

head "plume" or "fan"; operculum spherical or fig-shaped.

Distribution: Florida, Louisiana; east coast of Central America; Caribbean.

Habitat: Epifaunal on submerged roots, shells of mollusks and crustaceans, and other hard substrata; protected estuarine waters (i.e. marsh tide pools) in salinities from less than 2‰ to over 25‰.

Remarks: This little serpulid was described from tubes attached to the carapace of a freshwater shrimp, *Macrobrachium americanum* Bate, 1868, collected at Miami, Florida. I have seen thousands of its tubes clustered on the submerged roots of *Spartina* marsh grass in the vicinity of St. Marks, Florida. It also occurs in the low salinity waters of Lake Pontchartrain, Louisiana. It has not yet been reported from the coasts of Mississippi or Alabama. No other serpulids are known from tidal marshes along the northern coast of the Gulf of Mexico.

References: Ten Hove and Weerdenburg (1978).

PHYLUM MOLLUSCA (MOLLUSKS)

Members of two classes of this phylum, the Gastropoda (snails and conchs) and the Bivalvia (clams and mussels), are important parts of the tidal marsh fauna. One member of the Class Cephalopoda - the common, estuarine squid, *Lolliguncula brevis* (Blainville, 1823) - during warmer months enters tidal marsh bayous and creeks where salinities are above 20‰. *Lolliguncula* is primarily a pelagic form that occurs intermittently along the edges of tidal marshes, where it feeds on shrimps and small fishes.

I have collected or there are reports of at least 16 species of gastropods and 9 species of bivalves in the tidal marshes of the northern Gulf of Mexico. Authorities disagree on the classifications above the family level (subclasses, superorders, orders, etc.) for the Classes Gastropoda and Bivalvia. For detailed listings of these various taxonomic categories, the works of Abbott (1974) and Andrews (1977) should be consulted.

Class Gastropoda (Gastropods)

Family Neritidae (Nerites)

The family Neritidae, along with several other families, has been placed in a group called the Archiogastropoda (=Diotocardia). The gastropods belonging to this group are characterized by a pair of unipectinate gills, or as in Neritidae, a single bipectinate gill.

Neritina usnea (Röding, 1798)

Figure 6

Common Name: Olive Nerite

Synonym: *Neritina reclivata* (Say, 1822)

Recognition Characters: Size 10 to 14 mm; shell globular, greenish-brown or light brown with surface having many transverse, often wavy, dark lines; body whorl large, expanded; spire low, often eroded; animal with single bipectinate gill.

Distribution: Atlantic coast from North Carolina to Florida; entire Gulf coast; east coast of Mexico to Central America.

Habitat: Estuarine in shallow bays, ponds, bayous and tidal marshes; euryhaline in salinities from less than 1‰ to over 40‰; lower intertidal and silt substrata rich in organic matter, submerged vegetation (*Ruppia*, *Valasinaria*).

Remarks: This snail was long known by the name *Neritina reclivata*; however, recent reports (Porter, 1974; Clarke, 1978) list this name as a synonym under the obscure and older name *N. usnea*. Since the name "*usnea*" has been used so rarely in the past, it may eventually be surpassed by taxonomists in favor of the familiar and well-used name "*reclivata*."

This globular, euryhaline snail, one of the most common invertebrates found in the protected shallow bays and bayous of the Gulf coast, is often numerous in damp, lower, intertidal areas of tidal marshes. I have observed specimens climbing up the lower parts of *Spartina* stalks to graze on encrusted algae and other microflora that often occur there. On Horn Island, Mississippi, *Neritina* occurs in tide pools that sometimes have salinities exceeding 40‰, whereas large numbers of specimens have been collected in the St. Marks River in Florida from water that is fresh except during very high tides.

One of the most frequent requests that I receive from laymen, students, and colleagues is to identify the egg cases of *Neritina*. During the breeding season in the warmer months, females may lay over 50 small, white, oval, egg capsules measuring about 1 mm in diameter. The female snail deposits the conspicuous, white capsules on marsh grass stems, submerged vegetation, living and dead mollusk shells, dead wood, and any other hard surfaces available. When laid, each egg capsule usually contains from 60 to 80 eggs. The capsule ruptures several days after being laid, releasing planktonic veliger larvae with small, embryonic shells. The veliger larvae remain in the plankton and grow until they settle to the bottom as small juveniles to begin a bottom-dwelling existence.

Populations of *Neritina* in the bays and marshes are thought to be an important food for wild ducks. I have observed blue crabs and Gulf toadfish eating adult snails and seaside sparrows eating juvenile snails. The shells of *N. usnea* from marsh tide pools often are encrusted with barnacles (*Balanus* spp.), and bryozoans (*Membranopora*). In marsh pools at St.

Marks, Florida, shells were found fouled with tubes of serpulid polychaetes (*Ficopomatus miamiensis*).

References: Andrews (1935); Andrews (1977); Clarke (1978); Porter (1974).

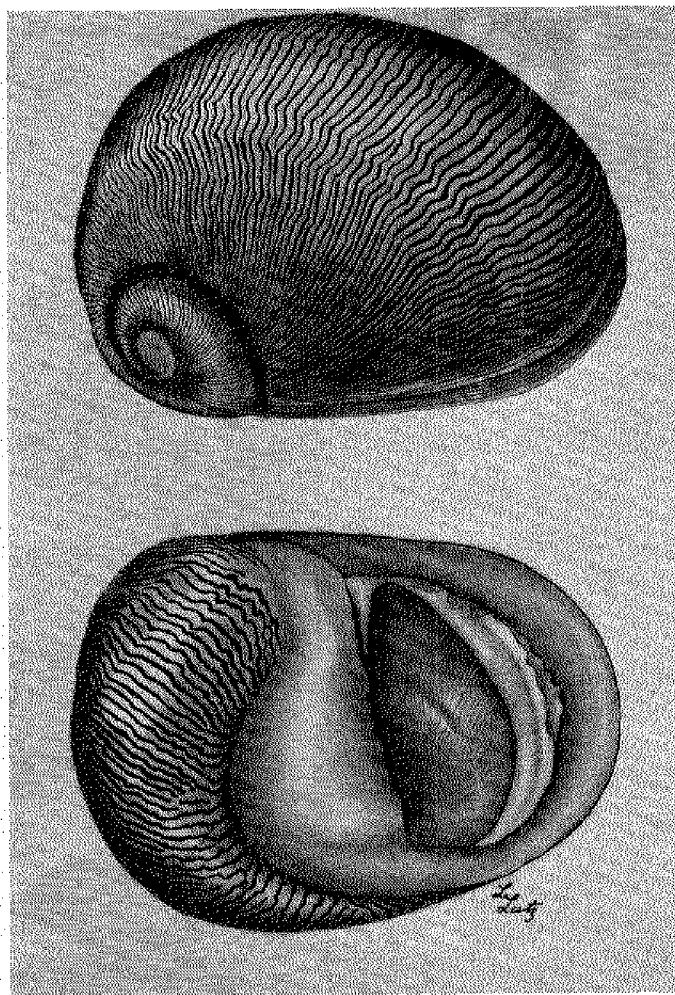


Figure 6. *Neritina usnea* (= *N. reclinata*): dorsal and ventral aspects of shell.

Family Hydrobiidae (Hydrobiids)

Members of this family can be found in large numbers in marsh pools and other wet areas of Gulf tidal marshes; however, they often are overlooked by the casual observer because of their very small size. Eight or more species occur in the estuarine areas of the northern Gulf of Mexico, and of these, at least six can be found in tidal marsh habitats. Hydrobiids feed on detritus and its associated microflora. Since their populations are often large, in some cases exceeding 10,000 snails per square meter, and since they have a rapid feeding rate, these small snails may be ecologically important in some tidal marsh systems.

The taxonomy of the Gulf species is still unsettled, and several new species may be present. The shells of some species are almost identical; however,

the males of these forms can often be separated by the number and kind of papillae on their copulatory organs (verges). Other characters used to separate closely related hydrobiid species include the number of gills and morphology of the female reproductive system. This requires refined dissecting and histological techniques, which are beyond the scope of this guide. Help from an expert will often be required to identify many hydrobiid snails because of their small sizes and similar appearance.

Littoridinops palustris Thompson, 1968

Figure 7 e; 8 d

Recognition Characters: Small, reaching 4.5 mm in length; shells similar to *Littoridinops monroensis* (Frauenfeld, 1863); verge of male usually with single row of 8 to 15 papillae on convex margin and 2 to 3 subterminal papillae on concave margin.

Distribution: Coast of the Gulf of Mexico from western Florida (Yankeetown) to eastern Louisiana (Lake Borgne).

Habitat: On muddy or silty substrata rich in organic matter; intertidal in marshes and shallow bays immediately adjacent to land; or subtidal, associated with widgeon grass (*Ruppia*) in shallow bayous and bays; wide range of salinities from nearly fresh to over 25‰.

Remarks: In the wetter parts of tidal marshes this hydrobiid is often one of the most common and important invertebrates. These little snails apparently feed on microflora (diatoms, filamentous algae, bacteria) and other organic matter occurring on the marsh floor or on the surfaces of living or decaying vegetation. I have found these snails in the stomachs of blue crabs, killifishes (*Fundulus*), and seaside sparrows, and undoubtedly they are eaten by other animals such as mud crabs, rails, and ducks.

Littoridinops palustris is similar to *L. monroensis* and to *L. tenuipes* (Couper, 1844), an east coast species. On the Gulf coast, *L. palustris* occasionally occurs with *L. monroensis* in brackish water tidal ponds; however, *L. palustris* usually does not occur in the more open pond habitats preferred by *L. monroensis*, and *L. monroensis* is not commonly found in the intertidal marsh habitats where *L. palustris* is common. Often the shells of *L. palustris* from subtidal areas in shallow bayous and bays have a thickened or swollen area on the last body whorl near the aperture. The reason for the occurrence of this phenomenon in subtidal populations is unknown.

On the southeast Atlantic coast, *L. tenuipes* occurs in the same habitat types occupied by *L. palustris* on the Gulf coast. Although the two species are very similar, the verge of *L. tenuipes* has an extra

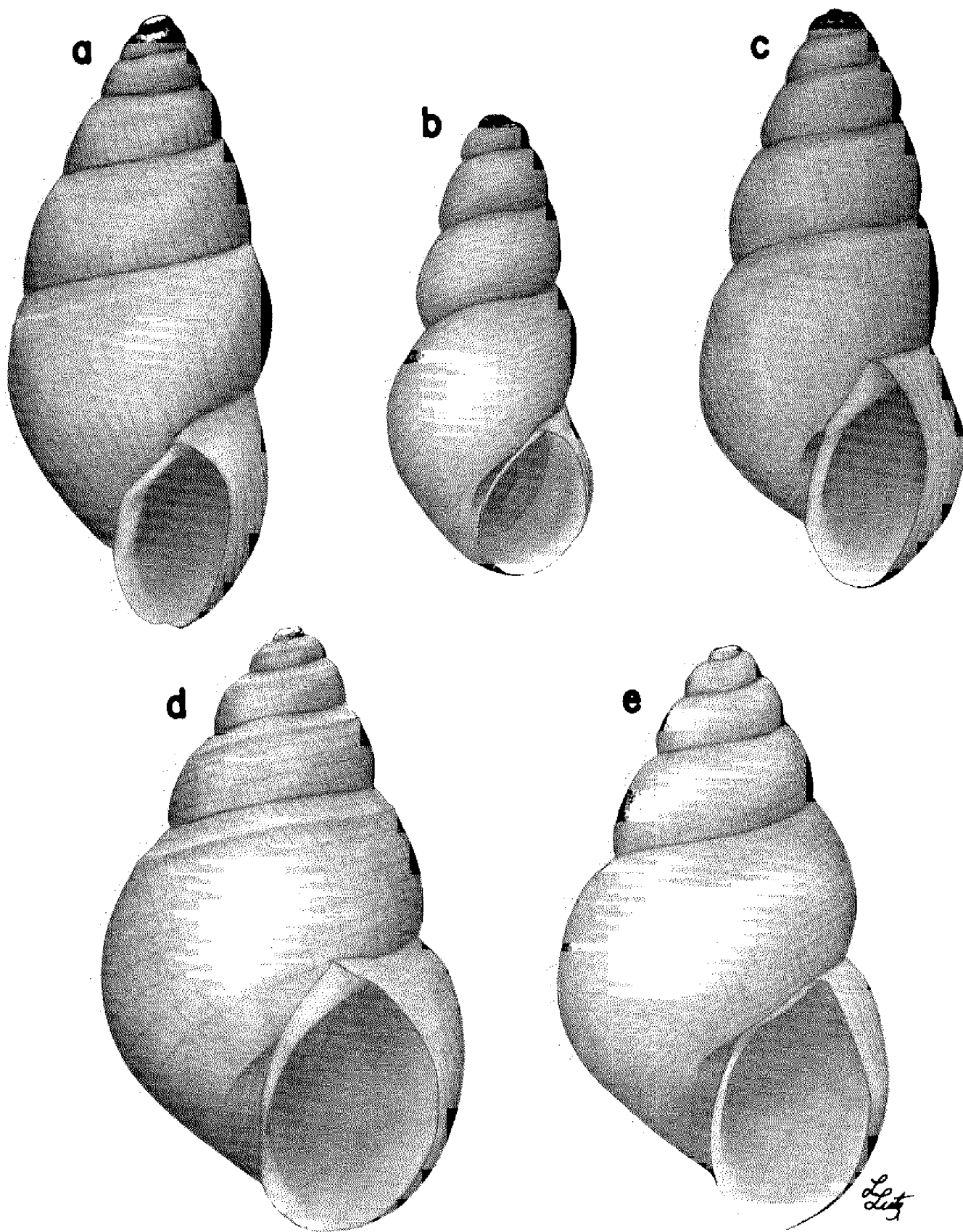


Figure 7. Hydrobiid shells: a – *Texadina sphinctostoma*; b – *Onobops* cf. *jacksoni*; c – *Helebops* sp. (form B); d – *Pyrgophorus* sp.; e – *Littoridinops palustris*.

cluster of 3 to 10 papillae at its base (Figure 8 c).

Reference: Thompson (1968).

Littoridinops monroensis (Frauenfeld, 1863)

Figure 8 b

Synonyms: *Littoridina monroensis* (Frauenfeld, 1863)

Littoridinops sp. A: Taylor in Andrews (1977)

Recognition Characters: Shell smooth, similar to *Littoridinops palustris*; verge with 2 or 3 rows of papillae on convex margin, 2 to 3 individual glands on concave margin.

Distribution: Atlantic and Gulf coasts from South Carolina (Georgetown) to Texas (Galveston).

Habitat: On mud-silt bottoms or submerged vegetation; in fresh and brackish water coastal lakes, ponds, and tide pools.

Remarks: This snail was common in several oligohaline ponds on Galveston Island in 1975, and large populations exist in several fresh and oligohaline ponds on Horn Island, Mississippi. I have also examined specimens from tidally influenced, freshwater ponds near Georgetown, South Carolina. Specimens have been collected from tide pools in *Juncus* and *Spartina* marshes at St. Marks, Florida, and Dauphin Island, Alabama. The development of its young is similar to that of *Heleobops* with young snails hatching directly from relatively large egg capsules attached to mollusk shells and other hard substrata.

References: Andrews (1977); Thompson (1968).

Heleobops spp.

Figures 7 c; 8 f, g

Recognition Characters: Shells relatively narrow with fine striations on whorls; verge with 6 to 8 suction-cup-like glands on outer (convex) margin, with 2 subterminal glands smaller and distinctly separated from proximal glands; subterminal process on inner margin adjacent to opening of sperm duct.

Distribution: Gulf coast from northwest Florida to Mississippi.

Habitat: Near or adjacent to open Gulf; mesohaline; intertidal to shallow subtidal; in tidal marshes, shallow bays and inlets; on mud, mud-silt, and sand-silt bottoms.

Remarks: There appear to be two, or possibly three, new species of *Heleobops* in the northeastern Gulf tidal marshes. All of the specimens of *Heleobops* that I have collected came from areas of moderate salinities near the open Gulf. Three distinct verge types and at least two shell types can be recognized. The verge of one form (Form A), known only from habitats at or near St. Marks, Florida, has a wide, low,

keel-like process directly adjacent to the opening of the sperm duct (Figure 8 f). The verge of another form (Form B), which occurs sporadically along the northeastern Gulf, has finger-like processes instead of the wide, keel-like structure (Figure 8 g). Another type (Form C), which has a verge similar to Form B, has a shell with distinct striations on the whorls that are similar, but not as strongly pronounced as those on *Onobops* spp. *Heleobops docima* Thompson, 1968, known from marshes and mangroves in the southern half of Florida, is related to Form B but lacks the subterminal sac-like glands on its verge. Fred Thompson and I are attempting to clarify the taxonomy of this group and to publish taxonomic papers on the species from the northeastern Gulf. Until then I suggest that they be classified as *Heleobops* sp. (Forms A, B, and C). All three forms lay relatively large, individual, egg capsules. There is no pelagic veliger stage. A single snail emerges from each capsule after a week or more, depending on the temperature during incubation.

Reference: Thompson (1968).

Onobops cf. *jacksoni* (Bartsch, 1953)

Figures 7 b; 8 c

Common Name: Jackson's Hydrobiid

Synonym: *Hydrobia jacksoni* Bartsch, 1953

Recognition Characters: Shell elongate, whorls impressed, striations; verge simple without glands; gill with 20-24 lamellae; operculum with about 3 whorls.

Distribution: Atlantic and Gulf coasts from Maryland to Mississippi.

Habitat: Mesohaline; in tide pools or wet areas of *Juncus* and *Spartina* marshes; mud or mud-silt bottoms with organic matter.

Remarks: As in the case of *Heleobops*, a complex of two or three species may be present in the northeastern Gulf tidal marshes. On Horn Island, Mississippi, a large form almost twice as large as the normal size reported for *O. jacksoni* is present in marsh pools with mud bottoms and large amounts of organic matter. Also on Horn Island I found populations of a minute form about half the size of typical *O. jacksoni*. The egg capsules of all three size groups appear similar. A second species of *Onobops*, *O. crassa* Thompson, 1968, was described from southern Florida. Though similar to *O. jacksoni*, the snail has more gill lamellae (26-28) and usually four opercular whorls.

As in the case of *Texadina sphinctostoma* Abbott and Ladd, 1951, after several days of incubation, a well-developed, shelled veliger larva emerges from each capsule. Further taxonomic, ecological, and life history studies are needed to determine whether one or more species are involved in the northern Gulf marshes.

Reference: Thompson (1968).

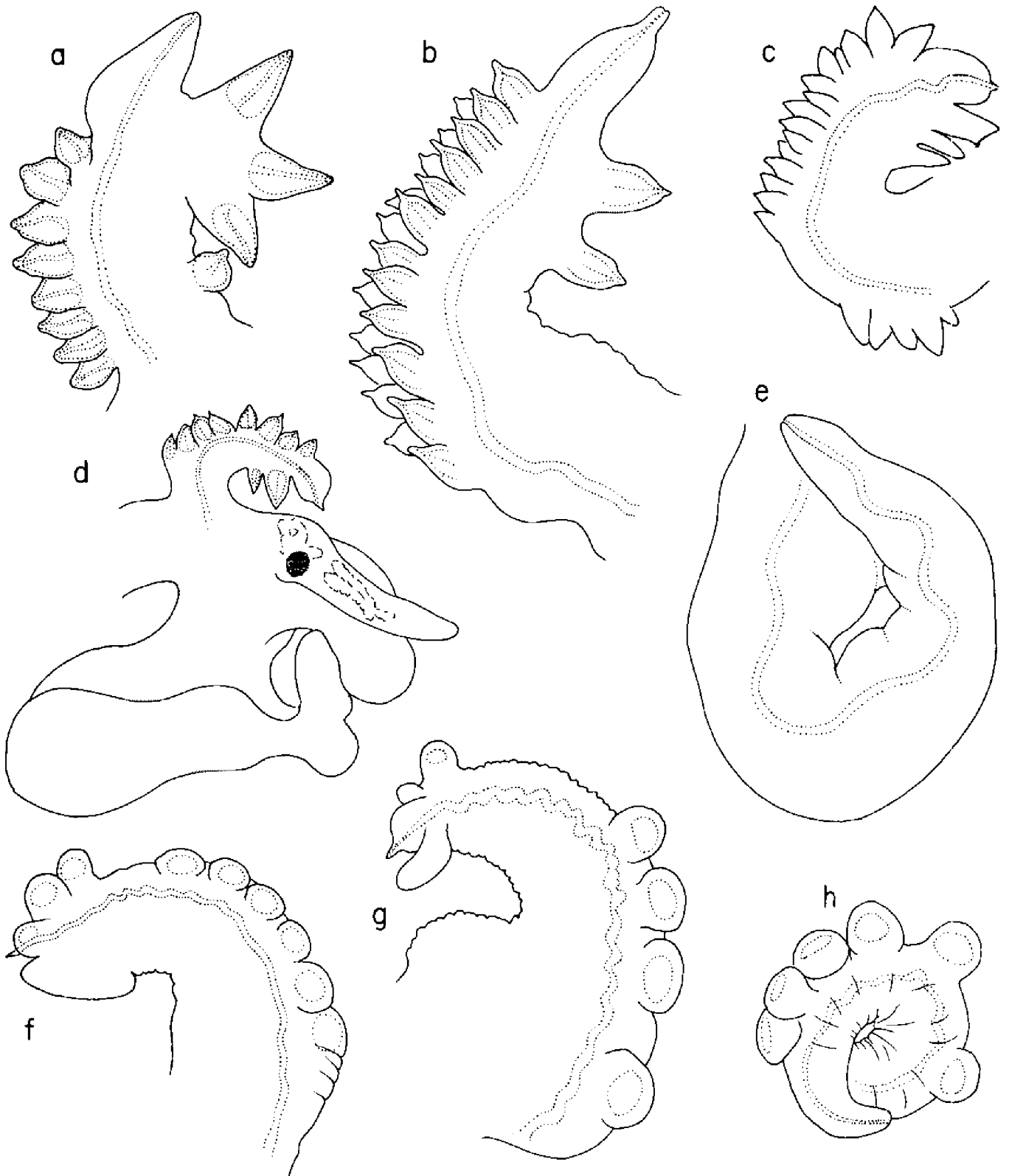


Figure 8. Hydrobiid verges (male copulatory organs): a – *Pyrgophorus* sp.; b – *Littoridinops monroensis*; c – *Littoridinops tenuipes*; d – *Littoridinops palustris* (anterior part of body with verge); e – *Onobops* cf. *jacksoni*; f – *Heleobops* sp. (form A); g – *Heleobops* sp. (form B); h – *Texadina spinctostoma*.

Pyrgophorus sp.

Figures 7 d; 8 a

Recognition Characters: Shells similar in size and shape to *Littoridinops* but with distinct keel or ridge near anterior margin of whorls; ovoviviparous (young snails often visible through semi-transparent shell of female); verge similar to *Littoridinops palustris*, but usually with a single papilla on concave side near base.

Distribution: Mississippi (Horn Island).

Habitat: Mesohaline marsh pools on muddy or silty bottoms rich in detritus.

Remarks: This species or form of *Pyrgophorus* lacks the spines on the whorls that are so often characteristic of this genus. It is similar to the unspined form of *P. platyrachis* Thompson, 1968, which was described from southern Florida and was recently reported from Louisiana.

Spined and unspined forms of *P. platyrachis* occur in both fresh and brackish waters. The spined and unspined forms of another species, *P. (=Lyrodes) parvulus* (Guilding, 1828) also have been reported from brackish waters in Louisiana. The species from Horn Island, Mississippi, may represent an ecotype (ecological form) of *P. platyrachis*, *P. parvulus*, or *P. cornatus* (Pfeiffer, 1840) or may be a new species. Additional research will be needed to determine the taxonomic status of this species.

Females of the genus *Pyrgophorus* are the only hydrobiids from the northeastern Gulf of Mexico that do not deposit their eggs. Instead, the eggs are brooded within the female until the young snails are fully formed. This type of reproductive development is termed "ovoviviparity." In fact, females of the genus *Pyrgophorus* can be easily identified while they are brooding their young, since the young snails can be seen through the semi-transparent shells of the females' bodies. When the young are released, they are each contained within a thin, membranous, egg capsule. The juvenile snails immediately rupture the egg capsules and crawl out on to the sediment to begin feeding and growing. As in the genera *Littoridinops* and *Heleobops*, *Pyrgophorus* bypasses a planktonic larval stage.

References: Bridgeman (1969); Garrett and Dundee (1979); Thompson (1968).

Texadina sphinctostoma Abbott and Ladd, 1951

Figures 7 a; 8 h

Common Name: Small-mouthed Hydrobiid

Synonym: *Littoridina (Texadina) sphinctostoma* Abbott and Ladd, 1951.

Recognition Characters: Aperture constricted in

adult specimens; male verge with 5 to 6 glands along outer margin.

Distribution: Coast of the Gulf of Mexico from Alabama (Mobile Bay) to the Yucatan Peninsula.

Habitat: Estuarine, oligohaline to lower mesohaline; in shallow bays and bayous on silt and fine sand-silt bottoms.

Remarks: I have collected *T. sphinctostoma* from oligohaline tidal marsh pools in Mississippi, but in general it is rare in tidal marsh habitats. It usually occurs, often in large numbers, in subtidal areas on the bottom of shallow oligohaline bays, where it is commonly associated with the clam, *Rangia cuneata* (Gray, 1831), and with another hydrobiid, *Probythiella (=Vioscalba) louisiana* (Morrison, 1965). *Texadina sphinctostoma* lays egg capsules containing a single egg, which ruptures after several days and releases a veliger larva with a well-developed shell.

Another species of *Texadina*, *T. barretti* (Morrison, 1965), occasionally occurs with *T. sphinctostoma* on silt-mud bottoms. *Texadina barretti* was originally placed in the genus *Odostomia* (Family Pyramidellidae) and was later listed under the name *Hydrobia hoonae* Morrison, 1973. It appears to be a subtidal species and is not currently known from tidal marsh habitats.

References: Abbott and Ladd (1951); Heard (1979); Taylor in Andrews (1977).

Family Assimineidae

Assimineea succinea (Pfeiffer, 1840)

Figure 9

Common Name: Atlantic Assiminea

Synonym: *Syncera succinea* (Pfeiffer, 1840)

Recognition Characters: Small, hydrobiid-like snails; length under 3 mm; shell smooth; fine, thread-like ridge often around anterior margin of body whorls; narrow, slightly raised callus on margin of inner lip; eyes on tips of reduced, stubby tentacles.

Distribution: U.S. Atlantic and Gulf coasts from Massachusetts to Texas; Brazil; Bermuda.

Habitat: Upper intertidal zone of salt marshes and mangrove swamps, moderate to high salinities; often among debris or on bases of plants.

Remarks: This little snail superficially resembles a hydrobiid, but it can be distinguished from those aquatic forms by its short, stubby tentacles with the eyes on the tips and by its ability to tolerate desiccation. The hydrobiids, which have well-developed tentacles with the eyes at their bases, are unable to withstand desiccation even for a few minutes. Development of *A. succinea*, as in many hydrobiids, is direct. Females deposit egg capsules, each containing a single egg, on damp leaves or other debris in upper intertidal

zones. After several weeks of development, juvenile snails emerge from the capsules and begin crawling and feeding among the damp debris.

References: Abbott (1974); Andrews (1977); Marcus and Marcus (1964).

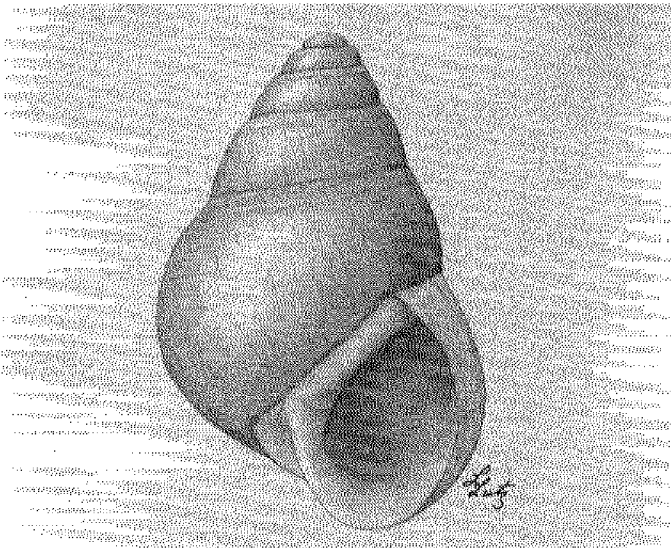


Figure 9. Shell of *Assimineea succinea*.

Family Potamidae (Horn Shells)

Genus *Cerithidea* Swainson, 1840

Three species of this genus occur in salt marshes of the northern Gulf. The genus is characterized by an elongate shell with axial ribs, 10-15 convex body whorls, and a flared, thickened, outer lip in adults.

Cerithidea pliculosa (Menke, 1829)

Figure 10 c

Common Name: Plicate Horn Shell

Recognition Characters: Several old varices present; adults reaching over 26 mm in length.

Distribution: Gulf coast from Alabama to Texas; east coast of Central America to northern South America (Venezuela); West Indies.

Habitat: Muddy substrata in coastal marshes and mangrove swamps; moderate to high salinities.

Remarks: The plicate horn shell is the only species of its genus known to occur in the northwestern Gulf of Mexico. Its shell is distinguished from the other two northwestern Atlantic species, *C. costata* (de Costa, 1778) and *C. scalariformis* (Say, 1825), by irregular, swollen, vertical ridges (old varices). *Cerithidea pliculosa* appears to be more similar and closely related to a west coast species, *C. californica* Haldeman, 1840, than to the two northwestern Atlantic species. Like *C. pliculosa*, *C. californica* has old varices markings on its shell; these structures do not occur on the shells of *C. costata* and *C. scalariformis*.

Plicate horn shells are known to be an important food of shore birds and to serve as host for a variety of larval flatworm (trematode) parasites. These snails feed on algae and detritus occurring on the muddy marsh floor and at the bases of marsh plants.

References: Abbott (1974); Andrews (1977), Bequaert (1942); Fotheringham and Brunenmeister (1975).

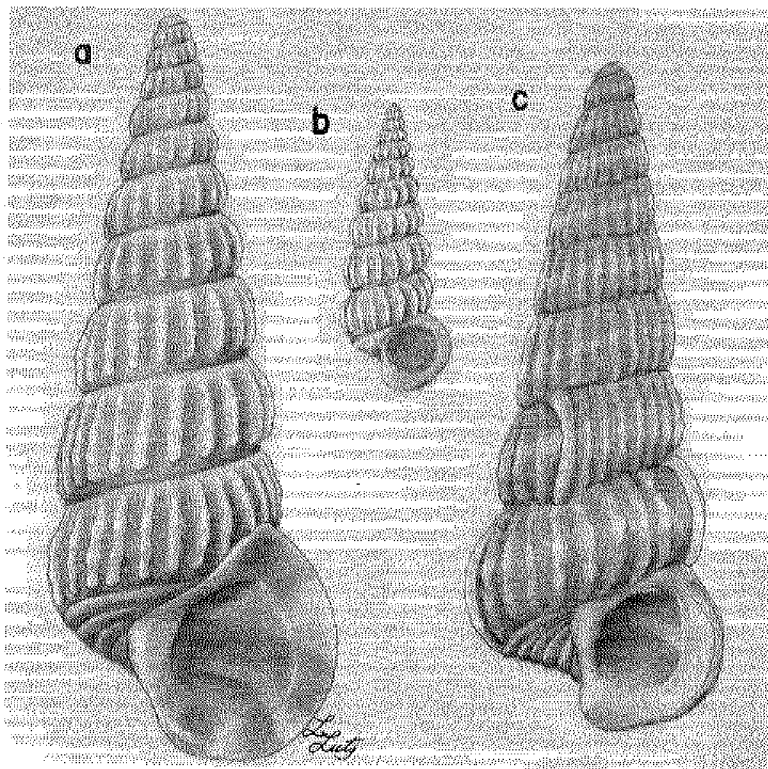


Figure 10. Shells of *Cerithidea* spp.; a – *C. scalariformis*; b – *C. costata*; c – *C. pliculosa*.

Cerithidea scalariformis (Say, 1825)

Figure 10 a

Common Name: Ladder Horn Shell

Recognition Characters: Body without old varices; approximately same size as *C. pliculosa*; last two body whorls with strongly developed axial ribs; base of shell with several distinct spiral ridges; outer lip of aperture strongly flared.

Distribution: Atlantic and Gulf coasts from South Carolina to northwestern Florida; West Indies; Bermuda.

Habitat: Upper intertidal zone in mangrove swamps and salt marshes; on mud to sand-mud substrata; moderate to high salinities.

Remarks: This species is often associated with *Melampus bidentatus* Say, 1822, *Melampus coffeus* (L., 1758), and *C. costata* (de Costa, 1778). It can live higher in the intertidal zone than can *C. costata* and *C. pliculosa* and can withstand longer periods of desiccation (up to three weeks). *Cerithidea scalariformis* is part of the diet of many salt marsh predators, including mud and blue crabs, rice rats, rails, and large shore birds. The larvae of over 10 different species of trematode parasites are known to develop in the tissues of this marsh snail.

References: Abbott (1974); Bequaert (1942); Holliman (1961).

Cerithidea costata (de Costa, 1778)

Figure 10 b

Common Name: Costate Horn Shell

Recognition Characters: Small; one-half length of *C. pliculosa* and *C. scalariformis*; no old varices present; axial ribs indistinct on last two body whorls.

Distribution: Atlantic and Gulf coasts from South Carolina to northwestern Florida; West Indies.

Habitat: Intertidal zone in mangrove swamps and salt marshes; on mud, sand-mud substrata; moderate to high salinities.

Remarks: This species usually occurs with its larger relative *C. scalariformis*. In northern Florida I found populations of *C. costata* occurring in *Spartina-Juncus* marshes as far west as Cape San Blas. Like the other two Gulf species of *Cerithidea*, it is eaten by mud and blue crabs and by a variety of shore birds. It is also a host for the larvae of many trematode parasites.

References: Abbott (1974); Bequaert (1942).

Family Littorinidae (Periwinkles)

Littorina irrorata (Say, 1822)

Figures 11, 12

Common Name: Marsh Periwinkle

Recognition Characters: Adults up to 23 mm in length, slightly longer than broad; shell thick, stout, having 8 to 10 body whorls with many evenly spaced, spiral grooves; last body whorl about half length of whole shell; color of shell light gray or grayish white with reddish-brown flecks on the spiral ridges; inner margin of outer lip with reddish-brown flecks corresponding to spiral grooves; smooth margin of inner lip pale brownish-orange.

Distribution: Atlantic and Gulf coasts from New York to Texas excluding southern Florida.

Habitat: Mesohaline *Spartina-Juncus* marshes.

Remarks: This species is probably the best known salt marsh invertebrate of southeastern North America. It is absent from southern Florida where salt marshes are replaced by mangroves and where its tropical relative *Littorina angulifera* (Lamarck, 1822) is common.

Female marsh periwinkles shed their fertilized eggs directly into the water during high tides. After a short period of development, the eggs hatch and develop into planktonic veliger larvae. The veliger stages



Figure 11. Marsh periwinkles on *Spartina* marsh grass stalks.

gradually change into small juvenile snails which settle on the marsh floor and immediately begin feeding and growing. Marsh periwinkles can live for several years. During low tide they feed on detritus and algae from the marsh floor and the bases of marsh grass stalks.

Littorina irrorata has been the subject of several ecological and behavioral studies, some of which are cited in the references. Although they have gills, these snails rarely enter the water and then only for short periods of time. Usually, as the tide rises, they retreat up marsh grass stalks. This apparent avoidance of water is thought to be due, in part, to a behavioral response to avoid predation by blue crabs. Gliding over the marsh floor, these snails leave mucous trails, which can be detected and followed by other marsh periwinkles.

References: Abbott (1974); Alexander (1979); Andrews (1977); Bandel (1974); Bequaert (1943); Bingham (1972); Fotheringham and Brunenmeister (1975); Hall (1973); Hamilton (1976, 1977, 1978a, 1978b), Odum and Smalley (1959).

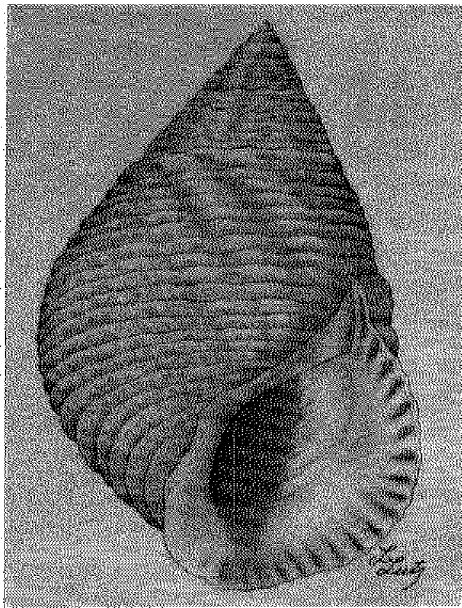


Figure 12. Shell of *Littorina irrorata* (marsh periwinkle).

Family Melongenidae (Whelks)

Melongena corona (Gmelin, 1791)

Figure 13

Common Name: Common Crown Conch

Recognition Characters: Relatively large shell (50 to 100 mm); prominent crown of spines on shoulder and base of shell; well-developed siphonal notch present.

Distribution: Southern Florida and Florida Gulf coast.

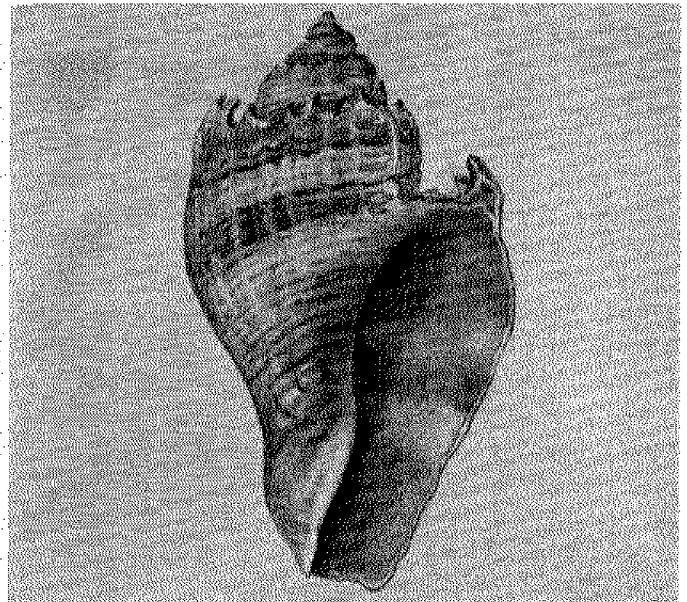


Figure 13. Shell of common crown conch (*Melongena corona*).

Habitat: Subtidal and intertidal, in or along the edges of mesohaline (12‰ to over 30‰) bays, usually associated with oysters, *Crassostrea virginica* (Gmelin, 1791).

Remarks: This species has long been considered an important predator of oysters and other mollusks; however, studies have demonstrated that it also commonly feeds on detritus and dead animal matter and thus may serve an important role as scavenger.

The females deposit strings of disc-shaped egg capsules, often attaching them to oyster shells. Each capsule usually contains from 100 to over 300 eggs. The larvae "hatch" from the egg capsule after approximately 20 days of incubation. They have well-formed shells and apparently do not go through a planktonic (pelagic) stage.

I have often observed crown conchs associated with oysters on the edges of *Spartina* marshes of northwestern Florida. Their occurrence in Alabama is sporadic and apparently does not occur in the United States west of Mobile Bay.

References: Abbott (1974); Hathaway and Woodburn (1961).

Family Pyramidellidae (Pyram Shells)

Sayella spp.

Figure 14

Recognition Characters: Tentacles flat, triangular, not extending beyond front of large flat foot; front of foot "squared-off," posterior to bases of tentacles; shell elongate with end of spire blunt, often eroded; aperture with oblique fold on inner margin.

Distribution: Gulf Coast from Florida (St. Marks) to Mississippi (Horn Island).

Habitat: Mesohaline *Spartina* tidal marsh pools and ponds on muddy or silty bottoms; collected with the anthozoans (*Nematostella*) and the hydrobiid snails (*Heleobops* and *Littoridinops*).

Remarks: The taxonomy of *Sayella*, *Odostomia*, and other genera belonging to the family Pyramidellidae is still unsettled and as a result often very confusing. Based on Abbott's 1974 treatment of the family, I consider the specimens collected from tidal marshes at St. Marks and Horn Island to belong to the genus *Sayella* Dall, 1885. Other authorities consider forms that are closely related to this species to be members of the genus *Odostomia*, such as *O. producta* (C. B. Adams, 1840) and *O. livida* Rehder, 1935.

Members of the genus *Sayella* are usually considered ectoparasites of other invertebrates, especially polychaete worms and bivalve mollusks. As a modification for a parasitic existence, the radula of *Sayella* and other pyramidellids has been replaced by a tubular proboscis, used when feeding on the host (which is unknown for *Sayella* from the northern Gulf).

Sayella superficially resembles hydrobiid snails, with which it is often collected. It is distinguished from the hydrobiids by the "squared-off" foot, flat, triangular tentacles, and a fold on the inner margin of the shell's aperture.

References: Abbott (1974); Andrews (1977); Morrison (1939).

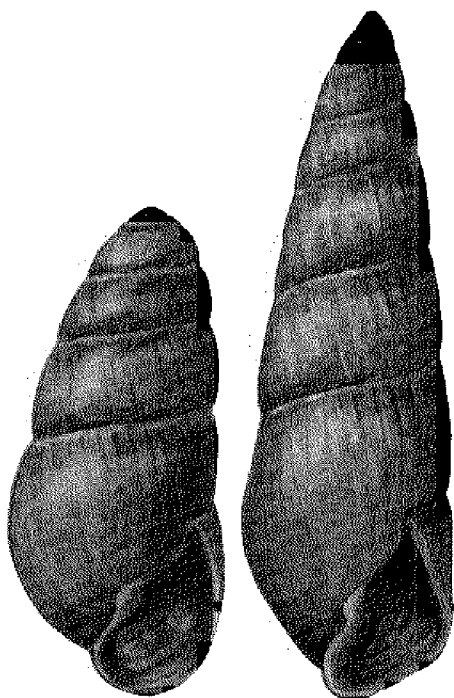


Figure 14. Shells of two different *Sayella* spp.: a — specimen from Cedar Key, Florida; b — specimen from St. Marks, Florida.

Family Melampidae (Melampid Snails)

Snails belonging to the family Melampidae, or Elliobiidae, lack gills. They breathe or respire with a "lung" that is formed by a modification of the mantle cavity. They are considered one of the most primitive members of the "air-breathing" gastropods, the Pulmonata. Two species of melampid snails occur in northern Gulf tidal marshes.

Melampus bidentatus Say, 1822

Figure 15, left

Common Name: Eastern Melampus

Recognition Characters: Moderately small (10-15 mm); shell ovateconical; broadest anteriorly with last body whorl approximately three-fourths body length; spire low and blunt with fine, spiral, incised lines or striations on whorls; aperture elongate with two folds on posterior margin of inner lip (folds on inner lip look like teeth, or denticles, hence the specific name "*bidentatus*"); other lip of aperture with 1 to 4 small, thin, elevated, spiral ridges (lirae); operculum absent; color brownish, often with several dark bands, especially on younger, smaller specimens.

Distribution: Atlantic and Gulf coasts of North America, southern Canada to Texas; Bermuda; West Indies.

Habitat: Salt marshes and mangrove swamps; upper intertidal; exposed to wide range of salinities (0 to 50‰; occurring on marsh grass stems, under intertidal debris (wood, dead grass).

Remarks: This little bean-shaped snail is one of the more characteristic snails in tidal marshes of the northern Gulf. It is amphibious but usually avoids water. It also avoids bright light and during sunny, hot days usually retreats to shaded areas (under logs, dead marsh grass, and other intertidal debris). *Melampus bidentatus* is most active at night and feeds then or during periods of reduced sunlight. It feeds on algae and detritus, which it obtains from the bases of marsh stems and from the marsh floor, and on decaying animal matter. *Melampus bidentatus*, in turn, serves as food for other animals, including mud crabs, blue crabs, fishes, wild ducks, rails, seaside sparrows and rice rats.

During the warmer months, adult snails usually deposit gelatinous egg masses, which generally contain 500 to 1000 eggs, on damp or wet areas under debris on the marsh floor. Unlike other pulmonate snails, *M. bidentatus* and its relatives have a planktonic veliger stage. The hatching of larvae and the settling of the post-larvae in the upper intertidal region of the salt marsh corresponds to the phases of the moon and the resultant tidal effects. Young snails

become sexually mature at about 5 mm in length. *Melampus bidentatus* lives for 3 to 4 years with adults attaining lengths of up to 15 mm.

Another closely related species, *Melampus coffeus* (L., 1758), overlaps with *M. bidentatus* in the coastal mangrove regions of southern Florida and the West Indies. Although the shells of the two species are very similar, *M. coffeus*, which is usually larger, lacks spiral, incised lines on its spire (see Figure 15, right).

References: Abbott (1974); Apley (1970); Fotheringham and Brunenmeister (1975); Hausman (1936a, b); Holle and Dineen (1957, 1959); Morrison (1958a, b); Russell-Hunter *et al.* (1972).

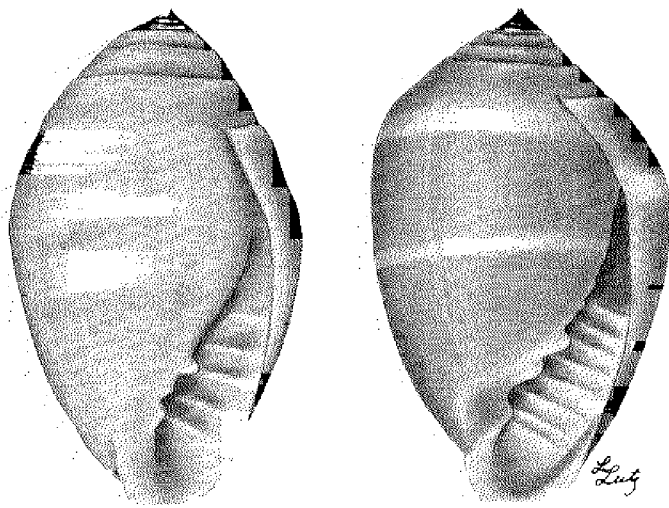


Figure 15. Shells of melampid snails: left — *Melampus bidentatus*; right — *Melampus coffeus*.

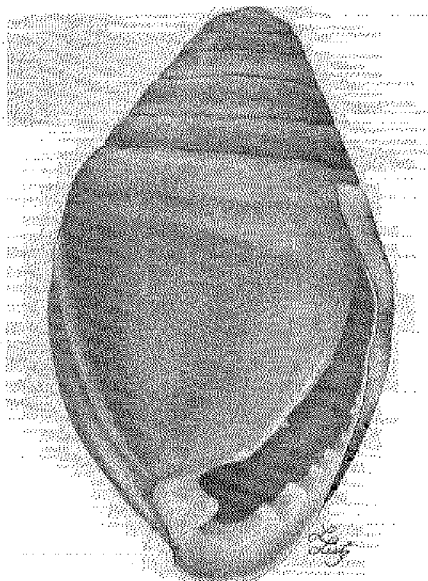


Figure 16. Shell of *Detracia floridana*.

Detracia floridana (Pfeiffer, 1856)

Figure 16

Common Name: Florida Melampus

Synonym: *Melampus floridana* Pfeiffer, 1856

Recognition Characters: Shell small (6 to 8 mm), glossy, biconical, spires higher than *M. bidentatus*, often eroded, lacking spiral striations; aperture with posterior inner margin having large denticle (fold), smaller denticle located anteriorly, outer lip of aperture with approximately 10 small, thin, elevated, spiral ridges (lirae); color dark brown, often with a few light bands.

Distribution: Atlantic and Gulf coasts from New Jersey to Louisiana.

Habitat: Upper intertidal zone in brackish marshes, on marsh grass stalks, or on or under debris on marsh floor.

Remarks: In the northern Gulf this species often occurs with its larger relative *M. bidentatus* in brackish *Juncus* marshes. Unlike *M. bidentatus*, which can also occur in high salinity marshes near the open Gulf, *D. floridana* appears to be restricted to the low salinity marshes of tidal rivers, bayous and bays. The life cycle is apparently similar to that of *M. bidentatus*, but *D. floridana* deposits larger and far fewer (20-50) eggs per egg mass. The eggs hatch into planktonic veliger larvae. Like *M. bidentatus*, it feeds on algae and detritus and is itself a common food of crabs, fishes, ducks, rails, seaside sparrows, and rice rats. In some east coast tidal marshes it often occurs in large numbers; one authority estimated 4 billion snails per square mile in the Virginia tidal marsh.

References: Abbott (1974); Morrison (1951, 1953, 1964); Holle and Dineen (1959).

Class Bivalvia (=Pelecypoda) (Bivalves)

Clams, mussels, and oysters belong to this highly modified class of mollusks. The class is characterized by the absence of a head and radula and by the presence of a hatchet-shaped foot and a shell made up of two valves. The valves of the shell are attached by a hinge with an associated ligament and by one or two adductor muscles. In addition to the shape and external morphology of the valves of the shell, other characteristics (e.g., the type and number of teeth on the hinge, the location of the ligament, the shape and location of the anterior and posterior adductor muscles, the shape of the pallial sinus, and the location of the pallial line) are important taxonomic characters used to identify bivalves.

Many bivalves are adapted for digging with a modified foot, and they usually live completely or

partially buried in the sediment (infaunal). Other bivalves, such as many species of mussels, are epifaunal, often attaching externally to the shells of other bivalves, roots, pilings, or other substrata.

Five species of bivalves occur commonly in tidal marshes along the northern Gulf of Mexico and another four species have been listed from Gulf marshes.

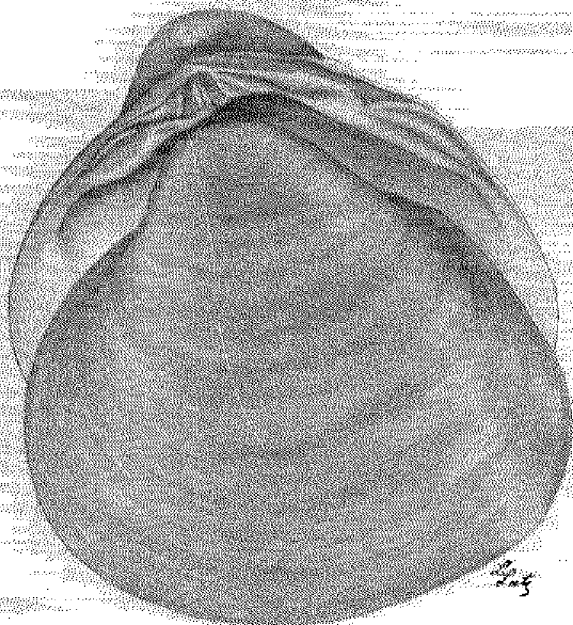


Figure 17. Shell of *Polymesoda caroliniana*.

Family Corbiculidae (Marsh Clams)

Polymesoda caroliniana (Bosc, 1802)

Figure 17

Common Name: Carolina Marsh Clam

Recognition Characters: Moderate-sized (25 to 40 mm), deep-bodied, suboval-shaped clams; beaks (umbones) close together; ligament narrow, external; three subequal cardinal teeth; one anterior lateral tooth; one posterior lateral tooth, not extending to posterior adductor scar; inner surface of living or recently dead shells often pale blue; periostracum prominent, dark, often eroded away on and adjacent to beaks.

Distribution: Virginia to Texas (excluding southern Florida).

Habitat: Intertidal, occasionally subtidal, oligohaline and mesohaline tidal marshes; in mud, mud-fine sand, or fine sand-silt substrata.

Remarks: The Carolina marsh clam is one of the most characteristic species found in tidal marshes of the southeastern United States. In protected *Juncus* marshes where salinity is low, this species often

occurs in large numbers. The adults are often eaten by raccoons and blue crabs.

Though quite different, *P. caroliniana* is often confused with *Rangia cuneata* (Family Mactridae) (Figure 18). These two species are both infaunal and are superficially similar in shape and size, but the resemblance stops there. *Rangia* nearly always is found in the subtidal zone in bays of low salinity; very rarely does it occur in the intertidal areas of tidal

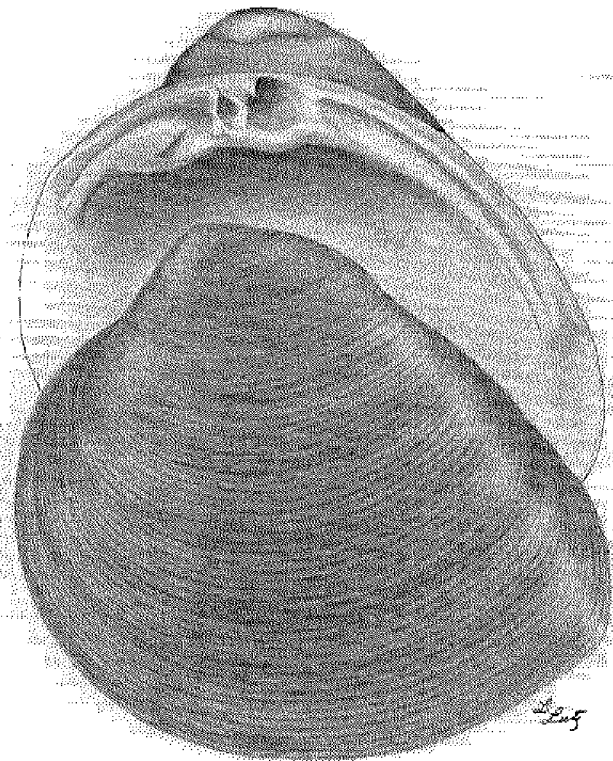


Figure 18. Shell of *Rangia cuneata*.

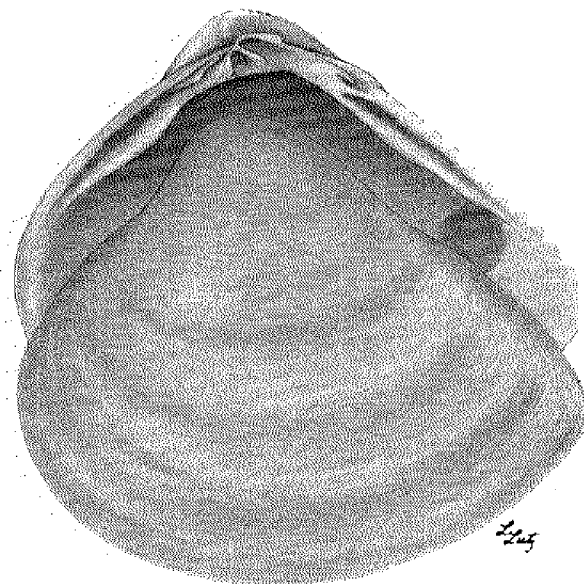


Figure 19. Shell of *Polymesoda maritima*.

marshes. The shell of *Rangia* is much thicker, and the beaks are noticeably more separated than those of *P. caroliniana*. The most striking difference between the two clams is the hinge area. In *R. cuneata* there is a deep pit, or chondrophore, between the cardinal teeth and posterior lateral tooth. This pit contains a tough pad or ligament-like structure, the resilium, which causes the valves of the shell to gape open when the adductor muscles relax. The posterior lateral tooth is very long, reaching nearly past the posterior adductor muscle, and its margin is finely serrate. Another species of *Rangia*, *R. (=Rangianella) flexuosa* (Conrad, 1839) can be distinguished from *R. cuneata* by its more wedge-shaped shell and shorter, non-serrate, posterior, lateral tooth.

References: Abbott (1974); Andrews (1977); Andrews and Cook (1951); Van der Schalie (1933).

Polymesoda maritima (Orbigny, 1842)

Figure 19

Common Name: Florida Marsh Clam; Orbigny's Marsh Clam.

Synonyms: *Pseudocyrena maritima* (Orbigny, 1842)
Pseudocyrena floridana (Conrad, 1846)

Recognition Characters: Shell smaller, more variable; less robust and more elongate than that of *P. caroliniana*; lacks thick, dark, periostracum; inner surface of living or recently dead shells partially or completely purple; outer surface of shell tinged with pink or light purple.

Distribution: Gulf coast of North America from Key West, Florida, to the Yucatan Peninsula.

Habitat: Salt marshes and mangrove swamps; near surface, usually in sand and sand-mud substrata; in areas of moderate to high salinities near or adjacent to open Gulf water.

Remarks: This species is much more colorful than its drab cousin, *P. caroliniana*, which usually occurs in muddier areas and in lower salinities. In the northern Gulf there are well-established populations of *P. maritima* in several coastal marsh systems of north-west Florida. As yet, this clam is not known from Alabama-Mississippi tidal marshes, which may be due to the lower salinities or the lack of collections in this region.

References: Abbott (1974); Andrews (1977).

Family Mytilidae (Mussels)

Geukensia demissa (Dillwyn, 1817)

Figure 20

Common Name: Ribbed Mussel

Synonyms: *Arcuatula demissa* (Dillwyn, 1817)
Modiolus demissus (Dillwyn, 1817)

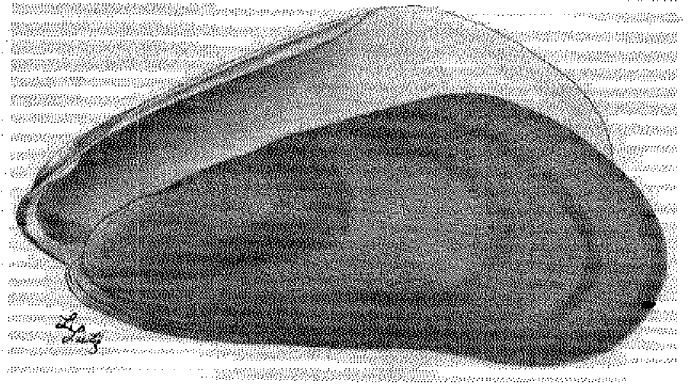


Figure 20. Shell of *Geukensia demissa*.

Recognition Characters: Moderate size (to over 100 mm); elongate with rounded posterior margin; over 25 strong, radial, beaded ribs; no teeth on long hinge; with byssus; epifaunal or infaunal.

Distribution: Atlantic and Gulf coasts from Maine to Texas; California (introduced).

Habitat: Intertidal or rarely subtidal (juveniles); mesohaline tidal marshes in mud among marsh grass roots (infaunal) or attached to exposed marsh grass roots (epifaunal).

Remarks: Many authorities consider the populations of *G. demissa* in southeastern Florida and the Gulf to be a distinct subspecies, *G. d. granosissima* (Sowerby, 1914). This subspecies is characterized by more and smoother ribs than the typical Atlantic form.

The ribbed mussel often occurs in large colonies on the tidal marsh floor. Often juveniles and sub-adults are present on the exposed roots of marsh grass (*Juncus* and *Spartina*). In a tidal pond at St. Marks Refuge in Florida, I have found large numbers of ribbed mussels attached to the submerged roots of *Spartina*. With these mussels, often attached to them, were equally large numbers of Conrad's false mussel, *Mytilopsis (=Congeria) leucophaeta* (Conrad, 1831). As the common name implies, *Mytilopsis* is not a true mussel, although it is often confused with mussels because of its elongate shell and byssal threads (see Figure 21). It belongs to the family Dressenidae,

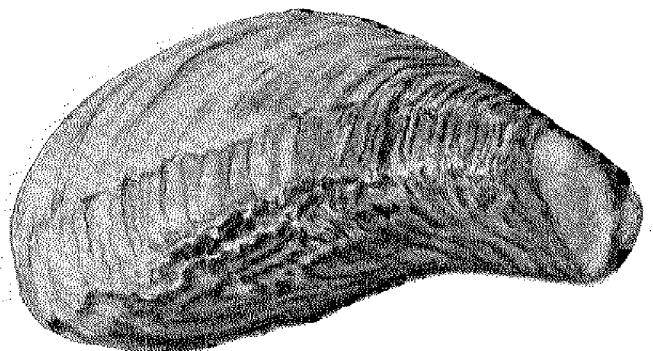


Figure 21. Shell of *Mytilopsis leucophaeta*.

which is only remotely related to the family Mytilidae.

Two other species of true mussels, the hooked mussel *Ischadium recurvum* (Rafinesque, 1820) and the paper mussel *Amygdalum papyrium* (Conrad, 1846), occasionally occur in tidal marshes. The hooked mussel is epifaunal, often attached to oysters or even to the exposed shells of the ribbed mussel. It differs from the ribbed mussel by having fewer and relatively larger ribs, not beaded, and a hooked anterior end (see Figure 22). The paper mussel, usually occurring subtidally in soft bottoms, is generally infaunal. Its shell resembles that of the ribbed mussel but is smaller, glossy, and lacks ribs (see Figure 23). The paper mussel is also quite colorful, often with fine greenish and reddish markings.

The ribbed mussel is the only mussel well-adapted for living in tidal marshes along the northern Gulf of Mexico. The false, hooked, and paper mussels should not be considered typical marsh species, since they occur only marginally in tidal marshes and are better adapted to other estuarine habitats.

References: Andrews (1977); Fotheringham and Brunenmeister (1975); Kuenzler (1961); Stiven and Kuenzler (1979); Teal (1962).

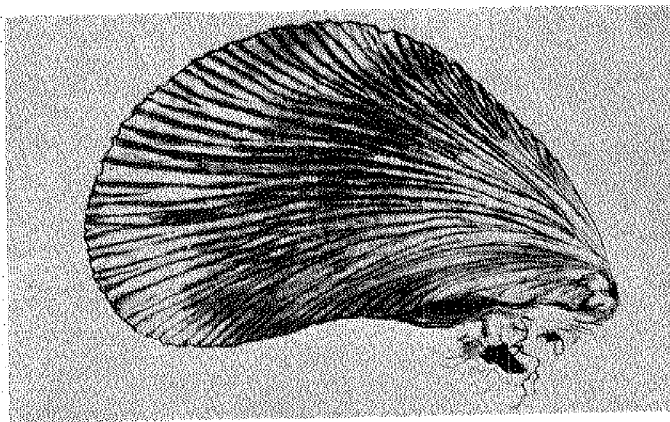


Figure 22. Shell of *Ischadium recurvum*.

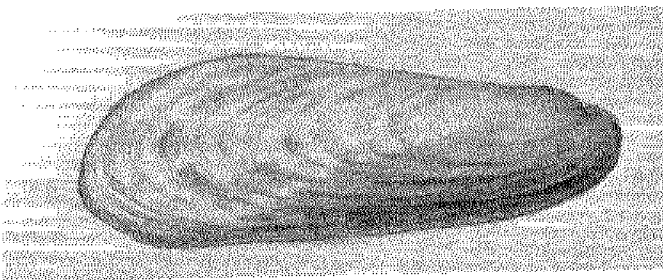


Figure 23. Shell of *Amygdalum papyrium*.

Family Cyrenoididae

Cyrenoida floridana Dall, 1896

Figure 24

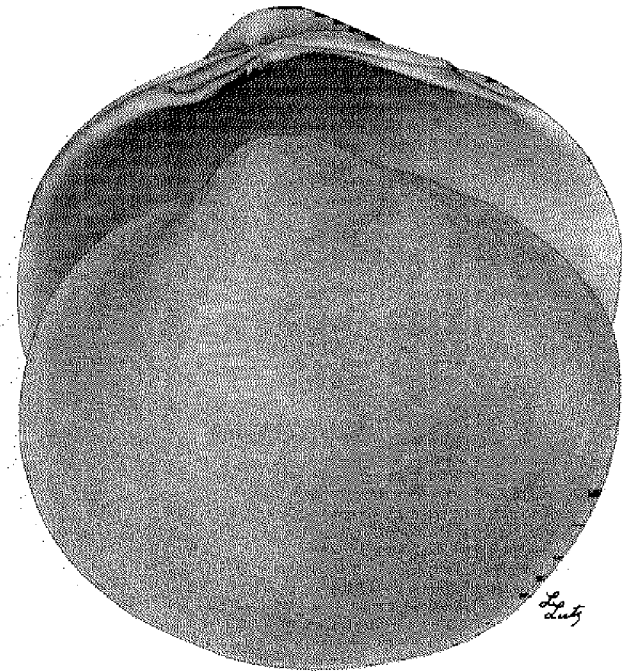


Figure 24. Shell of *Cyrenoida floridana*.

Common Name: Florida Marsh Clam; Dall's Marsh Clam.

Recognition Characters: Shell small (up to 10 mm), oval, thin, fragile, moderately deep; periostracum thin, inconspicuous; left valve with delicate, bidentate, cardinal tooth and a prominent, narrow, blade-like, anterior, lateral tooth; posterior, lateral teeth appearing absent; foot, when extended; extremely narrow and long.

Distribution: Atlantic and Gulf coasts from Delaware to Louisiana.

Habitat: Brackish (from less than 1‰ to over 25‰) in marshes and mangroves; in damp intertidal areas under decaying vegetation or mats of filamentous algae or in mud-sand, fine sand, or sand-silt substrata.

Remarks: Dall's marsh clams, often very abundant in brackish marshes, are often overlooked because of their small size. As a result, little is known about their biology. Externally they resemble the equally small freshwater "pill clams" of the family Sphaeriidae. In fact, like the "pill clams," *C. floridana* broods its young, releasing them as young juveniles. Dall's marsh clams have also been confused with juveniles of the Carolina marsh clam *P. caroliniana*. Juvenile Carolina marsh clams have thicker shells, a thick, well-developed periostracum, and distinctly different hinge teeth (three cardinals and a well-developed posterior lateral).

Dall's marsh clam has been reported previously from brackish waters in Delaware, Georgia, southern Florida, and Mississippi. I have collected *C. floridana* from tidal marshes near Tuckahoe, New Jersey; Beau-

fort, North Carolina; and Lake Pontchartrain, Louisiana. My New Jersey and Louisiana collections are northern and western range extensions for *C. floridana*.

Often the interior of the shells of *Cyrenoida* are covered with igloo-like bumps. These bumps, which can be seen in a photograph of *C. floridana* in Abbott (1974), are caused by the larvae of trematode (flatworm) parasites. The trematodes, after settling on the inner surface of the shell, become partially surrounded with mother-of-pearl, produced by the clam. The infected clams are then eaten by marsh birds and raccoons, and the adult trematodes develop in the intestinal tracts of these animals. The life histories of this trematode and several other parasites of *Cyrenoida* are currently being studied by the author and R. M. Overstreet.

References: Abbott (1974); Leathem *et al.* (1976).

Family Solecurtidae

Tagelus plebius (Solander, 1786)

Figure 25

Common Name: Stout Tagelus; Stout Razor Clam

Synonym: *Tagelus gibbus*

Recognition Characters: Valves elongate, equal, rectangular, with ends gaping when closed; hinges with cardinal teeth present, laterals absent; living specimens with well-developed, elongate siphons; shells reaching lengths of over 10 cm.

Distribution: Atlantic and Gulf coasts of North America from Cape Cod to Texas.

Habitat: Mesohaline bays in fine sand and mud substrata; subtidal to lower intertidal.

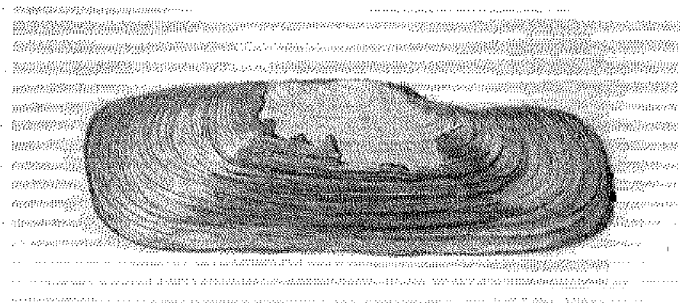


Figure 25. Shell of *Tagelus plebius*.

Remarks: Stout razor clams are often common in mud banks along the edges of Gulf salt marshes. I have collected them buried among the roots of *Spartina alterniflora* in the lower intertidal zone. These distinctive bivalves are deep burrowers; however, they are preyed upon by blue crabs and occasionally by large fishes such as rays and drum.

References: Abbott (1974); Andrews (1977).

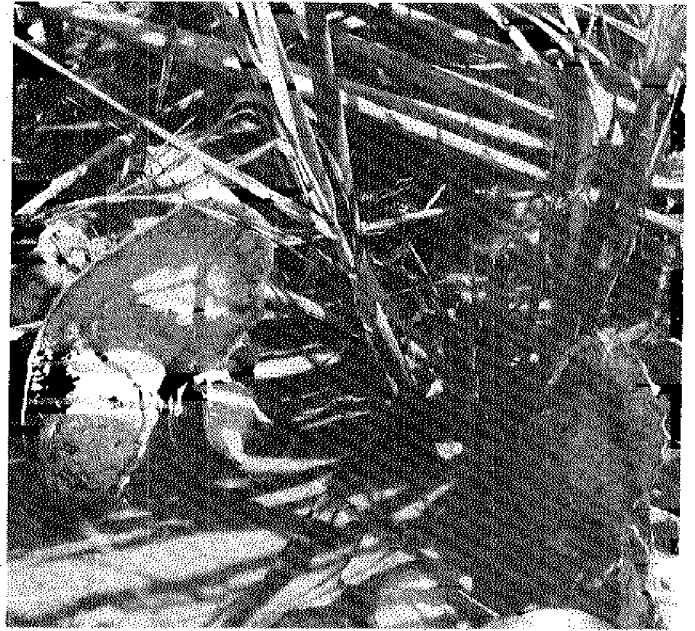


Figure 26. Common oyster *Crassostrea virginica*.

Family Ostreidae

Crassostrea virginica (Gmelin, 1791)

Figures 26,27

Common Name: Eastern Oyster; American Oyster

Recognition Characters: Shell reaching over 150 mm in length, irregularly shaped depending on growth conditions; attached to hard objects at umbo; often occurring in clumps of several individuals; outer edges of valves thin, fragile, sharp; single, large, adductor muscle, scar conspicuous, dark purple.



Figure 27. Common oysters in the edge of a *Spartina* marsh.