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Abstract

(July 2005) - An analysis of the Menidia complex in the Mississippi River Valley and in two nearby minor drainages. By Royal D. Suttkus, Bruce A. Thompson, and Jason K. Blackburn

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Number 48 July 2005

Southeastern Fishes Council Proceedings

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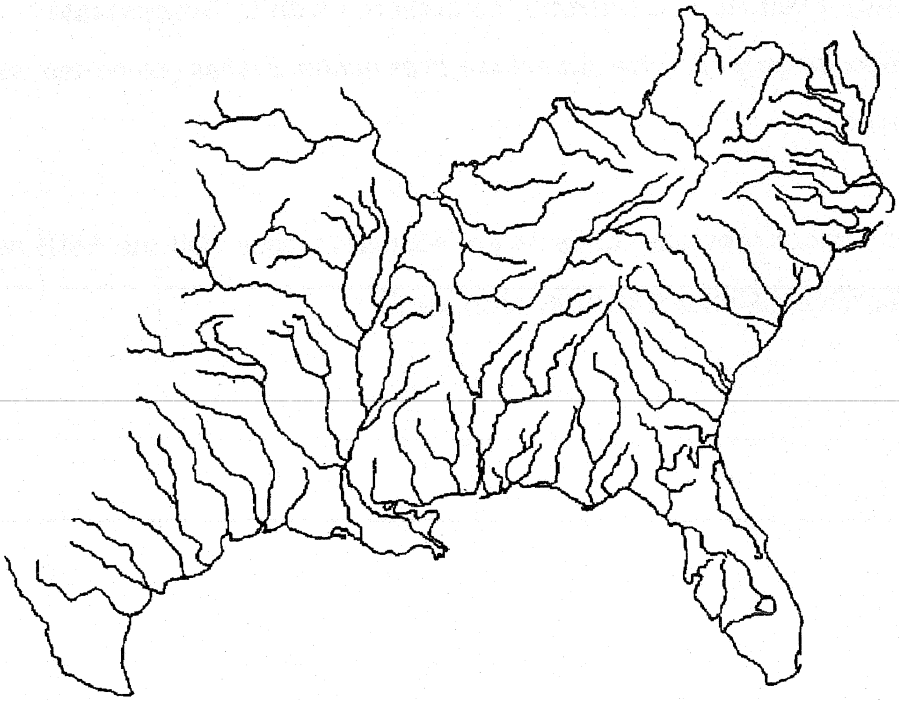

CONTENTS

2004 ROBERT H. GIBBS, JR. MEMORIAL AWARD FOR EXCELLENCE IN SYSTEMATIC ICHTHYOLOGY

The 2004 Robert H. Gibbs, Jr. Award Memorial Award for Excellence in Systematic Ichthyology was awarded to Dr. Edward O. Wiley of the University of Kansas, for his numerous contributions to fish systematics and systematics theory, including the books *Phylogenetic Systematics*, the *Compleat Cladist* (co-authored with D. Siegel-Causey, D. Brooks and V. Funk), *Evolution as Entropy* (co-authored with D. Brooks) and *Zoogeography of North American Freshwater Fishes* (co-edited with C. Hocutt).

For a list of previous Gibbs Award winners, please visit the ASIH website (http://www.asih.org/awards/gibbs.html).

An Analysis of the *Menidia* Complex in the Mississippi River Valley and in Two Nearby Minor Drainages

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INTRODUCTION

Chernoff et al. (1981) concluded that *Menidia beryllina* (Cope, 1869) and *Menidia audens* (Hay, 1882) were conspecific. The purpose of this paper is to present an alternative view of the systematic status of *M. beryllina* and *M. audens*. Our basic premise is that *Menidia beryllina* is a brackish or tidewater inhabitant whereas *Menidia audens* is a freshwater inhabitant. We present data and discussion to support this view. Suttkus and Thompson (2002:7) designated the largest specimen of Hay's (1882) Vicksburg series of syntypes as lectotype of *Menidia audens*, so this study of *Menidia* was concentrated along the main channel of the Mississippi River and from two large tributaries in order to determine uniformity of characters and similarity to syntypes from the Mississippi River at Vicksburg. We also discuss recent changes in distributions and abundances of the two species in several regional rivers.

METHODS AND MATERIALS

Our *Menidia* samples came from six major sites along the Mississippi River, one from the Arkansas River, and two from the Red River. The lowermost site on the Mississippi River was at Fort Jackson, LA, River Mile (RM) 19 (U.S. Army Corps of Engineers, 1969), and the uppermost site was in northwest Tennessee, Lake County, at RM 872 (Fig. 1). The sample from the Arkansas River was from just below Lock and Dam 13 near Fort Smith, AR, RM 293. The single large sample from the upper Red River system came from Lake Texoma, OK and the lower Red River samples came from between RM 86 & RM 112 in the Alexandria, Rapides Parish, LA area (U.S. Army Corps of Engineers, 1958).

In addition, we obtained several series from the

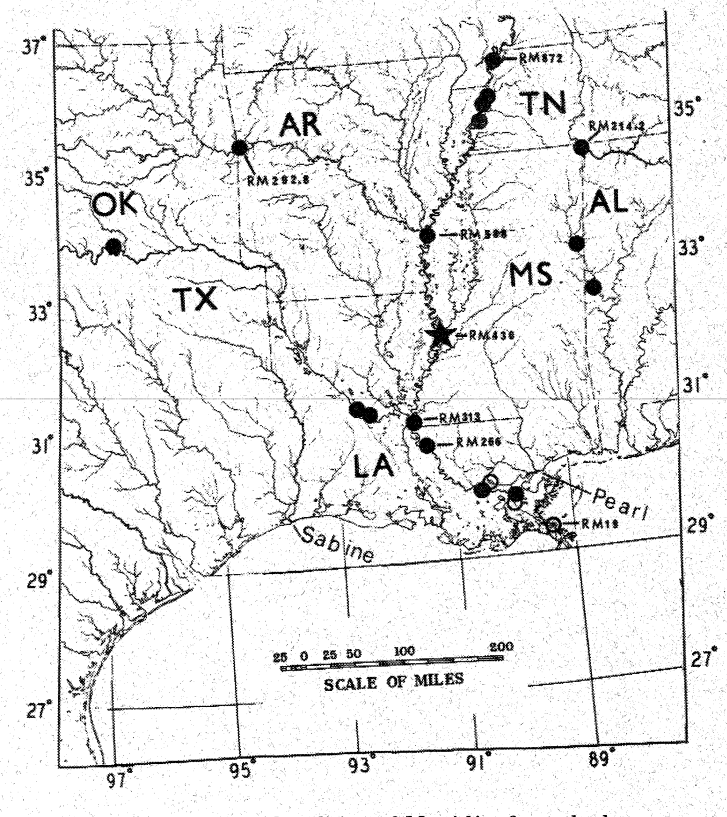

Figure 1. Collecting localities of *Menidia*, from the lower Mississippi valley area, used in this study. ★ Type locality of *Menidia audens*; • *Menidia audens*; ○ *Menidia beryllina*.

Bonnet Carré Spillway (Floodway) near Norco, St. Charles Parish, LA and from five sites along the shores of Lake Pontchartrain (Fig. 2). Figure 3 is an enlargement of the Sabine River system depicting most of the *M. audens* and *M. beryllina* collecting sites along the Sabine River system above Sabine Lake. Also included in our study is one sample of *M. audens* from the Tennessee

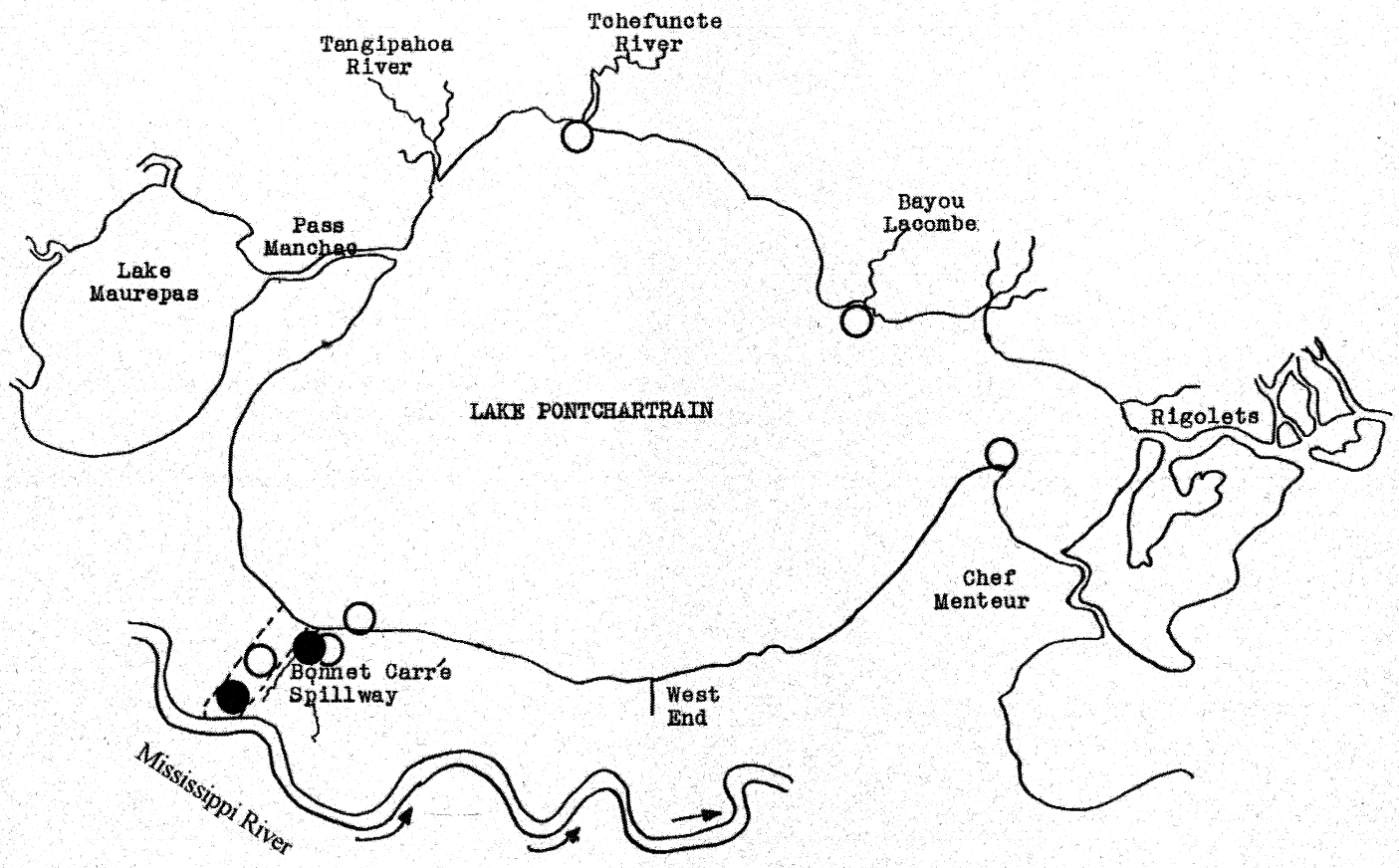

Figure 2. Collecting localities of *Menidia*, from the Lake Pontchartrain area, used in this study. • *Menidia audens*; ° *Menidia beryllina*.

River in Lauderdale County, AL and two collections from the Tombigbee River system, one from the mouth of Noxubee River in Sumter County, AL, and the other from Luxapallila Creek, Lowndes County, MS (Fig. 1). All collections made by the authors were obtained with a nylon seine that was 10 feet (3.05 m) long, 6 feet (1.82m) high, or deep, and had 3/16 inch (0.48 cm) Ace mesh.

Pectoral and anal fin ray counts, pre-dorsal and lateral-line scale counts were made on representative samples of *M. audens* and *M. beryllina* from the localities mentioned above. Standard length and eleven proportional measurements were taken to the nearest 0.1 mm with dial calipers. The eleven proportional measurements were: 1) first dorsal fin origin to snout; 2) second dorsal fin origin to snout; 3) anal fin origin to snout; 4) pelvic fin origin to snout; 5) anal fin origin to caudal base; 6) head length; 7) head depth; 8) orbit length; 9) snout length; 10) body depth; 11) caudal peduncle depth. Proportional measurements were expressed in thousandths of standard length (SL). A simple character index was developed to differentiate the two species by summing pre-dorsal and lateral-line scale counts. Specimens used to construct the index were from English Turn Bend (Mississippi River – RM 78) and the Bonnet Carré Spillway and were identified based upon differences in body morphology (Fig. 4).

Discriminant function analysis (DFA) was performed in SPSS version 11.0 (SPSS, Inc, Chicago, IL, USA) to predict individual specimen membership into two groups-1 = *M. audens*, 2 = *M. beryllina*- based on standard length and the eleven proportional measurements taken. The Shapiro-Wilk test for normality was used to test for a normal distribution and the Box's M statistic was used to test the more important model assumption of equality between population covariance matrices. Stepwise DFA was performed using the smallest F ratio method with an F probability criteria defined at p = 0.5 for variable entry into and p = 0.10 for variable removal from the model. Ninety-eight individuals were used in the DFA. Individuals were assigned to either the *M. audens* or *M. beryllina* species from 27 collections from English Turn Bend and Fort Jackson based on the character index (n = 48 *M. audens*, n = 50 *M. beryllina*). The DFA model was calculated from a random selection of 78.6% of the original specimens (n = 77; *M. audens* = 37, *M. beryllina* = 40) with a 21.4% hold out sample to test accuracy and for model validation (n = 21; *M. audens* = 11, *M. beryllina* = 10).

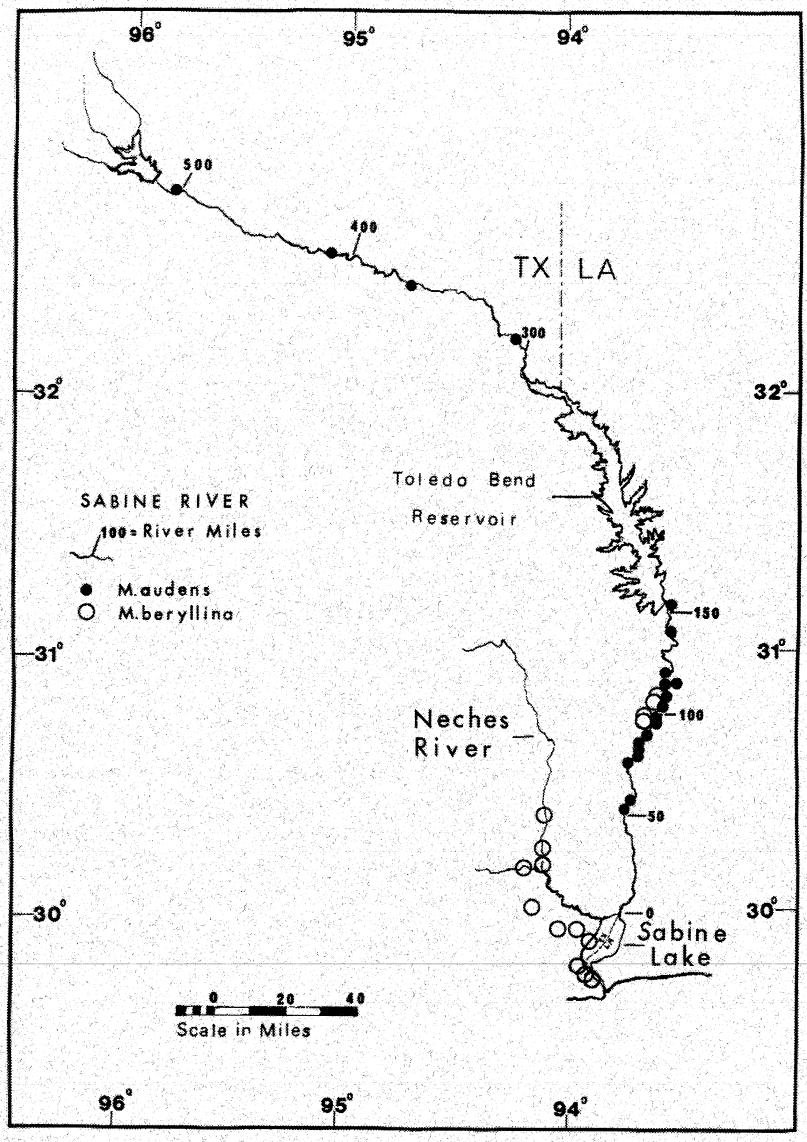

Figure 3. Collecting localities of *Menidia*, from Sabine River drainage, used in this study. •*Menidia audens*; °*Menidia beryllina*. River miles from head of Sabine Lake (e.g. 0, 50, 100, 150) are illustrated along the right side of the River.

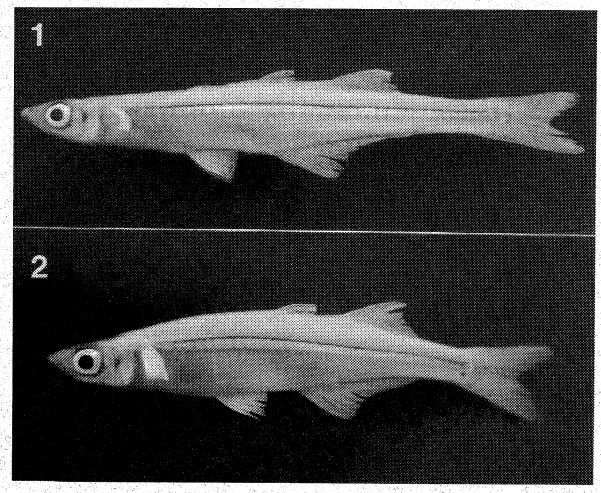

Figure 4. Two species of *Menidia* from the lower Mississippi River, Plaquemines Parish, Louisiana. (1) *M. audens*, TU 151180, adult 92.8 mm SL from English Turn Bend, RM 78; 13 January 1988; R.D. Suttkus and Rudolph Meier. (2) *M. beryllina*, TU 148179, adult 70.4 mm SL from Fort Jackson, RM 19; 30 March 1987; R.D. Suttkus and Veronica C. Trau.

Material Examined. The specimens examined are housed at the following institutions: Geological Survey of AL (GSA); Tulane University Museum of Natural History (TU); University of New Orleans Vertebrate Collection (UNOVC); and University of Tennessee (UT). State Abbreviations: Alabama = AL, Arkansas = AR, Louisiana = LA, Mississippi = MS, Missouri = MO, Oklahoma = OK, Tennessee = TN, Texas = TX, County = Co., Parish (LA Co. equivalent) = Par. Each catalog number is followed by number of specimens examined. Materials are organized by drainage and county or parish.

Menidia beryllina

Mississippi River. LA, Plaquemines Par.: TU 148052 (37), TU 148064 (10), TU 148879 (26), TU 148461 (21), TU 148879 (25), TU149092 (11), TU 149367 (15), TU 149725 (21), TU 150562 (36), TU 150733 (54), TU 150865 (61), TU 151140 (35), TU 151443 (93), TU 151485 (18), TU 152020 (19), TU 152026 (30), TU 153579 (25), TU 195062 (10), TU 195063 (8), TU 195064 (2), TU 195065 (1), TU 195066 (1), TU 195067 (1), TU 195069 (1), TU 195070 (3), TU 195071 (8), TU 195076 (1), TU 195077 (1), TU 195072 (1), TU 195073 (6), TU 195242 (2), TU 153461 (215). **LA, St. Charles Par.:** TU 45526 (8), TU 7757 (5), TU 44893 (6), TU 46218 (2), TU 47863 (40).

Lake Pontchartrain Drainage. LA, St. Charles Par.: UNOVC 7289 (2), UNOVC 7314 (6), UNOVC 7416 (8, 52-70), UNOVC 8282 (14), UNOVC 8299 (10), UNOVC 8308 (19), UNOVC 8326 (4), TU 182174 (1), TU 182184 (2), TU 182195 (7), TU 182203 (2), TU 182212 (1), TU 182380 (6), TU 182401 (1), TU 182411 (20), TU 182422 (3),

TU 182435 (2), TU 182556 (2), TU 182568 (6), TU 182686 (7), TU 183417 (2), TU 183436 (11), TU 183448 (2), TU 183501 (18), TU 183515 (12), TU 183745 (6), TU 183833 (5), TU 183837 (38), TU 184531 (1), TU 184542 (1), TU 184555 (13), TU 184825 (1), TU 184841 (1), TU 184852 (1), TU 185120 (5), TU 185132 (2), TU 185373 (10), TU 188204 (50). **LA, Orleans Par.:** TU 1 (150), TU 8880 (70), TU 63018 (20). **LA, St. Tammany Par.:** UNOVC 7130 (60), TU 80664 (50).

Sabine River Drainage. TX, Jefferson Co.: TU 21497 (20), TU 22332 (3), TU 22354 (1), TU 22036 (9), TU 22292 (3), TU 22059 (13), TU 22196 (27), TU 21521 (30). **TX, Hardin Co.:** TU 109630 (5), TU 110292 (4), TU 113650 (2). **TX, Orange Co.:** TU 112091 (1), TU 113618 (1). **LA, Beauregard Par.:** TU 112787 (2), TU 112753 (1). **TX, Newton Co.:** TU 115059 (2), TU 112769 (3), TU 112739 (4).

Menidia audens

Mississippi River Drainage. LA, Plaquemines Par.: TU 194788 (1), TU 195241 (1), TU 130521 (10), TU 134979 (12), TU 135086 (10), TU 135300 (3), TU 135322 (1), TU 135429 (2), TU 135565 (3), TU 135805 (6), TU 138142 (3), TU 140119 (6), TU 140251 (4), TU 140459 (1), TU 151180 (6), TU 151436 (4), TU 189926 (36). **LA, St. Charles Par.:** TU 45526 (24), TU 5926 (2), TU 7757 (5), TU 15412 (6), TU 17928 (4), TU 18559 (15), TU 195078 (5), TU 46218 (7), TU 47891 (5), TU 48321 (18). **LA, West Feliciana Par.:** TU 99595 (19), TU 99614 (15), TU 108193 (1), TU 109751 (13), TU 109791 (7). **LA, Pointe Coupee Par.:** TU 99659 (20), TU 99677 (22), TU 99706 (28), TU 106729 (3), TU 108132 (50), TU 108155 (5), TU 108177 (10), TU 109810 (1), TU 113160 (2), TU 113215 (10), TU 113378 (5), TU 114546 (4), TU 115679 (3), UT 158.84 (3). **LA, West Baton Rouge Par.:** TU 107985 (4), TU 108042 (30), TU 110839 (3), TU 114513 (9). **LA, East Baton Rouge Par.:** TU 108023 (5), TU 108075 (21), TU 109683 (1), TU 109702 (1), TU 114458 (11), TU 114501 (16). **LA, Rapides Par.:** TU 45166 (2), TU 47562 (1), TU 47635 (1), TU 47635 (1), TU 166549 (2), TU 185475 (10), TU 185484 (31), TU 185492 (17), TU 185500 (10), TU 185511 (41), TU 185523 (20), TU 185530 (10), TU 185542 (11), TU 185585 (10), TU 185597 (20), TU 185612 (45), TU 185622 (10), TU 185635 (40), TU 185644 (15), TU 185653 (10), TU 185667 (10), TU 186518 (10). **OK, Marshall Co.:** TU 56398 (6), TU 72951 (158). **MS, Wilkinson Co.:** TU 59853 (32), TU 70994 (13), TU 86248 (1), UNOVC 5308 (15), UNOVC 5316 (11), UNOVC 5370 (6), UNOVC 5972 (3), UNOVC 6025 (3), UNOVC 6645 (22), UNOVC 8260 (13), UNOVC 9079 (3), UNOVC 9387 (8). **LA, Madison Par.:** TU 48255 (3). **AR, Yell Co.:** TU 43185 (1). **AR, Crawford Co.:** TU 186714 (15), TU 123555 (227). **MS, Bolivar Co.:** TU 86150 (39), **TN, Tipton Co.:** UT 158.132 (34). **MO, Pemiscot Co.:** UT158.192 (12). **TN, Dyer Co.:** UT 158.19 (32), UT 158.20 (23), UT 158.161 (9). **TN, Lake Co.:** UT 158.119 (20).

Lake Pontchartrain Drainage. LA, St. Charles Par.: TU 194787 (1).

Sabine River Drainage. LA, Calcasieu Par.: TU 126391 (3). **LA, Beauregard Par.:** TU 126363 (18), TU 126310 (1), TU 113592 (3), TU 126243 (7), TU 113568 (1), TU 112720 (1), TU 113543 (3), TU 115014 (2). **TX, Newton Co.:** TU 126320 (1), TU 126289 (1), TU 126274 (1), TU 126255 (1), TU 126461 (1), TU 113580 (5), TU 112738 (11), TU 113557 (6), TU 126425 (12), TU 126201 (5). **LA, Vernon Par.:** TU 113515 (4), TU 113529 (40), TU 115005 (4), TU 115915 (15), TU 126401 (7), UT 158.11 (1), TU 112696 (4). **TX, Panola Co.:** TU 127487 (2). **TX, Gregg Co.:** TU 127906 (2), **TX, Smith-Upshur Co. Line:** TU 127958 (2). **TX, Van Zandt Co.:** TU 136897 (5).

Tennessee-Tombigbee Waterway System. AL, Lauderdale Co.: GSA 4963.05 (31). **AL, Sumter Co.:** GSA 3532 (26). **MS, Lowndes Co.:** GSA 3655 (6).

RESULTS AND DISCUSSION

Frequency distributions of anal fin rays and number of pre-dorsal and lateral-line scales were analyzed for *Menidia* from six sites along the main channel of the Mississippi River, one site from the Arkansas River and two sites along the Red River. Our data did not demonstrate clinal variation (Table 1, 2). Rather the data indicated similarities in meristics of *M. audens* from the Mississippi River, Arkansas River, Red River, Bonnet Carré Spillway, Sabine River, recently collected material from Alabama and Mississippi, and Suttkus and Thompson's (2002) material from the Pearl River. Similarly, there were no major differences in the frequency distributions of meristic variables among samples of *Menidia beryllina* from along the shores of Lake Pontchartrain (Fig. 2), from the Bonnet Carré Spillway, or from the Mississippi River at Fort Jackson (RM 19). Our reexamination of TU 45526 from Bonnet Carré Spillway (32 specimens, all considered to be *M. beryllina* by Chernoff et al. 1981) revealed 24 specimens (45-75 mm SL) of *M. audens* and eight specimens (45-52 mm SL) of *M. beryllina*, thus we differ profoundly from the interpretation by Chernoff et al. (1981:331) of the same lot. Chernoff et al. (1981) also did not examine any specimens from the lower Mississippi River proper.

Chernoff et al. (1981:324) determined that, "the fish <50 mm could be classically interpreted as *M. beryllina* on the basis of lateral and pre-dorsal scales, whereas the larger fish have counts of *M. audens*." We size-grouped 30 specimens of *M. beryllina* contained in UNOVC 7130 from the mouth of Bayou Lacombe, northeast shore of Lake Pontchartrain. Ten of the 30 specimens ranged from 40.0 to 44.9 mm SL; 20 of the 30 ranged from 61.8 to 76.0 mm SL. The 10 smaller specimens have 15 to 17 pre-dorsal scales, $\bar{x}$ = 16.2 and have 36 or 37 lateral-line scales, $\bar{x}$ = 36.5; the 20 larger specimens also have 15 to 17 pre-dorsal scales, $\bar{x}$ = 16.25 and have 36 to 38 lateral-line scales, $\bar{x}$ = 37.35. Variation between size groups in this sample showed strong overlap and does not indicate

Table 1. Frequency distribution of predorsal scale counts in species of *Menidia* from Mississippi River and tributaries.

	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	N	$\bar{X}$	SD
M. audens																		
TN area						2	4	13	18	21	19	12	6	1		96	23.0	1.7
Rosedale, MS						2	7	10	11	5	4					39	21.6	1.3
Ft Smith, AR					4	15	48	68	54	36	16	2				243	21.3	1.9
Ft Adams, MS						3	14	33	29	31	14	4	1	1		130	22.1	1.5
Lake Texoma, OK				6	11	37	42	37	25	6						164	20.2	1.4
Alexandria, LA				1	7	44	90	87	61	24	10	1	–	1		326	20.8	1.4
St. Francisville, LA				1	2	8	52	67	76	60	28	14	10	3	1	322	22.0	1.7
English Turn Bend, LA - RM 78																		
M. audens					6	16	28	20	23	7	2	1				103	20.7	1.5
M. beryllina	3	19	89	84	47	12	1									255	16.7	1.0
Ft. Jackson, LA - RM 19																		
M. beryllina	1	75	215	154	59	24	7	2								537	16.6	1.1

Table 2. Frequency distribution of lateral-line scale counts in species of *Menidia* from Mississippi River and tributaries.

	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	N	$\bar{X}$	SD
M. audens																			
TN area							5	10	20	25	14	10	6	4	1	1	96	43.2	1.9
Rosedale, MS							3	14	9	6	6	1					39	42.0	1.3
Ft Smith, AR					1	15	56	59	67	37	6	2					243	41.3	1.3
Ft Adams, MS						2	13	33	49	21	7	3	1				129	41.9	1.2
Lake Texoma, OK						6	60	56	29	8	3	2					164	40.9	1.1
Alexandria, LA					1	37	92	90	55	34	13	4					326	41.0	1.4
St. Francisville, LA						6	29	65	92	67	37	15	5	4	2		322	42.3	1.6
English Turn Bend, LA - RM 78																			
M. audens							13	35	29	15	7	5	2	1			107	41.0	1.5
M. beryllina		3	20	107	101	27	1										259	37.5	0.8
Ft. Jackson, LA - RM 19																			
M. beryllina	1	9	113	217	155	38	4										537	37.2	0.9

that pre-dorsal and lateral-line scales increase in number with an increase in fish size. Alternatively, this wide range of individual sizes may represent various cohorts hatched at different times under various environmental conditions, but still having similar scale counts (Chernoff et al., 1981:331).

Gosline (1948), Moore (1957) and Suttkus and Thompson (2002) emphasized the high number of predorsal scales as a distinguishing feature of *M. audens*. Moore and Cross (1950) and Suttkus and Thompson (2002) also emphasized the high number of lateral-line scales as typical of *M. audens*, originally reported by Hay (1882) as transverse rows of scales. The character index of pre-dorsal and lateral-line scales was defined where a value greater than or equal to 58 represented *M. audens* and a value of 57 or less represented *M. beryllina*. Using this index, 98.4% of 888 (n = 874) specimens examined from the lower Mississippi Valley were correctly classified as either *M. audens* or *M. beryllina* as defined by differences of body depth (see below). This character index clearly differentiated between the two species in sympatric populations and can be used as a diagnostic tool (Table 3).

Morphometrics were analyzed for *M. audens* and *M. beryllina* samples from the mainstem of the Mississippi River, including samples from the Mississippi River at Fort Jackson and two combined sites from Lake Pontchartrain. As with the meristic data, morphometric data do not support the view of a geographical cline in *Menidia* along the Mississippi River (Chernoff et al.,

Table 3. Predorsal scales plus lateral-line scales in *Menidia* species from the Mississippi River at English Turn Bend, River Mile 78, Plaquemines Parish, Louisiana.

	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	N	$\overline{X}$	SD
M. audens								3	3	13	20	18	13	9	14	6	4	1	_	1	_	1			106	61.7	2.5
M. beryllina	1	4	12	38	60	43	34	18	2																212	54.4	1.5

Predorsal scales plus lateral-line scales in *Menidia* species from the Bonnet Carré Spillway, St. Charles Parish, Louisiana.

	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	N	$\overline{X}$	SD
M. audens									8	7	14	16	10	13	4	4	3	3	5	1	_	1	_	1	90	62.2	3.1
M. beryllina				7	3	6	9	5	4	2															36	54.5	1.8

Combined frequency distributions (predorsal and lateral-line scales) of co-inhabiting species of *Menidia* from the Mississippi River, English Turn Bend, and from the Bonnet Carré Spillway.

	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	N	$\overline{X}$	SD
M. audens								3	11	20	34	34	23	22	18	10	7	4	5	2	_	2	_	1	196	61.9	2.8
M. beryllina	1	4	19	41	66	52	39	22	4																248	54.5	1.5

1981). Three of the morphometric variables (depth of head, body, and caudal peduncle) show average differences between the two species (Table 4). The fact that the two forms, *M. audens* and *M. beryllina*, are identifiable by these characters where they occur sympatrically, in itself, is strong support for recognition of the two forms as distinct species. Separation of the two species in areas of sympatry is not easy when dealing with juveniles or specimens with twisted bodies and/or missing scales. Juveniles of *M. beryllina* do not have the same relative depth of head, body, and caudal peduncle as adults (Fig. 4), which helps distinguish adult *M. beryllina* from the slim-bodied adults of *M. audens*.

The DFA model successfully predicted two separate groups of individuals representing *M. audens* and *M. beryllina* based on a single discriminant function derived from five of the twelve variables (Table 5). Shapiro-Wilk results indicated that the majority of variables were normally distributed, with head depth, head length, and snout length not normal. In additional, the Box's M statistic was used to test for equality between population covariance matrices and found to be insignificant indicating equality (Box's M = 18.902, p = 0.288). Wilks' Lambda statistic with a Chi-square test was used to test the significance of the DFA model and found to be significant (Wilks' Lambda = 0.202, Chi-square = 115.957, p = 0.000). A total of 98.7% of the individuals randomly selected for model development were correctly predicted into the appropriate species category. A single specimen of *M. audens* was misclassified as *M. beryllina* in the original model (n=76 correct). A total of 90.5% of the individuals in the hold out sample were correctly classified using the DFA model (n=19 of 21 correct). One specimen of *M. audens* was misclassified as *M. beryllina* and one specimen of *M. beryllina* was misclassified as *M. audens*. Results of the DFA corroborate the results of the character index and support the presence of two distinct species based on proportional measurements.

We have not identified any hybrids in the area of sympatry in the Mississippi River at English Turn Bend (RM 78). *Menidia beryllina* spawns from February to early May in the Mississippi River at Fort Jackson (RM 19) and *Menidia audens* spawns from March through May in the Mississippi River at English Turn Bend (RM 78). A collection made on 31 March 1985 (RDS 8708) contained five ripe male *M. audens* (52-70 mm SL), one ripe female *M. audens* (66 mm SL), and one ripe female *M. beryllina* (57 mm SL). The female *M. audens* had ova 1.2 mm in diameter. The female *M. beryllina* had ova in a range from 0.9 mm to 1.2 mm in diameter. On 17 April 1985 (RDS 8723) three ripe male *M. audens* (61-69 mm SL) and one ripe female *M. audens* (63 mm SL) were taken with one ripe male *M. beryllina* (60 mm SL). These limited observations indicate the potential for hybridization.

We conclude our discussion with a brief analysis of population levels of *Menidia audens* before and after impoundment of former free flowing rivers – the Red, Arkansas, Sabine, and Tombigbee rivers. Lake Texoma, the impoundment created by Denison Dam of the Red and Washita rivers, was filled in 1944 (Riggs and Bonn, 1959). Moore and class collected three specimens of *Menidia audens* from barpits along the Red River in Bryan County, OK, below Denison Dam on 15 April 1949 (Moore and Cross, 1950), and this constituted the first published record of *M. audens* in Oklahoma. By 1951, *M. audens* became very abundant in the tail waters of Denison Dam (Riggs and Bonn, 1959:165).

Another example of *Menidia audens* population changes took place along the lower Red River in the Alexandria, Rapides Parish, LA area as a result of a series

Table 4. Selected proportional measurements (expressed in thousandths of Standard Length) for *Menidia audens* and *Menidia beryllina* from lower Mississippi River Valley collection sites.

Species	Locality	Proportional Measurement	Range	Mean	S.D.
M. audens	Miss. River, TN (n=55)	Head Depth	111-129	119	4.1
		Body Depth	140-178	160	9.3
		Caudal Peduncle Depth	73-88	80	3.7
	Miss. River, St. Francisville, LA (n=70)	Head Depth	107-130	119	4.5
		Body Depth	147-182	165	6.8
		Caudal Peduncle Depth	71-88	80	3.6
	Miss. River, English Turn Bend, LA (n=48)	Head Depth	101-131	119	5.0
		Body Depth	152-189	169	7.6
		Caudal Peduncle Depth	72-86	79	3.5
M. beryllina	Miss. River, English Turn Bend, LA (n=27)	Head Depth	122-146	134	6.4
		Body Depth	172-199	189	8.7
		Caudal Peduncle Depth	77-97	87	4.6
	Miss. River, Fort Jackson, LA (n=70)	Head Depth	125-146	136	5.1
		Body Depth	168-218	197	8.9
		Caudal Peduncle Depth	77-97	87	4.2
	Lake Pontchartrain, LA (n=50)	Head Depth	124-146	136	5.3
		Body Depth	171-203	185	7.4
		Caudal Peduncle Depth	76-93	85	3.6

Table 5. Standardized Canonical discriminant function (CDA) coefficients from Discriminant Function Analysis of proportional measurements.

Proportional Measurement	CDA Coefficient
Pelvic fin origin to snout	2.198
Anal fin origin to caudal fin base	1.774
Head depth (greatest)	-1.6909
Body depth (greatest)	-1.229
Caudal peduncle depth (least)	-1.02

of impoundments. Lock and Dam No. 1 is located at RM 50, above the mouth of the Red River. We started biological sampling of the Red River in 1966-67. Our sampling sites extended from RM 86 upriver to RM 105 until mid-year 1987 at which time Lock and Dam No. 2 at RM 87 prevented us from sampling at RM 86. After mid-year 1987 we adjusted our sampling sites from RM 87 upriver to RM 112 (U.S. Corps of Engineers, 1958). During the pre-Lock and Dam No. 2 period 386 collections from the Alexandria area contained 582 specimens (1.5 specimens per collection) of *M. audens*. In the post-Lock and Dam No. 2 period, mid year 1987 to December 2002, 446 collections were taken in approximately the same area i.e., above Lock and Dam No. 2 but below Lock and Dam No. 3, contained 38,852 specimens of *M. audens* (87.1 specimens per collection).

A similar pattern of population expansion has been observed in the Arkansas River. On 2 February 1967 (RDS 4081) a single specimen of *M. audens* was collected from the impounded Arkansas River at Dardanelle, Yell County, AR. Fourteen years later, on 31 October 1981 a collection (RDS 7719) from the Arkansas River just below Lock and Dam 13 at Fort Smith, AR contained 2,152 specimens of *M. audens*. Robison and Buchanan's (1988:344) distribution map for *Menidia beryllina* (= *Menidia audens*) shows no pre-1960 records from the Arkansas River. They stated that most of the pre-1970 records were obtained from near Fort Smith, AR, whereas between 1960 and 1987 the inland silverside was taken along the entire reach of the Arkansas River across the state. Robison and Buchanan (1988:344) reported the inland silverside was the most abundant species in collections from the Arkansas River at Fort Smith since 1971.

Anderson et al. (1995) compared Texas freshwater fish assemblages from the various river systems across the state of Texas based on collections obtained in 1953 and 1986. The family Atherinopsidae was represented by only a trace in the Sabine drainage in both 1953 and 1986 (Anderson et al., 1995: Fig. 2). Hubbs et al. (1997:79 and Fig. 8) apparently using the same data set stated that two Red River sites (R-86 and R-94) and a Trinity River site (T-84) had large numbers of inland silverside, *Menidia beryllina* in 1986 versus none in 1953. There was no mention of *Menidia beryllina* in the Sabine River collections (Hubbs et al. 1997) and we assume that the trace of the family Atherinidae in Figure 2 of Anderson et al. (1995) probably represented *Labidesthes sicculus*.

Knapp (1953:100-101) reported *Menidia beryllina* as a coastwise inhabitant of Texas and that *M. audens* had been reported in the Red River by Moore and Cross (1950) and in Caddo Lake, also Red River system, by Bonn and Kemp (1952). There was no mention of either species being in the Sabine River system. Moore (1957:122) reported *M. audens* in Texas only in the Red River drainage. Gilbert and Lee's (1980:558) distribution map included both *M. audens* and *M. beryllina*, but showed no records for the Sabine River in Texas and Louisiana. Etnier and Starnes (1993:376-378) followed Chernoff et al. (1981) and discussed the presence of *M. beryllina* (= *M. audens*) in Tennessee. However, their general distribution map of *M. beryllina* (1993:377) did not show the species in the Sabine River.

Herein, we report the first record of *M. audens* and *M. beryllina* in the Sabine River above the tidal area of Sabine Lake. The two species were sympatric in the lower middle section of the Sabine River and only *M. audens* occurred in the upper section of the river. *Menidia beryllina* only occurred in Sabine Lake, lower sections of the Neches River, Sabine Pass, and along the coastal areas. Frequency distributions of pre-dorsal and lateral-line scale counts agreed strongly with those of the lower Mississippi River and again show no clinal variation.

The appearance of *Menidia* in the Sabine River coincided with impoundment by the Toledo Bend Dam. The dam was completed in 1966 and the reservoir was filled in 1968 (Shampine, 1971: 88). During a four year period, 1963-1966, twelve collections made from between Logansport, LA and Anthony's Ferry Landing near Toro, LA yielded 18,969 specimens, but no *Menidia*. This entire stretch of the Sabine River and lower parts of tributaries was inundated by the Toledo Bend Reservoir (Fig. 3). The Sabine River at TX Hwy. 63 crossing, about ten miles downriver from the Toledo Bend dam site, was sampled seven times between July 1948 and August 1968 which resulted in 18,538 fish specimens, but no *Menidia*. Four quarterly samples at seven stations along the Sabine River between RM 140 and RM 100 were obtained during 1969-70 and yielded 42,689 fish specimens, but no *Menidia* (Fig. 3). In addition there were two annual trips, one in 1969 and the other in 1970, each included 13 samples taken from the Sabine River between RM 140 and RM 48 (Fig. 3). The 1969 and 1970 annual surveys resulted in 10,757 and 16,142 fish specimens respectively, but neither included any *Menidia*. A single specimen of *Menidia audens* was first collected in the Sabine River in 1977 at RM 140 (UT 158.11). Quarterly surveys were repeated in 1979-80 at the same seven stations between RM 140 and RM 100. The total number of fish specimens was 10,910 of which 117 were *Menidia audens* and 12 were *Menidia beryllina*. During July 1982, a survey trip was made from RM 140 downriver to RM 48 which resulted in 9,257 specimens that included 36 *M. audens* from seven sites between RM 140 and RM 100, and 15 *M. audens* from 12 sites between RM 100 and RM 48. Also in July 1982, 59 specimens of *M. audens* were obtained from the Sabine River at RM 150 a short distance below Toledo Bend Dam. In September and October of 1982, nine collections totaling 68,990 specimens were obtained from the Sabine River above the Toledo Bend Reservoir. There were two specimens of *Menidia audens* in each of three collections from Panola, Gregg and Smith-Upshur Counties (Fig. 3). Our most recent collection of *M. audens* (60 specimens) from the Sabine River was taken on 3 August 1984 at RM 500, 16 mi. north of Canton, Van Zandt County, TX at TX Hwy. 19. This site is only a few miles below the Tawakoni Reservoir in the headwaters of the Sabine River.

Finally, we examined three recently collected lots of *Menidia audens*: one sample from the Tennessee River in Lauderdale County, AL and two samples from the Tombigbee River system; one from the mouth of Noxubee River, Sumter County, AL and the other from near the mouth of Luxapallila Creek, Lowndes County, MS (Mettee et al. 2002:26-27). It is likely *Menidia audens* gained entrance into the Tombigbee River system via the Tennessee-Tombigbee Waterway that was created by the U.S. Corps of Engineers. This waterway was completed in 1985 (Boschung, 1989). *Menidia* were not reported from the Tombigbee River system by Boschung (1989), Mettee el al. (1989), nor by Mettee et al. (1996). Scale counts from regions of Tennessee within the native range of *M. audens* agree with those of the Tombigbee River. Frequency distributions of the pre-dorsal and lateral-line counts also agree with the native *M. audens* from its native Mississippi River range (Table 1, 2).

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REGIONAL REPORTS

REGION I – NORTHEAST

As a preface to this report, attention is called to the fact that common names of fishes are capitalized throughout the section for Region I. It is happily reported that fishes have now gained equal respect to their fellow vertebrates (e.g., birds and herps) and Copeia (instructions to authors) has now officially adopted the policy that such names will be capitalized in future articles published therein. SFC members Wayne Starnes and Melvin Warren, along with Joe Nelson of the University of Alberta, published an article addressing this situation in Fisheries (2002).

Beginning in the north of our region one of the high profiles stories surrounds the discovery of an apparently established population of Northern Snakehead (*Channa argus*) in the lower Potomac River, Virginia and Maryland. This is clearly a serious development and may forebode an invasion of this renowned predator from Asia which is tolerant of temperate conditions and potentially could disperse widely in North America. There is also word of a parallel situation involving this species developing in the Schuylkill River system within greater Philadelphia. John Odenkirk, of the Virginia Department of Game and Inland fisheries, has been

involved with the developments in the Potomac and contributes the following:

Northern Snakeheads (NSH) in the Tidal Potomac System

Snakehead hysteria reached down into Virginia on May 7, 2004. It started on a Friday afternoon when Robert Hinds, Jr. was prefishing a tournament and caught what he believed was a NSH. Robert's fish came from a canal off Little Hunting Creek in Fairfax County, and he convinced a skeptical John Odenkirk that he had the real thing (rather than a bowfin or eel). John verified the catch, and recreational anglers caught two more during the following week. Another NSH (the fourth) was caught during May by a commercial haul seiner in Pohick Bay (two drainages south of Little Hunting Creek).

Five more NSH were collected during June – one each by Maryland and Virginia electrofishing crews and three by anglers. One of the angler catches was a 6 pound male. July's pace increased with seven additional NSH verified – another by VDGIF electrofishing, one by dip net and five by anglers. Tom Woo of Ft. Belvoir had the distinction of angling three of these. As of this writing (8/11/04), the NSH count stood at 17, with the only August catch provided by the Fredericksburg VDGIF electrofishing crew (a.k.a. Jerky Crew – tied with Tom Woo).

Sampling by Maryland DNR, VDGIF and the USFWS, while at a bit of a frantic pace during June and early July was reduced from nearly daily trips with seines, trap nets, gill nets, trawls and electrofishing to several electrofishing trips per month. No nests or juvenile fish (but see below [editor's note]) have been documented. NSH respond fairly well to standard pulsed DC gear; however, reaction can be varied and violent (similar to grass carp). If located fully within the electrical field, they are pacified nicely. Preferred habitat seems to be hydrilla and milfoil beds along lily pad edges – water depth usually ranges from one to two feet, but they have been capture in dense submerged vegetation in water up to five feet deep.

The fish have been found throughout a 15-mile reach of tidal river including tributaries of both states. However, distribution was clumpy, as three NSH were captured in Little Hunting Creek, seven were taken from Dogue Creek, and two were collected in Pohick Bay – all adjacent Virginia drainages.
Size range was 305 – 634 mm TL and 348 – 2635 g. The sex of five was unknown, while four were believed to be males. Eight were females, and six of these had eggs (the last five captured were all females with eggs). Male sex organs seemed to be underdeveloped. Otolith removal was standard, and the best reads were obtained using whole views. Stomachs were usually empty, except one NSH had a White Perch in its gut (the most dominant species in the system). Fourteen of the 17 NSH were available for ageing:

Age	2	3	4	5	6
N	2	6	3	2	1

The NSH source and the implications for the tidal Potomac resource remain unknown. We have yet to test the culinary attributes of the NSH, as all fish were delivered to the Smithsonian for genetic evaluation (results not provided to date) but eagerly await the opportunity.

Brian Watson, former NCWRC biologist now with the VGDIF, further emends that the total specimens now (as of Feb. 2005) number 20 (total of all collected by 1 Oct. 2004) and include a young-of-year, probably indicating natural reproduction. The Dogue Creek area of the Potomac in Fairfax Co., VA, currently appears to be a bit of an epicenter for the population.

Elsewhere in Virginia, on a more cheerful note, Eugene Maurakis of the Science Museum of Virginia, reports that an important piece of the puzzle involving the breeding behavior of gravel nest-building *Nocomis* species has finally fallen into place, namely detailed observations on the behavior of *N. effusus* (which involved forays into Region III, of course). This will now enable him and colleagues to test proposed relationships in this group using a bank of behavioral data assembled on its members. He also reports that the Museum has established a new science center at Belmont Bay, VA, and has initiated long-term monitoring of water quality, plankton, aquatic vegetation, macroinvertebrates, and fishes in the nearby Occoquan and Potomac rivers. Doubtless they may soon encounter some of the unwanted Asian invaders discussed above.

Moving south into North Carolina, Bryn Tracy and colleagues at the NC Division of Water Quality have been very busy over the past year and have lots of accomplishments to relate in connection with their statewide IBI program and other surveys. They also have several interesting new species occurrences to report. Unlike last year when the sampling efforts were constantly hindered by never ending rains and high flows, 2004's efforts were record setting! More than 140 stream sites were evaluated. The sampling season saw the field work completed on two of NCDENR's Ecosystems Enhancement Program projects (Mountain Creek in the Yadkin River basin and Catheys/Hollands Creeks in the Broad River basin), NCDWQ's Basinwide Monitoring in the Roanoke, Watauga, Little Tennessee, and Hiwassee River basins, a project with Dr. Jim Gilliam at North Carolina State University, and a biological impact special study due to catastrophic flash flooding from Hurricanes Frances, Ivan, and Jeanne in the French Broad and Watauga River basins. Thirty sites in the Piedmont portion of the Roanoke River basin were

sampled from the Dan River in Stokes County to Chockyotte Creek in Halifax County. The fish communities in the Hiwassee (13 sites) and Watauga River (10 sites) basins had never been assessed by DWQ and more sites were evaluated in the Little Tennessee River basin (22 sites) than ever before.

Based upon a cursory examination of the data, new distributional records have been recorded for:

- Little Tennessee River basin – *Ameiurus brunneus*;
- Hiwassee River basin – *A. natalis*, *A. nebulosus*, and *Lepomis cyanellus*; and
- Watauga River basin – *Phoxinus oreas* and *Semotilus atromaculatus*.

The Dan River and its tributaries in Stokes County continued to support a unique fauna including *Exoglossum maxillingua*, *Hypentelium roanokense*, *Scartomyzon ariommus*, *Etheostoma podostemone*, and *Cottus caeruleomentum*. However, no *Thoburnia hamiltoni* or *Noturus gilberti*, species of former rare occurrence in the area, were collected from any of the small tributaries. However it should be noted that, in this area, *N. gilberti* is known mainly from somewhat larger streams, such as Dan River.

The NCSU-Water Resources Research Institute-funded project: *"Stream fish as bioindicators of water quality: assessing threshold responses to urbanization and correlations with invertebrate indicies"* will correlate fish, benthic macroinvertebrate, percent impervious area, and an urbanization index data from approximately 130 samples sites to determine thresholds for measures of urbanization.

Staff also participated in the Pigeon River Fish Re-Introduction Project (French Broad River basin, Haywood County, NC and Cocke County, TN) by transplanting almost 2,000 fish of four species of shiners (Silver, Telescope, Saffron, and Mirror) from Cosby Creek (TN) and the upper Pigeon River to the Pigeon River in NC below the paper mill. The project was described in an article (*Pigeon River Revival*) in the December 2004 issue *Wildlife in North Carolina*. Further information on this project may be found at: http://web.utk.edu/~mjwilson/index.php.

For further information on the Division's on-going fish studies, please visit the Biological Assessment Unit's web site http://www.esb.enr.state.nc.us/BAU.html or contact Bryn Tracy (bryn.tracy@ncmail.net).

Steve Fraley, nongame fish biologist with the NCWRC, reports further on the Pigeon River restoration effort. NCWRC's cooperative project with UTK, Blue Ridge Paper, NCDWQ, and other area agencies to reintroduce non-game fishes to the recovering Pigeon River in NC is making progress. After the floods that resulted from hurricanes Frances and Ivan in September, we were pessimistic about the fate of minnows that were stocked in March and August (*Notropis photogenis*, *N. rubricroceus*, *N. spectrunculus*, *N. telescopus*). Sampling in November in less than optimum conditions yielded 12 Telescope Shiners and 1 Mirror Shiner just upstream from our transplant site and 2 Mirror Shiners at the transplant site. All of these individuals appeared to be in very good condition. We also collected one YOY Mirror Shiner over 3 miles upstream from our transplant site. It is unlikely that it was one of our transplant individuals due to the upstream distance from the release site. The floods may have helped stock the Pigeon below the paper mill with some of our target transplant species that before were known only from above the mill. It appears that our re-introduction efforts were not in vain and much of the silt that existed in the river before the flood was flushed away, hopefully improving spawning habitat for most species.

Further east, on the Piedmont, a major study has been launched to determine the immediate and longer term effects of removing a small dam on the Deep River located near the junction of Moore, Lee, and Chatham counties, NC. The 12-mile impoundment created by this dam bisects the known range of the endangered Cape Fear Shiner, *Notropis mekistocholas* and, at the same time, harbors possibly the largest remaining population of the rare and undescribed Carolina Redhorse, *Moxostoma* sp. Tom Kwak, leader of the cooperative fisheries unit at North Carolina State University, elaborates:

"A team of biologists and students from NC State University, NC Wildlife Resources Commission, NC Museum of Natural Sciences, and NC Division of Water Quality have joined forces to study the effect of a proposed dam removal on the riverine fish community. The Carbonton Dam on the Deep River in the upper Cape Fear drainage of North Carolina is at the top of a prioritized list of dams to be removed for environmental reasons, and knowledge on the impact to riverine fishes, including the endangered Cape Fear Shiner, undescribed and rare Carolina Redhorse, and the invasive Flathead Catfish, is critically needed.

In response, Drs. Tom Kwak (NC Coop Unit Leader) and Ryan Heise (NCWRC) summoned a group of colleagues representing some of the leading fish biologists in the state and region. Crews from NC State and the Wildlife Commission joined Dr. Wayne Starnes (NC Museum of Natural Sciences) and Bryn Tracy (NC Division of Water Quality) and set out to document the fish communities at sites upstream and downstream of Carbonton Dam prior to its removal. Reference data before the dam is removed are important to quantitatively document the expected changes in riverine fishes that will occur after the impounded habitat is restored and fish migration is unrestricted.

Sampling the weeks of October 25 to November 5 using boat and backpack electrofishing techniques yielded hundreds of stream-dwelling fishes, including sportfishes, such as trophy Largemouth Bass and Redbreast Sunfish, interesting nongame fishes, including Margined Madtoms and the Piedmont Darter, and imperiled fishes

like the Cape Fear Shiner and Carolina Redhorse. No single institution could have conducted this sampling alone, and the strong, mutually beneficial relationships among the university and state resource agencies facilitates a better understanding of our natural resources. The cooperative group will repeat this fish sampling on at least one more occasion before the dam is removed, and then follow up after the removal."

On the Pee Dee River, the Pee Dee Technical Working Group (TWG, of the Robust Redhorse Recovery Committee) continues to spearhead efforts to locate further specimens of this large species which nowadays is extraordinarily rare in the Pee Dee. The hope is to locate sufficient stock to mount a propagation program such as that which has been successfully conducted with stock from the Altamaha and Savannah basins to the south. Preliminary genetic investigations have shown that the Pee Dee population is considerably divergent from those in the more southerly drainages and, if at all possible, propagation of this genetic stock would be desirable. However efforts to locate further specimens or, better still, a breeding aggregation, have met with very limited success thus far with only seven captures since beginning of concerted efforts in 2000, including the two discussed below.

In spring of 2004, boat electrofishing surveys of the Pee Dee from Blewett Falls Dam in NC downstream to reaches in SC east of Florence were once again undertaken with a cooperative effort between biologists of Progress Energy, NCWRC, and SCDNR. For 2004, the TWG decided to alter strategies and distribute resources to mount protracted surveys over several weeks surrounding the assumed spawning season rather than an all out intensive one-week survey involving all available boats as in past years. However this yielded comparable results as in previous years (2000-2003) with only a single, very large, nearly 14-lb. male, being dipped by Wayne Starnes during the earlier sampling on 6 May about 3 miles downstream of the US 74 crossing in NC. This is the largest specimen by far collected in the Pee Dee. This specimen was implanted with a transmitter by Tim Grabowski of Clemson University who is studying the Savannah population (see below) and released about one mile below US 74. Sampling for the remainder of the spring season, and efforts to relocate the implanted fish, were hampered by low flow conditions that rendered shoals impassable and neither effort was successful.

Oddly, on 5 November 2004, Jeff Isely, cooperative fisheries unit leader at Clemson University, and Lawrence Dorsey of NCWRC, were conducting a small amount of routine sampling in the Pee Dee in the vicinity of the US 74 bridge, connected with a toxicity study, when they encountered another specimen of Robust Redhorse, a 7-lb. female. This specimen, too, was implanted with a transmitter for later tracking studies. The TWG did not conduct fall sampling in the Pee Dee in 2004 due to other heavy commitments among its members but fall sampling in past years has resulted in only the usual one-specimen-per-survey yield of spring efforts! The Pee Dee TWG meets in early March 2005 to plan strategies for further sampling. The NCWRC is acquiring new tracking equipment with the aim of studying movements of the two fishes implanted thus far and any others that can be captured for these studies. John Crutchfield of Progress Energy, who did a superb job of heading the TWG for three years, has now handed over the reins to Ryan Heise of NCWRC.

News to report from the NC Museum of Natural Sciences is varied in nature. On the research front, a second year of funding was granted by Progress Energy to aid with survey efforts and genetic studies of the Carolina Redhorse. Preliminary genetic studies, conducted by Morgan Raley and Wayne Starnes, utilizing the cytochrome-b sequence and involving nearly 50 specimens of Carolina Redhorse plus comparative material, yielded some extraordinary results. This sequence was found to be virtually invariant among samples from the Pee Dee and Cape Fear (Deep) river basins with only two haplotypes found, varying by but a single transition; these haplotypes did not correspond to river basins. By comparison, a single smaller sample from a population of the Carolina Redhorses's presumed closest relative based on uniquely shared morphology, *Moxostoma erythrurum*, from the Little Tennessee River, yielded a more normal complement of eight haplotypes. We can only hypothesize preliminarily that this result indicates an extreme bottleneck in the history of the Carolina Redhorse. Moreover, phylogenetic analysis recovered the morphologically dissimilar but syntopic *Moxostoma collapsum* (plus allopatric *M. anisurum*) as sister clade to the Carolina Redhorse with *M. erythrurum* actually several steps removed on the tree. We hypothesize past introgressive hybridization, perhaps coupled with the implicated bottleneck event, may be responsible for this result and plan to further test these theories with microsatellite data and perhaps nuclear sequences.

Further survey efforts for Carolina Redhorse in 2004 were somewhat thwarted by repeated high flow conditions but there was some success early and late in the season. In spring, with help from Progress Energy biologists we were able to conduct surveys in two short reaches of the heretofore unsurveyed Rocky River, a major tributary to the Pee Dee River, which is presumed to be within the former range of the species. That river, heading in the greater Charlotte area, has had a history of serious water quality problems. While other species of redhorse were captured in good numbers, no Carolinas were found. However, with the elusive nature of this species, we do not consider this definitive proof of extirpation as of yet. With Progress' help, we also more thoroughly surveyed a small impoundment in upper Little River, tributary to Pee Dee, wherein a population containing very large specimens (to nearly 7 lbs.)

was discovered in 2003. This year's efforts yielded a good percentage of recaptures of PIT-tagged specimens which may indicate that his population is quite small and is denied access to upstream spawning habitat by a dam immediately upstream. In fall of 2004, with assistance from NCDWQ and NCWRC, we were finally able to launch small shocking boats in several heretofore unsampled reaches (defined by dams) of the Deep River (Cape Fear basin). However, we succeeded in located Carolinas in only one of these reaches, above the dam at Highfalls in Moore County, NC, which, along with a young-of-year collected in a tributary in 1990, extends the known range of the species several miles upriver. However we have learned that Carolinas seem to occupy bank habitat in the deepest pools of the river much of the year and therefore may not be effectively sampled by smaller electroshocking boats. There is much yet to be learned about the extent of surviving populations. A further testament to their rarity in collections was borne by results of a recent canvass, conducted by Wayne Starnes and Bob Jenkins, of the extensive backlog of NCWRC material collected in the basin surveys of the early 1960s and deposited at NCSM which yielded only two small specimens.

In conjunction with the Progress Energy funding to NCSM, Bob Jenkins received funds to conduct studies of spawning behavior in Carolina Redhorse. He plans to trek the Little and Deep rivers repeatedly this spring in hopes of documenting this behavior, which has only been briefly viewed on one occasion, along with mapping essential spawning habitats. Bob spent considerable time at NCSM and Roanoke College gathering morphological data and documenting various aspects of the biology of Carolinas ascertainable from museum specimens, in particular, meticulous age and growth studies based on opercular bones.

Other work includes preparation of the final report (by Wayne Starnes and Gabriela Hogue) on the FWS-funded study of communities of potential fish hosts for the endangered Carolina Heelsplitter Mussel which was based on repeated sampling of habitat streams in the Pee Dee, Catawba, and Savannah basins in NC and SC. In addition to analyses of fish species compositions and searches for elements in common among these streams, over 1100 specimens were examined for the presence of glochidia. Despite the presence of substantial populations of other mussel species, such as *Elliptio* spp., infestation rates were found to be very low during the particular spring and fall sampling periods. If further funding is forthcoming, attempts will be made to associate the few glochidia found with adult examples via DNA sequencing. In addition to this project, Morgan Raley and Wayne Starnes have preliminary genetic investigations going on several groups, such as various forms currently regarded as *Notropis procne*, *Etheostoma nigrum/olmstedi*, and an extensive study of *Lythrurus umbratilis*-like forms (well west of Region I!).

NCSM is several months into its 3-year NSF-funded databasing effort. It is estimated that the collection now comprises in excess of 100,000 lots, about 60,000 of which are currently cataloged as either NCSM or UNC-IMS lots, with over 14,000 of the NCSM lots currently databased. However a large number of localities supporting the as yet undatabased lots are already upgraded, GIS'd, and entered into the database. About 70% of the UNC-IMS collection (~17,500 lots) is now converted to ethanol and stabilized in well-sealed containers in preparation for recataloging it into the NCSM database thanks to the tireless efforts of Jesse Taylor, a recent graduate of NCSU. Other part-time techs, Carol Phillips and Tom Walker (another recent grad) are also making good contributions to the curation and databasing effort under the supervision of Gabriela Hogue. Clearly, there is a long way to go with this project but we are proud of the progress made thus far. Major new accessions to the collection within the past year included a large amount of material (~1900 lots) from DNR surveys of West Virginia (all worked up by Dan Cincotta of WVDNR and Stuart Welsh of WVU coop unit) and over 1100 voucher lots stemming from the aforementioned 2004 NCDWQ efforts. Both accessions are completely databased and assimilated into the collection. NCSM is a major repository of West Virginia (Region I or III?!) fish material stemming from the above accession plus the large amount previously acquired with the UNC-IMS collection that was collected by Frank Schwartz and others during his days at West Virginia University several decades earlier.

On the conservation front, Art Bogan, John Cooper, and Wayne Starnes (NCSM), Fritz Rohde (NC Division of Marine Fisheries), Bryn Tracy (NCDWQ), Steve Fraley (NCWRC), John Alderman, and others have been working with Salinda Daley of NCWRC to develop the comprehensive conservation plans for fishes and aquatic invertebrates funded under the federal Wildlife Conservation and Restoration program (sometimes known as "CARA LITE") and State Wildlife Grants (SWG) program. In South Carolina, Art, John, Wayne and Fritz, along with Joe Quattro of University of South Carolina, have been involved in a similar effort managed by Jason Bettinger and Jennifer Price of the SCDNR. These plans attempt to prioritize and group jeopardized or potentially imperiled species for future studies and conservation measures under these programs. Both states' plans are well along in development.

The Scientific Council on Fishes for the Nongame Committee of the NCWRC is currently preparing a document identifying nonnative species that are potentially injurious to regional aquatic ecosystems. This document will be considered by the Committee in April and should lead to recommendations to the state legislature for the banning of import or intrastate movement of a number of species, including Black, Silver, and Bighead carp, Rudd, Flathead Catfish, Red Shiner, all snakehead

species (already banned via emergency measures), swamp eels, and several other species. The Council is chaired by Wayne Starnes and is served on by about ten biologists from the NCWRC, NCSU, NC Heritage Program, NCDWQ, and others. Flatheads and Red Shiner are, of course, already well established in the state but hopes are to legislate and educate against further abetting their dispersal. It appears that Red Shiners have dispersed through much of the Yadkin-Pee Dee basin in NC in recent years and are probably nearing SC.

The Council is also preparing a report that will readdress the status of several state-listed species for consideration by the Nongame Committee at its fall meeting. In particular, the status of several peripheral species is being reevaluated in light of their global status to see if emendments might be in order plus changes stemming from such things as the rediscovery in the lower Neuse of the Bridle Shiner, formerly thought to be extirpated.

Further south, Fritz Rohde reports that he, Rudy Arndt, Joe Quattro, and Jeff Foltz are still plugging away on their book on the freshwater fishes of South Carolina. They have conducted surveys over the entire state for quite a few years and that material, too, resides at NCSM. Fritz also reports a new state record for North Carolina. *Fundulus chrysotus* was captured at two sites in the Waccamaw River system. This is perhaps not surprising as the species has been found at a few sites in adjacent South Carolina but implications are it may be dispersing.

Mark Scott reports that stream assessments by SCDNR biologists have been picking up steam over the last two years. Nearly 150 sites have been surveyed for fish assemblage, water quality, and habitat data. Collections in 2005 are anticipated to add approximately 100 more sites, and include more detailed measurements of channel bed sediments, depth and flow heterogeneity, and GIS-based measures of watershed land use. The information from the program will help SCDNR understand status and trends of stream resources in the state, evaluate threats to resource integrity, and guide design of management actions under the Comprehensive Wildlife Conservation Strategy currently being developed.

Other studies ongoing in SC include targeted basin surveys of fish assemblage, habitat, and watershed conditions in the Broad River, headed by Jason Bettinger (SCDNR), and the Reedy River, coordinated by Teresa Wilson (Clemson U.) and Kevin Kubach (SCDNR). Leo Rose of DNR completed a detailed multiyear survey of the fish fauna in Congaree National Park, finding that variation in assemblage structure was closely tied to hydrologic conditions during and after the five year drought that ended in 2003.

Finally, on the border of regions I & II, Tim Grabowski of Clemson University has been diligently conducting doctoral research on the Robust Redhorse population in the Savannah River. He is looking at the spatial and temporal partitioning of gravel bar habitat by spawning catostomids. Additionally, he is conducting radio telemetry studies of habitat use, site fidelity, and seasonal migrations of catostomids, with central emphasis on the Robust Redhorse. His results show that, while three catostomid species in the river spatially overlap in spawning habitat, they are temporally discrete. It is hypothesized that other factors, such as high egg predation by minnows and other phenomena might be more limiting. Tim's dissertation will contribute much information important to the future conservation of this species. He plans to defend next fall.

– Wayne Starnes

REGION II- SOUTHEAST

Steve Walsh, USGS, Gainesville, FL, is in the process of completing a 4-year study on fishes of the Apalachicola River floodplain, in collaboration with Helen Light, biohydrologist with USGS, Tallahassee. The main objectives of the study are to associate faunal metrics with different flow regimes, in part to address minimum flow needs as part of inter-state deliberations between Florida and Georgia over allocation of water for the entire Apalachicola-Chattahoochee-Flint drainage. Most of the effort has been on documenting age-0 recruitment in varied floodplain systems, including oxbows, permanently flowing loop rivers, and smaller sloughs, many of which are intermittently disconnected from the main river channel due to low flows and excessive sedimentation resulting from years of navigational dredging and in-channel spoil deposition. A Florida Department of Environmental Protection dredging permit to the Army Corps of Engineers has lapsed and there is currently no ongoing navigational dredging, thus it is quite possible that the very limited commercial navigation on the Apalachicola River is nearing an end. During the course of the study, the investigators discovered what appears to be a population of *Etheostoma zonifer*, previously unreported from Florida; additional effort is planned to collect tissues and preserved whole specimens for further study. Steve and assistant Bill Tate recently completed a status survey of *Enneacanthus chaetodon* in Florida, where they unfortunately report collecting no specimens at any of the historical or new sites visited. While the blackbanded sunfish may not be entirely extirpated from the state, it is certainly rare enough to warrant threatened, if not endangered status. Steve has also been actively involved with the Florida Fish and Wildlife Conservation Commission and The Nature Conservancy in establishing the state's Comprehensive Wildlife Conservation Strategy.

Leo Nico continues to work on non-native fishes

found in Florida and other parts of the USA, including Asian swamp eels (*Monopterus* spp.), South American catfishes, and other fish groups. A chapter by Nico on native and introduced fishes of Florida's Kissimmee River is in press. He recently co-authored a paper with University of Florida student Ann Marie Muench on the nests and nest habitats of the South American catfish *Hoplosternum littorale*. Their publication – in Southeastern Naturalist (2004) – includes photos showing the unusual floating nests that the males construct from plant material.

Three USGS researchers stationed in Gainesville, Florida, have a book in press on the mollusk-eating black carp – a large, mollusk-eating fish from Asia that has been introduced into the United States and may already be established in the Mississippi River. The book should be available in March 2005. The full citation is:

Nico, L. G., J. D. Williams, and H. L. Jelks. *In Press*. Black Carp: Biological synopsis and risk assessment of an introduced fish. American Fisheries Society Special Publication 31, Bethesda, Maryland. ~320 pages + index.

James P. Kirk of U. S Army Engineer Research and Development Center, Vicksburg, MS and Thomas D. Bryce and Tiffany E. Griggs, of the Fish Wildlife Branch, Fort Stewart, GA completed a report in January 2005 titled "Annual Report to the National Marine Fisheries Service Describing Shortnose Sturgeon Studies During 2004 on the Ogeechee River".

Shortnose Sturgeon: During 2004, a total of 2,204 person-hours and just over 32,400 net-meter-hours of sampling effort were expended. Ninety-eight percent of the shortnose sturgeon (SNS) were captured from early June through the end of August and most were captured at either river kilometer 56.5 or 54.4. No SNS were captured from January through May and only one SNS was captured after September 1, 2004. The mean daily catch per effort for shortnose sturgeon was 0.00158 (95% CL 0.000249-0.00290) fish per net-meter-hour. (Note: One would have to set 21.1 30-meter nets before catching 1 SNS.) A total of 51 shortnose sturgeon were captured, 7 of these were previous-year recaptures, and 5 were in-year recaptures. One recapture was originally caught and tagged by South Carolina Department of Natural Resources on December 17, 1997 on the Savannah River. Of the 5 in-year recaptures, only 1 SNS was caught in both holes (river kilometer [rkm] 1.0 and rkm 56.5) inferring that during these hot, dry periods, they may be limiting their movement. Gordon Rogers observed the same behavior in the Altamaha River during his sampling in the late 1980's and early 1990's. Heavy rains associated with several tropical storms in September brought increased river flows, high water conditions, and lower river temperatures in coastal Georgia. As a result of these river conditions, SNS appeared to move out of the deeper holes and disperse throughout the lower Ogeechee River system making is more difficult to capture SNS. Only one SNS was captured following August 31, 2004. (See the discussion below.)

In 2004, the smallest SNS caught was 35.7cm TL. This is the smallest recorded SNS captured in the Ogeechee River system since population assessments began in 1993. Juveniles, ranging from 35.7 to 42.6 cm, made up 20.8% of all SNS captures in 2004 (23.3% of individual SNS captured in 2004 – not including recaptures). This is most significant since this is the first sizable capture of juveniles since sampling began in 1993 indicating that a successful spawn occurred in 2003 or 2002 (depending on the age of these juveniles) and this component reflects the presence of a strong year class (relatively speaking). Aging of the spines should help determine whether these young fish are age 1+ or 2+. The last time any recognizable evidence of spawning occurred was in the 1993-94 sampling year (Rogers & Weber) when juveniles between 38.0 and 47.5 cm TL comprised 15.4% of the catch.

Of the 7 juvenile SNS captured prior to July 19, 2004 all were captured in the Ogeechee River at rkm 56.5 and were taken from the upstream side of the gillnet (in the small mesh panel only). This suggests that the SNS spawn occurred in the Ogeechee River (vs. the Canoochee) and that juveniles appear to remain up river for their first year of life before moving downstream. Two juveniles were captured in August in the Canoochee at rkm 1.0 inferring that when these young fish come down river, they may remain in the vicinity of the Ogeechee and Canoochee confluence, seeking deeper holes during high temperature periods similar to behavior exhibited by sub-adults and adults.

Considering that all 10 of the juvenile SNS were caught in only the smallest mesh panel of our experimental gillnets (4.5 m long X 1.8 m deep) and considering our success rate of capturing relatively high numbers of these juveniles, the likelihood of there being considerably more of these juveniles in the system is very high and sampling efforts in out-years should produce moderately high numbers of this strong year class as they attain lengths that more vulnerable to all the mesh sizes of our gillnets. Being that these juveniles have made it past the most vulnerable life stages for predation, this year class may turn out to perhaps increase the small Ogeechee River system adult population by as much as 25% to 100% as they move up into the sexually mature component of the population. If this happens, the number of potential spawners each year could increase dramatically, that in turn could further accelerate recovery.

As in 2003, early spring gillnetting was initiated in mid-February 2004 in an attempt to capture and radio tag shortnose sturgeon on an upstream spawning run. Initial river conditions were favorable for gillnetting until heavy rains increased river flows and water levels,

forcing the sampling crew off the river until discharge rates dropped to a more acceptable level in late March. Consequently, no up-river running SNS was captured and the opportunity for radio tagging was again thwarted.

Our first SNS was captured on June 9, 2004. In an attempt to try to collect some movement data using the small radio tags we had available, we externally tagged three SNS (dorsal scute attachment method). It was not until after releasing the tagged fish that we realized that the batteries were too weak to be detected by the receiver once the fish moved beyond 10 feet of the antenna. All three tagged SNS were recaptured and the inoperable tags removed. Slightly larger radio tags with longer battery life will be used next spring in an attempt to intercept and tag potential spawning-run fish.

Shortnose sturgeon continued to be captured up through August 31, 2004. Following August, weather patterns were influenced heavily by several tropical storms and hurricanes that brought heavy and prolonged rains. As a result, coastal rivers throughout the Southeast rose significantly and the high volumes of freshwater entering the rivers and the reduced water temperatures prompted SNS to leave the deep holes and disburse throughout the lower Ogeechee River system. Despite extensive sampling, no SNS were captured again until November 30, 2004, when one 112 cm TL adult, weighing 10.12 kg, was caught in a trammel net at rkm 26.5. This fish was a recapture from previous Georgia DNR sampling conducted in 1997 in the Ogeechee River. Originally, this fish was captured on October 23, 1997 at rkm 32.5 and measured 103 cm TL and weighed 6.5 kg.

Because our objective has been to internally implant an adult with a long-lived battery transmitter for tracking these fish to their spawning sites, the decision was made to surgically implant this fish with an ultrasonic transmitter (Sonotronics). The trained surgical team successfully implanted the transmitter and the fish was released in excellent condition after an hour of post-operation observation. As a result of the surgical procedure, the fish was identified as a gravid female with a large mass of black-colored eggs making her an even better candidate for tracking her on a spawning run. This fish was tracked throughout the first 2 weeks in December between rkm 26 and 32 and was observed to be actively swimming throughout all observed tidal stages. Beginning the third week of December, the tracking crew lost contact with the transmitter. After extensive ultrasonic monitoring in the lower reaches of the Ogeechee River, upstream monitoring was initiated. As of January 3, 2005, the tracking crew has searched up to rkm 119 in the Ogeechee River and up to rkm 26 on the Canoochee River without success in relocating her. Monitoring effort continues in search of this fish. When considering the gravid condition of this female at the time of capture and the fact that our attempts to relocate the fish in the lower reaches of the Ogeechee River system, we believe that this fish has made an upstream run in preparation to spawn.

A population estimate using a Modified Schnabel method was calculated for Shortnose sturgeon. This is only the second statistically valid estimate we have been able to generate since intensive sampling was resumed in 1999 due to the high catch rate and the frequency of recapture. The 2004 SNS population is estimated to be 174 (95% CL 97-874). It must be noted that this confidence interval overlaps with Georgia Department of Natural Resource's(GA DNR) 1993 estimate of 266 (95% CL 236-300) and the 2000 Fort Stewart estimate of 147 (95% CL 105-249). These estimates infer that the population may be stable at this time or perhaps even be increasing from a possible lower level in 2000. This year's population estimate was definitely boosted by the strong presence of juveniles.

Atlantic Sturgeon: We captured 137 Atlantic sturgeon while sampling. Of these fish, 11 were in-year recaptures and 3 were previous-year recaptures. One recapture was originally tagged by Georgia Department of Natural Resources on June 16, 1998 at rkm 55.7. Of the 11 in-year recaptures, only 2 ATL were caught in both holes (rkm 1.0 and rkm 56.5) inferring that during these hot, dry periods, they may also limit their movement, similar to SNS. Our catch per effort was 0.00545 fish per net meter hour (95% CL 0.002671-0.00822). (Note: One would have to set 6.1 30-meter nets before catching 1 ATL.) Most of the fish during the summer were summering juveniles captured near river kilometer (rkm) 56.5 or wintering juveniles captured between rkm 22 to rkm 34. This year's sampling has yielded the highest numbers of ATL since 1999 and the length-frequency distribution reflects a strong possible age 2+ or 3+ year class (48.5-71.2 cm TL: 47.0% of the catch) and a moderate size possible age 1+ or 2+ year class (21.3-43.3 cm TL: 14.7% of the catch), confirming again another successful spawn of this population. The catch rate of these juveniles has been very high in both 2003 and 2004. Ages of these fish will be determined using spine sections and this should help us identify date of these two year classes.

A population estimate using a Modified Schnabel method was calculated for Atlantic sturgeon. The 2004 ATL population is estimated to be 614 (95 % CL 392-1413). This estimate can only be used as an indicator of population status as our gear and sampling locations appear to only be successful in capturing juveniles and sub-adults. It would appear that either large ATL adults cannot be held by the lighter gillnets or they are spatially separated from our site-specific sampling locations. It must be noted that this confidence interval does **not** overlap with the 2000 Fort Stewart estimate of 122 (95% CL 78-279). These estimates are significantly different (P=0.05) and this difference suggests that the population is increasing from a possible lower level in 2000. This year's population estimate was definitely boosted by the

strong presence of juveniles from two good year classes.

Concerns and Future Efforts: This year has been the best year since 2000 for SNS and ATL, probably in part to hotter and dryer conditions earlier in the summer verses 2003 when we experienced very wet conditions throughout the summer. The hurricanes and tropical systems that plagued SE Georgia in September dropped considerable rains and brought the river up, that in turn did drop catch rates and make netting more challenging. However, despite the higher flows later in season, catch rates overall have been very good for both SNS and ATL. The improved catch rates over 2001 through 2003 and the presence of juvenile SNS provide a glimmer of hope for this river system's SNS population. Prior trends were indicative of a diminishing population and possible accelerated extirpation. Only time will tell if the strong SNS year class will boost future population levels.

Brett Albanese reports that it has been a good year at the Georgia Natural Heritage Program. Jason Wisniewski, a recent graduate of Tennessee Tech, was hired as the official mussel biologist for the State of Georgia. Jason assisted Jim Williams and Chris Skelton with a mussel survey in the Ogeechee system last year and is currently assisting Chris Skelton with a mussel survey of the Broad River system and Jim Peterson with a mussel-distribution modeling project in the lower Flint River. Deb Weiler was also hired to help us with survey work in the field season and database development in the off-season. Deb began her career working on Caribbean fishes and was eager to return to fishes after a long stint as a biomedical lab technician. With these two hires, we have effectively tripled our aquatic staff in the past year and are very excited about that. Jason and Deb assisted Brett Albanese and the Freeman gang with a survey for the bluenose shiner (*Pteronotropis welaka*) in southwest Georgia. Before this survey, this species was only known from 4 streams in GA and most of our occurrence records predated 1980. We were able to document this species in three of these four streams and verified a new stream occurrence reported to us by John Ruiz. If you have records for this species in GA that we may not know about, please send them to Brett Albanese.

Other projects that we have worked on or help fund during the past year include 1) surveys for the Altamaha spinymussel and Altamaha arcmussel, 2) a survey of Chattahoochee basin crayfishes (George Stanton-Columbus State University), and 3) a survey of Canoochee River mussels (Ellie Sukkestaad–Savannah State University).

Kyle Pillar reports his continued work on greenside darter systematics and taxonomy and is currently working on taxonomic issues in the Upper Tennessee and Hiwassee River Basins. In addition, he recently began examining genetic variation within *Ichthyomyzon gagei* across its entire range. Two new graduate students started in his lab this past fall. Devin Bloom is working on a molecular systematic study of the Tribe Menidiini (*Menidia*, *Labidesthes*, *Chirostoma*, and *Poblano*). Lisa Cordes is using microsatellites to examine genetic variation between Lake Pontchartrain and Mississippi River basin populations of blue catfish. Lisa's work is critical because a man-made diversion will soon be constructed to connect these basins. The overall goal of the construction project is to provide freshwater to Lake Maurepas to "freshen the lake" and revitalize its surrounding wetlands. Finally, we are in the process of reorganizing and moving the SELU fish collection to a new building. We have new shelves and more floor space and are 100% computerized!

Gary Grossman's laboratory at the University of Georgia is currently active in the following areas: 1) Assessment of the effects of stocked rainbow trout on native non-game fishes in Southern Appalachian mountain streams. This study focuses on both population-level and microhabitat-level effects. Students associated with this project are Megan Hill (PhD) and Jessica Skyfield (MSc). 2) Peter Hazelton (MSc student) is examining the effects of turbidity on competitive interactions for foraging positions between rosyside dace and yellowfin shiner in Coweeta Creek N.C. There is evidence that yellowfin shiners were introduced to this drainage. 3) Mark Fairbrass (PhD student) and Richard Zamor (MSc student) are conducting experimental studies to quantify the effects of turbidity on foraging success and ultimately, population success of rosyside dace, river chub, bluehead chub, and yellowfin shiner in Southern Appalachian streams. 4) Michael Wagner has finished his PhD on the effects of social interactions on foraging positions of both rosyside dace and yellowfin shiner in Coweeta Creek N.C. He is now an Assistant Professor of Fisheries at Michigan State University. 5) Jessica Skyfield (MSc) is currently conducting experiments on stocked rainbow trout – warpaint shiner interactions (competition for space and foraging sites) and will be starting research on prey resource availability and microhabitat use in gilt darters. 6) We are continuing to develop fitness-based, mechanistic models for microhabitat selection in both benthic and water-column stream fishes. In these models we quantify both patch (or focal-point velocity) quality and fitness characteristics of fishes in these patches (i.e., residence times, prey-capture success, growth, survivorship, etc.). We intend to extend these models to the population level, via future removal experiments or artificial manipulation of patch quality. 7) Pending funding approval, we may have both a post-doc and Phd student working on the role of large woody debris on flow dynamics and foraging success in several Texas riverine fishes. 8) Bob Ratajczak continues to assist with all lab and field studies in the Grossman lab.

– Chris Skelton

REGION III- NORTH-CENTRAL

Status surveys and other interesting finds

David Eisenhour reported that, after a long drought, madtom descriptions are appearing again. In addition to Thomas and Burr's 2004 description of *N. gladiator*, Brooks Burr, Jim Grady, and David finally finished the manuscript (currently in review in Copeia) describing two more rare species of Tennessee madtoms– the "saddled madtom" and the "cryptic madtom" (aka "chucky madtom"). Although a survey in 1992 suggested the "saddled madtom" to be in decline, recent collections suggest improvement; Lynn and David Eisenhour collected about 30 individuals in 15 minutes at the type locality.

As reported last year, on 3 May 2004, two "cryptic" or "Chucky" madtoms were collected from near an historic collection site and moved to Conservation Fisheries Inc. (CFI) for propagation attempts. These individuals were only the 13th and 14th ever collected from Little Chucky Creek. These individuals appeared to be a pair, but they did not spawn and the female died, possibly she was egg-bound. USGS Rapid Response Grant funds awarded to TN Cooperative Fisheries Unit will result in another collection effort in 2005.

David Eisenhour also reported that the Kentucky Department of Fish and Wildlife Resources is enacting a new program, funded by a federal State & Tribal Wildlife Grant, designed to protect Kentucky's rare species. Matt Thomas has taken the position of ichthyologist for the new program and has a primary responsibility of developing and coordinating research and monitoring activities for native Kentucky fishes of concern identified under their Comprehensive Wildlife Conservation Strategy. Matt will be conducting substantial field work as well as securing the long-term museum storage of valuable Kentucky fish specimens.

David also reported that he and his graduate student, Rob Hopkins, have become interested in *Lythrurus umbratilis* and *L. fasciolaris* interactions. Their data to date suggest two things. First, *L. umbratilis* exhibits clinal variation in the Ohio River basin – specimens from upper Ohio basin populations are elongate, typically lack the black fins in breeding males, and often have only 10 anal rays, resulting in them being potentially "keyed out" as *L. fasciolaris*. Second, hybridization of these species appears to be common all along their area of contact, from the Green River drainage in southern Kentucky northeast through Louisville and into central Ohio.

CFI is continuing snorkel surveys for rare fish in selected streams in the Coosa drainage within the Chattahoochee National Forest. They have been asked to document any population effects that may be attributed to the Hurricane Ivan floods in mid-September 2004. So far they report extensive scouring of the Jacks and Conasauga rivers, with significant reductions of all benthic fish noted.

Yellowfin madtom surveys (VADGIF Section 6-funded) in the Clinch River in Russell County, VA detected an apparently robust population spanning 15 river miles from Nash Ford to downstream of Carbo. This is considerably upstream from the Copper Creek population, where yellowfins have only been detected in the Clinch River near the mouth of the creek.

An ashy darter was collected (and now resides at CFI) from the Clinch River at St. Paul (downstream of Carbo). This is the first specimen taken from the Clinch in VA since perhaps 1964—Bob Jenkins hypothesized that the species might have been extirpated from VA by the 1967 Carbo fish kill.

Poor collecting conditions for much of 2004 negatively impacted much of the field season and in spite of multi-agency efforts, no *Erimystax cahni* were collected.

Captive propagation, reintroduction, and other management activities

Previously, we have reported status of the long-term project to restore the aquatic community in the Pigeon River. Joyce Coombs (University of Tennessee) and Jonathan Burr (Tennessee Department of Environment & Conservation) report to date, 1126 gilt darters, 334 bluebreast darters, 1010 blueside darters, 729 stripetail darters, 499 stargazing minnows, 677 mountain madtoms, 664 American brook lampreys, 534 mountain brook lampreys, 1144 mirror shiners, 233 saffron shiners, 485 silver shiners, and 941 telescope shiners have been stocked there. Individual gilt, bluebreast, and stripetail darters, stargazing minnows, mountain madtoms, silver shiners and telescope shiners have all been observed in follow-up surveys.

Also in support of this effort, tangerine darters (*Percina aurantiaca*) were collected from the Pigeon River just upstream of Canton, NC in 2003 and 2004. These individuals would be used by CFI to captively produce young to stock as part of the Pigeon River restoration project. Unfortunately, the captive tangerine darters did not spawn in captivity, possibly because the individuals collected as adults never acclimated well to captivity. With the idea that juveniles would adapt better to captivity, several were collected in late 2004 to add to the captive population. They have now successfully spawned. Many of the early stage larvae appeared to spend significant periods of time surface-feeding in the meniscus along tilted shallow edges within the tub.

A similar effort is underway with blotchside logperch (*P. burtoni*), collected as juveniles from Spring Creek, Hiwassee River system. They spawned several times, and eggs and larvae were recovered, but none survived to swim up and feed. CFI will continue these efforts, and hope to use this species to develop propa-

gation protocols for all logperch. To date, unsuccessful efforts with Conasauga logperch (*P. jenkinsi*) are on hold pending the outcome of the blotchside effort.

In 2004 CFI was successful in spawning and rearing warrior darters, *Etheostoma bellator*, as surrogates for the endangered vermilion darter, *E. chermocki*. Several hundred young darters were successfully produced, and innovative rearing and husbandry techniques were developed in the process. These techniques were also successfully applied to the Etowah darter, *E. etowahae*, yellowcheek darter, *E. moorei*, and boulder darter, *E. wapiti*.

CFI has begun working with goldstripe darters, *E. parvipinne*, as surrogates for the imperiled rush darter, *E. phytophylum*. Initial indications from the goldstripe darter efforts indicate that, surprisingly, spawning began in mid-January when water temperatures in the hatchery were in the 50s. Larvae are very small (<5 mm) and pelagic. The tiny (1 mm) eggs are not adhesive and are easily collected since the adults like to scatter them in yarn mops, from which they can be shaken into an incubation tray.

Duskytail darters are also being propagated to augment the population further upstream in Little River where they no longer occur, in spite of suitable habitat. This area has been isolated from the extant population downstream in Little River by intervening barriers such as heavily polluted tributaries and old mill dams. The World Wildlife Fund's Southern Rivers Initiative has provided three years of funding for this effort. Young duskytail darters (135) were stocked in November 2003 upstream of Coulter Bridge. During an August 2004 survey, several individuals were observed, including at least two that resulted from wild spawnings.

As reported previously, the Tellico River Nonessential Experimental Population (NEP) area has been stocked with spotfin chubs, duskytail darters, and yellowfin and smoky madtoms, beginning in October 2002 and continuing in 2003 and 2004. In 2004, for the first time, all four species were detected in snorkel monitoring. Also, young-of-the-year duskytail darters were observed, indicating the first wild reproduction and recruitment of any of these fishes.

In Abrams Creek, a single release of smoky madtoms took place in 2004. Snorkel observations there resulted in good numbers of adults and young-of-the-year (and two nests) of both madtoms, and record numbers of duskytail darters. Reproduction of the madtoms and duskytail darter was again documented, as nests of both madtoms were found, and young-of-year darters were wild-spawned since none had been stocked there for the past three years. Duskytail darters were observed several miles upstream of the campground at a site stocked only once before. Both smoky and yellowfin madtoms were observed near the mouth of Abrams Creek at the Chilhowee Lake embayment, more than three miles below the nearest stocking site, indicating dispersal is taking place.

The final rule for the Shoal Creek NEP for the boulder darter and spotfin chub restoration has been published in the Federal Register in 2005. Boulder darters were stocked at a site above Iron City, TN on International Paper property April 19 and May 5. 2005. IP has provided funding for the propagation work and strongly supports this restoration effort. Spotfin chub releases will not take place until at least 2006. Based on discussions about the appropriate parental stock, although Buffalo River spotfin chubs are geographically closer, they are probably more distantly related to the original Shoal Creek population than extant upper Tennessee River drainage populations. Therefore, Emory River system broodstock (yet to be collected) will likely be used to produce individuals stocked in Shoal Creek. Tennessee Technological University grad student William Thomas Russ is monitoring the Emory River population which is surrounded by increasing threats.

Efforts continue to restore populations of *Fundulus julisia* to portions of their former range. Numerous sites were stocked with thousands of captively reared individuals in 2004. In addition to CFI, several private landowners, the Natural Resources Conservation Service, the USFWS, (including the Cookeville office and the Dale Hollow, Wolf Creek, and Chattahoochee National Fish hatcheries), students and faculty at Tennessee Technological University, and the Tennessee Aquarium are cooperators in this project. Grad student Malabika Laha's aquarium studies suggest that topminnows may not successfully reproducing when mosquitofish are present because *Gambusia* prey on the young. Grad students Andrea Johnson's and Cory Goldsworthy's monitoring of restored populations supported the hypothesis—successful reproduction/recruitment was only observed in the absence of mosquitofish. Thus there is accumulating evidence to support Pat Rake's suspicion that the introduced "exotic" mosquitofish is primarily responsible for the topminnow's imperilment.

Other activities of interest

Mark Cantrell, USFWS, reported a unique event from the Tuckasegee River, where the US Fish and Wildife Service and Duke Power joined with the Eastern Band of Cherokee Indians to organize a re-enactment of traditional fishing methods at an Indian weir - fish trap. Originally planned for early September, tropical storms postponed the event until a cold mid-October morning when students from Cherokee High School braved the cold to understand the traditional methods of their forefathers. The effort resulted in the capture of a handsome river chub. The students ate pizza. The Tribe plans to make this an annual demonstration and education event. The Tribal Historic Preservation Office and FWS are working to catalogue and protect other fish weirs in the Little Tennessee and Hiwassee basins.

David Etnier and Henry Robison report the following on an interesting *Hybognathus* from the Mississippi River.

On 17 October 2003 a University of Tennessee Regional Faunas class collected and preserved 45 *Hybognathus* specimens from River Miles 14-15, lower White River, Desha/Arkansas county line, Arkansas. One of these (39 mm SL) has a basioccipital process characteristic of *H. argyritis*, a species not known from Arkansas. It was entered into the University of Tennessee Research Collection of Fishes (UT) as *H. argyritis* (UT 44.10001). Etnier noted at the time that its eye did not seem appreciably smaller that that of a 41 mm SL specimen of *H. nuchalis* from the same collection (UT 44.10002, 44 specimens, 41-75 mm SL). A more careful examination of the "*H. argyritis*" specimen indicated that its eye was even larger (3.2 mm) than that of the 41 mm SL *H. nuchalis* from UT 44.10002 (3.0 mm). Comparison with a 40 mm SL *H. argyritis* (UT 44.7179), from Missouri River Mile 16.4 made it clear (eye diameter 2.1 mm) that we did not have a typical specimen of *H. argyritis*.

Possible identifications of this specimen are (1) a southern "race" of *H. argyritis* with a large eye; (2) a hybrid between *H. placitus* and *H. nuchalis*; (3) a hybrid between *H. nuchalis* and some other cyprinid; (4) a misidentification of a non-*Hybognathus* minnow; (5) a riverine waif of *H. hayi*, a species associated with cypress swamps; (6) mere within population variation in basioccipital shape in *H. nuchalis*; or (7) an unknown species of *Hybognathus*. Possibility (2) seems unlikely, as *H. placitus* is known from only extreme western Arkansas and has an extremely small eye; (3) and (4) seem unlikely as the coiled gut, black peritoneum, and pharyngeal tooth count and shape are typical for *Hybognathus*, and the specimen is definitely not *Notropis nubilus*; (4) a 39 mm SL *H. hayi* from the Hatchie River system, TN, has a much more terminal mouth and more broad basioccipital process (1.1 mm vs. 0.6 mm); and (6) we examined the basioccipital process of all 44 specimens in UT 44.10002 and from hundreds of additional *Hybognathus* collected in the lower Mississippi River, and have not noted visible variation. The most likely possibilities are thus a large-eyed southern race of *H. argyritis* or an unknown species. Since a dam is already under construction at White River Mile 0.5, efforts should be made to secure additional specimens in the lower White River and adjacent Mississippi River and lower Arkansas River.

The senior author's name plus the association with a dam under construction plus the rapidly approaching month of April suggest an 8th possibility, which we assure you is untrue.

REGION IV- SOUTH-CENTRAL

Frank Parauka of the Panama City, Florida Field Office, U.S. Fish & Wildlife Service, along with Laura Kovatch conducted investigations on the availability of spawning habitat for gulf sturgeon, *Acipenser oxyrinchus desotoi*, in northwest Florida and southeast Alabama river systems, including the Escambia/Conecuh, Yellow, Pea, Choctawhatchee, Apalachicola, and Ochlockonee rivers. One hundred fifty two sites were identified in 93 km of river as having characteristics similar to documented spawning habitats. Sites ranged from 45 m to 7.2 km in length. Ninety percent of the potential habitat was in Alabama, with most of the river km in the Conecuh, Pea, and Choctawhatchee. The Choctawhatchee had the largest number of potential spawning sites, followed by the Pea and the Conecuh. A typical spawning site in Alabama had rocks, limestone, clay bluffs, rock and limestone walls and outcroppings, shoals and hard substrate, and cobble. Frank is continuing his study in the Escambia/Conecuh River that began in 2002 where he is collecting sturgeon for a database that will be used to calculate the size of the population in the system. About 20% of the netted individuals are over 100 lbs. Sonic tagging of specimens from the Escambia over to the Ochlockonee also continues.

Daniel Drennen of the Jackson, Mississippi Field Office, U.S. Fish and Wildlife Service Office has been examining land use changes in the Turkey Creek watershed, Locust Fork drainage, Jefferson County, AL, using black and white aerial photographs. Turkey Creek is home to three species of imperiled darters, the vermilion darter, *Etheostoma chermocki*, the rush dater, *E. phytophyllum*, and an introduced population of the watercress darter, *E. nuchale*. Daniel examined photos of a portion of the watershed from 1956, 1977, and 1997. Overall obvious land changes as percent acreage change was discernible, but the footprint of urbanization was not visible at a scale that was anticipated. Qualitative differences between non- and sparsely-vegetated areas and vegetated areas were noted, but the overall net change was not as large as expected. It appears that these three imperiled darter species are impacted by site destruction rather than overall watershed disturbances based on the aerial photos. This emphasizes the need for best management practices in close proximity to the creek for the recovery of these species.

Pat Rakes and J.R. Shute at Conservation Fisheries Inc. report that annual surveys continue in the Conasauga River, and surveys within the Cherokee and Chattahoochee National Forests for *Cyprinella caerulea*, *Etheostoma brevirostrum*, *Percina* sp. cf. *macrocephala*, and *P. jenkinsi* indicate that these species appear to be doing well. Additional surveys were also initiated in the Etowah River and Conasauga

River tributaries within the Chattahoochee National Forest. Efforts to propagate *P. jenkinsi* were unsuccessful—apparently the four specimens collected in August 2002 were all females! Two more individuals have been acquired for the 2004 effort; hopefully at least one is a male. Somewhat more success was achieved with *E. etowahae*, with the production of a small number of juveniles. Egg deposition sites were variable, with some found buried in sand both under and beside rocks, while others were found in small pebble interstices, mostly under cover objects. Most eggs were individually deposited, but some were found in adhesive clusters. The only possible pattern appeared to be related to a preference for small, mostly enclosed cavities under cover objects—substrate on the floor of the cavity seemed less important. Development of propagation protocols and establishment of an ark population for *E. chermocki* was put on hold due to questions about the species' status. Therefore, in order to be prepared to do so in the future and utilize funding, Pat and J.R. collected *E. bellator* to work with as surrogates from the most closely related population just north of Turkey Creek. These are currently being winter conditioned for spring spawning efforts. Three old *P. aurora* refused to spawn in 2003, possibly due to old age, sex composition, or too small of a group. Fortunately, in October Todd Slack collected eight young fish to utilize for 2004. Finally, as noted last year, Susie Adams at the Southern Forest Research Station in Oxford, Mississippi has contracted CFI to propagate *E. stigmaeum*, *E. artesiae*, and *E. douglasi* from the Sipsey Fork for a growth study of otoliths (using oxytetracycline marking). Limited numbers of all three species were produced, some from original wild adults as well as from F2s. Perhaps the most significant development to come from this work was a circular flow-thru rearing chamber fashioned for the tiny pelagic larvae of *E. douglasi*. Pat and J.R. look forward to testing the set-up with all *Etheostoma* (*Nothonotus*) and *Percina* spp. larvae in 2004.

Scott Mettee of the Geological Survey of Alabama in Tuscaloosa reports that GSA biologists continued fish bioassessment studies in the Tennessee River drainage and Terrapin Creek, studies to track paddlefish, *Polyodon spathula*, and southeastern blue sucker, *Cycleptus meridionalis*, in the Alabama River, the Bobcat Cave study at Redstone Arsenal, mussel studies in the Coosa River and Bear Creek (Tennessee River drainage), the fish passage study at Claiborne and Millers Ferry Locks and Dams on the Alabama River, and a biological inventory of fish, mussel, snail, crayfish, and aquatic insect species inhabiting the Mobile Delta. GSA completed fish and mussel species accounts for Volumes 1 through 4 of the forthcoming Alabama Imperiled Species Report scheduled for release sometime in 2004. Additionally, two papers were published, one on mussels and one on Alabama shad, *Alosa alabamae*, and skipjack herring, *A. chrysochloris*. A status report was published on the Cahaba shiner, *Notropis cahabae*, and Coal and Tuskaloosa darters (*Percina brevicauda* and *Etheostoma douglasi*) in Locust Fork in the GSA publication series. A manuscript on the biology of a spawning population of the southeastern blue sucker in the Alabama River will be published soon. GSA has initiated new projects to investigate the status of imperiled fishes inhabiting the Elk River in north Alabama and several small coastal rivers in south Alabama.

Todd Slack from the Mississippi Museum of Natural Science reports the recent hiring of Mark Dugo to collaborate on a 2+ year project addressing movement of non-indigenous Nile tilapia in coastal waterways of Mississippi using telemetry. Mark completed his MS in August 2003 at The University of Southern Mississippi assessing fine-scale genetic structure of Gulf sturgeon, *Acipenser oxyrinchus desotoi*, within the Pascagoula drainage. Todd is continuing his collaboration with Mark Peterson (USM-Gulf Coast Research Laboratory) on research projects addressing the distribution, expansion and potential impact of Nile tilapia in aquatic systems of Mississippi. Research on Gulf sturgeon in the Pascagoula drainage is in the final stages of completion. This project began in 1997 and is based primarily on the collaborative efforts between Todd, Steve Ross (USM), his students (Ryan Heise, M. Dugo), and Brian Kreiser (USM). During the period from 1997 to January 2004, the Gulf sturgeon research team has processed a total of 289 individuals when all recaptures are included. The total number of unique Gulf sturgeon captured, processed and tagged in the Pascagoula drainage since 1997 is 201. In addition, one spawning area has been documented on the Bouie River near Hattiesburg and based on telemetry patterns over successive field seasons, likely spawning sites have identified in the upper Chickasawhay River. These sites represent isolated patches of potential spawning habitat totaling 20 kilometers of riverine habitat distributed along a 120-kilometer reach between Waynesboro and Enterprise. Beginning in Spring 2005, the Gulf sturgeon research efforts will be directed on the Pearl River in collaboration with biologists from Louisiana Department of Wildlife and Fisheries. Todd will initiate a survey of the upper Pascagoula drainage (i.e., Leaf and Chickasawhay rivers) for Pearl darters, *Percina aurora*, during Summer 2004 along with Brian Kreiser, Bryant Bowen and Paul Mickle (USM). The Pascagoula River proper was surveyed during 2000-2001 and resulted in the capture of 145 individuals from among 28 sites. The Ichthyology Collection at MMNS continues to grow. The collection is approaching 31,000 cataloged lots with approximately 66% of the total holdings computerized. Backlog collections are being cataloged, many collected by MDWFP personnel from the Tombigbee, Pascagoula and Pearl drainages during the 1980's. Following the acquisition of the MSU Ichthyology Collection in 2001, MMNS has completely computerized the catalog with approximately 85% of the holdings georeferenced. Todd anticipates incorpo-

rating these holdings into the main collection within the near future.

Mark Peterson at the Gulf Coast Research Lab in Ocean Springs, Mississippi, is still working on mapping water quality and habitat of the Pascagoula River ecosystem with Steve Ross, Melissa Partyka and Marisa Weber, a study of *Phragmites australis* with M. Partyka, and altered habitats with Bruce Comyns and M. Partyka. All three projects are funded by the NOAA, CIAP program. He is also involved in the production of a Mississippi-Alabama SeaGrant project entitled "Field Guide to Aquatic Habitats and common fauna of the Northern Gulf of Mexico from Chandeleur Islands, Louisiana to St. Joseph's Bay, Florida", which, in conjunction with Dauphin Island Sea Lab and Ken Heck, will be used for summer teaching programs. Mark is also working with Todd Slack on tilapia migration studies and has just started organizing and developing a site profile for the Grand Bay NERR site with Mark Woodrey. He continues to work with Chet Rakocinski and Bruce Comyns on otolith microchemistry of spotted seatrout, *Cynoscion nebulosus*, and red drum, *Sciaenops ocellatus*. Mark and Nancy Brown-Peterson continued their work in Mexico collaborating with colleagues at FES-Iztacala, UNAM in Mexico City on fishes of Alvarado lagoon near Veracruz, Mexico. Nancy and Mark received funding from Environmental Defense, the Harte Research Institute and USM College of Science and Technology to organize, translate, edit and submit for peer-review senior theses from FES-Iztacala on research activities in Alvarado lagoon and the Tecolutla estuary. To date, six papers have been completed and accepted for publication in *Gulf and Caribbean Research*. Mark recently resumed his Editorship of this journal that he previously held from 1996-2001.

Bob Jenkins at Roanoke College, Virginia, requests any information on specimens of *Moxostoma* that may be preserved from the Ochlockonee River drainage. A 1983 report by the Georgia Department of Natural Resources, authored by Russell Ober and Lee Keefer, lists *Moxostoma* sp., grayfin redhorse, from one mainstem site. Unfortunately, the specimens were too big to preserve. This species has long been known only from the Apalachicola River drainage. Bob has not seen a *Moxostoma* from the Ochlockonee, but Russell told him that circumpeduncle scales were counted on the released fish and the spotted sucker, *Minytrema melanops*, was eliminated as a possibility with this count. Bob intended to change the common name of this undescribed species from grayfin to Apalachicola redhorse because some specimens have orangish lower fins. If the fish inhabits an additional drainage, it would be good to document this and rethink its name.

Jim Godwin of the Alabama Natural Heritage Program in Montgomery has begun a survey for mussels in the headwaters of the Paint Rock River along with Doug Shelton of the Alabama Malacological Research Center. Approximately 100 species of freshwater fish and 45 extant species of mussels are found in the Paint Rock. Four of the mussels are federally listed as endangered, the shiny pigtoe (*Fusconaia cor*), fine-rayed pigtoe (*Fusconaia cuneolus*), Alabama lampmussel (*Lampsilis virescens*), and pale lilliput (*Toxolasma cylindrellus*). The Alabama lampmussel and pale lilliput have been extirpated throughout their range except within the headwaters of the Paint Rock River. Three additional species are considered globally imperiled based on the Natural Heritage ranking system developed by The Nature Conservancy. These are the Tennessee pigtoe (*Fusconaia barnesiana*), slabside pearlymussel (*Lexingtonia dolabelloides*), and the purple lilliput (*Toxolasma lividus*). So far over 500 individuals of 23 species have been captured, measured and marked.

Rob Angus and Ken Marion at the University of Alabama at Birmingham, along with Jaideep Honavar, have been examining the status of fish communities in the rapidly developing upper Cahaba River watershed. Their objective was to identify the fish species that are most sensitive to siltation and whose change in abundance can serve as an indicator of the impact of sediment stress in a stream system. They assessed the habitat quality and then investigated the degree to which sediment-indicative habitat quality variables at the study sites were correlated with ichthyofaunal assemblages at those same sites. An index of biotic integrity was also calculated and correlated to sediment-indicative habitat parameters. Multivariate ordination techniques were used to investigate overall changes in species composition at sites with different degrees of siltation. The index of biotic integrity did not correlate very strongly with sediment-indicative habitat quality variables. Other characteristics of the ichthyofaunal community, such as the percent relative abundance of crevice-spawning minnows, disturbance-sensitive darters, suckers, top carnivores, herbivores and omnivores did show associations with sediment-indicative variables. Multivariate ordination successfully separated silt-impacted from non-impacted sites.

Carol Johnston at Auburn University reports that graduate student Wendi Hartup is examining population levels of *Etheostoma boschungi*, the slackwater darter. Habitat loss due to agricultural practices and water use changes is the greatest threat to the continued existence of this species. This study assesses population levels at historic sites, calculates survival rates for each life stage (larvae, juvenile, and adult), and uses the program, Poptools, to construct a stage-based Leslie matrix and run a Monte Carlo simulation. Analyses of the model will assess which life stages are most sensitive to environmental changes and which life stage has the greatest effect on population growth rate, predict average extinction time periods, and estimate minimum viable population size. Results from this study will aid in the prioritization of populations of *E. boschungi* for management and may provide evidence for strengthened federal protec-

tion. Carol and another graduate student, Casey Knight, are examining the predation of pygmy sculpin (*Cottus paulus*) eggs by crayfish (*Cambarus latimanus*) and male sculpin, which exhibit filial cannibalistic behavior. Nesting tiles were placed in Coldwater Spring run. The egg clutches produced on these tiles were then placed inside enclosures within the run. The enclosures (with egg clutches) were used in one of four treatments ranging from the control (a lone clutch of eggs) to a clutch of eggs, a male sculpin and a crayfish. The findings of this experimental study support the contention that both parental male sculpin and crayfish are predators in this system.

Rick Mayden at Saint Louis University and his students are still involved in research on southeastern fishes. Nick Lang is looking at morphological and genetic characters within the *Etheostoma swaini* and *E. whipplei* complexes, Anna George is examining relationships among logperches, and post-doc Dave Neely continues his research on sculpins.

Michael Stewart of Troy State University, Alabama currently has a graduate student doing a project on life history of some rare mussels in the Choctawhatchee/Pea River drainage. In addition, he hopes to start a student on crayfish and environmental indicators in the same drainage. Michael is also continuing some mussel work on the Conecuh River this summer if water levels cooperate.

Some quick notes: Dave Etnier at the University of Tennessee reports that Ben Keck has completed his thesis on the fishes of the Hatchie River system. Bob Butler at the U.S. Fish and Wildlife Service in Asheville, North Carolina, reports that the recovery plan for seven mussel species endemic to drainages between Econfina Creek (St. Andrew Bay) and Suwannee River basins is finalized and can be accessed from the USFWS website.

Steve Powers left the University of Alabama upon completion of his doctorate and is now an Assistant Professor at Reinhardt College in Waleska, Georgia. He can be reached there at SLP@reinhardt.edu. A manuscript by Steve, Rick Mayden and Dave Etnier on the conservation genetics of the ashy darter, *Etheostoma cinereum*, identifies populations from tributaries to the Cumberland, Duck and Upper Tennessee rivers as three different genetically divergent, imperiled management units and has been accepted for publication in Copeia. Detailed examination of nuptial pigmentation and other morphological differences among these management units will continue this spring. In his dissertation, Steve identified six (yes 6) different allopatric, diagnosable species within the *Etheostoma simoterum* species complex. Ranges of each species are largely consistent with areas of endemism within the Cumberland and Tennessee rivers. One more field season is required to identify exact distributions of each species, but the descriptions should be submitted for publication this summer. Steve, along with Mel Warren at the Southern Forest Research Station in Oxford, Mississippi has identified genetic divergence between two disjunct population of *Etheostoma raneyi* in the Yocona and Little Tallahatchie rivers. The two populations are restricted to small streams in the upper Coastal Plain hills of Mississippi and separated by extensive reaches of unsuitable habitat in the downstream portions of each river on the lower Coastal Plain. A similar pattern exists in the recently described *Etheostoma cervus* and *E. pyrrhogaster* from western Tennessee and Kentucky.

Jim Williams of the U.S. Geological Survey Center for Aquatic Resource Studies in Gainesville, Florida discovered the blackmouth shiner, *Notropis melanostomus*, in Bay Minette Creek, Mobile Bay drainage, in April 2003. Fourteen specimens were collected in a backwater area off of the main creek. This discovery fills in the gap between populations in the Pascagoula and Blackwater/Yellow River drainages. Jim and myself are examining morphological and genetic variation across these three drainages.

Lastly, I am pleased to report that Fishes of Alabama by Herb Boschung and Rick Mayden, with color illustrations by Joe Tomelleri, is expected to be available in May!! Included are 112 color plates illustrating about 350 fishes. The book is being published by the Smithsonian Press and will sell for the low price of $55.

– Bernie Kuhajda

REGIONS V AND VI – NORTHWEST AND SOUTHWEST

Bob Hrabik and his crew at the Open Rivers and Wetlands Field Station (ORWFS) are staunch proponents of river trawling. Their development and use of small mesh trawls has enabled them to collect large and small fishes in main channel environments of the Missouri and Mississippi Rivers inaccessible to traditional collecting gear. Last year, the ORWFS used their "Missouri trawl" to obtain hard-to-find fish species to photograph for the upcoming "Fishes of Minnesota," larval river sturgeons, and the second-ever specimen of crystal darter taken in the middle Mississippi River since 1901. Bob and the ORWFS field crew are also collaborators with Southern Illinois University and the U.S. Army Engineer Research and Development Center at Waterways Experiment Station (WES) on population and life history studies of the pallid sturgeon in the middle Mississippi River.

Henry Robison, Southern Arkansas University, continues to revise and update his regional fish books. He and Rudy Miller recently finished the second edition of "Fishes of Oklahoma" which is now available from the University of Oklahoma Press. Rob is now busily working with Tom Buchanan, Westark College, to complete a second edition of "Fishes of Arkansas." The bulk of last year's work consisted of big-river collecting and photog-

raphy of fishes.

Another Arkansan, Brian Wagner, reports that he spent last year working mostly with crayfish but still found time to conduct a local survey for the Arkansas darter, *Etheostoma cragini*, near Fayetteville and will be working on a distribution and status survey of the species throughout its range in the state. Etheostoma cragini, Brian notes, is one of the rarest fishes in the state and has been designated as a candidate for listing under the Endangered Species Act. It was first found in Arkansas in 1979 in Wilson Spring near Fayetteville. Harris and Smith (1985) found the species at five locations, three of which persisted more recently (Hargrave 1998, Hargrave and Johnson 2003). A survey in Oklahoma (Echelle and Fisher 1996) found E. cragini at fourteen localities and failed to find them at nine of eleven historically known sites. A recent Missouri study (Combes and Winston, in press) found *E. cragini* at 43 sites. All targeted surveys for this species in Arkansas have been confined to the Illinois River basin. In addition to sampling in this basin, sites should also be sought in the Lower Neosho, Lake of the Cherokees, and possibly Elk River basins. Rapid population growth and development in Benton and Washington Counties make the need to document the locations of populations of this rare fish even more urgent. The objective of this study is to reassess the status of the 5 historically known populations of *Etheostoma cragini*, identify potential locations for undiscovered populations, and conduct fish collections at 30 or more of these locations.

A different species of darter in Arkansas was the focus of two separate investigations. Researchers at Arkansas Tech University are looking at habitat use by the yellowcheek darter, *Etheostoma moorei*, at a variety of scales. Researchers at Arkansas State University recently completed a study of movement of this species as well. That study attempted to do this by recapture of marked individuals, but recapture rates were so low that no conclusions could be made.

The USFWS Arkansas Field Office is leading an effort with Arkansas Game and Fish Commission and several other entities to conserve the upper Little Red River watershed. This area is home to the yellowcheek darter, *Etheostoma moorei*, (a federal candidate) and a federal listed mussel, *Lampsilis streckeri*. The hope is to develop an umbrella Candidate Conservation Agreement and Safe Harbor Agreement, respectively, for these 2 species to encourage on the ground habitat conservation efforts.

Frank Pezold reports that several projects are in progress at the University of Louisiana – Monroe, most of which are affiliated with the Museum of Natural History. Professor and Curator Emeritus Neil Douglas refuses to retire. A recent report on the holdings of the Museum fish collections indicates that more than 2/3 of the roughly 1400 lots catalogued in the last 3 years were contributed by Neil and his colleagues at the U.S. Army Engineer Research and Development Center at Waterways Experiment Station (WES). These collections have been principally in Missouri, Arkansas, Louisiana, and Mississippi and were made as part of environmental studies associated with civil works projects of the Corps of Engineers.

Three students in Frank's lab are looking at regional fish questions. Brook Fluker, a graduate of Henderson State University, is examining morphometric and genetic variation in lower Mississippi River basin *Menidia* populations. A study by Royal Suttkus, Bruce Thompson and Jason Blackburn soon to-be-published in the SFC Proceedings revives the old debate on the species status of inland vs. coastal population of *M. beryllina*. Preliminary morphometric data suggest that patterns of population variation are equivocal on the argument. DNA has been extracted for sequencing (in the Museum's spanking new Molecular Genetics Lab) and will hopefully shed some light. Another student, Andrew Perry, a graduate of Valdosta State University, is studying the seasonal chronology of fish assemblage structure in a Ouachita River floodplain pond. He will be looking at all life stages. The third student, Janet Gregory, one of ULM's own, is working with Jan Hoover of WES. They are conducting a laboratory experiment designed to test the reaction of juvenile pallid sturgeon to simulated dredging noises. Patterns of spatial assortment within an artificial stream are being compared pre- and post-noise impact.

A new faculty member, Russ Minton, came to ULM from the University of Alabama via a post-doc at the Field Museum. Russ is coordinating the molecular lab activities. He has a student, Jeff Brooks from Arkansas Tech, who has completed a survey of freshwater mussels in the Arkansas portion of Bayou Bartholomew. His work complements the work by one of Frank's students, Jimmy Alley (currently working at WES), who did a survey of mussel distributions in the Louisiana portion.

Hank Bart, Tulane University, filed a rather lengthy report to make up for a number of years of not filing reports. As SFC Chair, he has spoken with SFC membership, educators and various education funding agencies about developing K-12 educational resources on imperiled southeastern fishes. Hank's plan is to bring together interested SFC members and K-12 teachers for a series of workshops starting in Spring 2006. The goal of the workshops will be to develop lesson plans at different grade levels on imperiled southeastern fishes. The teachers will be expected to put the plans in use in their classrooms and evaluate their effectiveness for teaching environmental science concepts. Hank was hoping to hold the first workshop in 2005, but learned that winning funding for this sort of thing can be tricky. SFC members will get an update at the Annual Business Meeting in Tampa.

Hank and R.D. Suttkus are continuing their systematic revision of ictiobines (carpsuckers and buffalofishes). New species of *Carpiodes* will be described from the southeast. However, as those familiar with Hank's work knows, genetics of this group are problematic. Sadly

(especially for Hank), many people think of carpsuckers and buffalofishes as trash fish unworthy of conservation concern. Hank and Suttkus are finding that some of the rivers in which new forms occur are so impacted that those carpsuckers are disappearing. For example, an undescribed form of *C. velifer* has not been seen in the Pee Dee since 1975 and apparently is rarely encountered in the Cape Fear River.

Hank and graduate students Mark Clements and Mike Doosey are collaborators on the *Cypriniformes Tree of Life* project with Rick Mayden, Phil Harris, Rob Wood, Andrew Simon, and a host of other folks. Mark Clements is close to finishing his dissertation on western suckers of Subgenus *Scartomyzon*. Mike Doosey is starting a dissertation on the anatomy of the palatal organ complex (the huge, fleshy pad with a bony core that hangs down in the back of the throat) in cypriniform fishes.

Rebecca Blanton is continuing her dissertation work on the *Etheostoma flabellare* species complex. In addition to assessing phylogenetic relationships across the entire group, she is doing a detailed phylogeographic assessment of populations distributed across the Atlantic Slope and upper Tennessee River system, and examining historic and contemporary processes contributing to speciation in this region. No one should be surprised to hear that Rebecca is finding new species within *E. flabellare*. What is surprising is what she is finding out about relationships among populations in some of the basins. Stay tuned.

Mollie Cashner is examining the evolution of nest association in Genus *Hydrophlox*. She is conducting in-stream surveys, assessing variation in egg and larval development, examining egg predation on nests, and how species respond to chemosensory stimuli (e.g., *Nocomis* milt) all within a phylogenetic context. She was able to make some great spawning observations of *Notropis baileyi* in Mississippi and Alabama last spring and summer, and was also able to develop embryos in the laboratory. One interesting nest associate she encountered in Alabama (Chenault Springs, Bear Creek trib of Tennessee R. drainage in Franklin Co.) was a large snapping turtle camped out on top of an active *Nocomis* mound!

Lastly, Andy Abernathy, Hank's newest student, is starting some interesting studies on how changing fish names in natural history collection databases influence niche modeling, an emerging research area.

The Nekton Research Laboratory (NRL) at the Pontchartrain Institute for Environmental Sciences has of late been particularly active in fish conservation research in southeastern Louisiana. Director Martin T. O'Connell in cooperation with Robert C. Cashner, Vice Chancellor for Research at the University of New Orleans, has organized a team of expert fish biologists, ecologists, and graduate students to address numerous fish and fishery issues in the valuable aquatic environments of coastal Louisiana.

Marty, Bob, and senior biologist Chris S. Schieble recently (October 2004) published research results on estuarine fish assemblage stability in the Lake Pontchartrain Estuary (see *Estuaries* 27(5): 807-817). This research has led to further coastal fish work including the NRL's current project on the Chandeleur Islands. These efforts represent the most extensive survey of marine fishes ever conducted on Louisiana's oldest barrier island chain. Monthly sampling began in October 2003 and the NRL has been lucky enough to collect fish data both prior to and after Hurricane Ivan hit the Islands in September 2004. Chris has been personally leading this sampling effort and hopes that Hurricane Ivan proves to be an excellent opportunity to measure the effects of a "natural experiment" on the local marine fishes. Jason P. Turner, an expert on aquatic food webs and trophic interactions, is also a member of the Chandeleur Islands research team and is co-author on multiple upcoming scientific publications. These manuscripts include dietary information on fatty acid signatures and turnover rates in important fish species such as cobia (*Rachycentron canadum*) and red drum (*Sciaenops ocellatus*). Another manuscript describes trophic relationships among pelagic fishes associated with *Sargassum* mats in the Gulf of Mexico. Finally, Jason is currently using similar laboratory techniques to compare spotted seatrout (*Cynoscion nebulosus*) diets among different coastal Louisiana populations and is also assessing the possibility of using formalin-preserved fish specimens for stable isotope analyses.

Senior biologist and database manager Meg Uzee O'Connell is presently conducting ecological meta-analysis on fish assemblage data collected from different Louisiana coastal ecosystems. Along with co-authors Robert W. Hastings (Director of the Alabama Natural Heritage Program) and Martin T. O'Connell, she hopes to compare fish data collected from the Barataria Basin, Lake Maurepas, and portions of the entire Lake Pontchartrain Basin. The ultimate goal is to assess each of these regions in regard to their relative ecological health over time. Meg O'Connell is also a co-author with James D. Williams (United States Geological Service) and Martin T. O'Connell on an upcoming publication describing their assessment of the population status of the rare blackmouth shiner (*Notropis melanostomus*). Results from a model of museum fish data suggested that undiscovered populations of blackmouth shiners likely still exist. This finding was confirmed by Williams when a new population was found in Alabama, the first for that state.

Graduate students in the NRL are also pursuing various research projects. Tom Lorenz (Ph.D. student) is continuing his work on the invasive Rio Grande cichlid (*Cichlasoma cyanoguttatum*). This exotic freshwater fish has become established in the canals of New Orleans and is now moving into valuable estuarine habitats, threatening native species. Tom is focusing on studying the role of inter-species aggression in determining the

success of this aquatic invader. Kenneth G. Blanke (M.Sc.) has just completed a year of monthly sampling at the Chandeleur Islands where he is evaluating how marine fish assemblages respond to different species of submersed aquatic vegetation (SAV). This research has serious implications to current restoration and SAV re-planting efforts being carried out to counter-act Louisiana's accelerated coastal erosion. Lissa Lyncker (M.Sc.) has recently begun her thesis research and it will involve the assessment of essential habitat for juvenile blue crabs (*Callinectes sapidus*) in the Lake Pontchartrain Estuary. Lissa hopes to use remote sensing data to help her determine which environmental variables help determine recruitment success. Jeff Van Vrancken (M.Sc.) will begin his thesis research this spring which involves comparing freshwater fish assemblages among different sites in the Lake Pontchartrain Basin. In particular, Jeff is interested in possible faunal changes in drainages that have undergone recent significant urban development. Molly Dillender (M.Sc.) is also beginning her research this year and will be collecting fishes from both freshwater and estuarine habitats. One goal of Molly's research will be to find out more about the consistent occurrence of nominally freshwater fish species in estuarine habitats.

In conjunction with Susie Adams, US Forest Service, Brian Kreiser, University of Southern Mississippi, and two of his graduate students are working on Alabama shad (*Alosa alabamae*). Paul Mickle is studying the status and viability of the Pascagoula population. Bryant Bowen is conducting an assessment of the population genetic structure across the range.ert Brian's para here if not included in other Regional Report)

The Fish Team at the U.S. Army Engineer Research and Development Center at Waterways Experiment Station (WES) was active throughout much of the lower Mississippi River Basin. Projects last year included life history studies of the pallid sturgeon in the lower and middle Mississippi River (including first-time estimates of natural mortality and descriptions of diet), impact analysis of the Arkansas River Navigation Project, surveys of Ozark stream fishes in tributaries of White River, AR. Also completed last year, were studies of the environmental benefits of erosion control in Mantachie Creek, a tributary of the Tombigbee River, and of weirs in Steele Bayou, a tributary of the Yazoo River.

Closer to home, the WES Fish Team also conducted baseline surveys for planned habitat restoration efforts in the Mississippi Delta. One study investigated three Mississippi Delta oxbow lakes over the summer. Various habitat restoration alternatives were evaluated and collections indicate that interesting, intolerant and invaluable species can still be found in these fishing holes. Two specimens of northern starhead topminnow, *Fundulus dispar dispar*, were collected in Little Eagle Lake, an oxbow in Humpheys County near Belzoni, Mississippi in July 2004. It is a species of special concern in Mississippi with only eight collections statewide, most made prior to 1960. The male and female specimens were 42 and 60mm in length (max. 65mm), respectively, and were captured 45 meters from shore in 6 feet of water along with golden topminnow, *F. chrysotus*. Another study investigated benefits of restoring flow to now stagnant Indian Bayou, a tributary of the Big Sunflower River. Despite fragmented reaches, extreme sedimentation, and pervasive hypoxia, fish communities were found to be moderately species rich, sirens and amphiuma were present, and alligator snapping turtles were abundant, large, and successfully reproducing. Unfortunately, tilapia (tentatively identified as *Tilapia nilotica*) were also discovered. A single collection contained one adult and several young-of-year.

Swimming performance studies on young-of-year acipenseriform fishes continued at WES. Prior to entering dental school, April Turnage completed laboratory studies of paddlefish (provided by Private John Allen National Fish Hatchery) and very small pallid sturgeon (provided by Natchitoches National Fish Hatchery). Her successor, Joseph Beard, a senior at Vicksburg High School, has continued that work with the growing sturgeon. Data on swimming endurance and behavior at different water velocities are being used to assess entrainment risk posed by the flow fields of dredges.

Several new projects for the upcoming year will keep the WES Fish Team busy throughout the ARK-LA-MISS. Fieldwork in the Mississippi River includes studies of Gulf sturgeon in the Mississippi River Gulf Outlet (MRGO), impacts of sand and gravel mining on pallid sturgeon, effects of tow boat navigation on fish, and the fishery benefits of dike notching. As part of the White River Comprehensive Study, population studies have begun on the paddlefish. Environmental impact studies are planned for the Coldwater River and Pearl River, MS and in the Cache River, AR. Also under study are demography and control of sailfin catfishes, silver and bighead carps.

Activities by the North American Native Fishes Association (NANFA) grow in this region. Brian Wagner and colleagues at the Arkansas Game and Fish Commission will host the annual NANFA convention in Little Rock, 09-12 June 2005 with field trips planned to the Ozarks, Ouachitas, Gulf Coastal Plain, Mississippi Delta, and the Arkansas River Valley. NANFA members Tyler Strange and Heather Smith continued their studies of the floodplain pool ecosystem in Warren County, MS. Unusually low stages of the Mississippi River, however, prevented spring flooding in the Halpino Lake system last year. As a result, Heather and Tyler abandoned plans to study alligator gar and other pool fishes, and, instead described populations of fairy shrimp and clam shrimp occupying the fishless waters. Also documented last year were changes in distribution of the endangered wood storks (*Mycteria americana*) as they sought new feeding grounds and new records for silver and grass carps inhabiting flooded borrow pits.

– Jan Hoover

SOUTHEASTERN FISHES COUNCIL
TREASURER'S REPORT • MAY 2004

Dues and Contributions, 7 March 2003 through 21 May 2004:

EARNINGS

Dues: (1 January through 20 May 2004)	$1770.00
Button sales (old & new buttons)	$27.00
Donations & miscellaneous (old reprint purchase)	$208.50
Investment check from UBS Financial Services (Account Closed)	$3,377.02
TOTAL:	**$5,382.52**

Expenditures (7 March 2003 through 21 May 2004)

Proceedings # 45, printing cost	$600.00
Proceedings # 45, postage	$75.00
Proceedings #46, printing cost	$569.35
Proceedings #46, postage	$146.00
TN Secretary of State (annual report)	$20.00
Miscellaneous supplies (new checks)	$19.00
TOTAL:	**$1,429.35**

CHECKING ACCOUNT BALANCE AS OF 21 MAY 2004: $10,225.26

TOTAL ASSETS $10,225.26

Notes:

Membership (individuals and organizations) on 21 May 2004, distributed as follows:
Paid through 1997: 4
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 & lifetime members: 93

Respectfully submitted, Kyle R. Piller

MINUTES
Business Meeting
30th Annual Meeting (2004) • Southeastern Fishes Council

The 2004 meeting of the Southeastern Fishes Council was called to order by chairperson Hank Bart at 5:05 p.m. on 28 May 2004. The meeting was held at the National Center for Employee Development (NCED) in Norman, Oklahoma in conjunction with the annual meeting of the American Society of Ichthyologists and Herpetologists (ASIH). Twenty-five people attended the meeting, including four members of the Executive Committee (Hank Bart-Chair-Elect, Kyle Piller-Treasurer, Frank Pezold-managing editor, and Brett Albanese-Secretary).

Chairperson Bart noted that SFC will meet with ASIH during 2005 (Tampa) and 2006 (New Orleans). This bodes very well for the SFC because of the potential for increased attendance.

Chairperson Bart announced that Business Meeting minutes will be posted and approved electronically from this day forward. Members will have one month from the date of posting to notify the secretary of any corrections. If no one comments on the minutes during that time period, then the minutes will be considered approved as written.

SECRETARY'S REPORT

Minutes from the 2003 SFC Meeting were distributed by Brett Albanese for review and were then approved by the membership.

Brett thanked all members who participated in the electronic adoption of the Key Cave Resolution. However, he noted that only 20 people participated (out of approximately 90 active members), which is the minimum number necessary to conduct society business. Thus, he encouraged all members to participate in the future and promised to give members as much time as possible to consider resolutions.

Brett also asked for electronic copies of past resolutions that are not currently posted on the website.

TREASURER'S REPORT

The treasurer's report was distributed for review and officially accepted by the membership.

Kyle Piller reported that the SFC's Paine Weber investment was recently closed due to inactivity, which prevented us from losing $75.00 in fees. The remaining balance from the account was deposited into the SFC checking account. Kyle reported that we currently have 93 members that are paid through 2004. Finally, Kyle indicated that our total checking account balance exceeds $10,000, which is far more than needed for SFC's regular operating expenses.

NOMINATING COMMITTEE

No report.

EDITORIAL COMMITTEE

Frank Pezold reported that the number of submissions to the Proceedings is still disappointingly low. Despite this, one manuscript is currently in review and another one has just been submitted. Frank expects that 2 issues of the Proceedings will be published this year.

In an effort to increase recognition of the Proceedings and to archive important information that is poorly represented in our nations' libraries, Mel Warren suggested that all issues of the Proceedings be posted on the website as searchable PDF documents. The membership agreed with this idea and approved a motion to post all future and past issues electronically. It was agreed that the editorial committee would be tasked with this project. Carol Johnston noted that someone at Auburn might be able to scan the SFC issues for free.

TECHNICAL ADVISORY COMMITTEE

No report.

RESOLUTIONS COMMITTEE

Bernie Kuhadja thanked members who voted for the recent resolution opposing the construction of an industrial park near Key Cave, Alabama. The resolution was officially adopted by the membership in April. Copies were mailed out to organizations/agencies with a direct interest/responsibility for conservation of the cave's aquatic biota.

Mollie Cashner agreed to serve as the new chair of the Resolutions Committee. The role of the chair is to draft resolutions in the accepted form and grammar and present them to the membership for discussion and vote. The membership at large is responsible for selecting resolution topics and for supplying all of the factually accurate information needed to construct the resolution.

OLD BUSINESS

Hank requested that any important files or other official SFC correspondence be sent to him for archival.

Hank Bart expressed appreciation for all of the web-site assistance we have been receiving from the Florida Museum of Natural History. Cathy Bester and Sean Morey deserve special recognition for their efforts.

NEW BUSINESS

Hank suggested that we consider using some of our surplus funds to support student travel to meetings. Mel Warren made an official motion that the Executive Committee decide how much funding the council can provide annually for student travel and that proposals be presented to the membership for an official vote. The motion was approved.

As part of an effort to increase the conservation effectiveness of the SFC, Hank Bart discussed an initiative to train educators about rare aquatic species. Hank's concept is to send a group of SFC members to a Naturalist Center in Virginia. The SFC members would work with Virginia school teachers to develop curricula on rare aquatic species. The teachers would be responsible for disseminating the information to their students and other teachers. SFC would ultimately post these and other curricula (customized for different parts of the southeast) on the SFC website, so that teachers could access the information easily.

Hank has written a proposal to fund the initiative and plans to submit it to several funding agencies. If the proposal is funded, Hank has already received a commitment to host the workshop from the director of the Naturalist Center. Hank is also counting on several SFC members to participate in the workshop. Hank's idea spurred a whole lot of discussion among the membership and many members expressed their support for the initiative. Keep us posted Hank!

Respectfully submitted, Brett Albanese, Secretary

Southeastern Fishes Council Proceedings

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.

Manuscripts should be submitted in duplicate. A good guide for manuscript preparation is the Sixth Edition of the *CBE Style Manual* available form the Council of Biology Editors, One Illinois Center, Suite 200, 111 East Wacker Drive, Chicago, IL 60601-4298.

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 ed.* for journals not included in the *World List.*

Tables should be typed on a separate page, consecutively numbered and should have a short descriptive heading. Figures (to include maps, graphs, charts, drawings and photographs) should be consecutively numbered and if grouped as one figure each part block lettered in the lower left corner. Computer-generated graphics should be high quality prints; for drawings, high quality prints or photocopies are preferred to the original line art. Legends for figures must be on a separate sheet and each figure must be identified on the back. The desired location of each table or figure should be indicated in the margin of the manuscript. When possible, tables and figures will be reduced to one column width (3.5 in), so lettering on figures should be of appropriate size. Color figures can be printed at the author's expense.

Manuscripts will be subject to editing and will be reviewed by at least two anonymous persons knowledgeable in the subject matter. The edited manuscript and page proofs will be furnished to the author. Upon returning the reviewed and corrected manuscript to the editor, a PC disk copy of the final form of the text, tables and computer-generated graphics are also requested. Specific formatting information for the disk will be sent to the author with the edited manuscript. Reprints can be ordered at the time of printing, and will be supplied to the author at the cost of printing.

Regional reports, news notes and other short communications will also be edited and included when possible in the next number.

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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