THE SPAWN OF THE EMPEROR HELMET SHELL, *CASSIS MADAGASCARIENSIS* LAMARCK, FROM SOUTH FLORIDA[1]

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ABSTRACT

Egg masses of *Cassis madagascariensis* are described and illustrated. Data is presented on capsular dimensions, enumerations of the embryos and capsules, and the developmental pattern. The known spawn of the Cassidae from *Cassis, Cypraecassis, Galeodea, Morum,* and *Phalium* are compared and grouped according to structure.

INTRODUCTION

The family Cassidae is a widely distributed tropical and temperate group containing the following genera: *Cypraecassis, Galeodea, Morum, Phalium, Cassis, Casmaria,* and *Sconsia.* Egg masses were previously recorded from the first four, as noted in the discussion, and a species of *Cassis* is described here for the first time.

A large egg mass of *C. madagascariensis* was collected on July 3, 1969, during a survey of the Biscayne National Monument by Mr. Martin Gomon and Mr. Edward T. LaRoe from the Institute of Marine and Atmospheric Sciences, University of Miami. While being towed on a diving sled southwest of Triumph Reef and east of Bache Shoal, Mr. Gomon observed an unusually large animal in a sandy area between *Thalassia* beds. When the specimen was retrieved, the egg mass, described below, was found directly under and surrounded by the foot. The substrate on which the spawn was deposited was coarse, carbonate sand typical of reef habitats and grass flats in southern Biscayne Bay and the Florida Keys.

The oothecae are arranged in a single layer to form an ellipsoidal mass, 11 cm by 8 cm, and their peduncles are spaced 2 or 3 mm apart above the base (Fig. 1,a,b). As indicated by the nonaligned lateral keels, placement of individual capsules is very irregular. It is interesting that capsules deposited at extreme angles are simply covered by the basal membrane as spawning progresses. When viewed from below, the fused basal membranes form a distinct concave structure which probably reflects the uneven substrate on which oviposition occurred. Some carbonate sand and shells remain attached to the membrane. The egg mass contains 260 capsules,

[1] Contribution No. 1099 from the Institute of Marine and Atmospheric Sciences, University of Miami. This investigation was conducted under the auspices of the U. S. Public Health Service (GM 125-41-02).
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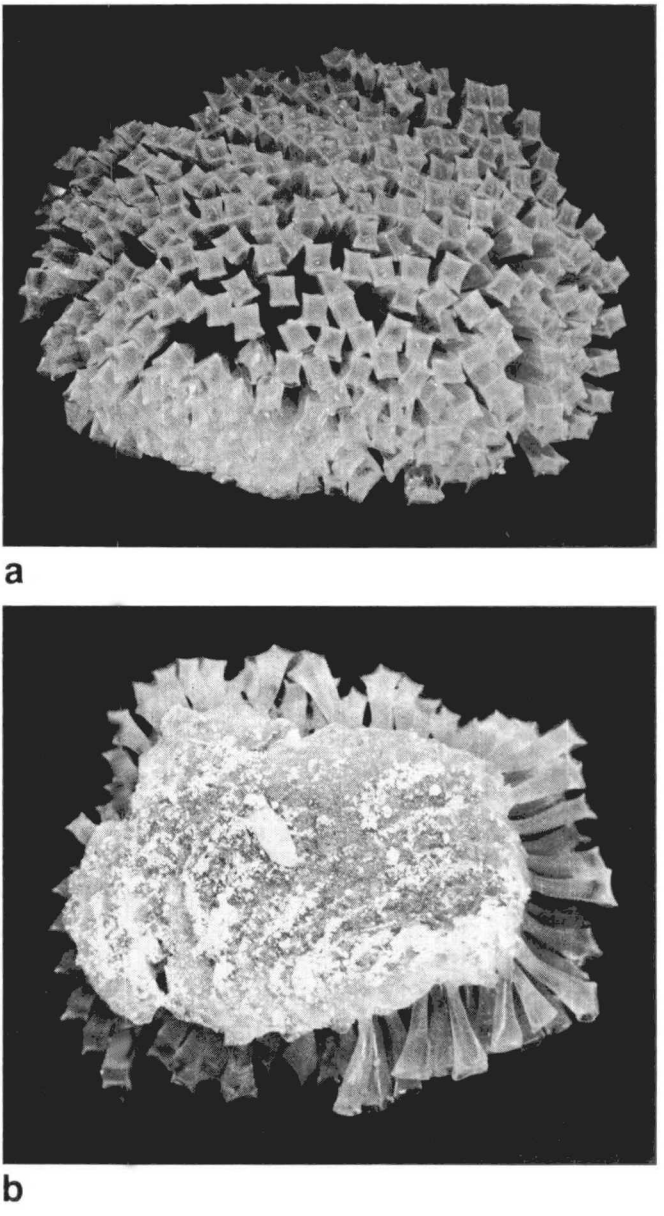

FIGURE 1. The egg mass of *Cassis madagascariensis*: a, apical view showing the irregular arrangement of the capsules; b, view of the basal membrane. Approximately one half natural size.

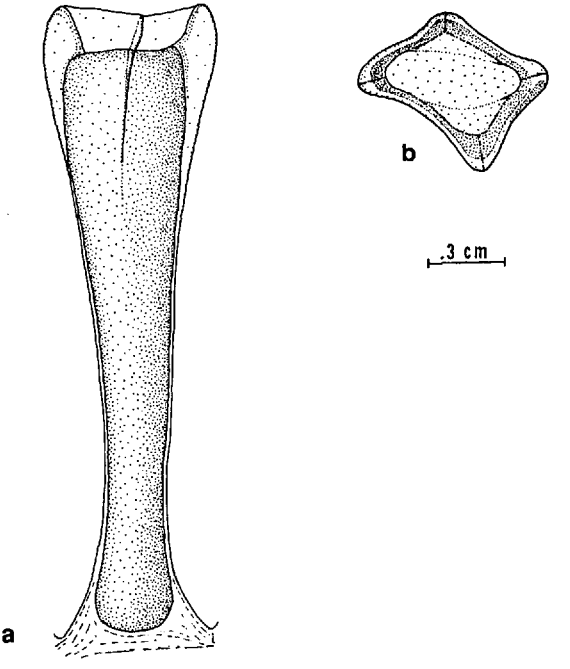

FIGURE 2. Oothecae of *Cassis madagascariensis:* a, lateral view showing the wide keels; b, a view of the apical plate only.

somewhat less than expected considering an adult's average size, probably because the female was interrupted during oviposition.

Individual capsules are slightly opaque, vasiform structures with very smooth walls and almost no sculpturing (Fig. 2,a). The vasiform shape has an enlarged base, gradually narrows in the stem, and then expands to a point just below the apical plate where it is again constricted. A cross section at any point below the limits of the lateral keels and ridges is round or ellipsoidal. In contrast, a cross section just below the apical plate is roughly quadrangular. This shape is due to four keels and associated ridges from the quadrangular apical plate, which extend a short distance toward the base from each corner (Fig. 2,a). At the apex where the capsule is constricted, distinct keels arise from the angles of the apical ridge, cross the constricted area, and form the associated ridges mentioned above. The largest keels are usually located on opposite sides and roughly align with the long axis of the egg mass. In apical view, the capsules are quadrangular. The plate is concave and surrounded by a sharp, slightly indented ridge (Fig. 2,b). In the peduncular region, the edges of the flared-out base are

connected to the thickened basal membrane very close to the edge of adjacent oothecae in such a manner that they are almost continuous. All capsules containing embryos become light brown as development proceeds, especially in the peduncular region. Nourishment for the embryos is provided by an extremely viscous, albuminous fluid which tends to push the embryos toward the capsular walls and base. The average capsular dimensions are: height, 2.4 cm; width (between the edges of the large keels), 0.8 cm; thickness (between the edges of the small keels), 0.7 cm. A range from 2400 to 2900 embryos with an average of 2400 was found in a sample of five oothecae. Comparisons with the embryos of other prosobranchs are indicative of a planktotrophic veliger stage. No nurse eggs are involved.

Discussion

Great variability occurs in the spawn produced by members of the Cassidae. In certain genera, no homology can be made between the species and other cassids. For example, the egg capsules of *Morum oniscus*, illustrated by Work (1968), are extremely unusual in that they are roughly triangular in outline (height, 10 mm; width, 11 mm; thickness, 4 mm). The narrow apical region is spiny and bordered by spines. Except for the elliptical escape-aperture located just below the apex on one side, no additional sculpture appears on the front and back sides. The oothecae are attached in a row on a basal membrane. Development is direct.

Spawn from *Galeodea* (= *Cassidaria*) *echinophora*, which was studied by Erlanger (1893) and Fioroni (1966), can be used as another example of variability. A similar egg mass described by Fioroni & Sandmeier (1964) and later tentatively identified by Fioroni (1966) as *Cassidaria* sp. can also be included. Egg masses from both animals are composed of domed capsules united in large irregular masses up to 15 cm in diameter. They differ in that *Cassidaria* sp. has a preformed escape-aperture with lateral sutures passing around the capsule to the connecting membrane, while *Galeoda echinophora* has none. In both cases, nutrient eggs are involved and development is direct. Spawn from this genus does not show simple homologies with other related genera.

Egg masses from several species of *Phalium* have been described. *Phalium granulatum* from Florida has often been photographed (see Abbott, 1968) atop its tower-shaped egg mass. The oothecae are roughly columnar with a wide apex and are deposited in discoidal layers to form the tower. Development is indirect. Abbott (1968) also included a photograph of the communal egg masses of *P. glaucum* from Malaya. In this case, the spawn is composed of many turreted structures fused into a single mass. No details are available on capsular morphology. Anderson (1966) described the communal spawn from *P. labiatum* (New South Wales). In this case, the capsules are rectangular and are similar to the columnar

structures attached in layers. Capsular morphology in the genus is directly comparable with that of *Cypraecassis* and *Cassis*; the major differences are communal spawning and the habit of constructing elaborate towers, which results in some modification and compression.

Cypraecassis produces spawn which is most similar to *Cassis*. Work (1968) figured *Cypraecassis testiculus*. The egg mass is a wide, belt-like, single layer containing columnar, unsculptured and rounded capsules (height, 4.2 mm; width, 2.0 mm), each with an apical ridge surrounding a concave plate that has a round escape-aperture. This species also has a free-swimming veliger.

Since the spawn of prosobranchs directly reflects their internal anatomy (structure of the oviduct and pedal gland) and habits, it is possible to place emphasis on the close relationship of *Cassis, Cypraecassis,* and *Phalium*, with *Galeodea* and *Morum* in isolated groups. This agrees with Abbott's (1968) outline suggesting four main evolutionary stocks in the family.

Acknowledgments

The author wishes to thank Mr. Martin Gomon and Mr. Edward T. LaRoe for making available the spawn of *Cassis madagascariensis*, and Mr. Robert Work for allowing examination of egg masses from *Morum oniscus* and *Cypraecassis testiculus* in his collection.

Sumario

Desove del Molusco *Cassis madagascariensis* Lamarck, del Sur de la Florida

Se describen e ilustran masas de huevos de *Cassis madagascariensis*. Se dan datos sobre dimensiones de las cápsulas, número de embriones y cápsulas y patrón de desarrollo. Se comparan y agrupan de acuerdo con su estructura los desoves conocidos de la familia Cassidae: *Cassis, Cypraecassis, Galeodea, Morum* y *Phalium.*

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