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Abstract

Fieldwork was conducted during 2002-2003 on the rare, Arkansas endemic crayfish, *Fallicambarus gilpini* Hobbs and Robison. Collections at 87 localities revealed this crayfish at 8 sites, all located in southeastern Arkansas in Jefferson and Cleveland counties which significantly expands its known range. *Fallicambarus gilpini* was generally found inhabiting roadside ditches and areas of standing water where it was always taken from upslope areas away from the static water. A sex ratio of 1:1.3 males to females was determined for this species. Ovigerous females were collected from burrows on 20 March 2003. A conservation status of "threatened" is recommended for this crayfish species.

Introduction

Crayfish represent 1 of the largest aquatic faunal groups in North America north of Mexico with approximately 353 known species or nearly two thirds of the world's crayfish fauna (Butler, et al. 2003). To illustrate how poorly crayfishes are known, Williams et al. (1997) reported common names for less than 28% of the species they listed.

Hobbs (1969) proposed the taxon *Fallicambarus* to receive 8 species of crayfishes that had been formerly assigned to the more commonly known crayfish genus, *Cambarus*. Hobbs (1973) revised the genus *Fallicambarus* and divided this assemblage of the then known 11 species into 2 subgroups or subgenera. Six were placed in the nominate subgenus *Fallicambarus*, and 5 species were placed in the subgenus *Creaserinus*, which presently includes *F. gilpini*. Currently, there are 16 species included in the genus *Fallicambarus*, 7 in the subgenus *Fallicambarus* and 9 in the subgenus *Creaserinus*.

The genus *Fallicambarus* is thought to have originated in southwestern Arkansas on the West Gulf Coastal Plain (Bouchard and Robison, 1980). Of the 16 known species of *Fallicambarus* in North America, 8 occur in Arkansas. Six of the 8 crayfish species, *Fallicambarus strawni*, *F. caesius*, *F. jeanae*, *F. gilpini*, *F. harpi* and *F. petilicarpus*, are endemic to Arkansas (Robison and Allen, 1995). Distribution, biology, and conservation status of most of these state endemics are poorly known. One of the endemic species is *F. gilpini* which was originally described by Hobbs and Robison (1985) from 3 localities in the vicinity of Pine Bluff, Jefferson County, Arkansas, and is the subject of this investigation.

General Habitat Description.–*Fallicambarus* species are rarely found in permanent bodies of water and as adults frequent temporary pools or runoff only after rains or during floods (Hobbs and Robison, 1989). As primary burrowers, they inhabit burrows where the water table does not drop more than a meter or so beneath the surface for most of the year. Hydrophilic sedges characterize such areas and many occur near highways in roadside ditches or low-lying areas near the roadbed.

Characteristically, burrows of *Fallicambarus* crayfish are occasionally topped with slender chimneys, although more often the burrows are marked by irregular mounds of earthen pellets of a size proportional to that of the crayfish occupant. In rare cases, large colonies of these crayfishes occupy an entire field.

Taxonomic Status.–*Fallicambarus gilpini* was originally described by Hobbs and Robison (1989) from Jefferson County, Arkansas. *F. gilpini* has its closest affinities with *F. caesius* (Hobbs and Robison; 1989). The 2 species share many features, including being the only typically blue members of the genus and the only ones that lack a ventrolateral row of tubercles on the merus of the first cheliped. The most readily observed features that distinguish the 2 species are the absence of tubercles on the mesial surface of the dactyl of the chela and the presence of a distolateral spine on the mesial ramus of the uropod in *F. gilpini*. While the close relationship of *F. caesius* and *F. gilpini* is acknowledged, discovery of an undescribed species in Bastrop, Louisiana recently may alter this view. These specimens appear to have a number of characteristics in common with *F. gilpini* (Joseph Fitzpatrick, pers. comm.). Twenty specimens of this new related form were collected by George Patton and Martha Ann Messenger and sent to Keith Crandall, Brigham Young University, for DNA analysis. HWR and Crandall are currently studying this form.

The objectives of this study were to determine the relative abundance and distributional limits of *F. gilpini*; to gather data on life history aspects of *F. gilpini* including information on habitat, description of burrows, and reproductive period; to gather data on ecological requirements of *F. gilpini*; and to assess the current conservation status (as to rarity) of *F. gilpini*.

Methods and Materials

Fieldwork was conducted from September 2002 hrough the spring and early summer of June 2003. Most ollecting occurred in March, April, May, and into early une 2003, when conditions were optimal. *Fallicambarus gilpini* is a primary burrower, i.e. it burrows all year long in 1 place and rarely exits, therefore to collect specimens, it is necessary to physically dig individuals out once the burrow is discovered. In addition to digging specimens from burrows, baited strings and crayfish traps were used; however, excavation proved to be the superior method of collecting specimens of *F. gilpini.*

While most specimens were released unharmed, a few specimens were preserved in 95% ethyl alcohol and deposited in the Brigham Young University Crayfish Collection after identification to species.

Prior to this study, *F. gilpini* was known from only three localities in Jefferson County. Based on this localized distribution, a search pattern for additional populations was centered on the type locality and radiated outward from this area and Jefferson County. Six counties in that circle were searched, as well as Jefferson County itself. Collection sites were searched for by driving area highways and looking for chimneys in the roadside ditches. This method has previously produced good results for members of the genus *Fallicambarus.* Crayfishes were collected from 87 sites where burrows were seen in the 7 county search area in an effort to locate additional populations of *F. gilpini.*

Results and Discussion

Habitat.–Inspection of the type locality began in September 2002 and continued monthly until May 2003, revealing no burrowing activity prior to March. The first burrows of *F. gilpini* were seen on 20 March 2003 at the type locality. The height of burrowing activity was 25 April 2003; 27 burrows were seen at the type locality; and burrowing activity was greatest at other locations in Jefferson County.

Fallicambarus gilpini has been taken only in complex burrows consisting of branching galleries, several of which, except in dry seasons, reach the surface, some of their openings marked by rather crudely constructed turrets (Hobbs and Robison, 1989). In this study 12 burrows of *F. gilpini* were completely excavated, and all were complex burrows with branching galleries. Crudely constructed turrets topped ten of these burrows. Of the 12 burrows excavated completely, burrow depth ranged from 37.5 cm to 77.5 cm and chimney height ranged from 2.5 cm to 10 cm. In all cases excavated, burrows of *F. gilpini* were complex burrows in sandy clay soil situated in wet grassy areas, often with abundant sedges nearby. No burrows were found in or directly adjacent to standing water.

In this study it was noted that burrows of F. gilpini were always situated high up on the seepage slope and never down near the standing water areas, just as reported previously by Hobbs and Robison (1989). Hobbs and Robison (1989) hypothesized that *F. gilpini* might prefer areas in which the groundwater is moving rather than static. In areas where *F. gilpini* was collected syntopically with *F. fodiens*, the latter was always collected from burrows situated in areas in which the water was more static while the burrows of *F. gilpini* were away from the static water more upslope.

Distribution.–*Fallicambarus gilpini* was known from only three locations prior to this study (Hobbs and Robison, 1989). These 3 sites are all located within Jefferson County, Arkansas (Fig. 1). The sites are: (1) Type Locality: Roadside seepage, 4.96 km south of southern junction of State Route 54 and U.S. Highway 79 at junction of latter with Pepperridge Road (T7S, R10W, Sec. 19), approximately 17.6 km south of Pine Bluff and about 4.8 km north of the Cleveland County line; (2) Roadside ditch, 0.32 km south of Pine Bluff on U. S. Highway 79; and (3) Roadside seepage, 5.76 km north of Cleveland County line on U.S. Highway 79.

Searches for additional populations of *F. gilpini* were made in 6 counties contiguous with Jefferson County including Lonoke, Arkansas, Lincoln, Cleveland, Grant and Pulaski, plus Jefferson County itself. Only 1 new population was discovered in Cleveland County, and 4 additional populations were discovered in Jefferson County (See below). Interestingly, no populations were discovered north of the Arkansas River, thus all known populations of *F. gilpini* occur south of the Arkansas River.

New populations discovered during this study are as follows: Jefferson County: (1) Roadside seepage, ca. 6.4 km south of Pine Bluff on U. S. Hwy. 79 (Sec. 17, T7S, R10W). 20 March 2003. H. W. Robison.; (2) Roadside ditch ca. 11.2 km south of Pine Bluff on U. S. Hwy. 79 (Sec. 20, T7S, R10W). 18 April 2003. H. W. Robison; (3) Roadside seepage, ca. 1.6 km south of Pine Bluff on U. S. Hwy. 79 (Sec. 3, T7S, R10W). 25 April 2003. H. W. Robison.; and (4) Roadside seepage along U. S. Hwy. 79, ca. 3.2 km south of Pine Bluff (Sec. 9, T7S, R10W). 26 April 2003. H. W. Robison. Cleveland County: (1) Roadside seepage ca. 5.6 km south of the Cleveland-Jefferson County line on U. S. Hwy. 79 (Sec. 23, T8S, R11W). 25 April 2003. H. W. Robison.

In summary, the distribution of *F. gilpini* now includes eight localities in two Arkansas counties, Jefferson and Cleveland (Fig. 1). A new population was discovered in Cleveland County, as well as 4 new sites in Jefferson County. At each of these locations, *F. gilpini* was found to be a highly localized and uncommon crayfish. It was never abundant at any site collected during the study. *Fallicambarus fodiens* was present and always numerically superior at each site where *F. gilpini* was collected.

Biological Aspects.–Nineteen collections of *F. gilpini* were made during this 1-year study (Table 1). Form I males were first collected on 20 March 2003 from the type-locality, and were only collected in March and April. Seventeen males were collected, of which 5 were Form I, 9 were Form II, and 3 were juveniles.

Twenty-two females were taken in the study, of which 17 were adults and 5 were juveniles (Table 1). Two ovigerous females were collected from burrows on 20 March 2003. Hobbs and Robison (1989) reported three ovigerous females taken from burrows on 11 March 1988. One of these had a carapace length of 22.3 mm and 18 eggs, a second had a carapace length of 24.9 mm and 20 eggs and the third had a carapace length 0f 25.5 mm and 35 eggs (Hobbs and Robison, 1989). Of the 2 ovigerous females collected in this study, 1 had a carapace length of 24.2 mm and carried 26 eggs while the other specimen had a carapace length of 23.7 mm and carried 17 eggs.

During this study 437 individual crayfishes were collected, including six additional species taken while searching for *F. gilpini*. These species included *F. fodiens*, *Procambarus clarkii*, *Procambarus acutus*, *Orconectes lancifer*, *Cambarus ludovicianus*, and *Faxonella clypeata*.

Sex Ratio.–During this study collections of *F. gilpini* included 17 males (5 Form I males, 9 Form II males, and 3 juvenile males) versus 22 females (17 adult females and 5 juvenile females). This provides a sex ratio of 1:1.3 (male to female) for *F. gilpini*.

Conservation Status.–Because of the long-term degradation of freshwaters in North America, it should not come as a surprise that some freshwater crustacean species are having difficulty surviving (Schuster, 1997). In particular, a number of crayfishes in the United States are in trouble and their continued survival is in question. The degree of crayfish imperilment may exceed that of fishes and is second only to the most imperiled group in North America, freshwater mussels (Master et al., 2000; Butler et al., 2003).

Taylor et al. (1996) published a paper entitled "Conservation Status of Crayfishes of the United States and Canada" which provides the most current conservation estimates dealing with crayfishes. They found 19.2% of the crayfish fauna in the United States and Canada to be endangered, 13.3% threatened and 14.8% of special concern. While 52.0% or 176 of the 338 native crayfishes were considered "stable," a whopping 48.0% or 162 species were in need of some conservation status! Only 2 species of crayfish inhabiting Arkansas are currently listed as endangered under the Endangered Species Act, *Cambarus aculabrum* and *C. zophonastes*, both of which are cave forms with very limited distribution.

In their report, Taylor et al., (1996) listed *Fallicambarus gilpini* as "endangered" based on the best information available at the time. In this survey it appears that *F. gilpini* is slightly more common than previously believed, having been found at 5 additional localities in 2 counties. The known range now stands at 8 localities in 2 counties in southeast Arkansas where it is quite localized and never abundant. It is therefore recommended to move *F. gilpini* from its "endangered" status to a status of "threatened." Future monitoring is needed to document trends in the population.

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Table 1. Frequency of occurrence of form I males, form II males, females, and juveniles in collections of *Fallicambarus gilpini*.*

Month	Number of Collections	Number of Individuals				
		Form I Males	Form II Males	Females	Juveniles	Total
March	3	2	0	1	0	3
April	10	3	5	8	3	19
May	4	0	3	6	5	14
June	2	0	1	2	0	3
Totals	**19**	**5**	**9**	**17**	**8**	**39**

* No specimens of *F. gilpini* were collected in January, February, or July through December of either 2002 or 2003.

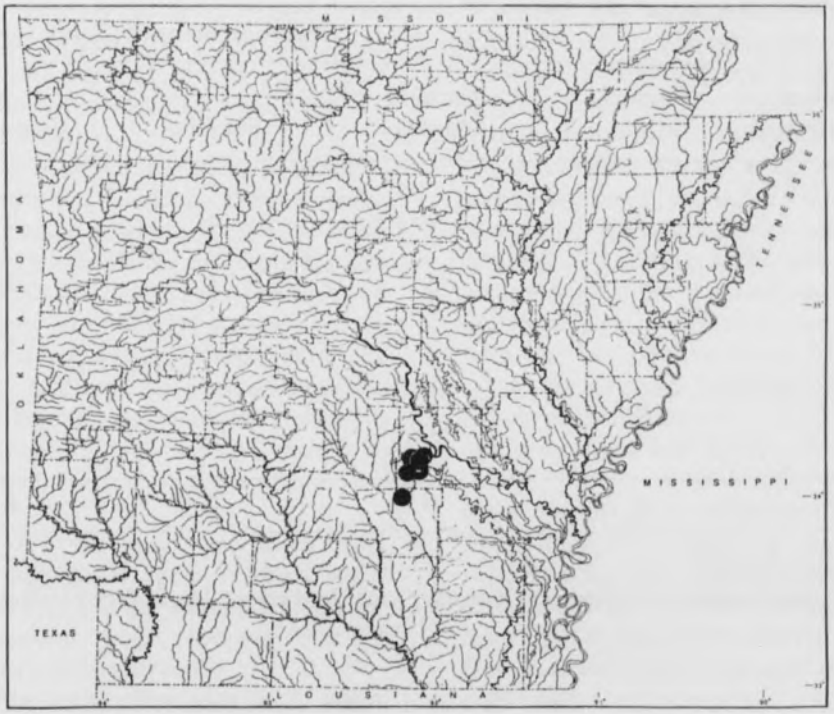

Fig. 1. Known localities of *Fallicambarus gilpini* following 2002-2003 survey.

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