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EULIMNADIA OVILUNATA AND *E. OVISIMILIS*, NEW SPECIES OF CLAM SHRIMPS (CRUSTACEA, BRANCHIOPODA, SPINICAUDATA) FROM SOUTH AMERICA

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Abstract.—Two new species of the clam shrimp genus *Eulimnadia* are described from South America. *Eulimnadia ovilunata*, a species with spherical eggs bearing circular crater-like depressions, is described from Argentina, and *Eulimnadia ovisimilis*, a species with stout cylindrical eggs that closely resemble those of the North American species *E. texana* (Packard), is described from Paraguay.

Species of the clam shrimp genus *Eulimnadia* Packard (sometimes considered synonymous with *Limnadia*; see Webb & Bell 1979) in North, Central, and South America were the subject of two recent reviews by Belk (1989) and Martin (1989). Although many traditionally employed characters were shown by those authors to be variable and unreliable, an additional character, morphology of the external egg shell, appears to be conservative and species-specific. In his comparison of described Central and South American species, Martin (1989) examined two South America forms that did not conform to any known species. Those species, described from samples in the collections of Denton Belk in San Antonio, Texas, were referred to by Martin as *Eulimnadia* sp. A (DB 305) and *Eulimnadia* sp. B (DB 632). In this paper we describe the two new species.

Materials and Methods

Illustrations were made from ethanol-preserved specimens with a Wild M-5APO stereoscope with camera lucida. All specimens are catalogued in the Natural History Museum of Los Angeles County, abbreviated LACM. The abbreviation DB refers to the cataloging system of the private collection of the junior author in San Antonio, Texas; lots from that private collection formed the basis for this report.

The highway designations in Catamarca Province, Argentina, changed between the time Arthur Hulse made clam shrimp collections in 1973–1974 and today. We cite the current nomenclature according to the 14 April 1986 map published by Automovil Club Argentino in addition to including the location information originally supplied by Dr. Hulse (in parentheses).

Eulimnadia ovilunata, new species

Figs. 1, 3A–C

Eulimnadia sp. A.—Martin, 1989, fig. 5d (eggs).

Material.—DB 303, paratypes, LACM 74-107.1, 3 males, 45 females (22 ovigerous), Argentina, Catamarca Province, highway 46 W of Andalgalá in flood plain of Río Amanao (formerly Route 62, km 1508, at time of collection), 4 Mar 1974, coll. A. Hulse; DB 304, paratypes, LACM 74-108.1, 11 females (1 ovigerous), Argentina, Catamarca Province, highway 46 S of Andalgalá (formerly Route 1, km 104, at time of collection), 8 Mar 1974, coll. A. Hulse; DB 305, holotype female (ovigerous), LACM 73-180.1; paratypes, LACM 73-180.2, 19 fe-

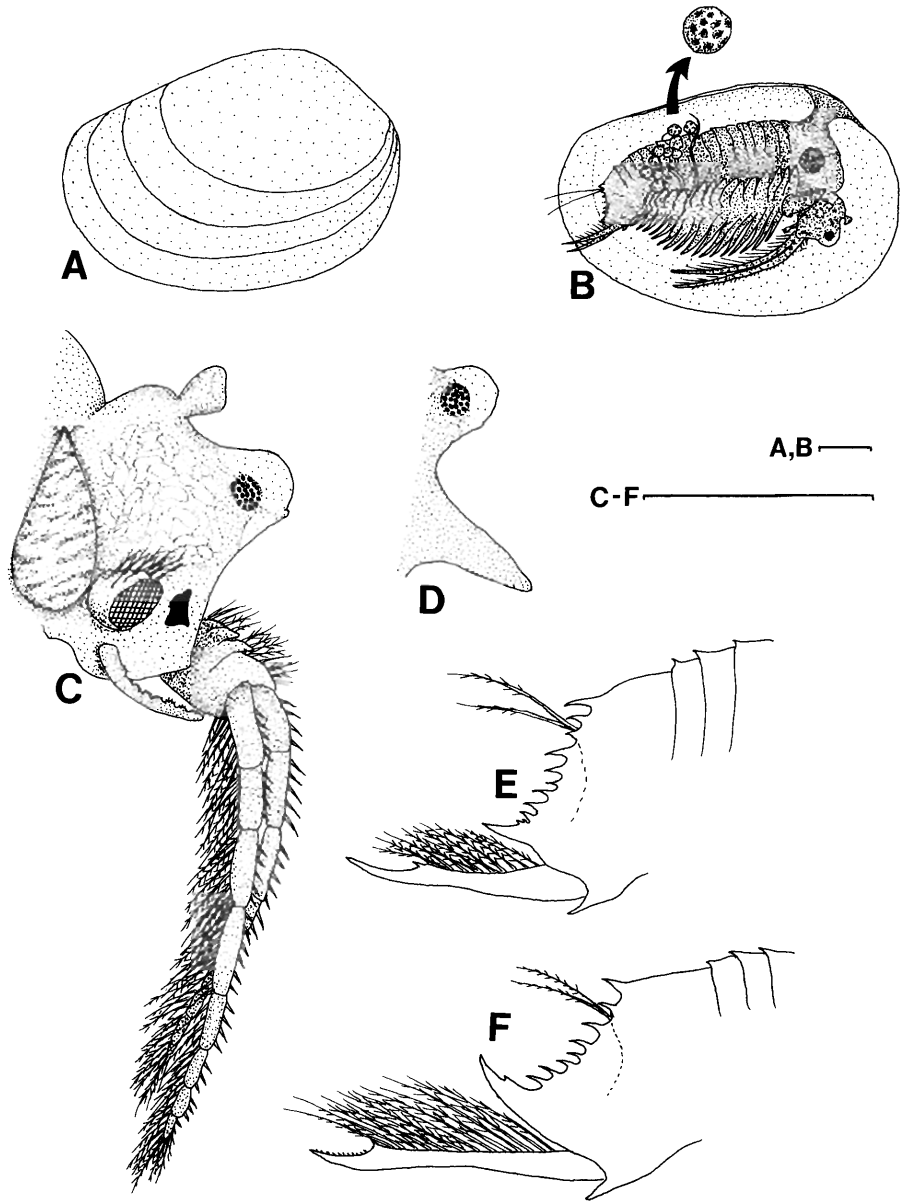

Fig. 1. *Eulimnadia ovilunata*: A, Right valve of holotype female; B, Holotype female, right valve removed, with egg enlarged above; C, Frontal region of holotype female; D, Rostrum and eye of one of three poorly preserved males; E, Caudal region of holotype female; F, Caudal region of male. Scale bars indicate 1.0 mm.

males (15 ovigerous), Argentina, Catamarca Province, highway 46 S of Andalgalá (formerly Route 1, km 45, at time of collection), 30 Dec 1973, coll. A. Hulse, 1 female destroyed in SEM preparation (Fig. 3).

Measurements.—Male carapace 5.5 to 6.0 mm length, 3.5 to 4.1 mm height (but see Remarks below) (n = 3; DB 303, no males in other collections). Female carapace 5.1 to 6.8 mm length, 3.3 to 4.7 mm height (n

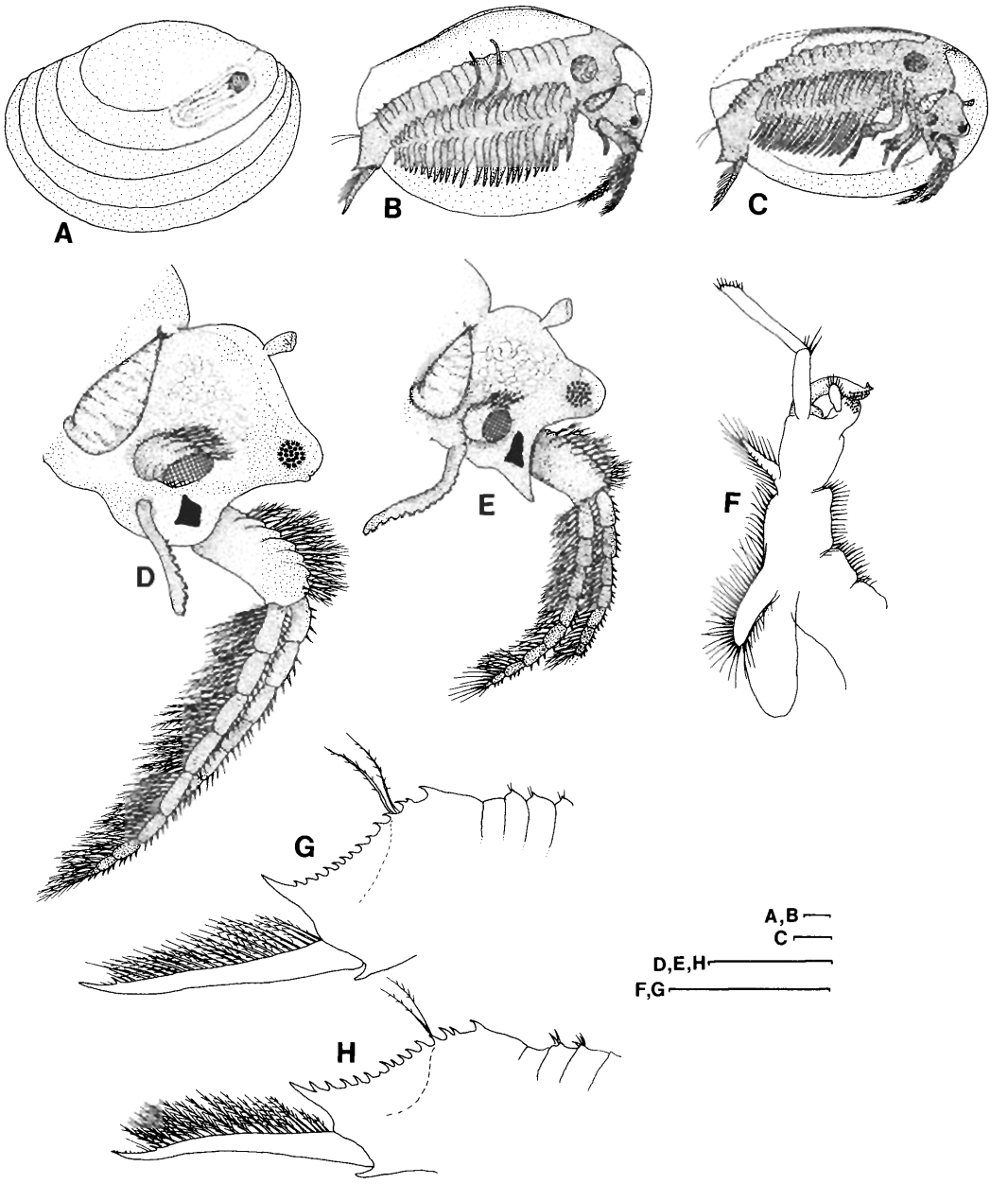

Fig. 2. *Eulimnadia ovisimilis*: A, Carapace (right valve) of holotype female; B, Holotype female with right valve removed; C, Allotype male with right valve removed; D, Head region of holotype female; E, Head region of allotype male; F, Second male clasper of allotype male; G, Caudal region of allotype male; H, Caudal region of holotype female. Scale bars indicate 1.0 mm.

= 76, DB 303, DB 304, DB 305; smallest and largest females both ovigerous).

Carapace.—Female carapace (Fig. 1A, B) broadly oval, with hinge border domed and with three or four lines of growth. Male carapaces all shriveled; condition indeterminate (see below).

Head region.—Female (Fig. 1C) with broadly triangular rostrum; male (Fig. 1D) with very prominent acute rostrum.

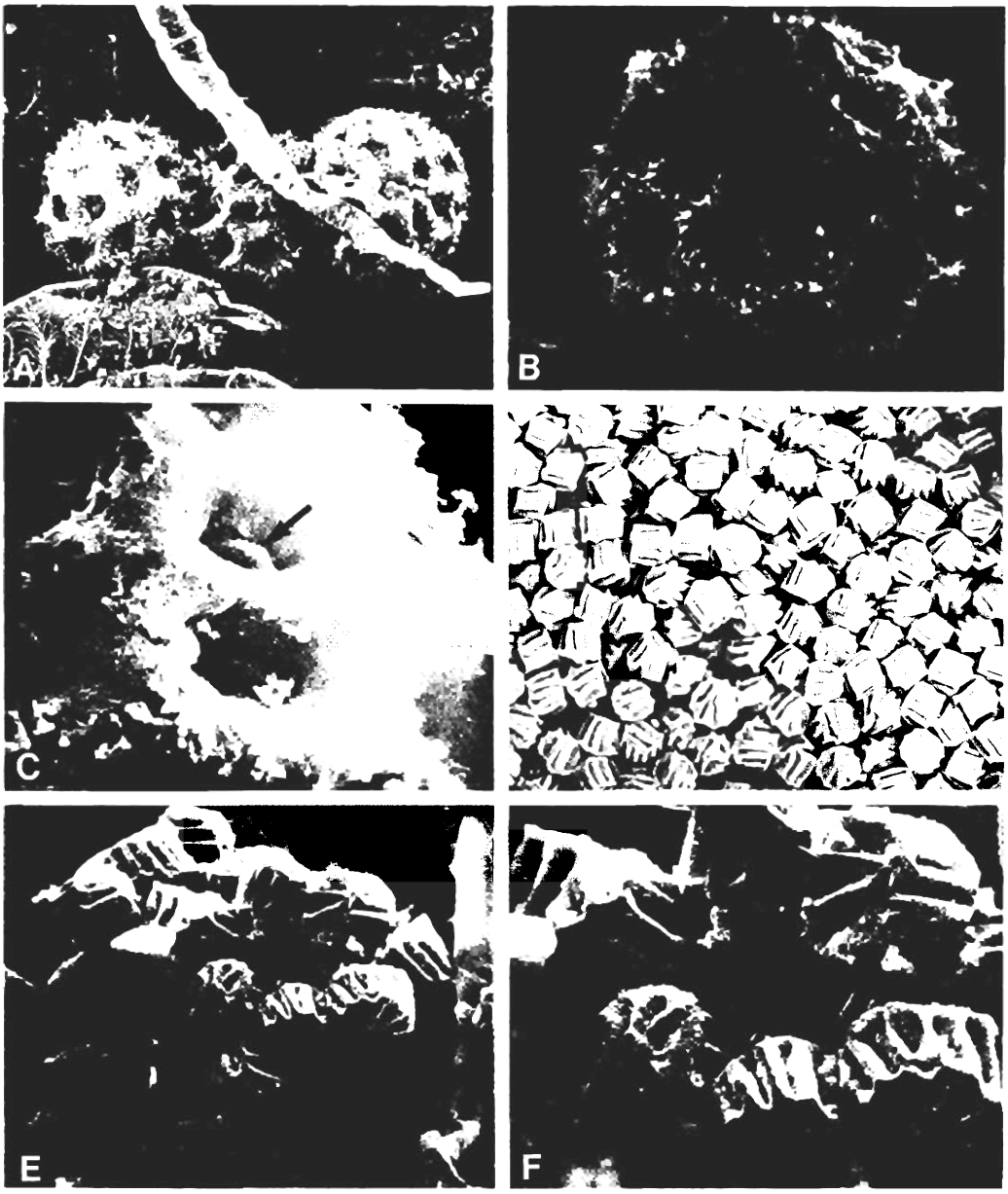

Fig. 3. Scanning electron micrographs of eggs of *Eulimnadia ovilunata* (A–C) and *E. ovisimilis* (D–F): A, Eggs of *E. ovilunata* (paratype) from Catamarca, Argentina (DB 305), ×200; B, Single egg of *E. ovilunata* (from same female as in A), ×520; C, Higher magnification of crater-like depression of egg in B showing mound at bottom of depression (arrow), ×1,180; D, Eggs of *E. ovisimilis* (paratype) from Paraguay (DB 632), ×75; E, Cluster of eggs of *E. ovisimilis* on epipod of female, ×120; F, Higher magnification of eggs shown in E showing nature of end pieces, ×250.

Antennae.—First antennae pseudosegmented with aesthetascs on anterior border of each lobe. Second antennae natatory, with spines on dorsal border and plumose setae on ventral border of each segment; number of segments varies from seven to nine.

Male thoracopods.—Not examined (see below).

Caudal region.—Female (Fig. 1E) and male (Fig. 1F) caudal regions similar, with 8 to 10 stout downward curved spines on posterior borders and with telsonal filaments arising from between second and third such spines.

Eggs.—Spherical, with oval or circular depressions that appear fringed with small fingerlike projections of the shell or tertiary envelope, each depression with a slightly convex and relatively smooth floor (Figs. 1B, 3A–C).

Type locality.—Argentina, Catamarca, highway 46, 45 km S of Andalgalá.

Range.—Known from three localities in Catamarca, Argentina.

Etymology.—From the Latin "luna" (moon) and "ova" (egg), because the depressions on the eggs are reminiscent of craters on the lunar surface.

Remarks.—*Eulimnadia ovilunata* does not differ appreciably from many other species of the genus except by virtue of the egg morphology. Of the South American species described or reviewed by Martin (1989), only the egg of *E. brasiliensis* Sars is spherical. However, the *E. brasiliensis* egg lacks the minute projections fringing each indentation, and the indentations do not appear as regularly formed and do not bear the clearly defined oval "floor" of the crater (compare Martin's (1989) fig. 4c to his fig. 5d and to Fig. 3A, this paper). The North American species *Eulimnadia diversa* Mattox, *E. agassizii* (Packard), and *E. antlei* (Mackin) also have spherical eggs, but the eggs of all three of these species clearly differ from *E. lunaova* eggs under high magnification (see Belk 1989). The eggs of *Eulimnadia antillarum* (Baird), a species that occurs in North and South America, remain undescribed, but the caudal region of that species is nearly devoid of spines (see Martin 1989:fig. 5A), whereas the caudal region in *E. ovilunata* bears relatively large, well developed spines in both sexes (Fig. 1E, F).

The only males in the series are in very poor condition, apparently having completely dried out at some time in the past. Structures traditionally described for males could not be ascertained, and the illustration of the male rostral region (Fig. 1D) should be verified when males in good condition are collected. Because of the condition of the males no allotype was designated among the three male paratype specimens in DB 303.

Eulimnadia ovisimilis, new species
Figs. 2, 3D–F

Eulimnadia sp. B.—Martin, 1989, fig. 5e–g (eggs).

Material.—DB 632, holotype female (ovigerous), LACM 84-204.1; allotype male, LACM 84-204.2; paratypes (2 males, 48 females (21 of which are ovigerous)), LACM 84-204.3, Paraguay, Chaco Departamento, Parque Nacional Defensores del Chaco, Tribo Nuevo, "encontrado en regiónes bajas de laguna recién inundada," from shallow regions with submerged grass about one week after heavy rains filled a formerly dry pond-marsh (Terry Bonace, personal letter to D. Belk), 23 Nov 1984, coll. T. Bonace and D. Drenner.

Measurements.—Male carapace 6.9 to 7.5 mm length, 4.5 to 4.7 mm height. Females (including ovigerous females) 6.0 to 10.0 mm length, 4.2 to 6.9 mm height.

Carapace.—Female carapace (Fig. 2A, B) broadly oval, distinctly elevated along dorsal border, with four lines of growth. Male carapace (Fig. 2C) usually smaller, oval but not elevated along dorsal border, instead somewhat flattened along hinge line, with two or three lines of growth.

Head region.—Female (Fig. 2D) with very short bluntly rounded rostrum; male (Fig. 2E) with short but acute rostrum.

Antennae.—Similar to that described for *E. ovilunata* (and many other members of the genus); second antennae with eight or nine segments.

Male thoracopods.—Typical for the genus, with long 2-segmented palp, stout dis-

tal spines on clasper border, and small cup-like projection on distal border of clasper finger (Fig. 2F).

Caudal region.—Similar in males (Fig. 2G) and females (Fig. 2H), with 13 to 17 stout caudal spines and with telsonal filaments arising from about level of fourth posterior spine.

Eggs.—Stout and cylindrical, with parallel grooves separating rounded ridges along cylinder axis and with perpendicular grooves on end pieces (Fig. 3D–F; see also Martin 1989, fig. 5e–g).

Type locality.—Paraguay, Chaco Departamento, Parque Nacional Defensores del Chaco, Tribo Nuevo, "encontrado en regiónes bajas de laguna recién inundada," shallow region with submerged grass.

Range.—Known only from the type locality.

Etymology.—The name refers to the marked similarity that eggs of this species bear to eggs of the North American species *E. texana* (see Belk 1989).

Remarks.—The eggs of *Eulimnadia ovisimilis* are virtually identical to those of *E. texana,* a predominantly North American species that has been reported, probably mistakenly, as far south as Sao Paulo, Brazil (Lutz 1929, Daday 1926). This is disturbing in light of our recent findings that egg morphology is often species-specific in the Limnadiidae and is in any case a more conservative taxonomic character than any previously employed feature. Indeed, we at first thought that we had encountered a southern hemisphere population of *E. texana* rather than an undescribed form. However, there are several salient differences between the two species. In *E. texana* males and females have a similar rostral morphology. In contrast, sexual dimorphism is marked in *E. ovisimilis.* In females of *E. ovisimilis* the rostrum is rounded and slightly protruding, whereas in males the rostrum is attenuated and sharply produced (see Fig. 2D, E). Although there is known to be variation in rostral morphology in *E. texana,* there is never sexual dimorphism as marked as is seen in *E. ovisimilis* (Sissom 1971, Belk 1989). Additionally, the eggs of *E. ovisimilis* appear less domed on the end pieces than are eggs of *E. texana.*

Discussion

Morphology of the external egg shell has been shown to be a useful and reliable character in identifying species of the genus *Eulimnadia* (Belk 1989). Some caution is advised when consulting previous published accounts of egg morphology where scanning electron microscopy was not used. Specifically, some of the illustrations or verbal accounts given by Daday (1926) were shown by Belk (1989) to be erroneous or lacking in sufficient detail to be of taxonomic value, perhaps a result of limitations of the microscopy available at that time. Even when SEM is applied, however, there may be cases where egg morphology will fail to distinguish between two otherwise recognizable species. This was pointed out by Mura (1986) for distinct species of anostracans that have identical egg morphologies, and the present paper demonstrates that this scenario also occurs in some species of clam shrimp (Spinicaudata only; the Laevicaudata do not have sculptured eggs; Martin & Belk 1988). This need for caution was noted by Belk (1989) in anticipation of this sort of problem. We emphasize again the need for using SEM on branchiopod egg morphology, but advise against using egg morphology to the exclusion of other characters.

Finally, as mentioned briefly by Belk (1989) and Martin (1989), the present status of the genera *Limnadia* Brongniart and *Eulimnadia* Packard is unclear. Most morphological characters previously used for separating the two genera are variable, and there is some overlap, leading several workers to suggest that the two genera should be synonymized (Webb & Bell 1979). However, there are at least two characters that serve to separate the two genera for species

in the Americas. First, the well developed spine on the posteroventral border of the caudal somite is always easily discerned in *Eulimnadia,* whereas in the only species of *Limnadia* known from the Americas (*L. lenticularis*) this spine is absent (although a small lobe is present in the same location). Webb & Bell (1979:fig. 1) show a morphological gradation from one state to the other based on drawings in existing literature, and suggest that this character is therefore unreliable. Second, the telsonal filaments arise from between the paired spinose posterocaudal borders in all American *Eulimnadia,* whereas in *Limnadia lenticularis* the filaments arise from a location anterodorsal to the point where these borders become fused. We will address these two characters and the status of *Eulimnadia* vs. *Limnadia* in a future paper.

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