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THE OSTRACODS OF THE GENUS ENTOCYTHERE FROM THE LOWER CHATTAHOOCHEE-FLINT BASIN:

With a Review of the Occurrence of the Genus in Florida, and Descriptions of Two New Species

C. W. Hart, Jr.

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OLIVER L. AUSTIN, JR., *Editor*

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THE OSTRACODS OF THE GENUS *ENTOCYTHERE* FROM THE LOWER CHATTAHOOCHEE-FLINT BASIN:

With a Review of the Occurrence of the Genus in Florida, and Descriptions of Two New Species

C. W. HART, JR. [1]

SYNOPSIS: During a systematic survey of the flora and fauna of the Apalachicola River drainage area supported by the National Park Service and the National Science Foundation, those ostracods epizoic on crayfishes were studied. A key to the known species of entocytherid ostracods found in Florida and the lower Chattahoochee-Flint basin, a survey of the ranges of these ostracods, a list of their crayfish "hosts," and descriptions of two new ostracod species are included. The new species, *Entocythere geophila* and *E. torreya,* are placed in a new group, the Geophila Group, which is here designated.

INTRODUCTION

During a survey of the decapod crustaceans of the lower Chattahoochee-Flint Basin in the late summer of 1955 (Hobbs and Hart, 1959), a number of epizoic ostracods were obtained from the crayfishes. Among these specimens from 26 localities—14 in Florida, 3 in southeastern Alabama, and 9 in southwestern Georgia—were several species of the genus *Entocythere.* Represented among them are *E. elliptica* Hoff, *E. hobbsi* Hoff, *E. equicurva* Hoff, and two new species that are described below. There appear to be several more undescribed species from Georgia and Florida, but their determinations must await the study of larger series from the area.

Because only one previous study (Hoff, 1944) has been made of the Florida entocytherid ostracods, it seems appropriate that a key to the species, a survey of the ranges, and a list of the "hosts" for all species from the state be included here with the descriptions of the two new species.

All the ostracods were mounted on slides. They were transferred directly from 70 percent alcohol to a drop of Hoyer's fluid on a slide, positioned with a needle, and covered with No. 1 glass cover slips. It was found that specimens could be "dissected" for better observation of details merely by pressing the cover slip directly over the

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[1] The author is Editor of Scientific Publications of the Academy of Natural Sciences of Philadelphia. He is particularly interested in the taxonomy of ostracods and in the morphology of crayfishes. These investigations were supported in part by Research Grant No. G-942 from the National Science Foundation. Manuscript submitted 12 April 1958.—ED.

specimen before the mounting medium dried. This was done with a needle or forceps while observing the specimen under a stereoscopic microscope.

Paratypes of the new species have been deposited in the collections of Dr. Horton Hobbs, Jr., Dr. Enrique Rioja, Dr. E. A. Crawford, and the author.

A Key to the Known Species of Ostracods of the Genus *Entocythere* Found in Florida and the Lower Chattahoochee-Flint Basin (Based on the Male)

1a. Length of distal portion of the base equal to or shorter than vertical ramus of clasping apparatus 2

b. Length of distal portion of base longer than vertical ramus of clasping apparatus (figs. 6 and 11) 6

2a. External border of clasping apparatus entire (figs. 12, 14, and 15) 3

b. A talon or emargination on external border of clasping apparatus (figs. 13 and 17) 5

3a. Clasping apparatus stout, swollen at juncture of two rami; two rami never joined at an angle much greater than a right angle (fig. 15)..... *E. elliptica*

b. Clasping apparatus slender; little, if any, swollen at the juncture of vertical and horizontal rami (figs. 12 and 14) 4

4a. Clasping apparatus C-shaped; distal margin with two teeth. Teeth of internal border of horizontal ramus grouped together some distance proximal to distal margin (fig. 14) ..... *E. equicurva*

b. Clasping apparatus not distinctly C-shaped; distal margin with more than two teeth. Teeth of internal border of horizontal ramus well-developed (fig. 12) ..... *E. dorsorotunda*

5a. Two teeth on external border of horizontal ramus subequal in size (fig. 13) ..... *E. talulus*

b. An elongate talon on external border of horizontal ramus and occasionally a tooth distal to it (figs. 17-19) ..... *E. hobbsi*

6a. Distal portion of base bifurcate (fig. 11) ..... *E. torreya* sp. nov.

b. Distal portion of base blunt with a dorsally-directed protuberance (fig. 6) ..... *E. geophila* sp. nov.

Annotated List

In recent years a number of species groups in the genus *Entocythere* have been established to express the interrelationships of its members. For the most part these groups are based on certain characteristics inherent in the morphology of the clasping apparati. Three previously recognized groups are represented in the Florida fauna, but the two ostracods described here are not readily assignable to

any of them. Because of the highly distinctive distal portions of the bases of their copulatory complexes, I propose that these animals be assigned to a new group—the Geophila Group.

Geophila Group (here designated)

DEFINITION.—Terminal tooth of mandible with cusps. No finger guards on copulatory complex. External border of clasping apparatus entire; internal border with one or two small denticles at apex, but otherwise entire. Distal portion of the base conspicuously large and extending ventrally some distance beyond the clasping apparatus. Female without a "ruffled skirt."

The two new species, *E. geophila* and *E. torreya,* described below, are assigned to this group.

Entocythere geophila, sp. nov.

Type specimens of this species were taken from a collection of crayfishes consisting of *Cambarus d. diogenes* Girard, *Procambarus spiculifer* (LeConte), and *P. paeninsulanus* (Faxon). It seems probable that a host specificity exists between this ostracod and the burrowing crayfish *C. d. diogenes.* It was found only in collections in which this crayfish appeared, and in no instance was it found in collections of *P. spiculifer* and *P. paeninsulanus* when they were unaccompanied by *C. d. diogenes.* The name *geophila* has been chosen to designate the apparent subsurface habitat of the species.

MALE.—The shell (fig. 1) is subelliptical in outline and somewhat vaulted posterior to the midlength. The ventral margin is straight or slightly convex, and is continuous with the well rounded arcs that form the anterior and posterior margins. Setae are scarce, but they occur singly or in pairs near the anterior and posterior margins. The eye is located approximately 1/5th the shell length from the anterior margin.

The shell, which lacks any features that might be of special taxonomic importance, is also fairly constant in size. The measurements of eight male specimens are given below (mounted in Hoyer's Fluid and measured to the nearest .01 mm.).

Length	Height	Length	Height
.40 mm.	.23 mm.	.41	.23
.40	.23	.43	.25
.40	.25	.40	.22
.42	.25	.41	.24

The antennule is composed of six podomeres, of which the proximal one is the longest and the third from the base the shortest. The second and the distal three podomeres diminish regularly distally. The basal podomere bears one subapical seta which extends to the midlength of the second podomere. The second podomere bears one seta which extends distally to the midlength of the fourth podomere. The third podomere bears two setae, both of which extend to approximately the midlength of the penultimate podomere. The antipenultimate podomere has four setae arranged around its distal edge, the penultimate podomere is devoid of setae, and the ultimate podomere bears four setae. These latter four setae are subequal in length to that of the distal three podomeres combined.

The antenna (fig. 3) consists of four podomeres. The basal podomere is devoid of setae, and the exopodite, or "flagellum," extends from its distal extensor margin for a distance equal to the length of the remainder of the antenna. The second, or antipenultimate podomere, is about 1.3 times as long as it is wide, and bears a single seta on its distal flexor margin. This seta extends beyond the proximal portion of the penultimate podomere. The penultimate podomere is divided into two distinct parts which are subequal in length. The distal flexor angle of the basal portion of the penultimate podomere bears two setae, one of which is half the length of the distal portion of the podomere, and one of which is subequal in length to the distal portion. A single seta is located near the midlength of the flexor surface of the distal portion of the penultimate podomere and extends to the base of the terminal claw. In most specimens the ventral claw is straight. This claw is equal in legnth to the distal portion of the penultimate podomere. The dorsal claw is heavier than the ventral one, and the enlarged distal portion bears a row of teeth on its ventral edge. The shortest claw, which also bears a row of teeth on its ventral edge, is about half the length and thickness of the ventral claw. The three claws are borne on the short terminal podomere.

The protopodite of the mandible (fig. 4) bears a distal row of six multicuspid teeth. The proximal tooth has 2 cusps, the four middle ones 3; and the distal one 5. The convex surface of the protopodite bears a short seta just proximal to the level of the proximal tooth. The podomeres of the mandibular palp are not clearly defined. On the flexor surface of the proximal portion of the palp is a long seta which extends to the base of the terminal setae. Two additional setae are borne on the distal extensor surface of the penultimate podomere; the proximal one extends to the midlength of the terminal setae, the

distal one to the base of the two slender terminal setae. The ultimate podomere bears three setae, two of which are slenderer than the third. These three setae are approximately equal in length, but because the two finer ones are borne slightly proximal to the heavy one, they appear to be shorter.

The maxilla (fig. 5) bears three setae on an unsegmented palp. The two distal setae are curved gently ventrad, and the ventral one is somewhat heavier than the other. The third seta, which is borne slightly proximad on the dorsal surface of the palp, extends to the midlength of the two just mentioned. The protopodite of the maxilla bears two terminal setae which extend distad beyond the bases of the two terminal setae of the palp.

The copulatory complex (fig. 6) of this ostracod, although differing markedly from those of the previously described species of *Entocythere,* consists of the usual elements. The distal portion of the base (dp) is heavily sclerotized and extends distally beyond the clasping apparatus (ca) for a distance subequal to the length of the horizontal ramus of the clasping apparatus. A falcate corneous penis (p) is located on the mesial face of the distal portion of the base, and a clearly delineated sperm tube extends proximally through the base. Attached to the proximal portion of the base (pp) are the typical short dorsal finger (df) and the longer ventral finger (vf). The dorsal finger may bear either one or two terminal spines, and the ventral finger one spine. The horizontal and vertical rami of the clasping apparatus are easily distinguishable; the vertical ramus is about 1.5 times as long as the horizontal ramus and is S-shaped; the horizontal ramus is not curved, its external border is convex, its internal border is straight (or nearly so), and it bears two or three distal serrations.

FEMALE.—The shell of the female (fig. 2) is similar to that of the male except that it is slightly smaller. The measurements of nine female specimens are given below (mounted in Hoyer's fluid and measured to the nearest .01 mm).

Length	Height	Length	Height
.38 mm.	.23 mm.	.40	.25
.39	.23	.39	.23
.40	.25	.38	.23
.38	.22	.37	.22
.40	.24		

TYPE LOCALITY AND RANGE.—*Entocythere geophila* was found in three collections from Florida and one from Georgia. Specimens (holotypes and paratypes) taken in the type locality—a clear, coffee-colored stream and adjacent craylsh burrows on Route 71, 11.4 miles north of Altha, Jackson County, Florida—were from a crayfish collection consisting of *Procambarus spiculifer* (LeConte), *P. paeninsulanus* (Faxon), and *Cambarus d. diogenes* Girard. The collection was made on 3 September 1955. *Entocythere geophila* was also found in a crayfish collection consisting of *P. spiculifer* and *C. d. diogenes* that was taken 5.6 miles north of Altha, Jackson County, Florida on Route 71 on 3 September 1955; in a crayfish collection consisting wholly of *Cambarus d. diogenes* taken 3.9 miles north of Altha, Jackson County, Florida on Route 71 on 3 September 1955; and in a crayfish collection consisting of *Procambarus spiculifer* and *Cambarus d. diogenes* taken from Spring Creek, 4.8 miles east of Iron City, Georgia on 1 September 1955.

REMARKS.—Although evidence is not conclusive, I suspect a degree of host specificity for this ostracod. *Cambarus d. diogenes* was represented in every collection from which it was taken; and in one case was the sole host. Holotype (male), allotype (female), and paratype (male) are in the U. S. National Museum in Washington, D. C. (USNM 101464, 101465), and additional paratypes are in the collections listed in the introduction.

Entocythere torreya sp. nov.

All of the specimens of this ostracod were taken from the crayfish *Cambarus d. diogenes* Girard. The specific name refers to the type

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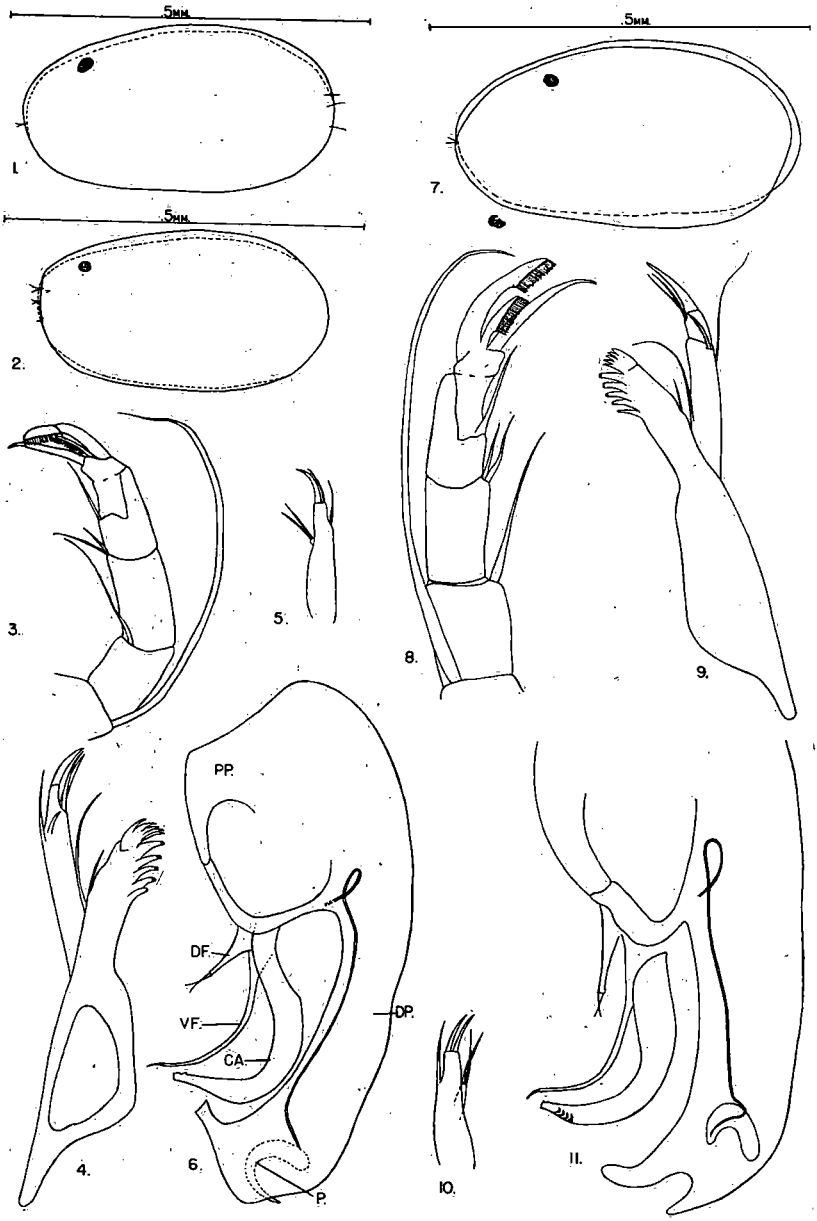
Explanation of Figures 1-11

Entocythere geophila, sp. nov.

Figure 1. Lateral view of shell of male.
Figure 2. Lateral view of shell of female.
Figure 3. Antenna of male.
Figure 4. Mandible of male.
Figure 5. Maxilla of male.
Figure 6. Copulatory complex of male.

Entocythere torreya, sp. nov.

Figure 7. Lateral view of shell of male.
Figure 8. Antenna of male.
Figure 9. Mandible of male.
Figure 10. Maxilla of male.
Figure 11. Copulatory complex of male.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locality—Torreya State Park, Florida. Because none of the specimens was found copulating and because several other ostracods were also found in the collection, I hesitate to describe the females found in the collection as females of *E. torreya*. Therefore only the male is described here. The holotype (male) and paratype (male) are in the U. S. National Museum (USNM 101462, 101463), and additional paratypes are in the collections listed in the introduction.

MALE.—The shell of this species (fig. 7) is subelliptical in outline and is similar to that of *E. geophila*. It is, however, somewhat larger —averaging 0.46 mm. in length. The measurements of six specimens are given below (mounted in Hoyer's fluid and measured to the nearest .01 mm.).

Length	Height	Length	Height
.45 mm.	.28 mm.	.46	.29
.47	.28	.45	.29
.48	.27	.43	.27

The antennule, antenna (fig. 8), mandible (fig. 9), maxilla (fig. 10), and the thoracic legs of *Entocythere torreya* are, for all practical purposes, identical with those of *Entocythere geophila*. It is therefore unnecessary to describe them here.

The copulatory complex (fig. 11) of this ostracod basically resembles the copulatory complex of *Entocythere geophila*, which is described above. The easily recognizable distal portion of the base is heavily sclerotized and extends distally beyond the clasping apparatus for a distance subequal to the length of the horizontal ramus of the clasping apparatus. A falcate corneous penis is located on the mesial face of the distal portion of the base, and attached to the proximal portion of the base are the typical short dorsal finger and the longer and more delicate ventral finger. The dorsal finger may bear one or two terminal spines, and the ventral finger one spine. The horizontal and vertical rami of the clasping apparatus are not sharply delineated, the vertical ramus being only slightly longer than the horizontal ramus. The horizontal ramus bears a few distal serrations, but these show considerable variation from one animal to another. The distolateral surface of the horizontal ramus may also bear a variable number of low ridges.

TYPE LOCALITY.—The only specimens of this ostracod were taken from the crayfish *Cambarus d. diogenes* collected from burrows near Blue Springs, Torreya State Park, Liberty County, Florida on 8 September 1955.

Illinoisensis Group

DEFINITION.—Terminal tooth of mandible without cusps (except in *E. ruibali*). No finger guard on copulatory complex. External border of clasping apparatus entire; internal border with four or more serrations. Females without a "ruffled skirt."

Only one species of this group occurs in the Chattahoochee area, but as a second one has been reported northeast and southeast of it, it may subsequently be found here.

Entocythere elliptica Hoff, 1944

(Figure 15)

Specimens of *E. elliptica* were collected in Calhoun, Liberty, and Gadsden counties, Florida; in Decatur and Henry counties, Georgia; and in Houston County, Alabama. The crayfishes represented in these collections were *Procambarus spiculifer, P. paeninsulanus, P. pycnogonopodus, P. kilbyi, P. r. rogersi,* and *Cambarus latimanus.*

Hoff's type specimens were collected north of Fargo, Clinch County, Georgia on *Procambarus seminolae.* He states that *E. elliptica* is common in Florida and Georgia, and mentions its association with *P. alleni* in Orange County, Florida.

In mounting one of the specimens of *E. elliptica* found in Liberty County, Florida, the clasping apparatus happened to be lying in such a way that it could be seen in caudal aspect. When I later examined this specimen I noticed a peculiar broad scoop-like projection at the angle near the outer border. Because this is not mentioned in any previous study, it is illustrated here (fig. 16).

Entocythere dorsorotunda Hoff, 1944

(Figure 12)

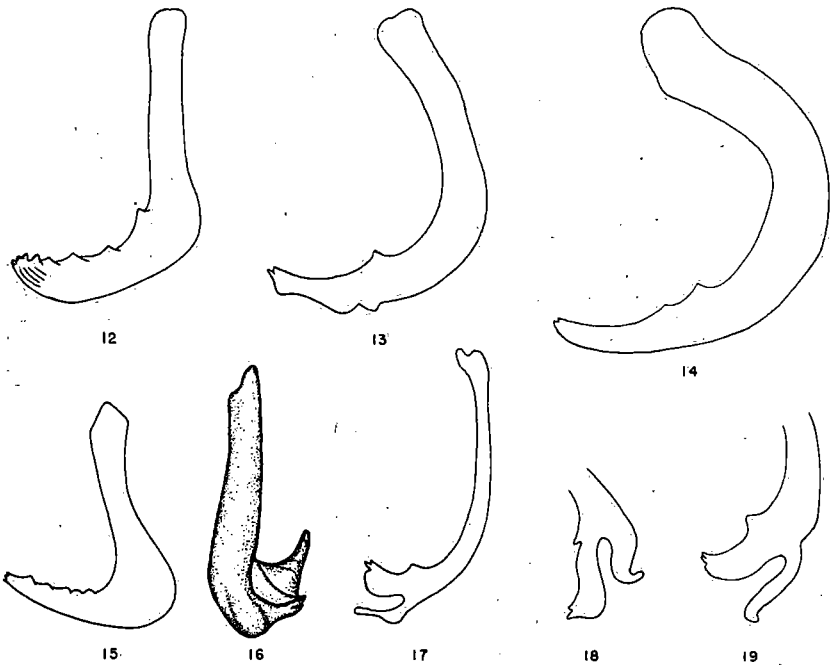
E. dorsorotunda was not found in the collections from the Apalachicola River drainage area. As in the case of *E. talulus* (see below), it is included here because of the likelihood of its occurring in the area. The type specimens were taken from *Procambarus advena* collected near Fitzgerald, Ben Hill County, Georgia, but this ostracod has also been collected in Clay, Dade, and Charlotte counties, Florida, and has been found associated with *P. alleni* and *P. seminolae.*

Heterodonta Group

DEFINITION.—Terminal tooth of mandible with cusps. No finger guard on copulatory complex. Talon or excrescence present on external border of clasping apparatus, or if without such an excrescence,

the internal border of clasping apparatus with only one denticle. Females without a "ruffled skirt."

This group is represented by two species in Florida, only one of which is known to occur in this region.



Explanation of Figures 12-19

Figures 12-15 and 17-19. Lateral views of clasping apparatus of males (after Hoff, 1944).
Figure 16. Caudomesial view of clasping apparatus of male *E. elliptica*.
Figure 12. *Entocythere dorsorotunda.*
Figure 13. *Entocythere talulus.*
Figure 14. *Entocythere equicurva.*
Figure 15. *Entocythere elliptica.*
Figure 16. *Entocythere elliptica.*
Figure 17. *Entocythere hobbsi.*
Figure 18. *Entocythere hobbsi* (distal portion only).
Figure 19. *Entocythere hobbsi* (distal portion only).

Entocythere hobbsi Hoff, 1944
(Figures 17-19)

A number of specimens of *E. hobbsi* were obtained from collections made in Gadsden and Liberty counties, Florida. The Hetero-

donta group is also represented by several specimens from Decatur County, Georgia, and Jackson and Calhoun counties, Florida. Among them appear to be several undescribed species, the determinations of which must await a more extensive study of a larger number of specimens.

The specimens of *E. hobbsi* were taken from collections of crayfishes containing *Procambarus leonensis, P. paeninsulanus,* and *P. spiculifer.* The undetermined members of the group were from collections containing *P. spiculifer, P. pycnogonopodus, P. kilbyi,* and *P. rogersi ochlocknensis.*

Hoff's type specimens of *E. hobbsi* came from *P. advena* taken from burrows near Fitzgerald, Ben Hill County, Georgia. "Other localities from which this form was secured were widely scattered in Florida and Georgia, except for a single collection (on *P. lunzi*) from Hampton Co., South Carolina." (Hoff, 1944: 356). Previously reported hosts are *P. advena, P. lunzi, P. alleni, P. seminolae, P. barbatus, P. blandingii acutus, P. hubbelli, P. kilbyi, P. leonensis, P. paeninsulanus, P. pictus,* and *P. pubescens.*

Entocythere talulus Hoff, 1944
(Figure 13)

Although *E. talulus* was not collected in the Apalachicola River drainage area, it is found in Florida, and is therefore included here. It is known only from the type locality, a marsh at N.W. 20th Street and 27th Avenue, Miami, Dade County, Florida. It was found on the crayfish, *P. alleni.*

Columbia Group

DEFINITION.—Terminal tooth of mandible with cusps. No finger guard on copulatory complex. External border of clasping apparatus entire; internal border usually with more than one denticle present. Females without a "ruffled skirt."

Entocythere equicurva Hoff, 1944
(Figure 14)

Specimens of *Entocythere equicurva* show considerable variation in the clasping apparatus, ranging from a single tooth on the inner margin of the horizontal ramus to several teeth extending proximally toward its base. Although Hoff describes the proximal tooth of the clasping apparatus of this species as always being the largest, I have

seen several specimens in which the distal tooth is the largest. Specimens of *E. equicurva* were collected in Jackson and Liberty counties, Florida; in Decatur, Seminole, and Early counties, Georgia; and in Houston County, Alabama. All of these localities are in the Apalachicola River drainage area.

The crayfishes from which these specimens were taken are *Procambarus spiculifer, P. paeninsulanus, Cambarus d. diogenes, C. fodiens,* and *Cambarellus schmitti.*

The type specimens of this species were taken from *Procambarus paeninsulanus* collected 2.3 miles south of Woodbine, Camden County, Georgia, on September 1, 1938. Hoff states that *E. equicurva* "has been taken in ten collections from Florida and one from Alabama." The crayfishes from which it has previously been reported are *P. leonensis, P. fallax, P. kilbyi, P. lucifugus alachua, P. paeninsulanus,* and *Orconectes spinosus.*

Acknowledgments

This work was done in connection with a systematic survey of the flora and fauna of the Apalachicola River drainage area in southeastern Alabama, southwestern Georgia, and the panhandle of Florida. The survey was supported by the National Park Service and The National Science Foundation through the University of Florida. The ostracods were obtained from crayfishes collected by Dr. Horton Hobbs, Jr. and the author, and the crayfishes were identified by Dr. Hobbs. Special thanks are due to the Mountain Lake Biological Station of the University of Virginia and to Dr. Ruth Patrick of the Academy of Natural Sciences of Philadelphia for providing laboratory spaces in which to complete this study. The definitions of the several groups were made by Dr. Hobbs, who is preparing a manuscript on the entocytherid fauna of Mexico and Cuba.

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Illustrations, including maps and photographs, should be referred to as "figures" wherever possible. All illustrations are reduced to a maximum of 4¼ by 7⅛ inches. The scales, wherever it is necessary, should be incorporated into the figure.

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