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ORCONECTES (PROCERICAMBARUS) THEAPHIONENSIS (DECAPODA: CAMBARIDAE), THE SINKHOLE CRAYFISH, A NEW SPECIES OF CRAYFISH FROM SOUTHCENTRAL INDIANA

Thomas P. Simon[1], **Anne E. Timm**[2], and **Charles C. Morris**[1]: [1]Aquatic Research Center, Indiana Biological Survey, 6440 South Fairfax Road, Bloomington, Indiana 47401 USA; [2]Hoosier National Forest, U.S. Forest Service, 248 15th Street, Tell City, Indiana 47586 USA

ABSTRACT. A new species of crayfish ***Orconectes (Procericambarus) theaphionensis*** is described from southcentral Indiana in the karst areas of the Lost River and Blue Creek drainages. The species occurs both above and below the Orangeville Rise and in Stampers Creek. The species is distinguished from other recognized members of the subgenus by its strong carina, rostrum deflected, non-serrate mandible, broad carapace, presence of setae just posterior to the cervical groove and the anterior portion of the areola, and distinct chelae tubercle formula. The rostrum is concave dorsally, terminating in an upturned acumen, median carina strong. Rostral margins thickened; edges distally converging providing a slightly convex appearance; terminating in spines. The dactyl formula ranges from 0, 4–8, I, 3–4 (5), while the propodus formula is 0, i, 3–6, I, (2) 3–4. The central projection diverges from the mesial process and the central projection length to total length of pleopod (mean = 44.86%, range = 34.4–56.3%) is intermediate between *Orconectes cristavarius* and *O. putnami*. Of the recognized members of the subgenus *Procericambarus*, it is most similar to *Orconectes (P.) juvenilis*, which is found in southeastern Indiana and Kentucky. The new form can be differentiated from *O. (P.) juvenilis* by the presence of a strong median carina, the suborbital angle obsolete, and a divergent central and mesial projection that is greater than 35% central projection length to total length of pleopod.

Keywords: Taxonomy, *Procericambarus*, Cambaridae

Taylor (2000) diagnosed the *Orconectes juvenilis* complex and provided empirical data that elucidated the taxonomic status of members of this group. The group belongs to the crayfish subgenus *Procericambarus* (Fitzpatrick 1987), which possesses a strong angular shoulder on the cephalic surface at the base of the form I male pleopod's central projection, the central projection accounting for at least 35% of the total pleopod length. The *Orconectes juvenilis* complex as described by Taylor (2000) includes six species. Hobbs (1972) and Bouchard (1976) included in the complex, *Orconectes juvenilis* (Hagen 1870), *Orconectes spinosus* (Bundy 1877), and *Orconectes putnami* (Faxon 1884), while Taylor (2000) added *Orconectes rusticus* (Girard 1852), *Orconectes ronaldi* Taylor 2000, and *Orconectes cristavarius* Taylor 2000. All six species are native in the unglaciated Interior Plateau region of Kentucky, Indiana, West Virginia, and Ohio, and inhabit rocky streams and rivers.

During studies of the crayfish fauna of Indiana, the senior author has found several new crayfish species of the *Procericambarus* subgenus. The recent taxonomic diagnosis by Taylor (2000) has provided an opportunity to reduce the complexity of this group and validate other closely related taxa. Faxon (1885) recognized extreme variation in character state combinations of species later assigned to *Procericambarus*; while Hagen (1870), Ortmann (1931), and Faxon (1884) recognized varieties of *O. rusticus* and various combinations of synonymized species within *O. juvenilis*.

Here we examine the morphological variation within an undescribed member of *Procericambarus* occurring in Indiana. As the southern unglaciated portions of Indiana are analyzed, character states necessary for distinguishing species boundaries will likely provide information necessary for description of additional new species in the *Procericambarus* complex.

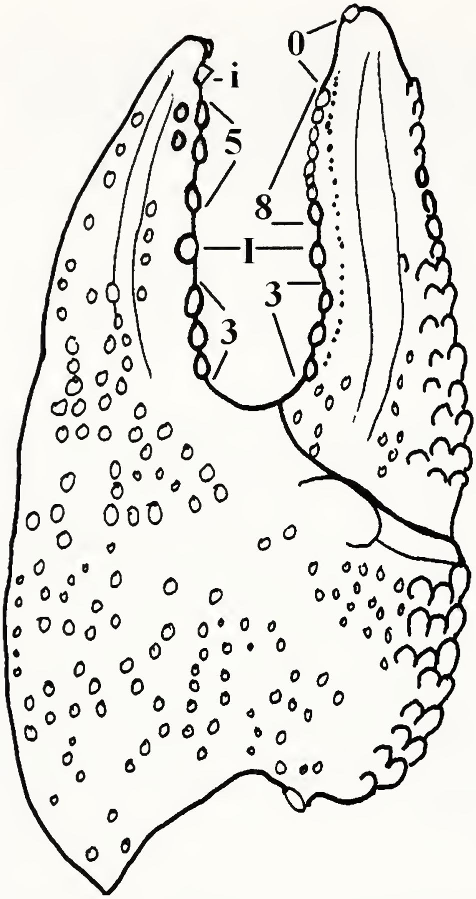


Figure 1.—Left chelae showing an example of the dactyl and propodus formula. *Note:* Propodus tubercles are in two rows; dactyl tubercle formula: 0, 8, I, 3; propodus tubercle formula: i, 5, (3 + 2), I, 3.

METHODS

Specimen measurements follow Taylor (2000), with the exception of a formula we develop for describing the number of tubercles on the opposable margins of the dactyl and propodus. This formula does not include the corneous distal tip of either the dactyl or propodus. The formula is derived by counting the number of denticles on distal edge of the dactyl and propodus (see example in Fig. 1). Generally, if this area is blade-like then a zero is noted. The first set of denticles is usually a series of very small tubercles that slightly increase in size. These denticles can be in several rows on the dactyl. The denticles are reported as Arabic numbers. A small triangular, corneous canine-like tooth is often the first denticle found on the propodus. We denote this triangular tooth with a lower case Roman numeral series. Generally, the mid-point of both the dactyl and propodus has a large, spherical to oval, tubercle that is the largest in the series. We denote this tubercle by an upper case Roman numeral. Finally, the tubercles that are proximal to the palm are denoted by Arabic numbers. Using this convention provides a methodology to differentiate between corneous, triangular tubercles, denticles, and large tubercles. We have found these tubercle characters to be consistent and diagnostic of crayfish species in both *Orconectes* and *Cambarus* genera (T.P. Simon unpubl. data).

Orconectes (Procericambarus) theaphionensis new species
Sinkhole Crayfish
Figs. 2, 3–12; Table 1

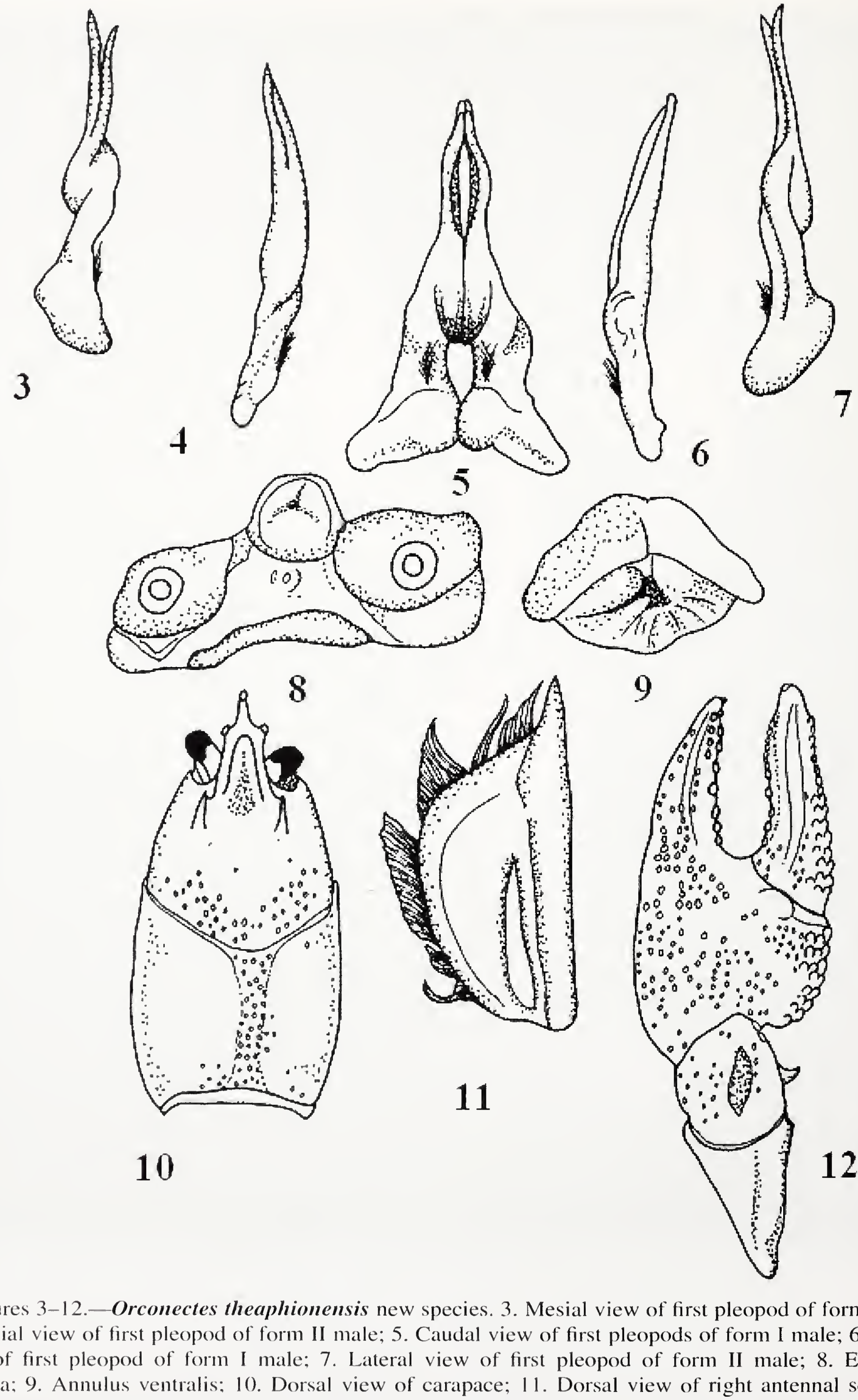
Cambarus rusticus.—Girard 1852:8; Faxon 1885: 108, pl. 9: figs. 8, 8′, 8a, 8a′ [in part]; Hay 1891: 149 [in part].
Cambarus (Faxonius) rusticus.—Ortmann 1905: 112 [in part]; Ortmann 1931:82 [in part]; Eberly 1955:182 [in part].
Faxonius (Faxonius) rusticus.—Creaser 1933:21 [in part].
Orconectus rusticus.—Dubois & Sharma 1977:27 [in part].
Procambarus rusticus.—Huner 1978:4 [in part].
Orconectes (Procericambarus) rusticus.—Hobbs 1972:92 figs. 74c, 75b,d; 1974:40, fig. 136 [in part]; Fitzpatrick 1987:58 [in part]; Hobbs 1989: 49 [in part]; Page & Mottesi 1995:109 [in part]; Taylor 2000:138 [distribution map]; Simon 2001: 107 [in part].

Etymology.—The species is named for the sulphur springs that are prevalent in the study area. Greek *theaphion*—of sulphur and brimestone. The vernacular name, sinkhole crayfish, refers to the Lost River watershed, perhaps among the largest cave systems in Indiana and North America.

Diagnosis.—Body and eyes pigmented. Rostrum concave dorsally, terminating in upturned acumen, median carina strong. Rostral margins thickened; edges distally converging providing a slightly convex appearance; terminating in lateral spines. Areola 29.0–40.2% ($\bar{x}$ = 34.2, n = 100, SD = 1.63) of total length of carapace, narrowest part at midpoint, 12.4–39.4% ($\bar{x}$ = 21.6, n = 100, SD = 5.11) times as long as wide with 3–5 punctations (mode

Figure 2.—***Orconectes theaphionensis*** new species. Total length of carapace is 33.2 mm. Holotype form I male, Half Moon Springs at Indiana County Road 200 E bridge, 2.6 km W of Chambersburg, Paoli Township, Orange County, Indiana (USNM 1075206).

= 4, n = 100, SD = 0.58). One corneous hepatic spine on each side of carapace. Post-orbital ridges well-developed, terminating in slightly upturned corneous spines. Suborbital angle obsolete. Antennal scale broadest at midlength, thickened lateral margin terminating in large corneous spine. Ischia of third pereiopods of males with hooks; hooks over-



Figures 3–12.—***Orconectes theaphionensis*** new species. 3. Mesial view of first pleopod of form I male; 4. Mesial view of first pleopod of form II male; 5. Caudal view of first pleopods of form I male; 6. Lateral view of first pleopod of form I male; 7. Lateral view of first pleopod of form II male; 8. Epistomal zygoma; 9. Annulus ventralis; 10. Dorsal view of carapace; 11. Dorsal view of right antennal scale; 12. Dorsal view of left chela. 3, 6, 8, 10, 12 of holotype (USNM 1075206); 5. Paratype (INBS 841); 4,7. Morphotype (USNM 1075208); 9,11, Allotype (USNM 1075207).

Table 1.—Measurements (mm) of ***Orconectes theaphionensis*** new species.

	Holotype	Allotype	Morphotype
Carapace:			
Total length	33.2	36.4	28.3
Postorbital length	26.3	27.5	20.9
Width	16.3	18.3	14.4
Height	15.4	18.1	11.6
Areola:			
Width	2.4	3.1	1.5
Length	11.5	11.7	9.6
Rostrum:			
Width	3.5	4.1	3.0
Length	6.9	9.0	7.4
Chela, right:			
Length, mesial margin of palm	10.1	7.3	7.0
Palm width	16.1	11.5	8.6
Length, lateral margin	35.9	24.6	21.9
Dactyl length	17.8	11.4	9.4
Abdomen:			
Width	14.4	17.2	11.9
Length	33.0	37.3	29.6

reaching basioischial articulation in form I males only. Chela with 2–3 rows of tubercles along mesial margin of palm, usually 6–10 tubercles in mesial most row, 4–8 in dorsomesial row, and occasionally present are a proximalmesial row of 3–9 weakly developed tubercles running to knob at base of dactyl; small tufts of setae on mesial margin of palm, dorsomesial and dorsolateral surfaces, and fingers; dorsal surfaces of fingers with well-developed longitudinal ridges. First pleopods of form I male symmetrical, extending to just past anterior edge of bases of second pereiopods when abdomen flexed. First pleopod of form I male with well-developed shoulder on cephalic surface at base of central projection; without strong 90° central projection corneous, constituting 34.4–56.3% ($\bar{x}$ = 44.86%, n = 50, SD = 5.47) of total length of first pleopod, straight and tapering to a pointed tip; mesial process non-corneous and straight, distal end dorsally compressed and tapering to acute tip (see Variation), slightly subequal in length to central projection. First pleopod of form II male noncorneous, extending to anterior edge of bases of second pereiopods when abdomen flexed; central projection straight, mesial process divergent from central projection, straight and subequal in length; both elements tapering to rounded tips. Annulus ventralus immovable, subcircular; cephalic half with wide median trough and two caudally-directed protuberances overhanging centrally located fossa; sinuate sinus running from center of fossa to caudal edge.

Description of holotypic male, form I.—Body slightly depressed dorsoventrally, carapace wider than abdomen (16.3 and 14.4 mm, respectively). Greatest width of carapace larger than height at caudodorsal margin of cervical groove (16.3 and 11.5 mm, respectively). Postorbital carapace length (26.3 mm) 79.2% of length of carapace. Areola 20.9 times longer (11.5 mm) than wide (2.4 mm) with four punctations across narrowest part; length of areola 34.5% of total length of carapace. Rostrum densely covered with punctations, excavated, strong median carina present; margins thickened, distal halves straight and slightly converging, terminating in rounded corneous spines, proximal halves slightly convex. Acumen terminating in upturned corneous spine and reaching just distal of midpoint of antennular peduncle. Postorbital ridges well-developed, terminating in slightly upturned corneous spines. Suborbital angle obsolete. Cervical spines corneous; branchiostegal areas of carapace smooth to slightly granular, dorsal surface with scattered punctations. Setae present posterior to the cervical groove and anterior area of the areola.

Carapace length nearly equal in length to abdomen (33.2 and 33.0 mm, respectively). Cephalic section of telson with two immovable spines in each caudolateral corner extending over exopodite. Caudal margin of cephalic section of exopodite with numerous fixed spines (21) and one large movable spine in caudolateral corner. Cephalic and caudal sections of exopodite with prominent median ridge. Lateral margin of endopodite terminating in spine; endopodite with prominent median ridge terminating in premarginal spine. Dorsal surface of telson and uropods setiferous. Antennal scale broadest at midlength, thickened lateral margin terminating in large corneous spine. Right antennal scale 7.02 mm long, 2.43 mm wide.

Mesial surface of palm of left chelae with three rows of tubercles, eight tubercles in mesial most row, seven tubercles in dorsomesial row, and three small widely interspersed tubercles lateral to dorsomesial row, six basiodactyl punctations form a weak row running to knob at base of dactyl. Mesial and lateral surfaces of chela covered with numerous setiferous punctations; ventral surface with scattered punctations. Dorsal surface of finger of propodus with submedian longitudinal ridges flanked by setiferous punctations; basal half of opposable margin with four small tubercles, a large prominent tubercle near midlength, five well-developed distal tubercles, and a small, triangular, corneous tubercle near distal edge (propodus tubercle formula: 0, 8, I, 4). Dorsal and ventral surfaces of dactyl with submedian longitudinal ridges flanked by setiferous punctations; basal half of opposable margin with four well-developed tubercles, a large prominent tubercle at midlength, and eight distal tubercles in two interdigitated row (dactyl tubercle formula: 0, i, 5, I, 4). Finger of propodus and dactyl with rounded subterminal corneous tip.

Carpus with deep oblique furrow dorsally; mesial margin with a single large corneous procurved spine at midlength and three small corneous spines along distomesial margin; ventral surface with a single corneous spine just mesial to mid-length of distal margin, distoventrolateral corner enlarged and globular with a single small corneous spine overhanging chelae. Dorsodistal surface of merus with three corneous spines; ventral surface with two large corneous spines and a single tubercle at midlength of ventrolateral margin and lateral to mesial row of seven spines, some corneous; row terminating in large corneous spine; small tubercle at distolateral corner. Ischium with a single tubercle just proximal to midlength of mesial margin and a single noncorneous spine on distal end of mesial margin.

Hook on ischium of third pereiopod only; hook simple, overreaching basioischial articulation and opposed by large rounded tubercle on basis. First pleopod as in Diagnosis above, central projection constituting 47.7% of total length of first pleopod.

Description of allotypic female.—Differing from holotype as follows. Areola constituting 32.1% of length of carapace and 3.8 times longer than wide. Postorbital carapace length 75.4% of length of carapace. Acumen with upturned corneous spine at distal tip. Mesial row of tubercles along palm of left chela with eight tubercles, dorsomesial row with seven, and distal dorsomesial row with three tubercles. Propodus with tuft of long setae at base of finger of opposable propodus with four well-developed tubercles proximal to palm, a prominent large tubercle at midlength, and five small distal tubercles in two interdigitated rows, with a single small, corneous, triangular, hooked tubercle at distal edge (propodus tubercle formula: 0, i, 5, I, 4). Opposable margin of dactyl with four well-developed tubercles, a single prominent tubercle at midlength, and five distal tubercles (dactyl tubercle formula: 0, 5, I, 4). Ventral surface of left merus with two corneous spines at midlength and lateral row of tubercles along mesial margin.

Sternum between third and fourth pereipods narrowly V-shaped. Postannular sclerite as wide as annulus ventralis. Annulus ventralis described in Diagnosis. First pleopods uniramous, barely reaching caudal margin of annulus when abdomen flexed.

Description of morphotypic male, form II.—Differing from holotype as follows. Areola constituting 33.9% of length of carapace and 6.4 times longer than wide. Postorbital carapace length 73.7% of length of carapace. Acumen with upturned corneous spine at distal tip. Mesial row of tubercles along palm of left chela with eight tubercles, dorsomesial row with five tubercles, and distal dorsomesial row with five tubercles. Dorsodistal surface of left merus with two corneous spines. Ventral surface of left merus with a single corneous spine and another single tubercle at midlength and lateral to row of tubercles along mesial margin.

Hook on ischium of third pereiopod not overreaching basioischial articulation. First pleopod without well-developed divergent mesial projection, instead blunt and blade-shaped, as described in Diagnosis.

Size.—Largest specimen examined 39.2 mm total carapace length (CL) form I male. Females (n = 25) ranging in size from 22.8–36.4 mm CL. Form I males (n = 50) ranging from 21.4–39.2 mm CL. Form II males (n = 25) ranging in size from 19.4–36.5 mm CL.

Color.—Dorsal and lateral surfaces of cephalothorax, pereiopods, and tail fan light brown to olive green. Dorsum with one large laterally elongate dark brown patch just anterior to areola. Cephalothorax with dark brown dorsolateral U-shaped saddle connected at caudal margin and extending to just posterior of midlength of lateral surfaces. Dorsal surfaces of abdominal segments 1–5 with dark brown patches, patches forming solid dark brown bar running from posterior edge of carapace to fifth abdominal segment when abdomen extended. Lateral surfaces of abdominal segments light orange, followed laterally by dark brown patches at edges. Dorsal and lateral surfaces of chelae, carpus, and merus olive green; dorsal surface of chelae covered with small dark flecks. Fingers of chelae with orange tips, followed proximally by wide black bands. Ventral surfaces of chelae, cephalothorax, and abdomen cream to white.

Type locality.—Half Moon Springs at bridge at Indiana County Road 200 E, 2.57 km W of Chambersburg, Paoli Township, Orange County, Indiana; 38.5207348 °N, 86.4229192 °W. The holotype was collected from a riffle on limestone bedrock in mid-channel, about 20 m upstream of the bridge. The allotype, morphotype, and paratypes were collected from cobble and slab bolder riffle habitats in close proximity to the holotype collection. At the time of collection, Half Moon Spring was 2.7 m wide with an average depth of 0.4 m. Substrate at the type locality was limestone bedrock with slab cobble and boulders. The stream is located in Hoosier National Forest and land use adjacent in the stream channel is pasture and forest.

Disposition of types.—The holotype, allotype, and morphotype are deposited at the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM 1075206, USNM 1075207, and USNM 1075208, respectively). Paratypes consisting of 12♂I, 30♂II, 2juv♂; 42♀, 7juv♀ (INBS 841) are deposited at the Indiana Biological Survey, Aquatic Research Center, Crustacean Collection, Bloomington, Indiana; paratypes 1♂I, 1♂II, and 1♀ (OSUMC 5972) are deposited at the Ohio State University Museum of Biodiversity, Columbus, Ohio; and paratypes 1♂I, 1♂II, and 1♀ (INHS 9552) are deposited at the Illinois Natural History Survey Crustacean Collection, Champaign, Illinois.

Range.—***Orconectes theaphionensis*** new species, is found in the Lost River drainage, above and below the Orangeville Rise, including Stampers Creek and other sinkholes, and adjacent Blue Creek (East Fork White River drainage) in south central Indiana (Fig. 13). The Lost River originates in eastern Orange County flowing northeast for about 57.3 km before emptying into the East Fork White River. Stampers Creek is a disjunct stream channel that is connected to the Lost River through sinkhole connections. Blue Creek occurs directly west of the Lost River entering the East Fork White River near Shoals. Both watersheds drain interbedded limestones, sandstones, and shale deposits of middle Pennsylvanian age. The species may be present in Blue River (Harrison County; C.A. Taylor pers. commun.) and Indian Creek (Harrison County; TPS, unpubl. data); however, further genetic analysis of these two drainage forms may be necessary since our morphometric and pigmentation data suggest that they are new species.

A total of 1354 specimens has been examined from 42 locations in Indiana. Museum collection numbers and counties for these sites are listed in the Material Examined section, below.

Habitat and life-history notes.—*Orconectes theaphionensis* new species, occurs in creeks and small rivers with substrates of limestone bedrock, slab boulder and cobble rubble, and large gravel. The species is most commonly encountered along rock substrates

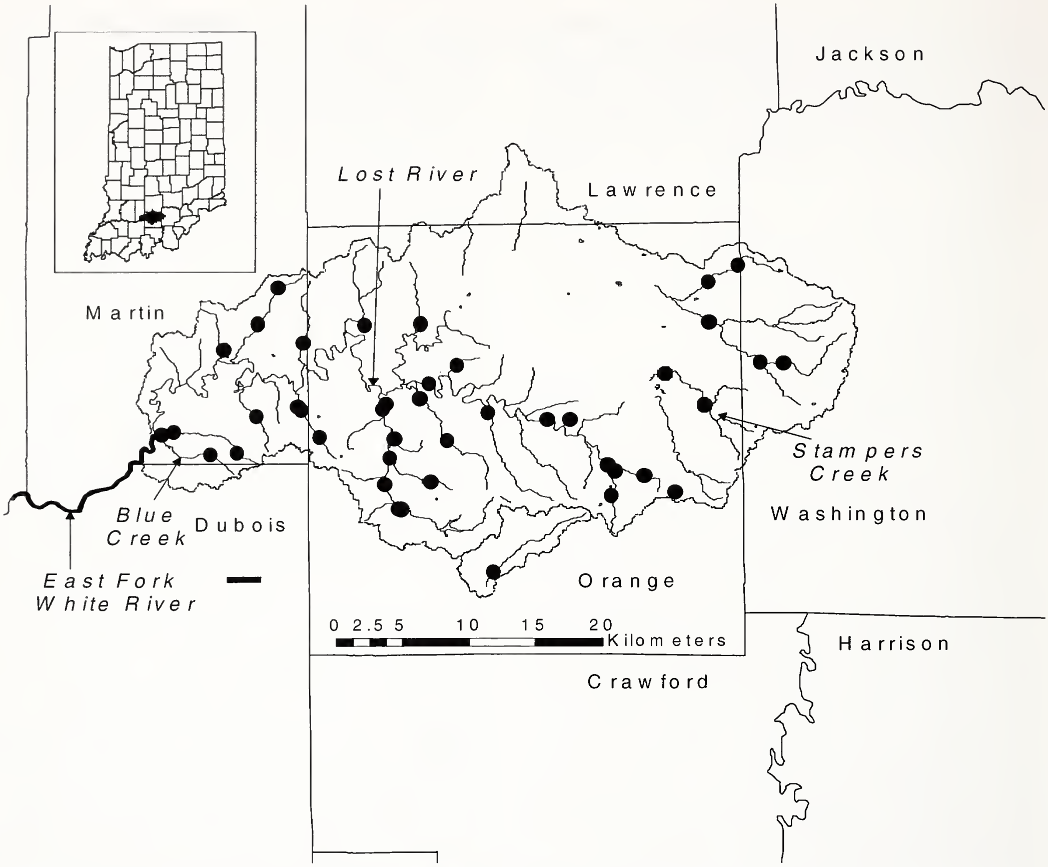


Figure 13.—Distribution of ***Orconectes theaphionensis*** new species, throughout its known range in the Lost River, Stampers Creek, and Blue Creek drainages, Indiana.

Table 2.—Seasonal data showing by month numbers of individuals of each sex including sex ratios for ***Orconectes (Procericambarus) theaphionensis***, new species. [a] = Female with eggs collected during this month, [b] = Female with eggs and young collected during this month.

	Male I	Male II	Females	Sex ratio
February	0	0	4	—
March	8	2	16[a]	1/1.6
April	3	0	18	0.17/1
May	138	46	214[b]	1/2.5
June	44	178	334	1/1.5
July	12	31	50	1/1.16
August	4	12	23	1/1.4
September	55	43	142	1/1.4
October	118	23	211	1/1.5

in shallow riffle areas or among slowly-flowing runs.

Form I males have been collected in all months sampled March-October, and we have not sampled during November to January (Table 2). No males were collected during February. Juveniles have been collected in June and July. Ovigerous females were collected on 25 March 1999 and 18 May 2004. One 26.7 mm CL female was carrying 113 eggs that averaged 1.20 mm in diameter, whereas a 28.9 mm CL individual carried 121 eggs that averaged 1.18 mm in diameter.

Crayfish associates.—The following species were collected from habitat containing *O. theaphionensis* new species: *Cambarus (Erebicambarus) tenebrosus* Hay 1902 (formerly *Cambarus (Erebicambarus) laevis* Faxon 1914); and *Orconectes (Trisellescens) immunis* (Hagen 1870); *Cambarus (Lacunicambarus)* sp. "B"; *Cambarus (Lacunicambarus)* sp. "C"; *Cambarus (Tubericambarus)* sp. "A."

Variation.—Ontogenetic variation is observed in *Orconectes theaphionensis* new species, none of which shows any geographic patterns of distribution. Weakly developed granular tubercles are occasionally apparent on the branchiostegal area. The pleopod in most form II male individuals has a mesial process that tapers to a sharply pointed distal tip, but in some specimens the distal one-third is spatulate due to a dorsoventral compression of the process. The dactyl and propodus formulas show distinct patterns, but the largest individuals have slightly more tubercles, such as the holotype. The dactyl formula range is 4–8 (usually in two rows), I, 3–4 (rarely 5), while the propodus formula is, 0, i, 3–6, I, (rarely 2) 3–4. Some increase in carapace width was observed in populations from Sulphur Creek; however, we view this variability as an ecomorph due to the prevalent cool temperatures (< 17 °C year round). In many smaller individuals, the entire length of the rostral margin is straight.

Comparisons.—*Orconectes theaphionensis* new species, differs from all other members of the genus *Orconectes* by possessing a unique combination of form I male pleopod, mandible, rostral carina, and chelae characters (Table 3). Only *O. theaphionensis* has a slightly caudally-divergent central and mesial projection in form I males. The central projection to total length of pleopod (mean = 44.86%, range = 34.4–56.3%) is intermediate between *Orconectes cristavarius* and *O. putnami* (Taylor 2000). In addition to *O. theaphionensis*, within the subgenus *Procericambarus*, only *O. luteus* (Creaser 1933) has a deflected central projection, but *O. theaphionensis* lacks a deflected mesial projection as *O. luteus*. The mandible is unserrated, and the chelae has three rows of mesial tubercles. The new form differs from *O. juvenilis* and *O. rusticus* by the presence of the strong median carina, suborbital angle obsolete, a divergent central and mesial projection that is greater than 35% central projection length to total length of pleopod.

Relationships.—The form I male pleopod of *O. theaphionensis* is most similar in length and general shape to members of the subgenus *Procericambarus*, and we assign *O. theaphionensis* to that subgenus. Until either molec-

Table 3.—Comparison of characters diagnostic for ***Orconectes (Procericambarus) theaphionensis*** new species for differentiation from other *Procericambarus* species. TLP = total length of pleopod, mean value reported with range of values in parentheses. *n* = number of individuals examined for each species.

Characters	*Orconectes theaphionensis* (*n* = 100)	*Orconectes juvenilis* (*n* = 134)	*Orconectes rusticus* (*n* = 68)	*Orconectes cristavarius* (*n* = 180)	*Orconectes putnami* (*n* = 43)	*Orconectes ronaldi* (*n* = 81)
Carina	strong	absent	absent	present	absent	absent
Mandible incisor	non-serrate	non-serrate	non-serrate	serrate	serrate	serrate
Cervical groove setae	present	absent	absent	absent	absent	absent
Mesial palm tubercles	2–3 rows	2 rows	2 rows	2 rows	2 rows	2 rows
mesial tubercles	6–10	6–11	6–11	7–11	9–10	7–9
dorsomesial	4–8	7–11	7–12	5–10	8–10	6–8
proximal mesial	3–9					
Central projection length: TLP	44.9% (34.4–56.3%)	48.3% (41.2–52.3%)	41.7% (35.7–46.5%)	47.0% (40.0–52.0%)	53.1% (48.4–57.0%)	45.0% (41.0–49.0%)
Chelae tubercle formula						
dactyl	0, 4–8, I, 3–4 (5)	0, 4–5, III, 4	0, 10–16	0, 1–2, I, 4–5	0, 7–8, III–IV, 3–4	0, 3–4, I, 5–6
propodus	0, i, 3–6, I, (2) 3–4	0–2, i, 5, I–III, 2	8–13, i, 3–4, I, 2–4	0, –, 1–2, I, 3–4	3–4, i, 3–4, III–IV, 2	0, i, 3–4, I, 5–6

ular or morphological data from *O. theaphionensis* can be included in a phylogenetic analysis, we refrain from inferring the position of *O. theaphionensis* within the subgenus.

Material examined.—Number, sex, and form of specimens examined are in parentheses. Asterisks (*) denote samples from which specimens were obtained for the statistical analyses; females and form II males were limited to 25 specimens. Data for monthly sex ratios (Table 2) was from the data below and from monthly repeat visits to the type locality. Form I male is indicated by MI, MII = form II male by MII, F = female, and juv = juvenile. CR = County Road, SR = State Road, N = North, S = South, E = East, W = West and combinations. Collector(s) names are abbreviated after first use. INBS = Indiana Biological Survey Crustacean Collection.

Orconectes theaphionensis

INDIANA: *Martin County:* Tributary to Big Creek, fire road, 4.8 km N Natchez, Halbert Twp, 38.64704 N, 86.70642 W, (Thomas P. Simon, Erin R. Lawrence, Stephanie L. Worden, Jake L. Burskey), 17 May 2004, (* 3 MI, 6 MII, 20 F), INBS 835. Big Creek, US 150 bridge, 1.3 km W Natchez, Halbert Twp, 38.61883 N, 86.72565 W, (TPS, ERL, SLW, JLB), 17 May 2004 (* 2 MI), INBS 836. Unnamed tributary Lost River, 1.0 km N on CR 191, 1.8 km N Roland, Halbert Twp, 38.60868 N, 86.68498 W, (TPS, SLW), 1 September 2004, (* 1 MI, 6 MII, 3 F), INBS 859. Unnamed tributary Lost River, CR 198 bridge, 3.7 km S Roland, Lost River Twp, 38.56330 N, 86.68717 W, (TPS), 12 July 2004, (* 2 MII, 8 F, 65 juv), INBS 861. Unnamed tributary Lost River, CR 4 bridge, 3.5 km S Roland, Lost River Twp, 38.56534 N, 86.68970 W, (TPS), 12 July 2004, (5 juv), INBS 862. Unnamed tributary Lost River, CR 195 bridge, 1.0 km NNW Natchez, Halbert Twp, 38.62170 N, 86.72446 W, (TPS), 1 July 2004, (5 MI, 4 MII, 11 F), INBS 863. Blue Creek, CR 900 E bridge, 3.5 km SE Rusk, Lost River Twp, 38.53398 N, 86.74278 W, (TPS), 14 July 2004, (11 juv), INBS 864. Blue Creek, CR 5 bridge, 0.2 km N Yenne, Lost River Twp, 38.54859 N, 86.79698 W, (TPS, JLB), 12 July 2004, (6 MII, 2 F, 41 juv), INBS 865. Blue Creek, CR 37 bridge, 1.3 km W Yenne, Lost River Twp, 38.54683 N, 86.80775 W, (TPS, SLW), 1 September 2004, (11 *I, 36 MII, 37 F), INBS 866. Unnamed tributary Lost River, CR 177 bridge, 2.7 km SE Yenne, Lost River Twp, 38.53297 N, 86.76574 W, (TPS), 14 July 2004, (3 juv), INBS 867. Qualkenbush Spring, CR 7, 3.5 km WSW Natchez, Halbert Twp, 38.60410 N, 86.75406 W, (TPS, JLB, ERL, SLW), 1 July 2004, (*2 MI, *3 MII, *4 F), INBS 868. *Orange County:* Carters Creek, CR 650 E bridge, 3.2 km SE Leipsic, North East Twp, 38.64843 N, 86.33554 W, (TPS, Brant E. Fisher, Katherine Gremillion-Smith), 18 March 1999, (12 MI, 6 MII, 5 F), INBS 828. Lost River, CR 650 E bridge, 3.2 km N Bromer, North East Twp, 38.62109 N, 86.33545 W, (TPS, BEF, KGS), 18 March 1999, (19 MI, 3 MII, 12 F), INBS 829. Carters Creek, Sutter Lane bridge, 4.8 km ESE Leipsic, North East Twp, 38.65931 N, 86.30991 W, (TPS, BEF, KGS), 18 March 1999, (7 MI, 1 MII, 10 F), INBS 830. Tributary to Halfmoon Springs, US 150 bridge, 3.2 km SE Paoli, Paoli Twp, 38.54503 N, 86.44936 W, (TPS, ERL), 16 June 2004, (1 MI, 1 F, 12 juv), INBS 833. Tributary to Halfmoon Springs, US 150 bridge, 0.3 km NW Chambersburg, Paoli Twp, 38.51769 N, 86.39197 W, (TPS, ERL, SLW, JLB), 17 June 2004, (*1 MI, 1 MII, 4 F), INBS 834. Stampers Creek, SR 56 bridge, 0.5 km SE Millersburg, Stampers Creek Twp, 38.55731 N, 86.33351 W, (TPS), 21 June 2004, (2F), INBS 837. Stampers Creek, CR 500 E bridge, 2.6 km NE Millersburg, Stampers Creek Twp, 38.58821 N, 86.36446 W, (TPS, ERL, SLW, JLB), 21 June 2004, (19 MII, 29 F, 12 juv), INBS 838. Lick Creek, CR 350 S bridge, 2.6 km WSW Chambersburg, Paoli Twp, 38.50657 N, 86.41743 W, (TPS, SLW), 13 September 2004, (*1 MI, 11 MII, 9 F, 3 juv), INBS 839. Halfmoon Springs, CR 200 E bridge, 5.2 km W Chambersburg, Paoli Twp, 38.52073 N, 86.42292 W, (TPS), 21 June 2004, (29 MII, 81 F, 31 juv), INBS 840. Unnamed tributary Lick Creek, Spring Mill Road bridge, 2.3 km WNW Chambersburg, Paoli Twp, 38.52488 N, 86.41997 W, (TPS, SLW), 13 September 2004, (*16 MI, *34 MII, *46 F, 9 juv), INBS 841. Willow Creek, CR 125 W, 4.8 km SSW Paoli, Paoli Twp, 38.50398 N, 86.45630 W, (TPS, SLW), 13 September 2004, (16 MI, 2 MII, 10 F), INBS 842. Lick Creek, S Elm Street bridge, 1.9 km W Paoli, Paoli Twp, 38.55585 N, 86.47484 W, (TPS), 24 June 2004, (2 MI, 18 MII, 22 F, 6 juv), INBS 843. Log Creek, Log Creek Road, 4.8 km SW Paoli, Paoli Twp, 38.54277 N, 86.52128 W, (TPS), 24 June 2004, (4 juv), INBS 844. Log Creek, Log Creek Road, 4.5 km W Paoli, Paoli Twp, 38.56097 N, 86.52625 W, (TPS, Anne E. Timm, JLB, ERL, SLW), 30 June 2004, (*13 MI, *26 MII, *53 F, 47 juv), INBS 845. Unnamed tributary Lick Creek, CR 500 W bridge, 6.1 mi NE West Baden Springs, Orangeville Twp, 38.59293 N, 86.55263 W, (TPS), 24 June 2004, (*10 MI, *21 MII, *22 F, 2 juv), INBS 846. Lick Creek, US 150 bridge, 2.7 km NE West Baden Springs, French Lick Twp, 38.5061 N, 86.57680 W, (TPS, SLW), 13 September 2004, (1 MI, 2 MII, 1 F), INBS 847. Upper Sulphur Creek, CR 100 S bridge, 4.0 km E French Lick, French Lick Twp, 38.54200 N, 86.56122 W, (TPS, JLB), 28 June 2004 (1 MI, 9 MII, 37 F, 34 juv), INBS 848. Upper Sulphur Creek, Abydel Road bridge, 2.3 km E West Baden Springs, French Lick Twp, 38.57078 N, 86.58461 W, (TPS), 29 June 2004, (2 MI, 1 MII, 2 F), INBS 849. French Lick Creek, CR 410 S bridge, 6.3 km SSE French Lick, Jackson Twp, 38.49564 N, 86.60119 W, (TPS, ERL, SLW, JLB), 28 June 2004, (5 MII, 4 F, 4 juv), INBS 850. Unnamed tributary French Lick Creek, CR 625 W bridge, 5.5 km SE French Lick, French Lick Twp, 38.51430 N, 86.57527 W, (TPS), 28 June 2004 (4 MI, 13 MII, 24 F, 3 juv), INBS 851. French Lick Creek, SR 145 bridge, 6.1 km SSE French Lick, Jackson Twp, 38.49571 N, 86.60317 W, (TPS, SLW), 2 September 2004, (5 MI, 10 MII, 25 F), INBS 852. French Lick Creek, CR 300 S bridge, 4.3 km S French Lick, French Lick Twp, 38.51249 N, 86.61496 W, (TPS, ERL, JLB, SLW), 28 June 2004, (*1 MI, 9 MII, 13 F, 5 juv), INBS 853. French Lick Creek, Old SR 145, 2.7 km S French Lick, French Lick Twp, 38.53062 N, 86.61094 W, (TPS, SLW), 2 September 2004, (4 MI, 1 MII, 11 F), INBS 854. Unnamed tributary French Lick Creek, CR 75 S bridge, 1.3 km SE French Lick, French Lick Twp, 38.54354 N, 86.60658 W, (TPS), 29 June 2004, (3 F), INBS 855. French Lick Creek, Sinclair Street bridge, 0.8 km W West Baden Springs, French Lick Twp, 38.56346 N, 86.60555 W, (TPS), 19 July 2004, (6 MII, 12 F), INBS 856. French Lick Creek, West Baden Springs Hotel driveway bridge, West Baden Springs, French Lick Twp, 38.56702 N, 86.61398 W, (TPS), 19 July 2004, (5 MII, 3 F), INBS 857. Sulphur Creek, CR 500 N bridge, 2.6 km SSW Bonds, Northwest Twp, 38.62035 N, 86.63228 W, (TPS, AT, JLB, ERL, SLW), 30 June 2004, (4 MI, *21 MII, *10 F, 8 juv), INBS 858. Unnamed tributary Lost River, CR 1125 W bridge, 4.3 km W French Lick, French Lick Twp, 38.54475 N, 86.67119 W, (TPS), 12 July 2004, (4 MI, 5 MII, 10 F, 2 juv), INBS 860. Unnamed tributary Lost River, CR 425 N bridge, 2.6 km WSW Orangeville, Orangeville Twp, 38.62129 N, 86.58393 W, (TPS, JLB, ERL, SLW), 29 June 2004, (1 MI, 13 juv), INBS 869. *Washington County:* Lost River, Vernon School Road bridge, 2 mi SE Claysville, Vernon Twp, 38.59304 N, 86.27104 W, (TPS, BEF, KGS), 18 March 1999, (2 MI, 1 MII, 3 F), INBS 831. Lost River (including unnamed tributary mouth), Satillo-Livonia Road bridge, 2.5 mi NW Livonia, Vernon Twp, 38.59349 N, 86.29107 W, (TPS, BEF, KGS), 18 March 1999, (4 F), INBS 832.

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