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HYDROBIID SNAILS (MOLLUSCA: GASTROPODA: RISSOOIDEA) FROM ST. ANDREW BAY, FLORIDA

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ABSTRACT *Heleobops* sp. of Hershler and Thompson appears to be the only previously published record for the gastropod family Hydrobiidae Troschel in tidal waters of the St. Andrew Bay System, Florida. Six species occurred in bayous, marshes, and brackish ponds associated with the System during studies conducted between 1984 and 1999: *Texadina barretti* (Morrison), *Texadina sphinctostoma* Abbott and Ladd, *Littoridinops monroensis* (Frauenfeld), *Littoridinops palustris* Thompson, *Onobops jacksoni* (Bartsch), and *Heleobops* sp. A. The last is an apparently undescribed species closely related to *Heleobops carrikeri* Davis and McKee. Based in part on this study, *Heleobops* sp. A, which occurs in brackish habitats from the System westward to the Chandeleur Islands, is considered conspecific with *Heleobops* sp. of Hershler and Thompson (1992) as well as *Heleobops* sp. Forms B and C of Heard (1992). There are two ecophenotypic shell types of *Heleobops* sp. A, a grayish-brown, smooth-shelled, intertidal variant and a tannish, light-orange, striate, subtidal form, which represent Forms B and C of Heard, respectively. In addition to constituting new records, the occurrence of *T. barretti* and *T. sphinctostoma* in the St. Andrew Bay System represents eastern range extensions for both species. Although their ranges encompass northwestern Florida, *L. palustris* and *L. monroensis* are reported from the System for the first time. The relatively large egg capsules of *Heleobops* sp. A, *L. palustris*, and *L. monroensis* each contain a single ovum, and, depending on temperature, generally require 9 to 14 days before hatching as juveniles. The egg capsules of *T. barretti*, *T. sphinctostoma*, and *O. jacksoni* also contain a single ovum per capsule, but their capsules are distinctly smaller, and, when maintained at room temperature for 5 to 8 days, eggs hatch into free-swimming, shelled-veligers. The distributions of other brackish water hydrobiids known from Florida and the Gulf of Mexico are briefly reviewed.

INTRODUCTION

In his monograph on the hydrobiid snails of the Florida peninsula, Thompson (1968) reported six species, three of which were new, in brackish water habitats (Table 1). The brackish hydrobiids of Florida are all relatively small species, having a shell with a length rarely exceeding 6 mm. Since Thompson's (1968) pioneering work, three additional brackish species, *Floridiscrobs dysbatus* (Pilsbry and McGinty, 1949), *Spurwinkia minuta* (Pilsbry, 1905), and *Texadina sphinctostoma* Abbott and Ladd, 1951 have been listed from Florida brackish and marine habitats (Cooley 1978, Lyons 1998).

Although hydrobiid snails are often common in Florida's brackish bays and tidal marshes (Thompson 1968), there is only a single published record of a hydrobiid, *Heleobops* sp. from the tidal waters of the St. Andrew Bay System in the Florida Panhandle. That record occurred in the monograph on the hydrobiid subfamily Cochliopinae Tyron, 1866 by Hershler and Thompson (1992).

As part of an extensive investigation of the brackish water mollusks and their digenean parasites, we collected six species of hydrobiids from the environs of St. Andrew Bay. Our study presents new distribution records

with observations on the biology and ecology of these snails.

MATERIALS AND METHODS

Study Area

The St. Andrew Bay System is located on the northern coast of the Gulf of Mexico, referred to here as "Gulf." Figure 1 illustrates station locations. The St. Andrew Bay system is a high salinity estuary with four major basins: St. Andrew Bay, North Bay, West Bay, and East Bay. Geologically, the system is a drowned river channel with many brackish water bayous formed along the local watershed from ancient tributaries (Schmidt and Clark 1980, Taylor 1991).

Collection Sites

Mill Bayou. Collections were made at two stations located on Mill Bayou. Station 1, located immediately south of the bridge on FL Hwy 390 (30°13.9'N, 85°35.9'W), consisted of a muddy creek bottom, intertidal mud flats, and associated needle rush (*Juncus roemerianus*) with under-story carpets of the plants *Lilaeopsis chinensis* and *Eleocharis parvula*. Depths ranged from 0 to 2 m. During all of our visits, the callianassid ghost shrimp *Lepidophthalmus louisianensis*

TABLE 1

Nominal species (and forms) of extant brackish water hydrobiids known or reported from Florida coastal areas (in Florida, *Probythinella protera* is known only from a fossil record near Tampa). *1 = Thompson (1968), 2 = Heard (1982), 3 = Hershler and Thompson (1992), 4 = Lyons (1998), 5 = present report, 6 = Heard, Hershler, Thompson (personal observations).

Taxa	Florida coastal distribution	References*
<i>Floridiscrobs</i> Pilsbry and McGinty, 1949		
<i>F. dysbatus</i> (Pilsbry and McGinty, 1949)	SW (high salinity)	4
<i>Heleobops</i> Thompson, 1968		
<i>H. docima</i> Thompson, 1968	Peninsular	1, 3
<i>Heleobops</i> sp. A	NW	5
<i>Heleobops</i> sp. Form A	NW(E. of Apalachicola R.)	2
<i>Heleobops</i> sp. Form B	NW (W. of Apalachicola R.)	2
<i>Littoridinops</i> Pilsbry, 1952		
<i>L. monroensis</i> (Frauenfeld, 1863)	Entire	1, 2, 5
<i>L. palustris</i> Thompson, 1968	Gulf	1, 3, 5
<i>L. tenuipes</i> Couper in Haldeman, 1844	NE	1, 3
<i>Onobops</i> Thompson, 1968		
<i>O. crassus</i> Thompson, 1968	SW	1, 3
<i>O. jacksoni</i> (Bartsch, 1953)	Entire	1, 3
<i>Pyrgophorus</i> Ancey, 1888		
<i>P. platyrachis</i> Thompson, 1968	SE, Gulf	1, 3
<i>Spurwinkia</i> Davis, Mazurkiewicz, and Mandracchia, 1982		
<i>S. salsa</i> (Pilsbry, 1905)	NE	4, 6

(Schmitt, 1935) and the barnacle *Balanus subalbidus* Henry, 1973 (on bridge pilings and submerged wood) were common at this site. The second site, Mill Bayou Station 1A, is located at the east end of Suwanee Street on the western margin of the bayou (30°15.2'N, 85°36.7'W), less than 100 m south of the bayou mouth. This site is characterized by muddy sand and had depths to 2 m. Burrow openings of *L. louisianensis* were a prominent feature of the sediment at this site. Mill Bayou opens into the upper part of North Bay, just below Deer Point Reservoir Dam.

Upper Goose Bayou. Station 2 (30°13.9'N, 85°40.1'W), located in the upper reaches of Upper Goose Bayou, is an artificially altered bayou which empties into North Bay about 5 km west of Station 1. The study area was an oval-shaped section of marsh located between marginal pine bluffs and separated by a causeway on the bayou side, with culvert openings connecting it with the primary area termed "Upper Goose Bayou." The collection site was located near the center of the study area along a tidal creek adjacent to a bluff through which a storm-water drainage pipe was buried. The marsh was predominantly characterized by needle rush and drained by several shallow creeks. Smooth cord grass (*Spartina*

alterniflora), widgeon grass (*Ruppia maritima*), and other vascular plants occurred along the creek margins. Sediments consisted of an anaerobic, black, silty mud, with a hydrogen sulfide odor.

Mill Point Marsh. Station 3 (30°15.8'N, 85°35.7'W) is located about 200 m north of Bailey Bridge at Mill Point in North Bay along FL Hwy 77. It consisted of a short drainage canal that flowed through a larger creek directed south to Mill Point. Station 3 was identified as the subtidal and intertidal areas at the source of the canal. At the collection site, the water depth varied from intertidal to 0.5 m. The area was vegetated predominantly by widgeon grass and needle rush, with the higher areas of the marsh floor covered by a sparse carpet of *L. chinensis* and *E. parvula*. Station 3A was designated as the supratidal area of the higher marsh. Needle rush constituted the primary vegetation at this site, but, as elevation increased, it was replaced by non-marine grasses.

Maggie Bayou. Station 4 (30°15.0'N, 85°39.2'W) is located near the head of Maggie Bayou, a small inlet located 0.5 km east of Haven Point and 1.0 km west of Bailey Bridge on North Bay. The collection site was adjacent to and 25 m downstream from a culvert located at the intersection of Tennessee Avenue and 5th Street in

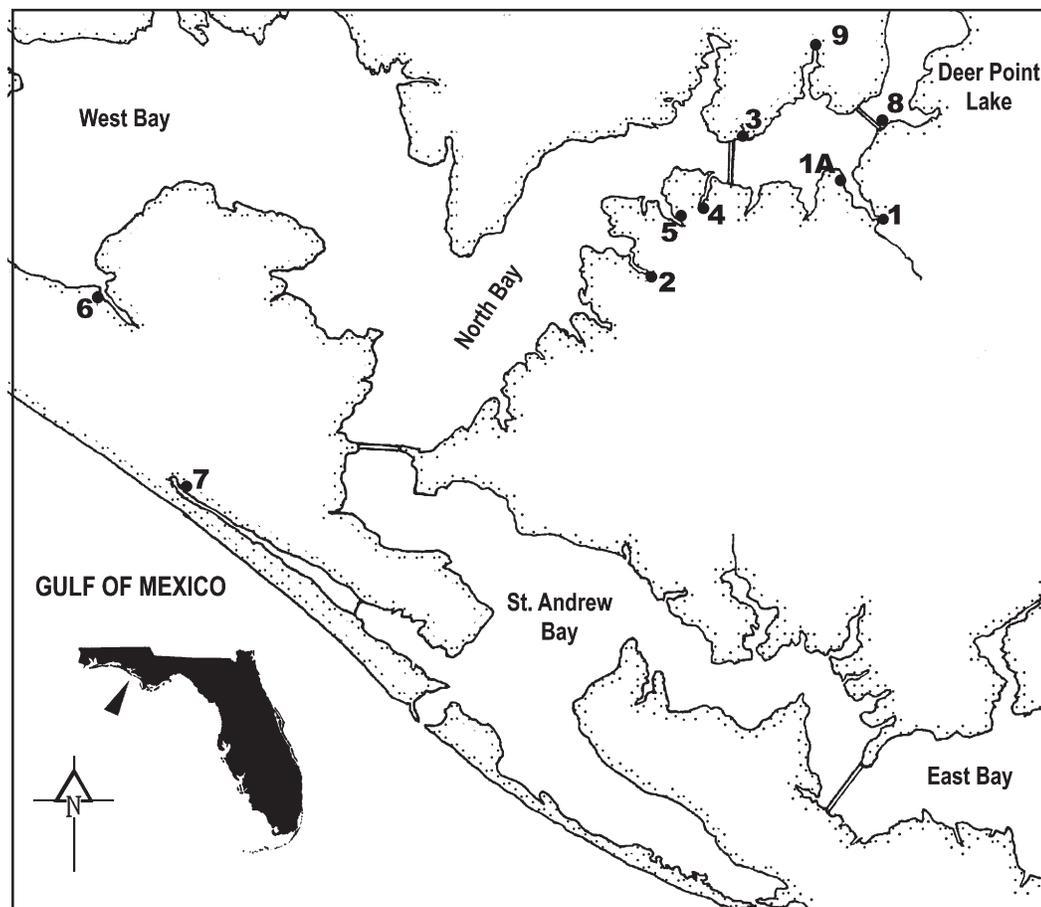


Figure 1. Sampling locations in the St. Andrew Bay System, Florida, 1989–1999. 1. Mill Bayou. 1A. Mill Bayou, 2nd collection site. 2. Upper Goose Bayou. 3. Mill Point Marsh. 4. Maggie Bayou. 5. Lynn Haven Bayou. 6. West Bay Marsh. 7. Grand Lagoon Pond. 8. Deer Point Dam Reservoir. 9. Gainer Bayou.

Lynn Haven. The elevation difference associated with the culvert and the street created a distinct change in the vegetation between the collection site and the area upstream of the culvert under 5th Street. South of the street, cattail (*Typha angustifolia*) dominated. Downstream from the culvert, the creek flowed across a shallow bed of muddy sand that was fringed with a mixture of needle rush and *Cladium jamaicense*. Upgrade from the marsh, a band of *Spartina patens* occurred. The entire station occupied no more than 400 m².

Lynn Haven Bayou. Station 5 (30°14.5'N, 85°39.7'W) is located at the northern terminus of New Hampshire Avenue in Lynn Haven at Lynn Haven Bayou. Station 5 was a mud-silt area of the bayou at the street terminus. It is a mesohaline area with a depth range from intertidal to 0.5 m. The bayou margins were fringed primarily with needle rush and smooth cord grass. Station 5A was a drainage ditch that flowed north to the bayou along the street. During our observations, a natural weir had blocked the ditch. Flooding on very high

tides was observed to affect the salinity at the lower end of the ditch, and heavy rainfall abruptly lowered the salinity of the bayou, especially during low tide.

West Bay Marsh. Station 6 (30°13.5'N, 85°40.3'W) was associated with a broad expanse of needle rush fringing the shore of Botheration Bayou, a creek which flowed into West Bay along its southern shore. The creek drained a large area of pine flat woods. It formed a broad intertidal delta vegetated with needle rush and smooth cord grass.

Grand Lagoon Pond. Station 7 was an oligohaline pond of about 2 ha and formed the headwaters of Grand Lagoon, a narrow arm of St. Andrew Bay that lay shoreward and parallel to a barrier peninsula (30°10.3'N, 85°47.7'W). The pond lay between FL Hwy 30B and Joan Avenue, adjacent to a trailer park on Panama City Beach. Runoff from the park and a nearby golf course appeared to contribute to the nutrification of the pond. At the source of the pond, the marginal vegetation consisted of dense growths of cattail and green taro (*Colocasia*

esculentum). The eastern end of the pond, where collections were made, was drained by a short creek run, which formed a brackish tidal marsh (needle rush). During our observations, the pond experienced episodes of elevated salinity associated with high, wind-blown tides, especially during summer months. Water-hyssop (*Bacopa monnieri*) extended in dense floating mats from the shore into part of the pond and creek run. The water depth in this area of the pond and in the small creek connecting it to Grand Lagoon was less than 1 m in depth. During Hurricane Georges (26 September 1998) the water depth of the pond was temporarily elevated by 0.5 m, and its water was fresh (0‰) for over a week.

Deer Point Dam Reservoir. Station 8 is located at the public boat ramp on FL Hwy 2321, 4.5 km north of US Hwy 231 and adjacent to Deer Point Dam in Bay County, Florida (30°15.8'N, 85°36.2'W). The lake is a man-made, freshwater reservoir of 2000 ha created in 1961 by the damming of the northeastern arm of North Bay. The reservoir was fed by three creeks, one of which had a relatively constant, year-round flow due to the contribution of several large artesian springs (Schmidt and Clark 1980). During our visits, the dominant submerged vegetation at the site was Eurasian spiked water-milfoil (*Myriophyllum spicatum*). Fringing the lakeshore were dense stands of cattail (*Typha angustifolia*). Sediment consisted of medium to coarse sand covered by a veneer of organic debris.

Gainer Bayou. Station 9 is located along the eastern side of FL Hwy 77 on the northern shore of North Bay. The collection site was located in an artificial tidal basin behind a concrete water control structure with two overflow pipes. During our visit on 8 November 1998, the tide was low and the tidal basin was largely dry except for two large tidal pools. Collections were made in the larger pool about 30 m northwest of the concrete water-control structure. The water depth of this pool was less than 1 m. *Balanus subalbidus*, *Callinectes sapidus* Rathbun, 1896, *Lepidophthalmus louisianensis* (Schmitt, 1935), and *Neritina usnea* (Röding, 1798) were common in the collecting area. The bottom substratum of the pool sampled consisted of a fine silt layer about 20 to 40 cm thick, overlying a coarse sand base.

Collection Methods

Collections for hydrobiids were made using kick nets with 0.5 and 1.0 mm mesh bags. The nets were used either to dip aquatic vegetation (e.g., widgeon grass and water-hyssop) or to skim over intertidal and subtidal substrata. Samples were placed in 19-L buckets, which were partially filled with water from the collection site.

The hydrobiids (and other invertebrates) were then extracted by elutriation or by sieving with a series of screens ranging from 0.5 to 2.0 mm. In more confined areas (small marsh tidal pools), a stainless steel “tea strainer” with 1-mm mesh was employed to scoop and sieve sediments for snails.

Reproduction

Adult males and females of each species collected from the St. Andrew Bay System were each isolated into separate 15-cm diameter finger bowls containing brackish water having a salinity similar to that of the water from which each species-group was collected. Egg capsules initially attached to shells of snails used in these observations were removed before isolation. Other substrata that might accommodate the deposition of egg capsules by various hydrobiid species were added to the bowls. These substrata included uncontaminated filamentous green algae (*Cladophora* sp.) and empty hydrobiid shells. Bowls and snails were examined daily, with water changed every 2 or 3 days or when water quality dictated (e.g., fouling by blue-green algae). When egg capsules were observed attached to the bottom or sides of a bowl, the adult snails were transferred to a clean bowl and the date recorded. These bowls were dated and maintained until the corresponding ova hatched or died. When capsules were deposited on the algae or empty hydrobiid shells, these substrata were removed from the bowl and isolated in other bowls until hatching or death of the eggs occurred. Water in bowls containing the various substrata with attached egg capsules was changed daily and the infertile or dead eggs culled. The bowls were examined daily until hatching occurred.

General Information

Shells for scanning electron microscopy (SEM) were washed in distilled water, air-dried, and placed in a desiccator prior to sputter coating with gold film. Specimens were examined with a Jeol JSM T-330 scanning electron microscope. Morphological comments follow the terminology proposed by Hershler and Ponder (1998). When a common name is provided by Turgeon et al. (1998), we have included it.

RESULTS AND REMARKS

Collections and ecological observations from the St. Andrew Bay System were conducted over 10 years from September 1988 through September 1998. During this study, we collected hydrobiids belonging to four genera. These are *Heleobops* Thompson, 1968; *Littoridinops*

Pilsbry, 1952; *Onobops* Thompson, 1968; and *Texadina* Abbott and Ladd, 1951. They represent six species and came from bayou, tidal marsh, and pond habitats.

***Littoridinops monroensis* (Frauenfeld, 1863)
(Cockscomb hydrobe)**

Figure 2

Synonymy.—*Hydrobia monroensis* Frauenfeld, 1863, p.1023; Pilsbry 1899, p. 87–88, Figures 17–19.—*Bythinella monroensis*, Tyron, 1870, p. 48.—*Littoridina monroensis*, Walker 1818, p. 141.—*Amnicola forsythi* Pilsbry, 1930, p. 300 (Plate 22, Figure 7).—*Amnicola oscitans* Pilsbry, 1930, p. 300–301 (Plate 22, Figure 8).—*Amnicola sablensis* Pilsbry, 1951, p. 119–120 (Plate 9, Figures 1–1c).—*Littoridina* sp., Moore 1961, p. 52.—*Littoridinops monroensis*, Thompson 1968, p. 67–74; Leigh 1974, p. 768; Heard 1982, p. 11–14 (Figures 7e, 8d); Britton and Morton 1989, p. 209, 211; Hershler and Thompson 1992, p. 70–71; Lyons 1998, p. 18; Turgeon et al. 1988, p. 61; Turgeon et al. 1998, p. 73.—*Littoridinops* sp. A, Taylor in Andrews 1977.—*Littoridinops* [sic] *monroensis*, Heard and Overstreet 1983, p. 171–174; Font et al. 1984, p. 396.

Material examined. St. Andrew Bay, Florida.—Station 4 (Maggie Bayou): 50+ adults ($\sigma\sigma$, ♀♀ , juveniles), 26 August 1998.—Station 7 (Grand Lagoon Pond, snails associated with submerged and floating water-hyssop): 6 adults (1 σ , 5 ♀♀) plus numerous empty shells, 11 December 1994; 20 adults (7 $\sigma\sigma$, 13 ♀♀) plus numerous juveniles and empty shells, salinity near 0‰, 20°C, 12 January 1995; 500+ ($\sigma\sigma$, ♀♀ , juveniles), salinity 5‰, 18.5°C, 23 November 1996; 250+ ($\sigma\sigma$, ♀♀ , juveniles), salinity near 0‰, 17°C, 9 February 1997; 200+ adults, salinity 3.5‰, 26°C, 12 September 1998.

Remarks. The shells of *Littoridinops monroensis*, especially those of the females, are more robust than those of *Littoridinops palustris* Thompson, 1968 and *Littoridinops tenuipes* Couper in Haldeman, 1844. A penis, or male copulatory organ (= verge of some authors), bearing two to five more or less distinct rows of mammiform apocrine glands on the convex (right) margin and one to three subapical apocrine glands on the concave (left) margin near the distal end of penis, distinguishes *L. monroensis* from other Florida brackish water hydrobiids (Figure 2D). Difficulty existed when attempting to distinguish the shells of *L. monroensis* from those of the closely related Gulf and East coast endemic species, *L. palustris* and *L. tenuipes*, respectively.

In life, the dark body pigmentation of the females of *L. monroensis* and *L. palustris* overlaps to such an extent

that we were unable to reliably distinguish the two in the populations from the St. Andrew Bay System. However, when comparing the living males of the two species, we observed that those of *L. monroensis* had dark pigmentation that could be seen through translucent upper whorls of the shell. A dark melanistic layer covered the area around the testis and part of the digestive gland. Because *L. monroensis* commonly occurred near the surface of ponds on vegetation, perhaps this pigment layer evolved as a means of protection for the testis from ultraviolet radiation. Such a distinct dark layer in the region of the testis was not observed in the male of *L. palustris* from subtidal and tidal marsh populations at Mill, Lynn Haven, and Upper Goose bayous, where there was less direct exposure to sunlight.

Distribution and Ecological Observations. During our study, we observed a well-established population of *L. monroensis* on Panama City Beach in an oligohaline to lower mesohaline pond intermittently connected to the headwaters of Grand Lagoon (Station 7). Also, on two occasions, we recorded it from Upper Goose Bayou (Station 4). On those occasions, it co-occurred with *L. palustris*, *Heleobops* sp. (smooth form), and *Onobops jacksoni* (Bartsch, 1953). At the Upper Goose Bayou site, *L. monroensis* was collected on widgeon grass in a marsh pond. Because it occurs from Maryland southward throughout Florida and westward to Texas, the Bahamas, and Cayman Islands (Heard 1982, Hershler and Thompson 1992, Heard and Overstreet, personal observations), the presence of *L. monroensis* in the St. Andrew Bay System was not unexpected. Along the coast of the northern Gulf, it commonly occurs in brackish ponds, often in high densities, associated with submerged aquatic vegetation (e.g., widgeon grass and water-hyssop) and filamentous algae. It appears to be especially well adapted for living in the brackish water ponds that commonly occur on the barrier islands along the northern Gulf (Heard 1982).

Egg capsules of *L. monroensis* were deposited on algal filaments, aquatic vascular plants, and the shells of other snails (Figure 2E). The size and development of the egg capsules was about the same as for *L. palustris*, and a single embryo developed in each capsule. Depending on the temperature, a fully formed juvenile emerged from the capsule within 10 to 15 days after being deposited (Heard 1982, present study, Figure 2F–H). The incorrect report by Hershler and Thompson (1992) of a pelagic larva for this species was the result of a miscommunication from R. Heard.

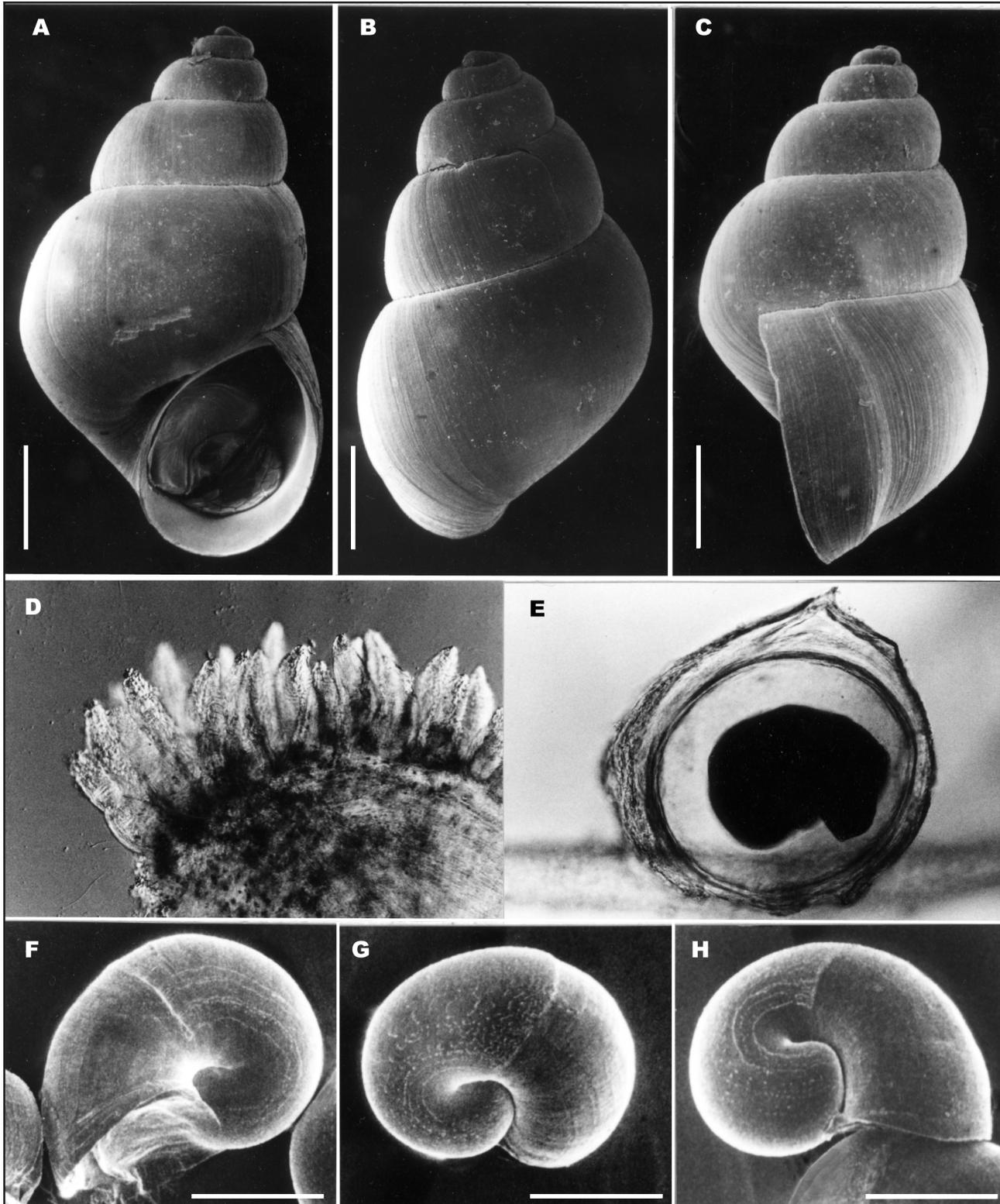


Figure 2. *Littoridinops monroensis*. A–C. Adult female, three aspects of shell (SEM). D. Male, penis, showing two to three rows of apocrine glands. E. Egg capsule on filamentous green alga. F–H. Protoconchs, various aspects of individuals hatched within 24 hr showing new growth (SEM). Scales: A–C = 500 μ m; F–H = 100 μ m.

***Littoridinops palustris* Thompson, 1968**
(Bantam hydrobe)

Figures 3, 4

Synonymy.—*Littoridinops palustris* Thompson, 1968, p. 65–67; Heard 1982, p. 11–14 (Figures 7e, 8d); Hershler and Thompson 1992, p. 70; Lyons 1998, p. 18; Turgeon et al., 1988, p. 61; Turgeon et al., 1998, p. 73.—*Littoridinops* [sic] *palustris*, Heard and Overstreet 1983, p. 171–174.

Material examined. St. Andrew Bay, Florida.—Station 1 (FL Hwy 390 at Mill Bayou, subtidal; 1–2 m depth): 40+ adults (♂♂, ♀♀), 30+ subadults, 25 October 1994; 10+ adults, 11 December 1994; 30+ adults, 3 February 1995; 25+ adults, 9 February 1997; 100+ (♂♂, ♀♀), 12 September 1998.—Station 1A (mouth of Mill Bayou at Memorial Park): 1♂, 11 December 1994.—Station 4 (Maggie Bayou): 50+ adults (♂♂, ♀♀, juveniles), 13 May 1995.—Station 5A (Lynn Haven Bayou; brackish water ditch adjacent to boat ramp): 30+ adults (♂♂, ♀♀), 13 May 1995.—Station 9 (Gainer Bayou): 15 adults (4♂♂, 11♀♀), salinity 14‰, 25°C, 7 November 1998.

Remarks. Some of the shells of *L. palustris* from subtidal habitats along the northern Gulf had a distinctively thickened or swollen area at or near the outer lip of the shell aperture. We have often observed this characteristic in greater than 25% of adult specimens collected from low salinity, subtidal sites in Alabama and Mississippi. Only a few individuals (Figure 3D) from the Mill Bayou population exhibited this feature, one which has not been noted in populations of *L. palustris* from the southern part of the snail's range along the Gulf coast of peninsular Florida (Thompson 1968, Heard, Overstreet, and Foster, personal observation). Also, no such condition was observed for the shells of *L. monroensis*.

The penis of *L. palustris* (Figure 4) bears a single row of five to 15 mammiform apocrine glands on the convex margin and one to three on the distal concave margin near the distal end of the penis (Thompson 1968, Heard 1982). These characteristics clearly distinguish the male of *L. palustris* from that of *L. monroensis*, which has two or more rows of mammiform apocrine glands on the convex margin of the penis. Absence of proximal apocrine glands on the concave margin distinguishes the penis of *L. palustris* from the superficially similar ones of *L. tenuipes* and of *Pyrgophorus platyrachis* Thompson, 1968. Although the species occasionally co-occur with *L. palustris*, both *L. monroensis* and *P. platyrachis* characteristically inhabit low salinity coastal ponds and tidal backwaters associated with the aquatic plants, principally widgeon grass and water-hyssop.

Of the living adult specimens of *L. palustris* examined from Mill Bayou, most males were smaller than the corresponding females. Except for two males infected with digenean parasites, the penes of the specimens were well developed. One difference noted for the Mill Bayou population and another population of *L. palustris* from Lake Shelby, a brackish lake near Gulf Shores, Alabama, was that most of the adult males had a single mammiform apocrine gland on the concave margin of the penis adjacent to its distal end.

Distribution and Ecological Observations. *Littoridinops palustris* is widely distributed along the Gulf from Mississippi to southern Florida (Thompson 1968, Heard 1982), and, like *L. monroensis*, we expected to find it in the St. Andrew Bay System. It is replaced on the east coast of Florida by *L. tenuipes*, which has a range extending northward to Massachusetts (Smith 1987, Hershler and Thompson 1992).

Littoridinops palustris commonly occurs intertidally in the wetter parts of marshes where salinities vary from less than 1 to over 20‰. In low salinity (usually less than 10‰) areas of bays, bayous, and mouths of tidally influenced rivers, it can occur subtidally to depths greater than 2 m. In these subtidal habitats, it is usually associated with plant detritus or with submerged vegetation, such as widgeon grass and water celery, or eel grass (*Vallisneria americana*).

There is no true planktonic larval or free swimming veliger stage for *L. palustris*. The egg capsules were relatively large and were often deposited on the shells of other individuals of *L. palustris* and other associated hydrobiids. A single embryo developed in each spherical egg capsule. After about 2 to 3 weeks, depending on temperature, a small, fully formed juvenile emerged (Heard 1982). The newly hatched young, and even the adult stage, can be dispersed by clinging to the surface film or to small pieces of plant material being transported by tidal currents. On several occasions, one of us (RWH) collected numerous small juveniles and a few adult specimens in surface-plankton tows from Davis Bayou, Mississippi.

***Heleobops* sp. A**

Figures 5–7

Synonymy.—*Heleobops* sp. (Forms A, B, C), Heard 1982, p. 13.—*Heleobops* sp., Hershler and Thompson 1992, p. 61.—*Heleobops* sp., Heard and Kinsella 1995, p. 97, 101.—“undescribed species of *Heleobops*,” Heard and Overstreet 1983, p. 171.

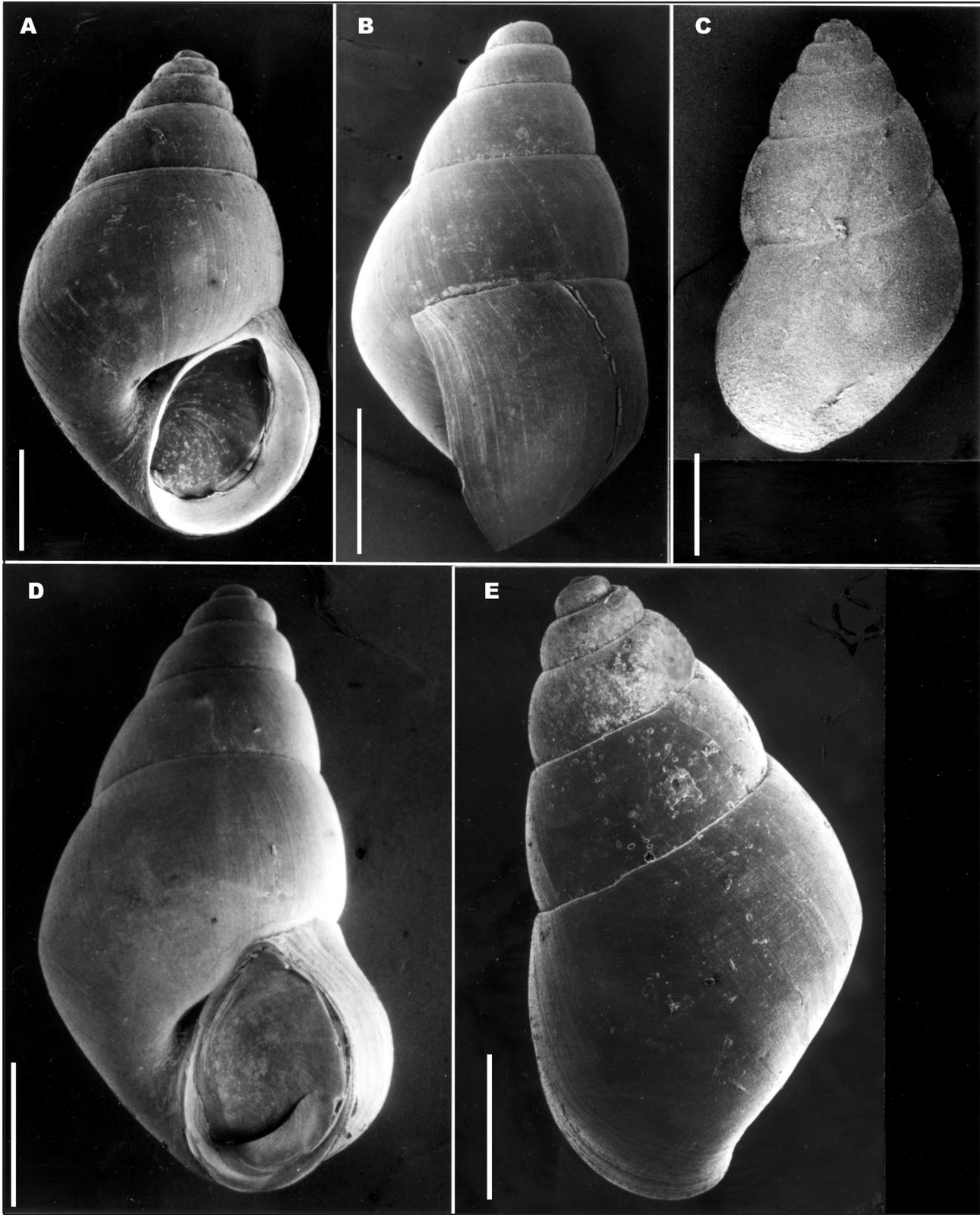


Figure 3. *Littoridinops palustris*. Shells of adult females (SEM). A–E. Various aspects. B, C. Note swollen shell behind outer lip, characteristic of subtidal forms. Scale: A–E = 500 μ m.

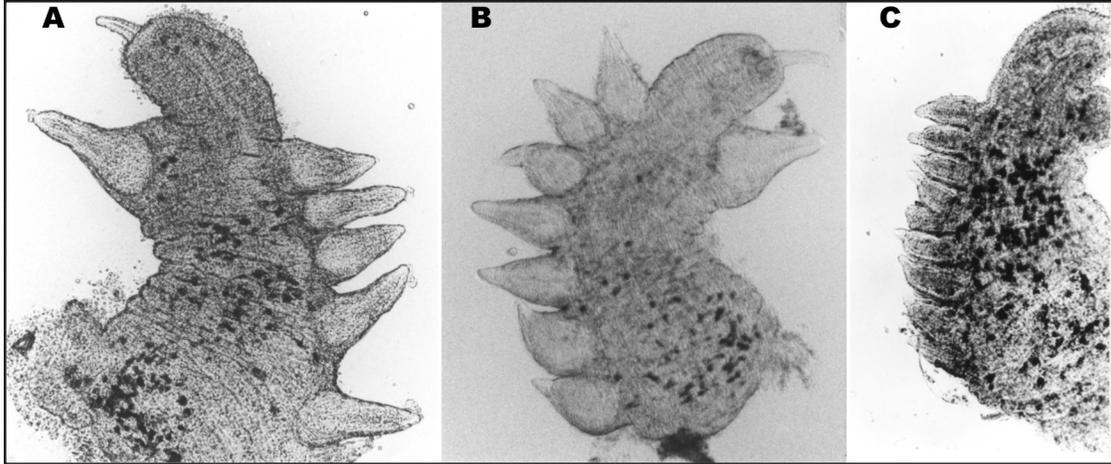


Figure 4. *Littoridinops palustris*. Male, penis, showing variation in the single row of apocrine glands on convex margin. A. Row of five. B. Row of seven. C. Row of nine.

Material examined. St. Andrew Bay, Florida.—Station 1 (FL Hwy 390 at Mill Bayou; subtidal, 1–2 m depth, pale orange, striate form): 50+ adults (18♂♂, 32+♀♀), 25 October 1994; 30+ subadults; 10+ adults, 11 November 1994; 30+ adults (♂♂, ♀♀), 3 February 1995; 25+ adults (♂♂, ♀♀), 9 February 1997; 100+ (♂♂, ♀♀), 12 September 1998.—Station 1A (mouth of Mill Bayou at Memorial Park): 1♂, 11 December 1994.—Station 4 (Maggie Bayou): 100+ subadults (mostly smooth form, with a few individuals intermediate between striate and smooth forms), 13 May 1995.—Station 5A (Lynn Haven Bayou; brackish water ditch adjacent to boat ramp): 30+ adults (♂♂, ♀♀) (grayish smooth form), 13 May 1995.—Station 9 (Gainer Bayou): 50+ adults (♂♂, ♀♀), salinity 14‰, 25°C, 8 November 1998.

Remarks. *Heleobops* sp. A appears to represent a recently evolved species derived from ancestral stock also common to *Heleobops carrikeri* Davis and McKee, 1989 during or after the re-emergence of the Florida Peninsula. *Heleobops* sp. A is distinguished from *H. carrikeri* by having a small, poorly developed apocrine gland on the penial lobe just distal to the last large apocrine gland. Populations of *H. carrikeri* are known from only the Chesapeake Bay side of Delmarva Peninsula (Maryland).

Heleobops docima Thompson, 1968 is the only other member of the genus known from Florida. It occurs in central Florida southward to the Bahamas and some of the northern Caribbean islands (Hershler and Thompson 1992), and its range appears to overlap that of *Heleobops* sp. A south of the Suwannee River. Although the shells of the two species are nearly indistinguishable, the male of *H. docima* can be separated from that of *Heleobops*

sp. A by the lack of apocrine glands on the distal third of the penis (see Figure 38 in Thompson 1992).

There appear to be two geographical forms of *Heleobops* sp. A, and these are distinguished by the shape of the anterior penial lobe on the penis. A form characterized by a “keel-shaped” lobe (see Figure 8f in Heard 1982) was apparently confined to an area just east of the Apalachicola River, Florida, southward to at least Tampa Bay. The other form, well represented in the St. Andrew Bay System, has a finger-like anterior penial lobe (Figures 6E, F, 7B). Its known range extends from just east of the Apalachicola River westward to the Chandeleur Islands, Louisiana, immediately east of the mouth of the Mississippi River.

Based largely on observations of the subtidal population of *Heleobops* sp. A (striate form) from Mill Bayou, we consider members of the striate population conspecific with *Heleobops* Forms A and B (smooth shell) and Form C (striate shell) of Heard (1982) and also *Heleobops* sp. (smooth shell form) previously reported from the headwaters of the St. Andrew Bay System by Hershler and Thompson (1992). Naturally occurring adults, newly hatched young, and juveniles were maintained in laboratory culture for several months. Study of the shell sculpture of these specimens (Figure 6D) confirms that the striate form of *Heleobops* sp. A from Mill Bayou is conspecific with *Heleobops* Forms A, B, and C *sensu* Heard (1982). These two shell forms represent intertidal, soft substrata (Forms A and B), and subtidal, sand-substrata (Form C) ecophenotypes. Additional circumstantial evidence that the striations on the shell were influenced by environmental conditions (chemical erosion or mechanical abrasion) was suggested by the pres-

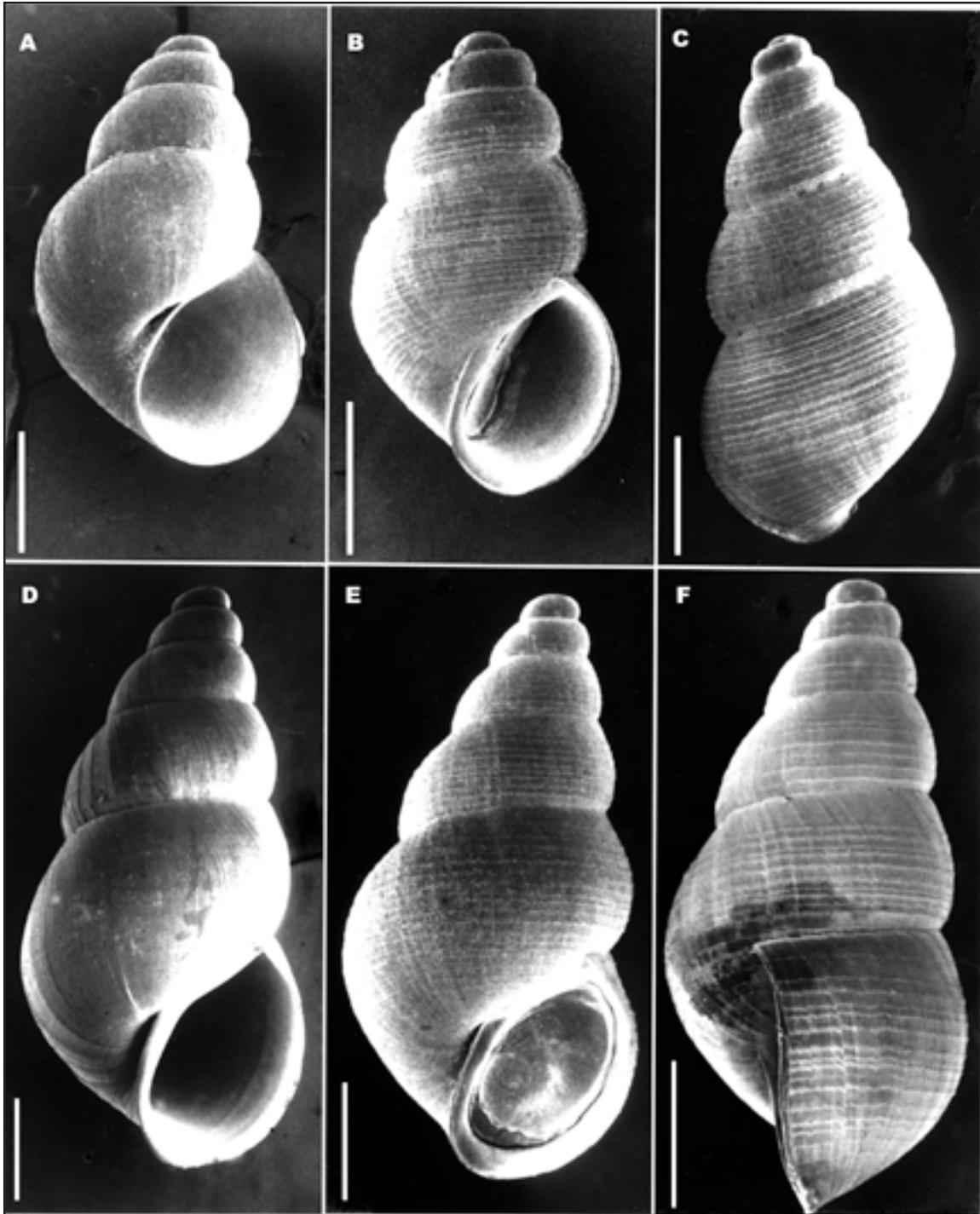


Figure 5. *Helicobops* sp. A. Shells of adults (SEM). A. Smooth-shelled male. B. Striate-shelled male. C. Striate-shelled female. D. Smooth-shelled female. E. Striate-shelled female, showing operculum. F. Striate-shelled female. Scale: A–F = 500 μ m.

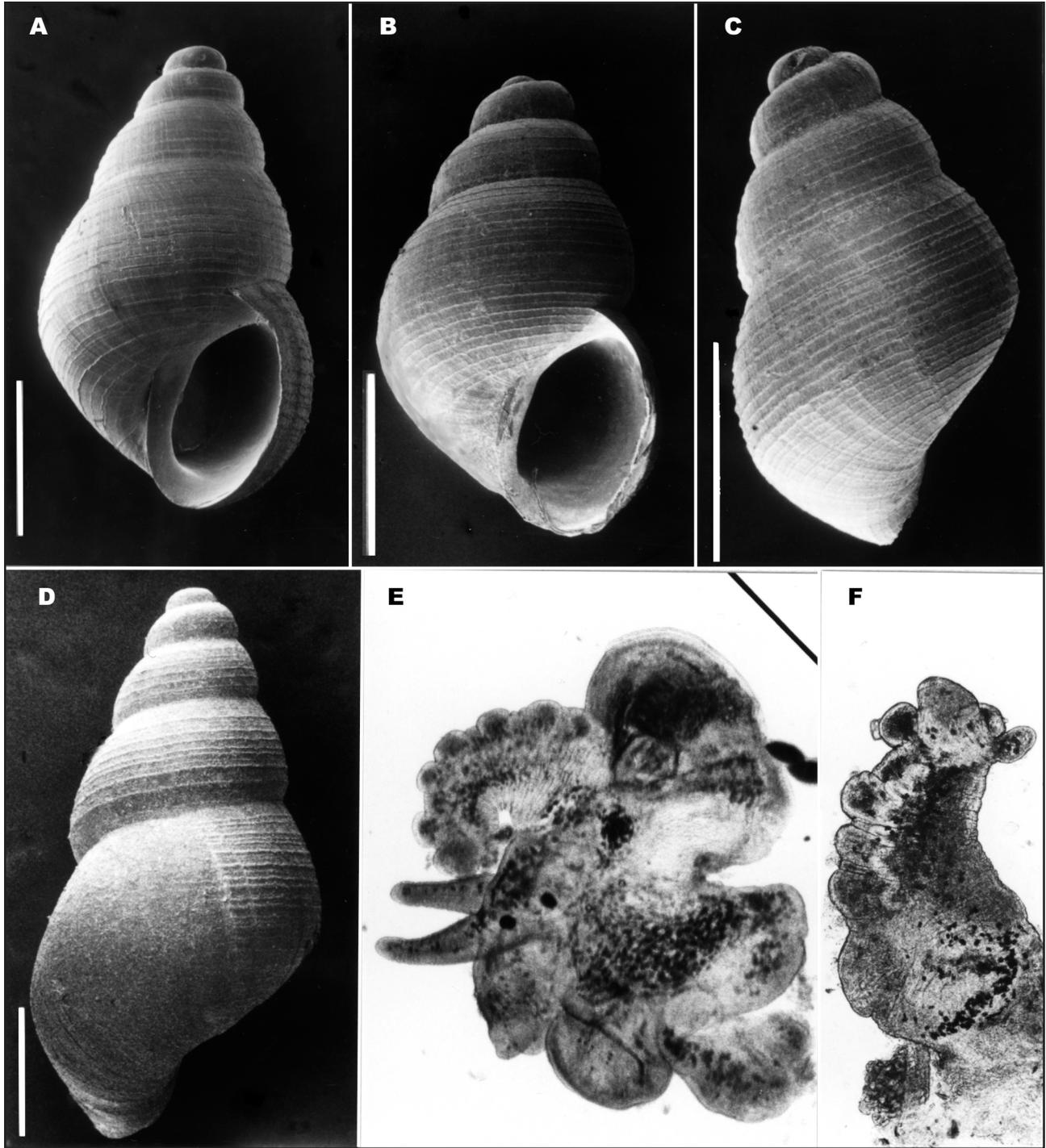


Figure 6. *Heleobops* sp. A. A–D. Shell (SEM). A–C. Male, various aspects striate-shelled form. C. Dorsal aspect of juvenile. D. Dorsal aspect of adult female showing transition from striate to smooth form that occurred when individual was maintained in laboratory culture for two months. E. Male individual removed from shell showing entire body, including penis. F. penis. Scale: A–D = 500 μ m.

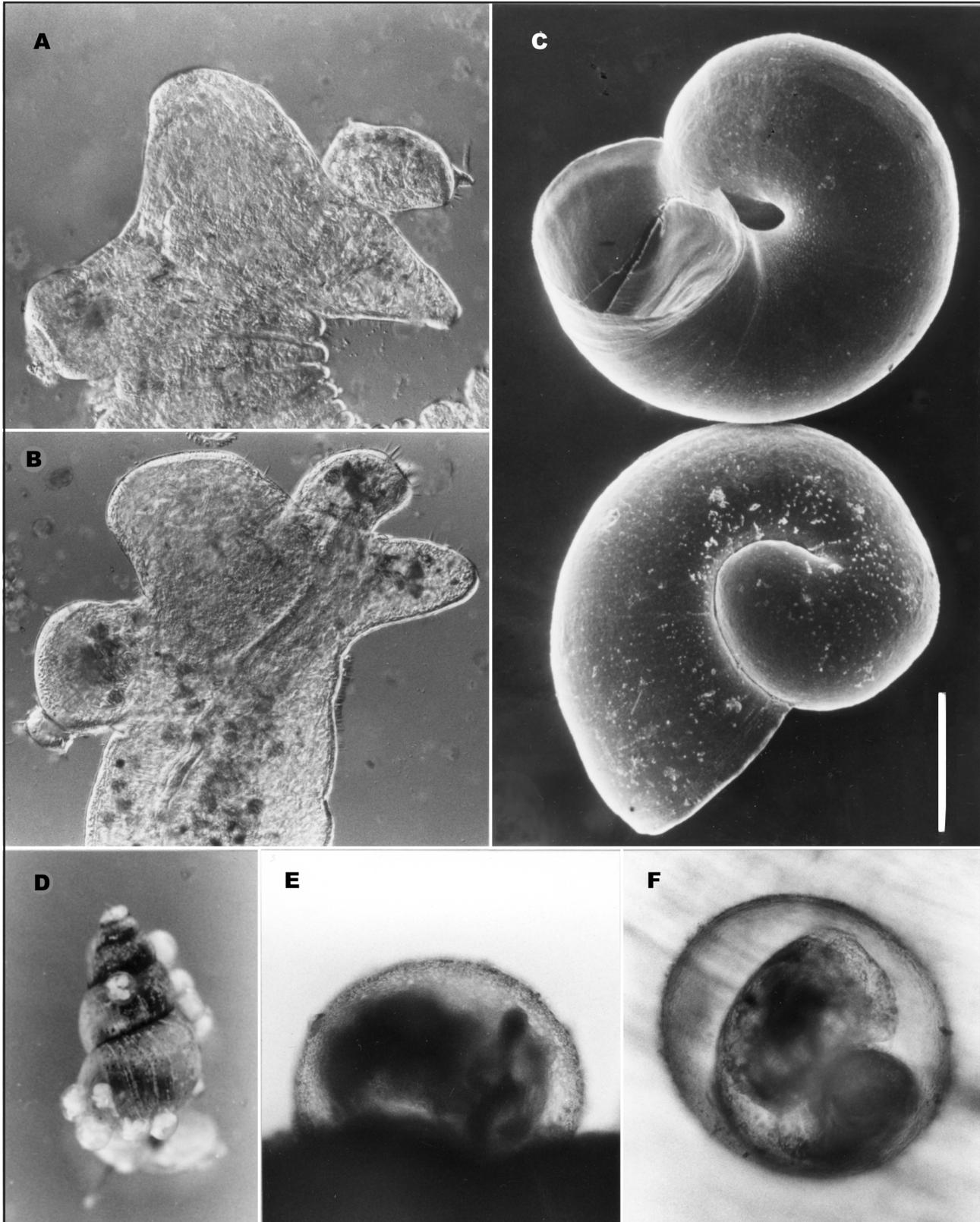


Figure 7. *Heleobops* sp. A. A. Penis, showing terminal stalked apocrine gland with pressure. B. Penis, showing terminal apocrine gland and associated duct, with pressure. C. Recently hatched striate form showing two aspects of protoconch. D. Egg capsules of marsh-type individual on another marsh-type individual. E. Close-up of egg capsule of marsh-type individual on marsh-type individual containing developing juvenile. F. Close-up of egg capsule of striated type containing developing juvenile. Scale: C = 100 μ m.

ence of similar orange-edged striations on the upper whorls in some individuals of *Texadina sphinctostoma* which co-occurred with *Heleobops* sp. A at the Mill Bayou site.

Distribution and Ecological Observations. One of us (RWH) has previously collected striated specimens (Form C of Heard 1982) from a small brackish pond on Horn Island, Mississippi, during September 1975 and from the upper part of Perdido Bay, Florida, during June 1980. Both of these collections were made in water depths ranging from 1 to 2 m. At all three collection sites, the striate shell form (Figures 5B, C, E, F, 6A–C) occurred in salinities usually less than 10‰ and on bottoms with a largely coarse quartz-sand substratum. In Perdido Bay, as in Mill Bayou, the striate form of *Heleobops* sp. A co-occurred with *T. sphinctostoma* and *L. palustris*.

During March of 1995, we discovered mesohaline populations of the smooth-shell form (Figure 5A, D) in several intertidal, tidal marsh habitats along the southern edge of West Bay and the eastern edges of North Bay (Stations 3, 4, and 5). In the more brackish habitats of West Bay, intertidal marsh populations of *Heleobops* sp. A co-occurred with *L. palustris* and *O. jacksoni*. In the higher salinity habitats of West Bay, *Heleobops* sp. A was found with the pyramidelid *Sayella* cf. *adamsi* and the pototomid horn snail *Cerithidea scalariformis* (Say, 1825).

Heleobops sp. A, like *L. monroensis* and *L. palustris*, deposits relatively large egg capsules, 0.34–0.41 mm in diameter, which contain a single embryo (Figure 7D–F). At room temperature (24–27 °C), the egg capsules hatched, producing fully formed juveniles within 11 to 15 days (Figure 7C). At the Mill Bayou (FL Hwy 390) site, egg capsules were observed on the shells of *Heleobops* sp. A as well as on those of the co-occurring hydrobiids *T. sphinctostoma* and *L. palustris*.

Under natural conditions, *Heleobops* sp. A most readily used the available shells of other hydrobiids for capsule deposition. We have observed juvenile and even adult shells of other hydrobiids so heavily fouled by *Heleobops* sp. A egg capsules, especially on the operculum or around the large body whorl, that movement and feeding of the snails were greatly impeded, often with fatal consequences. In some instances, we estimated that the combined mass of egg capsules was greater than that of the juvenile of *L. palustris* or *T. sphinctostoma* to which it was attached. A formal description of *Heleobops* sp. A with additional information on its ecology and ecophenotypic variation will be the subject of another report.

***Texadina sphinctostoma* (Abbott and Ladd, 1951)
(Narrowmouth hydrobe)**

Figures 8–10

Synonymy.—*Littoridina* (*Texadina*) *sphinctostoma*, Abbott and Ladd 1951, p. 335, Figures 1–12; Solem 1961, p. 74; Garcia-Cubas, A. 1963, p. 43 (Plate 2, Figure 9); 1968, p. 34; Andrews 1971, p. 62.—*Littoridina sphinctostoma*, Moore 1961, p. 52; Traver and Dugas 1973, p. 11, 12, 16, 19, 20, 27; Dugas et al. 1974, p. 1, 6, 13, Figure 9.—*Texadina sphinctostoma*, Taylor 1966, p. 182, 196; Abbott 1974, p. 79; Andrews 1977, p. 84; Cooley 1978, p. 18, 64; Heard 1979, p. 311–312; 1982, p. 12, 14–15 (Figures 7a, 8h); Britton and Morton 1989, p. 209, 211; Hershler and Thompson 1992, p. 102–105 (Figures 67, 68); Lyons 1998, p. 18; Turgeon et al. 1988, p. 63; Turgeon et al. 1998, p. 76.

Material examined. St. Andrew Bay, FL.—Station 1 (FL Hwy 390 at Mill Bayou; subtidal, 1–2 m depth): 100+ adults (♂♂, ♀♀), 30+ subadults, 25 October 1994; 10+ adults (3♂♂, 7♀♀), 11 December 1994; 150+ adults (♂♂, ♀♀), 3 February 1995; 50+ adults (♂♂, ♀♀), 9 February 1997; 100+ (♂♂, ♀♀), 12 September 1998.—Station 1A (mouth of Mill Bayou at Memorial Park; subtidal, 1–1.5 m depth): 75+ adults (♂♂, ♀♀), 11 December 1994.

Remarks. The relatively small and constricted aperture of the shell of an adult specimen of *T. sphinctostoma* (Figure 8A–D) easily distinguishes that species from *Texadina barretti* (Morrison, 1965) and most other brackish water hydrobiids occurring along the northern Gulf. Juveniles of *T. sphinctostoma* lack the constricted aperture characteristic of adults. The turbonate shell shape of juveniles of *T. sphinctostoma* (Figure 8E–F) distinguishes them from juveniles of the more conically shaped *T. barretti*.

The male penis of *T. sphinctostoma* is similar to that of *T. barretti*, but it has five to six rather than three to four suction cup-like apocrine glands on its convex margin (Figure 9A–C). Cooley (1978) incorrectly listed *T. sphinctostoma* in the Pyramidellidae, the same family of parasitic snails to which Morrison (1965) incorrectly assigned *T. barretti* when he originally described it as a member of the genus *Odostomia* Fleming, 1813.

Distribution and Ecological Observations. *Texadina sphinctostoma* was originally described from San Antonio Bay, Texas, by Abbott and Ladd (1951). La Laguna de Terminos on the coast of Campeche, Mexico, is the western known occurrence for this hydrobiid (Garcia-Cubas 1963, 1968). This species was also known from the brackish waters of Louisiana, Mississippi, Ala-

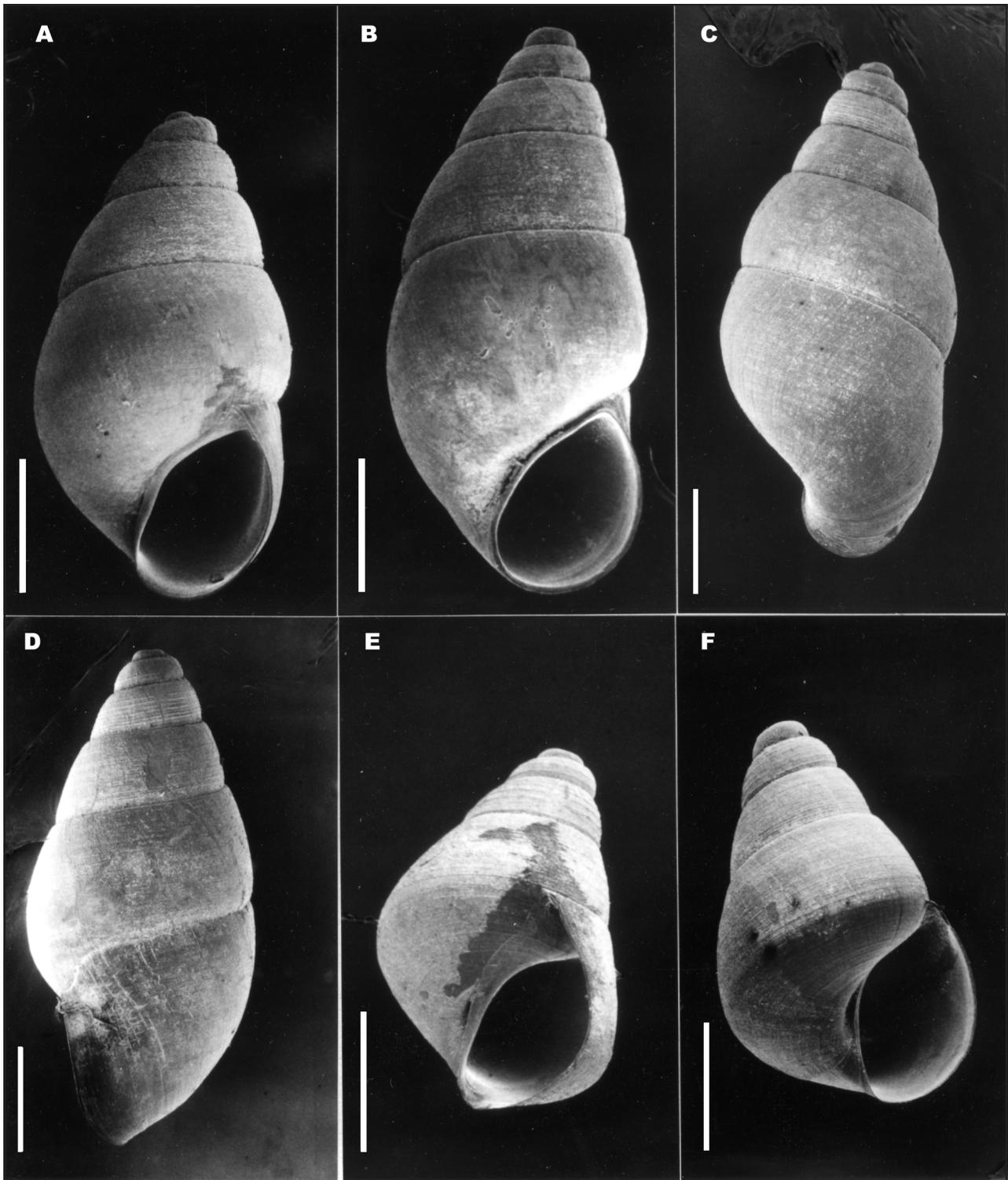


Figure 8. *Texadina sphinctostoma*. Shells (SEM). A–D. Various aspects of shell of four females. E. Early juvenile. F. Older juvenile. Scale: 500 μm .

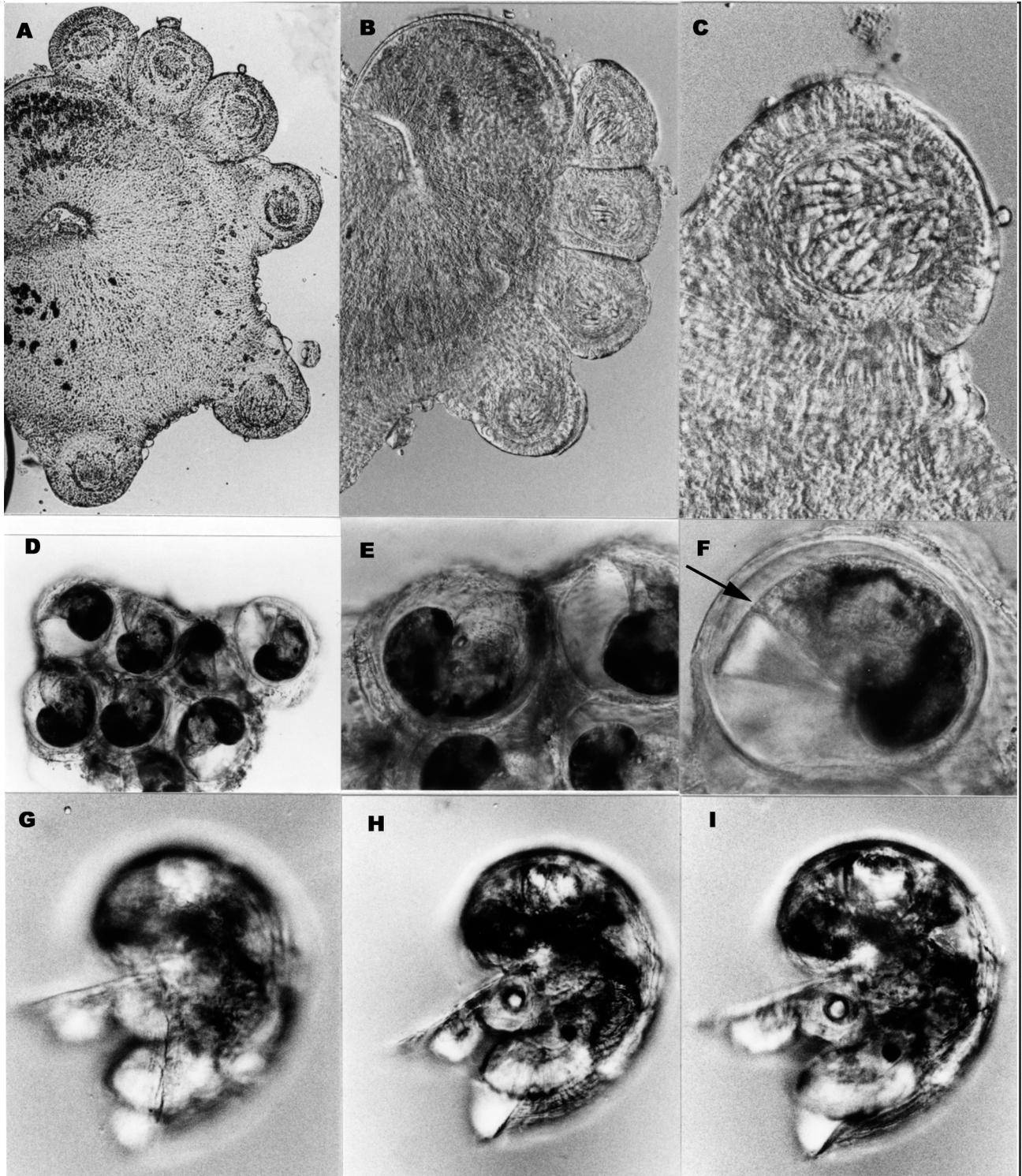


Figure 9. *Texadina sphinctostoma*. A–C. Male. A. Male, penis, showing “sucker-like” apocrine glands. B. Same, showing gonad and four distal-most apocrine glands. C. Enlargement of an apocrine gland. D–E. Egg capsules. D. Cluster of eight egg capsules from surface of *T. sphinctostoma* shell. E. Close-up of egg capsule cluster. F. Enlargement of egg capsule indicating recent shell growth (see arrow) in developing protoconch. G–I. Different planes of view of same shelled-veliger. G. Peripheral plane aspect. H. Plane toward mid-plane, showing clear statocyst adjacent to operculum. I. Near mid-plane aspect, also showing statocyst.

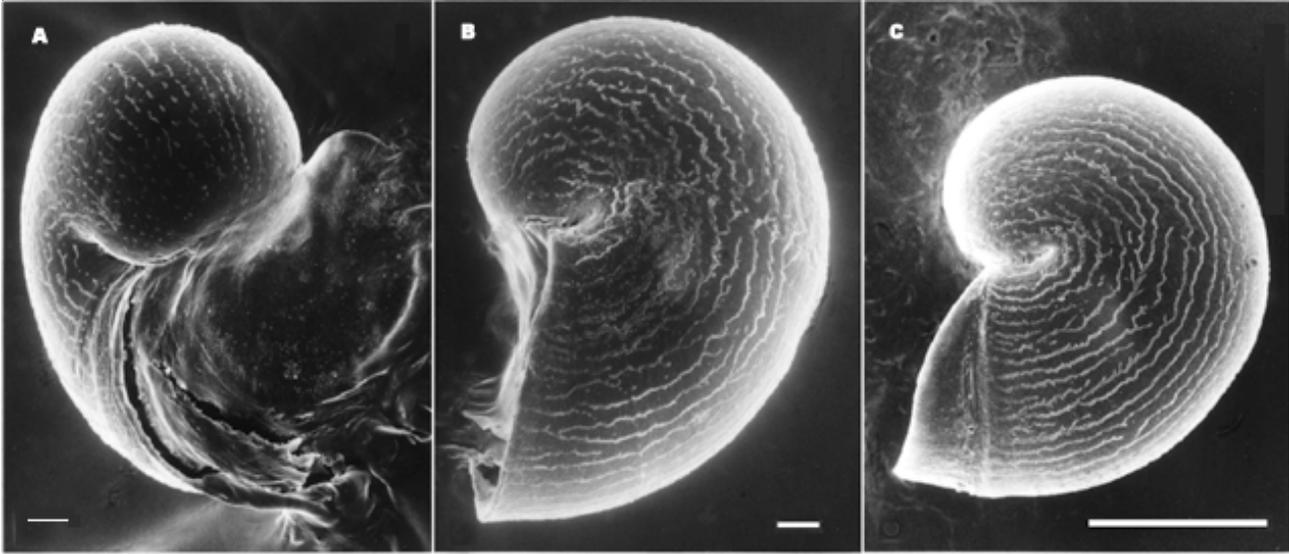


Figure 10. *Texadina sphinctostoma*. A–C. Shelled-veliger showing architecture of protoconch (SEM). C. Note recent differential growth of lip. Scales: A, B = 10 μ m; C = 50 μ m.

bama, and extreme West Florida (Cooley 1978, Hershler and Thompson 1992).

Texadina sphinctostoma co-occurs, often in large numbers, with the hydrobiid species reported as *Probythinella protera* Pilsbry, 1953 in the low salinity bayous and bay habitats of Texas, Louisiana, Mississippi, and Alabama (Solem 1961, Morrison 1965, Dugas et al. 1974, Heard 1979, Vittor 1979). Based on such collections of *P. protera* from Lake Pontchartrain, Solem (1961) found that some mature specimens had a constricted aperture like that reported for the adult of *T. sphinctostoma*. He suggested that some similar environmental factor or factors may have induced this condition in both species.

Our present records on *T. sphinctostoma* from Mill Bayou extend its eastern range from Escambia Bay (Cooley 1978) eastward to St. Andrew Bay, a distance of about 160 km. In the laboratory, we observed that some of the females deposited egg capsules on the shells of other specimens and on the finger bowls in which they were being maintained (Figure 9D–F). These capsules hatched as free-swimming, shelled-veligers in 8 days at room temperature (Figures 9G–I, 10A–C).

***Texadina barretti* (Morrison, 1965)
(Boone hydrobe)**

Figure 11

Synonymy.—*Odostomia barretti* Morrison, 1965, p. 218, Figure 4 (not *Odostomia barreti* Morlet, 1885).—*Hydrobia booneae* Morrison, 1973, p. 28; Turgeon et al. 1988, p. 61.—*Texadina barretti*, Taylor in Andrews

1977 p. 82; Heard 1982, p.15; Britton and Morton 1989, p. 209; Hershler and Thompson 1992, p.103; Lyons 1998, p. 18; Turgeon et al.1998, p.76.

Material examined. St. Andrew Bay, FL.—Station 1 (Mill Bayou at FL Hwy 390; subtidal, 1–2 m depth): 3 adults (1 σ , 2 f), 11 December 1994; 1 adult (σ), 4 April 1995; 1 adult (σ), 23 November 1996; 4 adults (σ , f), 9 February 1997; 19 adults (3 σ , 16 f), 10+ juveniles, salinity 1‰, 24 °C, 26 August 1998.

Remarks. Originally, *T. barretti* was described by Morrison (1965) from Lake Pontchartrain, Louisiana, as a member of the pyramidellid genus *Odostomia*. Later, Morrison (1973) transferred this species to Hydrobiidae in the genus *Hydrobia* Hartman, 1821; however, since the specific name “*barretti*” was a junior homonym of the older name *Hydrobia barreti* Morlet, 1885, he proposed the replacement name *Hydrobia booneae* Morrison, 1973 to accommodate the Gulf species. Based on the structure of the male penis, Taylor (in Andrews 1977) transferred *H. booneae* to the genus *Texadina*, resulting in the restoration of the original specific name, *barretti*.

The distinctive, seemingly stalked, sucker-like apocrine glands on the convex margin of the penis of *T. barretti* and *T. sphinctostoma* are characteristic of the genus *Texadina* and distinguish them from other brackish water hydrobiids of the northern Gulf of Mexico. *Texadina barretti* is distinguished from the co-occurring *T. sphinctostoma* by having 1) a typical non-constricted aperture, 2) a smooth, glossy shell lacking striations on the whorls; however, under SEM preparation, subadults and juveniles do exhibit faint spiral striations as seen in Figure 11A–D, and 3) fewer, three to four rather than

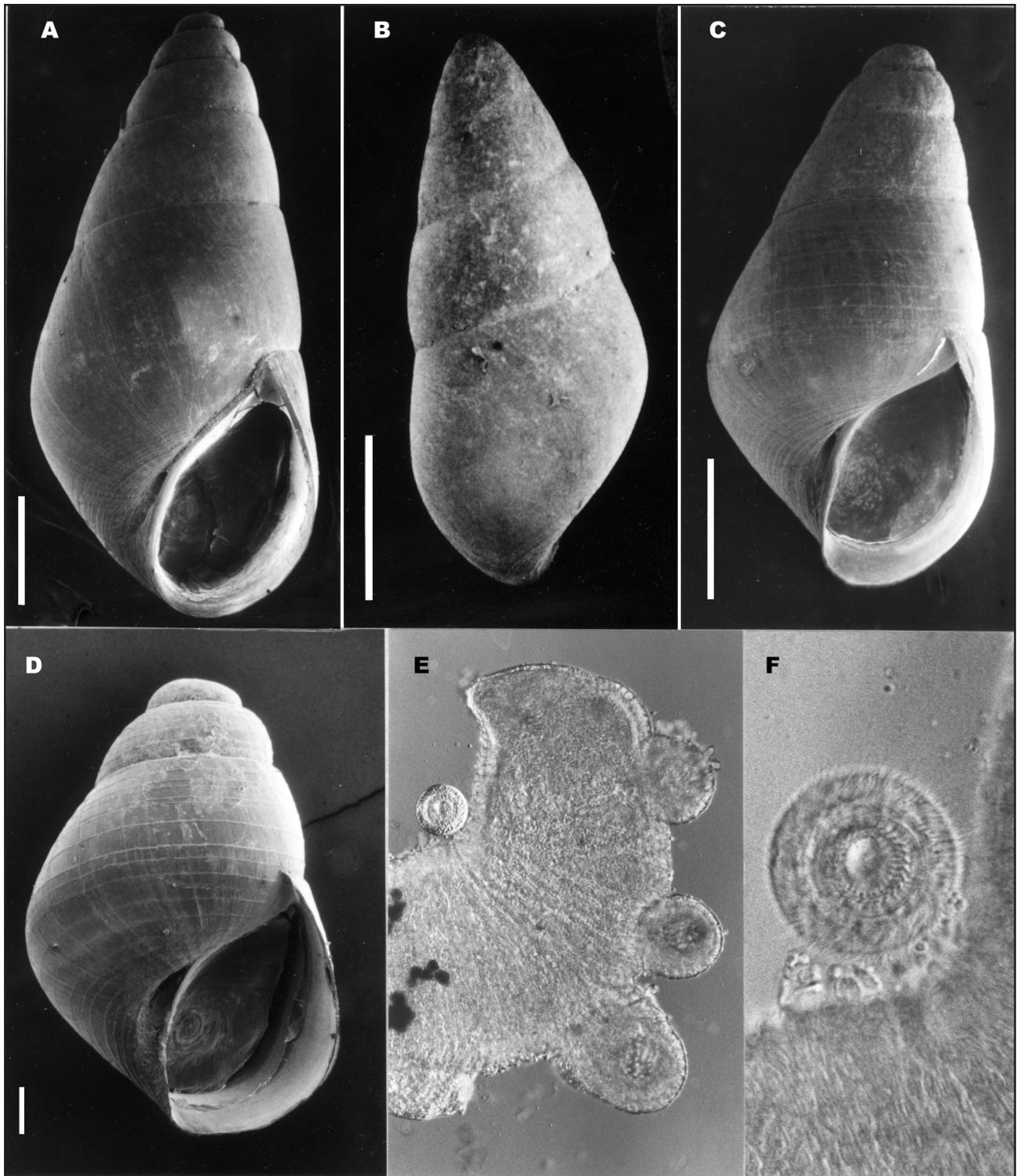


Figure 11. *Texadina barretti*. A–D. Shells (SEM). A, B. Adults. C. Subadult. D. Juvenile; compare with juvenile of *Texadina sphinctostoma*. E. Male, penis showing apocrine glands; note single trichodinid ciliate symbiont. F. Close-up of trichodinid peritrich symbiont. Scales: A, C = 500 μ m; B = 1 mm; D = 100 μ m.

five to six, sucker-like apocrine glands on the convex margin of the penis (Figure 11E).

Distribution and Ecological Observations. The presence of *T. barretti* in Mill Bayou extends its eastward range from Heron Bay in western coastal Mississippi (Morrison 1973) to St. Andrew Bay, a distance of approximately 370 km. Galveston Bay, Texas, is its reported western range limit (Morrison 1973). We also have two records of *T. barretti* from Jackson County, Mississippi (Davis Bayou, Gulf Coast Research Laboratory [GCRL] boat basin, and the Escatawpa River).

In a shallow brackish water lake near Port Fouchon, Louisiana, we found *T. barretti* associated with the callianassid ghost shrimp *Lepidophthalmus louisianensis* in wet sand along the edge of the shoreline. On several occasions at this site during June 1980, we observed specimens of *T. barretti* in the upper, constricted part of this ghost shrimp's burrow (Heard in Britton and Morton 1989). In all the other locations, Texas (Galveston Bay), coastal Mississippi (Davis Bayou), and Florida (Mill Bayou), where *T. barretti* occurred, populations of *L. louisianensis* also occurred (Heard and Foster, personal observations).

During September 1998, we made collections at Station 1 (Mill Bayou) specifically to determine whether or not the distribution of *T. barretti* was directly related to the presence of *L. louisianensis*. Although burrows of this callianassid occurred throughout the collecting area around the FL Hwy 390 bridge, they were far less dense in the deeper (1.5–2.0 m) parts of the bayou. We made eight 5-m sweeps with a 0.5 mm mesh kick net in this part of the bayou and four 5-m sweeps in the shallow sandy shoal areas where there were large concentrations of burrows (greater than 100 burrow openings/m²). The eight sweeps from deeper water yielded relatively large numbers of *Heleobops* sp. A, *L. sphinctostoma*, and *L. palustris* but only four specimens of *T. barretti*. In contrast, the four sweeps over the sandy shoal areas with callianassid burrows produced 26 specimens of *T. barretti*, further suggesting that *T. barretti* associates with *L. louisianensis*. Notwithstanding, additional field and laboratory observations are needed to determine whether or not a true symbiotic relationship exists between *L. louisianensis* and *T. barretti* or whether the observations at Port Fouchon resulted from the snails fortuitously entering the burrows to avoid dessication during low tide.

We maintained several adult male and female specimens of *T. barretti* collected from upper Galveston Bay in the laboratory for several weeks. During that period, females deposited egg capsules on the bottom surface of a large glass finger bowl. The capsules were similar in

size and structure (“fried egg-shaped”) to those of *T. sphinctostoma* and each contained a single ovum. Within 7 days of deposition, a free swimming, shelled-veliger emerged from each capsule.

***Onobops jacksoni* (Bartsch, 1953)
(Fine-lined hydrobe)**

Figures 12A–H

Synonymy.—*Onoba jacksoni* Bartsch, 1953.—*Onobops jacksoni*, Thompson 1968; Hershler and Thompson 1992; Lyons 1998, p. 18; Turgeon et al. 1988, p. 61; Turgeon et al. 1998, p. 74.—*Onobops* cf. *jacksoni*, Heard 1982.—*Cingula jacksoni* Bartsch, 1953 as erroneous listing of Turgeon et al. 1988 (see Turgeon et al. 1998, p. 219).

Material examined. St. Andrew Bay, FL.—Station 2 (Upper Goose Bayou): 100+ adults and subadults, 13 March 1995; 50+ adults (♂♂, ♀♀), 25+ subadults, 12 August 1998.—Station 4 (Maggie Bayou): 75+ adults (♂♂, ♀♀), 50+ subadults, 13 May 1995.—Station 5A (Lynn Haven Bayou): 50+ adults and subadults, 12 March 1995; 23 adults, 25+ subadults, 13 May 1995.

Remarks. The relatively small, elongate shell with incised whorls (Figure 12A–D) and the simple, unornamented penis of the male distinguish the two Florida species of *Onobops* from those of other hydrobiid genera from the Florida Gulf coast. *Onobops jacksoni* is similar to *Onobops crasus* Thompson, 1968, the only other member of the genus. *Onobops crasus* was described from the southwest coast of Florida, and *O. jacksoni* can be distinguished from it by having 22 to 24 gill lamellae rather than 26 to 28 and usually five rather than four opercular whorls (Thompson 1968).

Distribution and Ecological Observations. *Onobops jacksoni* appears to be a common resident of the mesohaline marshes and backwaters associated with the St. Andrew Bay system. It has been found commonly in the wet, muddy, intertidal parts of mesohaline tidal marshes and mangrove swamps from Maryland southward to Florida and westward to Mississippi (Heard 1982, Hershler and Thompson 1992).

The female of *O. jacksoni* deposits her “fried egg-shaped” egg capsules on the surfaces of empty shells, wood, leaves, and shells of various living hydrobiids (Figure 12E), including *O. jacksoni*. Similar to capsules of other known estuarine hydrobiids from the southeastern US, those of *O. jacksoni* contain a single ovum (Heard 1982, Davis and McKee 1989). Like those of *T. barretti* and *T. sphinctostoma*, the capsule of *O. jacksoni* is distinctly smaller than those known for species in the

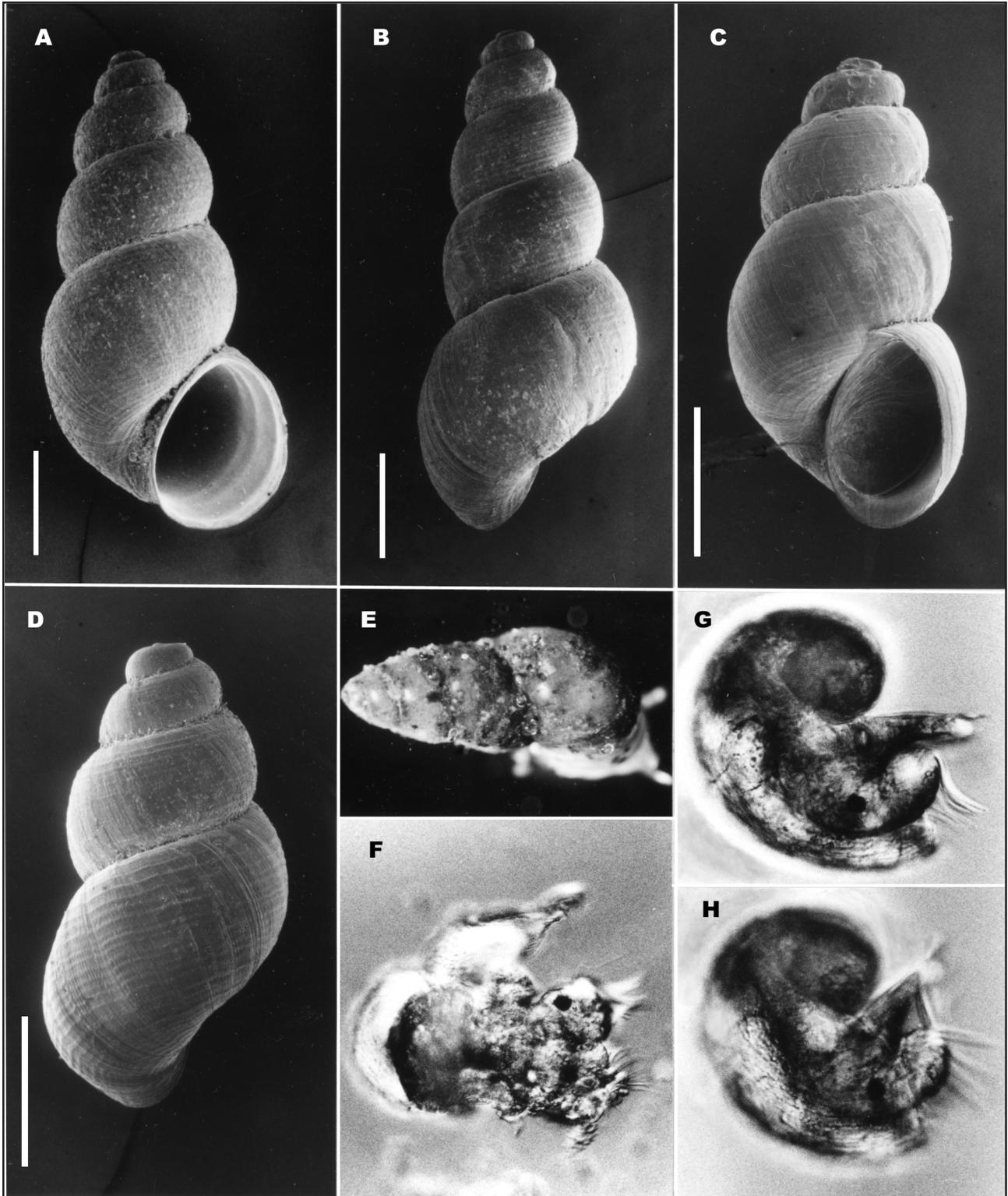


Figure 12. *Onobops jacksoni*. A–D. Shell (SEM), various aspects. A, B. Adults. C, D. Subadults. E. Egg capsules on shell of same species. F. Veliger, with shell broken to reveal dorsum of snail. G. Veliger, mid-plane aspect, showing side of operculum. H. Veliger, peripheral plane aspect. Scale: A–D = 500 μ m.

genera *Heleobops*, *Littoridinops*, and *Spurwinkia* (Davis, Mazurkiewicz, and Mandracchia, 1982). The ovum of *O. jacksoni* develops into a shelled-veliger with a developed protoconch, which hatches from the capsule after 7 to 14 days (Figure 12F–H), depending on the temperature. As previously reported, the protoconch has longitudinal striae, or raised ridges, on its surface (see Figure 5E, G, H in Davis and McKee 1989).

DISCUSSION

With the addition of *Texadina barretti*, nine hydrobiid species are now known from the tidewater and marine environs of Florida. Table 1 lists these species and their general distribution in Florida coastal waters.

The hydrobiid populations of *T. barretti* and *T. sphinctostoma* that we observed at Mill Bayou may represent the remnants of larger stocks that may have once existed in the more extensive brackish habitats in the upper east St. Andrew Bay System prior to the construction of Deer Point Dam. Much of the oligohaline and lower mesohaline bay bottom habitat was lost when the Dam was constructed in 1961, cutting off the upper, northeastern part of the Bay.

To determine if low salinity/freshwater tolerant species such as *Littoridinops monroensis*, *Pyrgophorus platyrachis*, or *Probythinella protera* were present, we made an extensive collection of invertebrates from shallow water habitats of the Deer Point Reservoir adjacent to the Dam (Station 8) during November 1994; however, no hydrobiid of brackish origin was observed. With one exception, we found that the aquatic fauna present in the reservoir was typically freshwater. The euryhaline mysid *Taphromysis bowmanni* Băcescu, 1961 appeared to be the only Bay species that was able to acclimate to the freshwater conditions now present in the Reservoir. The hydrobiid *Notogillia wetherbyi* (Dall, 1885), the pleurocerid *Elimia* cf. *floridensis*, and the planorbid *Planorbella scalaris* (Jay, 1839) were common on submerged vegetation and on the shallow sand bottom of the Reservoir. These freshwater gastropods appear to be characteristic of the streams and springs that empty into the Reservoir.

Possible Presence of Other Estuarine Hydrobiids in the St. Andrew Bay System

At least three species belonging to three different hydrobiid genera, *Littoridina* Souleyet, 1852; *Pyrgophorus* Ancey, 1888; and *Probythinella* Thiele, 1928, are presently known from the northern Gulf, but we did not see them in the St. Andrew Bay System during our study. Along the northern Gulf, *Littoridina crosseana*

(Pilsbry, 1910) appears to be restricted to the coastal areas of Texas and Mexico (Hershler and Thompson 1992). The ovoviviparous *Pyrgophorus platyrachis* occurs most commonly in vegetated, low salinity, tidal marsh ponds; brackish water drainage ditches; and canals. It has been reported from Florida (Thompson 1965) westward to Mississippi and Louisiana (Garrett and Dundee 1979, Heard 1982). This species should be present in the St. Andrew Bay System, but we have not yet visited habitats expected to be typical for this species. Hershler and Thompson (1992) considered the taxonomic status of most of the nominal species of *Pyrgophorus* as uncertain. They included *P. platyrachis*, which is closely related to or possibly an ecophenotype of *Pyrgophorus coronatus* (Pfeiffer, 1840). Subspecies of *P. coronatus* have been reported to occur widely throughout the Caribbean Region (Hershler and Thompson 1992). There also remains the possibility that *Probythinella protera sensu* Solem, 1961, a taxon accepted by Hershler (1996), may be present in the headwaters of the St. Andrew Bay System. *Probythinella protera* was originally described from what appeared to be fossil shells taken from Pliocene sediments near Tampa Bay (Pilsbry 1953). Solem (1961) reported a large extant population from Lake Pontchartrain, Louisiana. Morrison (1965) described a new genus for *Vioscalba louisianae* Morrison, 1965 from Louisiana coastal waters (Lake Pontchartrain). The species was later reported to be a common resident of Texas bays by Andrews (1971, 1977). Heard (1982) considered *Vioscalba* Morrison, 1965 a junior synonym of *Probythinella*. He also suggested that *P. protera* and *P. louisianae* were conspecific or that both were ecophenotypic forms of *Probythinella lacustris* (Baker, 1928), a nominal species previously known from the fresh waters of the Mississippi River Drainage System. Notwithstanding, Heard (1982) tentatively chose to recognize *P. louisianae* and the possibly extinct *P. protera* as distinct species. In a recent review of the genus, Hershler (1996) recognized only two extant North American species, *Probythinella emarginata* (Kuster, 1852), previously known as *P. lacustris*, and *P. protea*, previously known as *P. louisianae*. We follow his classification here.

Species of *Probythinella* have a wide distribution. *Probythinella emarginata* is now known from the North American drainages of the Mississippi and Mackenzie rivers, the Great Lakes, and Hudson Bay. Extant populations of *P. protera sensu* Solem (1961) and Hershler (1996) occur in the low salinity coastal habitats along the northern Gulf from Texas to Mobile Bay. Regardless of the taxonomic status of the nominal species of

Probythinella, we expect extant populations of species in the genus to occur in some of the oligohaline and tidal freshwater reaches of estuaries and river mouths between Mobile and Tampa Bays. The Mill Bayou (FL Hwy 390) and Deer Point Reservoir collecting sites appeared to be especially suitable habitats for species of *Probythinella*; however, no such snail or empty shell was observed at either site during our study.

ACKNOWLEDGMENTS

We thank P. Monson for the SEM micrographs, J. Fowler and S. Carranza for printing the figures, and M. Bakenhaster for technical assistance. Partial support was provided by NOAA, NMFS, Award No. NA06FL0501, and USDA, CSREES, Grant No. 98-38808-6019.

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