Volume 1
Number 50 *Number 50 (October 2008)*

Article 1

10-1-2008

Number 50 (October 2008)

Southern Fishes Council

Number 50 (October 2008)

Abstract

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Regional Southeastern Fishes Council Reports

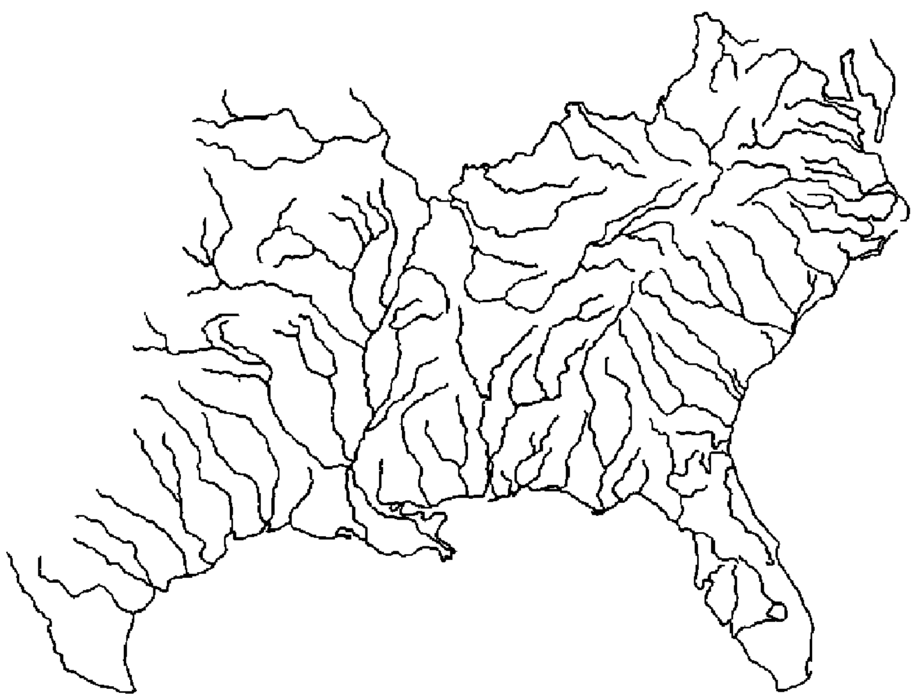
Keywords

visible implant fluorescent elastomer, tag, VIE, darters, teleostei, percidae, mortality, native freshwater mussels, mussels, bayou bartholomew, arkansas, cyprinodontid, fishes

Number 50 October 2008

Southeastern Fishes Council Proceedings

Dedicated to the Conservation of Southeastern Fishes



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34th Annual Meeting, Southeastern Fishes Council

The SFC will meet in Chattanooga, Tennessee on Thursday and Friday, the 13th and 14th of November 2008, with possible field trips on Saturday, the 15th. Our meeting host is Tennessee Aquarium. The finalized program and call for abstracts is posted on our website <www.sefishescouncil.org>.

Use of Visible Implant Fluorescent Elastomer (VIE) Tag Technique on Darters (Teleostei: Percidae): Mortality and Tag Retention

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ABSTRACT

We assessed mortality and tag retention for the Visible Implant Fluorescent Elastomer (VIE) tagging technique in four species of darters. Redline darters (*Etheostoma rufilineatum*) VIE-tagged in the laboratory experienced no mortalities and exhibited 100% tag retention after 125 d. A subset of these *E. rufilineatum* was released in the wild and VIE-tagged individuals were recaptured up to a year after their release with identifiable tags. Gilt (*Percina evides*), blueside (*E. jessiae*), and bluebreast darters (*E. camurum*) were also tagged with VIE in the field. Of the 1,917 darters VIE-tagged and immediately released, only 1.2 % died from the tagging procedure. Subsequent surveys revealed that recaptured *P. evides* retained VIE tags for as long as 915 d (2.5 yrs). Also, one *E. camurum* that had been VIE-tagged in 2003 was recaptured in 2007, representing a tag retention time of approximately four years (1,449 d). While tagging mortality was low and tag retention time high, there were some limitations in tag visibility and discriminating different VIE colors (e.g., green versus yellow).

INTRODUCTION

Marking small fishes for research and conservation purposes has always been problematic. There is a need to develop an effective marking method for small (< 100 mm) fishes that is inexpensive, biocompatible with the organism, permanent, and can be easily used in the field. To conduct precise studies of population dynamics and life histories, a marking method must have minimal effect on fish behavior, reproduction, life span, growth, feeding, movement, and vulnerability to predation. Physical tags are especially cumbersome for small fishes and chemical marking has evolved as a possible alternative method. Fishes have been marked using various chemicals including metallic compounds, fluorescent compounds, radioactive isotopes, latex, plastic, inks, paints, dyes, and stains (Arnold, 1966). Application techniques include immersing fishes in chemical markers, spraying or tattooing fishes, and injecting markers into fishes either with needles or through pressure (Murphy and Willis, 1996). Injection involves embedding inert materials or pigments in or under the epidermis of a fish, thereby creating an internal mark. Marking fishes with injected pigment tags is relatively inexpensive, easy, and can be considered the precursor to the visible implant tag (Murphy and Willis, 1996). Other chemical marking methods are typically used for batch tagging fishes, which does not allow for the identification of individual organisms. Pigment tagging, though, can be applied to a fish using a combination of tag locations and colors, thus creating an individually recognizable subject. Another advantage of pigment tagging is that it also allows for long-term tag retention in small fishes.

In 1991, Northwest Marine Technology, Inc. of Shaw Island, WA, developed a pigment tagging technique which used visible implant fluorescent elastomer (VIE). This two-part material consists of medical grade fluorescent silicone and a curing agent. While it has been used successfully to tag small fishes in several studies (Bonneau et al., 1995; Dewey and Zigler, 1996; Haines and Modde, 1996; Frederick, 1997; Bailey et al., 1998; Olsen and Vollestad, 2001), the utility of VIE for tagging darters (Teleostei: Percidae) has not been extensively tested. The first VIE-tagging of a darter was conducted by a team of researchers from Conservation Fisheries, Inc. (CFI) of Knoxville, TN. The CFI team used the technique beginning in 2000 while propagating, tagging, and monitoring populations of the boulder darter, *Etheostoma wapiti*, in the Elk River system, TN (Rakes and Shute, 2002). Similar fish propagation and monitoring efforts are being made in the Pigeon River in western North Carolina and eastern Tennessee. Although this river has in the past been impacted by pollution and hydrological alteration, recent improvements in water quality have led state, federal, and private agencies to attempt the reintroduction of several fish species. As an offshoot of fish propagation and monitoring efforts in the Pigeon River, we wanted to test the effectiveness of the VIE-tagging technique on darters in terms of fish survival and tag retention. Our hope was that information generated by this research would have implications for our broader studies on accurately determining the survival of reintroduced fishes.

To achieve this objective, we conducted both laboratory and field studies to assess the survival of relocated tagged fishes and tag retention using the VIE-tagging technique. For the laboratory studies, we used a common surrogate species, the redline darter (*E. rufilineatum*), to evaluate possible health impacts on these darters and VIE tag retention. For the first set of field studies, we released a subset of these laboratory-tagged *E. rufilineatum* at a site on the Little Pigeon River. This site was subsequently sampled in an attempt to recapture the tagged *E. rufilineatum* and to collect additional darter species for tagging. During this sampling event we found some of our tagged *E. rufilineatum* and collected and VIE-tagged gilt darters (*Percina evides*) and blueside darters (*Etheostoma jessiae*). For the second set of field studies, we released these tagged gilt and blueside darters into one of two Pigeon River sites along with gilt and bluebreast (*E. camurum*) darters collected from a site on the Nolichucky River. Subsequent surveys were then conducted at the Pigeon River release sites to monitor tagged darter survival, assess long-term tag retention, and to determine whether VIE tags could be recognized when marked darters were recaptured in the field.

MATERIALS AND METHODS

Laboratory Studies

The laboratory studies evaluated possible mortality in *E. rufilineatum* due to VIE-tagging and also assessed VIE tag retention over time. This surrogate species was chosen because it is common at our collection and release sites and typically co-occurs with the other three Pigeon River darters we studied. All *E. rufilineatum* used in the laboratory studies were collected on 2 October 2001 from one site on the Little Pigeon River just above its confluence with the West Prong of the Little Pigeon River (latitude 35^{o}52'25"N, longitude 83^{o}23'21"W). Fish were collected by kick seining using a 4.6-m seine (5-mm mesh). The darters were placed in oxygenated insulated holding tanks (coolers) containing ambient river water until ready for transport to the laboratory. Dissolved oxygen concentration and temperature were monitored continuously. Fish were placed in plastic transport bags (55 cm x 39 cm x 37 cm) containing approximately 8-12 L of river water. These bags were filled with oxygen gas and sealed for transport. Bags containing *E. rufilineatum* were placed in sealed coolers, which helped minimize transport stress (no light) and temperature change (Williams et al., 1988). They were transported to the University of Tennessee fisheries laboratory, Johnson Animal Research and Teaching Unit, where they were held overnight. Subsequently, *E. rufilineatum* were taken to CFI where they were acclimated to the new setting and then distributed among three 189-L aquaria that were part of a larger recirculating aquaria system. No mortalities occurred during the acclimation period. All laboratory studies were conducted at the CFI facility.

After four weeks of acclimation, *E. rufilineatum* were removed from the three aquaria and placed in aerated holding buckets in preparation for laboratory study. Water temperature was monitored throughout the procedure and remained between 12-13^{o} C. Immediately prior to tagging, three to four fish were placed in a small aquarium with 100 mg of anesthetic (MS-222) in 1.0 L of ambient water. Once anesthetized, each fish was removed from the aquarium and tagged with VIE using a 0.3-ml insulin syringe with an ultra-fine 29-gauge needle. These same methods were used successfully by CFI to tag and reintroduce endangered *E. wapiti* in the Elk River, TN (Rakes and Shute, 2002).

The tagging material, VIE, is a bio-compatible silicone that when injected as a liquid cures to a pliable solid. VIE comes in five fluorescent colors: red, green, yellow, orange, and pink. These colors are easily seen in ordinary light but in reduced light conditions, a blue LED (light emitting diode) light can be used to enhance tag visibility. Because the curing time of VIE is temperature dependent, it may take 24 hours for the tag to cure if water temperature during tagging $< 10^{o}$C (Northwest Marine Technology, Inc.).

Initial observations revealed that needle technique was very critical to the visibility and retention of the mark. The technique involved the needle piercing the skin of the fish, bevel up, and then being inserted 5-6 mm just beneath the skin (Figure 1). The goal was to place the VIE between the skin and the muscle layer to maximize tag visibility through the skin layer. Ideally, each tag was 3-5 mm in length. VIE was injected as the needle was withdrawn, filling the cavity made by the needle. Injection was halted just prior to removal of the needle and any excess VIE exuding from the entry wound was wiped off to minimize tag loss after curing.

Ninety *E. rufilineatum* (36 - 83 mm TL) were double-tagged, meaning VIE was injected on each side of the second dorsal fin just adjacent to the midline and parallel to the dorsal fin. This double-tagging approach was done to make it easier for surveyors to identify a tagged fish upon recapture. Each of three groups of 30 *E. rufilineatum* was marked with either red, green, or yellow VIE. After tagging, fish were placed in an aerated recovery tank. Upon recovery, 10 *E. rufilineatum* of each color were placed in one of three aquaria for a total of 30 fish per aquarium.

Fish were observed at 24- and 48-hours post-tagging to assess mortality. No fish were handled in the first 14-d post-tagging to minimize stress, allow the VIE to cure, and ensure that the tissue injection site had time to heal. For observations conducted at 14, 30, 60, 90, and 125 d post-tagging, *E. rufilineatum* were netted from the aquaria and observed individually for general health and tag retention. The parameters used to determine the health of the fish included clarity of eyes, condition of the fins, and activity level. These same parameters were used for all subsequent observations. VIE tags were initially checked for

visibility with the naked eye on day 14. All subsequent observations were checked for tag visibility with the eye, and if not readily visible, a LED blue light flashlight and amber glasses were used to locate the tag. A color reference block of latex containing samples of all VIE colors was provided by CFI for the 90-d and final observations. When used in conjunction with the blue light and amber lenses, tag color identification became much more reliable.

Field Methods

For the first set of field studies, 60 of the 90 VIE-tagged *E. rufilineatum* from the laboratory studies were released at the Little Pigeon River collection site on 15 March 2002. Three sets of fish with different color VIE tags were released: 20 red, 20 green, and 20 yellow. A total of 16 seine samples each covering an area 91.4 m^2 per effort was conducted 7 d later at the release site and in areas just upstream and downstream in an attempt to recapture tagged *E. rufilineatum*. All captured darters were observed in an attempt to detect VIE tags.

For the second set of field studies, we collected individuals of *P. evides*, *E. jessiae*, and *E. camurum* from two sites: the Little Pigeon River from below the Highway 66 Bridge to just upstream of its confluence with the West Prong of the Little Pigeon River in Blount County, near Sevierville (latitude 35°52'24"N, longitude 83°34'20"W) near the *E. rufilineatum* collection site and the Nolichucky River (at river mile 28) just downstream of Hale Bridge at Bewley Island in Greene County (latitude 36°05'58"N, longitude 83°03'17"W). All collections and releases were made between 14 March 2001 and 13 March 2003. After tagging, all darters were released at a reintroduction site on the Pigeon River located at Tannery Island, Cocke County (latitude 35°56'39"N, longitude 83°10'44"W) or, for later reintroductions of *E. jessiae*, at McSween Memorial Bridge in Newport, TN (latitude 35°56'39"N, longitude 83°10'44"W). All four sites are within Tennessee.

To avoid heat stress on the fishes, collection and tagging operations were conducted during cooler, non-summer months. Collection methods followed those for the laboratory-tagged *E. rufilineatum*. On warm days, the temperature of the MS-222 solution was maintained by placing ice in sealed plastic bags which were floated in the holding container. Temperature and dissolved oxygen were monitored in all fish containers. We used five different VIE colors (red, green, yellow, orange, and pink) in each batch tagging effort so that river source, timing of release (spring or fall), and year of collection could be discerned based on tag color.

Monitoring for the tagged reintroduced species began 1 October 2001 and was accomplished, in part, by qualitative and quantitative underwater visual surveys. Other occurrence data were obtained from the annual Index of Biotic Integrity survey (IBI) conducted at the Tannery Island reintroduction site by a multi-agency effort by Tennessee Department of Environment and Conservation, Tennessee Wildlife Resources Agency, and the Tennessee Valley Authority. A qualitative survey consisted of a snorkel surveyor following an arbitrary zig-zag pattern while moving in a downstream direction. The quantitative snorkel survey was conducted on 26 July 2002 and involved using the strip transect method of Watson et al. (1995). The survey consisted of five parallel line transects at the Tannery Island site and covered a downstream distance of 100 m. The width of each transect lane was set at 1.20 m because, during previous qualitative surveys (1 October 2001, 10 June 2002, and 1 July 2002) at the release site, it was determined that neither the tagging site nor tag color of a tagged darter could be confirmed at a distance > 0.60 m in full sunlight. This recognition distance was typically > 0.45 m in the shade.

RESULTS

Laboratory Results

There were no observed mortalities or abnormal behaviors of VIE-tagged fishes 24 - 48 h after tagging and there were no mortalities after 125 d. All fishes exhibited 100% tag retention through the end of the 125 d study period. Although fish health was good and behavior appeared normal on subsequent checks, tag visibility varied. Thirty days after tagging, VIE tags on darkly pigmented *E. rufilineatum* were difficult to see, especially those consisting of green and yellow VIE. While these two VIE colors appeared to be the same under the blue light, the use of amber glasses removed the blue tint of the blue LED light, allowing the true color to be recognized. The combination of using the blue light in conjunction with the amber glasses helped differentiate between larger green and yellow tags but did not help in identifying smaller yellow and green tags. Smaller VIE tags were the result of inexperienced tagging personnel who did not inject uniform amounts of VIE. The ideal VIE tag was a 3 – 5 mm stripe; however, some of the smaller tags appeared as blotches or pinpoints. At 60 d post-tagging, more tags became visible only with the blue light while the problem of differentiating between green and yellow tags also remained.

Tag visibility was greatly affected by the depth under the darter's skin at which the tag was placed. It was noted that inexperienced personnel were more likely to inject the VIE too deeply into the tissue instead of just under the skin. This reduced tag visibility. Tag visibility also appeared to be affected by fish coloration and tag color, in addition to the experience level of the tagger and the observer, though an overall pattern of tag loss could not be detected from these observations. The number of tags visible to the naked eye and the number visible with the blue light varied among observations. The yellow VIE was the least visible of the three tag colors used throughout the study. However, on the final observation (125 d post-tagging), 8 of 30 yellow tags and 1 of 30 red tags were not

visible to the naked eye, but all were visible under the blue LED light. At 125 d, all 30 green tags were visible to the naked eye.

Field Results

On 22 March 2002 (7 d after being released), 5 of 60 tagged *E. rufilineatum* were collected at or around the Little Pigeon River release site: 1 red tag, 3 green tags, and 1 yellow tag (Table 1). For all 16 seine samples taken, only one tagged fish was caught in any one effort. All VIE-tagged *E. rufilineatum* were collected downstream of the release site. Tagged *E. rufilineatum* were also caught incidentally during subsequent collections for other target species: one fish was caught on 21 May 2002 (red tag), three fish were caught on 28 May 2002 (red tags), and three more fish were caught on 23 October 2002 (2 green tags, 1 yellow; Table 1). In all recaptured *E. rufilineatum*, the VIE tags were visible without artificial illumination. All recaptured *E. rufilineatum* had been originally tagged for the laboratory studies on 30 October 2001, indicating a possible tag retention time in the field of approximately one year.

Of the 1,867 darters VIE-tagged in the field and released (939 *P. evides*, 619 *E. jessiae*, and 309 *E. camurum*), only 24 (14 *P. evides*, 9 *E. jessiae*, and 1 *E. camurum*) died before being released. This represents a tagging mortality rate of 1.2 %. During the quantitative snorkel survey conducted on 26 July 2002 at the Tannery Island release site, 173 *P. evides* (19 red, 22 green, 11 yellow, and 78 orange tags) and 2 *E. camurum* (yellow tags) were recaptured and had visible VIE tags (Table 1). No VIE-tagged *E. jessiae* were recaptured. Based on these results, we determined that the Tannery Island release site had only marginal habitat for *E. jessiae*. Therefore, later reintroductions of *E. jessiae* were conducted at the McSween Memorial Bridge release site.

The multi-agency annual IBI survey conducted at the same release site on 10-11 July 2002, yielded five tagged *P. evides* (1 red, 1 green, and 3 orange tags) at the Tannery Island site, which was the same area of the reintroductions. Three VIE-tagged *P. evides* (1 red and 2 orange tags) were also collected during this survey in the riffle area above the reintroduction site. The qualitative snorkel surveys conducted at riffle areas upstream and downstream of Tannery Island (in an attempt to locate darters which may have moved from the reintroduction site) also produced VIE-tagged darters. For example, 21 tagged *P. evides* (5 red, 1 green, and 15 orange tags) and 1 tagged *E. camurum* (yellow tag) were identified on 13 August 2002 at the riffle above Tannery Island. Further qualitative snorkel surveys and IBI surveys conducted from 2003 - 2007 yielded more observations of tagged *P. evides* in 2003 and 2004 (Table 1). Recaptured *P. evides* were shown to retain VIE tags for as long as 915 d (2.5 yrs). Also, as recently as 2007, one *E. camurum* was collected at Tannery Island that had been tagged in 2003. This represents a retention time of approximately four years (1,449 d).

DISCUSSION

We have shown through both laboratory and field studies that VIE-tagging can be used successfully on darter species being reintroduced into natural habitats. While tagging mortality was low (0 - 1.2 %) and tag retention time high (up to four years), there were some limitations in tag visibility and discriminating different VIE colors (e.g., yellow versus green). Our studies suggest that low mortality can be added to the advantages that VIE-tagging has over other methods for marking small fishes. Not only are the VIE tags externally visible, they are entirely internal and biocompatible with the fish's tissue. After the injection site wound has healed, there are no long-term openings in the tissue that may lead to infection as with external tags. This small internal tag is less vulnerable to environmental damage and is less likely to alter fish behavior compared with typical marking methods (Hale and Gray, 1998). Other benefits are that the expense of extracting and reading of other types of tags is eliminated and the VIE tags can be identified without sacrificing the fish. Also VIE-tagged fishes can be identified without handling or removing the fish from its environment which will also improve survivorship. The tag mortality we observed in the field studies was most likely a result of multiple environmental stressors. Stress results when fish experience fright, discomfort, or pain (Schreck, 1981). Loss of mucus or scales, breaks in the skin, or damage to internal organs can lead to shock, increased susceptibility to infection, suppressed immune system, and delayed mortality (Schreck, 1981). The fishes tagged for the field studies were trapped in a net, carried in small buckets, confined in a cooler, dropped into an anesthetizing bath, and stuck with a needle. Some were confined in an unfamiliar environment for as many as 6 d. Also, six of the darters that died were in peak spawning condition and were likely already in duress from reproductive activities.

Our results indicate that another advantage of VIE-tagging is successful long-term tag retention. In our laboratory studies, VIE tags in *E. rufilineatum* were retained for 125 d with no mortalities. Even more impressive are those VIE-tagged fishes we recollected 2 to 4 years after tagging. Although these field tag retention times are somewhat anecdotal, they have value for the broader study to determine the survival of transplanted darters. Having tags that are retained over 2 to 4 years is especially helpful considering that the reported life span for some of the darter species we used is not much greater than this (Etnier and Starnes, 1993). It is also interesting to note that the number of recaptures did not appear to be biased toward any one color of VIE tag or the timing of the release (Table 1). We also demonstrated one basic benefit of such tagged reintroductions in that we could roughly assess initial reintroduction success. Based on the lack of *E. jessiae* recaptures at the Tannery Island release site, we were able to take action against making more introductions of *E. jessiae* in marginal habitats and continue reintroductions else-

where. Future attempts at darter reintroduction can use VIE-tagging and expect to accurately assess whether released individuals survived in the new habitat.

The two disadvantages of VIE-tagging we experienced were reduced tag visibility and discriminating between yellow and green tags. In some cases differentiation was difficult without using the blue LED light and amber glasses which may limit the usefulness of the technique in field settings. Tag visibility was affected most by two factors: subcutaneous depth of the injected VIE, and darter skin pigmentation at the injection site. With practice and experience, though, these problems can be avoided. Inexperienced taggers affected tag visibility in other studies (Frederick, 1997; Bailey et al., 1998; Close and Jones, 2002). For example, Kelly (1967) stated that the placement of the tagging material at the proper intra-cutaneous level is likely the most critical factor in subsequent recognition of tags. He further suggested that the needle insertion may be judged as being at the correct depth if the needle shows as a dark line under the skin. Based on the difficulty of differentiating between yellow and green tags in this study, it is not recommended to use both colors in a study using a single species. Tagging with red, orange, and pink VIE in a single species with the same tag location may also pose a similar problem. Tag location and VIE color should be assessed on a species-specific basis. Before using VIE in a research study requiring marked fish, investigators should be trained and experienced in tagging fish to assure maximum tag retention and visibility.

ACKNOWLEDGMENTS

We are grateful to Pat Rakes and J.R. Shute of Conservation Fisheries, Inc., for the use of their facilities. We thank them and Sherry Wehner for their time and fisheries expertise that helped make the laboratory study possible. Our thanks go to all the biologists at the Tennessee Department of Environment and Conservation (TDEC), Division of Water Pollution Control, for their expertise and perseverance in the field. We acknowledge the University of Tennessee, the Department of Forestry, Wildlife and Fisheries, for their financial and material support for this project. All collection efforts were conducted using TDEC collecting permits.

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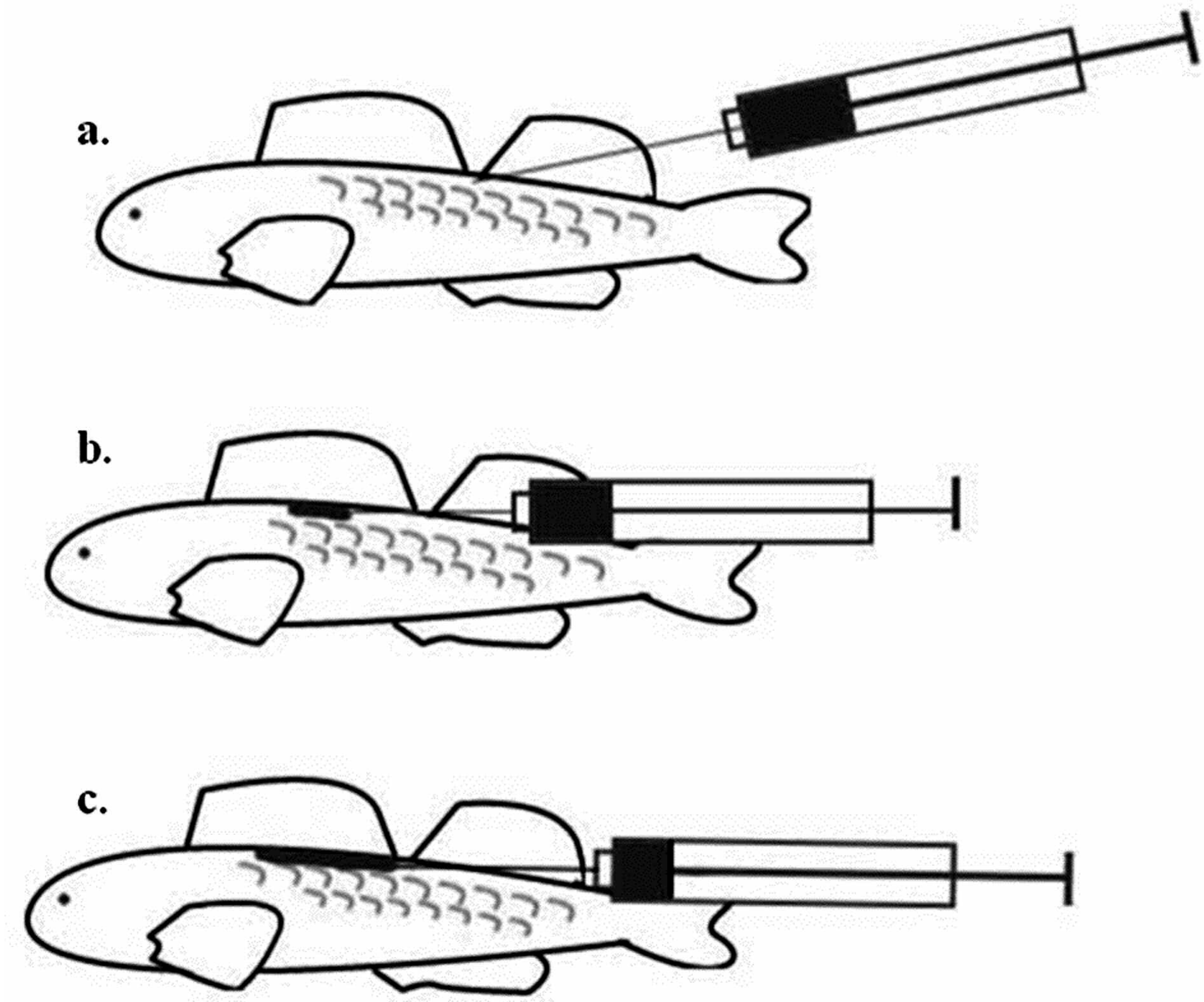

FIGURE 1. Schematic of VIE tagging technique as used on darters. A hypodermic needle is inserted 5-6 mm beneath the skin (a) with the intent of injecting VIE between the skin and the muscle. VIE is injected as the needle is withdrawn (b) filling the cavity created by the needle. Injection of VIE is halted just prior to removal of the needle (c) and any excess VIE exuding from the injection point is wiped away to minimize tag loss after curing.

TABLE 1. Tagging data for VIE-tagged darters, including maximum tag retention time for different VIE tag colors based on recapture data. Laboratory-tagged *E. rufilineatum* were tagged and held in the laboratory for a 125 d observation period after which they were held an extra 301 d prior to being released in the river on 15 March 2002. The other three species (*P. evides*, *E. camurum*, and *E. jessiae*) were VIE-tagged in the field and released immediately into the natural habitats on the indicated date. Collection and release site localities are: Little Pigeon River just upstream of its confluence with the West Prong of the Little Pigeon River (LPR), Little River at Coulters Bridge (LRCB), Pigeon River at Tannery Island (TI), Nolichucky River just downstream of Hale Bridge at Bewley Island (NOL), and Pigeon River at McSween Memorial Bridge in Newport (MMB).

Species	Number Initially Tagged	Collection Site	Tag Color	Tag Date	Release Site	Recapture Dates (number of tagged darters)	Maximum Tag Retention Time (days)
E. rufilineatum (laboratory-tagged)	20	LPR	red	30 Oct 2001	LPR	22 March 2002 (1); 21 May 2002 (1); 28 May 2002 (3)	206
	20	LPR	green	30 Oct 2001	LPR	22 March 2002 (3); 23 Oct 2002 (2)	474
	20	LPR	yellow	30 Oct 2001	LPR	22 March 2002 (1); 23 Oct 2002 (1)	474
P. evides	120	LPR	red	23 May 2001	TI	10-11 July 2002 (2); 26 July 2002 (19); 13 Aug 2002 (5); 2 Oct 2002 (1)	497
	61	LPR	red	13 Mar 2003	TI		
	132	LPR	green	2 Oct 2001	TI	10-11 July 2002 (1); 26 July 2002 (22); 13 Aug 2002 (1); 24 Jun 2003 (1)	630
	52	NOL	yellow	6 Nov 2001	TI	26 July 2002 (11); 2 Oct 2003 (1)	696
	41	NOL	yellow	9 Oct 2001	TI		
	51	LPR	orange	8 Feb 2002	TI	10-11 July 2002 (5); 26 July 2002 (78); 13 Aug 2002 (15); 9 Aug 2004 (1)	915
	43	LPR	orange	15 Feb 2002	TI		
	157	LPR	orange	21 May 2002	TI		
	136	LPR	orange	28 May 2002	TI		
	28	NOL	pink	28 Aug 2002	TI	2 Oct 2003 (4)	401
	126	LPR	pink	23 Oct 2002	TI		
E. camurum	121	NOL	yellow	9 Oct 2001	TI	13 Aug 2002 (1)	308
	122	NOL	yellow	6 Nov 2001	TI		
	86	NOL	pink	28 Aug 2002	TI	no recaptures	-
	5	LRCB	red	21 Jul 2003	TI	12 Jul 2007 (1)	1,449
E. jessiae	128	LPR	red	14 Mar 2001	TI	no recaptures	
	1	LPR	red	23 May 2001	TI		
	4	LPR	green	2 Oct 2001	TI	no recaptures	-
	6	NOL	yellow	6 Nov 2001	TI	no recaptures	-
	113	LPR	orange	8 Feb 2002	MMB	no recaptures	-
	107	LPR	orange	15 Feb 2002	MMB		
	145	LPR	orange	15 Mar 2002	MMB		
	115	LPR	red	13 Mar 2003	MMB		

Diversity and Distribution of Native Freshwater Mussels in Bayou Bartholomew, Arkansas

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ABSTRACT

Bayou Bartholomew in Arkansas and Louisiana is one of the largest free-flowing unchannelized rivers in the United States. A 2004 survey of the unionoid mussel fauna of Bayou Bartholomew in Arkansas yielded 35 native species across 50 sites. The washboard (*Megalonaias nervosa*) was the most common mussel encountered. Relict valves of black sandshell (*Ligumia recta*) and the federally endangered pink mucket (*Lampsilis abrupta*) were also found during the survey. Species richness, Pielou's evenness, and Shannon's diversity all increased from upstream to downstream. These data provide baseline information about the aquatic diversity of Bayou Bartholomew and can serve as possible benchmarks for restoring freshwater ecosystems in other Southeastern rivers and streams.

INTRODUCTION

The southeastern United States harbors one of the most diverse freshwater mussel assemblages in the world (Williams et al., 1993; Neves et al., 1997). Of the roughly 300 recognized species of unionoid bivalves (Turgeon et al., 1998), the number of taxa estimated to have occurred historically within Arkansas ranges between 68 and 75 (Harris and Gordon, 1990; Posey et al., 1996; Harris et al., 1997; NatureServe, 2007). Eight of these species are currently considered either federally endangered or threatened and two species are candidates for listing (USFWS, 2005). Modern assessments of unionoid populations serve three important purposes. First, distribution and status surveys provide baseline data for tracking population fluctuations and declines before extirpation (Hartfield and Rummel, 1985; Blalock and Sickel, 1996; Vaughn, 1997; Lydeard et al., 1999; Vaughn and Taylor, 1999). Second, these studies can reveal biotic and abiotic interactions that may be influencing mussel community structure (Roper and Hickey, 1995; Tyrrell and Hornbach, 1998; Strayer and Fetterman, 1999). Finally, given their dependence on fishes to serve as hosts for their larval stage (glochidia), healthy and diverse mussel populations suggest equally healthy and diverse ichthyofaunas.

Few river and stream channels in the United States with abundant mussel resources remain unaltered. Minimally impacted systems offer a glimpse of conditions prior to widespread impoundment, channelization, and other human influences. Bayou Bartholomew in Arkansas and Louisiana remains one of the few unmodified rivers in the United States harboring a diverse mussel fauna. Most research conducted on Bayou Bartholomew has focused on fishes (Black, 1940; Thomas, 1976; Hutchins, 1988; Pezold et al., 2002). The Louisiana portion of Bayou Bartholomew was sampled for mussels by George and Vidrine (1992) and Pezold et al., (2002). Their results suggested that Bayou Bartholomew harbors one of the most diverse mussel assemblages in Louisiana. Surveys of the Louisiana portion of the river (George and Vidrine, 1993) yielded forty native mussel species including the federally endangered pink mucket (*Lampsilis abrupta* Say, 1831). However, no intense mussel survey of the Arkansas portion of the river has been conducted. Our objectives were to assess the current status and distribution of unionoid species in the Arkansas portion of Bayou Bartholomew and to provide baseline data for monitoring these species in the future.

METHODS

Originating in loess hills west of Pine Bluff, Arkansas, Bayou Bartholomew flows 457 km through Jefferson, Lincoln, Drew, Desha, and Ashley counties in Arkansas and then into Morehouse Parish in Louisiana before its confluence with the Ouachita River near Sterlington, Louisiana. Currently, it is the only non-channelized river in southeast Arkansas and northeast Louisiana. The Bayou Bartholomew watershed occupies approximately 20 percent of the Ouachita River basin and drains over one million acres in southeast Arkansas and northeast Louisiana (Broom, 1973). Most of Bayou Bartholomew occurs within the Mississippi Alluvial Basin ecoregion that is characterized by fine textured and fertile alluvial soils well suited to agricultural development (Alley, 2005). The watershed is dominated by agriculture fields and pastureland. The riparian zone is dominated by bottomland hardwood species such as water tupelo (*Nyssa aquatica* L.), bald cypress (*Taxodium distichum* L. [Rich]), and maples (*Acer* spp.) and in most cases is less than 50 m wide. Erosion, sedimentation, input of agricultural, and urban nutrients, input of contaminants, and irrigation water withdrawals associated with agriculture have been the main stressors of the stream ecosystem for many years (Alley, 2005).

We surveyed the Arkansas portion of Bayou Bartholomew from 27 August to 15 October 2004. Fifty sites, evenly distributed along the Bayou, were chosen based on ease of vehicular access starting at the headwaters west of Pine Bluff, Arkansas and ending at the Arkansas-Louisiana state line (Figure 1 and Appendix). Using a timed protocol modified from Metcalfe-Smith et al., (2000), we conducted hour-long searches at each site and all mussels encountered were collected, identified to species, and returned to the streambed. Voucher specimens of some species were preserved in 95% ethanol and housed at Arkansas State University. Searches were conducted using "pollywogging" (tactile search using hands to rake through the substrate). Deeper sites were surveyed through free diving. Latitude and longitude coordinates were taken for each site using a handheld Magellan Gold Global Positioning Satellite unit. Live and dead specimens were included in the survey with no distinction being made between fresh dead and relict valves. While including all dead valves may bias survey results (e.g., no evidence when an individual died, empty valves being washed downstream, predators moving valves, etc.), their inclusion is consistent with quantitative survey guidelines elsewhere (e.g., Wisconsin Department of Natural Resources, 2005). The Asian clam (*Corbicula fluminea*) and specimens of native fingernail clams (Sphaeriidae) were collected at many sites but are not included in any calculations. All specimens were identified in the field based on shell features. Nomenclature follows Turgeon et al., (1998) and Cicerello and Schuster (2003) except for *Quadrula verrucosa* (Rafinesque, 1820). Molecular evidence (Serb et al., 2003; Campbell et al., 2005) published after Turgeon et al., (1998) places *Tritogonia verrucosa* in *Quadrula* and we have chosen to follow it accordingly. Complete records for each site are available from the authors.

For each site, we recorded species richness (*S*) and the number of live and dead mussels. We also recorded catch per unit effort (CPUE) which was calculated by dividing the total number of individual mussels encountered by the total number of hours spent surveying at each site. Additionally, Shannon's diversity (*H'*) and Pielou's evenness (*J*) indices were calculated for each site using the Palaeontological Statistics (PAST) statistical package (Hammer et al., 2006). Since no distinction was made between fresh dead and relict valves, both indices were calculated using only all live mussels encountered. Species richness, diversity, and evenness using all mussels were regressed against distance from the confluence with the Ouachita River in PAST to test for any significant upstream-downstream trends in distribution.

RESULTS

A total of 9,218 native mussels (2,438 dead valves and 6,780 live animals) representing 35 species in 23 genera were encountered (Tables 1 and 2). Of the 35 species, eight are considered species of special concern in Arkansas. Black sandshell (*Ligumia recta*) and the federally endangered pink mucket (*L. abrupta*) were represented by shells of dead mussels only. *Lampsilis teres* was the most widely distributed species, being found at 43 sites. *Megalonaias nervosa* was the most abundant species with 1,729 individuals encountered, followed closely by *Amblema plicata* (1,710 individuals) and *Plectomerus dombeyanus* (1,591 individuals). These three species accounted for 54 % of all mussels encountered.

No mussels were found at two urban sites (sites 5 and 6). Species richness ranged from $S = 1$ (sites 4 and 14) to $S = 25$ at site 49 (Table 3). Site 49 also had the highest Shannon index ($H' = 2.51$). Species evenness for sites with more than one species of mussels ranged from $J = 0.30$ at site 1 to $J = 0.95$ at site 9. Site 22 had the highest CPUE with 202 individuals encountered per hour surveying (Table 3). All three diversity measures showed a negative relationship with distance from the Ouachita River confluence (i.e., downstream values were higher than upstream values). While the relationship was significant ($p < 0.001$) for all three measures, distance from confluence did not explain a large amount of variability in any measure: species richness ($r^2 = 0.44$), Shannon diversity ($r^2 = 0.39$), and evenness ($r^2 = 0.20$).

DISCUSSION

Our survey indicated that the Arkansas portion of Bayou Bartholomew contains thirty-five native freshwater mussel species. Diversity ranged from taxa that are both regionally common to those with more restricted or local-

ized ranges. Points of concern include our finding only valves of the federally endangered *L. abrupta* while George and Vidrine (1993) had found live individuals in the Louisiana portion of the Bayou. The urbanization and lack of mussels at sites 5 and 6 also raises concerns that continued human development could lead to further declines in mussel diversity in the region. The overall increase in mussel diversity from upstream to downstream is typical of many healthy aquatic systems. Bayou Bartholomew harbors relatively undisturbed habitats that may serve as both a source of species for other streams in the region and may provide important refugia for species sensitive to environmental changes.

The preservation of this unique system is therefore vital in maintaining local mussel populations though several anthropogenic effects are readily noticeable in Bayou Bartholomew. Sedimentation from intensive agriculture practices may pose the largest threat to this river system. Human pollution sources in the form of refuse, old appliances, and abandoned cars are present in the river, especially at bridge sites. Dewatering of the bayou for irrigation is also likely affecting the river negatively. During the survey, many large pumps were noticed withdrawing water from the river. The combination of irrigation and drought led to the discovery of beached or stranded mussels at several sites. Since the end of our survey these impacts may have been exacerbated because of the occurrence of a significant drought in the region (National Weather Service, 2007). Currently, steps are being taken to preserve and restore land that lies within the Bayou Bartholomew watershed. In the last four years, thousands of acres in the watershed have been enrolled in programs such as Environmental Quality Incentives Program and Conservation Reserve Program (Bayou Bartholomew Alliance, 2000). These programs will support the planting of trees along the riparian areas to reduce sedimentation and increase the streamside water table level.

As a whole, freshwater mussels remain one of the most imperiled groups of animals in the world and their plight parallels similar conservation problems with Southeastern freshwater fishes. In 1997, only 25 percent of the mussel fauna in the southeastern United States was considered stable (Neves et al., 1997). Like freshwater fishes such as minnows and darters, the extinction, extirpation, or decline of most freshwater mollusks can be attributed to biological attributes and ecological requirements that make species especially vulnerable to anthropogenic effects (Neves et al., 1997). Because of the unique life cycle of freshwater mussels, the organisms themselves do not directly have to be harmed in order to disrupt their life cycle. For example, the extirpation of host fishes ultimately leads to the decline of mussel populations. Host specificity is the rule rather than the exception in freshwater mussels (Hogarth, 1992). Although the number of parasitic glochidia varies among species, few attach to the appropriate host fish. Therefore the presence and abundance of a wide diversity of fish species are crucial for survival of mussel assemblages (Neves et al., 1997).

The information obtained in this survey is important in understanding the status and distribution of freshwater mussels in Bayou Bartholomew in Arkansas. Since this river system represents relatively stable habitat for many species of mussels, we recommend that follow-up surveys be conducted to assess the status and distributions of current populations. Future work should also include combining mussel, fish, and invertebrate studies on the entirety of Bayou Bartholomew to target potential diversity hotspots in the drainage.

ACKNOWLEDGMENTS

This project was funded by the Louisiana field office of The Nature Conservancy and Winrock International. The Arkansas Game and Fish Commission issued collecting permits. Jimmy Alley provided information on the mussel survey on the Louisiana portion of Bayou Bartholomew and GIS shape files. Brook Fluker, Wes Carmicle, Melissa Malcolm, and Ben Mounsey assisted in the field. Al Christian and John Harris assisted in cataloging voucher specimens. Anna Hill, Kathryn Perez, and three reviewers provided helpful comments.

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TABLE 1. Native freshwater mussel species identified from the Arkansas portion of Bayou Bartholomew. State and global heritage ranks taken from NatureServe (2007) range from rare and imperiled (S1/G1) to widespread and common (S5/G5). Species of special concern (SSC) in Arkansas are indicated.

Species	Common Name	State Rank	Global Rank	SSC
Amblema plicata	threeridge	S5	G5	
Anodonta suborbiculata	flat floater	S3	G5	
Arcidens confragosus	rock pocketbook	S3	G4	
Elliptio dilatata	spike	S4	G5	
Fusconaia ebena	ebonyshell	S3/S4	G4/G5	
Fusconaia flava	Wabash pigtoe	S4	G5	
Lampsilis abrupta	pink mucket	S2	G2	
Lampsilis cardium	plain pocketbook	S4	G5	
Lampsilis hydiana	Louisiana fatmucket	S3	G4	
Lampsilis teres	yellow sandshell	S4	G5	
Leptodea fragilis	fragile papershell	S4	G5	
Ligumia recta	black sandshell	S2	G5	X
Ligumia subrostrata	pondmussel	S4	G4/G5	
Megalonaias nervosa	washboard	S3	G5	
Obliquaria reflexa	threehorn wartyback	S4	G5	
Obovaria jacksoniana	Southern hickorynut	S2	G1/G2	X
Plectomerus dombeyanus	banckclimber	S4	G4	
Pleurobema rubrum	pyramid pigtoe	S2	G2	X
Potamilus purpuratus	bleufer	S4	G5	
Pyganodon grandis	giant floater	S5	G5	
Quadrula apiculata	Southern mapleleaf	S2	G5	X
Quadrula metanevra	monkeyface	S3/S4	G4	X
Quadrula nodulata	wartyback	S4	G4	
Quadrula pustulosa	pimpleback	S5	G5	
Quadrula quadrula	mapleleaf	S5	G5	
Quadrula verrucosa	pistolgrip	S4	G4	
Strophitus undulatus	creeper	S3	G5	
Toxolasmus parva	liliput	S4	G5	
Toxolasmus texasensis	Texas liliput	S3	G4	
Truncilla donaciformis	fawnsfoot	S3	G5	
Truncilla truncata	deertoe	S4	G5	
Uniomerus declivis	tapered pondhorn	S2	G5	X
Uniomerus tetralasmus	pondhorn	S2	G4	X
Utterbackia imbecillis	paper pondshell	S3/S4	G5	
Villosa lienosa	little spectaclecase	S3	G5	X

TABLE 2. Species and total number of native freshwater mussel species identified from 50 sampling sites in the Arkansas portion of Bayou Bartholomew. Site number increases from upstream to downstream. See Appendix for locality information. Numbers of dead mussels (i.e., valves) shown in parentheses.

	Sites																
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Amblema plicata											7(2)	13(1)	11(1)			1(1)	37(4)
Anodonta suborbiculata												5			1	1	
Arcidens confragosus												1				2(2)	
Elliptio dilatata																	
Fusconaia ebena																	
Fusconaia flava													1				8(9)
Lampsilis abrupta																	
Lampsilis cardium																	
Lampsilis hydiana																1	
Lampsilis teres			4				1(4)	1(1)	2	4(40)	8(3)		32(4)	(3)	27(13)	17(5)	10
Leptodea fragilis																16(19)	7(5)
Ligumia recta																	
Ligumia subrostrata			(1)				7(5)	14(7)	(1)	2(3)		4(4)				5(10)	
Megalonaias nervosa												1					27(2)
Obliquaria reflexa																	
Obovaria jacksoniana																	
Plectomerus dombeyanus											14(1)		8(1)			4	79(7)
Pleurobema rubrum																	
Potamilus purpuratus													(1)		(1)	4	15(10)
Pyganodon grandis							(7)				7(1)	2(1)	(1)		3	13(8)	3(2)
Quadrula apiculata																	
Quadrula metanevra																	
Quadrula nodulata																	
Quadrula pustulosa											(1)	2	(1)		4		13(1)
Quadrula quadrula															1	2	2
Quadrula verrucosa												(1)				3	
Strophitus undulatus																	
Toxolasmus parva	1	1(1)	1(1)	1			18(5)	13(8)	(2)	14(22)	(2)				3(2)	18	
Toxolasmus texasensis			1					2(5)				16(3)	2			2(4)	3(1)
Truncilla donaciformis																	
Truncilla truncata															2	6	
Uniomerus declivis								3(1)		16	(1)				(1)		3(2)
Uniomerus tetralasmus	17(1)																
Utterbackia imbecillis							3(3)	10			(1)					7(2)	(1)
Villosa lienosa																	

TABLE 2. (Continued)

	Sites																
Species	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Amblema plicata	135(9)	35(8)	26(18)	83(6)	92(17)	78(1)	13(13)	72(10)	57(2)	78(11)	56(7)	2	57(37)	36(10)	1(32)	37(16)	16(4)
Anodonta suborbiculata																	
Arcidens confragosus	1	2	5	3	5(1)	2(3)	(1)	1	1	3		3	1	5	(1)	5(1)	(1)
Elliptio dilatata			(3)			(1)	1				(4)		2(5)	3(4)	(1)	1(4)	
Fusconaia ebena													(1)	(1)			
Fusconaia flava	34(9)		10(19)	15(2)	14(1)	1(2)	17(8)	15	2	4	26	1	52(19)	102(17)	(7)	3(11)	(2)
Lampsilis abrupta																	
Lampsilis cardium													3(1)	6(2)			
Lampsilis hydiana					5			(1)					2				
Lampsilis teres	2(1)	7(4)	7(5)	6(8)	13(3)	5(9)	2	2(3)	(6)	2(1)	6(1)	3	18(3)	17(6)	1	4(3)	(11)
Leptodea fragilis	5(11)	2(1)	8(8)	5	7(5)	(6)	1(2)	2(2)	7(6)		4	1(1)	5	12(1)	1(1)	2(1)	2(4)
Ligumia recta																	
Ligumia subrostrata																	
Megalonaias nervosa	39(6)	5(2)	51(6)		48(2)		56	5(1)	11		28(3)	7	42(12)	78(11)	3(13)	20(4)	21(4)
Obliquaria reflexa						4(1)		(1)	2				(2)			1(1)	
Obovaria jacksoniana			1													(1)	
Plectomerus dombeyanus	71(5)	77(31)	67(52)	42(6)	105(9)	57(18)	42(25)	55(13)	37(6)	55(2)	32(4)	7	31(10)	27(3)	11(10)	22(10)	29(6)
Pleurobema rubrum					1								(3)			(1)	
Potamilus purpuratus	29(5)	22(4)	2(3)	17(3)	3	7(2)	1(1)	3(1)	2	3	1(1)	2	2(4)	4(2)	1(1)	(5)	1(6)
Pyganodon grandis		2		(1)	1(1)	1		1		2		2			2		
Quadrula apiculata	34(1)				1									3		3	
Quadrula metanevra																	
Quadrula nodulata	3												1			(3)	
Quadrula pustulosa	11	6(2)	18(51)	1	18(4)	4(1)	9(10)	1	17(2)	5	47(3)	1	60(47)	96(3)	1(9)	6(21)	(6)
Quadrula quadrula	28	4	8(10)	1(1)	10(1)	15(2)	1	1	5(1)	2	6		19(3)	41(1)	(4)	14(4)	5(2)
Quadrula verrucosa	48(7)	1(2)	6(4)	4	21(5)	3(1)	1(1)	2(1)	8(2)	(1)	20(9)		17(6)	35(1)	(2)	2(2)	
Strophitus undulatus																	
Toxolasmus parva				3							(1)	4	2	2			
Toxolasmus texasensis		(1)				1		1	1		1	(1)	1				
Truncilla donaciformis																	
Truncilla truncata	42(14)		5	1	3(2)	(3)		1	1(1)		4		9	6		2	1
Uniomerus declivis	(4)		1(1)		1(4)	2(2)				1			3(1)	(1)			
Uniomerus tetralasmus																	
Utterbackia imbecillis												1					
Villosa lienosa	1												1	1			

TABLE 2. (Continued)

	Sites																
Species	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
Amblema plicata	21(4)	1(4)	2(1)	32(24)	24(7)	17(6)	3(1)	1(15)	11(12)	40(2)	72(19)	22(17)	21(3)	68(27)	35(30)	8(7)	
Anodonta suborbiculata																	
Arcidens confragosus		4	1		(1)	1			1	1	1(1)	(1)			4	3	
Elliptio dilatata		(1)						(7)		2(1)	(6)	(8)	3	6	26(21)	5(14)	
Fusconaia ebena						3(1)		(2)				1(2)	1(1)	2	6(31)	(17)	
Fusconaia flava	(3)	4(4)		1(19)		7	2	1(19)	(1)	4	6(12)	17(9)	24(31)	24(18)	64(7)	38(10)	
Lampsilis abrupta															(4)		
Lampsilis cardium															(1)		
Lampsilis hydiana									1						(1)		
Lampsilis teres	5(1)	10(4)	(2)	(3)	6(2)	6	2(2)			1	4	1(1)	(2)	4(1)	2(2)	1(2)	
Leptodea fragilis	10(5)	2(4)	4(8)	2(8)	2(1)	5(1)	3(1)	(1)	2(1)	(3)	3	3(2)	2(2)	1	2	2(1)	
Ligumia recta														(1)	(1)		
Ligumia subrostrata																	
Megalonaias nervosa	25(2)	1(4)	42(5)	28(3)	17(2)	14(4)	28	2(4)	18(2)	308(10)	241(7)	63(1)	122(8)	118(12)	79(13)	24(14)	
Obliquaria reflexa	2							1	(1)						1	1	
Obovaria jacksoniana	(1)			(1)								1			(2)		
Plectomerus dombeyanus	47(17)	4(16)	10(1)	17(24)	31(4)	9	4	1(30)	10(25)	9(1)	24(8)	13(13)	18	16(39)	15(71)	17(6)	
Pleurobema rubrum				(1)		9(4)		(1)		2(1)	11(4)	1(4)	19(11)	(4)	29(54)	2(20)	
Potamilus purpuratus	3	6(2)	2	2(1)	1	2(1)	2		1(1)			1	1(1)	1	2		
Pyganodon grandis							1										
Quadrula apiculata										5	3		2	4	7	(1)	
Quadrula metanevra										(1)	1	(2)	(2)	(1)	11(13)	3(6)	
Quadrula nodulata	1			(1)				(1)						(1)	1(1)		
Quadrula pustulosa	14(7)	(4)		3(11)	(4)	11(4)	10(1)	6(6)	(2)	23(1)	31	11(9)	81(4)	48(14)	64(20)	32(10)	
Quadrula quadrula	10(1)	6		4(1)	(1)	6	1	(3)	(1)	6	1	11(1)	3(1)	3(2)	13(2)	3(1)	
Quadrula verrucosa	6(3)	(1)		1(1)		4(1)	4	5(1)		10	1	1(3)	1		15(6)	18(9)	
Strophitus undulatus											(1)						
Toxolasmus parva																	
Toxolasmus texasensis			(1)														
Truncilla donaciformis															3	1	
Truncilla truncata		(1)						3		2(1)		1		2	8	4(3)	
Uniomerus declivis	(2)																
Uniomerus tetralasmus											1	(1)					
Utterbackia imbecillis	(1)				1												
Villosa lienosa																	

TABLE 3. Species richness (S), Shannon diversity (H'), Pielou's evenness (J), and catch per unit effort (CPUE) for freshwater mussel assemblages at 50 sampling sites in the Arkansas portion of Bayou Bartholomew. Indices were calculated for both live and dead mussels (i.e., valves) combined and live mussels only. Site number increases from upstream to downstream. CPUE was calculated as the total number of mussels encountered at each site divided by the total number of hours surveying each site.

	Live and Dead			Live only					Live and Dead			Live only			
Site	S	H'	J	S	H'	J	CPUE	Site	S	H'	J	S	H'	J	CPUE
1	2	0.21	0.30	2	0.21	0.31	6.33	26	14	1.98	0.75	13	1.83	0.71	88.50
2	2	0.64	0.92	1	-	-	1.50	27	11	1.28	0.53	10	1.27	0.55	85.00
3	4	1.12	0.88	3	0.87	0.79	4.00	28	14	2.10	0.80	12	2.03	0.82	132.00
4	1	-	-	0	-	-	0.33	29	13	2.34	0.91	12	2.25	0.90	18.00
5	0	-	-	0	-	-	-	30	23	2.29	0.73	20	2.31	0.77	160.67
6	0	-	-	0	-	-	-	31	19	2.27	0.77	17	2.23	0.79	179.00
7	5	1.44	0.89	4	0.99	0.71	26.50	32	13	1.96	0.77	8	1.57	0.75	102.00
8	6	1.54	0.86	5	1.25	0.77	21.67	33	18	2.33	0.81	14	2.07	0.78	105.00
9	3	1.04	0.95	0	-	-	2.50	34	11	1.98	0.82	7	1.46	0.75	121.00
10	4	1.17	0.84	4	1.13	0.82	50.50	35	15	2.08	0.77	11	1.97	0.82	95.50
11	9	1.75	0.80	4	1.34	0.97	49.00	36	13	2.26	0.88	9	1.99	0.91	41.50
12	9	1.72	0.79	8	1.65	0.79	18.00	37	8	1.29	0.62	6	1.02	0.57	39.50
13	8	1.29	0.62	5	1.11	0.69	63.00	38	13	1.94	0.76	9	1.57	0.71	94.00
14	1	-	-	0	-	-	1.50	39	10	1.64	0.71	7	1.44	0.74	104.00
15	9	1.20	0.55	7	1.21	0.62	58.00	40	13	2.33	0.91	13	2.37	0.92	116.00
16	16	2.33	0.84	16	2.38	0.86	51.00	41	11	1.86	0.78	11	1.79	0.75	32.50
17	13	2.04	0.80	12	1.92	0.77	83.67	42	14	2.12	0.80	8	1.82	0.88	55.00
18	16	2.28	0.82	15	2.20	0.81	185.00	43	11	1.59	0.66	7	1.45	0.74	30.00
19	12	1.61	0.65	11	1.60	0.67	109.00	44	15	1.12	0.41	13	1.05	0.41	108.50
20	15	2.10	0.77	14	2.04	0.77	131.67	45	16	1.52	0.55	14	1.34	0.51	114.50
21	13	1.72	0.67	12	1.64	0.66	69.33	46	18	2.18	0.75	14	1.78	0.68	55.25
22	18	2.09	0.72	17	2.29	0.81	202.00	47	15	1.82	0.67	13	1.67	0.65	91.00
23	16	1.88	0.68	13	1.58	0.62	116.00	48	17	1.86	0.66	13	1.71	0.67	104.25
24	12	1.73	0.70	11	1.60	0.67	102.50	49	25	2.51	0.78	20	2.39	0.80	166.74
25	16	1.57	0.57	13	1.45	0.57	97.50	50	18	2.45	0.85	16	2.20	0.79	142.00

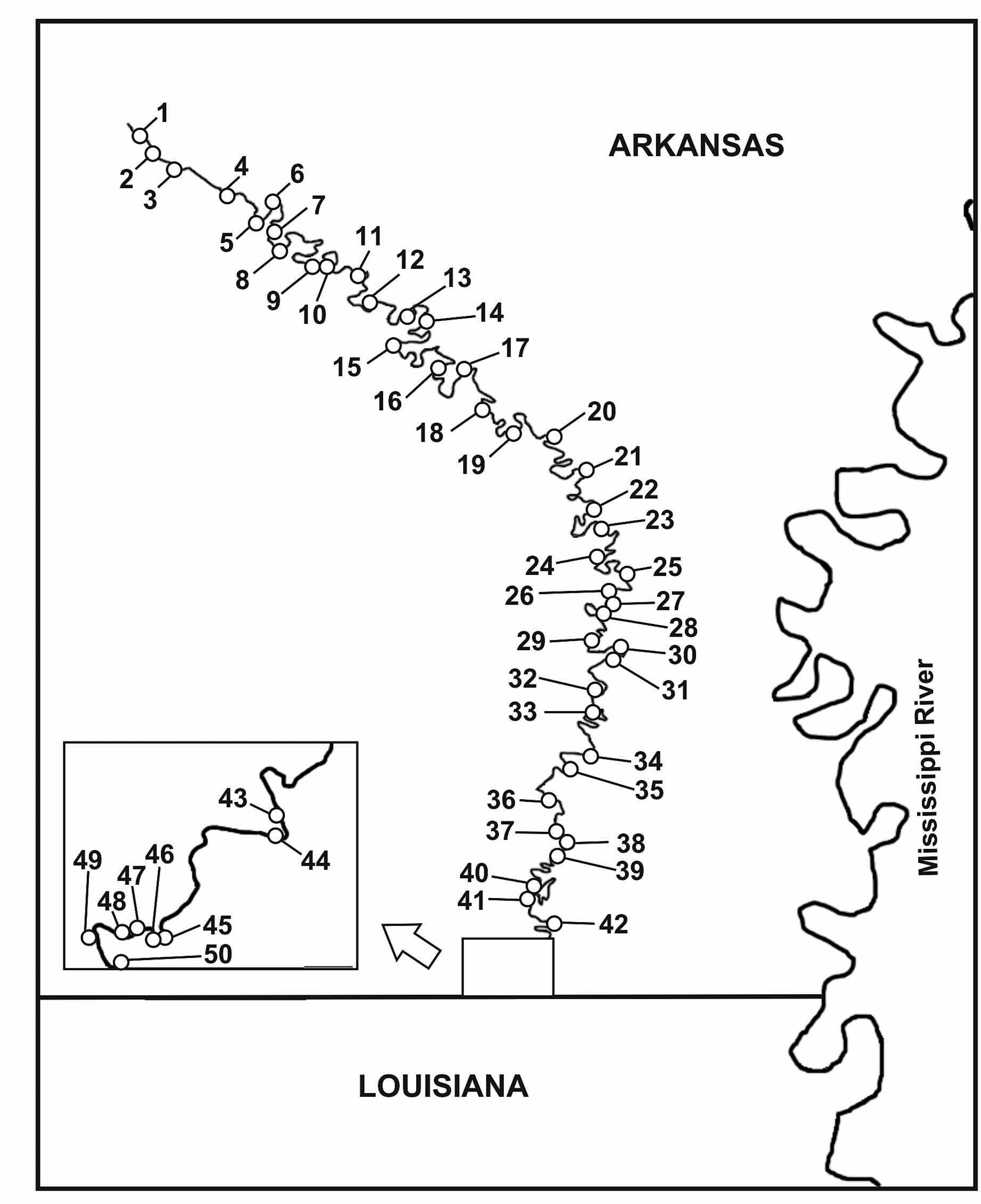

FIGURE 1. Map of the Arkansas portion of Bayou Bartholomew. Sampling sites are numbered starting at the headwaters. See Appendix for locality information.

APPENDIX. Bayou Bartholomew collection sites along with location description and date sampled.

Site 1. Hardin Rd bridge crossing, 3.7 km N of Princeton Pike, NW of Pine Bluff, Jefferson Co., AR (34.25912°N, 92.15047°W). 03 Sept 2004. **Site 2.** 2.4 km along Princeton Pike Rd. off Int. 530, W of Pine Bluff, Jefferson Co., AR (34.23594°N, 92.13336°W). 15 Oct 2004. **Site 3.** 0.4 km behind private fence at the end W 13th St., W of Pine Bluff, Jefferson Co., AR (34.21440°N, 92.10303°W). 17 Sept 2004. **Site 4.** Haze St. bridge crossing, 0.1 km N of 530 bypass in Pine Bluff, Jefferson Co., AR (34.17494°N, 92.02402°W). 03 Sept 2004. **Site 5.** 0.5 km along Behanon Rd., E of Hwy 63, S of Pine Bluff, Jefferson Co., AR (34.13651°N, 91.98112°W). 17 Sept 2004. **Site 6.** 1.0 km along Wilbur West Rd. off of Grider Field Rd., S of Pine Bluff, Jefferson Co., AR (34.16578°N, 91.96042°W). 15 Oct 2004. **Site 7.** 0.05 km off of Gibb Anderson Rd., 3.9 km off Grider Field Rd., SW of Pine Bluff, Jefferson Co., AR (34.12109°N, 91.95349°W). 15 Oct 2004. **Site 8.** CR 12 bridge crossing, SE of Pine Bluff, Jefferson Co., AR (34.09604°N, 91.94732°W). 03 Sept 2004. **Site 9.** Bridge crossing 6.0 km along CR 70 off Hwy 425,W of Tarry, Lincoln Co., AR (34.67228°N, 91.96155°W). 15 Oct 2004. **Site 10.** 4.2 km along CR 70, W of Tarry, Lincoln Co. AR (34.07162°N, 91.88061°W). 17 Sept 2004. **Site 11.** Bridge crossing 1.9 km along CR 11, N of Star City, Lincoln Co., AR (34.05941°N, 91.83381°W). 22 Sept 2004. **Site 12.** Hwy 425 bridge crossing at Yorktown, Lincoln Co., AR (34.02000°N, 91.81514°W). 04 Sept 2004. **Site 13.** 2.4 km along Bloomfield Rd off of CR 1, NW of Star City, Lincoln Co., AR (34.00131°N, 91.76230°N). 22 Sept 2004. **Site 14.** 6.8 km along CR 2, off of CR 1, NW of Star City, Lincoln Co., AR (33.99249°N, 91.73670°W). 17 Sept 2004. **Site 15.** Hwy 11 bridge crossing, N of Cane Creek Lake, Lincoln Co., AR (33.96129°N, 91.78561°W). 22 Sept 2004. **Site 16.** Hwy 293 bridge crossing (Person's Bridge), SE of Star City, Lincoln Co., AR (33.92592°N, 91.71605°W). 18 Sept 2004. **Site 17.** CR 82 bridge crossing off of Hwy 293, near Avery, Lincoln Co., AR (33.92040°N, 91.62815°W). 04 Sept 2004. **Site 18.** Hwy 54 bridge crossing (Garrett's Bridge), NW of Tyro, Lincoln Co., AR (33.86692°N, 91.65615°W). 18 Sept 2004. **Site 19.** Hwy 273 bridge crossing, SW of Gould, Lincoln Co., AR (33.83352°N, 91.60882°W). 24 Sept 2004. **Site 20.** CR 36 bridge crossing off of Hwy 65, W of Pickens, Desha Co., AR (33.82449°N, 91.55177°W). 04 Sept 2004. **Site 21.** Hwy 138 bridge crossing, 2.1 km W of Winchester, Drew Co., AR (33.77288°N, 91.50455°W). 18 Sept 2004. **Site 22.** CR 77 bridge crossing, W of Tillar, Drew Co., AR (33.72000°N, 91.49610°W). 24 Sept 2004. **Site 23.** Hwy 277 bridge crossing, 3.7 km SW of Tillar, Drew Co., AR (33.69215°N, 91.48332°W). 05 Sept 2004. **Site 24.** 5.1 km N of Hwy 278 on M & J Farms Rd., 6.4 mi W of McGehee, Drew Co., AR (33.64784°N, 91.48609°W). 26 Sept 2004. **Site 25.** Hwy 278 bridge crossing, W of McGehee, Drew Co., AR (33.62883°N, 91.44675°W). 05 Sept 2004. **Site 26.** 4.2 km along CR 67 off of Hwy 278, SW of McGehee, Drew Co., AR (33.60079°N, 91.47034°W). 09 Oct 2004. **Site 27.** 2.1 km off of CR 67, 4.2 km W of Masonville, Drew Co., AR (33.57537°N, 91.47815°W). 19 Sept 2004. **Site 28.** Hwy 35 bridge crossing, W of Dermott, Drew Co., AR (33.52835°N, 091.49712°W). 05 Sept 2004. **Site 29.** 4.3 km along Rose Hill Rd off of Hwy 165, SE of Dermott, Drew Co., AR (33.50259°N, 91.46763°W). 26 Sept 2004. **Site 30.** CR 59 bridge crossing off of Hwy 922, near Lake Wallace, Drew Co., AR (33.45450°N, 91.48953°W). 06 Sept 2004. **Site 31.** 0.4 km downstream of CR 59 bridge crossing off of Hwy 922, near Lake Wallace, Drew Co., AR (33.45473°N, 91.49160°W). 06 Sept 2004. **Site 32.** 5.3 km along Silver Mt. Church Rd., off of CR 52, NW of Jerome, Drew Co., AR (33.42259°N, 91.49488°W). 29 Sept 2004. **Site 33.** 0.5 km along Cotton Gin Rd., W of Boydell, Ashley Co., AR (33.36215°N, 91.49749°W). 08 Oct 2004. **Site 34.** CR 104 bridge crossing, NW of Montrose, Ashley Co., AR (33.34659°N, 91.53061°W). 29 Sept 2004. **Site 35.** Hwy 82 bridge crossing, W of Montrose, Ashley Co., AR (33.29817°N, 91.56237°W). 01 Oct 2004. **Site 36.** 10.1 km along Hwy160, NW of Portland, Ashley Co., AR (33.52272°N, 091.45662°W). 09 Oct 2004. **Site 37.** 4.2 km along Hwy 160 off of Hwy 165, W of Portland, Ashley Co., AR (33.24860°N, 91.54837°W). 08 Oct 2004. **Site 38.** Hwy 160 bridge crossing, W of Portland, Ashley Co., AR (33.23590°N, 91.53512°W). 01 Oct 2004. **Site 39.** 5.1 km along CR 48 across from Wilson Brake boat ramp, SW of Portland, Ashley Co., AR (33.21893°N, 91.54545°W). 07 Oct 2004. **Site 40.** 2.7 km along CR 33 off of Hwy 8, NW of Parksdale, Ashley Co., AR (33.17610°N, 91.57961°W). 07 Oct 2004. **Site 41.** 0.1 km off of Hwy 8, 6.6 km W of Parksdale, Ashley Co., AR (33.15835°N, 91.59049°W). 25 Sept 2004. **Site 42.** Hwy 8 bridge crossing, in Parksdale, Ashley Co., AR (33.12150°N, 91.55402°W). 25 Sept 2004. **Site 43.** 0.4 km upstream of Hwy 173 bridge crossing, NW of Wilmot, Ashley Co., AR (33.07555°N, 91.58027°W). 27 Aug 2004. **Site 44.** 2.4 km downstream of Hwy 173 bridge, NW of Wilmot, Ashley Co., AR (33.06750°N, 91.58082°W). 28 Aug 2004. **Site 45.** 5.6 km downstream of Hwy 173 bridge, W of Wilmot, Ashley Co., AR (33.02520°N, 91.62608°W). 28 Aug 2004. **Site 46.** 7.2 km downstream of Hwy 173 bridge, W of Wilmot, Ashley Co., AR (33.025545°N, 91.63111°W). 29 Aug 2004. **Site 47.** 8.0 km downstream of Hwy 173 bridge, W of Wilmot, Ashley Co., AR (33.02976°N, 91.63848°W). 29 Aug 2004. **Site 48.** 11.3 km downstream of Hwy 173 bridge, SW of Wilmot, Ashley Co., AR (33.02870°N, 91.64340°W). 29 Aug 2004. **Site 49.** 4.0 km N of AR state line on CR 365, SW of Wilmot, Ashley Co., AR (33.02450°N, 91.65600°W). 02 Oct 2004. **Site 50.** 0.05 km N of the AR state line at the end of CR 364, SW of Wilmot, Ashley Co., AR (33.00710°N, 91.62750°W). 02 Oct 2004.

A Note on Three Collections of Cyprinodontid Fishes Housed in the British Museum of Natural History, Including Syntypes and Historically Important Specimens

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ABSTRACT

We reveal the presence of three North American cyprinodontids in the British Museum of Natural History (BMNH) that have been overlooked by some authors of recent ichthyological literature. Brief descriptions are given of the three specimens and comparisons are made with recently collected material. The BMNH specimen of *Cyprinodon elegans* is a syntype, the specimen of *C. gibbosus* (= *C. variegatus*), although not a type, is of historical importance, and the *C. mydrus* (= *Floridichthys carpio*) specimen was collected by Silas Stearns and we believe should be considered as a syntype.

INTRODUCTION

After the termination of the Great International Fisheries Exhibition at London in 1883 many fishes were donated to the British Museum of Natural History (BMNH). Two hundred sixty three entries, comprising 292 fish specimens were recorded in their catalog of fishes. The following statement was recorded in the BMNH catalog at the beginning of these cataloged specimens: “Received from the Smithsonian Institution. Number attached to specimens (see catalogue of Coll. of Fishes exhibited by the U.S. Nat. Mus. by T. H. Bean. Washington 1883)”. Many of the specimens bear metal tags that exhibit the United States National Museum (USNM) catalog numbers.

One of us (RDS) borrowed 20 specimens of North American fishes that had been donated to the BMNH after the termination of the Great International Fisheries Exhibition, London, 1883. Among the 20 specimens were 3 cyprinodontids: *Cyprinodon elegans* BMNH 1883.12.14.198 (ex USNM 21321), Comanche Springs N. Rio Grande, J. H. Clark; *C. gibbosus* BMNH 1883.12.14.197 (ex USNM 30758), Pensacola, Florida, Silas Stearns, with metal tag 30758 tied to specimen; and *C. mydrus* BMNH 1883.12.14.196 (ex USNM 31931), Pensacola, Florida, Silas Stearns, with metal tag 31931 tied to specimen. These 3 cyprinodontids, plus the remaining 17 specimens on loan, were examined in some detail during April of 1976 before being returned to the BMNH. We also examined five males and five females of recently collected *C. elegans*, *C. variegatus*, and *Floridichthys carpio* for comparison with the three BMNH specimens. We include here morphometric and collection data for these Tulane University (TU) specimens that were used for the comparison. The purpose of this paper is to reveal the existence of these specimens, none of which has been mentioned in any recent literature.

MATERIALS AND METHODS

We used the following materials for comparison with the BMNH specimens: 1. *C. elegans* TU 97090 (73, 30-49 mm); Texas, Reeves County, irrigation ditch below San Solomon Springs; 18 November 1971; Anthony A. Echelle and Michael M. Stevenson; 2. *C. variegatus* TU 77544 (120, 22-50 mm); Louisiana, St. Bernard Parish, Chandeleur Islands; isolated pools near Monkey Bayou about 50 yards from open beach, about six miles south of Redfish Point; 22 January 1971; Anthony Laska and John Van Conner; and 3. *F. carpio* TU 44002 (31, 19-52 mm) Florida, Monroe County, Atlantic Ocean at Knight’s Key near Marathon; 4 March 1967; RDS 4095; R. D. Suttkus, Glenn H. Clemmer, Kenneth Relyea, and Ichthyology Class.

RESULTS AND DISCUSSION

Cyprinodon elegans Baird and Girard 1853

Baird and Girard's 1853 description of *C. elegans* is rather brief, however, Girard (1859) subsequently provided additional information. Besides the brief general description, including color, fin ray counts, and general locality (Rio Grande del Norte), Girard added some specifics, plus illustrations of a male and female. His list of specimens included two USNM catalog numbers: Cat. No. 686 (21 specimens), Comanche Springs, Rio Grande del Norte (Rio Bravo), collected 1851, Col. J. D. Graham, alcoholic specimens, John H. Clark, collector and Cat. No. 687 (11 specimens), Comanche Springs, Rio Grande del Norte (Rio Bravo), collected 1851, Col. J. D. Graham, alcoholic specimens, John H. Clark, collector. According to Eschmeyer (1998), Cat. No. 686 was re-cataloged as USNM 21320 and Cat. No. 687 was re-cataloged as USNM 21321, thus BMNH 1883.12.14.198 is a syntype of *C. elegans*.

The BMNH specimen is 39.5 mm SL with dorsal rays 11; anal rays 10; pectoral fin rays 16-16; pelvic fin rays 6-6; caudal rays branched plus two, 16; and lateral scales 28. The ten (five males, five females) recently collected *C. elegans* (TU 97090) had the following counts: dorsal rays 10 (2) and 11 (8); anal rays 10 (3) and 11 (7); pectoral rays, left side only 15 (2) and 16 (8); pelvic rays 6-6 (1), 7-5 (1), 7-7 (7), and one female without pelvic fins; caudal rays, branched plus two 15 (5) and 16 (5); and lateral scales 26 (2) and 27 (8). Of the twelve morphometrics compared between the BMNH specimen and the ten TU specimens, six measurements for the BMNH specimen were outside the ranges of the TU specimens: dorsal origin to snout, dorsal origin to caudal base, head width, caudal peduncle depth, dorsal fin depressed length, and anal fin depressed length (Table 1).

A sketch made during the April 1976 examination of the BMNH specimen (by RDS) shows a black marginal band on the caudal fin and the description of contact organs on the anal fin was as follows: on posterior margin of second ray, anterior and posterior margin of third ray, anterior margin of fourth, fifth and sixth rays, and a few on anterior and posterior margin of seventh ray; most contact organs were on distal half of rays. Based on color pattern and breeding tubercles, the BMNH specimen is a male and was in nuptial condition at the time of capture.

Cyprinodon gibbosus Baird and Girard 1853
= *Cyprinodon variegatus* Lacepède 1803

Cyprinodon gibbosus BMNH 1883.12.14.197 (ex USNM 30758) came from Pensacola, Florida and was collected by Silas Stearns. Baird and Girard's *C. gibbosus* came from brackish waters of Indianola, [Texas]. Based on the different collection localities, the BMNH specimen of *C. gibbosus*, which was included along with other USNM fishes donated to the British Museum and collected by Silas Stearns, is not type material.

The BMNH specimen is 51.3 mm SL and has the following meristics: dorsal rays 11; anal rays 11; pectoral rays 16-16; caudal rays 16; and lateral scales 27. Based primarily on the depth of the caudal peduncle, we believe the BMNH specimen is a male. The ten (five males and five females) recently collected *C. variegatus* (TU 77544) had the following counts: dorsal rays 11 (2) and 12 (8); anal rays 11 (10); pectoral rays, left side only 15 (4), 16 (5), and 17 (1); pelvic rays 6-6 (1), 7-7 (8), and 8-7 (1); caudal rays 14 (1), 15 (1), 16 (7), and 17 (1); and lateral scales 24 (3), and 25 (7). Of the 14 morphometrics compared between the BMNH specimen and the ten TU specimens, four measurements for the BMNH specimen were outside the ranges of the TU specimens: body depth, interorbital distance, dorsal fin depressed length, and anal fin depressed length (Table 2).

Cyprinodon mydrus Goode and Bean 1882
= *Floridichthys carpio* (Günther 1866)

Goode and Bean's (1882) description of *C. mydrus* is somewhat brief. However, some critical morphological characters were given, such as: dorsal rays 13, anal rays 29 (no doubt this was a typographical error and should have read 9), and humeral scale scarcely as large as the contiguous scales. The specimen came from Pensacola, Florida.

The BMNH specimen of *C. mydrus* (BMNH 1883.12.14.196) was also from Pensacola, Florida, collected by Silas Stearns (ex [USNM] 31931), and there was a metal tag tied to the specimen. This specimen is 39.5 mm SL; dorsal rays 12; anal rays 9; pectoral rays 19-19; pelvic rays 7-7; caudal rays 16; and lateral scales 23. The humeral scale is not enlarged and silver spots were visible on the sides of the specimen, especially on the caudal peduncle. Contact organs were present on the second through sixth anal rays, indicating that the BMNH specimen is a male. The ten (five males and five females) recently collected *F. carpio* (TU 44002) had the following counts: dorsal rays 11 (8) and 12 (2); anal rays 9 (9) and 10 (1); pectoral rays, left only 17 (5) and 18 (5); pelvic rays 7-7 (10); caudal rays 15 (4), 16 (3), and 17 (3); lateral scales 22 (1) and 23 (9); and caudal peduncle scales 16 (10). Of the 15 morphometrics compared between the BMNH specimen and the ten TU specimens, nine measurements for the BMNH specimen were outside the ranges of the TU specimens: dorsal origin to snout, dorsal origin to caudal base, pelvic insertion to snout, head width, caudal peduncle depth, interorbital distance, dorsal fin depressed length, anal fin depressed length, and pectoral fin length (Table 3).

Miller (1974) stated that in 1953 he had suggested that the actual types of *C. mydrus* might be USNM 31931. However, Miller decided that, because Bean did not indicate that USNM 31931 was type material in his listing of specimens being sent to the Fisheries Exhibition (especially since he was coauthor of the original description of *C. mydrus*) the USNM 31931 specimens must not be type material. We differ in our opinion with regards to the for-

mer status of USNM 31931. We think that Bean and Goode's staff probably did not verify which specimens were types. They were likely under the impression that all of the material would be returned to the USNM. We also assume the catalog number USNM 30479 that was given in the original description was incorrect and that Bean and Goode did not carefully proof the manuscript or they would have caught the error farther on in the same paragraph. In a comparison with *C. gibbosus* they stated that *C. mydrus* differed, "…by the smaller number of its anal rays, of which there are 29". No doubt it should have read, "…of which there are 9."

There was an inconsistency about the designation of type material of other specimens sent to BMNH. Bean (1883) listed: *Lucania goodei* [USNM] 23505 (two of the type specimens), St. John's River, Florida, G. B. Goode [collector], whereas the BMNH catalog listed: *L. goodei* BMNH 1883.12.14.194-5, St. John's River, Florida (ex USNM 23505, two of the type specimens), with no identification of the collector. Bean (1883) listed: *C. elegans* [USNM] 21321, Comanche Springs, N. Rio Grande, J. H. Clark (no mention of being type material), whereas the BMNH catalog listed: *C. elegans* BMNH 1883.12.14.198, Comanche Springs, N. Rio Grande, J. H. Clark (no mention of being type material and no mention of the USNM origin). Bean (1883) listed *Plagopterus argentissimus* [USNM] 15776, Colorado Chiquito River, New Mexico, C. G. Newberry, whereas the BMNH catalog listed: *P. argentissimus* BMNH 1883.12.14.239, Colorado Chiquito River (ex USNM 15776). Again, there was no mention by Bean (1883) of the specimens being type material (Gilbert, 1998).

Perhaps the best evidence of the inconsistency in designating type material is that concerning *Dallia pectoralis*. Bean (1880) diagnosed his new genus, *Dallia*, and described the species *D. pectoralis*. There were two series of type material: USNM 23498 (7 specimens) from St. Michaels, Alaska, February 1877, L. M. Turner and USNM 6661 (17 specimens), St. Michaels, Alaska, H. M. Bannister. Bean (1883) listed *D. pectoralis* [USNM] 6661, St. Michaels, Alaska, H.M. Bannister (no mention of being type material). However, Bean (1883) listed another specimen of *D. pectoralis* [USNM] 6661, St. Michaels, Alaska, H. M. Bannister (one of type specimens). Apparently the latter specimen of *D. pectoralis* was cataloged first in the British Museum (BMNH 1883.12.14.155), St. Michaels, Alaska, (ex USNM 6661) as one of the types. The other specimen of *D. pectoralis* was cataloged as BMNH 1883.12.14.172, St. Michaels, Alaska (no other comment). A review of the other North American material in the BMNH that was donated by the United States following the Great International Fisheries Exhibition in 1883 will appear in subsequent papers.

ACKNOWLEDGMENTS

We express our deep appreciation for the help and courtesies extended to us by the personnel at the British Museum of Natural History during the 1970s and for the loan of specimens. We thank Anthony A. Echelle and Michael Stevenson for the deposition of *C. elegans* specimens into the Tulane University Museum of Natural History. Also we are grateful for the use of the facilities at the Tulane University Museum of Natural History.

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TABLE 1. Measurements in thousandths of SL for five male and five female *C. elegans* (TU 97090) and a single specimen of *C. elegans* from the British Museum of Natural History (BMNH 1883.12.14.198: ex USNM 21321).

	C. elegans TU 97090 males (n = 5)		*C. elegans* BMNH 1883.12.14.198 (n = 1)	*C. elegans* TU 97090 females (n = 5)	
	Range	X		Range	X
SL (mm)	42.1-49.5	44.7	39.5	39.4-43.0	41.8
Dorsal origin to snout	571-605	587	562	582-604	592
Dorsal origin to caudal base	452-470	458	500	427-446	438
Pelvic insertion to snout	547-575	563	—	533-555	546
Pelvic insertion to caudal base	490-506	497	—	475-501	493
Anal origin to snout	664-705	679	—	661-698	681
Anal origin to caudal base	355-370	362	—	343-371	359
Body, greatest depth	363-405	382	392	326-371	343
Body, greatest width	230-254	243	—	229-245	236
Head, length	305-315	309	312	295-313	304
Head, width	220-237	228	210	221-233	227
Caudal peduncle, depth	169-178	173	185	155-160	158
Interorbital distance	124-128	126	112	111-125	120
Dorsal fin, depressed length	239-261	251	297	213-233	221
Anal fin, depressed length	223-230	227	247	192-215	205
Pectoral fin, length	225-235	229	222	208-228	219
Pelvic fin, length	88-110	99	107	91-101	94

TABLE 2. Measurements in thousandths of SL for five male and five female *C. variegatus* (TU 77544) and a single specimen of *C. gibbosus* (= *Cyprinodon variegatus*) from the British Museum of Natural History (BMNH 1883.12.14.197)

	C. variegatus TU 77544 males (n = 5)		*C. gibbosus* (= C. variegatus) BMNH 1883.12.14.197 (n = 1)	*C. variegatus* TU 77544 females (n = 5)	
	Range	X		Range	X
SL (mm)	43.6-49.6	45	51.3	42.3-45.0	43.4
Dorsal origin to snout	495-513	501	522	538-555	545
Dorsal origin to caudal base	547-559	553	543	507-524	514
Pelvic insertion to snout	511-529	519	545	538-585	569
Pelvic insertion to caudal base	524-551	534	—	480-522	504
Anal origin to snout	641-662	655	673	689-710	698
Anal origin to caudal base	398-415	409	—	341-373	357
Body, greatest depth	396-440	414	465	400-437	420
Body, greatest width	206-227	219	—	239-266	257
Head, length	287-303	298	300	304-321	311
Head, width	217-227	221	232	235-251	243
Caudal peduncle, depth	191-208	203	201	174-189	181
Interorbital distance	114-124	119	95	109-126	119
Dorsal fin, depressed length	340-374	354	325	289-315	302
Anal fin, depressed length	236-250	243	171	172-203	187
Pectoral fin, length	247-267	258	241	229-268	248
Pelvic fin, length	129-135	132	129	124-138	130

TABLE 3. Measurements in thousandths of SL for five male and five female *F. carpio* (TU 44002) and a single specimen (and possible syntype) of *C. mydrus* (= *F. carpio*) from the British Museum of Natural History (BMNH 1883.12.14.196).

	F. carpio TU 44002 males (n = 5)		*C. mydrus* (= F. carpio) BMNH 1883.12.14.196 (n = 1)	*F. carpio* TU 44002 females (n = 5)	
	Range	X		Range	X
SL (mm)	43.8-51.7	47.5	41.6	41.3-47.7	44.6
Dorsal origin to snout	502-520	512	492	517-527	524
Dorsal origin to caudal base	524-559	538	590	510-544	526
Pelvic insertion to snout	476-506	493	456	495-531	516
Pelvic insertion to caudal base	583-595	589	588	550-588	566
Anal origin to snout	636-693	665	636	670-709	692
Anal origin to caudal base	396-435	419	—	380-402	390
Body, greatest depth	414-424	417	422	408-426	416
Body, greatest width	207-229	215	—	220-238	228
Head, length	318-334	328	324	322-345	337
Head, width	212-231	218	197	227-233	231
Caudal peduncle, depth	216-222	220	228	202-215	207
Interorbital distance	121-123	122	106	118-128	123
Dorsal fin, depressed length	371-397	388	437	309-331	320
Anal fin, depressed length	301-328	314	348	204-229	214
Pectoral fin, length	235-253	243	281	226-245	237
Pelvic fin, length	185-198	191	197	141-164	150

REGIONAL REPORTS

REGION I-NORTHEAST

John Odenkirk of the Virginia Department of Game and Inland Fisheries (VDGIF) reports that the 2007 sampling season for the non-native northern snakehead (*Channa argus* or NSH) saw decreased time on the Potomac River for VDGIF crews in the form of boat electrofishing samples due to the presence of investigators from Virginia Tech University. The Tech students and technicians were involved in a variety of intensive studies, many of which had parallel objectives. This crew made a variety of timely discoveries and data are still being analyzed, but look for some good future publications. Sampling that was completed by VDGIF crews during 2007 resulted in a NSH boat electrofishing mean catch rate of 2.9 fish per hour which represented a decline from 2006 (6.1 fish per hour). However, there was no significant difference between catch rates in 2006 and 2007. Catch rate in 2006 was significantly higher than in 2004 or 2005. The linear trend continued to indicate an increasing population. Reported angler catches (34) reached a third consecutive annual record despite decreased publicity. This linear trend also indicated an increasing population. Range, based on angler catches, increased substantially and known colonized waters included approximately 80 km of the mainstem Potomac River from Little Falls (Washington, D.C.) downstream to Aquia Creek (Stafford County, Virginia) including tributaries within Maryland, Virginia, and D.C. VDGIF plans to resume bi-monthly assemblage and NSH-specific sampling April-September in an effort to document NSH population characteristics and any potential changes to the fish assemblage.

When not analyzing specimens and writing up results on the sicklefin redhorse and Carolina redhorse (*Moxostoma sp. cf. erythrurum*), Dr. Robert Jenkins did find the time to retire from Roanoke College. Since then he has worked with Lee Henebry, a Roanoke College senior, who is completing a major report on a two-year study of age, growth, maturation, female gonadal cycle, chronology of spawning, and sexual dimorphism of the bigeye jumprock (*M. ariommum*), an upper and middle Roanoke River basin drainage endemic. The species is listed as State Threatened in North Carolina. For a small fish (standard length < 200 mm), they have aged this somewhat bizarre sucker to a maximum age of 15 years.

The Carolina madtom (*Noturus furiosus*) is a rare fish endemic to the Tar and Neuse River basins in North Carolina. It is a species of Special Concern and also a proposed state Threatened species as ranked by the North Carolina Wildlife Resources Commission and the North Carolina Natural Heritage Program. Surveys over the last two decades suggested a decline in historic populations. Two projects are currently underway. The first project is at North Carolina State University where work is entering its second year. Graduate student Steve Midway, who is advised by Drs. Tom Kwak and Derek Aday, is working in the field and in the laboratory trying to answer general life history questions as well as understand more specific behaviors. Field work is helping them understand habitat use and availability, whereas habitat preferences are being tested in controlled laboratory experiments. Surveys were conducted in 2007 in the Tar River basin (TRB), while 2008 surveys will be conducted in the Neuse River basin (NRB).

The second project started in 2007 when Chris Wood and Rob Nichols, non-game biologists with the NCWRC, conducted 60 surveys at 30 sites with historical records of *N. furiosus*. Data were compared to records from the 1960s to detect any temporal change in occurrence. They also applied a new method to estimate the proportion of sites occupied (occupancy) and detection probabilities for a subset of sites with the computer software package PRESENCE using repeat detection/non-detection data. Additionally, they examined aspects of the general biology and population structure of *N. furiosus* (e.g., spawning period, size structure, age structure, CPUE, etc.). Results indicated a significant temporal change in occurrence in the NRB ($X^2 = 0.30$, $p < 0.05$). Frequencies of occurrence decreased from 0.67 (SE = 0.05) to 0.13 (SE =0.04) between the 1960s and 2007 data. Only one site surveyed in the NRB displayed a robust population. There was no significant temporal change in occurrence in the TRB. Occupancy estimates were similar to observed frequencies of occurrence due to high detection probabilities. Availability of nesting locations was an important covariate in estimates of occupancy. Further investigations are needed to determine if estimating occupancy represents an important state variable for long term, large scale monitoring programs.

Michael Fisk, a graduate student at North Carolina State University, has begun working with staff from the NCWRC and Progress Energy, studying robust redhorse (*M. robustum*) on the Pee Dee River in North and South Carolina. The goals of the project are to describe spawning habitat, compare spawning and non-spawning habitat-use versus habitat availability, and to determine the effects on habitat-use before and after a spring minimum flow is established for the Blewett Falls Hydroelectric Plant. The Robust Redhorse Pee Dee Technical Working Group will be sampling the river this spring to collect additional adult fish to insert radio tags with the hope that habitat-use data will be collected from relocating radio-tagged fish. The purpose of the study is to gain a better understanding of the species spawning habitat requirements in the Pee Dee River and to determine if the minimum flow regime will benefit spawning riverine fishes such as *M. robustum*.

Ryan Heise with the North Carolina Wildlife Resources Commission has also been working with *M. robustum*, conducting electrofishing surveys and radio tracking on the Pee Dee River in North and South Carolina. Ryan is working with the Robust Redhorse Conservation Committee (RRCC), a cooperative, voluntary partnership formed between state and federal resource agencies, private industry, and the conservation community to direct the recovery of the species. One of the major goals of the RRCC is to evaluate the population status and distribution of this species throughout its known range. The objectives in the Pee Dee River are to determine the status of the *M. robustum* population, document habitat use, and determine migratory patterns. A total of 51 *M. robustum* were captured from 2000-2007 (including 14 recaptures). Forty-nine adult *M. robustum* have been captured in large Piedmont shoals and side channels in a 20 rkm reach immediately downstream from Blewett Falls Dam in North Carolina. To improve catch rates and learn more about *M. robustum* life history, a radio tagging study began in 2005. Telemetry relocations and capture data indicate that some of these fish make long distance movements (up to 100 rkm) downstream into the South Carolina Coastal Plain region, use the shoal habitats near Blewett Falls Dam for spawning, and show spawning site fidelity. Efforts on the Pee Dee River will continue in order to better understand *M. robustum* life history requirements.

John Crutchfield, lead environmental specialist for Progress Energy, reports that in the near future, American shad (*Alosa sapidissima*) and American eel (*Anguilla rostrata*) will be making their way past Blewett Falls Dam on the Pee Dee River, thanks to a hydro relicensing agreement reached between Progress Energy (the hydro project owner) and NMFS, USFWS, NCWRC, and the South Carolina Department of Natural Resources. The agreement provides for fish passage around Progress Energy's Blewett Falls and Tillery hydroelectric plants, beginning in 2013. Under the agreement, fish passage facilities will be built and will begin operation by 2013, including provisions for creating downstream passage. *Alosa sapidissima* will be captured, sorted, and transported by tanker truck to specified areas in the river basin above the Blewett and Tillery dams. *Anguilla rostrata* will utilize a lift-ladder system to move them past Blewett Falls Dam. The plan will focus on the long-term enhancement of these two major migratory species in the Yadkin-Pee Dee River basin. In addition to the passage program, several studies will be conducted to monitor the populations of both species and to determine the effectiveness of the passage program. According to Crutchfied, these agreements provide a balanced, scientific approach to passing these species upstream of our power plants and they are the culmination of two years of negotiations among all parties to reach a mutually agreeable solution to enhance this migratory fish resource. The relicensing process for the Tillery and Blewett hydroelectric plants began in 2003 and the next license is expected to be issued during this summer.

The North Carolina Wildlife Resources Commission has recently updated non-technical, educational profiles for several species of fishes: the Carolina madtom (*Noturus furiosus*), tangerine darter (*Percina aurantiaca*), American shad (*Alosa sapidissima*), Atlantic sturgeon (*Acipenser oxyrinchus*), walleye (*Sander vitreus*), largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), Roanoke hog sucker (*Hypentelium roanokense*), black crappie (*Pomoxis nigromaculatus*), and white crappie (*Pomoxis annularis*). These profiles may be found at: http://www.ncwildlife.org/pg10_OutdoorKids/pg10d_1.htm

According to Bryn Tracy at the North Carolina Division of Water Quality (NCDWQ), between early April and late June 2007, the stream fish assemblage assessment program sampled 87 basin-wide sites in the Tar, Catawba, and French Broad River basins. The complete data, ratings, analyses, and reports for these river basins will be available in spring 2008 at http://www.esb.enr.state.nc.us/BAU.html and http://www.esb.enr.state.nc.us/bar.html). Fish assemblage data collected by NCDWQ are used for more than just basin-wide assessments. Each year the data are screened from sites that are consistently rated excellent and may be eligible for supplemental classification as High Quality Waters (HQW) or Outstanding Resource Waters (ORW). HQW is a supplemental classification that is, "…intended to protect waters with quality higher than state water quality standards." HQW are generally those waters that are, "…rated as excellent based on biological and physical-chemical characteristics through Division monitoring or special studies," (NCAC, 2007). ORW are considered, "unique and special waters of exceptional state or national recreational or ecological significance and that the waters have exceptional water quality while meeting the following conditions: 1) that the water quality is rated as excellent based on physical, chemical or biological information; and 2) the characteristics which make these waters unique and special may not be protected by the assigned narrative and numerical water quality standards," (NCAC 2007). In addition, a waterbody must exhibit one or more values or uses: "1) there are outstanding fish (or commercially important aquatic species) habitat and fisheries; 2) there is an unusually high level of water-based recreation or the potential for such recreation; 3) the waters have already received some special designation which do not provide any water quality protection; 4) the waters represent an important component of a state or national park or forest; or 5) the waters are of special ecological or scientific significance such as habitat for rare or endangered species or as areas for research and education," (NCAC 2007). In addition to the HQW and ORW requests for reclassifications, DWQ also receives reclassification requests to reclassify waterbodies to trout waters. Trout waters are those that, "…are freshwaters protected for natural trout propagation and survival of stocked trout... trout waters are those waters which have conditions which shall sustain and allow for trout

propagation and survival of stocked trout on a year-round basis" (NCAC 2007).

Based on these criteria, since 2000 at least 14 waters have been formally reclassified or are in the process of being reviewed for reclassification, using fish data. These waters are:

- Outstanding Resource Waters (ORW): Swift Creek, Tar River basin; Little Grassy Creek, Catawba River basin; Deep Creek, Neuse River basin; North Fork First Broad River, Broad River basin, and Buffalo Creek and upper Yadkin River, Yadkin River basin
- High Quality Waters (HQR): Walnut Creek, Broad River basin, and North Prong Lewis Fork, Yadkin River basin.
- Trout Waters: Wesser Creek, Tuskeegee Creek, and Camp Creek, Little Tennessee River basin; and Richland Creek, Fines Creek, and Boylston Creek, French Broad River basin.

(Reference: NCAC. 2007. North Carolina administrative code. Effective May 1, 2007. Environmental Management Commission. North Carolina Department of Environment and Natural Resources. Division of Water Quality. Raleigh, NC.)

Based upon an examination of the 2007 data, unusual or new DWQ distributional records have been recorded for the following river basins. The basis for determining if a record is unusual or new is if the collection is not shown in Menhinick (1991) or if it was collected for the first time by staff from a particular county in the river basin of interest. These records are:

Tar River basin

- eastern mudminnow (*Umbra pygmaea*), Little Fishing Creek, Warren County
- flat bullhead (*Ameiurus platycephalus*), Red Bud Creek, Nash County
- green sunfish (*Lepomis cyanellus*), Parker and Tyson creeks, Pitt County

Yadkin River basin

- central stoneroller (*Campostoma anomalum*), Forbush Creek, Yadkin County

Catawba River basin

- fieryblack shiner (*Cyprinella pyrrhomelas*), Glade Creek, Alexander County
- coastal shiner (*Notropis petersoni*), Waxhaw Creek, Union County
- fathead minnow (*Pimephales promelas*), Duck Creek, Alexander County
- mountain redbelly dace (*Phoxinus oreas*), Mulberry Creek, Caldwell County
- green sunfish (*L. cyanellus*), Curtis and North Muddy creeks, McDowell County

French Broad River basin

- rosyside dace (*Clinostomus funduloides*), Crab Creek, Transylvania County
- green sunfish (*L. cyanellus*), North Toe River, Avery County
- swamp darter (*Etheostoma fusiforme*), Fines Creek, Haywood County

The inter-basin transfer and introduction of species has been documented in years past during the assemblage assessments. For example, in the Catawba River basin, the greenhead shiner (*Notropis chlorocephalus*) should be one of the dominant native species. In the adjacent Yadkin River Bain, it is the redlip shiner (*N. chiliticus*). However, in several streams in Alexander, Lincoln, and Mecklenburg counties, *N. chiliticus* has displaced or has hybridized with the *N. chlorocephalus*. Ethanol-and formalin-preserved specimens of both species from throughout the Catawba River basin were vouchered at the North Carolina State Museum of Natural Sciences for future studies on the distribution and possible hybridization of these two species. Mollie Cashner, a Ph.D. candidate at Tulane University, is actively studying the hybridization of these two species in this part of the Catawba-Santee River basin.

A recent examination of data from the French Broad River Basin in North Carolina, documented at least 21 non-indigenous species have been reported from the basin. The list includes: threadfin shad (*Dorosoma petenense*), goldfish (*Carassius auratus*), rosyside dace (*C. funduloides*), grass carp (*Ctenopharyngodon idella*), common carp (*Cyprinus carpio*), bluehead chub (*Nocomis leptocephalus*), fathead minnow (*P. promelas*), creek chubsucker (*Erimyzon oblongus*), white catfish (*Ameiurus catus*), flat bullhead (*A. platycephalus*), chain pickerel (*Esox niger*), rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), eastern mosquitofish (*Gambusia holbrooki*), white bass (*Morone chrysops*), redbreast sunfish (*Lepomis auritus*), green sunfish (*L. cyanellus*), pumpkinseed (*L. gibbosus*), redear sunfish (*L. microlophus*), swamp darter (*E. fusiforme*), and yellow perch (*Perca flavescens*). Not included in this list are some tropical fish that now call the Basin home — the blue tilapia (*Oreochromis aureus*) and the Amazon sailfin catfish (*Pterygoplichthys pardalis*) which are found in Lake Julian (Buncombe County) and an unknown species of pacu which was caught in the Pigeon River (Haywood County) in August 2007. Species that seem to be recently expanding their ranges include *N. leptocephalus*, *E. niger*, and *A. platycephalus*. If you are aware of additional distributional records of the North Carolina fauna or introduced species, please share this information and voucher your specimens with Wayne Starnes at NCSMNS (wayne.starnes@ncmail.net). Also, please share any of your locality records with Bryn H. Tracy (bryn.tracy@ncmail.net).

Wayne Starnes and Gabriela Hogue report that the big push to database NCSM's fish holdings made substantial headway over the past year. Fully databased lots (including complete geo-referencing) number approximately 45,000 as of this writing. These include the entire original NCSM holdings (i.e., exclusive of the numerous orphan collections acquired over the past 15 years), the nearly 3,000

large tank and vat specimens (most of these stemming from the UNC Institute of Marine Science collection acquired in 1996), thousands of lots of NC Division of Water Quality voucher material from their statewide IBI program, and numerous other freshwater and marine accessions. Moreover, locale data for nearly the entire UNC IMS collection, the extensive NC Wildlife Resources Commission 1960s statewide surveys material, and the collections of Rudy Arndt and Fritz Rohde from NC, SC, and NJ have been upgraded, georeferenced, and entered in preparation for databasing an additional 30,000 or more lots associated with those acquisitions. NCSM's current funding from NSF expires in July and an attempt to renew fell slightly short, but will be sought again for 2009. Meanwhile, support from the NCWRC for the curation and databasing of the backlog of their early 1960s surveys material appears to be committed and will be important in sustaining this heightened databasing effort until perhaps NSF support can be again obtained. It is estimated that an additional 45,000 to 50,000 lots comprising the various orphan collections are yet to be fully processed and databased, though the aforesaid effort to enter and georeference locales will facilitate the completion of a large portion of these.

By about the time this report is published it is hoped that the databased portions of NCSM's fish holdings (plus herpetological and aquatic invertebrate holdings) will be fully accessible online via the new collections webpage that is now in the final testing phases. These may also include a mapping feature. All should soon be available as a link from the Museum's main site (http://www.naturalsciences.org/) plus other avenues. It is also planned to participate in the GBIF effort and other networks that globally link collections. Uploads of NCSM's holdings are already supplied to the Discover Life site (http://www.discoverlife.org/) created in a large part and maintained by John Pickering of the University of Georgia.

In other NCSM news, Morgan Raley, Wayne Starnes, and Art Bogan are in the final stages of translocating and re-equipping the museum's molecular lab, formerly operated jointly with the NCSU College of Veterinary Medicine. It will occupy a mobile lab facility located at the museum ResLab facility in west Raleigh and reside there for approximately two years until the new Nature Search facility is completed in downtown Raleigh adjacent to the main museum. This will be a multi-venue forum in which scientists and the public are in close interaction, with the aim of better conveying how research is done and its relevance to that public. It will feature a working molecular lab which interfaces with programming and outreach, showcasing the role of both genetics and natural history collections in biodiversity research and conservation. Both in the interim facility and future home, various systematic and conservation genetics projects on fishes, freshwater mussels, and other organisms will be pursued. Tangential to this effort, NCSM has begun the accumulation of sizeable collections of ethanol preserved tissues and associated vouchers of diverse species from the eastern U.S. and further afield. Currently, funding for freezer facilities are being sought in order to better maintain tissues for the long term and it is proposed that this facility could become a designated major tissue repository for the southeastern U.S.

In other news, perhaps not reported elsewhere, North Carolina has had a new native species recorded from the state. The federally endangered Roanoke logperch (*Percina rex*) was twice taken in 2007. Duke Energy biologists took a juvenile while sampling in the Dan River below the dam at Eden, NC. Follow up work by Wayne Starnes NCWRC biologists Rob Nichols, Chris Wood, and Megan McCormick yielded a large adult male from a large shoal area in the nearby Smith River in the town of Eden. This is a considerable downstream range extension from populations known in the upper Smith River area in Virginia. Further sampling is planned to learn more of the extent of this population. On the other side of the state, the golden topminnow (*Fundulus chrysotus*) was discovered by Fritz Rohde to now penetrate into NC in swampy areas south of Lake Waccamaw. Just how long this species has resided in the state is questionable but this region has not been without a significant amount of sampling in past decades. These collections may represent the gradual and somewhat recent northward dispersal of this extremely attractive species into NC waters.

During June to October 2007, Gerald Pottern of Robert J. Goldstein and Associates and NC-WRC staff surveyed for the federally endangered Cape Fear shiner (*N. mekistocholas*) in Haw River (10 collections), Deep River (14 collections), Rocky River (11 collections), Cape Fear River (15 collections), and a few major tributaries in Chatham, Lee, Harnett, Moore, and Randolph counties in central NC. This was the first comprehensive range-wide survey for *N. mekistocholas* since the original status survey in 1984-1986. Backpack shocking and seining were both attempted, but shocking was discontinued when it became apparent that using two seines was much more effective in capturing large schools of mixed shiners in which *N. mekistocholas* were often found. The extreme drought of 2007 facilitated sampling in bedrock and boulder-dominated river segments. These are extremely difficult to wade and sample during normal flow conditions. Tributary streams, even the largest ones, had negligible flow and most yielded only fish species typical of headwater streams and lentic habitats. This suggested that fishes typical of larger flowing streams had moved downstream out of the tributaries. Consequently, most effort was focused on the main rivers and mouths of tributaries.

In the Lower Deep and Rocky Rivers, the 2007 survey yielded approximately 85 *N. mekistocholas* at five sites on the Deep River between NC Highway 22 below Highfalls Dam (Moore County) and US-1 near Moncure (Chatham-Lee County line). *Notropis mekistocholas* appears to be doing well in this 56 km river segment, especially in shallow rocky areas with abundant water willow (*Justicia* sp.), riverweed (*Podostemum* sp.), and filamentous algae. The

removal of Carbonton Dam in 2005 has restored several miles of free-flowing habitat and may improve genetic exchange between shiner sub-populations upstream and downstream. The 2007 survey also found 13 *N. mekistocholas* specimens at five sites on the lower five miles of Rocky River in Chatham County, between Woody Dam and the Rocky-Deep River confluence. Previous collections from 1984 to 2004 have also found *N. mekistocholas* to be relatively common in the lower Rocky River and Deep River between Highfalls Dam and Moncure.

In the Upper Deep River, the 2007 survey yielded only one *N. mekistocholas* from the Deep River upstream of Highfalls Dam, taken at the foot of Coleridge Dam near NC Highway 22-42 in southeastern Randolph County. This represents the furthest upstream that *N. mekistocholas* has been collected in Deep River. Previous collections between Coleridge Dam and Highfalls Dam include 3 specimens taken in 1985 (Pottern) and 28 specimens taken between 1992 and 1994 (NC-WRC). *Notropis mekistocholas* appears to be uncommon or rare in Deep River between Coleridge Dam and Highfalls Dam and has never been reported upstream of Coleridge Dam. Our farthest upstream sample was just below Ramseur Dam, 11 km above Coleridge. It is unclear what effects the recently built Randleman Reservoir (on Deep River just upstream of Ramseur) may have on flow regimes, temperature, water chemistry, nutrient cycling, or other ecological parameters downstream in occupied *N. mekistocholas* habitat.

In the Upper Rocky River, six collections from Rocky River upstream of Woody Dam in Chatham County, where *N. mekistocholas* was common in collections from 1966 to 1971, yielded no specimen in 2007. The species apparently declined in Rocky River during the 1970s (prompting the 1984 status survey) and the last record upstream of Woody Dam was a single specimen collected at NC Highway 902 (type locality) in 1985. *Notropis mekistocholas* appears to be extirpated from Rocky River above Woody Dam. However, all other species of minnows, darters, killifish, madtoms, and other riffle-pool dwelling fishes previously reported from Rocky River are still present in this segment as of 2007 and the habitat still looks suitable for Cape Fear shiners.

The 2007 survey yielded one *N. mekistocholas* in Haw River, taken 6.4 km upstream of Bynum Dam in Chatham County, slightly upstream of the Rock Rest area where NC-WRC collected several specimens in 1993 and one in 2000. No specimens were found in 2007 in Haw River downstream of Bynum Dam where NC-WRC collected a few specimens in 1992 between US-15-501 and US-64. The lower 13 km of Haw River, downstream of US-64, is impounded by two dams and no longer suitable for *N. mekistocholas*, including the Robeson Creek area where this shiner was fairly numerous in the 1960s prior to Jordan Lake Dam construction. *Notropis mekistocholas* appears to be rare in Haw River above Bynum Dam and rare, or perhaps extirpated, between Bynum Dam and Jordan Lake. It is almost certainly extirpated from the segments impounded by Jordan Lake Dam and Buckhorn Dam.

The 2007 survey yielded only one *N. mekistocholas* in Cape Fear River, just below NC Highway 217 near Erwin in southern Harnett County. This represents the farthest downstream the species has been recorded in Cape Fear River. No *N. mekistocholas* were found in tributaries in 2007, or in 7 collections from Neills Creek over a two-day period in 2003 (according to Gerald Pottern and Ryan Heise). Previous collections in Cape Fear River and tributaries below Buckhorn Dam include 22 specimens from Neills Creek and Parkers Creek in 1962 (NC-WRC), one specimen from the main river in 1975 (CP and L), and six specimens from Neills Creek in 1986 (Pottern). This new collection near Erwin confirms that *N. mekistocholas* is extant but rare in Cape Fear River and in Harnett County. Apparently suitable habitat extends from the foot of Buckhorn Dam (Chatham-Lee County line) to the Harnett-Cumberland County line, below which rocky riffle-pool habitat is absent and the river transitions to a Coastal Plain ecosystem.

Amanda Hill of the USFWS (Charleston, SC) was selected to present at the 2nd International Symposium on Diadromous Fish: *Challenges for Diadromous Fishes in a Dynamic Global Environmen*t, held in Halifax, Nova Scotia in June. Amanda was one of 42 selected worldwide to provide an oral presentation at the symposium. Her presentation titled, "*The Santee Cooperative Accord: Restoring Diadromous Fish through Prioritization of Sub-basins*" focused on a developing collaborative approach among federal and state resource agencies and utility companies to restore diadromous fish in the Santee Basin. Amanda represents the Service's goals of protecting and conserving inter-jurisdictional fishes as the Service's hydropower coordinator in South Carolina. She actively participates in the Federal Energy Regulatory Commission's relicensing processes for hydroelectric projects.

Mark A. Cantrell of the USFWS (Asheville, NC) also attended the symposium and was selected to contribute in one of two poster sessions. His poster titled "*How Dammed is Your Watershed: First Approximation of an Index to Relative Dammedness of United States Watersheds"* provides an index of dams on multiple scales with focus on the Atlantic Coast. The Dammed Index can be used to evaluate diadromous fish restoration efforts among watersheds. In related work, Mark continues to seek out-migrating American eels (*A. rostrata*) while they are in their 'silver eel' phase with an array of large fyke nets in the Lower Pee Dee and Santee Rivers during late Fall.

The symposium was sponsored by the American Fisheries Society Northeast Division and was attended by over 200 international scientists. Only the second international symposium on the topic, attendees reflected on the first symposium held in 1986, *Common Strategies of Anadromous and Catadromous Fishes.* The 2007 symposium focused on new aspects of biology, migration, energetics, effects of climate change, and population dynamics

of diadromous fishes. Presenters and attendees came from over 20 countries to listen to 42 presentations on a diverse range of topics in six sessions, with a special emphasis on anthropogenic impacts and management in a changing global climatic environment. Proceedings from the meeting, including Amanda's full manuscript and Mark's poster abstract will be published in the AFS Symposium series.

– Wayne Starnes

REGION II-SOUTHEAST

Carrie Straight, Bud Freeman, Mary Freeman, and Brett Albanese are continuing to work on the Georgia Fish Atlas Project. To date, they have developed a draft website with pictures and dowloadable maps for over 100 species. The draft website will be advertised to SFC members when it is ready for review. On a related note, the Nongame Section is working with species experts to develop species accounts and photos for fishes, crayfishes, mussels, and dragonflies that were added to Georgia's protected species list in fall of 2006. Carrie Straight has begun her dissertation work on robust redhorse (*M. robustum*) in the Broad River system of Georgia. Bud and Mary's students along with Megan Hagler have many projects in the Conasauga and Coosa systems this year, including a sampling efficiency study for the federally endangered Conasauga logperch (*Percina jenkinsi*). The DNR Stream Team has initiated sampling in the Southern Coastal Plain Ecoregion of Georgia, which is resulting in many new distribution records for Georgia fishes. The Stream Team recently hired Paula Marcinek to assist them with fish identification, sampling, and data analysis. Jim Peterson and Jason Meador of UGA Forestry-USGS have recently completed a monitoring protocol for freshwater mussels in the Altamaha Basin. Jason Wisniewski is working with Colin Shea on a similar monitoring program for mussels in the lower Flint River system of southwest Georgia. The Warnell School of Forest Resources (UGA) hired Dr. Robert Bringolf in 2007. Robert has extensive experience with fishes, mussels, and toxicology issues and is eagerly pursuing these interests in the Conasauga system. Also in the Conasauga, the USFWS Crew and TNC sponsored a conservation and research summit for the Conasuaga system this spring. The summit was very successful and Alice Lawrence (USFWS) has followed through with a list of high priority tasks and an email listserve for conference participants.

– Brett Albanese

REGION III-NORTH CENTRAL

Steve Fraley and T. R. Russ of the North Carolina Wildlife Resources Commission (NCWRC) report that the Pigeon River Fish Restoration (French Broad River basin) continues to move forward. Since 2003, the NCWRC and cooperators from the University of Tennessee, Blue Ridge Paper Products, the North Carolina Division of Water Quality, Western Carolina University, and others have been working to reintroduce native fishes to the recovering Pigeon River in North Carolina. Silver shiners (*Notropis photogenis*), telescope shiners (*N. telescopus*), mirror shiners (*N. spectrunculus*), Tennessee shiners (*N. leuciodus*), and gilt darters (*Percina evides*) have been translocated from source populations in North Carolina and Tennessee. To date, best indications of success are from the *N. photogenis* which are now considered reestablished over more than 12 km of our target reach and *N. telescopus*, of which multiple year classes are consistently being recovered in decent numbers over several stretches of the River. First reintroduced in spring 2007, *N. leuciodus* are already showing early promise for success. After three years of translocations, the first evidence of *P. evides* recruitment was documented by the capture of an untagged individual in August 2007, however overall recovery rates are low. Fall 2007 translocations were cancelled due to the 2007-2008 drought, high water temperatures, and stressed source populations. Banded darters (*E. zonale*), highland shiners (*N. micropteryx*), and bigeye chubs (*Hybopsis amblops*) will be added to the efforts over the next couple years as other species become established.

With assistance from staff from the USFWS and Conservation Fisheries, Inc. (CFI), the first year survey of a 10-year population monitoring study for the federally threatened spotfin chub (*Erimonax monachus*) in the Little Tennessee River (Macon County) was completed. This population is considered one of the strongholds for the species. The scope and duration of this study specifically follows the Recovery Plan's prescribed actions for obtaining information needed for delisting the species. Ten sites were surveyed by visual snorkeling techniques between Franklin and Fontana Reservoir. Area-specific transects and timed random searches were performed at each site. Previous anecdotal impressions of relatively low numbers were confirmed: a total of 333 fish were observed and the majority of these were found in the lower reaches of the river. On average, the number of *E. monachus* observed per hour and number observed per 50 m transect were much higher at the lower five sites than the upper fiver sites: 8.2 vs. 0.9 fish and 3.6 vs. 0.8 fish, respectively. Overall, the population appeared low with the total observed average for all 10 sites being 4.6 *E. monachus* per 1 hour snorkel time and 2.2 per 50 m transect.

Fraley and Truss have also provided an update on the Cheoah River Restoration (Little Tennessee River basin. With minimum flows restored and other habitat improvements, substantial habitat for *E. monachus* appears to be available in the formerly bypassed Cheoah River in Graham County. In cooperation with the USFWS and CFI, Fraley and Russ will rear *E. monachus* fry produced by CFI for release in the Cheoah River. The first cohort should be hatched during the summer of 2008 and be ready for release in the summer of 2009.

They also report that a lot is happening with sicklefin redhorse (*Moxostoma sp. cf. macrolepidotum*) which is a significantly rare, proposed state threatened, species as ranked by the NCWRC and NC Natural Heritage Program. These actions were made possible by great cooperative efforts among agencies and academia. Scott Favrot, a graduate student at North Carolina State University and supported by funding from the NCWRC and USFWS, recently completed his field studies in the Hiwassee River System. Seasonal movements, spawning habitat, and other aspects of migratory and reproductive ecology were the focus of his study and he will be completing his thesis this spring or early summer. In the meantime, Dr. Robert Jenkins is nearing completion of his long-awaited extensive study and description of the species. Genetic analyses are underway by Dr. Greg Moyers at USFWS in Warm Springs, GA. Fraley and Russ (NCWRC) collected gametes from the Little Tennessee River population during the spring of 2007 for propagation experiments by CFI, with support and assistance from Mark Cantrell, USFWS. These experiments were successful enough for approximately 1,500 juveniles to be released into the Oconaluftee and Tuckasegee rivers (Little Tennessee River System) as an early part of efforts to augment and expand the Tuckasegee River population. The Eastern Band of Cherokee Indians are also partners in this effort and will be working with CFI to grow-out sicklefin redhorse fry again in 2008 and gametes will again be collected in April 2008.

As part of implementation of the NCWRC's Wildlife Action Plan, Fraley and Russ will also be monitoring the status of priority non-game fishes in eight river basins (the New, Watauga, Catawba, Broad, French Broad, Little Tennessee, Hiwassee, and Savannah) in the Western Region at 5 year intervals. In 2007, they began that effort in the French Broad (SFC Region III) and Catawba River (SFC Region I) systems. The sampling regime augments data collected in IBI bio-assessments by the North Carolina Division of Water Quality and the Tennessee Valley Authority. Generally, the news was better from the French Broad River basin than from the Catawba River basin. A few highlights from the results included:

- declines in some of the more sensitive species in the Catawba River basin, notably the Santee chub (*Cyprinella zanema*), a significantly rare species as ranked by the NC Natural Heritage Program;
- mountain madtom (*Noturus eleutherus*), a special concern species as ranked by the NCWRC and NC Natural Heritage Program, was found in the mainstem of the French Broad River at Hot Springs in Madison County for the first time since a specimen was collected by Dr. David Starr Jordan in 1888;
- Ohio lamprey (*Ichthyomyzon bdellium*), a significantly rare species as ranked by the NC Natural Heritage Program, is expanding into the Blue Ridge portion of the French Broad system;
- mooneye (*Hiodon tergisus*), a special concern species as ranked by the NCWRC and NC Natural Heritage Program, was found in the mainstem of the French Broad River near Hot Springs in Madison County for the first time since specimens were obtained by W. D. Harned in 1977 from local fisherman fishing the mainstem of the river near river mile 115 between the towns of Marshall and Hot Springs;
- sharphead darter (*Etheostoma acuticeps*), a state threatened species as ranked by the NCWRC and NC Natural Heritage Program, continues to do well in the upper Nolichucky River system; and
- stonecat and the blotchside logperch (*N. flavus and Percina burtoni*, respectively), both state endangered species as ranked by the NCWRC and NC Natural Heritage Program, are still extant, but narrowly distributed in the upper Nolichucky River system.

Fraley and Russ anticipate publishing all the results in the near future. They will be conducting status surveys in 2008 in the New and Watauga River systems.

According to Dave Coughlan of Duke Power Company, Duke Energy will be removing the Dillsboro Dam on the Tuckasegee River in Jackson County in 2009. The Dillsboro Dam was constructed in 1913 to supply hydroelectric power and impounds almost 5.7 ha. In 2007, the Federal Energy Regulatory Commission issued an order decommissioning it. Its removal will restore the impounded reach (with a length of over 1.5 km), re-establish a river continuum, and allow for the unimpeded access to an additional 15 km of river upstream to the Cullowhee Dam. As one part of the 401 Water Quality Certification process, Duke Power Company staff will evaluate the Tuckasegee River fish assemblage, both upstream and downstream of the dam, for one year prior to and three years post-dam removal. Sampling will be by a variety of boat and tote-barge or backpack electrofishing methods during May and October of each year. It is anticipated that dam removal will benefit fish and mussel species such as the sicklefin redhorse, (*M. sp. cf. macrolepidotum*) and the Appalachian elktoe mussel (*Alasmidonta raveneliana*) in the river.

Josh Schiering and David Eisenhour (Morehead State University) surveyed Kinniconick Creek, Lewis County, Kentucky in the summer and early fall of 2007 for longhead darters (*Percina macrocephala*). This survey, along with a detailed habitat analysis of *P. macrocephala*, is Josh's M.S. thesis. Prior to this survey, *P. macrocephala* was only known from Kinniconick Creek from three specimens collected by Lew Kornman in the early 1980s. In a 55 km stretch of the stream, 41 sites (most sites were about 120 m) were snorkelled and at 10 of these sites seining and backpack shocking were also used. *Percina macrocephala* appears to be doing fairly well in Kinniconick Creek: a total of 98 individuals were observed, including both adults and YOY. Most specimens were found in the lower part of the Creek, below the mouth of Laurel Fork. There the species is locally common with a few sites containing over

10 individuals. Almost all individuals were encountered while snorkeling, suggesting that *P. macrocephala* successfully avoids seining and shocking. Populations in the Green-Barren River drainage appear to be declining while the Kinniconick Creek population may be the healthiest in Kentucky. Audrey Richter, a "new" graduate student at Morehead, is continuing the survey this summer. Eisenhour also reports that work on the Kentucky Fish Book is progressing. He now has a contract with the University of Kentucky Press, although a manuscript is still several years away. Matt Thomas has joined Brooks Burr and Eisenhour in developing the book. Matt is particularly good at photography and will be contributing a large number of high-quality photos.

Matt Thomas of the Kentucky Department of Fish and Wildlife completed a status survey of the Cumberland darter (*Etheostoma susanae*) in the upper Cumberland River drainage of Kentucky. Prior to this survey, Cumberland darters had been collected from a total of 23 localities, three of which are in Tennessee (O'Bara 1988, Shoup and Peyton 1940). Between 23 May 2006 and 26 April 2007, 45 sites were sampled qualitatively including historic localities and additional sites having potentially suitable habitat that might have resulted in range extensions. A total of 45 specimens were collected from13 localities, including 12 substantiated historic records and one new occurrence record. An additional historic occurrence in TN (Jellico Creek drainage) was not investigated. The 13 current records are distributed in 12 different streams. These streams lie within six different watersheds, each of which likely contains multiple population fragments isolated from one another by poor quality habitat or natural barriers. The six watersheds containing population fragments include Bunches Creek, Indian Creek, Marsh Creek, Jellico Creek, Clear Fork, and Youngs Creek. Males were observed in spawning condition in two streams between mid-April to late May, although spawning was not observed and no nests or eggs were found. Previous records of *E. susanae* reported from the Poor Fork Cumberland River were determined to be Johnny darters (*E. nigrum*). Because of apparent declines during the past two decades, including possible extirpation from 9 streams and 10 historic collection sites, a proposed rule is being drafted that will add *E. susanae* to the federal list of endangered species.

In 2007, the Kentucky Department of Fish and Wildlife Resources began a long-term (20+ year) plan to restore lake sturgeon (*Acipenser fulvescens*) to Kentucky. The primary goal is to re-establish a self-sustaining population within its native range in the upper Cumberland River drainage. The Cumberland River drainage below Cumberland Falls was chosen as the focal area for *A. fulvescens* restoration efforts in Kentucky because of its relatively good water quality and potentially suitable habitat conditions. This section of the Cumberland River also includes two large free-flowing tributaries, the Rockcastle River and Big South Fork, which may be utilized by the sturgeon as they undergo long-distance movements in search of feeding and (eventually) spawning areas.

Last April, the Department's Pfeiffer Fish Hatchery in Frankfort received fertilized eggs from Wisconsin Department of Natural Resources taken from the upper Mississippi River drainage. The eggs hatched in 5 to 7 days, after which the young were fed a variety of natural and commercially prepared foods. At present, 296 *A. fulvescens* averaging approximately 180 mm in length are ready to be released into the Cumberland River between Lake Cumberland and Cumberland Falls. About 270 of these fish will be released in the Cumberland River near Noe's Dock at the mouth of Laurel River during mid-April 2008. They will be marked using a scute removal protocol to identify year classes. The remaining 20 to 30 fish will be retained in the hatchery for another year allowing them to grow large enough to be implanted with radio transmitters to monitor movement and habitat utilization. The Pfeiffer Hatchery anticipates receiving an additional allotment of eggs from Wisconsin that will be hatched and reared over the next year. The hatchery and staff are now prepared to handle a larger number of fish to be released in 2009.

A valiant effort (a veritable Slender Chub Blitz) over two days in May 2007 at several historic localities in the Clinch River by CFI, USFWS, TVA, and UTK failed to locate the elusive Slender chub (*Erimystax cahni*). The group did have some other significant finds, including a record number of pygmy madtoms (*Noturus stanauli*) at several sites in the past few years. Last spring, five specimens of this federally endangered fish were collected at a single site with minimal effort. Several of these fish spawned at CFI. Plans are being made to put forth more effort to collect *E. cahni* in May and June 2008 in the Clinch and Powell Rivers.

Jim Herrig of the US Forest Service reported on the Citico Creek Buffalo Spawning Run, a natural phenomenon enjoyed by a choice few at Citico Creek on the Cherokee National Forest, during 2007. This event is quite spectacular to see approximately 50,000 fish that are from 400 mm to over 500 mm in length, weighing from 1 to 3 kg congregated in a 400 m stretch of stream. Whether you watch the fish from the bridge or get in the water with them (snorkeling in a wetsuit), it is worth the trip to Citico Creek to view firsthand. Every year in April, the buffalo fishes make their spawning runs into Citico Creek (as well as other streams). J.R. Shute (CFI) points out that at least two species of buffalo are present: the black buffalo (*Ictiobus niger*), and the smallmouth buffalo (*I. bubalus*). In 2007, carpsuckers (*Carpiodes* spp.) and several redhorses (mostly *Moxostoma anisurum*) joined these spawning runs. According to Herrig, water temperature and moon phase did not seem to have an effect on the timing of the Citico Creek buffalo spawning run in 2007. There were large temperature fluctuations (4.4° C to 17.2° C) in Citico Creek prior to the run. The run occurred when the water temperature was 8.3° C to 15.5° C. The 2006 run occurred during a full moon while the 2007 run occurred during a new

moon. Rather, Herrig suspects that day length and the relatively warm water temperatures in Tellico Reservoir stimulate the buffalo fishes to stage at the mouth of Citico Creek in early April. Once they are staged at the mouth of Citico Creek and day length is adequate, the buffalo fishes will wait for a significant flow event and move upstream as the water is dropping. It is suggested to look for the fishes from the Lower Citico Creek Bridge to the mouth of Duncan Branch. They will remain in the Lower Citico Creek for only 5 days.

Conservation Fisheries Incorporated (CFI) had an extremely busy year in 2007, with more news than can be discussed in a reasonable amount of space. Newsletters at CFI's website provide additional information, along with photos and video. Field work was initiated unusually early during a bizarre warm spell in mid-March, with a trip to southern Tennessee to collect endangered boulder darter (*Etheostoma wapiti*) brood stock and survey for threatened slackwater darters (*E. boschungi*). Eight *E. wapiti* were collected to add to the captive population, along with a bonus: two ashy darters (*E. cinereum*). These were the first collected from the Elk River since 1981 and only the second and third from that stream in Tennessee. The darters were given to Steve Powers, who is re-describing the species and elevating two populations to new species.

Surveys of numerous potential *E. boschungi* sites near Lawrenceburg were unsuccessful with the exception of the first site visited, a historic (1976) locality on Chief Creek, a tributary of the Buffalo River. Here, in a scour hole below a culvert, filled with leaves and trash (including a toilet), six *E. boschungi* were collected with fine-mesh dipnets. Because the site was the last remaining pool in a dry creek bed and about to dry up (the 2007 drought was already underway) all were returned to CFI to maintain as an 'ark population'.

April is when many species begin to spawn at CFI and when several species are 'stocked out' in order to have an opportunity to spawn in the wild, as well as to create space for new fishes. During this period, 46 tangerine darters (*Percina aurantiaca*) were released to the Pigeon River at Denton (the first ever). Also released were 277 endangered smoky madtoms (*Noturus baileyi*), 419 threatened yellowfin madtoms (*N. flavipinnis*) and 295 threatened spotfin chubs (*Erimonax monachus*) to Tellico River. In Shoal Creek south of Lawrenceburg, 628 endangered boulder darters (*Etheostoma wapiti*) were also released.

May through July required the usual juggling of hatchery spawning and rearing (spotfin chubs, boulder darters, logperch, blueface darters, etc.) combined with collection of wild nests to rear endangered duskytail darters (*E. percnurum*) from Citico Creek and Little River (TN). Wild nest collections of *N. baileyi* and *N. flavipinnis* were also made from Citico Creek, Copper Creek (VA), and the Powell River (TN and VA). Survey work ranged from central Tennessee (Kelley Creek, a tributary of Harpeth River), to north Georgia (Etowah River and Conasauga River tributaries), to western Virginia (Clinch River near Cleveland). Pygmy madtoms (*N. stanauli*) collected from the Clinch River produced several spawns and, ultimately, several progeny, despite numerous problems with the incubation of eggs. Propagated *N. flavipinnis* were released in the Powell River near Jonesville for only the second time, but not before monitoring by snorkeling located three tagged individuals that had been stocked during the first (i.e., previous) year, one of which was a male defending a clutch of eggs. These were collected and taken to CFI to rear for 2008 stocking, along with other nests collected from the main population many kilometers downstream.

Typically, the period from August until the end of the field season is the primary snorkel monitoring and survey season for CFI, during normally low flows and optimal visibility. Due to the ongoing drought in 2007, water was so low that some smaller streams were too low to survey many habitats effectively, except pools. More positively, however, many larger rivers (particularly the Clinch River) were at levels and visibilities more optimal than had ever been experienced, permitting ideal snorkel conditions. Some of the results of this survey work (as briefly as possible) are:

- Abrams Creek: restored populations of *N. baileyi* and *N. flavipinnis* continue to thrive, while *E. percnurum* appear to be more numerous than in the source population in Citico Creek. Keith Gibbs and Jason Throneberry (TTU students) did the bulk of the monitoring for thesis work.
- Citico Creek: minimal monitoring, but the three latter species appear to be at least stable.
- Tellico River: *N. baileyi* and *E. percnurum* populations are reproducing while *E. monachus* were observed, but did not appear to have reproduced this year (due to low flows). This is despite notable recruitment in 2006. It is hoped that additional releases of >1200 *E. monachus* in 2007 will offset this low recruitment year.
- Little Tennessee River: Populations of *E. monachus* have recovered somewhat at most survey sites from worrisome lows observed in 2006.
- Clinch River (VA): The known distribution of *N. flavipinnis* doubled from approximately 24 km to 40 km while *E. cinereum* distribution (not collected from VA from 1964 to 2006) expanded to 24 rkm.
- North and South Toe Rivers (NC): Surveys of these rivers produced observations of blotchside logperch (*Percina burtoni*), olive darter (*P. squamata*), sharphead darter (*Etheostoma acuticeps*), and blotched chub (*Erimystax insignis*).
- Shoal Creek: 14 stocked and tagged *E. wapiti* observed at their release site, but none were observed in the shoals or other potential habitat downstream. Also, approximately 600 *E. monachus* were released (first release for the species in this Creek).

- Little River: No *E. percnurum* were observed at two stocking sites, so the fall release of approximately 90 darters will be at a new site. Surveys revealed a robust new local population.
- Conasauga River: While population of blue shiners (*Cyprinella caerulea*), holiday darters (*E. brevirostrum*), and bridled darters (*Percina kusha*) appear to be expanding, no endangered Conasauga logperch (*P. jenkinsi*) were observed.
- Little Chucky Creek: Three checks of PVC pipe traps set out in March failed to produce any Chucky madtoms (*N. crypticus*). Either the technique is unproductive or the species increasingly appears to be extinct.

After successfully producing more than 1,200 logperch to serve as mussel hosts, CFI collected *P. burtoni* from the Little River to attempt propagation in 2008. The goal is to restore *P. burtoni* to Tellico River, Citico Creek, and Abrams Creeks. Endangered Roanoke logperch (*P. rex)* were collected from the Roanoke River (VA) to develop propagation protocols and hopefully produce life history information critical to population viability analysis. The goal is to promote the conservation of this fragmented and highly imperiled species.

Finally, CFI hatchery technician, Meredith Penland, left to pursue graduate work at Coastal Carolina University (on, of all things, sharks…but maybe we will get her back in freshwater someday). We welcomed her able replacement, Becky Franklin, from Appalachian State, as well as UTK graduate student and part time worker, Russ Bohl. Missy Petty joined the crew in early 2008. Many thanks are also deserved by all the volunteers that assisted this year, particularly UTK students and state and federal agency staff too numerous to list.

– Mark Cantrell

REGION IV- SOUTH CENTRAL

Mark Peterson and Todd Slack have initiated juvenile Gulf sturgeon (*Acipenser oxyrinchus desotoi*) research on the lower Pascagoula River (USFWS funds) and a project on habitat delineation and reproduction of saltmarsh topminnow (*Fundulus jenkinsi*) through SWG funds. Part of the latter project will also develop a diagnostic guide and key to many estuarine members of the Family Fundulidae based on spawning of known adults. Mark is also working with Rich Fulford at the Gulf Coast Research Laboratory on a northern GOM NOAA initiative on mapping the lower Pascagoula river water quality and CPUE of juvenile spot (*Leiostomus xanthurus*) in order to test a spatially-explicit model of habitat use. Work is winding down on oyster restoration trajectories and food web tracking with stable isotopes in the Grand Bay NERR. Finally, both Mark and Todd are collaborating with Pam Schofield of USGS in Gainesville on some Nile tilapia (*Oreochromis niloticus*) eradication (see paper reference below) and salinity-temperature tolerance experiments. Some recent papers include:

Partyka, M.L. and M.S. Peterson. (2008). Habitat quality and salt marsh species assemblages along an anthropogenic estuarine landscape. *Journal of Coastal Research* (in press).

McDonald, J.L., M.S. Peterson, and W.T. Slack. (2007). Morphology, density, and spatial patterning of reproductive bowers in an established alien population of Nile tilapia, *Oreochromis niloticus* Linnaeus. *Journal of Freshwater Ecology* 22(3):461-468.

Schofield, P.J., W.T. Slack, M.S. Peterson, and D.R. Gregoire. (2007). Assessment and control of an invasive aquaculture species: an update on Nile tilapia (*Oreochromis niloticus*) in coastal Mississippi after Hurricane Katrina. *Southeastern Fishes Council, Proceedings* 49:9-15.

Bernie Kuhajda at the University of Alabama reports that graduate students are working on several projects. Brook Fluker is continuing his work on the population genetics of spring darters in Alabama, where he is finishing work on watercress darters (*Etheostoma nuchale*) and has started examining rush darters (*E. phytophilum*) and coldwater darters (*E. ditrema*), as well as two Tennessee River species, the slackwater darter (*E. boschungi*) and the Tuscumbia darter (*E. tuscumbia*). He is also looking at the status of *E. nuchale* and the Turkey Creek population of *E. phytophilum* during recent drought conditions. Mike Sandel is continuing his work on relationships and phylogeography of *Elassoma* and has finished a status survey of the spring pygmy sunfish (*E. alabamae*) in the Tennessee River drainage. Grey Hubbard continues his work on the population genetics of *Pteronotropis*. Former undergraduate student Micah Bennett (now at Saint Louis University) has finished life history studies on the black madtom (*Noturus funebris*) and the frecklebelly madtom (*N. munitus*), with publication due out soon. Undergraduate Heath Howell continues his work on a survey of lower Shades Creek, an urbanized tributary to the Cahaba River. He has surprising found two federally listed fishes, the endangered Cahaba shiner (*Notropis cahabae*) and the threatened goldline darter (*Percina aurolineata*), as well as a recently-dead shell of a listed mussel, the fine-lined pocketbook mussel (*Hamiota altilis*), in a stream that was considered too impaired to support such sensitive species.

– Bernie Kuhajda

REGIONS V AND VI – NORTHWEST AND SOUTHWEST

Bob Hrabik of the Missouri Department of Conservation and his colleagues from Nebraska (Steve Schainost, Ed Peters, and Rick Stasiak) are nearing completion of "A Field Guide to Nebraska Fishes" which is to

be published by the University of Nebraska in 2009. The book will be illustrated by Justin Sipiorski and will include a dichotomous key, family and species accounts, distributional maps, and more. The authors are viewing this book as a fairly rapid production to introduce students and enthusiasts to some fishes of the Great Plains. It is written in anticipation of a "more scholarly" textbook on the fishes of the Central Plains. The authors hope to live long enough to write the Central Plains book and before global warming and dewatering extirpate fishes from this region. Bob also provided the following detailed reports on regional studies of a failed reservoir, restoring riverine habitats, and the reintroduction of alligator gar (*Atractosteus spatula*).

On the morning of 14 December 2005, a triangular section on the northwest side of a pump-storage reservoir in southeastern Missouri failed, releasing one billion gallons of water in twelve minutes and sending a 20 foot (7 m) crest of water down the East Fork Black River. This wall of water decimated the lower elevations of Johnson Shut-Ins State Park and deeply scoured and reconfigured the channel of the East Fork. This most unfortunate event will have long-lasting impact on the aquatic resources of this river. However, amidst this tragedy, biologists from the Missouri Department of Conservation's Open Rivers and Wetlands Field Station (ORWFS) and regional staff were fortunate that in June 2005, an extensive fishery survey was conducted by this team to establish a fish assemblage baseline. Since that fateful day, ORWFS and regional staffs have been monitoring the recovery of the fish assemblage. Two sampling designs are being employed at present. One is a fixed point sampling design carried out by one crew and the second is a stratified-random design carried out by another. To date, several subsequent surveys have been completed with one more year of post-failure data collection scheduled. Preliminary data analysis suggests that benthic fishes (darters and madtoms) suffered dramatic initial losses, as well as a large population of bigeye chub (*Hybopsis amblops*). Subsequent surveys suggest that the benthic fishes are rebounding, but *H. amblops* has not. This may be due to a lack of potential *H. amblops* founders to re-colonize the area because many of the benthic species can move from downstream to upstream locations, but the largest *H. amblops* population was between the lower reservoir (which did not fail) and the upper reservoir (which failed). Downstream populations of *H. amblops* cannot pass the lower dam and there may not be a large population of this species above the area that was impacted by the flood. Bob and staff are currently analyzing the data for an interim report.

The staff of ORWFS have long been involved in restoration planning for the Middle Mississippi River (MMR). Some rehabilitation projects conceived by MMR partners have been assimilated into the Navigation Environmental Sustainabilty Project (NESP) for the Upper Mississippi River. One such project, the restoration of Buffalo Island, located between river miles 24.7 and 26.1 (right descending bank), is designed to improve connectivity between the main and side channels, improve water quality, and diversify water depths and substrate with the goal of improving species richness and heterogeneity. Field Station personnel are completing three years of pre-construction monitoring in the chute (side channel) and have established a baseline for fish assemblage structure and water quality (including nutrients). Water quality is being monitored using data loggers, especially during low flow periods, and the fish assemblage is being sampled specifically when the communities become isolated during low flows. The hypothesis is that greater connectivity (thus shorter periods of isolation) will be reflected by higher species richness and water quality values indicative of the main channel of the river (e.g., elimination of dissolved oxygen sags).

Alligator gar (*A. spatula*) were reintroduced to Mingo NWR. The goal of this project is to monitor with radio transmitters the movement and habit use of *A. spatula* in Mingo NWR. This project is being performed by Southeast Missouri State University (SEMO) graduate student Levi Solomon, with assistance from another SEMO graduate student, Liz Brothers, and from ORWFS and regional fisheries personnel. The project is being conducted under the guidance of Mike Taylor (SEMO), Chris Kennedy (MDC), and Bob Hrabik (ORWFS). Ina progress report, Dr. Taylor writes that 19 juvenile *A. spatula* were stocked randomly into Monopoly Marsh, located in Mingo NWR on 25 May 2007. Beginning on 29 May, *A. spatula* were monitored on a daily basis for the first 30 days to track dispersal patterns into the marsh. During this 30 day period, each tagged individual was located every other day during daylight hours. After this 30 day period, the monitoring effort was reduced to two days per week with a goal of recording the location of each tagged gar once per week. While monitoring the dispersal patterns of *A. spatula*, 222 locations were obtained during the first 30 days with an average of 12 locations per day. The location of each tagged individual was well established within the first seven days. During the six months from July through December 2007, 270 gar locations were recorded. Initial results indicate one of two movement patterns. Some individuals have shown little movement since their first recorded location following introduction. Most movement is restricted to less than 100 m of their previous locations. In comparison, other individuals have moved considerable distances during a short time span and then remained sedentary for long periods, followed by another long distance movement to a new location. For example, one individual was initially located in Ditch 5, moved north overnight nearly 1.6 km to a new position in Monopoly Marsh and then remained at this new location for nearly three months. This individual subsequently moved south 640 m to a new and still current location.

To facilitate accelerated learning, *A. spatula* were also placed in a 140 ha floodplain lake near Cape Girardeau, Missouri. This objective has two goals. The first is to determine the dietary composition of juvenile *A. spatula* introduced into Marquette North Lake. The second goal is

to monitor movement of radio-tagged gar. This objective is being performed by SEMO graduate student Elizabeth Brothers, with assistance from Levi Solomon, from MDC personnel, and from SEMO undergraduate students. Twelve radio-tagged juvenile *A. spatula* were released in Marquette North Lake in 2007: six in May, and six in November. In July 2007, each individual was monitored four times per week, once for each time of the following time periods: dawn, day, dusk, and night. Dawn and dusk locations of the *A. spatula* are determined in the hour preceding and succeeding sunrise and sunset.

In general, *A. spatula* were mostly sedentary during the summer, exhibiting little to no movement. Two exceptions to this observation included the long distance movements of one individual (tag #23) in early July and another individual in late August. These movements lasted less than one week before they returned to their prior sedentary behavior. During this time individual #23 presumably left the Lake through the outflow at the northeast side. This individual has not been located during any subsequent tracking events. Another individual (tag #563) was located in a small slough connected to the Lake. This slough was surrounded by trees and water temperatures may have been cooler in this area than in Marquette North Lake. In fall, rain events and artificial flooding raised water levels and juvenile alligator gar began to exhibit sporadic movements including both short and long distances. Five of six radio-tagged *A. spatula* released in November initially moved to the inflow area, which is characterized by greater flow and warmer water temperatures. After a short period of time these individuals dispersed out to different areas of the Lake. Some of these individuals seemed to establish territories quite readily and then become sedentary, while others exhibited sporadic long distance movements. In winter, *A. spatula* exhibited variable movement patterns. Most individuals have remained sedentary, exhibiting only occasional short distance movements. In contrast, three others exhibited short to moderate distance movements more regularly, or are sedentary for a few weeks followed by sporadic long distance movements. Winter movement patterns of *A. spatula* may be complicated by variable and, at times, unseasonably warm temperatures. A recent rain event followed by a string of warm days has prompted a formerly sedentary individual (#744) to make a long distance movement out of the Lake and into an adjacent, shallow, flooded field.

The fish assemblage in Mingo NWR has been surveyed annually for the last three years to document annual variation in fish assemblage structure (relative changes in species richness and heterogeneity) in anticipation of potential trophic changes in the fish assemblage in response to reintroductions of *A. spatula*. The survey design incorporates the methods of occupancy sampling to determine capture probabilities of species that are *and those that are not* sampled using a multi-gear approach. Much of the first three years of data collection has been used to fine-tune the sampling design. We think this acceptable because we assume that impacts to the fish assemblage by *A. spatula* are minimal due to their small size and very low stocking rate (1 fish per 1.2 ha). We feel that a good fish assemblage baseline has been established and includes a few species not previously recorded from the Basin (mostly Ozarkian waifs). Nearly 80 species of fishes can be found in the Mingo Basin, many of which represent some of the farthest northern distributions for the species, such as taillight shiner (*Notropis maculatus*), banded pygmy sunfish (*Elassoma zonatum*), bantam sunfish (*Lepomis symmetricus*), and flier (*Centrarchus macropterus*). This work is being lead by Bob Hrabik, Chris Kennedy, and Steve Sheriff, all of MDC.

Steve Filipek of the Arkansas Game and Fish Commission (AGFC) reports that the Arkansas Stream Team program (a citizen's based effort managed by the AGFC supported by dozens of state, federal, local agencies, and NGOs that works with the US Army Corps of Engineers and local landowners) continues to improve aquatic habitat for fishes, invertebrates, and amphibians. On both the Eleven Point and Current Rivers in north central and northeastern Arkansas, AGFC biologist Stephen O'Neal is working with herpetologist Kelly Irwin and COE employee Louis Clarke to both mitigate for environmental disturbance while at the same time enhancing the aquatic environment using large slab rock at the end of stream bank remediation structures. This large, flat, and irregular rock is preferred substrate and habitat for the imperiled Ozark hellbender (*Cryptobranchus alleganiensis bishopi*), a very large endemic salamander that inhabits clear, rocky-bottomed Ozarkian streams in Arkansas and Missouri. In addition, this slab rock is good habitat for various invertebrates including numerous crayfish species, which not only hellbenders, but also smallmouth bass (*Micropterus dolomieu*) and Ozark bass (*Ambloplites constellatus*), another Ozark endemic, feed on. This work is a "win-win" situation for the landowner, who gets his or her streambank erosion controlled and the aquatic biota, including some species of greatest conservation need in the Ozark ecoregion, get improved feeding and cover habitat.

Henry Robison, Southern Arkansas University, will retire 30 June 2008. He and Tom Buchanan are still feverishly working on the completion of the second edition of "Fishes of Arkansas" by autumn so they can take the manuscript to the University of Arkansas Press for publication. Rob and Keith Crandall are working on the crayfishes of Arkansas for an eventual book treatment. Currently, they are collecting statewide and getting DNA information for all state crayfish species.

In July 2007 following the ASIH meetings, Wayne Starnes and Morgan Raley made a foray through Missouri and Arkansas with the principal aim of filling in sampling gaps for the long ongoing study of the redfin shiner (*Lythrurus umbratilis*) complex in that region. This study is an outgrowth of an investigation of a form having much reduced melanistic fin pigmentation in breeding

specimens that occurs above the fall line in the Ouachita River system which Wayne discovered some 28 years ago and, about every decade, has the opportunity to further explore. Wayne, Henry Robison, Dick Bryant, and Morgan have been collaborating to study Ouachita populations and those in adjacent basins via a combination of morphological and molecular techniques, coupled with careful analysis of breeding coloration documented photographically. Like so many other investigations that initially present themselves as straightforward, this one has quickly blossomed into a perplexing problem, especially once exposed to some genetic scrutiny. There is evidence of interaction between the upper Ouachita form and related taxa in adjacent basins that must be sorted out and, to complete the regional investigation, sampling areas critical to investigating the status of the two currently recognized subspecies of *L. umbratilis* needs to be accomplished, especially in tributaries to the Arkansas River in northwestern Arkansas. Attempts to sample a few of these tributaries in July were not fruitful and more effort will have to be brought to bear in this area, hopefully facilitated by better information on recent occurrences of this minnow. Once that is accomplished, hopefully publication of at least a molecular based analysis of the regional problem will be forthcoming. Despite the incomplete success with *Lythrurus* sampling, there were some nice bonus collections of other species taken along the way. Perhaps most significant among these was the collection of pallid shiner (*Hybopsis amnis*) in the lower mid reach of Strawberrry River in Arkansas which, according to Henry Robison, may constitute only the second record of this species in that region of the state and the sole record in the past 40 or 50 years.

Bobby Reed of the Louisiana Department of Wildlife and Fisheries (LDWF) reports that the Inland Fish Division, District 5, continues to monitor streams and rivers of southwest Louisiana as part of the post Hurricane Rita recovery efforts. Indications are that area fisheries resources are well on the way to recovery and this year's focus is on the Calcasieu River and Lacassine National Wildlife Refuge. While low levels of salinity are still present in the freshwater pool of the refuge, centrarchids, especially redear sunfish (*L. microlophus*) and largemouth bass (*M. salmoides*) are growing and reproducing well. In addition to age, growth, and genetic studies of *M. salmoides*, LDWF biologists will be conducting a creel survey during the open fishing season to assess harvest effort, catch rates, and angler satisfaction. The information is used to manage the fisheries resources on the refuge and a cooperative venture with the USFWS (the landowner). District 5 fisheries biologists are also assessing the life history of *A. spatula* in Louisiana, with this year's focus of developing a reliable method to age these large, long-lived species. Otoliths are being examined under differing techniques in order to determine reliability and precision of aging. Other information being collected include: lengths, weights, sex, maturity, and fecundity.

Pallid sturgeon (*Scaphirhynchus albus*) continue to be studied in and around the Old River Control Complex (ORCC) near Simmesport, Louisiana, in an effort to assess populations and seasonal movements in the Atchafalaya River. Studies using mark and recapture techniques, identification of sex and stage of maturity, and morphometric analyses continue as part of a three year project involving Louisiana's only endangered fish species. In a cooperative venture involving the USFWS, LDWF, the US Army Corps of Engineers, and Mississippi State University, *S. albus* are being implanted with sonic tags and actively tracked (MSU personnel) and passively tracked, utilizing VR-2 receivers positioned on bridge abutments and other useful structures along the River.

Neil Douglas, professor emeritus at the University of Louisiana at Monroe, continues work on the re-organization, consolidation, and expansion of the university's museum collections. After over 50 years of having natural history items and research collections scattered throughout several buildings and departments, the University of Louisiana at Monroe, Museum of Natural History is finally housed under one roof. The move was recently completed and all facets of the zoological, botanical, archeological, and paleontological collections now reside in the 8000 square foot (743 square meters) third floor of Sandel Hall. Exhibits occupy approximately one third of the area while the fluid research collections of fishes, amphibians, and reptiles plus the herbarium fill the remainder of space. The vertebrate and plant collections are among the largest in the world with a primary focus on southern North America. but important collections from Africa, Asia, Micronesia, and the Neotropics are also present. The archeological collections contain the largest number of excavated Archaic mound artifacts from the oldest mounds in North America.

Biologists at the US Army Engineer Research and Development Center (ERDC) Waterways Experiment Station are assisted by Neil Douglas, in the field and in the laboratory, and by commercial fisherman William Lancaster, in the field. Together, the team is studying fish assemblage ecology of several drainages. In collaboration with Henry Robison, Jan Hoover is compiling results from a comprehensive study of the White River basin – including field surveys of Ozark stream fishes and the paddlefish (*Polyodon spathula*) population in the lower White River, AR. The ERDC team is also studying fishes in Big Cypress Bayou, TX, prior to and following restoration of a gravel bed intended to provide spawning habitat for *P. spathula*. Jack Killgore is taking the lead on experimental field studies to assess fish passage in the New Madrid floodway. Most of the group's work, however, is focused on the Mississippi River. Bradley Lewis is using videography and field data to assess importance of dike-notching and secondary channels as fish habitat. Krista Varble is continuing studies of silver carp (*Hypophthalmichthys molitrix*) in floodplain wetlands. Catherine Murphy is completing analysis of a long-term study of delta stream fish assemblages and their ecological stressors. Phil Kirk conducted

surveys of fishes for a proposed water diversion structure to restore habitat at Lake Maurepas. Jay Collins designed, constructed, and began trials of a new swim tunnel that can accommodate large, fast swimming species. The entire team continues work with pallid sturgeon (*S. albus*) including assessments of demography, morphological variation, and entrainment risk. ERDC biologists recently collaborated with Steve Hernandez-Divers, a professor of veterinary medicine at the University of Georgia. Steve trained members on surgical techniques requisite for an interagency telemetry study and for ERDC studies of sturgeon reproduction. Members of the ERDC team are also working with Ron Nassar and the Lower Mississippi River Conservation Committee (LMRCC) to refine a multi-level decision support model to prioritize habitat restoration projects in the Lower Mississippi Basin.

Marty O'Connell with the Nekton Research Laboratory (NRL) at the University of New Orleans (UNO) reports that fish research activities continue in post-Katrina southeastern Louisiana. While Bob Cashner retired from UNO and moved to North Carolina in 2008, he still plans on taking breaks from his numerous travels to pursue some longtime fish projects, including work in Arkansas and Oklahoma. Senior Biologist Chris Schieble continues his research at the Chandeleur Islands, Louisiana's oldest and most remote barrier island system. Chris also led a team of UNO researchers in analyzing the fishery impacts of releasing Mississippi River flood waters into the estuarine habitats of Lake Pontchartrain via the Bonnet Carre Spillway. While no fish kills have been reported as of early July 2008, there is anecdotal photographic evidence that many non-native silver and bighead carp (*Hypophthalmichthys molitrix* and *H. nobilis*, respectively) were transported from the River to the Lake. Senior Biologist and Database Manager Meg Uzee O'Connell continues her work with the Coastal Conservation Association of Louisiana to geo-reference their large database of angler-tagged fishes. This database includes recapture data for hundreds of fishes collected along the Louisiana coast. Meg and Marty also continue to work on their status survey for the rare blackmouth shiner (*Notropis melanostomus*) in southern Mississippi. This work began last year and will go on through the end of 2008 with the help of NRL Laboratory Manager Jeff Van Vrancken, graduate student Chad Ellinwood (M.Sc.), and undergraduate student worker Ashley Walker. In early summer 2008, with the help of Becky Stowe at the Mississippi Chapter of the Nature Conservancy (TNC) and Todd Slack at the Mississippi Museum of Natural Science, NRL researchers were allowed access to TNC property in the Pascagoula River drainage to survey for *N. melanostomus*. This will be the first time these areas will be surveyed for *N. melanostomus* and the hope is to discover more populations of shiners in these protected regions.

Other NRL projects include the recent completion of Tom Lorenz's dissertation research on the invasive Rio Grande cichlid (*Herichthys cyanoguttatus*), a non-native fish that has become established in southeastern Louisiana and continues to expand. Within the last year, *H. cyanoguttatus* was reported for the first time on the west bank of the Mississippi River in the Barataria Basin and there have been more confirmed collections of this species within estuarine habitats of Lake Pontchartrain. For example, in May 2008 Chris Schieble and a team of NRL researchers collected a pair of *H. cyanoguttatus* at a regular sampling site in Lake Pontchartrain near the Inner Harbor Navigational Canal. This site has been sampled monthly for over eight years, yet this was the first time in that period that *H. cyanoguttatus* had been collected. Graduate student Scott Eustis (M.Sc.) continues his thesis work on the impacts of bycatch on coastal fish assemblages. His preliminary data suggest that over the last half century there has been an increase in the biomass of Lake Pontchartrain catfishes such as hardhead (*Ariopsis felis*) and gafftopsail (*Bagre marinus*) catfishes. It is possible these omnivorous scavengers are benefiting over other species as a result of consuming discarded bycatch from commercial fishing activities. Graduate Student Sunny Brogan (M.Sc.) continues her thesis research on restoring red drum (*Sciaenops ocellatus*) to an urban fishery in Bayou St. John. Her preliminary tracking data confirmed that reintroduced fish could survive in the urban system and she hopes to further define which habitats reintroduced fish prefer within the Bayou.

– Jan Hoover

MINUTES

Business Meeting

33rd Annual Meeting (2007) • Southeastern Fishes Council
Chattanooga Marriott and Convention Center • Chattanooga, Tennessee

The 2007 meeting of the Southeastern Fishes Council was called to order by Chair Noel Burkhead at 5:33 P.M. This was the first stand-alone meeting of the Southeastern Fishes Council. Ninety-eight people were in attendance. Ballots were passed out to each attendee. The following officers were elected:

Gerald Dinkins—Chair Elect
Rebecca Blanton Johansen—Secretary
Anna George-Treasurer

SECRETARY'S REPORT
Brett Albanese noted that minutes from last year's business meeting had previously been approved electronically by the membership.

TREASURER'S REPORT
Kyle Piller discussed our financial situation and provided a hard copy of the following report to Executive Committee members. He noted a recent increase in membership and a healthy bank account.

Dues and Contributions:
July 2006 through 6 November 2007

EARNINGS
Dues: (1 January 2007 through
6 November 2007)..$1,390.00
Back-dues (2005, 2006 dues)..$40.00
Forward dues (2008 dues)..$40.00
Donations & miscellaneous (old reprint purchase)...$55.00

TOTAL $1,525.00

EXPENDITURES
(JULY 2006 THROUGH 6 NOVEMBER 2007)
Proceedings #49, printing/postage cost
(August 2007) $1,325.11
TN Secretary of State (annual report) $20.00

TOTAL $1,345.11

CHECKING ACCOUNT BALANCE
AS OF 6 NOVEMBER 2007..........................$11,043.85

TOTAL ASSETS $11,403.85

Notes
Membership (individuals and organizations) on 5 June 2007, distributed as follows:

Paid through 1998: 6
Paid through 1999: 12
Paid through 2000: 30
Paid through 2001: 31
Paid through 2002: 47
Paid through 2003: 57
Paid through 2004: 93
Paid through 2005: 55
Paid through 2006: 51
Paid through 2007 & lifetime members: 78
(64 regular members, 4 life-members, and 11 students)

Respectfully submitted, Kyle R. Piller

EDITORS REPORT
In the interest of time, Marty did not present this report at the annual meeting. Martin O'Connell and Chris Skelton are preparing the next issue and are lining up other manuscripts for publication in the Proceedings, including one from Royal Suttkus and Jim Williams. Marty would be very happy if some of the presenters at the meeting would submit manuscripts to Proceedings. Directions for submission are on the SFC website.

OLD BUSINESS
Mel Warren asked if all Proceedings had been put on the website. Marty O'Connell and Noel Burkhead replied yes. Noel added that the website has a password protected feature that will enable members to download the current issue of the Proceedings. The intent of website revisions is to provide more services to the members and to provide more information about Southeastern fishes.

NEW BUSINESS
Electronic Only Journal
Mel Warren suggested that we do not print the *Proceedings* anymore and only generate a PDF copy for web posting. He argued that it would save cost and paper. A few members argued that they really enjoy the hardcopy and cited possible technical challenges for some members. A hybrid solution would provide the hardcopy by default, but give the members the option of receiving the PDF only. There was a motion for the Executive Committee to study the issue in further detail, with the options being: 1)Electronic media only (no print), 2) Both electronic and printed editions of *Proceedings* (membership cost to any member wishing

printed edition of *Proceedings* would be slightly higher). The motion was seconded and passed with no dissentions.

SARP

Jay Troxel gave an introduction to SARP, the Southeast Aquatic Resource Partnership. The Partnership includes 14 states, several federal agencies, private companies, and conservation groups. SARP wants us to become a partner and possibly assist on their technical committees. They also formally invited us to their meeting in mid-November.

Noel Burkhead suggested that participation in SARP would be a good opportunity for SFC to help direct resources toward the conservation of southeastern fishes. Peggy Shute asked if SFC could see a list of projects funded by SARP. Noel began reading a list of current projects, which included a GIS project in the Tennessee-Cumberland, a restoration partnership with NOAA, a project to coordinate high priority State Wildlife Action Plan priorities across states, a spring restoration project in the Altamaha, and Pilot watershed conservation plans for the Altamaha, Roanoke, Pascagoula, and Duck Rivers.

Rachel Muir spoke about how SARP fits into the National Fish Habitat Initiative. This national initiative, modeled after the highly successful North American Waterfowl Management Plan, can support regional conservation efforts through funding and coordination activities. SARP is one of 5 regional partnerships currently approved under the initiative.

Mel Warren likes the idea of a formal partnership with SARP, but he would like to see our role more clearly defined. Brett Albanese added that we should proceed carefully, because participation in SARP will likely involve a lot of time for some SFC members. Someone mentioned that would not necessarily have to go to every SARP meeting.

Jim Williams motioned that we send a letter a letter of interest to SARP and send some one to the meeting to explore the idea of a partnership. Jim's motion was seconded and passed with no votes against. Bernie Kuhajda agreed to modify our letter to SARP accordingly, which will express our interest in developing a partnership as opposed to agreeing to partnership status now.

The Drought

Given the negative publicity rare aquatic species have received during the drought, Jim Williams suggested that SFC develop a Resolution or a White Paper on considering rare aquatic species in water supply planning. He asked Bud Freeman to discuss some of the less damaging alternatives for a reservoir. Bud discussed two options. The first option involves building a reservoir off-channel (i.e., in a dry valley) and filling it from a river during high flows. One problem with this design, however, is the incentive to fill off channel reservoirs during low flows. The incentive occurs because sediment laden flood waters are expensive to treat. Apparently, the Bear Creek Reservoir near Athens has been operated in this manner. The second option involves raising the height of existing dams, which still may require filling from a river.

Mark Cantrell said he would not like to see us providing reservoir guidelines without strongly emphasizing the need for greater water conservation. He also mentioned that reservoirs increase evaporative losses.

Peggy Shute recommended that we identify a list of high quality streams that should not be dammed under any circumstances. Jim Williams was concerned that such an effort would leave the impression that rivers not on the list would be fair game for reservoir development. Jim suggested that the Executive Committee appoint a drought resolutions committee.

Andrew Sheldon pointed out that a group out of the RiverBasin Center at UGA already completed a white paper on water supply development a few years ago. Mary Freeman confirmed this.

Mary Freeman offered that it would be difficult for us to articulate detailed policy on water supply issues, but that we could do a resolution or white paper showing the true economic and ecological costs of reservoir building.

Coal Fines

Citing the unacceptable conditions (i.e., frequent "blackwater" events) in the Clinch River, Jim Williams suggested that we send a resolution on coal fines to the EPA, USFWS, OSM, and to the States of Tennessee and Virginia. Lee Barclay pointed out to Jim a 1996 Biological Opinion which OSM may cite in defense of the current activity.

Than Hitt suggested that we comment on a current proposed "buffer rule" related to mountain top mining.

Peggy Shute suggested that opportunities to comment occur regularly and suggested that the SFC become more active in responding to time-sensitive environmental issues.

Bryn Tracey suggested that we send a letter to the state of Virginia first. An unknown person suggested that we send our resolutions to the paper and issue a press release. Bernie confirmed that press releases would be a standard component of all resolutions.

Than Hitt and Lee Barclay agreed to help the SFC officers (or the Resolutions Committee) comment on the proposed buffer rule.

Regional Reports

These reports are now posted on the webpage.

Closing Comments

Noel thanked Jim and Anna and the other executive committee members for setting up a very successful meeting and welcomed Bernie Kuhajda to the chair position.

Chair Kuhajda adjourned the meeting at 6:30 P.M.

Respectfully submitted,
Brett Albanese, Secretary

Information for Contributors

The primary purpose of the *Proceedings* is to publish peer-reviewed research papers and critical reviews of activities; regional reports and notes; and other pertinent information pertaining to the biology and conservation of southeastern fishes. The *Proceedings* is also an outlet for range extensions, distributions, and status papers, covering ecology and conservation ichthyology. Life history studies, faunal surveys, management issues, behavior, genetics and taxonomy of southeastern fishes are appropriate topics for papers in the *Proceedings*. Review papers or information on imperiled waters or fishes are particularly appropriate.

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The entire manuscript including the Abstract (required for longer articles), Introduction, Methods, Results, Discussion, Acknowledgments, Literature Cited, Appendices, Tables, and Figure Legends must be double-spaced. The title, author's name and author's address (including fax number and email address for corresponding author) should be centered on the first page. Indicate a suggested running head of less than ten words at the bottom of the first page. An Abstract (if necessary) will be placed at the beginning of the text. Acknowledgments will be cited in the text immediately before the Literature Cited. All references cited in the paper will follow the standard format of using the last name of the author(s) followed by the year of publication of the paper. In the Literature Cited, the references will be alphabetical by the author's last name and chronological under a single authorship. Literature cited should be standardized and abbreviated, using the *World List of Aquatic Sciences And Fisheries Serial Titles* or guidelines in *CBE Manual for Authors, Editors, and Publishers, 6th edition* for journals not included in the World List.

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Only manuscripts from members of The Southeastern Fishes Council will be considered for publication. There is no charge for publishing in the *Proceedings*. All manuscripts and short communications should be sent to the editor:

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Proceedings is a publication of the Southeastern Fishes Council, Inc., and is published in Milledgeville, Georgia. Officers are Bernie Kuhajda, Chair; Gerry Dinkins, Chair-Elect; Noel M. Burkhead, Immediate Past Chair; Rebecca Blanton, Secretary; and Anna George, Treasurer. Managing Editor for the Proceedings is Martin T. O'Connell, Pontchartrain Institute for Environmental Sciences, 1008 Geology-Psychology Building, University of New Orleans, New Orleans, LA 70148, 504-280-4032, moconnel@uno.edu; Associate Editor is Christopher E. Skelton, Department of Biological and Environmental Sciences, Georgia College & State University, Milledgeville, GA 31061, (478)-445-2440, chris.skelton@gcsu.edu. Proceedings is printed on recycled paper.