

**Note**  
**End-Plate Spicules in *Bohadschia marmorata* (Jaeger)**  
**(Holothuroidea: Holothuriidae)**

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**Abstract**—End-plate spicules from the tube feet of the sea cucumber *Bohadschia marmorata* are described. These spicules may be confused with large plate-like spicules in the body wall, which are not supposed to be in this genus. End-plate spicules are generally considered of no taxonomic value, but they are conspicuously missing from specimens originally described as *Holothuria bivittata* and currently placed in synonymy with *B. marmorata*. Considering the taxonomic problems with *Bohadschia*, and the type species, *B. marmorata*, it may be useful to use end-plate spicules in future Holothurian taxonomic work.

**Introduction and Methods**

Sea cucumbers (Holothurians) constitute a significant percentage of the biomass and diversity of shallow Indo-pacific waters. This contrasts sharply, however, with the small worldwide number of experts in Holothurian taxonomy. In such situations, reliance on the literature is extremely important, since direct communication with Holothurian taxonomists is not always easy. For the person curious about Holothurian taxonomy but untrained in its details, the common genus *Bohadschia* presents major difficulties. First, the type species for *Bohadschia*, *B. marmorata* has been divided and recombined in various ways and with varying degrees of agreement into as many as seven species (*similis*, *koellikeri*, *tenuissima*, *vitiensis*, *clemens*, *bivittata*, and *marmorata*) (Panning 1929, Panning 1944, Rowe & Doty 1977, Cherbonnier 1984). *Bohadschia cousteaui* Cherbonnier (1955) may be yet another synonym. Second, two species were assigned to *Bohadschia* without exactly fitting Jaeger's (1833) original definition of the genus: *B. graeffei* (Semper) and *B. drachi* Cherbonnier have 25 tentacles rather than the specified 20. Finally, what has become the defining character for *Bohadschia*, a lack of plate-like or table-like spicules (Rowe 1969, Rowe & Doty 1977, Clark & Rowe 1971), can be extremely confusing for the neophyte who is unaware of end-plate spicules. The purpose of this note is to describe these end-plate spicules, demonstrate their potential significance to taxonomy, and discuss recent taxonomic changes in *Bohadschia*.

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In December 1995, I collected 26 specimens of *B. marmorata* around the Micronesian island of Pohnpei (7°N, 158°10'E), specifically, from mangroves and grassflats around Temwen (Nan Madol). These specimens had the color pattern originally described for *B. marmorata*: dark brown dorsal blotches clearly demarcated from a light brown background. In addition, two specimens were collected that match the species originally described as *Holothuria bivittata* (Mitsukuri 1912) but currently placed in synonymy with *B. marmorata* (Rowe and Doty 1977); this type has two dorsal cloudy beige transverse bands across a cream-colored background. All specimens were stored in isopropyl alcohol and transported to Archbold Biological Station, Lake Placid, Florida. For all 28 specimens, spicule samples were made from the dorsal body wall about 1 cm anterior to the anus, the middle ventral body wall, and the tentacles. Body wall samples were made by slicing down to, and sometimes through, the musculature and removing an approximately 10 mm by 2 mm strip. These were cleared on microscope slides by adding household bleach, removing excess tissue with tweezers, and washing with water as described by Rowe & Doty (1977). The remaining spicules were preserved under Euparal mounting medium and cover slips. Later, spicule samples were made from just tube feet by removing five tube feet from each specimen and clearing away tissue with bleach as described above. All spicule slides and whole specimens have been deposited at USNM-Smithsonian.

### Results and Discussion

The body wall spicules generally match the spicule descriptions for *B. marmorata* (Fig. 1). However, twenty of the 26 dorsal spicule samples (77%) from the classic *B. marmorata* types contain large plate-like spicules, two of which are shown in Figures 2 and 3. One ventral sample contains a plate-like spicule, but they are missing from oral tentacle samples. No such spicules are found in the two cream-colored (*B. bivittata*) types. Plate-like spicules are often broken, and no more than two such spicules are found per slide. They are much larger than the usual rosette or club-like spicules (also shown in Figs. 2 and 3 for comparison), and

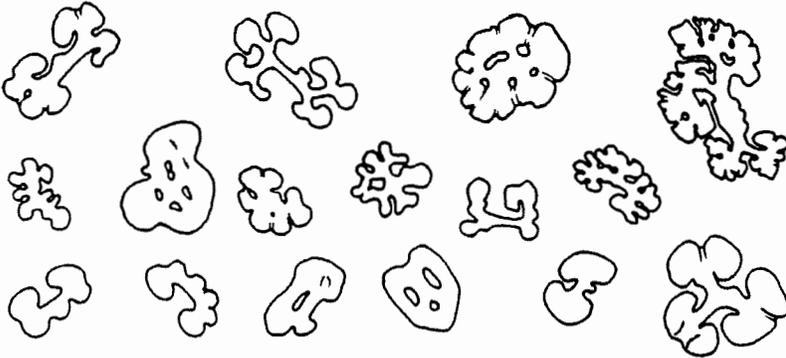


Figure 1. Body wall spicules from specimens of *Bohadschia marmorata*.

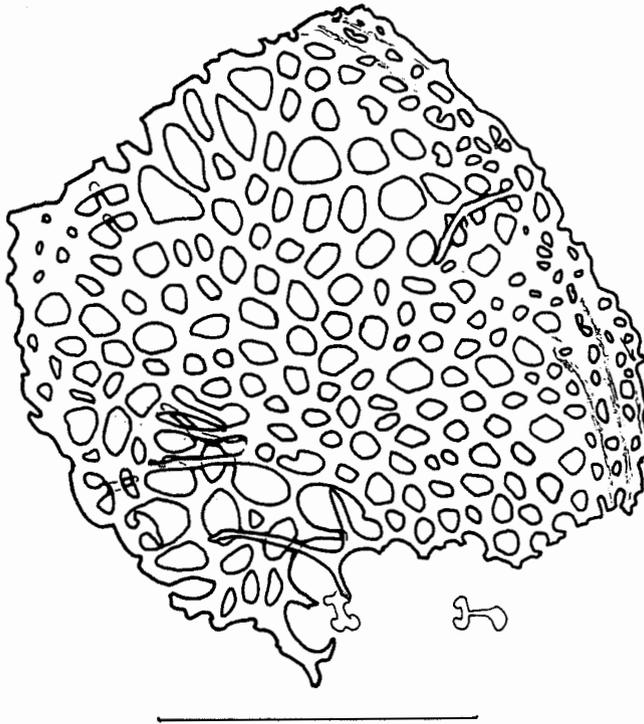


Figure 2. End-plate spicule from *Bohadschia marmorata*; scale bar 100 $\mu$ m.

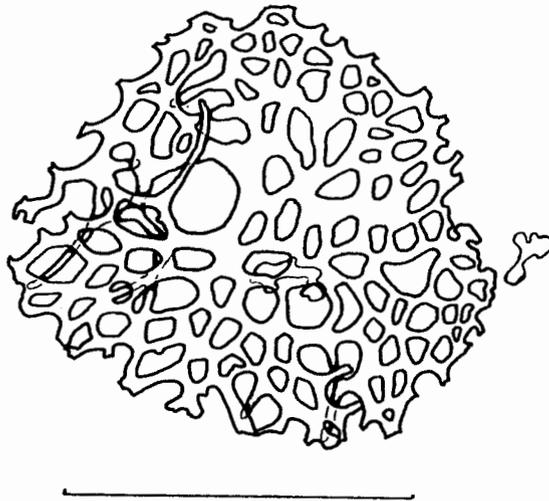


Figure 3. End-plate spicule from *Bohadschia marmorata*; scale bar 100 $\mu$ m.

they are curved in the middle. After communicating with Drs. F.W.E. Rowe and C. Massin, I learned that these are not body wall spicules, but end-plate spicules from the ends of the tube feet, thus explaining the directive in Rowe and Doty (1977) to take only small body wall samples when making preparations of body wall spicules; large body wall samples also include tube feet. Indeed, just tube feet samples contained end-plate spicules in the *B. marmorata* specimens. However, no end-plate spicules were found in the two cream-colored (*B. bivittata*) specimens.

End-plate spicules are generally considered to be of little or no taxonomic value. However, their complete absence from samples of the cream-colored, *bivittata*-type specimens, a phenomenon mentioned also by Mitsukuri in his notes on the species, provides a strong basis to question its synonymy with *marmorata*. Indeed, in the absence of experiments determining reproductive compatibility, taxonomy of sea cucumbers will have to depend on documentation of characters that sharply differ from type to type versus those that change gradually in concert with geographic differences. This process of documenting character states and noting breaks and clines has implications even at the generic level.

When Rowe published his review of the Holothuriidae (1969), the description given for *Bohadschia* was already contradicted in the literature. Cherbonnier's (1955) description of *B. drachi* showed large plate-like spicules from the tentacles (Fig. 4b) and reported the presence of 25 oral tentacles. In 1984, Cherbonnier published drawings of plate-like spicules from tentacles of *B. graeffei* (Fig. 5c), and Levin et al. (1984) reported it as having 25 oral tentacles. *Bohadschia drachi* and

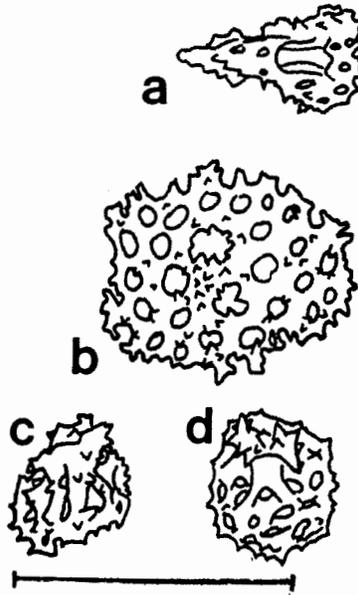


Figure 4. *Pearsonothuria drachi* (Cherbonnier) (formerly *Bohadschia drachi*) spicules redrawn from Cherbonnier 1955; scale bar 100 $\mu$ m.

*graeffei* also have spicules called “towers” or “stools” (Figs. 4c, d; Figs. 5d, e), which are not found in other species of *Bohadschia*.

Levin et al. (1984) compiled a list of differences between *B. graeffei* and other *Bohadschia* long enough to warrant erecting a new genus: *Pearsonothuria*. The presence of “rocket-shaped” or “club-shaped” spicules (Figs. 4a, 5a, b) sufficiently separates *graeffei* and *drachi* from all other Holothuriids. More important than spicules, perhaps, the behavior and general morphology of *P. graeffei* are unlike species currently in *Bohadschia*. *Pearsonothuria graeffei*'s pipe-shaped body, shallow coral habitat preference, diurnal activity, and long tentacles contrast sharply with the cigar-shaped, sand-ingesting, often nocturnal, short-tentacled *B. marmorata* and *B. argus*. In addition, *Pearsonothuria* has a thinner body wall and discharges Cuvierian tubules more reluctantly than *Bohadschia*. In this light, chemical differences between *P. graeffei* and *Bohadschia*, as reported by Levin et al. (1984), are not surprising and only strengthen their case for removing *graeffei* and closely related species from *Bohadschia*.

With this report, perhaps end-plate spicules can become a regular item in taxonomic accounts of Holothurian species. They have potential as a new character, which is important in cases such of highly variable species like *B. marmorata*. At the very least, they should not be confused with plate-like spicules in the body wall, as I had done.

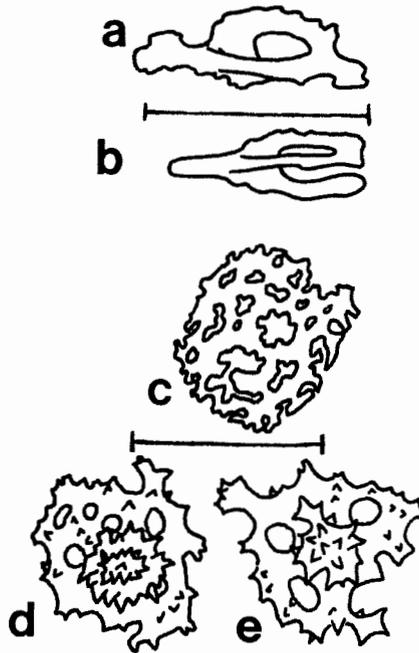


Figure 5. *Pearsonothuria graeffei* (Semper) (formerly *Bohadschia graeffei*) spicules redrawn from Cherbonnier 1984. Scale bars: a, b = 100 $\mu$ m, c-e = 50 $\mu$ m.

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