

A NEW TROGLOBITIC CRAYFISH OF THE GENUS *PROCAMBARUS*
FROM FLORIDA (DECAPODA: ASTACIDAE)

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ABSTRACT

A new troglobitic crayfish of the genus *Procambarus* is described from northern Florida. The new crayfish is most closely related to *P. lucifugus lucifugus* and *P. lucifugus alachuua*. The Florida troglobitic crayfishes are illustrated, and a key to them is presented.

Only a year ago, the description of a new troglobitic crayfish, *Procambarus milleri* Hobbs (1971), from Dade County Florida, appeared. Suspecting that it was probably the last undescribed troglobitic crayfish occurring in the State, Hobbs presented a key to the seven species and subspecies that were known at that time and illustrated certain of their diagnostic features. After that manuscript had been accepted for publication, adult specimens of the crayfish from Leon and Wakulla counties that he had tentatively identified (loc. cit., p. 123) as *Procambarus pallidus* (Hobbs, 1940), were obtained by D. Bruce Means, and specimens of another troglobite were collected in Jefferson County by Michael N. Horst. Both proved to be distinct and were described by Hobbs and Means (1972).

In the meantime, Frank Redmon had discovered the sinkhole that is here designated the type-locality of the new species described below, and in November, 1971, Frank Hurt collected the first specimens of this species, one of which is being maintained alive in the Jacksonville Children's Museum. Additional specimens, including the holotypic male, were collected by him and Barry W. Mansell on November 23, 1971. Except for the holotype, all of the specimens on which

the following description is based were obtained in January and February 1972 by the authors.

In order to provide a comparable series of illustrations of all of the Floridian troglobitic crayfishes, Figures 2-4 are included to complement those of the seven species and subspecies figured in Hobbs, 1971. A revised key to these troglobites is also presented.

We extend our appreciation to Frank Hurt and Barry W. Mansell who first collected the crayfish described herein and who have permitted us to prepare this account of it. We are deeply indebted to Dr. Horton H. Hobbs, Jr., Smithsonian Institution, who actually prepared the bulk of the description of the new species and the Figures, and who has kindly allowed publication in this paper of his revised key to the troglobitic crayfishes. This contribution to science is as much his as ours.

Procambarus (Ortmannicus) erythrops,
new species

Diagnosis: Integument white to pale tan; eyes moderately small, lacking facets, but with conspicuous red pigment spot. Rostrum with marginal spines. Areola 8.3 to 14.5 times longer than wide and comprising 35.3% to 38.7% of entire length of carapace (45.3% to 48.1% of postorbital length). Single pair of cervical spines present. Suborbital angle absent. Postorbital ridges terminating cephalically in a spine and several tubercles at caudal base. Hepatic area of carapace with crowded tubercles, some spiniform. Antennal scale approximately 1.7

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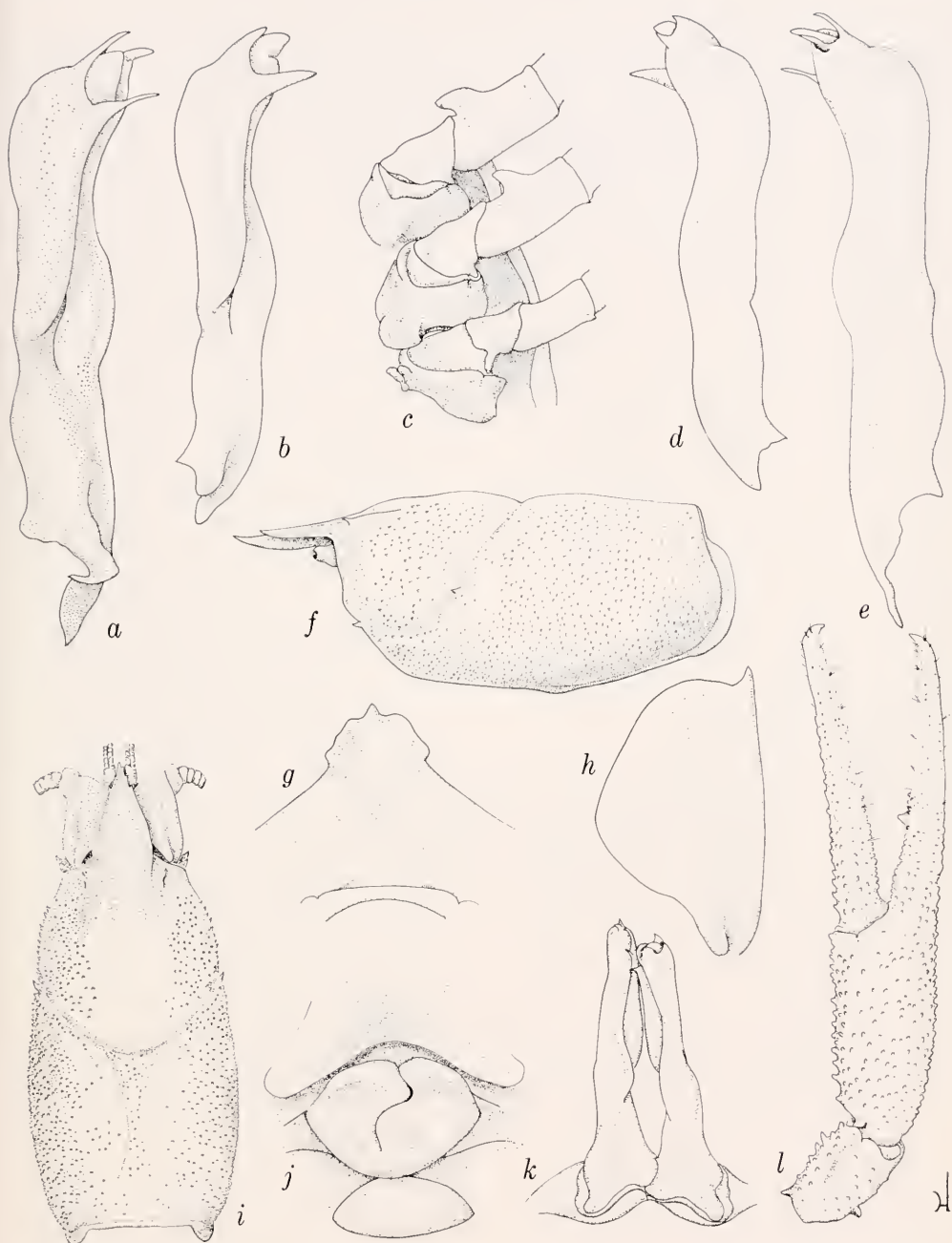


Figure 1. *Procambarus erythropus*, new species. a, Mesial view of first pleopod of holotype; b, Mesial view of first pleopod of paratypic male, form II; c, Basal podomeres of third, fourth, and fifth pereiopods of holotype; d, Lateral view of first pleopod of paratypic male, form II; e, Lateral view of first pleopod of holotype; f, Lateral view of carapace of holotype; g, Epistome of holotype; h, Antennal scale of holotype; i, Dorsal view of carapace of holotype; j, Annulus ventralis of allotype; k, Caudal view of first pleopods of holotype; l, Dorsal view of distal podomeres of cheliped of holotype.

times longer than wide, widest proximal to midlength. Ischia of third and fourth pereopods with hooks, that on third overreaching basioischial articulation. First pleopods asymmetrical, with distinct rounded hump on cephalic surface, subapical setae, and reaching cephalically to coxae of third pereopods; distal extremity bearing (1) subspiciform mesial process directed caudodistally and slightly laterally; (2) prominent, slender, acute cephalic process cephalic to and partially hooding central projection, directed caudodistally; (3) corneous, long central projection extending caudodistally at 75° to 80° to main shaft of appendage and almost as far caudally as mesial process, and (4) caudal element consisting of prominent crestlike adventitious ridge (process) situated mesial to central projection; caudal knob and caudal process absent. Annulus ventralis with cephalolateral margins elevated (ventrally) and with raised caudomedian prominence; sinus originating on cephalic margin, and, following sinuous contour, ending on caudomedian prominence. Sternum immediately cephalic to annulus entire, lacking caudally projecting prominences and tubercles.

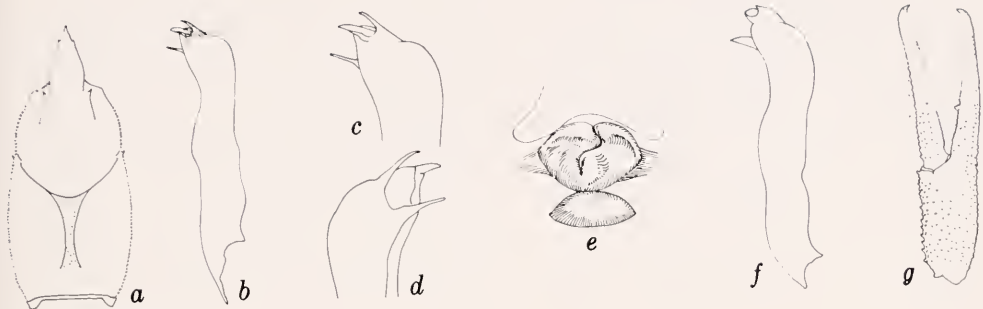
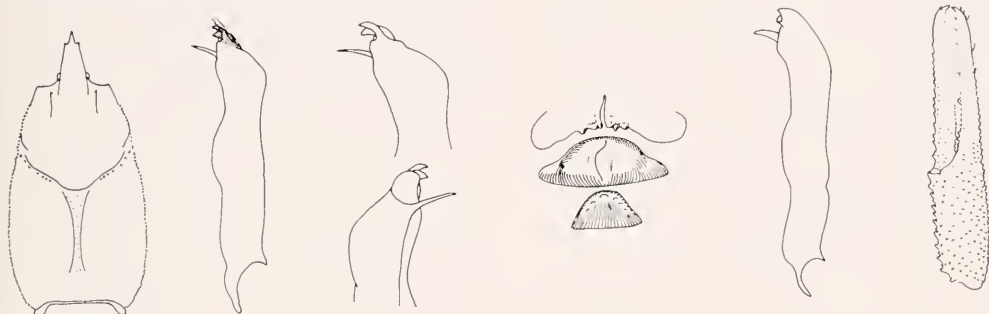
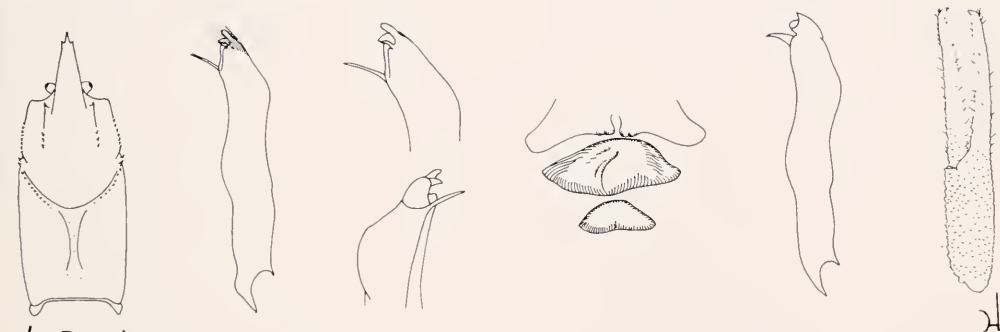
Holotypic Male, Form I: Body (Fig. 1*f,i*) subcylindrical. Eye reduced in size, lacking facets but provided with small red pigment spot. Abdomen narrower than thorax (16.0 and 21.1 mm, respectively). Width of carapace greater than height at caudodorsal margin of cervical groove (21.3 and 18.0 mm). Areola 10.0 times longer than wide with one or two punctations across narrowest part. Cephalic section of carapace about 1.7 times longer than areola; length of areola 37.3% of entire length of carapace (47.1% of postorbital length). Rostrum excavate dorsally with unthickened, convex margins interrupted by paired marginal spines at base of acumen, latter reaching level of distal end of peduncle of antennule and bearing two accessory spines on dextral margin and two smaller ones on sinistral margin; setiferous punctations arranged in submarginal row and few scattered over remainder of surface of rostrum, most abundant at level of orbit. Subrostral ridges rather weak, not evident in dorsal aspect except in caudalmost portion of orbit. Postorbital ridges clearly defined, with acute,

curved spines cephalically and few small tubercles caudally; dorsolateral groove shallow, inconspicuous. Suborbital angle absent. Branchiostegal spine prominent, acute. Dorsomedian portion of carapace sparsely punctate; hepatic region tuberculate except cephalically, some tubercles acute or spiniform; branchiostegites thickly studded with tubercles, especially cephaloventrally; only one cervical spine present on each side although part of a series of small acute tubercles along caudal flank of cervical groove.

Abdomen shorter than carapace (44.0 and 45.6 mm). Cephalic section of telson with three spines in each caudolateral corner, mesial two movable. Cephalic lobe of epistome (Fig. 1*g*) with convergent, somewhat thickened, ventrally elevated, undulating cephalolateral margins; subtruncate cephalic margin bearing acute median projection; basal portion with median longitudinal depression, lacking distinct fovea. Antennules of usual form with prominent distally directed spine near midlength of ventral surface of basal article of peduncle. Antennae exceeding caudal margin of telson by length slightly greater than that of carapace. Antennal scale (Fig. 1*h*) 1.7 times longer than broad with greatest width distinctly proximal to midlength, lamellar area about 2.5 times broader than thickened lateral part, latter terminating in strong, short spine.

Third maxillipeds extending anteriorly to level of tip of rostrum; opposable margin of ischium with teeth, its lateral surface serrate distally; ventral surface almost naked, but mesioventral surface with several sublinear series of stiff, long setae.

Right chela (Fig. 1*l*) slender, subovate in cross section, not strongly depressed. Mesial surface of palm with tubercles not distinctly arranged in linear series but with 10 or 11 in relatively straight line and additional ones above and below; lateral margin of palm with serrations extending to distal end of proximal third of fixed finger; dorsal and ventral surfaces of both fingers with submedian longitudinal ridges flanked proximally by conspicuous tubercles, distally by setiferous punctations. Fixed finger with row of 15 tubercles along proximal two-fifths; with distinctly larger, corneous-tipped tubercle on lower level (between twelfth

2. *P. erythropus*3. *P. horsti*4. *P. orcinus*

Figures 2-4. Floridian troglobitic crayfishes. *a*, Dorsal view of carapace; *b*, Lateral view of left first pleopod of first form male; *c*, Mesial view of distal portion of same; *d*, Lateral view of distal portion of same; *e*, Annulus ventralis; *f*, Lateral view of left first pleopod of second form male; *g*, Dorsal view of chela of first form male.

and thirteenth tubercle from base) followed immediately distally by two additional progressively smaller tubercles; band of crowded minute denticles beginning between rows at level of large tubercle, broadening distally, extending almost to corneous tip of finger. Opposable margin of dactyl with row of 12 tubercles extending from base almost to level of major tubercle on fixed finger, with row of seven tubercles beginning dorsal to,

and between, two distalmost tubercles in latter row, ending at level immediately proximal to distalmost tubercle of row on fixed finger; tubercles of both rows decreasing in size distally, band of crowded minute denticles as on fixed finger; mesial surface of dactyl with tubercles extending from proximal portion to base of distal one-fourth of finger.

Carpus of right cheliped longer than broad

TABLE 1. Measurements (mm) of *Procambarus (Ortmannicus) erythrops*.

	Holo-type	Allo-type	Morpho-type
Carapace:			
Height	18.0	14.3	18.0
Width	21.1	16.1	20.0
Length	45.6	34.8	42.7
Areola:			
Width	1.7	1.5	1.3
Length	17.0	12.9	16.0
Rostrum:			
Width	5.9	4.5	5.5
Length	11.9	8.3	10.6
Right Chela:			
Length of mesial margin of palm	15.0	10.5	14.9
Width of palm	8.9	6.0	8.2
Length of lateral margin of chela	41.5	28.6	42.1
Length of dactyl	25.1	17.4	25.3

(10.3 and 6.0 mm), with all surfaces tuberculate; dorsal surface with distinct oblique furrow; dorsomesial surface with row of three tubercles, distalmost distinctly larger than others nearby; largest tubercle on podomere situated on distal ventromesial border; additional strong tubercle on ventrodistal condyle.

Merus of right cheliped tuberculate except for proximal portion of mesial and lateral surfaces; dorsal surface with crowded tubercles, more numerous distally, largest subspiniform and situated subapically; ventral surface with sublinear series of 20 tubercles mesially, less well defined row of 14 laterally; additional tubercles between and flanking both rows; distal ventrolateral angle with strong, spiniform tubercle. Ischium with tubercles dorsally and ventrally, five larger ones linearly arranged along ventromesial margin. Basis with single tubercle in position corresponding to ventromesial row of tubercles on ischium (two on left cheliped).

Hooks on ischia of third and fourth pereopods (Fig. 1c) simple, that on third overreaching basioischial articulation, that on fourth not reaching corresponding articulation, not opposed by tubercle on basis. Coxa of fourth pereopod with prominent,

swollen caudomesial boss, that of fifth with small tuberculiform prominence extending caudomesially and somewhat ventrally from caudomesial angle.

Sternum between second, third, and fourth pereopods rather deep, ventrolateral margins bordered with long setae.

First pleopods (Fig. 1a,e,k) as described in diagnosis. In addition, subterminal setae arising around base of cephalic process and along lateral base of central projection, completely obscuring both processes in lateral aspect.

Uropod with distally directed spine on each basal lobe; median spine on mesial ramus not nearly reaching distal margin of ramus.

Allotypic Female: Differing from holotype in following respects: acumen without accessory spines; punctations on dorsal surface of rostrum at level of orbit few, most lacking setae; cephalic section of telson with only two spines in each caudolateral corner; cephalic margin of cephalic lobe of epistome more deeply emarginate on each side of median projection; tubercles on mesial margin of palm of chela more nearly linearly arranged, mesialmost row consisting of 11 or 12; opposable margin of both fingers of chela with row of 12 tubercles, fixed finger with usual additional large tubercle on lower level, but with additional two on holotype lacking; carpus of cheliped with three large spines on distal margin, two ventral ones as described in holotype, and one mesial to dorsal articular knob; merus with several distinctly spiniform tubercles on dorsodistal surface, ventral surface with one or two more tubercles in each of two poorly defined rows; ischium with tubercle on ventromesial margin virtually obsolete.

Annulus ventralis (Fig. 1j) not deeply embedded in sternum, subovate, broader than long with cephalic margin elevated ventrally, bearing median emargination marking origin of sinus; latter extending caudally in form of tilted, reversed "S," ending sinistral to median line on submedian elevation near caudal margin of annulus. Sternum immediately cephalic to annulus without caudally projecting prominences or tubercles. Post-annular plate much broader than long, only little narrower than width of annulus, its

width, however, greater than greatest length of annulus.

Morphotypic Male, Form II.—Differing from holotype in following respects: acumen of rostrum lacking accessory spines; lateral surface of fixed finger of cheliped with serrations extending to midlength of finger; opposable margin of dactyl with row of 18 tubercles in single row; irregular row of 15 or 16 tubercles on ventrolateral surface of merus; ventromesial surface of ischium with row of six tubercles on left cheliped, corresponding basis lacking tubercle; basis of right cheliped with one tubercle mesially. Hooks on ischia of third and fourth pereopods distinctly reduced, neither reaching basioischial articulation; prominences on coxae of fourth and fifth pereopods not conspicuously smaller than those in holotype.

First pleopods strongly asymmetrical with few subapical setae, as depicted in Fig. 1*b,d*. Mesial and cephalic processes and central projection much more robust than in holotype; caudal element represented by tumescence at caudomesial base of central projection.

Type-locality: Sim's Sink, 1 mi west of the junction of U.S. Hwys. 27 and 129, and 0.1 mi south of Hwy. 27, Suwannee County, Florida (Sec. 24, T. 6S, R. 14E). The shallow, funnel-shaped sink reaches ground water at a depth of approximately 12 feet. The original owners have partially covered it with boards upon which there is an accumulation of detritus, mosses, and ferns, but broken portions of the roof and spaces between boards allow detritus to filter into the sinkhole. The pool of water is elliptical, measuring approximately 8 by 12 feet, and is bounded by a nearly vertical shaft of limestone for half of its circumference to a depth of about 30 feet (bottom of pool). There are small ledges and crevices in the limestone wall. Opposite the vertical wall, the pool opens to a cave of unknown extent, and during periods of lower water levels, the surface area of the pool is greater since part of the ceiling of the cave is then above the water. *Procambarus erythroops* occurs throughout the sink and explored cave area.

Types: The holotypic male, form I, allotypic female, and morphotypic male, form II (Nos. 133471, 133472, and 133473 re-

spectively) are deposited together with paratypes (4♂ I, 3♂ II, 8♀, 6 juv.♂, 1 juv.♀) in the National Museum of Natural History, Smithsonian Institution. An additional series of paratypes (1♂ I, 1♂ II, 1♀) are in the Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands.

Range: *Procambarus erythroops* is known to occur in only two localities in Suwannee County, Florida. The location of the type-locality is cited above, and the other is an unnamed sink situated only 0.2 mi south of it.

Variations: The more conspicuous variations noted probably have resulted from regenerations of lost parts. For example, the multiple spines on the acumen of the holotype is unique among available specimens, and there is evidence that the acumen was injured in an earlier instar. The usual minor differences in the arrangement of spines and tubercles obtain, and, while not mentioned in the above descriptions, the opposable margins of the coxae of the chelipeds may bear zero to three spiniform tubercles that may or may not be symmetrically balanced or arranged. The range of variations in certain body proportions are cited in the Diagnosis, and certain secondary sexual differences are shown in Table 1. In addition, the setose ventrolateral margins of the sternum in the first form males contrast markedly with the sparse, short setae on the corresponding areas of the females and second form males.

Life History Notes: With the exception of the holotype, which was obtained on November 23, 1971, all specimens included in the type-series were collected on January 23 and February 25, 1972. First form males were obtained on all three dates. No ovigerous females or ones carrying young have been observed. Seven juveniles with carapace lengths ranging from 8.9 to 20.0 mm were among the two 1972 lots. Another troglobitic crayfish, *Troglocambarus mac-lanei*, is a coinhabitant of the type locality.

Size: The largest specimen available is the holotype that has a carapace length of 45.6 mm (postorbital length 36.1 mm). The smallest first form male has corresponding lengths of 36.8 and 29.3 mm, respectively.

Relationships: *Procambarus erythroops* is more closely allied to *P. lucifugus lucifugus*

(Hobbs, 1940) and *P. lucifugus alachua* (Hobbs, 1940) than to any other crayfishes, sharing with them not only albinistic qualities, but also a strongly tuberculate carapace and chelipeds, the latter slender and long. In the males, all of the secondary sexual characters are markedly similar, and in the females, not only are the annuli ventrales nearly identical but also the sternum immediately cephalic to the annulus is without tubercles or caudally projecting prominences. This crayfish may be distinguished from *P. l. lucifugus* most readily by the red eye spot and an areola less than 15 times longer than broad and usually constituting less than 38% of the total length of the carapace. It differs from *P. l. alachua* in having red instead of black pigment in the eye, convex rostral margins, and a stronger curvature of the distal portion of the first pleopod of the male. More distantly, it is related to *P. horsti*, *P. orcinus*, and *P. pallidus* from which the male can be distinguished by the hook on the ischium of the fourth pereopod that does not overreach the basioischial articulation and which is not opposed by a tubercle on the basis; also, the terminal portion of the first pleopod is distinctly different having a longer central projection, and the cephalic process is never situated lateral to the central projection. The females of the latter three species all have tubercles on the caudal margin of the sternum immediately cephalic to the annulus ventralis, whereas, in *P. erythropros* this portion of the sternum lacks tubercles.

Procambarus erythropros resembles the two subspecies of *P. lucifugus* so closely that it could be designated a third subspecies of the complex. There are two reasons for considering it a full species: (1) we have no evidence of intergradation; and (2) *P. erythropros* shares much more in common with the nominate species than with *P. l. alachua*, its geographically closer relative. Only in possessing pigment in the eye does it resemble *P. l. alachua* more closely; even in this similarity, however, the pigment of *P. erythropros* is distinctly red whereas that of *P. l. alachua* is black. To our knowledge, only one other crayfish, *P. orcinus*, has red pigment in its eyes, but in no other respect does it approach *P. erythropros* as closely as do the two subspecies of *P. lucifugus*.

Etymology: Erythros (G., red) + Ops (G., eye); alluding to the red pigment spot in the eye of this crayfish.

KEY TO THE TROGLOBITIC CRAYFISHES OF FLORIDA

By Horton H. Hobbs, Jr.

(Modified from Hobbs, 1971.

The subgeneric designations are those treated by Hobbs 1969, 1972)

- 1 Third maxillipeds lacking teeth on opposable border of ischium *Troglocambarus maclanei* Hobbs, 1942. (Caves from Citrus and Hernando to Suwannee Counties)
- 1' Third maxillipeds with teeth on opposable border of ischium 2
- 2 Male with hooks on ischia of third pereopods only; first pleopod with two terminal elements bent at right angles to main shaft of appendage. Female with annulus ventralis fused to sternum immediately cephalic to it ... *Cambarus (Jugicambarus) cryptodytes* Hobbs, 1941. (Caves and well in Jackson County, Florida and Decatur County, Georgia)
- 2' Male with hooks on ischia of third and fourth pereopods; first pleopod with more than two terminal elements and never with all bent at right angles to main shaft of appendage. Female with distinct flexible membrane separating annulus ventralis from sternum immediately cephalic to it, or membrane obscured by multituberculate processes projecting caudally from sternum 3
- 3 Eye with pigment spot 4
- 3' Eye without pigment 7
- 4 Pigmented area of eye with facets; rostrum without marginal spines or tubercles. Male with first pleopod bearing distally directed mesial process. Female unknown *Procambarus (Leconticambarus) milleri* Hobbs, 1971. (Well in Dade County)
- 4' Pigmented area of eye without facets; rostrum with marginal spines or tubercles. Male with first pleopod

- bearing caudally or caudodistally directed mesial process 5
- 5 Pigment spot in eye black. Areola more than 20 times longer than broad
Procambarus (Ortmannicus) lucifugus alachua (Hobbs, 1940).
 (Caves and sinkholes in Alachua and Gilchrist counties)
- 5' Pigment spot in eye red. Areola less than 20 times longer than broad 6
- 6 Male with hook on ischium of fourth pereopod reaching basioischial articulation and opposed by tubercle on basis; cephalic process of first pleopod situated lateral to central projection. Female with caudally directed tuberculiform prominences on caudal margin of sternum immediately cephalic to annulus ventralis
Procambarus (Ortmannicus) orcinus (Hobbs and Means, 1972).
 (Springs and sinkholes in Leon and Wakulla counties)
- 6' Male with hook on ischium of fourth pereopod not reaching basioischial articulation and not opposed by tubercle on basis; cephalic process of first pleopod situated cephalic to central projection. Female without caudally directed tuberculiform prominences on caudal margin of sternum immediately cephalic to annulus ventralis *Procambarus (Ortmannicus) erythrops*, new species
 (Sinkholes in western Suwannee County)
- 7 Male with hooks on ischia of third and fourth pereopods bituberculate; first pleopod lacking subapical setae, and cephalic and mesial processes directed distally. Female with annulus ventralis at least as long as broad
Procambarus (Lonnbergius) acherontis (Lönnerberg, 1895).
 (Spring and well in Seminole County)
- 7' Male with hooks on ischia of third and fourth pereopods simple; first pleopod with subapical setae, and cephalic and mesial processes directed caudally or caudodistally
- Female with annulus ventralis shorter than broad 8
- 8 Rostrum narrower at base than along orbit. Male with central projection of first pleopod narrow and elongate; hook on ischium of fourth pereopod not reaching basioischial articulation. Female without caudally directed tubercles on caudal margin of sternum immediately cephalic to annulus ventralis
Procambarus (Ortmannicus) lucifugus lucifugus (Hobbs, 1940).
 (Caves from Citrus and Hernando counties northward to Marion County where it intergrades with *P. l. alachua*)
- 8' Rostrum tapering from base. Male with central projection of first pleopod beaklike; hook on ischium of fourth pereopod overreaching basioischial articulation. Female with caudally directed tubercles on caudal margin of sternum immediately cephalic to annulus ventralis 9
- 9 Postorbital ridges with caudally situated spines or tubercles; areola less than 20 times longer than broad. Male with cephalic process of first pleopod situated lateral to central projection
Procambarus (Ortmannicus) horsti Hobbs and Means, 1972.
 (Well and spring in Jefferson and Leon counties)
- 9' Postorbital ridges without caudally situated spines or tubercles; areola more than 20 times longer than broad. Male with cephalic process of first pleopod situated cephalic to and partially hooding central projection *Procambarus (Ortmannicus) pallidus* (Hobbs, 1940).
 (Caves and sinkholes in Alachua, Columbia, and Suwannee counties)

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