapala drainages have the greatest number of imperiled fishes.

Oral Presentation

Cooperative conservation and restoration of the Barrens topminnow (*Fundulus julisia*) on the Eastern Highland Rim, Tennessee

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The Barrens topminnow (*Fundulus julisia*) was described in 1982 and was known from 14 sites in 1984, restricted to a few headwater streams of the Caney Fork, Duck, and Elk rivers on the Eastern Highland Rim of Tennessee. By 1997, surveys found the species persisting at only 2 sites. Collaborative efforts to conserve this species were formalized in a Memorandum of Understanding signed by nine partners in 2001, which established the Barrens topminnow Working Group. The purpose of this working group was to protect existing Barrens topminnow sites and establish the species throughout a significant portion of its historic range by stocking captive-propagated fish. This group has also acquired funding for and overseen research investigations to: (1) characterize Barrens topminnow habitat and evaluate habitat modifications undertaken in some reintroduction sites, (2) assess the population genetic structure of Barrens topminnows, (3) examine interactions with invasive western mosquitofish (*Gambusia affinis*), (4) compare swimming performance of these two species, and (5) investigate designs of potential mosquitofish barriers and *in situ* artificial refugia for juvenile Barrens topminnows. Results of these investigations have influenced site selection for restoration efforts and will be used to explore management options to reduce competitive interactions with western mosquitofish during vulnerable life history stages. Barrens topminnows have been stocked in over two dozen sites and monitoring has revealed persistence of stocked fish in many of these. Evidence of recruitment from wild reproduction has also been observed in many sites. Detecting limited signs of persistence and recruitment has been encouraging, given that monitoring has been limited to stocked sites, from which Barrens topminnows might well be dispersing into other suitable habitat.

Oral Presentation

Diadromous fish restoration in the Santee Basin.

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Federal and state agencies and others are working to restore diadromous fish to the Santee River Basin. Some focal diadromous fishes include the American shad, Blueback herring, Hickory Shad, American eel, and Shortnose sturgeon.
Once abundant through much of the basin, these species now occur in only limited reaches of the streams nearest the Atlantic Ocean, blocked by hydroelectric dams. Guided by a basin restoration plan, several efforts promise to restore diadromous fishes to stream reaches. Recent fishways provide upstream passage for several diadromous species. Re-regulation of discharges from hydroelectric dams is designed to increase seasonal habitat for spawning and juvenile maturation. One initiative, the Santee Cooperative Accord, is a collaborative approach among utilities and federal and state agencies to address diadromous fisheries protection, restoration, and enhancement in the Santee River Basin. This initiative promises funding for applied research, hatchery operations to "jump-start" dwindling stocks, and future fish ways at dams in the basin. Prompted by several dam relicense proceedings in the basin, the group has developed a 10-year action plan that will be implemented beginning in 2008.

Oral Presentation

The role of fish propagation in restoration of regulated rivers.

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Many of the streams of the Southeast – from creeks to large rivers – have been impounded, diverted, dammed, or otherwise regulated during the 19th and 20th centuries. Many of the larger privately owned dams, or those on navigable waterways, are licensed by the Federal Energy Regulatory Commission for production of hydroelectricity. Under FERC rules, these dams are licensed for terms of 30 – 50 years. The process of relicensing these existing dams presents an opportunity for re-regulation of stream flows and restoration of the effected streams under the current environmental laws, many of which enacted after these dams were constructed and licensed originally. Along with increased awareness and improved methodologies, scientists can analyze and recommend new flow regimes for restoration of native aquatic assemblages, riparian systems, and ecosystem functions. In some streams, particularly high energy stream systems that have been bypassed by normative streamflows, while still serving as a conduit for extreme high flow spill events, the stream substrata has coarsened, as smaller particles (silt, sand, gravel) are detached and transported downstream. Transportation and movement of the bedload is a normal condition in all streams, with variable rates. However, reservoirs often sequester smaller particles, ebbing the supply of important features of the downstream habitat. In many instances, natural recolonization of re-regulated streams is limited to a few common fishes, usually those in smaller tributaries. Sources of recolonzation may be fragmented by other dams, chemical, or thermal barriers. I present a framework and examples for river restoration that incorporates a series of steps beginning with defining a target fish assemblage, re-regulation of stream flows, restoration of stream substrate, and re-stocking fish species.

Oral Presentation (Student Competition)

Genetic characterization of the hybrid zone between *Notropis chiliticus* and *N. chlorocephalus* in the Catawba River system

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Notropis chlorocephalus occurs in the Catawba River system (North Carolina) and is in limited sympatry with an aberrant (likely introduced) population of *N. chiliticus*. It has been previously noted that *N. chiliticus* and *N. chlorocephalus* hybridize where they co-occur, and my observations during the spawning season further support this. Using both mitochondrial and nuclear DNA, I characterize the extent of hybridization between these two species, primarily within streams in the Lake Norman area of the Catawba River system. The hybrid zone appears to be limited to a small geographic area where individuals with intermediate morphology (coloration) are regularly captured. Genetic data indicate little evidence of dispersal of the *N. chiliticus* genotypes into other streams in the Catawba River system.

Oral Presentation

Restoration of Pigeon River fish fauna in eastern Tennessee and western North Carolina

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Beginning in 2001, a cooperative effort was begun to restore viable native fish populations to the Pigeon River, once so polluted that all mollusks and many fish species were extirpated. Volunteers from federal and state agencies, industry, and private organizations created the Pigeon River Recovery Project to begin re-introduction of native fish and other aquatic species. Early successes in TN led to the expansion of the project upstream into western NC. A total of 15 species of fish have been collected from the French Broad basin and the upper reaches of the Pigeon River itself. To assess survival of relocated species, fluorescent visible implant elastomer (VIE) was used to tag darter species, which were easily observed by snorkelers. Reproduction was first documented in gilt darters in 2003. Monitoring surveys over the past three years have documented gilt, bluebreast, and stripetail darters and mountain madtoms in the Pigeon River near Newport, TN. During the fall of 2005, a snorkel survey in the lower Pigeon River approximately five miles downstream of the release site documented healthy gilt darters of every age inhabiting nearly every riffle; this species appears to be successfully re-colonizing the Pigeon River in TN. Of six re-introduced species in NC, four shiners (mirror, telescope, Tennessee, silver) and the gilt darter have been collected during monitoring efforts. Silver shiners have dispersed almost eight miles upstream of the nearest release site. Conservation Fisheries Inc. propagated the first tangerine darters in captivity in 2005 with the goal of re-introducing it into NC and TN. In 2007, the first tangerine darters were released into the Pigeon River near Denton, TN.

Oral Presentation

Microsatellite variation among River Sturgeons of the genus *Scaphirhynchus* (Actinopterygii: Acipenseridae): A preliminary assessment of hybridization.

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Microsatellite variation from 13 disomic loci is reported and analyzed for a total of 208 individuals representing the genus *Scaphirhynchus*. This includes 105 individuals of the Pallid Sturgeon (*Scaphirhynchus albus*) from the lower Mississippi River, 11 Pallid Sturgeon from the Upper Mississippi and Missouri rivers, 65 Shovelnose Sturgeon (*S. platorynchus*) from the lower Mississippi River, six Alabama Sturgeon (*S. suttkusi*), and 21 individuals of sturgeon identified as intermediate between *S. albus* and *S. platorynchus*. Results indicate that all five of the above population/species units are significantly differentiated from one another based on pairwise F_{ST} estimates. Locus Spl-7 was diagnostic for the Alabama Sturgeon and serves to further differentiate this allopatric species from other *Scaphirhynchus*. The presence of six unique alleles in five of the 21 morphologically "intermediate" sturgeon examined strongly suggests that these individuals are not the result of hybridization and thus raises a serious question regarding the issue of hybridization as a "fact" of river sturgeon life history.

Oral Presentation

Health considerations for captive rearing and translocation of fishes.

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Population management plans and stock enhancement programs usually require captive rearing of the target fish species followed by release of reared fishes to natural habitats, sometimes outside of their original drainage. Along with the risks of genetic "contamination" of unique native genotypes, the risks of introducing parasites and diseases should be among the greatest concerns of those involved in these sorts of programs. Certain types of pathogens present the greatest risks of surviving translocation events to establish in the field population, and a subset of these present a different risk of causing disease in populations of fish (of the same or different species) already resident in the basin. The traits of these pathogens can be characterised to some degree using invasion biology concepts and this means that they can be identified *a priori*. This then allows for a risk assessment based on pathogen surveys of the population to be translocated, and subsequent strategic actions to minimise the risk of introducing pathogens to naïve fish populations. Interestingly, the introduction of pathogen-free fishes can still cause problems for wild fish populations through the "enemy release" hypothesis, whereby the introduced fish has a competitive advantage. Either way, pathogens and the diseases they cause should feature prominently in the management plans for captive-reared fishes.

Oral Presentation

Reproductive ecology and laboratory spawning in the western sand darter, *Ammocrypta clara,* with observations of previously undocumented behavior.

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A reproductive life-history study was conducted on the western sand darter, *Ammocrypta clara*, in the Black River system in northeastern Arkansas. While much is generally known about percid fishes within the genus *Ammocrypta*, limited research has been conducted specifically dealing with *A. clara*. Gravid females and mature males were collected from the Current, Strawberry, and Black rivers from June to mid September 2007, indicating a late and protracted spawning season. Reproductively mature specimens were collected in late August for laboratory observation and spawning behavior was first observed on 28 August 2007. Males and females were observed undulating and vibrating vigorously in corners and along the side of the tank, creating depressions in the sand substrate. Spawning events varied in the number of individuals participating, from one male and one female, up to 8 individuals of unknown sex ratios. Similar to spawning observations of *A. pellucida*, eggs were buried singly in the sand, but in contrast, eggs were also found at the sand surface. Eggs were collected from the aquaria on 29 August (n=58) and 30 August (n=31). Spawning behavior, including group or paired vibrations and depression building, continued through early September but no eggs were found after 30 August. During spawning, fish remained buried in the sand except in crepuscular periods with more activity occurring at dawn compared to dusk. Most individuals came to the surface within 5 minutes of the application of light (to simulate dawn) and remained active for approximately one hour before burying in sand. Feeding was not observed during the spawning period, and active feeding did not resume until several weeks after spawning. In addition, post-spawn adults were active diurnally.

Oral Presentation

Coal Mining Related Factors Affecting Recovery of Biota and Habitats in the Clinch River System, Virginia

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In southwestern Virginia, the Clinch River system and its major tributary, the Powell River, drain portions of the Appalachian coalfields. Within the Commonwealth, the Clinch system harbors 20 aquatic species listed under the Endangered Species Act (ESA), plus four aquatic species that are candidates for listing. Some of these listed species, especially endangered mussels, have declined significantly over the past decade. Existing data coupled with ongoing U.S. Fish and Wildlife Service (FWS) sponsored research indicate that among the myriad of land uses affecting aquatic ecosystems, coal mining is a significant contributor to physical and chemical degradation of aquatic habitat in the Clinch system. Over the past five years, FWS has observed and photo-documented circumstances in Virginia where mining activities appeared, on occasion, to be inconsistent with the Clean Water Act. In addition, FWS is collaborating with the U.S. Geological Survey on a project initiated in 2007 that indicates some coal-related discharges can be toxic to aquatic life. Headwater stream habitats in the Clinch system clearly have been or are being impacted by mining and other upland disturbances, but the extent to which adverse effects may be transferred along the river continuum is not fully understood. However, it is likely the cumulative loss of headwater stream functions, either by modification of hydrology, substrate, or water quality, is a hindrance to FWS goals of sustaining or recovering downstream populations of listed species and their federally designated critical habitat. Although mussels throughout much of the Clinch system in Virginia and aquatic communities in its headwaters have declined, some sensitive fish taxa, including the yellowfin madtom, recently have expanded their range in the main stem Clinch and Powell. To bolster the apparent ongoing recovery of rare fishes and begin recovery of mussels, FWS has worked with the mining regulatory authority to develop specific protective measures for habitats where listed species occur.

Oral Presentation

The influence of historical gene flow and contemporary population translocations on genetic diversity in the endangered Watercress Darter, *Etheostoma nuchale,* inferred from multiple microsatellite DNA markers

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The Watercress Darter, *Etheostoma nuchale*, is native to only four springs within the Black Warrior River drainage in Alabama, including Glenn, Thomas, and Seven springs in the Valley Creek system and Roebuck Spring in the Village Creek system. Due to its restricted range, *E. nuchale* was listed as endangered only five years after its original description in 1965. All springs are located in the greater Birmingham metropolitan area and are jeopardized by urban development, pollution, and introduced species. Early conservation efforts included three population translocations into springs in the Birmingham area. Translocation of two-hundred individuals from Roebuck Spring into Tapawingo Spring (Turkey Creek system) in 1988 is the only known successful introduction. Mitochondrial DNA sequence data has shown that Watercress Darters from Roebuck Spring are more closely related to Gulf Darters (*E. swaini*) from upper Black Warrior tributaries than they are to populations from the Valley Creek system (Glenn, Thomas, and Seven springs). Using seven polymorphic microsatellite DNA loci, our objectives were to identify the number of evolutionary significant units (ESUs) within *E. nuchale* and evaluate the relationship between *E. nuchale* and *E. swaini* from upper Black Warrior tributaries. Analysis of microsatellite DNA identified three ESUs within *E. nuchale*: 1) Glenn + Thomas springs; 2) Seven Springs; 3) Roebuck + Tapawingo springs. Though microsatellite DNA corroborate the mitochondrial DNA hypothesis that *E. nuchale* is paraphyletic, our data suggest Valley Creek *E. nuchale* share a more recent ancestry with upper Black Warrior *E. swaini* than do Roebuck Spring *E. nuchale*. Finally, we use these seven microsatellite loci to assess the genetic composition of the introduced Tapawingo Spring population.

Oral Presentation

Scutes Away: Lessons Learned from Tennessee's Lake Sturgeon Restoration Program

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The Tennessee Lake Sturgeon Recovery Program has just completed its seventh successful year in reintroducing these charismatic megafauna to Tennessee rivers. Lake Sturgeon (*Acipenser fulvescens*) were presumed extirpated from the Tennessee River over 50 years ago and are currently listed as endangered in Tennessee waters. Extirpation of the species was initiated by overexploitation of the species by fishermen, and the subsequent decline of water quality in the Tennessee River from land use practices and widespread impoundments within the watershed. Since the 1980s, Reservoir Release Improvements by the Tennessee Valley Authority at Douglas Dam created an environment that could once again support Lake Sturgeon. Since 1998, with fertilized Lake Sturgeon eggs from Wisconsin, we have released over 50,000 sturgeon in Tennessee. As this program develops some of our activities have proven to be quite successful, though we have identified areas of our program that need improvement. We believe we need to improve our sampling and monitoring efforts to accurately assess the current status of Lake Sturgeon. However, we have been able to involve the public in our monitoring efforts through cooperation with commercial fishermen, reporting of recreational catches of sturgeon, and positive attention from media outlets around the region. We have also had measurable success with our public outreach efforts utilizing local schools, regional universities, and exhibitry at the Tennessee Aquarium. In the future, we plan to expand our monitoring and educational outreach programs by offering more opportunities for public interaction with our efforts in the form of additional internships, outreach to a growing number of schools and universities, and increased cooperation with commercial and recreational fishermen.

Oral presentation.

Stream fishes in Kentucky's Upper Green River Basin: an assessment of the influence of watershed- and reach-scale environmental variables.

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As part of a larger study examining the influence of land-use at multiple spatial scales on the structure of fish and macroinvertebrate assemblages in Kentucky's Upper Green River Basin, the relationship between abundance patterns of darters (*Etheostoma*, *Percina*) and environmental variables across several subbasins is assessed and presented. A canonical correspondence analyses (CCA) performed in a forward selection procedure retained six variables, but also removed agriculture land-use and most indicators of anthropogenic perturbation. A second CCA identified only watershed area, summer baseflow and temperature as important to structuring darter assemblages. An unweighted pair-group method analysis plus indicator species analysis identified taxa that characterized the partitioning of stream reaches. Stepwise multiple linear regressions were then used to model the relationships between the significant indicator species and the retained CCA variables. Watershed area and percent urban land-use were the prominent variables linearly related to the abundance of individual species, whether independently or combined with other parameters in multiple models. These results correspond with prior analyses in this basin, namely revealing that species abundance patterns of whole fish assemblages are reflective of natural, background environmental variation and the sole variable indicative of environmental perturbation is small-scale urban (5–8 %) within only one subbasin.

Oral Presentation

Declines of several shoal-dependent fish species in the Conasauga River over the last decade – potential mechanisms and future research needs

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Annual fish surveys have been conducted from 1996 to 2006 at thirteen shoals along the Conasauga River between Hwy 2 at Beaverdale and Hwy 76/52, east of Dalton, GA (i.e., upstream of any significant urban or industrial land-uses). Surveys were conducted using kick-seine and sweep-seine methods; sampling effort and data collection have remained constant during the study, allowing us to look at population trends over time. The data show a severe decline in abundance or apparent loss of several species within the study reach, including the Coosa madtom (*Noturus sp. cf. N. munitus*), Coosa chub (*Macrhybopsis sp. cf. M. aestivalis*), tricolor shiner (*Cyprinella trichroistia*) and riffle minnow (*Phenacobius catostomus*), while populations of most other sampled species appear relatively stable. We hypothesize that indirect or direct effects of eutrophication and/or pesticide run-off may be major stressors, possibly exacerbated by recent drought conditions. A concurrent severe decline in the extent of riverweed (*Podostemum ceratophyllum*) may have been caused by the same stressors, and likely has a negative indirect effect on fish populations. The Conasauga River is historically known to be biologically diverse, harboring several fish species that occur only there or in the Etowah River. Future research should test hypotheses that confirm or exclude potential stressors as mechanisms of species declines and provide direction for conserving biodiversity within the Conasauga River.

Oral Presentation

Good intentions but a bad idea: Pallid Sturgeon (*Scaphirhynchus albus*) stocking in the Mississippi River

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Little was known of the status of Pallid Sturgeon in the Mississippi River at the time the species was protected under the Endangered Species Act in 1990, and the upper Missouri River was considered to be the stronghold of the species. Data compiled at the time of listing recognized only 19 recent and historical records from the Mississippi River, and it was believed that over-fishing, river engineering, pollution, and other environmental factors had resulted in Pallid Sturgeon recruitment failure and a severely depleted population in the Mississippi River. Based on this information, the recovery strategy for Pallid Sturgeon focused on stocking to prevent extinction and to rebuild populations throughout the range. Limited stocking of Pallid Sturgeon into the Middle Mississippi and Lower Missouri rivers was initiated in 1994. Over the past 7 years, however, efforts to assess existing pallid sturgeon populations and habitat throughout the Middle and Lower Mississippi River indicate that this portion of the species range contains extensive high quality habitats for Pallid Sturgeon, the highest numbers of wild fish, and the only known recruiting populations. Other recent studies show morphological and genetic differences in populations between and within the Missouri and Mississippi river reaches. Acting on this information, the Lower Basin Pallid Sturgeon Recovery Workgroup declared a moratorium on stocking Pallid Sturgeon in the Mississippi River in 2005, and recently the Pallid Sturgeon Recovery Team recommended using only locally collected gametes to produce progeny for supplementation into any management unit where stocking is considered necessary. The Pallid Sturgeon story demonstrates the need to thoroughly assess population size and genetic structure prior to initiating conservation stocking for any species.

Oral Presentation (student competition)

Dam Removal on the Cahaba River Improves Utilization of Riffle Habitat by Imperiled Fish Species

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The Cahaba River is recognized as one of the most biologically diverse systems in North America with 131 species of fishes inhabiting its 307 kilometers of stream that flow through central Alabama. The Cahaba River has long been advertised as the longest free-flowing stream in Alabama, however, an impoundment has been present since the 1960s. Only recently was the Cahaba River restored to its natural flow by the removal of a low head dam known as the Marvel Slab located in Bibb County. The dam removal led to the creation of two new riffle habitats, one at the base of the dam where sediments were once scoured by overflow, and one upstream of the dam where suitable habitat was inundated. Our study monitors the changes in fish populations on these newly formed riffles. We made five seasonal fish collections along three transects of both new riffles and four reference riffles directly upstream and downstream of the dam site. All 22,772 collected fish were identified and our results show that the new riffles have been colonized by a diverse assortment of riffle fish species. Among the 34 species of fishes collected on the riffle at the former dam site is the federally endangered Cahaba Shiner (*Notropis cahabae*), and the threatened Goldline Darter (*Percina aurolineata*). The formerly inundated riffle is also rebounding with 26 species documented including both federally protected species. This level of fish diversity closely mimics that of nearby reference riffles. Improved water quality and connectivity may have also contributed to the discovery of Goldline Darters and Cahaba Shiners in Shades Creek, an adjacent, historically polluted tributary.

Oral Presentation

Tools for Conserving Land and Protecting Riparian Buffers

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The Georgia/Alabama Land Trust, Inc., works with private landowners to help them permanently protect the lands they cherish through the use of conservation easements. The Land Trust has helped to protect over 70,000 acres of land in Georgia and Alabama alone, and we expect to protect another 20,000 acres in 2007. Conservation easements are an invaluable tool to protect watershed health, riparian buffers, rare species, and threatened habitat, while still providing for the landowner's goals for his or her property. For more information, please visit www.galandtrust.org or www.allandtrust.org or call us at (256) 447-1006.

Oral Presentation

Conservation Status and Recovery Options for Alabama's Imperiled Freshwater Fishes.

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The freshwaters of Alabama contain the highest species richness of fishes of any state. However modification and degradation of Alabama's rivers have resulted in substantial species losses over the last century. Of 317 species historically found in state waters, 10 are now extirpated, 15 are federal conservation targets, and state conservation planning efforts have identified yet another 32 species of concern. To promote recovery efforts with rare species in state waters the Alabama Department of Conservation and Natural Resources has initiated a new program organized under the Division of Wildlife and Freshwater Fisheries. The Alabama Aquatic Biodiversity Center (AABC) situated in Marion, Alabama will work with other recovery partners to conserve rare species in the state. As the construction of the AABC is nearing completion, the recovery programs will not be initiated until 2008. Although the initial focus of AABC recovery programs will be freshwater mollusks, fisheries projects will be implemented within the next few years. This presentation will detail mollusk recovery planning efforts in the Mobile and Tennessee River basins and how this approach may serve as a template for future fish recovery planning.

Oral presentation

Occupancy rates of selected shoal dwelling fishes in the Tallapoosa River basin.

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Fishes that occupy shoals are imperiled at high rates due to habitat destruction and disturbance from river impoundment and regulation. In support of an adaptive management project, we are collecting data to assess effects of management actions, specifically, modified flows at R.L. Harris Dam. These data will be used in a Bayesian belief network constructed for decision support relative to management prescriptions. Program MARK was used to estimate occupancy and rank the effects of co-variates (e.g., specific habitat) using model selection techniques for a suite of fishes. Occupancy was related to specific habitat characters and other factors, such as, distance from the dam; relations varied among species. For example, occupancy rates of black redhorse *Moxostoma duquesnei* were higher at unregulated sites and related to vegetation (%), depth and velocity. Muscadine darter *Percina smithvanizi* occupancy varied with vegetation (%) and distance from the dam. These models are valuable for identification of fishes that may directly respond to flow modification. In addition, we analyzed a post-dam, long-term dataset (1982-1989; Alabama Power Company) of fish species presence from regulated and unregulated sites in the middle Tallapoosa River and associated tributaries. Results indicated that extinction/colonization rates were stable for the period of analysis; colonization rates were equal to or greater than extinction rates for all species. However extinction/colonization rates did not differ between regulated and unregulated sites nor did they change with increasing distance from dam. These long-term data will be used to construct prior probabilities for the decision support model and to establish specific management goals, such as increased occupancy of fishes inhabiting shoals near the dam. Monitoring efforts are ongoing in support of the adaptive management project.

Oral Presentation

The South Carolina Stream Assessment: A Proactive Conservation Framework

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The degradation of aquatic ecosystems and subsequent imperilment of native aquatic faunas observed in the southeastern United States underscore the demand for proactive, watershed-based conservation. The South Carolina Stream Assessment (SCSA), a multi-organization effort, was implemented in 2006 to address the need for science-based resource management. The goals are to characterize the biological, physical, and chemical condition of wadeable freshwater streams statewide, and relate these stream indicators to conditions in their watersheds. Watersheds are distributed according to "ecobasins," spatial strata representing unique combinations of South Carolina's four major river basins and seven level-IV ecoregions, with sample size proportional to ecobasin area. Fixed, annually-sampled reference sites are established within each ecobasin to reflect least-disturbed watersheds and capture temporal dynamics in measured parameters. In addition, 75-100 randomly selected sites are sampled annually for spatial representation of watershed conditions, with statewide coverage scheduled for five years. Stream reach-scale biological variables include fish and macroinvertebrate assemblage structure as well as crayfish, mussel, and herpetofaunal distribution. Physical stream habitat is assessed in addition to channel geomorphology and water chemistry. Watershed-scale and riparian indicators are derived from land cover and pollution discharge data, facilitating the development of quantitative models describing the effects of watershed management scenarios on aquatic habitats and biological communities. Ultimately, we hope to provide land planners and managers with an empirically-derived, spatially-explicit decision support framework for watershed and riparian management.

Oral Presentation

Translocating and stocking non-game fishes: using past lessons and present techniques

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Game fishes have been propagated and stocked to support recreational fisheries in North American for over a century, including large-scale introductions outside of the native ranges of these species. This practice has altered stock structure and reduced genetic variability within many game fishes, degraded native aquatic communities across the continent, and has led to the extirpation and extinction of non-game species. Since the enactment of the Endangered Species Act, numerous imperiled non-game fish species have been propagated and stocked, while other rare fishes have been translocated to areas of extirpation within historic ranges or have been moved into exotic favorable habitats. These "conservation efforts" have mirrored the negative impacts of game fish management, including several efforts in the southeastern US. Populations of the endangered Shortnose Sturgeon (*Acipenser brevirostrum*) in the Savannah and Edisto river drainages possess depressed overall genetic diversity due to stocking efforts. The translocation of the endangered Watercress Darter (*Etheostoma nuchale*) into a spring outside of its native range has led to the extirpation of the imperiled Rush Darter (*E. phytophilum*). Presently there are numerous genetic tools, phylogenies, and replicated biogeographic patterns to guide stocking and translocation efforts of imperiled or any other taxa. These tools must be used to minimize the inherent risks in any translocation or stocking efforts.

Oral Presentation

Distribution, abundance, and genetics of the imperiled Vermilion Darter (*Etheostoma chermocki*) in relation to its sister species the Warrior Darter (*E. bellator*)

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The endangered Vermilion Darter (*Etheostoma chermocki*) is endemic to 12 stream km within the Turkey Creek system, an urban tributary to the Locust Fork of the Black Warrior River drainage (Mobile Basin) in Alabama. Conservation and restoration of this species requires an understanding of its distribution, life history, and population genetic structure. *Etheostoma chermocki* has recently been discovered in habitats previously thought to be too degraded to support a viable population, but the presence of extensive aquatic vegetation allows for reproduction and year-long residence in this stream segment. A limited number of preserved museum specimens were available for a life history study of the Vermilion Darter, therefore a study was also conducted on its sister species, the Warrior Darter (*E. bellator*) from Gurley Creek, a rural Locust Fork tributary adjacent to Turkey Creek. Similar life history attributes are shared between these species indicating that this population of *E. bellator* is an ideal surrogate to supplement missing life history information for *E. chermocki*. Nine microsatellite loci were used to determine the population structure between *E. chermocki* and the *E. bellator* population from Gurley Creek. Both species exhibited similar genetic diversity and population structure, with no bottleneck detected. Estimates of effective population size (N_e) for *E. chermocki* are similar to the total population size estimates based on census data (1,847 to 3,238), but the long-term effective population size estimate (N_e) is 12,000 individuals. Conservation strategy of *E. chermocki* should include the protection of habitat and maintenance of habitat connectivity throughout the Turkey Creek system, as well as regular monitoring of population genetics and abundance. Captive breeding and/or relocation of *E. chermocki* is currently not a viable option considering the inherent risks these methods would impose on the Vermilion Darter and other aquatic species.

Oral Presentation

Genetic considerations for hatchery-based enhancement of aquatic species: Are good intentions enough?

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The predominant motivation for most restoration projects is ecological. That is, the goal is to bring a species back to something closer to its historical abundance and as a result, restore the ecological functions and services it provided and possibly even a limited, sustainable fishery. From this perspective, goals can be described largely in terms of population sizes. Abundance, however, is not necessarily and indicator of population viability; therefore the primary goal of any restoration plan should be to maintain or restore the evolutionary processes that allow long-term species persistence. This requires minimizing genetic risks associated with hatchery propagation and knowledge about levels and types of genetic diversity necessary to maintain the ability to adapt over time. I present an overview of genetic problems and pitfalls associated with hatchery-based enhancement including genetic risks associated hatchery propagation and augmentation.

Oral Presentation

Using fish communities to monitor water quality in Alabama

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A statewide effort has been undertaken by three natural resource, conservation, and environmental agencies (GSA, WFFD, and ADEM) to adapt and calibrate the Index of Biotic Integrity (IBI) for use in Alabama's river and streams. The goal of this six year project is to create a comprehensive water-quality bioassessment tool to help agencies better manage water quality and habitat more efficiently and effectively. Several tasks were identified as critical to successful implementation of the IBI on a statewide basis: 1) a standardized wadeable stream sampling protocol must be developed, 2) the IBI must be calibrated to Alabama's high fish biodiversity and diverse ecoregions, 3) IBI metrics must be selected and evaluated for their ability to detect water-quality and habitat changes and 4) regional reference sites need to be established. Task 1 has been completed consisting of a habitat-effort sampling design where a fixed amount of effort is expended in four basic habitat strata (riffles, runs, pools, and shorelines). For task 2, a comprehensive database of 855 historical fish community samples, compatible for use in the IBI, was compiled and analyzed to determine the most favorable and consistent groupings of these samples within the confines of ecoregions and river drainages. Five preliminary ichthyoregions were delineated–Tennessee Valley, Plateau, Ridge and Valley/Piedmont, Hills and Coastal Terraces, and Southern Plains. Twelve IBI metrics have been selected (task 3) in three broad categories- biodiversity and species composition, trophic structure of the fish community, and fish abundance and condition- that appear to effectively discriminate water quality and habitat differences. The ADEM has established regional reference sites (task 4) for their benthic macroinvertebrate biomoitoring program and these will be adopted in part as fish IBI reference sites.

Oral Presentation

The use of behavior in the captive propagation of threatened and endangered fishes.

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Understanding the behavioral ecology of a particular species can provide valuable clues towards species recovery. Often when dealing with threatened and endangered species little is known about their reproductive behavior or habitat needs. Captive propagation of these aquatic organisms may not only play a role in recovery in the event of rapid loss of wild populations, but may also provide important life history information. In addition, offspring of wild stock refugium fishes can provide a source of research organisms useful in the further understanding of the species. Practical application of culture techniques coupled with species behavioral information often is the first step towards development of a successful captive propagation program. Behavior has been successfully used to refine captive propagation for threatened *Dionda diaboli*, the Devils River minnow. However, captive propagation of endangered *Percina pantherina*, the leopard darter, has been difficult and knowledge of behavior combined with techniques developed for surrogates may aid in its future propagation.

Oral Presentation

Phylogeography of the greenside darter complex, *Etheostoma blennioides* (Teleostomi: Percidae): A wide-ranging polytypic taxon

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The greenside darter, *Etheostoma blennioides* (Teleostomi: Percidae), is a wide-ranging polytypic taxon that occurs throughout eastern North America. A previous morphological study recognized four subspecies (*blennioides*, *newmanii*, *gutselli*, and *pholidotum*), several morphological races, and three zones of morphological intergradation. We generated complete cytochrome b (1,140bp) sequence data for 51 individuals from across the range of the greenside darter inclusive of all of the currently recognized taxa to assess genetic variation and taxonomic boundaries. Both maximum parsimony and mixed model Bayesian analyses resulted in two strongly supported deeply divergent clades including 1) a Tennessee River drainage clade, and 2) an Ohio River and Great Lakes basins, Interior Highlands, and Atlantic slope clade. *Etheostoma blennius*, a closely related congener, nested within the Tennessee River clade of *E. blennioides*, rendering the complex paraphyletic. The inclusion of nuclear sequence data from intron 1 of the S7 ribosomal protein (523 bp) from a subset of the populations was included to independently test whether the currently recognized taxa conform to distinct evolutionary lineages and also to clarify potential issues associated with ancestral hybridization. Although the nuclear data was less variable that the mitochondrial data, it recovered nearly identical clades and recovered a monophyletic *E. blennioides* clade.

Oral Presentation

Life History Aspects of the Coosa Shiner, *Notropis xaenocephalus* (Actinopterygii: Cyprinidae) in Northern Georgia.

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The biology of the Coosa Shiner, *Notropis xaenocephalus*, was investigated using 12 monthly collections from Moore Creek (Etowah River Drainage) in Cherokee County, Georgia. Specimens were collected primarily from pools with slow current and examined to determine age, growth, food habits, and reproductive cycle. The bulk of the diet consisted of Diptera adults, Chironomidae larvae, Hymenoptera and unidentified insect parts. Feeding was greatest in the spring and lowest during winter months. Spawning occurred in spring to early summer with 86-540 mature oocytes ranging from 0.9 to 1.3 mm in diameter present in specimens collected from March to June. Sexual maturity occurred at 1 year of age. The largest specimen collected was a female 63.8 mm SL and 4.4 g total weight. Two specimens estimated to be 38 months of age were the oldest specimens collected. As one of the most abundant minnows in the upper Alabama River Drainage, these findings provide a greater understanding of the ecology of this imperiled ecosystem.

Oral Presentation

Reintroduction and restoration of endangered fishes to Abrams Creek, Great Smoky Mountains National Park, Blount County, Tennessee.

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A project to restore populations of four imperiled fishes into Abrams Creek in the Little Tennessee River system has been underway now for 22 years. These fish, all on the U.S. Endangered Species List include: smoky madtom, *Noturus baileyi* (E); yellowfin madtom, *N. flavipinnis* (T); duskytail darter, *Etheostoma percnurum* (E); and spotfin chub, *Erimonax monachus* (T). By the end of 2007, 3239 smoky madtoms, 1,638 yellowfin madtoms, 3,430 duskytail darters and 11,367 spotfin chubs had been stocked into Abrams Creek. The smoky and yellowfin madtoms were stocked from 1986 to 2002. Smoky madtoms were stocked annually, and yellowfin madtoms periodically. Duskytail darters were stocked annually (except 2000) from 1993 to 2001. Spotfin chubs were originally translocated from the upper Little Tennessee River in 1986; captively produced individuals were stocked periodically from 1994 to 2001. By summer 2000, there was evidence that all four species had reproduced in Abrams Creek. Abundance indices calculated from snorkel surveys at the reintroduction sites indicated increasing sizes for populations of three of the four fishes, and, by 2006, smoky madtom and duskytail darter indices were comparable to those in Citico Creek, the source for the reintroductions. Population dispersal over more than three creek miles from a stocking site was observed for both madtoms in 2004. Spotfin chubs apparently failed to establish in Abrams Creek and restoration efforts for the species were shifted to the nearby Tellico River in 2001. Populations of the other three species have become established in several reaches of Abrams Creek. At present, stocking in Abrams Creek is very limited and efforts are centered on monitoring the reintroduced fish.

Oral presentation

How big is a population of darters?

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To be effective at conserving fish, we should assess, protect, and manage fish populations at spatial scales that match those of key demographic and evolutionary processes. Such efforts are complicated for darters, because we seldom understand the size or structure of darter populations on the landscape. I use data from my previous and ongoing studies of five species of darters to investigate the spatial scales over which population processes act, essentially asking, "How big is a population of darters"? Movement, demographic, and genetic data are considered. Observed movements were mostly localized (<0.5 km), with infrequent extensive movements (>2 km), suggesting that populations are small-grained. However, strong demographic correlation and genetic similarity over large distances (10-40 km) suggest that populations are larger-grained than typically assumed. Conservation efforts for many darters may therefore be inappropriately focused at a scale too local to be effective.

Oral Presentation (Student Competition)

Conservation Genetics of Metapopulations: A Case Study of the Spring Pygmy Sunfish (*Elassoma alabamae*)

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The spring pygmy sunfish ranks among one of North America's most geographically restricted vertebrate species, native to a single spring system in Limestone County, Alabama. As such, attempts have been made to reestablish populations in formerly occupied habitats. In the mid 1980's, two nearby springheads were stocked with 36 and 120 individuals, all collected from the same source locality. Since that time, gene flow has not been documented between founding subpopulations. These reintroductions did not benefit from an understanding of population dynamics in the source system, and the effective founding population was exceedingly small for both localities. The goal of this study is to assess the effects of short-term isolation in small populations of *E. alabamae*. Intraspecific and interspecific microsatellite polymorphism is described for native and reintroduced populations using standard population-genetic methods. Effective population size, F_{st}, heterozygosity and gene-flow indices are presented along with a network topology of the native and reintroduced systems. Additionally, deleterious mutations are reported for the first time in reintroduced populations, including high incidence of scoliosis, which is likely an effect of inbreeding. Preliminary data suggest that the reintroduced populations of *E. alabamae* suffer from extremely low levels of intraspecific variation, and may represent a failed attempt to reintroduce this species to otherwise suitable habitats. Metapopulation dynamics are suspected to promote and maintain genetic variation in this system. These results have obvious implications upon other imperiled small-bodied fishes, and a general model of low-dispersal population dynamics is suggested.

Oral Presentation

Current status of the Clinch River and its imperiled fishes

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The Clinch River watershed in Tennessee and Virginia continues to support one of the most diverse fish faunas in North America, totaling at least 107 species. Of these, 22 are listed on state protection list, and five of these are also listed as threatened or endangered federally. Based on recent sampling, status of these protected species ranges from extremely rare and possibly extirpated to common and stable. The persistence of the highly diverse fish fauna in the Clinch River watershed can be attributed to the region's rugged topography and consequent low rate of development. Changes in land uses, however, may pose additional threats to survival of Clinch River fishes in the future.

Oral Presentation

Snail darter monitoring in the French Broad River below Douglas Dam, 1997-2005

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In 1997 TVA initiated a nine year study of the snail darter (*Percina tanasi*) population in the French Broad River, as the four hydro turbines at Douglas Dam were replaced with more efficient, higher volume turbines. Highest concentrations of snail darters were found at Campbell Islands (FBRM 8), 24 miles downstream from the dam. Conclusions were based on snail darter catch rates and sizeclass distribution, particularly Age 1+ fish. The study found no adverse effects of the new turbines on snail darters in the lower third of Douglas Tailwater. Fluctuations in snail darter abundance during the study period were related to April discharges from Douglas Dam and a four year drought. Ironically, routine operation of Douglas Dam is thought to favor snail darter survival, although late spring floods could diminish year class strength.

Oral Presentation

Threatened species or threatened communities: 70 years of change in Owego Creek, NY

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The fishes of Owego Creek (Susquehanna drainage) have been investigated since 1935 with intensive surveys 1961-1963 and 2003-2005; miscellaneous collections are numerous enough to sketch the intervening years. Four species (*Clinostomus elongatus, Notropis amoenus, N. heterolepis, N. procne*) disappeared and five(*Notropis volucellus, Culaea inconstans, Ambloplites rupestris, Etheostoma blennioides, E. zonale*) have invaded from outside the Susquehanna or expanded ranges within it. In upstream reaches sampled quantitatively in 1963, midwater minnows (e.g., *Luxilus cornutus, Notropis hudsonius, N. rubellus*), other minnows (*Campostoma anomalum*) and suckers are reduced or absent although they remain common downstream; *Culaea inconstans* has replaced *Fundulus diaphanus* in weedy backwaters. Persisting species (*Exoglossum maxillingua, Margariscus margarita, Pimephales notatus, Rhinichthys atratulus, R. cataractae, Noturus insignis*, sculpins, darters) are benthic, less conspicuous or utilize shallow habitats. Possible drivers of these community changes include invasions and landscape change (decline of agriculture, riparian recovery, forest succession). Circumstantial evidence implicates predation by brown trout as a very important factor. Climate changes (temperature, stream discharge) coincide with periods of faunal change. Subtle long term changes and biotic interactions may determine the fates of species of concern and entire fish assemblages in which they are embedded.

Oral Presentation

The Successes and Failures of Two Decades of Propagation and Reintroductions of Imperiled Fishes at Conservation Fisheries

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More than 20 years of captive propagation and monitoring of imperiled fishes at Conservation Fisheries, Inc. (CFI) has led to numerous successes, but these have not come without failures. The obvious successes, Abrams Creek for example, have often been covered by us and others in varied presentations. We have spawned and/or reared more than 40 fish species. But some successes cannot be measured in terms of survivorship of reintroduced species or status of rare populations. In many cases, the successes involve discoveries of unique aspects of early life histories, something for which there is a notable lack of information, especially in rare, non-game fishes. These findings can translate into potential management tools that can be applied to wild populations.

Many of our failures can be traced to funding issues, resulting in short staffing and a general lack of time and hatchery space. We have accumulated a considerable base of knowledge that has not been published. Publishing our findings would not only disseminate this information, but would open it up to review and the associated suggestions and criticism. Some of the failures to spawn or rear particularly difficult fish could almost certainly be overcome with more space and funding to support technicians dedicated to those particularly difficult fish.

A general failure throughout the entire “fish restoration community” is to recognize that projects such as this are rarely easy and rarely accomplished quickly. A long-term commitment must be made by all to see these projects through and to continue monitoring beyond the point where further stockings seem necessary.

Oral Presentation

Thirty years after snail darter, *Percina tanasi*, translocations; where are they now?

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Thirty years after discovering snail darters in the Little Tennessee River, the species' known geographic range includes eight tributaries along about 400 miles of the impounded Tennessee River. The species was introduced into two Tennessee River system headwater tributaries and two mainstem tributaries in hopes that one or more would provide appropriate habitat for a fish that was believed to remain relatively sedentary. However, the species' unique life history, including ability to traverse impoundments and migrate through tens of stream miles to spawning shoals resulted in the present existence of six extant populations. These include populations in headwater streams and streams tributary to Fort Loudoun Reservoir in the upper Tennessee River system as far downstream in the system in a tributary to Wheeler Reservoir. Repeated observations of adults in tributaries to Fort Loudoun and Chickamauga reservoirs indicate that these populations are the most robust and are probably the source for downstream dispersal to other streams, including recent observations in new localities. Snail darters have been observed in tailwaters of all mainstem reservoirs between Fort Loudoun and Wheeler. Populations may persist in the Tennessee River mainstem in relatively riverine portions of these tailwaters, as indicated by persistence of adults in tributary streams. There is some question that some may result from translocation via larval drift or from local reproduction. These hypotheses could be confirmed with diving surveys in mainstem reservoirs and population genetic studies.

Oral Presentation

Reproductive behavior, captive breeding, and species recovery: Taking stock of potential consequences

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A variety of reproductive behaviors in fishes have evolved to increase fitness of individuals through facilitating evaluation of mates and spawning habitat, thereby increasing survival of gametes and larvae. These behaviors can therefore affect population dynamics, including recovery from catastrophic declines. Disruptions of mating systems can take many forms, such as impeding movement to a spawning location, altering spawning habitat, or removing individuals for captive propagation. We consider evidence that riverine catostomids engage in mate choice during spawning and the potential implications of by-passing the process of mate choice by using captive breeding as a primary tool for species recovery.

Oral presentation

Conservation Status of the Okaloosa Darter.

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The Okaloosa darter was listed as a species endangered throughout its range in 1973 with a revision to the recovery plan approved in 1998; however, USFWS has not revised the listing, designated critical habitat, or prepared formal 5-year status reviews since the 1973 listing. As part of the first formal status review for the Okaloosa darter, we compiled available population monitoring and range data in addition to evaluating threats to the species. It is our assessment at this time that the intent of the 1998 Recovery Plan's five downlisting criteria has been fulfilled. We have seen substantial progress on Eglin AFB, addressing threats to the Okaloosa darter's habitat. All monitoring sites in all six darter basins do not show stable or increasing population trends, but the darter persists in all six basins with at least 1,200 mature individuals. Substantial increasing trends are evident in the two largest basins, Turkey Creek and Rocky Creek. We estimate that the range-wide population exceeds 200,000. Given the substantial reduction in threats to its habitat and large and increasing subpopulations in the majority of its range, we do not believe that the Okaloosa darter currently meets the definition of endangered in that it is not "in danger of extinction throughout all or a significant portion of its range."

Oral Presentation

The Nonindigenous Fishes of the Yadkin-Pee Dee River Basin in North Carolina

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As part of the North Carolina Division of Water Quality's basinwide water quality monitoring program, more than 250 fish community samples from 148 wadeable stream sites have been collected from the Yadkin-Pee Dee River basin since 1996. Integrated with fish occurrences in Menhinick's 1991 book, *The Freshwater Fishes of North Carolina*, historical publications dating back to the 1860s, a review of major collections through electronic database queries, and recent sampling efforts by the North Carolina Wildlife Resources Commission, Progress Energy, and the North Carolina State Museum of Natural Sciences, an up-to-date description of the indigenous *vs*. nonindigenous fish fauna has emerged. Currently, 112 freshwater fishes are known from the basin; 33 of these species are believed to be have been introduced, many within the last 50 years, as bait fish, sport fish, or forage fish, through aquarium releases, for aquatic plant management, and for species conservation. More than 80 percent of the samples had at least one nonindigenous species present; at some sites almost 40 percent of the species and 50 percent of the fish by number were nonindigenous. Examples of the historical and recent geographical distributions of select species such as the Central Stoneroller, Red Shiner, Warpaint Shiner, Northern Hog Sucker, and Striped Jumprock will be presented. General mechanisms aiding and thwarting future introductions and ramifications of introduced species on the native fauna will also be discussed. A better understanding of riverine fish communities may facilitate improved management and conservation of these systems and their faunas.

Oral Presentation

Status and Distribution of the Arkansas Darter (*Etheostoma cragini*) in Arkansas

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The Arkansas darter, *Etheostoma cragini*, has an extremely limited distribution in Arkansas and is designated as a candidate for listing under the Endangered Species Act. It was first discovered in the state in 1979 in Wilson Spring near Fayetteville and has since been found in 4 additional headwater streams in Benton and Washington counties prior to this study. A study in 1997 found the species in 3 of the 5 historic streams, but one stream yielded only a single individual. This study sought to reassess the status of the 5 historically known populations and sample additional spring-run habitats in the Arkansas River basin in these 2 counties. Spring branch habitats were identified using USGS topographic maps and available GIS coverages. Surveys targeting *E. cragini* were conducted at 75 sites providing a broad coverage of the basin and including intense searches in the vicinity of historic sites. *E. cragini* were encountered in 15 stream segments, concentrated in 4 areas within the Illinois River basin. All segments supported numerous *E. cragini* and fell within a 2 km radius of historic sites. Each segment was broadly surveyed to delineate the extent of occupied stream length, which ranged from 10 to 1,645 m. Based on this survey the total occupied stream length for *E. cragini* in Arkansas was determined to be 5,676 m. These segments include three historic locations and 5 disjunct stream reaches. While the presence of *E. cragini* in Arkansas is persisting, rapid urban development in northwest Arkansas raises concern for some populations.

Oral Presentation

Community assemblages of age-0 fishes in the Apalachicola River and floodplain in relation to altered hydrology

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The Apalachicola River has the largest discharge of Florida rivers and has one of the most extensive forested floodplains of the Gulf Coastal Plain. Decades of regulated hydrology, long-term droughts, and increased water consumption have significantly affected aquatic habitats and fish communities in the floodplain and the river. Allocation of water resources to restore and protect aquatic habitats and management of associated fish populations are major issues within this stressed system. Of particular concern are low-flow conditions and habitat availability during critical life-history phases of floodplain-dependent fishes. Studies were conducted from 2002-2004 to characterize fish communities within the floodplain, with emphasis on examining assemblage structure and temporal appearance of the age-0 class. Additional collections were made in 2006-2007 to: (1) further refine estimates of peak spawning periods, (2) compare river and floodplain catches as related to a restoration project, and (3) correlate with movement activities of adults as part of a separate telemetry study. For the period 2002-2006, a total of about 56,000 larval and juvenile fish were collected from a total of 1,239 light trap sets (identification of specimens collected in 2007 is incomplete). At least 50 species were recorded from floodplain habitats representing about 55% of all freshwater and diadromous fishes in the Florida portion of the drainage. Families represented by greatest abundance were cyprinids, centrarchids, catostomids, and percids. Habitat heterogeneity and variation in the distribution of species belonging to different guilds accounted in part for differences in relative abundances of individual taxa among macrohabitats. Spawning extended from March to late summer with various peaks from March through June for individual species and families. Species richness and abundance was inconsistently correlated with several physicochemical parameters and showed no clear trend.

Oral Presentation

Fish faunal regions of the southern United States: isolation by distance as structuring mechanism

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The southern United States supports one of the richest temperate freshwater fish faunas on Earth. Fishes of the region also show high levels of drainage endemism, suggesting isolation as an important mechanism structuring the fauna spatially. I examined geo-spatial structure of this large, rich fauna using a database of 685 fish taxa with each taxon allocated across 51 drainage units. I used the total native fauna and faunal subsets (darters, minnows, catfishes, and suckers) to define fish faunal regions and to examine the association of isolation by distance and fish assemblage structure among drainage units. I used distance matrices to compare geo-spatial structuring among faunal subsets and drainage networks. The analysis revealed eight, highly distinctive faunal regions (Atlantic North; Atlantic South; Florida Peninsula and Panhandle; Mississippi River (including Interior Highland tributaries) plus the Ohio River, and Red River mainstems; Western Gulf Slope; Tennessee and Cumberland Rivers and Ohio River tributaries; and Missouri River and tributaries plus the Illinois-Neosho River). The phenetic relationships of the fauna of drainage units (all native and subsets) were significantly and strongly congruent with geographical linkages of drainages (isolation by distance). Overall, the results indicate highly, distinct, strongly geo-spatially structured inter-drainage and inter-regional native fish faunas.

Oral Presentation

The Etowah Aquatic Habitat Conservation Plan

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The Etowah River Basin is rich in aquatic biodiversity, including three federally protected fish species: the Etowah darter, amber darter and Cherokee darter. These and other fish species are threatened by rapidly increasing urban and suburban land uses in the watershed. The Etowah Aquatic Habitat Conservation Plan (Etowah HCP) is a program designed to minimize the impacts of new urbanization on the federally protected fish species of the Etowah Basin, ensuring their survival and recovery, without placing unnecessary restrictions on landowners. The Etowah HCP includes policies for managing six aspects of urbanization: (1) stormwater runoff, (2) road crossings, (3) utility crossings, (4) erosion and sedimentation, (5) riparian buffers, and (6) water supply reservoirs. Stormwater runoff, the most critical of these threats, is managed through a set of performance standards that limit the volume of runoff from new development sites. The standards were set using spatially-explicit predictive modeling of species response to runoff. The Etowah HCP was developed over a 5-year period with extensive participation of local governments, development industry professionals, conservationists, landowners, and a team of scientists and lawyers from the University of Georgia and other institutions. It is currently in review by the US Fish and Wildlife Service (FWS). Once approved, its policies will be administered by participating counties and municipalities, with oversight by a regional implementation body and the FWS.

POSTERS

Poster Presentation

Small impoundments influence up- and downstream crayfish commuity composition and seasonal abundance patterns

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Most drainages in northern Mississippi contain numerous small impoundments in the headwaters. During various stream studies, we observed high densities of *Procambarus hayi* only in proximity to such impoundments. In a study of drought recovery by crayfish, I observed that the total abundance of crayfish typically declined from summer to fall, except in sites downstream of lakes, where abundances increased in fall. I conducted a study to test whether differences in lake-influenced versus non-lake-influenced community patterns were real and to explore factors responsible for the differences. I sampled crayfish in four stream sites downstream of lakes and four sites not near lakes in late July/early August (mid summer), September, and November and observed the same patterns of total abundance previously observed. The differences in crayfish abundances among sites were due primarily to juvenile recruitment of several *Procambarus* species downstream of lakes in November. *Orconectes* numbers typically decreased from summer to fall, especially in lake-influenced sites. Differences in reproductive timing and possibly in burrowing habits caused the differences in abundance patterns between the genera. I measured lower levels of dissolved oxygen during summer and lower width/depth ratios in lake-influenced than other sites, but otherwise physical habitat variables were similar. Factors not measured, such as a more clay substrate and greater abundances of predaceous fishes and snakes downstream of lakes, may have contributed to differences in crayfish communities. Ongoing work should reveal crayfish species composition in the reservoirs.

Poster Presentation (Student Competition)

Reproductive Aspects of Three Darter Species (Percidae) within the Etowah River Basin

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Surveys were conducted on reproductive aspects for three imperiled species in the Etowah River Basin: *Etheostoma sp. cf. E. brevirostrum* (the holiday darter), the federally endangered *E. etowahae* (the Etowah darter), and the recently described *Percina kusha* (the bridled darter). Five sites, two on the upper Etowah mainstem (Lumpkin County, GA), two on Amicalola Creek (Dawson County, GA), and one on Cochrans Creek (Dawson County, GA) were snorkeled bi-weekly from mid-March to mid-July of 2007, and observations were made on spawning activities by the targeted species. The peak spawning period for holiday darters was March to late April, with spawning occurring in low-velocity microhabitats primarily composed of sand, cobble, boulder and bedrock. Spawning pairs of bridled darters were found in sand and bedrock habitats of slow to moderate velocity from late-March to early-June. No spawning observations other than courting behavior were made on the Etowah darter during snorkeling surveys, although individuals collected by seine exhibited nuptial conditions through late July. Preliminary observations also indicate that after their spawning season, the holiday darter populations within the Etowah and Amicalola systems exhibit a migration to moderate-high velocity habitats containing gravel and cobble substrate. Understanding the life history dynamics of these species, including timing and lengths of spawning periods and the associated microhabitat involved, is necessary to aid in the conservation of these three imperiled species.

Poster Presentation

Ohio microhabitat use of three state-listed darter species belonging to the subgenus *Nothonotus.*

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Etheostoma maculatum, the spotted darter, is an Ohio State Endangered species belonging to the subgenus *Nothonotus,* with historically fragmented populations in glaciated watersheds of Ohio, Indiana and Pennsylvania, and unglaciated watersheds of Kentucky and West Virginia. Sympatric *Nothonotus* species include *E. camurum* and *E. tippecanoe,* which are listed as State Threatened species in Ohio. These species have recently been downgraded to species of concern or de-listed in Indiana and Pennsylvania.

We are proposing to use logistic regression to model the Ohio presence-absence distributional patterns of these three species at stream, reach and microhabitat scales. Habitat variables applicable to the corresponding scale will be selected as predictor variables. The primary goal of this poster is to get input from other researchers into what would be good predictor variables to measure and what type of data are readily available.

Understanding the distributional scales will enable informed recommendations for reintroduction to stream segments, where these species historically occurred and may currently be excluded due to degraded habitat and water quality in connecting watersheds, or due to blocked migration by low-head dams. These models will hopefully decrease the statewide search area to locate undocumented Ohio populations of these species, such as the discovery of *E. camurum* in the Little Muskingum in 2006. The model may also help explain the curious historical absence of *E. maculatum* in certain streams such as Paint Creek, despite great abundances of *E. camurum* and *E. tippecanoe*, in what appears to be kilometers of suitable *maculatum* habitat.

Poster Presentation

Habitat Use by Larval and Juvenile Cape Fear Shiners (*Notropis mekistocholas*) in the Rocky River, North Carolina.

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Freshwater fishes are among the most imperiled organisms on earth. The factors responsible for imperilment are diverse and usually synergistic, but most could be categorized as some form of habitat alteration. Understanding the effects of various forms of habitat alteration on various fish species is difficult, as basic knowledge of habitat requirements is usually lacking, especially for non-game fishes. Our objective was to document habitat use of juvenile and larval Cape Fear shiners (*Notropis mekistocholas*) so that a better understanding of habitat requirements can be achieved for conservation purposes. Cape Fear shiners are a federally endangered species restricted to just five localities in the Cape Fear drainage, NC. We measured habitat parameters of areas used by Cape Fear shiners throughout the summer of 2007 in the Rocky River, NC. We also observed spawning behavior of this species in the field. Larvae and juveniles appear to use more shallow depths in the water column than adults, and favor vegetative cover (*Justicia americana*). We documented some consequences of drought over the summer, such as an algal bloom resulting from a lack of flow.

Poster Presentation

From the Ledger to the Web: Improving the Functionality of the Collections of the North Carolina State Museum of Natural Sciences to Respond to the Rapidly Changing Needs of Conservation Planners

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Museum collections serve multiple purposes in the area of managing biodiversity in a given region. These range from providing key materials for investigations into the true extent of biodiversity, to providing a thorough documentation of the distributional history of a region's biota in space and time. This documentation is critical in assessing the population status and habitat requirements of that biota and for conservation planning based on solid data. Along with such resources as heritage databases, natural history collections play an especially crucial role, as their holdings serve to voucher species occurrences in the face of any questions that may confront future planners. In the rapidly developing Southeast and mid-Atlantic regions it is important that such repositories be able to respond rapidly to the needs of resource managers and scientists that are engaged in decision making and long range conservation planning. These resource managers and scientists require thorough data coverage for such things as range fragmentation analyses, habitats critical to jeopardized species, and more. To meet these needs the North Carolina State Museum of Natural Sciences (NCSM) has engaged in an intensive effort to database its research collections, including the collection of fishes which number 100,000+ lots. In order to have outputs that would be responsive to the needs of resource managers, educators, and those researching systematics and biologies of fishes, it was necessary to develop a complex, relational database and web presence. The outputs developed include detailed breakdowns of occurrence in both natural drainages and political subdivisions, plus complete georeferencing. In this poster we outline the process of developing the NCSM fishes database and demonstrate its utility.

Poster Presentation

Multiple factors leading to precipitous decline: *Etheostoma boschungi* as a conservation case study

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The reasons for extirpation of aquatic species can sometimes be puzzling, and are often the result of cumulative effects. Leading causes of fish imperilment include habitat alteration (dams, changes in land use, water pollution, etc.) and the introduction of exotic species. These factors and their effect on specific species can be difficult to document. However, the reasons for the decline of *Etheostoma boschungi*, the slackwater darter, seem more obvious. *Etheostoma boschungi* has a complex life history, requiring specialized breeding and non-breeding habitats, and an unimpeded migration route between the two areas. The species has a relatively widespread but disjunct distribution in the Tennessee River drainage, Alabama and Tennessee. Since 1974 when the species was described, it has undergone dramatic local extirpation. Our four years of survey data, coupled with data from previous surveys, indicate three primary factors that are most likely responsible for the loss of this species from historical habitat: culverts, channel incision and impoundment of seepage areas. These factors account for the loss of *E. boschungi* from approximately 80% of historical breeding sites, and have accounted for severe degradation of habitat used in the non-breeding season.

Poster Presentation

Temporal patterns of development in southern brook lamprey (*Ichthyomyzon gagei*) in Cadron Creek, Arkansas.

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Lampreys are one of the few living representatives of the ancient jawless fishes. Of the four species in Arkansas, three are nonparasitic, including Southern Brook Lamprey, *Ichthyomyzon gagei*. *Ichthyomyzon gagei* live for approximately 51 months and have a distinct larval and adult period. Subsequent to spawning, adults die due to loss of the digestive tract that occurs during adult transformation. Specimens were collected from September 2004 through April 2006 with a backpack electrofisher. We measured total body length, eye diameter and weight of the digestive tract, gonads, fat, and total body. Eye diameter increased significantly throughout the collection period in both metamorphosing and non-metamorphosing individuals. Metamorphosing individuals developed a significantly larger eye compared to non-metamorphosing individuals. Gonadal development began in November and gonadosomatic index (GSI) peaked in January and remained high through February. In metamorphosing individuals GSI was negatively correlated with both visceral fat ($r = -0.73$, $P < 0.001$) and digestive somatic index ($r = -0.72$, $P < 0.001$). Digestive tract mass of metamorphosing specimens decreased sharply during early (September to November) metamorphosis to a nonfunctional remnant and feeding ceased. As a result, energy stored as fat is utilized for the large energy requirements of gonad development. Based on our data, use of digestive somatic index may provide a mechanism for detecting transformers at an earlier date than previous studies. Due to the imperiled status of several lamprey species, species determination at the ammocete phase is critical to understanding and protecting these species

Poster Presentation

Salinity tolerance of Nile tilapia (*Oreochromis niloticus*) from southern Mississippi.

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The Nile tilapia (*Oreochromis niloticus*) is commonly used in aquaculture worldwide. Feral populations exist in many regions where individuals escape culture and establish in natural habitats. In Mississippi, Nile tilapia are established in at least three distinct localities: the lower Pascagoula and Escatawpa river drainages and a coastal bayou (Davis Bayou). All three of these populations have access to coastal waterways. In this study, we determined the salinity tolerance of Nile tilapia from Mississippi, to assist in predicting their potential spread to estuarine and coastal regions. Individuals acutely transferred from freshwater to salinities up to 20 ppt showed good survival for at least seven days. When fish were transferred more gradually (at a rate of 5 ppt per week) they survived at salinities up to 40 ppt for $\geq$ 55 days. The remarkable salinity tolerance of Nile tilapia from southern Mississippi indicates they may be able to use estuarine and coastal waters, at least during the warmer months. Experiments investigating how salinity tolerance is affected by cooler (e.g., winter) temperatures is currently ongoing.

Poster Presentation (student competition)

Spatially realistic models aid management decision-making for a federally threatened species (blackside dace) in the face of geographically varying stressors

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The inherent connectivity of stream networks compounds the complexity of recovery programs for imperiled freshwater species due to the discontinuity among populations and the effects of multiple stressors on habitat quality. In order to allow managers to react to influences both within and outside their management area, spatially realistic approaches to population management are needed. We developed a spatially realistic model of stressors affecting persistence of the federally threatened blackside dace (*Phoxinus cumberlandensis*) in the Upper Cumberland River drainage of Tennessee and Kentucky. We first mapped population locations and status for 52 extant blackside dace populations. Next, we created GIS data layers for multiple stressors thought to effect dace survival, including mining, logging, and agriculture runoff. Populations were then attributed with stream network parameters affecting survival and persistence such as watershed stressors and downstream impoundments. Combining spatially-explicit parameters, we characterized probability of persistence for each dace population using Bayesian belief network decision models. Our models demonstrate that individual populations have unique management requirements based on unique quantities and spatial configurations of potential stressors. Application of this tool may assist land managers in evaluating threats of multiple stressors that vary geographically and provide a broad-scale adaptive management framework for metapopulation persistence.

Poster Presentation

Critical habitat units for threatened and endangered mussels in the Mobile River Basin

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The U.S. Fish and Wildlife Service has designated 26 river and stream segments (units) in the Mobile River Basin (69 FR 40084) as critical habitat for three threatened and eight endangered freshwater mussel species under the Endangered Species Act of 1973, as amended. The habitat units encompass approximately 1,093 miles (1,760 kilometers) of stream and river channels in four states. Although this is a small portion of each species' historic range, the habitat units include a significant part of the Mobile River Basin's remaining high-quality, free-flowing rivers and streams and reflect the variety of small stream to large river habitats once occupied by these species. The 26 habitat units were selected based on best available information about the essential habitat components required by these 11 species including: (1) geomorphically stable stream and river banks and channels; (2) a stream flow regime sufficient for normal behavior, growth, and survival of all life stages of mussels and their fish hosts; (3) acceptable water-quality conditions necessary for normal behavior, growth, and viability of all life stages; (4) sand, gravel, and (or) cobble substrates with low amounts of fine sediment and low amounts of attached filamentous algae; (5) the presence of fish hosts with adequate living, foraging, and spawning areas; and (6) few or no competitive or predaceous nonnative species. These critical habitat units can serve to focus funding, research, and watershed restoration activities to conserve these rare mussel species.

Poster Presentation (student competition)

Ecomorphological Shape Variation within the Darter Subgenus *Nothonotus*

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Characters derived from a geometric morphometric (GMM) analysis of the darter subgenus *Nothonotus* were used to create phylogenetic trees. The GMM based phylogenetic trees did not recover the relationships hypothesized by molecular based trees. Instead, geographical species clusters were recovered which suggests that species occupying similar niches have similar phenotypes. To examine how much variation in the data was attributable to geographic locality versus taxonomic ranking, an ANOVA was performed on the relative warp scores for each character used in the phylogenetic analysis. The output from the ANOVA was then used to partition the variance in the dataset.

Poster Presentation

Current Knowledge of the Distributional Status and Genetic Relationships (Based On Cytochrome-b and S7 Intron Sequences) of the Rare "Carolina Redhorse", *Moxostoma* sp.

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The "Carolina" Redhorse is a rare, undescribed member of genus *Moxostoma* (Catostomidae) restricted to the Pee Dee and Cape Fear drainages in North and South Carolina. R. E. Jenkins recognized the species in 1995 and proposed it as sister to the Golden Redhorse, *M. erythrurum*, a widely distributed species occurring in the Mobile, Mississippi, Great Lakes, and Hudson Bay drainages, as well as on the Atlantic slope in the James and Roanoke drainages with a probable introduction in the Potomac drainage. No similar form was known south of the Roanoke drainage prior to 1995. While the "Carolina" Redhorse shares several features allying it to the Golden Redhorse (e.g., shape of lips, breeding tuberculation, nuptial and non-nuptial colorations, and spawning behavior), several anatomical and fixed genetic differences attest to its distinctiveness and validity as a separate taxon. Since 1996, periodic intensive electroshocking surveys were conducted to refine knowledge of the range and age structure of this elusive species. Thus far these efforts have revealed detectable populations remain only in limited reaches of the Pee Dee and Cape Fear basins. A preference for deeper habitats is indicated, with some use of tributaries by young juveniles; migrations to shoals during spawning may be brief compared to other species. These factors may work jointly to reduce detectablilty and thus partially explain the rarity of the "Carolina" Redhorse in collections. Here we present the history of discovery, current known distribution of this Carolinas' endemic, as well as an update to genetic information concerning its phylogenetic placement within *Moxostoma* based on cytochrome-b and S7 intron sequence data.

Poster Presentation

An Initial Examination of Diet in Spotted and Shortnose Gar from the Fourche LaFave River, Arkansas

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Gars are generally known to be avid predators, predominantly feeding on fishes and invertebrates. Though studies of diet have been conducted for individual species, few data exist examining variability in diet between species from the same drainage and potential variation due to sex, reproductive status, and river hydrology. Stomachs were dissected and examined from 41 adult spotted gar (46 - 79 cm TL), *Lepisosteus oculatus*, and 38 adult shortnose gar (49 - 74 cm TL), *Lepisosteus platostomus*, from the Fourche LaFave River collected during May to July 2007. Thirty stomachs of each species contained food items. Considering frequency of occurrence, 70.0 percent of spotted gar stomachs contained fish and 23.3 percent contained insects and crayfish. In contrast, fish were found in 46.7 percent of shortnose gar stomachs and 36.7 and 6.7 percent contained insects and crayfish, respectively. Variation in diet due to sex was evident in spotted gar, as females (n = 18) mostly contained fish and a higher percentage of males (n = 12) contained insects and crayfish in addition to fish. No difference in diet was observed between male and female shortnose gar. Our initial analyses suggest sympatric spotted and shortnose gar have different feeding habits, and male spotted gar tend to consume a wider variety of prey items relative to females. Future analyses will contain larger sample sizes and will examine other diet metrics (e.g., abundance and mass). Data are also being collected on longnose gar, *Lepisosteus osseus*.