

## Two New *Cassis* (Gastropoda: Cassidae) and a New *Malea* (Gastropoda: Tonnidae) from the Pliocene and Pleistocene Beds of Southern Florida

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**ABSTRACT** Two new fossil Helmet Shells of the genus *Cassis* Scopoli, 1777 (Cassidae) and a new fossil Grinning Tun Shell of the genus *Malea* Valenciennes, 1832 (Tonnidae) are described from the Pliocene and Pleistocene fossil beds of southern Florida. The new Helmet Shells, *Cassis rasae* n. sp. and *Cassis viliusi* n. sp., were both collected in the rich fossil beds of the Holey Land Member of the Bermont Formation (Calabrian Stage, Early Pleistocene) and the new Grinning Tun, *Malea hyaducki* n. sp., was collected in the Fruitville Member (Kissimmee River Valley equivalent beds) of the Tamiami Formation (late Piacenzian Stage of the Pliocene). The discovery of two new large Helmet Shells in the Holey Land Member demonstrates that four species of *Cassis* are present in the Bermont Formation, making this the single largest fossil *Cassis* fauna found anywhere on Earth. The new Grinning Tun represents the oldest-known *Malea* found in Florida, and is the direct ancestor of the Gelasian Pleistocene *Malea springi* (Caloosahatchee Formation) and the Calabrian Pleistocene *Malea petiti* (Bermont Formation).

**KEY WORDS** *Cassis*, *Cassis rasae*, *Cassis viliusi*, *Malea*, *Malea hyaducki*, Bermont Formation, Tamiami Formation, Calabrian Stage, Pleistocene Epoch, Piacenzian Stage, Pliocene Epoch

### INTRODUCTION

Although quite rare in the worldwide fossil record, large Helmet Shells of the genus *Cassis* are relatively common in the Holey Land Member of the Bermont Formation of southern Florida. Here, four *Cassis* species are now known to have occurred sympatrically during the Calabrian Stage of the Early Pleistocene, making this the single richest fossil *Cassis* fauna known from anywhere on Earth. The four large Bermont Helmet Shells, which include *Cassis schnireli* Petuch, 1994, *C. jameshoubrieki* Petuch, 2004, and two new species that are described here, were apparently predators of the extremely rich fauna of echinoids that is characteristic of the Holey Land Member (found in the paleoecosystem of

the “*Titanostrombus williamsi* Community”; see Petuch, 2004: 230-233). In contrast to the relative abundance of large cassids in the Bermont Formation, the tonnid genus *Malea* is rarely found in the fossil beds of southern Florida and is known from only a few specimens in private and museum collections. Three species are currently known from southern Florida; *Malea petiti* Petuch, 1989 from the Holey Land Member of the Bermont Formation, *M. springi* Petuch, 1989 from the Fort Denaud Member of the Caloosahatchee Formation, and an unnamed Late Pliocene species (previously misidentified as “*Malea densecostata*” and described here) from the Fruitville Member of the Tamiami Formation.

The authors are currently in the process of completing the first comprehensive overview of the paleontology, stratigraphy, paleoceanography, and paleogeography of the Everglades region of Florida ("Ancient Seas of Southern Florida", CRC Press) and the new cassid and tonnid taxa described here will be included within the upcoming book. The holotypes of the two new *Cassis* species and the new *Malea* are deposited in the molluscan type collection of the Paleontological Research Institution (hereinafter "PRI"), Ithaca, New York and bear PRI catalog numbers.

### SYSTEMATICS

Class Gastropoda

Subclass Sorbeoconcha

Order Prosobranchia

Infraorder Mesogastropoda

Superfamily Tonnoidea

Family Cassidae

Genus *Cassis* Scopoli, 1777

*Cassis rasae* Petuch and Berschauer,  
new species  
(Figures 1A, B)

**Description.** Shell of average size for genus, averaging around 200 mm in length, elongated and narrow, with only slightly inflated body whorl; spire proportionally high and elevated, distinctly subpyramidal; shoulder sharply angled, with sharply-sloping subsutural areas; shoulder ornamented with 10-14 proportionally-large, sharply-pointed knobs; body whorl ornamented with 2 rows of smaller, less-developed knobs, one around anterior one-third of body whorl and one around mid-body, with each row having 8-12 low, rounded knobs; areas between rows of smaller knobs ornamented with 4-6 strong, wide, low cords, with smaller secondary cords between pair of larger cords; anterior area of body whorl, between row of knobs and siphonal canal, ornamented with 6-8

thin, strong cords; sloping shoulder and subsutural area ornamented with 5 thin cords; shoulder cords often intersected by strong longitudinal growth lines, producing distinct fenestrate sculpture pattern; siphonal canal short, narrow, recurved dorsally; parietal shield roughly triangular in shape, with rounded sides, often preserving original central color patch (such as on holotype, Figure 1B); columellar area of parietal shield ornamented with 20-30 thin, elongated teeth, arranged in parallel, that are longer and better developed on anterior half; aperture proportionally narrow, widening toward the anterior end; outer lip wide and flattened, ornamented with 10-12 large, widely-separated pointed teeth, with middle teeth being largest and best developed, extending into aperture.

**Type Material.** HOLOTYPE - Length 165.2 mm, width 108.4 mm, Holey Land Member of the Bermont Formation, Loxahatchee, Palm Beach County, Florida, PRI 13346; OTHER MATERIAL EXAMINED - Three specimens, lengths 246 mm, 220 mm, and 192 mm, from the same locality as the holotype.

**Type Locality and Stratigraphic Range.** The holotype was collected from the lowest beds in Palm Beach Aggregates Pit #9, Loxahatchee, Palm Beach County, Florida. The new species is confined to the lower beds of the Holey Land Member, Bermont Formation, Calabrian Stage of the Early Pleistocene.

**Etymology.** Named for Rasa Petuch of Vilnius, Lithuania, daughter-in-law of the senior author.

**Discussion.** Of the four known *Cassis* species found in the Holey Land Member, *Cassis rasae* is the smallest and also has the most elongated body whorl and highest spire. The new species is morphologically closest to *C. schnireli* Petuch, 1994 (Figures 1G, H), but differs in being a

smaller, far less inflated, less rounded, and more protracted species, in having larger, fewer, and better developed knobs on the shoulder and body whorl, and in having a higher, more pyramidal spire.

*Cassis viliusi* Petuch and Berschauer,  
new species  
(Figures 1C, D)

**Description.** Shell of average size for genus, averaging around 150 mm in length, inflated and barrel-shaped, triangular in shape; spire proportionally low, broadly pyramidal; shoulder sharply angled, subcarinate, with sharply-sloping subsutural areas; shoulder edge ornamented with 17-20 small, closely-packed, sharply-pointed knobs; body whorl ornamented with 2 rows of smaller, poorly-developed, almost obsolete knobs, one around anterior one-third of body whorl and one around mid-body, with each row having 15-20 low, rounded knobs; areas between rows of smaller knobs ornamented with 5-6 strong, wide, low cords, with smaller secondary cords between pair of larger cords; anterior area of body whorl, between row of knobs and siphonal canal, ornamented with 6-8 thin, wider and more flattened cords; shoulder and subsutural area ornamented with 4-5 thin cords; early whorls of spire heavily ornamented with 4 rows of large, prominent rounded beads; siphonal canal short, narrow, recurved dorsally; parietal shield broad and expanded, oval in shape, often preserving original central color patch (such as on holotype, Figure 1D); columellar area of parietal shield ornamented with 35-40 thin, elongated teeth, arranged in parallel rows, with smaller secondary ribs often present between pairs of larger ribs; aperture proportionally narrow, widening toward anterior end; outer lip wide and flattened, ornamented with 10 large, widely-separated pointed teeth, with middle 4

teeth being largest, best developed, and with flattened, bifurcated ends.

**Type Material.** HOLOTYPE - Length 169.5 mm, width 115.1 mm, Holey Land Member of the Bermont Formation, Loxahatchee, Palm Beach County, Florida, PRI 13348; OTHER MATERIAL EXAMINED - Two specimens, lengths 176 mm and 139 mm, from the same locality as the holotype.

**Type Locality and Stratigraphic Range.** The holotype was collected from the lowest beds in Palm Beach Aggregates Pit #9, Loxahatchee, Palm Beach County, Florida. The new species is confined to the lower beds of the Holey Land Member, Bermont Formation, Calabrian Stage of the Early Pleistocene.

**Etymology.** Named for Vilius Vaičiulis of Vilnius, Lithuania, an inspired young naturalist and student of science.

**Discussion.** Of the four known *Cassis* species found in the Holey Land Member, *Cassis viliusi* most closely resembles *C. schnireli* Petuch, 1994 (Figures 1G, H), but differs in having a more inflated shell with a distinctly triangular shape and lower spire, in being a smoother, less ornamented shell that lacks strong cords and pronounced rows of knobs on the body whorl, and in having more numerous and proportionally smaller knobs along the shoulder.

Family Tonnidae

Genus *Malea* Valenciennes, 1832

*Malea hyaducki* Petuch and Berschauer,  
new species  
(Figures 2A, B)

**Description.** Shell of average size for genus, averaging around 100 mm, thin, inflated, globose, bulliform, with rounded shoulder; spire

elevated, subscalariform, broadly pyramidal, with deeply incised sutures; body whorl smooth and shiny, encircled by 18-20 wide, low, flattened, equally-spaced spiral cords; aperture wide and flaring, distinctly crescent-shaped; columellar area with deep, prominent rectangular notch along anterior one-third; columellar notch bordered by pair of large prominent knobs, with each knob bearing 3 large blade-like teeth; smaller, less-developed elongated pustules present along entire columella and on edge of parietal shield, particularly anterior end; parietal shield proportionally large and expansive, covering approximately three-quarters of shell base, with prominent recurved edge along anterior end; outer lip wide and flattened, ornamented with 20 large, evenly-spaced narrow ribs, with each terminating in small rounded tooth within edge of aperture.

**Type Material.** HOLOTYPE - Length 120 mm, width 90.6 mm, Fruitville Member of the Tamiami Formation, Rucks Pit, Fort Drum, Okeechobee County, Florida, PRI 13349; OTHER MATERIAL EXAMINED - (fragmentary, missing the outer lip) length 91 mm, from the same locality as the holotype.

**Type Locality and Stratigraphic Range.** The holotype was collected from the lowest beds of the Rucks Pit (Fort Drum Crystal Mine), Fort Drum, Okeechobee County, Florida. The new species is confined to the Fruitville Member of the Tamiami Formation, late Piacenzian Stage of the Late Pliocene.

**Etymology.** The new tonnid is named for Harry J. Hyaduck, Sr. of Atlanta, Georgia, an inspired amateur paleontologist who collected the holotype in the Rucks Pit and generously donated it to the senior author for further study.

**Discussion.** This large and distinctive Floridian *Malea* was first found by Olsson and Petit, who illustrated it in their 1964 paper on new Pliocene and Pleistocene mollusks that had been uncovered in canal excavations around Lake Okeechobee. Although representing the first *Malea* species found in Florida, they erroneously referred this large and impressive tonnid to the taxon *Malea densecostata* (Rutsch, 1934) from the Punta Gavilan Formation of Venezuela (Zanclean Stage, Early Pliocene). That older Gatunian Paleoprovince South American species differs from the younger late Piacenzian Stage North American *Malea hyaducki* in being a much more narrow and elongated shell with finer and more numerous spiral ribs on the body and spire whorls and in having a proportionally lower spire. The teeth on the outer lip of *M. densecostata* are also more numerous, stronger, and better developed than those seen on the new Floridian species. Of the two other known Floridian species, *Malea hyaducki* is closest to *M. springi* Petuch, 1989 (Figures 2C, D) from the Gelasian Stage Fort Denaud Member of the Caloosahatchee Formation. The new Tamiami Formation species differs from its younger Early Pleistocene descendant species in being a smaller, thinner, and more inflated shell with a proportionally-higher spire, and in having fewer cords on the body and spire whorls. The outer lip of the Caloosahatchee *M. springi* is also wider and has much more numerous and stronger teeth that extend into the aperture (readily seen here by comparing Figures 2B with 2D).

**Fossil *Cassis* and *Malea* Species known from the Pliocene and Pleistocene Formations of Southern Florida (Okeechobee Group of Formations)**

Only around 20 species of Helmet Shells of the genus *Cassis* are known from fossil beds around

the world (Petuch and Berschauer, 2018). Of these, 9 are only known from the fossil beds of southern Florida, demonstrating that the Okeechobean Sea (the paleosea that flooded the Floridian Peninsula during the late Neogene Period) was the center of *Cassia* evolution for the entire Western Atlantic Region (Tucker & Wilson, 1932; Petuch, 2004; Petuch and Roberts, 2007). Here, large *Cassia* species have been found to be abundant in several of the formations of the Okeechobee Group (all the carbonate-rich formations of southern Florida, including the Tamiami, Caloosahatchee, Bermont, and Fort Thompson Formations; see Petuch and Roberts, 2007). These are arranged here chronologically and stratigraphically and include:

Piacenzian Stage, Late Pliocene: 3.6-2.58 mya

**Tamiami Formation, Pincrest Member**

*Cassia floridensis* Tucker and Wilson, 1932

**Tamiami Formation, Fruitville Member**

*Cassia ketteri* Parodiz and Tripp, 1992

Gelasian Stage, Early Pleistocene: 2.58-1.8 mya

**Caloosahatchee Formation, Fort Denaud Member**

*Cassia calusa* Petuch and Berschauer, 2018

**Caloosahatchee Formation, Ayers Landing Member**

*Cassia powelli* Petuch and Berschauer, 2018

Calabrian Stage, Early Pleistocene: 1.8 mya-780,000

**Bermont Formation, Holey Land Member**

*Cassia jameshoubrieki* Petuch, 2004 (Figure 1E, F)

*Cassia rasae* Petuch and Berschauer, n. sp. (Figure 1A, B)

*Cassia schnireli* Petuch, 1994 (Figure 1G, H)

*Cassia viliusi* Petuch and Berschauer, n. sp. (Figure 1C, D)

Tarantian Stage, Late Pleistocene: 126,000-17,700 ybp

**Fort Thompson Formation, Coffee Mill Hammock Member**

*Cassia* cf. *spinella* Clench, 1944

In addition to these large Pliocene and Pleistocene species, two small and rare *Cassia* taxa are also known from northern Florida and southern Georgia, and these include *Cassia*

*flintensis* Mansfield, 1940 (Flint River and Suwannee Formations; Rupelian Age, Oligocene) and *Cassia delta* Parker, 1948 (Chipola Formation; Burdigalian Age, Early Miocene). The four Calabrian-aged Holey Land species appear to be the direct ancestors of the four *Cassia* species that are now living in Florida and the tropical western Atlantic. These include: *Cassia madagascariensis* (Lamarck, 1822) (Florida Keys, Yucatan, and Caribbean Sea area only), which is the descendant of the Bermont *C. schnireli*; *Cassia spinella* Clench, 1944 (Cape Hatteras to the Florida Keys and the entire Gulf of Mexico), which is the descendant of the Bermont *S. viliusi*; *Cassia flammea* (Linnaeus, 1758) (Florida Keys and Caribbean Sea area only), which is the descendant of *C. rasae*; and *Cassia tuberosa* (Linnaeus, 1758) (Florida, Gulf of Mexico, Caribbean Sea, and south to Cabo Frio, Brazil), which is the descendant of *C. jameshoubrieki* (Figures 1E, F). Southeastern Florida, the Florida Keys, and the Yucatan Peninsula of Mexico are the only places where the northern (Carolinian Province) *C. spinella* occurs sympatrically with the southern (Caribbean Province) *C. madagascariensis*; north of Florida and Yucatan, only *C. spinella* occurs, while south of Florida and Yucatan, only *C. madagascariensis* can be found.

Although numerous tonnids of the genus *Malea* are known from the fossil beds of the Caribbean Region and South America, as well as the Eastern Pacific from California to Central America, the few records of the genus in the southeastern United States are known only from the fossil beds of southern Florida (Petuch, 1989; 1994; 2004). Only three *Malea* species are known from southern Florida, and these include the following (arranged here chronologically and stratigraphically and all illustrated on Figure 2):

Piacenzian Stage, Late Pliocene: 3.6-2.58 mya  
**Tamiami Formation, Fruitville Member**  
*Malea hyaducki* Petuch & Berschauer, n. sp. (Fig. 2A, B)

Gelasian Stage, Early Pleistocene: 2.58-1.8 mya  
**Caloosahatchee Formation, Fort Denaud Member**  
*Malea springi* Petuch, 1989 (Figure 2C, D)

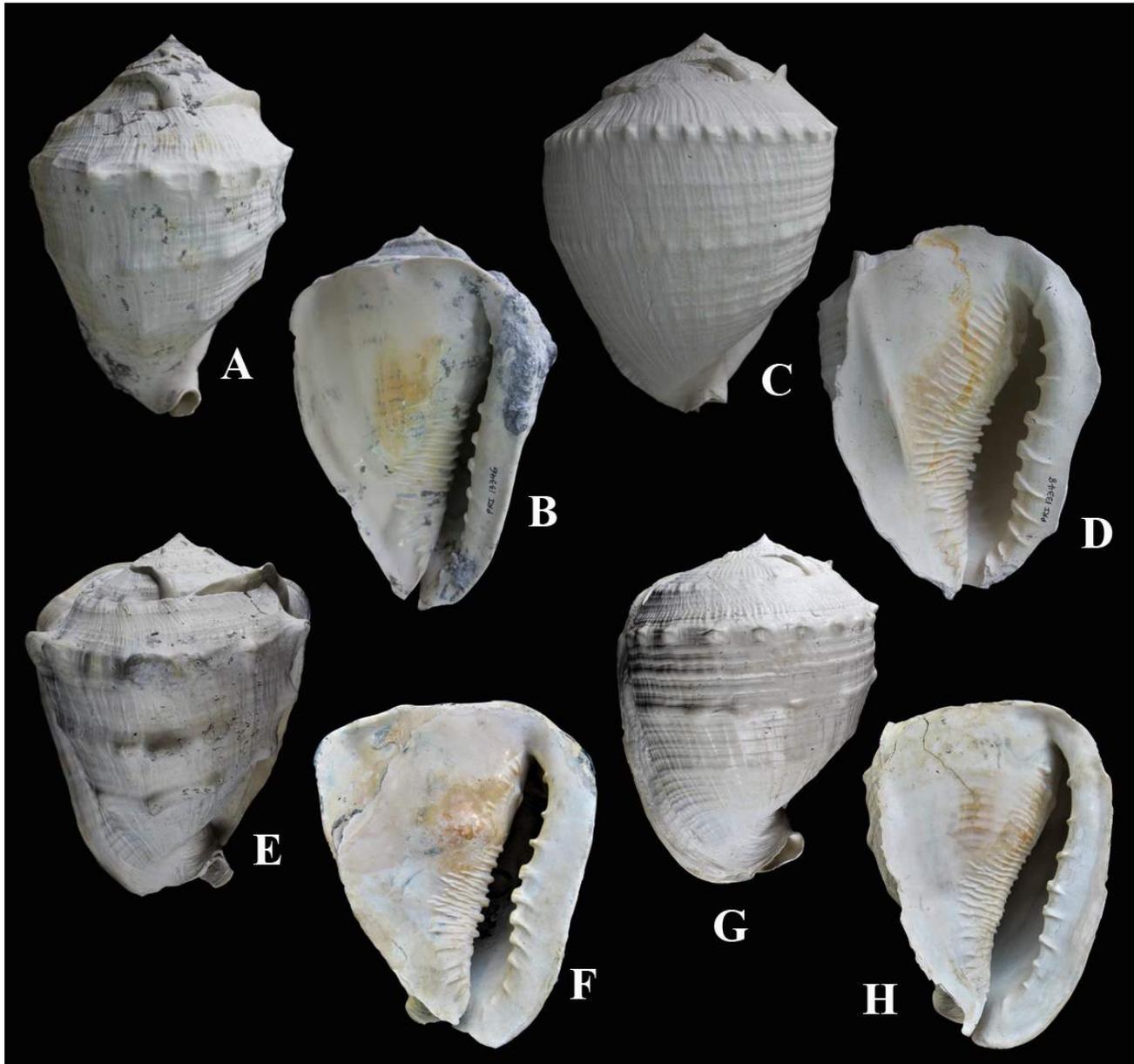
Calabrian Stage, Early Pleistocene: 1.8 mya-780,000  
**Bermont Formation, Holey Land Member**  
*Malea petiti* Petuch, 1989 (Figure 2E, F)

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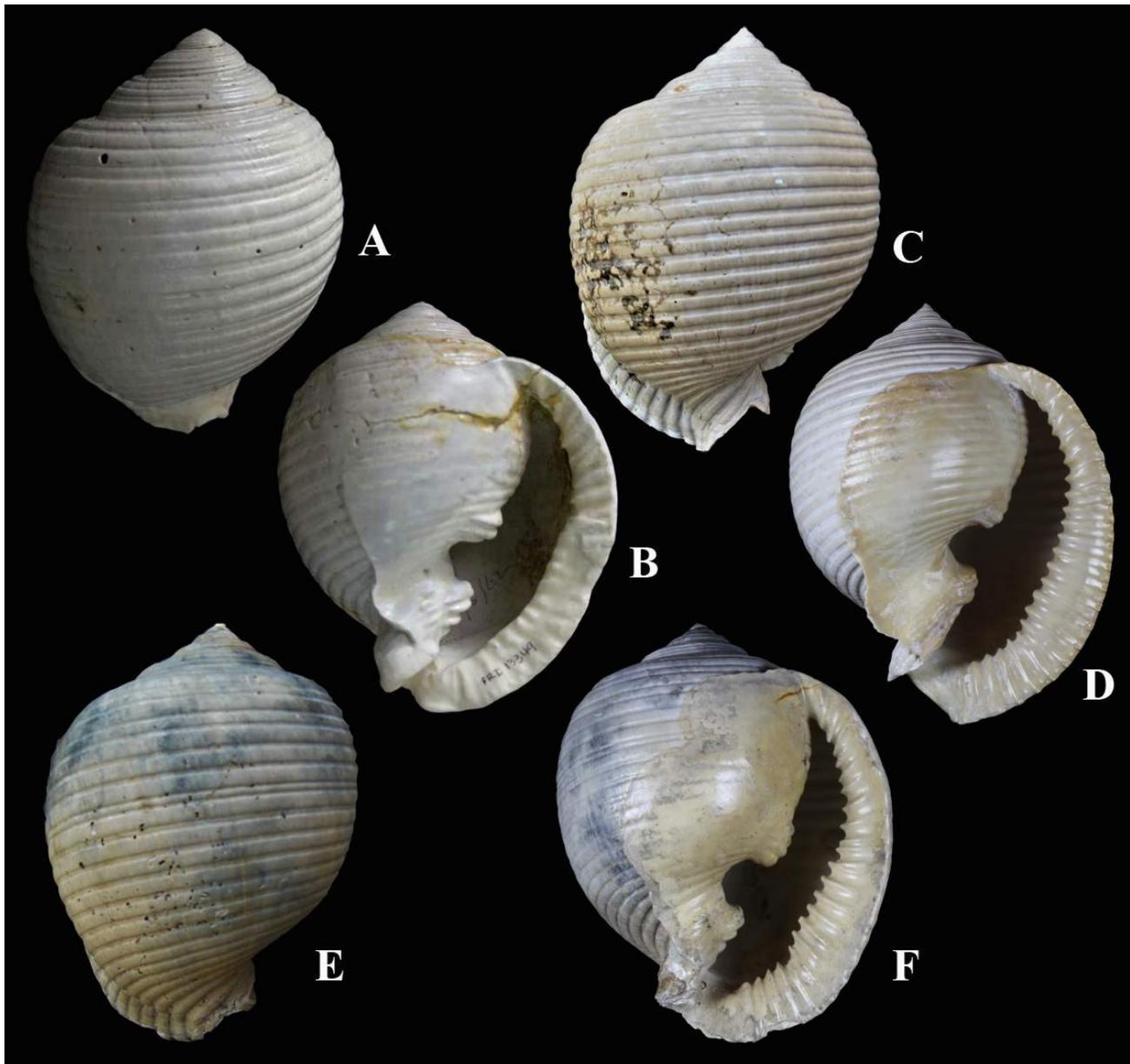
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**Figure 1.** *Cassis* species from the Holey Land Member of the Bermont Formation (Calabrian Stage, Early Pleistocene).

**A, B**= *Cassis rasae* Petuch and Berschauer, new species, holotype, length 108.4 mm, PRI 13346; collected in Palm Beach Aggregates Pit #9, Loxahatchee, Palm Beach County, Florida; **C, D**= *Cassis viliusi* Petuch and Berschauer, new species, holotype, length 115.1 mm, PRI 13348; collected in Palm Beach Aggregates Pit #9, Loxahatchee, Palm Beach County, Florida; **E, F**= *Cassis jameshoubrieki* Petuch, 2004, length 203 mm, in the research collection of the senior author; collected in Palm Beach Aggregates Pit #9, Loxahatchee, Palm Beach County, Florida; **G, H**= *Cassis schmireli* Petuch, 1994, length 186 mm, in the research collection of the senior author; collected in Palm Beach Aggregates Pit #9, Loxahatchee, Palm Beach County, Florida.



**Figure 2. *Malea* species from the Pliocene and Pleistocene of southern Florida.**

**A, B= *Malea hyaducki*** Petuch and Berschauer, new species, holotype, length 120 mm, holotype, PRI 13349; collected in Rucks Pit, Fort Drum, Okeechobee County, Florida, from the Fruitville Member (Kissimmee River Valley equivalent) of the Tamiami Formation, late Piacenzian Stage, Late Pliocene; **C, D= *Malea springi*** Petuch, 1989, length 202 mm, in the research collection of the senior author; collected along the Miami Canal, 10 miles south of Lake Harbor, Palm Beach County, Florida; from the Fort Denaud Member of the Caloosahatchee Formation, Gelasian Stage of the Early Pleistocene; **E, F= *Malea petiti*** Petuch, 1989, length 122 mm, in the research collection of the senior author; collected in Palm Beach Aggregates Pit #6, Loxahatchee, Palm Beach County, Florida; Holey Land Member of the Bermont Formation, Calabrian Stage of the Early Pleistocene.