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Discovery of the Carolina Marsh Clam, *Polymesoda caroliniana* (Bosc), A Supposed Florida Disjunct Species, in Everglades National Park, Florida

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DISCOVERY OF THE CAROLINA MARSH CLAM, *POLYMESODA CAROLINIANA* (BOSC), A SUPPOSED FLORIDA DISJUNCT SPECIES, IN EVERGLADES NATIONAL PARK, FLORIDA[1]

by

D. C. Tabb and D. R. Moore

INTRODUCTION

The presence of disjunct species of animals on either side of the Florida peninsula has been reported by a number of authors. The littorinid mollusk, *Littorina irrorata* Say, which has a range from Massachusetts to the Rio Grande of Texas, except for south Florida, is one such species (Bequaert 1943). The marsh crab, *Sesarma cinereum* (Bosc), is another example of an animal with a distribution from Virginia to the western Gulf of Campeche except for a break in southern Florida (Rathbun, 1918). Williams (1965) lists 23 species of crustaceans having interrupted distribution at the Florida peninsula. This report on discovery of a breeding population of the Carolina marsh clam, *Polymesoda caroliniana* (Bosc) in southern Florida supports the contention by Hedgpeth (1953) that at least some, perhaps many, of the disjunct records may be a result of insufficient collecting in south Florida. The Carolina marsh clam has been assumed to be a typical disjunct species since it was described as such by van der Schalie (1933). It was not included in Marine Shells of Southwest Florida by Perry (1940) nor in Florida Marine Shells by Vilas and Vilas (1945). Abbott (1954) apparently knew of no southern Florida material, and recent examination of collections of this species in the U. S. National Museum provided no material south of New Smyrna on the east coast or Fort Myers on the west coast of Florida. Gunter and Hall (1963) found a breeding colony in the St. Lucie River estuary near Fort Pierce, Florida extending the range nearly 275 km farther south along the Florida east coast but gave no details on the size of the population.

The initial discovery of a single valve of the Carolina marsh clam in extreme southern Florida was made by Tabb and Manning (1961) in deltaic muds at the mouth of the East River where it enters Whitewater Bay in Everglades National Park. Since 1962 sufficient discoveries have been made in Everglades National Park to prove the existence of a breeding population occupying two rather different but adjoining habitats over an extensive area of southern coastal marsh (Figure 1).

[1] Contribution #1395 from the University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami, Florida.

SYNONYMY AND DIAGNOSIS

When the first specimen was found in Everglades National Park it was necessary to consult several old publications for a description, and to unravel the synonymy. Because of the general scarcity of these publications and relative rarity of the species it is thought desirable to reproduce the most important of these references.

Dr. H. A. Rehder, Research Curator of Mollusks, U. S. National Museum, has kindly made the following comments concerning the nomenclature: "*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."

Diagnosis of Family *Cyrenidae* (=*Corbiculidae*) after Dall, Wm. H., 1895.

p. 540. Anatomy as in *Veniellinae*, except that the mantle is more open ventrally, the siphons distinctly developed, short, united more or less, usually with papillose orifices; dioecious; fluviatile or estuarine.

Shell porcellanous, with a conspicuous epidermis, usually with concentric sculpture; valves equal, free, closed, usually with plain margins; area obscure or none; ligament and resilium external, paravincular, opisthodetic; adductor scars subequal, separate from the pedal; pallial line simple or with a small sinus; hinge with anterior and posterior laminae usually double in the right, single in the left valve, distinctly separated from the cardinals; cardinal teeth bifid at the summit, three in each valve when none are obsolete.

Lias to Recent fauna.

Synonymy after Dall, Wm. H., 1903.

p. 1447. *Cyrena* (*Polymesoda*) *caroliniana* (Bosc)
Cyclas caroliniana Bosc, Hist. Nat. des Coq., iii., p. 37, pl. xviii., fig. 4, 1802; Say, Am. Conch., vii., lxii., 1833.

Cyrena caroliniensis Lamarck, An. s. Vert., v., p. 553.

Cyrena carolinensis Hanley, Rec. Shells, p. 93, pl. xiv., fig. 54, 1842.

Cyrena caroliniensis Holmes, Post-Pl. Fos. S. Car., p. 31, pl. vi., fig. 7, 1860.

Cyrena floridana Sowerby, Conch. Icon., 1878; not of Conrad, 1846.

Pleistocene of Simmons Bluff, South Carolina, and of North Creek near Osprey, on the west coast of Florida; Recent from South Carolina to Florida and westward to the coast of Texas, in streams and brackish water near the sea.

Synonymy after van der Schalie, H., 1933.

Cyclas caroliniana Bosc, 1802, Hist. Nat. Coq., 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 caroliniensis Bosc., Dall, 1903, Trans. Wag. Free Inst. Sci., 3: 1447.

Cyrena caroliniensis Lamarck, 1818, Hist. Nat. des An. sans Vert., Part ii, 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. 37: 56; Simpson, 1889 Naut., 3: 80; Johnson, 1890, Natur., 4: 4; Baker, F. C., 1891, Proc. Acad. Nat. Sci. Phila.: 45; Simpson, 1892, Naut., 6: 40; Hinkley, 1907, Naut., 21: 80; Mazyck, 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., No's. 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.

DISCUSSION

Following the first discovery of *P. caroliniana* at the mouth of the East River in Everglades National Park (Tabb and Manning, *op. cit.*) no additional material was found there until the

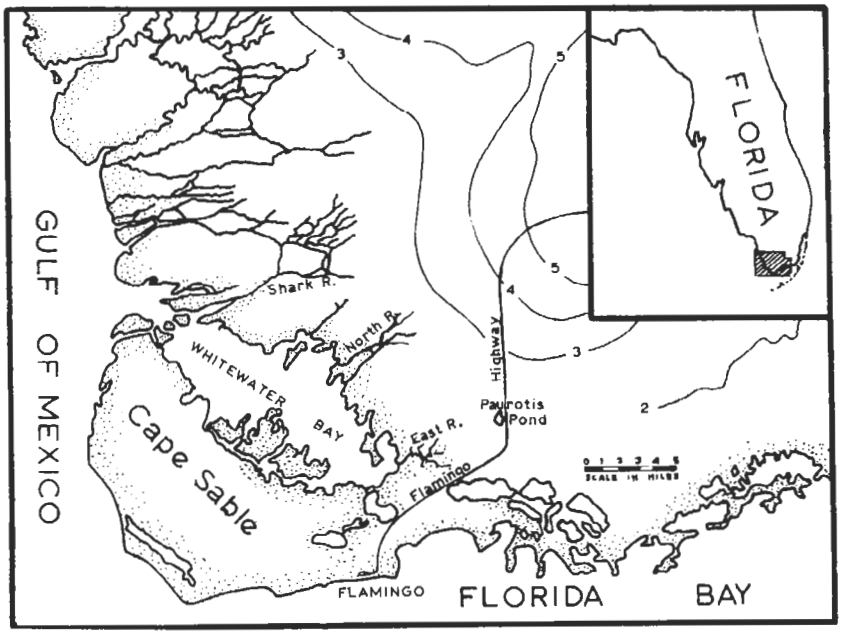

Figure 1. The Cape Sable region of South Florida showing Paurotis Pond and the North and East River systems where *Polymesoda caroliniana* populations are known to occur.

period of 4-23 March 1962 when large numbers of moribund specimens were found being washed ashore at Paurotis Pond, a fresh-water lake about 12 miles north of Flamingo on Florida Highway 27 (Figure 1).

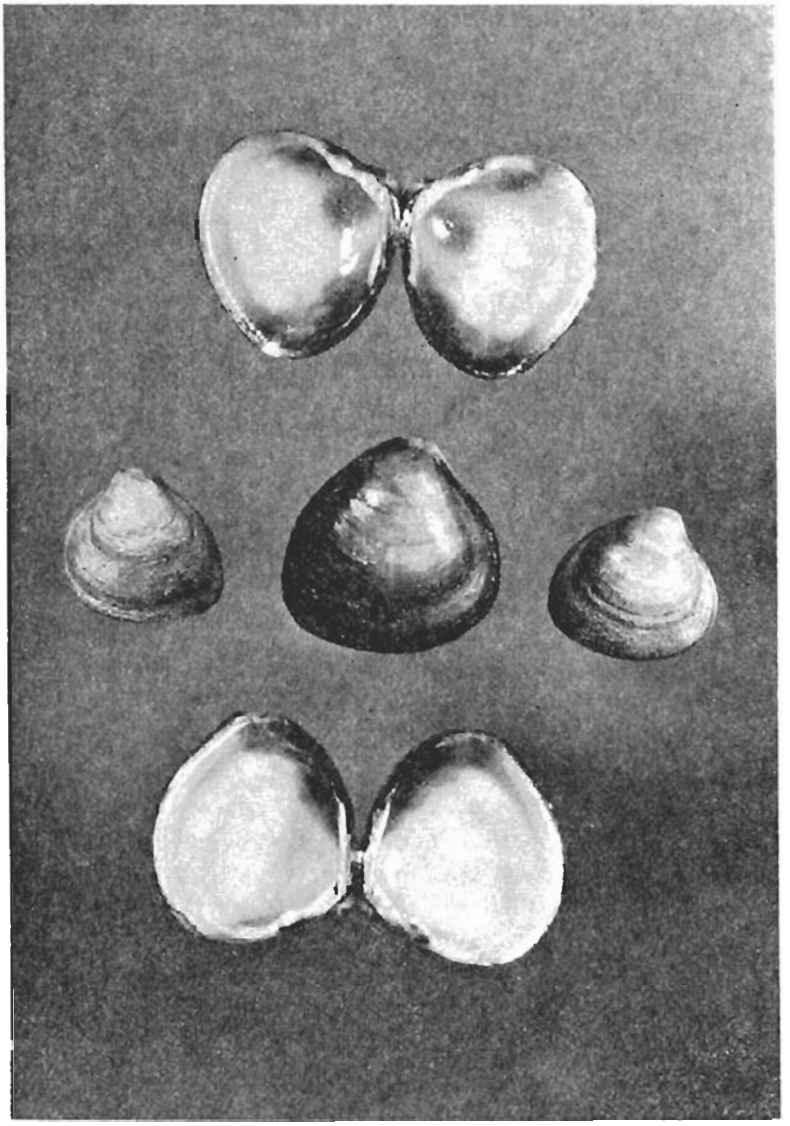

Figure 2. External and internal aspect of shells of *Polymesoda caroliniana* from Paurotis Pond showing thick, highly colored valves with flaky periostracum.

The abnormal condition under which the specimens were collected was a result of a severe, prolonged invasion of wind-driven salt water from Whitewater Bay during a southerly windstorm on March 4 through 10 (Craighead and Holden 1965). This saline invasion occurred at the peak of a severe drought which had lowered the levels of fresh water in the coastal region surrounding Paurotis Pond thus paving the way for replacement by wind-driven salt-water. During the saline intrusion the salinity increased from 2 ppt to 20 ppt in six days.

Many hundreds of the clams, all near the 40.0 mm maximum size for the species given by Abbott (*op. cit.*) were washed ashore by the strong winds which caused the saltwater invasion. After stranding they were killed by the heat of the sun and then preyed upon by crows, racoons and seagulls from nearby Florida Bay. Although the mortality of *P. caroliniana* from these causes was extensive it was apparently not total, because a visit to the pond on the following May 4 produced a small sample of living adults. At that time the salinity had fallen to about 12 ppt. The survivors were located in 0.5 to 0.8 m of water in soft, fine-grained calcium carbonate mud having the local name of Flamingo marl.

Until August 1965, the Paurotis Pond population was the only known concentration of this species in the Park. However, during August and September 1965, and again in March 1966, additional specimens were found in headwater marshes of the North River some 13 km west of Paurotis Pond and about 5 km inland from the northern edge of Whitewater Bay.

HABITAT

P. caroliniana of Everglades National Park occurs in soft mud, generally 2.5 to 5.0 cm below the surface film of benthic algae and organic debris. All living specimens found by us have been in water less than 1 m deep although dead shell can be found on the bottom of the North River in 1 to 2 m depths.

The Paurotis Pond population occurs most abundantly in marginal shallows where the fresh-water needle rush, *Eleocharis cellulosa* Torr. is abundant, and where the yellow-flowering bladderwort, *Utricularia lutea* Birdsey and the euryhaline green alga, *Batophora oerstedi* var. *occidentalis* (Harvey) Howe, occur side-by-side. The water in this area is characteristically clear and without color imparted by organic material. The clarity of the water, the characteristically high pH of 7.8 to 9.0, and the general absence of humus in the mud all combine to produce a brightly colored form of *P. caroliniana* (Figure 2) having a high gloss, straw-yellow flaky periostracum and no erosion of the shell at the umbo as reported by van der Schalie. In addition to the above characteristics the shells of the Paurotis Pond population are more massive than specimens from the North River population.

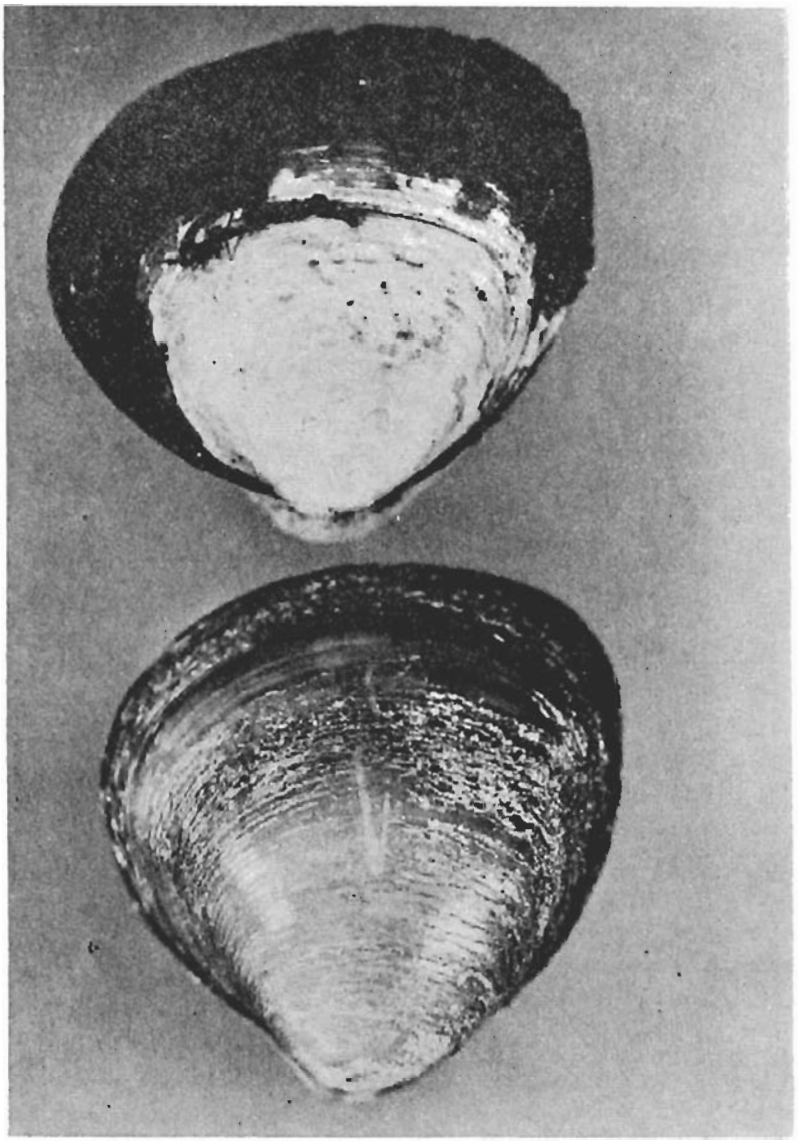

Figure 3. Comparison of external appearance of adult *Polymesoda caroliniana* from Paurotis Pond (upper) and North River (lower).

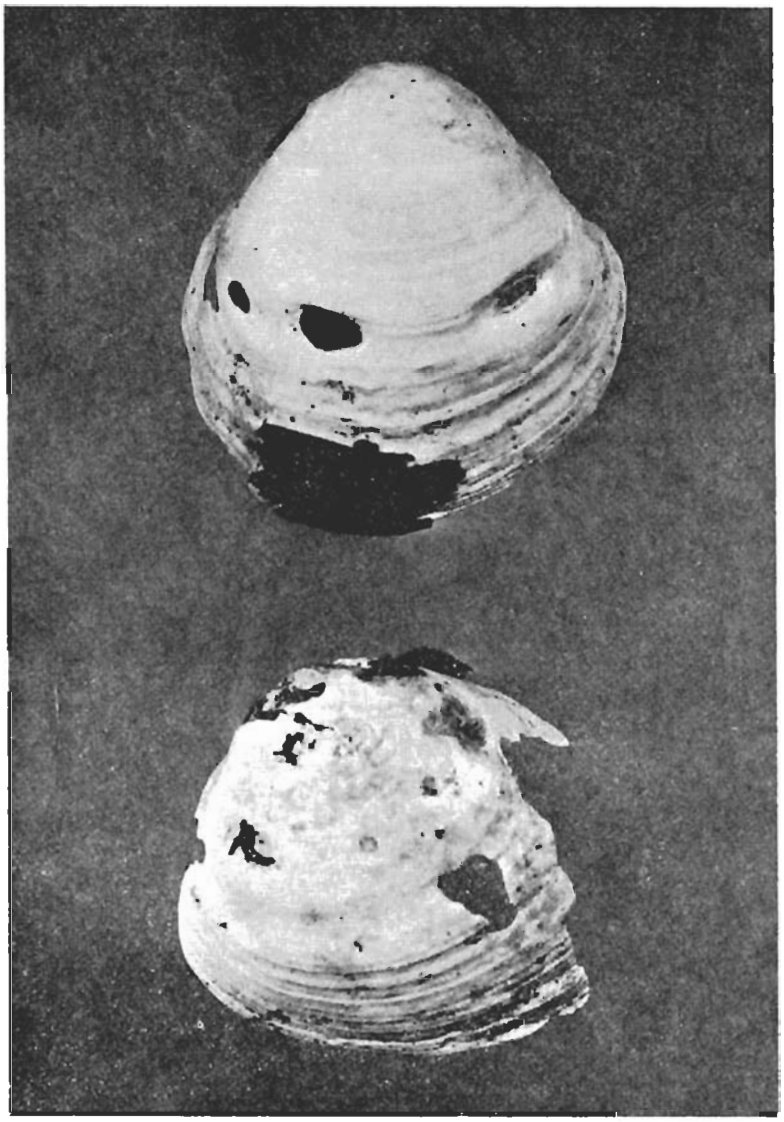

Figure 4. Single values of *Polymesoda caroliniana* from North River peat marsh illustrating eroded condition of the shell material approximately 6 months after death of the animal. Note periostracum fragment still adhering to upper specimen.

In the North River the living clams were found in an environment like that described by van der Schalie in that they occur in the soft mangrove peat deposits along the edges of the brackish-water creeks. In the same region small specimens may also be collected at some distance back from the creek edges in seasonally flooded marshes where water depth fluctuations of 15 to 60 cm are common due to accumulation of fresh-water runoff during the rainy season.

All living specimens in the North River peat had eroded umbos, thinner chalky shells, thick, dark periostracum and somewhat longer and flatter shell profile (Figure 3). The peats are slightly acidic and the shells are quickly eroded by solution after death of the animal (Figure 4). The shells dissolve appreciably in 3 to 4 months when left in flooded mangrove leaf litter in the marsh shallows. Solution of the calcified shell material is often far advanced before the periostracum has decomposed.

The dominant emergent vegetation in the North River habitat is a mixture of black rush, *Juncus roemerianus* Scheele, and stunted red and white mangroves, *Rhizophorae mangle* L. and *Laguncularia racemosa* Gaertn.

Van der Schalie subjected *P. caroliniana* from Back Creek, a tributary of the Neuse River near Beaufort, North Carolina, to "normal sea water" for 2 weeks. After that period 9 of an original 14 animals used in the experiment were still alive but the "bodies of the surviving specimens were so emaciated that it was evident that they had suffered starvation". Considering that his 14 test animals were collected from waters having salinity of 18.63 ppt and placed in "normal sea water" which, presumably was at about 35.00 ppt it is likely that they were also seriously affected by salt. The mortality at Paurotis Pond in Everglades National Park was initiated by salt intrusion which finally led to stranding and predation. Considering the habitat salinity of the breeding populations in Everglades National Park it is likely that the normal salinity range will be about 0.5 to 10.0 ppt with occasional rises to 12.0 to 15.0 ppt. The limited observations we have on reproduction, as indicated by the presence of 2-5 mm young, suggest that this occurs at salinity under 5.0 ppt and probably is most successful in fresh water. Van der Schalie himself took them in fresh water and noted that "Mazyck (1913) reports the salinity probably does not exceed the 3.5 ppt salinity tolerated by wild rice of the region (Palmer 1949)."

Table 1 records the salinity, temperature, and dissolved oxygen conditions prevailing at one of the marsh stations in the North River where a large colony was found. Living animals were collected at that station until late March 1966, when salinity exceeded 15.0 ppt and water temperature rose to 24.5° C.

Table 1: Maximum, minimum and average salinity (ppt.), temperature (C°) and average dissolved oxygen values (ppm) for five day sampling periods in each month measured at North River Station 6, Everglades National Park.

	Salinity (ppt)			Temperature (C°)			Oxygen (ppm)
	Maxi-mum	Mini-mum	Aver-age	Maxi-mum	Mini-mum	Aver-age	
1965							
17-20 Aug	20.8	17.7	19.3	32.3	30.0	31.7	3.75
13-17 Sept	0.0	0.0	0.0	29.0	24.8	27.9	0.80
11-15 Oct	5.5	0.0	3.0	28.2	23.9	26.4	2.75
8-12 Nov	10.0	6.2	7.9	25.6	24.2	25.5	5.20
6-10 Dec	8.0	5.9	6.5	21.0	17.7	19.7	6.00
1966							
3-7 Jan	13.4	9.5	10.9	24.0	21.0	22.6	5.75
28 Feb	13.8	12.5	12.9	18.0	14.4	16.5	6.75
1-4 Mar	15.5	14.6	15.0	24.0	23.5	23.7	4.50
28 Mar*	23.4	21.0	22.5	24.8	21.0	24.5	5.40
25-29 Apr	26.5	22.0	24.6	25.3	23.0	25.2	4.40
23-7 May	25.0	20.0	22.4	31.5	28.5	30.0	3.80
20-24 June	0.0	0.0	0.0	32.8	29.0	30.5	2.05
18-22 July**	0.0	0.0	0.0	31.0	29.6	30.5	2.60
15-19 Aug	0.0	0.0	0.0	29.7	29.0	29.4	2.00

*Point of apparent total mortality of population at station 6.
**Reproduction indicated by presence of 4-7 mm young in sediments of channel edges.

Successful re-colonization of the station, as evidenced by 2.5 mm young, was observed during the following July after the marsh had been re-flooded by fresh water. Gunter and Hall *(op. cit.)* recorded salinity of 0.15 to 26.3 ppt where *P. Carolin-iana* occurred in the St. Lucie River with the majority of young animals (6 to 18 mm) being found when salinity was below 1.0 ppt. In a later paper (Gunter and Hall 1965) they recorded 109 specimens in the Caloosahatchee Estuary of Florida at salinities ranging from 0.13 to 19.8 parts per thousand. The length range was 7-25 mm.

SIZE AT MATURITY

Abbott (*op. cit.*) gives the size of *P. caroliniana* as 25.5 to 38.0 mm in length and about as high. This is in general agreement with measurements of south Florida specimens. A series of 25 adults from Paurotis Pond ranged from 27.0 to 36.0 mm in length, averaging 31.8 mm. The range in height was 26.0 to 33.0 mm with an average of 29.7 mm.

Shells of the North River series were noticeably larger. The shell length range was 33.0 to 47.0 mm with an average for the series of 40.3 mm while the height range was between 30.0 and 38.0 mm with an average of 36.2 mm.

No growth estimates are possible at this time, but the ultimate size of the mature individuals suggests that conditions for growth are somewhat more favorable in the North River habitat than in Paurotis Pond. This might be expected since the North River population is most abundant along the edges of marsh drainage channels where water movement, hence food availability, is most dependable. In Paurotis Pond, the water movement is caused almost exclusively by wind circulation.

CONCLUSIONS

The Carolina marsh clam, *Polymesoda caroliniana* (Bosc), is not a Florida disjunct species, but instead it occupies a restricted habitat in coastal marshes where little collecting has been done until recently.

Before drainage of coastal marshes it is probable that the species distribution was continuous along the east Florida coast in the marsh belt adjacent to the coastal lagoons and estuaries. However, as these marshes were drained for development of cities, breaks were made in the distribution.

Thus, colonies probably exist today only in extensive remnants of the marshes which have nearly natural overland flow of fresh water emptying into coastal bays and estuaries, such as that found in Everglades National Park.

The optimum habitat in southern Florida is found in a narrow belt of shallow marshland where the mangrove forests intergrade with fresh-water flora of the interior. The normal depths of water there range between 0.25 and 1.0 m. The salinity range there is 0.0 to 10.00 ppt but may rise to 20.0 ppt or higher during drought or during wind-driven intrusions of sea water.

The adults at least can tolerate salinity as high as 26.3 ppt for short periods of time but become adversely affected when salinity rises above 18 to 20 ppt.

South Florida populations apparently spawn during the spring and early summer coincident with the onset of the rainy season.

Discovery of the population of marsh clams in Everglades National Park provides yet another important reason for preserving the traditional volume and seasonal pattern of overland flow of fresh water into coastal marshes there.

ACKNOWLEDGEMENTS

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Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6