Orconectes (Trisellescens) taylori, a new species of crayfish from western Tennessee (Decapoda: Cambaridae)

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Abstract.—A new species of crayfish, Orconectes taylori, is described from tributaries of the North Fork Obion River in western Tennessee (common name: Crescent Crayfish). It occurs in small to medium size sandy bottom streams, and is found in leaf litter and woody debris along the banks. It belongs to the subgenus Trisellescens Bouchard & Bouchard, 1995 and can be distinguished from other species in the group by a combination of the length and curvature of the central projection of the form I gonopod, carina on the rostrum, appressed tubercles on the margin of the palm of the chela, and width of the areola. In the course of this study, a new drainage record was obtained for Orconectes pagei Taylor & Sabaj, 1997 formerly thought to occur only in tributaries of the Tennessee River in western Tennessee.

The new species described herein was apparently first collected in 1971 during a fish survey of the Obion River system in Tennessee. The exact location of this collection is in doubt because of poor location information on the label. It was rediscovered in 1999 through a collection made from Terrapin Creek just south of the Kentucky border. Subsequent surveying revealed that this new species of crayfish is apparently restricted to small and medium size tributaries of the North Fork Obion River in northwestern Tennessee. Sections of the entire Obion River system have been surveyed for this species, but it has only been found in five streams and from seven locations. Based on form I male gonopod morphology, this new species is tentatively assigned to the subgenus Trisellescens Bouchard & Bouchard, 1995. Previously, members of this group were placed into the “virilis section” of Orconectes Cope, 1872 (Cooper & Hobbs 1980), and then later into the subgenus Gremicambarus Fitzpatrick, 1987 (Fitzpatrick 1987, Hobbs 1989). Crandall & Fitzpatrick (1996) and Taylor & Knouft (2006) suggested that, based on molecular data the subgenera of Orconectes, which were erected solely based on morphological data, may not represent monophyletic groups. However, since no alternate classification has been published, the morphologically based subgenera by Fitzpatrick (1987) and Bouchard & Bouchard (1995) are used here. Historically, this group of species has presented numerous taxonomic problems. The work of Cooper & Hobbs (1980) is the only systematic attempt to deal with some of these problems. However, their treatise did not cover all of the species in the virilis section, but rather, the study was geographically restricted mostly to northern Alabama and Mississippi. Currently, the subgenus Trisellescens consists of 10 species, including the wide ranging O. immunis (Hagen, 1870). Most species in this subgenus, however, have much narrower distributions, and it appears that the center of radiation for this group is in central and western Tennessee, north-
western Alabama, and northeastern Mississippi. Nine of the 10 species are restricted to this geographic area.

*Orconectes* (*Trisellescens*) *taylori*, new species

Figs. 1, 2

**Diagnosis.**—Body and eyes pigmented. Rostrum (Fig. 1H) flat anteriorly, concave posteriorly, terminating in moderately long acumen; with median carina on anterior half; basal half with circular depression. Rostral margins thickened and converging distally; lateral spines usually weak (see Variation). Areola (Fig. 1H) anterior to midpoint, 5.9–15.7 \((\bar{X} = 9.2, n = 30, SD = 2.4)\) times as long as wide with 3–4 punctations across narrowest part. Single large cervical spine on each side of carapace. Hepatic spines absent; branchiostegal spine small and acute. Postorbital ridges well developed, terminating usually in weak spine (see Variation). Suborbital angle (Fig. 1C) obtuse. Antennal scale (Fig. 1J) widest at midlength, 2.3–2.9 \((\bar{X} = 2.5, n = 30, SD = 0.2)\) times as long as wide. Ischia of third pereopods of form I (Fig. 1L) and form II males with hooks, hooks over-reaching basioischial joint in form I males only; sometimes ischia of fourth pereopods with hooks. Chelae (Fig. 1I) with two rows of tubercles (sometimes with partial third row) along mesial margin of palm, with additional scattered tubercles on dorsal surface; tufts of setae covering mesial margin of palm, most of dorsal surface, and fingers; dorsal surfaces of fingers with well defined longitudinal ridges. First pleopods of form I male (Fig. 1A, B, G) symmetrical, extending to bases of third pereopods when abdomen is flexed; without a distinct shoulder on cephalic surface at base of central projection; central projection conocephalic, constituting 21.1–26.2% \((\bar{X} = 23.8, n = 16, SD = 1.8)\) of total length of first pleopods, flattened laterally, blade-like, and broadly rounded, tapering to sharply pointed tip; mesial process shorter in length than central projection, constituting 0.04–0.58 mm less than central projection \((\bar{X} = 0.22, n = 16, SD = 0.15)\), element extends beyond central projection in lateral view because of curvature, truncate distally in ventral view, tapered in lateral view. Central projection and mesial process of form I pleopod parallel and lying contiguously (Fig. 1G). Annulus ventralis (Fig. 1D) immovable, subrhomboidal; cephalic half with median trough leading to central fossa; sinuate sinus running from fossa to caudal edge.

**Description of holotype male, form I** (measurements, Table 1).—Body somewhat compressed (Fig. 1C, H) laterally, carapace slightly wider than abdomen \((12.1 \text{ and } 11.6 \text{ mm, respectively})\). Carapace width slightly greater than height at caudodorsal margin of cervical groove \((12.1 \text{ and } 11.9 \text{ mm, respectively})\). Total carapace length (TCL) 24.8 mm and postorbital carapace length (PCL) is 18.6 mm. Areola (Fig. 1H) 14.2 times longer \((7.1 \text{ mm})\) than wide \((0.5 \text{ mm})\) with 3 punctations across narrowest part; length of areola 28.4% \((38.0% \text{ of PCL})\) of TCL. Rostrum with scattered punctations and setae, posterior half with rounded excavation, anterior half with central carina (Fig. 1H); margins slightly converging, anteriorly fringed with fine setae and ending with small rounded tubercle (left side corneous). Acumen terminating in small rounded conocephalic tubercle. Postorbital ridges well developed, ending with small rounded conocephalous tubercles. Suborbital angle obtuse, slightly rounded. Cervical spines large \(\text{(left with tip corneous)}\). Dorsal and branchiostegal areas of carapace densely punctuate.

Abdomen longer than carapace \((28.7 \text{ mm and } 24.8 \text{ mm, respectively})\). Cephalic section of telson with 1 movable and 1 immovable spine in each caudolateral corner. Protopodite of uropod with spine extending over endopodite and spine in
Fig. 1. *Orconectes taylori*. A. Mesial view of first pleopod of form I male; B. Lateral view of first pleopod of form I male; C. Lateral view of carapace; D. Annulus ventralis; E. Mesial view of first pleopod of form II male; F. Lateral view of first pleopod of form II male; G. Caudal view of first pleopods of form I male; H. Dorsal view of carapace; I. Dorsal view of right chela; J. Antennal scale; K. Cephalic lobe of epistome; L. Hook on ischium of third pereopod. Figures 1A–C, G–I, K, L are of holotype; figure 1E and 1F are of morphotype; figure 1D is of allotype.
caudolateral corner extending over exopodite. Caudal margin of cephalic section of exopodite with numerous spines and one movable spine in caudolateral corner. Lateral margin of endopodite with prominent median ridge terminating in pre-marginal spine. Dorsal surfaces of telson and uropods setiferous.

Table 1.—Measurements (mm) of *Orconectes taylori*.

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<tr>
<th></th>
<th>Holotype</th>
<th>Allotype</th>
<th>Morphotype</th>
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<tr>
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<tr>
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<tr>
<td>Width</td>
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Cephalic lobe of epistome (Fig. 1K) with thickened margins converging to form sharp angle. Main body of epistome with distinct median fovea; epistomal zygoma moderately arched. Antennal scale (Fig. 1J) broadest at midlength; thickened lateral margin straight and terminating in a large corneous spine. Right antennal scale 6.2 mm long, 2.6 mm wide.

Mesial surface of palm of right chelae (Fig. 1I) (left propodus with damaged tip) with 2 rows of tubercles, mesial-most row with 9 tubercles, second dorsal row 8; ventral to mesial-most row 3 tubercles present, with scattered tubercles on dorsal surface of palm. Dorsal and lateral surface of palm covered with numerous setiferous punctations. Ventral surface of palm with rounded cone shaped tubercle at base of dactyl. Dorsal and ventral surfaces of finger of propodus with submedian longitudinal ridge flanked with setiferous punctations, dense patch of long setae at base; basal half of opposable margin with 5 rounded tubercles. Dorsal and ventral surfaces of dactyl with submedian longitudinal ridges flanked by setiferous punctations; inner ventral margin with dense setation. Dactyl and propodus with corneous subterminal tip.

Carpus (Fig. 1I) with deep oblique furrow dorsally; mesial surface with large procurred spine near midlength, distally near joint with propodus a smaller rounded tubercle; ventral surface with 1 corneous spine and one rounded tubercle. Dorsal surface of merus with 2 large corneous spines near distal margin; ventral surface with 1 large corneous spine just distal to midlength of ventrolateral margin and mesial row of 8 pointed tubercles, some corneous; row terminating distally with large corneous spine. Ischium with several very small rounded tubercles on mesial margin.

Hook on ischium of third pereopods only (Fig. 1L); hook simple, overreaching basioischial joint and not opposed by tubercle on basis. First pleopods (gonopods) (Fig. 1A, B) as in Diagnosis, reaching to cephalic margin of bases of third pair of pereopods when abdomen flexed.

**Description of allotype female** (measurements, Table 1).—Differing from holotype in following respects: TCL is 20.1 mm and PCL is 15.3 mm. Areola constituting 28.3% of TCL (36.9% of PCL) and 8.1 times longer than wide. Antennal scale 5.3 mm long, 2.1 mm wide. Mesial row of tubercles on palm of chela with 8 tubercles, second row with 6. In general, all spines on allotype much better developed than those on the holotype, very pointed and corneous.

Sternum between third and fourth pereopods narrowly V-shaped. Annulus ventralis (Fig. 1D) as in Diagnosis. Postannular sclerite about half as long as width of annulus. First pleopods uniramous and reaching anteriorly to annulus when abdomen flexed.

**Description of morphotype male, form II** (measurements, Table 1).—Differing from holotype in the following respects: TCL is 18.1 mm and PCL is 13.2 mm. Areola constituting 29.2% of TCL (39.8% of PCL) and 12.8 times longer than wide. Antennal scale 4.5 mm long, 2.0 mm wide. Mesial row of tubercles on palm of chela with 9 tubercles, second row with 6.

Hook on ischium of third pereopods not overreaching basioischial joint. First pleopod (Fig. 1E, F) of uniform texture; neither terminal elements corneous, mesial process slightly longer than central projection, both with rounded distal tips.

**Size.**—Form I males \( (n = 16) \) range in size from 15.3–30.5 mm TCL (11.2–23.3 mm PCL). Form II males \( (n = 4) \) range in size from 13.2–18.1 mm TCL (9.6–13.3 mm PCL). Females \( (n = 10) \) range in size from 14.5–26.0 mm TCL (10.7–19.4 mm PCL).

**Color** (Fig. 2).—Ground color of carapace tan to light brown. Posterior margin

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of cephalothorax with a slightly darker inconspicuous saddle that widens anterolaterally. Large diagonally and medially directed rectangular blotches just posterior to cervical groove on both sides of branchiostegals. Mandibular muscle scars distinct, circular with darker brown coloration. Surface of rostrum uniform brown to green with margins highlighted in cream to tan. Abdomen with similar background color as carapace, and may have green highlights. Dorsolaterally abdominal segments with a pair of dark scalloped brown spots that progressively become smaller from anterior to posterior segments; spots from segment to segment coalesce to form, in dorsal view, a pair of scalloped dark brown longitudinal bands that slightly converge posteriorly. Telson and uropods uniform brown to greenish. Chelae with numerous large green to brown dorsal blotches. Pereopods with distinct alternate bands of lighter cream and darker brown or green. Ventral surfaces of chelae, cephalothorax and abdomen uniformly cream to white.

**Type locality.**—Terrapin Creek at Tennessee State Route (SR) 69 crossing, approximately 1.4 km NE of Midway, Henry County, Tennessee (36.4984°N, 88.4903°W) (Fig. 3). The holotype was collected in woody debris and tree roots along the right downstream bank about 100 m downstream of the SR 69 bridge. The stream is approximately 10–15 m wide with an average depth of 0.5 m at time of collection. Substrate at the type locality was sand with very little mid-channel cover. The collection was made October 10, 1999, and included both the holotype and allotype.

**Disposition of types.**—The holotype, allotype, and morphotype are deposited at the National Museum of Natural History (USNM), Smithsonian Institution, Washington, D.C. (catalogue numbers USNM 1107765, USNM 1107766, USNM 1107767, respectively). The following paratypes are deposited in the following museums: National Museum of Natural History, Washington, D.C. (USNM 1107768, USNM 1107769); Illinois Natural History Survey Crustacean Collection (INHS), Champaign, IL (INHS 10834, INHS 10835); Branley A. Branson Museum of Zoology (EKU), Eastern Kentucky University, Richmond, KY (EKU 3959–3963).

**Range and specimens examined.**—*Orconectes taylori* is confined to streams that are tributaries to the North Fork Obion River in Henry Co., TN (Fig. 3). The North Fork Obion is a tributary of the Obion River which flows into the Mississippi River. To date this species has been collected from only five streams: Clear Cr., Mill Cr., Sandy Cr., Terrapin Cr., and unnamed spring feeder. Although the type locality is within 0.3 km of the Kentucky border, and after numerous attempts to collect it on the Kentucky side of the North Fork Obion River drainage, it has not been found in Kentucky.

A total of 34 specimens from 7 localities have been examined from the following Henry County, Tennessee sites: 1) USNM 1107765 and USNM 1107766, Terrapin Creek at State Route 69 crossing, approximately 1.4 km NE of Midway (36.4984°N, 88.4903°W), 10 Oct 1999 (holotype and allotype); 2) USNM 1107769, INHS 10835 and EKU 3962, Mill Creek at State Route 140 crossing, 8.0 km W Puryear (36.44225°N, 88.42230°W), 5 Nov 2005 (paratypes); 3) USNM 1107767 and EKU 3961, Mill Creek at Mill Creek Rd crossing, 6.3 km WNW Puryear (36.44746°N, 88.40351°W), 16 Mar 2006 (morphotype and paratypes); 4) USNM 1107768, INHS 10834 and EKU 3963, Clear Creek at Goldston Spring Rd crossing, 5.0 km SW Puryear (36.42268°N, 88.38169°W), 5 Nov 2005 (paratypes); 5) EKU 3960, Clear Creek at State Route 140 crossing, 2.7 km W Puryear (36.44387°N, 88.36161°W), 16 Mar 2007 (paratypes); 6) EKU 3959,
Sandy Branch at Terrapin Creek Rd crossing, 3.3 km SE Midway (36.47405°N, 88.46663°W), 5 Nov 2005 (paratype); 7) USNM, Spring feeder to (North Fork) Obion River off U.S. 641, between Clear Creek and Phillips Creeks (W of Puryear), 1971.

Etymology.—Named in honor of Dr. Christopher A. Taylor, Illinois Natural History Survey. Dr. Taylor has contributed greatly to our knowledge of crayfishes of North America through his interest and research in crayfish taxonomy, systematics, biogeography and con-

Fig. 3. Known range of *Orconectes taylori*. Type locality denoted by black dot with concentric circle, other *O. taylori* localities denoted by black dot, other sites examined but with no *O. taylori* present denoted by black square. 1 = North Fork Obion River, 2 = Middle Fork Obion River, 3 = South Fork Obion River, 4 = Rutherford Fork Obion River, 5 = Obion River main stem.
servation. I am also very appreciative of the numerous enjoyable and productive years of collaborative crayfish work.

**Common name.**—Crescent Crayfish, as to the shape of the central projection of the gonopod.

**Conservation status.**—Based on the criteria of the American Fisheries Society as outlined by Taylor et al. (2007) and the system developed by The Nature Conservancy/NatureServe (Masters 1991), it is proposed that this species, because of its apparent narrow range, be considered Vulnerable (V) with a G3 global ranking, respectively.

**Habitat and life-history notes.**—All individuals were collected from small to medium size streams that are within the North Fork Obion River drainage in NW Tennessee. The streams typically have sandy substrate, and specimens were collected along the stream margins in wood and leaf debris piles. The water depth was usually about 0.25 m or less. The flow is generally slow to moderate. At all sites the water was clear, and the main land use was farming with mixed deciduous riparian vegetation. The species was not found in streams that have been heavily channelized with debris removed.

All collections were made either in the fall (October or November) or spring (March) season. Form I males were collected from each site. No ovigerous females or females with young have been collected.

**Crayfish associates.**—The only species collected with *O. tayloiri* were *Cambarus diogenes* Girard, 1852 and *Procambarus acutus* (Girard, 1852). Elsewhere in the Obion River system the above two species were also widely collected. In addition, *Cambarus striatus* Hay, 1902, *Orconectes pagei* Taylor & Sabaj, 1997, and *O. palmeri* (Faxon, 1884) were all collected from the Middle Fork Obion River. The *O. pagei* records are the first records for this species outside of the Tennessee R. system in Benton, Carroll, Henderson and Henry counties, Tennessee (Taylor & Sabaj 1997). The locations of these records are: 1) TN: Henry Co., Middle Fork Obion R. at SR 140 crossing, and 2) TN: Henry Co., Middle Fork Obion R., at Gate 3 Rd. crossing. All crayfishes were collected with seines along the margins of these streams often in leaf litter or other organic debris.

**Variation.**—There is some variation in the lateral spines on the rostrum. In most individuals these spines are reduced and short, but occasional individuals may either have them absent or they may be well developed. The anterior tip of the postorbital ridge is most often broadly rounded and not corneous, but in some specimens it is corneous and developed into a spine. The mesial process of the form I gonopod usually is always shorter ($\bar{X} = 0.21$ mm, $SD = 0.15$) than the central projection, but because of element curvature the mesial process extends to or beyond the tip of the central projection in lateral view. The gonopods of form I males reach to the third pereopod; in some individuals they reach the posterior edge, while in others they extend to the anterior edge. Most form I males have hooks only on the ischium of the third pereopod; however, two males also had small reduced hooks on the ischium of the fourth pereopod. Setae on chelae are densest at the base of the dactyl and propodus and dorsally on the palm. The setae are less dense dorsally on rounded surfaces. It is evenly distributed ventrally, but is somewhat more dense on the ventral surfaces of the fingers. The base color may be somewhat variable among individuals. In most individuals it is tan to light brown, but in individuals that have not molted recently the coloration becomes darker and may have a greenish tinge. In freshly molted individuals the color is more intense and the tan may be brighter and more reddish.

**Comparisons.**—Cooper & Hobbs (1980) noted the extreme similarity among *Tri-
sellecsens (= “virilis section”) species, and yet at the same time it has been noticed that there is a puzzling high degree of variation in important taxonomic characters such as areola width, gonopod and chela morphology among species. *Orconectes taylori* can be distinguished from other species in the group by the following combination of characters: 1) the relatively short, stout and strongly curved central projection of the form I gonopod; 2) all individuals have a distinct carina on the rostrum; 3) appressed and rounded tubercles on the margin of the palm of the chela and; 4) a wide areola with room for 3–4 punctuations.

**Relationships.**—Species of the subgenus *Trisellescens* show considerable variation in the following characters: areola width (linear to narrow to wide open); rostral carina (absent or present or variable in populations); marginal tubercles of the mesial palm of the chelae (appressed, sub serrate or serrate); curvature of the central projection (curved along entire length or curved only near the tip); cervical spines (absent or weakly developed to strongly developed). *Orconectes taylori* has the following combination of these characters: wide open areola; rostral carina; appressed marginal tubercles; central projection curving along entire length, crescent-shaped; and well developed cervical spines. The combination of these characters suggests that *O. taylori* has its greatest affinities with *O. etnieri* Bouchard & Bouchard, 1976 in that both species have a carina on the rostrum, an open areola, a central projection curved along entire length and well developed cervical spines. [The carina of *O. etnieri* was not described by Bouchard & Bouchard (1976) nor figured in Hobbs (1989), but examination of the holotype indicates that it is present and weakly to moderately developed.] The two species differ on the length of the central projection (much shorter and more broadly rounded in *O. taylori*) and in the tubercles on the margin of the palm of the chelae (appressed in *O. taylori* and sub serrate in *O. etnieri*). Bouchard & Bouchard (1976) indicated that *O. etnieri* had its closest affinities with *O. validus*. *Orconectes taylori* differs from *O. validus* (Faxon, 1914) in a number of ways. The areola of *O. validus* is moderately wide to obliterated in some populations and the cervical spines are greatly reduced or absent. The main distinction between the two species is the length and curvature of the central projection of the gonopod. In *O. validus* it is much longer, and more slender, while in *O. taylori* it is more stout and broadly rounded, crescent-shaped and wide at the base. In addition, the distributions of the three species are disjunct. *Orconectes taylori* is restricted to the North Fork Obion River; *O. etnieri* is found in western tributaries of the Tennessee R. and in the Forked Deer, Hatchie and Loosahatchie drainage systems (Bouchard & Bouchard 1976, Hobbs 1989); *O. validus* is the most widespread of the three, and is found in the Tennessee and Black Warrior river systems in northern Alabama and southern Tennessee (Hobbs 1989).

**Acknowledgments**

I am grateful to R. R. Cicerello, M. R. Thomas, and M. C. Compton for assistance in the field. I am also grateful to K. Reed for providing access to the crustacean collections at the National Museum of Natural History, Smithsonian Institution. I also wish to thank anonymous reviewers for improving the manuscript.

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