

Additional Distributional Records of the Ouachita Mountain Crayfish, *Procambarus tenuis* (Decapoda: Cambaridae), in Arkansas and Oklahoma, with Notes on Ecology and Natural History

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The Ouachita Mountain crayfish (*Procambarus tenuis*) is an uncommon endemic species known from several localities in the Ouachita Mountain Province of four counties (Howard, Montgomery, Polk, and Scott) of western Arkansas and three counties (LeFlore, Pittsburg, and Pushmataha) of eastern Oklahoma. Populations of *P. tenuis* are typically small. They inhabit small first and second order clear streams and springs where they hide and burrow under rocks. Forty-eight *P. tenuis* were collected during our 1.5 year study period from 19 of 93 (20.4%) localities. First form males were captured in May and June. We document several new localities for *P. tenuis* as well as providing a summation of all known localities for the species. Additional aspects of the biology of *P. tenuis* are discussed. We recommend a conservation status of vulnerable for *P. tenuis*. © 2008 Oklahoma Academy of Science.

INTRODUCTION

The Ouachita Mountain crayfish (*Procambarus tenuis*) was originally described by Hobbs (1950) from specimens collected in 1934 by Charles E. Burt at two localities in the headwaters of the Little River system in Oklahoma and Arkansas (Ouachita Mountains). Voucher specimens were deposited in the collection of the United States National Museum, Smithsonian Institution (USNM). Since the description, few collections of this species have been made and the species is apparently rare and its current distribution is poorly known (Jones and Bergey 2007). Indeed, populations of *P. tenuis* are considered by the Natural Heritage Inventory to be imperiled (S2 rank) in Arkansas, endangered (S1 rank) in Oklahoma, and imperiled/vulnerable (G2-G3 rank) in rounded global status (NatureServe 2008; E. A. Bergey "personal communication"). In his unpublished thesis, Reimer (1963) reported

that specimens from Polk County, Arkansas, were examined and noted additional specimens from Montgomery County in Arkansas. In addition, Reimer (1968) cited *P. tenuis* only briefly and noted its distribution was the "Ouachita Mountain Province of Oklahoma and Arkansas." Jones and Bergey (2007) reported collections of 28 *P. tenuis* from tributaries of the upper Kiamichi River, all sites within the known range.

Unfortunately, we know little about the distributional limits of *P. tenuis* and even less about natural history and ecological aspects including its reproductive biology, habitat requirements, and general biology. Our study is a compilation of information on the geographic distribution, life history aspects, and conservation status of *Procambarus tenuis*.

Specific objectives of the study were (1) to determine the relative abundance and precise distributional limits of the range of *Procambarus tenuis*; (2) to gather data on

life history aspects of this crayfish species including information on habitat, reproductive period, and any other biological data available; (3) to provide data on ecological requirements of *P. tenuis*; and (4) to assess the current status of this crayfish species based on distributional data collected.

MATERIALS and METHODS

Field work was conducted from October 2006 through June 2008. Much of it occurred during the fall, spring, and summer to utilize optimal field environmental conditions. A total of 93 collections were made in Montgomery, Polk, and Scott counties, Arkansas, and LeFlore County, Oklahoma. A variety of collecting methods were used including the use of aquatic dipnets, baited and unbaited crayfish traps, and seines. One to two specimens from each collecting site were preserved in 60% isopropyl alcohol for later study. Voucher specimens were deposited in the Southern Arkansas University (SAU) Invertebrate Collection, Magnolia, Arkansas, and the Brigham Young University (BYU) crayfish collection. In addition to collections made during this survey, museum specimens of *P. tenuis* housed in the USNM and SAU were studied to document the overall geographic distribution of this species. All previous literature dealing with this crayfish species was also consulted and distributional information was utilized when deemed accurate.

RESULTS

Of these collections, 48 specimens from 19 of 93 (20.4%) localities were taken during this study (see Appendix). However, none of the *P. tenuis* were collected from Scott County, Arkansas, sites re-visited where historical collections were previously known. First form males were collected in May and June. This crayfish was found in small first and second order streams, living primarily beneath rocks. It was also found in springs and spring run-off streams in

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several localities in the Ouachita Mountains. Often, *P. tenuis* was the only crayfish species living in the smaller spring-fed, first order and second order streams. However, other crayfishes collected where *P. tenuis* was found included the redspotted stream crayfish (*Orconectes acares*), the Little River creek crayfish (*O. leptogonopodus*), the Mena crayfish (*O. menae*), and the western painted crayfish (*O. palmeri longimanus*).

DISCUSSION

Overview of crayfishes

Freshwater crayfish are a highly diverse group of decapod crustaceans with over 540 species currently described (Crandall and Buhay 2008). In North America alone, 363 native crayfish or nearly two-thirds of the world's crayfish fauna inhabit the continent (Butler et al 2003; Taylor et al 2007). Crayfish play important roles in ecosystems as predators, bioprocessors of vegetation and carrion, and serve as an important food resource for fishes and numerous other terrestrial and aquatic organisms (Hobbs 1993; Butler et al 2003; DiStefano 2005). Crayfish are true omnivores and occupy many trophic roles (Adams 2006).

Crayfish exhibit four main habit types: primary burrowers (those crayfish who spend their entire life cycle in burrows); stream-dwellers; pond/lake/large river dwellers (including secondary burrowers who do require connectivity of burrows with freshwater); and stygobitic species (obligate cave-dwellers) (Bouchard and Robison 1980; Crandall and Buhay 2008). Crayfish inhabiting each of these habitats occur in Arkansas and Oklahoma.

Recognition characters of *P. tenuis*

The name "*tenuis*" refers to the slender or compressed carapace of this crayfish species. When seen from above, the carapace of *P. tenuis* is noticeably more slender and strongly compressed than other sympatric crayfish species. The rostrum of *P. tenuis* does not possess lateral spines nor bran-

chiostegal spines and the areola is narrow with only two punctuations in the narrowest part. The antennal scale is widest anterior to the mid-length. The first pleopod terminates in three processes with the mesial process projecting caudad at nearly a 90° angle with the axis of the shaft. The basic coloration of the body is light tan with blackish speckles.

Taxonomic Remarks

Hobbs (1950) stated that *P. tenuis* was more closely allied to the White River crayfish (*Procambarus acutus*) morphologically than to any other described species. Pending on-going DNA analyses of *P. tenuis* being conducted by K. Crandall at BYU, no additional systematic work has been published on this species.

Type Locality

The type locality of *P. tenuis* was described by Hobbs (1950) as "six miles east of Page and just west of the Oklahoma state line, LeFlore County, Oklahoma; in a spring at base of mountains, a tributary of the Little River." The holotype is USNM 90390 collected on June 3, 1934 by Charles E. Burt.

Relative Abundance

Hobbs (1950) described *P. tenuis* from 34 specimens taken from only two localities. Jones and Bergey (2007) found 29 *P. tenuis* between July 2002 and May 2003, 13 from riffles and 15 from pools. During our field study, 48 specimens of *P. tenuis* were collected from 19 different sites of 93 sites (20.4%) sampled. Collections ranged from one to 19 specimens. The largest single collection on record was 23 paratypes collected by C. E. Burt on 3 June 1934 (Hobbs 1950; see Appendix). Typically, few (1-5) specimens were collected because they were locally rare. The total specimens of *P. tenuis* from these three studies equals 111.

Habitat

Hobbs (1950) did not describe the habitat of *P. tenuis* in his original description as

details were unknown to him. The only note concerning habitat made in the description was in the type locality description which mentioned "in spring at base of mountains." This shallow burrowing species has been collected from under rocks in clear cold streams, where it is apparently quite active even in very cold water (Williams, 1954). Robison (2000) collected *P. tenuis* from simple burrows beneath rocks in a spring-fed runoff area in Arkansas and in spring-outflows under rocks in Oklahoma. This species was also taken from beneath rocks in shallow pool margins in first and second order streams. Jones (2004: 35) noted that "*P. tenuis* was not captured in any streams that did not harbor *O. saxatilis*." However, other museum collections do not support this generalization. In addition, Jones and Bergey (2007) provided detailed descriptions of streams with *P. tenuis* in the upper Kiamichi River in Oklahoma.

Distribution

The range of *P. tenuis* was given as the Arkansas, Ouachita, and Red River basins of eastern Oklahoma and western Arkansas (Hobbs 1989). Prior to Hobbs (1989), the Ouachita Mountain crayfish was known from only three localities in Montgomery (Ouachita River drainage) and Polk (Ouachita River drainage) counties, Arkansas, and one locality in LeFlore County (Red River drainage), Oklahoma, the type locality. Reimer (1963) mentioned he examined specimens from Polk County at a site in the Ouachita River on US 71. He also reported an additional record from Montgomery County collected in 1948 (see Appendix; Hobbs 1950). Later, Robison (2000) found this crayfish at only four localities, two in Polk County, Arkansas, and two in LeFlore County, Oklahoma (Appendix). In addition, Bergey et al (2005) cited unpublished collections from a spring in Pushmataha County in 2001 and from Cucumber Creek in LeFlore County in 2002 (Appendix). Thirty-two individuals of *P. tenuis* have been reported from four sites in Scott County

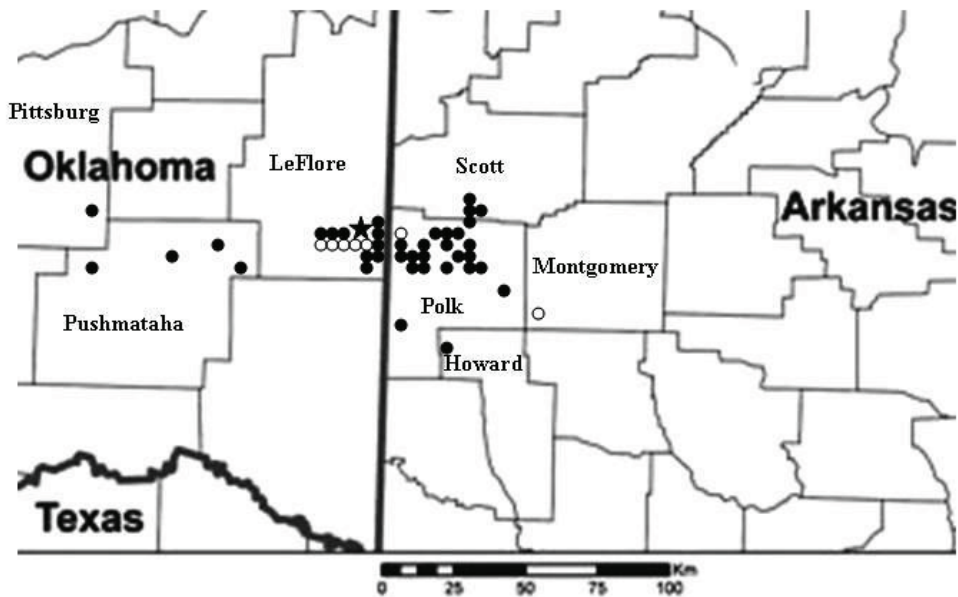


Figure 1. County records of *Procambarus tenuis*. Type locality (star); previously published records (open circles); new and previously unpublished records (solid circles).

(Arkansas River drainage), Arkansas (see Appendix); however, *P. tenuis* was not recollected in Scott County during this study. The southernmost locality is Howard County, Arkansas, collected by H. H. Hobbs, Jr., on 29 April 1976 (USNM 147204). In Oklahoma, the westernmost locality is Pittsburg County (see Appendix, USNM 132712).

Life History Aspects

Little is known about time of reproduction or other life history aspects of this species. Adults normally range from 76 to 127 mm in total length. Reimer (1963) reported one first form male that was captured in June. Hobbs (1950) reported form I males, form II males, females, and immatures in June. In the present study, first form males were only taken in May and June, although attempts were made to find them in every month. One of us (HWR) collected eight specimens on 27 June 2005 of which two were form I males, two were form II males, and four were females. Bergey ("personal communication") collected two form II

males and a female in July. Ovigerous females or those carrying eggs have not been collected to date; however, a juvenile specimen measuring 16 mm was collected on 6 March 2005 from a spring on Rich Mountain, Polk County, Arkansas.

Conservation Status

Taylor et al. (2007) provided the most current conservation estimate dealing with 363 species of North American crayfish. In that report they found less than 1% of the crayfish fauna of the United States and Canada was "endangered, possibly extinct" while 18% were "endangered," 14% were "threatened," and 15% were considered as "vulnerable." Fifty-two percent or 189 of the 363 native crayfish were considered "currently stable," and 48% or 174 North American crayfish species were in need of some conservation protection.

Jones (2004:35) recommended that the conservation of *P. tenuis* in the upper Kiamichi River watershed be the same as that for *O. saxatilis*. *Procambarus tenuis* was given

a conservation status of "vulnerable" by Taylor et al (2007) based on the information derived, in part, from data in this study. This species is herein considered "vulnerable" as a result of the present study.

In summary, *P. tenuis* is an Ouachita Mountain endemic that is uncommon within its range (Jones 2004; Bergey et al 2005; this study). Furthermore, this crayfish has never been captured in large numbers (Jones 2004; this study). Further study aimed specifically at its ecology and natural history are needed to better understand why it is uncommon and what measures, if any, are needed to ensure the conservation of *P. tenuis*.

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APPENDIX. Known locations of 260+ specimens of *Procambarus tenuis* in Oklahoma and Arkansas (locality [section, township, range or latitude/longitude in decimal degrees when available], date of collection, collector, and number of specimens, if known).

OKLAHOMA (86 specimens)

LEFLORE COUNTY (67 specimens):

1. **TYPE LOCALITY:** Spring at base of "mountains" (a tributary of Little River), 6 mi (9.7 km) E of Page, OK and just W of OK state line. 3 June 1934. C. E. Burt.
2. Same locality, same date. C. E. Burt. 23 paratypes.
3. Brook, S side of Blackfork Mountain on US 270, just west of AR state line (Arkansas River Drive). 2 March 1951. H. A. Dundee. 2.
4. Tributary to Kiamichi River at St. Rt. 63, 4.3 mi. (6.9 km) W jct. US 259. 30 April 1976. R. W. Bouchard. 4.
5. Cedar Creek at St. Hwy. 63. 30 April 1976. R. W. Bouchard. 3.
- 6a. Pigeon Creek, 34.64540°N, 94.53889°W. 20 July 2002. S. N. Jones.
- 6b. Pigeon Creek, 34.60400°N, 94.51608°W. 22 July 2002. S. N. Jones.
- 6c. Pigeon Creek, 34.63165°N, 94.53168°W. 23 July 2003. S. N. Jones.
- 6d. Pigeon Creek, 34.60692°N, 94.51682°W. 29 August 2002. S. N. Jones.
- 6e. Pigeon Creek, 34.60666°N, 94.51836°W. 5 October 2002. S. N. Jones.
- 6f. Pigeon Creek, 34.62438°N, 94.51941°W. 18 December 2002. S. N. Jones.
- 6g. Pigeon Creek, 34.61764°N, 94.51517°W. 9 January 2003. S. N. Jones.
- 6h. Pigeon Creek, 34.61679°N, 94.51514°W. 15 February 2003. S. N. Jones.
- 6i. Pigeon Creek, 34.60609°N, 94.51978°W. 19 March 2003. S. N. Jones.
- 6j. Pigeon Creek, 34.62487°N, 94.51934°W. 27 April 2003. S. N. Jones.
- 6k. Pigeon Creek at St. Hwy. 63, ca. 5 mi (8.0 km) W of OK/AR line (Sec. 14, T2N, R26E). 23 February 2007. HWR. 7.
- 7a. Billy Creek Recreation Area (Sec. 36, T3N, R24E). 16 April 2000 and 10 April 2006. HWR. 6, 3.
- 7b. Billy Creek, 34.69120°N, 94.73344°W. 11 January 2003. S. N. Jones.
- 7c. Billy Creek, 34.69151°N, 94.73381°W. 11 January 2003. S. N. Jones.
- 7d. Billy Creek, 34.68805°N, 94.73513°W. 25 April 2003. S. N. Jones.
8. Sycamore Creek, 34.69505°N, 94.83191°W. 21 December 2002. S. N. Jones.
- 9a. Big Cedar Creek (Sec. 14, R26E, T2N). 23 February 2002. S. N. Jones and J. Waterbury. 3.
- 9b. Big Cedar Creek, 34.66953°N, 94.65456°W. 18 March 2003. S. N. Jones.
10. Kiamichi River, 34.64722°N, 94.54192°W. 20 May 2003. S. N. Jones.
11. Cucumber Creek at US 259 bridge (Sec. 8, R25E, T1N). 18 June 2002. S. N. Jones, D. Fenolio, and J. Waterbury. 2.
12. Pipe Spring Recreation Area on US 259 (Sec. 35, T3N, R25E). 16 April 2000 and 5 April 2006. HWR. 4.
13. Horsepen Creek at St. Hwy. 63, ca. 1 mi (1.6 km) W of OK/AR line (Sec. 15, T2N, R26E). 5 April 2007. HWR. 3.
14. Richmond Creek at St. Hwy. 63 (Sec. 16, T2N, R25E). 6 April 2007. HWR. 8.

PITTSBURG COUNTY (3 specimens)

1. Unnamed creek, 3 mi (4.8 km) NW of Counts (Arkansas River Drive). 24 March 1951. A. B. Williams. 3

PUSHMATAHA COUNTY (16 specimens):

1. Tributary to Little River at jct. of St. Rt. 144 and Pat's Pike Road S of Honobia. 28 April 1976. R. W. Bouchard. 6.
2. Tributary to Hardy Creek on U.S. 71, 1.5 mi (2.4 km) N of jct. with St. Rt. 144. 27 April 1976. R. W. Bouchard. 4.
3. Crumb Creek at St. Rt. 2. 28 April 1976. R. W. Bouchard. 3.
4. Unnamed tributary of Cedar Creek, just downstream of Sulphur Spring (Sec. 30, T1S, R19E). 11 July 2001. E. Bergey, J. Fry, and J. Waterbury. 3.

ARKANSAS (174 specimens)**HOWARD COUNTY (3 specimens):**

1. Stream and seepage area, 1.8 mi (2.9 km) E of Sevier Co. line on US 278. 29 April 1976. H. H. Hobbs, Jr., and Kearney. 3.

MONTGOMERY COUNTY (5 specimens):

1. Little Missouri River at Albert Pike Recreational Area, 7 mi (11.3 km) NW Langley. 5 October 1948. A. B. Leonard. 5.

POLK COUNTY (134 specimens):

1. 6 mi (9.7 km) NW of Rich Mountain just E of state line (tributary of Little River system). 3 June 1934. C. E. Burt. 7.
2. 9.5 mi (15.3 km) NW of Mena. Date unknown. A. B. Williams.
3. Ouachita River at U.S. 71. Date unknown. R. D. Reimer. 1.
4. Tributary to Iron's Fork Creek on Posey Hollow Rd., ca. 1 mi (1.6 km) E of US 71, 4.5 mi (7.2 km) N of Acorn. 20 April 1973. H. H. Hobbs, Jr. 6
5. Stream, 5.7 mi (9.2 km) S of Scott Co. line on US 71. H. H. Hobbs, Jr. 10.
6. Tributary to Irons Fork Creek in Ouachita National Forest. 29 April 1976. H. H. Hobbs, Jr. 1.
7. Unnamed spring ca. 2.5 mi (4.0 km) W of Hatton on co. rd. 6 June 1981. HWR. 1.
8. Spring seep on Rich Mountain at jct. of St. Hwy. 88 and 272 (2,400 ft.) 27 September 1986. HWR. 3.
9. Roadside seepage, 9.5 mi (15.3 km) NW of Mena on US 71 (Sec. 10, T1S, R30W). HWR. 18 May 1997 and 27 June 2005. 7, 8.
10. Queen Wilhelmina State Park on Rich Mountain, 12 mi (19.3 km) NW of Mena at spring behind Wonder House (Sec. 11, T1S, R32W). 18 May 1997, 6 March 2005, and 5 March 2008. HWR. 3, 1, 2.
11. Unnamed tributary, ca. 9 mi (14.5 km) N of Mena on US 71 (Sec. 10, T1S, R30W). 23 February 2007 and 14 March 2008. HWR. 12, 12.
12. 6 mi (9.7 km) NW of Rich Mountain just east of state line (tributary of Little River system). 24 February 2007. HWR. 3.
13. Unnamed tributary at US 71, ca. 10 mi (16.1 km) NW of Mena (Sec. 4, T1S, R30W). 5 April 2008. HWR. 7.
14. Unnamed tributary to Gap Creek, ca. 4 mi (6.4 km) NE of Acorn (Sec. 12, T1S, R30W). 15 March 2008. HWR. 4.
15. Unnamed tributary to Ouachita River, 3.5 mi (5.6 km) NW of Acorn (Sec. 14, T1S, R31E). 10 May 2007. HWR. 2.
16. Queen Creek at St. Hwy. 8 (Sec. 34, T1S, R32W). 5 May 2007. HWR. 3.
17. West Fork of Powell Creek (Sec. 6, T2S, R31W). 19 April 2008. HWR. 5.
18. Unnamed tributary to Iron's Fork of Ouachita River (Sec. 16, T1S, R29 W). 6 May 2007 and 9 March 2008. HWR. 19, 9.
19. Unnamed tributary of Ouachita River at Eagleton (Sec. 9, T1S, R31W). 13 May 2007 and 4 April 2008. HWR. 2, 2.
20. Weehunt Creek at St. Hwy. 8 (Sec. 30, T1S, R32W). 8 March 2008. HWR. 3.
21. Collins Creek at St. Hwy. 8 (Sec. 28, T1S, R32W). 8 March 2008. HWR. 1.

SCOTT COUNTY (32 specimens):

1. Stream, 1.7 mi (2.7 km) N of Polk Co. line on US 71 (Fourche la Fave Dr.). 18 April 1973. H. H. Hobbs, Jr. 2.
2. Roadside stream, 2.2 mi (3.5 km) S of jct. of US 71 and US 270 in Y-City on US 71. (Fourche la Fave Drive). 18 April 1973. H. H. Hobbs, Jr. 21.
3. Johnson Creek ca. 7 mi (11.3 km) E of Y-City just off US 71 on NFM rd. (Fourche la Fave Drive) 15 September 1974. HWR. 7.
4. Roadside burrows, 5.3 mi (8.5 km) S of Y-City on US 71 at jct. of US 270 and 71. 16 April 1982. HWR and D. Koym. 2.

