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and *Cambarus unestami*

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FINAL REPORT

Status Survey for three rare Alabama crayfishes, *Cambarus cracens*, *Cambarus scotti*, and *Cambarus unestami*

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Introduction

The Southeastern United States is famous for aquatic biodiversity. This area is known as a hotspot for fish and mussel species and is the most diverse region in the world for freshwater crayfishes. Because of this, the region is also an area of great conservation concern. A review by Taylor et al. (2007) found that nearly half of the crayfish in the area were in need of some conservation attention. This is of particular importance for the state of Alabama and its 85 species of crayfish, some of which are limited to a single drainage and are still substantially understudied.

Three such species were the focus of the current study. The Slender Claw crayfish, *Cambarus cracens*, the Chattooga River Crayfish, *C. scotti*, and the Blackbarred Crayfish, *C. unestami* each have limited ranges confined to northeastern Alabama and northwestern Georgia. As such they are vulnerable to population declines due to single catastrophic events and are listed as either Endangered (*C. cracens*) or Threatened (*C. scotti* and *C. unestami*) according to American Fisheries Society criteria (Taylor et al. 2007). Following conservation priority criteria developed by the Alabama Department of Conservation and Natural Resources, *C. cracens* was classified as a P1 (Highest Conservation Priority) species, *C. scotti* was classified as a P4 (Low Conservation Priority), and *C. unestami* was classified as a P2 (High Conservation Priority) by Smith et al. (2011). These three species were chosen based upon their need for range-wide status assessments and limited detection rates in past surveys. The current status survey was conducted

to determine true distribution and population statuses of *C. cracens*, *C. scotti* and *C. unestami* and had four main goals: 1) visit all known historical locations for all three species and sample using traditional methods to determine the presence of each species; 2) attempt to find additional populations of the species by sampling other streams with suitable habitat in northeastern Alabama and northwestern Georgia; 3) assess population sizes of the species at locations where appropriate quantitative methods can be employed; 4) determine preferred habitat for the three species by recording abiotic habitat variables at sites containing the species.

Species Accounts

Cambarus (Puncticambarus) scotti (Fig. 1a) – The Chattooga River Crayfish is historically known from the Chattooga River basin in Chattooga and Walker counties, Georgia and the Coosa River in Calhoun, Cherokee and St. Clair counties, Alabama (Hobbs 1989). It occurs in streams with swift water flowing over rocky substrates where it can find adequate refuge. Its type locality is Clarks Creek, 1 mile north of Holland, in Chattooga County, Georgia. First form males range in size from around 24.5mm to 41.8mm carapace length (CL) (Hobbs 1981). This species can closely resemble *Cambarus coosae*, but differs in possessing a long acuminate rostrum without marginal spines or tubercles (Hobbs, 1981, Schuster and Taylor 2004). Taylor et al (1996, 2007) lists this species as Threatened.

Cambarus (Jugicambarus) unestami (Fig. 1b)– The Blackbarred Crayfish is known from tributaries of Chattanooga, Cole City, Lookout and Long Island creeks of the Tennessee River basin of Walker and Dade counties in Georgia and Jackson County, Alabama and from tributaries of the Little River of the Chattooga-Coosa Basin in Chattooga County, Georgia (Hobbs 1989). Its entire range is found within the Appalachian Plateau. The type locality for *C.*

unestami is Daniel Creek, a tributary of Lookout Creek, 2.5 miles west of Walker County line on State Route 143, Dade County, Georgia. This species appears to be confined to those streams found on Lookout and Sand mountains between 333 and 500 meter altitudes. Preferred streams have moderate to swift current with bedrock or rock-littered substrates for cover. First form males can range in size from 26.9mm to 31.3mm carapace length (Hobbs, 1981, 1989). The species is listed as Threatened by Taylor et al. (1996, 2007).

Cambarus (Exilicambarus) cracens (Fig. 1c)—Except for its original description by Bouchard and Hobbs (1976), very little is known of the Slenderclaw Crayfish. It is known only from Alabama and its range is limited to five total sites in southeastern tributaries of Guntersville Lake (Tennessee River) in DeKalb and Marshall counties, Alabama. The type locality of the species is Short Creek at State Route 75, 1.1 miles southwest of the junction with State Route 68 in Marshall County, Alabama (Hobbs, 1989). Bouchard and Hobbs (1976) described the habitat at the type locality as a clear, slow flowing stream with bedrock and sandy substrate, and large rocks throughout. First form males range in size from 24.7mm to 37.3mm carapace length (Hobbs, 1981, 1989). *Cambarus cracens* is listed as Endangered according to Taylor et al, (1996, 2007).

Methods

During March, June and October 2011 field surveys for the three crayfish species were conducted in streams of Northeastern Alabama and Northwestern Georgia. Sites visited were chosen for either known historical occurrences or as potentially new occurrences based on

suitable habitat. For *C. cracens*, all sites were repeat visits of localities surveyed in March 2009. Historical site selection and detailed locality information was obtained through museum database queries at the United States National Museum of Natural History Smithsonian Institution (USNM), Eastern Kentucky University Crustacean Collection (EKU) and Illinois Natural History Survey Crustacean Collection (INHS). Sampling at most sites was conducted with a 3m x 1.5m kick net (3.2mm mesh) while visual searches were also conducted at smaller stream sites. At each site the seine net was set below groupings of cobble, boulders or woody debris and held by one person while one or two others lifted and moved rocks while kicking and shuffling crayfish into the net. All crayfish in that set were collected and kept in a bucket with aerator until all sampling was finished. Some small stream sites (< 2 m in width) required only visual searches, which involved turning over cobble and boulders and hand capturing crayfish or handpicking those crayfish out in the open.

Density estimates were conducted at select locations for each target species by selecting a random reach of the sampling site, measuring both stream length and width of that reach, and sampling to depletion. General in-stream habitat characteristics, dominant substrate type, turbidity, current type, % cover, depth and width were recorded for every collection site.

Average substrate size was estimated by measuring a minimum of five randomly selected rocks found across a randomly selected stream transect.

After collection efforts were completed, crayfish were identified in the field if possible, and then preserved in 70% ethanol. Specimens were then transported back to the lab to verify identifications or identify those not resolved in the field. All species were separated, counted, sexed, and cataloged into the Illinois Natural History Survey Crustacean Collection.

Results

The present survey assessed 55 separate stream sites across northeastern Alabama and northwestern Georgia (Table 1). Stream sites consisted of both historical localities and potentially new locations. Many of the historical sites referenced in Hobbs (1981) and Smith et al. (2011) for *C. scotti* and *C. unestami* were close in proximity to one another and thus not all were revisited. Of the 55 sites, 19 were historical. In March, June and October, 19, 15 and 21 sites were sampled respectively.

Cambarus scotti – Of the 55 sampling sites, *C. scotti* was found at 19 locations (Fig. 2), ten of which were historical. This species tended to occur in streams with sluggish to moderate flow, no turbidity to moderate turbidity, substrates consisting of mostly gravel and cobble with isolated boulder patches and depths and widths ranging from 0.1m to 0.7m and 2-35m respectively. It was also found at some sites that had bedrock substrate. Density estimates were made at the following sites: 1) Clarks Creek - 0.3/m²; 2) Cane Creek off GA Highway 151 - 0.104/m²; 3) Duck Creek - 0.05/m²; 4) Choccolocco Creek at Calhoun Co Rd 45 (AL) - 0.04/m²; 5) Tallasseehatchee Creek - 0.08/m²; 6) Little Canoe Creek - 0.39/m² (Table 2). *Cambarus scotti* occurred most often with *Orconectes erichsonianus*.

Cambarus unestami – This species occurred at nine of 55 sites (Fig. 3), six of which were historical. Creeks where this species was found had no turbidity, sluggish to moderate current, gravel and cobble or gravel and boulder substrates and were 0.1m to 0.5m deep and 2m to 12m wide. Density measurements were made at the following sites: 1) Daniel Creek - 1.06/m²; 2) Stephens Branch - 0.43/m²; 3) Bear Creek - 0.08/m²; 4) Gilreath Creek - 0.33/m²; 5) Brush Creek

- 0.1/m² (Table 2). *Cambarus unestami* occurred with a variety of other species including *Cambarus striatus*, *Procambarus lophotus*, and *Cambarus parvoculus*.

Cambarus cracens – One site historical site out of the 55 sampling sites (Fig. 4) contained *C. cracens*. Specimens were found at Shoal Creek at CR 372, which had moderate flow, no turbidity, a mix of sand, cobble and boulders, and was 0.1m to 0.5m deep and about 6m wide. The density estimate for the species at this location was 0.037/m² (Table 2).

Discussion

The current survey presents evidence that both *Cambarus scotti* and *Cambarus unestami* appear stable across their ranges. Though not all historical locations were visited, each species was present at multiple sampling sites within their historical ranges. New populations of both species were not encountered during our surveys.

We do not believe that conservation action is warranted for either species. The range of *C. unestami* is relatively small compared to *C. scotti*'s or other imperiled southwestern aquatic taxa, however, our results suggest that *C. unestami* has not experienced population declines or loss of habitat. The density estimates for both species range were highly variable and ranged from 0.05 to 1.06 individuals per square meter. While densities at the lower end of that range indicate that both species are uncommon at many sites, our personal field experience suggests that those densities are well in line with average densities of other members of the genus *Cambarus* across Alabama.

Ideal habitat for *C. scotti* consisted of a variety of stream sizes with this species occurring most often in slow to moderate flow streams, 5-10 meters wide with 0.1 m to 0.3 m depth and substrates made up mostly of gravel with isolated cobble and boulder patches (Fig. 5a).

However, some specimens were found in larger streams with widths up to 35m and depths reaching 1 meter. Habitat for *C. unestami* tended to be first or second order streams in the range of one to five meters in width, though some sites reached 10 meters. Flow was sluggish to moderate and depths ranged from 0.1 to 0.5 meters. The substrate tended towards sand and gravel material with cobble or isolated boulders interspersed or fractured bedrock (Fig. 5b).

The stability of *Cambarus cracens* is of concern. Our failure to find the species at any of the five historical sites reported by Bouchard and Hobbs (1976), mirrors the results of surveys conducted by two of us (CAT and GAS) in 2009 and by GAS in 2005. In addition, the type locality was intensively sampled by another researcher and six field assistants in 2007 and *C. cracens* was not collected. Even with the addition of new survey points beyond the historical locations, no other populations could be found. *Cambarus cracens* is now known to occur at a single site, Shoal Creek at County Road 372. The species was also found at this site by CAT and GAS during a visit in 2009. Habitat at this Shoal Creek site comprised of gravel and cobble substrate intermixed with patches of sand (Fig. 5c) and thus closely matched that described at the type locality. However, Shoal Creek at CR 372, at 6 m wide, is a smaller stream than the type locality. The reasons for the decline of *C. cracens* are unknown since sampling locations contained suitable habitat with proper substrate and low siltation. Riparian vegetation along both banks was in place at all sites and no obvious signs of high nutrient loads were present. While we lack empirical data, we did notice an abundance of poultry farms in the immediate vicinity of most historical *C. cracens* locations and in the southcentral portion of Sand Mountain in general.

Given the results of our surveys, we recommend that the Slenderclaw Crayfish be considered for listing under the Endangered Species Act of 1973 (as amended). This recommendation is based

on three criteria: 1) the species has experienced a significant reduction of a native range severely restricted to begin with; 2) the species is now currently known to exist at a single site; and 3) intensive field efforts have been expended in efforts to collect *C. cracens* across its native range and in other nearby locations with suitable looking habitat. We also recommend that efforts be undertaken to determine possible causes for decline of the species.

Acknowledgements

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Figure 1a: *Cambarus scotti*, from Terrapin Creek, Cleburne County, Alabama (photo by C.A. Taylor).



Figure 1b: *Cambarus unestami*, from Guest Creek, Jackson County, Alabama (photo by G.A. Schuster).



Figure 1c: *Cambarus cracens*, from Shoal Creek, Marshall County, Alabama (photo by G.A. Schuster).

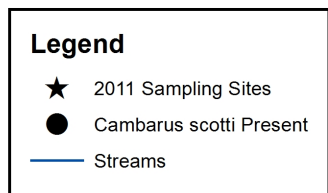
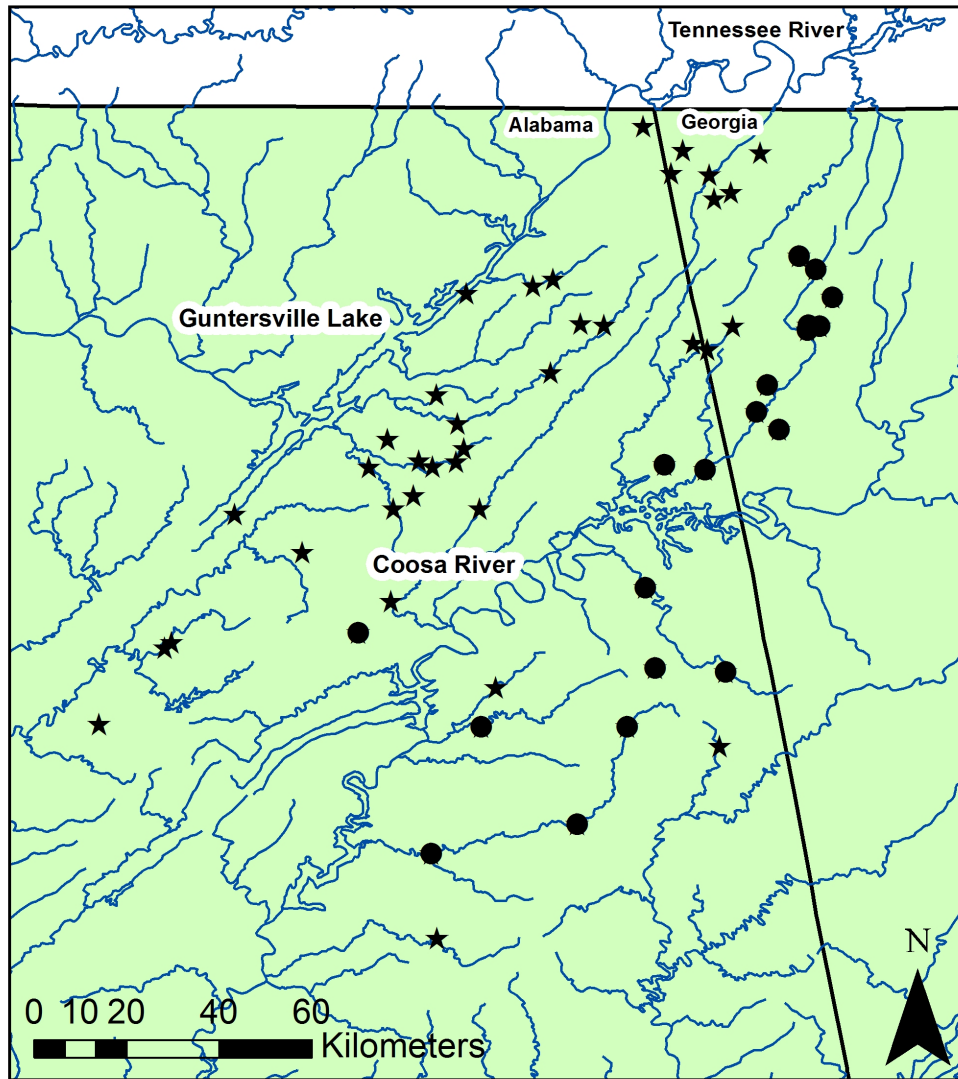


Figure 2: Map representing survey locations where *Cambarus scotti* was present (closed circles) and all current survey sampling locations (closed stars).

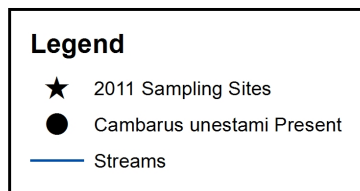
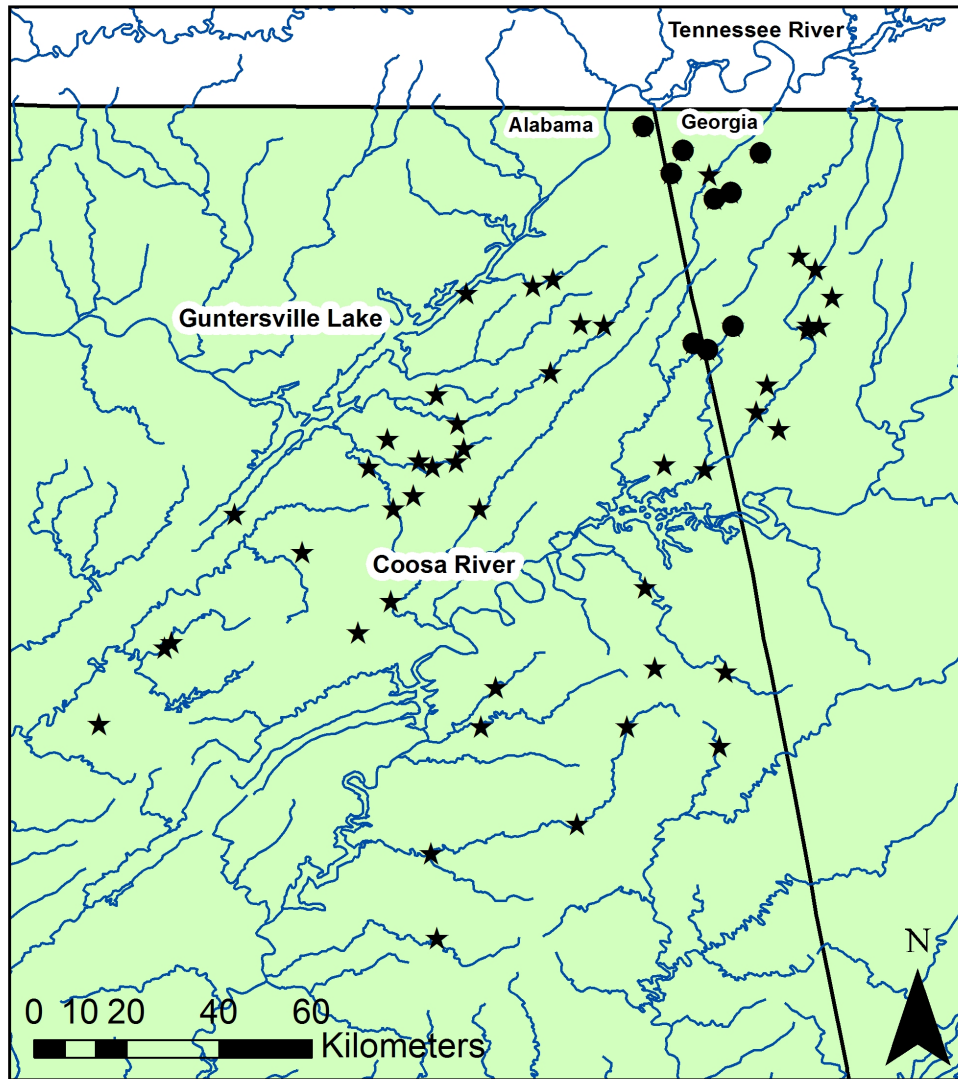


Figure 3: Map representing survey locations where *Cambarus unestami* was present (closed circles) and all current survey sampling locations (closed stars).

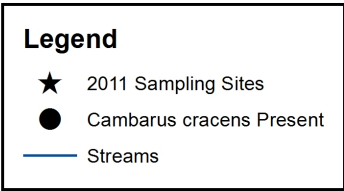
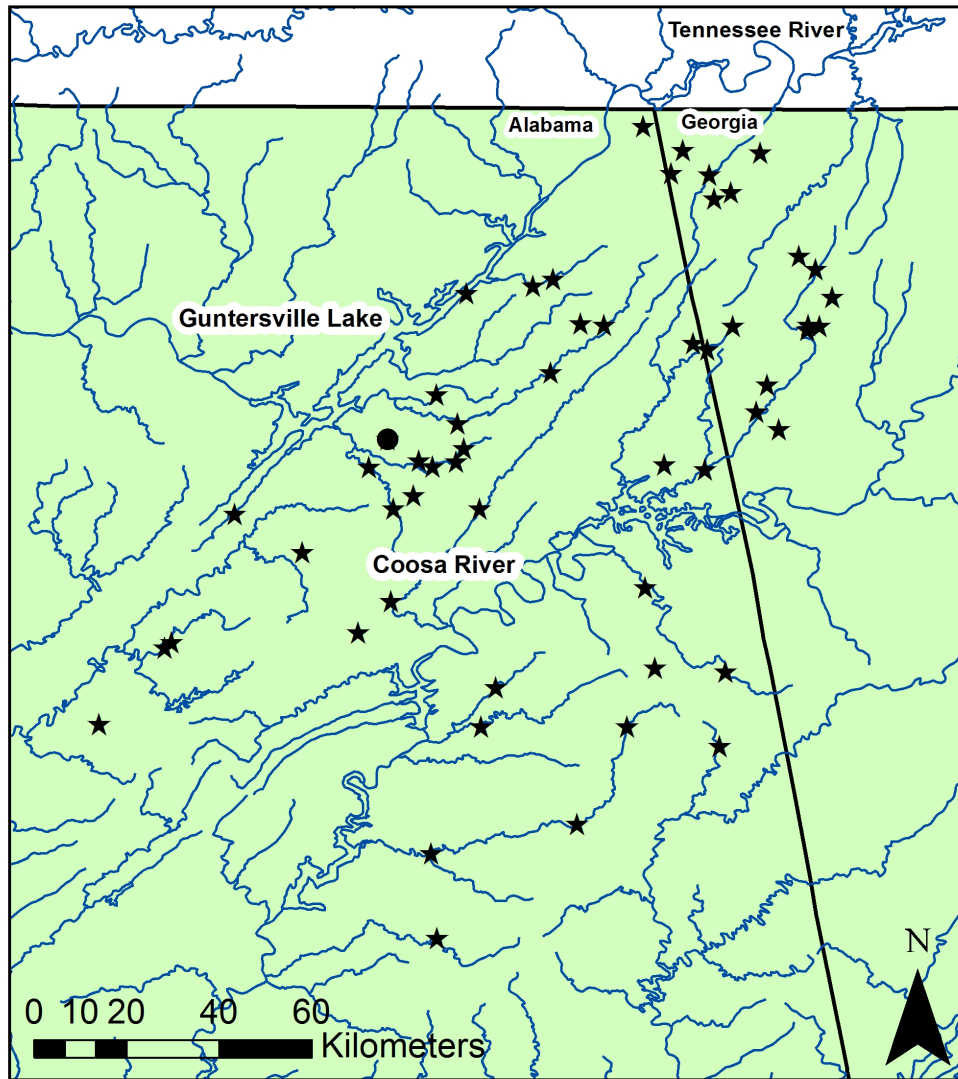


Figure 4: Map representing survey locations where *Cambarus cracens* was present (closed circle) and all current survey sampling locations (closed stars).



Figure 5a: Chattooga River, Chattooga County GA (photo by G.A. Schuster).



Figure 5b: East Fork Little River, Chattooga County, Georgia (photo by G.A. Schuster).



Figure 5c: Shoal Creek, Marshall County, Alabama (photo by G.A. Schuster).

Table 1: Alabama and Georgia sampling locations from the 2011 status survey and number of individuals collected.

Date	Drainage	State	County	Location	Latitude	Longitude	Species	Number
03/22/11	Tenn. R.	GA	Dade	Daniel Creek	34.8154	-85.4912	<i>C. unestami</i>	5+
03/22/11	Tenn. R.	GA	Walker	Rock Creek	34.9052	-85.4019	<i>C. unestami</i>	13
03/22/11	Tenn. R.	GA	Dade	Lookout Creek	34.8626	-85.5008	<i>C. unestami</i>	0
03/22/11	Tenn. R.	GA	Dade	Stephens Branch	34.9101	-85.5522	<i>C. unestami</i>	11
03/22/11	Tenn. R.	AL	Jackson	Warren Creek	34.9566	-85.6289	<i>C. unestami</i>	14
03/22/11	Tenn. R.	GA	Dade	Higdon Creek	34.8649	-85.5744	<i>C. unestami</i>	1
03/23/11	Tenn. R.	GA	Dade	Bear Creek	34.8281	-85.4591	<i>C. unestami</i>	24
03/23/11	Coosa R.	GA	Chattooga	Gilreath Creek	34.5679	-85.4550	<i>C. unestami</i>	16
03/23/11	Coosa R.	GA	Chattooga	East Fork Little River	34.5225	-85.5049	<i>C. unestami</i>	15
03/23/11	Coosa R.	AL	DeKalb	Brush Creek	34.5348	-85.5320	<i>C. unestami</i>	15
03/23/11	Coosa R.	GA	Chattooga	Raccoon Creek	34.4537	-85.3887	<i>C. scotti</i>	40
03/23/11	Coosa R.	GA	Chattooga	Mosteller Creek	34.4016	-85.4095	<i>C. scotti</i>	4
03/23/11	Coosa R.	GA	Chattooga	Clarks Creek	34.3679	-85.3659	<i>C. scotti</i>	27
03/24/11	Coosa R.	GA	Chattooga	Chappel Creek	34.5685	-85.2860	<i>C. scotti</i>	37
03/24/11	Coosa R.	GA	Chattooga	Cane Creek	34.5607	-85.3105	<i>C. scotti</i>	1
03/24/11	Coosa R.	GA	Chattooga	Cane Creek	34.5700	-85.3084	<i>C. scotti</i>	1
03/24/11	Coosa R.	GA	Walker	Cane Creek	34.6240	-85.2618	<i>C. scotti</i>	13
03/24/11	Coosa R.	GA	Walker	Chattooga River	34.6788	-85.2942	<i>C. scotti</i>	11
03/24/11	Coosa R.	GA	Walker	Duck Creek	34.7044	-85.3260	<i>C. scotti</i>	15
06/07/11	Coosa R.	AL	Talladega	Chocolocco Creek	33.5430	-86.0416	<i>C. scotti</i>	1
06/07/11	Coosa R.	AL	Talladega	Tallegda Creek	33.3782	-86.0301	<i>C. scotti</i>	0
06/07/11	Coosa R.	AL	Calhoun	Chocolocco Creek	33.6000	85.7573	<i>C. scotti</i>	7
06/07/11	Coosa R.	AL	Calhoun	Chocolocco Creek	33.7899	-85.6604	<i>C. scotti</i>	4
06/07/11	Coosa R.	AL	Cleburne	Cane Creek	33.7514	-85.4804	<i>C. scotti</i>	0
06/07/11	Coosa R.	AL	Cleburne	Terrapin Creek	33.8965	-85.4696	<i>C. scotti</i>	22
06/08/11	Coosa R.	AL	Calhoun	Talloseehatchee Creek	33.7900	-85.9446	<i>C. scotti</i>	8
06/08/11	Coosa R.	AL	Calhoun	Ohatchee Creek	33.8655	-85.9152	<i>C. scotti</i>	0
06/08/11	Coosa R.	AL	Calhoun	Nances Creek	33.9041	-85.6066	<i>C. scotti</i>	9
06/08/11	Coosa R.	AL	Cherokee	Little Creek	34.0597	-85.6256	<i>C. scotti</i>	1
06/08/11	Coosa R.	AL	Cherokee	Spring Creek	34.2987	-85.5879	<i>C. scotti</i>	8
06/08/11	Coosa R.	AL	Cherokee	Chattooga River	34.2898	-85.5088	<i>C. scotti</i>	7
06/09/11	Coosa R.	AL	St Clair/ Etowah	Little Canoe Creek	33.9725	-86.1834	<i>C. scotti</i>	20
06/09/11	Coosa R.	AL	Etowah	Clear Creek	34.0338	-86.1191	<i>C. scotti</i>	0
06/09/11	Coosa R.	AL	DeKalb	Big Wills Creek	34.2135	-85.9470	<i>C. scotti</i>	0
10/03/11	Tenn. R.	AL	DeKalb	Town Creek	34.5706	-85.7049	<i>C. cracens</i>	0
10/03/11	Tenn. R.	AL	DeKalb	Bengis Creek	34.5734	-85.7512	<i>C. cracens</i>	0
10/03/11	Tenn. R.	AL	DeKalb	Town Creek	34.4775	-85.8089	<i>C. cracens</i>	0
10/03/11	Tenn. R.	AL	Jackson	Bryant Creek	34.6462	-85.8437	<i>C. cracens</i>	0
10/03/11	Tenn. R.	AL	Jackson	Bryant Creek	34.6600	-85.8042	<i>C. cracens</i>	0

10/04/11	Tenn. R.	AL	Jackson	Guntersville Reservoir	34.6325	-85.9723	<i>C. cracens</i>	0
10/04/11	Tenn. R.	AL	DeKalb	Black Oak Creek	34.4348	-86.0306	<i>C. cracens</i>	0
10/04/11	Tenn. R.	AL	DeKalb	Town Creek	34.3789	-85.9895	<i>C. cracens</i>	0
10/04/11	Tenn. R.	AL	DeKalb	Scarham Creek	34.3308	-85.9779	<i>C. cracens</i>	0
10/04/11	Tenn. R.	AL	DeKalb	Scarham Creek	34.3047	-85.9924	<i>C. cracens</i>	0
10/04/11	Tenn. R.	AL	DeKalb	Scarham Creek	34.2950	-86.0382	<i>C. cracens</i>	0
10/04/11	Tenn. R.	AL	DeKalb	Little Scarham Creek	34.3063	-86.0655	<i>C. cracens</i>	0
10/04/11	Tenn. R.	AL	DeKalb	Shoal Creek	34.3480	-86.1256	<i>C. cracens</i>	11
10/05/11	Tenn. R.	AL	Marshall	Short Creek	34.2939	-86.1622	<i>C. cracens</i>	0
10/05/11	Tenn. R.	AL	Marshall	Short Creek	34.2134	-86.1145	<i>C. cracens</i>	0
10/05/11	Tenn. R.	AL	DeKalb	Cross Creek	34.2389	-86.0759	<i>C. cracens</i>	0
10/05/11	Locust Fork R.	AL	Marshall	Clear Creek	34.1284	-86.2919		
10/05/11	Locust Fork R.	AL	Blount	Big Spring Creek	34.2024	-86.4232		
10/06/11	Locust Fork R.	AL	Blount	Calvert Prong	33.9433	-86.5588		
10/06/11	Locust Fork R.	AL	Blount	Chitwood Creek	33.9530	-86.5456		
10/06/11	Locust Fork R.	AL	Jefferson	Gurley Creek	33.7942	-86.6867		

Table 2: Density estimates from select streams for *Cambarus scotti*, *Cambarus unestami* and *Cambarus cracens*.

Density Estimates		
Location	<i>Species</i>	Density
Clarks Creek	<i>C. scotti</i>	0.3/m ²
Cane Creek	<i>C. scotti</i>	0.104/m ²
Duck Creek	<i>C. scotti</i>	0.05/m ²
Chocolocco Creek	<i>C. scotti</i>	0.04/m ²
Talloseehatchee Creek	<i>C. scotti</i>	0.08/m ²
Little Canoe Creek	<i>C. scotti</i>	0.39/m ²
Daniel Creek	<i>C. unestami</i>	1.06/m ²
Stephens Branch	<i>C. unestami</i>	0.43/m ²
Bear Creek	<i>C. unestami</i>	0.08/m ²
Gilreath Creek	<i>C. unestami</i>	0.33/m ²
Brush Creek	<i>C. unestami</i>	0.1/m ²
Shoal Creek	<i>C. cracens</i>	0.037/m ²