The Journal of the Elisha Mitchell Scientific Society, 116(1), 2000, pp. 1–12

A NEW SPECIES OF CRAYFISH OF THE GENUS *CAMBARUS*, SUBGENUS *CAMBARUS* (DECAPODA: CAMBARIDAE), FROM THE BROAD RIVER BASIN OF NORTH CAROLINA

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Abstract: *Cambarus* (*Cambarus*) *lenati* is a new species of crayfish found in the First Broad River subdrainage of the Broad River basin in North Carolina. Its closest relative appears to be *Cambarus* (*C.*) *bartonii* (s.l.), but it is easily distinguished from this species and all other members of the subgenus *Cambarus*, as well as nearly all species in the genus *Cambarus*, by the 90° mesial bend in the caudal portion of the central projection of the gonopod (first pleopod) of form I, form II, and juvenile males. It is further distinguished by the structure of the female annulus ventralis, with its wide, spindlelike shape, its narrow, usually unrounded caudal walls, and its greatly depressed, strongly sloping cephalic three-fourths.

Key Words: New crayfish species; *Cambarus*; North Carolina.

INTRODUCTION

Few subgenera within the genus *Cambarus* present the diagnostic and taxonomic challenges posed by the nominate subgenus. It ranges from New Brunswick in the northeast, south as far as northwestern South Carolina and northern Georgia, west into eastern Alabama, and then north into Ontario, and Quebec. As currently understood, this widespread assemblage of populations encompasses six described species (Hobbs, 1989, pp. 13–14; Hobbs and Bouchard, 1994; Thoma and Jezerinac, 1999). The most broadly distributed and problematic of the six is *Cambarus* (*Cambarus*) *bartonii* (Fabricius, 1798), whose range includes nearly the entire range of the subgenus. In the extreme southern parts of its distribution, *C. bartonii* (s.l.) exhibits immense variation. Except for the work of Hobbs (1981) in Georgia, no analysis of variation in this part of the range has appeared in print. An ostensible subspecies, *Cambarus* (*Cambarus*) *bartonii cavatus* Hay, 1902, has long been controversial, and another formerly disputable subspecies, *Cambarus* (*Cambarus*) *bartonii carinirostris* Hay, 1914, was recently elevated to species status (Thoma and Jezerinac, 1999).

Introducing a new taxon into this confusion, especially one that appears to be closely related to *C. bartonii* (s.l.), would seem to be a risky proposition. Fortunately, the new species herein described exhibits differences in primary characters that clearly set it apart from all other members of the subgenus and nearly all other species in the genus.

METHODS

The following abbreviations are used in the text: Crk = Creek; j = juvenile; NCSM = North Carolina State Museum of Natural Sciences, Raleigh; PCL =

postorbital carapace length; R = River; SR = North Carolina secondary (county) road; TCL = total carapace length; USGS = United States Geological Survey; and WGS = World Geodetic System.

Cambarus (Cambarus) lenati, new species

Fig. 1, Table 1

Diagnosis.—Body and eyes pigmented, eye relatively small ($\bar{x}$ adult diam 1.8 mm, n = 11). Rostrum acarinate; margins slightly thickened, slightly converging from base to level of eyestalk, then subparallel to base of acumen, which not delimited by marginal spines or tubercles and not constricted; acumen comprising 35.4 to 47.1% ($\bar{x}$ = 40.9%, n = 17) of rostrum length, latter constituting 16.3 to 20.9% ($\bar{x}$ = 19.0%, n = 16) of TCL. Areola 2.9 to 4.7 ($\bar{x}$ = 3.8, n = 15) times longer than wide (narrower in form I males than others), constituting 33.1 to 37.2% ($\bar{x}$ = 35.9%, n = 15) of TCL and 40.1 to 45.0% ($\bar{x}$ = 42.9%, n = 15) of PCL, and with five to seven punctations across narrowest part. Thoracic section of carapace dorsally punctate, laterally with scattered granules; cephalic section laterally with many prominent tubercles. Cervical spines reduced to small tubercles, one to five (usually two or three) each side of carapace, cervical groove uninterrupted; branchiostegal spine weak or reduced to tubercle. Suborbital angle subacute, with tubercle. Postorbital ridge short, weak, dorsolaterally grooved, cephalic margin rounded and usually with minute tubercle. Antennal scale 2.0 to 2.6 ($\bar{x}$ = 2.2, n = 17) times as long as broad, widest just distal to midlength; lateral margin thickened and terminating in spine.

Palm of chela of cheliped 1.5 to 1.7 ($\bar{x}$ = 1.6, n = 16) times wider than deep, 1.3 to 1.5 ($\bar{x}$ = 1.4, n = 16) times wider than length of mesial margin, latter constituting 29.4 to 32.8% ($\bar{x}$ = 31.3%, n = 16) of total chela length; mesial margin of palm with row of six or seven (rarely eight) prominent tubercles, and row of two to six weak tubercles dorsal to mesial row. Fingers widely gaping in form I males, scarcely so in others; dactyl 1.9 times length of mesial margin of palm; mesial surface of dactyl with tubercles on proximal half or less, opposable surface with seven to nine tubercles, fourth tubercle from base usually enlarged and displaced toward ventral surface; opposable surface of fixed finger of propodus with single subconical tubercle ventral to denticles, and five to eight additional tubercles.

Hook on ischium of third pereiopod of male; in form I male, hook large, uniramous, oblique, distally bent and somewhat flattened, overreaching basioischial articulation by half of length and opposed by tubercle on basis; coxa of fourth pereiopod of males with vertically disposed caudomesial boss.

In situ gonopods (first pleopods) of form I male (Fig. 1G) symmetrical; proximomesial apophyses strong, tightly abutted; proximolateral portion of gonopod thick, subtruncate, and most of base separated from rest of shaft by deep groove; total length of gonopod 24.0 to 25.8% ($\bar{x}$ = 25.0%, n = 3) of TCL; central projection directed caudally, but caudal portion twisted mesially at nearly 90° to axis of projection (same in form II and juvenile males; Fig. 1E, F, I), with strong subapical notch directed mesially; mesial process inflated, tip extruded, acute, directed caudodistally and inclined laterally; in lateral aspect (Fig. 1B), cephalic margin of shaft with deep concavity just proximal to midlength; central projection

curved over 90° to axis of shaft, tip bent mesially; mesial process inflated, tapered, with caudolateral invagination (present in 5 of 11 males, both forms) from which acute tip extruded and directed caudodistally; caudal process represented by rounded protuberance at proximal base of central projection.

Annulus ventralis (Fig. 1L) symmetrical, basically spindle-shaped in ventral outline, ca. 1.5 to 2.0 ($\bar{x}$ = 1.7, n = 7) times as wide as long; cephalic margin with low cephalomedian dome, flanked each side by broad cephalolateral concavity; cephalic three-fourths or more of annulus depressed, strongly sloping from narrow caudal walls to cephalic margin, with relatively broad, shallow median trough; trough flanked each side by rather weak ridge; sinistral ridge caudally merging with upper arm of caudosinistral wall, dextral ridge terminating well cephalic to base of transverse tongue and caudodextral wall; caudal walls narrow, neither dextral nor sinistral wall with overtly rounded caudal margin; transverse tongue narrow, originating just dextral to midline, proceeding sinistrally and slightly curving before plunging into deep fossa beneath caudosinistral wall; sinus dissecting caudal margin at midline.

Measurements of type specimens provided in Table 1.

Description of holotypic male, form I.—Body and eyes pigmented, eye 1.9 mm diam. Cephalothorax (Fig. 1A, D) subovate, moderately depressed dorsoventrally, cephalic section 1.7 times length of areola and constituting 63.6% of TCL. Areola 4.1 times as long as wide, comprising 36.4% of TCL (43.8% of PCL), with seven punctations across narrowest part; width of areola constituting 17.6% of greatest carapace width; branchiocardiac grooves relatively indistinct. Rostrum with proximal margins somewhat thickened, row of punctations along inner edge; walls sloping and elevated; margins slightly more convergent from base to level of eyestalks, then subparallel to base of acumen, which not delimited by tubercles or spines; margins not constricted at base of acumen, but more convergent from there to apex, which a corneous, dorsally directed tubercle reaching distal margin of penultimate podomere of antennular peduncle; acumen comprising 38.6% of rostrum length, latter constituting 19.6% of TCL; floor (dorsal surface) of rostrum moderately concave, caudal two-thirds punctate; subrostral ridge prominent in dorsal aspect. Postorbital ridge short, dorsolaterally grooved, cephalic margin rounded and devoid of tubercle. Suborbital angle subacute, with vestigial tubercle; branchiostegal spine reduced to small tubercle. Cervical spine area with three small tubercles; cervical groove uninterrupted, but indistinct near cephalic terminus, ventral margin of which with row of small tubercles. Thoracic section of carapace dorsally punctate, dorsolaterally and laterally with scattered granules; lateral surface of cephalic section of carapace with many prominent tubercles; dorsal surface, including gastric region, covered with small punctations.

Antennal peduncle with subacute distolateral tubercle on basis, small ventral tubercle on ischium; tip of antennal flagellum reaching cephalic margin of caudal section of telson when flagellum adpressed; antennular peduncle with small, laterally displaced spine distal to midlength of ventral surface of basal podomere. Antennal scale (Fig. 1M) 2.2 times as long as wide, broadest just distal to midlength; lateral margin slightly convex, thickened, terminating in strong distal spine, tip of which reaching midlength of ultimate podomere of antennular peduncle; lamella 1.3–1.4 times width of thickened lateral portion, distal margin

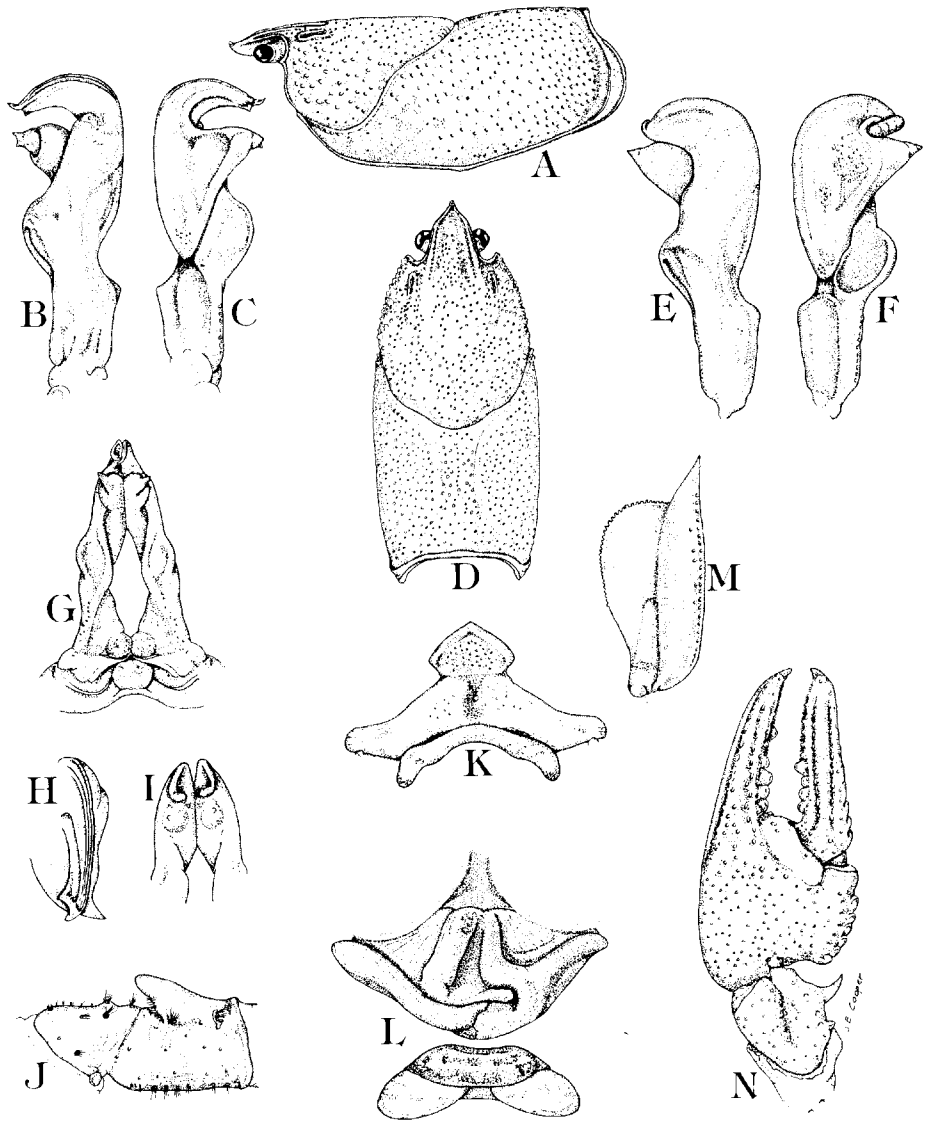

FIG. 1. *Cambarus* (*Cambarus*) *lenati*, new species (all from holotypic male, form I, except E, F, I, from morphotypic male, form II, and L, from allotypic female): A, lateral aspect of carapace; B, E, lateral aspect of gonopod (first pleopod); C, F, mesial aspect of gonopod; D, dorsal aspect of carapace; G, caudal aspect of in situ gonopods; H, distal aspect of tip of left gonopod; I, caudal aspect of tips of gonopods; J, hook on ischium of third perciopod; K, epistome; L, annulus ventralis and postannular sclerite; M, antennal scale; N, dorsal aspect of distal podomeres of left cheliped.

subtransverse for lateral half of width before curving proximomesially, mesial margin somewhat rounded.

Abdomen narrower than carapace, length slightly less than TCL (Table 1); pleura of most segments rounded ventrally, caudoventrally, and caudally; terga moderately punctate. Proximal podomere of uropod with very small caudolateral spine on lateral lobe, larger caudomedian spine on mesial lobe; mesial ramus of

Table 1. Measurements (mm) of types of *Cambarus (Cambarus) lenati*, new species.

	Holotypic male	Allotypic female	Morphotypic male
Carapace			
Total length	29.1	27.5	29.5
Postorbital length	24.2	23.0	25.1
Length cephalic section	18.5	17.9	18.6
Width	14.8	13.7	15.1
Depth	12.0	9.5	9.2
Length rostrum	5.7	5.7	5.3
Length acumen	2.2	2.3	2.3
Length areola	10.6	9.6	10.9
Width areola	2.6	2.8	2.8
Antennal scale			
Length	4.8	5.2	4.9
Width	2.2	2.2	2.5
Abdomen			
Length	28.7	28.6	30.0
Width	12.9	13.5	12.6
Cheliped			
Length lateral margin chela	25.7	20.6	25.9
Length mesial margin palm	8.1	6.5	8.0
Width palm	12.6	9.1	11.3
Depth palm	7.3	5.9	6.9
Length dactyl	15.3	12.2	14.2
Length carpus	9.7	8.1	9.2
Width carpus	7.7	6.3	7.1
Length dorsal margin merus	11.8	10.5	11.4
Depth merus	7.1	6.3	7.1
Gonopod length	7.5	N/A	7.3

uropod with submedian dorsal ridge terminating caudally in small subterminal spine, caudolateral spine of ramus small; lateral ramus of uropod with broad submedian ridge on cephalic section; transverse flexure of right ramus with margin bearing row of 17 fixed spines, and large, articulated sublateral spine. Telson with two spines in each caudolateral corner of cephalic section, innermost articulated; transverse flexure of telson strong, caudal margin rounded. Uropods and telson very setiferous dorsally.

Epistome (Fig. 1K) with subpentagonal to subtriangular cephalic lobe lacking cephalomedian projection; margins of lobe thickened, elevated (ventrally); floor subplane, punctate, with some short setae; body of epistome with small, very deep central depression containing central fovea; lamellae with punctations and striations, tapering laterally to subtruncate corners devoid of prominent tubercles; zygoma moderately arched, flanked cephalolaterally by usual elongate pits.

Third maxilliped with tip of exopodite reaching base of distal two-thirds of merus of endopodite; basal podomere of exopodite fringed with long, dense setae; ventrolateral margin of ischium of endopodite with row of punctations at base of longitudinal ridge, punctations bearing setae of moderate length; ventrolateral half of ischium with many setiferous punctations, distolateral corner rounded; ventro-

mesial half with longitudinal rows of long bristles obscuring most of mesial margin, which on right bearing 25 denticles; basis of ischium with clumps of long setae forming brushes. Right mandible with incisor ridge bearing six denticles, five on left mandible.

Length of chela of left cheliped (Fig. 1N; right cheliped regenerate) 88.3% of TCL; palm moderately inflated, 1.7 times wider then deep, 1.6 times wider than length of mesial margin; dorsal surface of palm punctate, without tubercles, distolateral margin mildly costate for short distance, lacking impression but with deep punctations; lateral surface rounded, punctate; ventral surface less punctate than dorsal; lateral eminence of ventral articular ridge with conical subdistal tubercle, and two tubercles proximal to ridge; distolateral margin of ventral surface with moderate depression (mostly on base of fixed finger); mesial margin of palm with mesial row of seven strong, moderately adpressed tubercles, proximal pair fused at bases and forming rounded proximomesial curvature of palm; mesial row subtended dorsally by row of five very small tubercles, no tubercles ventral to mesial row. Fingers gaping in proximal three-fourths, greatest width of gape ca. 90% of width of fixed finger at base. Dactyl 59.5% of total chela length, 1.9 times as long as mesial margin of palm; dorsal surface of dactyl with strong longitudinal median ridge, flanked each side by punctate groove; mesial surface with six prominent tubercles on proximal third of finger, rest of surface punctate; ventral surface of dactyl rounded, without ridge, with two longitudinal rows of punctations; opposable surface of dactyl with total of nine tubercles, fourth from base largest and offset ventrally; denticles in two, occasionally three, rows from tip of finger to level of seventh tubercle from base. Fixed finger dorsolaterally costate, with strong longitudinal dorsal ridge, flanked mesially by row of large punctations; lateral surface with row of large punctations; ventral surface with indistinct, rounded longitudinal ridge, flanked each side by row of punctations; proximolateral corner of base with slight depression and large punctations; opposable surface with stout subconical tubercle ventral to denticles at base of distal third; six tubercles proximal to subconical one, single tubercle distal to it, first tubercle near base very small, fourth from base large; denticles in two rows to level of subconical tubercle, single row for short distance proximal to it; base of opposable surface with tuft of short setae.

Carpus of cheliped 1.3 times as long as wide, 1.2 times as long as mesial margin of palm; dorsal surface with deep, oblique sulcus, lateral to which surface punctate, mesial to which with several moderate dorsomesial tubercles; mesial surface of carpus with long, acute, curved distal spine and one moderate, conical tubercle near proximal margin; ventral surface with subconical distolateral tubercle, prominent subconical distomedian tubercle with acute nipple, and one moderate tubercle proximomesial to latter. Merus of cheliped 1.7 times as long as deep, length 40.5% of TCL; dorsal surface with two prominent, rounded subdistal tubercles, lateral and mesial surfaces with some punctations but mostly glabrous; ventrolateral ridge with two small tubercles and one vestigial distal tubercle; ventromesial ridge with seven small, subacute tubercles and one rounded, moderate distal tubercle; ventral surface of merus between ridges with setiferous punctations. Ischium with row of three small tubercles on ventral ridge. Merus of second through fourth pereiopods without distolateral spine.

Hook on ischium of third pereiopod (Fig. 1J) simple, slightly curved and some-

what flattened distally, overreaching basioischial articulation by more than half of length, opposed by tubercle on basis. Coxa of fourth pereiopod with moderate, vertically disposed caudomesial boss. Coxae of third pereiopods, and sternites between third and fourth pereiopods, with long, dense setae obscuring distal portions of in situ gonopods.

Gonopod as described in "Diagnosis"

Description of allotypic female.—Excepting secondary sexual characters, differing from holotypic male in following respects: Cephalic section of carapace 1.9 times length of areola and constituting 65.1% of TCL. Areola 3.4 times as long as wide, comprising 34.9% of TCL (41.7% of PCL), with six punctations across narrowest part; width of areola constituting 20.4% of greatest carapace width. Subrostral ridge of rostrum not visible in dorsal aspect; acumen comprising 40.4% of rostrum length, latter constituting 20.7% of TCL. Cephalic margin of postorbital ridge with minute tubercle. Cervical spine area with one fairly prominent and three or four small tubercles. Antennal peduncle with small spine on basis. Antennal scale 2.4 times as long as wide, tip of distolateral spine reaching distal margin of antennular peduncle; lamella ca. 1.8 times width of lateral portion, mesial margin subparallel to lateral margin for most of length. Transverse flexure of lateral ramus of right uropod with row of 13 fixed spines in addition to large articulated sublateral spine. Incisor ridge of right mandible bearing seven denticles.

Palm of right chela of cheliped 1.5 times wider than deep, 1.4 times wider than length of mesial margin; lateral eminence of ventral articular ridge with acute distal tubercle. Fingers only slightly gaping in proximal fourth of length. Dactyl 59.2% of total chela length. Carpus of right cheliped lacking dorsomesial tubercles, that of left cheliped with several weak ones. Length of merus of right cheliped 38.2% of TCL, dorsal surface with one acute and one rounded tubercle (two small subacute tubercles on left merus); ventrolateral ridge with three small tubercles and one small distal tubercle; ventromesial ridge with long distal spine in addition to seven stout, relatively short spines (eight such spines on left merus).

Annulus ventralis as described in "Diagnosis"

In addition, postannular sclerite (Fig. 1L) subsamiform, with elongate central mound flanked by lateral extensions and alate caudal margin; ventral surface of mound pitted. First pleopods uniramous, moderately long, with conspicuous setae.

Description of morphotypic male, form II.—Differing from holotypic male in following respects: Cephalic section of carapace 1.6 times length of areola and constituting 63.1% of TCL. Areola 3.9 times as long as wide, comprising 36.9% of TCL (43.4% of PCL), with five punctations across narrowest part; width of areola constituting 18.5% of greatest carapace width; branchiocardiac grooves comparatively distinct. Subrostral ridge prominent in dorsal aspect; acumen comprising 43.4% of rostrum length, latter constituting 18.0% of TCL. Suborbital angle subacute, with tubercle. Cervical spine area with one or two very small tubercles. Antennal peduncle with acute tubercle on basis. Antennal scale 2.0 times as long as wide, lamella ca. 1.4 times lateral width. Transverse flexure of lateral ramus of right uropod with margin bearing 16 fixed spines in addition to

large articulated one. Cephalic lobe of epistome subcordiform; zygoma noticably arched. Incisor ridge of right mandible with seven denticles.

Palm of right chela of cheliped 1.6 times wider than deep, 1.4 times wider than length of mesial margin; lateral eminence of ventral articular ridge with conical distal tubercle, and one tubercle proximal to ridge; mesial margin of palm with mesial row of seven or eight tubercles (rounded proximomesial corner of palm quite long, probably consisting of two fused tubercles), row subtended dorsally by two small, squamous tubercles. Greatest width of gape between fingers of chela ca. 75% width of base of fixed finger. Dactyl 54.8% of total chela length, 1.8 times as long as mesial margin of palm; proximal half of mesial surface of dactyl with weak tubercles; opposable surface of dactyl with 10 tubercles, first, second, and fourth from base same size and larger than others, fourth displaced ventrally. Opposable surface of fixed finger with subconical tubercle at base of distal two-fifths, five tubercles proximal and two tubercles distal to it, third from base largest. Dorsal surface of carpus of cheliped without dorsomesial tubercles; distal spine on mesial surface relatively short, stout, acute. Merus of cheliped 1.6 times as long as deep, length 38.6% of TCL; dorsal surface with two or three small subdistal tubercles; ventrolateral ridge with two strong spines and one small distal spine; ventromesial ridge with seven small, acute tubercles and one long distal spine.

Hook on ischium of third pereiopod comparatively strong, slightly overreaching basioischial articulation and opposed by moderate, setiferous tubercle on basis; sternites between coxae of third and fourth pereiopods with moderately long setae. Gonopods (Fig. 1E, F, I) symmetrical, proximomesial apophyses slightly separated; central projection curving slightly caudolaterally, but proximal margin sharply folded at nearly 90° mesially; mesial process with extruded tip directed caudally and slightly laterally, inclined slightly caudoproximally; in lateral aspect, no evidence of juvenile suture present; central projection curved slightly less than 90°, tip subacute; mesial process strongly tapered, tip extruded, acute, extending farther caudally than tip of central projection; proximal margin of mesial process directed caudodistally at ca. 45° to main shaft of gonopod, latter with deep concavity in cephalic surface proximal to midlength and pronounced convexity on caudal surface at level of proximal base of mesial process.

Color notes.—Basic ground color varies from greenish brown to grayish tan, with some juveniles approaching orangeish tan. Carapace mottled with tan, mottling generally diffuse; branchiostegites laterally with darker, saddlelike markings. Margins of rostrum and postorbital ridges tan. Cephalic portion of first abdominal tergum with broad greenish bar, caudal portion with light lateral blotch on each side of body; caudal margins of other terga with thin, light-colored band; dorsal surface of abdomen of juveniles very mottled. Pleura paler than terga, and with white spots or splotches. Cephalic sections of uropods pale, caudal section of lateral ramus with orange tinge. Antennal flagellae tan; thickened lateral portion of antennal scale dark, lamella whitish. Ventral surface of antennal peduncle and lamella of epistome bluish, but margins of cephalic lobe orange.

Dorsal surfaces of chela and fingers of cheliped tan, ventral surfaces paler; lateral surface of entire propodus (palm and fixed finger) varying from pale grayish to creamy orange; tips of fingers pale, usually orange. Tubercles on opposable surfaces of fingers, mesial margin of palm, and carapace, white or gray.

Disposition of types.—The holotypic male, allotypic female, and morphotypic male are in the crustacean collections of the NCSM (catalogue numbers C-5083, 5084, and 5082, respectively), as are paratypes consisting of 1 ♂ I, 3 ♂ II, 1 j ♂, 1 ♀, 1 j ♀ (C-5136), 1 ♂ I, 1 j ♀ (C-4971), 2 ♂ II, 1 ♀, 1 j ♀ (C-4517), 1 j ♂ (C-4152), 2 ♀ (C-5078), and paratopotypes consisting of 1 j ♂, 1 ♀, 1 j ♀ (C-4980).

Type locality.—North Carolina, Rutherford Co., Brier Crk at SR 1735, ca. 11.2 air km NE of town of Lanes Store (Benn Knob 7.5′ USGS quadrangle; WGS 84: N35.31.388, W81.43.130).

Range and specimens examined.—Appears to be endemic to streams in the First Broad River subdrainage of the upper Broad River basin of North Carolina, where the following collections have been made: *Cleveland Co.*—(1) Pheasant Crk (trib Brier Crk) at SR 1535, ca. 6.6 air km WNW of Casar; 2 ♀ (NCSM C-5078), 24 July 1964, coll. N.C. Wildlife Resources Commission. *Rutherford Co.*—(2) trib Brier Crk along SR 1732, ca. 3.2 rd km SSW of Burke Co. line & 14.1 air km N of Hollis; 1 j ♂ (NCSM C-4152), 23 May 1997, coll. J. C. Beane, T. J. Thorpe, J. S. Zawadowski; (3) Brier Crk at SR 1733/1735, ca. 10.9 air km NNE of Hollis; 1 ♂ I, 1 j ♀ (NCSM C-4971), 1 ♀ (NCSM C-5084), 28 September 1998, coll. M. Hale, N. Medlin, D. Penrose, B. Tracy; (4) Brier Crk at SR 1735, ca. 11.2 air km NE of town Lanes Store [type locality]; 1 j ♂, 1 ♀, 1 j ♀ (NCSM C-4980), 1 ♂ I (NCSM C-5083), 28 November 1998, coll. D. A. Jackan; (5) North Fork First Broad R at SR 1728, ca. 9.8 air km NE of town Lanes Store; 2 ♂ II, 1 ♀, 1 j ♀ (NCSM C-4517), 1 ♂ II (NCSM C-5082), 20 June 1995, coll. D. R. Lenat, V. Schneider; 1 ♂ I, 3 ♂ II, 1 j ♂, 1 ♀, 1 j ♀ (NCSM C-5136), 7 June 1999, coll. N. Medlin, M. Hale, D. Penrose, B. Tracy; (6) small trib First Broad R at SR 1733, ca. 2.4 rd mi E of NC 226; 7 ♂ II, 5 ♀ (Ohio State Univ. collection, uncatalogued), 4 September 1999, coll. R. F. Thoma, C. Winslow, P. Pira.

Variations.—Some variations other than those provided in the "Diagnosis" have been observed. The mesial (lamellar) portion of the antennal scale varies from ca. 1.2 to 1.8 ($\bar{x}$ = ca. 1.5) times the width of the thickened lateral portion. In nearly all specimens the distal margin of the lamella is transverse or subtransverse for at least the lateral half of its width, but in several it is slightly declivous from the base of the spine before curving near the mesial margin. The mesial margin is usually rounded, sometimes broadly so, but in a few specimens it approaches being subparallel to the lateral margin.

Viewed in dorsal aspect, the subrostral ridge is normally strong and quite visible from the base of the rostrum to the base of the acumen, but in some specimens it is only narrowly visible, and in the allotypic female it is underslung and not visible. The overall shape of the cephalic lobe of the epistome varies in ventral outline from subtriangular or subcordiform to subpentagonal. One adult female has three spines in the caudolateral corner of the cephalic section of the telson on the right side rather than the usual two.

Five specimens completely lack dorsomesial tubercles on the carpus; the number of such tubercles in others varies from one to three, and the tubercles are usually weak or only moderately strong. All specimens have tubercles on the proximal half or less of the mesial surface of the dactyl of the chela, but these tubercles are strong in only a few individuals, weak in the others. The number of

tubercles on the opposable surface of this finger is usually seven to nine; the fourth tubercle from the base is almost always larger than the others and is always displaced toward the ventral surface, and in three specimens it lies decidedly ventral to the denticles. The number of tubercles on the corresponding surface of the fixed finger of the propodus (excluding the usual subconical tubercle) varies from five to eight, but is generally six or seven; in all specimens the tubercle at the base of the finger is very small, and the third or fourth tubercle from the base is almost always enlarged, occasionally massive.

There are usually two, rarely more, subdistal projections on the dorsal surface of the merus of the cheliped, and they vary in shape from small spines to rounded tubercles, or combinations of both. The ventrolateral ridge of this podomere is normally ornamented with two small to moderate spines or acute tubercles, plus one small distal spine, but one specimen has a single proximal spine, and others have three such spines, in addition to the distal spine. The number of small proximal tubercles on the ventromesial ridge is usually seven or eight, and the distal ornament on this ridge varies in development from a rounded tubercle to a strong spine.

The total length of the chela of form I and large form II (TCL > 27 mm) males averages more than 90% of TCL, whereas the average for smaller males is around 77% and for females is about 73%.

Size.—The largest specimen collected is a form I male measuring 31.3 mm TCL (26.1 mm PCL). The two other form I males have TCLs of 29.1 and 27.5 mm (24.2 and 23.1 mm PCL, respectively). The largest form II male measures 30.3 mm TCL (25.5 mm PCL). The largest female measures 27.5 mm TCL (23.0 mm PCL), and four adult females have a mean TCL of 26.7 mm (22.2 mm PCL). The smallest individual yet collected is a juvenile female with a TCL of 11.8 mm (9.3 mm PCL).

Life history notes.—Form I males were found in early June, late September, and late November. No females bearing ova or young have been collected.

Crayfish associates.—*Cambarus* (*Jugicambarus*) *asperimanus* Faxon, 1914, occurs at several localities with *C. lenati,* and is a common species in upland streams in the Broad River basin (Cooper and Braswell, 1995, p. 96). The only other crayfishes yet known from *C. lenati* sites are a member of the undiagnosed *Cambarus* (*Puncticambarus*) sp. C ("*C. acuminatus*") complex, and *Cambarus* (*Puncticambarus*) *spicatus* Hobbs, 1956, which is endemic to the Broad River basin of the Carolinas (Cooper and Braswell, 1995, pp. 118, 132; Cooper et al., 1998, p. 7).

Cambarus (*Cambarus*) sp. A (see Hobbs and Peters 1977, pp. 8–9), which may be conspecific with *Cambarus* (*Cambarus*) *howardi* Hobbs and Hall, 1969, is known from the Broad River basin, but has not yet been found with *C. lenati.* Specimens of a crayfish currently assigned to *C. bartonii* (s.l.) have been collected in upper tributaries of the Broad River in Henderson and McDowell counties; no such animals, however, are known to occur in the First Broad River subdrainage.

Remarks.—In many respects, *C. lenati* appears to be most closely related to the members of some southern populations now identified as *C. bartonii* (s.l.), but is readily distinguishable from that species, all other members of the subgenus, and most members of the genus, by the unique mesial bend in the caudal terminus of the central projection of all males (juveniles and adults). The structure of the annulus ventralis, with its elongate, spindlelike shape, its narrow caudal walls

with their usually unrounded caudal margins, and the great depression and strong cephalic slope of the cephalic three-fourths or more of its length, is also diagnostic. *Cambarus lenati* further differs from *C. bartonii* (s.l.) in having (1) an antennal scale with a broader lamella, the distal margin of which is never strongly declivous as it generally is in *C. bartonii,* and a mesial margin that is usually rounded rather than subparallel to the lateral margin; (2) a slightly longer acumen, and a considerably longer rostrum whose margins are not constricted at the base of the acumen; and (3) a generally broader, more punctate areola.

The conspicuous departures from the gonopod and annulus configurations that are usually seen in the subgenus *Cambarus* presumably provide an intrinsic mechanism that fosters reproductive isolation in *C. lenati.*

Etymology.—This species is named for David R. Lenat, biologist with the Division of Water Quality, North Carolina Department of Environment and Natural Resources. For many years Dave has been instrumental in assuring that crayfishes collected during the Division's extensive field efforts are separated from the less interesting beasts and make their way to the NCSM collections. Suggested vernacular name: Broad River stream crayfish.

Acknowledgments: I am greatly indebted to the biologists of the Division of Water Quality, North Carolina Department of Environment and Natural Resources, for their continuing contributions to our knowledge of the State's crayfish fauna. Two specimens of *C. lenati* were found in fish collections donated to NCSM by the North Carolina Wildlife Resources Commission. A particular debt of gratitude is owed to Dale A. Jackan, graduate student at Appalachian State University in Boone, who made a special effort to collect this species, supplied a number of live specimens that included the holotypic male, and provided me with the WGS coordinates for the type locality. As usual, my thanks are extended to Alvin L. Braswell and Don Howard for their generosity. I appreciate the reviews of the manuscript by Roger F. Thoma and an anonymous referee. Nancy Childs, NCSM, provided technical assistance in the final preparation of Figure 1.

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Received 10 August 1999