

AN ILLUSTRATED KEY TO THE OHIO *CAMBARUS* AND *FALLICAMBARUS* (DECAPODA: CAMBARIDAE) WITH COMMENTS AND A NEW SUBSPECIES RECORD¹

RAYMOND F. JEZERINAC, Department of Zoology, The Ohio State University, Newark, OH 43055
 ROGER F. THOMA, Department of Zoology, The Ohio State University, Columbus, OH 43210

ABSTRACT. An illustrated taxonomic key is presented using structures of the chela and carapace to identify the 4 species and 2 subspecies of *Cambarus*, and one species of *Fallicambarus* known to occur in Ohio. Those forms broadly distributed throughout the state are *C. (Lacunicambarus) diogenes diogenes* Girard, a primary or secondary burrower; and *C. (Cambarus) bartonii cavatus* Hay, a secondary or tertiary burrower; the latter crayfish has not been previously recorded from the state. Species with restricted distributions are *C. (C.) ortmanni* Williamson, a primary or secondary burrower confined to the Ordovician region of southwestern Ohio; *C. (C.) sciotosensis* Rhoades, a stream dweller occurring in the Scioto River, Little Scioto River, and tributaries of the Ohio River in Scioto and Lawrence counties; *C. (C.) b. carinirostris* Hay, a secondary or tertiary burrower frequenting streams of the Flushing Escarpment, Mahoning River, and Grand River drainages in eastern and northeastern Ohio; *C. (Puncticambarus) robustus* Girard, a stream inhabitant occupying primarily tributaries to Lake Erie and central and northern tributaries to the Ohio River, and *F. (Creaserinus) fodiens* (Cottle), a primary burrower occurring chiefly in the glaciated regions of northern Ohio. Species with broad distributions generally have a larger number of species as associates than those with restricted distributions.

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INTRODUCTION

The only published key for the identification of the crayfishes of Ohio (Turner 1926) is now 58 years old and is obsolete for the genera *Cambarus* and *Fallicambarus* due to the significant revision of these genera by Hobbs (1969 and 1973). This paper presents a new key, with illustrations, to the species of these genera occurring in the state. Comments on the identification, distribution, habitats, and crayfish associates of each taxon are provided; a new subspecies of *Cambarus* from the state is recorded, and Rhoades' (1944b) taxonomic list is updated.

The artificial key utilizes structures of the chela and carapace. Therefore, one does not need a first form male (necessary for most keys and often unavailable) for identi-

fication purposes. For maximum success in using the key, one should have a specimen with a minimum total carapace length of 4 cm and bearing at least one typical chela. Atypical chela are usually regenerated appendages which are smaller in size and possess elongated fingers and shorter palms than do typical chela. Unfortunately, only experience can be relied upon to determine if a specimen has 2 regenerated chelae.

All Ohio species belonging to the genera *Cambarus* and *Fallicambarus* lack spines on the rostral margins. Males, either first or second form, have both the central projection and mesial process of the gonopod bent at an angle of 90° or more to the main shaft. The other genera, *Orconectes* and *Procambarus*, will lack the combination of characters mentioned. The nomenclature of Hobbs (1974) has been followed. Consult Hobbs (1972) for additional information on crayfish anatomical terminology.

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A TAXONOMIC LIST OF THE OHIO CAMBARUS AND FALLICAMBARUS

Family Cambaridae Hobbs

Subfamily Cambarinae Hobbs

Genus *Cambarus* Erichson

Subgenus *Cambarus* Erichson

Cambarus (Cambarus) bartonii carinirostris Hay

Cambarus (Cambarus) bartonii cavatus Hay

Cambarus (Cambarus) ortmanni Williamson

Cambarus (Cambarus) sciotensis Rhoades

Subgenus *Lacunicambarus* Hobbs

Cambarus (Lacunicambarus) diogenes diogenes
Girard

Subgenus *Puncticambarus* Hobbs

Cambarus (Puncticambarus) robustus Girard

Genus *Fallicambarus* Hobbs

Subgenus *Creaserinus* Hobbs

Fallicambarus (Creaserinus) fodiens (Cottle)

This revised list differs from previous ones (Turner 1926 and Rhoades 1944b) by including *C. (C.) b. carinirostris* (recorded by Thoma and Jeszerinac 1982) and *C. (C.) b. cavatus* and excluding *C. (C.) b. bartonii* (Fabricius) and *C. (Eribicambarus) laevis* Faxon. These changes are necessary because all of the specimens that were seen at The Ohio State University Museum of Zoology and the Smithsonian Institution identified as *C. (C.) b. bartonii* from Ohio were either *C. (C.) b. carinirostris* or *C. (C.) b. cavatus*, whereas material labeled *C. b. laevis* was assignable to either *C. (C.) ortmanni* or to *C. (C.) b. cavatus*.

Cambarus (C.) b. cavatus has not been reported previously from Ohio and was thought to be endemic to the upper Tennessee River drainage. The only significant differences between the syntypes of *C. (C.) b. cavatus* from Tennessee and the Ohio material is that the former have deeply excavated rostrums. However, one Ohio specimen collected from Blue Rock Creek, Muskingum Co., almost perfectly matches the largest second form males of the syntypes, including its regenerated chela. This subspecies can be distinguished from the nominate species *C. (C.) b. bartonii* (Fabricius 1798) in that it possesses 2 rows of tubercles on the mesial margin of the palm of the chela, the dorsal row numbering 3-5 and greatly adpressed, and the 2nd or 3rd tubercle on the opposable margin of the propodus is greatly enlarged; moreover the chela has well developed dorsal ridges and a deep lateral impression at the base of the fixed finger. *Cambarus (C.) b. bartonii* has a single row of palmar tubercles, no enlarged tubercle on the propodus, poorly developed longitudinal ridges, and a shallow lateral impression. These characters are most pronounced in first form males.

Synonymies of *C. (C.) b. cavatus* in the Ohio literature are as follows: *Cambarus bartonii*—Osburn and Williamson 1898 (?-no localities cited), Williamson 1899; *Cambarus bartonii*—Ortmann 1906, Turner 1926 (in part-3 records for *C. (C.) b. carinirostris*);

Cambarus bartoni bartonii—Rhoades 1944a 1944b 1962, Jezerinac 1974; *Cambarus bartonii laevis*—Rhoades 1944a 1944b 1962; *Cambarus ortmanni*—Rhoades 1944b (in part-mixed taxa in some collections); *Cambarus (Cambarus) bartonii*—Clark and Rhoades 1979; *Cambarus* sp.—St. John 1982; *Cambarus (Cambarus) Species A.*—Jezerinac 1982; *Cambarus (Cambarus) sp. A.*—Thoma and Jezerinac 1982.

AN ARTIFICIAL KEY TO THE OHIO CAMBARUS AND FALLICAMBARUS

1a. Proximalateral margin of dactyl of chela with conspicuous notch (incised); proximomesial surface of margins of opposable propodus with tufts of elongate setae . . . (fig. 1-a, b)

. *Fallicambarus (C.) fodiens*

1b. No notch on proximalateral margin of dactyl of chela; no tufts of elongate setae on proximomesial surface of opposable margin of propodus 2

2a. Areola very narrow, lacking punctations, or partly closed; mesial surface of palm of chela with more than 2 rows of tubercles . . . (fig. 2-c, 3-d)

. *Cambarus (L.) d. diogenes*

2b. Areola with at least one row of punctations; mesial margin of palm of chela with one or 2 rows of tubercles 3

3a. Postorbital ridge with upturned spine or sharp knob . . . (fig. 4-e) 4

3b. Postorbital ridge without upturned spine or sharp knob 5

4a. Rostral margins acuminate (gently curving to a point), margins of uniform thickness; chela with 2 rows of 7-9 tubercles of approximately equal size on mesial surface of palm . . . (fig. 4-f, 5-g)

. *Cambarus (P.) robustus*

4b. Rostral margins parallel (truncate—abruptly forming a point), margins of rostrum thicker than distal margins; chela with 2 rows of 6-7 tubercles of unequal size, 2nd row ½ height of first . . . (fig. 6-h, i; 7-j)

. *Cambarus (C.) sciotensis*

5a. One row of tubercles on mesial surface of palm; margins of rostrum thicker posteriorly than anteriorly; chela with fingers moderately gaping and dorsal longitudinal ridges poorly developed . . . (fig. 8-k, 9-l,

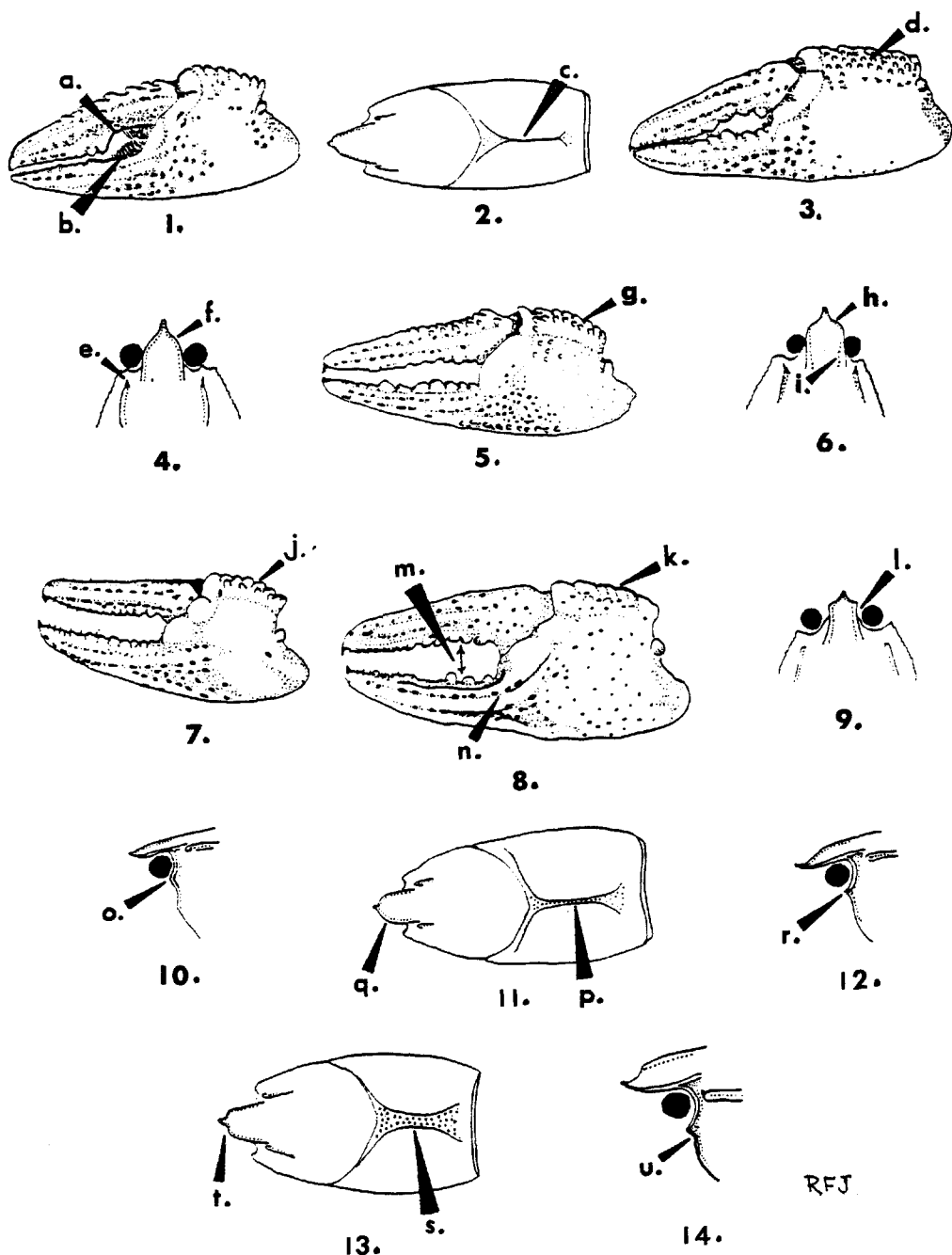


FIGURE 1-a. Incised base of dactyl; 1-b. Tufts of elongate setae (*F. fodiens*); 2-c. Partly closed areola; 3-d. More than 2 rows of palmar tubercles (*C. d. diogenes*); 4-e. Spine on postorbital ridge; 4-f. Acuminate rostrum 5-g. Two rows of palmar tubercles (*C. robustus*); 6-h. Truncate rostrum; 6-i. Thickened rostral margins; 7-j. Two rows of palmar tubercles, dorsal row $\frac{1}{2}$ height of mesial row (*C. sciotosensis*); 8-k. One row of palmar tubercles; 9-l. Thickened rostral margins; 8-m. Moderate gap of fingers; 8-n. Poorly developed dorsal longitudinal ridges (*C. b. carinirostris*); 10-o. Obsolete suborbital angle; 11-p. Areola with one row of punctations; 11-q. Rostrum shovel-like (*C. ortmanni*); 12-r. Acute suborbital angle; 13-s. Areola with 2 rows of punctations across narrowest width; 13-t. Rostrum subtruncated at base of acumen (*C. b. cavatus*); 14-u. Notch under suborbital angle (*C. sciotosensis*).

8-m, n) . . . *Cambarus (C.) b. carinirostris*

5b. Two rows of tubercles on mesial margin of palm, 2nd row numbering 3-5 and greatly adpressed; rostral margins of uniform thickness; chela with fingers straight to slightly gaping and bearing well-developed dorsal longitudinal ridges6

6a. Suborbital angle obsolete; areola with one row of punctations; rostrum shovel-like . . . (fig. 10-o, 11-p, q)

.*Cambarus (C.) ortmanni*

6b. Suborbital angle acute; areola with 2-5 rows of punctations; rostrum usually subtruncated at base of acumen . . . (fig. 12-r, 13-s, t)

.*Cambarus (C.) b. cavatus*

DISCUSSION

Cambarus (C.) b. carinirostris might be confused with *C. (C.) b. cavatus* but differs from the latter in having a wider areola, usually with 4-5 rows of punctations, and in lacking a second row of 3-5 greatly adpressed palmar tubercles. *C. (C.) b. carinirostris* appears to be restricted to streams of the Flushing Escarpment, Mahoning River, and headwaters of the Grand River in eastern and northeastern Ohio (Thoma and Jezerinac 1982). The 3 records of *C. bartoni* in Jefferson Co. (Turner 1926) are based upon collections of this subspecies. *C. (C.) b. carinirostris* is usually found in small streams, less than 4 m in width, with moderate to high gradients. It is a secondary or tertiary burrower and has been captured in one or more sites with *C. (P.) robustus*, *O. rusticus* (Girard) and/or *O. obscurus* (Hagen).

Cambarus (C.) b. cavatus exhibits considerable morphological variation (see Rhoades 1944a and 1944b), especially in the number of punctations across the narrowest part of the areola. One of us (RFJ) has noticed that specimens collected from burrows in roadside ditches and small streams usually have 2 or 3 rows of punctations, whereas those captured from under rocks on the banks of larger streams, or spring-fed streams with watercress (*Nasturtium officinale* L.), often will have 4 or

5 rows of punctations. This subspecies occurs in Ohio streams where *C. (C.) b. carinirostris* is absent. At present, it has not been recorded from the Conneaut, Ashtabula, Grand, Portage, or Wabash drainages. The subspecies is a secondary or tertiary burrower that is common in springs, seeps, and small streams less than 3 m wide, especially if watercress is present, in roadside ditches with running water, and streams of almost any size if a clay substrate is present. It is uncommon under large rocks along the banks of larger streams. It has been captured in the company with most Ohio crayfishes except *C. (C.) b. carinirostris*, *O. obscurus*, *O. sloanii* (Bundy), *O. immunis* (Hagen), *F. (C.) fodiens*, and *Procambarus (Scapulicambarus) clarkii* (Girard).

Cambarus (C.) ortmanni can be distinguished from *C. (C.) b. cavatus*, which it closely resembles, by the absence of an acute suborbital angle, a vaulted carapace, a V-shaped sternum, and its smaller chela. In Ohio, the species is mostly confined to the Ordovician region of the state (a circle with a radius of approximately 90 km centered at Cincinnati). It is a primary or secondary burrower found in small streams, temporary pools, and ditches in the early spring. The species has been found in association with one or more of the following: *C. (C.) b. cavatus*, *C. (L.) d. diogenes*, *O. rusticus*, and/or *O. sloanii*.

Cambarus (C.) sciotensis has a conspicuous notch, with a straight dorsal border, ventral to the acute postorbital angle (fig. 14-u), and thicker, often concave, rostral margins compared with *C. (P.) robustus*. The species appears to be restricted to the Scioto River, Little Scioto River, and tributaries of the Ohio River in Scioto and Lawrence counties. It is most abundant in the riffles and pools of small (3 m wide) to moderate (15 m wide) size streams and uncommon in the riffles of larger streams. *C. (C.) sciotensis* has been collected at the same site with *C. (C.) b. cavatus*, *O. rusticus*, *O. sanbornii sanbornii* (Faxon), and *O. juvenilis* (Hagen).

Cambarus (L.) d. diogenes is a distinct

Ohio species, although 2 forms appear to be present: a western form which is large, chestnut in color, with a red band on the caudal portion of the dorsal abdominal tergites; and an eastern form that is smaller, greenish to brown in color, with no red band on the tergites. The taxonomic status of these forms is unclear. Marlow (1960) suggests that 3 forms may be present in Ohio. The demarcation of the range of these 2 forms in Ohio is not well established but the following boundary, based upon 71 collections from 35 counties, is approximate: the eastern watershed divides of the Little Miami, Great Miami, Maumee, and Portage rivers. Western-type specimens also have been collected from streams and ditches along the southern shore of Lake Erie as far east as Lorain Co. This crayfish is a primary or secondary burrower and is probably present in every Ohio county (Rhoades 1944b, Thoma and Jezerinac 1982). It uses the same type of habitat as *C. (C.) ortmanni* in the early spring. Members of the species have been found in association with one or more of the other Ohio crayfishes, except *P. (S.) clarkii*, *O. sloanii*, *O. propinquus* (Girard), *O. virilis* (Hagen), *C. (C.) sciottensis*, and *C. (C.) b. carinirostris*. *C. (L.) d. diogenes* is most often associated with *P. (Ortmannicus) acutus acutus* (Girard), *O. immunis*, and *F. (C.) fodiens* in northwestern Ohio and with *C. (C.) ortmanni* in the southwestern part of the state.

Cambarus (P.) robustus exhibits considerable morphological variation, especially in the presence or absence of cervical spines and the number of tubercles in the palmar rows of the chela. The species is common in Lake Erie tributary streams from Conneaut Creek (Ashtabula Co.) westward to Pickeral Creek (Sandusky Co.), in the Mahoning River, the middle and upper Muskingum River drainages, and eastern tributaries flowing directly into the Ohio River as far south as, but not including; Duck Creek (Washington Co.). The species is very uncommon in the Sandusky River and Maumee River basins (one collection from the Tiffin River).

Cambarus (P.) robustus is conspicuously absent in the Lower Muskingum, Duck Creek, Hocking, and Raccoon Creek drainages in southeastern Ohio. It is apparently replaced by *C. (C.) sciottensis* in the Scioto River basin and is not known to occur in other streams in southwestern and western Ohio. Its habitat is similar to that of *C. (C.) sciottensis*. Its crayfish associates at one or more sites include *C. (C.) b. carinirostris*, *C. (C.) b. cavatus*, *C. (L.) d. diogenes*, *O. propinquus*, *O. s. sanbornii*, *O. rusticus*, *O. juvenilis*, *O. virilis*, *O. obscurus*, and *O. immunis*.

Fallicambarus (C.) fodiens has a dorsoventrally flattened chela very similar to that of *O. immunis*. The limits of its range in Ohio have not been well determined, but it is more common in the northern glaciated region of the state than elsewhere. It has been collected by Dr. D. H. Stansbery (The Ohio State University Museum of Zoology) from only one locality (Jackson Co.) in the unglaciated part of Ohio. *Fallicambarus (C.) fodiens* is a primary or secondary burrower. In the glaciated area of the state it is usually found in swamps and wet woods associated with glacial potholes and morainal ridges. *F. (C.) fodiens* has been captured at one or more sites with *P. (O.) a. acutus*, *O. immunis*, *O. rusticus*, and/or *C. (L.) d. diogenes*.

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