

Florida's Fossil Cowries:
Miocene to Pleistocene



John D. Daughenbaugh
and
Randall Bridges

Front & Back Covers: Lithified *Callianasa* Leach, 1814 shrimp burrow with a *Cerithioclava dalli* (Olsson & Pettit, 1964) and two (2) *Pseudadusta lindae* (Petuch, 1986) cowries. Old Mule Pen Quarry, East Naples, Collier County, Florida.

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Dedication

This book is dedicated to:

My wife: Su Mei Ho

and

My parents †: F. C. “Duffy” and Marjorie J. Daughenbaugh

and

Randall’s life partner Gina for her loving support

and

Dr. Edward J. Petuch

All specimens illustrated herein, as well as the cover specimen,
are an intended donation to the Natural History Museum of Los Angeles County.

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Introduction

Fossils, including molluscan fossils, would have been a part of the lives of humans from when they first inhabited Florida ~ 12 Ka. Encountered in eroded sites, such as river banks, streams and wells, the better-preserved specimens would have been a source of wonder and puzzlement. That would remain the case for thousands of years until the 19th century.

In the late 19th and early 20th centuries, W. Dall described *Cypraea* (*Cypraeorbis*) *heilprini* Dall, 1890 and *Cypraea* (*Cypraeorbis*) *chilona*, Dall 1900 while A. Heilprin described *Cypraea tumulus* Heilprin, 1887. The first two were collected from river banks in Calhoun and Liberty Counties in the Florida's northern Panhandle, the focal point of the Burdigalian Miocene Chipola Formation. The latter was collected from Ballast Point in the Tampa area. While W. Ingram and J. Gardner added descriptions in 1939 and 1947, it was L. Dolin in 1991, entrusted with the Emily Vokes Cypraeidae collection, who contributed immensely with his description of the species from that collection.

In 1841, T. Conrad described the cowry (Cypraeidae) species, *Cypraea carolinensis*. Conrad's specimen was from North Carolina but it was subsequently discovered to also be present in southern Peninsular Florida. In 1948, Julia Gardner expanded the description of the *Cypraeorbis* (Conrad, 1865) genus and introduced *Akleistostoma* as a Section of the genus, designating *A. carolinensis* (formerly *C. carolinensis*) as its type. In 1886, A. Heilprin introduced and described the cowry genus *Siphocypraea* with *S. problematica* as the type and only species of the genus. In 1931, W. Mansfield introduced and described *Cypraea carolinensis floridana* collected at a road construction site along the Tamiami Trail. In 1939, W. Ingram introduced and described *Cypraea pilsbryi*. 1964, Olsson and Petit described two species from the Kissimmee River Valley: *Siphocypraea* (*Siphocypraea*) *carolinensis hughesi* and *Siphocypraea* (*Siphocypraea*) *carolinensis transitoria*.

However, it was not until the 1980s that a major construction boom throughout the southern peninsular region commenced, with the related quarries and construction sites revealing significant lower strata and the fossils therein. J. F. Meeder, T. M. Missimer, W. G. Lyons, J. DuBar, J. S. Waldrop & D. Wilson were some of the geologists who made significant contributions to our understanding of southern Florida's stratigraphy. Most significantly, in 1982 Dr. E. J. Petuch (Petuch, 1982), Florida Atlantic University, published the stratigraphy of the APAC Pit in Sarasota, assigning the strata to the Late Zanclean-Piacenzian Pliocene. The individual strata were assigned names and unit numbers from 10-1 with 10 being the oldest. Previously, the strata had been assigned to a spectrum of epochs with the Miocene being the most common. Petuch's assigned strata has been widely accepted and has served as a reference for dating equivalent strata in other sites.

During a span of more than 30 + years, Dr. Petuch's explorations produced a plethora of new and previously undescribed Cypraeidae species. These provided the basis for a succession of species descriptions. Described by Petuch and others, all such species have been retained herein, with their characteristics presented in a uniform format.

Acknowledgments

The pioneering works of Emily Vokes are essential for an understanding of the Chipola Formation and its Cypraeidae. Ms. Vokes entrusted her collection to Luc Dolin who described the species therein with the holotypes placed with the U. S. National Museum (the Smithsonian).

The work of Jules DuBar and Donald Beardsley on the geology of the Alum Bluff and surrounds is still relevant today. William Ingram and Julia Gardner also made significant contributions.

Based on the works of Bernard Landau and Lindsey Groves (2011) on the roughly contemporaneous Cantaure Formation of Venezuela, many of the Chipola Formation genera have been reassigned to align with the Eastern Atlantic genera of the period.

In 1987, Dr. E. J. Petuch (Petuch, 1987), Florida Atlantic University, transformed the understanding of the geology of Southern Florida by proposing that the Everglades was formed by the impact of a fragment which broke off from a giant bolide meteor which struck in the Chesapeake Bay area. Long rejected by others, it is now widely accepted and sheds light on the findings of other geologists.

Other geologists have also made major contributions, including A. Heilprin, W. C. Mansfield, J. Gardner, Olsson & Petit, J. F. Meeder, T. M. Missimer, W. G. Lyons, J. DuBar, J. S. Waldrop & D. Wilson.

The specimens illustrated herein are in the first author's collection. The Chipola Formation specimens were acquired from the Petuch collection along with many Plio-Pleistocene specimens from throughout southern Peninsular Florida. Dr. Petuch has also generously shared his extensive collecting, research knowledge and experience as noted throughout the text.

In addition, Don Pisor of Pisor's Marine Shells, San Diego, CA obtained a collection of molluscan fossils collected in Florida in the 1980s. Don generously made these available. The collection also benefited from specimens obtained from Betty and Melanie Briskin's Florida Seashells & Fossils over the years. More recently, specimens acquired from the Wolfgang Grulke, U. K., collection provided a greater variety of specimens from hard to obtain collection sites. Lastly, Dylan Sarmiento of Pinellas Park, FL provided numerous specimens from the Lavender Road Pit, Ruskin, FL which contributed immeasurably to our understanding of the area.

To those we may have missed acknowledging, we extend our sincerest apologies.

Geological Framework

Provinces. Geologists have divided the world into geologic provinces which are defined as “any large area or region considered as a whole, all parts of which are characterized by similar or by a history differing significantly from that of adjacent areas” (Glossary of Geology, 1980).

Atlantic Plain Province. The U.S. Geological Survey, last updated in the mid-2000s, designated the region from Cape Cod to the Mexican border and then to the Yucatan Peninsula as the Atlantic Plain Province. In the present day, it is the flattest of the American provinces, sloping gently seaward in a series of terraces far into the Atlantic and Gulf of Mexico where it forms the continental shelf. However, during previous epochs, land formations and coast lines did not conform to the present day.

Baitoan Province. In the Burdigalian Miocene (~ 20.4-15.97 Ma), Petuch proposed the Baitoan Province which stretched from South Carolina, across the Caribbean to South America as far south as northern Brazil, through the Bolivar Strait (pre-Isthmus of Panama), to southern California and northern Peru. **Chipolan Subprovince.** Within the province, the Chipolan Subprovince (based on the Chipola Formation) encompassed southeastern Georgia, Florida and the coasts of the Gulf states. As an eutropical subprovince, it was the only Gulf coast area to have developed zonated coral reef tracts (Petuch, 2004).

Caloosahatchian Province. For the latest Zanclean-Piacenzian Pliocene (~ 3.8-2.6 Ma), Petuch proposed the Caloosahatchian Province which extended from Nova Scotia, around Florida and into the Gulf of Mexico as far as Texas. **Duplinian Subprovince.** Within the province, the Duplinian Subprovince extended from Cape Fear, North Carolina to northeastern Florida. **Buckinghamian Subprovince.** The Buckinghamian Subprovince extended from northeastern Florida, across and around the Everglades area and north to near Tampa, Florida.

The Duplinian extended south to the northern edges of the Buckinghamian and can be considered a shared overlap zone, having shared many genera and species with its southern neighbor.

Gulf Stream. Around 2.8 Ma, during the Pliocene-Pleistocene transition, the Isthmus of Panama finally closed off the Bolivar Strait separating North and South America. Before the closing, the North Equatorial Current conveyed warm water westward all the way to the southern California Imperial Valley. After the closing, the modern Gulf Stream formed, creating a more complex coastal current structure with more and stronger southward-flowing countercurrents. The Duplinian influences would have persisted into the Buckinghamian, but the two subprovinces no longer overlapped.

Formations & Groups. Within subprovinces, geologists have recognized formations. Formations consist of distinct strata in a geological region that have comparable visible characteristics which distinguish the strata from all other adjacent formations. Together, two or more sequential formations can form a group, the formations of which also share certain characteristics. For a geological formation to be recognized, its geographical extent must be mapped. In cases where that is not possible as the areal extent is not known or defined, biogeographical formations may be recognized and substituted based upon the fossil record contained within a localized stratum.

Within the Chipolan Subprovince, the Alum Group of four formations was recognized. Of the four, the zonated reefs of the Chipola Formation, which hosted the Burdigalian Miocene Cypraeidae, were a relatively short-lived phenomenon, estimated to have existed from ~ 18.9-18.3 Ma. The reefs were located in the present-day Florida Panhandle of northern Florida.

In southern Florida, the Okeechobee Group of eight formations were recognized, encompassing late Zanclean-Piacenzian Pliocene (~ 3.8 Ma) to the late Pleistocene (~ 126 Ka).

Members & Beds. Within formations, there may also be recognized members or, in the alternative, beds. Members or beds represent part of a formation but distinct strata within the formation. Within the Tamiami Formation of the Late Zanclean-Piacenzian Pliocene, the members (strata) represent separate and different depositional sea beds which were deposited as the result of sea level and climate changes over time.

Florida fossil Cypraeidae are associated with specific formations:

Chipola Formation	Burdigalian Miocene	18.9-18.3 Ma
Tamiami Formation	Piacenzian Pliocene	3.8-2.6 Ma
Caloosahatchee Formation	Gelasian Pleistocene	2.6-1.8 Ma
Nashua Formation	Gelasian Pleistocene	2.6-1.8 Ma
Bermont Formation	Calabrian Pleistocene	1.8 Ma-781 Ka
Fort Thompson Formation	Ionian Pleistocene	781-126 Ka

Part One

Burdigalian Miocene

Chapter 1

Florida

Before the Miocene (~ 24 Ma), peninsular Florida did not exist. Thirty-two Ma, a small, shallow carbonate bank had developed on the underlying bedrock Florida Platform (a rampart between the Gulf of Mexico and the Atlantic Ocean). It lay over 150 km off the coast of Georgia, in what is now the northern part of peninsular Florida, and was separated from the mainland by a wide shallow seaway (Suwannee Strait). The bank was the highest point of six thick (~ 2–6 km), carbonate formations which had developed on the platform prior to the Miocene. As the Miocene approached, erosion of carbonate areas to the north flowed to the south and allowed the bank to become an island (Orange Island). Ultimately, this, combined with the growth of reef systems around the island, led to the closure of the Suwannee Strait and the merger with the mainland northern Florida. (Petuch, 2004).

The Burdigalian age of the Miocene epoch of the early Lower Miocene commenced ~ 20.4 Ma and ended ~ 15.97 Ma and was present throughout the world, including Europe. In Florida, sections of the present-day northern Florida Panhandle region were emergent in a large coastal area in which coral reef patches and tracts were interspersed with sand and mud flats. Sea grass was present as well. These were a part of the relatively short lived Chipola Formation which was the first, longest and only significant warming period of the Miocene. The number, type and variety of coral and molluscan species collected from the formation was on a par with other tropical regions and reflect the last truly tropical conditions of the Miocene. The age of the Chipola beds is roughly contemporary with the Cantaure Formation of Venezuela and the Baitoa Formation of the Dominican Republic. The Chipola represents the last major transgression of sea levels in the Western Atlantic before Late Miocene glaciation lowered sea levels (see fig. 1).

Chipola Formation

Biogeography

The Chipola Formation is a member of the Alum Bluff Group whose members encompass Georgia, Florida and Alabama. The formation is centered in present day Calhoun and Liberty Counties in Florida's northern Panhandle. This part of the Panhandle "is covered by widespread continental sands of Pleistocene age which are loosely consolidated and easily eroded. Thus, it is only along the steep bluffs of the major streams, such as the Apalachicola and Ochlockonee Rivers, that deposits of earlier Neogene age are exposed and accessible for study. The areas near the major streams are highly dissected but the divides are flat and poorly drained. The average elevation of western Liberty County is about 150 feet above sea level." (DuBar & Beardsley).

"The name, Chipola Marl, was first suggested in field notes by collector Frank Burns, of the U.S. Geological Survey, and was originally used as a member of the Alum Bluff Formation; however, Julia Gardner (1926) considered the faunas of the different units to be so completely distinct that she elevated the members to the rank of formation. The Chipola is a blue-gray to yellowish brown (depending on how deeply weathered it is), highly fossiliferous marl. The Oak Grove and Shoal River units are sands, presumably very near-shore." (Vokes). In other words, the Chipola Formation is a coastal biogeographic formation.

The type locality of the Chipola Formation is the Chipola River, Calhoun County, while the type area

is the small area comprising “the outcrops on the Chipola River, west of Blountstown, together with its tributaries, and at Alum Bluff, on the Apalachicola River just to the northeast of Blountstown”. (Vokes). The principle collecting exposures/outcroppings in the type area are at: 1. the Chipola River, together with its Tenmile Creek and Farley Creek tributaries (together the Outcroppings) and 2. Alum Bluff, Liberty County, due east from the type locality.

The Chipola River is a modest river which flows south through canyon cuts from the Alabama-Florida border for about 100 miles where it joins the Apalachicola River. The most northerly of the Outcroppings occur along a 1 ½ mile stretch of Tenmile Creek which flows east southeast toward its confluence with the Chipola River. The river continues southward for about 1 ½ miles to its confluence with Farley Creek. The most southerly of the major Outcroppings occur along this creek which flows southward and then curves westward for 1 ¾ miles. (Vokes). While there are scattered Outcroppings on the river south of Farley’s Creek, these appear to be outside the main Cypraeidae habitats. There are less than five miles of productive Outcroppings.

Access to these collecting sites is challenging. The sites consist of river bluffs and banks which can only be reached by small boat as land access to the tributaries is over private property. As the sites are mostly unmarked, they could only be found with a local guide or by exploration. (Petuch, pers. comm.)

The second principal Outcropping occurs at Alum Bluff, near the town of Bristol, and due east of the type locality on the Chipola River. The bluff rises more than 130 feet and overlooks a sharp bend in the Apalachicola River. Today, it is part of the Apalachicola Bluffs and Ravines Preserve. When river levels were low, fossil collectors descended to the ledge along the bluff which has proved to be a productive collecting site. (Petuch, pers. comm.)

Geology

The west bank of the Chipola River, approximately ½ mile downstream from the confluence of the Tenmile Creek, is the type locality of the formation. Weisbord noted that during a May, 1970 visit, the river was very low and reflected Cooke’s 1945 description: “About 10 feet of fine blue-gray to yellow sand, loaded with firm, perfectly preserved shells, crop out in the bank of the river and is turned up by the plow in nearby fields. The shell marl lies directly on yellowish sandy Tampa limestone which is visible only at low water”.

Tampa Limestone

Tampa limestone is best known from Ballast Point, Tampa Bay, where at least two Cypraeidae species belonging to the Chipola Formation have been collected. This was a sheltered back-reef area of the Tampa Reef Tract which supported dense forests of branching corals, including *Porites*, *Stylophora*, *Acropora*, *Goniopora* and *Alveopora* species. Among the species inhabiting this quiet, coralline habitat were *Zonaria ballista* (Dall, 1915) and *Zonaria tumulus* (Heilprin, 1886). Specimens of which are often encrusted in coralline deposits. (Petuch, 2004).

The Tampa Coralline reef environment or its equivalent extended westward into present day Calhoun County. This is supported by Weisbord’s (1971) research which identified thirteen species of stony corals from the Chipola River, Tenmile Creek and Farley Creek type localities. Seven of the species were new to science. Among the species identified were *Porites*, *Stylophora* and *Goniopora*. This supports the presence of coral reef patches and back-reefs in the type area.

Upper Beds

Overlying the Tampa limestone in the Outcropping area, the facies, as described by Vokes, was “blue-gray to yellowish brown (depending on how deeply weathered it is)” and highly fossiliferous. Weisbord’s observations added that the facies were of various colored sands, silty gray clay and similar to Alum Bluff facies at one locale in Tenmile Creek. These constituted the upper part of the beds.

More recent research has shown that “[t]he Chipola Formation is the oldest stratigraphic unit of the Alum Bluff Group, dated at approximately 18.3 mya ... (Jones et al.) making it late early Miocene (Burdigalian). It consists of blue-gray to yellowish-brown, highly fossiliferous marl or indurated limestones. The Chipola Formation contains one of the most ecologically diverse and species-rich faunas of Western Atlantic deposits of this age. The Chipola Formation accumulated during the last truly tropical climate conditions of the Miocene, the overlying Shoal River Formation representing a more temperate climate. It was also deposited during the last major transgression in the Western Atlantic before sea level fell due to the onset of late Miocene glaciation” (Di Martino et al., 2017).

Alum Bluff

While Vokes does not address the Alum Bluff facies nor its molluscan fauna, a description of the collecting site was given by DuBar & Beardsley: “The lowermost beds exposed along Alum Bluff are those of the marine “Chipola facies” of the “Alum Bluff Stage” (Middle Miocene). The Chipola beds at this locality are as much as 10 feet in thickness and consist of tan, calcareous sands which are sparsely fossiliferous in the lower part but become very fossiliferous in the upper 5 feet. The Chipola facies is soft, but rather tough, and is a prominent ledge formed along the river”.

Vokes

Vokes notes “Thus, in this small [type] area we have a section from shoreline to a patch-reef that was about two miles offshore. To the west there were quiet muddy lagoons, to the east more calcareous back-reef flats. Nowhere was the water probably more than 15 fathoms (30 meters) in depth – warm, clear, and absolutely teeming with life.”

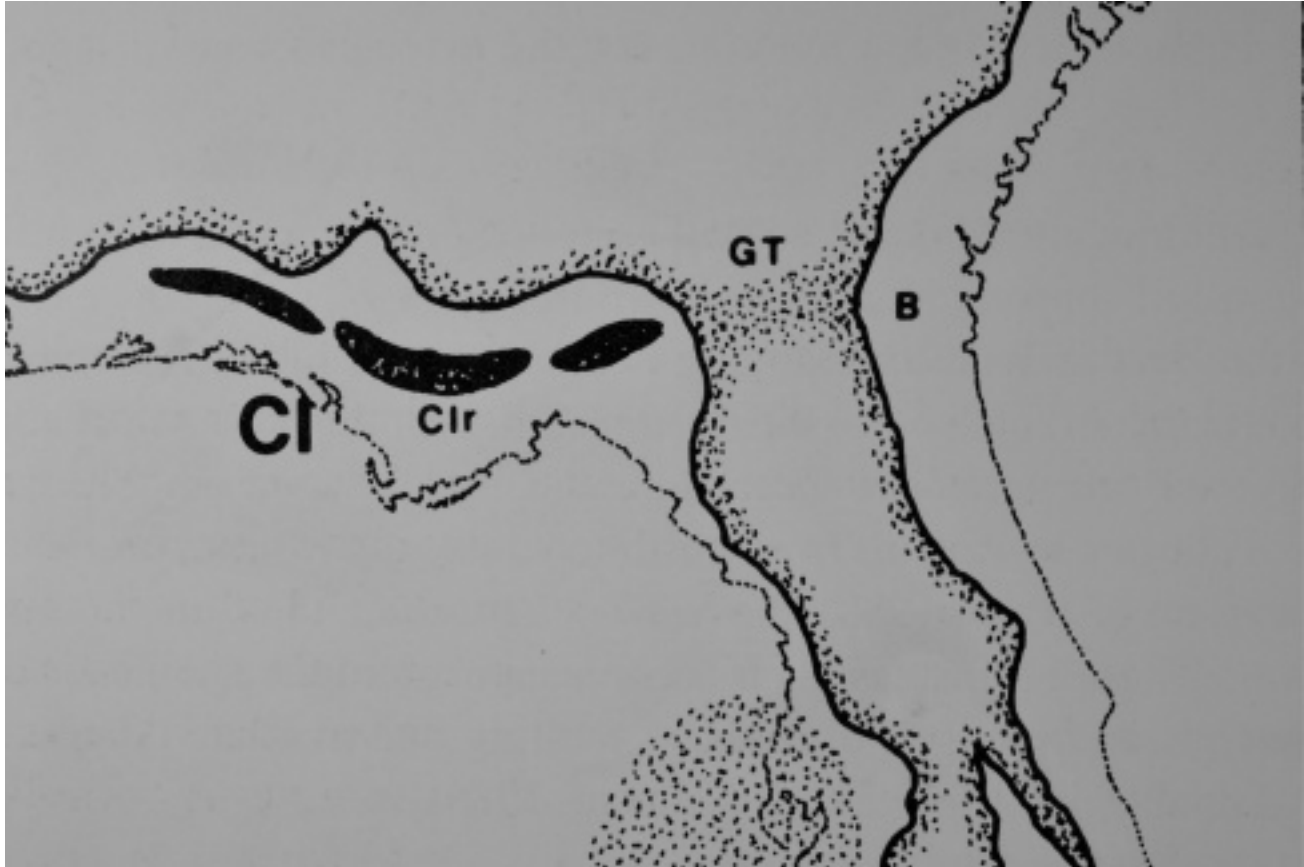


Figure 1: CI = Chipola Sea; Clr = Chipola Reef System; GT = Gulf Trough; B = the Arcadia Subsea of the Okeechobean Sea. Outer dotted line = Outline of Recent Florida.

From Petuch, 1997a, Figure 3, p. 6.

Chapter 2

Chipola Formation Species

Cypraeorbis Conrad, 1865

Cypraeorbis alumensis (Ingram, 1948)

Cypraeorbis willcoxi (Dall, 1890)

Cypraeorbis hertleini (Ingram, 1948)

Cypraeorbis testudinea Dolin, 2015

Loxacypraea Petuch, 2004

Loxacypraea chilona (Dall, 1900)

Loxacypraea tapeina (Gardner, 1947)

Loxacypraea emilyae (Dolin, 1991)

Loxacypraea arlettae (Dolin, 1991)

Zonaria Jousseume, 1884

Zonaria theresae (Dolin, 1991)

Zonaria heilprini (Dall, 1890)

Zonaria shirleyae (Dolin, 1991)

Zonaria praelatior (Dolin, 1991)

Zonaria ballista (Dall, 1915)

Zonaria tumulus (Heilprin, 1886)

Trona Jousseume, 1884

Trona calhounensis (Dolin, 1991)

Luria Jousseume, 1884

Luria mariaelisabethae (Dolin, 1991)

The above list of species has been adopted primarily from Dolin (1991). All endemic Florida species set forth therein have been accepted. However, the genera in which they were assigned is reevaluated below.

Additions

In addition to Dolin's list, several species are added.

1. *Cypraeorbis alumensis* (Ingram, 1948). Type locality: Alum Bluff.

Dolin substituted Ingram's description of *C. alumensis* for that of *C. willcoxi*, thereby effectively placing *C. alumensis* into synonymy with *C. willcoxi* without comment. This was done despite the geographic separation of the two species. The Vokes collection apparently did not have a specimen of *C. alumensis* as Dolin based his decision on "excellent photographs of the holotypes of Ingram".

Ingram's description is accepted herein and follows:

"Shell ovate, sloping gently in lateral profile toward the anterior and posterior canals; shelves over both canals, anterior one 2 mm, broad, posterior one 4 mm, broad; lateral margins calloused; base calloused, convex, angled upward at its union with the shell sides; terminal ridge extends directly back from columellar side of aperture and bends dorsad into shell; fossula absent; anterior canal straight ventrally, curved to the left dorsally, 1.50 mm. wide and 3.50 mm long; posterior canal slightly curved to the left, 2 mm. wide and 4 mm. long; outer lip teeth declivous at anterior

extremity; outer lip teeth with interstices of approximately .50 mm., confined to the aperture, and extending dorsad around lip into shell; teeth very minute caudad on outer lip, and extending on to posterior canal; first anterior columella tooth very elongate, fine with broader interstices than those of anterior teeth. The type measures: length, 28.50 mm.; breadth, 20.50 mm.; height, 14.50 mm.

Holotype, No. 8043, Calif. Acad. Sci. Paleo. Type Coll., from Loc. 578 (C.A.S.), marl bed about twenty feet above the water level, on the left bank of the Apalachicola River, about three and one-half miles above Bristow, at Alum Bluff on the Apalachicola River, Calhoun County, Florida; E. L. Packard, collector. Lower Miocene.

Discussion: The shell is moderately eroded; no indication of its original color remains. The aperture area and lips are intact.”

The species is restricted to Alum Bluff and has not been collected elsewhere.

2. *Cypraeorbis willcoxi* (Dall, 1890). White Beach, near Osprey; northern part of Little Sarasota Bay.

With the original description of *C. alumensis* accepted and restored, Dall’s description of *C. willcoxi*, which does not align with that of Ingram’s *C. alumensis*, is also accepted and restored herein. Dall’s description follows:

“Shell large, solid, with a narrow, closely denticulate aperture, and slightly flattened, moderately wide base; the shell has much the form of *C. cinerea*, from which it differs chiefly in its much large size, more deeply cut and upturned posterior commissure, and less swollen base. There are about twenty-two teeth on the right lip, which appears to rise vertically inside the shell to a rather unusual height, the whole of which is crossed by the teeth, which, however, do not extend laterally on the base. Max. lon. of shell 46.0; lat. of shell 32.0; alt. of shell 25.0.

Lower Miocene. In the Chipola red sand, West Florida (Burns); and at White Beach, near Osprey, Florida, at the northern part of Little Sarasota Bay, in a water-worn sandstone of yellowish brown color, by Messrs. Willcox and Dall.

This species is the largest fossil form from the United States except *C. carolinensis*, which is a much thinner and lighter shell, with a wider and less uniform aperture, recalling that of *C. mus* L. With it were found small internal casts recalling *C. pingis*, but the fossils in this particular ledge are so poorly preserved for the most part as to be hardly identified with absolute confidence. *C. willcoxi* reaches a length of 64.0, and a width of 42.0 mm. The specimen figured has suffered a little at the lower end of the aperture, figure 12 c, in the process of cutting out the matrix.”

However, the type locality of Dall’s *C. willcoxi* is White Beach, near Osprey, northern part of Little Sarasota Bay, Sarasota County, Florida. This is an error as Sarasota is located in central Peninsular Florida, well south of the Florida Panhandle. Additionally, no Cypraeidae species are known from the Sarasota area until the Piacenzian Pliocene c. 3.8 Ma.

Specimens accepted as *C. willcoxi* are known from the Chipola River and Farley’s Creek and those Outcroppings should be considered the type area for the species. The specimens illustrated by Dolin are from Farley’s Creek. They are larger and more elongate in shape with more projecting extremities than *C. alumensis* with larger columellar and labial teeth. In addition, *C. willcoxi* has a distinct, smooth, shallow, cup-like fossula. While the characteristics of the specimens do not align entirely with Dall’s description, they align closely enough to allow acceptance as *C. willcoxi*.

Comparisons:

C. alumensis is a small, ovate shell, averaging about 25 mm. Extremities blunt; slightly projecting; base slightly flattened; margins callous, subangular, angular; aperture uniformly narrow; columellar teeth thin, extending onto the columellar ridge, but not onto the base; labral teeth thin, confined to the aperture, longer anteriorly; columella smooth, straight and narrow. Fossula is absent.

C. willcoxi is a large, oval-elongate shell, averaging about 40 mm. Extremities blunt, projecting; base slightly flattened; margins callous, subangular; aperture uniformly narrow; columellar teeth thin, extending onto the columellar ridge, but not onto the base; labral teeth thick, extending slightly onto base, longer anteriorly; columella smooth, wide, slightly undulating. Fossula distinct, smooth, shallow, cup-like.

As Ingram's description and the actual shell characteristics support the acceptance of the specie's validity, *C. alumensis* is accepted herein. Dall's *C. willcoxi* is also accepted, albeit with its original description as above. Both are assigned to the *Cypraeorbis* Conrad, 1865 genus as below.

3. *Loxacypraea tapeina* (Gardner, 1947), Type locality: Whites Creek, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Florida. Also, Chipola River, Calhoun County, Florida.

Dolin placed *Cypraea* (*Cypraeorbis*) *tapeina* (*Loxacypraea tapeina* herein) into synonymy with *Siphocypraea chilona* (*Loxacypraea chilona* herein) stating: "Despite a larger size, the species named *Cypraea* (*Cypraeorbis*) *tapeina* by Gardner (1947) cannot be separated." No further explanation or support provided. The Vokes/Hoerle collection does not appear to have contained a specimen.

Gardner's 1947 comparison of *L. tapeina* with *L. chilona*, based upon a complete and well-preserved specimen, follows.

"*Cypraea tapeina* is the most highly inflated of any of the three Alum Bluff species. *Cypraea chilona* Dall from the Chipola approaches most closely to it, but the Chipola species is less evenly inflated and the maximum less posteriorly."

A comparison of Gardner's *L. tapeina* with Ingram's *Cypraea apalachicolae* (*Loxacypraea apalachicolae* herein) is actually more on point. Ingram's description of *C. apalachicolae* was based on an eroded specimen which was missing the anterior fossula section, postulating the "concave surface of the columella is produced enough to be considered a toothless fossula". Other described characteristics are similar to Gardner's which was based on a complete specimen. As such, Gardner's earlier description is accepted and takes precedence over Ingram's later description.

While Dolin placed *L. apalachicolae* into synonymy with *C. hertleini*, the characteristics of *L. apalachicolae* are actually closer to *L. tapeina*. Further, *Loxacypraea tapeina* is indeed closest to *L. chilona* and both exhibit the characteristics of the *Loxacypraea* genus.

See table 1 for type localities. Following are descriptions and color plates of the Chipola Formation species.

Table 1: Distribution of Species (West → East)

The type localities and other collection localities for each species are indicated by **T** and from the Vokes/Hoerle collections by **V**. Collection localities from the Petuch collection (presently in the senior author's collection) are indicated by **P**. The localities are organized from the west to the east to indicate the known distribution spread.

T = Type locality. Other localities: **(V)** = Vokes &/or Hoerle collections, **(P)** = Petuch collection

Species	Tenmile Creek	Chipola River	Farley Creek	Alum Bluff	Ballast Point Tampa Bay
<i>C. alumensis</i>				T (P)	
<i>C. willcoxi</i>		(V)	(V/P)		
<i>C. hertleini</i>				T (P)	
<i>C. testudinea</i>			T (V)	(P)	
<i>L. chilona</i>				T (V/P)	
<i>L. tapeina</i>		P		T (P)	
<i>L. emilyae</i>		T (V/P)			
<i>L. arlettae</i>		(V/P)	T (V)		
<i>Z. theresae</i>	T (V)				
<i>Z. heilprini</i>	(V)	T (V/P)			
<i>Z. shirleyae</i>	T (V)	P			
<i>Z. praelator</i>		P	T (V)		
<i>Z. ballista</i>	(V)	(V)	(V/P)		T (P)
<i>Z. tumulus</i>	(V)	(V)			T (P)
<i>T. calhounensis</i>		P	T (V)		
<i>L. mariaelisabethae</i>		V	T (V/P)		

The species which inhabited the Chipola Formation in the Florida Panhandle appear to be mostly locally restricted as above.

Chapter 3

Chipola Formation Genera

Genera

Prior to 1991, eight Cypraeidae species had been described. In 1991, Dolin described an additional seven species and in 2015, an eighth. The latter eight species were based on the extensive collection of Emily Vokes and her unparalleled personal knowledge of the Alum Bluff area and its surrounds. The species, which have been accepted by other researchers and herein, were placed in a plethora of genera with little consistency.

Since 1991, there have been a number of noteworthy sequential contributions to the genera:

- 2004. Petuch proposed two new genera: *Floradusta*, Type Species: *Floradusta heilprini* and *Loxacypraea*, Type Species: *Loxacypraea chilona*, and placed a number of species in each.
- 2011. Darragh, based on Dolin's descriptions and his personal observation of two of the species, synonymized *Floradusta* and *Loxacypraea* with *Cypraeorbis*, stating the type species of the two genera possess a fossula similar to that of *Cypraeorbis*. Both the *Floradusta* and *Loxacypraea* descriptions assert the absence of a fossula. However, Darragh also stated that the fossula in other species in *Floradusta* are unlike *Cypraeorbis*. Further revision of the American taxa was beyond the scope of the paper.
- 2011. Landau and Groves proposed a number of revisions to Dolin's genera (see below).
- 2015. Dolin redefined and accepted the *Loxacypraea* genus (see below).
- 2016. Bouchet (WoRMs website) synonymized *Floridacypraea* genus with *Palmadusta* Iredale, 1930.
- 2017. Lorenz assigned the fossil Cypraeidae species, including the Chipola species, to various genera "focused on the general morphology of the cowries that existed, and how they might fit in with those that still populate the oceans". (Lorenz, 2017, I).

"Cypraeids are a difficult group to work with, and both the specific and supraspecific classification varies enormously between researchers." (Landau & Groves).

Due to a lack of preserved color pattern, animal features and scarcity of material: "The characterization of a [fossil] species or genus has to be derived solely from the structural features of the fossils, in combination with their geological epoch, and, in some cases, their geographical origin" (Lorenz, 2017, I).

In their 2011 account of the Cantaure Formation of northern Venezuela, roughly contemporaneous with the Chipola Formation of northern Florida, Landau and Groves sought to update Dolin's 1991 genera as many of the genera were also present in the Cantaure Formation. Both formations, Chipola and Cantaure, share biogeographical affinities with European and West African genera.

As a result, certain genera which do not share such biogeographical affinities are not accepted.

Genera Not Accepted

Zoila Jousseaume, 1884 is not accepted for Chipola Formation Cypraeidae. *Zoila* is an Australian genus with its fossil members confined to Irian Jaya, Indonesia and Australia. It is a likely surviving branch of the Cypraeorbini Schilder, 1927 tribe (Darragh, 2011). “Molecular biological studies by Meyer (2004) showed that the nearest living relatives of the Australian living *Zoila* species are the western Indian Ocean species of *Barycypraea* and he grouped both genera in the subfamily Bernayinae. He included no other living taxa in the subfamily. Species of *Barycypraea* have a similar fossula to *Zoila* species and they are known to be spongivores like *Zoila* (Liltved, 1989). Species of *Barycypraea* occur in South Africa, Pakistan, India and Indonesia, and range in age from Miocene to recent (Kay, 1990). The morphology and biogeography of *Barycypraea* suggests an origin similar to that of *Zoila* and a probable common ancestry.” (Darragh, 2011). As such, there is no biogeographic affinity with the Americas.

Siphocypraea Heilprin, 1886 is not accepted. Originally described “from a cylindrical shell strongly rugose [corrugated] the length of the straight inner lip and with a curious hook shaped opening at the posterior extremity”. The genus is confined to the Piacenzian Pliocene and Gelasian Pleistocene. To extend the genus to the Middle Miocene Chipola Formation Cypraeidae species, whose characteristics deviate so significantly from those of *Siphocypraea*, would render the genus meaningless (Gardner, 1948).

Floradusta. The species originally assigned to the *Floradusta* genus have been assigned to other genera. The name is considered *nomen dubium*.

Indo-Pacific restricted. The following are also not accepted as they are Indo-Pacific genera with no affinity to either Europe or West Africa:

Barycypraea Schilder, 1927

Bistolida Cossmann, 1920

Erosaria Troschel, 1863, now *Naria* Broderip, 1837

Erronea Troschel, 1863

Lyncina Troschel, 1863

Ovitipsa Iredale, 1931

Palmadusta Iredale, 1930

Prolyncina Schilder, 1927 syn. *Austrocypraea* Cossmann, 1903

Talostolida Iredale, 1931

Talparia Troschel, 1863

Accepted Genera and Their Species

Cypraeorbis Conrad, 1865

Type by Monotypy: *Cypraeorbis sphaeroides* (Conrad, 1848)

Type Locality: Vicksburg Oligocene of Mississippi

***Cypraeorbis*.** In 1865, Conrad entered *Cypraeorbis* as a subgenus of *Cypraeidae* in a catalogue in the Journal of American Conchology, Volume 1, page 31. *Cypraea sphaeroides* Conrad, 1848 from Vicksburg, Mississippi was aligned within the subgenus as the Type by monotypy as *Cypraeorbis sphaeroides* (Conrad, 1848). This was a simple entry without further comment. The original description of *C. sphaeroides* is not available today.

In 1947, filling a void, Gardner wrote a description of *Cypraeorbis*. Her description was based on the Type, *Cypraeorbis sphaeroides* (Conrad, 1848).

“Medium size turtle-shaped shells flattened on the apertural face, asymmetrically arched dorsally, the posterior inflation greater than the anterior. Surface smooth, enameled. Aperture narrow, the margins subparallel and following the curvature of the body dorsally. Fossula shallow. Dentition rather fine (between 20 and 25 in both the labral and the labial series in the subgenotype), restricted to the apertural margins. Posterior notch U-shaped, with the sides flattened and parallel. Anterior notch narrow, sinistrally inclined, the inner margin pinched, and a sulcus behind it; the base of the outer lip also pinched and flattened.” (Gardner, Part VIII).

At the time, only three species of *Cypraeidae* were known from Alum Bluff and Gardner included all three within the *Cypraeorbis* genus as:

Cypraea (Cypraeorbis) heilprini Dall 1890

Cypraea (Cypraeorbis) chilona Dall 1900

Cypraea (Cypraeorbis) tapeina Gardner, n. sp.

In 1948, Gardner restated her description of *Cypraeorbis* with two revisions: 1. eliminated medium size and turtle-shaped and 2. added distinct to the shallow fossula. (Gardner, Part 2).

Lorenz (2017, I) elaborated further: “The type species of the genus is poorly documented, but the written description clearly refers to the characteristics that unite the taxa ...: a globular shell with a flattened base, a smooth fossula, short, distinct teeth, and rounded extremities.” However, Gardner’s description suggests a more ovoid, rather than globular shell.

As a result, the above three species and two others have been reassigned (see Chapter 4).

Three of the Chipola Formation *Cypraeorbis* species possess a smooth, shallow, cup-like fossula while the fossula of the fourth species, *C. testudinea*, is similar but more elongate.

***C. alumensis*.** In 1948, Ingram described *Cypraea alumensis*. See pages 11-12 for the original description.

C. alumensis is a small, ovate shell, averaging about 25 mm. Extremities blunt; slightly projecting; base slightly flattened; margins callous, subangular, angular; aperture uniformly narrow; columellar teeth thin, extending onto the columellar ridge, but not onto the base; labral teeth thin, confined to the aperture, longer anteriorly; columella smooth, straight and narrow. Fossula is absent.

Three intact, non-eroded specimens in the senior author's collection align with Ingram's description. The species is not known outside the Alum Bluff area.

C. willcoxi. In 1890, Dall described *Cypraea willcoxi*. See page 12 for the original description.

C. willcoxi is a large, oval-elongate shell, averaging about 40 mm. Extremities blunt, projecting; base slightly flattened; margins callous, subangular; aperture uniformly narrow; columellar teeth thin, extending onto the columellar ridge, but not onto the base; labral teeth thick, extending slightly onto base, longer anteriorly; columella smooth, wide, slightly undulating. Fossula distinct, shallow.

The specimen in the senior author's collection was collected from the Farley Creek River bank at its confluence with the Chipola River, Calhoun County, ex. Petuch collection. This suggests the species was widespread within the Chipola Formation beyond the type localities.

The shell as illustrated by Dall and in hand is an ovate shell, broader than *C. alumensis* with a shallow, smooth but distinct fossula. The shell resembles a giant, *C. alumensis*.

NOTE: Although *C. alumensis* lacks a fossula, its other characteristics align with *Cypraeorbis* and, as none of the other Chipola Formation genera lack a fossula, the species is retained in the genus as an exception.

C. hertleini. Described by Ingram in 1948. See page 27 for the original description.

As Ingram stated, the shell is "bulbous, sloping steeply in lateral profile from the dorsum toward the anterior and posterior canals". The ovoid shape and its characteristics align with others in the genus. The fossula is distinct, smooth, shallow, cup-like.

The specimen in the senior author's collection was collected by Petuch at Alum Bluff and measures 40.2 mm.

Assigned to the *Cypraeorbis* genus by Dolin, Landau and Groves, and Lorenz, we agree and retain the species within *Cypraeorbis*.

C. testudinea. Described by Dolin in 2015. See page 29 for the Key Characteristics. The fossula is distinct, smooth, shallow, cup-like.

The specimen in the senior author's collection was collected by Petuch at Alum Bluff and measures 40.1 mm.

Assigned to the *Cypraeorbis* genus by Lorenz, we concur.

Conclusion. It is within the *Cypraeorbis* genus, well-known from the southeast of the United States as well as Europe, that these four species are best assigned.

Cypraeorbis alumensis (Ingram, 1948)

Cypraeorbis willcoxi (Dall, 1890)

Cypraeorbis hertleini (Ingram, 1948)

Cypraeorbis testudinea (Dolin, 2015)

The four were placed into the *Cypraeorbis* genus by Lorenz.

Loxacypraea* Petuch, 2004*Type:** *Loxacypraea chilona* (Dall, 1900)**Type Locality:** Alum Bluff, lower Bed, Florida

Described by Petuch: “Cypraeorbinine cowries with larger shells than average, heavy, thickened, broadly oval, highly inflated; extremities blunt, only moderately projecting; margins extremely thickened and callused, giving adults of some species flattened appearance; marginal calluses often covering dorsum of shell, producing faint dorsal furrow or dorsal band; aperture uniformly narrow; dentition simple, proportionally large and coarse; fossula absent.

However, as Darragh pointed out, the Type as well as other species do have a fossula. The fossula are smooth, scalene triangular [unequal sides], mostly distinct. As a result, the genus was not accepted.

In his 2015 article, Dolin redefined and accepted the *Loxacypraea* genus, comparing its fossula and characteristics to both *Siphocypraea* Heilprin 1886 and *Barycypraea* Schilder, 1927. He noted the presence of the genus in both Europe (France and Italy), South Africa and Mozambique, thereby establishing its connection with the Americas. *Loxacypraea chilona*, *Loxacypraea emilyae* and the newly named *Loxacypraea testudinea*, all from the Chipola Formation of Florida were included.

Petuch’s description is accurate with the exception of the presence of a distinct, proportionally large fossula in all of the species. Dolin has correctly redefined the genus. A number of species which were not mentioned by Dolin in 2015 also fit well into the genus. Accordingly, the following are included in the genus:

Loxacypraea chilona (Dall, 1900)*Loxacypraea tapeina* (Gardner, 1947)*Loxacypraea emilyae* (Dolin, 1991)*Loxacypraea arlettae* (Dolin, 1991)***Zonaria* Jousseaume, 1884****Type:** *Zonaria zonaria* (Gmelin, 1791)**Type Locality:** Guinea, West Africa

Landau and Groves (2011): “*Zonaria* is characterized by species with oval to pyriform, small to moderate-sized shells, the teeth are fine and widely spaced, the fossula is much reduced, the columellar area is smooth, the callus surrounding the siphonal canal is well-developed. ... *Zonaria* has been known in Europe since the early Miocene and is distributed today in the Mediterranean and West Africa.”

Lorenz (2017, I): “Small to medium size. Elongate oval to pyriform. Spire rather flat. Extremities short and rounded. Fossula flat and indistinctly denticulate. Teeth well produced and widely spaced. Terminal ridge rather broad.”

In 2011, Landau and Groves reclassified the five Florida species below within the *Zonaria* genus. Accepted herein.

Zonaria theresae (Dolin, 1991)*Zonaria heilprini* (Dall, 1890)*Zonaria shirleyae* (Dolin, 1991)*Zonaria praelatior* (Dolin, 1991)*Zonaria tumulus* (Heilprin, 1886)

Zonaria ballista (Dall, 1915)

In addition, *Cypraea ballista* described by Dall in 1915 is being added as *Zonaria ballista*. The description is contained within the species taxa below.

The shell as illustrated by Dall and in hand is a small, pyriform shell and possesses a shallow, smooth, indistinctly denticulate fossula. Its characteristics align with the *Zonaria* genus.

NOTE: The specimen illustrated by Dolin as *C. ballista* (figs. 8a and 8b) was illustrated by Dall in 1890 as *C. willcoxi* (Plate 5, figs. 12b and 12c). Accepted herein as *C. willcoxi* as originally described. Specimens labeled as *willcoxi ballista* do not appear to align with Dall's description or illustration.

***Trona* Jousseume, 1884**

Type: *Trona stercoraria* (Linnaeus, 1758) (type by subsequent designation)

Type Locality: West Africa

In 1884, the genus was published as *Etrona* by Jousseume with *Etrona stercoraria* and two other species listed. Poorly documented, but today accepted as *Trona*.

Per Lorenz (2017, I): "Solid, cylindrical to oval, often calloused shells. Anterior extremity pointed. Aperture narrow, widening anteriorly. Teeth fine and dense, short. Fossula coarsely denticulate and strongly projecting".

Dolin assigned *Trona calhounensis* to the subgenus *Trona leporina* from France, i.e., *Trona Leporina calhounensis*. He stated: "The definition of this subspecies bestows a purely typological value [a group with shared morphological characteristics] expressed by the author. It does not definitely demonstrate the sequence of changes leading to the Recent *T. stercoraria*, nor does it show the process of sporadic changes that could have happened – notably at the Paleogene/Neogene boundary – between the two peri-Atlantic faunalistic provinces, now disjunct". (Dolin).

Dolin based his classification on the morphological similarity with a single described and an undescribed *Trona leporina* species from France. However, he did not state the characteristics which would be considered similar nor did he provide any further support. As such, his classification is regarded herein as an unsupported suggestion. In 2011, Landau and Groves reassigned Dolin's classification to the *Trona* genus as *T. calhounensis* to go along with the other contemporaneous *Trona* species from the Cantaure Formation (early Miocene: Burdigalian) of Venezuela and the adjacent Caribbean. This was without comment but is, on balance, a credible revision.

Lorenz (2017, I), while recognizing *Trona ingrami* Landau and Groves, 2011 and *T. trinitatensis* (Mansfield, 1925) from the Cantaure Formation, places the species within *Miolyncina* Schilder, 1932, genus, an extinct Miocene genus. "The Miocene *Miolyncina calhounensis* from Florida links *Trona* with *Macrocypraea* [Schilder, 1930] conchologically."

However, the differences cited between *Trona* and *Miolyncina* are slight and the characteristics of *T. calhounensis* appear to be a better fit within the *Trona* genus. Specifically, the aperture of *T. calhounensis* is narrow and widens anteriorly while the aperture of *Miolyncina* species have a wider aperture. The ribbed coarsely ribbed columella and the deep, denticulate fossula more closely align with the *Trona* genus. Lastly, the suggestion that the species represents a link between the *Trona* genus and the *Macrocypraea* genus is without support and is unlikely given the vast time difference (~ 16 Myr) between the two genera without any intervening connection(s).

There is one Florida species within the genus:

Trona calhounensis (Dolin, 1991)

Luria Jousseaume, 1884

Type: *Luria lurida* (Linnaeus, 1758)

Type Locality: Mediterranean to West Africa

In 1884, the genus was simply entered as *Luria* by Jousseaume, including *Luria cinerea* (Gmelin, 1791) among the species listed. Poorly documented, but today accepted as *Luria*.

Per Lorenz (2017, I): “Elongate-oval shells with short, well developed, often very fine teeth”.

Dolin classified *Luria mariaelisabethae* within the *Talparia* genus as *Talparia (Talparia) mariaelisabethae*. However, *Talparia* is an Indo-Pacific genus without an affinity to either Europe/West Africa or the Southeastern American or Caribbean Provinces. As such, it, along with other Indo-Pacific restricted genera are not accepted herein.

Petuch reclassified the species as *Pseudozonaria*, but without comment.

In 2011, Landau and Groves reclassified the species as *Luria mariaelisabethae*. The species resembles an inflated *Luria cinerea* with a rounded dorsum, base and margins. The dentition and fossula are also similar. The latter is deep and denticulate on the lower portion of the fossula. *Pseudozonaria* species have a flattened base and subangular, angular margins.

Lorenz (2017, I) classified *mariaelisabethae* within the *Lyncina* genus. However, *Lyncina* is an Indo-Pacific genus without an affinity to either Europe/West Africa or the Southeastern American or Caribbean Provinces.

Landau and Groves classification is accepted herein.

There is one Florida species within the genus:

Luria mariaelisabethae (Dolin, 1991)

Chipola Formation Taxa & Iconography

Chapter 4

Genera

Cypraeorbis Conrad, 1865

Cypraeorbis alumensis (Ingram, 1948)

1948. *Cypraea alumensis* Ingram

1997. *Erronea alumensis* Petuch

2004. *Floradusta alumensis* Petuch

2016. *Palmadusta alumensis* Bouchet

2017. *Cypraeorbis alumensis* Lorenz

HOLOTYPE: California Academy of Science, 8043

Type Locality: about 3 ½ miles above Bristow, at Alum Bluff, Calhoun County, Florida.

Size: 22.3-28.5 mm

Key Characteristics: Small, ovate shell, averaging about 25 mm. Extremities blunt, slightly projecting; base slightly flattened; margins callous, subangular, angular; aperture uniformly narrow; columellar teeth thin, extending onto the columellar ridge, but not onto the base; labral teeth thin, confined to the aperture, longer anteriorly; columella smooth, straight and narrow. Fossula absent.

Cypraeorbis willcoxi (Dall, 1890)

1890. *Cypraea willcoxi* Dall

1971. *Cypraeorbis willcoxi* Schilder & Schilder

1991. *Zoila willcoxi* Dolin

1997. *Erronea (Solvadusta) willcoxi* Petuch

2004. *Floradusta willcoxi* Petuch

2011. *Cypraeorbis willcoxi* Landau & Groves

2016. *Palmadusta willcoxi* Bouchet

2017. *Cypraeorbis willcoxi* Lorenz

HOLOTYPE: United States National Museum, USNM 112441

Type locality: White Beach, near Osprey; northern part of Little Sarasota Bay.

Size: 33.6-64.0 mm

Key Characteristics: Large, oval-elongate shell, averaging about 40 mm. Extremities blunt, projecting; base slightly flattened; margins callous, subangular; aperture uniformly narrow; columellar teeth thin, extending onto the columellar ridge, but not onto the base; labral teeth thick, extending slightly onto base, longer anteriorly; columella smooth, wide, slightly undulating. Fossula distinct, smooth, shallow, cup-like.

***Cypraeorbis hertleini* (Ingram, 1948)**

1948. *Cypraea hertleini* Ingram, 1948

1991. *Cypraeorbis hertleini* Dolin

1997. *Miolyncina hertleini* Petuch

2004. *Loxacypraea hertleini* Petuch

2011. *Cypraeorbis willcoxi willcoxi* Landau & Groves

2017. *Cypraeorbis hertleini* Lorenz

HOLOTYPE: California Academy of Science, 8044

Type Locality: about 3 ½ miles above Bristow, at Alum Bluff, Calhoun County, Florida.

Size: 36.6-48.5 mm

Key Characteristics: “Shell bulbous, sloping steeply in lateral profile from the dorsum toward the anterior and posterior canals; spire obscured; sides of shell calloused; callosity of sides extends over lateral margins, leaving an undulating pattern on top of the dorsum; ... a 4 mm. wide shelf is present dorsally over anterior canal, shelf lacking over posterior canal; base convex, upturned at lateral margins, leaving a barely visible ridge at dorsal margin of upturned basal sides, ...; anterior canal extremity straight ventrally, strongly curved to the left dorsally; posterior canal turned toward the left; anterior canal lips of equal length; anterior canal 3 mm. broad by 4 mm. wide; terminal ridge of anterior canal sunken; anterior region of outer lip declivous; outer lip teeth approximately 4 mm. long; outer lip teeth along anterior one-half of lip have interstices of approximately 1 mm.; along posterior one-half interstices are approximately 1.50 mm. wide; anterior columellar teeth over anterior two-fifths of lip exist as nodules, the longest two extending 2 mm., into the aperture on the columella of the shell; three poorly developed non-noduled teeth are present on the central fifth of the columella; posterior two-fifths of the columella without teeth; barely noticeable depression on columella just posterior to the terminal ridges; columella from terminal ridge to approximately mid-point of its length slightly concave [fossula area]; columella from mid-point to posterior extremity convex; columellar surface just behind terminal ridge approximately 10 mm. deep; aperture 5 mm. wide anteriorly just behind terminal ridge, and narrowing posteriorly to 3 mm. just in front of posterior canal. The type measures: length, 40 mm.; breadth, 29.50 mm.; height, 22.50. ... The preservation of the holotype is excellent” (Ingram, 1948).

Fossula, distinct, smooth, shallow, cup-like.

***Cypraeorbis testudinea* Dolin, 2015**

2017. *Cypraeorbis testudinea* Lorenz

HOLOTYPE: United States National Museum, USNM 438596

Type Locality: Farley Creek, Calhoun County, Florida.

Size: 36.3-40.1 mm

Key Characteristics: Round, broad, depressed (turtle-like); heavy, callous; extremities blunt; margins callous, upturned; aperture straight, slightly curved left posteriorly; columellar and labial teeth thin, confined to the aperture; columella smooth. Fossula, distinct, smooth, shallow, cup-like.

Plate 1 →

1. *Cypraeorbis alumensis*, 25.8 mm, Alum Bluff, Apalachicola River, Liberty County
2. *C. alumensis*, 26.1 mm, Apalachicola River, Liberty County
3. *C. willcoxi*, 40.3 mm, Farley Creek River bank at confluence w/ Chipola River, Calhoun County
4. *C. testudinea*, 40.1 mm, Alum Bluff, Apalachicola River, Liberty County
5. *C. hertleini*, 40.2 mm, Alum Bluff, Apalachicola River, Liberty County



Loxacypraea, Petuch, 2004

***Loxacypraea chilona* (Dall, 1900)**

1900. *Cypraea chilona* Dall
1939. *Siphocypraea augustirina hyaena* Schilder
1947. *Cypraea (Cypraeorbis) chilona* Gardner
1964. *Siphocypraea (Siphocypraea) chilona* (Dall) Olsson & Petit
1991. *Siphocypraea chilona* Dolin
1997. *Barycypraea chilona* Petuch
2004. *Loxacypraea chilona* Petuch
2011. *Cypraeorbis chilona* Landau & Groves
2015. *Loxacypraea chilona* Dolin
2017. *Cypraeorbis chilona* Lorenz
2022. *Loxacypraea chilona* Daughenbaugh and Bridges

LECTOTYPE: United States National Museum, USNM 498388

Type Locality: Chipola Beds, Alum Bluff, Liberty County, Florida.

Size: 30.4-59.1 mm

Key Characteristics: “Shell rotund, heavy, anterior canal very slightly produced; base angled at outer margins on both columellar and outer lip sides; anterior canal straight, about 4 mm. broad at point of maximum width; posterior canal curved, about 5 mm. broad at point of maximum width; the strange curvature of the aperture at the center is possibly due to a malformation of the shell in this region; anteriorly the aperture is straight, posteriorly it is curved to the left; the aperture is about 6 mm. broad at the point of maximum width; teeth heavy, rounded, indefinite toward the posterior end of the base; incisures between the teeth broad; no shell color is preserved. This description is based upon the lectotype. Length 42.25 mm.; width 37 mm.” (Ingram, 1939b).

Columellar teeth extend to the columellar ridge; fossula smooth, distinct, proportionally deep, scalene. While the characteristics of the fossula align with that of *Loxacypraea*, it is broader vertically than others in the genus suggesting an affinity with the *Cypraeorbis* genus. Its retention in the *Loxacypraea* genus is provisional [P].

Note: Dall illustrated the species without a description. Ingram’s 1939 description, based upon the lectotype in the USNM, is adopted herein. The lectotype is illustrated by Ingram who attests the specimen “is without doubt the specimen in dorsal view figured by Dall for specific distinction”.

***Loxacypraea tapeina* (Gardner, 1947)**

1947. *Cypraea (Cypraeorbis) tapeina* Gardner
1948. *Cypraea apalachicolae*, Ingram
1991. *C. apalachicolae* synonymized with *Cypraeorbis hertleini* (Ingram) Dolin
1997. *Zoila apalachicolae* (Ingram) Petuch
2004. *Zoila tapeina* (Ingram) Petuch
2017. *Cypraeorbis apalachicolae* (Ingram) Lorenz
2022. *Loxacypraea tapeina* (Gardner) Daughenbaugh and Bridges

HOLOTYPE: United States National Museum, USNM 497854

Type Locality: about 3 ½ miles above Bristow, at Alum Bluff, Calhoun County, Florida.

Size: 48.0-49.1 mm

Syn.: *Loxacypraea apalachicolae* (Ingram, 1948)

Key Characteristics: “Shell broad, flattened on the apertural surface, highly inflated on the posterodorsal surface, narrowing both laterally and dorsoventrally toward the anterior extremity;

outline as viewed toward the posterior end very high and full but broader than it is high. Surface glaze probably heavy in fresh specimens. Aperture as long as the shell; narrow, subparallel margins flexed slightly with the dorsal curvature of the body. Inner wall of aperture flattened. Fossula shallow. Labial teeth rather coarse and somewhat irregular, 14 in the holotype, 18 in the paratype, restricted to the margins of the aperture. Teeth along outer lip shorter than those on the inner lip and in the holotype more numerous by 4. Margins of anterior notch sharply pinched, particularly the inner margin, which is set off by the sulcus behind it. Base of outer lip scooped slightly. Terminal notch deep and narrow, with parallel sides.” (Gardner). Holotype length, 33 mm width, 24 mm.

Columellar teeth extend to the columellar ridge; fossula smooth, distinct, proportionally deep, scalene.

Note: Ingram’s description of *C. apalachicola* was based on a specimen which was missing the anterior fossula section, postulating the “concave surface of the columella is produced enough to be considered a toothless fossula”. Other described characteristics are similar to Gardner’s which was based on a complete specimen. As such, Gardner’s earlier description is accepted and takes precedence over Ingram’s later description.

***Loxacypraea emilyae* (Dolin, 1991)**

1991. *Cypraeorbis emilyae* Dolin

1997. *Schilderia emilyae* Petuch

2004. *Floradusta emilyae* Petuch

2011. *Cypraeorbis emilyae* Landau & Groves

2015. *Loxacypraea emilyae* Dolin

2017. *Cypraeorbis emilyae* Lorenz

2022. *Loxacypraea emilyae* Daughenbaugh and Bridges

HOLOTYPE: United States National Museum, USNM 438580

Type Locality: about 1/3 mile above mouth of Farley Creek, Calhoun, County, Florida.

Size: 32.7-41.7 mm

Key Characteristics: “Large bulbous shell, somewhat egg-shaped; in lateral profile the ventral side adapically depressed, but regularly inflated; aperture flowing axis, weakly parasigmoidal; siphonal canal deep, elongate, in the shape of a long neck; each of the lips pearled; terminal ridge adaxially flat, plunging regularly inside aperture; fossula trigonal [triangular], rather concave, the angulation at right angle; columellar teeth extending into aperture about 3 mm on columella area, bounded by the angle, strong, binoduled and regularly disposed at equal length; labral teeth calloused, on adapical two-thirds extending abaxially across basal side of lip.” (Dolin).

The shell is broadly oval, heavy, thickened, inflated; extremities blunt, only moderately projecting; margins extremely thickened and callused, giving adults of some species flattened appearance. The fossula is typical of the *Loxacypraea* genus. The fossula is smooth, distinct, proportionally deep, scalene.

***Loxacypraea arlettae* (Dolin, 1991)**

1991. *Zoila arlettae* Dolin

1997. *Erosaria arlettae* Petuch

2004. *Loxacypraea arlettae* Petuch

2011. *Cypraeorbis arlettae* Landau & Groves

2022. *Loxacypraea arlettae* Daughenbaugh and Bridges

HOLOTYPE: United States National Museum, USNM 438590

Type Locality: Farley Creek, north bank, just east of bridge at FL Highway 275, Calhoun County, Florida.

Size: 40.3-46.9 mm

Key Characteristics: “Shell moderately large to large, cabochon-shaped [rounded dorsum, flat base], dorsal side weakly, but regularly inflated and ventral area entirely flat; spire prominent, covered; aperture regularly parasigmoidal, slightly abaxial; deep, straight siphonal canal on basal view; tubular, truncated and pipe-like, dorsally rolled up, turned to left in front profile; exhalant channel deeper adaxially toward the left and lengthened by auriform extremities of lips; circumbasal callus not upturned at lateral margins, making a true ridge; abapical crease abaxially flat to rather concave; columellar teeth bounded by angulation of columellar area, strong, short (less than 2 mm), regularly spaced, sometimes poorly developed over posterior two-fifths of inner lip in sub-adult samples, labral teeth also strong, disposed of equal length and bounded at adaxial margins of outer lip, short, especially on anterior portion; terminal ridge declivous at approximately 45°; fossula shallow, concave, inner margin calloused, making a border.” (Dolin).

The fossula is smooth, distinct, proportionally deep, scalene.

Plate 2 →

1. *Loxacypraea arlettae*, 32.7 mm, Farley's Creek, 2 miles north of Chipola River, Calhoun County
2. *L. emilyae*, 41.5 mm, West Bank of Chipola River, ½ mile south of Bailey's Ferry, Calhoun County
3. *L. chilona*, 56.3 mm, Alum Bluff, Apalachicola River, Liberty County
4. *L. tapeina*, 49.1 mm, West Bank of Chipola River, ½ mile south of Bailey's Ferry, Calhoun County



Zonaria Jousseaume, 1884

***Zonaria theresae* (Dolin, 1991)**

1991. *Lyncina theresae* Dolin

2004. *Loxacypraea theresae* Petuch

2011. *Zonaria theresae* Landau & Groves

2017. *Lyncina theresae* Lorenz

2022. *Zonaria theresae* Daughenbaugh and Bridges

HOLOTYPE: United States National Museum, USNM 438607

Type Locality: Tenmile Creek, about 1 ½ mile west of Chipola River, Calhoun County, Florida.

Size: 37.6-53.0 mm

Key Characteristics: “Large pyriform shell, ventral area slightly swollen, inner and outer sides slightly flattened; lateral margins regularly rounded; spire not too prominent, covered; aperture adapically curved in abaxial sense; siphonal canal deep, abaxially asymmetrical, surrounded in relation to ventral area, forming a bridge; apical canal narrow, equally lengthened by both extremities; inner lip slightly parasigmoidal; teeth numerous, anteriorly strong, then finer; limited to angulation of basal and columellar areas, stretching onto flattened, abrupt columellar area forming a second tooth line; horizontal terminal ridge lightly calloused, broken at right angle by a vertical strip (inner edge); fossula slightly concave, covering ridges joining thick inner denticles to columellar teeth; labral teeth less numerous, short, limited to adaxial peristome of lip, slightly parasigmoidal, a few declivous abapically.” (Dolin).

***Zonaria heilprini* (Dall, 1890)**

1890. *Cypraea heilprini* Dall

1927. *Zonaria heilprini* Schilder

1947. *Cypraea (Cypraeorbis) heilprini* Gardner

1971. *Zonaria (s. s.) heilprini* Schilder & Schilder

1991. *Erronea (Adusta) heilprini* Dolin

2004. *Floradusta heilprini* Petuch

2011. *Zonaria heilprini* Landau & Groves

2016. *Palmadusta heilprini* Bouchet

2017. *Cypraeorbis heilprini* Lorenz

2022. *Zonaria heilprini* Daughenbaugh and Bridges

HOLOTYPE: United States National Museum, USNM 112073

Type Locality: “Ten Mile Creek, one mile west of Bailey’s Ferry, on the Chipola River, Calhoun County, Florida.” CORRECTED from Ballast Point, Tampa Bay by Ingram.

Size: 23.9-38.5 mm

Key Characteristics: “This species is best described by comparison with *C. Pinguis*. It differs from the latter in being more cylindrical; in its somewhat straighter and proportionally narrower aperture, which is also less curved at the posterior commissure; in being less elevated in proportion to its length, and having the posterior slope of its dome less abrupt; in being more attenuated laterally at either end, and in the greater production of the extreme ends of the base; lastly, it appears to average smaller than *pinguis*, and none of the specimens indicate any such *Aricia*-like basal callus as *pinguis* assumes in its fullest stage of development. The specimens show nothing of the spire; the teeth are strong but small, and not extended (even faintly) across the basal callus; there are twenty-two on the right lip and about eighteen on the left, which latter are less prominent.” (Dall).

Ingram, 1939, called attention to certain inaccuracies in Dall's figures.

"Dall's illustration of the ventral view of *heilprini* gives the impression that the specimen is broader in proportion to its length than it really is. His figure shows no tooth bordering the columellar incisure anteriorly; in reality there is a prominent tooth anterior to the incisure, and the incisure is deeper than his figure portrays. The photograph of the ventral view shows that the anterior canal lips are produced ventrally, the columellar lip being especially pointed. The original figure does not indicate this condition of the anterior canal lips, and shows the columellar lip to be blunt."

In 1947, Gardner added additional comments.

"By some misfortune, the figured type of this species comes not from Ballast Point, the locality cited by Dall, but from locality 2212, Tenmile Creek, 1 mile west of Bailey's Ferry, Chipola River, Fla. There is an error, too, in the dimensions: the length of the type is 29 millimeters, not 26.5 millimeters. It is by no means, however, the largest specimen in the Chipola; one individual attains a length of 45 millimeters. Immature forms, such as the figured type, are more cylindrical than the fully mature forms. The adult outline is asymmetrically ovate, and the maximum diameter falls behind the median horizontal. The posterior extremity of the aperture is inclined toward the left, the posterior notch obliquely U-shaped. The anterior extremity is truncated, the anterior notch asymmetric and inclined to the left. The Ballast Point forms that have been referred to this species are higher relatively and the aperture less strongly flexed at the posterior extremity."

***Zonaria shirleyae* (Dolin, 1991)**

1991. *Erronea (Adusta) shirleyae* Dolin

1997. *Erronea (Ovitipsa) shirleyae* Petuch

2004. *Floradusta shirleyae* Petuch

2011. *Zonaria shirleyae* Landau & Groves

2016. *Palmadusta shirleyae* Bouchet

2017. *Zonaria shirleyae* Lorenz

HOLOTYPE: United States National Museum, USNM 438613

Type Locality: Tenmile Creek, about 1 ½ mile west of Chipola River, Calhoun County, Florida.

Size: 21.0-32.3 mm

Key Characteristics: "Medium-sized oviform shell, regularly rounded; in lateral profile maximum height in middle; extremities slightly separated around flanks; siphonal canal short, U-shaped; exhalant channel weakly bent adaxially; adapical extremity of inner margin giving aperture a vaguely sigmoidal aspect; spire covered but slightly projecting (also in gerontic state) to center of adapical umbilicus; ventral area calloused, regularly concave, rounded; terminal ridge slightly plunging, bifurcated by doubling of transverse comma-shaped ridge; inner edge short but thick, making abaxial protrusion on aperture; fossula rather deep, flat, sculpted by numerous regular ridges; denticulation of inner margin fine, regularly disposed, becoming finer on median third and being prolonged on columellar area; outer lip with anteriorly constricted peristome and with denticulation pinched, few in number and dispersed." (Dolin).

***Zonaria praelator* (Dolin, 1991)**

1991. *Bistolida praelator* Dolin

1997. *Erronea (Talostolida) praelator* Petuch

2004. *Floradusta praelator* Petuch

2011. *Zonaria praelator* Landau & Groves

2016. *Palmadusta praelator* Bouchet

2017. *Talostolida praelator* Lorenz

2022. *Zonaria praelator* Daughenbaugh and Bridges

HOLOTYPE: United States National Museum, USNM 438616

Type Locality: Farley Creek, north bank, about 0.8 mile east of bridge at FL Highway 275, Calhoun County, Florida.

Size: 31.3-32.2 mm

Key Characteristics: “Medium-sized fusiform shell, dumpy, pointed at extremities; spire totally covered, enclosed; siphonal canal elongate, forming strong, well-detached bridge, strongly calloused; posterior channel deep, forming stout collar, raised in lateral profile; ventral area regularly convex like the prow of a ship; aperture somewhat rectilinear; circumbasal callosity well-developed, bordered on flanks, lateral outer margin leaving a series of barely discernible nodules; terminal ridge straight, obsolete and sunken then lamellose and projecting; inner edge plunging, short and lamellar; fossula very weakly concave and crossed by strong ridges, joining inner denticles to first teeth of crenulated inner lip; remainder of denticulation, regularly disposed, stronger at abrupt angulation of basal area and columellar area, extending deeply on latter; teeth of outer lip (barely bent) strong but pinched, few in number and very distant.” (Dolin).

***Zonaria ballista* (Dall, 1915)**

1915. *Cypraea ballista* Dall

1927. *Prolyncina ballista* Schilder

1971. *Cypraeorbis willcoxi ballista* Sch. & Sch.

1991. *Cypraeorbis ballista* Dolin

2004. *Floradusta ballista* Petuch

2011. *Cypraeorbis willcoxi ballista* Landau & Groves

2016. *Palmadusta ballista* Bouchet

2017. *Cypraeorbis ballista* Lorenz

2022. *Zonaria ballista* Daughenbaugh and Bridges

HOLOTYPE: United States National Museum, USNM 165098

Type Locality: Tampa silex beds at Ballast Point, Tampa Bay, Florida.

Size: 22.3-48.0 mm

Key Characteristics: “Shell small, pyriform, with a slight dimple over the spire, the sides of the base somewhat expanded by callus; aperture rather wide flexuous, with (on the right side 25 and on the opposite side about 20) sharp-edged lirae or denticulations, which do not extend over the base, but on the left side pass deeply into the aperture; these are separated by interstices of greater width which on the right side are somewhat excavated, on the left side rather less so; posterior sinus curved upward, anterior sinus direct. Length 27, maximum width 19, height 16 mm.” (Dall).

The species also possesses a flat, slightly denticulate fossula.

***Zonaria tumulus* (Heilprin, 1886)** NOTE: Date corrected by Wilson and Petit in 1986

1887. *Cypraea tumulus* Heilprin
 1890. *Cypraea pinguis* Dall
 1915. *Cypraea tumulus* Dall
 1971. *Zonaria* (s. s.) *tumulus* Schilder & Schilder
 1991. *Erronea (Adusta) tumulus* Dolin
 2004. *Loxacypraea tumulus* Petuch
 2011. *Zonaria tumulus* Landau & Groves
 2017. *Cypraeorbis tumulus* Lorenz
 2022. *Zonaria tumulus* Daughenbaugh and Bridges

HOLOTYPE: Wagner Free Institute of Science, Philadelphia, WFIS 861

Type Locality: Tampa Limestone, Ballast Point, Hillsborough County, Florida.

Size: 24.4-34.8 mm

Key Characteristics: “Shell completely involute, inflated, very convex, the greatest elevation being immediately back of the apex, the dome abruptly truncated posteriorly, sloping more gradually in the direction of the anterior extremity; aperture narrow, subcentral, slightly flexuous, directed obliquely over the apex; outer lip produced somewhat beyond the inner lip posteriorly, with about twenty-five evenly spaced dental plications; columellar surface flattened, the teeth less prominent; surface of shell covered by very fine revolving lines, which, however (in specimens before me), are only visible in immediate proximity to the aperture; base gently convex.” (Heilprin).

Dolin did not examine the holotype, rather “a well preserved topotype was examined”. The specimen is described as having a wide aperture. His figured specimen is wide, wider and more declivous than the original description and that figured by Dall, 1890 as *C. pinguis* [= syn. *tumulus*]. The original description stated “aperture narrow, subcentral, slightly flexuous”. A specimen in the senior author’s collection is more closely aligned with Heilprin’s description and Dall’s illustration. The columellar teeth extend well into the aperture and the fossula is denticulate. The characteristics lead to a classification within the *Zonaria* genus.

Dolin cited the original type locality and holotype dimensions rather the corrected type locality cited by Ingram and the type dimensions cited by Gardner. However, he contributes to our understanding of the species by adding “fossula very weakly concave, crossed by ridges forming beaded inner denticles; denticulation of inner margin sharp, serrate, elongated on the columellar area and slightly on basal area”. While the beaded denticles are barely discernable on some specimens, their existence leads us to classification within the *Zonaria* genus.

Plate 3 →

1. *Zonaria praelatior*, 21.0 mm, West Bank of Chipola River, ½ mile south of Bailey's Ferry, Calhoun County
2. *Z. ballista*, 22.5 mm, Ballast Point, on Tampa Bay, St. Petersburg, Pinellas County
3. *Z. tumulus*, 24.4 mm, Ballast Point, on Tampa Bay, St. Petersburg, Pinellas County
4. *Z. shirleyae*, 31.3mm, West Bank of Chipola River, ½ mile south of Bailey's Ferry, Calhoun County
5. *Z. heilprini*, 38.5 mm, West Bank of Chipola River, ½ mile south of Bailey's Ferry, Calhoun County
6. *Z. theresae*, 48.3 mm, West Bank of Chipola River, ½ mile south of Bailey's Ferry, Calhoun County



Trona Jousseaume, 1884

***Trona calhounensis* (Dolin, 1991)**

1991. *Trona Leporina calhounensis* Dolin

1997. *Trona calhounensis* Petuch

2004. *Trona calhounensis* Petuch

2011. *Trona calhounensis* Landau & Groves

2017. *Miolyncina calhounensis* Lorenz

2022. *Trona calhounensis* Daughenbaugh and Bridges

HOLOTYPE: United States National Museum, USNM 438598

Type Locality: Farley Creek, north Bank, just east of bridge at FL Highway 275, Calhoun County, Florida.

Size: 46.5-60.8 mm

Key Characteristics: “Large, light-weight, subcylindrical shell, posteriorly swollen; in lateral profile the dorsal curvature, regularly attenuated abapically, joining two extremities; ventral area slightly convex in anterior two-thirds; spire projecting, covered by adapical callus; sides rounded, not calloused; aperture parasigmoidal, anteriorly dilated by hemispherical expansion, affecting each lip in first third; siphonal canal deep, abaxially asymmetrical and abapically orthogonally truncated; exhalant channel deeper, limited by parallel lips; five strong anterior columellar teeth, well-spaced; other numerous inner lip teeth parallel, bituberculated, 6 mm in length on the columellar area, abrupt; all restricted to angulation of basal and columellar planes; first third of labral lip teeth stretched out on constricted, depressed, hemicircular area; remainder short, heavier; terminal ridge obsolete, flexuous, merging into abapical edge, fringed with denticles from fossula into inner margin; the deep, concave, spoon-like fossula covered by ridges, sometimes interrupted, joining fossular denticulation to anterior columellar teeth.” (Dolin).

Luria Jousseaume, 1884

***Luria mariaelisabethae* (Dolin, 1991)**

1991. *Talparia (Talparia) mariaelisabethae* Dolin

1997. *Pseudozonaria mariaelisabethae* Petuch

2011. *Luria mariaelisabethae* Landau & Groves

2017. *Lyncina mariaelisabethae* Lorenz

2022. *Luria mariaelisabethae* Daughenbaugh and Bridges

HOLOTYPE: United States National Museum, USNM 438602

Type Locality: Farley Creek, at abandoned mill about ¼ mile west of bridge at FL Highway 275, Calhoun, County, Florida.

Size: 22.2-48.3 mm

Key Characteristics: “Medium-sized, cylindrically oblong shell; in lateral profile the dorsal outline regularly rounded, with greatest height in posterior-most third, not forming a siphonal canal bridge abapically; ventral area varying from swollen to flat; lateral margins weakly calloused; circumbasal callosity creating abapically two dimples on either side of anterior portion of siphonal canal; spire projecting, covered; aperture straight, narrow, adapically slightly curved abaxially; siphonal canal short, surrounded relative to ventral area, abaxially asymmetrical, limited by acuminate, declivous extremities; exhalant channel deep, U-shaped, calloused; inner lip straight; teeth short, numerous, of equal size and limited to the first millimeter inside columellar area; terminal ridge straight, “T” shaped, obsolete and depressed; anterior edge spatulate; fossula deep, slightly concave, and in some cases, covered by banded ridges joining together the five to six inner denticles to the seven anterior teeth on inner lip; outer lip teeth short, equal in strength, becoming obsolete on right side.” (Dolin).

Plate 4 →

1. *Luria mariaelisabethae*, 32.7 mm, West Bank of Chipola River, ½ mile south of Bailey's Ferry,
Calhoun County
2. *Trona calhounensis*, 46.5 mm, West Bank of Chipola River, ½ mile south of Bailey's Ferry,
Calhoun County



1



2



Part Two

Late Zanclean – Piacenzian Pliocene

Chapter 5

Peninsular Florida

By the late Zanclean-Piacenzian Pliocene (~ 3.8-3.6 Ma), the northern peninsular area had filled out to a great extent. The Polk Peninsula in the center of present-day peninsular Florida and the St. Lucie Peninsula on the eastern coast constituted its southern edge. In the present-day Sarasota area and surrounds on the western side of the Polk Peninsula, there existed a shallow, estuarine lagoon fed by the Myakka River. In the present-day Kissimmee River Valley, between the two peninsulas, there was a long, shallow embayment. At the same time, coral reef tracts were building in the Immokalee Reef Tract, south of Sarasota, as well as the Palm Beach and Miami Reef tracts to the east and southeast, encompassing the Everglades area.

The Cypraeidae

The Chipola Formation Cypraeidae did not survive the Late Miocene uplifting which saw its marine environments exposed as terrestrial environments. No Cypraeidae species would ever again inhabit the area from Tenmile Creek to Alum Bluff. By the beginning of the Early Pliocene Zanclean Stage, ~ 5.3 Ma, the Suwannee Strait had been filled, closing the gap with the present-day Florida Panhandle. Little is known about any relictual Cypraeidae populations from the extinction event to the reappearance of Cypraeidae species during the Zanclean-Piacenzian transition ~ 3.8 Ma in central Peninsular Florida.

However, the Miocene-Pliocene Peace River Formation in DeSoto and Charlotte Counties does contain molds and casts from this period. These have replaced the actual fossils when they were heavily leached by infiltrating ground water. Two casts (steinkern) were collected at a mine in southwest Polk County, northeast of Sarasota. One cast was described as *Akleistostoma ductor* (Petuch and Drolshagen, 2011) (see fig. 2) and the second *Calusacypraea polkensis* (Petuch and Drolshagen, 2011) (see fig. 3). While the former cast was poorly preserved, there were enough inferred characteristics to place it provisionally in the *Akleistostoma* Gardner, 1948 genus. It is closest to *Akleistostoma carolinensis* (Conrad, 1841). The *C. polkensis* cast was also poorly preserved, but there were enough inferred characteristics to place it provisionally in the *Calusacypraea* genus. It is probable that there were other ancestors, but that is unknown at this point. (Petuch and Drolshagen, 2011).

In the late Zanclean Pliocene and the early Piacenzian Pliocene (~ 3.8-3.6 Ma) Duplinian Subprovince, *Akleistostoma carolinensis* (Conrad, 1841) has been found in Virginia and the Carolinas as well as the Sarasota quarries and surrounds. *Akleistostoma (Ingramicypraea) pilsbryi* (Ingram, 1939) has been found along the Cape Fear River in North Carolina and along with *A. carolinensis* in the Sarasota, Sarasota County quarries. These two contemporaneous species, coupled other Duplinian species, demonstrate that the molluscan fauna of that subprovince extended south into the Buckinghamian Subprovince, i.e., the Sarasota area and present-day Okeechobee County of peninsular Florida, but no further south. As tropical conditions progressed in southern peninsular Florida, only residual Duplinian molluscan influence remained.



Figure 2: *Akleistostoma ductor* (Petuch and Drolshagen, 2011)



Figure 3: *Calusacypraea polkensis* (Petuch and Drolshagen, 2011)

Everglades Pseudoatoll

Unlike true atolls which are formed around sinking volcanic islands, there was no such volcanic activity in southern Florida which would account for the formation of the Everglades Pseudoatoll. Unlike the older Eocene formations in central and northern Florida, which are characteristically composed of limestone with small stringers of gypsum and anhydrite (calcium sulphates) in the deep subsurface, the pseudoatoll lithofacies were replaced by fractured and vuggy (hollow cavity) dolostone (carbonate) – limestone facies which have formed fractured boulder zone areas. In addition, there is a small magnetic anomaly within a valley-like depression under the southern Everglades. This steep, high magnetic anomaly is surrounded by a low magnetic area which extends ~ 300+ km to the south and west and ~ 200+ km to the north and east (Klitgord et al., 1984).

In 1987, Petuch proposed an explanation for this phenomenon. A giant bolide meteor, i.e., a fireball and large impactor, impacted at what is today the mouth of the Chesapeake Bay of Maryland in the late Eocene, 35.5 +/- 0.3 Ma. The meteor entered the earth's atmosphere over the north pole and fragmented with the Chesapeake Bay impact fragment being the largest. Secondary fragments and debris spread southward, hitting all along the eastern United States and as far south as Argentina. The southern Florida platform would also have been impacted. The valley-like depression in the southern part of the present-day Everglades National Park suggests a hit from a small impactor at a then depth of 250-300 m. This could account for the crater-like feature and the fragmenting of the underlying limestone, to a depth of eight kilometers.

The impact caused a series of giant tsunamis, estimated as high as 300+ m, to spread out from the center of the impact. These would have swept over the entire bedrock Florida Platform which underlies peninsular Florida, which was not as yet emergent. These tsunamis would have scoured the sea bottom of unconsolidated sea floor sediments, including the area which was to become the Everglades Pseudoatoll. The scouring is the probable cause of the Everglades Unconformity. An unconformity is a type of discontinuity whereby layers of rocks between older and younger strata are missing due to erosion or the lack of sediment deposition over an extended period of time. The unconformity dates to the end of the Ocala deposition, which is entirely missing in southern Florida and aligns with the age of the Chesapeake Bay impact.

While these tsunamis would account for the unconformity, they would not account for the lithological and geological formation of the Pseudoatoll. In the area of the Everglades Unconformity, ground water would have penetrated the fractured limestone and dissolved its smaller fragments, leaving only limestone boulder zones in place. As a result, the surface would have collapsed over time producing a relatively shallow, irregular oval depression which extended northward and is known as the Everglades Depression. It was deepest at the probable southern impact area.

Following and probably the result of the meteor impact, the Northern Hemisphere experienced a four-million-year ice age that dropped southern Florida sea levels 200-300 m, resulting in land exposure over the entire Florida Platform. Subsequently, as temperatures and sea levels rose, two banks formed along the southeastern and southwestern higher edges of the depression. These were the precursor to the Everglades Pseudoatoll. As sea levels continued to rise, similar banks progressed northward along the rims of the depression, ultimately resulting in the Pseudoatoll. However, the Pseudoatoll was not a static feature. Climate and sea level changes produced the growth, erosion and even collapse of certain features. Ultimately, tropical hard coral reefs, reef tracts and coralline habitats emerged in full force, reaching their maximum development during the

mid to late Piacenzian Pliocene as the warming of southern Florida also reached its maximum, producing the richest tropical hard coral fauna ever found in the Western Atlantic. Most of the Pseudoatoll coral species also occur in the Gatunian (Caribbean) Province, adjacent to the south. This indicates that they had migrated northward from the Caribbean Region.

The lagoon within the pseudoatoll was dominated by the broad, shallow, quartz sand and carbonate Hendry Platform which fronted the leeward or east side of the Immokalee Reef tract. The platform extended eastward to south of Lake Okeechobee. There, its termination is marked by the north-south running West Everglades Reef chain where it sloped into the deep-water Loxahatchee Trough. The trough fronted the leeward side of the two eastern reef tracts and dominated that section of the lagoon. (Petuch and Roberts).

Area Components

There were three primary areas which contained habitats capable of hosting viable Cypraeidae populations.

Myakka Lagoon System. Named after and fed by the Myakka River, the Myakka Lagoon System was a tropical estuarine habitat, enclosed behind a string of near offshore fringing reefs. It stretched along the southwest coast of the incipient Polk Peninsula in the present-day Sarasota area and northward approximately 20 miles. It consisted of sand and sea grass flats and intertidal mud flats, sections of which fronted mangrove tree forests. The latter were to become common by the beginning of the early Pleistocene (~ 2.8 Ma). The intertidal flats were covered by extensive sea grass beds. Coral bioherms were also present. These hosted a number of Cypraeidae species, some of which are normally associated with the coral reefs of Lee and Collier Counties. Its totality, which encompasses Sarasota and surrounds, and northward ~ 20 miles, is known today as the Myakka Lagoon System. Extensive quarry operations were conducted into the early 1990s. Recent excavation has taken place off Lavender Road, off Highway 41, Ruskin, Florida. The earliest fossil Cypraeidae to come from the quarries, date to the late Zanclean-Piacenzian crossover boundary and into the early Piacenzian Pliocene (~ 3.8-3.5 Ma).

Kissimmee River Valley. The Kissimmee River Valley enclosed an embayment between the Polk and St. Lucie Peninsulas and behind the Okeechobee Reefs which formed a concave assemblage at the southern mouth of the embayment. It was far larger and more extensive than the Myakka Lagoon System, but its habitat was similar, i.e., sea grass beds, intertidal mud flats and mangrove tree forests. Sediments from the Kissimmee River and surrounding land areas eventually entirely filled the embayment, leaving low flatlands north of present-day Lake Okeechobee in the Kissimmee River Valley. The river valley encompasses present day Okeechobee, Highlands, Glade, and Osceola Counties.

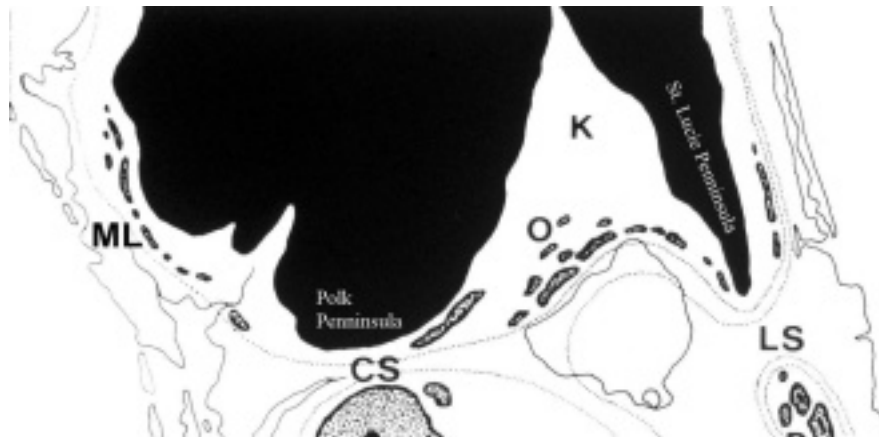


Figure 4: Map reflecting the Tamiami Subsea. ML = Myakka Lagoon System; K = Kissimmee Embayment; O = Okeechobee Patch Reefs; CS = Caloosahatchee Strait; LS = Loxahatchee Strait.

Adapted from Petuch et al. 2018, Figure 1.5, p. 37.

Coral Reef Tracts. In Florida, during a crossover period between the late Zanclean Pliocene and the early Piacenzian Pliocene (~ 3.8-3.6 Ma), the sea environments were reversing the colder water conditions of the Zanclean which impacted both the Duplinian and Buckinghamian Subprovinces. While species adapted as more temperate conditions emerged, the growth and development of tropical marine fauna was stunted during this period. This was followed by a warming trend which began ~ 3.6 Ma and intensified to such an extent that it produced tropical conditions, including extensive coral reef systems south of present-day Sarasota and Okeechobee Counties.

By the mid to late Piacenzian Pliocene (~ 3.1- 2.6 Ma), the pseudoatoll was open in the north. Its “U-shaped” perimeter was bounded on the east southeast, south of the Kissimmee Embayment, by the Palm Beach Reef Tract with the Miami Reef Tract representing a continuation of the former, curving to the southwest along the southeast of the pseudoatoll. Along present-day southeastern Florida, the coastal cities from Palm Beach to Miami sit atop this rim. The pseudoatoll was bounded on the west by the Immokalee Reef Tract, a broad, zoned reef system which ran south southeast from below the Myakka Lagoon System and encompassed a large chain of carbonate islands. The Long Pine Key Reefs, a set of small reefs, ran from west to east between the southernmost tips of the Immokalee and Miami Reef Tracts. The pseudoatoll was separated from the Kissimmee River Valley and Myakka Lagoon System by the Loxahatchee Strait in the east and the Caloosahatchee Strait in the west. Over 120 species of coral have been identified, making this the most extensive coral fauna ever found in the Americas (see figs. 4 and 5).

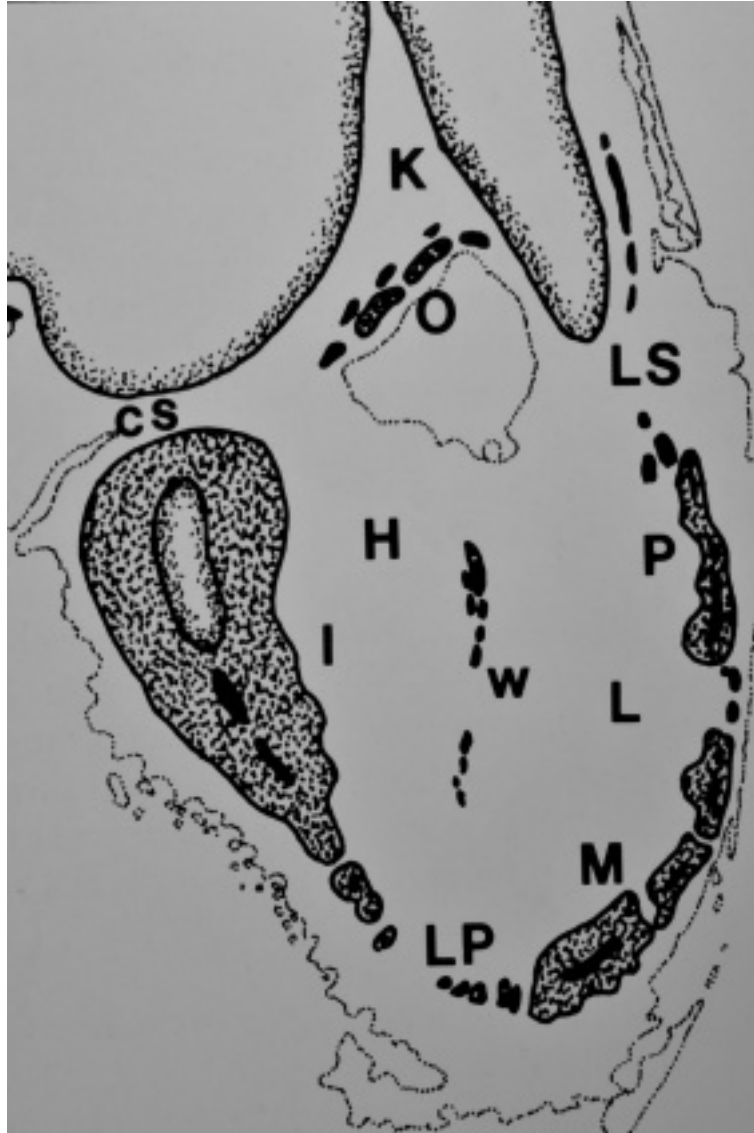


Figure 5: Map reflecting the Everglades Pseudoatoll. K = Kissimmee Embayment; CS = Caloosahatchee Strait; LS = Loxahatchee Strait; O = Okeechobee Reef Tract; H = Hendry Platform; I = Immokalee Archipelago and Reef Tract; W = West Everglades Reef Tract; P = Palm Beach Archipelago and Reef Tract; L = Loxahatchee Trough; M = Miami Archipelago and Reef Tract; LP = Long Pine Keys.

Stippled areas = coral reef growth; Solid dark areas = coral cays and barrier islands; Outer dotted line = Outline of Recent southern Florida.

From Petuch, 1997a, Figure 5, p. 10.

Chapter 6

Tamiami Formation

Tamiami Formation. The Tamiami Formation was first proposed informally by Mansfield, 1939 as the Tamiami limestone along the Tamiami Trail, U.S. Highway 41, in Collier County. Well drillings in Lee and Hendry counties have shown that the formation transcends the Miocene-Pliocene boundary (Peck et al., 1979). The Tamiami Formation contains a wide range of mixed - lithologies and associated faunas. It occurs at or near the land surface in the southern peninsula with numerous named and unnamed members recognized within the Tamiami Formation. Its unevenness indicates that the upper part has been subjected to erosion (Missimer, 1992).

As there are no natural outcroppings in the formation, particularly in the Sarasota area and Kissimmee River Valley, the only access to collecting sites has been through quarries, which are subject to depth limitations, temporary pits, canal digs and construction sites. As such, various studies after Mansfield have focused on these near surface depositions which demonstrated the formation extended from the late Zanclean-early Piacenzian Pliocene and continued to the end of the Pliocene. The formation extended throughout southern Peninsular Florida, 3.8 to 2.6 Ma. These represent the thickest and richest shell fossil beds in southern Florida.

Formations, Members and Beds. A formation is the main stratigraphic unit in the study of sedimentary rocks. A formation is defined as a series of strata that is distinct from other strata above and below, and is thick enough to be shown on the geological maps that are widely used within the area under study. The thickness of formations can vary from less than a meter to several thousand meters.

Within a formation, there may be strata which have a specific and distinctive lithology. Lithology involves describing the general characteristics of sediments, rocks, and rock types present in a stratigraphic division. Such characteristics may include color, grain size, texture or composition. Such strata represent changes in sedimentary deposition over time and are called Members within a formation. Within a member, there also may be strata which have special geological significance. They are designated Beds. If the Member/Bed strata contain distinctive fossils, the fossils can help give the relative age of that part of the sedimentary rock sequence. The fossils themselves can help geologists map a biostratigraphic sequence.

Within a formation, there may be geographical areas which have no described Members and whose lithology is not distinct. In such cases, Equivalent Members may be designated when the marine fauna is similar to that of a described Member. This is commonly based on Index species, i.e., Index fossil species are species which have a short vertical range indicating a narrow range in time, wide geographic distribution and exhibit rapid evolutionary trends. This allows the alignment of the Equivalent Member with the Member, together representing geologic time markers, allowing geologists to sequence strata.

Myakka Lagoon System Members. In 1982, in the APAC quarry (APAC Pit) at Sarasota, Florida, a deep cut exposed a wall with clearly defined strata. These strata provided the basis for Dr. Edward Petuch to assign unit numbers to the strata within the formations. The unit numbers run from 11 to 0, with the higher the number the older the strata. Unit 10 was the oldest unit to contain recorded Cypraeidae species. The strata represent successive sea beds, one on top of the other (see fig. 6).

Rather than creating new Member names for Unit 10 and 7, Petuch chose to retain older geological names as designations for their component fauna.

Buckingham Member (Unit 10) was adopted in lieu of the Buckingham limestone marl (Parker & Cooke, 1944), named for the town of Buckingham on the Caloosahatchee River.

Pinecrest Member (Unit 7). In 1964, Olsson and Petit informally named the “Pinecrest Beds” as a molluscan biozone for the Index fauna contained in its sandy units, after the old Pinecrest settlement on the Everglades Road off U. S. Route 41 on the Dade-Collier County line. In 1968, Hunter provided the first lithologic description of the widespread shell beds and their fauna. This was further refined in Petuch’s 1982 work. In 1992, Missimer gave a more detailed description of the areal extent of what he called the “Pinecrest Sand Beds”. The name has been shortened to the Pinecrest Member.

Fruitville Members (Units 4 – 2). In 1990, Waldrop and Wilson proposed the “Fruitville Formation” for the Pliocene sequence at Sarasota (Petuch Units 10-2) as most of the members of the Tamiami Formation lacked formal descriptions. Fruitville is a small town east of Sarasota, Florida. As the authors’ work was based on a biostratigraphic approach which created a proposed biozone, it was not appropriate for geologic purposes. As such, Petuch assigned Units 9-5 at Sarasota to the Pinecrest Member as the lithology aligns with the Olsson and Petit (1964) description as refined by Missimer, T.M. (1992). Further, as “Fruitville Formation” had been used by a number of workers, including Emily Vokes, Petuch retained the name to differentiate the lithostratigraphy of Units 4-2 at Sarasota as a member, i.e., the Fruitville Member.

Kissimmee River Valley Equivalents. The Kissimmee Embayment’s Sea grass beds, intertidal mud flats and mangrove tree forests do not present as describable strata. Rather they present as a mixed continuum. Although separated from the Myakka Lagoon system by the Polk Peninsula, equivalent time unit status has been assigned to the Cypraeidae species inhabiting the lower levels of the embayment. In certain cases, this is based on shared Index fossils and, in other cases, on the position of species in the strata in relation to other known species from higher or lower positions in the strata.

Rucks Pit, Fort Drum, Okeechobee County, the Type locality for most Kissimmee River Valley species, was operated as a pumped, dry quarry. Over a two-year period in the 1990s, excavations which deepened the pit uncovered four sequential beds which provided the basis for the 7 through 4 equivalent Units of the Kissimmee River Valley. The four beds constituted the deepest beds uncovered at Rucks. Each bed was scraped flat, allowing a collector to walk on the actual bedding plane surfaces of the individual units, which were exposed for acres. The scraping of each bed also produced about 6-inch-deep, parallel grooves across the surface of the bed. Many cowries along with other molluscan fauna were exposed within the grooves. The fauna were named and assigned to the bed in which they were found with the bed being assigned an equivalent Unit, Tamiami Formation designation. Subsequent excavation removed each bed but uncovered the next lower bed where the process was repeated. The lithology of the beds was undifferentiated throughout, representing intertidal mud flats, with changes in the molluscan fauna inferring a change in position within the formation. As such, the equivalent units are based on biostratigraphy, not lithology.

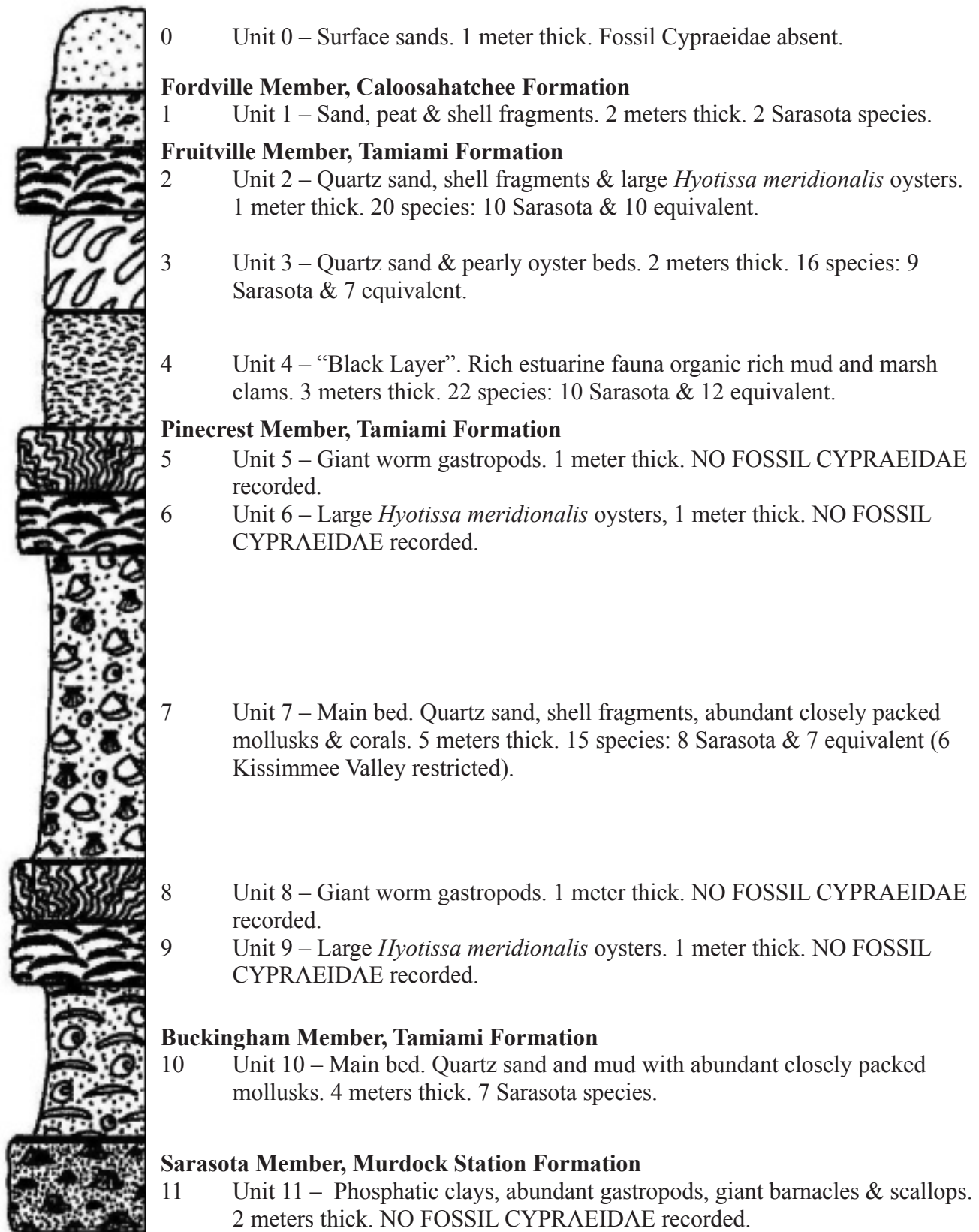


Figure 6: APAC Pit Stratigraphic Column.

Adapted from Petuch & Roberts, 2007, Figure 4.3, p. 73.

(Petuch, pers. comm., 2020). Unit 7 through 4 equivalent described species found in spoil piles at Rucks or elsewhere retain the assigned Unit equivalent designation.

Above these beds, specimens were collected from spoil piles along the edge of the road leading to the floor below. Unit assignments of specimens collected from there were made on the basis of perceived morphological developments over equivalent time. As such, these assignments are considered provisional. [P]

Golden Gate Member Equivalents. In 1987, Meeder, in an unpublished doctoral dissertation, mapped the wide, zoned coral reef complexes, lithology and faunal composition of Collier and Lee Counties. This was a more complete survey of the same subject published in 1980. In 1984, Swayze and Miller in a separate survey encompassing parts of Dade and Palm Beach Counties described limestone strata which extended from Dade County into northern Palm Beach County, forming what would have been a continuous reef system. In 1985, Petuch was notified that fossil corals and mollusks were being discovered at a housing development west of Miami on Bird Road (Lakes of the Meadows). These fossils, especially corals, were similar to those found by Meeder in Collier County. In 1986, Petuch published this data, incorporating both Meeder's and Swayze and Miller's findings. In 1992, Missimer resurrected "Golden Gate Reef" from Meeder's unpublished dissertation and gave it member status. Golden Gate refers to the Golden Gate housing development at the old Mule Pen Quarry, Naples, Florida. The name has been shortened to Golden Gate Member and encompasses the coral reefs, reefs tracts and coralline limestones that surround the Everglades basin.

The Golden Gate beds form a continuum from Lower through Uppermost beds without any defining breaks or separation between them. Complicating matters, no fossil Cypraeidae have been collected in situ from the Golden Gate quarries or construction sites. Rather, they have been collected from spoil piles at the collecting sites. The spoil piles do not suggest any specific depositional beds. This was the result of the intertonguing of laterally adjacent (next to each other) similar strata facies. In other words, the carbonate facies intertongue with the subjacent and superjacent carbonate facies of the Golden Gate Members. In addition, as these sediments are close to the surface, their mining tends to intermingle the strata. As a result, fossil species collected exclusively in the Golden Gate quarries are assigned provisional [P] equivalent times as the intertonguing of facies and quarry operations has made definitive assignments problematic.

As a result, the Golden Gate quarries have been assigned three provisional depositional beds. The assignments have been made on the basis of the interpretation of morphological changes, representing the evolution of characteristics over time. At the same time, it is not believed that the quarries uncovered deposits lower than Unit 4 time due to depth limitations. (Petuch, pers. comm., 2020). The assignments correspond in time to the Fruitville Members Unit 4 (Middle), Fruitville Unit 3 (Upper) and Fruitville Unit 2 (Uppermost), in seriatim oldest to youngest. These are time equivalents, not member equivalents. The Golden Gate is a separate Member.

Portions of the Lower (basal) Beds of the Golden Gate were exposed at the Bird Rock housing development west of Miami. The composition of the tropical, hard coral reefal deposits suggest that deposition began in the early middle Piacenzian time, ~ 3.1 Ma, which was contemporaneous with the uppermost Pinecrest Member (Unit 7 equivalent). This represents a fourth and lowermost bed.

Chapter 7

Western Coastal - Buckingham Member (Unit 10)

Species

Akleistostoma (Akleistostoma) carolinensis (Conrad, 1841)

Akleistostoma (Mansfieldicypraea) crocodila (Petuch, 1994)

Akleistostoma (Ingramicypraea) pilsbryi (Ingram, 1939)

Akleistostoma (Gardnericypraea) erici (Petuch, 1998)

Pseudadusta (Bithloa) buckinghamensis Petuch and Drolshagen, 2011

Siphocypraea (Seminolecypraea) micanopy Petuch and Drolshagen, 2011

Calusacypraea (Calusacypraea) duerri (Petuch, 1996)

Myakka Lagoon System. All recorded Buckingham Member fossil Cypraeidae species are from the Myakka Lagoon System, present-day Sarasota area and surrounds.

The Buckingham's best and most defined exposures were in the Sarasota APAC Pit and consisted of quartz/lime sand and mud with closely packed mollusk bioclasts intermixed. The stratum suggest a quartz sand substrate in a quiet, shallow water environment and would have hosted sea grass beds, although the beds were probably not as extensive as in subsequent Members. Bivalves as well as oysters were interspersed within the sea grass beds, among large clumps of barnacles, forming separate infauna beds (fauna that live in the substrate of a soft sea bottom). Recent Turtle Grass beds also support rich faunas of bivalves and gastropods, most of which are restricted to these beds. This suggests that Buckingham Cypraeidae were also dependent upon such beds for their continued survival.

The sea grass beds, along with mud flats, were the most common and widespread habitats for Cypraeidae not associated with the coralline habitats of the later Pliocene. These provided the habitats for the seven species with the neotenic *Calusacypraea* (Petuch, 2004) genus specifically associated with the mangrove mud flats of the Lagoon System. **Note:** Neoteny is defined as the retention in adults of certain juvenile characteristics, either delayed or permanent, which represent an advantage to the species. A genus is considered neotenic when all species within the genus are neotenic. With *Calusacypraea* species, it is a likely a permanent adaptation to the environment of its habitat.

The four meters thick exposures of the Buckingham Member indicate a relatively long-lived depositional period.

The Buckingham extended into the Kissimmee Embayment. However, its sediments have been leached leaving only riverine stones/rocks intermixed with broken mollusk fragments. No Buckingham equivalent fossil Cypraeidae have been recorded from the Kissimmee Embayment.

Plate 5 →

1. *Akleistostoma (Akleistostoma) carolinensis* 60.3 mm
2. *A. (Ingramicypraea) pilsbryi* 34.2 mm
3. *A. (Mansfieldicypraea) crocodila* 66.9 mm
4. *Siphocypraea (Seminolecypraea) micanopy* 46.1 mm
5. *Calusacypraea (Calusacypraea) duerri* 71.0 mm
6. *Pseudadusta (Bithloa) buckinghamensis* 54.8 mm
7. *A. (Gardnericypraea) erici* 75.9 mm



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2



3



4



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6



7

Pinecrest Member (Unit 7) and Golden Gate Equivalent

Species

Myakka

Akleistostoma (Akleistostoma) floridana (Mansfield, 1931)
Akleistostoma (Mansfieldicypraea) rugostoma Petuch and Drolshagen, 2011
Akleistostoma (Gardnericypraea) mansfieldi (Petuch, 1998)
Akleistostoma (Paludacypraea) patula Petuch and Drolshagen, 2011
Pseudadusta (Bithloa) hertweckorum (Petuch, 1991)
Siphocypraea (Seminolecypraea) trippeana (Parodiz, 1988)
Calusacypraea (Calusacypraea) globulina Petuch, 2004
Calusacypraea (Myakkacypraea) briani (Petuch, 1996)

Golden Gate

Akleistostoma (Mansfieldicypraea) miamiensis Petuch and Drolshagen, 2011 [P]
Also reported from the Lavender Road Pit, north of Sarasota.

Interim. Following the disappearance of the seven Buckingham Member (Unit 10) Cypraeidae from the Myakka Lagoon System (Myakka), there was a hiatus in the early Piacenzian Pliocene, from which no Cypraeidae have been recorded. Two thin (one meter thick each) depositional units overlay the quartz sand and mud of Unit 10, suggesting short depositional periods. Unit 9 represented a dramatic change with oyster shell beds (*Hyotissa meridionalis* Heilprin, 1886) dominating. They formed in subtidal surface areas in quiet lagoon areas and were so tightly packed that only small amounts of sand were present among these beds. Unit 8, overlaying Unit 9, also represented a further dramatic change with gastropod worm reefs (*Vermicularia recta* Olsson & Harbison, 1953) overlaying the oyster beds. The large size of the worms and their solid beds suggests a significant high riverine input into the lagoon in support.

Such conditions suggest that the climax of the late Zanclean Age cooling period extended into the earliest Piacenzian causing reduced sea levels. This would have reduced the sea grass beds and mud flats, which so dominated Unit 10, such that no Cypraeidae have been recorded in either the Unit 9 or Unit 8 strata. This does not mean that there were no Cypraeidae populations extant during these periods. The presence of small, isolated populations may be inferred by the emergence of new species in Unit 7 of the Pinecrest. These would have existed outside the recent quarries and collection sites in those areas.

Myakka Lagoon System. The interim was followed by warm and tropical conditions. The sea grass beds and mud flats, which were virtually identical to the Buckingham, were the preferred habitats of the Cypraeidae, which returned in force. The resulting five-meter-thick depositional stratum, designated Pinecrest Member (Unit 7), suggests a long period of uninterrupted deposition.

The shallow water, low salinity mud flats associated with river mouths supported the emergence of two new estuarine species in the neotenic *Calusacypraea* genus and its subgenus, a likely adaptation to the environment. Separately, *Akleistostoma (Paludacypraea) patula* Petuch and Drolshagen, 2011 is also associated with mud flats near mangrove forests and is the oldest in its subgenus (previously, in the *Akleistostoma* genus). Small, intertidal sea grass beds would have served as perfect habitats for emergent weed eating Cypraeidae species. Fossil specimens collected at the Sarasota quarries and the Lavender Road Pit, north of Sarasota, exhibit varied matrix coloration which suggests an overlap in the sea grass and mud flat habitats of the species.

Golden Gate Member Reef Tracts. Portions of the Lower (basal) Beds of the Golden Gate were exposed at both the Bird Rock development west of Miami and in Collier County on the west coast. These showed that the tropical, hard coral reefal deposition began in the early middle Piacenzian time, ~ 3.1 Ma, and was contemporaneous with the uppermost Pinecrest Member. The Bird Rock site contained many classic Pinecrest fossils, e.g., *Hystriyasum olsoni* (Hollister, 1971) from Kissimmee Pinecrest facies, but only one Cypraeidae species, *Akleistostoma (Mansfieldicypraea) miamiensis* Petuch and Drolshagen, 2011. This was the first Cypraeidae species associated with coralline environments in the Golden Gate. It was attributed to the Lower coral beds (Uppermost Pinecrest equivalent Time) based on shell characteristics which suggest an affinity with *A. (Akleistostoma) carolinensis* and *A. (Gardnericypraea) erici* species. However, the attribution is provisional [P] as all specimens were collected from spoil piles at the site. The species was also collected at the Lavender Road Pit, north of Myakka, suggesting the presence of coral bioherm habitats outside of the coral reef tracts.

Plate 6 →

1. *Siphocypraea* (*Seminolecypraea*) *trippeana* 50.7 mm
2. *Pseudadusta* (*Bithloa*) *hertweckorum* 58.6 mm
3. *Akleistostoma* (*Mansfieldicypraea*) *miamiensis* 63.6 mm
4. *A.* (*Gardnericypraea*) *mansfieldi* 67.3 mm
5. *Calusacypraea* (*Calusacypraea*) *globulina* 70.3 mm
6. *C.* (*Myakkacypraea*) *briani* 73.6 mm
7. *A.* (*Akleistostoma*) *floridana* 73.8 mm
8. *A.* (*Paludacypraea*) *patula* 79.6 mm
9. *A.* (*Mansfieldicypraea*) *rugostoma* 80.7 mm



1



2



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4



5



6



7



8



9

Fruitville Member (Unit 4) and Golden Gate Equivalent

Species

Myakka

Akleistostoma (Akleistostoma) olssoni Petuch and Drolshagen, 2011
Akleistostoma (Mansfieldicypraea) macbrideae (Petuch, 1998)
Akleistostoma (Paludacypraea) cookei Petuch and Drolshagen, 2011
Akleistostoma (Paludacypraea) fruitvillensis Petuch and Drolshagen, 2011
Akleistostoma (Paludacypraea) williamdalli Petuch and Drolshagen, 2011
Akleistostoma (Gardnericypraea) jenniferae (Petuch, 1998)
Pseudadusta (Carlosocypraea) metae (Petuch, 1994) (G)
Siphocypraea (Seminolecypraea) grovesi (Petuch, 1998) (G)
Siphocypraea (Lokossea) dimasi (Petuch, 1998) (G)
Calusacypraea (Calusacypraea) tequesta (Petuch, 1996)
Calusacypraea (Myakkacypraea) myakka Petuch, 2004

Golden Gate (Middle Coral Beds) (Immokalee Reef Tract)

Pseudadusta (Pseudadusta) lindae (Petuch, 1986)
Pseudadusta (Seminolecypraea) grovesi (Petuch, 1998)
Pseudadusta (Bithloa) irisae Petuch and Drolshagen, 2011
Siphocypraea (Lokossea) dimasi (Petuch, 1998)

G = also reported from the Golden Gate

Interim. The disappearance of all Pinecrest and equivalent Cypraeidae species from most of their habitats was caused by the ~ 200,000-year cooling period in the mid Piacenzian Pliocene, ~ 3.2-3.0 Ma, and the associated significantly lower sea levels and dry terrestrial conditions in southern Florida. This is reflected in Units 6 and 5 which mirrored Unit 9 and 8 conditions in the Myakka Lagoon System. In both Myakka and Kissimmee this greatly constricted the sea grass and mud flat Cypraeidae habitats, resulting in the disappearance of all Pinecrest species. The cooling period was followed by a warming period which resulted in the Tamiami Subsea being flooded to its maximum size and produced wide-spread tropical conditions throughout southern Florida, roughly similar to today's southwest Pacific.

Myakka Lagoon System. The prior Pliocene Cypraeidae habitats (Unit 10 and Unit 7 time) were largely confined to sea grass beds with a small number of specimens exhibiting some black/blue staining characteristic of muddy, brackish habitats. However, by Fruitville Unit 4 time, Myakka was flooded, producing what became the largest and best developed mangrove forests of the Tamiami Subsea. The mangrove forests formed a niche habitat along the coast line of the estuarine Myakka. These probably resembled similar forests in New Guinea and, along with associated intertidal mud flats and tidal channels, contained the richest estuarine molluscan fauna of the American Pliocene. The Fruitville basal Unit 4 is thickest and best developed at Myakka.

In the muddy peat layers at Sarasota, the most iconic of the Unit 4 Myakka habitats, darkly stained tannins leached from decaying vegetation in an oxygen poor, sulfuric environment. Small iron pyrite crystals (aka fool's gold) are often found attached to molluscan fossils and quartz sand grains. This is associated with brackish, swamp-like muddy estuaries and coastal marshlands and produced many black, blue and/or tan stained fossil Cypraeidae specimens. Thus, the "Black Layer" designation. Fossil specimens recorded from such areas commonly exhibit such staining. For species inhabiting such habitats, Petuch proposed the subgenus *Akleistostoma (Paludacypraea)* Petuch and Drolshagen, 2011. Three Unit 4 species are assigned to the subgenera.

Separately, intertidal mud banks, adjacent to and encroaching on the mangrove jungles, provided the habitat for *Calusacypraea*.

In slightly deeper water (1-3 m), mud bottoms and tidal channels hosted extensive beds of the small mactrid bivalve (estuarine associated) *Mulinia sapotilla* Dall, 1898. These were interspersed with sea grass beds in open areas along the edges of the banks and channels. These beds were inhabited by other Cypraeidae species, such as *Pseudadusta (Carlosocypraea) metae* (Petuch, 1994). Generally, these are not stained black/blue. However, some specimens occasionally exhibit such staining or tan/brown staining, suggesting they lived in close enough proximity to sometimes encroach on the Black Layer habitat.

Cypraeidae populations which had been isolated in Myakka in the Pinecrest saw cracks in this isolation. Several Unit 4 species have been reported from both Myakka and the Golden Gate of the Everglades Pseudoatoll in Lee and Collier Counties. This suggests that the highest sea levels of the period enabled migration to coral back reef environments which provided suitable habitats for the migrants.

Golden Gate Reef Tracts. The areal distribution of the Golden Gate Member follows the shape of the reef tracts of the Everglades Pseudoatoll. In the west, member thickness varies from 15 m to 5 m in Collier County. The member is 5 m below the surface at the Old Mule Pen Quarry. In the east, the thickness is over 50 m under the Atlantic Coastal Ridge. The facies consist of interspersed (interbedded) highly fossiliferous limestones, including mostly unconsolidated layers of carbonate grains (dolomite silts) and cemented corals (calclutites), highly porous, vuggy limestone molds, and limestone containing densely packed fossil corals and molluscs intermixed. Small amounts of quartz sand are present in some of the facies.

Of note, sand flats covered with sea grass, as well as mangrove forests, also interfingered with the reefs and reef tracts in the pseudoatoll providing substantially the same habitats as the Myakka Lagoon System and the Kissimmee River Valley to the north.

The Golden Gate reached its maximum development in the mid to late Piacenzian, i.e., Fruitville Time. While there is no clear delineation of the beds above the base, the recording of *Siphocypraea (Seminolecypraea) grovesi* Petuch, 1998 in both Fruitville Member Unit 4 at the Quality Aggregates Pit in Sarasota and the Old Mule Pen Quarry, Naples, Florida, allows a Middle Beds assignment of the fossil Cypraeidae recorded within similar strata. Other Index Fossils recorded in Unit 4 at Sarasota and the Golden Gate include *Strombus sarasotaensis* Petuch, 1994 and *Hystriwasum lindae* Petuch, 1994.

Plate 7 →

1. *Akleistostoma* (*Gardnericypraea jenniferae*) 63.6 mm
2. *A.* (*Akleistostoma*) *olssoni* 64.6 mm
3. *Siphocypraea* (*Seminolecypraea*) *grovesi* 67.1 mm
4. *A.* (*Paludacypraea*) *williamdalli* 67.3 mm
5. *Pseudadusta* (*Bithloa*) *irisae* 68.2 mm
6. *A.* (*Paludacypraea*) *cookei* 68.6 mm
7. *A.* (*Mansfieldicypraea*) *macbrideae* 70.8 mm
8. *Calusacypraea* (*Calusacypraea*) *tequesta* 72.3 mm
9. *P.* (*Pseudadusta*) *lindae* 46.8 mm
10. *S.* (*Lokossea*) *dimasi* 53.5 mm
11. *C.* (*Myakkacypraea*) *myakka* 55.0 mm
12. *A.* (*Paludacypraea*) *fruitvillensis* 61.4 mm
13. *P.* (*Carloscypraea*) *metae* 62.8 mm



1



2



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4



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8



9



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11



12



13

Fruitville Member (Unit 3) and Golden Gate Equivalent

Species

Myakka

Akleistostoma (Akleistostoma) rilkoii (Petuch, 1998)
Akleistostoma (Mansfieldicypraea) juliagardnerae Petuch and Drolshagen, 2011
Akleistostoma (Gardnericypraea) buchecki (Petuch and Drolshagen, 2011)
Akleistostoma (Paludacypraea) walleri Petuch, Berschauer & Myers, 2018
Pseudadusta (Pseudadusta) ketteri (Petuch, 1994) (**G**)
Pseudadusta (Bithloa) kalafuti (Petuch, 1994)
Siphocypraea (Aestuariumcypraea) parodizi (Petuch, 1994)
Siphocypraea (Aestuariumcypraea) cannoni (Petuch, 1994)
Calusacypraea (Calusacypraea) sarasotaensis (Petuch, 1994)
Calusacypraea (Myakkacypraea) kelleyi (Petuch, 1998)

Golden Gate (Upper Coral Beds) (Immokalee Reef Tract)

Pseudadusta (Pseudadusta) collierensis Petuch and Drolshagen, 2011
Pseudadusta (Pseudadusta) fehsei Petuch and Drolshagen, 2011
Pseudadusta (Carloscypraea) ketteri (Petuch, 1994)
Siphocypraea (Lokossea) daughenbaughii Berschauer and Waller, 2020
Siphocypraea (Lokossea) rucksorum Petuch, 2004 (**K**)

G = also reported from the Golden Gate (K) = also reported from the Kissimmee River Valley

Transition. The transition from the highest sea levels of the Tamiami subsea, which was the hallmark of Unit 4 time, to Unit 3 time at Myakka and Kissimmee was marked by falling sea levels, resulting in reduced and altered molluscan habitats. Tropical conditions still persisted, but were less intense. At this time, all Unit 4 Cypraeidae species were replaced by new species in a sequential evolution as the populations adapted to the altered habitats during the subsequent Unit 3 time.

Unit 3, along with Unit 4, marked the highpoint of Cypraeidae diversity in the late Piacenzian Pliocene. The decline in diversity would not be precipitous, and included a significant interim reprieve during Unit 2 time. For the Cypraeidae genera this meant either adaptation or extinction.

Myakka. In the western Myakka estuary and lagoon system and surrounds, the receding sea levels reduced, but did not eliminate the mangrove forests, leaving significant remnants in the most seaward sections. However, the “Black Layer” which characterized Unit 4 was not dominant in Unit 3. The last of the *Akleistostoma (Paludacypraea)* Petuch and Drolshagen, 2011 species, i.e., *A. (P.) walleri*, was confined to this layer. Specimens exhibit the black/blue or tan staining associated with brackish, swamp like muddy estuaries. Other species inhabited the interspersed estuarine mud flats which also served as a shared habitat with the remnant Black Layer and intertidal shoals.

The adjacent seaward waters consisted of large quartz sand intertidal shoals which dominated the Cypraeidae habitats. These shoals hosted extensive beds of the pearly mussel *Perna conradiana* (d'Orbigny, 1852) which formed low, unlayered, massive reef like mounds, half buried in the substrate. Patches of sea grass were scattered between the mussel beds and hosted many of the Unit 3 Cypraeidae. These patches were associated with *C. (C.) sarasotaensis* and *C. (M.) kelleyi* and they also hosted *A. (A.) rilkoii*, *P. (B.) kalafuti* and *P. (C.) ketteri*. The Unit 3 estuarine patches also hosted two *Siphocypraea* (Heilprin, 1886) species, i.e., *S. (A.) cannoni* and *S. (A.) parodizi*.

Myakka Cypraeidae populations remained largely isolated in Unit 3 time. However, *P. (C.) ketteri* has been recorded in both Myakka and the Golden Gate of the Everglades Pseudoatoll in Lee and Collier Counties.

Golden Gate. The recording of *P. (C.) ketteri* in both Fruitville Member 3 at the APAC Pit in Sarasota and in the quarries at both Bonita Springs and Naples allows an Upper Beds assignment of the fossil Cypraeidae recorded within close proximity in the Golden Gate. Other Index Fossils recorded in Unit 3 at Sarasota and the Golden Gate include *Chicoreus miccosukee* Petuch, 1991 and *Pterorhytis squamulosa* Petuch, 1994.

Plate 8 →

1. *Siphocypraea* (*Lokossea*) *daughenbaughi* 63.2 mm
2. *Calusacypraea* (*Myakkacypraea*) *kelleyi* 45.3 mm
3. *Pseudadusta* (*Pseudadusta*) *collierensis* 40.3 mm
4. *P.* (*Pseudadusta*) *ketteri* 50.1 mm
5. *C.* (*Calusacypraea*) *sarasotoensis* 44.4 mm
6. *P.* (*Pseudadusta*) *fehsei* 63.2 mm
7. *Akleistostoma* (*Paludacypraea*) *walleri* 67.5 mm
8. *S.* (*Aestuariumcypraea*) *cannoni* 74.5 mm
9. *A.* (*Mansfieldicypraea*) *juliagardnerae* 74.3 mm
10. *P.* (*Bithloa*) *kalafuti* 71.7 mm
11. *A.* (*Akleistostoma*) *rilkoi* 66.8 mm
12. *A.* (*Gardnericypraea*) *buckhecki* 65.9 mm
13. *S.* (*Aestuariumcypraea*) *parodizi* 67.9 mm



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13

Fruitville Member (Unit 2) and Golden Gate Equivalent

Species

Myakka

Akleistostoma (Akleistostoma) adrianae Petuch and Drolshagen, 2011
Akleistostoma (Mansfieldicypraea) ivyi Petuch and Drolshagen, 2011
Pseudadusta (Carlosocypraea) marilynae (Petuch, 1994)
Pseudadusta (Carlosocypraea) yingsti Petuch and Drolshagen, 2011
Pseudadusta (Bithloa) juyingae Petuch and Drolshagen, 2011
Pseudadusta (Bithloa) gumbinneri Petuch and Drolshagen, 2011
Siphocypraea (Seminolecypraea) alligator (Petuch, 1994)
Siphocypraea (Aestuariumcypraea) janowskyi (Petuch and Drolshagen, 2011)
Calusacypraea (Calusacypraea) loxa Petuch and Drolshagen, 2011
Calusacypraea (Myakkacypraea) schnireli Petuch, 2004

Golden Gate (Immokalee Reef Tract)

Siphocypraea (Lokossea) mulepenensis (Petuch, 1991)

Transition. The transition from Unit 3 to Unit 2 time was marked by a continuation of falling sea levels, to levels below Unit 3 time, as temperatures again fell. Lower sea levels and temperatures resulted in altered molluscan habitats producing new species in a sequential evolutionary radiation as the populations adapted to the altered habitats. Unit 2 marks the end of the Tamiami Formation and the last Cypraeidae radiation of the late Piacenzian Pliocene. For the Cypraeidae genera this meant either adaptation or extinction.

Myakka. In the western Myakka estuary and surrounds, the mangrove forests were reduced to the extent that they were no longer a viable habitat for most molluscan populations. The iconic Unit 3 pearly mussel *Perna conradiana* (d'Orbigny, 1852) beds which formed in the large quartz sand intertidal shoals were overlain by beds of *Chama gardnerae* Olsson and Harbison, 1953 (cemented saltwater clams). As with the *P. conradiana* beds, patches of sea grass were scattered between the *Chama* beds and hosted many of the Unit 2 Cypraeidae. The mud flats remained a viable Cypraeidae habitat and adjoined the sea grass patches.

Sea grass patches survived and were associated with *S. (S.) alligator* and *C. (M.) schnireli* as their preferred habitat. They also hosted *P. (C.) marilynae*.

Myakka Cypraeidae populations remained isolated in Unit 2 time.

Golden Gate. The degradation of the coral reefs in the Immokalee Reef Tract, specifically those in Lee and Collier Counties, began in Unit 2 time and continued into the succeeding Fordville Member, Caloosahatchee Formation. The degradation process resulted in the depositional environment staying constant throughout. As a result, Unit 2 and Fordville Immokalee Reef Tract sediments in the present day appear the same. This was the result of the intertonguing of these two laterally adjacent (next to each other) strata facies. In other words, the carbonate facies of the Fordville-aged reefs intertongue with the subjacent carbonate facies of the upper Immokalee Reef Tract (Unit 2) of the Golden Gate Member. As these sediments are close to the surface, their mining tends to intermingle the two strata. As a result, the present placement of the of the Golden Gate Cypraeidae species into either Unit 2 or the Fordville Member reef sediments should be considered provisional.

Two Stage Extinction Event

The end of Unit 2 signaled the commencement of a two-stage sequential extinction event (Petuch, 1995). This first stage was a wounding event caused by the abrupt cooling of sea waters and the accompanying drop of water levels. Cooling temperatures and lower sea levels reached their nadir at the end of Unit 2 time, ~ 2.65 Ma. This event was characterized by the degradation of the extensive coral reef tracts which outlined the Everglades Pseudoatoll as well as the reduction of a great number of sea grass beds, mud flats and mangrove forests. By the end of Unit 2 time, the marine environments of southern Florida had become landlocked with the center of the Everglades Pseudoatoll becoming a landlocked salt water lake surrounded by degrading reef tracts.

Extinction

At this time, the *Akleistostoma*, *Pseudadusta*, *Calusacypraea*, *Pahayokea* and *Yeehawcypraea* genera became extinct while the *Siphocypraea Lokossea* subgenus did survive this wounding event in the estuarine environments of southern Florida and carry on. Additionally, the *Siphocypraea* genus along with three new *Siphocypraea* subgenera did emerge, rebound within the *Siphocypraea* genus and subgenera and radiate in southern Florida, all during the early Gelasian Pleistocene, a period of modest warming.

However, ecological habitats and populations were not fully restored before a second extinction occurred. Coupled with the wounding event, this second extinction event resulted in the mass extinction of all remaining Cypraeidae genera. This occurred toward the end of the Gelasian Age, Early Pleistocene, ~ 1.8 Ma, with the return of cooling waters and dropping sea levels. (Petuch, 1995 and 2004).

Plate 9 →

1. *Calusacypraea* (*Myakkacypraea*) *schnireli* 38.0 mm
2. *Pseudadusta* (*Carloscypraea*) *marilynae* 40.3 mm
3. *P.* (*Bithloa*) *juyingae* 45.0 mm
4. *C.* (*Calusacypraea*) *loxa* 46.2 mm
5. *P.* (*Carloscypraea*) *yingsti* 48.1 mm
6. *Siphocypraea* (*Lokossea*) *mulepenensis* 66.7 mm
7. *Akleistostoma* (*Mansfieldicypraea*) *ivy* 77.2 mm
8. *S.* (*Lokossea*) *rucksorum* 66.8 mm
9. *P.* (*Bithloa*) *gumbinneri* 50.5 mm
10. *A.* (*Akleistostoma*) *adrianae* 57.3 mm
11. *S.* (*Aestuariumcypraea*) *janowskyi* 59.5 mm
12. *S.* (*Seminolecypraea*) *alligator* 62.3 mm



Tamiami Formation Taxa & Iconography

NOTE OF CAUTION

Included in the taxa herein are all presently described species known to the authors. Each species has been assigned by its author to a specific geologic stratigraphic unit, identified as a member or a unit within a member. The stratigraphic unit is determined in a number of ways, represented by three geologic systems for naming stratigraphic units:

Lithostratigraphic: defined by the composition of the sediments and rocks.
Geochronologic: defined by geologic time.
Chronostratigraphic: defined by the time of deposition (time-rock)

For a thorough discussion of the geology and paleontology of southern Florida see *Ancient Seas of Southern Florida*, CRC Press, Petuch and Berschauer, 2021.

Species found *in situ* within a known stratum are considered the most reliably assigned. Such species may be identified as Index Fossils. Index Fossils are commonly, but not necessarily, bivalves. Species found in spoil piles of similar composition in known pits may be assigned based upon known and described Fossils of a specific stratum. If Index Fossils are not available in such spoil piles, a species may be collected and described by researchers and assigned to a stratum on the basis of perceived morphological developments over equivalent time. Such an assignment is considered provisional [P] pending further information and study. Specimens from other locations with taxonomic characteristics which align with known taxa can be assigned to the specific taxa and its stratum.

However, many specimens have been collected from spoil piles of mixed strata at various pits. As such, it is not possible to determine and assign a specific stratum. While many specimens collected at such sites may align with the morphological characteristics of described taxa and may be accepted as such, many other specimens may have taxonomic characteristics which suggest described species, but whose characteristics may be imperfectly aligned. Therefore, it cannot be determined whether the latter represent an unusual variation of a known species or an undescribed species. This is particularly challenging with the western coastal *Akleistostoma* genus and subgenera species. If the taxonomic characteristics are imperfectly aligned, an assignment cannot and should not be made as the geologic stratum of the specimen is unknown. Described species are not known to overlap strata. It is possible, if not probable, that the specimens would be improperly assigned. (see **NOTE** below).

There are still an indeterminate number of species which remain undescribed due to a lack of specimens and/or precise collection data. Given the paltry number of known areal excavations with defined strata in southern Florida, this is not surprising. The lack of precise data is problematic for many specimens.

NOTE: Some such specimens are often designated “*cf.*” in taxonomy which is the Latin abbreviation for “compare”. The term can mean either compare or like/similar to. In either case, the specimen cannot be assigned to the species to which it is being compared or to which it is similar. Herein, such specimens are excluded as their taxonomic treatment is beyond the scope of this work.

TAXONOMIC ORGANIZATION

Akleistostoma (Akleistostoma) floridana (Mansfield, 1931)

1931. *Cypraea carolinensis floridana* Mansfield

1994. *Siphocypraea floridana* Petuch

1997. *Siphocypraea (Akleistostoma) floridana* Petuch

2011. *Akleistostoma floridana* Petuch and Drolshagen

2022. *Akleistostoma (Akleistostoma) floridana* Daughenbaugh and Bridges

HOLOTYPE: United States National Museum, U.S.N.M. No. 371333

TYPE Locality: Tamiami Trail, 42 miles west of Miami, FL.

Pinecrest Member (Unit 7)

Organization is by section with each section representing a genus, followed by the subgenera within the genus. Individual species assigned to the respective genus/subgenus are entered on a top line as above. The top line represents the name of the species as accepted herein. If there have been reassignments of the species' genus/subgenus, they are listed immediately below from oldest to most recent. In the example, reassignments took place from 1994 to 2022. NOTE: Only reassignments are listed. Intervening affirmations or reaffirmations are not listed.

Holotype denotes the location of the holotype and its reference/collection number. Type Locality denotes the location the Type specimen was recorded. Individual entries are from oldest to youngest, represented by the stratigraphic unit or its equivalent. In the example, the stratigraphic unit is Pinecrest Member (Unit 7).

Taxonomic Characteristics

Most Cypraeidae species from the Pliocene and Pleistocene were described based upon the holotype alone or, in some cases, two similar specimens.

Rather than repeating the descriptions of individual species, we have attempted to outline the major defining characteristics of each species as well as the variations of these characteristics. The characteristics have been adapted from the original descriptions, modified and outlined based upon a standard set of characteristics for each species to better enable comparisons.

Size range:

Shape:

Base:

Margins:

Auricles:

Columella:

Fossula:

Apical sulcus:

Aperture:

Columellar teeth:

Number:

Labral lip; teeth:

Number:

Where individual species possess similar characteristic(s), comparisons are made to assist in separating the species. This is important as many specimens either lack specific collection data or were collected from spoil piles at quarries, construction sites or canal digs.

Size Range: Based on published sources, mainly from Petuch, and personal observation from specimens in the first author's collection.

Shape: The shape of the shell, viewed dorsally (modifiers may be added):

- Oval: rounded, slightly elongated (egg shaped); syn. ovoid
- Ovate: egg shaped; posterior section broader
- Bulliform: globose, thin, bulging
- Cylindrical: straight, parallel sides
- Globose: spherical
- Pyriform: pear shaped
- Rectangular

Apical sulcus: [Latin: apex groove] Morphological characteristic which encompasses the posterior extremity of the shell on three sides (labral and columellar flanges, connected dorsally). The flanges are lateral extensions of the labial and columellar sides of the body whorl. In many genera/subgenera, the characteristic is a more complex version of the posterior canal of many extant Cypraeidae.

VARIATIONS:

- Both flanges: simple, parallel, "slot-like", pinched
- Labral flange: curved or coiled; compressed or projecting
- Columellar flange: straight or partially/fully covering the labral flange
- Apical center: smooth; apical tip in center on neotenic species

Aperture: Longitudinal basal opening running from the posterior to the anterior, lined with denticles on the columellar and labral edges of the aperture.

Arcuate: Anterior end of the aperture: **bow-like curve**.

Base: The underside of the shell which is described as:

- Round or slightly rounded
- Flattened or slightly flattened
- Flat

Margins: Upward marginal extensions of the base. If the base is rounded, the margins will tend to be rounded. If the base is slightly rounded, slightly flattened or flat, the margins will be angled to varying degrees, i.e., subangular to angular. The margins may be bent up midsection in some specimens. The maturity of the individual specimen will influence the degree of angularity with more mature specimens producing more angled margins in some specimens.

Auricles: The anterior extremity, tips of the shell. They are described as:

- Poorly produced: thin, lacking callosity
- Produced: thicker callosity
- Blunt: truncated, not projecting
- Projecting: beyond body whorl
- Flanged: the marginal tips form flat flanges of varying size and length

Columella: Exterior of a spiral, longitudinal ridge, within and on the columellar side of the aperture, running from the posterior end to the anterior end. The columella may be smooth, ribbed along the top of the columella or ribbed. A fossula may or may not be present at the anterior end.

Columellar Side: Right side when viewed dorsally, left side when viewed ventrally.

Columellar teeth: Denticles running along the columellar side of the aperture. Some may extend into the aperture and onto/over the columella while some may extend onto the base. The length of the teeth will depend upon the maturity of the specimen. The dentition may be thin, thick rounded, flattened or poorly produced. **Note:** The number of columellar teeth can vary significantly. (I)

Labral side: Left side when viewed dorsally, right side when viewed ventrally.

Labral teeth: Denticles running along the labral side of the aperture. The dentition may be small, large, pointed or rounded. The teeth may extend onto or over the labral side of the base, producing crenulations. The crenulations may be covered in callosity in older specimens. (I)

Fossula: **“Due to a lack of colour pattern in most [fossil] shells, ... The characterization of a species or genus has to be derived solely from the structural features of the fossil. ... One of the most important structural features considered when attempting to assign cowries to genera and species is the fossula, because it is nearly always preserved due to its protected position inside the shell.”** (Lorenz, 2017, Vol. 1).

A fossula is a depressed area within the anterior, interior end of the aperture representing a continuation of the columella. The fossula may be steep or curved, smooth or ribbed, indistinct or distinct with a distinct shape among the most common characteristics. (II)

- **Absent fossula:** The fossular area is smooth throughout without a discernable depression.
- **Indistinct fossula:** A shallow depression in the fossular area without a discerning or defined shape.
- **Distinct fossula:** A distinct depression in the fossular area without a discerning or defined shape.
- **Scalene fossula:** A distinct depression in the fossular area with a scalene triangular shape, i.e., there are no equal sides or angles.
- **Pseudofossula:** In some specimens within a species, the columella may fold onto itself creating a shelf-like projection in the anterior portion of the columella that gives the appearance of a fossula. This is called a Pseudofossula, but it is not a fossula.

As differing genera/species may have similar fossula, the characteristic of the columella, along with other structural characteristics, should also be considered in conjunction with the fossula to determine the proper genera/species.

(I) More mature and less eroded specimens will possess more defined dentition, particularly the length of the teeth and their possible extension onto the columella or onto the base. These may be obscured in the most callused specimens or eroded specimens.

(II) In species which possess a fossula, the degree of maturity and/or erosion of the specimen will impact how distinct (defined) the fossula. Subadult specimens may not have developed a fossula while young specimens may possess an indistinct (ill-defined) fossula. Some fully mature specimens may still possess an indistinct fossula.

Chapter 8

Western Coastal Genera

Separated geographically from the Kissimmee River Valley by the Polk Peninsula, Western Coastal Genera developed along parallel lines during the Piacenzian Pliocene.

Akleistostoma Gardner, 1948

Cypraea carolinensis

Original Description (Conrad, 1841): *Cypraea carolinensis*. Plate II, figure 6. Ovate, ventricose, superior margin of the labrum prominent at the apex; base plano-convex. Conrad's description of *C. carolinensis* was, by today's standards, unacceptably terse.

NOTE: Page 80 illustrates the base of the holotype (immature specimen) while Plate 10, figure 1 illustrates a more mature specimen with 15 columellar and 19 labral teeth. The aperture is wide, expanding at the anterior end and arcuate. The columellar profile shows the anterior auricles slightly flanged, extending slightly beyond the end of the anterior canal.

Cypraeorbis Description

In 1948, Gardner revised and expanded Conrad's 1865 description of *Cypraeorbis*. Her description was based on the Type by monotypy, *Cypraeorbis sphaeroides* (Conrad, 1848) from the Oligocene of Vicksburg, Mississippi. Included in the revision: "Aperture narrow, the margins subparallel and following the curvature of the body dorsally. Fossula shallow, distinct". [emphasis added].

Cypraeorbis (*Akleistostoma*) Description

She simultaneously introduced *Akleistostoma* as a section of *Cypraeorbis* with *Cypraea carolinensis* Conrad, 1841 as the Type and only species introduced in the section. Today, section is not recognized as valid. The genus was described as: "Shell fairly large for the genus, inflated medially, commonly depressed laterally; the posterior slope shorter and steeper than the anterior. Spire entirely concealed in the adult; indicated by an apical dimple in the immature shells. Apertural face flattened. Aperture fairly wide posteriorly and medially, expanding anteriorly with the slight contraction of both the outer and inner lips. Outer lip coarsely ridged. Ridges on inner apertural face feeble or obsolete posteriorly and medially; about 6 or 8 slightly oblique, irregular rugae [ridges] on the anterior half of the shell; not extending within the aperture. Fossula obscure [indistinct], shallow, smooth. [emphasis added]. Margin of inner lip pinched into a sharp fold; both outer and inner lips sharp and compressed anteriorly. Terminal anterior notch deep, inclined toward the left. Posterior terminal notch, oblique; the sides flattened. The section differs from *Cypraeorbis* by the widening of the aperture anteriorly and by the feeble or obsolete wrinkling on the anterior and medial portion of the inner lip." (Gardner, Part 2).

***Cypraea (Cypraeorbis) carolinensis* Description**

Concurrently, Gardner introduced *Cypraea (Cypraeorbis) carolinensis*.

Description (Gardner, 1948): “Shell thick, solid, semiovoid in outline, involute [tightly coiled]. Maximum dorsal inflation a little behind the median line; ventral surface flattened, somewhat thickened at the lateral margins; exterior smooth, polished. Aperture narrow, slightly expanded anteriorly. Outer lip broadly arcuate, very heavy, its inner margin armed with 20 denticles. Inner lip is also heavy, rugosely [roughly] plicate [pleated], somewhat sinuous in outline. Posterior extremities of both labrum and labium thickened, forming the straight solid walls of the posterior emargination. Anterior canal short, with thickened, parallel margins. Anterior notch less profound than the posterior, relatively broader, and inclined toward the columella.

Cypraea carolinensis Conrad strongly suggests both by its outline and surface finish a longitudinal section of an egg shell. The species is very rare in the Yorktown formation and, though widely distributed in the Duplin, is relatively common only at Natural Well, in Duplin, N. C.” (Gardner, Part 2).

NOTE: Plate 29, figures 2, 7. Figure 2 illustrates a dorsal view with the dorsum removed and supports Gardner’s described shape. Figure 7 is a bulla. (Gardner, Part 2).

Reports of *Akleistostoma carolinensis*, a Piacenzian Pliocene species, from the Miocene Choctawhatchee Formation, Jackson Bluff, Leon County are discounted herein. Jackson Bluff was fully emergent subsequent to the Miocene and has remained so ever since.

Akleistostoma carolinensis

Gardner designated *carolinensis* as the **Type** of *Akleistostoma*, and left the latter in the *Cypraeorbis* genus. However, she also designated *Akleistostoma* as a section. Section is not a recognized genus or subgenus. Today, ICZN recognizes “section” as equivalent to “subgenus”.

In 2004, Petuch informally recognized *Akleistostoma* as a full genus with *Akleistostoma carolinensis* as the **Type** without further comment.

Acceptance of the *Akleistostoma* genus is supported by shell characteristics which are clearly differentiated from *Cypraeorbis*, especially the shallow/indistinct to absent fossula. *Cypraeorbis* species were last extant during the Burdigalian Miocene and bear little resemblance to middle-late Pliocene *Akleistostoma* species. The *Akleistostoma* genus is retained herein.

Akleistostoma carolinensis is considered the founder species for the genus and all of its subgenera throughout Southern Florida.

Comparisons

Akleistostoma (Akleistostoma): Oval to cylindrical shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, rounded, subangular, angular; auricles produced, flanged, projecting but short.

- Columellar teeth extending to/onto the columellar ridge, but not onto or only slightly onto the base; columella smooth; fossula steep, smooth, shallow/indistinct to absent.

NOTE: Some of the characteristics of *A. (A.) olssoni* and *A. (A.) rilkoii* do not align with others in the genus. However, while these characteristics do suggest other genera, they are imperfectly aligned. Their retention herein as *Akleistostoma* species is Provisional [P] pending further study. See individual entries.

Akleistostoma (Mansfieldicypraea): Oval to roughly rectangular shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, subangular, angular; auricles well produced, flanged, projecting beyond the body whorl.

- Columellar teeth extending to the columellar ridge and onto the base; columella smooth; fossula steep, smooth, shallow/indistinct to absent.

Akleistostoma (Ingramicypraea): small, rounded, flattened species with wide apertures; apical sulcus simple, shallow, poorly produced, blunt; auricles poorly produced; blunt.

- Columellar teeth extending to the columellar ridge; columella smooth; fossula absent.

Akleistostoma (Gardnericypraea): Oval, oval-elongate to roughly rectangular, highly inflated, rotund, domed shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, rounded, subangular, angular; auricles produced, flanged, pinched.

- Columellar teeth extending to the columellar ridge and onto the base; columella smooth; fossula absent.

Akleistostoma (Paludacypraea): Oval, oval-elongate shell; apical sulcus simple, shallow, poorly produced; aperture widening anteriorly; base rounded, slightly flattened; margins rounded, subangular; auricles blunt, slightly projecting.

- Anterior columellar teeth extend over the columella; columella smoothly undulating; fossula absent. Pseudofossula present in some specimens.

Akleistostoma (Akleistostoma) Tamiami Formation species:

Akleistostoma (Akleistostoma) carolinensis (Conrad, 1841) **TYPE**

Akleistostoma (Akleistostoma) floridana (Mansfield, 1931)

Akleistostoma (Akleistostoma) olssoni Petuch and Drolshagen, 2011 [P]

Akleistostoma (Akleistostoma) rilkoii (Petuch, 1998) [P]

Akleistostoma (Akleistostoma) adrianae Petuch and Drolshagen, 2011

Akleistostoma (Akleistostoma) (Gardner, 1948)

***Akleistostoma (Akleistostoma) carolinensis* (Conrad, 1841) - Florida Records Only**

1841. *Cypraea carolinensis* Conrad

1903. *Cypraea (Umbilia) carolinensis* Cossman

1948. *Cypraea (Cypraeorbis) carolinensis* Gardner

1997. *Siphocypraea (Akleistostoma) carolinensis* Petuch

2004. *Akleistostoma carolinensis* Petuch

2021. *Akleistostoma (Akleistostoma) carolinensis* Petuch and Berschauer

HOLOTYPE: Academy of Natural Sciences of Philadelphia, Cat. no. 18858

TYPE Locality: The Natural Well 2 miles southwest of Magnolia, Duplin County, NC.

Buckingham Member (Unit 10)

See above for the original and expanded descriptions by Conrad and Gardner respectively.

Size range: 40.7–74.3 mm

Shape: Oval, broad

Base: Slightly flattened, flattened

Margins: Callous, subangular, angular

Auricles: Produced, flanged, projecting

Columella: Smooth

Fossula: Steep, smooth, shallow/indistinct to absent

Apical sulcus: Simple, parallel, slot-like

Aperture: Sinuous, open, constricted mid-body, wide anteriorly, arcuate

Columellar teeth: Thick, wide interstices, extending to columellar ridge and slightly onto base, posterior teeth poorly produced or absent

Number: 12-17

Labral lip; teeth: Thin; short, pointed

Number: 18-20

Key Characteristics: [Adapted from Conrad, Gardner and Petuch, Berschauer & Myers, 2018] Oval, broad shell; apical sulcus simple, parallel, slot-like; aperture sinuous, open, constricted mid-body, wide anteriorly, arcuate [bow-like]; columellar teeth thick, poorly developed, interstices wide, extending to the columellar ridge; posterior columellar teeth often missing or weak; the five anterior teeth are stronger; base slightly flattened, flattened; margins callous, subangular, angular; labral lip thin; columella smooth; fossula indistinct to absent.

Comparisons: *A. (Akleistostoma) carolinensis* specimens may resemble *A. (Mansfieldicypraea) crocodila* (Petuch, 1994), also from Unit 10. However, *A. (M.) crocodila* is a more oval, stunted shell, with more numerous, thin, well developed columellar teeth and narrow interstices which extend onto the top of the columella and well onto the base.

Range: The species is most often found in the Quality Aggregates Pits, but has also been collected in the APAC Pit, Sarasota, Sarasota County, Florida. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

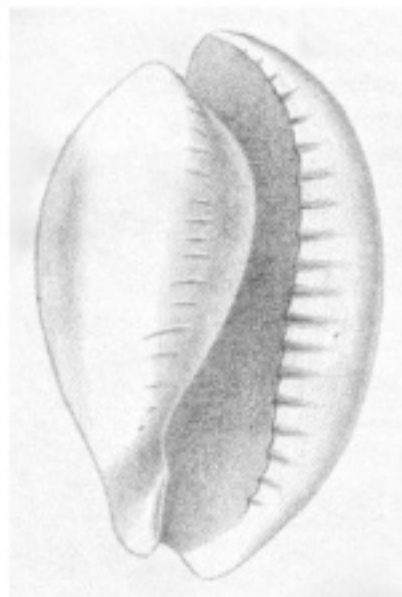


Plate 10 →

Akleistostoma (Akleistostoma) carolinensis (Conrad, 1841).

1. 54.5 mm, Lavender Road Pit, Ruskin

2. 62.4 mm, APAC Pit, Sarasota

3. 60.3 mm, Quality Aggregates Pit, Sarasota

Holotype: Am. Jour. Sci Vol. XLI No. 2, PL. II, 6
Acad. of Nat. Sciences, ANSP 18858



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***Akleistostoma (Akleistostoma) floridana* (Mansfield, 1931)**

1931. *Cypraea carolinensis floridana* Mansfield

1994. *Siphocypraea floridana* Petuch

1997. *Siphocypraea (Akleistostoma) floridana* Petuch

2011. *Akleistostoma floridana* Petuch and Drolshagen

2022. *Akleistostoma (Akleistostoma) floridana* Daughenbaugh and Bridges

HOLOTYPE: United States National Museum, U.S.N.M. No. 371333

TYPE Locality: Tamiami Trail, 42 miles west of Miami, FL.

Pinecrest Member (Unit 7)

Original description: See Appendix B(I)

Size range: 56.8–102.3 mm

Shape: Sub-oval, rounded, elongate

Base: Rounded, slightly flattened

Margins: Rounded, subangular

Auricles: Produced, flanged, slightly projecting

Columella: Smooth

Fossula: Steep, smooth, shallow/indistinct to absent

Apical sulcus: Simple, straight, only slightly recurved

Aperture: Proportionally slender, widening anteriorly, arcuate

Columellar teeth: Distinct anteriorly, weak or missing posteriorly; extending to columellar ridge, but not onto base

Number: 12-17

Labral lip; teeth: Thin, rounded; thick, rounded

Number: 18-24

Key Characteristics: [Adapted from Mansfield and Petuch, Berschauer & Myers, 2018] Sub-oval, rounded, elongate shell; apical sulcus simple, straight, only slightly recurved; aperture proportionally slender, widening anteriorly, arcuate [bow-like]; columellar teeth distinct anteriorly, weak or missing posteriorly on most specimens, extending to the columellar ridge, but not onto base; base rounded, slightly flattened; margins rounded, subangular; auricles produced, flanged, slightly projecting; labral lip rounded; columella smooth; fossula indistinct to absent.

Comparisons: *A. (A.) floridana* can resemble elongate specimens of *A. (Mansfieldicypraea) macbrideae*. However, *A. (M.) macbrideae* is an oval, elongate shell with columellar teeth which extend onto the base and more produced, projecting auricles. It can also resemble some specimens of *A. (Paludacypraea) williamdalli*. However, the latter is more tapered anteriorly and has a narrower aperture.

Range: Hillsborough, Sarasota, Lee and Collier counties. Primarily collected in the APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.



Holotype: USNM No. 371333

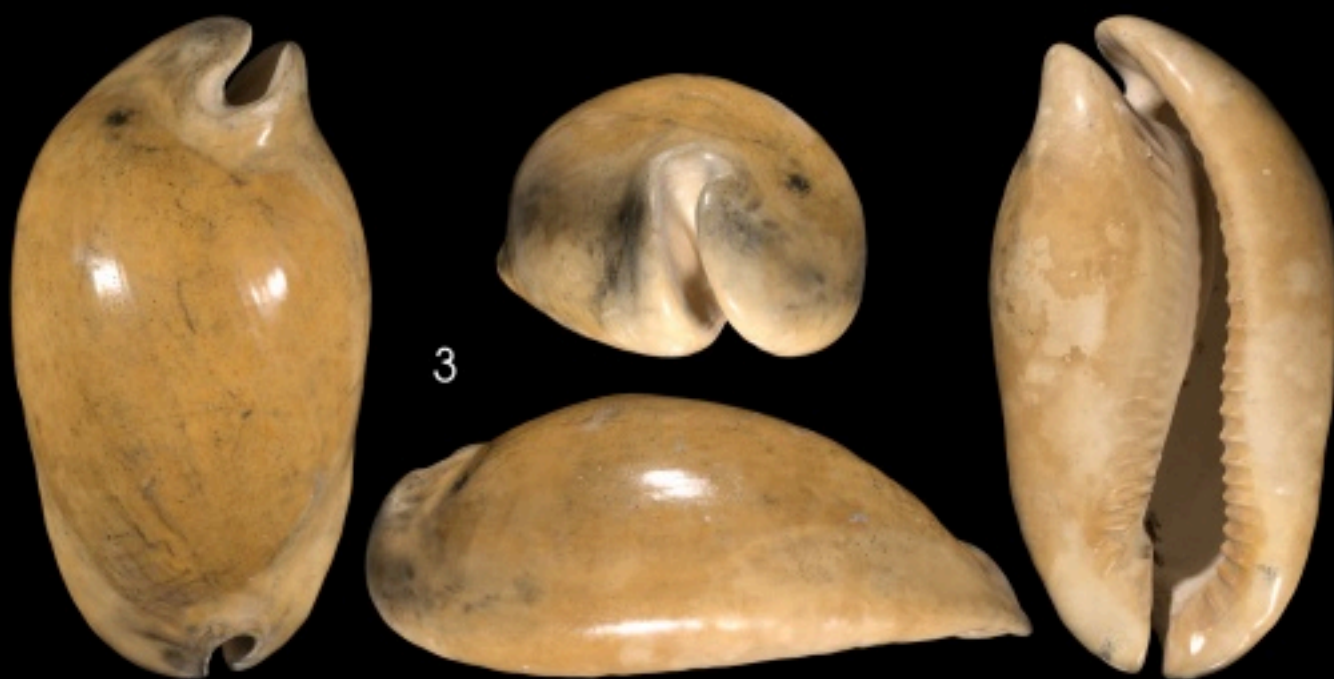
Plate 11 →

Akleistostoma (Akleistostoma) floridana (Mansfield, 1931).

1. 66.5 mm, Lavender Road Pit, Ruskin

2. 73.8 mm, Lavender Road Pit, Ruskin

3. 92.7 mm, APAC Pit, Sarasota (Gerontic Specimen)



***Akleistostoma (Akleistostoma) olssoni* (Petuch and Drolshagen, 2011) [P]**

2011. *Akleistostoma olssoni* Petuch and Drolshagen

2021. *Akleistostoma (Akleistostoma) olssoni* Petuch and Berschauer

HOLOTYPE: Paleontological Research Institute, PRI 13216

TYPE Locality: Quality Aggregates Pit # 9, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 4)

Size range: 61.8-84.7 mm

Shape: Cylindrical, elongate, flattened

Base: Slightly flattened, flattened

Margins: Callous, compressed, subangular, angular

Auricles: Produced, flanged, slightly projecting

Columella: Smooth

Fossula: Steep, smooth, shallow/indistinct to absent

Apical sulcus: Simple, straight, slightly pinched

Aperture: Narrow, widening slightly anteriorly

Columellar teeth: Thin, long, extending onto the columellar ridge

Number: 18-23

Labral lip; teeth: Thick, rounded; thick, pointed longer anteriorly

Number: 20-24

Key Characteristics: Cylindrical, elongate shape with a flattened, angular, rectangular appearance; apical sulcus simple, straight, slightly pinched; aperture narrow, widening slightly anteriorly; base slightly flattened, flattened; margins callous, compressed, subangular, angular; auricles produced, flanged, slightly projecting; columellar teeth thin, extend onto the columellar ridge; columella smooth, fossula indistinct to absent.

Comparisons: *A. (A.) olssoni* is most similar to *A. (A.) floridana* and *A. (A.) rilkoii*. However, *A. (A.) floridana* is not as flattened with a more sloping anterior dorsum; an open, wide aperture which widens anteriorly and is fully arcuate; fewer columellar teeth. *A. (A.) rilkoii* is a smaller, inflated shell with a slightly rounded base and subangular margins.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

COMMENT: Its narrow aperture, which widens only slightly on some specimens, and apical sulcus, which is simple, slot-like, slightly pinched, are characteristics which suggest an alignment with certain *Pseudadusta* subgenera species. However, not all characteristics are aligned. The cylindrical shape with callous, compressed, angular margins; the large, flanged, projecting auricles have prompted us to retain the species in the *Akleistostoma* genus. The absence of a fossula is noted. The retention is provisional.

Plate 12 →

Akleistostoma (Akleistostoma) olssoni (Petuch and Drolshagen, 2011)

1. 76.5 mm, Lavender Road Pit, Ruskin

2. 80.4 mm, Quality Aggregates Pit, # 9, Sarasota (Gerontic Specimen)

3. 77.3 mm, APAC Pit, Sarasota



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***Akleistostoma (Akleistostoma) rilkoi* (Petuch, 1998) [P]**

1998. *Siphocypraea (Akleistostoma) rilkoi* Petuch

2011. *Akleistostoma rilkoi* Petuch and Drolshagen

2021. *Akleistostoma (Akleistostoma) rilkoi* Petuch and Berschauer

HOLOTYPE: Graves Museum of Archeology & Natural History, UF 84985

TYPE Locality: Quality Aggregates Pit Phase # 6, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 3)

Size range: 52.6-73.6 mm

Shape: Cylindrical, elongate, roughly rectangular

Base: Slightly rounded, flattened

Margins: Compressed, subangular, angular

Auricles: Produced, blunt

Columella: Smooth

Fossula: Steep, smooth, shallow/indistinct to absent

Apical sulcus: Simple, slot-like, slightly pinched

Aperture: Narrow, slightly sinuous, widening slightly anteriorly

Columellar teeth: Thin, extending onto the columellar ridge, poorly produced, missing posteriorly on some specimens

Number: 16-19

Labral lip; teeth: Thick, rounded; thick, pointed
Number: 19-21

Key Characteristics: Cylindrical, elongate, roughly rectangular shell; apical sulcus simple, slot-like, slightly pinched; aperture narrow, slightly sinuous, widening slightly anteriorly; base slightly rounded, flattened; margins compressed, subangular, angular; columellar teeth thin, extending onto the columella, missing posteriorly on some specimens; auricles produced, blunt; columella smooth; fossula indistinct to absent.

Comparisons: *A. (A.) rilkoi* is similar to the older *A. (A.) olssoni* and *A. (Kissimmeensis) ingrami*. However, *A. (A.) olssoni* is a larger, more elongate, flattened shell with a narrower aperture with more produced, flanged, slightly projecting auricles. *A. (A.) rilkoi* is also similar to *A. (K.) ingrami* from the Kissimmee River Valley. *A. (K.) ingrami* is a smaller, more depressed, truncated shell with better developed, projecting auricles.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Comment: Its narrow aperture and apical sulcus, which is simple, slot-like, slightly pinched, are characteristics which suggest an alignment with certain *Pseudadusta* subgenera species. However, not all characteristics are aligned. The roughly rectangular shape with callous, compressed, subangular, angular margins; the flanged, short auricles have prompted us to retain the species in the *Akleistostoma* genus. The retention is provisional.

Plate 13 →

Akleistostoma (Akleistostoma) rilkoi (Petuch, 1998)

1. 60.0 mm, APAC Pit, Sarasota
2. 64.4 mm, Lavender Road Pit, Ruskin
3. 70.9 mm, Quality Aggregates Pit, Pit # 6, Sarasota
4. 66.8 mm, SMR Aggregates Pit, Sarasota



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***Akleistostoma (Akleistostoma) adrianae* Petuch and Drolshagen, 2011 [P]**

2011. *Akleistostoma adrianae* Petuch and Drolshagen

2022. *Akleistostoma (Akleistostoma) adrianae* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13218

TYPE Locality: Quality Aggregates Pit # 9, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 2)

Also: Golden Gate Member (Unit 2 equivalent)

Size range: 50.0-72.9 mm

Shape: Roughly rectangular, tapering slightly anteriorly, flattened

Base: Slightly rounded, flattened

Margins: Subangular, angular

Auricles: Produced, slightly projecting

Columella: Smooth

Fossula: Steep, smooth, shallow/indistinct to absent

Apical sulcus: Simple, parallel, slot-like, only slightly curved

Aperture: Narrow, widening anteriorly

Columellar teeth: Short, extending onto the columellar ridge, missing posteriorly on some specimens

Number: 13-17

Labral lip; teeth: Thin, rounded; thick, pointed

Number: 17-21

Key Characteristics: *A. (A.) adrianae* is a roughly rectangular, tapering slightly anteriorly on most specimens, flattened shell; apical sulcus simple, parallel, slot-like; aperture narrow, widening anteriorly; base slightly rounded, flattened; margins rounded, subangular; auricles produced, slightly projecting; columellar teeth short, extending onto the columella, missing posteriorly on some specimens; fossula indistinct to absent.

Comparisons: *A. (A.) adrianae* is similar to *A. (A.) rilkoii*, also similar to *A. (Mansfieldicypraea) ivyi* and *A. (Kissimmeensis) ingrami*. However, *A. (A.) rilkoii* is a larger, more elongate, inflated shell with a more curved apical sulcus and better produced columellar dentition and blunter auricles. *A. (M.) ivyi* possesses a very wide, arcuate aperture. Specimens of *A. (K.) ingrami* from the Kissimmee River Valley are of similar size, but broader, more depressed, truncated with better developed, projecting auricles.

Primary Collection Sites: APAC and Quality Aggregates Pits, Sarasota, Sarasota County. Also collected in the, Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 14 →

Akleistostoma (Akleistostoma) adrianae Petuch and Drolshagen, 2011

1. 55.3 mm, APAC Pit, Sarasota

2. 57.3 mm, Quality Aggregates Pit, Pit # 9, Sarasota

3. 50.0 mm, Quality Aggregates Pit, Sarasota



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***Akleistostoma (Mansfieldicypraea)* Petuch and Drolshagen, 2011**

Originally proposed as subgenus of *Akleistostoma*, “representing large, flattened cowries with wide apertures, and extremely well-developed apertural dentition”. (Petuch & Drolshagen, p. 129).

Described as: “Shells of average size for genus, broad and oval-shaped, very flattened, with wide, well-developed shell margins; base flat; terminals extremely well produced, with anterior auricles large and flangelike; auricles of some species wide and projecting, resembling large earlike processes; aperture proportionally wide, becoming wider at anterior end; apertural dentition extremely well-developed, extending onto base of shell”. (Petuch & Drolshagen, p. 129).

“Although somewhat resembling typical *Akleistostoma* species, especially when viewed from the dorsum, members of the subgenus can be immediately separated by their large and well-developed apertural dentition. In some members of *Mansfieldicypraea*, such as *Akleistostoma (Mansfieldicypraea) crocodila* and *A. (M.) rugostoma*, the teeth are so large that they extend almost half way across the base of the shell. The auricles of *Mansfieldicypraea* species are also better developed than other *Akleistostoma* subgenera, with some species, such as *A. (M.) macbrideae* and *A. (M.) ivyi* having wide flanges, resembling rodent’s ears. Although occurring together with other typical *Akleistostoma* species, *Mansfieldicypraea* species are never as commonly encountered.” (Petuch & Drolshagen p. 130).

Comparisons

Akleistostoma (Akleistostoma): Oval to cylindrical shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, rounded, subangular, angular; auricles produced, flanged, projecting but short.

- Columellar teeth extending to/onto the columellar ridge, but not onto or only slightly onto the base; columella smooth; fossula steep, smooth, shallow/indistinct to absent.

NOTE: Some of the characteristics of *A. (A.) olssoni* and *A. (A.) rilkoii* do not align with others in the genus. However, while these characteristics do suggest other genera, they are imperfectly aligned. Their retention herein as *Akleistostoma* species is Provisional [P] pending further study. See individual entries.

Akleistostoma (Mansfieldicypraea): Oval to roughly rectangular shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, subangular, angular; auricles well produced, flanged, projecting beyond the body whorl.

- Columellar teeth extending to the columellar ridge and onto the base; columella smooth; fossula steep, smooth, shallow/indistinct to absent.

Akleistostoma (Ingramicypraea): small, rounded, flattened species with wide apertures; apical sulcus simple, shallow, poorly produced, blunt; auricles poorly produced; blunt.

- Columellar teeth extending to the columellar ridge; columella smooth; fossula absent.

Akleistostoma (Gardnericypraea): Oval, oval-elongate to roughly rectangular, highly inflated, rotund, domed shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, rounded, subangular, angular; auricles produced, flanged, pinched.

- Columellar teeth extending to the columellar ridge and onto the base; columella smooth; fossula absent.

Akleistostoma (Paludacypraea): Oval, oval-elongate shell; apical sulcus simple, shallow, poorly produced; aperture widening anteriorly; base rounded, slightly flattened; margins rounded, subangular; auricles blunt, slightly projecting.

- Anterior columellar teeth extend over the columella; columella smoothly undulating; fossula absent. Pseudofossula present in some specimens.

Akleistostoma (Mansfieldicypraea) Tamiami Formation species:

Akleistostoma (Mansfieldicypraea) crocodila (Petuch, 1994) **TYPE**

Akleistostoma (Mansfieldicypraea) rugostoma Petuch and Drolshagen, 2011

Akleistostoma (Mansfieldicypraea) miamiensis Petuch and Drolshagen, 2011

Akleistostoma (Mansfieldicypraea) macbrideae (Petuch, 1998)

Akleistostoma (Mansfieldicypraea) juliagardnerae Petuch and Drolshagen, 2011

Akleistostoma (Mansfieldicypraea) ivyi Petuch and Drolshagen, 2011

Akleistostoma (Mansfieldicypraea) Petuch and Drolshagen, 2011

***Akleistostoma (Mansfieldicypraea) crocodila* (Petuch, 1994) TYPE**

1994. *Siphocypraea crocodila* Petuch

1997. *Siphocypraea (Akleistostoma) crocodila* Petuch

2011. *Akleistostoma (Mansfieldicypraea) crocodila* Petuch and Drolshagen

HOLOTYPE: FI Museum of Natural History, IP collection, UF 66228

TYPE Locality: Quality Aggregates Pit # 6, Sarasota, Sarasota County, FL.

Buckingham Member (Unit 10)

Size range: 51.3-72.2 mm

Shape: Oval, oval-elongate, flattened

Base: Slightly flattened, flattened

Margins: Subangular, angular

Auricles: Produced, poorly flanged,
slightly projecting

Columella: Smooth

Fossula: Steep, smooth, shallow/indistinct
to absent

Apical sulcus: Simple, parallel, slot-like

Aperture: Open, widening anteriorly, arcuate

Columellar teeth: Long, narrow interstices,
extending onto columellar ridge
and onto base

Number: 18-19

Labral lip; teeth: Rounded; thick, pointed

Number: 19-23

Key Characteristics: Oval, oval-elongate, flattened shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; base slightly flattened; margins subangular, angular; auricles produced, poorly flanged, slightly projecting; columellar teeth long, interstices narrow, extending onto columellar ridge and onto base; columella smooth; fossula indistinct to absent.

Comparisons: *A. (M.) crocodila* is similar to some specimens of *A. (Akleistostoma) carolinensis* and *A. (Mansfieldicypraea) rugostoma*. However, *A. (A.) carolinensis* has fewer columellar teeth which are thick, poorly produced with wide interstices and do not extend onto the base. *A. (M.) rugostoma* is a larger, broader and more elongate shell with wider interstices and better produced auricle flanges.

Range: Primarily collected in the APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 15 →

Akleistostoma (Mansfieldicypraea) crocodila Petuch and Drolshagen, 2011

1. 57.9 mm, Quality Aggregates Pit, Pit # 6, Sarasota

2. 66.9 mm, Lavender Road Pit, Ruskin

3. 64.0 mm, Warren Brothers Pit, Sarasota

4. 66.8 mm, Lavender Road Pit, Ruskin



***Akleistostoma (Mansfieldicypraea) rugostoma* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13219

TYPE Locality: APAC Pit, Sarasota, Sarasota County, FL.

Pinecrest Member (Unit 7)

Size range: 52.6-88.4 mm

Shape: Oval elongate, broad, stocky
somewhat flattened

Base: Flattened

Margins: Subangular, angular

Auricles: Well-produced flattened flanges,

Columella: Smooth

Fossula: Steep, smooth, shallow/indistinct
to absent

Apical sulcus: Simple, parallel, slot-like

Aperture: Open, slightly sinuous, widening
anteriorly, arcuate

Columellar teeth: Thick, interstices wide, teeth
extending onto columellar ridge and base

Number: 16-17

Labral lip; teeth: Thin, rounded; thick, pointed

Number: 19-21

Key Characteristics: Oval elongate, broad, somewhat flattened shell; apical sulcus simple, parallel, slot-like; aperture open, slightly sinuous, widening anteriorly, arcuate; base flattened; margins subangular, angular; auricles well produced flattened flanges, projecting; columellar teeth thick, interstices wide, extending onto columellar ridge and base; columella smooth; fossula indistinct to absent.

Comparisons: *A. (M.) rugostoma* resembles a larger version of *A. (M.) crocodila*. However, *A. (M.) crocodila* is a smaller, oval, oval-elongate shell whose columellar teeth extend onto the columellar ridge and farther onto the base. The interstices between columellar teeth are also narrower in *A. (M.) crocodila*. It is also similar to *A. (M.) macbrideae* as the auricles may, in some species, be of similar length. However, *A. (M.) macbrideae* is a roughly rectangular shell with more numerous columellar teeth; and better produced, more projecting flanged auricles in most specimens.

Range: Primarily collected in the APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Note: Some specimens from the Lavender Road Pit have the characteristics of *A. (M.) rugostoma* with the exception of the dentition which have the characteristic dentition of *A. (M.) macbrideae*. The taxonomic implication(s) are not known at this time.

Plate 16 →

Akleistostoma (Mansfieldicypraea) rugostoma Petuch and Drolshagen, 2011

1. 72.8 mm, APAC Pit, Sarasota
2. 74.2 mm, Lavender Road Pit, Ruskin
3. 76.7 mm, Lavender Road Pit, Ruskin
4. 80.7 mm, Lavender Road Pit, Ruskin



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***Akleistostoma (Mansfieldicypraea) miamiensis* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13220

TYPE Locality: Coralline sediments from a housing development excavation at the Lakes of the Meadows, Bird Road, Miami, Dade County, FL.

Lower beds, Golden Gate Member (Pinecrest equivalent) [P]

Also, Pinecrest Member (Unit 7), Tamiami Formation [P]

Size range: 51.0-87.1 mm

Shape: Roughly rectangular, elongate
somewhat inflated, inflated

Base: Flat

Margins: Produced, angular

Auricles: Well-produced, flanged, projecting

Columella: Smooth

Fossula: Absent

Apical sulcus: Simple, parallel, slot-like

Aperture: Open, slightly sinuous, widening
anteriorly, arcuate

Columellar teeth: Thick, interstices wide, poorly
produced or absent posteriorly, extending
to columellar ridge and onto base

Number: 13-16

Labral lip; teeth: Thin, rounded; thick, pointed,
extending onto base

Number: 19-24

Key Characteristics: Roughly rectangular, broad, elongate shell with an inflated appearance; apical sulcus simple, parallel, slot-like; aperture open, slightly sinuous, widening anteriorly, arcuate; base flat, not flattened; margins produced, angular; auricles well produced, flanged, projecting well beyond body whorl; columellar teeth thick, poorly produced or absent posteriorly; labral teeth extending onto base; columella smooth; fossula absent.

Comparisons: *A. (M.) miamiensis* is similar to *A. (M.) rugostoma*. However, *A. (M.) rugostoma* is an oval elongate, broad, more flattened shell with better produced columellar teeth. It is also similar to *A. (M.) macbrideae*. However, *A. (M.) macbrideae* is a flattened, roughly rectangular, slenderer shell with well-produced columellar teeth. Both possess an indistinct fossula.

Range: Five specimens were collected by Petuch in coralline sediment spoil piles at a housing development at the Lakes of the Meadows, Bird Road, Miami, Dade County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 17 →

Akleistostoma (Mansfieldicypraea) miamiensis Petuch and Drolshagen, 2011

1. 87.1 mm, Lakes of the meadows construction Dig, Bird Road, Miami
2. 54.2 mm, Lavender Road Pit, Ruskin
3. 63.6 mm, Lavender Road Pit, Ruskin
4. 77.1 mm, Lakes of the meadows construction Dig, Bird Road, Miami



1



2



3



4



***Akleistostoma (Mansfieldicypraea) macbrideae* (Petuch, 1998)**

1998. *Siphocypraea (Akleistostoma) macbrideae* Petuch

2011. *Akleistostoma (Mansfieldicypraea) macbrideae* Petuch and Drolshagen

HOLOTYPE: Graves Museum of Archeology & Natural History, UF 84983

TYPE Locality: APAC Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 4 Black Layer)

Size range: 58.5-102.9 mm

Shape: Roughly rectangular, elongate, proportionally slender, flattened

Base: Flattened

Margins: Produced, angular

Auricles: Produced, flanged, projecting

Columella: Smooth

Fossula: Steep, smooth, shallow/indistinct to absent

Apical sulcus: Simple, parallel, slot-like

Aperture: Open, sinuous, widening anteriorly, arcuate

Columellar teeth: Thick, interstices regularly spaced, extending onto the columellar ridge and onto base

Number: 18-21

Labral lip; teeth: Thick, rounded; thick, pointed, extending onto base

Number: 21-23

Key Characteristics: Roughly rectangular, proportionally slender, elongate, flattened shell; apical sulcus simple, parallel slot-like; aperture open, sinuous, widening anteriorly, arcuate; base flattened; margins produced angular; auricles produced, flanged, projecting well beyond the body whorl; columellar teeth thick, interstices regularly spaced, extending onto the columellar ridge and the base; columella smooth; fossula indistinct to absent.

Comparisons: *A. (M.) macbrideae* is similar to *A. (M.) rugostoma* and *A. (Akleistostoma) floridana*. However, *A. (M.) rugostoma* is an oval, elongate, broad, stocky, more flattened shell with fewer columellar teeth. The shape of some specimens is also similar to *A. (A.) floridana* which is a suboval, elongate shell; auricles are not as well produced; and the columellar teeth do not extend onto the base.

Range: APAC and Quality Aggregates Pits (later SMR Aggregates), Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Note: Some specimens from the Lavender Road Pit have the characteristics of *A. (M.) macbrideae* with the exception of the dentition which have the characteristic dentition of *A. (M.) rugostoma*. The taxonomic implication(s) are not known at this time.

Plate 18 →

Akleistostoma (Mansfieldicypraea) macbrideae (Petuch, 1998)

1. 70.8 mm, Lavender Road Pit, Ruskin

2. 82.8 mm, Lavender Road Pit, Ruskin

3. 72.2 mm, APAC Pit, Sarasota



1



2



3



***Akleistostoma (Mansfieldicypraea) juliagardnerae* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13221

TYPE Locality: Quality Aggregates Pit # 9, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 3)

Size range: 60.1-83.4 mm

Shape: Oval-elongate, rounded, broad, slightly flattened

Base: Slightly flattened, flattened

Margins: Subangular, angular

Auricles: Produced, flanged, short, projecting

Columella: Smooth

Fossula: Steep, smooth, shallow/indistinct to absent

Apical sulcus: Simple, parallel, slot-like

Aperture: Open, slightly sinuous, widening anteriorly, arcuate

Columellar teeth: Thick, interstices wide, extending to columellar ridge and onto base

Number: 17-18

Labral lip; teeth: Thin; thick, pointed

Number: 20-21

Key Characteristics: Oval-elongate, rounded, broad, flattened shell; apical sulcus simple, parallel, slot-like; aperture slightly open, slightly sinuous, widening anteriorly, arcuate; base slightly flattened, flattened; margins subangular, angular; auricles produced, flanged, short, projecting; columellar teeth thick, interstices wide, extending to the columellar ridge and onto base; columella smooth; fossula indistinct to absent.

Comparisons: *A. (M.) juliagardnerae* is similar to *A. (M.) macbrideae* and *A. (M.) ivyi*. However, *A. (M.) macbrideae* is a roughly rectangular shell; with more numerous columellar teeth; and better produced, more projecting auricles. *A. (M.) ivyi* is a roughly rectangular, elongate, flattened shell; margins not rounded; thinner columellar teeth.

Range: APAC and Quality Aggregates Pits (later SMR Aggregates), Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 19 →

Akleistostoma (Mansfieldicypraea) juliagardnerae Petuch and Drolshagen, 2011

1. 82.8 mm, Lavender Road Pit, Ruskin
2. 68.0 mm, Quality Aggregates Pit, Pit # 9, Sarasota
3. 70.0 mm, Lavender Road Pit, Ruskin
4. 74.3 mm, Lavender Road Pit, Ruskin



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2



3



4



***Akleistostoma (Mansfieldicypraea) ivyi* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13222

TYPE Locality: Quality Aggregates Pit # 9, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 2)

Size range: 52.3-77.2 mm

Shape: Roughly rectangular, elongate, flattened

Base: Flattened

Margins: Subangular, angular

Auricles: Produced, flanged, short, projecting

Columella: Smooth

Fossula: Steep, smooth, shallow/indistinct to absent

Apical sulcus: Simple, parallel, slot-like

Aperture: Open, slightly sinuous, widening anteriorly, arcuate

Columellar teeth: Thin, extending to columellar ridge and onto base

Number: 16-17

Labral lip; teeth: Thin; thick, pointed

Number: 17-23

Key Characteristics: Roughly rectangular, elongate, flattened shell; apical sulcus simple, parallel, slot-like; aperture open, slightly sinuous, widening anteriorly, arcuate; base flattened; margins subangular, angular; auricles produced with a short flange, projecting; columellar teeth thin, extending to the columellar ridge and onto the base; columella smooth; fossula indistinct to absent.

Comparisons: *A. (M.) ivyi* is similar to *A. (M.) macbrideae* and *A. (M.) juliagardnerae*. However, *A. (M.) macbrideae* is a larger, less flattened shell; with longer columellar teeth; and auricles which are better produced, with flattened flanges which extend well beyond the body whorl. *A. (M.) juliagardnerae* is an oval-elongate, broad, flattened shell; with rounded margins; and thicker columellar teeth.

Range: APAC and Quality Aggregates Pits (later SMR Aggregates), Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 20 →

Akleistostoma (Mansfieldicypraea) ivyi Petuch and Drolshagen, 2011

1. 77.2 mm, Lavender Road Pit, Ruskin
2. 61.9 mm, Quality Aggregates Pit, Pit # 9, Sarasota
3. 62.5 mm, Lavender Road Pit, Ruskin
4. 77.8 mm, Lavender Road Pit, Ruskin



***Akleistostoma (Ingramicypraea)* Petuch and Drolshagen, 2011**

Originally proposed as a subgenus of *Akleistostoma*, “representing small, rounded, flattened species with wide apertures”. (Petuch & Drolshagen).

Described as: “Shells small for genus, averaging less than 30 mm, round or oval in outline, distinctly flattened; shell bases flat; margins thickened, with rounded keel around periphery; terminals, short, blunt; apertures wide, arcuate [bow-like curve], becoming very wide on anterior half.” (Petuch & Drolshagen).

“*Ingramicypraea* differs from the other *Akleistostoma* subgenera in having very small shells, often less than 30 mm in length, that are very rounded and turtle-shaped. The terminals, particularly the auricle flanges, are very reduced and truncated and the apertures are wide and flaring, especially at the anterior end. Within the Kissimmee Valley, members of the new subgenus are locally common, especially at Fort Drum and Fort Basinger, demonstrating that *Ingramicypraea* was a successful group right up to the time of its extinction.” (Petuch & Drolshagen).

Akleistostoma (Ingramicypraea) pilsbryi (Ingram, 1939), the **TYPE** of the subgenus, is known from the Buckingham Member (Unit 10) of the Sarasota quarries. It is not known from the Unit 10 Kissimmee River Valley equivalent as that stratum is missing due to erosion. Originally described by Ingram based on specimens collected along the Cape Fear River, North Carolina, its presence in the Kissimmee River Valley has not been confirmed. However, as all other species of the subgenus appear derived from *A. (I.) pilsbryi* and are restricted to the Kissimmee River Valley, its presence there may be inferred.

See Chapter 10 (page 232) for a discussion of all other species in the subgenus.

Comparisons

Akleistostoma (Akleistostoma): Oval to cylindrical shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, rounded, subangular, angular; auricles produced, flanged, projecting but short.

- Columellar teeth extending to/onto the columellar ridge, but not onto or only slightly onto the base; columella smooth; fossula steep, smooth, shallow/indistinct to absent.

NOTE: Some of the characteristics of *A. (A.) olssoni* and *A. (A.) rilkoii* do not align with others in the genus. However, while these characteristics do suggest other genera, they are imperfectly aligned. Their retention herein as *Akleistostoma* species is Provisional [P] pending further study. See individual entries.

Akleistostoma (Mansfieldicypraea): Oval to roughly rectangular shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, subangular, angular; auricles well produced, flanged, projecting beyond the body whorl.

- Columellar teeth extending to the columellar ridge and onto the base; columella smooth; fossula steep, smooth, shallow/indistinct to absent.

Akleistostoma (Ingramicypraea): small, rounded, flattened species with wide apertures. Apical sulcus simple, shallow, poorly produced, blunt; auricles poorly produced; blunt.

- Columellar teeth extending to the columellar ridge; columella smooth; fossula absent.

Akleistostoma (Gardnericypraea): Oval, oval-elongate to roughly rectangular, highly inflated, rotund, domed shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, rounded, subangular, angular; auricles produced, flanged, pinched.

- Columellar teeth extending to the columellar ridge and onto the base; columella smooth; fossula absent.

Akleistostoma (Paludacypraea): Oval, oval-elongate shell; apical sulcus simple, shallow, poorly produced; aperture widening anteriorly; base rounded, slightly flattened; margins rounded, subangular; auricles blunt, slightly projecting.

- Anterior columellar teeth extend over the columella; columella smoothly undulating; fossula absent. Pseudofossula present in some specimens.

Akleistostoma (Ingramicypraea) western Coastal Tamiami Formation species:

Akleistostoma (Ingramicypraea) pilsbryi (Ingram, 1939)

Akleistostoma (Ingramicypraea) Petuch and Drolshagen, 2011

***Akleistostoma (Ingramicypraea) pilsbryi* (Ingram, 1939) TYPE**

1939. *Cypraea pilsbryi* Ingram

1994. *Siphocypraea pilsbryi* Petuch

1997. *Siphocypraea (Akleistostoma) pilsbryi* Petuch

2011. *Akleistostoma (Ingramicypraea) pilsbryi* Petuch and Drolshagen

HOLOTYPE: The Academy of Natural Sciences of Philadelphia, IP No. 781

Type Locality: along the Cape Fear River, NC.

Buckingham Member (Unit 10)

Florida Specimens Only

Size range: 25.0-34.5 mm

Shape: Ovate, rounded, inflated

Base: Rounded

Margins: Produced, subangular

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Absent

Apical sulcus: Simple, shallow, poorly produced

Aperture: Sinuous, open, widening anteriorly, arcuate

Columellar teeth: Thin, poorly produced, interstices wide, extending to the columellar ridge

Number: 10-12

Labral lip; teeth: Thin, rounded; pointed, extending onto base

Number: 17-18

Original description: “Shell broadly ovate; spire obscured; anterior and posterior canals produced but slightly.” (Ingram, 1939a).

Key Characteristics: [Adapted from Petuch, Berschauer & Myers, 2018] Broadly ovate, rounded, inflated, turtle-like shaped shell; apical sulcus simple, shallow, poorly produced; aperture sinuous, open, widening anteriorly, arcuate; base rounded; margins produced, subangular; auricles poorly produced, blunt; columellar teeth thin, poorly produced, interstices wide, extending to the columellar ridge; columella smooth; fossula absent.

Comparisons: There are no real comparisons within the genus/subgenera. However, specimens may resemble small *Akleistostoma (Olssonicypraea) diegelae* from the Kissimmee River Valley. However, *A. (O.) diegelae* is a more pyriform, flattened shell, wider posteriorly.

Range: In Florida, primarily in the Sarasota quarries. In the Kissimmee River Valley by inference.

Plate 21 →

Akleistostoma (Ingramicypraea) pilsbryi (Ingram, 1939)

1. 34.2 mm, Quality Aggregates Pit, Pit # 6, Sarasota

2. 34.5 mm, Quality Aggregates Pit, Sarasota

3. 30.6 mm, Quality Aggregates Pit, Pit # 6, Sarasota



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3

Akleistostoma (Gardnericypraea) (Petuch and Drolshagen, 2011)

2011. *Pahayokea (Gardnericypraea)* Petuch and Drolshagen

Originally proposed as subgenus of *Pahayokea* Petuch, 2004, representing large, highly inflated cowries that lack recurved apical sulci and that have wide, flaring apertures.

Described as “Shells large for subgenus, highly inflated, rotund, with some species being distinctly pyriform; bases relatively flattened; margins well-developed, rounded; terminals well-developed, projecting, with auricular flanges proportionally large and pointed; apical sulci simple, straight, slotlike, only slightly recurved; apertures wide, flaring, open, becoming wider at anterior end; inner edge of lip with large, pointed teeth; columellar areas with numerous long, thin teeth that extend onto base of shell.” (Petuch & Drolshagen, p. 156).

Type: *Akleistostoma (Gardnericypraea) mansfieldi* (Petuch, 1998).

“With the exception of the subgenus *Gardnericypraea* (which has only been found in the Myakka Lagoon System area of Sarasota), all other Pliocene species of *Pahayokea* ... were restricted to the Kissimmee River Valley (the Kissimmee Embayment of the Okeechobean Sea).” (Petuch and Drolshagen, p. 150).

Reassignment

In 2020, Daughenbaugh (2020) reassigned *Gardnericypraea* as a subgenus of *Akleistostoma*, noting:

“The subgenus represented large, highly inflated cowries that lack recurved apical sulci (i.e., a coiled apical sulcus) and have wide, flaring apertures. This does not accord with *Pahayokea* genus described characteristics, i.e., curved apical sulci and narrow apertures. In comparison, all *Akleistostoma* species show a wide range of characteristics, but all also share an essentially straight or slightly recurved apical sulci and wide, open and widening apertures. The contradictions with true *Pahayokea* species do not support the status of the *Gardnericypraea* as a subgenus of *Pahayokea*.

The four species were also considered the root stock for the *Pahayokea* genus, although all four species were restricted to the Myakka Lagoon System and surrounds. However, Kissimmee is separated and isolated from Myakka by the massive Polk Peninsula to the west as well as the narrow, deep water Caloosahatchee and Loxahatchee Straits to the south. In addition, intracapsular direct development and the associated restricted migration may be inferred based on the sister genus, *Muracypraea* Woodring, 1957 and the Recent *Muracypraea mus* Linnaeus, 1758 complex. The absence of a viable path of migration into Kissimmee from Myakka means the status of the subgenus species as the root stock for the *Pahayokea* genus, restricted to Kissimmee, is unsupported.

In summary, the characteristics of the four species of the subgenera support their reassignment as *Akleistostoma (Gardnericypraea)* species.”

Discussion

Three of the four species in the subgenus were described as *Siphocypraea* in 1998. The fourth species, *A. (G.) buchecki*, was described in 2011 along with the introduction of *Gardnericypraea* as

a subgenus of *Pahayokea*. The three original 1998 descriptions were retained as described and all four species were assigned/reassigned to the *Gardnericypraea* subgenus.

In 2018 (Petuch, Berschauer & Myers), the original description of *A. (G.) buchecki* was retained, while the other three descriptions were revised. The revisions contained clarifications of the species' characteristics with the exception of specimens with elongated shapes. All three species also contain specimens with more elongate shapes.

Comparisons

Akleistostoma (Akleistostoma): Oval to cylindrical shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, rounded, subangular, angular; auricles produced, flanged, projecting but short.

- Columellar teeth extending to/onto the columellar ridge, but not onto or only slightly onto the base; columella smooth; fossula steep, smooth, shallow/indistinct to absent.

NOTE: Some of the characteristics of *A. (A.) olssoni* and *A. (A.) rilkoii* do not align with others in the genus. However, while these characteristics do suggest other genera, they are imperfectly aligned. Their retention herein as *Akleistostoma* species is Provisional [P] pending further study. See individual entries.

Akleistostoma (Mansfieldicypraea): Oval to roughly rectangular shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, subangular, angular; auricles well produced, flanged, projecting beyond the body whorl.

- Columellar teeth extending to the columellar ridge and onto the base; columella smooth; fossula steep, smooth, shallow/indistinct to absent.

Akleistostoma (Ingramicypraea): small, rounded, flattened species with wide apertures. Apical sulcus simple, shallow, poorly produced, blunt; auricles poorly produced; blunt.

- Columellar teeth extending to the columellar ridge; columella smooth; fossula absent.

Akleistostoma (Gardnericypraea): Oval, oval-elongate to roughly rectangular, highly inflated, rotund, domed shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, rounded, subangular, angular; auricles produced, flanged, pinched.

- Columellar teeth extending to the columellar ridge and onto the base; columella smooth; fossula absent.

Akleistostoma (Paludacypraea): Oval, oval-elongate shell; apical sulcus simple, shallow, poorly produced; aperture widening anteriorly; base rounded, slightly flattened; margins rounded, subangular; auricles blunt, slightly projecting.

- Anterior columellar teeth extend over the columella; columella smoothly undulating; fossula absent. Pseudofossula present in some specimens.

Akleistostoma (Gardnericypraea) Tamiami Formation:

Akleistostoma (Gardnericypraea) erici (Petuch, 1998)

Akleistostoma (Gardnericypraea) mansfieldi (Petuch, 1998) **TYPE**

Akleistostoma (Gardnericypraea) jenniferae (Petuch, 1998)

Akleistostoma (Gardnericypraea) buchecki (Petuch and Drolshagen, 2011)

Akleistostoma (Gardnericypraea) (Petuch and Drolshagen, 2011)

***Akleistostoma (Gardnericypraea) erici* (Petuch, 1998)**

1998. *Siphocypraea (Akleistostoma) erici* Petuch

2011. *Pahayokea (Gardnericypraea) erici* Petuch and Drolshagen

2020. *Akleistostoma (Gardnericypraea) erici* Daughenbaugh

2021. *Pahayokea (Gardnericypraea) erici* Petuch and Berschauer

2022. *Akleistostoma (Gardnericypraea) erici* Daughenbaugh and Bridges

HOLOTYPE: Graves Museum of Archeology & Natural History UF 84981

Type Locality: Quality Aggregates Pit Phase # 6, Sarasota, Sarasota County, FL.

Buckingham Member (Unit 10)

Size range: 61.8-87.6 mm

Shape: Oval, oval-elongate, inflated,
high domed

Base: Flat

Margins: Callous, angular

Auricles: Produced, flanged, projecting

Columella: Smooth

Fossula: Absent

Apical sulcus: Simple, parallel, slot-like

Aperture: Open, slightly sinuous, widening
anteriorly, arcuate

Columellar teeth: Thin, extending onto columellar
ridge and slightly onto base

Number: 17-18

Labral lip; teeth: Rounded; thick, pointed

Number: 20-23

Key Characteristics: Oval, inflated, high domed shell; apical sulcus simple, parallel, slot-like; aperture open, slightly sinuous, widening anteriorly, arcuate; base flat, not flattened; margins callous, angular; auricles flanged, projecting; columellar teeth thin, extending onto the columellar ridge and slightly onto the base; columella smooth; fossula absent. On some specimens, a fold in the columella can give the appearance of a fossula.

Comparisons: *A. (G.) erici* is similar to specimens of *A. (G.) jenniferae*. However, *A. (G.) jenniferae* has fewer and coarser apertural teeth; less developed marginal callosities and blunter extremities. *A. (G.) jenniferae* is also similar to *A. (G.) mansfieldi*. However, *A. (G.) mansfieldi* is a more elongated shell with more rounded marginal callosities; larger and coarser apertural dentition and less developed, blunter extremities.

Range: APAC and Quality Aggregates (later SMR aggregates) Pits, Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 22 →

Akleistostoma (Gardnericypraea) erici (Petuch, 1998)

1. 87.6 mm, Lavender Road Pit, Ruskin

2. 75.9 mm, Quality Aggregates Pit, Pit # 6, Sarasota

3. 58.1 mm, Quality Aggregates Pit, Sarasota

4. 81.3 mm, Quality Aggregates Pit, Pit # 6, Sarasota



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2



3

4

***Akleistostoma (Gardnericypraea) mansfieldi* (Petuch, 1998) TYPE**

1998. *Siphocypraea (Akleistostoma) mansfieldi* Petuch

2011. *Pahayokea (Gardnericypraea) mansfieldi* Petuch and Drolshagen

2020. *Akleistostoma (Gardnericypraea) mansfieldi* Daughenbaugh

2021. *Pahayokea (Gardnericypraea) mansfieldi* Petuch and Berschauer

2022. *Akleistostoma (Gardnericypraea) mansfieldi* Daughenbaugh and Bridges

HOLOTYPE: Graves Museum of Archeology & Natural History, UF 84984

TYPE Locality: APAC Pit, Sarasota, Sarasota County, FL.

Pinecrest Member (Unit 7)

Size range: 60.5-77.3 mm

Shape: Oval, oval-elongate, inflated, high domed, twisted, asymmetrical appearance, anterior end tapering

Base: Slightly flattened, flattened

Margins: Callous, subangular, angular

Auricles: Produced, tapering, stunted flanged, slightly projecting

Columella: Smooth

Fossula: Absent

Apical sulcus: Simple, parallel, recurved

Aperture: Open, slightly sinuous, widening anteriorly, arcuate

Columellar teeth: Thin, extending onto columellar ridge and onto base

Number: 17-18

Labral lip; teeth: Rounded; thin, pointed

Number: 19-21

Key Characteristics: Oval, oval-elongate, inflated, high domed shell with a tapering anterior end; apical sulcus simple, parallel, sharply recurved; aperture open, slightly sinuous, widening anteriorly, arcuate; base slightly flattened, flattened; margins callous, subangular, angular; auricles produced, tapering, stunted flange, slightly projecting; columellar teeth thin extending to the columellar ridge and well onto the base; columella smooth; fossula absent.

Comparisons: *A. (G.) mansfieldi* is similar to *A. (G.) erici*. However, *A. (G.) erici* has more numerous and finer dentition; better developed marginal callosities and better developed, extended extremities. Its inflated, high domed dorsum shape with a tapering anterior end; sharply recurved apical sulcus, giving it a somewhat twisted appearance, and the lack of a fossula separate *A. (G.) mansfieldi* from other *Akleistostoma* species.

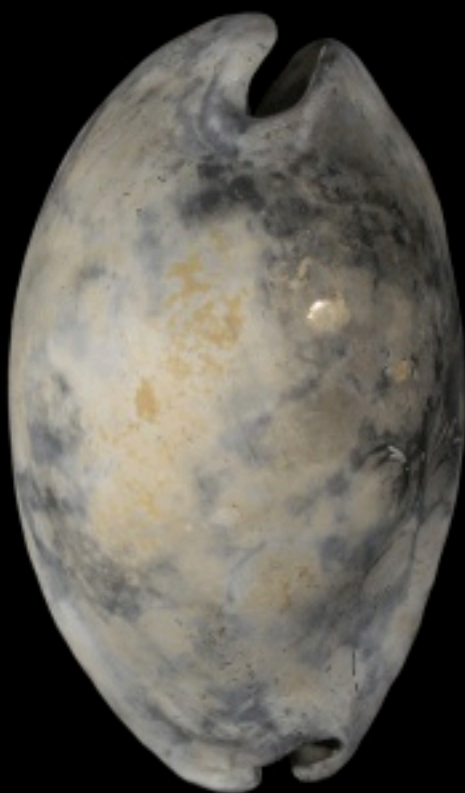
Range: APAC and Quality Aggregates (later SMR aggregates) Pits, Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 23 →

Akleistostoma (Gardnericypraea) mansfieldi (Petuch, 1998)

1. 77.3 mm, Lavender Road Pit, Ruskin

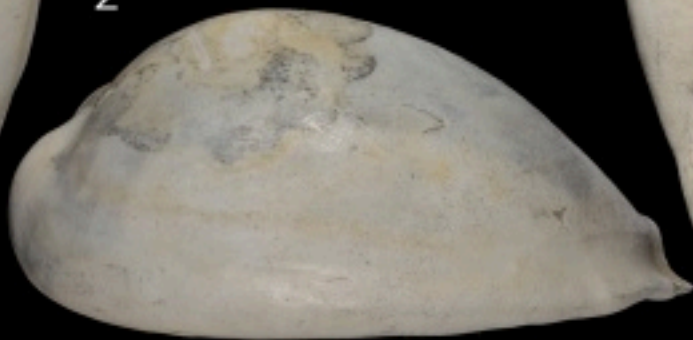
2. 67.3 mm, APAC Pit, Sarasota



1



2



***Akleistostoma (Gardnericypraea) jenniferae* (Petuch, 1998)**

1998. *Siphocypraea (Akleistostoma) jenniferae* Petuch

2011. *Pahayokea (Gardnericypraea) jenniferae* Petuch and Drolshagen

2020. *Akleistostoma (Gardnericypraea) jenniferae* Daughenbaugh

2021. *Pahayokea (Gardnericypraea) jenniferae* Petuch and Berschauer

2022. *Akleistostoma (Gardnericypraea) jenniferae* Daughenbaugh and Bridges

HOLOTYPE: Graves Museum of Archeology & Natural History, UF 84982

TYPE Locality: APAC Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 4)

Size range: 63.6-74.3 mm

Shape: Oval, oval-elongate. globose, inflated, high domed anteriorly

Base: Flat

Margins: Callous, angular

Auricles: Produced, projecting

Columella: Smooth

Fossula: Absent

Apical sulcus: Straight, parallel, slot-like

Aperture: Open, slightly sinuous, widening

Columellar teeth: Thick, extending onto the columellar ridge and onto the base

Number: 13-17

Labral lip; teeth: Rounded; thick, pointed

Number: 16-20

Key Characteristics: Oval, globose, inflated, high domed dorsum shell; apical sulcus straight, parallel, slot-like; aperture open, slightly sinuous, widening anteriorly; base flat; margins callous, angular; auricles produced, projecting; columellar teeth thick, extending onto the columellar ridge and onto the base in fully mature specimens; columella smooth; fossula absent.

Comparisons: *A. (G.) jenniferae* is similar to *A. (G.) erici*. However, *A. (G.) erici* has more numerous and finer apertural teeth; better developed marginal callosity and better developed, extended extremities.

Range: APAC and Quality Aggregates (later SMR aggregates) Pits, Sarasota, Sarasota County.

Plate 24 →

Akleistostoma (Gardnericypraea) jenniferae (Petuch, 1998)

1. 74.3 mm, APAC Pit, Sarasota

2. 63.6 mm, APAC Pit, Sarasota



1



2



***Akleistostoma (Gardnericypraea) buchecki* Petuch and Drolshagen, 2011**

2011. *Pahayokea (Gardnericypraea) buchecki* Petuch and Drolshagen

2020. *Akleistostoma (Gardnericypraea) buchecki* Daughenbaugh

2021. *Pahayokea (Gardnericypraea) buchecki* Petuch and Berschauer

2022. *Akleistostoma (Gardnericypraea) buchecki* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13244

TYPE Locality: Quality Aggregates Pit # 6, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 3)

Size range: 65.9-87.4 mm

Shape: Roughly rectangular, elongate, inflated, domed

Base: Flattened

Margins: Callous, subangular, angular

Auricles: Produced, flanged, slightly projecting

Columella: Smooth

Fossula: Absent

Apical sulcus: Simple, parallel, slot-like

Aperture: Open, sinuous, widening anteriorly, arcuate

Columellar teeth: Thin, extending to columellar ridge

Number: 15-19

Labral lip; teeth: Rounded; thin, rounded

Number: 19-21

Key Characteristics: Roughly rectangular, elongate, inflated, domed shell; apical sulcus simple, parallel, slot-like; aperture open, sinuous, widening anteriorly, arcuate; base flattened; margins callous, subangular, angular; auricles produced, flanged, slightly projecting; columellar teeth thin, extending to the columellar ridge; columella smooth; fossula absent.

Comparisons: *A. (G.) buchecki* is similar to *A. (Paludacypraea) patula* and *A. (Mansfieldicypraea) rugostoma*. However, *A. (P.) patula* is a more oval, truncated shell with an indistinct fossula. *A. (M.) rugostoma* is more oval shell, not domed, with a sloping dorsum and an indistinct fossula.

Range: APAC and Quality Aggregates (later SMR aggregates) Pits, Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 25 →

Akleistostoma (Gardnericypraea) buchecki Petuch and Drolshagen, 2011

1. 65.9 mm, APAC Pit, Sarasota

2. 77.3 mm, APAC Pit, Sarasota

3. 66.1 mm, Lavender Road Pit, Ruskin

4. 79.4 mm, APAC Pit, Sarasota



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Akleistostoma (Paludacypraea) Petuch and Drolshagen, 2011

Restricted to the intertidal and brackish muddy estuaries and marshlands of the Myakka Lagoon area of the Okeechobean Sea, *Akleistostoma (Paludacypraea)* species have only been collected in the Myakka Lagoon System, primarily in the Sarasota quarries from the Fruitville (Units 4 & 3) as well as from the Lavender Road Pit, Ruskin, approximately 20 miles north of Sarasota.

Akleistostoma (Paludacypraea) was proposed as subgenus of *Akleistostoma*, “representing large, domed, rounded cowries with wide apertures and twisted columellar areas”. (Petuch and Drolshagen).

Described as: “Shell of average size for genus *Akleistostoma*, rounded on edges, base distinctly flattened, terminals blunt, poorly-developed; aperture wide, arcuate, becoming wider toward anterior end; apertural dentition strong and well-developed; columellar area characteristically undulating, twisted in outline, with anterior one-third projecting into aperture, producing a pseudofossula.” (Petuch & Drolshagen).

Type Species: *Akleistostoma (Paludacypraea) fruitvillensis* Petuch and Drolshagen, 2011.

When originally introduced, the subgenus was monotypic, i.e., comprised of a single species.

I. Discussion: *Akleistostoma (Paludacypraea) fruitvillensis*

The 2011 description of *A. (P.) fruitvillensis* did not address the shape of the species. The specimen illustrated (Figure 4.9, A, B) was the 60.6 mm Holotype. The shape was oval with a proportionally narrow aperture; and dentition characteristics, both columellar (extending onto the base) and labral (longer anteriorly) which are characteristic of the species. In 2018 (Petuch et al.), two specimens were illustrated (Figures 2.19 Figures A, B, C, & D, E with D, E also illustrated herein). The former was very similar to the Holotype but with a somewhat aberrant shape. The latter was a more pyriform shell with an aperture which was more open and wider anteriorly; and columellar dentition extending onto the base and anterior labral dentition only slightly longer. The latter was collected in the APAC Pit, Sarasota. A larger, but virtually identical specimen with more defined labral dentition, was collected at the Lavender Road Pit and is illustrated herein. A second specimen, with a somewhat truncated, rectangular shape was collected at the Lavender Pit. Its dentition characteristics align with that of the species. It is also illustrated herein. Other such specimens collected at the Lavender Road Pit exhibit mixed characteristics, columellar dentition confined to the aperture, labral dentition of even length or combinations. As these were collected from spoil piles, it cannot be determined whether they are variants, hybrids of *A. (P.) cookei* or an undescribed species.

II. Discussion: *Akleistostoma (Paludacypraea) cookei & williamdalli*

Also in 2011, *Pseudadusta (Dallicypraea)* was proposed as a subgenus in the *Pseudadusta* Petuch, 2004 genus, “including species with inflated, bulbous shells with wide flaring apertures”. (Petuch & Drolshagen).

Described as “Shells of large to average size for genus, broadly oval to pyriform in shape, inflated; base of shells slightly flattened; margins thickened, rounded; terminals well-developed, with auricles forming wide flanges; apical sulci broad, wide, open, formed as simple vertical slot; apertures wide and flaring, becoming wider at anterior end; apertural teeth proportionally small and poorly-developed”.

The original classification within the *Pseudadusta* genus was based on shell shape and apical sulcus structure of *Pseudadusta*, although wide apertures and a general resemblance to *Akleistostoma* species was noted. (Petuch & Drolshagen).

Type Species: *Pseudadusta (Dallicypraea) williamdalli* Petuch and Drolshagen, 2011.

The subgenus consisted of two species:

- *Pseudadusta (Dallicypraea) cookei* Petuch and Drolshagen, 2011
- *Pseudadusta (Dallicypraea) williamdalli* Petuch and Drolshagen, 2011

In 2018:

Pseudadusta (Dallicypraea) cookei was reassigned to the *Akleistostoma (Paludacypraea)* subgenus as *A. (P.) cookei* without comment. (Petuch et al.).

Pseudadusta (Dallicypraea) williamdalli was reassigned as *Akleistostoma (Dallicypraea) williamdalli* without comment. (Petuch et al.).

Reassignment

The apical sulcus of the *Dallicypraea* subgenus does not differ significantly from *Akleistostoma (Paludacypraea)* sulci. Other characteristics are also similar to those of the other species within the subgenera, i.e., poorly produced posterior columellar teeth with the last five anterior teeth projecting over the columella; a smooth columella which is smoothly undulating: bulging posteriorly, recessed anteriorly; fossula absent. As there are no significant characteristics separating the two subgenera, the species is reassigned within the *A. (Paludacypraea)* subgenus herein.

Akleistostoma (Paludacypraea) williamdalli (Petuch and Drolshagen, 2011)
 2011. *Pseudadusta (Dallicypraea) williamdalli* Petuch and Drolshagen, 2011
 2018. *Akleistostoma (Dallicypraea) williamdalli* (Petuch, Berschauer and Myers)
 2022. *Akleistostoma (Paludacypraea) williamdalli* Daughenbaugh and Bridges

III. Discussion: *Akleistostoma (Paludacypraea) patula*

In 2021, Petuch and Berschauer reassigned *Akleistostoma Patula* to the *Paludacypraea* subgenus. Dr. Petuch noted “It always bothered me that there were two *Akleistostoma* (s.s.) species living together at the same time (*floridana* and *patula*); ... The rounded shell shape and wide aperture points to having *patula* included in *Paludacypraea*”. (Petuch, per. comm., 2021).

Comparisons

Akleistostoma (Akleistostoma): Oval to cylindrical shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, rounded, subangular, angular; auricles produced, flanged, projecting but short.

- Columellar teeth extending to/onto the columellar ridge, but not onto or only slightly onto the base; columella smooth; fossula steep, smooth, shallow/indistinct to absent.

NOTE: Some of the characteristics of *A. (A.) olssoni* and *A. (A.) rilkoi* do not align with others in the genus. However, while these characteristics do suggest other genera, they are imperfectly aligned. Their retention herein as *Akleistostoma* species is Provisional [**P**] pending further study. See individual entries.

Akleistostoma (Mansfieldicypraea): Oval to roughly rectangular shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, subangular, angular; auricles well produced, flanged, projecting beyond the body whorl.

- Columellar teeth extending to the columellar ridge and onto the base; columella smooth; fossula steep, smooth, shallow/indistinct to absent.

Akleistostoma (Ingramicypraea): small, rounded, flattened species with wide apertures. Apical sulcus simple, shallow, poorly produced, blunt; auricles poorly produced; blunt.

- Columellar teeth extending to the columellar ridge; columella smooth; fossula absent.

Akleistostoma (Gardnericypraea): Oval, oval-elongate to roughly rectangular, highly inflated, rotund, domed shell; apical sulcus simple, parallel, slot-like; aperture open, widening anteriorly, arcuate; margins callous, rounded, subangular, angular; auricles produced, flanged, pinched.

- Columellar teeth extending to the columellar ridge and onto the base; columella smooth; fossula absent.

Akleistostoma (Paludacypraea): Oval, oval-elongate shell; apical sulcus simple, shallow, poorly produced; aperture widening anteriorly; base rounded, slightly flattened; margins rounded, subangular; auricles blunt, slightly projecting.

- Anterior columellar teeth extend over the columella; columella smoothly undulating; fossula absent. Pseudofossula present in some specimens.

Akleistostoma (Paludacypraea) Tamiami Formation species:

Akleistostoma (Paludacypraea) patula (Petuch and Drolshagen, 2011)

Akleistostoma (Paludacypraea) williamdalli (Petuch and Drolshagen, 2011)

Akleistostoma (Paludacypraea) cookei (Petuch and Drolshagen, 2011)

Akleistostoma (Paludacypraea) fruitvillensis Petuch and Drolshagen, 2011 **TYPE**

Akleistostoma (Paludacypraea) walleri Petuch, Berschauer and Myers, 2018

Akleistostoma (Paludacypraea) Petuch and Drolshagen, 2011

***Akleistostoma (Paludacypraea) patula* (Petuch and Berschauer, 2021)**

2011. *Akleistostoma patula* Petuch and Drolshagen

2021. *Akleistostoma (Paludacypraea) patula* (Petuch and Berschauer, 2021)

HOLOTYPE: Paleontological Research Institute, PRI 13217

TYPE Locality: APAC Pit, Sarasota, Sarasota County, FL.

Pinecrest Member (Unit 7)

Size range: 57.3–88.1 mm

Shape: Oval, oval-elongate, broad, inflated, domed

Base: Flattened, flat

Margins: Expanded; subangular, angular

Auricles: Produced; weakly flanged, flanged, slightly projecting

Columella: Smooth

Fossula: Steep, smooth, shallow, indistinct or absent

Apical sulcus: Simple, parallel, slot-like

Aperture: Wide, open, expanding anteriorly, arcuate

Columellar teeth: Thick, wide interstices, weak or absent posteriorly, extending to the columellar ridge

Number: 16-19

Labral lip; teeth: Thin, rounded; thick, rounded

Number: 19-21

Key Characteristics: Oval, oval-elongate, broad, inflated, domed shell; apical sulcus simple, parallel, slot-like; aperture wide, open, expanding anteriorly, arcuate [bow-like]; base flattened, flat; margins expanded, subangular, angular; auricles produced, weakly flanged, flanged, slightly projecting; columellar teeth thick with wide interstices, weak or absent posteriorly, extending to the columellar ridge; columella smooth; fossula indistinct or absent.

Comparisons: *A. (P.) patula* is similar to *A. (P.) williamdalli* and *A. (P.) cookei*. However, *A. (P.) williamdalli* has a similar, but a more consistently elongate, shape with compressed laterals and a narrower aperture. *A. (P.) cookei* is an oval, broad shell with a slightly rounded base and an aperture which is not as wide nor as arcuate.

Range: Primarily collected in the APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota. In the Sarasota quarries it has been found along with *A. (Akleistostoma) floridana*. However, *A. (A.) floridana* inhabited sea grass beds while *A. (P.) patula* inhabited mud flats near mangrove jungles. (Petuch et al., 2018). The latter is the habitat of *A. (Paludacypraea)* species.

Plate 26 →

Akleistostoma (Paludacypraea) patula (Petuch and Berschauer, 2021)

1. 79.6 mm, Lavender Road Pit, Ruskin

2. 67.0 mm, Quality Aggregates Pit, Sarasota

3. 67.9 mm, APAC Pit, Sarasota

4. 69.8 mm, Lavender Road Pit, Ruskin



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***Akleistostoma (Paludacypraea) williamdalli* (Petuch and Drolshagen, 2011)**

2011. *Pseudadusta (Dallicypraea) williamdalli* Petuch and Drolshagen

2018. *Akleistostoma (Dallicypraea) williamdalli* Petuch, Berschauer and Myers

2022. *Akleistostoma (Paludacypraea) williamdalli* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13266

Type Locality: APAC Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 4)

Size range: 57.0-71.5 mm

Shape: Oval-elongate, inflated

Base: Slightly flattened

Margins: Subangular

Auricles: Produced, flanged, slightly projecting

Columella: Smooth

Fossula: Absent; pseudofossula present in some specimens

Apical sulcus: Open, slot-like, projecting

Aperture: Open, widening slightly anteriorly

Columellar teeth: Poorly produced posteriorly, extending to columellar ridge; anterior most teeth projecting over the columella

Number: 15-17

Labral lip; teeth: Rounded; thick, pointed

Number: 22-23

Key Characteristics: Oval-elongate, inflated shell; apical sulcus open, slot-like, projecting; aperture open, widening slightly anteriorly; base slightly flattened; margins subangular; auricles produced, flanged, slightly projecting; columellar teeth poorly produced posteriorly, extending to the columellar ridge, anterior most teeth projecting over the columella; columella smooth; fossula absent. Pseudofossula present in some specimens.

Comparisons: *A. (P.) williamdalli* is similar to *A. (P.) Patula* but with more compressed laterals producing a more consistently elongate shell and an aperture which is not as wide nor arcuate. It is also similar to *A. (P.) cookei*. However, *A. (P.) cookei* is a more oval, broad shell with a slightly rounded base and rounded margins.

Range: APAC and Quality Aggregates Pits (later SMR Aggregates), Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 27 →

Akleistostoma (Paludacypraea) williamdalli (Petuch and Drolshagen, 2011)

1. 60.5 mm, Lavender Road Pit, Ruskin

2. 75.6 mm, Lavender Road Pit, Ruskin

3. 67.3 mm, APAC Pit, Sarasota



***Akleistostoma (Paludacypraea) cookei* (Petuch and Drolshagen, 2011)**

2011. *Pseudadusta (Dallicypraea) cookei* Petuch and Drolshagen

2018. *Akleistostoma (Paludacypraea) cookei* Petuch, Berschauer and Myers

HOLOTYPE: Paleontological Research Institute, PRI 13265

Type Locality: APAC Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 4)

Size range: 51.8-75.1 mm

Shape: Oval, broad, rounded, domed

Base: Slightly rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Absent; pseudofossula present in some specimens

Apical sulcus: Simple, shallow, poorly produced

Aperture: Proportionally narrow, widening slightly anteriorly

Columellar teeth: Thin, flattened, extending onto the columellar ridge

Number: 16-20

Labral lip; teeth: Thin; short, pointed

Number: 18-21

Key Characteristics: Oval, broad, rounded, domed shells; apical sulcus simple, shallow, poorly produced; aperture proportionally narrow, widening slightly anteriorly; base slightly rounded; margins rounded; auricles poorly produced, blunt; columellar teeth thin, flattened, extending onto the columellar ridge; columella smooth; fossula absent. Pseudofossula present in some specimens.

Comparisons: *A. (P.) cookei* is similar to *A. (P.) williamdalli* and *A. (P.) fruitvillensis*. However, *A. (P.) williamdalli* is an oval-elongate, inflated shell with more compressed laterals and a narrower, less arcuate aperture. *A. (P.) fruitvillensis* has a wider, more arcuate aperture, longer columellar teeth and longer anterior labral teeth. *A. (P.) walleri* is a broader, more oval and more rounded shell.

Range: APAC and Quality Aggregates Pits (later SMR Aggregates), Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

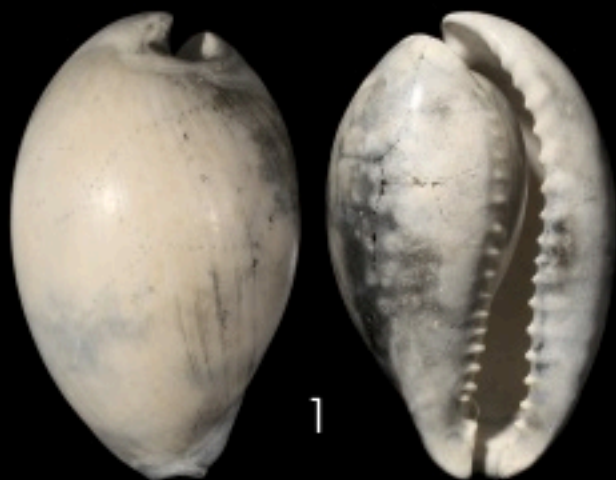
Plate 28 →

Akleistostoma (Paludacypraea) cookei (Petuch and Drolshagen, 2011)

1. 51.8 mm, APAC Pit, Sarasota

2. 61.9 mm, Lavender Road Pit, Ruskin

3. 68.6 mm, Lavender Road Pit, Ruskin



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***Akleistostoma (Paludacypraea) fruitvillensis* Petuch and Drolshagen, 2011 TYPE**

HOLOTYPE: Paleontological Research Institute, PRI 13226

TYPE Locality: APAC Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 4)

Size range: 47.9-74.9 mm

Shape: Variable, rounded, domed

Base: Slightly flattened

Margins: Rounded, subangular

Auricles: Produced, blunt, slightly projecting

Columella: Smooth

Fossula: Absent; pseudofossula present in some specimens

Apical sulcus: Simple, shallow, poorly produced, slightly projecting

Aperture: Open, widening anteriorly, slightly arcuate

Columellar teeth: Thin posteriorly, extending onto the base, anterior most teeth projecting over the columella

Number: 16-17

Labral lip; teeth: Thin; thick, rounded, longer anteriorly

Number: 18-20

Key Characteristics: Variable, rounded, domed shells; apical sulcus simple, shallow, poorly produced, slightly projecting; aperture open, widening anteriorly, slightly arcuate; base slightly flattened; margins rounded, subangular; auricles produced, blunt, slightly projecting; columellar teeth thin posteriorly, extending onto the base, anterior most teeth projecting over the columella; columella smooth; fossula absent. A pseudofossula, produced by a fold in the columella, is present in some specimens. Labral teeth longer anteriorly

Comparisons: See **Discussion** above, page 118.

Range: APAC and Quality Aggregates Pits (later SMR Aggregates), Sarasota, Sarasota County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 29 →

Akleistostoma (Paludacypraea) fruitvillensis Petuch and Drolshagen, 2011

1. 71.0 mm, Lavender Road Pit, Ruskin
2. 61.4 mm, Lavender Road Pit, Ruskin
3. 47.9 mm, APAC Pit, Sarasota
4. 63.5 mm, Lavender Road Pit, Ruskin



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***Akleistostoma (Paludacypraea) walleri* Petuch, Berschauer and Myers, 2018**

HOLOTYPE: Los Angeles County Museum of Natural History, LACMIP 14661

Type Locality: SMR Pit (formerly Quality Aggregates Pit # 11), Sarasota, Sarasota County, FL.

Fruitville Member (Unit 3)

Size range: 55.9-68.0 mm

Shape: Oval, oval-elongate, broad, rounded, domed

Base: Slightly rounded

Margins: Produced, rounded

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Absent

Apical sulcus: Simple, shallow, stunted

Aperture: Open, widening slightly anteriorly

Columellar teeth: Thin, extending onto columellar ridge; anterior most teeth projecting over the columella

Number: 15-16

Labral lip; teeth: Thin; thick, pointed

Number: 19-22

Key Characteristics: Oval, oval-elongate, broad, rounded shell with a domed dorsum; apical sulcus simple, shallow, stunted; aperture open, widening slightly anteriorly; base slightly rounded; margins produced, rounded; auricles poorly produced, blunt; columellar teeth thin, extending onto columellar ridge; anterior most teeth projecting over the columella; columella smooth; fossula absent.

Comparisons: *A. (P.) walleri* is similar to *A. (P.) cookei* and more oval specimens of *A. (P.) fruitvillensis*. However, *A. (P.) cookei* is a less rounded shell with a narrower aperture; poorly developed flattened columellar teeth and a pseudofossula in some specimens. *A. (P.) fruitvillensis* specimens have better developed extremities and longer columellar dentition and a pseudofossula in some specimens.

Range: APAC and Quality Aggregates Pits (later SMR Aggregates), Sarasota, Sarasota County. Also collected in the Caloosa Minerals Pit, Lavender Road, Ruskin, about 20 miles north of Sarasota.

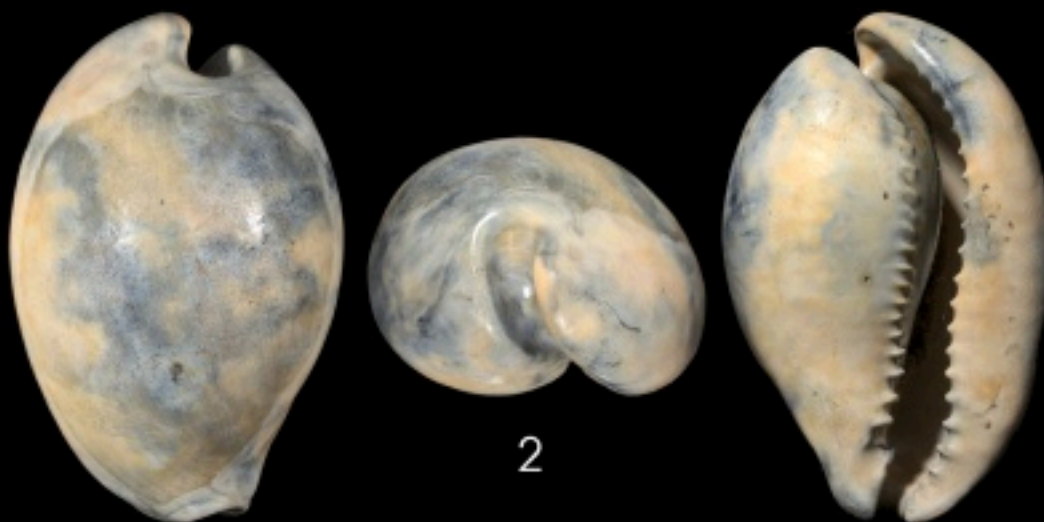
Plate 30 →

Akleistostoma (Paludacypraea) walleri Petuch, Berschauer and Myers, 2018

1. 66.0 mm, Quality Aggregates Pit # 11, Sarasota
2. 60.1 mm, SMR Aggregates Pit, Sarasota
3. 67.5 mm, Lavender Road Pit, Ruskin



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Calusacypraea (Calusacypraea) Petuch, 1996

“Originally described as a subgenus of *Siphocypraea* Heilprin, 1886 ..., this unusual group of cowries was later considered to be a full genus” in 2004. (Petuch, 2018).

Describes as; “ Cypraeid shells of average to large size, ranging from 35 to 70 mm in length, extremely inflated, thin, delicate, bulliform; apices characteristically very depressed, forming a distinct apical pit; posterior edge of lip typically highly-developed, greatly-projecting beyond plane of spire; columellar side of apical area poorly-developed, only slightly projecting beyond plane of spire; anterior extremities poorly developed, without distinct projecting beaks; ends of anterior extremities do not extend beyond end of anterior canal, producing rounded, blunt, sheared-off appearance; in some species, anterior extremity on labial side almost absent, with extremity blending into rounded end of lip and giving shell juvenile appearance; bases of shells very rounded; margins of shells poorly developed, with only thin enamel deposits, anterior canal thickened, bordered by prominent enamel collar, apertures proportionally narrow, variably widening toward anterior end; columellar teeth proportionally small, thin, and narrow, extending along length of columella; some species with row of obsolete, secondary teeth developed along anterior end of columella; labial teeth well-developed, confined to edge of lip; fossula nonexistent; color pattern (when preserved) composed of numerous small, closely spaced dots on dorsum”. (Petuch, 1996).

“Ecologically, *Calusacypraea* species appear to have occupied a different niche than did *Siphocypraea* species. Without exception, all four known species of the new genus have only ever been found in muddy-sand, extreme nearshore facies of the Pinecrest beds. These depositional environments imply estuarine conditions, and *Calusacypraea* may have represented a neotenic offshoot of *Siphocypraea* that had evolved to live in the extensive brackish water lagoons (such as the paleoestuary of the proto-Myakka River) that fringed the entire western coast of the Pliocene Floridian peninsula.” (Petuch, 1996). [Emphasis added]

In addition to the Sarasota quarries, *Calusacypraea* species have been collected at the Lavender Road Pit, Ruskin, approximately 20 miles north of Sarasota.

While Petuch originally felt that *Calusacypraea* was most closely related to *Siphocypraea* as part of a sister group, the two genera do not share characteristics in common. He later elevated the group to full genus status. Its characteristics suggest that it is an offshoot of either *Akleistostoma carolinensis* or *Akleistostoma (Ingramicypraea) pilsbryi*. Both genera inhabited the Myakka Lagoon System in parallel, with each occupying a separate ecological niche. *Akleistostoma* occupied sea grass beds while *Calusacypraea* occupied muddy, brackish, nearshore estuarine lagoons.

Neotenic Characteristics

- Shallow, open, short, poorly produced apical sulcus
- Open apertures which widen anteriorly to varying degrees
- Poorly produced, stunted columellar teeth
- Poorly produced, blunt auricles

However, there exist fully mature, gerontic specimens which have developed a greater degree of callosity. The neotenic characteristics are retained in these specimens but they are more callous, thicker. In these instances, the shallow apical pit in the apical sulcus will have been covered by callus and will not be visible.

Comparisons

Calusacypraea (Calusacypraea): Oval, ovoid, inflated shells with wide apertures which widen anteriorly and are arcuate.

- Columella smooth; fossula steep, smooth, shallow: elongate on older species (Units 10-4), indistinct or absent on younger species (Units 3-2).

Calusacypraea (Myakkacypraea): Distinctly pyriform, inflated, elongated shells with narrow apertures which widen anteriorly and are slightly arcuate.

- Columella smooth; fossula steep, smooth, shallow: elongate on older species (Units 7-4), indistinct or absent on younger species (Units 3-2).

Calusacypraea (Calusacypraea) Tamiami Formation species:

Calusacypraea (Calusacypraea) duerri (Petuch, 1996) **TYPE**

Calusacypraea (Calusacypraea) globulina Petuch, 2004

Calusacypraea (Calusacypraea) tequesta (Petuch, 1996)

Calusacypraea (Calusacypraea) sarasotaensis (Petuch, 1994)

Calusacypraea (Calusacypraea) loxa Petuch and Drolshagen, 2011

Calusacypraea (Calusacypraea) (Petuch, 1996)

Calusacypraea duerri (Petuch, 1996) TYPE

1996. *Siphocypraea (Calusacypraea) duerri* Petuch

2004. *Calusacypraea duerri* Petuch

2022. *Calusacypraea (Calusacypraea) duerri* Daughenbaugh and Bridges

HOLOTYPE: FI Museum of Natural History, IP collection, UF 68249

TYPE Locality: Quality Aggregates, Inc., Phase 6 Pit, Sarasota, Sarasota County, FL.

Buckingham Member (Unit 10)

Size range: 50.0-72.5 mm

Shape: Globose, inflated, bulliform, elongate, thin

Base: Rounded

Margins: Rounded

Auricles: Blunt, truncated, rounded

Columella: Smooth

Fossula: Steep, smooth, shallow, elongate

Apical sulcus: Open, shallow, labral extension projecting; shallow pit in the center

Aperture: Open, wide, widening anteriorly, arcuate

Columellar teeth: Short, poorly produced, posterior teeth weak or absent

Number: 21-25

Labral lip; teeth: Thin; poorly produced, pointed

Number: 19-24

Key Characteristics: Globose, inflated, bulliform, elongate, thin, shell; apical sulcus open, shallow, projecting labral extension; aperture open, wide, widening anteriorly, arcuate; base rounded, margins rounded, auricles blunt, truncated, rounded; columellar teeth short, poorly produced, posterior teeth weak or absent; columella smooth; fossula smooth, shallow, elongate.

Comparisons: *C. (C.) duerri* is similar to *C. (C.) globulina* and *C. (Myakkacypraea) briani*.

However, *C. (C.) globulina* is a broader, more rounded shell with a more compressed apical sulcus (labral extension); and fewer but better developed columellar teeth. *C. (M.) briani* is a subcylindrical shell whose aperture is not as wide or arcuate as *C. (C.) duerri*.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 31 →

Calusacypraea (Calusacypraea) duerri (Petuch, 1996)

1. 62.1 mm, Lavender Road Pit, Ruskin

2. 71.0 mm, Lavender Road Pit, Ruskin

3. 68.1 mm, Lavender Road Pit, Ruskin

4. 68.3 mm, Quality Aggregates Pit, Pit # 6, Sarasota



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2



3

4

***Calusacypraea (Calusacypraea) globulina* (Petuch, 2004)**

2004. *Calusacypraea globulina* Petuch

2022. *Calusacypraea (Calusacypraea) globulina* Daughenbaugh and Bridges

HOLOTYPE: American Museum of Natural History, N.Y., FI-50656

TYPE Locality: Quality Aggregates, Inc., Phase 6 Pit, Fruitville, Sarasota, Sarasota County, FL.

Pinecrest Member (Unit 7)

Size range: 50.8-70.3 mm

Shape: Globiform, highly inflated

Base: Rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Steep, smooth, shallow, elongate

Apical sulcus: Open, shallow, labral extension projecting, compressed; shallow pit in the center

Aperture: Open, wide, widening anteriorly, arcuate

Columellar teeth: Short, poorly produced, sometimes bifurcated

Number: 14-16

Labral lip; teeth: Thin; poorly produced, pointed

Number: 19-20

Key Characteristics: Globiform, highly inflated; apical sulcus open, shallow, labral extension projecting, compressed; aperture open, wide, widening anteriorly, arcuate; base rounded, margins rounded; auricles poorly produced, blunt; columella teeth short, poorly produced, sometimes bifurcated; columella smooth; fossula smooth, shallow, elongate.

Comparisons: *C. (C.) globulina* is similar to *C. (C.) duerri* and *C. (Myakkacypraea) myakka*.

However, *C. (C.) duerri* is not as broad a shell with more numerous but more poorly developed columellar teeth. *C. (M.) myakka* is a pyriform, elongate, inflated shell with a narrower aperture and a tapered anterior end.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 32 →

Calusacypraea (Calusacypraea) globulina (Petuch, 2004)

1. 55.6 mm, APAC Pit, Sarasota

2. 57.8 mm, Quality Aggregates Pit, Sarasota

3. 70.3 mm, Lavender Road Pit, Ruskin



1



2



3

***Calusacypraea (Calusacypraea) tequesta* (Petuch, 1996)**

1996. *Siphocypraea (Calusacypraea) tequesta* Petuch

2004. *Calusacypraea tequesta* Petuch

2022. *Calusacypraea (Calusacypraea) tequesta* Daughenbaugh and Bridges

HOLOTYPE: FI Museum of Natural History, IP collection, UF 68250

TYPE Locality: APAC Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 4)

Size range: 58.7-80.0 mm

Shape: Globose, ovoid, inflated, rounded

Base: Rounded

Margins: Rounded

Auricles: Produced, blunt

Columella: Smooth

Fossula: Steep, shallow, elongate, smooth

Apical sulcus: Open, shallow, labral extension projecting; shallow pit in the center

Aperture: Open, wide, widening anteriorly, arcuate

Columellar teeth: Long, wide interstices;

extending to columellar ridge

Number: 16-18

Labral lip; teeth: Thin; poorly produced, pointed

Number: 20-23

Key Characteristics: Globose, ovoid, inflated, rounded shell; apical sulcus open, shallow, labral extension projecting; aperture open, wide, widening anteriorly, arcuate; base rounded; margins rounded; auricles produced, blunt; columellar teeth long, wide interstices, extending to the columellar ridge; columella smooth; fossula smooth, shallow, elongate.

Comparisons: *C. (C.) tequesta* is similar to the older *C. (C.) duerri* and the younger *C. (C.) loxa*. However, *C. (C.) duerri* has a more bulliform shape, a more compressed apical sulcus and smaller, poorly produced columellar teeth with narrower interstices. *C. (C.) loxa* is an oval, rounded, domed, flattened shell with thin, short, sharply pointed anterior teeth and low, adherent posterior teeth.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 33 →

Calusacypraea (Calusacypraea) tequesta (Petuch, 1996)

1. 70.3 mm, Lavender Road Pit, Ruskin

2. 72.3 mm, APAC Pit, Sarasota

3. 58.7 mm, Lavender Road Pit, Ruskin

4. 65.1 mm, APAC Pit, Sarasota



1



2



3



4

***Calusacypraea (Calusacypraea) sarasotaensis* (Petuch, 1994)**

1994. *Siphocypraea sarasotaensis* Petuch

2004. *Calusacypraea sarasotaensis* Petuch

2021. *Calusacypraea (Calusacypraea) sarasotaensis* Petuch and Berschauer

HOLOTYPE: FI Museum of Natural History, IP collection, UF 66226

TYPE Locality: APAC Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 3)

Size range: 41.0-44.6 mm

Shape: Pyriform, rounded, slightly inflated

Base: Rounded

Margins: Produced, rounded

Auricles: Produced, blunt

Columella: Smooth

Fossula: Steep, shallow, smooth, indistinct
or absent

Apical sulcus: Open, shallow, short, blunt

Aperture: Open, wide, widening anteriorly

Columellar teeth: Thin, short, extending to
columellar ridge

Number: 16-18

Labral lip; teeth: Thin, rounded; produced, pointed

Number: 20-23

Key Characteristics: Pyriform, rounded, slightly inflated shell; apical sulcus open, shallow, short, blunt; aperture open, wide, widening slightly anteriorly, slightly arcuate; base rounded; margins produced, rounded; auricles produced, blunt; columellar teeth thin short, extending to the columellar ridge; columella smooth; fossula smooth, shallow, indistinct.

Comparisons: *C. (C.) sarasotaensis* is similar to *C. (C.) loxa* and *C. (Myakkacypraea) schnireli*. However, *C. (C.) loxa* is more inflated and domed with an oval to oval-elongate shape with a narrower aperture and *C. (M.) schnireli* tapers more anteriorly producing a pyriform but slightly flattened, pear-like shape.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 34 →

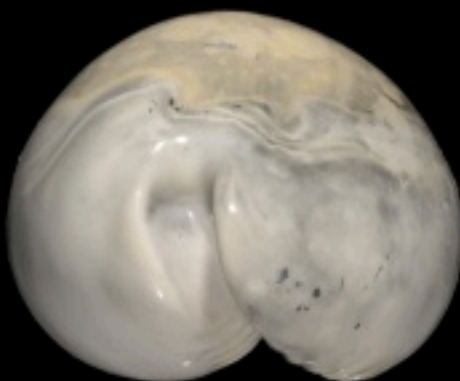
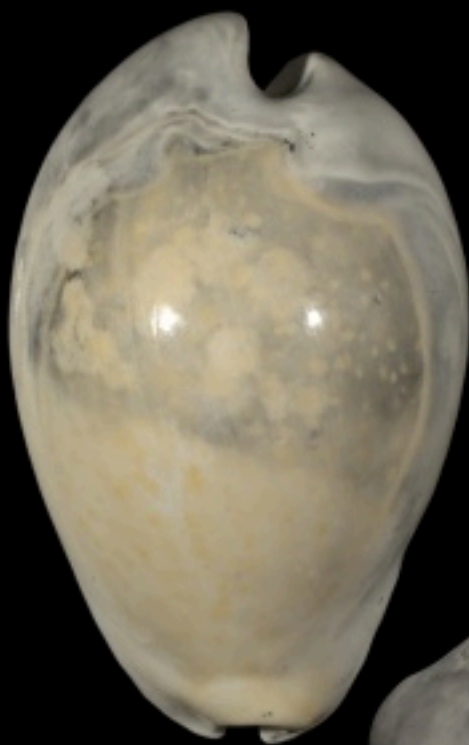
Calusacypraea (Calusacypraea) sarasotaensis (Petuch, 1994)

1. 44.4 mm, Quality Aggregates Pit, Pit # 6, Sarasota

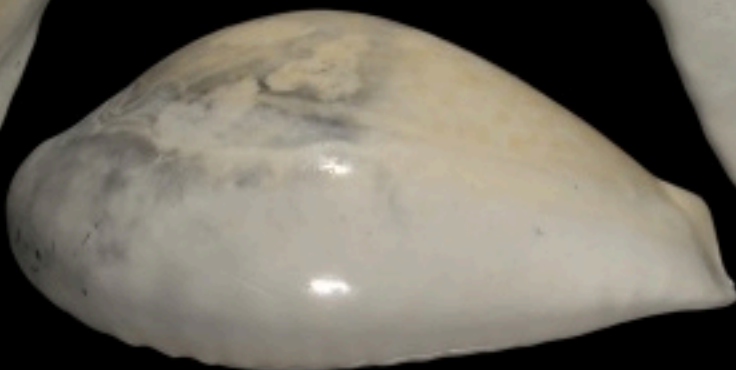
2. 44.6 mm, Quality Aggregates Pit, Sarasota



1



2



***Calusacypraea (Calusacypraea) loxa* Petuch and Drolshagen, 2011**

2011. *Calusacypraea loxa* Petuch and Drolshagen

2022. *Calusacypraea (Calusacypraea) loxa* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13246

TYPE Locality: Quality Aggregates Pit # 9, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 2)

Size range: 42.0-49.4 mm

Shape: Oval, oval-elongate, inflated, rounded, domed

Base: Slightly flattened, flattened

Margins: Produced, subangular, angular

Auricles: Produced, blunt

Columella: Smooth

Fossula: Steep, shallow, smooth, indistinct or absent

Apical sulcus: Open, shallow, short, blunt

Aperture: Open, widening anteriorly

Columellar teeth: Thin, extending to/over columellar ridge; anterior teeth distinct, posterior teeth low, adherent

Number: 12-14

Labral lip; teeth: Thin; poorly produced, pointed

Number: 17-19

Key Characteristics (mature specimens): Oval, oval-elongate, inflated, rounded, domed shell; apical sulcus open, shallow, short, blunt; aperture open, widening anteriorly; base slightly flattened, flattened; margins subangular, angular; auricles produced, blunt; columellar teeth thin, extending to/over columellar ridge; anterior teeth distinct, posterior teeth low, adherent; columella smooth; fossula steep, smooth, shallow, indistinct.

Comparisons: *C. (C.) loxa* is similar to *C. (C.) sarasotaensis*. However, *C. (C.) sarasotaensis* is a more pyriform shell, rounded, only slightly inflated, with shorter columellar teeth and regular interstices while *C. (C.) loxa* is a more oval, inflated shell with mixed columellar teeth. It is also similar to *C. (Myakkacypraea) schnireli*. However, *C. (M.) schnireli* is a more pyriform, slightly flattened shell which tapers anteriorly, resulting in a pear-like shape.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 35 →

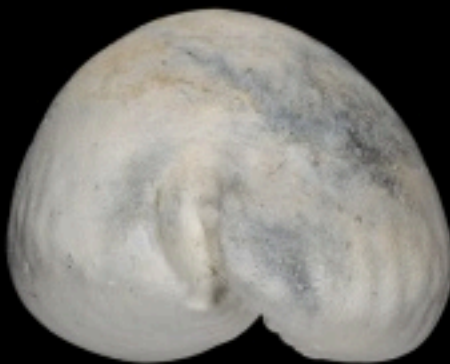
Calusacypraea (Calusacypraea) loxa Petuch and Drolshagen, 2011

1. 46.2 mm, Lavender Road Pit, Ruskin

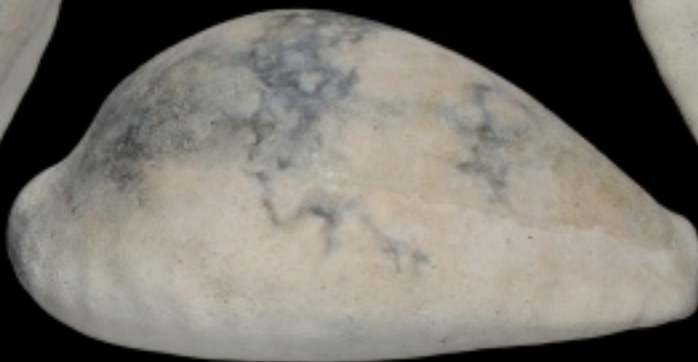
2. 47.5 mm, Lavender Road Pit, Ruskin



1



2



Calusacypraea (Myakkacypraea) Petuch, 2004

Described as “species with more elongated and pyriform shells than seen in the nominate subgenus; apertures narrow, widening only at the anterior end; apertural teeth small and fine; marginal calluses poorly developed or obsolete on old adults; posterior end of lip extending well beyond spire line; apical pit well developed, with tip of spire projecting within”. (Petuch, 2004).

“Myakkacypraea represents a separate lineage of *Calusacypraea* that broke off from *C. duerri* at the end of Buckingham time, and co-occurred with *Calusacypraea (Calusacypraea)* species until the late Piacenzian. Members of the new subgenus differ from members of the nominate subgenus in having elongated, distinctly pyriform shells that contrast with the rounded, globose shells of typical *Calusacypraea* species. The apertures of the two groups also differ markedly. With those of *Calusacypraea* s.s. being wide and flaring and those of *Myakkacypraea* being narrow and flaring only at the anterior end. The new subgenus has only been found in the Myakka Lagoon System deposits of the Sarasota area.” (Petuch, 2004).

In addition to the Sarasota quarries, *Calusacypraea (Myakkacypraea)* species have been collected at the Lavender Road Pit, Ruskin, approximately 20 miles north of Sarasota. The subgenus occupied muddy, brackish, nearshore estuarine lagoons alongside the *Calusacypraea* genus species. This supports Petuch’s assertion that such brackish water lagoons were extensive and fringed the entire western coast of the Pliocene Floridian peninsula.

Neotenic Characteristics

- Shallow, open, short, poorly produced apical sulcus
- Open apertures which widen anteriorly to varying degrees
- Poorly produced, stunted columellar teeth
- Poorly produced, blunt auricles

However, there exist fully mature specimens which have developed a greater degree of callosity.

Comparisons

Calusacypraea (Calusacypraea): Oval, ovoid, inflated shells with wide apertures which widen anteriorly and are arcuate.

- Columella smooth; fossula steep, smooth, shallow: elongate on older species (Units 10-4), indistinct or absent on younger species (Units 3-2).

Calusacypraea (Myakkacypraea): Distinctly pyriform, inflated, elongated shells with narrow apertures which widen anteriorly and are slightly arcuate.

- Columella smooth; fossula steep, smooth, shallow: elongate on older species (Units 7-4), indistinct or absent on younger species (Units 3-2).

Calusacypraea (*Myakkacypraea*) Tamiami Formation species:

Calusacypraea (*Myakkacypraea*) *briani* (Petuch, 1996)

Calusacypraea (*Myakkacypraea*) *myakka* Petuch, 2004 **TYPE**

Calusacypraea (*Myakkacypraea*) *kelleyi* (Petuch, 1998)

Calusacypraea (*Myakkacypraea*) *schnireli* Petuch, 2004

Calusacypraea (Myakkacypraea) Petuch, 2004

***Calusacypraea (Myakkacypraea) briani* (Petuch, 1996)**

1996. *Calusacypraea briani* Petuch

1997. *Siphocypraea (Calusacypraea) briani* Petuch

2004. *Calusacypraea (Myakkacypraea) briani* Petuch

HOLOTYPE: FI Museum of Natural History, IP collection, UF 65245

TYPE Locality: Quality Aggregates, Inc., Phase 7 pit, Sarasota, Sarasota County, FL.

Pinecrest Member (Unit 7)

Size range: 51.0-75.0 mm

Shape: Subcylindrical, elongate

Base: Rounded

Margins: Rounded

Auricles: Produced, projecting, blunt

Columella: Smooth

Fossula: Steep, shallow, smooth, elongate

Apical sulcus: Open, shallow, labral extension projecting; shallow pit in the center

Aperture: Open, proportionally narrow, widening anteriorly

Columellar teeth: Thin, poorly produced posteriorly, extending to columellar ridge

Number: 19-22

Labral lip; teeth: Thin; small, pointed

Number: 21-24

Key Characteristics: Subcylindrical, elongate shell; apical sulcus open, shallow, labral extension projecting; aperture open, proportionally narrow, widening anteriorly; base rounded; margins rounded; auricles produced, projecting, blunt; columellar teeth thin, poorly produced posteriorly, extending to the columellar ridge; columella smooth; fossula steep, smooth, shallow, elongate.

Comparisons: *C. (M.) briani* is similar to *C. (Calusacypraea) duerri*. However, *C. (C.) duerri* is a more globose, bulliform shell, with a compressed apical sulcus and an aperture which is wider and more arcuate anteriorly.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 36 →

Calusacypraea (Myakkacypraea) briani (Petuch, 1996)

1. 74.2 mm, APAC Pit, Sarasota

2. 73.6 mm, Lavender Road Pit, Ruskin

3. 51.0 mm, APAC Pit, Sarasota

4. 71.1 mm, APAC Pit, Sarasota



1



2



3



4



***Calusacypraea (Myakkacypraea) myakka* Petuch, 2004 TYPE**

HOLOTYPE: American Museum of Natural History, N.Y., FI-50657

TYPE Locality: “Black Layer” APAC Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 4)

Size range: 57.2-63.5 mm

Shape: Pyriform, elongate, inflated, anterior slightly tapered

Base: Rounded

Margins: Rounded

Auricles: Poorly produced, slightly projecting, blunt

Columella: Smooth

Fossula: Steep, smooth, narrow, elongate

Apical sulcus: Open, very shallow, blunt

Aperture: Open, proportionally narrow, widening anteriorly

Columellar teeth: Thin, short, stunted; posterior teeth poorly produced

Number: 16-18

Labral lip; teeth: Thin; small, pointed, poorly produced

Number: 17-20

Key Characteristics: Pyriform, elongate, inflated shell with the anterior end slightly tapered; apical sulcus open, very shallow, blunt; aperture open, proportionally narrow, widening anteriorly; base rounded; margins rounded; auricles poorly produced, slightly projecting, blunt; columellar teeth thin, short, poorly produced posteriorly; columella smooth; fossula steep, smooth, narrow, elongate.

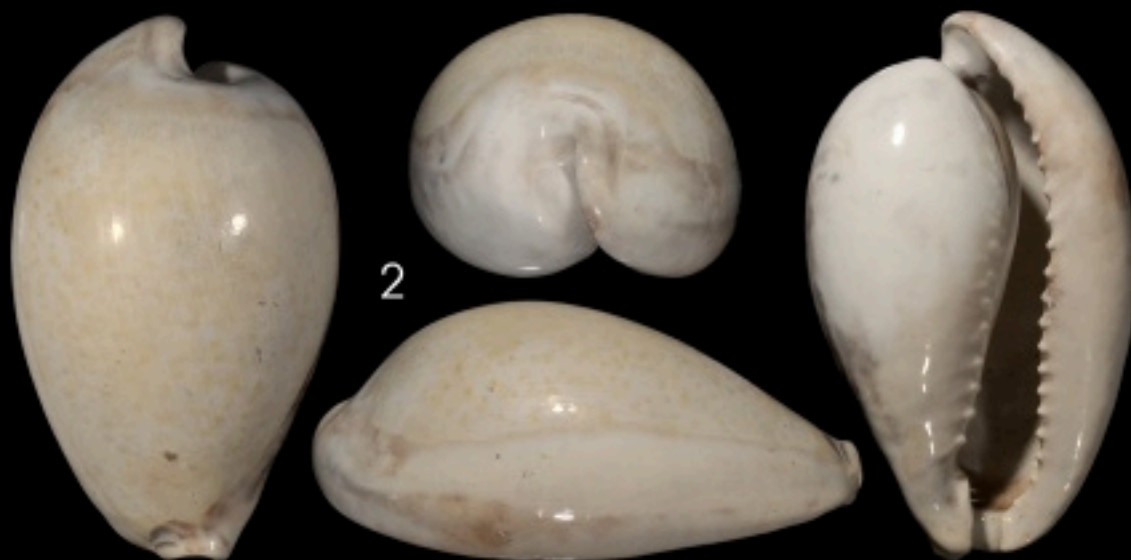
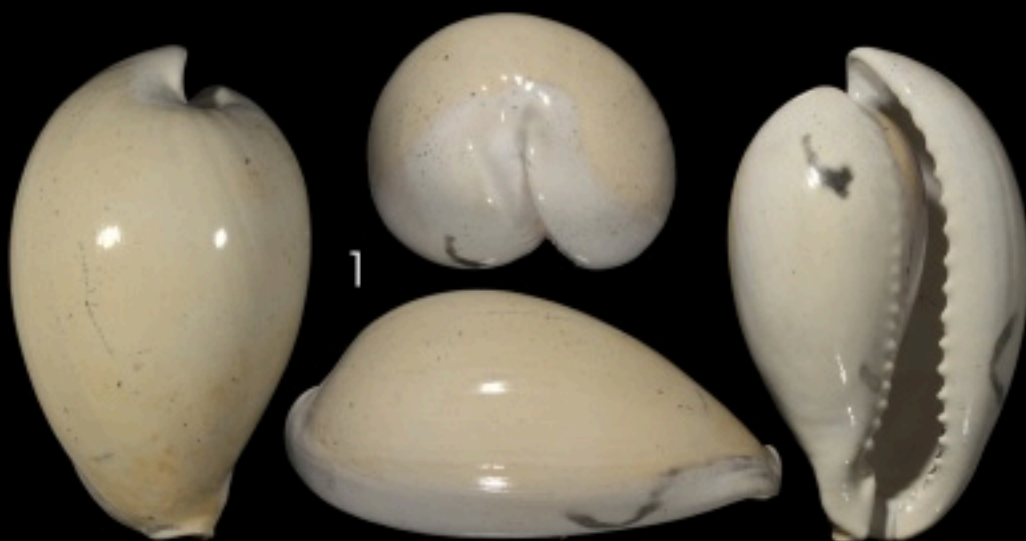
Comparisons: *C. (M.) myakka* is similar to *C. (M.) kelleyi*. However, *C. (M.) kelleyi* is a more ovoid shell, inflated, truncated and with a narrower aperture and an indistinct or absent fossula. *C. (M.) myakka* may also be similar to larger specimens of *C. (Calusacypraea) loxa*. However, *C. (C.) loxa* is a more oval shell with fewer and different columellar teeth.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 37 →

Calusacypraea (Myakkacypraea) myakka Petuch, 2004

1. 52.5 mm, APAC Pit, Sarasota
2. 57.9 mm, Quality Aggregates Pit, Sarasota
3. 55.0 mm, APAC Pit, Sarasota
4. 56.7 mm, APAC Pit, Sarasota



***Calusacypraea (Myakkacypraea) kelleyi* (Petuch, 1998)**

1998. *Siphocypraea (Calusacypraea) kelleyi* Petuch

2004. *Calusacypraea (Myakkacypraea) kelleyi* Petuch

HOLOTYPE: Graves Museum of Archeology & Natural History, UF 84986

TYPE Locality: Quality Aggregates Pit # 6, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 3)

Size range: 39.7-50.1 mm

Shape: Ovoid, inflated

Base: Rounded

Margins: Rounded

Auricles: Produced, slightly projecting,
blunt

Columella: Smooth

Fossula: Steep, smooth, indistinct or absent

Apical sulcus: Open, very shallow, blunt;
shallow pit in the center

Aperture: Narrow, widening slightly anteriorly

Columellar teeth: Thin, posterior teeth poorly
produced; extending to columellar
ridge

Number: 16-18

Labral lip; teeth: Thin; small, pointed

Number: 17-18

Key Characteristics: Ovoid, inflated shell; apical sulcus open, very shallow, blunt; aperture narrow, widening slightly anteriorly; base rounded; margins rounded; auricles produced, slightly projecting, blunt; columellar teeth thin, posterior teeth poorly produced, extending to the columellar ridge; columella smooth; fossula steep, smooth, indistinct or absent.

Comparisons: *C. (M.) kelleyi* is similar to *C. (M.) myakka*. However, *C. (M.) myakka* is a pyriform, elongate shell, with a wider aperture.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 38 →

Calusacypraea (Myakkacypraea) kelleyi (Petuch, 1998)

1. 49.4 mm, Lavender Road Pit, Ruskin

2. 39.7 mm, Lavender Road Pit, Ruskin

3. 40.3 mm, Quality Aggregates Pit, Pit # 6, Sarasota

4. 45.3 mm, Quality Aggregates Pit, Pit # 6, Sarasota



1



2



3



4

***Calusacypraea (Myakkacypraea) schnireli* Petuch, 2004**

HOLOTYPE: American Museum of Natural History, N.Y., FI-50658

TYPE Locality: Quality Aggregates Pit # 9, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 2)

Size range: 38.0-59.1 mm

Shape: Pyriform, inflated, tapered anteriorly

Base: Rounded, slightly flattened

Margins: Rounded, subangular

Auricles: Produced, projecting, blunt

Columella: Smooth

Fossula: Steep, shallow, smooth, indistinct or absent

Apical sulcus: Open, very shallow, blunt with posterior projection well produced

Aperture: Proportionally narrow, widening slightly anteriorly

Columellar teeth: Thin; absent or poorly produced posteriorly on some specimens, extending to columellar ridge

Number: 14-17

Labral lip; teeth: Rounded; small, pointed

Number: 17-18

Key Characteristics: Pyriform, inflated, tapered anteriorly shell; apical sulcus open, very shallow, blunt with the posterior projection well produced; aperture proportionally narrow, widening slightly anteriorly; base rounded, slightly flattened; margins rounded, subangular; auricles produced, projecting, blunt; columellar teeth thin, absent or poorly produced posteriorly on some specimens, extending to the columellar ridge; columella smooth; fossula smooth, shallow, indistinct or absent.

Comparisons: *C. (M.) schnireli* is similar to *C. (M.) myakka* and *C. (Calusacypraea) loxa*. However, *C. (M.) myakka* is an ovoid, more inflated shell which tapers only slightly toward the anterior end; and possesses a better developed and larger posterior labial extension. *C. (C.) loxa* is a more inflated, domed, oval, oval-elongate shell with a narrower aperture.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Note: the original description was based on an immature specimen.

Plate 39 →

Calusacypraea (Myakkacypraea) schnireli Petuch, 2004

1. 38.0 mm, Quality Aggregates Pit, Pit # 9, Sarasota

2. 52.3 mm, Quality Aggregates Pit, Sarasota



***Pseudadusta (Bithloa)* Petuch and Drolshagen, 2011**

Originally proposed as a subgenus of *Pseudadusta*, representing “species with extremely elongated, cylindrical shells with narrow apertures and fine apertural teeth”. (Petuch & Drolshagen).

Described as: “Shells generally large for genus, extremely elongated and cylindrical; bases of shells slightly flattened; apical sulci simple vertical slots, often slightly recurved; apertures uniformly narrow, slot-like”. (Petuch & Drolshagen).

“With their elongated, canoe-shaped shells, members of the new subgenus are among some of the oddest-appearing cowries in southern Florida. This characteristic shell shape, along with their extremely elongated and narrow apertures, readily separates *Bithloa* species from other species of *Pseudadusta* cowries. Like members of the nominate subgenus, species included in the new subgenus occurred in both coral reef and Turtle Grass areas. This was a short-lived group, first appearing in the late Piacenzian Pliocene and becoming extinct before the beginning of the Pleistocene.” (Petuch & Drolshagen).

Tamiami Formation *Pseudadusta (Bithloa)* species were aligned as follows (Petuch et al., 2011):

Pseudadusta (Bithloa) irisae Petuch and Drolshagen, 2011 **[P] TYPE**

Pseudadusta (Bithloa) kalafuti (Petuch, 1994)

Pseudadusta (Bithloa) juyingae Petuch and Drolshagen, 2011

Pseudadusta (Bithloa) gumbinneri Petuch and Drolshagen, 2011

Mature *Pseudadusta (Bithloa)* species are all ribbed along the top of the columella and possess a shallow fossula, varying from indistinct to distinct. See **Comparisons** below.

Reassignment

Originally placed in the *Pseudadusta* genus, *P. buckinghamensis* and *P. hertweckorum* possess characteristics which more closely with the *Pseudadusta (Bithloa)* subgenus. The ovately pyriform shape of *P. buckinghamensis* comes close to cylindrical on larger, elongated specimens (the Holotype is only 42.9 mm); the columellar teeth extend onto the top of the columella producing a columella which is ribbed along the top on mature specimens; the fossula is either indistinct or distinct depending on the maturity of the individual specimen. Based on these characteristics, the species is reassigned as *Pseudadusta (Bithloa) buckinghamensis* (Petuch and Drolshagen, 2011).

Similarly, *P. hertweckorum* possesses columellar teeth which extend onto the columella, producing a partially ribbed columella in mature specimens with a fossula which is either indistinct or distinct, depending upon the maturity of the specimen. It is also reassigned as *Pseudadusta (Bithloa) hertweckorum* (Petuch, 1991).

Pseudadusta (Bithloa) is the oldest group of *Pseudadusta* and is the predecessor of *Pseudadusta s.s.*, as *Seminolecypraea* is to *Siphocypraea s.s.*

Unit Designation

All *Pseudadusta (Bithloa) irisae* were collected from spoil piles at the Collier, Lee and Highlands quarries. None have been collected *in situ*. As such, the unit designation for that species is based upon perceived morphological development of the individual species and is considered provisional [P].

Comparisons

***Pseudadusta (Bithloa)*:** “Shells generally large for genus, extremely elongated and cylindrical; bases of shells slightly flattened; apical sulci simple vertical slots, often slightly recurved; apertures uniformly narrow, slot-like” (Petuch and Drolshagen, 2011).

- Columellar teeth thin, extending onto the top of the columella; columella ribbed along the top; fossula indistinct/distinct on mature specimens.

***Pseudadusta (Pseudadusta)*:** Pyriform or ovate, inflated, domed or high humped; apical sulcus simple, shallow, slightly pinched; aperture uniformly narrow; base rounded; auricles blunt; columellar dentition well developed.

- Columellar teeth thin, extending over the columella; columella ribbed; fossula absent.

***Pseudadusta (Carloscypraea)*:** Pyriform to cylindrical, elongated shells; apical sulcus simple, shallow, slightly pinched, blunt; aperture narrow, widening slightly anteriorly; base rounded; auricles blunt.

- Columellar teeth short, extending to/onto the columellar ridge; columella smooth; fossula absent.

Pseudadusta (Bithloa) Tamiami Formation species:

Pseudadusta (Bithloa) buckinghamensis (Petuch and Drolshagen, 2011)

Pseudadusta (Bithloa) hertweckorum (Petuch, 1991)

Pseudadusta (Bithloa) irisae Petuch and Drolshagen, 2011 [P] **TYPE**

Pseudadusta (Bithloa) kalafuti (Petuch, 1994)

Pseudadusta (Bithloa) juyingae Petuch and Drolshagen, 2011

Pseudadusta (Bithloa) gumbinneri Petuch and Drolshagen, 2011

Pseudadusta (Bithloa) Petuch and Drolshagen, 2011

***Pseudadusta (Bithloa) buckinghamensis* (Petuch and Drolshagen, 2011)**

2011. *Pseudadusta buckinghamensis* Petuch and Drolshagen

2022. *Pseudadusta (Bithloa) buckinghamensis* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13255

TYPE Locality: Quality Aggregates Pit # 6, Sarasota, Sarasota County, FL.

Buckingham Member (Unit 10)

Size range: 42.9-69.5 mm

Shape: Ovately pyriform, inflated

Base: Slightly rounded

Margins: Rounded

Auricles: Poorly produced, slightly projecting, blunt

Columella: Ribbed along top

Fossula: Steep, smooth, elongate, indistinct/distinct

Apical sulcus: Simple, shallow, slightly pinched, blunt

Aperture: Narrow

Columellar teeth: Thin, extending onto the top of the columella

Number: 17-18

Labral lip; teeth: Thin, rounded; thick, pointed

Number: 19-23

Key Characteristics: Ovately pyriform, inflated shell; apical sulcus simple, shallow, slightly pinched, blunt; aperture narrow; base slightly rounded; margins rounded; auricles poorly produced, projecting slightly, blunt; columellar teeth thin, extending onto the top of the columella; columella ribbed along the top; fossula indistinct/distinct.

Comparisons: *P. (B.) buckinghamensis* is similar to both *P. (B.) irisae*, *P. (B.) kalafuti* and *P. (Carloscypraea) metae*. However, *P. (B.) irisae* is a more cylindrical shell with a uniformly narrow aperture and a thicker labral lip. *P. (B.) kalafuti* is a cylindrical shell with a more open aperture and more numerous teeth. *P. (C.) metae* has a more open aperture and lacks a fossula.

Range: APAC and Quality Aggregates Pits (later SMR Aggregates), Sarasota, Sarasota County.

Plate 40 →

Pseudadusta (Bithloa) buckinghamensis (Petuch and Drolshagen, 2011)

1. 69.5 mm, Quality Aggregates Pit, Pit # 6, Sarasota
2. 50.1 mm, SMR Aggregates Pit, Sarasota
3. 54.8 mm, Quality Aggregates Pit, Sarasota
4. 58.4 mm, APAC Pit, Sarasota



***Pseudadusta (Bithloa) hertweckorum* (Petuch, 1991)**

1991. *Siphocypraea hertweckorum* Petuch

1997. *Siphocypraea (Akleistostoma) hertweckorum* Petuch

2004. *Pseudadusta hertweckorum* (Petuch)

2022. *Pseudadusta (Bithloa) hertweckorum* Daughenbaugh and Bridges

HOLOTYPE: Carnegie Museum of Natural History, CM35631

TYPE Locality: APAC Pit, Sarasota, Sarasota County, FL.

Pinecrest Member (Unit 7), Tamiami Formation

Also: Golden Gate Member (Unit 7 equivalent), Tamiami Formation

Size range: 59.0-68.4 mm

Shape: Oval-elongate, high domed

Base: Slightly rounded, flattened

Margins: Callous, subangular, angular

Auricles: Produced, slightly projecting,
blunt

Columella: Ribbed along top

Fossula: Steep, smooth, elongate,
indistinct/distinct

Apical sulcus: Simple, parallel, slightly pinched

Aperture: Narrow throughout

Columellar teeth: Thin, extending onto the
columellar ridge

Number: 18-20

Labral lip; teeth: Thicker anteriorly, rounded;
thick, pointed

Number: 18-22

Key Characteristics: Oval-elongate shell with a high domed dorsum; apical sulcus simple, parallel, slightly pinched; aperture narrow throughout; base slightly rounded, flattened; margins callous, subangular, angular; auricles produced, slightly projecting, blunt; columellar teeth extending onto the columellar ridge; columella ribbed along top; fossula steep, smooth, elongate, indistinct/distinct.

Comparisons: *P. (B.) hertweckorum* is similar to some inflated specimens of *P. (Carlosocypraea) metae*. However, *P. (C.) metae* is a more cylindrical, elongated shell; with an open aperture widening slightly anteriorly; produced, projecting, blunt auricles; and a thin labial lip. It also lacks a fossula.

Range: In coral bioherms at the APAC and Quality Aggregates Pits (later SMR Aggregates), Sarasota, and at the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 41 →

Pseudadusta (Bithloa) hertweckorum (Petuch, 1991)

1. 56.1 mm, APAC Pit, Sarasota

2. 59.0 mm, Lavender Road Pit, Ruskin

3. 58.6 mm, APAC Pit, Sarasota



1



2



3

***Pseudadusta (Bithloa) irisae* Petuch and Drolshagen, 2011 TYPE**

HOLOTYPE: Paleontological Research Institute, PRI 13261

TYPE Location: Florida Rock Industries Naples Quarry (Old Mule Pen Quarry), East Naples, Collier County, FL.

Golden Gate Member (Unit 4 equivalent) [P]

Size range: 57.5-68.2 mm

Shape: Cylindrical, elongate, rounded, inflated

Base: Slightly flattened

Margins: Subangular

Auricles: Produced, slightly projecting, blunt

Columella: Ribbed along top

Fossula: Steep, smooth, elongate, indistinct/distinct

Apical sulcus: Simple, shallow, slightly pinched, blunt

Aperture: Uniformly narrow

Columellar teeth: Thin, extending onto the top of the columella

Number: 19-21

Labral lip; teeth: Steep, rounded; thick, pointed

Number: 19-22

Key Characteristics: Cylindrical, elongate, rounded, inflated shell; apical sulcus simple, shallow, slightly pinched, blunt; aperture uniformly narrow; base slightly flattened; margins subangular; auricles produced, slightly projecting, blunt; columellar teeth extending onto the top of the columella; columella ribbed along the top; fossula distinct.

Comparisons: *P. (B.) irisae* is similar to *P. (B.) buckinghamensis* and *P. (B.) kalafuti*. However, *P. (B.) buckinghamensis* is a more ovately pyriform shell with more rounded base and margins; auricles and fossula that are not as well produced. *P. (B.) kalafuti* is not as rounded a shell with a more projecting apical sulcus; an open aperture, widening anteriorly; better produced, projecting auricles.

Range: Bonita Springs Aggregates Pit and Florida Rock Industries (Old Mule Pen Quarry).

Plate 42 →

Pseudadusta (Bithloa) irisae Petuch and Drolshagen, 2011
68.2 mm, Old Mule Pen Quarry, East Naples



***Pseudadusta (Bithloa) kalafuti* (Petuch, 1994)**

1994. *Siphocypraea kalafuti* Petuch

1997. *Siphocypraea (Akleistostoma) kalafuti* Petuch

2004. *Pseudadusta kalafuti* Petuch

2011. *Pseudadusta (Bithloa) kalafuti* Petuch and Drolshagen

HOLOTYPE: FI Museum of Natural History, IP collection, UF 66231

TYPE Locality: Quality Aggregates Pit # 6, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 3)

Size range: 64.7-83.0 mm

Shape: Cylindrical, rounded, very elongate

Base: Slightly flattened, flattened

Margins: Produced, rounded → angular

Auricles: Produced, projecting, blunt

Columella: Ribbed along top

Fossula: Steep, smooth, elongate, distinct

Apical sulcus: Simple, shallow, slightly pinched projecting

Aperture: Open, widening slightly anteriorly

Columellar teeth: Thin, extending onto the top of the columella

Number: 17-19

Labral lip; teeth: Rounded; thick, pointed

Number: 20-22

Key Characteristics: Cylindrical, rounded, very elongate; apical sulcus simple, shallow, slightly pinched, projecting; aperture open, widening slightly anteriorly; base slightly flattened, flattened; margins produced, rounded → angular; auricles, produced, projecting, blunt; columellar teeth thin, extending onto the top of the columella; columella ribbed along the top; fossula distinct.

Comparisons: *P. (B.) kalafuti* is similar to *P. (B.) irisae*. However, *P. (B.) irisae* is a more rounded shell with a blunt apical sulcus; and a uniformly narrow aperture. It is also similar to *P. (B.) juyingae*. However, *P. (B.) juyingae* is a pyriform shell with a rostrate appearance and an indistinct fossula.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 43 →

Pseudadusta (Bithloa) kalafuti (Petuch, 1994)

1. 79.3 mm, Lavender Road Pit, Ruskin

2. 71.7 mm, Quality Aggregates Pit, Sarasota

3. 74.1 mm, Quality Aggregates Pit, Pit # 6, Sarasota

4. 79.1 mm, Quality Aggregates Pit, Pit # 6, Sarasota



***Pseudadusta (Bithloa) juyingae* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13262

TYPE Locality: Quality Aggregates Pit # 9, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 2)

Size range: 45.0-59.9 mm

Shape: Pyriform, subglobose, elongate

Base: Flattened

Margins: Produced, subangular, angular

Auricles: Produced, projecting

Columella: Ribbed along top

Fossula: Steep, smooth, elongate, indistinct

Apical sulcus: Simple, shallow, slightly pinched, projecting beyond body whorl

Aperture: Open, widening slightly anteriorly

Columellar teeth: Thin, extending onto the columella

Number: 14-15

Labral lip; teeth: Rounded; thick, pointed

Number: 18-19

Key Characteristics: Pyriform, subglobose, elongated shell with a rostrate appearance; apical sulcus simple, shallow, slightly pinched, projecting beyond body whorl; aperture open, widening slightly anteriorly; base flattened; margins produced, subangular, angular; auricles produced, projecting; columellar teeth thin, extending onto the columella; columella ribbed along the top; fossula indistinct.

Comparisons: *P. (B.) juyingae* is similar to *P. (B.) kalafuti*. However, *P. (B.) kalafuti* is a very elongate shell with a narrower aperture which widens slightly anteriorly; a thick labral lip; a distinct fossula.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 44 →

Pseudadusta (Bithloa) juyingae Petuch and Drolshagen, 2011

1. 51.8 mm, Quality Aggregates Pit, Sarasota

2. 59.9 mm, Lavender Road Pit, Ruskin

3. 45.0 mm, Quality Aggregates Pit, Pit # 9, Sarasota



***Pseudadusta (Bithloa) gumbinneri* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13264

TYPE Locality: Quality Aggregates Pit # 9, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 2)

Also: Golden Gate Member (Unit 2 equivalent)

Size range: 42.0-53.2 mm

Shape: Cylindrical, roughly rectangular, elongate

Base: Flattened

Margins: Callous, subangular, angular

Auricles: Poorly produced, blunt

Columella: Ribbed along top

Fossula: Steep, smooth, elongate, indistinct/distinct

Apical sulcus: Simple, shallow, slightly pinched, slightly projecting

Aperture: Narrow, widening anteriorly on some

Columellar teeth: Thin, extending onto the columella in mature specimens

Number: 14-18

Labral lip; teeth: Rounded; thick, pointed

Number: 17-19

Key Characteristics: Cylindrical, roughly rectangular, elongate shell; apical sulcus simple, shallow, slightly pinched, slightly projecting; aperture narrow, widening slightly anteriorly on some specimens; base flattened; margins callous, subangular, angular; auricles poorly produced, blunt; columellar teeth thin, extending onto the columella in mature specimens; columella ribbed along the top; fossula indistinct. NOTE; Subadult, young adult specimens have poorly produced columellar teeth which do not extend as far into the aperture.

Comparisons: *P. (B.) gumbinneri* is similar to *P. (B.) juyingae*. However, *P. (B.) juyingae* is a pyriform, subglobose shell with an aperture which widens only slightly anteriorly; better developed columellar dentition; produced, projecting auricles.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County.

Plate 45 →

Pseudadusta (Bithloa) gumbinneri Petuch and Drolshagen, 2011

1. 53.2 mm, APAC Pit, Sarasota

2. 50.5 mm, Quality Aggregates Pit, Pit # 9, Sarasota



1



2



Pseudadusta (Pseudadusta) Petuch, 2004

Described as: “Shells of average size for family, pyriform in shape, inflated, solid and heavy; posterior and anterior ends projecting, well-developed; shell base rounded; margins thickened, well-developed, often heavily callused; apical sulci simple, slotlike, almost straight or only slightly curved; apertures very narrow throughout, with no anterior widening; labial and columellar dentition extremely well-developed, with prominent coarse teeth.” (Petuch, 2004, p. 275). The description is accepted with the proviso that the apertures on some species do widen slightly at the anterior end.

Type Species: *Pseudadusta (Pseudadusta) lindae* (Petuch, 1986) (as *Cypraea lindae*).

“This new, previously unrecognized genus of bernayinine cowries evolved from *Akleistostoma* Gardner, 1948 during the Zanclean Pliocene. Although sharing the same rounded, globose shape and having the same type of marginal callus development as *Akleistostoma*, *Pseudadusta* differs from the progenitor in having a very narrow aperture instead of an open one, in having narrower posterior and anterior canals, and in having a deeper and narrower apical sulcus. The new genus is also much more geographically limited, being found only in the Myakka Lagoon System and the coral reef tracts of the Tamiami Subsea of the Okeechobean Sea. *Akleistostoma*, on the other hand, had far greater range, with species being found all the way from Virginia to the northern Gulf of Mexico. *Pseudadusta* appears abruptly in the basal Piacenzian (Buckingham time) and existed only to the late Piacenzian (Fruitville Unit 2).” (Petuch, 2004, p. 175).

“Many *Pseudadusta* species were associated with coral reef environments, particularly the zoned reef complexes and coral bioherms of the Everglades Pseudoatoll (well-preserved in the Golden Gate Member of the Tamiami Formation). At fossil reef localities such as at the Mule Pen Quarry (East Naples, Collier County) and at the Bird Road excavation (Miami, Dade County), the majority of the cowries encountered belonged to the genus *Pseudadusta*, demonstrating their preference for coralline environments. These species apparently lived in the coral rubble environment of the Back Reef Zone, where they probably grazed on sponges, hydroids and dasycladacean algae. Other *Pseudadusta* species lived in muddy, nearshore environments and shallow water Turtle Grass beds.” (Petuch et al., 2018 p. 193).

NOTE: The presence of *P. (P.) lindae*, *P. (P.) collierensis* and *P. (P.) roachi* at the Lavender Road Pit, Ruskin, approximately 20 miles north of Sarasota suggests that patch reefs and coral bioherms existed outside the main coral reef systems. The bioherms would have consisted of corals, echinoderms, gastropods, mollusks and calcareous algae, providing habitats for these coralline loving species. The matrix at the Lavender Road Pit suggests that these species lived adjacent to estuarine habitats.

Mature *Pseudadusta (Pseudadusta)* species are all ribbed along the top and possess a shallow fossula, varying from indistinct to distinct. See **Comparisons** in following texts.

Assignment

Tamiami Formation *Pseudadusta* species, *Pseudadusta* (*Pseudadusta*) species herein, were assigned as follows (Petuch et al., 2011):

Pseudadusta (*Pseudadusta*) (Golden Gate Member, Tamiami Formation)

Also: (Fruitville Member, Tamiami Formation) species:

Pseudadusta (*Pseudadusta*) *lindae* (Petuch, 1986) **TYPE**

Pseudadusta (*Pseudadusta*) *collierensis* Petuch and Drolshagen, 2011

Pseudadusta (*Pseudadusta*) *fehsei* Petuch and Drolshagen, 2011

Pseudadusta (*Pseudadusta*) *ketteri* (Petuch, 1994)

Also, Golden Gate Member, Tamiami Formation

Pseudadusta (*Pseudadusta*) *roachi* Petuch and Drolshagen, 2011

Reassignment A

Originally assigned to the *Pseudadusta* genus in 2011, but reassigned herein as follows:

Pseudadusta (*Bithloa*) *buckinghamensis* (Petuch and Drolshagen, 2011)

Pseudadusta (*Bithloa*) *hertweckorum* (Petuch, 1991)

Pseudadusta (*Carloscypraea*) *metae* (Petuch, 1994)

Pseudadusta (*Carloscypraea*) *yingsti* (Petuch and Drolshagen, 2011)

See the *Pseudadusta* (*Bithloa*) and *Pseudadusta* (*Carloscypraea*) Sections.

Reassignment B

Pseudadusta judei Petuch and Drolshagen, 2011 was placed in the *Pseudadusta* genus. The Holotype of the *P. judei* was described as apical sulcus slightly curved, aperture narrow, becoming wider at the anterior end, posterior columellar teeth becoming obsolete. However, the *Pseudadusta* genus was described as apical sulcus simple slot-like, narrow aperture with strong dentition. The characteristics of the species do not align with the characteristics of the *Pseudadusta* genus.

As no other *Pseudadusta* species have been reported or recorded from Kissimmee, the genus appears to be restricted to Myakka and the Golden Gate Member of the Everglades Pseudoatoll. The latter are separated from Kissimmee by the massive Polk Peninsula to the west as well as the narrow, deep water Caloosahatchee and Loxahatchee Straits to the south. The absence of either an ancestor or successor *Pseudadusta* species or a viable path of migration into Kissimmee from known *Pseudadusta* areas means the presence of the genus *Pseudadusta* in Kissimmee is unsupported at this time.” (Daughenbaugh, 2019d).

Rather, the characteristics align with those of the *Pahayokea* genus, including the fossula. The species is reassigned to that genus as *Pahayokea judei* (Petuch and Drolshagen, 2011).

Unit Designation

Dating species from the Golden Gate Member coral facies is challenging as the facies of the member present no clear time delineation, i.e., the facies is a continuum. This is compounded by the intertonguing of laterally adjacent (next to each other) strata facies of the upper beds where the facies are virtually identical. For example, the carbonate facies of the Fordville-aged reefs intertongue with the subjacent carbonate facies of the upper Immokalee Reef Tract (Unit 2) of the Golden Gate Member. In addition, as sediments are relatively close to the surface, their mining tends to intermingle the strata. While the dating of lower bed species is sometimes possible based upon correlation with type species from geographically separate, more defined members, this does not apply to the upper bed members.

With *Pseudadusta* (*Pseudadusta*), all specimens were collected from spoil piles at the Collier, Lee, DeSoto, Sarasota and Lavender Road pits or from temporary pits at construction sites. As such, all unit designations are based upon perceived morphological developments of the individual species and are considered provisional [P].

Comparisons

Pseudadusta (*Bithloa*): “Shells generally large for genus, extremely elongated and cylindrical; bases of shells slightly flattened; apical sulci simple vertical slots, often slightly recurved; apertures uniformly narrow, slot-like” (Petuch and Drolshagen, 2011).

- Columellar teeth thin, extending onto the top of the columella; columella ribbed along the top; fossula indistinct/distinct on mature specimens.

Pseudadusta (*Pseudadusta*): Pyriform or ovate, inflated, domed or high humped; apical sulcus simple, shallow, slightly pinched; aperture uniformly narrow; base rounded, subangular; auricles blunt; columellar dentition well developed.

- Columellar teeth thin, extending onto the columella; columella ribbed; fossula absent.

Pseudadusta (*Carloscypraea*): Pyriform to cylindrical, elongated shells; apical sulcus simple, shallow, slightly pinched, blunt; aperture narrow, widening slightly anteriorly; base rounded; auricles blunt.

- Columellar teeth short, extending to/onto the columellar ridge; columella smooth; fossula absent.

Pseudadusta (Pseudadusta) (Golden Gate Member, Tamiami Formation)

Also: (Fruitville Member, Tamiami Formation) species:

Pseudadusta (Pseudadusta) lindae (Petuch, 1986) **TYPE [P]**

Pseudadusta (Pseudadusta) collierensis Petuch and Drolshagen, 2011 **[P]**

Pseudadusta (Pseudadusta) fehsei Petuch and Drolshagen, 2011 **[P]**

Pseudadusta (Pseudadusta) ketteri (Petuch, 1994) **[P]**

Also, Golden Gate Member, Tamiami Formation

Pseudadusta (Pseudadusta) roachi Petuch and Drolshagen, 2011 **[P]**

Pseudadusta (Pseudadusta) Petuch, 2004

***Pseudadusta (Pseudadusta) lindae* (Petuch, 1986) TYPE**

1986. *Cypraea lindae* Petuch

1997. *Siphocypraea (Akleistostoma) lindae* Petuch

2004. *Pseudadusta lindae* Petuch

2022. *Pseudadusta (Pseudadusta) lindae* Daughenbaugh and Bridges

HOLOTYPE: Museum of Comparative Zoology, Harvard, MCZ29221

TYPE Locality: “Lakes of the Meadows” housing excavation, 147th and Bird Road, Miami, Dade County, FL.

Golden Gate Member (Unit 4 equivalent) [P]

Also: Fruitville Member (Unit 4), Tamiami Formation

Size range: 43.2-56.0 mm

Shape: Ovate- elongate, ovate, compact, rounded, high domed

Base: Slightly flattened, flattened

Margins: Callous, angular

Auricles: Produced, slightly projecting, blunt

Columella: Ribbed

Fossula: Indistinct or absent

Apical sulcus: Simple, slot-like, slightly pinched, projecting

Aperture: Uniformly narrow

Columellar teeth: Thin, long, extending onto columella

Number: 15-18

Labral lip; teeth: Thick, steep; extending onto base

Number: 18-21

Key Characteristics: Ovate, compact, rounded, high domed shell; apical sulcus simple, slot-like, slightly pinched, projecting; aperture uniformly narrow; base slightly flattened, flattened; margins callous, angular; auricles produced, slightly projecting, blunt; columellar teeth thin, extending onto the columella; columella ribbed; fossula indistinct or absent.

Comparisons: *P. (P.) lindae* is similar to *P. (P.) collierensis* and *P. (P.) roachi*. However, *P. (P.) collierensis* is a more oval, inflated shell with slightly rounded, rounded base; rounded, subangular margins; and poorly produced, blunt auricles. *P. (P.) roachi* is a slender, less inflated shell with fewer apertural teeth and blunter auricles.

Range: Golden Gate Member at Miami, Naples and Bonita Springs. Also collected in the Fruitville Member at the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 46 →

Pseudadusta (Pseudadusta) lindae (Petuch, 1986)

1. 46.8 mm, Old Mule Pen Quarry, East Naples

2. 55.2 mm, Old Mule Pen Quarry, East Naples

3. 48.7 mm, Lavender Road Pit, Ruskin

4. 56.0 mm, Old Mule Pen Quarry, East Naples



1



2



3



4

***Pseudadusta (Pseudadusta) fehsei* (Petuch and Drolshagen, 2011)**

2011. *Pseudadusta fehsei* Petuch and Drolshagen

2022. *Pseudadusta (Pseudadusta) fehsei* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13256

TYPE Locality: Florida Rock Industries Naples Quarry (Old Mule Pen Quarry), East Naples, Collier County, FL.

Golden Gate Member (Unit 3 equivalent) [P]

Also: Fruitville Member (Unit 3), Tamiami Formation [P]

Size range: 63.2-73.9mm

Shape: Subpyriform, inflated, rounded

Base: Slightly rounded, flattened

Margins: Rounded → angular

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Absent

Apical sulcus: Simple, slightly curled, blunt

Aperture: Uniformly narrow

Columellar teeth: Thin, extending onto columella

Number: 17-20

Labral lip; teeth: Rounded; extending onto base

Number: 19-22

Key Characteristics: Subpyriform, inflated, rounded shell; apical sulcus simple, shallow, slightly curled, blunt; aperture uniformly narrow; base slightly rounded, flattened; margins rounded → angular in the most mature specimens; auricles poorly produced, blunt; columellar teeth extending onto the columella; columella ribbed; fossula absent.

Comparisons: The shape and size of *P. (P.) fehsei* are singular within the genus.

Range: Florida Rock Industries (Old Mule Pen Quarry).

Plate 47 →

Pseudadusta (Pseudadusta) fehsei (Petuch and Drolshagen, 2011)

1. 63.2 mm, Old Mule Pen Quarry, East Naples

2. 64.2 mm, Old Mule Pen Quarry, East Naples

3. 73.9 mm, Old Mule Pen Quarry, East Naples



1



2



3

***Pseudadusta (Pseudadusta) collierensis* (Petuch and Drolshagen, 2011)**

2011. *Pseudadusta (Bithloa) collierensis* Petuch and Drolshagen

2018. *Pseudadusta collierensis* Petuch et al.

2022. *Pseudadusta (Pseudadusta) collierensis* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13263

TYPE Locality: Florida Rock Industries Naples Quarry (Old Mule Pen Quarry), East Naples, Collier County, FL.

Golden Gate Member (Unit 3 equivalent) [P]

Also: Fruitville Member (Unit 3), Tamiami Formation.

Size range: 42.2-52.2 mm

Shape: Oval, inflated, high domed

Base: Slightly rounded, flattened

Margins: Rounded, subangular

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Absent

Apical sulcus: Simple, slightly curled, blunt

Aperture: Uniformly narrow

Columellar teeth: Thin, extending onto columella

Number: 15-18

Labral lip; teeth: Rounded; extending onto base

Number: 19-22

Key Characteristics: Oval, inflated, high domed shell; apical sulcus simple, slightly curled, blunt; aperture uniformly narrow; base slightly rounded to flattened; margins rounded, subangular; auricles poorly produced, blunt; columellar teeth extending onto the columella; columella ribbed; fossula absent.

Comparisons: *P. (P.) collierensis* is similar to *P. (P.) lindae* and *P. (P.) roachi*. However, *P. (P.) lindae* is a heavier, more ovate shell with callous, subangular, angular margins; better produced, projecting auricles and a steep, thick labral lip. *P. (P.) roachi* is a less inflated shell with fewer apertural teeth and blunt auricles.

Range: Naples, Collier County and Lee County quarries.

Plate 48 →

Pseudadusta (Pseudadusta) collierensis (Petuch and Drolshagen, 2011)

1. 52.2 mm, Old Mule Pen Quarry, East Naples

2. 40.3 mm, Burnt Store Road Pit, Lee County

3. 50.2 mm, Burnt Store Road Pit, Lee County



1



2



3

***Pseudadusta (Pseudadusta) ketteri* (Petuch, 1994)**

1994. *Siphocypraea ketteri* Petuch

2004. *Pseudadusta ketteri* Petuch

2022. *Pseudadusta (Pseudadusta) ketteri* Daughenbaugh and Bridges

HOLOTYPE: FI Museum of Natural History, IP collection, UF 66229

TYPE Locality: APAC Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 3)

Also: Golden Gate Member (Unit 3 equivalent)

Size range: 50.1-54.3 mm

Shape: Elongate, slender, arched dorsum

Base: Slightly flattened, flattened

Margins: Produced, subangular, angular

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Absent

Apical sulcus: Simple, slightly curled, blunt

Aperture: Narrow, widening slightly anteriorly in some specimens

Columellar teeth: Thin, extending onto columella

Number: 15-17

Labral lip; teeth: Rounded; extending onto base

Number: 17-18

Key Characteristics: Elongate, slender shell with compressed laterals and an arched dorsum; apical sulcus simple, slightly curled, blunt; aperture narrow, widening slightly anteriorly in some specimens; base slightly flattened, flattened; margins produced, subangular, angular, compressed to varying degrees; auricles produced, blunt; columellar teeth extending onto the columella; columella ribbed, fossula absent. Specimens from the Sarasota quarries possess a slightly wider aperture and widen slightly anteriorly.

Comparisons: *P. (P.) ketteri* is similar to *P. (Bithloa) juyingae* and *P. (B.) gumbinneri*. However, *P. (B.) juyingae* is a slightly broader, rostrate shell while *P. (B.) gumbinneri* is a broader, roughly rectangular shell. Both possess an indistinct fossula.

Range: The Sarasota quarries, Bonita Springs Aggregates Pit, Florida Rock Industries (Old Mule Pen Quarry). The holotype was collected in the APAC Pit, Sarasota.

Plate 49 →

Pseudadusta (Pseudadusta) ketteri (Petuch, 1994)

1. 56.8 mm, Quality Aggregates Pit, Sarasota

2. 50.1 mm, Old Mule Pen Quarry, East Naples

3. 53.4 mm, Old Mule Pen Quarry, East Naples

4. 54.3 mm, Quality Aggregates Pit, Pit # 9, Sarasota



1



2



3

4

***Pseudadusta (Pseudadusta) roachi* Petuch and Drolshagen, 2011**

2011. *Pseudadusta roachi* Petuch and Drolshagen

2022. *Pseudadusta (Pseudadusta) roachi* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13257

TYPE Locality: Florida Rock Industries Naples Quarry (Old Mule Pen Quarry), East Naples, Collier County, FL.

Golden Gate Member (Unit 2 equivalent) [P]

Also: Fruitville Member (Unit 2), Tamiami Formation

Size range: 32.3-37.1 mm

Shape: Oval, rounded, high humped

Base: Flattened

Margins: Produced, subangular, angular

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Absent/Pseudofossula

Apical sulcus: Simple, slightly curved, blunt

Aperture: Uniformly narrow

Columellar teeth: Thin, extending onto columella

Number: 15-17

Labral lip; teeth: Steep, thick; extending onto base

Number: 16-18

Key Characteristics: Oval, rounded shell with a high humped dorsum; apical sulcus simple, slightly curved, blunt; aperture uniformly narrow; base flattened; margins produced, subangular, angular; auricles produced, blunt; columellar teeth thin, extending onto the columella; columella ribbed; fossula absent/pseudofossula.

Comparisons: *P. (P.) roachi* is similar to *P. (P.) lindae*. However, *P. (P.) lindae* is a heavier, broader, more ovate, high domed shell with better produced, callous, angular margins and more projecting auricles. Specimens collected from the Golden Gate Member at the Old Mule Pen Quarry at Naples tend to be eroded as they are extracted from a hard coralline matrix. Some specimens (~ 43- 48 mm) from the Lavender Road Pit, Ruskin are somewhat larger and have a shallow pseudofossula. *P. (P.) roachi* remains a rare species.

Range: Florida Rock Industries (Old Mule Pen Quarry), Collier County. Lavender Road Pit, Ruskin.

Plate 50 →

Pseudadusta (Pseudadusta) roachi Petuch and Drolshagen, 2011

1. 32.3 mm, Old Mule Pen Quarry, East Naples

2. 43.6 Lavender Road Pit, Ruskin



Pseudadusta (Carloscypraea) new subgenus

Described as: Pyriform to cylindrical, elongated shells; apical sulcus simple, shallow, slightly pinched, blunt; aperture narrow, widening slightly anteriorly; columellar teeth short, extending to/onto the columellar ridge; columella smooth; fossula absent.

Type species: *Pseudadusta (Carloscypraea) metae* (Petuch, 1994) (as *Siphocypraea metae*).

While other *Pseudadusta* subgenera inhabited the coral, coralline back reef habitats of the coral reef tracts as well as coral bioherm patch reefs, *Pseudadusta (Carloscypraea)* species inhabited the Fruitville strata in the Myakka Lagoon System as represented in the Sarasota pits. The only exception is the Golden Gate (Unit 4 equivalent) strata in the Immokalee Reef Tract where *cf.* inflated *P. (C.) metae* with protracted extremities have been found at the Old Mule Pen Quarry at Naples. Their status is undetermined at this time.

While other *Pseudadusta* species inhabited a variety of habitats in the Myakka Lagoon System, *P. (C.)* species lived in a muddy estuarine environment.

Mature *Pseudadusta (Carloscypraea)* species possess a smooth columella and an absent fossula.

Etymology: Named for the Calusa Indians' Carlos Region of the Southwest Gulf Coast of Florida.

TYPE: *Pseudadusta (Carloscypraea) metae* (Petuch, 1994)

Tamiami Formation *Pseudadusta (Carloscypraea)* species assigned herein:

Pseudadusta (Carloscypraea) yingsti (Petuch and Drolshagen, 2011)

Pseudadusta (Carloscypraea) marilynae (Petuch, 1994)

Comparisons

Pseudadusta (Bithloa): "Shells generally large for genus, extremely elongated and cylindrical; bases of shells slightly flattened; apical sulci simple vertical slots, often slightly recurved; apertures uniformly narrow, slot-like" (Petuch and Drolshagen, 2011).

- Columellar teeth thin, extending onto the top of the columella; columella ribbed along the top; fossula indistinct/distinct on mature specimens.

Pseudadusta (Pseudadusta): Pyriform or ovate, inflated, domed or high humped; apical sulcus simple, shallow, slightly pinched; aperture uniformly narrow; base rounded; auricles blunt; columellar dentition well developed.

- Columellar teeth thin, extending onto the columella; columella ribbed; fossula absent.

Pseudadusta (Carloscypraea): Pyriform to cylindrical, elongated shells; apical sulcus simple, shallow, slightly pinched, blunt; aperture narrow, widening slightly anteriorly; base rounded; auricles blunt.

- Columellar teeth short, extending to/onto the columellar ridge; columella smooth; fossula absent.

Pseudadusta (*Carloscypraea*) Tamiami Formation species:

Pseudadusta (*Carloscypraea*) *metae* (Petuch, 1994) **TYPE**

Pseudadusta (*Carloscypraea*) *yingsti* (Petuch and Drolshagen, 2011)

Pseudadusta (*Carloscypraea*) *marilynae* (Petuch, 1994)

Pseudadusta (Carloscypraea) Daughenbaugh, 2021

***Pseudadusta (Carloscypraea) metae* (Petuch, 1994) TYPE**

1994. *Siphocypraea metae* Petuch

1997. *Siphocypraea (Akleistostoma) metae* Petuch

2004. *Pseudadusta metae* Petuch

2022. *Pseudadusta (Carloscypraea) metae* Daughenbaugh and Bridges

HOLOTYPE: FI Museum of Natural History, IP collection, UF 66230

TYPE Locality: “Black Layer” APAC Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 4)

Also: Golden Gate Member (Unit 4 equivalent)

Size range: 52.0-65.3 mm

Shape: Pyriform-cylindrical, elongate

Base: Rounded

Margins: Rounded, subangular

Auricles: Produced, blunt

Columella: Smooth

Fossula: Absent

Apical sulcus: Simple, slot-like, blunt

Aperture: Open, widening slightly anteriorly

Columellar teeth: Thin, extending to/onto the
columellar ridge

Number: 15-21

Labral lip; teeth: Thin, rounded; thick, pointed,
confined to the aperture

Number: 18-21

Key Characteristics: Pyriform-cylindrical, elongate shell; apical sulcus simple, slot-like, slightly pinched; aperture open, widening slightly anteriorly; base rounded; margins rounded, subangular; auricles produced, blunt; columellar teeth thin extending to/onto the columellar ridge; columella smooth; fossula absent.

Comparisons: *P. (C.) metae* is similar to *P. (Bithloa) buckinghamensis*. However, *P. (B.) buckinghamensis* is more ovately pyriform, inflated shell with a narrow aperture, widening only slightly anteriorly; poorly produced, blunt auricles; columellar teeth which extend onto the top of the columella; and an indistinct/distinct fossula.

Range: APAC and Quality Aggregates Pits (later SMR Aggregates), Sarasota, Sarasota County.

Plate 51 →

Pseudadusta (Carloscypraea) metae (Petuch, 1994)

1. 62.8 mm, APAC Pit, Sarasota

2. 64.5 mm, APAC Pit, Sarasota

3. 58.6 mm, APAC Pit, Sarasota



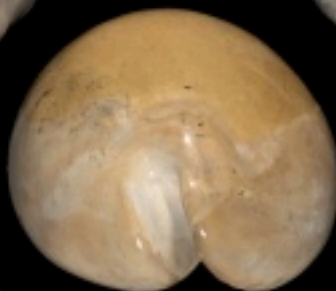
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2



3



***Pseudadusta (Carloscypraea) yingsti* (Petuch and Drolshagen, 2011)**

2011. *Pseudadusta yingsti* Petuch and Drolshagen

2022. *Pseudadusta (Carloscypraea) yingsti* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13260

TYPE Locality: Quality Aggregates Pit # 9, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 2)

Size range: 41.0-62.8 mm

Shape: Pyriform, slightly flattened

Base: Slightly rounded, slightly flattened

Margins: Rounded, subangular

Auricles: Produced, blunt

Columella: Smooth

Fossula: Absent

Apical sulcus: Simple, slot-like, slightly pinched, blunt

Aperture: Narrow, slightly wider anteriorly in some specimens

Columellar teeth: Thin, extending to/onto the columellar ridge

Number: 14-20

Labral lip; teeth: Rounded; thick, pointed

Number: 17-19

Key Characteristics: Pyriform shell with a slightly flattened appearance; apical sulcus simple, slot-like, slightly pinched, blunt; aperture narrow, widening slightly anteriorly in some specimens; base slightly rounded, slightly flattened; margins callous, rounded, subangular; auricles produced, blunt; columellar teeth extending to/onto the columellar ridge; fossula absent.

Comparisons: *P. (C.) yingsti* is similar to *P. (C.) metae*. However, *P. (C.) metae* is a more cylindrical, elongate shell with more rounded base and margins; and more numerous columellar teeth.

Range: APAC and Quality Aggregates (later SMR Aggregates) pits, Sarasota, Sarasota County.

Plate 52 →

Pseudadusta (Carloscypraea) yingsti (Petuch and Drolshagen, 2011)

1. 47.5 mm, APAC Pit, Sarasota

2. 52.0 mm, Quality Aggregates Pit, Pit # 9, Sarasota

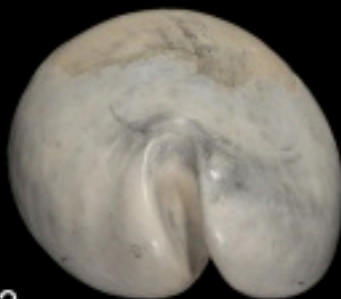
3. 48.1 mm, APAC Pit, Sarasota



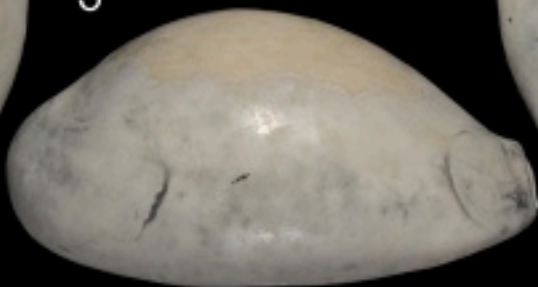
1



2



3



***Pseudadusta (Carlosocypraea) marilynae* (Petuch, 1994)**

1994. *Siphocypraea marilynae* Petuch

1997. *Siphocypraea (Akleistostoma) marilynae* Petuch

2004. *Pseudadusta marilynae* Petuch

2022. *Pseudadusta (Carlosocypraea) marilynae* Daughenbaugh and Bridges

HOLOTYPE: FI Museum of Natural History, IP collection, UF 66227

TYPE Locality: Quality Aggregates Pit # 9, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 2)

Size range: 37.9-52.8 mm

Shape: Cylindrical, elongate

Base: Slightly flattened

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Absent

Apical sulcus: Simple, slot-like, slightly pinched short, blunt

Aperture: Open, widening slightly anteriorly

Columellar teeth: Thin, short; extending to/onto the columellar ridge

Number: 12-14

Labral lip; teeth: Thin, rounded; thick, pointed

Number: 15-16

Key Characteristics: Cylindrical, elongate shell; apical sulcus simple, slot-like, slightly pinched, blunt; aperture open, widening slightly anteriorly; base slightly flattened; margins rounded; auricles poorly produced, blunt; columellar teeth thin, short, extending to/onto the columellar ridge; columella smooth; fossula absent.

Comparisons: *P. (C.) marilynae* is similar to *P. (Bithloa) juyingae*. However, *P. (B.) juyingae* has more numerous teeth and produced, projecting extremities (rostrate appearance) and a fossula.

Range: APAC and Quality Aggregates (later SMR Aggregates) pits, Sarasota, Sarasota County.

Plate 53 →

Pseudadusta (Carlosocypraea) marilynae (Petuch, 1994)

1. 37.9 mm, Quality Aggregates Pit, Sarasota

2. 40.3 mm, Quality Aggregates Pit, Pit # 9, Sarasota



1



2

Siphocypraea (Seminolecypraea) Petuch and Drolshagen, 2011

Originally proposed as a subgenus of *Siphocypraea*, representing “cowries with narrow apertures, strong apertural dentition, and thin, narrow apical sulci that are or only slightly curved or straight”. (Petuch & Drolshagen).

Described as “Shells of average size for genus, with primitive forms being slender and cylindrical and advanced forms being broad and inflated; apertures very narrow and slotlike; apertural dentition strong and well-developed; apical sulci very narrow, not coiled, instead varying from simple narrow slot to undulating or slightly curved”. (Petuch & Drolshagen).

“The new subgenus represents the primitive stem stock of *Siphocypraea*, from which all other subgenera evolved. The oldest known species, *S. micanopy* ..., dates from the earliest Piacenzian Pliocene and is found in the Buckingham Member of the Tamiami Formation. The subgenus survived to the end of the Piacenzian Pliocene, when the group became extinct. Members of *Seminolecypraea* differ from members of the other *Siphocypraea* groups in having very narrow apertures, often bordered by extremely large teeth, and in lacking the coiled apical sulcus, having, instead, a narrow vertical slot.” (Petuch & Drolshagen).

The hypothesis that *Seminolecypraea* represents the stem stock of *Siphocypraea* was based on morphological characteristics and, as such, leaves its status open to interpretation. In considering the status of *Seminolecypraea*, alternatives may be considered. For example, the slot-like apical sulcus and narrow aperture are also characteristics of the *Pseudadusta* genera. As observed, the taxonomic characteristics of the subgenus align imperfectly with both *Siphocypraea* and *Pseudadusta* genera. Lacking definitive support for an alternative, it is retained herein provisionally as a subgenus of *Siphocypraea*.

Reassignment

In examining the individual species within the subgenus, the taxonomic characteristics of *Siphocypraea parodizi* stand out. As originally described in 1994, its apical sulcus was described as “distinctly coiled, turning sharply to the right”. In addition, the species possesses a columella which is ribbed and an indistinct/distinct fossula while *S. (Seminolecypraea)* species possess simple, parallel apical sulci, ribbed columella and an absent fossula. The apical sulcus and fossula characteristics separate the genera.

Two other species share these characteristics, *S. cannoni* and *S. janowskyi*. The characteristics of the three species suggest a more primitive *Siphocypraea* subgenus which inhabited Fruitville Members, Units 3 and 2 in the late Pliocene Tamiami Formation before becoming extinct at the end of the Pliocene. These characteristics, unique to the species, suggest that it represents the short-lived, immediate predecessor to *Siphocypraea (sensu stricto)*. As such, we are reassigning all three species to *Siphocypraea (Aestuariumcypraea)*, a new subgenus herein. See separate Section below.

Comparisons

Siphocypraea (Seminolecypraea): Apical sulcus simple, parallel, narrow, projecting; aperture narrow, widening slightly in some species; base flat, flattened; margins produced; auricles produced, projecting.

- Columellar teeth extending well onto, over the columella; columella ribbed; fossula absent.

Siphocypraea (Aestuariumcypraea): Apical sulcus coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn; aperture narrow, proportionally narrow; base slightly flattened, rounded; margins produced, rounded, subangular; auricles blunt.

- Columellar teeth extending well onto, over the columella; columella ribbed; fossula indistinct/distinct.

Siphocypraea (Lokossea): Apical sulcus tightly coiled $\frac{1}{2}$ turn; aperture uniformly narrow; base rounded to flattened; margins callous.

- Columellar teeth thin, long, extending over the columella; columella ribbed; fossula distinct/indistinct.

Siphocypraea (Seminolecypraea) Tamiami Formation species:

Siphocypraea (Seminolecypraea) micanopy Petuch and Drolshagen, 2011

Siphocypraea (Seminolecypraea) trippeana (Parodiz, 1988) **TYPE**

Siphocypraea (Seminolecypraea) grovesi (Petuch, 1998)

Siphocypraea (Seminolecypraea) alligator (Petuch, 1994)

***Siphocypraea (Seminolecypraea) micanopy* (Petuch and Drolshagen, 2011)**

***Siphocypraea (Seminolecypraea) micanopy* (Petuch and Drolshagen, 2011)**

HOLOTYPE: Paleontological Research Institute, PRI 13232

TYPE Locality: Quality Aggregates Pit # 6, Sarasota, Sarasota County, FL.

Buckingham Member (Unit 10)

Size range: 43.6-58.0 mm

Shape: Subcylindrical, slightly pyriform

Base: Rounded, slightly flattened

Margins: Rounded, subangular

Columella: Ribbed

Auricles: Produced, slightly projecting

Fossula: Absent

Apical sulcus: Simple, slot-like, slightly projecting, pinched

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over columella

Number: 15-17

Labral lip; teeth: Rounded; thick, pointed, extending over base

Number: 17-20

Key Characteristics: Subcylindrical, slightly pyriform shell; apical sulcus simple, slot-like, slightly projecting, pinched; aperture uniformly narrow; base rounded, slightly flattened; margins rounded, subangular; auricles produced, slightly projecting; columellar teeth thin, long, extending over the columella; columella ribbed; fossula absent.

Comparisons: *S. (S.) micanopy* is similar to *S. (S.) trippeana*. However, *S. (S.) trippeana* is a more slender, elongated shell with compressed columellar margin and more projecting extremities.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County.

Note: The species was originally described based on several subadult specimens.

Plate 54 →

Siphocypraea (Seminolecypraea) micanopy (Petuch and Drolshagen, 2011)

1. 45.4 mm, APAC Pit, Sarasota intermediate to trippeana

2. 46.1 mm, APAC Pit, Sarasota



1



2



***Siphocypraea (Seminolecypraea) trippeana* (Parodiz, 1988) TYPE**

1988. *Siphocypraea trippeana* Parodiz

1997. *Siphocypraea (Siphocypraea) trippeana* Petuch

2004. *Siphocypraea trippeana* Petuch

2011. *Siphocypraea (Seminolecypraea) trippeana* Petuch and Drolshagen

HOLOTYPE: Carnegie Museum of Natural History, CM No. 42199

Type Locality: Newburn Mine, APAC Florida Inc. (Ashland Oil Inc.), Sarasota, Sarasota County, FL.

Pinecrest Member (Unit 7)

Original description: See Appendix B(IV).

Size range: 47.0-74.0 mm

Shape: Subcylindrical, slender, elongate

Base: Flattened

Margins: Produced, columellar margin
laterally compressed, angular

Auricles: Produced, projecting

Columella: Ribbed

Fossula: Absent

Apical sulcus: Blade-like projecting extremities,
pinched & covering apical sulcus

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over columella,
Number: 17-19

Labral lip; teeth: Steep, thick; thick, pointed,
extending far onto base

Number: 18-20

Key Characteristics: [Adapted from Petuch, Berschauer & Myers, 2018] Subcylindrical, slender, elongate shell; apical sulcus projecting, blade-like, pinched & covering apical sulcus; aperture uniformly narrow; base flattened; margins produced, columellar margin laterally compressed, angular; auricles produced, projecting; columellar teeth thin, extending over columella; columella ribbed; fossula absent.

Comparisons: *S. (S.) trippeana* is similar to *S. (S.) micanopy* and *S. (S.) grovesi*. However, *S. (S.) micanopy* is a slightly pyriform shell with an apical sulcus which does not project as far, and less angular margins. *S. (S.) grovesi* is a wider, cylindrical, slightly pyriform shell with an apical sulcus which does not project as far; an aperture which widens slightly anteriorly; compressed columellar margin; and columellar teeth which extend onto the top of the columella, producing a partially ribbed columella. Specimens from the Lavender Road Pit, Ruskin, examined by the senior author, are also similar to *S. (S.) trippeana*. However, their base is more rounded, their columellar teeth only extend to/onto the columellar ridge and they possess a distinct fossula. Their relationship to *S. (S.) trippeana* is not known.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 55 →

Siphocypraea (Seminolecypraea) trippeana (Parodiz, 1988)

1. 50.7 mm, APAC Pit, Sarasota

2. 64.3 mm, APAC Pit, Sarasota

3. 65.0 mm, APAC Pit, Sarasota



***Siphocypraea (Seminolecypraea) grovesi* (Petuch, 1998)**

1998. *Siphocypraea (Siphocypraea) grovesi* Petuch

2004. *Siphocypraea grovesi* Petuch

2011. *Siphocypraea (Seminolecypraea) grovesi* Petuch and Drolshagen

HOLOTYPE: Graves Museum of Archeology & Natural History, UF 84988

TYPE Locality: Florida Rock Industries, Inc., Naples Quarry (Old Mule Pen Quarry), Naples, Collier County, FL.

Golden Gate Member (Unit 4 equiv.)

Also, Fruitville Member (Unit 4)

Size range: 53.3-76.4 mm

Shape: Cylindrical, slightly pyriform

Base: Slightly flattened

Margins: Produced, columellar margin

slightly compressed laterally, angular

Auricles: Produced, projecting

Columella: Partially ribbed

Fossula: Absent

Apical sulcus: Simple, narrow, projecting, pinched

Aperture: Narrow, widening slightly anteriorly

Columellar teeth: Thin; extending onto columella

Number: 15-18

Labral lip; teeth: Steep, thick; slender, pointed, extending far onto base

Number: 20-23

Key Characteristics: Cylindrical, slightly pyriform shell; apical sulcus simple, narrow, projecting, pinched; aperture narrow widening slightly anteriorly; base slightly flattened; margins produced, columellar margin slightly compressed laterally, angular; auricles produced, projecting; columellar teeth thin, extending onto the columella; columella partially ribbed; fossula absent.

Comparisons: *S. (S.) grovesi* is similar to *S. (S.) trippeana*. However, *S. (S.) trippeana* is a slender, elongate, subcylindrical shell with a more projecting apical sulcus and a fully ribbed columella.

Range: Collier and Lee County quarries (Old Mule Pen and Bonita Aggregates Pits) and the Sarasota quarries. Also collected in the Lavender Road Pit, Ruskin, about 20 miles north of Sarasota.

Plate 56 →

Siphocypraea (Seminolecypraea) grovesi (Petuch, 1998)

1. 53.3 mm, Lavender Road Pit, Ruskin

2. 64.7 mm, Old Mule Pen Quarry, East Naples

3. 63.8 mm, APAC Pit, Sarasota

4. 67.1 mm, Old Mule Pen Quarry, East Naples



1



2



3



4



***Siphocypraea (Seminolecypraea) alligator* (Petuch, 1994)**

1994. *Siphocypraea alligator* Petuch

1997. *Siphocypraea (Akleistostoma) alligator* Petuch

2011. *Siphocypraea (Seminolecypraea) alligator* Petuch and Drolshagen

HOLOTYPE: FI Museum of Natural History, IP collection, UF 66225

TYPE Locality: APAC Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 2)

Size range: 52.3-65.0 mm

Shape: Oval, oval-elongate, slightly inflated, rounded dorsum

Base: Flat

Margins: Produced, angular

Auricles: Produced, slightly projecting

Columella: Ribbed

Fossula: Absent

Apical sulcus: Simple, parallel, projecting, slightly pinched

Aperture: Uniformly narrow

Columellar teeth: Thin; extending well onto base and over columella

Number: 14-18

Labral lip; teeth: Thick, rounded; thick, extending over base

Number: 17-18

Key Characteristics: Oval, oval-elongate, slightly inflated shell with a rounded dorsum; apical sulcus simple, parallel, projecting, slightly pinched; aperture uniformly narrow, widening slightly anteriorly; base flat; margins produced, angular; auricles produced, slightly projecting; thin, long columellar teeth extending well onto the base and over the columella; columella ribbed; fossula absent.

Comparisons: *S. (S.) alligator* is similar to a truncated *S. (S.) grovesi*. However, other than that, the characteristics of the two species are so distinctive that it would be difficult to confuse *S. (S.) alligator* with *S. (S.) grovesi* or any other species.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota, County.

Plate 57 →

Siphocypraea (Seminolecypraea) alligator (Petuch, 1994)

1. 52.3 mm, APAC Pit, Sarasota

2. 54.9 mm, APAC Pit, Sarasota

3. 62.3 mm, APAC Pit, Sarasota



1



2



3

Siphocypraea (Aestuariumcypraea) new subgenus

“The genus *Siphocypraea* Heilprin, 1886 was the first group of Plio-Pleistocene fossil cowries discovered in southern Florida (Heilprin, 1886). With their characteristic curled apical sulcus, members of this genus are unmistakable and stand out from all other fossil cowry groups found in the Everglades and adjacent areas. Although *Siphocypraea (sensu stricto)* was the first genus of southern Floridian cowries to be formally described and named, it was actually one of the geologically youngest genera, not appearing until the late Pliocene.” (Petuch & Drolshagen).

New Subgenus

The subgenus is described as: Apical sulcus coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn; aperture narrow, proportionally narrow; base rounded, slightly flattened; margins produced rounded, subangular; auricles blunt; columellar teeth extending well onto, over the columella; columella ribbed; fossula indistinct/distinct.

TYPE species: *Siphocypraea (Aestuariumcypraea) cannoni* (Petuch, 1994).

TYPE Locality: Quality Aggregates, Inc., Phase 6 Pit, Sarasota, Sarasota County, FL.

The species are known from the intertidal estuarine environments of the Myakka Lagoon System which were dominated by pearly mussel (*Perna conradiana*, d’Orbigny, 1852) beds and coralline algae. *S. (A.) janowskyi* has been collected at Bonita Springs, the latter of which is associated with the coral reefs of the Golden Gate Member. This suggests that mud flat habitats existed in the back reef environs which would have provided a viable habitat for the species.

The characteristics of *Siphocypraea (Aestuariumcypraea) parodizi*, *cannoni* and *janowskyi* from the late Pliocene Fruitville Member Units 3 and 2 suggest they are the likely immediate predecessors to *Siphocypraea (sensu stricto)* species. The characteristics include a partially coiled apical sulcus, columella teeth which extend over the columella and an indistinct/distinct fossula.

Etymology: Aestuarium is Latin for estuary, estuarine. Therefore, they are estuarine cowries.

Comparisons

Siphocypraea (Seminolecypraea): Apical sulcus simple, parallel, narrow, projecting; aperture narrow, widening slightly in some species; base flat, flattened; margins produced; auricles produced, projecting.

- Columellar teeth extending well onto, over the columella; columella ribbed; fossula absent.

Siphocypraea (Aestuariumcypraea): Apical sulcus coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn; aperture narrow, proportionally narrow; base slightly flattened, rounded; margins produced, rounded, subangular; auricles blunt.

- Columellar teeth extending well onto, over the columella; columella ribbed; fossula indistinct/distinct.

Siphocypraea (Lokossea): Apical sulcus tightly coiled $\frac{1}{2}$ turn; aperture uniformly narrow; base rounded to flattened; margins callous.

- Columellar teeth thin, long, extending over the columella; columella ribbed; fossula distinct/indistinct.

Siphocypraea (Aestuariumcypraea) Tamiami Formation species:

Siphocypraea (Aestuariumcypraea) parodizi (Petuch, 1994)

Siphocypraea (Aestuariumcypraea) cannoni (Petuch, 1994) **TYPE**

Siphocypraea (Aestuariumcypraea) janowskyi (Petuch and Drolshagen, 2011)

Siphocypraea (Aestuariumcypraea) Daughenbaugh and Bridges, 2022

***Siphocypraea (Aestuariumcypraea) parodizi* (Petuch, 1994) [P]**

1994. *Siphocypraea parodizi* Petuch

1997. *Siphocypraea (Siphocypraea) parodizi* Petuch

2011. *Siphocypraea (Seminolecypraea) parodizi* Petuch and Drolshagen

2022. *Siphocypraea (Aestuariumcypraea) parodizi* Daughenbaugh and Bridges

HOLOTYPE: FI Museum of Natural History, IP collection, UF 66223

TYPE Locality: Quality Aggregates, Inc., Phase 6 Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 3)

Size range: 49.0-69.4 mm

Shape: Pyriform, elongate, slender,
inflated, dorsum rounded

Base: Slightly rounded, flattened

Margins: Produced, subangular, angular

Auricles: Produced, slightly projecting,
blunt

Columella: Ribbed

Fossula: Steep, shallow, smooth, indistinct;
covered by last 4 denticles

Apical sulcus: Narrow, curved/coiled ~ ¼ turn

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over the
top of the columella

Number: 18-19

Labral lip; teeth: Steep, thick; thick, pointed,
extending over base

Number: 18-20

Key Characteristics: Pyriform, elongate, slender, inflated shell with a rounded dorsum; apical sulcus narrow, curved/coiled ~ ¼ turn; base slightly rounded, flattened; margins subangular, angular; auricles slightly projecting, blunt; columellar teeth thin, extending over the top of the columella; columella ribbed; labral lip and teeth thick with the teeth extending over the base; fossula indistinct, covered by last 4 denticles.

Comparisons: *S. (A.) parodizi* is similar to *S. (A.) cannoni* and *S. (A.) janowskyi*. However, *S. (A.) cannoni* is a cylindrical, inflated, elongate shell with a more open, projecting apical sulcus; an aperture which is not as narrow; and a more rounded base and margins. *S. (A.) janowskyi* is a subpyriform, inflated shell whose apical sulcus is partially covered by fold-like extension of body whorl; and has a uniformly narrow aperture. *S. (A.) parodizi* is also similar to fully mature specimens of *S. (Lokossea) daughenbaughi* from the Golden Gate Member (Unit 3 equivalent) which also feature a flattened base. However, *S. (L.) daughenbaughi* has a more coiled apical sulcus and possesses a distinct fossula. *S. (A.) parodizi* also resembles the Caloosahatchee Formation, *S. (Siphocypraea) haleyorum*. However, *S. (S.) haleyorum* is not an inflated shell and has a fully ribbed columella and a distinct fossula.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota County.

Comment: Other than size, the only other characteristic which varies is the apical sulcus which varies from pinched to pinched with an upward curl, similar to *S. (Seminolecypraea) trippeana*, to coiled with a ¼ turn, similar to *S. (A.) cannoni*. However, all specimens have an indistinct/distinct fossula which is a characteristic of *S. (Aestuariumcypraea)*. This suggests a transitional species representing the transition from the *Seminolecypraea* subgenera to the *Aestuariumcypraea* subgenera. As such, it is classified in the subgenus, although the classification is considered provisional.

Plate 58 →

Siphocypraea (Aestuariumcypraea) parodizi (Petuch, 1994)

1. 49.0 mm Quality Aggregates Pit, Sarasota

2. 57.7 mm APAC Pit, Sarasota

3. 67.9 mm Quality Aggregates Pit, Pit # 6, Sarasota



1



2



3



***Siphocypraea (Aestuariumcypraea) cannoni* (Petuch, 1994) TYPE**

1994. *Siphocypraea cannoni* Petuch

1997. *Siphocypraea (Siphocypraea) cannoni* Petuch

2022. *Siphocypraea (Aestuariumcypraea) cannoni* Daughenbaugh and Bridges

HOLOTYPE: FI Museum of Natural History, IP collection, UF 66221

TYPE Locality: Quality Aggregates, Inc., Phase 6 Pit, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 3)

Size range: 45.8-82.4 mm

Shape: Cylindrical, inflated, elongate

Base: Slightly rounded

Margins: Rounded, subangular

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Steep, shallow, smooth, indistinct;
covered by last 4 denticles

Apical sulcus: Open, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn, projecting

Aperture: Proportionally narrow

Columellar teeth: Thin; extending over the
columella

Number: 16-24

Labral lip; teeth: Steep, rounded; thick, pointed

Number: 19-29

Key Characteristics: Cylindrical, inflated, elongate shell; apical sulcus coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn and slightly projecting; proportionally narrow aperture; base slightly rounded; margins rounded, subangular; auricles produced, blunt; columellar teeth thin, extending over the columella; columella ribbed; fossula indistinct.

Comparisons: *S. (A.) cannoni* is similar to *S. (A.) parodizi* and *S. (A.) janowskyi*. However, *S. (A.) parodizi* is a pyriform, inflated, slender shell with a rounded dorsum; a narrow apical sulcus; uniformly narrow aperture; a more flattened base and subangular, angular margins. *S. (A.) janowskyi* is a subpyriform, inflated shell whose apical sulcus is partially covered by fold-like extension of body whorl; and it has a uniformly narrow aperture.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota County. Lee County.

Plate 59 →

Siphocypraea (Aestuariumcypraea) cannoni (Petuch, 1994)

1. 59.4 mm, Burnt Store Road Pit, Lee County

2. 74.5 mm, Quality Aggregates Pit, Pit # 6, Sarasota

3. 82.4 mm, Quality Aggregates Pit, Pit # 6, Sarasota



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2



3

***Siphocypraea (Aestuariumcypraea) janowskyi* (Petuch and Drolshagen, 2011)**

2011. *Siphocypraea janowskyi* Petuch and Drolshagen

2022. *Siphocypraea (Aestuariumcypraea) janowskyi* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13228

TYPE Locality: Quality Aggregates Pit # 6, Sarasota, Sarasota County, FL.

Fruitville Member (Unit 2)

Size range: 65.1-77.2 mm

Shape: Subpyriform, inflated

Base: Slightly rounded

Margins: Produced, subangular, angular

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, shallow, smooth,
indistinct/distinct; covered by
last 4 denticles

Apical sulcus: Coiled $\frac{1}{2}$ turn, partially covered
by fold-like extension of body whorl

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over columella
Number: 19-20

Labral lip; teeth: Steep, thick; thick, pointed,
extending onto base

Number: 23-25

Key Characteristics: Subpyriform, inflated shell; apical sulcus coiled $\frac{1}{2}$ turn, partially covered by fold-like extension of body whorl; aperture uniformly narrow; base slightly rounded; margins produced, subangular, angular; auricles poorly produced, columellar teeth thin, extending over the columella; columella ribbed; fossula indistinct/distinct, covered by last 4 denticles.

Comparisons: *S. (A.) janowskyi* is similar to *S. (A.) parodizi* and *S. (A.) cannoni*. However, *S. (A.) parodizi* is a pyriform, inflated, slender shell with a rounded dorsum; a uniformly narrow aperture; a more flattened base and subangular, angular margins. *S. (A.) cannoni* is a cylindrical, inflated, elongate shell with a more open and projecting apical sulcus; an aperture which is not as narrow. *S. (A.) janowskyi* is also similar to the Caloosahatchee Formation, *S. (Siphocypraea) haleyorum*. However, *S. (S.) haleyorum* is not an inflated shell and possess a fully ribbed columella and a distinct fossula.

Range: APAC and Quality Aggregates (later SMR Aggregates) Pits, Sarasota, Sarasota County. Also collected at Bonita Grande Aggregates Pit, Bonita Springs, Lee County.

Plate 60 →

Siphocypraea (Aestuariumcypraea) janowskyi (Petuch and Drolshagen, 2011)

1. 59.5 mm, Bonita Springs Aggregate Pit, Bonita Springs

2. 65.1 mm, Quality Aggregates Pit, Sarasota

3. 74.7 mm, Quality Aggregates Pit, Pit # 6, Sarasota



1



2



3



***Siphocypraea (Lokossea)* Petuch and Drolshagen, 2011**

Originally proposed as a subgenus of *Siphocypraea*, “representing large, inflated, rotund species with very tightly coiled apical sulci”. (Petuch & Drolshagen). Ranges from the late Piacenzian Pliocene to the late Gelasian Pleistocene.

Revised: “The subgenus *Lokossea* as modified is represented by variably shaped species that are slightly inflated/inflated with tightly coiled apical sulci, long thin columellar dentition that extends deep into the aperture and labral dentition that extends well onto/over the base, forming corrugations (Petuch and Drolshagen, 2011; Daughenbaugh, 2020).” (Berschauer & Waller, 2020). The labral dentition corrugations may be covered by callus in older specimens or absent in eroded specimens.

The **Type** species was designated as *Siphocypraea (Lokossea) swearingeni* Petuch and Drolshagen, 2011 of the Fort Denaud Member of the Caloosahatchee Formation. This represents a continuation of the subgenus from the Tamiami Formation into the Pleistocene Caloosahatchee Formation. The only *Siphocypraea* subgenus to bridge the transition. All other Tamiami *Siphocypraea* subgenera became extinct at the end the Piacenzian Pliocene.

The *Siphocypraea (Lokossea)* subgenus is continued below under the Gelasian Pleistocene.

Assignment/Reassignment

Tamiami Formation *Siphocypraea (Lokossea)* species were assigned/aligned by Berschauer & Waller as follows:

Siphocypraea (Lokossea) dimasi (Petuch, 1998)

Siphocypraea (Lokossea) daughenbaughi Berschauer and Waller, 2020

Siphocypraea (Lokossea) mulepenensis (Petuch, 1991)

Siphocypraea dimasi was reassigned in 2020 as the oldest member of the *S. (L.) Siphocypraea* subgenus with Golden Gate Unit 4 equivalent time hypothesized. This represented a reassignment from Unit 3 time as in Petuch’s original description. The newly described *S. (L.) daughenbaughi* was assigned to Unit 3 equivalent time and *S. (L.) mulepenensis* was retained in Unit 2 equivalent time. The assignments represent an evolutionary lineage and are based on morphology. (Berschauer & Waller, 2020).

NOTE: In 2011, *S. (L.) dimasi* and *S. (L.) mulepenensis* were reassigned to the Fordville Member of the Caloosahatchee Formation without comment (Petuch and Drolshagen), based on specimens collected from spoil piles at the Ole Mule Pen Quarry, Naples. However, the Fordville is absent from that quarry. The 2020 assignment/alignment is accepted herein.

Reassignment

Pahayokea rucksorum Petuch, 2004 is reassigned herein as *Siphocypraea (Lokossea) rucksorum* Petuch, 2004. The species possesses the characteristics of both the genus and subgenus as above, including a typical *Siphocypraea* fossula. The Type locality is Rucks Pit in the Kissimmee River

Valley as a Kissimmee Valley equivalent species. It has also been collected in the Bergeron Star Pit, Palm Beach County and the Bonita Springs Aggregate Pit, Lee County. The original Unit 2 equivalent assignment as well as a Unit 2 assignment is accepted herein. See **Comparisons** below.

Comparisons

Siphocypraea (Seminolecypraea): Apical sulcus simple, parallel, narrow, projecting; aperture narrow, widening slightly in some species; base flat, flattened; margins produced; auricles produced, projecting.

- Columellar teeth extending well onto, over the columella; columella ribbed; fossula absent.

Siphocypraea (Aestuariumcypraea): Apical sulcus coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn; aperture narrow, proportionally narrow; base slightly flattened, rounded; margins produced, rounded, subangular; auricles blunt.

- Columellar teeth extending well onto, over the columella; columella ribbed; fossula indistinct/distinct.

Siphocypraea (Lokossea): Apical sulcus tightly coiled $\frac{1}{2}$ turn; aperture uniformly narrow; base rounded to flattened; margins callous.

- Columellar teeth thin, long, extending over the columella; columella ribbed; fossula distinct/indistinct.

Unit Designation

Dating species from the Golden Gate Member coral facies is challenging as the facies of the member present no clear time delineation, i.e., the facies is a continuum. This is compounded by the intertonguing of laterally adjacent (next to each other) strata facies of the upper beds where the facies are virtually identical. For example, the carbonate facies of the Fordville-aged reefs intertongue with the subjacent carbonate facies of the upper Immokalee Reef Tract (Unit 2) of the Golden Gate Member. In addition, as sediments are relatively close to the surface, their mining tends to intermingle the strata. While the dating of lower bed species is sometimes possible based upon correlation with type species from geographically separate, more defined members, this does not apply to the upper bed members. As a result, the present placement of the of these Cypraeidae species should be considered provisional [P].

Dating species from the Kissimmee River Valley is also challenging as all specimens of *S. (L.) rucksorum* from the valley were collected from spoil piles at Rucks Pit. Dating herein is based on the morphological characteristics of specimens collected at all three known locales. As such, dating is considered provisional [P].

Siphocypraea (Lokossea) species of the Tamiami Formation:

Siphocypraea (Lokossea) dimasi (Petuch, 1998)

Siphocypraea (Lokossea) daughenbaughi Berschauer and Waller, 2020

Siphocypraea (Lokossea) mulepenensis (Petuch, 1991)

Siphocypraea (Lokossea) rucksorum (Petuch, 2004)

Siphocypraea (Lokossea) Petuch and Drolshagen, 2011

***Siphocypraea (Lokossea) dimasi* (Petuch, 1998)**

1998. *Siphocypraea (Siphocypraea) dimasi* Petuch

2011. *Siphocypraea (Lokossea) dimasi* Petuch and Drolshagen

HOLOTYPE: Graves Museum of Archeology & Natural History, UF 84987

TYPE Locality: Florida Rock Industries, Inc., Naples Quarry (Old Mule Pen Quarry), Naples, Collier County, FL.

Golden Gate Member (Unit 4 equiv.) [P]

Also, Fruitville Member (Unit 4)

Size range: 34.4-52.0 mm

Shape: Cylindrical, slender

Base: Slightly rounded, flattened

Margins: Slightly rounded, subangular

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, smooth, scalene

Apical sulcus: Deep, compressed, coiled ½ turn, partially covered by flange and body whorl extensions forming a collar

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over the columella

Number: 12-17

Labral lip; teeth: Steep, moderately thick; longer anteriorly, pointed

Number: 19-22

Key Characteristics: Cylindrical, slender shell; apical sulcus deep, compressed, coiled ½ turn, partially covered by flange and body whorl extensions forming a collar; aperture uniformly narrow; base slightly rounded, flattened; margins slightly rounded, subangular; auricles poorly produced, blunt; columellar teeth thin, extending over the columella; columella ribbed; fossula distinct.

Comparisons: *S. (L.) dimasi* is similar to *S. (Siphocypraea) problematica* and *S. (L.) daughenbaughii*. However, *S. (S.) problematica* is a larger, broader shell with an apical sulcus which projects; rounded base and margins; and better produced auricles which project. *S. (L.) daughenbaughii* is a larger, broader shell with a more flattened base and subangular, angular margins.

Range: Collier and Lee County quarries as well as the Sarasota quarries.

Plate 61 →

Siphocypraea (Lokossea) dimasi (Petuch, 1998)

1. 47.0 mm, Warren Brothers Pit, Sarasota
2. 53.5 mm, Bonita Springs Aggregate Pit, Bonita Springs
3. 50.1 mm, Old Mule Pen Quarry, East Naples
4. 52.0 mm, Quality Aggregates Pit, Sarasota



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2



3



4



***Siphocypraea (Lokossea) daughenbaughii* Berschauer and Waller, 2020**

HOLOTYPE: Los Angeles County Museum of Natural History, LACMIP 14868

TYPE Locality: Bonita Grande Aggregate Pit, Bonita Springs, Lee County, FL.

Golden Gate Member (Unit 3 equiv.) [P]

Size range: 54.3-72.8 mm

Shape: Oval-elongate, callous, inflated

Base: Slightly flattened, flattened

Margins: Produced, subangular, angular

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Steep, smooth, scalene

Apical sulcus: Deep, compressed, coiled $\frac{1}{2}$ turn,
body whorl extension forming a collar

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over the
columella

Number: 18-22

Labral lip; teeth: Steep, thick; thick, pointed,
longer anteriorly

Number: 22-24

Key Characteristics: Oval-elongate, callous, inflated shell; apical sulcus deep, compressed, coiled $\frac{1}{2}$ turn, body whorl extension forming a collar; aperture uniformly narrow; base slightly flattened, flattened; margins produced, subangular, angular; auricles produced, blunt; columellar teeth thin, extending over the columella; columella ribbed; fossula distinct.

Comparisons: *S. (L.) daughenbaughii* is similar to *S. (L.) dimasi* and *S. (L.) mulepenensis*. However, *S. (L.) dimasi* is a smaller, more slender shell with a more rounded base and margins which are slightly convex. *S. (L.) mulepenensis* is a more globose, inflated, truncated shell with a domed dorsum.

Range: To date, *S. (L.) daughenbaughii* is only known from Bonita Springs Aggregate Pit, Lee County where it has been collected by Melanie Briskin and Maurice Guy and from the Old Mule Pen Quarry, East Naples, Collier County.

Plate 62 →

Siphocypraea (Lokossea) daughenbaughii Berschauer and Waller, 2020

1. 69.4 mm, Bonita Springs Aggregate Pit, Bonita Springs

2. 69.8 mm, Bonita Springs Aggregate Pit, Bonita Springs (Holotype)

3. 63.2 mm, Bonita Springs Aggregate Pit, Bonita Springs



1



2



3



***Siphocypraea (Lokossea) mulepenensis* (Petuch, 1991)**

1991. *Siphocypraea mulepenensis* Petuch

1997. *Siphocypraea (Siphocypraea) mulepenensis* Petuch

2011. *Siphocypraea (Lokossea) mulepenensis* Petuch and Drolshagen

HOLOTYPE: Carnegie Museum of Natural History, CM35675

TYPE Locality: Florida Rock Industries, Inc., Naples Quarry (Old Mule Pen Quarry), Naples, Collier County, FL.

Golden Gate Member (Unit 2 equivalent) [P]

Size range: 54.3-81.0 mm

Shape: Globose, highly inflated, domed

Base: Rounded

Margins: Rounded

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Steep, smooth, scalene

Apical sulcus: Deep, compressed, coiled $\frac{1}{2}$ turn, body whorl extension forming a collar

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over the columella

Number: 18-20

Labral lip; teeth: Steep, thick; thick, pointed, Number: 23-24

Key Characteristics: Globose, highly inflated shell with a domed dorsum; almost spherical appearance; apical sulcus deep, compressed, coiled $\frac{1}{2}$ turn, body whorl extension forming a collar; aperture uniformly narrow; base rounded; margins rounded; auricles produced, blunt; columella teeth thin, extending over the columella; columella ribbed; fossula distinct.

Comparisons: *S. (L.) mulepenensis* is similar to *S. (L.) daughenbaughi*. However, *S. (L.) daughenbaughi* is an oval-elongate shell which, while inflated, is not domed; with slightly flattened, flattened base; and subangular, angular margins.

Range: Only known from the Collier and Lee County quarries.

Plate 63 →

Siphocypraea (Lokossea) mulepenensis (Petuch, 1991)

1. 66.6 mm, Old Mule Pen Quarry, East Naples

2. 66.7 mm, Bonita Springs Aggregate Pit, Bonita Springs

3. 57.3 mm, Old Mule Pen Quarry, East Naples

4. 62.2 mm, Old Mule Pen Quarry, East Naples



1



2



3

4

***Siphocypraea (Lokossea) rucksorum* (Petuch, 2004) [P]**

2004. *Siphocypraea (Pahayokea) rucksorum* Petuch

2011. *Pahayokea rucksorum* Petuch and Drolshagen

2022. *Siphocypraea (Lokossea) rucksorum* Daughenbaugh and Bridges

HOLOTYPE: American Museum of Natural History, N. Y., AMNH FI-50663

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 2, Kissimmee River Valley equivalent) [P] *

Also: Fruitville Member (Unit 2)

Size range: 50.0-69.0 mm

Shape: Ovate, pyriform, elongate, inflated, domed

Base: Flattened

Margins: Produced, subangular, angular

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Steep, smooth, scalene

Apical sulcus: Deep, coiled $\frac{1}{2}$ turn, partially covered by flange extension

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over the columella

Number: 15-16

Labral Lip; teeth: Steep, thick; small, pointed

Number: 21-23

Key Characteristics: Ovate, pyriform, elongate, inflated, shell with a domed dorsum; apical sulcus deep, coiled $\frac{1}{2}$ turn; partially covered by a columellar flange extension; aperture uniformly narrow; base flattened; margins subangular, angular; auricles produced, blunt; columellar teeth thin, extending over the columella; columella ribbed; fossula distinct on most specimens, shallow on some.

Comparisons: *S. (L.) rucksorum* is most similar to *Pahayokea gabriellae* and *S. (L.) mulepenensis*. However, *P. gabriellae* is a broad, oval shell with a flattened appearance and is absent a fossula. *S. (L.) mulepenensis* is a more globose, inflated, domed shell with a rounded base and margins.

Range: Specimens have been collected at Rucks Pit, Okeechobee County, the Bergeron Star Pit, Palm Beach County and Bonita Grande Aggregates Pit, Lee County. This suggests the species occurred throughout southern Florida.

* Originally placed in the Fruitville Member, Unit 2 (Kissimmee River Valley equivalent). Reassigned to Unit 4 equivalent in 2011 without comment. As its range extends southward beyond Kissimmee River Valley and its characteristics are similar to *S. (L.) mulepenensis*, this suggests that the original Unit 2 designation is more plausible. Reassigned herein.

Plate 64 →

Siphocypraea (Lokossea) rucksorum (Petuch, 2004)

1. 60.0 mm, Bergeron Star Pit Mine, Palm Beach County

2. 66.6 mm, Bonita Grande Aggregates Pit, Lee County, ex. Maurice Guy



1



2



Chapter 9

Tamiami Formation Members – Kissimmee Equivalents

Pinecrest Member (Unit 7) - Kissimmee River Valley Equivalent

Species

Kissimmee

Akleistostoma (Ingramicypraea) highlandensis Petuch and Drolshagen, 2011

Akleistostoma (Olssonicypraea) hughesi (Olsson and Petit, 1964)

Akleistostoma (Kissimmecypraea) transitoria (Olsson and Petit, 1964)

Pahayokea kissimmeensis (Petuch, 1994)

Yeehawcypraea osceolai Petuch and Drolshagen, 2011

Yeehawcypraea bartoni Petuch and Drolshagen, 2011

The western coastal Myakka Lagoon System (Myakka) is separated and isolated from the Kissimmee River Valley (Kissimmee) by the massive Polk Peninsula to the east as well as the narrow, deep-water Caloosahatchee and Loxahatchee Straits to the south. The two straits also separate Myakka and Kissimmee from the Golden Gate Reef tracks to the south. In addition, intracapsular direct development and restricted migration may be inferred based on the sister genus, *Muracypraea* Woodring, 1957 and the Recent *Muracypraea mus* Linnaeus, 1758 complex. The absence of viable paths of migration between the two areas means the three Cypraeidae populations evolved along separate evolutionary lines to the Pliocene-Pleistocene transition, c. 2.8- 2.6 Ma.

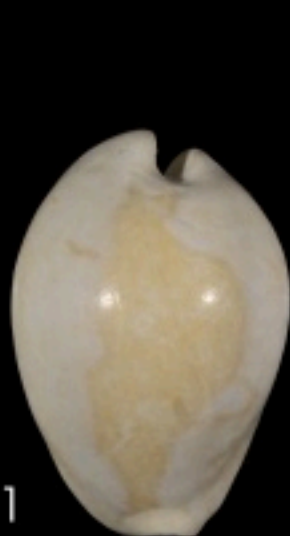
Buckingham Member (Unit 10 equivalent) stratum was extant in the upper reaches of Kissimmee. However, in the lower reaches, sediments have been leached leaving only riverine rocks/stones intermixed with broken mollusk fragments. No Unit 10 equivalent Cypraeidae species have been recorded from Kissimmee. Units 9 & 8 equivalent are not present in Kissimmee. However, the presence of Cypraeidae populations in Kissimmee prior to the succeeding Pinecrest (Unit 7 equivalent) time is inferred, supported by the emergence of six species in three genera in the Unit 7 equivalent stratum. Such populations probably lived in areas close to/adjacent to quarries such as Rucks Pit, Fort Drum, Okeechobee County.

In the Kissimmee, the sedimentary facies differ from other areas of the Pinecrest in general and Myakka in particular. The stratum, formed in its estuaries, shallow banks and tidal channels, consists of mud, clay minerals, organic particulate matter mixed with sand and shell bioclasts in mud flats and mangrove tree forests. Hence, fossil Cypraeidae collected in the river valley have been designated equivalent members. Fossil Cypraeidae have been collected in what would have been sea grass beds, and mud flats in tidal channels near Black and Red Mangrove forests.

The *Yeehawcypraea* (Petuch and Drolshagen, 2011) genus emerged in and was restricted to the Kissimmee. Its species preferred muddy estuarine and mangrove habitats which were exposed at low tide and represents a likely adaptation to its environment. The other Kissimmee genera, *Akleistostoma* and *Pahayokea*, are associated with sea grass beds and mud flat habitats.

Plate 65 →

1. *Akleistostoma (Ingramicypraea) highlandensis* 43.5 mm
2. *Yeehawcypraea bartoni* 57.9 mm
3. *Y. osceolai* 48.3 mm
4. *A. (Olssonicypraea) hughesi* 64.6 mm
5. *A. (Kissimmecypraea) transitoria* 81.4 mm
6. *Pahayokea kissimmeensis* 71.5 mm



1



2



3



4



5



6

Fruitville Member (Unit 4) – Kissimmee River Valley Equivalent

Species

Kissimmee

Akleistostoma (Ingramicypraea) cliffordi Petuch and Drolshagen, 2011

Akleistostoma (Olssonicypraea) hunterae new species

Akleistostoma (Kissimmecypraea) eddiematchetti (Petuch and Drolshagen, 2011)

Pahayokea gabriellae Petuch, 2004

Pahayokea judei (Petuch and Drolshagen, 2011)

Pahayokea basingerensis (Petuch, 2004)

Yeehawcypraea waldroni Petuch and Drolshagen, 2011

Yeehawcypraea matchetti Petuch and Drolshagen, 2011

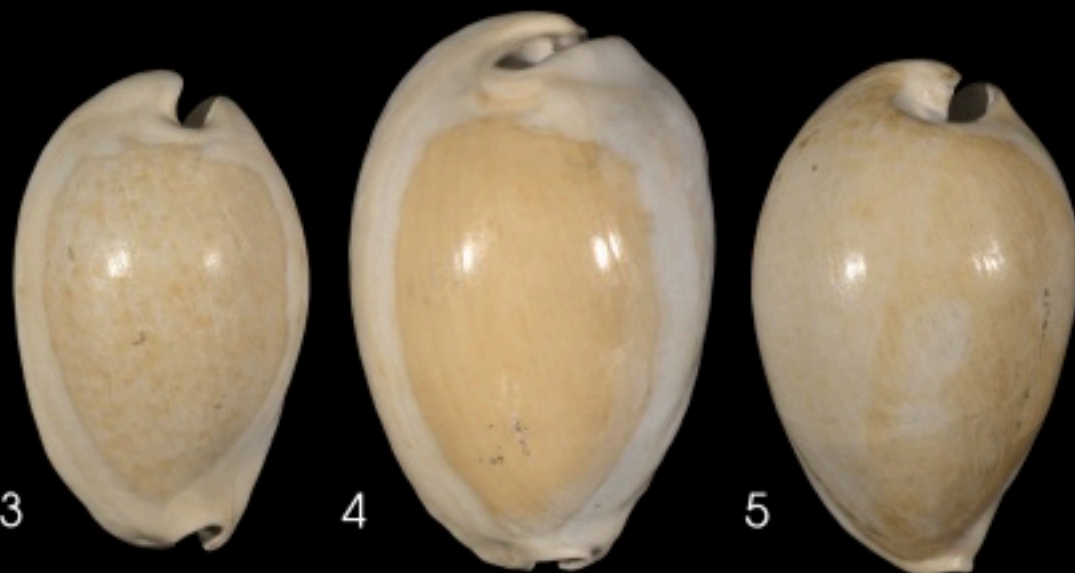
Following a 200,000-year cooling period, molluscan habitats were restored and reached their maximum expansion during Unit 4 time. Wide, shallow (1-5 meters deep) banks of compacted silica-based river sediments, interspersed with tidal channels, dominated the central area within Kissimmee. The banks supported extensive sea grass beds which formed the habitats for several Cypraeidae populations.

As at Myakka, Kissimmee also hosted mudflats and mangrove forest habitats. The mudflats were intertidal and served as the restricted habitat of the neotenic genus *Yeehawcypraea*. The species in the genus evolved along a geographically separate but parallel track with the Myakka *Calusacypraea* species. Near shore, intertidal mud flats also served as the habitat for *Akleistostoma (Ingramicypraea) cliffordi* Petuch and Drolshagen, 2011.

As the sedimentary facies within the embayment formed a continuum throughout Units 4 and 3 equivalent times, it is necessary to rely on Index Fossils in order to assign the Cypraeidae aggregations to the appropriate equivalent unit. Also inhabiting the sea grass beds were a number of shallow water bivalves which serve as Index Fossils. These included *Cardita seminolensis* Olsson, 1957, *Pleuromeris pitysia* (Olsson, 1967) and *Carditamera dasytes* Olsson, 1967 among others. These were recorded in the lowest Fruitville beds at Kissimmee (Unit 4 equivalent) and have also been recorded from Unit 4 at Sarasota. The Unit 4 equivalent Cypraeidae species were recorded among and adjacent to those beds.

Plate 66 →

1. *Pahayokea judei* 45.8 mm
2. *P. basingerensis* 52.3 mm
3. *Akleistostoma (Ingramicypraea) cliffordi* 53.2 mm
4. *P. gabriellae* 61.7 mm
5. *Yeehawcypraea waldroni* 57.0 mm
6. *A. (Olssonicypraea) hunterae* 66.0 mm
7. *A. (Kissimmecypraea) eddiematchetti* 73.1 mm
8. *Y. matchetti* 66.4 mm



Fruitville Member (Unit 3) – Kissimmee River Valley Equivalent

Species

Kissimmee

Akleistostoma (Olssonicypraea) bairdi (Petuch, 2004)

Akleistostoma (Olssonicypraea) diegelae (Petuch, 1994)

Akleistostoma (Kissimmecypraea) leonardi Petuch and Drolshagen, 2011

Pahayokea penningtonorum (Petuch, 1994)

Pahayokea heimeri Petuch and Drolshagen, 2011

Mud flats, mangrove forests and sea grass beds within Kissimmee continued to serve as principle Cypraeidae habitats during Unit 4 and 3 equivalent times. The exposures at Rucks Pit appear unchanged throughout both units, with mud flats serving as a habitat during Unit 4 and Unit 3 equivalent time. This is a biogeographic designation based upon the molluscan assemblages within each bed. In the nearby Dickerson Aggregates Pit, many specimens are stained black, indicating the presence of Mangrove forests. Further down the valley, at excavations near Fort Basinger, sea grass beds appear to have been extensive.

No individual species have been collected in situ from any of the Unit 3 equivalent habitats. The species have been collected from spoil piles and have been assigned a Unit equivalent number based upon perceived morphological evolutionary characteristics exhibited within the molluscan assemblages. Such assignments are provisional [P].

The receding sea levels had a dramatic effect upon the Cypraeidae populations in the Kissimmee Embayment and its southern sedimentary deposits. Only five species have been recorded from Unit 3 equivalent facies vs. eight from the preceding Unit 4 equivalent time. It is, however, noteworthy that while no Unit 3 equivalent *Yeehawcypraea* species have been recorded, their existence may be inferred as several species of the genus emerged during the following Unit 2 equivalent time.

Plate 67 →

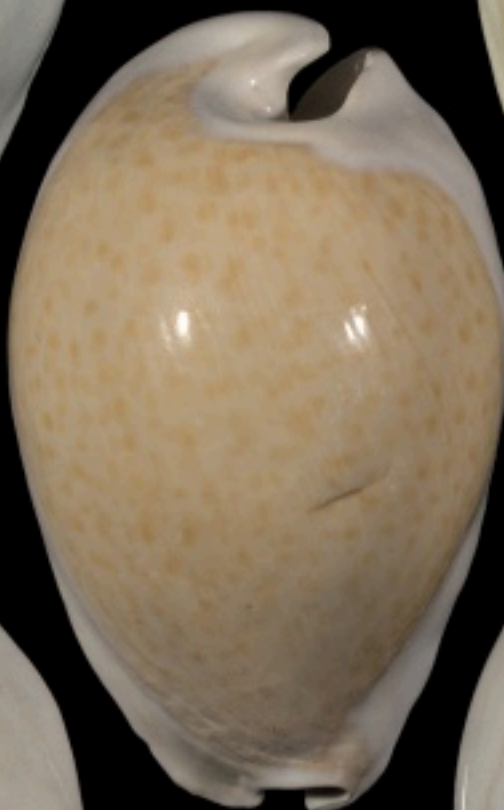
1. *Akleistostoma (Olssonicypraea) diegelae* 37.9 mm
2. *Pahayokea penningtonorum* 44.2 mm
3. *A. (Kissimmecypraea) leonardi* 58.5 mm
4. *P. heimeri* 51.6 mm
5. *A. (Olssonicypraea) bairdi* 57.6 mm



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Fruitville Member (Unit 2) – Kissimmee River Valley Equivalent

Species

Kissimmee

- Akleistostoma (Kissimmecypraea) ingrami* (Petuch and Drolshagen, 2011)
- Akleistostoma (Ingramicypraea) glennae* Petuch and Drolshagen, 2011
- Akleistostoma (Olssonicypraea) zahinai* Petuch and Drolshagen, 2011
- Pahayokea mauriceguyi* Petuch, Berschauer and Myers, 2018
- Pahayokea lybrandi* Petuch and Drolshagen, 2011
- Yeehawcypraea fortdrumensis* Petuch and Drolshagen, 2011
- Yeehawcypraea lindajoyceae* Petuch and Drolshagen, 2011
- Siphocypraea (Lokossea) rucksorum* Petuch, 2004

As in the western coastal Myakka Lagoon System, the receding sea levels resulted in widespread intertidal shoals forming with the greatest concentration along the western side of the embayment. Dense, thick beds of the scallop *Carolinapecten bertiensis* (Mansfield, 1946) formed along the deeper open sand patches adjacent to the east of the shoals. Sea grass beds were interspersed with the scallop beds and these formed the preferred habitat for the Unit 2 equivalent Cypraeidae which have been collected along the same stratum as the *Carolinapecten*, e.g., at Rucks Pit, and further south along the Kissimmee River Valley.

As Unit 2 equivalent time progressed, a series of narrow cuts across the St. Lucie Peninsula connected the northern end of the embayment with the Atlantic Ocean. The cuts formed cooler water corridors for the invasion of contemporaneous Virginia and Carolinas Chowan River Formation (Edenhouse Member) molluscan fauna into the embayment, including *Carolinapecten bertiensis*. The invasive fauna settled in the northern section of the embayment and were unable to move further south. While marine conditions were cooler, they were still able to support the last remaining Cypraeidae populations.

Plate 68 →

1. *Yeehawcypraea lindajoyceae* 36.4 mm
2. *Akleistostoma (Olssonicypraea) zahinai* 44.7 mm
3. *A. (Ingramicypraea) glennae* 46.5 mm
4. *Pahayokea mauriceguyi* 55.7 mm
5. *Y. fortdrumensis* 58.7 mm
6. *A. (Kissimmecypraea) ingrami* 63.2 mm
7. *Siphocypraea (Lokossea) rucksorum* 66.8 mm
8. *P. lybrandi* 66.9 mm



Chapter 10

Kissimmee River Valley Genera

The Kissimmee River Valley represents the Cypraeidae's eastern evolutionary track in southern Florida, parallel to the western coastal track. Due to erosion, the lowest stratum is missing, leaving the Unit 7 equivalent strata as the earliest known.

Akleistostoma (Ingramicypraea) Petuch and Drolshagen, 2011

Originally proposed as a subgenus of *Akleistostoma*, “representing small, rounded, flattened species with wide apertures”. (Petuch & Drolshagen).

Described as: “Shells small for genus, averaging less than 30 mm, round or oval in outline, distinctly flattened; shell bases flat; margins thickened, with rounded keel around periphery; terminals, short, blunt; apertures wide, arcuate [bow-like curve], becoming very wide on anterior half.” (Petuch & Drolshagen).

“*Ingramicypraea* differs from the other *Akleistostoma* subgenera in having very small shells, often less than 30 mm in length, that are very rounded and turtle-shaped. The terminals, particularly the auricle flanges, are very reduced and truncated and the apertures are wide and flaring, especially at the anterior end. Within the Kissimmee Valley, members of the new subgenus are locally common, especially at Fort Drum and Fort Basinger, demonstrating that *Ingramicypraea* was a successful group right up the time of its extinction.” (Petuch & Drolshagen).

Akleistostoma (Ingramicypraea) pilsbryi (Ingram, 1939) is known from the Buckingham Member (Unit 10) of the Sarasota quarries. It is not known from the Unit 10 Kissimmee River Valley equivalent as that stratum is missing due to erosion. Originally described by Ingram based on specimens collected along the Cape Fear River, North Carolina, its presence in the Kissimmee River Valley has not been confirmed. However, as all other species of the subgenus appear derived from *A. (I.) pilsbryi* and are restricted to the Kissimmee River Valley, its presence there may be inferred.

Akleistostoma (Ingramicypraea) Tamiami Formation species:

Akleistostoma (Ingramicypraea) pilsbryi (Ingram, 1939) **TYPE**

Akleistostoma (Ingramicypraea) highlandensis Petuch and Drolshagen, 2011

Akleistostoma (Ingramicypraea) cliffordi (Petuch and Drolshagen, 2011)

Akleistostoma (Ingramicypraea) glennae Petuch and Drolshagen, 2011

NOTE: See Chapter 8 for the *A. (I.) pilsbryi* entry.

Comparisons:

Akleistostoma (Ingramicypraea): Small, rounded, flattened species with wide apertures. Apical sulcus simple, shallow, poorly produced, blunt; auricles poorly produced, blunt.

- Columellar teeth extending to the columellar ridge; columella smooth; fossula absent.

Akleistostoma (Olssonicypraea): Round-to-oval flattened cowries with thickened margins and narrow apertures. Apical sulcus open, recurved, covered by horizontal labral curve; aperture proportionally narrow, narrow.

- Columellar teeth extending onto the top of or over the columella; columella ribbed along top or ribbed; fossula absent.

Akleistostoma (Kissimmecypraea): large, flattened cowries with apertures that are wider than those of *Pahayokea* (s.s.). Apical sulcus narrow, recurved, covered by horizontal labral curve with an upward bias; aperture proportionally narrow, narrow.

- Columellar teeth extending to the columellar ridge; columella smooth; fossula indistinct.

Akleistostoma (Ingramicypraea) Petuch and Drolshagen, 2011

***Akleistostoma (Ingramicypraea) highlandensis* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13223

TYPE Locality: Lower shell beds exposed by the Kissimmee River excavations at Fort Basinger, Highlands County, FL.

Pinecrest Member (Unit 7 equivalent)

Size range: 30.0-50.9 mm

Shape: Oval, flattened

Base: Rounded

Margins: Produced, rounded

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Absent

Apical sulcus: Simple, shallow, poorly produced

Aperture: Open, sinuous, widening anteriorly, arcuate

Columellar teeth: Thin, weak or absent posteriorly, extending to columellar ridge

Number: 10-12

Labral lip; teeth: Thin, rounded; pointed, extending onto/over base

Number: 15-18

Key Characteristics: Oval, flattened shell; apical sulcus simple, shallow, poorly produced; aperture open, sinuous, widening anteriorly, arcuate; base rounded; margins produced, rounded; auricles poorly produced, blunt; columellar teeth thin, weak or absent posteriorly, extending to the columellar ridge; columella smooth; fossula absent.

Comparisons: *A. (I.) highlandensis* is similar to *A. (I.) pilsbryi* and *A. (I.) cliffordi*. However, *A. (I.) pilsbryi* is a smaller, ovate, inflated, rounded shell with fewer columellar teeth and wider interstices. *A. (I.) cliffordi* is an elongate, slightly flattened shell with subangular, angular margins.

Range: Kissimmee River Valley, found at Rucks Pit, Okeechobee County and in spoil piles at the Kissimmee River dig near Fort Basinger, Highlands County.

Plate 69 →

Akleistostoma (Ingramicypraea) highlandensis Petuch and Drolshagen, 2011

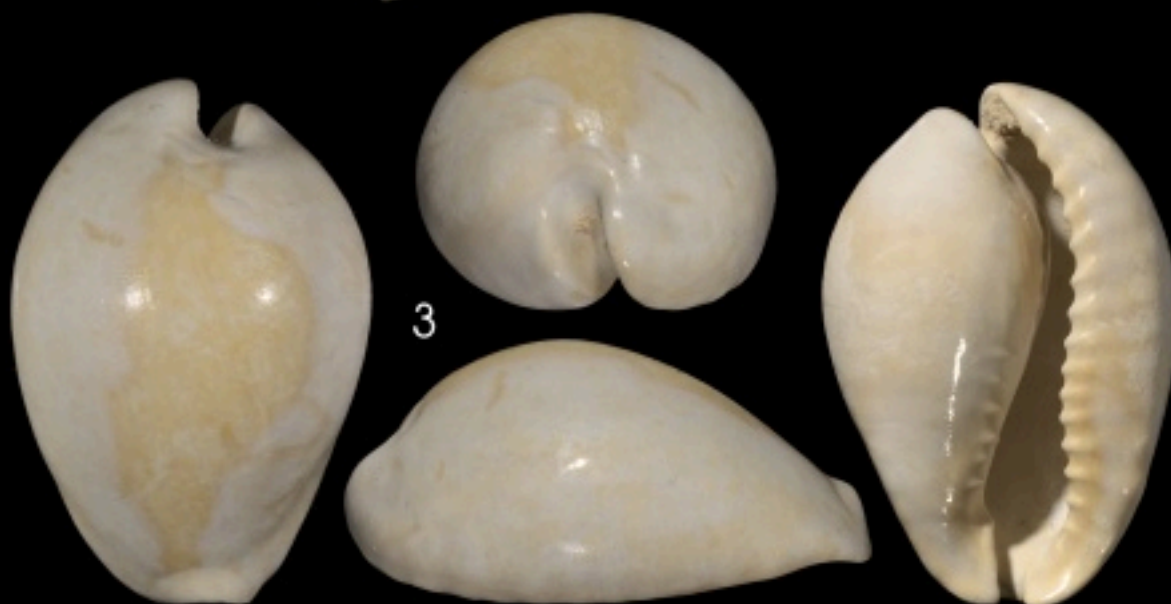
1. 40.6 mm, Kissimmee River Dig, Fort Basinger
2. 50.9 mm, Rucks Pit, Fort Drum, Kissimmee River Valley
3. 43.5 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



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***Akleistostoma (Ingramicypraea) cliffordi* (Petuch and Drolshagen, 2011)**

2011. *Akleistostoma (Olssonicypraea) cliffordi* Petuch and Drolshagen

2018. *Akleistostoma (Ingramicypraea) cliffordi* Petuch, Berschauer and Myers

HOLOTYPE: Paleontological Research Institute, PRI 13224

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 4 equivalent)

Size range: 44.0-53.2 mm

Shape: Elongate, rectangular, flattened

Base: Slightly flattened

Margins: Produced, subangular, angular

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Absent

Apical sulcus: Simple, shallow, slightly curved, blunt

Aperture: Open, widening anteriorly, slightly arcuate

Columellar teeth: 6-7 thin anterior teeth, weak or absent posteriorly; interstices wide, extending to columellar ridge

Number: 12-13

Labral lip; teeth: Thin, rounded; thick, pointed, extending onto base

Number: 17-19

Key Characteristics: Elongate, rectangular, flattened shell; apical sulcus simple, shallow, slightly curved, blunt; aperture open, widening anteriorly, slightly arcuate; base slightly flattened; margins produced, subangular, angular; auricles poorly produced, blunt; columellar teeth weak or absent posteriorly, interstices wide, extending to the columellar ridge; columella smooth; fossula absent.

Comparisons: *A. (I.) cliffordi* is similar to *A. (I.) highlandensis*. However, *A. (I.) highlandensis* is an oval shell with a rounded base and margins.

Range: Kissimmee River Valley.

Plate 70 →

Akleistostoma (Ingramicypraea) cliffordi (Petuch and Drolshagen, 2011)

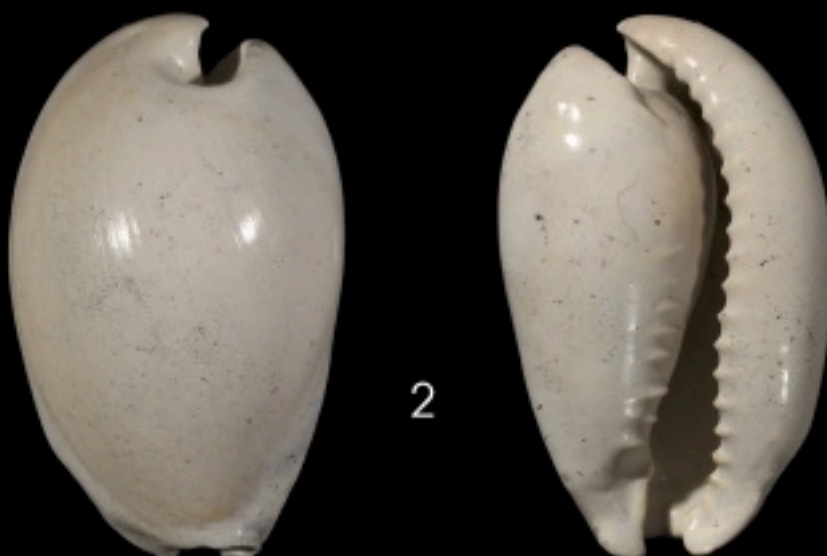
1. 47.8 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 48.3 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 53.2 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



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***Akleistostoma (Ingramicypraea) glennae* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 132225

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 2 equivalent) [P]

Size range: 25.0-46.5 mm

Shape: Roundly oval, broad, flattened

Base: Slightly rounded

Margins: Produced, rounded or upturned
(keel-like) on very mature specimens

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Absent

Apical sulcus: Simple, shallow, slightly curved,
blunt

Aperture: Open, recurved posteriorly, widening
slightly anteriorly

Columellar teeth: Thin, posterior teeth weak
or absent, extending to columellar ridge

Number: 12-13

Labral lip; teeth: Thin, extending onto base

Number: 17-19

Key Characteristics: Roundly oval, broad, flattened shell; apical sulcus simple, shallow, slightly curved, blunt; aperture open, recurved posteriorly, widening slightly anteriorly; base slightly rounded; margins produced, rounded or upturned, keel-like peripheral margins on very mature specimens; auricles poorly produced, blunt; columellar teeth weak or absent posteriorly, extending to the columellar ridge; columella smooth; fossula absent.

Comparisons: Young *A. (I.) glennae* specimens are similar to *A. (I.) highlandensis*. However, *A. (I.) highlandensis* is not as broad, nor rounded a shell, with an aperture which widens anteriorly, arcuate; and margins not as well produced.

Range: Kissimmee River Valley. Present at Rucks Pit and Dickerson Aggregates Pit, Okeechobee County.

Plate 71 →

Akleistostoma (Ingramicypraea) glennae Petuch and Drolshagen, 2011

1. 39.1 mm, Rucks Pit, Fort Drum, Kissimmee River Valley
2. 46.5 mm, Rucks Pit, Fort Drum, Kissimmee River Valley
3. 42.0 mm, Rucks Pit, Fort Drum, Kissimmee River Valley
4. 45.8 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



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***Akleistostoma (Olssonicypraea)* Petuch and Drolshagen, 2011**

Originally proposed as subgenus of *Akleistostoma*, “representing round-to-oval flattened cowries with thickened margins and narrow apertures”. (Petuch & Drolshagen).

Described as: “Shells of average-to-small size, round or oval in profile, flattened, with thickened margins that are rounded on their edges; base of shell rounded; terminals only moderately produced, with auricular flanges well-developed, flattened, projecting past siphonal canal area; apertures proportionally narrow, arcuate [bow-like curve], strongly recurved to the right; apertural dentition uniformly strong throughout apertural area; apical sulcus slightly curled to the right”. (Petuch & Drolshagen).

“The new subgenus is completely restricted to the Kissimmee Embayment of the Okeechobean Sea (modern Kissimmee River Valley) and represents a localized evolutionary radiation in the extensive Turtle Grass and Red Mangrove forest-mud flat environments that dominated the area in the middle and late Pliocene. In general shape and overall appearance, the new subgenus is closest to *Akleistostoma* s.s., but differs in having uniformly narrower apertures without the characteristic widening toward the anterior end, and in having apical sulci that are more curved to the right”. (Petuch & Drolshagen).

Comparisons

Akleistostoma (Ingramicypraea): Small, rounded, flattened species with wide apertures. Apical sulcus simple, shallow, poorly produced, blunt; auricles poorly produced, blunt.

- Columellar teeth extending to the columellar ridge; columella smooth; fossula absent.

Akleistostoma (Olssonicypraea): Round-to-oval flattened to slightly inflated cowries with thickened margins and narrow apertures. Apical sulcus open, recurved, covered by horizontal labral curve; aperture proportionally narrow, narrow.

- Columellar teeth extending onto the top of or over the columella; columella ribbed along top or ribbed; fossula absent.

Akleistostoma (Kissimmecypraea): large, flattened cowries with apertures that are wider than those of *Pahayokea* (s.s.). Apical sulcus narrow, recurved, covered by horizontal labral curve with an upward bias; aperture proportionally narrow, narrow.

- Columellar teeth extending to the columellar ridge; columella smooth; fossula indistinct.

Akleistostoma (Olssonicypraea) Tamiami Formation species:

Akleistostoma (Olssonicypraea) hughesi (Olsson and Petit, 1964) **TYPE**

Akleistostoma (Olssonicypraea) hunterae Daughenbaugh and Bridges, 2022

Akleistostoma (Olssonicypraea) bairdi (Petuch, 1994)

Akleistostoma (Olssonicypraea) diegelae (Petuch, 1994)

Akleistostoma (Olssonicypraea) zahinai Petuch and Drolshagen, 2011

Akleistostoma (Olssonicypraea) Petuch and Drolshagen, 2011

***Akleistostoma (Olssonicypraea) hughesi* (Olsson and Petit, 1964) TYPE**

1964. *Siphocypraea (Siphocypraea) carolinensis hughesi* Olsson and Petit

1994. *Siphocypraea hughesi* Petuch

1997. *Siphocypraea (Akleistostoma) hughesi* Petuch

2011. *Akleistostoma (Olssonicypraea) hughesi* Petuch and Drolshagen

HOLOTYPE: United States National Museum, USNM No. 644664

TYPE Locality: Slough Ditch, about five miles east of Brighton, Highlands County, FL.

Pinecrest Member (Unit 7 equivalent)

Original description: See Appendix B(II)

Size range: 52.6-78.5 mm

Shape: Oval, broad, rounded, flattened

Base: Flattened, body whorl side convex

Margins: Callous, projecting, angular,

upturned (keel-like) on some mature specimens

Auricles: Produced, flanged, short

Columella: Ribbed along top, ribbed

Fossula: Absent

Apical sulcus: Open, deep, strongly recurved, covered by horizontal labral curve

Aperture: Proportionally narrow, widening slightly anteriorly on some specimens

Columellar teeth: Thin, extending onto columella

Number: 14-19

Labral lip; teeth: Proportionally thin, rounded; short, pointed

Number: 17-22

Key Characteristics: [Adapted from Olsson & Petit, Petuch, Berschauer & Myers, 2018 and personal observation] Oval, broad, rounded, flattened shell (dorso-ventrally compressed); apical sulcus open, deep, strongly recurved, covered by horizontal labral curve; aperture proportionally narrow, widening slightly anteriorly on some specimens; base flattened, body whorl side convex; margins callous, projecting, angular with upturned, keel-like peripheral margins on some mature specimens; auricles produced, flanged, short; columellar teeth extending onto the columella, producing a columella which is ribbed along its top or fully ribbed; fossula absent.

Comparisons: *A. (O.) hughesi* is similar to *A. (O.) bairdi* and *A. (O.) hunterae*. However, *A. (O.) bairdi* is a pyriform, inflated, elongate shell with margins that are more rounded, not projecting; a shallower apical sulcus; a slightly arcuate aperture and produced, projecting auricles. *A. (O.) hunterae* is an oval, slightly inflated shell with a rounded dorsum.

Range: The Kissimmee River Valley, including Rucks Pit, Okeechobee County and spoil piles from Kissimmee Rivers dredgings near Fort Bassinger, Highlands County.

Plate 72 →

Akleistostoma (Olssonicypraea) hughesi (Olsson and Petit, 1964)

1. 52.6 mm, Rucks Pit, Fort Drum, Kissimmee River Valley
2. 64.6 mm, Kissimmee River Dig at Fort Basinger
3. 59.4 mm, Kissimmee River Dig, vicinity of Fort Basinger
4. 78.5 mm, Kissimmee River Dig, vicinity of Fort Basinger



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***Akleistostoma (Olssonicypraea) hunterae* new species**

HOLOTYPE: Los Angeles County Museum of Natural History,
LACMIP 43271.1, LACMIP Type 14917

TYPE Locality: Dickerson Aggregates Pit, Fort Drum, Okeechobee County

Fruitville Member (Unit 4 equivalent) [P]

Type material Holotype: 66.0 mm, Dickerson Aggregates Pit, Fort Drum
Paratype 1: 63.5 mm, along Highway 98, Fort Basinger
Paratype 2: 70.2 mm, Rucks Pit, Fort Drum (Petuch collection)
Paratype 3: 71.6 mm, Rucks Pit, Fort Drum
Paratype 4: 72.9 mm, Dickerson Aggregates Pit, Fort Drum
Paratype 5: 70.2 mm, Dickerson Aggregates Pit, Fort Drum

All collected by Dr. E. Petuch.

Size range: 63.5-86.8 mm

Shape: Oval, slightly inflated,
rounded dorsum

Base: Slightly rounded

Margins: Produced, subangular, angular

Auricles: Produced, blunt

Columella: Ribbed along top

Fossula: Absent

Apical sulcus: Open, deep, recurved, covered by
horizontal labral curve

Aperture: Proportionally narrow, widening slightly
anteriorly

Columellar teeth: Thin, extending onto the top
of the columella

Number: 15-17

Labral lip; teeth: Thin, rounded; thick, pointed
Number: 19-23

Key Characteristics: Oval, slightly inflated shell with a rounded dorsum; apical sulcus open, deep, recurved, covered by horizontal labral curve; aperture proportionally narrow, widening slightly anteriorly; base slightly rounded; margins produced, subangular, angular; columellar teeth thin, extending onto the top of the columella; columella ribbed along the top; fossula absent.

Comparisons: *A. (O.) hunterae* is similar to *A. (O.) hughesi* and *A. (O.) bairdi*. However, *A. (O.) hughesi* is a flattened shell with a more uniformly narrow aperture; produced, projecting margins which are upturned on some fully mature specimens; auricles which are produced, short and flanged. *A. (O.) bairdi* is a pyriform, more slender/elongate shell which is not inflated.

Etymology: Named for Muriel Hunter, geologist who expanded the Tamiami Formation, including the Buckingham and Pinecrest Members and named the Ochopee Member.

Range: The Kissimmee River Valley.

Note: As all specimens were collected from spoil piles at the Dickerson Aggregates Pit, Fort Drum, Okeechobee County, the unit attribution is considered provisional and is based on perceived morphological characteristics.

Plate 73 →

Akleistostoma (Olssonicypraea) hunterae new species

1. 63.5 mm, Paratype 1, Spoil piles along Highway 98, Fort Basinger
2. 66.0 mm, Holotype, Dickerson Aggregates Pit, Fort Drum, Kissimmee River Valley
3. 71.6 mm, Paratype 3, Rucks Pit, Fort Drum, Kissimmee River Valley
4. 72.9 mm, Paratype 4, Dickerson Aggregates Pit, Fort Drum, Kissimmee River Valley



***Akleistostoma (Olssonicypraea) bairdi* (Petuch, 2004)**

2004. *Akleistostoma bairdi* Petuch

2011. *Akleistostoma (Olssonicypraea) bairdi* Petuch and Drolshagen

HOLOTYPE: American Museum of Natural History, N. Y., AMNH FI-50655

TYPE Locality: Dredging along the Kissimmee River at Fort Basinger, Highlands County, FL.
Fruitville Member (Unit 3 equivalent) ▪ Originally assigned to Fruitville Unit 3 equivalent, reassigned by Petuch et al., 2018, to Fruitville Unit 4 equivalent without comment. Reassigned to Unit 3 equivalent as the smaller sizes of the specimens suggest a younger stratum. [P]

Size range: 47.6-59.0 mm

Shape: Pyriform/subovate, flattened, inflated, elongate

Base: Slightly rounded

Margins: Produced, rounded/subangular, angular

Auricles: Produced, slightly projecting/blunt

Columella: Ribbed along top

Fossula: Absent

Apical sulcus: Open, shallow, recurved, covered by horizontal labral curve

Aperture: Proportionally narrow, widening slightly anteriorly

Columellar teeth: Thin, extending onto the top of the columella

Number: 11-14; 16-18

Labral lip; teeth: Thin, rounded; short, pointed

Number: 16-19; 20-21

Key Characteristics: [Adapted from the 2004 and 2018 descriptions] Pyriform/subovate, flattened, inflated, elongate shell; apical sulcus open, shallow, recurved, covered by horizontal labral curve; aperture proportionally narrow, widening slightly anteriorly; base slightly rounded; margins, produced, rounded/subangular/angler; auricles produced, slightly projecting/blunt; columellar teeth thin, extending onto the top of the columella; columella ribbed along the top; fossula absent.

Comparisons: *A. (O.) bairdi* is similar to *A. (O.) hughesi* and *A. (O.) hunterae*. However, *A. (O.) hughesi* is a more oval, broad, flattened shell with more developed, projecting margins which are upturned on fully some mature specimens; an apical sulcus which is deep and more curved horizontally; an aperture which is more uniformly narrow with columellar teeth extending deeper onto the columella; and auricles which are produced, short and flanged. *A. (O.) hunterae* is an oval, larger, slightly inflated, inflated shell with a rounded dorsum.

Range: The Kissimmee River Valley.

Variations: Described as pyriform in 2004. Described as pyriform/oval in 2018. Variation A. The senior author's collection contains two specimens, 47.6-56.1 mm in length, from the Petuch collection. In addition to their pyriform shape, the apical sulcus is projecting and only partially covers the apical sulcus. The specimens also have a lesser number of columellar teeth (11-14) and labral teeth (16-19) as well as rounded margins and slightly projecting auricles. Variation B. The senior author's collection contains three specimens, 55.9-59.0 mm in length, from the Petuch collection, collected by Dr. Petuch during his first visit to Rucks Pit in 1997. The specimens exhibit a subovate shape and possess a typical *Olssonicypraea* horizontal labral curve which is more compressed. There are a greater number of columellar teeth (17-20) and labral teeth (20-22) as well as more callous, subangular, angular margins and blunter auricles. While the status of both variations is uncertain, they are retained in the subgenus pending future input(s).

Plate 74 →

Akleistostoma (Olssonicypraea) bairdi (Petuch, 2004)

1. 58.8 mm, Rucks Pit, Fort Drum, Kissimmee River Valley
2. 56.1 mm, Rucks Pit, Fort Drum, Kissimmee River Valley
3. 57.6 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



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2



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***Akleistostoma (Olssonicypraea) diegelae* (Petuch, 1994)**

1994. *Siphocypraea diegelae* Petuch

1997. *Siphocypraea (Akleistostoma) diegelae* Petuch

2011. *Akleistostoma (Olssonicypraea) diegelae* Petuch and Drolshagen

HOLOTYPE: FI Museum of Natural History, IP collection, UF 66232

TYPE Locality: From Kissimmee River dredgings, Okeetantie, Okeechobee County, FL.

Fruitville Member (Unit 3 equivalent) [P]

Size range: 35.5-43.7 mm

Shape: Pyriform, broad posteriorly, flattened

Base: Flattened

Margins: Subangular, angular

Auricles: Poorly developed, blunt

Columella: Ribbed along top, ribbed

Fossula: Absent

Apical sulcus: Open, shallow, recurved, covered by slight horizontal labral curve

Aperture: Narrow, widening slightly anteriorly

Columellar teeth: Thin, extending well onto/over the columella

Number: 12-13

Labral lip; teeth: Thin; thin, pointed, extending onto base

Number: 16-17

Key Characteristics: Small, pyriform, broad posteriorly, flattened shell; apical sulcus open, shallow, recurved, covered by slight horizontal labral curve; aperture narrow, widening slightly anteriorly; base flattened; margins subangular, angular; columellar teeth thin, extending well onto/over the columella; columella ribbed along the top, ribbed; fossula absent

Comparisons: *A. (O.) diegelae* is only similar to *A. (O.) zahinai* and *Yeehawcypraea lindajoyceae*. However, *A. (O.) zahinai* is a subcylindrical, domed shell with more numerous labral teeth. *Y. lindajoyceae* is an ovately pyriform shell; apical sulcus open with a hook-like projection and the spire tip showing within the apical pit; aperture is open, widening anteriorly, slightly arcuate; columella smooth; fossula distinct.

Range: The Kissimmee River Valley.

Plate 75 →

Akleistostoma (Olssonicypraea) diegelae (Petuch, 1994)

1. 33.7 mm, Kissimmee River Dig, vicinity of Fort Basinger

2. 38.8 mm, Kissimmee River Dig, vicinity of Fort Basinger

3. 39.0 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

4. 37.9 mm, Sand pits off Kissimmee River, east of Lock 65D, SC Florida



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3



4



***Akleistostoma (Olssonicypraea) zahinai* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13227

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County

Fruitville Member (Unit 2 equivalent) [P]

Size range: 30.0-47.3 mm

Shape: Subcylindrical, elongate, domed

Base: Slightly rounded, flattened

Margins: Produced, angular

Auricles: Produced, slightly projecting

Columella: Ribbed

Fossula: Absent

Apical sulcus: Open, shallow, recurved, covered by horizontal labral curve

Aperture: Narrow, widening slightly anteriorly

Columellar teeth: Thin, extending over the columella

Number: 13-16

Labral lip; teeth: Steep, proportionally thick; short, pointed, extending onto base

Number: 19-20

Key Characteristics: Subcylindrical, elongate shell with a domed dorsum; apical sulcus open, shallow, recurved, covered by labral horizontal curve; aperture narrow, widening slightly anteriorly; base slightly rounded, flattened; margins produced, angular; auricles produced, slightly projecting; columellar teeth thin, extending over the columella; columella ribbed; fossula absent.

Comparisons: *A. (O.) zahinai* is only similar to *A. (O.) diegelae*. However, *A. (O.) diegelae* is a more pyriform, flattened shell, narrowing anteriorly; rounded, subangular margins and less numerous labral teeth which only extend slightly onto the base.

Range: The Kissimmee River Valley.

Plate 76 →

Akleistostoma (Olssonicypraea) zahinai Petuch and Drolshagen, 2011

1. 36.0 mm, Kissimmee River Dig, vicinity of Fort Basinger

2. 47.3 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 44.7 mm, Kissimmee River Dig, vicinity of Fort Basinger



1



2



3

Akleistostoma (Kissimmecypraea) (Petuch and Drolshagen, 2011)

2011. *Pahayokea (Kissimmecypraea)* Petuch and Drolshagen

2022. *Akleistostoma (Kissimmecypraea)* Daughenbaugh and Bridges

Originally proposed as a subgenus of *Pahayokea*, representing “large, flattened cowries with apertures that are wider than those of *Pahayokea* (s.s.)”. (Petuch & Drolshagen).

Described as “Shells large for genus, broad to subcylindrical, flattened; bases flat; margins very well-developed, with anterior auricular flanges large and prominent; apical sulci coiled with one-half turn; apertures relatively wide, becoming wider at anterior end”. (Petuch & Drolshagen).

“The new subgenus differs from the other groups within the genus in having large shells with very flattened, almost bladelike margins and wide apertures.” (Petuch & Drolshagen).

At the time, the *Kissimmecypraea* subgenus was considered the morphological intermediate between *Pahayokea* (s.s.) and the *Gardnericypraea* subgenus which is restricted to the Myakka Lagoon System. The latter was reassigned as a subgenus of *Akleistostoma*.

Reassignment

I. The Type of the *Pahayokea* genus, *Pahayokea penningtonorum* (Petuch, 1994), and all other species within the genus feature a curved apical sulcus, fully ribbed columella and an absent, or rarely in some specimens, an indistinct fossula.

However, *Pahayokea (Kissimmecypraea)* subgenus species exhibit a clockwise, horizontally curved or pinched apical sulcus with some specimens exhibiting an upward bias, a smooth columella and an indistinct or absent fossula. These characteristics are similar to *Akleistostoma (Olssonicypraea)* species, also from the Kissimmee River Valley. Other characteristics deviate noticeably, supporting the retention of the subgenus status. See comparisons below. As a result, the subgenus is reassigned herein as *Akleistostoma (Kissimmecypraea)* with *Akleistostoma (Kissimmecypraea) eddiematchetti* retained as the **Type**.

II. “Based on a resemblance to the older, Unit 3 *Akleistostoma rilkoi* (Petuch, 1998) of the Myakka Lagoon System, *Akleistostoma ingrami* [(Petuch and Drolshagen)] was originally classified as the only Kissimmee *Akleistostoma* species in the *Akleistostoma* [parent] genus, which is restricted to the Myakka Lagoon system. ... Based on the [geographic] separation as well as the likely presence of an ancestor in the Kissimmee, the species is reclassified as *Akleistostoma (Ingramicypraea) ingrami* (Petuch and Drolshagen, 2011), Unit 2 equivalent.” (Daughenbaugh, 2020b).

However, with the reassignment of the *Kissimmecypraea* subgenus herein, it can be seen that *A. (K.) ingrami* actually bears a closer resemblance to certain species of that subgenus. The similarity with *A. (K.) eddiematchetti*, albeit as a dwarf species, becomes especially apparent upon closer examination and not *A. (Ingramicypraea) cliffordi* as previously suggested. As such, it appears to be better assigned to the *Akleistostoma (Kissimmecypraea)* subgenera as a Fruitville Member (Unit 3 equivalent, previously, Unit 2 equivalent) following *A. (K.) eddiematchetti* (Unit 4 equivalent). The Unit placement is provisional [**P**].

III. Three of the four species originally placed in the *Pahayokea* (*Kissimmecypraea*) subgenus have been reassigned herein as *Akleistostoma* (*Kissimmeensis*), see Comparisons below. The fourth species, *P. (K.) lybrandi* Petuch and Drolshagen, 2011, has also been reassigned herein. The specimens available to the authors display significant variations in the columellar dentition, columella and fossula. At present, we have chosen to provisionally reassign the species to the parent *Pahayokea* genus as *Pahayokea lybrandi*, pending resolution of these anomalies. See the *Pahayokea* genus for its entry.

Comparisons

Akleistostoma (*Ingramicypraea*): Small, rounded, flattened species with wide apertures. Apical sulcus simple, shallow, poorly produced, blunt; auricles poorly produced, blunt.

- Columellar teeth extending to the columellar ridge; columella smooth; fossula absent.

Akleistostoma (*Olssonicypraea*): Round-to-oval flattened to slightly inflated cowries with thickened margins and narrow apertures. Apical sulcus open, recurved, covered by horizontal labral curve; aperture proportionally narrow, narrow.

- Columellar teeth extending onto the top of or over the columella; columella ribbed along top or ribbed; fossula absent.

Akleistostoma (*Kissimmecypraea*): large, flattened cowries with apertures that are wider than those of *Pahayokea* (s.s.). Apical sulcus narrow, recurved, covered by horizontal labral curve with an upward bias; aperture proportionally narrow, narrow.

- Columellar teeth extending to the columellar ridge; columella smooth; fossula indistinct.

Akleistostoma (*Kissimmecypraea*) Tamiami Formation species:

Akleistostoma (*Kissimmecypraea*) *transitoria* (Olsson and Petit, 1964) *

Akleistostoma (*Kissimmecypraea*) *eddiematchetti* (Petuch and Drolshagen, 2011) **TYPE**

Akleistostoma (*Kissimmecypraea*) *ingrami* (Petuch and Drolshagen, 2011) *

Akleistostoma (*Kissimmecypraea*) *leonardi* (Petuch and Drolshagen, 2011) *

The above list includes three species (*) originally assigned to the *Pahayokea* (*Kissimmecypraea*) subgenus. *Akleistostoma* (*Kissimmecypraea*) *ingrami* has been added to the list. See **II.** above.

Akleistostoma (Kissimmecypraea) Petuch and Drolshagen, 2011

***Akleistostoma (Kissimmecypraea) transitoria* (Olsson and Petit, 1964)**

1964. *Siphocypraea (Siphocypraea) carolinensis transitoria* Olsson and Petit

1994. *Siphocypraea transitoria* Petuch

1997. *Siphocypraea (Siphocypraea) transitoria* Petuch

2004. *Akleistostoma transitoria* Petuch

2011. *Pahayokea (Kissimmecypraea) transitoria* Petuch and Drolshagen

2022. *Akleistostoma (Kissimmecypraea) transitoria* Daughenbaugh and Bridges

HOLOTYPE: United States National Museum, USNM 644663

TYPE Locality: Brighton, Highlands County, FL.

Pinecrest Member (Unit 7, Kissimmee River Valley equivalent)

Original description: See Appendix B(III).

Size range: 68.2-83.3 mm

Shape: Oblong, subrectangular, subovate, inflated

Base: Flat

Margins: Callous, expanded, angular

Auricles: Produced, flanged, slightly projecting, projecting on some

Columella: Smooth

Fossula: Steep, smooth, elongate, indistinct or absent

Apical sulcus: Narrow, deep, recurved, covered by horizontal labral curve with an upward bias

Aperture: Open, proportionally narrow, widening slightly anteriorly

Columellar teeth: Thin; extending to the columellar ridge; smooth posteriorly

Number: 17-20

Labral lip; teeth: Thin; short posteriorly, pointed

Number: 20-22

Key Characteristics: [Adapted from Olsson & Petit, 1964, Petuch, Berschauer & Myers, 2018 and personal observation] Oblong, subrectangular, subovate, inflated shell; apical sulcus narrow, deep, recurved. Covered by horizontal labral curve with an upward bias; aperture open, proportionally narrow, widening slightly anteriorly; base flat; margins callous, expanded, angular; auricles produced, flanged, slightly projecting, projecting; columellar teeth extending to the columellar ridge, smooth posteriorly on some; columella smooth; fossula indistinct or absent.

Comparisons: *A. (K.) transitoria* is roughly similar to *A. (K.) eddiematchetti*. However, *A. (K.) eddiematchetti* is a broader, more rectangular shell with fewer columellar teeth.

Range: Kissimmee River Valley. Collected at Rucks Pit, Okeechobee County and from the Kissimmee River excavations at Fort Bassinger, Highlands County.

Plate 77 →

Akleistostoma (Kissimmecypraea) transitoria (Olsson and Petit, 1964)

1. 64.2 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 83.3 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 81.4 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



1



2



3



***Akleistostoma (Kissimmecypraea) eddiematchetti* (Petuch and Drolshagen, 2011) TYPE**

2011. *Pahayokea (Kissimmecypraea) eddiematchetti* Petuch and Drolshagen

2022. *Akleistostoma (Kissimmecypraea) eddiematchetti* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13241

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 4, Kissimmee River Valley equivalent)

Size range: 62.4-74.8 mm

Shape: Rectangular, broad, flattened

Base: Flattened

Margins: Callous, flaring, angular

Auricles: Produced, flanged, projecting

Columella: Smooth

Fossula: Steep, smooth, elongate, indistinct

Apical sulcus: Narrow, deep, recurved, covered by horizontal labral curve with an upward bias

Aperture: Open, proportionally narrow, widening slightly anteriorly

Columellar teeth: Thin; extending onto the columellar ridge

Number: 15-18

Labral lip; teeth: Rounded; short posteriorly, pointed

Number: 19-22

Key Characteristics: Rectangular, broad, flattened shell; apical sulcus narrow, deep, recurved, covered by horizontal labral curve with an upward bias; aperture open, proportionally narrow, widening slightly anteriorly; base flattened; margins callous, flaring, angular; auricles produced, flanged, projecting; columellar teeth extending to the columellar ridge; columella smooth; fossula indistinct.

Comparisons: *A. (K.) eddiematchetti* is similar to *A. (K.) ingrami*. However, *A. (K.) ingrami* is smaller, narrower shell with a narrow aperture, margins expanded, but not flaring and blunter auricles.

Range: Kissimmee River Valley at Rucks Pit, Okeechobee County and from spoil piles along Highway 98, Fort Basinger, Highlands County.

Plate 78 →

Akleistostoma (Kissimmecypraea) eddiematchetti (Petuch and Drolshagen, 2011)

1. 62.4 mm, Spoil piles along Highway 98, Fort Basinger

2. 74.8 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 73.1 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



1



2



3

***Akleistostoma (Kissimmecypraea) ingrami* (Petuch and Drolshagen, 2011)**

2011. *Akleistostoma ingrami* Petuch and Drolshagen

2019. *Akleistostoma (Ingramicypraea) ingrami* Daughenbaugh

2022. *Akleistostoma (Kissimmecypraea) ingrami* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13215

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 3 equivalent) [P]

Size range: 47.9-63.2 mm

Shape: Rectangular, flattened

Base: Slightly rounded, flattened

Margins: Callous, expanded, angular

Auricles: Produced, blunt

Columella: Smooth

Fossula: Steep, smooth, elongate, indistinct

Apical sulcus: Narrow, deep, recurved, covered by horizontal labral curve with an upward bias

Aperture: Narrow

Columellar teeth: Thin, extending onto the columellar ridge

Number: 14-16

Labral lip; teeth: Thin; short posteriorly, pointed
Number: 16-18

Key Characteristics: Rectangular, flattened shell; apical sulcus narrow, deep, recurved, covered by horizontal labral curve with an upward bias; aperture narrow; base slightly rounded, flattened; margins callous, expanded, angular; auricles produced, blunt; columellar teeth thin, extending onto the columellar ridge; columella smooth; fossula indistinct.

Comparisons: *A. (K.) ingrami* is similar to *A. (K.) eddiematchetti* and the Myakka Lagoon System *A. (Akleistostoma) rilkoi* and *A. (Mansfieldicypraea) ivyi*. However, *A. (K.) eddiematchetti* is a larger, broader shell with a more open apical sulcus; aperture proportionally narrow, not arcuate; margins flaring outward. *A. (A.) rilkoi* is a larger, more elongated and inflated shell while *A. (M.) ivyi* has a very arcuate aperture.

Range: The Kissimmee River Valley.

Plate 79 →

Akleistostoma (Kissimmecypraea) ingrami (Petuch and Drolshagen, 2011)

1. 50.8 mm, Spoil piles, Dickerson Aggregates Pit, Fort Drum, Kissimmee River

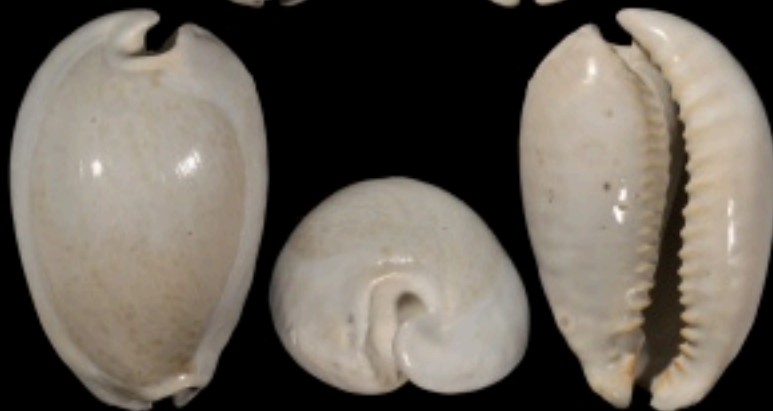
2. 51.7 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 56.2 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

4. 63.2 mm, Spoil piles, Dickerson Aggregates Pit, Fort Drum, Kissimmee River Valley



1



2



3



4

***Akleistostoma (Kissimmecypraea) leonardi* (Petuch and Drolshagen, 2011)**

2011. *Pahayokea (Kissimmecypraea) leonardi* Petuch and Drolshagen

2022. *Akleistostoma (Kissimmecypraea) leonardi* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13243

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 3, Kissimmee River Valley equivalent) [P]

Size range: 52.8-67.9 mm

Shape: Oval, humped

Base: Flattened

Margins: Callous, angular

Auricles: Produced, blunt

Columella: Smooth

Fossula: Steep, smooth, elongate, indistinct
or absent

Apical sulcus: Narrow, shallow, recurved, covered
by horizontal labral curve w/ an upward bias

Aperture: Narrow, widening slightly anteriorly

Columellar teeth: Thin; extending onto the
columellar ridge

Number: 12-17

Labral lip; teeth: Rounded; short posteriorly,
pointed

Number: 17-22

Key Characteristics: Oval shell with humped dorsum; apical sulcus narrow, shallow, recurved, covered by horizontal labral curve with an upward bias; aperture narrow, widening slightly anteriorly; base flattened; margins callous, angular; auricles produced, blunt; columellar teeth extending to the columellar ridge; columella smooth; fossula indistinct or absent.

Comparisons: *A. (K.) leonardi* is somewhat similar to *A. (K.) eddiematchetti*. However, *A. (K.) eddiematchetti* is a larger, rectangular, flattened shell; margins flaring; auricles flanged, projecting.

Range: Kissimmee River Valley.

Plate 80 →

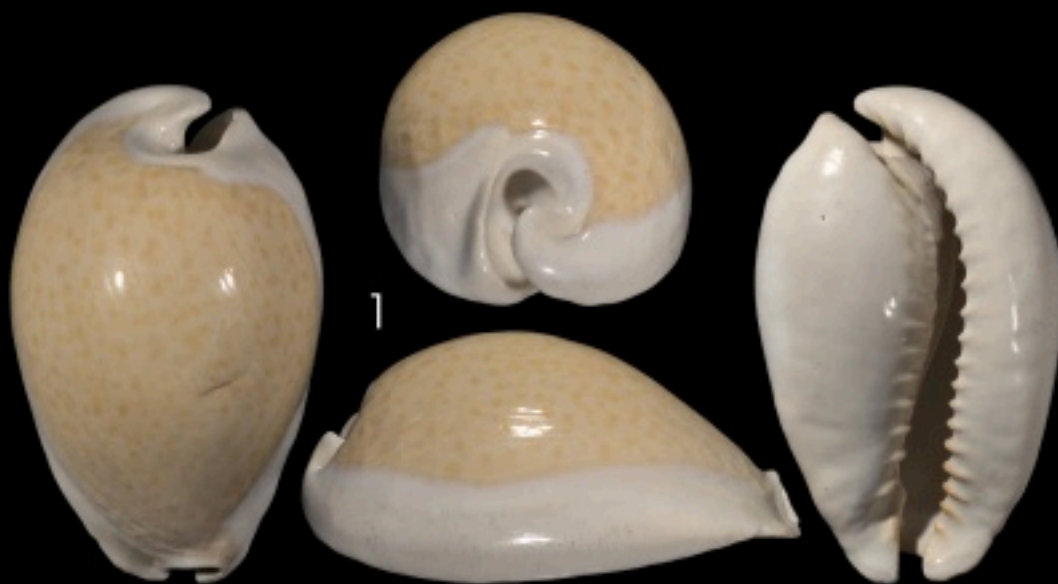
Akleistostoma (Kissimmecypraea) leonardi (Petuch and Drolshagen, 2011)

1. 58.5 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 52.8mm, Spoil piles, Dickerson Aggregates Pit, Fort Drum, Kissimmee River Valley

3. 56.4 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

4. 68.2 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



***Pahayokea* (Petuch, 2004)**

2004. *Siphocypraea* (*Pahayokea*) Petuch

2011. *Pahayokea* Petuch and Drolshagen

Originally proposed as a subgenus of *Siphocypraea*.

Described as: “Small, squat, stocky *Siphocypraea* species with rounded, inflated shells and well-developed posterior and anterior tips; shell bases flattened, only slightly rounded; shell margins generally well-developed, often heavily callused and sometimes flanged; coiling of apical sulci variable, with some species having sulci with one complete turn and others having sulci with only partial coiling; labial and columellar dentition coarse and prominent, with the labial teeth often being bifurcated”. (Petuch).

“This distinctive group of endemic Everglade’s cowries represent an offshoot of the *Siphocypraea trippeana* lineage that diverged during Fruitville Member (Unit 4) time. The new subgenus differs from *Siphocypraea* s.s. in having much fatter, broader shells with well-developed and often flaring marginal calluses. Although members of this group resemble *Akleistostoma* in shell shape and general appearance, they retain typical *Siphocypraea* characteristics, such as having narrow apertures and coiled apical sulci. This last characteristic is more variable in *Pahayokea* than in the nominate subgenus, with some species having only slightly coiled, slotlike sulci (such as *S. aspenae*) while others have tightly coiled sulci (such as *S. gabriellae*). A unique feature of the group is the presence of raised lines, arranged in a reticulate pattern, on the dorsum of some individuals, giving the shell a cracked glass appearance. The reticulate dorsal pattern is seen in several species but is most prevalent on *S. (Pahayokea) penningtonorum* and *S. (Pahayokea) rucksorum*. Throughout its short stratigraphic range, *Pahayokea* was restricted to the Okeechobean Sea area, being found only in the upper beds of the Tamiami Formation (Fruitville Member equivalent in the Kissimmee Embayment) and in the Caloosahatchee Formation”. (Petuch).

TYPE: *Siphocypraea* (*Pahayokea*) *penningtonorum* Petuch, 2004. Subsequently, *Pahayokea penningtonorum* in 2011.

In 2011, Petuch and Drolshagen raised *Pahayokea* to full genus status without comment.

Origin

Petuch postulated that the *Pahayokea* genus is an offshoot of *S. trippeana* from the Myakka Lagoon System. The Kissimmee Embayment is separated and isolated from Myakka by the massive Polk Peninsula to the west as well as the narrow, deep water Caloosahatchee and Loxahatchee Straits to the south. In addition, intracapsular direct development and the associated restricted migration may be inferred based on the sister genus, *Muracypraea* Woodring, 1957 and the Recent *Muracypraea mus* Linnaeus, 1758 complex. The absence of a viable path of migration into Kissimmee from Myakka means the status of *Pahayokea* as an offshoot of *S. trippeana* is unsupported. The origin of *Pahayokea* is not known at this time.

Reassignment A

Pseudadusta judei Petuch and Drolshagen, 2011 was originally placed in the *Pseudadusta* genus. The “Holotype of the *P. judei* was described as apical sulcus slightly curved, aperture narrow, becoming wider at the anterior end, posterior columellar teeth becoming obsolete. However, the *Pseudadusta* genus was described as apical sulcus simple slot-like, narrow aperture with strong dentition. The characteristics of the species do not align with the characteristics of the *Pseudadusta* genus.

“As no other *Pseudadusta* species have been reported or recorded from Kissimmee, the genus appears to be restricted to Myakka and the Golden Gate Member of the Everglades Pseudoatoll. ... The absence of either an ancestor or successor *Pseudadusta* species or a viable path of migration into Kissimmee from known *Pseudadusta* areas means the presence of the genus *Pseudadusta* in Kissimmee is unsupported at this time.” (Daughenbaugh, 2019d).

Rather, the characteristics align with those of the *Pahayokea* genus, including the fossula. The species is reassigned herein to that genus as *Pahayokea judei* (Petuch and Drolshagen, 2011).

In 2021, Petuch and Berschauer reassigned *Pahayokea judei* as *Akleistostoma (Paludacypraea) judei*. However, the *A. (Paludacypraea)* subgenus as well as all *Pseudadusta* subgenera, are restricted to Myakka and the Golden Gate Member of the Everglades Pseudoatoll. The presence of the *A. (Paludacypraea)* subgenus in the Kissimmee is without support and is not accepted herein.

Reassignment B

As described, many of the characteristics of the shells within the genus are variable, especially the fossula, aperture and apical sulcus. Certain species assigned to the *Pahayokea* genus have characteristics which better align with other taxa as below.

Tamiami Formation Genera:

- The four *Gardnericypraea* species have already been reassigned as *Akleistostoma (Gardnericypraea)*. See above.
- *Pahayokea (Kissimmecypraea)* is reassigned as *Akleistostoma (Kissimmecypraea)* herein. See above under the *Akleistostoma (Kissimmecypraea)* subgenus Section.

Tamiami Formation Species:

- *Pseudadusta judei* Petuch and Drolshagen, 2011 is now *Pahayokea judei* herein.
- *Pahayokea rucksorum* is now *Siphocypraea (Lokossea) rucksorum*. See above under the *Siphocypraea (Lokossea)* subgenus Section. *

Caloosahatchee Formation Genera:

- Three Caloosahatchee *Pahayokea* species (a new species, *aspenae* and *briskinae*) are assigned/reassigned under a new subgenus, *Siphocypraea (Brantleycypraea)* in the *Siphocypraea (Brantleycypraea)* Section below.

Caloosahatchee Formation Species:

- *Pahayokea bruggemani* is reassigned as *Siphocypraea (Lokossea) bruggemani*. See below under the *Siphocypraea (Lokossea)* subgenus Section. *
- *Pahayokea josiai* is reassigned as *Siphocypraea (Floridacypraea) josiai*. See below under the *Siphocypraea (Floridacypraea)* Section. *

* All three species exhibit typical *Siphocypraea* characteristics:

- a distinct fossula, coiled apical sulcus, uniformly narrow aperture, and a ribbed columella in fully mature specimens.

Pahayokea:

“Small, squat, stocky ... species with rounded, inflated shells and well-developed posterior and anterior tips; shell bases flattened, only slightly rounded; shell margins generally well-developed, often heavily callused and sometimes flanged.” (Petuch & Drolshagen). Apical sulcus progressively curved, curved or slightly coiled in younger species, proportionally narrow aperture, a ribbed columella in fully mature specimens, fossula very indistinct or absent.

Tamiami Formation species:

Pahayokea kissimmeensis (Petuch, 1994)

Pahayokea gabriellae (Petuch, 2004)

Pahayokea basingerensis (Petuch, 2004)

Pahayokea judei (Petuch and Drolshagen, 2011)

Pahayokea heimeri Petuch and Drolshagen, 2011

Pahayokea penningtonorum (Petuch, 1994) **TYPE**

Pahayokea mauriceguyi Petuch, Berschauer and Myers, 2018

Pahayokea lybrandi (Petuch and Drolshagen, 2011) [**P**]

NOTE: The characters of *P. lybrandi* do not align with others in the genus. However, while its characteristics do suggest other genera, they are imperfectly aligned. Its retention herein as a *Pahayokea* species is Provisional [**P**]. See individual entry.

Pahayokea (Petuch, 2004)

***Pahayokea kissimmeensis* (Petuch, 1994)**

1994. *Siphocypraea kissimmeensis* Petuch

1997. *Siphocypraea* (*Siphocypraea*) *kissimmeensis* Petuch

2004. *Siphocypraea* (*Pahayokea*) *kissimmeensis* Petuch

2011. *Pahayokea kissimmeensis* Petuch and Drolshagen

HOLOTYPE: Graves Museum of Archeology & Natural History, UF 66224

TYPE Locality: Kissimmee River dredging at Fort Basinger, Highlands County, FL.

Pinecrest Member (Unit 7, Kissimmee River Valley equivalent)

Size range: 52.0-71.5 mm

Shape: Oval, stocky

Base: Slightly rounded

Margins: Produced, subangular, angular

Auricles: Produced, slightly projecting

Columella: Ribbed along top/ribbed

Fossula: Indistinct or absent

Apical sulcus: Open, deep, clockwise, horizontal curve

Aperture: Narrow

Columellar teeth: Thin; extending onto the columella

Number: 16-20

Labral lip; teeth: Steep, thick; thick, pointed

Number: 20-23

Key Characteristics: Oval, stocky shell; apical sulcus open, deep with a clockwise, horizontal curve; aperture narrow; base slightly rounded; margins produced, subangular, angular; auricles produced, slightly projecting; columellar teeth extending onto the columella; columella ribbed along top/ribbed; fossula indistinct or absent.

Comparisons: *P. kissimmeensis* is similar to *A. (Kissimmeensis) transitoria* and *P. basingerensis*. However, *A. (K.) transitoria* is larger, more elongate shell with a flattened base; expanded margins; and better produced, flanged, projecting auricles. *P. basingerensis* is an oval to pyriform, squat, heavy, truncated shell; margins expanded, flaring; fossula indistinct.

Range: Kissimmee River Valley.

Plate 81 →

Pahayokea kissimmeensis (Petuch, 1994)

1. 52.0 mm, Kissimmee River Dig, vicinity of Fort Basinger

2. 71.5 mm, Fort Drum, Kissimmee River Valley

3. 55.1 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

4. 58.6 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



1



2



3

4

***Pahayokea gabriellae* (Petuch, 2004)**

2004. *Siphocypraea* (*Pahayokea*) *gabriellae* Petuch

2011. *Pahayokea gabriellae* Petuch and Drolshagen

HOLOTYPE: American Museum of Natural History, N. Y., AMNH FI-50662

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 4, Kissimmee River Valley equivalent) [P]*

Size range: 57.6-69.0mm

Shape: Broadly oval

Base: Flattened

Margins: Callous, expanded, angular

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Absent

Apical sulcus: Deep, narrow, clockwise upward curve or coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn, partially covered by columellar flange

Aperture: Narrow

Columellar teeth: Thin; extending over the columella

Number: 15-17

Labral Lip; teeth: Steep, thick; thick, rounded

Number: 20-22

Key Characteristics: Broadly oval shell; apical sulcus deep, narrow, clockwise curve or coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn, partially covered by columellar flange; aperture narrow; base flattened; margins callous, expanded, angular; auricles produced, blunt; columellar teeth thin, extending over the columella; columella ribbed; fossula absent.

Comparisons: *P. gabriellae* is similar to *S. (Lokossea) rucksorum*. However, *S. (L.) rucksorum* is an ovate, pyriform, slightly inflated/domed shell which possesses a distinct fossula. *P. gabriellae*'s apical sulcus is more distinctly curved/coiled than other species in the genus.

Range: Rucks and Dickerson Aggregates Pits where it is very rare.

NOTE: The characteristics suggest that *P. gabriellae* is related to *Siphocypraea*. The absence of a fossula, present in all *Siphocypraea* species, leads us to retain the species in the *Pahayokea* genus.

* Originally placed in the Fruitville Member, Unit 2 (Kissimmee River Valley equivalent). Reassigned to Unit 4 equivalent in 2011 without comment. Its characteristics, especially its larger size in comparison to younger species, support the 2011 reassignment.

Plate 82 →

Pahayokea gabriellae (Petuch, 2004)

1. 62.1 mm, Spoil piles, Dickerson Aggregates Pit, Fort Drum, Kissimmee River Valley
2. 61.7 mm, Rucks Pit, Fort Drum, Kissimmee River Valley
3. 50.7 mm, Rucks Pit, Fort Drum, Kissimmee River Valley
4. 57.6 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



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4



***Pahayokea basingerensis* (Petuch, 2004)**

2004. *Siphocypraea* (*Pahayokea*) *basingerensis* Petuch

2011. *Pahayokea basingerensis* Petuch and Drolshagen

HOLOTYPE: American Museum of Natural History, N. Y., AMNH FI-50661

TYPE Locality: Dredgings of the Kissimmee River at Fort Basinger, Highlands County, FL.

Fruitville Member (Unit 4, Kissimmee River Valley equivalent)

Size range: 53.7-59.1 mm

Apical sulcus: Open, clockwise, horizontal curve

Shape: Oval to pyriform, truncated, squat, heavy, thickened; flattened appearance

Aperture: Narrow, widening slightly anteriorly on some specimens

Base: Slightly rounded

Columellar teeth: Thin; extending to/over the top of the columella

Margins: Callous, expanded to flaring

Number: 14-16

Auricles: Produced, blunt

Columella: Ribbed along top/ribbed

Labral lip; teeth: Steep, rounded; thick, pointed

Fossula: Steep, smooth, elongate, indistinct

Number: 16-21

Key Characteristics: Oval to pyriform, squat, heavy, thickened, truncated shells with a flattened appearance; apical sulcus open, clockwise, horizontal curve; aperture narrow, widening slightly on some specimens; base slightly rounded; margins callous, expanded to flaring; auricles blunt; columella teeth extending onto top of the columella; columella ribbed along top; fossula indistinct.

Comparisons: *P. basingerensis* is similar to *P. heimeri*. However, *P. heimeri* is a more oval, rounded, slightly inflated shell with a rounded base and expanded margins which become keeled and upturned on mature specimens and shorter columellar teeth. Fossula absent.

Range: Kissimmee River Valley.

Plate 83 →

Pahayokea basingerensis (Petuch, 2004)

1. 53.7 mm, Spoil piles, Dickerson Aggregates Pit, Fort Drum, Kissimmee River Valley
2. 52.3 mm, Rucks Pit, Fort Drum, Kissimmee River Valley
3. 50.5 mm, Spoil piles, Dickerson Aggregates Pit, Fort Drum, Kissimmee River Valley
4. 58.9 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



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***Pahayokea judei* (Petuch and Drolshagen, 2011)**

2011. *Pseudadusta judei* Petuch and Drolshagen

2019. *Akleistostoma (Olssonicypraea) judei* Daughenbaugh

2021. *Akleistostoma (Paludacypraea) judei* Berschauer and Petuch

2022. *Pahayokea judei* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13259

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 4, Kissimmee River Valley equivalent) [P]

Size range: 38.9-46.0

Shape: Oval, oval-elongate, rounded

Base: Slightly rounded, rounded

Margins: Callous, rounded, subangular

Auricles: Produced, blunt

Columella: Ribbed along top/ribbed

Fossula: Indistinct or absent

Apical sulcus: Open, clockwise, horizontal curve

Aperture: Narrow

Columellar teeth: Thin; extending onto the columella

Number: 12-16

Labral lip; teeth: Thick; thick, pointed

Number: 17-20

Key Characteristics: Oval, oval-elongate, rounded shell; apical sulcus open, clockwise, horizontal curve; aperture narrow; base slightly rounded, rounded; margins callous, rounded, subangular; auricles produced, blunt; columellar teeth extending onto the columella; columella ribbed along top/ribbed; fossula indistinct or absent.

Comparisons: *P. judei* is most similar to *P. kissimmeensis*. However, *P. kissimmeensis* is a larger, stockier shell with a deep apical sulcus and produced and produced, slightly projecting auricles.

Range: Kissimmee River Valley.

In 2019, the senior author noted that *Pseudadusta* is not known from the Kissimmee River Valley and placed *P. judei* into synonymy with *A. (Olssonicypraea) bairdi* in error based on a subadult specimen.

In 2021, Petuch and Berschauer reassigned the species to the *Akleistostoma (Paludacypraea)* subgenus without comment. However, the *Paludacypraea* subgenus (and its species), as described, is restricted to the Myakka Lagoon System of the western coastal area. There are no *A. (Paludacypraea)* species known from the Kissimmee River Valley.

Akleistostoma (Paludacypraea) characteristics include an apical sulcus which is simple, shallow, poorly produced; an aperture which widens anteriorly; and a smooth, undulating columella with the anterior columellar teeth extending over the columella. *P. judei* does not share these characteristics.

Subsequent to 2019, the senior author discovered several mature specimens which possessed *Pahayokea* characteristics and matched the description of *P. judei*. Therefore, the species has been resurrected herein and placed into the *Pahayokea* genus which inhabited the Kissimmee River Valley.

Plate 84 →

Pahayokea judei (Petuch and Drolshagen, 2011)

1. 38.9 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 45.8 mm, 3 miles north of State Rte70, west bank of the Kissimmee River

3. 41.8 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

4. 47.5 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



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***Pahayokea heimeri* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13258

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 3, Kissimmee River Valley equivalent) [P]

Size range: 48.7-52.3 mm

Shape: Oval, rounded, slightly inflated

Base: Slightly rounded, rounded

Margins: Callous, rounded; keeled and upturned on very mature shells

Auricles: Produced, blunt

Columella: Ribbed along top

Fossula: Absent

Apical sulcus: Open, clockwise, horizontal curve

Aperture: Narrow

Columellar teeth: Thin; extending onto the top of the columella

Number: 12-15

Labral lip; teeth: Thick; thick, pointed

Number: 17-20

Key Characteristics: Oval, rounded, slightly inflated shell; apical sulcus open, clockwise, horizontal curve; aperture narrow; base slightly rounded, rounded; margins callous rounded, keeled and upturned on very mature specimens; auricles produced, blunt; columellar teeth extending onto the top of the columella; columella ribbed along top; fossula absent.

Comparisons: *P. heimeri* is similar to *P. basingerensis*. However, *P. basingerensis* is an oval to pyriform, truncated, squat, heavy, thickened, shell with a flattened appearance and longer columellar teeth. Fossula indistinct.

Range: Kissimmee River Valley.

Plate 85 →

Pahayokea heimeri Petuch and Drolshagen, 2011

1. 51.2 mm, Kissimmee River Dig, Fort Basinger

2. 51.6 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 48.7 mm, Spoil piles, Dickerson Aggregates Pit, Fort Drum, Kissimmee River Valley

4. 48.8 mm, Spoil piles, Dickerson Aggregates Pit, Fort Drum, Kissimmee River



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4



***Pahayokea penningtonorum* (Petuch, 1994) TYPE**

1994. *Siphocypraea penningtonorum* Petuch

1997. *Siphocypraea* (*Siphocypraea*) *penningtonorum* Petuch

2004. *Siphocypraea* (*Pahayokea*) *penningtonorum* Petuch

2011. *Pahayokea penningtonorum* Petuch and Drolshagen

HOLOTYPE: Graves Museum of Archeology & Natural History, UF 66222

TYPE Locality: From Kissimmee River dredging at Fort Basinger, Highlands County, FL.

Fruitville Member (Unit 3, Kissimmee River Valley equivalent) [P]

Size range: 44.2-55.0 mm

Shape: Oval, rounded dorsum, domed

Base: Flat

Margins: Callous, expanded, flaring

Auricles: Produced, flanged, slightly projecting

Columella: Ribbed

Fossula: Absent

Apical sulcus: Narrow, deep, slightly upturned clockwise curve, partially covered by body whorl extension

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over the columella

Number: 13-15

Labral lip; teeth: Steep, thick; thick, pointed, extending over base

Number: 17-18

Key Characteristics: Oval, rounded dorsum shell with a domed dorsum; apical sulcus narrow, deep, slightly upturned clockwise curve, partially covered by body whorl extension; aperture uniformly narrow; base flat; margins callous, expanded, flaring; auricles produced, flanged, slightly projecting; columellar teeth extending over the columella; columella ribbed; fossula absent.

Comparisons: *P. penningtonorum* is similar to *P. mauriceguyi*. However, *P. mauriceguyi* is a more elongate, cylindrical, domed shell; with an apical sulcus which is curved upward; blunter extremities.

Range: Kissimmee River Valley.

Plate 86 →

Pahayokea penningtonorum (Petuch, 1994)

1. 44.2 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 47.7 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



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2



***Pahayokea mauriceguyi* Petuch, Berschauer and Myers, 2018**

HOLOTYPE: Los Angeles County Museum of Natural History, LACMIP 14662

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 2, Kissimmee River Valley equivalent) [P]

Also, Golden Gate Member (Unit 2 equivalent) [P]

Size range: 48.7-60.6 mm

Shape: Cylindrical, high domed

Base: Flattened

Margins: Callous, expanded, angular

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Absent

Apical sulcus: Deep, narrow, upturned clockwise curve

Aperture: Narrow

Columellar teeth: Thin; extending over the columella

Number: 14-16

Labral lip; teeth: Steep, thick; thick, pointed

Number: 20-22

Key Characteristics: Cylindrical shell with a high domed dorsum; apical sulcus deep, narrow, clockwise curve upward; aperture narrow; base flattened; margins callous, expanded, angular; auricles produced, blunt; columella teeth extending over the columella; columella ribbed; fossula absent.

Comparisons: *P. mauriceguyi* is similar to *P. penningtonorum*. However, *P. penningtonorum* is an oval, not cylindrical shell with a rounded dorsum; with an apical sulcus which is only slightly upturned and partially covered by a body whorl extension; auricles flanged and slightly projecting.

Range: Fort Drum area, Okeechobee County. Also, Burnt Store Road Pit, Lee County.

Plate 87 →

Pahayokea mauriceguyi Petuch, Berschauer and Myers, 2018

1. 49.8 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 53.2 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 55.7 mm, Burnt Store Road Pit, Lee County



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***Pahayokea lybrandi* (Petuch and Drolshagen, 2011) [P]**

2011. *Pahayokea (Kissimmecypraea) lybrandi* Petuch and Drolshagen

2022. *Pahayokea lybrandi* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13242

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 2, Kissimmee River Valley equivalent) [P]

Size range: 66.9- 76.8 mm

Shape: Subcylindrical, elongate

Base: Flattened

Margins: Callous, subangular, angular

Auricles: Produced, slightly projecting

Columella: Ribbed along top, ribbed

Fossula: Absent

Apical sulcus: Deep, narrow, wide clockwise curve, projecting

Aperture: Narrow, expanding slightly anteriorly

Columellar teeth: Thin; extending to/onto the columella

Number: 15-21

Labral Lip; teeth: Steep, thick; thick, rounded

Number: 21-24

Key Characteristics: Subcylindrical, elongate shell; apical sulcus deep, narrow, wide clockwise curve, projecting; aperture narrow, expanding slightly anteriorly; base flattened; margins callous, subangular, angular; auricles produced, slightly projecting; columellar teeth extending to/onto the columella; columella ribbed; fossula absent.

Comparisons: *P. lybrandi* is assigned to the *Pahayokea* genus based upon a curved apical sulcus, narrow aperture and absent fossula. Previously, it was aligned with the *Pahayokea (Kissimmecypraea)* subgenus as the successor to *P. (K.) leonardi*. However, *P. (K.) leonardi* has been realigned as *Akleistostoma (Kissimmecypraea) leonardi* as its characteristics align more with *Akleistostoma* species, i.e., curved, apical sulcus, smooth columella and indistinct fossula.

Note: *P. lybrandi* is an anomaly as its overall size, shape and appearance are very different from others in the subgenus. There does not appear to be an obvious relationship to other species in the subgenus. The three specimens in the first author's collection are from Rucks Pit and were collected by Dr. Petuch. They exhibit columellar teeth of varying lengths, from extending to the columellar ridge to a fully ribbed columella. All three lack a fossula and have similar extremities. At this time, the species is provisionally retained in the *Pahayokea* lineage as *Pahayokea lybrandi* [P].

Range: Kissimmee River Valley.

Plate 88 →

Pahayokea lybrandi (Petuch and Drolshagen, 2011)

1. 74.4 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 66.9 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 74.7 mm, Excavation along Kissimmee River, Fort Basinger



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***Yeehawcypraea* (Petuch and Drolshagen, 2011)**

2011. *Okeechobea* (*Yeehawcypraea*) Petuch and Drolshagen

2022. *Yeehawcypraea* (Petuch and Drolshagen) Daughenbaugh and Bridges

I. *Siphocypraea* (*Okeechobea*) Petuch, 2004

In 2004, *Okeechobea* was proposed as a subgenus of *Siphocypraea* Heilprin, 1886, based upon species living during the Caloosahatchee Formation of the Gelasian Pleistocene. The Type and three other species were included in the subgenus: *S. (Okeechobea) brantleyi* **Type**, *S. (Okeechobea) philemoni* Fehse 1997 and two undescribed species which were subsequently described in 2011, i.e., *S. (O.) shawnae* and *S. (O.) loxahatcheensis*.

Type: *Siphocypraea* (*Okeechobea*) *brantleyi* Petuch, 2004

Range: Southern Florida, south of the Kissimmee River Valley.

- As set forth below in the Gelasian Pleistocene, Caloosahatchee Formation section, *Siphocypraea* (*Okeechobea*) is reinstated as originally proposed with its four species. Mature specimens exhibit a more coiled rather than a hooked apical sulcus and a ribbed rather than a smooth columella.

II. *Okeechobea* (Petuch, 2004)

Subsequently, in 2011, Petuch and Drolshagen elevated *Siphocypraea* (*Okeechobea*) Petuch, 2004 to full genus status as *Okeechobea* (Petuch, 2004). In addition to the four Caloosahatchee species from southern Florida which were originally described in 2004 and 2011 (see immediately above), three new species from the Kissimmee River Valley (type locality: Rucks Pit) Tamiami Formation were described and assigned to the *Okeechobea* genus. The Kissimmee species were species *O. osceolai*, *O. waldroni* and *O. fort drumensis*.

Range: The three new species were confined to the Kissimmee River Valley.

III. *Yeehawcypraea* (Petuch and Drolshagen, 2011)

***Okeechobea* (*Yeehawcypraea*) Petuch and Drolshagen, 2011**

At the same time in 2011, Petuch and Drolshagen introduced *Okeechobea* (*Yeehawcypraea*) as a subgenus of *Okeechobea* (Petuch, 2004) consisting of three species confined to the Kissimmee River Valley during Tamiami Formation of the Piacenzian Pliocene. The subgenus was described as neotenic, evidently based upon immature/subadult specimens. However, fully mature specimens of the three species exhibit degrees of callosity which obscure or cover these characteristics. Mature species possess an indistinct/distinct fossula, a hooked apical sulcus, proportionally narrow aperture, and a smooth columella.

“Throughout its evolutionary history, *Yeehawcypraea* species were confined to the mangrove forests areas of the Kissimmee Embayment of the Okeechobean Sea and have never been collected outside the Kissimmee River Valley. With the exception of a few rare specimens collected near Fort Basinger, Highlands County, all other examples of *Yeehawcypraea* have been collected only in the Fort Drum Quarries (Rucks Pit and Dickerson Aggregates).” (Petuch and Drolshagen).

Type: *Yeehawcypraea matchetti* (Petuch and Drolshagen, 2011)

Range: Confined to the Kissimmee River Valley.

- The differences cited between Kissimmee species (*Yeehawcypraea* more inflated and with wider/flaring apertures) are slight and they are more similar than not. Specifically, all species exhibit an indistinct/distinct fossula, an apical sulcus with a hook-like projection, rather than coiled sulcus, an open but proportionally narrow aperture which widens anteriorly and a smooth, rather than ribbed columella.

Yeehawcypraea is elevated to full genus status herein to include all six Kissimmee River Valley, Tamiami Formation species previously described as *Okeechobea* and *Okeechobea* (*Yeehawcypraea*).

Yeehawcypraea

“Shells of average size for the genus, inflated, bulliform, with high, rounded dorsums; base of shells slightly rounded to flat; apical sulci coiled one-half turn; posterior labial extensions well-developed and projecting, often extending well beyond apical sulci; apertures wide and flaring, becoming wider toward anterior end”. (Petuch and Drolshagen, 2011).

- Columella smooth, fossula steep, smooth, indistinct/distinct.

Yeehawcypraea Tamiami Formation species:

Yeehawcypraea osceolai (Petuch and Drolshagen, 2011)

Yeehawcypraea bartoni (Petuch and Drolshagen, 2011)

Yeehawcypraea waldroni (Petuch and Drolshagen, 2011)

Yeehawcypraea matchetti (Petuch and Drolshagen, 2011) **TYPE**

Yeehawcypraea fort drumensis (Petuch and Drolshagen, 2011)

Yeehawcypraea lindajoyceae (Petuch and Drolshagen, 2011)

At this time, the genus appears to be missing from Unit 3 equivalent facies, creating a gap between Unit 4 and Unit 2 equivalent facies. However, its presence may be inferred by its reappearance in Unit 2 time in the genus' highly restricted area.

Yeehawcypraea (Petuch, 2004)

***Yeehawcypraea osceolai* (Petuch and Drolshagen, 2011)**

2011. *Okeechobea osceolai* Petuch and Drolshagen

2022. *Yeehawcypraea osceolai* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13248

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Pinecrest Member (Unit 7 Kissimmee River Valley equivalent)

Size range: 43.2-52.3 mm

Shape: Globular, rounded, domed

Base: Rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Steep, smooth, elongate, distinct

Apical sulcus: Open, shallow; hook-like projection

Aperture: Narrow, widening slightly anteriorly

Columellar teeth: Thin; poorly produced,
extending to columellar ridge

Number: 14-16

Labral lip; teeth: Thin; short, thin, pointed

Number: 18-19

Key Characteristics: Globular, rounded shell with a domed dorsum; open, apical sulcus shallow with a hook-like projection; aperture open, widening slightly anteriorly; base rounded; margins rounded; auricles poorly produced, blunt; columellar teeth thin, poorly produced, extending to the columellar ridge; columella smooth; fossula distinct.

Comparisons: *Y. osceolai* is similar to *Y. waldroni* and *Y. matchetti*. However, *Y. waldroni* is a broad, cylindrical shell with an aperture which is proportionally narrow, widens only slightly anteriorly and is not arcuate; columellar teeth are coarse and flattened. *Y. matchetti* is an ovoid, inflated, dorso-ventrally flattened shell with an apical sulcus which extends beyond the body whorl; and an indistinct fossula.

Range: Kissimmee River Valley.

Plate 89 →

Yeehawcypraea osceolai (Petuch and Drolshagen, 2011)

1. 43.2 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 48.3 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 54.8 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



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***Yeehawcypraea bartoni* (Petuch and Drolshagen, 2011)**

2011. *Okeechobea (Yeehawcypraea) bartoni* Petuch and Drolshagen

2022. *Yeehawcypraea bartoni* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13252

TYPE Locality: Rucks Pit, Fort Drum, Okeechobea County, FL.

Pinecrest Member (Unit 7 Kissimmee River Valley equivalent)

Size range: 50.8-57.9 mm

Shape: Cylindrical, elongate, slightly humped posteriorly

Base: Slightly flattened

Margins: Rounded, subangular

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Steep, smooth, short, distinct

Apical sulcus: Open, shallow; poorly produced slight curve, compressed

Aperture: Proportionally narrow, widening slightly anteriorly

Columellar teeth: Thin, poorly produced, flattened posteriorly; extending to columellar ridge

Number: 14-17

Labral lip; teeth: Thin; short, pointed

Number: 18-20

Key Characteristics: Cylindrical, elongate shell, slightly humped posteriorly; apical sulcus open, shallow, poorly produced, only slightly curved, compressed; aperture proportionally narrow, widening slightly anteriorly; base slightly flattened; margins rounded, subangular; auricles poorly produced, blunt; columellar teeth thin, poorly produced, flattened posteriorly, extending to the columellar ridge; columella smooth; fossula distinct.

Comparisons: *Y. bartoni* is similar to *Y. waldroni* and *Y. matchetti*. However, *Y. waldroni* is a cylindrical, inflated, rounded, domed shell with a narrower aperture and a better produced apical sulcus. *Y. matchetti* is a rounded, inflated but dorsoventrally flattened shell with a better produced apical sulcus which extends beyond the body whorl and an indistinct fossula.

Range: Kissimmee River Valley.

Plate 90 →

Yeehawcypraea bartoni (Petuch and Drolshagen, 2011)

1. 61.3 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 57.9 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 50.8 mm, Spoil piles, Dickerson Aggregates Pit, Fort Drum, Kissimmee River Valley

4. 59.4 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



***Yeehawcypraea waldroni* (Petuch and Drolshagen, 2011)**

2011. *Okeechobea waldroni* Petuch and Drolshagen

2022. *Yeehawcypraea waldroni* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13247

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 4 Kissimmee River Valley equivalent)

Size range: 57.0-67.1 mm

Shape: Cylindrical, inflated, rounded,
domed

Base: Rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Steep, smooth, short, distinct

Apical sulcus: Open, shallow; hook-like projection

Aperture: Narrow, widening slightly anteriorly

Columellar teeth: Flattened posteriorly, extending
to columellar ridge

Number: 17-19

Labral lip; teeth: Thin; short, thick, pointed

Number: 19-20

Key Characteristics: Cylindrical, inflated, rounded shell with a domed dorsum; apical sulcus open, shallow with a hook-like projection; aperture narrow, widening slightly anteriorly; base rounded; margins rounded; auricles poorly produced, blunt; columellar teeth flattened posteriorly, extending to the columellar ridge; columella smooth; fossula distinct.

Comparisons: *Y. waldroni* is similar to *Y. bartoni* and *Y. fortdrumensis*. However, *Y. bartoni* is a cylindrical, less inflated shell with an apical sulcus which is less developed, curved and is slightly humped posteriorly. *Y. fortdrumensis* is not as inflated with a narrow aperture; short poorly produced columellar teeth.

Range: Kissimmee River Valley.

Plate 91 →

Yeehawcypraea waldroni (Petuch and Drolshagen, 2011)

1. 58.3 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 57.0 mm, Spoil piles, Dickerson Aggregates Pit, Fort Drum, Kissimmee River Valley

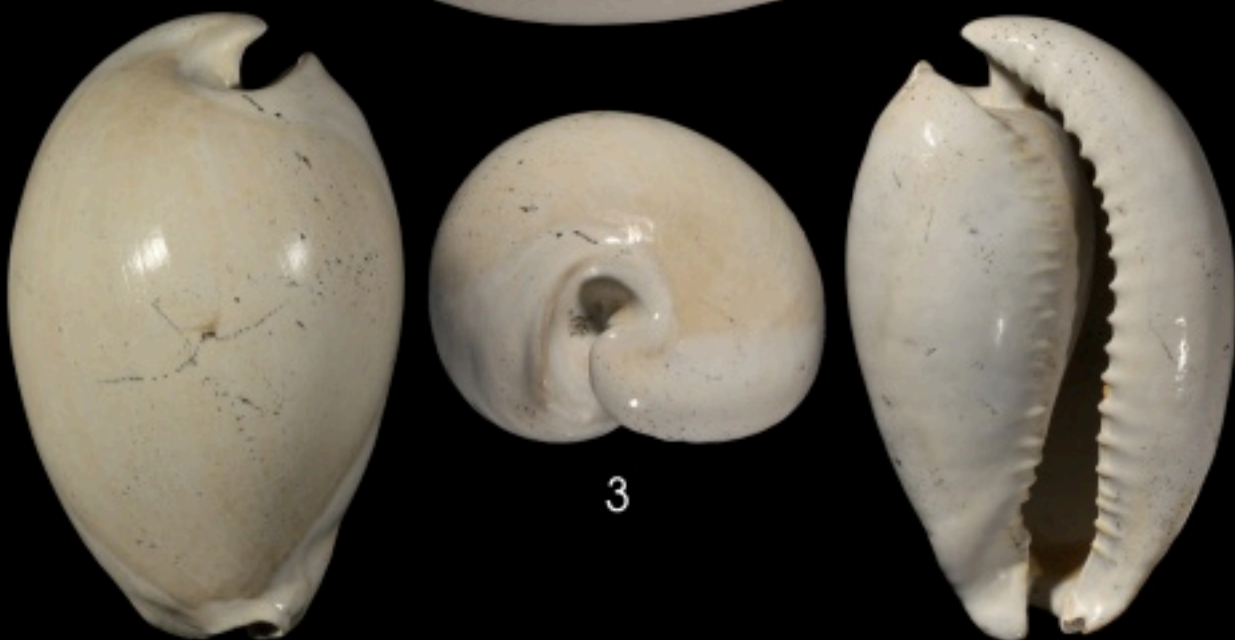
3. 67.1 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



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***Yeehawcypraea matchetti* (Petuch and Drolshagen, 2011) TYPE**

2011. *Okeechobea (Yeehawcypraea) matchetti* Petuch and Drolshagen

2022. *Yeehawcypraea matchetti* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13254

TYPE Locality: Rucks Pit, Fort Drum, Okeechobea County, FL.

Fruitville Member (Unit 4 Kissimmee River Valley equivalent)

Size range: 56.0-70.4 mm

Shape: Ovoid, inflated, dorso-ventrally flattened, domed

Base: Slightly rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Steep, smooth, narrow, indistinct

Apical sulcus: Open; hook-like projection extending beyond body whorl

Aperture: Proportionally narrow, widening anteriorly

Columellar teeth: Thin, poorly produced, flattened posteriorly; extending to columellar ridge

Number: 14-17

Labral lip; teeth: Thin; short, pointed

Number: 18-20

Key Characteristics: Ovoid, inflated, dorso-ventrally flattened, domed shell; apical sulcus open, with a hook-like projection which extends beyond the body whorl; aperture proportionally narrow, widening anteriorly; base slightly rounded; margins rounded; columellar teeth thin, poorly produced, flattened posteriorly, extending to the columellar ridge; columella smooth; fossula indistinct.

Comparisons: *Y. matchetti* is similar to *Y. osceolai* and *Y. bartoni*. However, *Y. osceolai* is a less inflated, globular, rounded, domed shell with a narrower aperture and a distinct fossula. *Y. bartoni* is a cylindrical, elongate shell; while humped posteriorly is not as inflated and has a poorly produced apical sulcus.

Range: Kissimmee River Valley.

Plate 92 →

Yeehawcypraea matchetti (Petuch and Drolshagen, 2011)

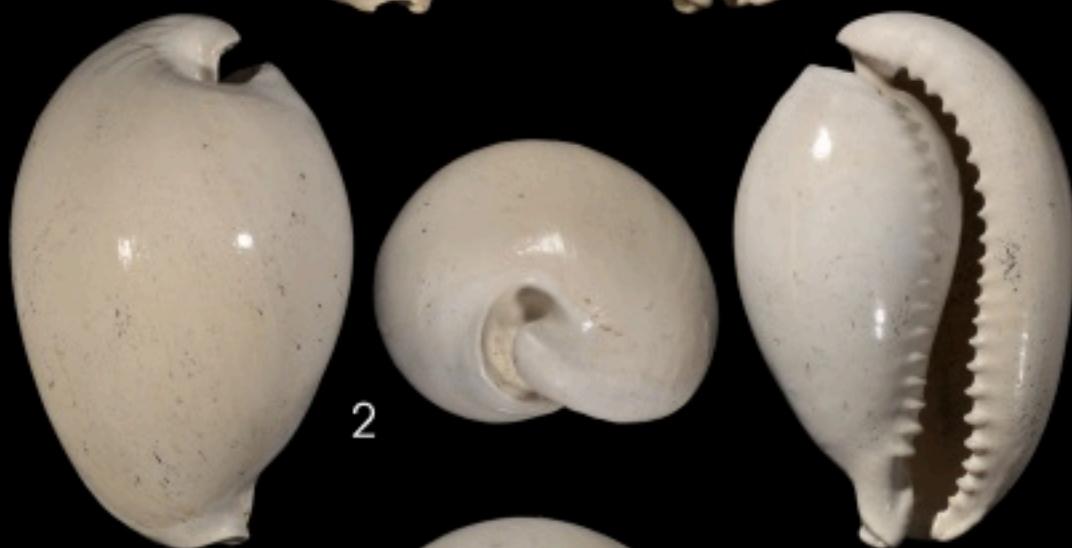
1. 55.9 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 56.0 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 66.4 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



1



2



3

***Yeehawcypraea fortdrumensis* (Petuch and Drolshagen, 2011)**

2011. *Okeechobea fortdrumensis* Petuch and Drolshagen

2022. *Yeehawcypraea fortdrumensis* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13249

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 2 Kissimmee River Valley equivalent) [P]

Size range: 49.1-63.2 mm

Shape: Cylindrical, inflated, elongated, rounded

Base: Rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Steep, smooth, shallow, indistinct

Apical sulcus: Open, shallow; hook-like projection

Aperture: Narrow, widening slightly anteriorly

Columellar teeth: Thin, short, flattened posteriorly; extending to columellar ridge

Number: 14-17

Labral lip; teeth: Thin; short, pointed

Number: 18-20

Key Characteristics: Cylindrical, inflated, elongated, rounded shell; apical sulcus open, shallow, hook-like projection; aperture narrow, widening slightly anteriorly; base rounded; margins rounded; auricles poorly produced, blunt; columellar teeth thin, short, extending to the columellar ridge; columella smooth; fossula indistinct.

Comparisons: *Y. fortdrumensis* is similar to *Y. bartoni* and *Y. waldroni*. However, *Y. bartoni* is a cylindrical, elongate shell which is not as inflated and slightly humped posteriorly; apical sulcus poorly produced, only slightly curved; and a distinct fossula. *Y. waldroni* is a broader, more inflated, domed shell with a distinct fossula.

Range: Kissimmee River Valley.

Plate 93 →

Yeehawcypraea fortdrumensis (Petuch and Drolshagen, 2011)

1. 49.6 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 58.7 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 57.0 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

4. 63.2 mm, Spoil piles, Dickerson Aggregates Pit, Fort Drum, Kissimmee River Valley



***Yeehawcypraea lindajoyceae* (Petuch and Drolshagen, 2011)**

2011. *Okeechobea (Yeehawcypraea) lindajoyceae* Petuch and Drolshagen

2022. *Yeehawcypraea lindajoyceae* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13253

TYPE Locality: Rucks Pit, Fort Drum, Okeechobea County, FL.

Fruitville Member (Unit 2 Kissimmee River Valley equivalent) [P]

Size range: 32.7-39.0 mm

Shape: Ovately pyriform, inflated

Base: Rounded

Margins: Rounded, subangular

Auricles: Poorly produced, blunt

Columella: Smooth

Fossula: Steep, smooth, shallow, distinct

Apical sulcus: Open, shallow; short, hook-like projection

Aperture: Proportionally narrow, widening anteriorly

Columellar teeth: Thin, stunted, poorly produced, flattened posteriorly; extending to the columellar ridge

Number: 14-17

Labral lip; teeth: Thin; extending onto base

Number: 18-20

Key Characteristics: Small, ovately pyriform, inflated shell; apical sulcus open, shallow with a short, hook-like projection; aperture proportionally narrow, widening anteriorly; base rounded; margins rounded, subangular; columellar teeth thin, stunted, poorly produced, flattened posteriorly, extending to the columellar ridge; columella smooth; fossula distinct.

Comparisons: Due to its small size, *Y. lindajoyceae* cannot be confused with any other *Yeehawcypraea* species. However, it is similar to *Akleistostoma (Olssonicypraea) diegelae*. *A. (O.) diegelae* is a small, pyriform shell, broad posteriorly and flattened; apical sulcus slightly curved horizontally; ribbed columella; fossula absent.

Range: Kissimmee River Valley.

Plate 94 →

Yeehawcypraea lindajoyceae (Petuch and Drolshagen, 2011)

1. 35.5 mm, Kissimmee River Dig, vicinity of Fort Basinger

2. 39.0 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

3. 36.4 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



1



2



3



Siphocypraea (Lokossea) Petuch and Drolshagen, 2011

See under Chapter 8 for characteristics of the subgenus and Western Coastal species.

Reassignment

Pahayokea rucksorum Petuch, 2004 is reassigned herein as *Siphocypraea (Lokossea) rucksorum* Petuch, 2004. The species possesses the characteristics of both the genus and subgenus as above, including a typical *Siphocypraea* fossula. The Type locality is Rucks Pit in the Kissimmee River Valley as a Kissimmee Valley equivalent species. It has also been collected in the Bergeron Star Pit, Palm Beach County and the Bonita Springs Aggregate Pit, Lee County.

***Siphocypraea (Lokossea) rucksorum* (Petuch, 2004) [P]**

2004. *Siphocypraea (Pahayokea) rucksorum* Petuch

2011. *Pahayokea rucksorum* Petuch and Drolshagen

2022. *Siphocypraea (Lokossea) rucksorum* Daughenbaugh and Bridges

HOLOTYPE: American Museum of Natural History, N. Y., AMNH FI-50663

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fruitville Member (Unit 2, Kissimmee River Valley equivalent) [P] *

Also: Fruitville Member (Unit 2)

Size range: 50.0-69.0 mm

Shape: Ovate, pyriform, elongate, inflated, domed

Base: Flattened

Margins: Produced, subangular, angular

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Steep, smooth, scalene

Apical sulcus: Deep, coiled ½ turn, partially covered by flange extension

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over the columella

Number: 15-16

Labral Lip; teeth: Steep, thick; small, pointed

Number: 21-23

Key Characteristics: Ovate, pyriform, elongate, inflated, shell with a domed dorsum; apical sulcus deep, coiled ½ turn; partially covered by a columellar flange extension; aperture uniformly narrow; base flattened; margins subangular, angular; auricles produced, blunt; columellar teeth thin, extending over the columella; columella ribbed; fossula distinct on most specimens, shallow on some.

Comparisons: *S. (L.) rucksorum* is most similar to *Pahayokea gabriellae* and *S. (L.) mulepenensis*. However, *P. gabriellae* is a broad, oval shell with a flattened appearance and is absent a fossula. *S. (L.) mulepenensis* is a more globose, inflated, domed shell with a rounded base and margins.

Range: Specimens have been collected at Rucks Pit, Okeechobee County, the Bergeron Star Pit, Palm Beach County and Bonita Grande Aggregates Pit, Lee County. This suggests the species occurred throughout southern Florida.

* Originally placed in the Fruitville Member, Unit 2 (Kissimmee River Valley equivalent). Reassigned to Unit 4 equivalent in 2011 without comment. Its characteristics, being similar to *S. (L.) mulepenensis*, suggests that the original Unit 2 designation is more plausible. Assigned herein.

Plate 95 →

Siphocypraea (Lokossea) rucksorum (Petuch, 2004)

1. 59.7 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 66.8 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



1



2



Part Three

Gelasian Pleistocene

Chapter 11

Peninsular Florida

The beginning of the Pleistocene has been designated the Gelasian Age and is dated to ~ 2.6 Ma based on geological deposits in Italy. However, this can only be an approximate dating for southern Florida as the duration of the transition to and the beginning of the Pleistocene varied from region to region. The age endured for ~ .8 thousand years until ~ 1.8 Ma and was marked by successive glacial and interglacial periods of varying intensity. This resulted in sea levels which fluctuated between progressive (rising) levels and regressive (lower) levels.

In southern Florida, from the end of Piacenzian Pliocene Unit 2 time, transitioning into the Gelasian, a glacial event produced a first stage wounding event. This marked the end of the Tamiami Formation and its Cypraeidae populations. The latter would regenerate in the succeeding interglacial periods as new species, adapted to changed habitats. Of note, all new Cypraeidae species were in the *Siphocypraea* genus or subgenera.

During this transition, the center of the Everglades Pseudoatoll became a landlocked salt water lake surrounded by degrading reef tracts. This was the Okeechobean Sea and its surrounds. From its nadir, the marine environment returned to conditions similar to those of Unit 2 time, becoming the only North American paleo sea to host tropical marine environments in the Gelasian age.

Residual Cypraeidae populations existed at Myakka, the Immokalee Reef Track to the south as well as the Brantley Embayment and the Rucks Embayment (the old Kissimmee Embayment). The lower sea levels coupled with infilling would have opened migration paths from the west to the southeast and from the northeast to the south. Such migration is suggested by the fossil Cypraeidae record.

In the west, the Myakka Lagoon System was fluctuating between marine, terrestrial and fresh water environments. As a result, it only hosted two *Siphocypraea* species during the early Gelasian. Its place would be taken by the Brantley Embayment (named for the Brantley Pit, Arcadia, to the south southeast of Myakka), a broad bay-like estuary which extended to the east of Arcadia. The embayment featured extensive quartz sand flats, sea grass beds, and deeper tidal channels with coral bioherms. The embayment would serve as a primary Cypraeidae habitat throughout the Gelasian.

To the south of Myakka, the corals of the pseudoatoll reef tracts were dying off. However, their structures would have remained viable Cypraeidae habitats, as at Bonita Springs, through the Gelasian. The reef tracts eventually turned into rubble and sand, ultimately becoming long low-lying island chains covered with mangrove and pine forests. Sand and mud flats became habitats for Cypraeidae, replacing the coralline habitats.

In the northeast, the Kissimmee Embayment narrow cuts across the St. Lucie Peninsula (Unit 2 equivalent time) became a series of narrow channels which connected the northern end of the embayment to the Atlantic Ocean behind a chain of barrier islands which ranged along Florida's east coast. The cuts and subsequent channels formed cooler, oceanic water corridors for the invasion of contemporaneous Virginia and Carolinas molluscan fauna into the northern section of the embayment. The embayment was then entirely transformed and, reflecting this, the Kissimmee Embayment has been renamed the Rucks Embayment (see fig. 7).

The first interglacial period has been named the Fordville Member, during which a modest warming trend returned marine conditions to approximately those existing in Unit 2 time. There were three succeeding interglacial periods/members: Fort Denaud, Bee Branch and Ayers Landing. It has not been possible to date either the start/end of the members nor the duration of either the members or the intervening glacial periods. It is possible, if not probable, that the Ayers Landing Member ended well before the end of the Gelasian Age.

The end of the Ayers Landing Member marked the second stage extinction event, during which all remaining *Siphocypraea* populations became extinct.

Formations

There were two contemporaneous formations in the Early Gelasian Pleistocene: the Nashua Formation (Nashua) in the northeast and the Caloosahatchee Formation which covered the rest of southern Florida. These succeeded and replaced the Tamiami Formation. As the Nashua was a rather short-lived habitat for Cypraeidae populations, it will be addressed first.

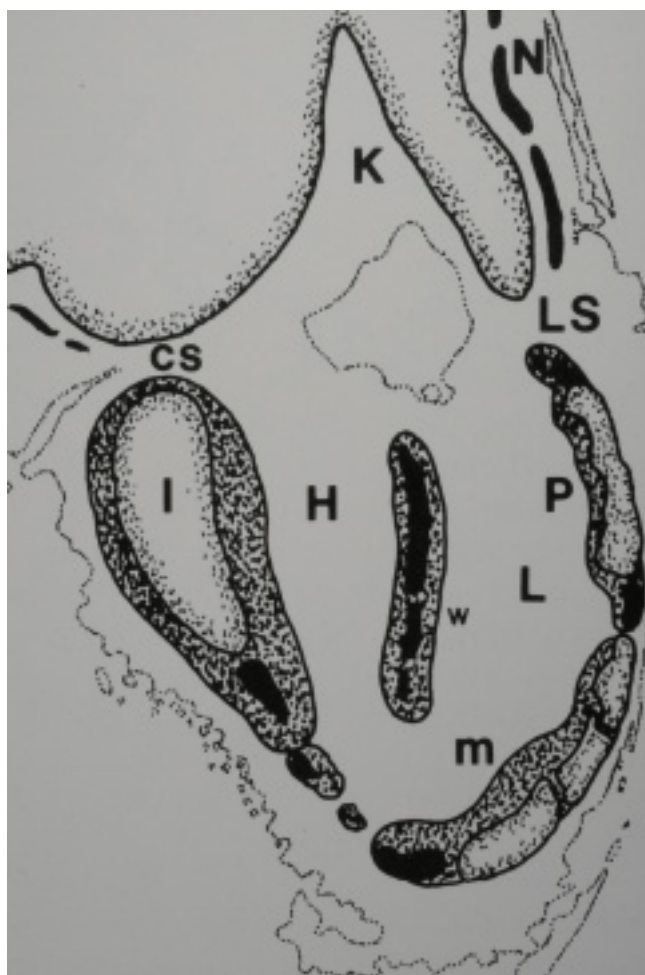


Figure 7: Map reflecting the earliest Pleistocene Everglades Pseudoatoll. N = Nashua Archipelago and Lagoon System; K = Kissimmee Embayment; CS = Caloosahatchee Strait; LS = Loxahatchee Strait; I = Immokalee Archipelago; H = Hendry Platform; w = West Everglades Reef System; P = Palm Beach Archipelago; L = Loxahatchee Trough; M = Miami Archipelago.

Stippled areas = coral reef growth; Solid dark areas = mangrove or barrier islands; Outer dotted line = Outline of Recent southern Florida.

From Petuch, 1997a, Figure 7, p. 15.

Chapter 12

Nashua Formation

The Pleistocene Nashua Formation (originally Nashua Marl) was described by Matson & Clapp (1909) based on the fossiliferous white shell marl beds from the vicinity of Nashua, Putnam County, Florida, a small population center on the St. Johns River, southwest of St. Augustine, Florida. The best exposures were found at that location. The river flows northward for ~ 310 miles from its origin in Indian River County which abuts Okeechobee County on the northeast corner of the latter.

“The matrix of the Nashua marl, while usually calcareous, is always more or less sandy and sometimes consists of pure sand. The shells are commonly well preserved though locally a marl consisting of broken and eroded fragments of shells is not uncommon. ... The Nashua marl bears a strong lithologic resemblance to the Caloosahatchee marl. ... The most striking difference between the faunas of the two formations is the existence of certain species in the Nashua marl which occur in the “Waccamaw” fauna of the Carolinas, but are not known to be present in the Caloosahatchee marl. This affinity with the faunas to the north suggests the existence of a cold current along the Atlantic coast which permitted a southward migration of the “Waccamaw” fauna.” (Matson & Clapp). The authors also reported a sample from “a well near Kissimmee”.

Similar fossil assemblages were reported from Daytona Beach, Volusia County, Seminole County, to the north of Orlando, and west of Fort Pierce, St. Lucie County. Nashua molluscan fossil fauna was also reported from Rucks Pit, Fort Drum, Okeechobee County. While first designated of Pliocene origin, it was later shown to be of Pleistocene age based upon molluscan faunal affinities. A poorly preserved specimen of *S. Problematica* was collected at Rucks Pit, Kissimmee, Okeechobee County (Petuch, 1994).

The areal extent, which stretched from Georgia to St. Lucie County, was contained within a narrow coastal lagoon that formed behind a chain of sand barrier islands (the Nashua Lagoon System). At the southern end of the chain, the northernmost of the channels cut the St. Lucie peninsula into a series of wide islands and emptied into a large, shallow bay at the northern end of the Rucks Embayment (formerly Kissimmee Embayment). It is there that Nashua sedimentation is centered. At Rucks Pit, the unconsolidated translucent sand beds are white or pale gray with white or pale tan molluscan fossils. The translucent cemented sandy limestones are typically dark gray with honey gold calcite crystals forming in cavities in rocks or in fossil bivalves. The dark gray sandy limestones frequently occurred in thick, massive layers and were commercially mined for road construction.

The formation had two members in the early Gelasian. However, only the Fort Drum Member hosted Cypraeidae species (two) which were the only species from the formation.

Chapter 13

Fort Drum Member

Species

Kissimmee River Valley

Siphocypraea (Lokossea) bruggemani (Petuch and Drolshagen, 2011)

Siphocypraea (Floridacypraea) klatti Petuch and Drolshagen, 2011

Only two species of *Siphocypraea* are known to have inhabited the lower Fort Drum Member: *Siphocypraea (Lokossea) bruggemani* and *Siphocypraea (Floridacypraea) klatti*. Both have been collected at Rucks Pit. The former has also been collected at Bonita Grande Aggregates Pit, Lee County while the latter has been collected at the Brantley Pit, Arcadia, DeSoto County. Both species were collected from Florida barge canal spoil piles near the Hendry/Glades County border, indicating the species also inhabited the upper Fordville Member of the Caloosahatchee Formation. They were first described from the lower Fort Drum Member, equivalent to the Fordville Member.

Fort Drum Member. In 2004, Petuch informally named both the lower Fort Drum Member and the upper Rucks Pit Member, both of the Nashua Formation. The areal extent of the member is the same as the formation. However, in Florida, the basal Fort Drum Member is only present in Northeastern Okeechobee (Rucks), St. Lucie and northern Martin counties. At Rucks Pit, the member is represented by a massive gray sandy limestone bed which overlays a thick bed of large, closely packed single valves of the clam *Mercenaria permagna* Conrad, 1838. These are often collected with dogtooth calcite spar inclusions. The unconsolidated clam beds grade into the gray sandy limestone above and into the muddy shell hash layer (a conglomerate of molluscan fossils and a calcareous sandstone matrix) below. The member dates from the latest Pliocene to the Early Gelasian age.

The lower Fort Drum Member is the only member of the Nashua Formation to have supported viable Cypraeidae populations, albeit impoverished. During the succeeding Rucks Pit Member, the water temperatures in the Rucks Pit Embayment ranged widely with winter temperatures cold and summer temperatures warm, subtropical at best. However, seasonal water temperatures appear to have been warm enough to allow some Caloosahatchee *Siphocypraea* species to migrate temporarily into Rucks. (Petuch, 2004). However, the upper Rucks Pit Member was not a viable habitat for marine molluscan fauna.

Plate 96 →

1. *Siphocypraea (Lokossea) bruggemani* 58.7 mm

2. *S. (Floridacypraea) klatti* 60.9 mm



1



2

Chapter 14

Caloosahatchee Formation

The Pleistocene Caloosahatchee Formation was originally based on the beds along the low water line of the Caloosahatchee River as described by Heilprin in 1886. This was the first geologic unit named from southern Florida. In 1887, Dall gave the unit the name Caloosahatchee beds, later renamed the Caloosahatchee Marl by Matson & Clapp (1909). The formation was formally described by DuBar in 1958, along with its three members. The members (Fort Denaud, Bee Branch and Ayers Landing) collectively represent the lithology of a progressive/regressive (rising/falling sea levels) depositional cycle. The type exposures of the formation and its members were found between Fort Denaud and the Ortona Locks ~ 20 miles east of Fort Denaud. Originally placed within the Pliocene, it was later placed in the Pleistocene based on the terrestrial vertebrate fossil record.

DuBar's description: "Typically, beds of the Caloosahatchee formation consist of marls composed primarily of quartz sand, silt, and shells. Most of the strata are soft or only slightly indurated [hardened], but some are calcareous and very hard, so as closely to approach the nature of true limestone. Most layers are moderately to abundantly fossiliferous, although some, especially sands, are almost or completely barren. Fresh exposures are generally light colored with white, light gray, cream and buff predominating. In the subsurface many sand layers are light green to olive green. Weathered marls are usually medium to dark gray" (DuBar, 1958a).

The thickness of the formation is less than 50 feet in most areas. "In many places it is completely absent, having been eroded away, or at some localities never deposited. The typical Caloosahatchee beds were deposited in a shallow sea. The Tamiami formation seems to have been eroded and well dissected by subaerial agents; consequently, the Caloosahatchee deposits are thickest where they fill the depressions and tend to thin over high areas" (DuBar, 1958a).

The areal extent covers much of southern Florida. However, "the Caloosahatchee marl does not crop out in many places and is generally covered by 10 to 20 feet or more of younger marine and fresh-water beds. Well records indicate that the Caloosahatchee Formation lies at shallow depth in subsurface throughout most of southeastern Florida" (DuBar, 1958a).

Chapter 15

Caloosahatchee Formation Members

Fordville Member

Species

Myakka Lagoon System (Sarasota)

Siphocypraea (*Siphocypraea*) *streami* Petuch and Drolshagen, 2011

Southern Florida

Siphocypraea (*Floridacypraea*) *klatti* Petuch and Drolshagen, 2011

Siphocypraea (*Lokossea*) *bruggemani* (Petuch and Drolshagen, 2011)

All species inhabited sea grass beds. Fordville was a time of extreme paucity for Cypraeidae species.

Myakka Unit 1 and Beyond

In 2007, based on distinct lithology and chronologically restricted molluscan fauna, Petuch informally named the lowest Caloosahatchee Formation beds the Fordville Member. Its designation was taken from Fordville, a small agricultural hamlet three kilometers southeast of the APAC pit on Fruitville Road. Quartz sands of varying color are typical of Fordville facies at Sarasota. However, the light gray or blue-green Fordville stringer beds outside of Sarasota contain a higher carbonate fraction, usually with variable amounts of calcilutites (limestone comprised of >50% carbonate grains) and dolosilts (carbonate silts). The member was present in all of the Sarasota quarries and, on a localized basis, at other locations. The restricted and localized nature of the member suggests that the marine environment was only in the initial stage of recovery and accounts for its absence in DuBar's southern Florida paleogeography explorations of the 1950s which were concentrated in the Fort Denaud area.

Previously, in 1982, Petuch described a ~ 0.9-meter-thick Unit 1 strata consisting of a yellow quartz sand with an abundance of shell fragments in the eastern section of the Sarasota Ashland Petroleum and Asphalt Corporation (APAC) pit. In Petuch's Unit 1 strata, the ~ 4.6-meter unit was gradational to the Unit 0 surface unit. The shattered shall fragments in yellow quartz sand suggest a turbulent beach environment inhabited by shallow water, sand dwelling species. Petuch suggested that this beach facies might be contemporaneous with the local Caloosahatchee Formation.

Myakka Unit 1

Later in 1992, Lyons described a more complex 2.5-meter-thick Unit 1 strata in the center, west side of the APAC Pit to the west of the Quality Aggregates Pits (see fig. 8). The lithology consisted of carbonized wood, variably colored quartz sands interspersed with peats and containing well preserved mollusks, including beds of bivalves. The differing strata represented fluctuating sea levels and illustrate the unsettled conditions prevailing there, which would have impacted the entire areal extent of the member to varying degrees.

The lowest stratum of Lyons' Unit 1 rests directly on top of the hardened crust sediments of Unit 2. There lay two zones of black and brown quartz sand facies, together ~ one meter thick. When the black facie is present, it is always on top of the brown facie. Within the brown facie, tree trunks and

roots lie in an upright position inferring terrestrial origins. Overlaying the two zones of the strata is a thin (~ 10-15 cm) strata composed of horizontal black wood. There were no marine or fresh water macrofossils in these strata, suggesting a significant pause in the marine deposition at the APAC Pit. This suggests cold temperatures and lower sea levels which resulted in the extinction of the *Calusacypraea*, *Akleistostoma* and *Pseudadusta* species.

Above these terrestrial layers lay a 1.2-meter stratum of loosely packed gray quartz sand (Sand-Shell Zone), facies which align with that of the Fordville Member. It is here that Lyons reported *Siphocypraea* (*Siphocypraea*) *problematica* Heilprin, 1886. However, that species was designated by DuBar as an Index fossil for the succeeding Fort Denaud Member. The characteristics of the specimen illustrated by Lyons (Appendix Figure 22) align with those of *Siphocypraea* (*Siphocypraea*) *streami* which was later described by Petuch and Drolshagen in 2011 with the **Type** locality Unit 1, APAC Pit, Sarasota, Sarasota County, Florida. The quartz sand facies suggest that these species lived in shallow sea grass beds in an estuary of fluctuating salinity.

This Sand-Shell Zone represents the Fordville component of Unit 1.

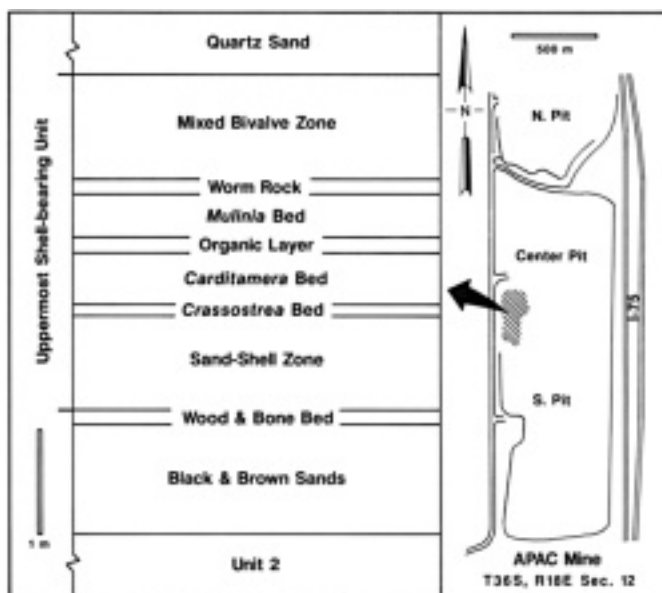


Figure 8: “Composite section of the uppermost shell-bearing unit on the western side of the APAC Mine during 1990. Maximum measured heights of all beds are depicted.” From Lyons, 1992, Figure 1, p. 135

Plate 97 →

1. *Siphocypraea* (*Lokossea*) *bruggemani* 72.8 mm
2. *S.* (*Floridacypraea*) *klatti* 59.3 mm
3. *S.* (*Siphocypraea*) *streami* 66.0 mm



Fort Denaud Member

Species

Myakka Lagoon System (Sarasota)

Siphocypraea (Siphocypraea) problematica Heilprin, 1886

Southern Florida

Siphocypraea (Siphocypraea) problematica Heilprin, 1886

Siphocypraea (Lokossea) swearingeni Petuch and Drolshagen, 2011

Siphocypraea (Floridacypraea) dubari Petuch and Drolshagen, 2011

Siphocypraea (Floridacypraea) josiai (Fehse, 1997)

Siphocypraea (Okeechobea) philemoni (Fehse, 1997)

Siphocypraea (Okeechobea) shawnae Petuch and Drolshagen, 2011

Siphocypraea (Brantleycypraea) mcgintyi new species

All species inhabited sea grass beds.

Siphocypraea (Siphocypraea) problematica is the most widespread of all the species in southern Florida and is relatively common in most exposures. It has been recorded from the well-defined gray sandy calcarenite (consolidated carbonate sands) of Griffin Brothers Pit, in southwest Palm Beach County where it is typical within that unit. Its presence at the Sarasota, Arcadia, Clewiston and other southern Florida quarries allows the placement of other Cypraeidae species within the Fort Denaud Member.

Fort Denaud Member

The Fort Denaud Member is the second oldest member of the Caloosahatchee Formation, described as the lower beds of the Caloosahatchee Formation by DuBar in 1958. DuBar's designation was taken from Fort Denaud, Hendry County, Florida on the Caloosahatchee River. DuBar noted that the lithology at almost all locales was comprised of sandy (quartz) and silty marls (or mudstone containing clays and silt) with cream, white and light gray colors predominating. Many of the beds are fossiliferous with mollusks dominating. Calcareous concretions may be formed within these facies, sometimes forming ledges. The beds were only observed where the marls lapped onto the erosional remnants of the Tamiami Formation.

Where both the Fordville and Fort Denaud members exist, the Fort Denaud beds lie unconformably atop the underlying Fordville Member beds. However, neither is present in all locations. Small erosional holes and pockmarks have been filled with sediments and fossils from overlying strata, making stratigraphic identification difficult.

Within the Fort Denaud Member, two zones are fairly widespread and can be used (with caution) as marker beds to which other beds and facies may be related:

Zone 1. Undifferentiated and brackish marl beds in localized areas, containing many fresh water mollusks, underly and are gradational to a thin, ~ 1.5 ', layer of *Cyrtopleura costata* Linnaeus, 1758 angel wing clam beds. This lower zone has been designated the *Cyrtopleura costata* faunizone. Where only scattered specimens are found, recognition of the zone must be based on the associated fauna or position in the stratigraphic sequence.

Zone 2. A thin marl, sharply differentiated in some places, transitional in others, separates this zone from the overlying Basal Oster Biostrome (a horizontal bed of fossilized sedentary organisms). Both the eastern oyster *Crassostrea virginica* (Gmelin, 1791) and *Ostrea sculpturata* Conrad, 1840, also an oyster, are commonly found together in the biostrome. Their valves are associated with and serve as an attachment for the scallop *Chlamys solarioides* Heilprin 1887. The bed is also thin, rarely exceeding 1' in thickness and covers essentially the same areal extent as *C. costata* faunizone. The oyster Biostrome is generally gradational upward to a sandy marl containing a brackish water fauna. (DuBar, 1958b).

Because the beds are gradational (both above and below), variable in appearance and discontinuous, beds are differentiated on the basis of and in the order of importance of:

1. "Faunal composition (key species, dominant forms)
2. Lithology (sandstone sandy marl, shell marl)
3. Degree of induration [hardening] and cementation
4. Bedding planes
5. Special (concretions, phosphatic grains, alignment of fossils)
6. Color of sediments and fossils." (DuBar, 1958b).

DuBar designated *Siphocypraea* (*Siphocypraea*) *problematica* as an **Index Fossil** for the Fort Denaud Member (DuBar, 1974). This was adopted by Petuch (2007). *Cyrtopleura costata* and *C. virginica* were also designated primary Index Fossils by DuBar.

The member is widespread throughout southern Florida, although not continuance throughout the region. Beyond the described area, in areas where it is present, it contains diverse environments, among which coral reef patches, oyster bioherms (as at the APAC Sarasota Pit), sea grass and mud flats hosted Cypraeidae species. Fossil identification is based on DuBar's criteria. Member thickness varies and abuts the Fordville Member and represents a modest warming of the marine environment, albeit with considerable fluctuation.

Myakka Unit 1

In Lyons' APAC Unit 1 at Sarasota, the stratum above the Fordville Sand-Shell Zone is separated irregularly by a thin compressed bed and consists of a thick (~ 0.5 meter) bed of densely packed *Carditamera* sp., *Chione cancellata* Linnaeus 1767 and *Argopecten anteamplicostatus* (Mansfield, 1936) bivalves. Lyons designated this as the *Carditamera* Bed where he reported the presence of *S. (S.) problematica* along with a small form (50-65 mm) of *S. (S.) problematica*. Their presence along with the presence of *Argopecten* suggests a shallow, warm water, high salinity lagoon with sea grasses interspersed among the bivalve beds.

Lyons equates the *Carditamera* sp. with DuBar's *Cardita* (*Carditamera*) *arata* (Conrad, 1832), noting the Unit 1 specimens exhibit variable shapes and number of ridges and suggest they may be intermediates to true *C. (C.) arata* from the lower beds and *Cardita* (*Carditamera*) *floridana* (Conrad, 1838) found in the higher beds. (Lyons). This would place the *Carditamera* sp. within the Caloosahatchee Formation. Both *C. (C.) arata* and *C. (C.) floridana* are common throughout southern Florida.

Plate 98 →

1. *Siphocypraea (Floridacypraea) josiai* 51.5 mm
2. *S. (Okeechobea) shawnae* 59.6 mm
3. *S. (Okeechobea) philemoni* 60.5 mm
4. *S. problematica* 63.7 mm
5. *S. (Brantleycypraea) mcgintyi* 69.4 mm
6. *S. (Floridacypraea) dubari* 73.8 mm
7. *S. (Lokossea) swearingeni* 69.8 mm



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Bee Branch Member

Species

Siphocypraea (Siphocypraea) haleyorum Petuch and Drolshagen, 2011
Siphocypraea (Lokossea) wigginsii Petuch and Drolshagen, 2011
Siphocypraea (Floridacypraea) desotoensis Petuch and Drolshagen, 2011
Siphocypraea (Okeechobea) brantleyi (Petuch, 2004)
Siphocypraea (Brantleycypraea) aspenae (Petuch, 2004)

A brief but severe glacial period at the end of Fort Denaud time was marked by reduced and lost habitats caused by regressive sea levels. This stressed the Fort Denaud Cypraeidae populations and saw those species passing.

During the low sea levels of the glacial period, widespread infilling of the Caloosahatchee Subsea resulted in sandy Cypraeidae habitats during Bee Branch time. DuBar described the facies as “softer, less consolidated” (see below). The facies existed in sand shoals, banks, bars, sand lagoon bottoms and intertidal sand flats where extensive sea grass beds hosted the remaining Cypraeidae populations. The facies would also have been interspersed with the “hard, calcareous beds” where sea grass would also have existed. The bivalve species assigned by DuBar to the Bee Branch would have co-existed with the Bee Branch Cypraeidae populations.

The progressive infilling of the Caloosahatchee Subsea also impacted the areal extent of the Cypraeidae habitats. The Myakka Lagoon System, the Kissimmee Embayment and the Immokalee Reef Tracts ceased to host such habitats. The Brantley Embayment, present day Arcadia, DeSoto County, became a primary location for the remaining populations. Other lesser locations were situated to the east and northeast of the Embayment.

Bee Branch Member

The Bee Branch Member, described by DuBar in 1958, followed and, with few exceptions, conformably overlays the Fort Denaud Member as the third oldest member of the Caloosahatchee Formation. The best developed stratigraphic exposures, deposited during a progressive rise in sea levels which produced the highest sea levels of the Gelasian Pleistocene, were found along the Bee Branch tributary of the Caloosahatchee River, hence the name. Within the member, two dominant facies and many minor variations of each occur.

The first facies is “represented by the Bee Branch deposits of the type locality which form a massive, hard calcareous bed. It forms a nearly vertical wall on both sides of the stream, juts out over the softer beds below, and above forms a distinct ledge, in places several feet wide. It is riddled with large and small solution holes that are filled with matrix from overlying beds. Commonly small pockets of softer marly material occur within the bed but are not related to holes above. The exposed vertical surfaces are pockmarked where these small patches of marl have been flushed out at flood stage. Most of the weathered surfaces are dark gray or black, but fresh surfaces are buff or cream colored. Yellow-brown mottling by limonite stain is common”. (DuBar, 1958b). Due to the hardened nature of this limestone marl, extraction of fossils from within is problematic and, as a result, the invertebrate fossil population is poorly sampled. DuBar felt the facies represented a deeper offshore marine environment.

The second facie “differs from that of the type locality in being much softer, less consolidated, arenaceous, and more distinctly concretionary. Generally, it does not form prominent ledges. The concretions contained within it are hard, dense calcareous nodules which locally occur in isolated manner but more commonly form an arborescent [treelike form] network extending throughout the entire bed”. (DuBar, 1958b). DuBar felt the facies represented a more near shore marine environment.

“The fauna of the Bee Branch member is distinctive. ... Among the most typical mollusk species are *Chlamys nodulus* [lion’s paw scallop], *Amusium mortoni* [pecten], and *Mulinia caloosaensis* [salt water clam]. All three species are rarely found in any other Caloosahatchee bed. ... The fauna of the marly facies contains the typical forms but otherwise more nearly approaches that of the beds above”. (DuBar, 1958b).

It is likely that the second facies would have hosted the sea grass beds which were the habitat of the Bee Branch Cypraeidae.

Myakka – Unit 1

In Lyons’ Unit 1 at the APAC Pit, Sarasota, the *Carditamera* bivalve beds, inferred as belonging to the Fort Denaud Member by the presence of *Siphocypraea problematica* Heilprin, 886 (Index fossil), are overlain by a thin (~ 3-10 cm) black layer of wood, other organic material, intermixed with freshwater gastropod shells. The layer is discontinuous, sometimes accompanied by or replaced by hard quartz sand. Packed crushed shell fragments are rarely present. No marine invertebrate fossil mollusks were found in this layer.

In turn, the organic layer was overlain by a ~ 0.4 m layer of quartz sand in which *Mulinia caloosaensis* is abundant. DuBar also noted the presence of this species in the Bee Branch Member (see above). Lyons named this the *Mulinia* Bed and it may be inferred as belonging to the Bee Branch or equivalent. However, while other gastropod species were found within this layer, Cypraeidae species were not among them, nor have any Bee Branch Cypraeidae species been reported from any of the Sarasota quarries.

This suggests that the Myakka Lagoon System ceased to be a viable Cypraeidae habitat by the end of Fort Denaud time.

Plate 99 →

1. *Siphocypraea* (*Floridacypraea*) *desotoensis* 57.2 mm
2. *S.* (*Brantleycypraea*) *aspenae* 57.2 mm
3. *S.* (*Okeechobea*) *brantleyi* 55.3 mm
4. *S. haleyorum* 58.9 mm
5. *S.* (*Lokossea*) *wigginsi* 65.6 mm



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Ayers Landing Member

Species

Siphocypraea (Siphocypraea) ridgdilli Petuch and Drolshagen, 2011

Siphocypraea (Lokossea) registeri Petuch and Drolshagen, 2011

Siphocypraea (Floridacypraea) griffini (Petuch, 1991)

Siphocypraea (Okeechobea) loxahatcheensis (Petuch and Drolshagen, 2011)

Siphocypraea (Brantleycypraea) briskinae (Petuch, Berschauer and Myers, 2018)

Three of the above species present as dwarfs. They are: *S. (S.) ridgdilli*, *S. (F.) griffini* and *S. (B.) briskinae*. They were collected among other dwarf molluscan populations and together appear as dwarf forms of their older ancestors. This suggests deteriorating climatic conditions and habitat impoverishment prior to the second and final extinction event. Most have been recorded from the Brantley Pit, and other nearby pits, Arcadia, DeSoto County. Others have been recorded from the Palm Beach Aggregates Pit, Palm Beach County and the vicinity.

As with the Fort Denaud Member, the Bee Branch ended with a short but severe glacial period with regressive sea levels, followed by a quick reversal.

The climate of the interglacial period, the Ayers Landing Member, remained the coolest and the lowest of the Gelasian progressive sea levels. As a result, the Cypraeidae populations continued to inhabit sea grass beds on sand and mud bottoms, but in shallower waters (intertidal – ten meters). The areal extent of the member was also much smaller than the older Caloosahatchee members. Five Cypraeidae species did follow the Bee Branch but their morphology suggests their status as relictual species in habitats which never fully recovered during the Gelasian.

Ayers Landing Member

The Ayers Landing Member, also described by DuBar in 1958, is the uppermost and final layer of the Caloosahatchee Formation. The best exposures, deposited during a regressive drop in sea levels which produced significantly lower sea levels, were found along the Caloosahatchee River in Hendry County, in the vicinity of Ayers Landing.

“The uppermost marine Caloosahatchee shell bed exposed in the vicinity of the Caloosahatchee River is preserved only as patches in sags or troughs in the underlying Bee Branch member. At one time it must have formed a continuous bed throughout most of the area between La Belle and Ft. Denaud. Typically, the shell bed is poorly consolidated and sandy, and in many sections does not greatly differ from the marl facies of the Bee Branch member. It is notably fossiliferous and usually the fossils are well preserved, but commonly give evidence of mild reworking and mixing.” (DuBar, 1958b).

“The member is discontinuous, being absent or greatly thinned over the arches. It reaches greatest thickness in the troughs of undulations of the underlying beds. ... Erosion concentrated on the arches seems to be mainly responsible for these difference in thickness and it probably accounts for the absence of the unit upstream from La Belle, although it is possible that deposition over the arches may not have been as great as in the troughs. ... At many localities the unit is very arenaceous [sand or sandstone] and the calcium carbonate content is mainly in the form of mollusk shells. Thick beds are generally only slightly consolidated and are easily eroded.” (DuBar, 1958b).

“*Chione cancellata* (Linné) [venus clam family] is the dominant marine species at nearly all localities, reaching its climax in individual size and relative abundance in the upper Caloosahatchee [Ayers Landing Member]. The megafossils are well preserved but show random orientation suggesting moderate reworking by wave action subsequent to death.” (DuBar, 1958b).

Second and Final Extinction Event

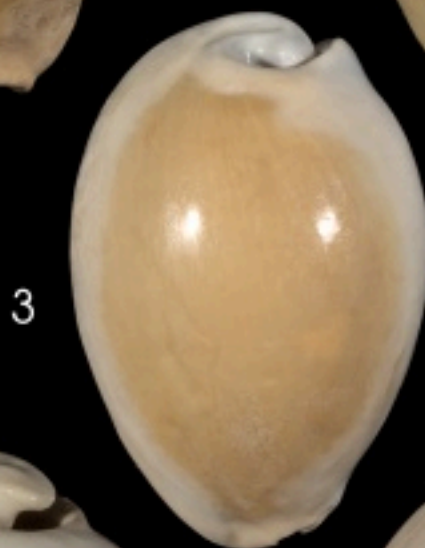
The first stage wounding event took place toward the end of Unit 2 time and into the Fordville Member during the transition from the Piacenzian, late Pliocene, Tamiami Formation into the Gelasian, Pleistocene, Caloosahatchee Formation. During that glacial period, five Cypraeidae genera became extinct and the number of species was drastically reduced. While the remaining genera/species did partially recover, habitats and climate never fully returned to prior conditions.

The end of the Ayers Landing Member also marked the end of the Caloosahatchee Formation *Siphocypraea* populations. The end was triggered by a severe and rapid glacial period during which sea levels dropped. As a result, all *Siphocypraea* habitats ceased to exist. This second stage extinction event eliminated all remaining Cypraeidae populations. (Petuch, 1995).

Cypraeidae populations would not return to southern Florida for 300k years and their composition would have no relation to the prior species.

Plate 100 →

1. *Siphocypraea* (*Brantleycypraea*) *briskinae* 49.1 mm
2. *S.* (*Siphocypraea*) *ridgdilli* 52.0 mm
3. *S.* (*Floridacypraea*) *griffini* 42.6 mm
4. *S.* (*Okeechobea*) *loxahatcheensis* 56.9 mm
5. *S.* (*Lokossea*) *registeri* 56.9 mm



Nashua & Caloosahatchee Formations Taxa & Iconography

Chapter 16

Genera

Siphocypraea (Siphocypraea) Heilprin, 1886

The genus *Siphocypraea (Siphocypraea)* differs “in the possession of a deep, comma-shaped sulcus or depression, occupying the apical portion of the shell, and which, as the posterior continuation of the aperture, is curved dextrally around the axis of involution”. (Heilprin, 1886).

“The genus *Siphocypraea* Heilprin, 1886 was the first group of Plio-Pleistocene fossil cowries discovered in southern Florida (Heilprin, 1886). With their characteristic curled apical sulcus, members of this genus are unmistakable and stand out from all other fossil cowry groups found in the Everglades and adjacent areas. Although *Siphocypraea (sensu strictu)* was the first genus of southern Floridian cowries to be formally described and named, it was actually one of the geologically youngest genera, not appearing until the late Pliocene.” (Petuch & Drolshagen).

Siphocypraea (sensu strictu) are first encountered in the Caloosahatchee Formation, Fort Denaud Member. They are cylindrical/subcylindrical shells, with a deep apical sulcus which is coiled at least ½ turn, uniformly narrow aperture, fully ribbed columella and distinct fossula. *Siphocypraea (Aestuariumcypraea)* species of the Myakka Lagoon System have characteristics which suggest a possible evolutionary precedent, but also significant differences such that not one characteristic, except a uniformly narrow aperture, aligns with *Siphocypraea (s.s.)*. However, there are enough partial similarities to provisionally acknowledge *Siphocypraea (Aestuariumcypraea)* as the immediate ancestor to *Siphocypraea (s.s.)*.

The genus is comprised of four species which inhabited successive members of the Caloosahatchee Formation. The genus became extinct at the end of the Ayers Landing Member when all *Siphocypraea* and *Siphocypraea* subgenera became extinct during the second stage of a two-stage extinction event.

Comparisons

Siphocypraea (Siphocypraea): Cylindrical/subcylindrical shells; apical sulcus deep, coiled at least ½ turn, uniformly narrow aperture; base rounded, slightly flattened; margins rounded, subangular, angular.

- Columella ribbed; fossula steep, scalene, smooth.

Siphocypraea (Lokossea): Oval, inflated shells; apical sulcus deep, tightly coiled ½ turn; aperture uniformly narrow; base rounded; margins rounded, subangular.

- Columella ribbed; fossula steep, scalene, shallow, smooth.

Siphocypraea (Floridacypraea): Larger species cylindrical, subcylindrical; smaller species pyriform, or ovoid shells; apical sulcus deep, open, coiled less than ½ turn; aperture uniformly narrow; margin callous, rounded, subangular.

- Columella ribbed; fossula steep, shallow, smooth, indistinct.

Siphocypraea (Brantleyocypraea): Ovoid/cylindrical shells; apical sulcus narrow, coiled $\frac{1}{4}$ turn; aperture narrow, but open; base rounded; margins rounded; auricles blunt.

- Columella ribbed; fossula steep, shallow, smooth, indistinct/distinct.

Siphocypraea (Okeechobea): Cylindrical/oval, inflated, elongate, rounded shells; apical sulcus deep, narrow, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn; aperture uniformly narrow; base rounded; margins rounded; auricles blunt.

- Columella ribbed; fossula steep, scalene, smooth.

Caloosahatchee Formation *Siphocypraea* species:

Siphocypraea (Siphocypraea) streami Petuch and Drolshagen, 2011

Siphocypraea (Siphocypraea) problematica Heilprin, 1886 **TYPE**

Siphocypraea (Siphocypraea) haleyorum Petuch and Drolshagen, 2011

Siphocypraea (Siphocypraea) ridgdilli Petuch and Drolshagen, 2011

Siphocypraea (Siphocypraea) Heilprin, 1886

***Siphocypraea (Siphocypraea) streami* Petuch and Drolshagen, 2011**

2011. *Siphocypraea streami* Petuch and Drolshagen

2022. *Siphocypraea (Siphocypraea) streami* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13230

TYPE Locality: APAC Pit, Sarasota, Sarasota County, FL.

Fordville Member (Unit 1), Caloosahatchee Formation

Size range: 55.8-75.4 mm

Shape: Subcylindrical, elongate, inflated

Base: Rounded

Margins: Produced, rounded

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, scalene, smooth

Apical sulcus: Deep, open, distinctly coiled $\frac{1}{2}$ turn

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over columella

Number: 22-25

Labral lip; teeth: Steep, thick; thick, pointed

Number: 24-27

Key Characteristics: Subcylindrical, elongate, inflated shell; apical sulcus deep, distinctly coiled $\frac{1}{2}$ turn; aperture uniformly narrow; base and margins rounded; columella ribbed; fossula distinct.

Comparisons: *S. (S.) streami* is similar to *S. (S.) problematica*. However, *S. (S.) problematica* is a cylindrical, slender shell, not as inflated laterally with a narrow, more tightly coiled apical sulcus and better developed, projecting auricles.

Range: The Sarasota quarries, Sarasota County and Bonita Grande Aggregates Pit, Lee County.

Plate 101 →

Siphocypraea (Siphocypraea) streami Petuch and Drolshagen, 2011

1. 66.0 mm, APAC Pit, Sarasota

2. 62.2 mm, De Soto Shell Pit, Bay & Shell Road, Arcadia



1



2



***Siphocypraea (Siphocypraea) problematica* Heilprin, 1886 TYPE**

1886. *Cypraea problematica* Heilprin

1887. *Siphocypraea problematica* Heilprin

1997. *Siphocypraea (Siphocypraea) problematica* Petuch

2011. *Siphocypraea problematica* Petuch and Drolshagen

2022. *Siphocypraea (Siphocypraea) problematica* Daughenbaugh and Bridges

HOLOTYPE: Wagner Free Institute of Science (Plesiotypes), 112209/10

TYPE Locality: Banks of the Caloosahatchee River below Fort Thompson, LaBelle, Glades County, FL.

Fort Denaud Member, Caloosahatchee Formation

Size range: 47.0-71.8 mm

Shape: Cylindrical, slender, elongate

Base: Rounded

Margins: Rounded

Auricles: Produced, slightly projecting

Columella: Ribbed

Fossula: Steep, scalene, smooth

Apical sulcus: Deep, narrow, coiled $\frac{1}{2}$ - $\frac{1}{2}$ + turn

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over columella

Number: 18-22

Labral lip; teeth: Steep, moderately thick; thin, longer, anteriorly

Number: 22-26

Key Characteristics: [Adapted from Petuch, Berschauer & Myers, 2018] Cylindrical, slender, elongate shell; apical sulcus deep, narrow, coiled $\frac{1}{2}$ - $\frac{1}{2}$ + turn; aperture uniformly narrow; base and margins rounded; auricles produced, slightly projecting; columella ribbed; fossula distinct.

Comparisons: *S. (S.) problematica* is similar to *S. (S.) streami* and *S. (S.) ridgdilli*. However, *S. (S.) streami* is a subcylindrical, laterally inflated shell; with a more open apical sulcus; and poorly produced, blunt auricles. *S. (S.) ridgdilli* is a subcylindrical, broad, rounded shell; with a more open apical sulcus; and poorly produced, blunt auricles.

Range: Warren Brothers Pit (APAC Pit predecessor)/APAC Pit, Sarasota; Bonita Springs Aggregate Pit, Lee County; Brantley Pit, DeSoto County; LaBelle and Clewiston, Hendry County. Abundant throughout Southern Peninsular Florida.

Plate 102 →

Siphocypraea (Siphocypraea) problematica Heilprin, 1886

1. 47.0 mm, Warren Brothers Pit, Sarasota

2. 63.7 mm, Cochran Pit, LaBelle

3. 68.7 Bonita Grande Aggregates Pit, Bonita Springs



***Siphocypraea (Siphocypraea) haleyorum* Petuch and Drolshagen, 2011**

2011. *Siphocypraea haleyorum* Petuch and Drolshagen

2022. *Siphocypraea (Siphocypraea) haleyorum* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 132229

TYPE Locality: Talisman Canal excavation, at the juncture with the Miami Canal, northern Holey Land Wildlife Management Area, southwestern Palm Beach County, FL.

Bee Branch Member, Caloosahatchee Formation.

Size range: 56.6-78.2 mm

Shape: Cylindrical, elongate

Base: Slightly flattened, flattened

Margins: Subangular, angular

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Steep, scalene, smooth

Apical sulcus: Deep, coiled $\frac{1}{2}$ turn, partially covered by body whorl extension

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over columella

Number: 19-23

Labral lip; teeth: Steep, thick; thin, pointed

Number: 23-26

Key Characteristics: Cylindrical, elongate shell; apical sulcus deep, coiled $\frac{1}{2}$ turn, partially covered by body whorl extension (NOTE: the body whorl extension varies from a large to a small foldlike extension providing varying degrees of apical sulcus coverage); aperture uniformly narrow; base slightly flattened, flattened; margins subangular, angular; auricles produced, blunt; columella ribbed; fossula distinct.

Comparisons: *S. (S.) haleyorum* is similar to *S. (Lokossea) dimasi* and *S. (Aestuariumcypraea) janowskyi* and *S. (S.) problematica*. However, *S. (L.) dimasi* is a much smaller shell with fewer columellar teeth. *S. (A.) janowskyi* is a larger, subpyriform, inflated shell with a columella which is only ribbed along the top half and an indistinct fossula. *S. (S.) problematica* is a more rounded shell with rounded base and margins; lacks the body whorl extension; and has better produced, projecting auricles.

Range: Southern Peninsular Florida. Very common in the Brantley Pit, Arcadia, DeSoto County.

Plate 103 →

Siphocypraea (Siphocypraea) haleyorum Petuch and Drolshagen, 2011

1. 56.6 mm, Florida Barge Canal, Hendry/Glades County border

2. 62.5 mm, Brantley Pit, Arcadia

3. 58.9 mm, Cochran Pit, LaBelle



1



2



3



***Siphocypraea (Siphocypraea) ridgdilli* Petuch and Drolshagen, 2011**

2011. *Siphocypraea ridgdilli* Petuch and Drolshagen

2022. *Siphocypraea (Siphocypraea) ridgdilli* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 132231

TYPE Locality: Ridgdill Pit, west of Moore Haven, Glades County, FL.

Ayers Landing Member, Caloosahatchee Formation

Size range: 36.3-52.0 mm

Shape: Subcylindrical, fusiform

Base: Rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, scalene, smooth

Apical sulcus: Open, deep, coiled ~ ½ turn

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over columella

Number: 15-18

Labral lip; teeth: Steep, relatively thin; thin, pointed

Number: 18-22

Key Characteristics: Subcylindrical, fusiform shell; apical sulcus open, deep, coiled ~ ½ turn; aperture uniformly narrow; base and margins rounded; auricles poorly produced, blunt; columella ribbed; fossula distinct.

Comparisons: *S. (S.) ridgdilli* is similar to *S. (S.) problematica*. However, *S. (S.) problematica* is a cylindrical, slender, elongate shell with a more tightly coiled apical sulcus; and better produced, projecting auricles.

Range: Southern Peninsular Florida.

Plate 104 →

Siphocypraea (Siphocypraea) ridgdilli Petuch and Drolshagen, 2011

1. 49.5 mm, Ridgdill Pit, west of Moore Haven

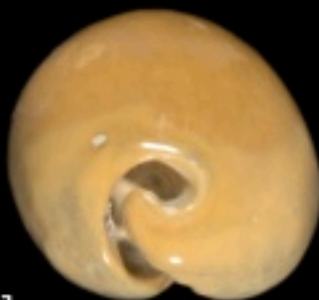
2. 52.0 mm, DeSoto Shell Pit, Hog Bay & Shell Road, Arcadia

3. 48.1 mm, Temporary Pit, South Bay

4. 48.2 mm, Bergeron Star Pit, south of South Bay



1



2



3



4



Siphocypraea (Lokossea) Petuch and Drolshagen, 2011

Siphocypraea (Lokossea) continued on into the Caloosahatchee from the Tamiami Formation on its own evolutionary line. The Tamiami (Unit 2 equivalent) *S. (L.) mulepenensis* possesses characteristics which presage the Caloosahatchee species. While retaining the tightly coiled apical sulcus of the older species, the more oval and rounded characteristics are considered transitional.

Reassignment

Siphocypraea (Lokossea) bruggemani was initially placed in the *Pahayokea* genus as *Pahayokea bruggemani* Petuch and Drolshagen, 2011 and had only been known from the lowermost bed of the Nashua Formation, equivalent to the Fordville Member, at Rucks Pit. However, it is now also known from the Fordville Member, Caloosahatchee Formation at the Florida Barge Canal near the Hendry/Glades County Border, the Bergeron Star Pit, Palm Beach County and the Bonita Grande Aggregates Pit, Lee County.

Pahayokea species, which were confined to the Kissimmee River Valley, are known for an indistinct or absent fossula, apical sulcus progressively curved, curved or slightly coiled in younger species. In *P. gabriellae* of Unit 2 equivalent, Tamiami Formation, the last of the *Pahayokea* species, the fossula is absent, the apical sulcus is curved or coiled $\sim \frac{1}{4}$ turn, the aperture is proportionally narrow and the columella ribbed. It is confined to the Kissimmee River Valley.

However, *S. (L.) bruggemani* has a distinct, scalene fossula, an apical sulcus which is coiled $\frac{1}{4}+ - \frac{1}{2}$ turn, a uniformly narrow aperture and a ribbed columella. These are typical *Siphocypraea* characteristics. In placing the species in the *Lokossea* subgenus, several anomalies are noted. The species is a more flattened shell than others in the subgenera and the coiling of the apical sulcus varies from $\frac{1}{4}+ - \frac{1}{2}$ turn. Otherwise, the species aligns with characteristics of the subgenus.

Comparisons

Siphocypraea (Siphocypraea): Cylindrical/subcylindrical shells; apical sulcus deep, coiled at least $\frac{1}{2}$ turn, uniformly narrow aperture; base rounded, slightly flattened; margins rounded, subangular, angular.

- Columella ribbed; fossula steep, scalene, smooth.

Siphocypraea (Lokossea): Oval, inflated shells; apical sulcus deep, tightly coiled $\frac{1}{2}$ turn; aperture uniformly narrow; base rounded; margins rounded, subangular.

- Columella ribbed; fossula steep, scalene, shallow, smooth.

Siphocypraea (Floridacypraea): Larger species cylindrical, subcylindrical; smaller species pyriform, or ovoid shells; apical sulcus deep, open, coiled less than $\frac{1}{2}$ turn; aperture uniformly narrow; margin callous, rounded, subangular.

- Columella ribbed; fossula steep, shallow, smooth, indistinct.

Siphocypraea (Brantleycypraea): Ovoid/cylindrical shells; apical sulcus narrow, coiled $\frac{1}{4}$ turn; aperture narrow, but open; base rounded; margins rounded; auricles blunt.

- Columella ribbed; fossula steep, shallow, smooth, indistinct/distinct.

Siphocypraea (Okeechobea): Cylindrical/oval, inflated, elongate, rounded shells; apical sulcus deep, narrow, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn; aperture uniformly narrow; base rounded; margins rounded; auricles blunt.

- Columella ribbed; fossula steep, scalene, smooth.

Caloosahatchee Formation *Siphocypraea (Lokossea)* species:

Siphocypraea (Lokossea) bruggemani (Petuch and Drolshagen, 2011)

Siphocypraea (Lokossea) swearingeni Petuch and Drolshagen, 2011 **TYPE**

Siphocypraea (Lokossea) wigginsi Petuch and Drolshagen, 2011

Siphocypraea (Lokossea) registeri Petuch and Drolshagen, 2011

Siphocypraea (Lokossea) Petuch and Drolshagen, 2011

***Siphocypraea (Lokossea) bruggemani* (Petuch and Drolshagen, 2011)**

2011. *Pahayokea bruggemani* Petuch and Drolshagen

2022. *Siphocypraea (Lokossea) bruggemani* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13239

Type Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fort Drum Member (Fordville Member, Rucks Embayment equivalent), Nashua Formation

Also, Fordville Member, Caloosahatchee Formation

Size range: 48.9-72.8 mm

Shape: Oval, oval-elongate, flattened

Base: Slightly rounded

Margins: Callous, expanded, rounded, subangular

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, scalene, shallow, smooth

Apical sulcus: Open, deep, narrow, coiled $\frac{1}{4}+$ - $\frac{1}{2}$ turn

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over columella

Number: 18-21

Labral lip; teeth: Steep, thick; thick, pointed

Number: 21-24

Key Characteristics: Oval, oval-elongate, flattened shell; apical sulcus open, deep, narrow, coiled $\frac{1}{4}+$ - $\frac{1}{2}$ turn; aperture uniformly narrow; base slightly rounded; margins callous, expanded, rounded, subangular; auricles poorly produced, blunt; columella ribbed; fossula distinct.

Comparisons: *S. (L.) bruggemani* is similar to *S. (Floridacypraea) klatti* and *S. (F.) josiai*. However, *S. (F.) klatti* has a flattened, flat base with subangular, angular margins. *S. (F.) josiai* is a smaller, pyriform, inflated, domed shell with a shallow apical sulcus, slightly flattened base and margins which are not expanded laterally. Larger specimens are also similar to *S. (L.) wigginsii*. However, *S. (L.) wigginsii* is a more inflated shell with more numerous columellar dentition.

Range: Rucks Embayment (Kissimmee River Valley), Florida Barge Canal near the Hendry/Glades County Border, the Bergeron Star Pit, Palm Beach County, Bonita Grande Aggregates Pit, Lee County, southern Peninsular Florida.

Plate 105 →

Siphocypraea (Lokossea) bruggemani (Petuch and Drolshagen, 2011)

1. 58.7 mm, Rucks Pit, Fort Drum, Kissimmee River Valley

2. 50.5 mm, Bergeron Star Pit, south of South Bay

3. 57.2 mm, Bonita Grande Aggregates Pit, Bonita Springs

4. 72.8 mm, Florida Barge Canal, Hendry/Glades County border



1



2



3



4



***Siphocypraea (Lokossea) swearingeni* Petuch and Drolshagen, 2011 TYPE**

HOLOTYPE: Paleontological Research Institute, PRI 13236

TYPE Locality: Okeelanta Sugar Corporation Road fill pit, 3 miles west of the Miami Canal and 6 miles south of Lake Harbor, Palm Beach County, Florida.

Fort Denaud Member, Caloosahatchee Formation

Size range: 56.5-86.0 mm

Shape: Oval, fusiform, inflated

Base: Slightly rounded

Margins: Callous, rounded → angular

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Steep, scalene, shallow, smooth

Apical sulcus: Deep, narrow; coiled ½ turn

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over columella

Number: 21-23

Labral lip; teeth: Steep, thick; thick, pointed

Number: 25-26

Key Characteristics: Oval, fusiform [tapering at both ends], inflated shell; apical sulcus deep, narrow, coiled ½ turn; aperture uniformly narrow; base slightly rounded; margins callous, rounded → angular; auricles produced, blunt; columella ribbed; fossula distinct.

Comparisons: *S. (L.) swearingeni* is similar to *S. (L.) wigginsii*. However, *S. (L.) wigginsii* is an oval elongate shell with a compressed apical sulcus, and shorter body whorl extension; auricles poorly produced, blunt.

Range: Southern Peninsular Florida.

Plate 106 →

Siphocypraea (Lokossea) swearingeni Petuch and Drolshagen, 2011

1. 56.5 mm, Bergeron Star Pit, south of South Bay
2. 69.8 mm, Bonita Grande Aggregates Pit, Bonita Springs
3. 74.4 mm, Griffin Brothers Pit, SW Palm Beach County



1



2



3



***Siphocypraea (Lokossea) wigginsi* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13237

TYPE Locality: Brantley Pit, Arcadia, DeSoto County, FL.

Bee Branch Member, Caloosahatchee Formation

Size range: 60.2-82.1 mm

Shape: Oval, elongate, inflated

Base: Slightly rounded

Margins: Callous, rounded → angular

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Steep, scalene, shallow, smooth

Apical sulcus: Deep, narrow; coiled ½ turn

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over columella

Number: 20-24

Labral lip; teeth: Steep, thick; thick, pointed

Number: 21-26

Key Characteristics: Oval, elongate, inflated shell; apical sulcus deep, narrow; coiled ½ turn; aperture uniformly narrow; base slightly rounded; margins callous, rounded → angular; auricles reduced, blunt; columella ribbed; fossula distinct.

Comparisons: *S. (L.) wigginsi* is similar to *S. (L.) swearingeni*. However, *S. (L.) swearingeni* is an oval, fusiform [tapered at both ends], inflated shell with a projecting body whorl extension and apical sulcus; and produced, projecting auricles.

Range: Southern Peninsular Florida.

Plate 107 →

Siphocypraea (Lokossea) wigginsi Petuch and Drolshagen, 2011

1. 60.2 mm, Brantley Pit, Arcadia

2. 65.6 mm, Brantley Pit, Arcadia

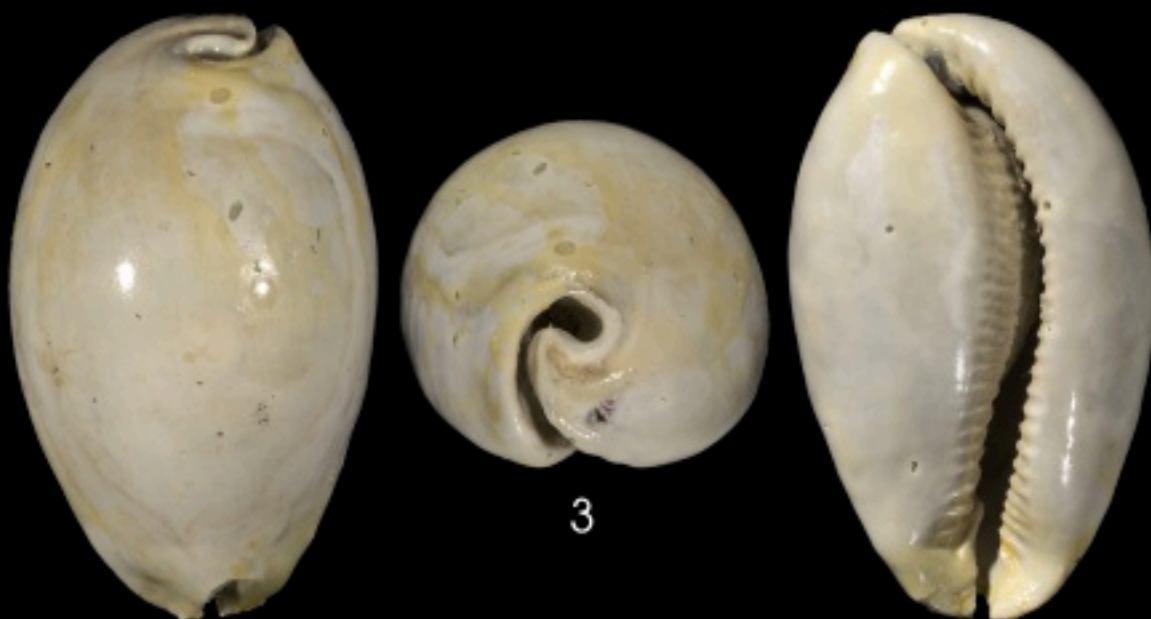
3. 74.1 mm, Brantley Pit, Arcadia



1



2



3

***Siphocypraea (Lokossea) registeri* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13238

TYPE Locality: Bergeron Star Pit Mine, 15 miles south of South Bay, Palm Beach County, FL.
Ayers Landing Member, Caloosahatchee Formation

Size range: 45.5-66.4 mm

Shape: Oval, oval-elongate, inflated

Base: Rounded

Margins: Callous, rounded

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, scalene, shallow, smooth

Apical sulcus: Open, deep, coiled $\frac{1}{4} \rightarrow \frac{1}{2}$ turn,

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over columella

Number: 16-21

Labral lip; teeth: Relatively thin; thick, pointed

Number: 20-26

Key Characteristics: Oval, oval-elongate, inflated shell; apical sulcus open, deep, coiled $\frac{1}{4} \rightarrow \frac{1}{2}$ turn; aperture uniformly narrow; base rounded; margins callous, rounded; auricles poorly produced, blunt; columella ribbed; fossula distinct.

Comparisons: *S. (L.) registeri* is similar to *S. (L.) mulepenensis*. However, *S. (L.) mulepenensis* is a larger shell with a deep, narrow apical sulcus, coiled $\frac{1}{2}$ turn, and a body whorl extension; auricles well produced, blunt.

Range: Southern Peninsular Florida.

Plate 108 →

Siphocypraea (Lokossea) registeri Petuch and Drolshagen, 2011

56.9 mm, Temporary road fill pit, Okeelanta Sugar Cane Fields



Siphocypraea (Floridacypraea) Petuch and Drolshagen, 2011

Originally proposed as a subgenus of *Siphocypraea*, representing “cowries with elongated, narrow shells, narrow apertures, and apical sulci that are only slightly coiled”.

Described as “Shells large for genus, cylindrical, with narrow apertures; margins thickened on adults; apertural teeth strong and numerous; apical sulci open, only partially coiled, usually less than one-half turn”. (Petuch & Drolshagen).

“Members of the subgenus *Floridacypraea* resemble species of *Siphocypraea* (*s.s.*), particularly in having the same type of cylindrical shell and narrow aperture. The main difference between the two groups is seen in the form of the apical sulcus. In *Siphocypraea* (*s.s.*), the sulcus is tightly coiled and extends around almost a full turn. In *Floridacypraea*, the sulcus is more open and only coils a small amount, about one-half turn. The two subgenera occurred together in the Fort Denaud, Bee Branch, and Ayers Landing Members of the Caloosahatchee Formation.” (Petuch & Drolshagen).

The earliest member of the subspecies was *Siphocypraea (Floridacypraea) klatti* Petuch and Drolshagen, 2011, collected at Rucks Pit from the basal beds of the Fort Drum Member of the Nashua Formation (equivalent to the Fordville Member of the Caloosahatchee Formation). A specimen was also collected from the Florida Barge Canal near the Hendry/Clades County border and the Bergeron Star Pit, Palm Beach County.

Reassignment

Siphocypraea (Floridacypraea) josiai was initially placed in the *Pahayokea* genus as *Pahayokea josiai*. However, the characters of the shell more closely align with those of *Siphocypraea (Floridacypraea)*.

Pahayokea species, which were confined to the Kissimmee River Valley, are known for an indistinct or absent fossula, apical sulcus progressively curved, curved or slightly coiled in younger species. In *P. gabriellae* of Unit 2 equivalent, Tamiami Formation, the last of the *Pahayokea* species, the fossula is absent, the apical sulcus is curved or coiled $\sim \frac{1}{4}$ turn, the aperture is proportionally narrow and the columella ribbed. It is confined to the Kissimmee River Valley.

However, *S. (F.) josiai* has a distinct fossula, an apical sulcus which is coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn, a uniformly narrow aperture and a ribbed columella. These are typical *Siphocypraea* characteristics. As such, the species is reassigned within the *Siphocypraea (Floridacypraea)* subgenus.

Comparisons

Siphocypraea (Siphocypraea): Cylindrical/subcylindrical shells; apical sulcus deep, coiled at least $\frac{1}{2}$ turn, uniformly narrow aperture; base rounded, slightly flattened; margins rounded, subangular, angular.

- Columella ribbed; fossula steep, scalene, smooth.

Siphocypraea (Lokossea): Oval, inflated shells; apical sulcus deep, tightly coiled $\frac{1}{2}$ turn; aperture uniformly narrow; base rounded; margins rounded, subangular.

- Columella ribbed; fossula steep, scalene, shallow, smooth.

Siphocypraea (Floridacypraea): Larger species cylindrical, subcylindrical; smaller species pyriform, or ovoid shells; apical sulcus deep, open, coiled less than $\frac{1}{2}$ turn; aperture uniformly narrow; margin callous, rounded, subangular.

- Columella ribbed; fossula steep, shallow, smooth, indistinct.

Siphocypraea (Brantleycypraea): Ovoid/cylindrical shells; apical sulcus narrow, coiled $\frac{1}{4}$ turn; aperture narrow, but open; base rounded; margins rounded; auricles blunt.

- Columella ribbed; fossula steep, shallow, smooth, indistinct/distinct.

Siphocypraea (Okeechobea): Cylindrical/oval, inflated, elongate, rounded shells; apical sulcus deep, narrow, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn; aperture uniformly narrow; base rounded; margins rounded; auricles blunt.

- Columella ribbed; fossula steep, scalene, smooth.

Siphocypraea (Floridacypraea) Caloosahatchee and Nashua Formation species:

Siphocypraea (Floridacypraea) klatti Petuch and Drolshagen, 2011

Siphocypraea (Floridacypraea) josiai (Fehse, 1997)

Siphocypraea (Floridacypraea) dubari Petuch and Drolshagen, 2011

Siphocypraea (Floridacypraea) desotoensis Petuch and Drolshagen, 2011 **TYPE**

Siphocypraea (Floridacypraea) griffini Petuch and Drolshagen, 2011

Siphocypraea (Floridacypraea) Petuch and Drolshagen, 2011

***Siphocypraea (Floridacypraea) klatti* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13234

TYPE Locality: Rucks Pit, Fort Drum, Okeechobee County, FL.

Fort Drum Member (Rucks Embayment, Kissimmee River Valley), Nashua Formation

Also, Fordville Member, Caloosahatchee Formation

Size range: 53.9-82.4 mm

Shape: Subpyriform, elongate, slightly inflated, inflated

Base: Rounded → flattened

Margins: Callous, rounded → angular

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, shallow, smooth, indistinct

Apical sulcus: Open, deep, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn, slightly projecting, projecting

Aperture: Narrow, widening slightly anteriorly

Columellar teeth: Thin; extending over columella

Number: 18-22

Labral lip; teeth: Steep, relatively thick; thick, pointed

Number: 21-24

Key Characteristics: Subpyriform, elongate, inflated shell; apical sulcus open, deep, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn; aperture narrow, widening slightly anteriorly; base rounded to flattened depending on the maturity of the specimen; margins produced, rounded to angular; auricles poorly produced, blunt; columella ribbed; fossula indistinct.

Comparisons: *S. (F.) klatti* is similar *S. (Lokossea) bruggemani* and *S. (F.) josiai*. However, *S. (L.) bruggemani* is a more flattened shell with more callous and expanded margins. *S. (F.) josiai* is a pyriform, truncated shell with a more open apical sulcus.

Range: Rucks Pit, Kissimmee River Valley; Barge canal near the Hendry/Glades County border; Bergeron Star Pit, Palm Beach County.

Plate 109 →

***Siphocypraea (Floridacypraea) klatti* Petuch and Drolshagen, 2011**

1. 60.9 mm, Rucks Pit, Fort Drum, Kissimmee River Valley
2. 53.9 mm, Bergeron Star Pit, south of South Bay
3. 59.3 mm, Florida Barge Canal, Hendry/Glades County border
4. 82.4 mm, Rucks Pit, Fort Drum, Kissimmee River Valley



1



2



3



4

***Siphocypraea (Floridacypraea) josiai* (Fehse, 1997)**

1997. *Siphocypraea josiai* Fehse

2004. *Siphocypraea (Pahayokea) josiai* Petuch

2011. *Pahayokea josiai* Petuch and Drolshagen

2022. *Siphocypraea (Floridacypraea) josiai* Daughenbaugh and Bridges

HOLOTYPE: Haus der Natur, Cismar, Germany, HNC 44659

Paratype: HNC 44660

TYPE Locality: Clewiston, Hendry County, Florida, U.S.A.

Fort Denaud Member

Original description: See Appendix B(V).

Size range: 42.0-52.6 mm

Shape: Subovate, inflated, domed

Base: Slightly rounded, rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, shallow, smooth, indistinct

Apical sulcus: Narrow, deep, coiled $\sim\frac{1}{2}$ turn

Aperture: Uniformly narrow

Columellar teeth: Thin; extending over columella

Number: 16-19

Labral lip; teeth: Steep, relatively thick; thick, pointed, longer anteriorly

Number: 21-23

Key Characteristics: [Adapted from Fehse and Petuch, Berschauer & Myers, 2018] Subovate, inflated, domed shell; apical sulcus narrow, deep, coiled $\sim\frac{1}{2}$ turn; aperture uniformly narrow; base slightly rounded, rounded; margins rounded; auricles poorly produced, blunt; columella ribbed; fossula indistinct.

Comparisons: *S. (F.) josiai* is similar to *S. (F.) klatti* and *S. (Siphocypraea) ridgdilli*. However, *S. (F.) klatti* is a larger, subpyriform, elongate shell with a more tightly coiled apical sulcus. *S. (S.) ridgdilli* is similar in size; however, it is a more cylindrical, somewhat fusiform, blunt shell with a more coiled apical sulcus.

Range: Southern Peninsular Florida.

NOTE: The weight of the shell and the length of the columellar teeth varies with the maturity of the individual specimen. With fully mature specimens, the teeth extend over the columella and the columella is ribbed. On less than mature specimens, the teeth may only extend partially onto the columella, the shell is lighter in weight and the fossula weakly formed.

Plate 110 →

Siphocypraea (Floridacypraea) josiai (Fehse, 1997)

1. 47.2 mm, Temporary pit, South Bay

2. 51.5 mm, Bonita Grande Aggregates Pit, Bonita Springs

3. 52.6 mm, Bonita Grande Aggregates Pit, Bonita Springs



1



2



3



***Siphocypraea (Floridacypraea) dubari* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13233

TYPE Locality: Bad-to-the-Bone Shell Pit, Okeechobee City, Okeechobee County, FL.

Fort Denaud Member, Caloosahatchee Formation

Size range: 62.0-77.3 mm

Shape: Subcylindrical, slender, slightly flattened

Base: Rounded, slightly flattened

Margins: Callous; columellar margin slightly constricted, constricted

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, shallow, smooth, indistinct

Apical sulcus: Open, deep, coiled ~ ½ turn, slightly compressed

Aperture: Narrow

Columellar teeth: Thin; extending over columella

Number: 21-23

Labral lip; teeth: Steep, thick; short, pointed

Number: 23-27

Key Characteristics: Subcylindrical, slender, slightly flattened shell; apical sulcus open, deep, coiled ~ ½ turn, slightly compressed; aperture narrow; base rounded, slightly flattened; margins callous, rounded, subangular; columellar margin slightly constricted, constricted; auricles poorly produced, blunt; columella ribbed; fossula indistinct.

Comparisons: *S. (F.) dubari* is similar to *S. (F.) klatti* and *S. (F.) desotoensis*. However, *S. (F.) klatti* is a subpyriform, inflated shell with a projecting apical sulcus. *S. (F.) desotoensis* is a cylindrical, broad, flattened shell with more projecting margins; and fewer labral teeth.

Range: Southern Peninsular Florida.

N.B. There are numerous specimens which possess characteristics of both *S. (F.) dubari* and *S. (F.) desotoensis*. Often labeled *cf. dubari* or *desotoensis*, it is not known whether these are just variations or undescribed species. The specimens illustrated herein adhere to the descriptions, in the opinion of the authors. In the experience of the senior author, there are more *cf.* specimens than specimens as described.

Plate 111 →

Siphocypraea (Floridacypraea) dubari Petuch and Drolshagen, 2011

1. 73.8 mm, Florida Barge Canal, Hendry/Glades County border
2. 75.2 mm, Port Mayaca excavation, east side of Lake Okeechobee
3. 73.9 mm, Hendry Rock Co., Rte. 80, east of Fort Myers
4. 77.3 mm, Bad-to-the-Bone Pit, Okeechobee



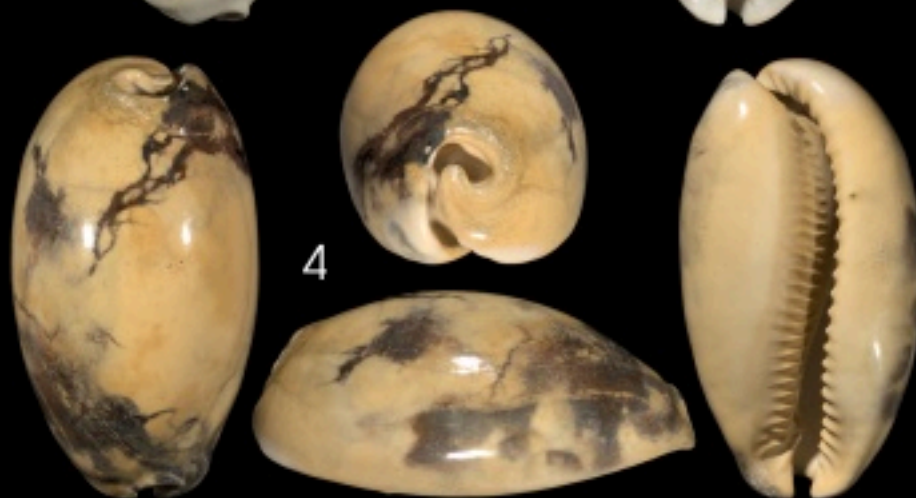
1



2



3



4

***Siphocypraea (Floridacypraea) desotoensis* Petuch and Drolshagen, 2011**

HOLOTYPE: Paleontological Research Institute, PRI 13235

TYPE Locality: Brantley Pit, Arcadia, DeSoto County, FL.

Bee Branch Member, Caloosahatchee Formation.

Size range: 51.3-64.9 mm

Apical sulcus: Open, deep, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn,

Shape: Cylindrical, broad, slightly flattened

Aperture: Narrow

Base: Rounded

Columellar teeth: Thin; extending over columella

Margins: Callous; columellar margin
laterally projecting

Number: 18-21

Auricles: Poorly produced, blunt

Labral lip; teeth: Steep, thin; short, pointed

Number: 21-23

Columella: Ribbed

Fossula: Steep, shallow, smooth, indistinct

Key Characteristics: Cylindrical, broad slightly flattened shell; apical sulcus open, deep, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn; aperture narrow; base rounded; margins rounded, subangular, columellar margin laterally projecting; auricles poorly produced, blunt; columella ribbed; fossula indistinct.

Comparisons: *S. (F.) desotoensis* is similar to *S. (F.) dubari*. However, *S. (F.) dubari* is a larger, subcylindrical, more slender, slightly flattened shell with less projecting margins, the columellar margin slightly constricted, constricted and more numerous labral teeth.

Range: Southern Peninsular Florida.

N.B. There are numerous specimens which possess characteristics of both *S. (F.) dubari* and *S. (F.) desotoensis*. Often labeled *cf. dubari* or *desotoensis*, it is not known whether these are just variations or undescribed species. The specimens illustrated herein adhere to the descriptions, in the opinion of the authors. In the experience of the senior author, there are more *cf.* specimens than specimens as described.

Plate 112 →

Siphocypraea (Floridacypraea) desotoensis Petuch and Drolshagen, 2011

1. 58.5 mm, Brantley Pit, Arcadia

2. 54.6 mm, Miami Canal Dig, 10 miles south of Lake Harbor

3. 57.2 mm, Bergeron Star Pit, south of South Bay

4. 64.9 mm, Miami Canal Dig, Lake Harbor



***Siphocypraea (Floridacypraea) griffini* (Petuch, 1991)**

1991. *Siphocypraea griffini* Petuch

1997. *Siphocypraea (Siphocypraea) griffini* Petuch

2011. *Siphocypraea (Floridacypraea) griffini* Petuch and Drolshagen

HOLOTYPE: Carnegie Museum of Natural History, CM 35674

TYPE Locality: Griffin Brother's Pit, Holey Land Wildlife Conservation Area, extreme southwestern Palm Beach County, FL.

Ayers Landing Member, Caloosahatchee Formation

Size range: 38.4-48.7 mm

Shape: Ovoid, inflated

Base: Rounded

Margins: Callous, rounded

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, shallow, smooth, indistinct or absent

Apical sulcus: Open, deep, coiled < ½ turn,

Aperture: Narrow

Columellar teeth: Thin; extending over columella

Number: 13-16

Labral lip; teeth: Steep, thin; short, pointed

Number: 17-20

Key Characteristics: Ovoid, inflated shell; apical sulcus deep, open, coiled < ½ turn, compressed; aperture uniformly narrow; base rounded; margins callous, rounded, laterally expanded; auricles poorly produced, blunt; columella ribbed; fossula indistinct or absent.

Comparisons: *S. (F.) griffini* is similar to *S. (F.) josiai* and *S. (Siphocypraea) ridgdilli*. However, *S. (F.) josiai* is a pyriform, inflated, domed shell with a shallow apical sulcus, a slightly flattened base and margins which are not expanded laterally. *S. (S.) ridgdilli* is similar in size; however, it is a more cylindrical, blunt shell with a more coiled apical sulcus.

Range: The eastern and central Everglade's region of Southern Peninsular Florida.

Plate 113 →

Siphocypraea (Floridacypraea) griffini (Petuch, 1991)

1. 38.4 mm, Temporary Pit, South Bay

2. 42.6 mm, Griffin Brothers Pit, SW Palm Beach County

3. 48.7 mm, Bonita Grande Aggregates Pit, Bonita Springs



***Siphocypraea (Brantleycypraea)* new subgenus**

2011. *Pahayokea* (Petuch, 2004)

2022. *Siphocypraea (Brantleycypraea)* Daughenbaugh and Bridges

Proposed as a subgenus of *Siphocypraea*.

Described as: Ovoid/cylindrical shells; apical sulcus narrow, shallow, coiled $\frac{1}{4}$ turn; aperture narrow, but open; base rounded; margins rounded; auricles blunt; columella ribbed; fossula indistinct/distinct.

Type Species: *Siphocypraea (Brantleycypraea) aspenae* (Petuch, 2004).

TYPE Locality: Brantley Pit, Arcadia, DeSoto County, FL.

The three species within the subgenus are ovoid, cylindrical shells with a coiled apical sulcus; rounded base and margins; ribbed columella and distinct fossula. *Siphocypraea (Brantleycypraea) mcgintyi* is described herein as a new species within the subgenus. The subgenus is contained within the Caloosahatchee Formation of southern Florida and traverse the Gelasian Pleistocene.

See below for comparisons with other *Siphocypraea* subspecies.

The species inhabited sea grass beds in the Everglades region of southern Florida. They were common in the Brantley Pit, Arcadia, DeSoto County.

Etymology: Named for the Brantley Pit where the type of the three species within the subgenus were collected. Owned by D. L. Brantley, he was very generous in allowing collectors into the pit, even opening new sections when requested. *S. (B.) aspenae* was named after his daughter (Petuch, per. comm.).

Reassignment

Two of the species in the subgenus were originally assigned to the *Pahayokea* genus which became extinct at the end of the Pliocene Tamiami Formation. The late Pliocene Tamiami Formation species have curved apical sulci; flattened base; subangular, angular margins and very indistinct or absent fossula. *S. (Brantleycypraea)* new subgenus species have coiled apical sulci; rounded base and margins and an indistinct/distinct fossula.

Comparisons

Siphocypraea (Siphocypraea): Cylindrical/subcylindrical shells; apical sulcus deep, coiled at least $\frac{1}{2}$ turn, uniformly narrow aperture; base rounded, slightly flattened; margins rounded, subangular, angular.

- Columella ribbed; fossula steep, scalene, smooth.

Siphocypraea (Lokosseae): Oval, inflated shells; apical sulcus deep, tightly coiled $\frac{1}{2}$ turn; aperture uniformly narrow; base rounded; margins rounded, subangular.

- Columella ribbed; fossula steep, scalene, shallow, smooth.

Siphocypraea (Floridacypraea): Larger species cylindrical, subcylindrical; smaller species pyriform, or ovoid shells; apical sulcus deep, open, coiled less than $\frac{1}{2}$ turn; aperture uniformly narrow; margin callous, rounded, subangular.

- Columella ribbed; fossula steep, shallow, smooth, indistinct.

Siphocypraea (Brantleycypraea): Ovoid/cylindrical shells; apical sulcus narrow, coiled $\frac{1}{4}$ turn; aperture narrow, but open; base rounded; margins rounded; auricles blunt.

- Columella ribbed; fossula steep, shallow, smooth, indistinct/distinct.

Siphocypraea (Okeechobea): Cylindrical/oval, inflated, elongate, rounded shells; apical sulcus deep, narrow, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn; aperture uniformly narrow; base rounded; margins rounded; auricles blunt.

- Columella ribbed; fossula steep, scalene, smooth.

Siphocypraea (Brantleycypraea) Caloosahatchee species:

Siphocypraea (Brantleycypraea) mcgintyi Daughenbaugh and Bridges, 2022

Siphocypraea (Brantleycypraea) aspenae (Petuch, 2004) **Type**

Siphocypraea (Brantleycypraea) briskinae Petuch, Berschauer & Myers, 2018

Siphocypraea (Brantleycypraea) new subgenus

***Siphocypraea (Brantleycypraea) mcgintyi* new species**

HOLOTYPE: Los Angeles County Museum of Natural History,
LACMIP 43270.1, LACMIP Type 14916

TYPE Locality: Brantley Pit, Arcadia, DeSoto County, FL.

Fort Denaud Member, Caloosahatchee Formation [P]

Type material Holotype: 66.2 mm, Brantley Pit, Arcadia
Paratype 1: 69.4 mm, Brantley Pit, Arcadia
Paratype 2: 62.5 mm, Brantley Pit, Arcadia (Petuch collection)
Paratype 3: 67.7 mm, Miami Canal Dig, 5 miles south of Lake Harbor,
Palm Beach County
Paratype 4: 63.3 mm, Brantley Pit, Arcadia
Paratype 5: 62.1 mm, Brantley Pit, Arcadia

Size range: 62.1- 67.7 mm

Shape: Ovoid, elongate, rounded, inflated

Base: Rounded

Margins: Rounded

Auricles: Produced, blunt

Columella: Ribbed

Fossula: Steep, shallow, smooth, indistinct/
distinct

Apical sulcus: Narrow, deep, thick coil $\frac{1}{4}$ - $\frac{1}{2}$
turn, projecting

Aperture: Open, widening slightly anteriorly

Columellar teeth: Thin, extending over the
columella

Number: 18-23

Labral lip; teeth: Steep, thick; short, pointed,
longer anteriorly

Number: 22-25

Description/Key Characteristics: Ovoid, elongate, rounded, inflated shell; apical sulcus narrow, deep, thick coil $\frac{1}{4}$ - $\frac{1}{2}$ turn, projecting; aperture open, widening slightly anteriorly; base rounded; margins rounded; auricles produced, slightly projecting; columella ribbed; fossula indistinct/distinct.

Comparisons: *S. (B.) mcgintyi* is similar to *S. (B.) aspenae*. However, *S. (B.) aspenae* is a smaller, cylindrical, elongate shell which is not as inflated. *S. (B.) mcgintyi* presents as a larger, overblown *S. (B.) aspenae* and is its likely predecessor.

Etymology: Named for Thomas L. McGinty, malacologist, for his contributions to our knowledge of the molluscan fossil populations of Florida.

Range: Southern Peninsular Florida.

Plate 114 →

Siphocypraea (Brantleycypraea) mcgintyi new species

1. 67.7 mm, Paratype 3, Miami Canal Dig, 5 miles south of Lake Harbor
2. 66.2 mm, Holotype, Brantley Pit, Arcadia
3. 69.4 mm, Paratype 1, Brantley Pit, Arcadia



***Siphocypraea (Brantleyocypraea) aspenae* Petuch, 2004 TYPE**

2004. *Siphocypraea (Pahayokea) aspenae* Petuch

2011. *Pahayokea aspenae* Petuch and Drolshagen

2022. *Siphocypraea (Brantleyocypraea) aspenae* Daughenbaugh and Bridges

HOLOTYPE: American Museum of Natural History, N. Y., AMNH FI-50660

TYPE Locality: Brantley Pit, Arcadia, DeSoto County, FL.

Bee Branch Member, Caloosahatchee Formation

Size range: 51.7-61.9 mm

Shape: Cylindrical, cylindrical-elongate

Base: Rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, shallow, smooth, indistinct

Apical sulcus: Deep, narrow, thick coil ~ ¼ turn, slightly projecting

Aperture: Open, widening slightly anteriorly

Columellar teeth: Thin, extending over the columella

Number: 18-20

Labral lip; teeth: Rounded; short, pointed longer anteriorly

Number: 22-23

Key Characteristics: Cylindrical, cylindrical-elongate shell; apical sulcus deep, narrow, thick coil ~ ¼ turn, slightly projecting; aperture open, widening slightly anteriorly; base rounded; margins rounded; auricles poorly produced, blunt; columella ribbed; fossula indistinct.

Comparisons: *S. (B.) aspenae* is similar to *S. (B.) mcgintyi* and *S. (B.) briskinae*. However, *S. (B.) mcgintyi* is an ovoid, inflated, rounded shell with more numerous columellar teeth. *S. (B.) briskinae* is a smaller, cylindrical, truncated shell with a shallow apical sulcus.

Range: Commonly collected in the Brantley Pit, Arcadia, DeSoto County. Also collected from the Florida Barge Canal, near the Hendry/Glades County border.

Plate 115 →

Siphocypraea (Brantleyocypraea) aspenae Petuch, 2004

1. 61.4 mm, Brantley Pit, Arcadia

2. 61.9 mm, Bergeron Star Pit, south of South Bay

3. 56.0 mm, Florida Barge Canal, Hendry/Glades County border



1



2



3



***Siphocypraea (Brantleyocypraea) briskinae* (Petuch, Berschauer and Myers, 2018)**

2018. *Pahayokea briskinae* Petuch, Berschauer and Myers

2022. *Siphocypraea (Brantleyocypraea) briskinae* Daughenbaugh and Bridges

HOLOTYPE: Los Angeles County Museum of Natural History, LACMIP 14663

TYPE Locality: Brantley Pit, Arcadia, DeSoto County, FL.

Ayers Landing Member, Caloosahatchee Formation

Size range: 33.0-51.2 mm

Shape: Cylindrical, truncated

Base: Rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, shallow, smooth, indistinct

Apical sulcus: Narrow, shallow, thick coil $\frac{1}{4}$ turn, slightly projecting

Aperture: Open, widening slightly anteriorly

Columellar teeth: Thin, extending over the columella

Number: 15-19

Labral lip; teeth: Rounded; short, pointed

Number: 20-23

Key Characteristics: Cylindrical, truncated shell; apical sulcus narrow, shallow, thick coil $\frac{1}{4}$ turn, slightly projecting; aperture open, widening slightly anteriorly; base rounded; margins rounded; auricles poorly produced, blunt; columella ribbed; fossula indistinct.

Comparisons: *S. (B.) briskinae* is similar to *S. (B.) aspenae*. However, *S. (B.) aspenae* is a larger, cylindrical, cylindrical-elongate shell.

Range: Commonly collected in the Brantley Pit, Arcadia, DeSoto County.

N. B.: Variation between specimens centers on the number of columellar teeth. A lower number of teeth exist in some specimens while a larger, finer number exist in others. As there are no other significant characteristic differences, these are treated as minor variations herein.

Plate 116 →

Siphocypraea (Brantleyocypraea) briskinae (Petuch, Berschauer and Myers, 2018)

1. 48.4 mm, Brantley Pit, Arcadia, variation with more numerous teeth

2. 51.2 mm, Brantley Pit, Arcadia

3. 49.1 mm, Brantley Pit, Arcadia



1



2



3

Siphocypraea (Okeechobea) Petuch, 2004

2004. *Siphocypraea (Okeechobea)* Petuch

2011. *Okeechobea* Petuch and Drolshagen

2022. *Siphocypraea (Okeechobea)* Daughenbaugh and Bridges

2004

Okeechobea was described as a subgenus of *Siphocypraea* Heilprin, 1886 and was based upon species living in the Caloosahatchee Formation of southern Florida in the Gelasian Pleistocene.

“This newly discovered lineage of *Siphocypraea* was well on its way to becoming a full genus, but was killed-off by the late Calabrian [Gelasian] and Nebraska cold times. *Okeechobea* appears to have been a neotenic offshoot of *Siphocypraea*, just as *Calusacypraea* was a neotenic offshoot of *Akleistostoma* (Petuch, 1996). By the end of Caloosahatchee time, this group had evolved a number of bizarre forms, with uncoiled and flaring apical sulci and exaggerated posterior labial extensions. The members of the subgenus differ from members of the nominate subgenus by having an extension on the posterior of the lip, causing it to project beyond the spire line, in having more open and flaring apical sulci, and in having reduced labial and columellar dentition. *Okeechobea* existed only in the Calabrian [Gelasian], being restricted to the Ft. Denaud, Bee Branch, and Ayers Landing Members of the Caloosahatchee Formation of southern Florida.” (Petuch, 2004).

Described as “Neotenic *Siphocypraea* cowries that are convergent on *Calusacypraea*, having highly inflated, fragile, bulliform shells with juvenile appearances; apical sulci open and flaring, extruded, producing deeply depressed apical pit; tip of spire showing within apical pit; posterior extension of outer lip extremely well developed, extending beyond line of spire; aperture uniformly narrow; labial teeth small and undeveloped; columellar teeth long and thin; auricles poorly developed, almost obsolete”. (Petuch, 2004).

Siphocypraea (Okeechobea) brantleyi (Petuch, 2004) from the Caloosahatchee Formation was designated the **Type** of the *Okeechobea* genus. In addition to the Bee Branch Member *S. (O.) brantleyi*, Petuch included the Fort Denaud Member *S. (O.) philemoni* and two undescribed species: an additional species from the Fort Denaud Member (later described as *Okeechobea shawnae* Petuch and Drolshagen, 2011) and a species from Ayers Landing Member (later described as *Okeechobea loxahatcheensis*, Petuch and Drolshagen, 2011).

Reassignment

The description of the Type and other species was apparently based upon immature specimens which exhibited neotenic characteristics. Fully mature specimens of *S. (O.) brantleyi* as well as fully mature specimens of the other three Caloosahatchee Formation *Siphocypraea (Okeechobea)* species, *S. (O.) philemoni*, *S. (O.) shawnae* and *S. (O.) loxahatcheensis*, have not retained neotenic characteristics. Rather, they more closely align with typical *Siphocypraea*.

- The species exhibit a coiled apical sulcus, uniformly narrow aperture, a ribbed columella and a distinct fossula.

As a result, the *Okeechobea* genus is reassigned herein as *Siphocypraea (Okeechobea)* Petuch, 2004 as originally proposed. *Siphocypraea (Okeechobea) brantleyi* (Petuch, 2004) is retained as the **Type** of the subgenus with three other species also reassigned as below.

NOTE: The weight of the shell and the length of the columellar teeth varies with the maturity of the individual specimen. With fully mature specimens, the teeth extend over the columella and the columella is ribbed. With less than mature specimens, the teeth may only extend partially onto the columella and the shell is lighter in weight.

2011

In 2011, *Siphocypraea* (*Okeechobea*) Petuch, 2004 was elevated to full genus status as *Okeechobea* Petuch, 2004 and *Okeechobea* (*Yeehawcypraea*) was introduced as a subgenus. At the same time, three new species restricted to the Kissimmee River Valley (type locality: Rucks Pit) were described and attributed to the *Okeechobea* genus. These were in addition to the three new *Yeehawcypraea* subgenus species. All six species were attributed to the Piacenzian Pliocene Tamiami Formation (Kissimmee equivalent units 7, 4 and 2).

Reassignment

However, the characteristics cited between the Kissimmee species are slight and they are more similar than not. There are no defining differences. As such, all six species are aligned herein within *Yeehawcypraea* which is elevated to full genus status. (see *Yeehawcypraea* section, p. 280).

Comparisons

Siphocypraea (*Siphocypraea*): Cylindrical/subcylindrical shells; apical sulcus deep, coiled at least $\frac{1}{2}$ turn, uniformly narrow aperture; base rounded, slightly flattened; margins rounded, subangular, angular.

- Columella ribbed; fossula steep, scalene, smooth.

Siphocypraea (*Lokossea*): Oval, inflated shells; apical sulcus deep, tightly coiled $\frac{1}{2}$ turn; aperture uniformly narrow; base rounded; margins rounded, subangular.

- Columella ribbed; fossula steep, scalene, shallow, smooth.

Siphocypraea (*Floridacypraea*): Larger species cylindrical, subcylindrical; smaller species pyriform, or ovoid shells; apical sulcus deep, open, coiled less than $\frac{1}{2}$ turn; aperture uniformly narrow; margin callous, rounded, subangular.

- Columella ribbed; fossula steep, shallow, smooth, indistinct.

Siphocypraea (*Brantleycypraea*): Ovoid/cylindrical shells; apical sulcus narrow, coiled $\frac{1}{4}$ turn; aperture narrow, but open; base rounded; margins rounded; auricles blunt.

- Columella ribbed; fossula steep, shallow, smooth, indistinct/distinct.

Siphocypraea (*Okeechobea*): Cylindrical/oval, inflated, elongate, rounded shells; apical sulcus deep, narrow, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn; aperture uniformly narrow; base rounded; margins rounded; auricles blunt.

- Columella ribbed; fossula steep, scalene, smooth.

Siphocypraea (Okeechobea) Caloosahatchee Formation species:

Siphocypraea (Okeechobea) philemoni (Fehse, 1997)

Siphocypraea (Okeechobea) shawnae Petuch and Drolshagen, 2011

Siphocypraea (Okeechobea) brantleyi (Petuch, 2004) **TYPE**

Siphocypraea (Okeechobea) loxahatcheensis Petuch and Drolshagen, 2011

Siphocypraea (Okeechobea) inhabited southern Peninsular Florida where they preferred sea grass bed environments.

Siphocypraea (Okeechobea) Petuch, 2004

***Siphocypraea (Okeechobea) philemoni* (Fehse, 1997)**

1997. *Siphocypraea (Siphocypraea) philemoni* Fehse

2004. *Siphocypraea (Okeechobea) philemoni* Petuch

2011. *Okeechobea philemoni* Petuch and Drolshagen

2022. *Siphocypraea (Okeechobea) philemoni* Daughenbaugh and Bridges

HOLOTYPE: Haus der Natur, Cismar, Germany, HNC 44657

Paratype: HNC 44658

TYPE Locality: Clewiston, Hendry County, Florida, U.S.A.

Fort Denaud Member

Original description: See Appendix B(VI).

Size range: 41.4-62.6 mm

Shape: Cylindrical, elongate, inflated

Base: Slightly rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, scalene, smooth

Apical sulcus: Open, deep, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn, slightly projecting

Aperture: Uniformly narrow in most specimens

Columellar teeth: Thin, extending over the columella

Number: 17-24

Labral lip; teeth: Rounded; short, pointed

Number: 21-23

Key Characteristics: [Adapted from Fehse and Petuch, Berschauer & Myers, 2018] Cylindrical, elongate, inflated shell; apical sulcus open, deep, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn, slightly projecting; aperture uniformly narrow in most specimens; base slightly rounded; margins rounded; auricles poorly produced, blunt; columella ribbed; fossula distinct.

Comparisons: *S. (O.) philemoni* is similar to *S. (O.) shawnae* and *S. (O.) loxahatcheensis*. However, *S. (O.) shawnae* is a larger, more inflated shell with a more open, projecting apical sulcus which is coiled $\frac{1}{2}$ turn. *S. (O.) loxahatcheensis* is a pyriform, elongate, inflated shell with an apical sulcus which is narrow, only coiled $\frac{1}{4}$ - $\frac{1}{4}+$ turn, projecting but folding back onto the itself.

Range: Southern Peninsular Florida.

NOTE: The weight of the shell and the length of the columellar teeth varies with the maturity of the individual specimen. With fully mature specimens, the teeth extend over the columella and the columella is ribbed. On less than mature specimens, the teeth may only extend partially onto the columella, the shell is lighter in weight and the fossula weakly formed.

Plate 117 →

Siphocypraea (Okeechobea) philemoni (Fehse, 1997)

1. 41.4 mm, Okeelanta Road Dig, west of Miami Canal, Lake Harbor

2. 49.7 mm, Florida Barge canal, Hendry/Glades County border

3. 60.5 mm, Miami Canal Dig, Lake Harbor



1



2



3

***Siphocypraea (Okeechobea) shawnae* (Petuch and Drolshagen, 2011)**

2011. *Okeechobea shawnae* Petuch and Drolshagen

2022. *Siphocypraea (Okeechobea) shawnae* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13250

TYPE Locality: Bad-to-the Bone Pit, Okeechobee, Okeechobee County, FL.

Fort Denaud Member

Size range: 53.2-74.0 mm

Shape: Cylindrical, elongate, inflated

Base: Slightly rounded, rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, scalene, smooth

Apical sulcus: Open, deep, coiled ~ ½ turn, projecting

Aperture: Narrow

Columellar teeth: Thin, extending onto the columella

Number: 20-24

Labral lip; teeth: Thin; short, pointed

Number: 23-24

Key Characteristics: Cylindrical, elongate, inflated shell; apical sulcus open, deep, coiled ~ ½ turn, projecting; aperture narrow; base slightly rounded, rounded, margins rounded; columella ribbed; fossula distinct.

Comparisons: *S. (O.) shawnae* is similar to *S. (O.) philemoni* and *S. (O.) brantleyi*. However, *S. (O.) philemoni* is a less inflated shell with a narrow, slightly projecting apical sulcus which is coiled < ½ turn. *S. (O.) brantleyi* is an oval, broad, inflated shell with a truncated appearance; apical sulcus narrow, coiled ¼-½ turn, slightly projecting.

Range: Southern Peninsular Florida.

Plate 118 →

Siphocypraea (Okeechobea) shawnae (Petuch and Drolshagen, 2011)

1. 59.6 mm, Brantley Pit, Arcadia

2. 74.0 mm, Bad-to-the-Bone Pit, Okeechobee



1



2



***Siphocypraea (Okeechobea) brantleyi* Petuch, 2004 TYPE**

2004. *Siphocypraea (Okeechobea) brantleyi* Petuch

2011. *Okeechobea brantleyi* Petuch and Drolshagen

2022. *Siphocypraea (Okeechobea) brantleyi* Daughenbaugh and Bridges

HOLOTYPE: American Museum of Natural History, N.Y., AMNH FI-50659

TYPE Locality: Brantley Pit, Arcadia, DeSoto County, FL.

Bee Branch Member

Size range: 45.2-59.3 mm

Shape: Oval, broad, inflated, truncated

Base: Rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, scalene, smooth

Apical sulcus: Deep, narrow, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn, slightly projecting

Aperture: Narrow

Columellar teeth: Thin, extending over the columella

Number: 14-20

Labral lip; teeth: Rounded; short, pointed

Number: 17-24

Key Characteristics: Mature specimens. Oval, broad, inflated shell with a truncated appearance; apical sulcus open, deep, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn, slightly projecting; aperture narrow; base rounded; margins rounded; columella ribbed; fossula distinct.

Comparisons: *S. (O.) brantleyi* is similar to *S. (O.) shawnae* and *S. (O.) loxahatcheensis*. However, *S. (O.) shawnae* is a large, cylindrical, elongate and inflated shell with a more open, projecting apical sulcus which is coiled $\frac{1}{2}$ turn. *S. (O.) loxahatcheensis* is a pyriform, elongate, inflated shell with an apical sulcus which is narrow, only coiled $\frac{1}{4}$ - $\frac{1}{4}+$ turn, projecting but folding back onto the itself.

Range: Southern Peninsular Florida.

Plate 119 →

Siphocypraea (Okeechobea) brantleyi Petuch, 2004

1. 53.8 mm, Brantley Pit, Arcadia

2. 55.3 mm, Brantley Pit, Arcadia



1



2



***Siphocypraea (Okeechobea) loxahatcheensis* (Petuch and Drolshagen, 2011)**

2011. *Okeechobea loxahatcheensis* Petuch and Drolshagen

2022. *Siphocypraea (Okeechobea) loxahatcheensis* Daughenbaugh and Bridges

HOLOTYPE: Paleontological Research Institute, PRI 13251

TYPE Locality: Palm Beach Aggregates Pit # 7, Loxahatchee, Palm Beach County, FL.

Ayers Landing Member

Size range: 48.1-60.8 mm

Shape: Pyriform, elongate, inflated

Base: Rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Steep, scalene, smooth

Apical sulcus: Open, deep, coiled $\frac{1}{4}$ - $\frac{1}{4}+$ turn, projecting, folding back onto the apical sulcus

Aperture: Narrow

Columellar teeth: Thin, extending over the columella

Number: 17-20

Labral lip; teeth: Thin; short, pointed

Number: 22-25

Key Characteristics: Pyriform, elongate, inflated shell; apical sulcus open, deep, coiled $\frac{1}{4}$ - $\frac{1}{4}+$ turn, projecting, but folding back onto the apical sulcus; aperture narrow; base rounded; margins rounded; auricles poorly produced, blunt; columella ribbed; fossula distinct.

Comparisons: *S. (O.) loxahatcheensis* is similar to *S. (O.) brantleyi*. However, *S. (O.) brantleyi* is an oval, broad, inflated shell with a truncated appearance; apical sulcus narrow, coiled $\frac{1}{4}$ - $\frac{1}{2}$ turn, slightly projecting. The distinctive apical sulcus and reduced columellar teeth separate *S. (O.) loxahatcheensis* from the other species in the subgenus.

Range: Southern Peninsular Florida.

Plate 120 →

Siphocypraea (Okeechobea) loxahatcheensis (Petuch and Drolshagen, 2011)

1. 55.6 mm, Bergeron Star Pit, south of South Bay
2. 57.3 mm, Palm Beach Aggregates, Loxahatchee
3. 56.9 mm, Palm Beach Aggregates, Loxahatchee



1



2



3



Part Four

Calabrian Pleistocene

Chapter 17

Peninsular Florida

Southern Florida was mostly emergent at the beginning of the Calabrian Pleistocene, ~ 1.8 Ma, and would remain so for ~ 300k years during which North America remained under a severe glacial age. Subsequently, an interglacial period produced a major transgression of sea levels. This flooded southern Florida and produced the Loxahatchee Subsea, in the southern sector of the old Caloosahatchee Subsea (see fig. 9). The pseudoatoll was compressing, with the Kissimmee Embayment covered with mangrove forests, the Immokalee Reef Tract becoming the Immokalee Island, extending inward to encompass most of the Hendry Platform, the Miami and Palm Beach Reef Tracts becoming chains of large, wide islands. On the inward, western side of these island chains, the Capeletti Reefs formed near present day Miami. At the northern end of the Palm Beach Islands, the Tomeu Islands, a large chain of sand, mud and mangrove forests, began to form, greatly restricting the Loxahatchee Strait.

This resulted in a complex environment as biogenetic depositions produced varied and diverse biogeographic patterns. While hosting a much-reduced relictual Caloosahatchee fauna, marine conditions warmed throughout this initial interglacial transgression. This resulted in environments which would host a number of migrants from the Caribbean. These would settle among the Capeletti Reefs. (Petuch, 2004, 2007).

With the closing of the Isthmus of Panama, ~ 2.3 Ma, oceanic currents no longer were able to flow east to west between North and South America. The Gulf Stream Current, flowing from the Caribbean northward along Florida and beyond was the result. This provided a migration route for molluscan larvae into southernmost Florida. The ability to migrate depends upon a number of factors including: duration life of the larvae, current strength at the time of spawning, conditions at the end point and the ability of the larvae to adapt to their new surroundings. This probably accounts for the small number of Cypraeidae species able to successfully make the transition.

However, even with the small number of individual species, the numbers of each species were evidently sufficient to establish breeding populations which allowed its components to speciate.

The Calabrian Pleistocene only contained one formation: the Bermont Formation. Within the formation there were three members: The Holey Land, the Okeelanta and the Belle Glade Members. Endemic fossil Cypraeidae can only be placed in the Holey Land Member with any certainty. However, at least one specimen of *Macrocypraea spengleri* Petuch, 1990, collected from a spoil pile at a commercial construction site, suggests a later date. This needs further confirmation and is considered herein as provisional [P].

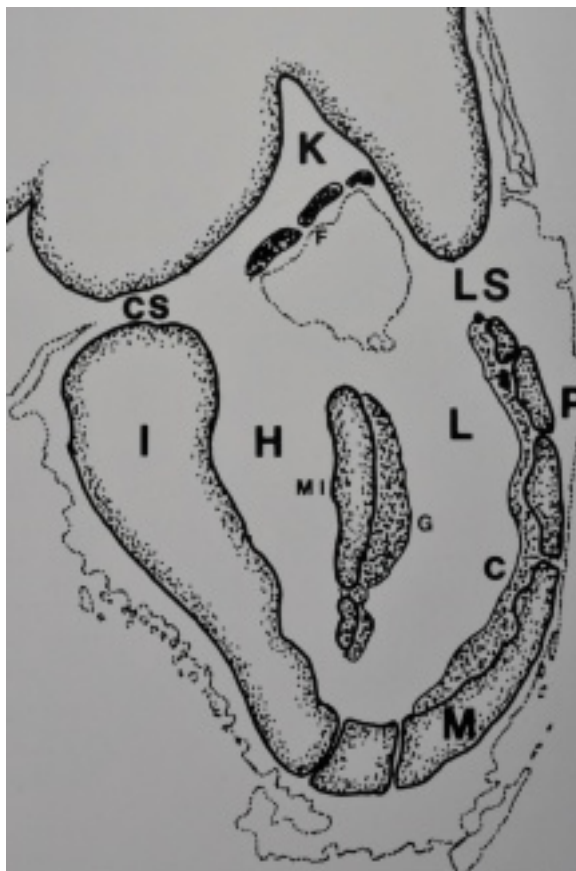


Figure 9: Map reflecting the Belle Glade Subsea and the middle Pleistocene Everglades Pseudoatoll.

K = Kissimmee Embayment; **CS** = Caloosahatchee Strait; **LS** = Loxahatchee Strait; **I** = Immokalee Island; **H** = Hendry Platform; **MI** = Miccosukee Island; **G** = Griffin Reef System; **L** = Loxahatchee Trough; **P** = Palm Beach Archipelago; **C** = Capeletti Reef System; **M** = Miami Island.

Stippled areas = coral reef growth; Outer dotted line = Outline of Recent southern Florida.

The Belle Glade Subsea was the location of the Bermont Formation and its Holey Land Member.

From Petuch, 1997a, Figure 8, p. 16.

Chapter 18

Bermont Formation

In 1974, DuBar informally proposed the Bermont Formation for the uppermost fossiliferous marine sands along Shell Creek near Bermont, Charlotte County. The formation lay unconformably over the Caloosahatchee Formation. The facie in the type area is typically a gray, unconsolidated sand shell marl. Fossils are abundant and well preserved, and assemblages are quantitatively and qualitatively homogeneous throughout the area. The type deposits rested largely on a shallow shelf in open water conditions with depths not exceeding 50 feet with little water turbulence and a low rate of sedimentation. Water temperatures were probably lower than those of the Caloosahatchee Subsea, but higher than present day Gulf of Mexico waters. (DuBar, 1974).

While the geographic areal extent is approximately the same as the Caloosahatchee Formation, fossil Cypraeidae have only been found in Palm Beach, Broward and Dade Counties. In the 1980s and 1990s, excavations in quarry pits and in canal diggings in southeast Florida's Dade, Broward and Palm Beach Counties revealed a much thicker, richer and more complex set of beds than DuBar's original work which was more focused to the north and northwest. Thickness varies from 12 meters at Palm Beach Aggregates to 15 meters at the Capeletti Brothers Pits in Miami, Dade County. The beds lie from 1.5 to 6 m below the surface with the surface of the formation undulating in a northeast to southwest direction in regular intervals, suggesting elongated sand bars and tidal channels. (Petuch, 2007).

Chapter 19

Holey Land Member

Species

Macrocypraea joanneae Petuch, 2004

Macrocypraea spengleri Petuch, 1990

Pseudozonaria portelli (Petuch, 1990)

Luria voleki Petuch, 2004

Holey Land Member

Informally named as the Holey Land Limestone (Petuch, 1990), the lithology was raised to the member status in 2007 by Petuch and the lithologic description, to include the lateral equivalents, revised. The stratotype of the member was designated to be the western side of the Griffin Brothers Pit #2, directly adjacent to the Holey Land Wildlife Management Area, on the power line access road, seven km west of Deem City, at the intersection of Highway 27, Palm Beach-Broward County line, Palm Beach County.

Relevant to the Cypraeidae habitats: “The unconsolidated sandy lime muds ... vary in color from yellow tan to light blue-gray (at the Capeletti Brothers Pit), to bluish (at the Leisey pit), to dark brownish-gray (at Palm Beach Aggregates). The dense aggregations of molluscan fossils contained in these unconsolidated units vary from a distinctive blue-gray color (at Capeletti Brothers Pit # 11) to bluish-white and pale tan (at Palm Beach Aggregates). ... Some facies, such as those found in the Capeletti and Palm Beach Aggregates quarries, contain rich assemblages of corals, often with over 20 species being present. At the Griffin Brothers Pit, the bedding surface of the massive limestone was frequently covered with a pavement of *Manicina* rose corals and *Clypeaster* sea biscuits.” (Petuch, 2007).

At the Capeletti Brothers Pit in Dade County: “Fossil shells from this dragline excavation ... resemble freshly-dead specimens, still having the original shine and gloss and with dark, lifelike color patterns. Many normally rare and desirable Bermont cowries were frequently collected here, including *Luria voleki* and *Pseudozonaria portelli*. The draglines also cut through huge thickets of *Porites* Finger Corals, and many spoil piles were composed of huge tangled masses of coral branches.” (Petuch, 2018).

This supports the presence of tropical Caribbean molluscan fauna in southeast Florida during the Calabrian Pleistocene.

Plate 121 →

1. *Macrocypraea spengleri* 107.9 mm

2. *Pseudozonaria portelli* 25.2 mm

3. *Luria voleki* 36.4 mm

4. *M. joanneae* 63.8 mm



1



2



3



4

Bermont Formation Taxa & Iconography

Chapter 20

Genera

“For the geologically-short period of the Gelasian-Calabrian boundary, cowries were absent from Florida and most of the tropical ecosystems of the Okeechobean Sea had collapsed or had been destroyed. With the initiation of climatic warming at the beginning of the Calabrian Age of the Early Pleistocene, the Florida Peninsula again reflooded as the result of sea level rises and the water temperatures returned to marginally tropical conditions. At this time, Florida was invaded by three groups of cowries that had originated in the Caribbean Sea region: the genus *Macrocypraea*, ... the genus *Pseudozonaria*, ... and the genus *Luria*. These Early Pleistocene Caribbean migrants gave rise to an endemic, but impoverished, cowrie fauna that existed on scattered reef complexes around the Everglades area for over a million years.

Two of these three migrant genera, *Macrocypraea* and *Luria*, survived the series of glacially-induced sea level drops and oceanic cooling that occurred during the Middle and Late Pleistocene and their descendant species are common components of Recent Florida marine ecosystems. The third Caribbean migrant, *Pseudozonaria*, was only present in Florida during the Early Calabrian Age and disappeared from the fossil record abruptly at the beginning of the Late Calabrian Age. This southern Floridan *Pseudozonaria* ... was the last living member of its genus in the western Atlantic.” (Petuch, Berschauer & Myers).

Reassignment

In 2011, Petuch and Drolshagen introduced *Lorenzicypraea* as a subgenus of *Macrocypraea* Schilder, 1930. Two fossil species were included in the new subgenus: *M. spengleri* and *M. janae*. The Recent *M. cervus* and subspecies were also included. However, *M. joanneae* was retained in the *Macrocypraea* genus. In 2017, Lorenz addressed the issue thusly:

“The subgenus *Lorenzicypraea* ... was proposed to distinguish between the inflated fossil and *cervus* like species, and the more depressed *zebra*. However, the common occurrence of hybrids between *cervus* and *zebra* abrogates this subdivision.” (Lorenz, 2017 (1)).

Such hybrids were described as *Macrocypraea cervus cervus* f. *cerebra* Lorenz, Chiapponi and Mont, 2012.

As such, *Macrocypraea (Lorenzicypraea) spengleri* (Petuch and Drolshagen, 2011) is reassigned as *Macrocypraea spengleri* (Petuch, 1990) along with *Macrocypraea joanneae* (Petuch, 2004).

Regarding *Macrocypraea (Lorenzicypraea) janae*, the description was based on a single specimen from a dubious locale, the Sarasota area. Therefore, we are considering the name *nomen dubium*, pending further specimens and better collection data.

Macrocypraea Schilder, 1927

***Macrocypraea joanneae* Petuch, 2004**

HOLOTYPE: American Museum of Natural History, N.Y., AMNH FI-50665

TYPE Locality: The Mecca orange grove fill pit, westernmost Palm Beach Lakes Boulevard, rural north Palm Beach, Palm Beach County, FL.

Holey Land Member and equivalents

Size range: 55.0--63.8 mm

Shape: Subcylindrical, elongate

Base: Rounded

Margins: Rounded

Auricles: Proportionally small, pointed, flattened

Columella: Ribbed

Fossula: Concave, deep, ribbed, slightly projecting

Apical sulcus: Simple, short, puckered, projecting

Aperture: Narrow, widening slightly anteriorly

Columellar teeth: Thin, extending over the columella; anterior most teeth more rounded and knoblike

Number: 27-28

Labral teeth: Thin, pointed

Number: 32-34

Key Characteristics: Subcylindrical, elongate shell; apical sulcus simple, short, puckered, projecting; aperture narrow, widening slightly anteriorly; base rounded; margins rounded; auricles proportionally small, pointed, flattened; columellar teeth thin, extending over the columella, anterior most teeth more rounded and knoblike; columella ribbed; fossula distinct.

Comparisons: In the fossil record, *M. joanneae* is only similar to *M. spengleri*. However, *M. spengleri* is a larger ovoid, inflated, bulliform shell. It would be difficult to confuse the two species.

Range: Southeast Peninsular Florida.

Note: *M. joanneae* “is most similar to, and is the direct Pleistocene ancestor of, the Recent *Macrocypraea zebra* (Linnaeus, 1758).” (Petuch, 2004).

Plate 122 →

Macrocypraea joanneae Petuch, 2004

63.8 mm, Moore Farm Pit, North Palm Beach County



***Macrocypraea spengleri* (Petuch, 1990)**

1990. *Cypraea spengleri* Petuch

1997. *Cypraea (Macrocypraea) spengleri* Petuch

2004. *Macrocypraea spengleri* Petuch

2011. *Macrocypraea (Lorenzicypraea) spengleri* Petuch and Drolshagen

2022. *Macrocypraea spengleri* Daughenbaugh and Bridges

HOLOTYPE: Carnegie Museum of Natural History, CM 35728

TYPE Locality: Capeletti Brothers Pit # 11, 7 km west of Florida Turnpike, due west of Hialeah, northeastern Dade County, FL.

Holey Land Member

Also, **Belle Glade Member [P]**

Size range: 83.9-107.9 mm

Shape: Ovoid, elongate, inflated, bulliform

Base: Rounded

Margins: Rounded

Auricles: Poorly produced, blunt

Columella: Ribbed

Fossula: Concave, deep, ribbed, slightly projecting

Apical sulcus: Simple, short, blunt; spire exposed, thinly enameled

Aperture: Proportionally narrow, widening anteriorly

Columellar teeth: Thin, extending over the columella

Number: 38-42

Labral teeth: Large, pointed

Number: 45-47

Key Characteristics: Ovoid, elongate, inflated, bulliform shell; apical sulcus simple, short, blunt, spire exposed, thinly enameled; aperture proportionally narrow, widening anteriorly; base and margins rounded; auricles poorly produced, blunt; columellar teeth thin, extending over the columella; columella ribbed; fossula distinct.

Comparisons: In the fossil record, *M. spengleri* is only similar to *M. joanneae*. However, *M. joanneae* is a smaller, subcylindrical, much less inflated shell. It would be difficult to confuse the two species.

Range: Southeast Peninsular Florida.

Variation: Possible subspecies. “A possible subspecies of Spengler’s Cowrie has been collected in the younger Belle Glade Member of the Bermont Formation. This rare shell appears to be intermediate between the older Holey Land *M. spengleri* and the living *M. cervus*, having short and poorly-developed labial dentition like the Holey Land shell but longer and better-developed columellar dentition like the living species.” (Petuch et al., 2018).

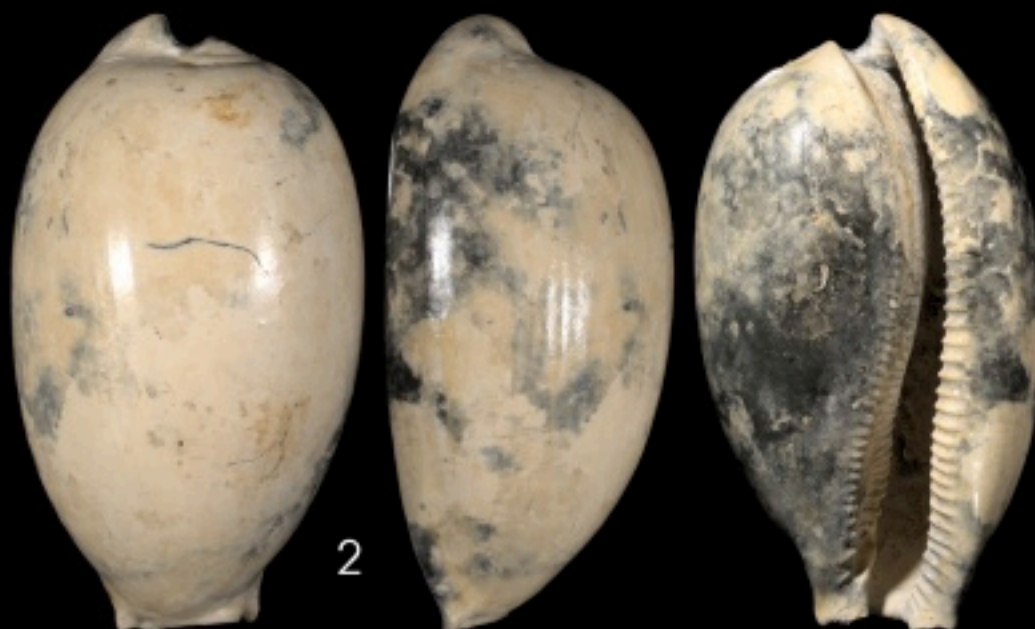
Plate 123 →

Macrocypraea spengleri (Petuch, 1990)

1. 83.9 mm, Capeletti Pit # 11, Miami

2. 107.9 mm, Palm Beach Aggregates Pit # 9, Loxahatchee

3. 107.1 mm, var. or ssp. Housing development Pit, north side of SR80, between Belle Glade and South Bay



Pseudozonaria Schilder, 1929

***Pseudozonaria portelli* (Petuch, 1990)**

1990. *Cypraea portelli* Petuch

1997. *Cypraea (Pseudozonaria) portelli* Petuch

2004. *Pseudozonaria portelli* Petuch

HOLOTYPE: Graves Museum of Archeology & Natural History, UF 28985

TYPE Locality: Griffin Brother's Pit, Holey Land Wildlife Conservation Area, extreme southwestern Palm Beach County, FL.

Holey Land Member, known only from quarries in Miami, Dade County and Palm Beach County, FL.

Size range: 22.0-25.2 mm

Shape: Oval, elongate, domed

Base: Flattened

Margins: Callous, subangular

Auricles: Poorly produced, blunt, rounded

Columella: Ribbed

Fossula: Steep, concave, ribbed, well produced, distinct

Apical sulcus: Poorly produced, short, rounded

Aperture: Narrow

Columellar teeth: Thin, extending over the columella

Number: 15

Labral teeth: Large, pointed

Number: 18

Key Characteristics: Oval, elongate shell with a domed dorsum; apical sulcus poorly produced, short, rounded; aperture narrow; base flattened; margins callous, subangular; auricles poorly produced, blunt, rounded; columellar teeth thin, extending over the columella; columella ribbed; fossula distinct.

Comparisons: None.

Range: Southeast Peninsular Florida.

NOTE: The *Pseudozonaria* genus was separated into separate eastern Atlantic and western Pacific populations about three million years ago by the closure of the Isthmus of Panama. *Pseudozonaria portelli* from Florida was the last of the eastern Atlantic species. In the western Pacific, the genus hosts five species of which, *Pseudozonaria robertsi* (Hidalgo, 1906) is the closet living relative.

Plate 124 →

Pseudozonaria portelli (Petuch, 1990)

1. 22.9 mm, Palm Beach Aggregates Pit # 11, Loxahatchee

2. 25.2 mm, Rinker Quarry, Miami



1



2



Luria Jousseume, 1884

***Luria voleki* Petuch, 2004**

HOLOTYPE: American Museum of Natural History, N.Y., AMNH FI-50664

TYPE Locality: Palm Beach Aggregates Pit, Loxahatchee, Palm Beach County, FL.

Holey Land Member and equivalents

Size range: 35.0-36.4 mm

Shape: Subcylindrical, elongate, inflated

Base: Flattened

Margins: Rounded

Auricles: Poorly produced, blunt, rounded

Columella: Ribbed

Fossula: Steep, concave, ribbed, well produced, distinct

Apical sulcus: Poorly produced, blunt, rounded

Aperture: Uniformly narrow

Columellar teeth: Thin, extending over the columella

Number: 20-22

Labral teeth: Thin, short, rounded

Number: 32-34

Key Characteristics: Subcylindrical, elongate, inflated shell; apical sulcus poorly produced, blunt, rounded; aperture uniformly narrow; base flattened; margins rounded; auricles poorly produced, blunt rounded; columellar teeth thin, extending over the columella; columella ribbed; fossula distinct.

Comparisons: None in the fossil record. *L. voleki* is similar to the Recent *Luria cinerea* (Gmelin, 1791).

Range: Southeast Peninsular Florida.

NOTE: “In the quarries in Miami and Loxahatchee, *Luria voleki* has been found in association with beds of Porites finger coral, indicating that it was coral reef-dwelling species, much like its living descendent.” (Petuch et al., 2018).

Plate 125 →

Luria voleki Petuch, 2004

36.4 mm, Palm Beach Aggregates Pit # 9, Loxahatchee



Appendix A

Principle Collection Sites – Southern Peninsular Florida

Western and Southwestern Everglades Region

Caloosa Minerals Pit (Lavender Road Pit herein) --- Lavender Road, off Highway 41, Rustin, Hillsborough County, near the Rock Pond Restoration Project. Spoil piles at the pit produced many very well-preserved fossil Cypraeidae. Many of the specimens were giants compared with more southerly collection sites. *Akleistostoma* genera species were the most common, but fine examples of *Calusacypraea* and *Pseudadusta* genera species were also collected, albeit in lesser numbers. The pit has two adjacent sections. One is ~ 300' in length, 50' wide and 20' deep. The second is ~ 750' in length, 50' wide and 30'+ in depth on average. The matrix indicates the presence of varied habitats: mud flats, sand and sea grass flats, and coral bioherms. In addition to species also known from the Sarasota pits, a number of species previously known only from the Lee & Collier County pits have been collected here.

Within the pit, the taxonomic characteristics of some specimens align with known species from other more southerly quarries. They have been accepted by the authors as such. Other specimens, often well preserved, have characteristics which suggest known species, but imperfectly. As they are from spoil piles of mixed strata, it cannot be determined whether they represent variations of known species or undescribed species. They have been excluded from this work.

“**APAC Pit** --- An acronym for the Ashland petroleum and Asphalt Corporation quarry, the APAC Pit was, and still is, considered the premier collecting locality in Florida. Previously known as the Richardson Pit, Warren Brothers Pit, and the Macasphalt Pit, this productive quarry was located north of Fruitville Road, in the Fruitville area of Sarasota, Sarasota County, just west of I-75. One of the longest-lived of all Florida quarries, the APAC Pit remained open from the early 1970's until 1993, when it was flooded as a large lake in a Sarasota municipal park. Continuously pumped, this immense shell pit (Over 1.5 km in length at its maximum development) was over 20 meters deep in the central drainage ditches and exposed three geologic formations Over 1000 species of shells were present within the three formations, and some of the rarest and most exotic species were regularly collected in the pit, often *in situ*. Over 25 species of cowries were collected here, including seldom-seen forms such as *Pahayokea (Gardnericypraea) mansfieldi*, *Calusacypraea globulina*, and *Calusacypraea (Myakkacypraea) myakka*. Other rarities that were regularly collected at the APAC Pit included the wide-ribbed ecphora *Latecphora druidi*. Many inspired amateur collectors regularly assisted the senior author while investigating the APAC Pit, ..., and numerous species described in their honor. Most of the road fill for the building of I-75 (interstate highway) along southwestern Florida came from the APAC Pit.” (Petuch et al., 2018).

“**Quality Aggregates Pits #6 and #9** --- Located on the eastern side of I-75, opposite the APAC Pit in the Fruitville area of Sarasota, the Quality Aggregates, Inc., series of pits uncovered the same geological formations that were exposed in the APAC Pit. The two best collecting sites were the #6 and 9 pits, located approximately 2 km from each other The westernmost pit (#6) was adjacent to I-75 and contained the thickest and best-developed beds of the Buckingham Member of the Tamiami Formation ever found in Florida Rare and seldom-seen fossil cowries such as *Calusacypraea duerri*, *Akleistostoma (Mansfieldicypraea) crocodila* and *Pahayokea (Gardnericypraea) erici*, were regularly collected in the Pit #6 Buckingham beds. Over 30 species of cowries were collected in Pits #6 and 9, making them, collectively, the single locality with the richest fossil cowrie fauna found

anywhere in the United States. Several inspired amateur collectors regularly assisted the senior author while studying the Quality Aggregates pits, ... and numerous species were described in their honor.” (Petuch et al., 2018).

In 1997, SMR, Inc. acquired the quarries and they are now known as the SMR Aggregates Pits. Limited collecting has been allowed by appointment only.

Bonita Grande Aggregates Pit --- Located on Bonita Grande Drive, Bonita Springs, Lee County, to the east of I-75 and west of and adjacent to the Crew Wildlife and Environmental Area. Established in 2004, this is a dragline, wet quarry with collecting from the quarry spoil piles. Access is by appointment only. The Briskin’s, particularly Melanie Briskin of Florida Seashells and Fossils, have been particularly active in the pit. She has been joined frequently by Maurice Guy of Naples, Florida. The pit is rich in *Siphocypraea* species with *Siphocypraea (Lokossea) mulepenensis* being particularly abundant. In 2020, a new species, *Siphocypraea (Lokossea) daughenbaughi* was described from specimens collected by Melanie Briskin.

Mule Pen Quarry (Florida Rock Industries Naples Quarry) --- “First discovered by inspired amateur paleontologists Robert and Shirley Hoerle in the early 1970’s, this quarry was once a mule breeding farm, hence the unusual name. Located in far eastern Naples, Collier County, off Immokalee Road, the original Mule Pen Quarry land was later purchased by Florida Rock Industries and expanded into a huge (1 km diameter) lake complex. The mine draglines dug into the Golden Gate Member of the Tamiami Formation ... and exposed the richest fossil coral fauna ever found in the Americas. Over 120 species of corals were collected or observed here, with some huge star coral heads reaching over 2 m in diameter. Many of the corals were species that were first discovered from the Dominican Republic (West Indies) or were members of genera now known only from the tropical Pacific Ocean. Some of these included species of *Pocillopora*, *Goniopora*, and *Galaxia* Equally unusual was the Mule Pen molluscan fauna, which contained such rare reef-dwelling cowries such as *Pseudadusta lindae*, *Pseudadusta (Bithloa) irisae*, and *Siphocypraea (Seminolecypraea) grovesi*. Many of the Mule Pen mollusks have only been found at that quarry, indicating that they were ecologically tightly-bound to the dense coral thickets that grew there during the Pliocene. Similar reef mollusks and corals were also brought up in transient housing construction sites at the **Lakes of the Meadows** development on Bird Road and 147th Street in western Miami in 1985.” (Petuch et al., 2018).

The Brantley Pit --- “Located in the orange grove area south of Arcadia, DeSoto County, the Brantley Pit yielded some of the best exposures of the Caloosahatchee Formation ever found in Florida Although a small quarry, the Brantley Pit was pumped dry, allowing access to three of the four members of the Caloosahatchee Formation; the Fort Denaud, the Bee Branch, and the Ayers Landing. Of these, the Bee Branch member was the best developed and contained many rare and seldom-seen species, including many that proved to be new to science. Some of the more interesting species found at the Brantley Pit included the hook-spined cowrie *Okeechobea brantleyi*, and the coiled-sulcus species *Siphocypraea haleyorum* and *Pahayokea aspenae*. The quarry was open only for a few years when, sadly, the generous owner (D.L. Brantley) died at a young age. The Brantley Pit was closed immediately after his death and is now an R/V park.” (Petuch et al., 2018).

The Cochran Pit --- Located in LaBelle, Hendry County, the Cochran Pit was similar to the Brantley Pit in that it possessed rich Caloosahatchee beds. “Here, the Fort Denaud Member was the best-developed unit and classic Caloosahatchee species such as the cowrie *Siphocypraea problematica* were extremely abundant in the exposed walls of the quarry. Like the Brantley Pit, the Cochran Pit was only open for a few years and was closed in the late 1970’s.” (Petuch et al., 2018).

North Central and Central Everglades Region

“Rucks Pit --- Located in Fort Drum, Okeechobee County, at the northern end of the Kissimmee Valley, the Rucks Pit (named for the owners, Edwin Rucks, Sr. and Edwin Rucks, Jr.) was one of the most exciting collecting localities ever encountered in Florida. Originally two separate quarries that were later connected, the Rucks Pit exposed three geological formations; the Tamiami Formation at the bottom, the Nashua Formation in the middle, and the Fort Thompson Formation at the top The Tamiami exposures, at the bottom of the pumped quarry, were the most exciting paleontologically, containing the most diverse fauna of Kissimmee Valley endemic mollusks ever seen. The single most spectacular find at the Rucks Pit was the discovery of an entire species radiation of cowrie shells, including Kissimmee Tamiami endemics such as *Pahayokea* (*Kissimmecypraea*) *eddiematchetti*, *Okeechobea* (*Yeehawcypraea*) *matchetti*, *Okeechobea* (*Yeehawcypraea*) *lindajoyceae*, *Pahayokea rucksorum*. After Hurricane Frances in 2004, the senior author and his friend and field assistant, Eddie Matchett (a local High School history teacher), visited the Rucks Pit and collected 27 species of cowries. Many of these, which were present in the thousands, were standing on small pedestals of mud, like miniature hoodoos.” (Petuch et al., 2018).

“The Rucks Pit Nashua beds, which sit directly upon the Tamiami beds, also contain an interesting fauna, and one that was never seen in Florida. Typically, the molluscan fauna found in the Fort Drum Nashua beds is composed of many species that were normally associated with the cooler-water fauna Waccamaw Formation of the Carolinas, but here these beds also contained two rare and seldom-seen endemic cowrie species, *Siphocypraea* (*Floridacypraea*) *klatti* and *Pahayokea bruggemani*. A large bed of the venerid bivalve *Mercenaria permagna* occurred at the top of the Nashua Formation, encased in a hard, rough gray sandstone. These clams were frequently filled with large golden calcite crystals, forming clam geodes. These are still mined at the Rucks Pit and the quarry is now better known as the Fort Drum Crystal Mine. The main pits, however, are now flooded as lakes.” (Petuch et al., 2018).

Dickerson Aggregates Fort Drum Pit --- Approximately 2 km east of the Rucks Pit is the similar appearing, but smaller Dickerson Aggregates Fort Drum Pit. This interesting quarry contained extremely rich beds of the Kissimmee Valley facies of the Fruitville Member of the Tamiami Formation. Particularly notable were beds of the large scallop *Carolinapecten bertiensis*, and these covered the bottom of the quarry in immense aggregations Large *Busycon* whelks, which were probably predators on the scallops, also occurred in extensive beds and included species such as *Busycotypus concinnum*, *Busycon auroraensis*, and *Sinistrofulgur adversarius*. Beautiful large specimens of the Nashua clam geodes were also present in the Dickerson Pit, but the clam layer was not as thick or as well-developed. Due to hard economic times and a drop in housing development, the Dickerson Pit was closed and flooded in 2008.” (Petuch and Drolshagen, 2011).

The only specimens known to the authors were collected by Petuch from spoil piles in front of the pit just prior to the pit’s closure. Some of the specimens have characteristics which align with known species and these have been accepted as such. However, other specimens have characteristics which, while similar to known species, are not totally aligned with those species. These specimens are considered unknown as their strata is not known and/or there are insufficient numbers to determine their species.

Kissimmee River Banks South of Rucks Pit --- “The distinctive Kissimmee Valley endemic fauna, with its large cowrie shell component, has also been collected along the banks of the Kissimmee River, primarily from spoil piles. In the early 1960’s, the river was channelized by the Army Corps of Engineers and fossils dredged from the river were heaped along its shoreline. The area around Fort

Basinger, Highlands County, was particularly noteworthy, as the large and extensive spoil piles contained a remarkably rich molluscan fauna. Some of the more impressive endemic species encountered were the cowries *Pahayokea kissimmeensis*, *Akleistostoma (Olssonicypraea) hughesi*, *Pahayokea basingerensis*, and *Akleistostoma (Ingramicypraea) highlandensis*. These species were also collected in the Rucks Pit, demonstrating they were widespread across the entire Kissimmee Valley.” (Petuch et al., 2018).

“Bergeron Star Pit and the Griffin Brothers Pit --- Located in the Everglades Agricultural Area (EAA) south of Lake Okeechobee, these two quarries contained some of the richest and most unusual shell faunas ever found in the Everglades region.

The Bergeron Star Ranch Pit (named for Ronald Bergeron and the Bergeron Family) ... is located on US Highway 27, approximately 15 miles south of South Bay, Palm Beach County while [T]he Griffin Brothers Pit (named for Howard A. Griffin and the Griffin Family) ... is located further south, on the Palm Beach-Broward County line, 5 miles west of US 27.

Both quarries contained well-developed beds of the Ayers Landing Member of the Caloosahatchee Formation and the suprajacent Holey Land Member of the Bermont Formation.

Classic Ayers Landing cowries, such as the dwarf taxa *Siphocypraea ridgdilli*, *Siphocypraea (Floridacypraea) griffini*, and *Siphocypraea (Lokossea) registeri*, were regularly collected in these quarries and were found in large aggregations.

The Griffin Brothers Pit was closed in 2000 and is being flooded as part of the Everglades restoration plan. The Bergeron Star Pit is still active ..., one of the few surviving quarries in the Everglades region.” (Petuch et al., 2018).

Miami Canal Widening --- “Approximately 10 miles to the west of the Bergeron Pit lies the Miami Canal, the main water conduit from Lake Okeechobee to Miami, which was widened in 1980-1982 along a 20-mile stretch extending from Lake Harbor to the Holey Land Wildlife Management Area, Palm Beach County. During this time, huge spoil piles of Caloosahatchee Formation mollusks were heaped along the eastern bank of the Miami Canal. Some of the most fascinating and best-preserved fossil cowries ever collected in Florida were encountered here, and included brightly-colored and highly-polished specimens of *Siphocypraea (Floridacypraea) desotoensis*, *Siphocypraea (Lokossea) swearingeni*, and *Okeechobea philemoni*. The shells were so well preserved they often retained their original color patterns. Today, these spectacular beds are plowed over and covered with grass as berms of the canal. A similarly rich and well-preserved Caloosahatchee fauna was also encountered in a small, ephemeral road fill pit west of the Miami Canal on **Okeelanta Sugar Corporation** property.” (Petuch et al., 2018).

“North New River Canal Excavation --- Near the Okeelanta Sugar Corporation main processing plant, 5 miles south of South Bay, Palm Beach County, excavations in the North New River Canal yielded a rich and spectacular shell fauna. This canal, which parallels US 27 and which is the main water conduit between Lake Okeechobee and Fort Lauderdale, was dredged and widened twice in a 14-year period (in 1980 and 1994). The spoil piles from these excavations yielded the richest and best-preserved fossils from the mid-Pleistocene Belle Glade member of the Bermont Formation ever seen anywhere in the Everglades region. Exceptional specimens of the classic Belle Glade cowrie, *Macrocypraea (Lorenzicypraea) spengleri*, were occasionally encountered in these canal bank spoil piles. These piles were later plowed over and covered with grass to create berms for the canal.” (Petuch et al., 2018).

Eastern Everglades Region

“Capeletti Brothers Pit #11 --- Located in the mining area (“Lake District”) west of Hialeah and the Florida Turnpike in northern Miami, Dade County, the Capeletti Brothers Pit #11 (named for Ronald Capeletti and the Capeletti family) contained the most beautifully-preserved and richest shell beds of the Holey Land Member (Bermont Formation) ever found anywhere in Florida. Fossil shells from this dragline operation ... resemble freshly-dead specimens, still having the original shine and gloss and with dark, lifelike color patterns. Many normally-rare and desirable Bermont cowries were frequently collected here, including *Luria voleki* and *Pseudozonaria portelli*. The draglines also cut through huge thickets of Porites Finger Corals, and many of the spoil piles were composed of huge tangled masses of coral branches. Excavation in Pit #11 lasted for only four years, from 1982 to 1986. The abandoned quarry lake is now adjacent to a Dade County prison.” (Petuch et al., 2018).

“Palm Beach Aggregates Pits --- Located at the “20-mile Bend” on State Road 80 (Southern Boulevard), Loxahatchee, Palm Beach County, this immense complex of quarries was originally known as the GKK Pit. As in the Capeletti Pit #11, all the quarries in the Palm Beach Aggregates complex cut primarily into the Bermont Formation ..., with the greatest part of the exposure belonging to the stratigraphically lowest Holey Land Member. An amazing array of new and previously unseen species was regularly uncovered in these quarries, particularly in Pits #5, 6, 9 and 11. Many of these new species were collected by the senior author’s friend and field assistant, Clifford Swearingen. Others were collected by seasoned collectors such as Larry and Judy Haley, Herbert and Fonda Waldron, Edward Volek and George Salony (the PBA security guards), Phyllis Diegel, and Richard Duerr. Of special interest here were the cowries *Pseudozonaria portelli*, dwarf specimens of *Macrocypraea (Lorenzicypraea) spengleri* and *Macrocypraea joanneae*. The northwesternmost quarry at Palm Beach Aggregates (Pit #9), was slightly deeper than the other quarries and cut into the very top of the Caloosahatchee Formation (Ayers Landing Member). This previously unstudied unit, which differed lithologically from other Ayers Landing localities, contained many unusual new species that had never been seen before, including the large hook-spined cowrie *Okeechobea loxahatcheensis*. This quarry, like all others at Palm Beach Aggregates, was flooded in 2003 and the remaining two pits are still mined by draglines.” (Petuch et al., 2018).

Appendix B

Selected Original Descriptions

(I) *Akleistostoma (Paludacypraea) floridana* (Mansfield, 1931)

Original description: “Shell rather large, solid, and subelliptical in outline. Dorsal area well rounded; ventral area slightly rounded. Aperture wide, more expanded below than above. Posterior commissure wide and deep. Teeth strongly developed on both lips. The holotype has 24 teeth on the outer lip and 17 on the inner. The number of teeth on the outer lip of paratype specimens ranges from 21 to 24, and on the inner lip, 16 to 18.” (Mansfield, p. 6).

NOTE: Plate 1 illustrates the 80 mm Holotype and the 69 mm Paratype. The latter has since been described as *Akleistostoma Patula*, a broad, elongate, inflated, domed species.

(II) *Akleistostoma (Olssonicypraea) hughesi* (Olsson and Petit, 1964) TYPE

Original description: “Shell variable in size, often large, heavy, broadly elliptical [oval-elongate], widest just above the middle line, the dorsum generally wide, low, broadly rounded. The base is wide, flattened, or a little bump on the body whorl side, the outer lip side wide, the anterior end strongly impressed over the end of the aperture. The aperture is narrow and of nearly uniform width throughout, strongly curved to the left, only a little wider in the anterior section. Outer lip is finely toothed throughout (with about 21 teeth in the type), the inner or parietal side with longer, narrower, and somewhat irregular lirations [teeth]. The anal or posterior canal is a deep sulcus, sunken, and excavated over the apex, its sides raised. Anterior end of shell with short plowlike, pinched in flanges.”

Holotype: 65.6 mm. (Olsson and Petit, p. 559).

(III) *Akleistostoma (Kissimmecypraea) transitoria* (Olsson and Petit, 1964)

Original description: “Shell large, oblong-subovate, with a moderately high, convex dorsum and a flattened base, the ventral face of the outer lip and body whorl together lying nearly in the same, flat plane, their lateral margins subangulated to weakly rounded. Aperture is intermediate between that of *S. carolinensis* and *S. problematica*, narrow and strongly curved to the left above, wider in the anterior one-quarter section, and in front of that deeply impressed on both sides over the siphonal canal. The labral margin of the outer lip is sharply lirate [toothed] throughout, the lirae on the parietal [columellar] side longer and narrower. Fossula distinct, excavated, with a strong, bounding ridge within. The posterior canal is a deep half-circle sulcus, hollowed out within above the buried apex with a high sharp rim elevated prominently above it on the left or body whorl side. Siphonal notch deep, rounded, pinched in at the entrance and sharply rimmed. Surface of the dorsum shows longitudinal growth lines in the middle zone covered by a glaze of enamel on the sides.” Holotype: 81.6 mm. (Olsson & Petit, p. 559-560).

(IV) *Siphocypraea (Seminolecypraea) trippeana* Parodiz, 1988

Original description: “Shell elongate, width slightly less than half the length; semiovalate, narrowed anteriorly, wider than high. Dorsum very convex, smooth. Base flattened anteriorly. Margin without regular pitting, outer area of the lip faintly marked by projections of teeth. Callus thick in rostral view, but angulated on portion that turns over dorsum at anterior end; regularly curved from middle to posterior end, showing some weak undulations. Line separates callus from dorsum. Anterior canal projecting to right in opposite direction of apical notch. Edge of anterior canal forms sharp terminal ridge oblique to first columellar tooth; between these features is wide depressed area that enhances sharpness of ridge, flattened at ends below ridge. Similar but smaller flat area on opposite (labial) side, which has no ridge. Small fossula only visible in oblique view, as is inconspicuous columellar sulcus described above. Crater or pit of sunken apex key-hole shaped, continuing from posterior deep canal, narrow and widely projected to right above (posterior view), with portion corresponding to extension of outer lip semilunar; viewed dorsally, notch much wider than in related species; posterior opening covered by curved end of lip with margination around keyhole edge which thickens toward columellar side. Width of aperture constant from anterior to posterior end. Eighteen teeth on columellar side; anteriormost tooth forms angle with terminal ridge between which is depressed area; teeth regularly spaced anteriorly, irregular and uneven toward posterior end. Twenty-two labial teeth, very regular and well separated at middle, but closer and sharper near anterior canal; fourth labial tooth is at level of first columellar tooth. Teeth near posterior notch smaller. Shell solid, heavier than specimens of comparable size in other species.” Holotype: 55.8 mm. (Parodiz, p. 92).

(V) *Siphocypraea (Floridacypraea) josiai* Fehse, 1997

Original description: “The shell is small in size, concallous and light in weight, smooth, dorsally badly vaulted and the base weakly convex. The body whorl is centrally swollen and narrows abruptly towards the extremities. The spire is completely covered by the siphonal channel. The aperture is narrow over all and almost straight. The siphonal channel is curved and well developed.

The aperture lip is covered from the parietal lip at the siphonal margin. The parietal lip has a strong, very steeply placed terminal fold. The bounded terminal fold of the anal channel is clearly separated from the remaining teeth. The columellar teeth (average 17) are well developed, delicate and thin and only slightly extending into the aperture. They become weak and obsolete leading to the siphonal channel. The labral teeth (average 20) are a little stronger and they become even more developed on the anterior part of the shell but they are only slightly extending into the aperture lip.

The fossula is weakly developed, but deeply arranged and separated from the columella. The fossular border is nearly straight, the columella smooth.” (Fehse, p. 39).

(VI) *Siphocypraea (Okeechobea) philemoni* Fehse, 1997

Original description: “The shell is cylindrical to globular inflated, noncallous and therefore very light in weight, even in adult specimens. The shell is smooth, dorsally badly vaulted and the base only very weakly convex. The spire is completely covered by the siphonal channel. The aperture narrows at the siphonal channel and is somewhat widening at the anal channel, it is curved (nearly at a right angle on the posterior part of the shell). The siphonal channel is curved and well developed.

The aperture lip is not or only slightly covered by the parietal lip at the siphonal margin. The parietal lip has a strong, very deeply placed terminal fold. The columellar teeth (average 20) are well developed, delicate and thin, slightly extending onto the base and into the aperture. They become weak and obsolete leading to the siphonal channel. The labral teeth (average 23) are a bit stronger and extend only slightly into the aperture lip.

The fossula is weakly formed, but deeply arranged and therefore clearly separated from the columella. The fossular border is somewhat curved, the columella is smooth.” (Fehse, p.38).

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About the Authors



John D. “Duffy” Daughenbaugh was born November, 1945 in Charles City, Iowa. He graduated from the University of Santa Clara, Santa Clara, CA with a BA in History and earned a commission in the US Army. After training, he was assigned as Commanding Officer of an Army Security Agency company on Okinawa. Active duty ended September, 1969, followed by attendance at the Thunderbird School of International Management, Glendale, AZ where he earned a Master’s degree. He then began his banking career with American Express International Banking Corporation June, 1971. Assignments to Okinawa, Vietnam, New York, Greece, Lahore, Pakistan and Singapore followed. He then joined the international division of United California Bank (subsequently, First Interstate Bank, acquired by Wells Fargo Bank) with assignments in Los Angeles, Taiwan and Singapore. Returning to Los Angeles in 1987, he culminated his career with an eight-year stint as Senior Director of Credit in Wells Fargo’s California Private Banking Division. He retired March, 2013, ending a 42-year banking career. He presently resides in Los Angeles with his wife, Su Mei Ho.

Duffy’s diving and shell collecting interest began in 1968 on Okinawa. Subsequent collecting activities were limited to Vietnam, Greece and Taiwan, supplemented by frequent dive trips. Among the most memorable trips were Lanai, Hawaii (1975), Cocos Island, Costa Rica, South China and Java Seas trips aboard MV Empress (Vidar Skoglie, Captain), Pitcairn Island, Nuka Hiva, Marquesas, and Starvation Boat Harbour and Esperance, Australia. Nearing retirement, he began writing a number of articles reviewing the Cypraeidae of the Tropical Eastern Pacific, the Marquesan Islands, the Pitcairn Group, the Vema Seamount and the Cypraeidae of Northern New Zealand from the Kermadec Islands to the Poor Knights Islands. He, along with Marty Beals, also described three new Cypraeidae subspecies: *Talostolida pellucens jacksoni* Daughenbaugh and Beals, 2013, *Talostolida pellucens sumeiohae* Daughenbaugh and Beals, 2013 and *Umbilia capricornica thorni* Daughenbaugh and Beals, 2014. Over the last 10 years, his interest has expanded to include fossil Cypraeidae with a particular emphasis on the Florida populations, culminating in a series of articles for the San Diego Shell Club’s *The Festivus* (see References).



Randall Bridges was born April, 1959 in Yakima, Washington and grew up in Illinois. He attended Bradley University in Peoria, Illinois and Arizona State University in Tempe, Arizona where he studied and conducted research on animal learning and behavior. He left the university to pursue what later proved to be a lifelong career in the platinum jewelry industry. His career took him to Florida where he developed a strong interest in molluscs and shell collecting. Eventually, he returned to Arizona to establish his own jewelry manufacturing company and continued to seriously study seashells, primarily the family Cypraeidae. Now retired from the jewelry industry, his passion for shells continues to keep him busy.

He has maintained his cowry oriented website, www.rbridges.com, since 2000. The site features photogalleries and informational articles, and includes a webshop.

Randy's interest in the Cypraeidae led him to collaborate with many other cowry researchers around the world. With a special interest in the biomineralization and pigmentation in the Cypraeidae, his research has also resulted in the publication of new subspecies of cowries: *Leporicypraea rosea ultraviola* Lorenz & Bridges, 2014, and *Talparia talpa lutani* Bridges, 2015. An article he coauthored with F. Lorenz in 2012, "A Revised morphometric formula for the characterization of cowries", established a uniform way to present morphometric data on cowries to allow statistical analysis. Randy is also recognized as one of the leading scientific photographers of seashells, particularly cowries. His work can be seen online, and in various publications including the San Diego Shell Club journal, *The Festivus*, and the German Shell Club's *Conchylia*. In this book, the senior author took the photographs and Randy performed the post processing and color plate production.

Why This Book?

The authors provide a taxonomic assessment of all currently described Florida species and related genera from the Miocene through the Pleistocene, accompanied by an overview of the environmental conditions prevailing at the time of their existence as reflected in the geology of the era. The authors have relied on the taxonomic and geological works of the original authors to the extent possible, in many cases utilizing their own words. Two new species are introduced and a uniform format for presenting the Plio-Pleistocene species is utilized to facilitate comparisons and identification. Contains 125 high resolution color plates that offer additional help in identifying specimens.

