A Redescription of Types of the Clam Shrimp *Eulimnadia agassizii* (Spinicaudata: Limnadiidae)[1]

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Abstract. Among the described North American species of the clam shrimp family Limnadiidae, *Eulimnadia agassizii* is poorly known, having been reported from only two localities in extreme southeastern New England. Though recently reported as nonexistent, the original specimens of this species are in the type collection of the Museum of Comparative Zoology, Harvard University. Specific data regarding the collection and an emended and expanded description of the type material are provided, using traditional and contemporary characters, to complement recent studies of the group.

In a revision of the Recent Limnadiidae of North America, Belk (1989) discussed traditional characters used to diagnose species and suggested that egg shell morphology demonstrates less intraspecific variation, thus allowing more confident separation of species. Among the several named forms included in his review was *Eulimnadia agassizii*, a poorly known species from southeastern New England. *E. agassizii* was described (as *Limnadia*) from Penikese Island in what is now the town of Gosnold, Barnstable County, Massachusetts, by Packard (1874a). Along with a stone plaque and a few obscured foundations, the description of *E. agassizii* is all that remains of an early attempt to establish a marine biology laboratory on the island (later permanently founded at nearby Woods Hole, Massachusetts). Packard (1883) eventually included *E. agassizii* in his genus *Eulimnadia*, first formally proposed as a subgenus (Packard, 1847b). *Eulimnadia* has been recognized by most subsequent authors, although Webb & Bell (1979) reviewed earlier data that suggested overlap in the two taxa and recommended that *Eulimnadia* be synonymized with *Limnadia*. Additional study is needed to resolve the two views.

Belk (1989) remarked that Packard did not "leave any type material." In fact, the specimens collected by Walter Faxon on Penikese Island, and certainly the same or part of the same collection used by Packard, exists in the Museum of Comparative Zoology, Harvard University, at Cambridge, Massachusetts. The specimens are labeled as "types" and are in the type collection but have not been cataloged. No specific holotype was designated. Unaware of the collection, Belk (1989) used specimens of *E. agassizii* collected in Woods Hole, Massachusetts, to characterize *E. agassizii*. Though the Woods Hole collection is useful for purposes of comparison with other species, it nevertheless would be useful to provide an accurate redescription of the type collection. Using type material, I redescribe the species below. Variations in certain characters

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discussed by Packard (1874a,b, 1883) are noted. Egg shell and telson morphology are redescribed based on scanning electron microscopy.

Materials and Methods

The series of specimens examined are distributed among two lots, each designated as part of the type collection. Neither lot is cataloged. The only written record in the collection concerning the specimens is a statement in an accession log dated September 1873, indicating that W. Faxon donated a series of specimens from Penikese Island, Buzzards Bay, Massachusetts. Both lots are preserved in 70% ethanol. The first lot is labeled "pool on Penikese Island, Buzzards Bay Mass 27 Aug. 1873 coll. by Walter Faxon." A second label states "Eulimnadia agassizii Packard Type!." The lot contains 196 specimens, all females. The second lot is marked "Eulimnadia agassizii Type! Penikese Island, Buzzards Bay Aug. 27 1873 W. Faxon." There are six female specimens in the lot.

Fourteen specimens were removed from the large lot and used to furnish body parts for light and scanning electron microscopical (SEM) investigations. Body parts used for light microscopy were cleared and mounted in Hoyer's medium, a semipermanent mounting medium. For SEM examination, eggs and entire telsons were dehydrated, coated, and examined with a JEOL model JSM 3500 scanning electron microscope. The drawings of the head are free-hand renditions of slide mounts using an ocular grid to determine key point dimensions. All prepared material, including slides and SEM stubs, was returned to the type collection in the Museum of Comparative Zoology, Harvard University.

In addition, specimens of *E. agassizii* maintained in the collections of the Marine Biological Laboratory (Grey Museum 994), Woods Hole, Massachusetts, collected 9 August 1970 by D. J. Zinn were examined. Nine female specimens are in the collection. Examinations of these latter specimens were limited to use of light microscopy.

Description

Family Limnadiidae Baird, 1849
Genus *Eulimnadia* Packard, 1874
Eulimnadia agassizii (Packard, 1874)
(Figs. 1, 2)

Carapace. As in other members of *Eulimnadia*. Largest specimens 6.0–6.2 mm in length, 3.8–4.1 mm in height. Most specimens with 4 growth lines, but some with 5 lines.

Head (Fig. 1a, b). With well-developed frontal organ (F); beak-like protuberance bearing ellipsoid to oval compound eyes (CE). Naupliar eye (NE) (obscured in lateral view by antenna 2 in Fig. 1a), present in low, bluntly pointed rostrum (R) (Fig. 1b).

Antennae (Fig. 1a). Antenna 1 (A1) small, single-segmented, uniramous, with several aesthetascs: length about two-thirds to nearly full length of peduncle of antenna 2. Antenna 2 (A2) biramous, inner ramus longer than outer

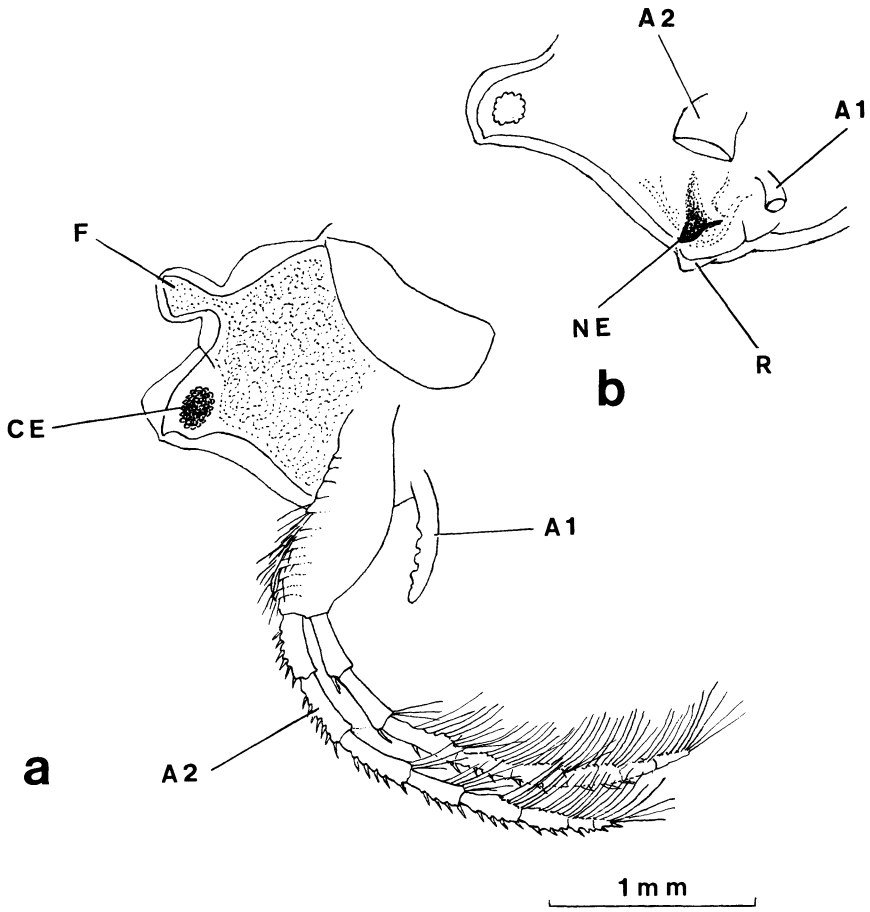
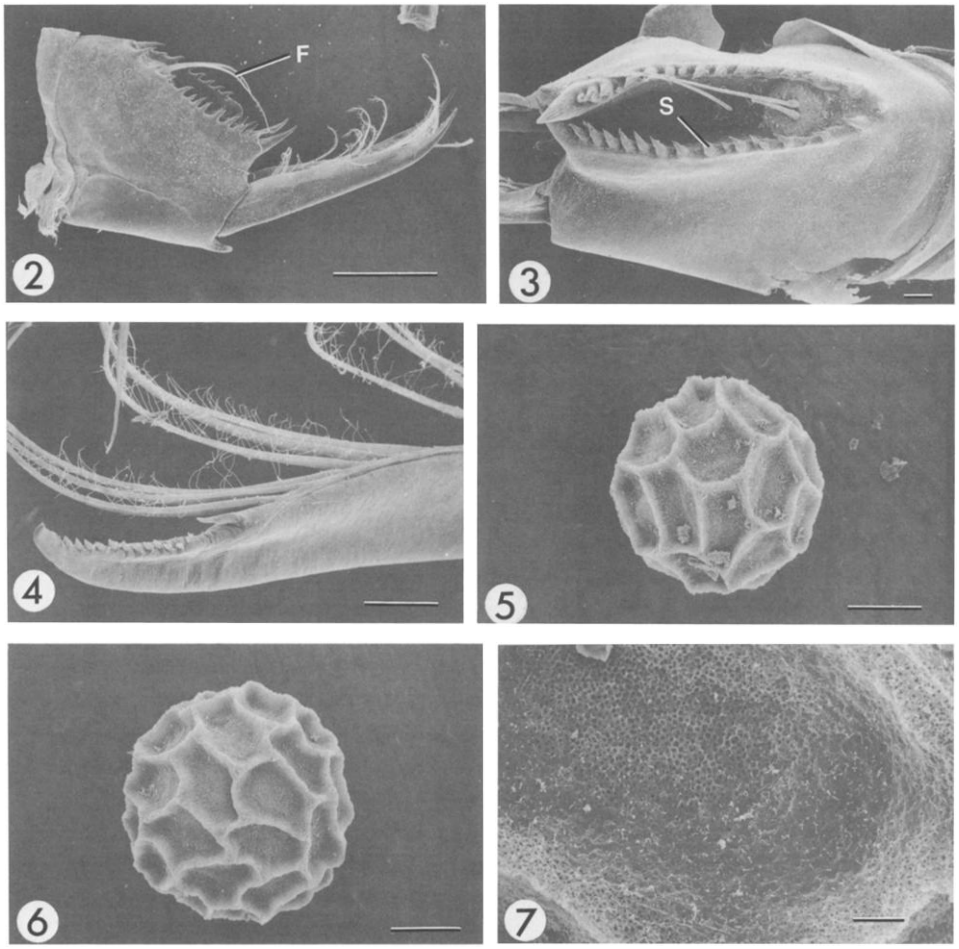


FIG. 1. Head region of *Eulimnadia agassizii*. a. Entire structure. b. Rostral area with antennae 1 and 2 removed. A1, antenna 1; A2, antenna 2; CE, compound eye; F, frontal organ; NE, naupliar eye; R, rostrum.

ramus. Inner ramus of 8–9, most commonly 8, segments; outer ramus with 7–9, most commonly 8; occasional partial or complete fusion of terminal segments. Dorsal surfaces of inner ramus segments 1 and 2 with usually only 1 or 2 distal spines. Dorsal surfaces of outer ramus segments 1 and 2 with several spines; remaining segments of both rami with several dorsal spines. Ventral surfaces of segments 1 and 2 in both rami with few or no setae near distal borders. All remaining segments of both rami with several long, plumose setae on ventral surfaces. Peduncle with several shallow dorsal clefts, each bearing several short plumose setae.

Telson (Figs. 2–4). Telson characteristic of the genus *Eulimnadia*. Dorsal spine (S) number along one row 11–17 (including occasional unpaired anterior spine). Two telsonal filaments (F) arise from small mound posterior to convergence of the dorsal spine rows. Spines present at distal lateral corners of ventral



FIGS. 2–7. Morphological characteristics of *Eulimnadia agassizii*; SEM. Fig. 2. Telson and uropod, lateral. Scale bar represents 500 μm. Fig. 3. Telson showing dorsal spines (S) and telsonal filaments (one broken). Scale bar represents 100 μm. Fig. 4. Terminal half of uropod. Scale bar represents 100 μm. Figs. 5, 6. Eggs. Scale bars each represent 100 μm. Fig. 7. Surface of a depression area of egg. Note dark pores. Scale bar represents 10 μm. F, telsonal filament.

margin. Claws (rami of telson) longer than telson; dorsal margins with long plumose setae for about two-thirds of claw's length; distal end of setal row marked by distinct spine. Remaining (posterior) dorsal surface of each ramus with small linearly arranged spines in a comb-like row.

Egg (Figs. 5–7). Eggs spherical, about 250–300 μm in diameter. Surface of egg sculptured with irregular polygonal flat-bottomed depressions defined by elevated, interconnected, sharp ridges. Surface pitted, especially on depression surfaces. No spinules, setae, or other superstructural features on depression surfaces or ridges.

Discussion

The original and subsequent descriptions of *Eulimnadia agassizii* by Packard (1874a,b, 1883) were, by modern standards, uncritical or incomplete in most respects. Except for the few figures provided in his last account of the species (1883, plate VII, figs. 5, 6), little detail can be discerned from the collective accounts. Packard (1874a, 1883) mentioned a "pair of long abdominal cirri," clearly depicted, but not labelled, in text fig. 14 of his 1883 paper. Possibly, these are the telsonal filaments of other workers (e.g., Martin & Belk, 1989).

The only other population of this species for which specimens are known to exist occurs in Woods Hole, Massachusetts. Zinn & Dexter (1962) first reported this population and were able to collect specimens in subsequent years. Belk (1989), using SEM procedures, provided a description of the egg from this population to characterize *E. agassizii*. The eggs from specimens examined in the present study of the type series compared well with the eggs of animals from Woods Hole studied by Belk (1989). Other features of the Woods Hole population are worth noting. The specimens are larger than the Penikese Island specimens, reaching 9 mm in length, and the carapace has 4–5 growth lines. The longer and shorter rami of antenna 2 have 8–9 and 7–9 segments, respectively. There are 19 trunk segments (one had 18), the number reported for Penikese Island *E. agassizii* by Packard (1874a) and observed during this study. The telson of each Woods Hole specimen has spines at the distal lateral corners of the ventral border and an average of 16 spines on one dorsal row.

Belk (1989) synonymized *E. stoningtonensis* (Berry, 1926) with *E. agassizii* on the basis of Berry's (1926) indication that the eggs were similar and because the two morphological characters highlighted by Berry (1926), the number of trunk appendages (20) and setation of the second antennae, are known now to be variable among described species of *Eulimnadia*. The Woods Hole specimens are transitional between the Penikese Island animals and the description of *E. stoningtonensis* (no specimens exist) from Stonington, Connecticut, in number of trunk appendages (average of 19 in Woods Hole specimens, 18 in types) and total length. Setation of the peduncle of the second antennae, though understood to be variable, is difficult to assess without specimens to examine. In the absence of any material of *E. stoningtonensis* available for examination, a presumed synonymy might be premature, especially considering the fact that *E. agassizii* is known only from female specimens, thereby suggesting hermaphroditism (*sensu* Sassaman, 1989). Whether or not Berry (1926) encountered males of *E. stoningtonensis* remains unknown. With respect to other described species of North American clam shrimp, no features or variations were detected among the types of *E. agassizii* that would require a revision of the arrangement proposed by Belk (1989).

Belk (1989) remarked that though egg morphology seemed to provide the most reliable means to distinguish among species, additional study would have to be undertaken before a general assessment is made. Indeed, Brendonck et al. (1990), investigating Galapagos forms, indicated that egg morphology was somewhat variable within the species they studied. Martin & Belk (1989) further

stressed the need for SEM techniques in any study of egg morphology to insure accurate interpretation. In at least some North American taxa, as shown by Belk (1989), there clearly exist characteristic morphologies within certain species groups. One aspect of the variability question revealed in this study is that in *E. agassizii* populations collected in nearby localities but almost 100 years apart (Belk, 1989, and this study), there appears to be no temporal variation in egg morphology. This finding lends support to Belk's (1989) assertion that egg morphology is stable within species.

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