

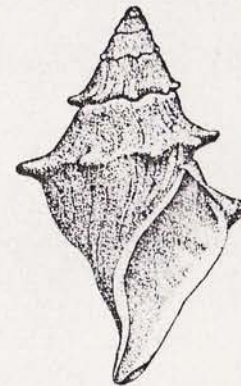
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- Risbec, J. 1928. Contribution à l'étude anatomique de quelques espèces de Mitres de la Presqu'île de Noumea. Bull. Mus. Natl. Hist. Nat. Paris, 34:105-112.
- Rundham, N. W. 1963. A study of the replacement mechanism of the pulmonate radula. Quart. J. Microscop. Sci., 104:271-278.

FEEDING MECHANISMS IN THE FAMILY TEREBRIDAE

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Terebrid gastropods are one of the most abundant components of tropical marine sand communities, but one of the least studied biologically. All terebrids have auger-shaped shells and all are restricted to the sand habitat. The purpose of my research over the past few years has been to study the ecology and life histories of terebrids from the Indo-Pacific, Eastern Pacific, and Western Atlantic provinces.

As a side project I have been developing a new classification of the family based on soft anatomy and life histories as well as shell shape and sculpture. The most important diagnostic character in this revised classification is the nature of the proboscis apparatus and the method of feeding. The terebrid proboscis does not consist of one eversible component as is the case for most gastropods, but has been completely divided into two separate functional components, an anterior labial tube and a posterior buccal tube, both of which may serve as an introvert during feeding. (A complete definition of terminology has been submitted to *The Veliger* for publication.)

Significant structural differences occur among the probosces of terebrids, particularly in the morphology of the buccal tube and the number and type of buccal organs present. I have used these differences to classify the family in five feeding types. Species of a particular feeding type are not only similar in morphology, but also in behavioral characteristics, habitat preferences, and other aspects of life history. Important differences are seen, however, when species of one feeding type are compared with those of another. I believe that these differences are of taxonomic significance, and can be used to separate several genera.

Type I species, of which there are two kinds, have a long labial tube and a short buccal tube. Buccal organs are limited to a pair of salivary glands. They have no poison gland and hence are incapable of rapid prey immobilization and capture. All species I have studied live subtidally in extensive sand flats.

Type IA terebrids are specialized to feed on slowly moving prey, all known species selecting hemichordates. Feeding is elicited by contact of the propodium of the foot with the prey. The labial tube everts, enters the hemichordate burrow, and grasps the worm. As the labial tube retracts, pulling the worm into the labial cavity, the buccal tube then grasps the worm and pulls it in farther. This sequence is continued until the prey is completely ingested. Feeding occurs on or just under the surface of the sand, and the snail does not pursue the prey deeply into its burrow.

Type IB terebrids have an extremely long labial tube and a broad fleshy

foot specialized for deep burrowing in the sand. All type IB species feed on capitellid polychaetes living in loosely compacted sand. When these species contact a capitellid in its burrow, the foot digs down and pulls the shell into the sand at a 90 degree angle. At the same time the long slender labial tube everts, enters the capitellid burrow, and extends into the burrow until it grasps the prey. Feeding is then similar to that of Type IA.

Species with the Type II proboscis are the only terebrids exhibiting typical toxoglossan characteristics. They have a long retractile buccal tube, and contain within the cephalic hemocoel a poison bulb, poison gland, and two rows of harpoon-like radular teeth. There are two kinds within this type.

Type IIA terebrids occur in great abundance on surf-washed beaches throughout the tropics. Some species live in the surf zone, occupying the same microhabitat as *Donax*, and others are found just beyond the breakers. Prey is initially detected by distance chemoreception and this is sufficient to elicit labial tube eversion. When the propodium of the foot comes into contact with the prey, the labial tube everts completely and begins scanning movements over the sand. The buccal tube holding the radular tooth everts at the same time, and when contact is made with the prey, the animal lunges, the tooth is injected, and poison flows into the wound. The labial tube then engulfs the prey, and the snail burrows into the sand to complete feeding. Prey capture is usually completed between the passage of two successive waves.

Type IIB species differ significantly from the Type IIA. All have a small foot, live in deep calm areas, are very secretive, and use the small poison apparatus to immobilize the prey, thus preventing it from retracting into its burrow. The animals are slow-moving and do not burrow deeply into the sand during feeding. Most feed on small tube-dwelling polychaetes.

Type III species lack the radular apparatus, as is the case for Type I terebrids, and many have lost the salivary glands and buccal tube as well. They differ from all other terebrids in that they have an accessory feeding organ contained in the labial cavity. This organ differs in structure and function from the boring organ of naticids and muricids, and has not been described before in any gastropod.

The organ consists of a long posterior glandular and muscular stalk, terminating anteriorly in a series of muscular papillae. I have not been able to feed the animals in the laboratory, but results of gut analyses and observations in the field indicate that the animals use the feeding organ to grasp the tentacles of cirratulid polychaetes and pull them into the labial cavity. Gut analyses indicate that digestion begins in the labial cavity, and the partly digested worm is passed to the buccal cavity by the accessory organ.

How can these feeding types be used in a more meaningful classification of the family? I do not intend to make any recommendations as to which generic names should be used, but will merely point out the feeding types that should be given generic status.

I would place all terebrids with the Type I feeding apparatus into one genus, primarily on the basis of internal morphology and similarities of life history. Shells in this group are weakly sculptured, have a wide aperture, and generally are large and heavy with a small number of whorls.

On the basis of shell morphology alone I would suggest that all Type IIA terebrids show evidence of descent from one ancestral type. These all have

small shiny shells with few whorls and a flared aperture. Based on similarities in internal morphology and life history as well, I conclude that the animals are sufficiently different to include them all in the genus *Hastula*, as is now done by many workers.

Type IIB species appear to be closely related. All have a long slender shell with many whorls, a constricted aperture, and a sinuated lip. This feeding type includes *Terebra subulata*, the nominal species for the genus, so I have included all Type IIB terebrids in the genus *Terebra*. *Terebra subulata* was erroneously described by Lamarck as lacking a radula.

Species with the Type III feeding apparatus are easily distinguished on the basis of shell characteristics. While it is possible that they may eventually be divided into more than one genus, I suggest for the present that they be included under one genus, possibly *Myurella*, as suggested by Adams and Adams, 1858.

REPRODUCTION AND DEVELOPMENT IN FLORIDA *CERITHIUM*

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The life histories of *Cerithium muscarum*, *C. variabile* [= *C. lutosum*—ED.], *C. eburneum*, *C. literatum*, and *C. auricomum* were investigated. The Cerithiidae have open genital ducts, are aphyllid, and lay their eggs in gelatinous strings or tubes attached to the substratum either as a tangled mass or a flat coil. Their mode of reproduction and development is of two kinds. The first occurs among the more stenohaline species: *C. floridanum*, *C. literatum*, *C. eburneum*, *C. algicola* and *C. atratum*, and is the most common kind seen by past workers (Lebour, 1945; Marcus, 1964; C. C. Davis, 1967) and in the present study. There are many eggs, rapid cleavage and attainment of the veliger stage, a short incubation period, and emergence of the larvae as free-swimming planktotrophic veligers. This is the type of development described for the closely related genera *Bitium* (Fretter and Graham, 1962), *Cerithiopsis* and *Triphora* (Lebour, 1933; Fretter, 1951).

The second pattern was seen in the two more euryhaline species, *Cerithium variabile* and *C. muscarum*, and involves fewer but larger eggs, slower development, and a lengthy incubation period within the egg capsules, the young emerging only when completely metamorphosed. In the case of *C. muscarum*, this involves the production of spermatophores, which have never before been recorded in a marine member of the superfamily Cerithiacea. Spermatophores of *C. muscarum* closely resemble those described for *Goniobasis* in the freshwater family Pleuroceridae (Cerithiacea) by Woodard (1934; 1940) and Dazo (1965).

Sperm transfer was not observed in any other of the species. All species examined had both eupyrene and apyrene sperm. The spawn of the Florida species studied is similar to spawn described for cerithiids in other parts of the world. The egg masses of the closely related genus *Cerithidea* are also similar.

Aspects of the reproduction and development were compared with the observations on West Atlantic species by other workers.

SEXUALLY DIMORPHIC ARCHAEOGASTROPODS AND RADULAE

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Both the shells and rhipidoglossate radulae of *Hiloua* Pilsbry, a subgenus of *Tricolia* Risso (Trochacea: Phasianellidae), are sexually dimorphic. Sexual differences in the sizes and shapes of archaeogastropod shells are already known [H. B. Baker, 1926:52-54, *Viana*; Lamy, 1937:296-297, review of other cases], but the shape differences reported herein are dissimilar. Previously, sexually dimorphic radulae have been convincingly reported only in the widely unrelated neogastropod (rachioglossan) families Muricidae (*Drapella*, *Nassa* [alias "*Topas*"], and possibly *Mancinella* and *Pexilla*] [Arakawa, 1958, 1964; Maes, 1966], and Buccinidae (*Pisania luctuosa* [Tappanone-Canevari]) [Cernohorsky, in press].¹

Hiloua is restricted to shallow water and ranges from East Africa to the Hawaiian and Cook Islands, north to Honshu, Japan, and south to New South Wales, Australia. Male shells are smaller than female shells and unlike females have flared outer lips and consequently enlarged apertures. Males and females have been considered different species, and so also have color forms in this notoriously polychromatic group. In both sexes there is substantial geographic variation in maximum attained shell sizes. The largest sizes occur in Japan (maximum observed shell lengths: 3.5 mm in males and 5.2 mm in females), and the smallest sizes in the Seychelles (maximum lengths: 1.3 mm in males and 1.8 mm in females) and Cocos-Keeling Islands. The allopatric forms of *Hiloua* show clinally continuous variation and the distinctness of populations reflects their geographic isolation. A pelagic larval stage is suppressed, and populations at islands surrounded by deep water are semi-isolated. Large samples collected from algae are available from some localities, and these include numerous juveniles. The sex ratio is curiously disparate: only 32 to 23 percent of all adults are males.

Except for Japanese populations (in which radular dimorphism is indistinct), male *Hiloua* radulae have about half as many marginal teeth per transverse row as do females. The actual numbers correlate with shell size. The illustrations show right halves of two transverse rows of teeth from each sex in a fairly large-shelled population of *Tricolia (Hiloua) variabilis* (Pease) at Kauai, Hawaiian Islands. The male (Fig. 1) has 8 marginals, the inner of which are pointed distally; the female (Fig. 2) has 16 marginals, the inner of which are digitately cusped. The cusps of the median and three lateral teeth are narrower in the male than the female. In the large-shelled Japanese specimens the maximum observed numbers of marginals are 43 in males and 51 in females. In

¹A nassariid (*Nassarius* [alias "*Nassa*"]) once was suggested to have sexually dimorphic radulae but this was later shown to be wrong. According to Maes (1966) they may occur in the Fasciolaridae. Recently, a heteropod (*Atlanta inflata* "Souleyet" [Orbigny?]) has been reported to have sexually dimorphic rachioglossate radulae [Richter, 1969:353-354, fig. 3]; I think the evidence is unconvincing. According to Arakawa (1969 and *in litt.*), Mr. H. Elton Woodward [Florida State University] has found sexually dimorphic radulae in a cymatiid; according to Woodward himself (*in litt.* to Hal Lewis) there is no evidence for this.