NUMBER 258 APRIL 3, 1933

OCCASIONAL PAPERS OF THE MUSEUM OF ZOOLOGY

UNIVERSITY OF MICHIGAN

ANN ARBOR, MICHIGAN THE UNIVERSITY OF MICHIGAN PRESS

NOTES ON THE BRACKISH WATER BIVALVE, *POLYMESODA CAROLINIANA* (BOSC)

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Synonymy of *Polymesoda caroliniana* (Bosc)[1]

Cyclas caroliniana Bosc, 1802, Hist. Nat. Coq., 3: 37, pl. xviii, fig. 4; Chenu, 1845, Biblio. Conch., 3: 27; Dall, 1903, Proc. Biol. Soc. Wash., 16: 6; Walker, 1918, Syn. Fresh-Water Moll. N. A.: 85.

Cyrena caroliniana Bosc, Dall, 1903, Trans. Wag. Free Inst. Sci., 3: 1447.

Cyrena caroliniensis Lamarck, 1818, Hist. Nat. des. An. sans Vert., Part ii, 5: 568; Dubois, 1825, Ep. Lam. Test.: 65; Ravenel, 1834, Cat. Rec. Shells: 4; Conrad, 1853, Proc. Acad. Nat. Sci. Phila., 6: 246; Prime, 1865, Smith. Misc. Coll. 145: 11; Paetel, 1890, Cat. Conch. Samm., (4th Ed.), 3: 97.

Cyrena carolinensis Bosc, Say, 1819, Nich. Encycl., (3rd Ed.), 4: 56; Hanley, 1842, Rec. Shells, p. 93, pl. xiv, fig. 54; DeKay, 1843, Zool. New York, V: 226, pl. xxv, fig. 266; Wheatley, 1845, Cat. Shells U. S., p. 6; Conrad, 1846, Am. Jour. Sci., 2: 394; Gibbes, 1848, Appen. Geol. S. C., p. xxi; Philippi, 1849, Abild. und Beschreib. Conch., p. 8, pl. ii, fig. 4; Deshayes, 1854, Brit. Mus. Conch. II; Say, 1858, Conch. U. S., p. 56, 226; Dall, 1889, Bull. U. S. Nat. Mus.

[1] The use of *Polymesoda* conforms with the views of Dr. H. A. Pilsbry who recently wrote me as follows: "*Polymesoda* was used as a generic name by von Martens, *Biologia Centrali Americana,* Moll., p. 540, 1900, and usually by others who worked with it since 1900. I think the group is generically distinct from the Old World *Cyrenas.* However, the fact is that *Cyrena* will go out, its type being a *Corbicula,* and the Old World group will be called *Geloina* Gray."

37: 56; Simpson, 1889, Naut., 3: 80; Johnson, 1890, Naut., 4: 4; Baker, F. C., 1891, Proc. Acad. Nat. Sci. Phila.: 45; Simpson, 1892, Naut., 6: 40; Hinkley, 1907, Naut., 21: 80; Mazÿck, 1913, Cat. Moll. S. C.: 25; Johnson, 1919, Naut., 33: 7.

Cyrena caroliniensis Bosc, Stark, 1828, Elements Nat. Hist., 2: 100; Hanley, 1842–56, Descrip. Cat.: 93; Holmes, 1860, Post-Pl. Fos. So. Car.: 31, pl. vi, fig. 7; Fischer, 1887, Man. de Conch.: 1091.

Unio carolinianus Bosc, Ferussac, 1835, Mag. de Zool., Nos. 59, 60, V: 26; Conrad, 1853, Proc. Acad. Nat. Sci. Phila., 6: 246.

Cyrena carolinensis Say, Roemer, 1849, Mollusca: 453.

Cyrena carolinensis Lamarck, Nylander, 1921, Naut., 34: 120.

For several weeks during the summer of 1932, the privilege of working at the United States Bureau of Fisheries Station at Beaufort, North Carolina, was extended to me. During that period most of the time was spent collecting marine mollusks, of which there is a remarkably rich fauna. With an interest in Naiades, I made an effort also to locate a freshwater bivalve fauna in the Newport River, in order to study the range of tolerance of Naiades as they approach marine conditions. Unfortunately, it was impossible to find freshwater mussels in the Newport River. This does not imply that they do not exist there, but, in a trip of approximately seven miles up the river with an outboard motor-boat, I could find no Naiades. Several other streams were examined in Carteret County with the same purpose, and with negative results.

While searching for Naiades, it was my good fortune to find *Polymesoda caroliniana* (Bosc) in some of the small creeks belonging to the Newport and Neuse drainages. This species is remarkable particularly for the wide range of tolerance that it possesses in the matter of salinity. An attempt was made to determine the extremes of conditions to which it is subject, though, with the short time available, only little could be learned about the ecology of this form. Since the species is so readily available to investigators at the Beaufort Laboratory, a summary has been made here of what is known about it, adding such information as was obtained during the past summer.

Polymesoda caroliniana was first noticed in Back Creek (Carteret County) a small branch of Adams Creek, which empties into the Neuse River. Sixteen specimens were collected at this station. The water was rather deep in the center of the creek, and the bottom being very muddy, it was necessary to collect at the edge of the stream by leaning far over the gunwale of the boat and feeling along the banks. The water had a brownish color, making it impossible for one to see the bottom. By feeling in the mud which lined the nearly perpendicular shore those specimens situated close to the banks could be located. Several places were examined along this same shore, and it was noticed that the species was rather local in its distribution. It seemed unobtainable in situations where large quantities of dead twigs had accumulated, preferring situations which were free from decaying wood and other vegetation, which was very common in the stream. This perhaps accounts to a large extent for the tea-brown color of the water. The pH was not determined, but since every specimen collected had eroded umbones it is safe to assume that acid conditions prevailed. A sample of the water was taken and tested at the Beaufort Laboratory for salinity. The sample was collected during ebb tide at about the depth at which the shells were found. The water proved to be decidedly brackish, with a salinity of 1.01425, or 18.63 parts per thousand.

In the laboratory two specimens were dissected. The remaining fourteen were used to test the degree of tolerance to marine conditions. They were placed in a small glass aquarium whose bottom was covered with about two inches of sand to serve as anchorage. It must be admitted that mud would have been a more suitable medium, but none had been collected at the time the shells were taken. The mollusks were supplied with a small stream of running water which was pumped from Beaufort Harbor at the southwest part of Piver's Island. Salinity tests taken at intervals indicated that the supply was normal sea water. At the end of two weeks it was necessary to discontinue the experiment. At that time there were still nine individuals of the fourteen alive.

The nine were medium sized specimens; the older individuals apparently died first. The bodies of the surviving specimens were so emaciated that it was evident that they had suffered starvation. Apparently, the food necessary for their existence was not present in the normal sea water of the harbor. Or might it have been impossible for them to take food at so high a salinity? It was, however, most remarkable how well these specimens survived when exposed to pure marine conditions over so extended a period of time.

A few days after finding *P. caroliniana* in Back Creek, a trip was taken by automobile to Harlowe Creek, a stream belonging to the Newport River drainage and entering it by way of the old Core Creek Canal. Collecting was done at North Harlowe (Carteret County). Here again this species was common under conditions quite similar to those noted at Back Creek, except that the water was not so conspicuously brown. Unfortunately, the tide was high at the time of collecting, which made it difficult to get the material in quantity. In spite of high water, a good series was taken from the mud forming the bottom of the creek. A salinity test again indicated decidedly brackish conditions, the figures being 1.01542, or 19.2 parts per thousand. The associates noted in this habitat consisted of a few small fishes, crabs, and *Modiola.*

Though it was not possible to check the stream during a heavy rain coupled with an ebb tide, it is my opinion that at such a period one would find this species exposed to water of a density nearly approximating that of fresh water. That the species is at times exposed to virtually fresh water was found to be the situation at another station. In the early part of August, Dr. Prytherch and I made a trip by motor-boat up the New Core Creek Canal, an inland route connecting the Newport and Neuse rivers. We had gone several miles when we noticed a small creek entering it. Upon investigation we found it ran at right angles from the canal for about one hundred feet and then branched into **T**-shaped tributaries. We were unable to find *P. caroliniana* in the first stretch. When we came to the fork, Dr. Prytherch agreed to examine the

right branch while I examined that to the left. We had hardly started when he found a single specimen in the soft mud only a few feet from where the stream forked. The tide was low while we were at this station, with the result that a very small stream of water was trickling through the tributary in which the specimen was found. A careful search was made for other individuals, but none could be found. A sample of the water tested at the laboratory gave the remarkable salinity of 0.9985, which for all practical purposes, might be considered fresh water.

Here, then, we found a specimen exposed to fresh-water conditions. From a reliable source I was informed that at high tide the salinity of the Core Creek Canal increases considerably. Since the tributary creek is so small and so near to the canal one has good reason to suppose that the species is subject to the very extremes of density within the few hours between the lowest ebb and the highest flood tides. Other brackish water life, such as small fish and crabs, was noted at the stations, but these forms are usually capable of migrating in order to adjust themselves to such rapid changes in conditions. *Polymesoda,* so far as could be determined from observations made in the laboratory, hardly moved from the places in which it was stationed in the aquarium. It is, therefore, likely that it possesses an entirely distinct physiological mechanism to adjust itself to the periodical alterations of the environment.

The shell is found in many collections and is known to most students. The less familiar animal, however, has never been figured. The general shape is oval. Mantle membranous, its margins slightly thickened with a finely papillated inner fold (fig. 1). Mantle margins free below, joining anteriorly in front of the anterior adductor. Posteriorly they join below the posterior adductor and above the anal siphon (figs. 3 and 6). They do not join to form the siphons, but surround them. Siphons are short, separate, and often pigmented. The anal siphon is smaller and usually simple, though it sometimes has minute papillae. The branchial siphon is larger and papillose

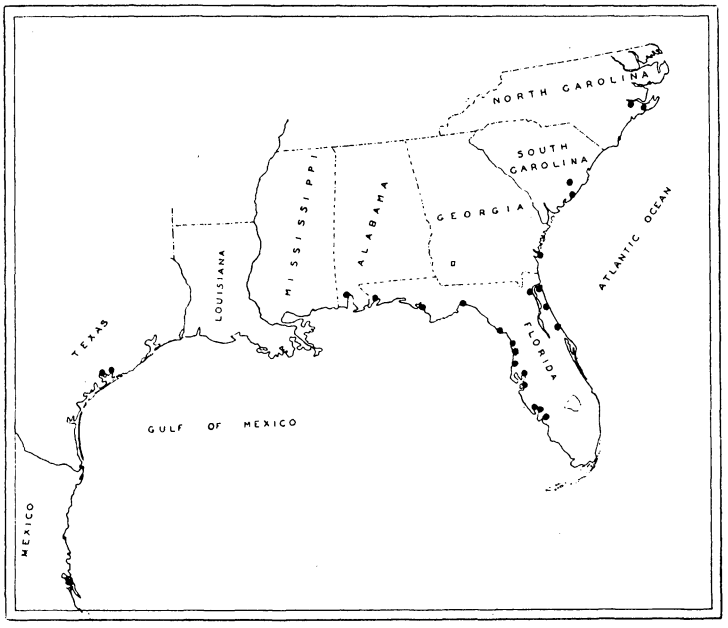
(fig. 6). The foot, when contracted, is thrown into a series of folds (fig. 3). The outer gills do not coincide with the inner in position, but are situated considerably higher. The upper half of the outer gill is thinner than the lower half and is joined to the mantle in the region of the pericardium. The inner lamina of the outer gill joins the outer lamina of the inner gill at about the center of the outer gill (fig. 3). The gills unite posterior to the visceral mass. In size the gills vary little, the inner being slightly smaller. There are two pairs of labial palps, a pair on each side, whose furrowed surfaces oppose each other. The inner palps are joined to the visceral mass, and the outer are partly joined to the mantle. The palps extend anteriorly to form the upper and lower lips. The mouth is large, transverse, and almost rectangular.

Dr. Wm. H. Dall has shown that the American Cyrenidae differ from the Old World species and those found in the Oriental seas at mouths of rivers mainly in possessing a more distinct pallial sinus (*Trans. Wagner Free Inst. Sci.*, Phila., 1903, 3, Part VI: 1444). This implies that there exists a well developed siphonal retractor muscle (fig. 3). The relationship of the function of this muscle to the varying ecological conditions to which the American species are subjected is of interest. Is it true that the members of the genus on other continents are subject to less extremes of density and therefore either lack a pallial sinus or possess only a trace of it?

Distribution

Through the courtesy of Mr. William B. Marshall of the National Museum, Dr. H. A. Pilsbry of the Academy of Natural Sciences of Philadelphia, and Mr. William J. Clench of the Museum of Comparative Zoology, I have been enabled to chart the range of *P. caroliniana* in much more detail than if I had depended solely on the literature. Each of the gentlemen sent me lists of the localities from which they had specimens. It was interesting to learn from these lists that the species was unknown from North Carolina.

The map shows definitely what is known of the distribution. The southern extreme is the region of Tampico, Mexico.[2] The northern limit appears to be the area of the Neuse River, North Carolina. Mazÿck reports the species to be common in the rice fields of South Carolina. There are several records of occurrence in Georgia. The records for Florida indicate a wider distribution on the west side of the peninsula than on the east side. This might be expected since there are more



The distribution of *Polymesoda caroliniana* (Bosc)

streams favorable for the habitation of *P. caroliniana* on the Gulf side than exist along the shore of the open Atlantic Ocean. From Florida southwest and west, the records are meager. It is particularly striking to note that there are no

[2] After writing this and making the map, I discovered that Mr. F. C. Baker reports this species from Vera Cruz, Mexico. (*Proc. Acad. Nat. Sci. Phila.*, 1891: 48.) This record extends the southern range about 200 miles.

records from Mississippi and Louisiana. This is perhaps not due to the absence of the species in those states, but rather to the fact that the brackish streams of the region have not been examined by naturalists interested in mollusks. The records for Texas and northeastern Mexico are sparse, but are thoroughly authenticated.

In one of the lists received is a single record, "Baker County, Georgia." This locality is too far inland to be influenced by the ocean tides, and it is known to have the typically fresh-water molluscan fauna of the southern coastal plain. It seems probable that there has been in this instance an inadvertent transfer of labels, if not, more likely, an error on the part of the original collector. The locality has been indicated on the map by a symbol different from that used for the other records.

PLATE I

All figures are of specimens taken from Back Creek, a branch of Adams Creek, Carteret County, North Carolina.

FIG. 1. Interior of right valve with dissection to show some of the internal anatomy.

FIG. 2. Interior of left valve.

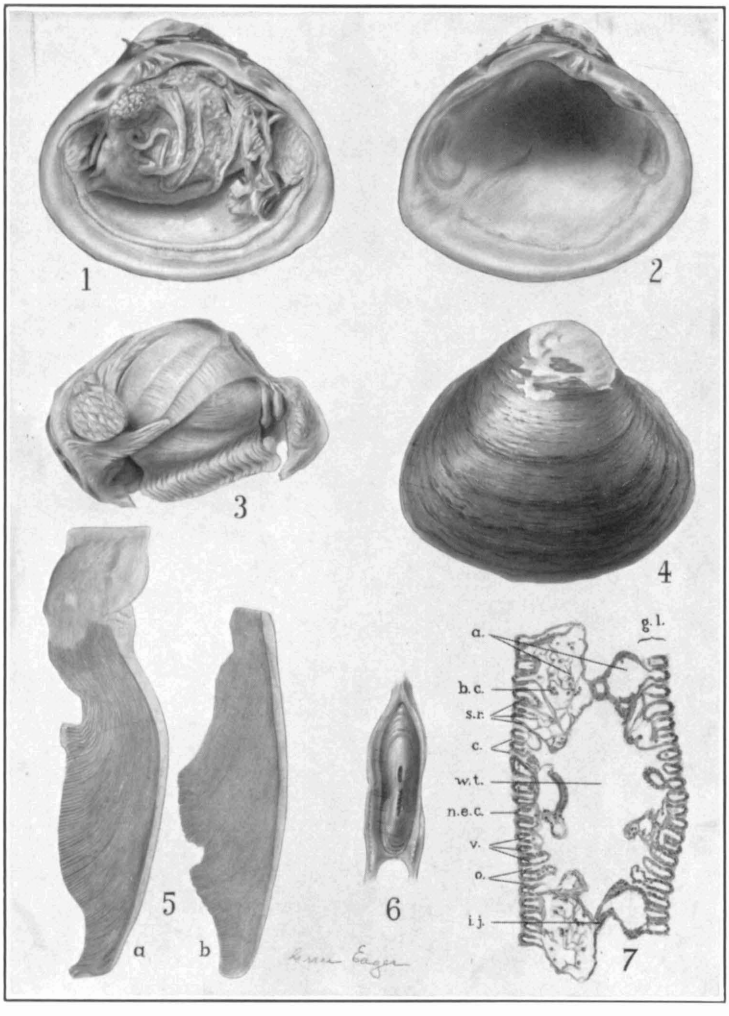
FIG. 3. External anatomy with mantle lobes removed.

FIG. 4. Exterior of right valve.

FIG. 5. Labial palps.
a. Right outer palp.
b. Left inner palp.

FIG. 6. View of siphons to show their relationship to the mantle folds.

FIG. 7. Cross-section of outer gill.
o.—ostia
g.l.—gill lamina
c.—cilia
s.r.—supporting rods
w.t.—water tube
v.—veins
a.—arteries
n.e.c.—nuclei of epithelia cells
b.c.—blood corpuscles
i.j.—interlamellar junction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