

***Megastraea turbanica* (Dall, 1910) vs. *Megastraea rupicollina*
(Stohler, 1959) (Turbinidae)**

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ABSTRACT The large eastern Pacific Turbinidae, *Megastraea rupicollina* (Stohler, 1959) and the fossil *M. petrothauma* (Berry, 1940) were treated by McLean (1970) as junior synonymies of *M. turbanica* (Dall, 1910). This paper focuses on *M. rupicollina* and *M. turbanica*, but includes *M. undosa* (Wood, 1828) and the fossil *M. petrothauma*. Holotypes of three of these species are illustrated, the location of the *M. undosa* holotype is unknown, a comparative diagnosis of the above four taxa is provided, and a historical perspective presented. *Megastraea rupicollina* and *M. undosa* are the species harvested commercially on the west coast of the Baja California peninsula, not *M. turbanica*. Based on information presented, *Megastraea rupicollina* is returned to species status. Based on the type series of *M. petrothauma* and diagnosis, it is also returned to full species status. In addition, a summary in Spanish is provided.

ABSTRACTO

Los grandes Turbinidae del Pacífico oriental, *Megastraea rupicollina* (Stohler, 1959) y el fósil *M. petrothauma* (Berry, 1940) fueron tratados por McLean (1970) como sinonimias menores de *M. turbanica* (Dall, 1910). Este artículo se centra en *M. rupicollina* y *M. turbanica*, pero incluye *M. undosa* (Wood, 1828) y el fósil *M. petrothauma*. Se ilustran los holotipos de tres de estas especies; se desconoce la ubicación del holotipo de *M. undosa*. Proporciona un diagnóstico comparativo de los cuatro taxones anteriores y se presenta una perspectiva histórica. *Megastraea rupicollina* y *M. undosa* son las especies que se cosechan comercialmente en la costa oeste de la península de Baja California, no *M. turbanica*. Sobre la base de la información presentada, *Megastraea rupicollina* vuelve a la categoría de especie. Sobre la base de la serie tipo de *M. petrothauma* y el diagnóstico, también se devuelve al estado de especie completa. Además, se proporciona un resumen en español.

KEY WORDS *Astraea*, *Pomaulax*, *Megastraea*, *petrothauma*, *undosa*, *turbanica*, *rupicollina*

INTRODUCTION

Currently, three extant species in the turbinid genus *Megastraea* are known from southern California and the west coast of Baja California, Mexico. They include *Megastraea turbanica* (Dall, 1910), *M. rupicollina* (Stohler, 1959), and *M. undosa* (Wood, 1828). The latter two species are harvested commercially along the Baja California peninsula and southern California.

While working on the biology of *Megastraea turbanica*, a review of the literature including the original description of that species and associated synonymies was conducted. The authors noted the description of *Pomaulax turbanicus* by Dall (1910),

[currently *Megastraea turbanica*] appeared notably different from the species that had been synonymized with that taxon. Consequently, the question was raised as to whether the name *M. turbanica* was being correctly applied to the species currently harvested commercially. Some descriptions by W.H. Dall (1910) were occasionally lacking in detail, and in this instance, the description of *Pomaulax turbanicus* did not include a diagnosis or illustration of the holotype.

The goals of this paper are to review the status of *M. turbanica*, *M. rupicollina*, *M. undosa*, and the fossil *M. petrothauma* (Berry, 1940); provide definitive diagnoses for each of these four species; review historical events; and evaluate the taxonomic status

of *M. rupicollina* and *M. petrothauma* as synonymies of *M. turbanica*. A partial summary of this paper in Spanish is included.

Abbreviations:

BD	Basal Diameter
CAS	California Academy of Sciences, Invertebrate Zoology and Paleontology, San Francisco
H/W	Ratio of Height to width. Ratio >1 shell taller than wide, <1 shell wider than tall
LACM	Natural History Museum of Los Angeles County, Malacology Department
SBMNH	Santa Barbara Museum of Natural History
SDNHM	San Diego Natural History Museum
SIOMIBC	Scripps Institute of Oceanography, Marine Invertebrate Benthic Collection, San Diego
UCMIP	University of California Museum of Invertebrate Paleontology, Berkeley
USNM	National Museum of Natural History, Smithsonian Institution, Washington

METHODS

Large numbers of commercially collected *Megastraea* shells from Mexico were available for examination and live specimens of *M. undosa* and the species thought to be "*M. turbanica*" were collected by the authors off the coast of San Diego, California. The following museums were visited: San Diego Natural History Museum (SDNHM), Natural History Museum of Los Angeles County (LACM), Santa Barbara Museum of Natural History (SBMNH), National Museum of Natural History, Smithsonian (USNM), and University of California Museum of Invertebrate Paleontology, Berkeley (UCMIP) and their material examined. The holotypes of *Pomaulax turbanicus*, *Astraea (Uvanilla) rupicollina*, and *Astraea (Pomaulax) petrothauma* were examined as were paratypes and

non-type material in those collections. Curators at the California Academy of Sciences (CAS), departments of Invertebrate Zoology and Paleontology and the Scripps Institute of Oceanography, Marine Invertebrate Benthic Collection (SIOMIBC) kindly reviewed their collections for *Megastraea*.

DISCUSSION

The large Turbinidae that occur in the northeastern Pacific from central Baja California Sur, Mexico, to southern California are unique, and were placed by McLean, 1970, in the *Astraea* subgenus (*Megastraea*), based on the size of mature shells, operculum, heavy fibrous periostracum, and shell structure. Hickman & McLean, 1990, continued the use of *Megastraea* as a subgenus of *Astraea*. Taniguchi & Rogers-Bennett, 2001, of California Fish and Game, may have been the first to use *Megastraea* as the generic name for *Astraea undosa*.

In 2023 the authors published a detailed paper regarding the biology of *Megastraea undosa* and had intended to include *M. turbanica* but did not have sufficient live collected specimens for comparison. During the subsequent effort on *M. turbanica*, they noted that the description by Dall (1910) was not consistent with shells currently being called *M. turbanica*. If the description by Dall did not match the current perception of *M. turbanica*, was the description in error? Or was the description correct, and subsequent authors mis-applied the name *M. turbanica* to a different species?

After examining the holotypes of *Pomaulax turbanicus* and *Astraea (Uvanilla) rupicollina* at the USNM, the authors confirmed that the description by Dall (1910) was consistent with the holotype of *P. turbanicus*. Therefore, for over five decades the name *Megastraea turbanica* has been mis-applied by subsequent authors to *M. rupicollina*, a very different species. Historical information, holotype illustrations, and comparative diagnosis of key characters are presented in support of the changes that returns *M. rupicollina* and *M. petrothauma* to full species status.

**Review of extant *Megastraea*, and
the fossil *M. petrothauma***

SYSTEMATICS

Phylum Mollusca Cuvier, 1795
 Class Gastropoda Cuvier, 1795
 Subclass Vetigastropoda Salvini-Plawen, 1989
 Order Trochida Rafinesque, 1815
 Superfamily Trochoidea Rafinesque, 1815
 Family Turbinidae Rafinesque, 1815
 Genus *Megastraea* McLean, 1970
 Type species: *Trochus undosus* Wood, 1828,
 by original designation
 Diagnosis: *Astraea (Megastraea) undosa* McLean, 1970

Megastraea turbanica (Dall, 1910)
 (Figures 1a & 1b, 5a)

Pomaulax turbanicus Dall, 1910:134-135.

Astraea (Megastraea) turbanica McLean, 1970:
 13(1):71-72.

Megastraea turbanica Taniguchi, I. & L. Rogers-
 Bennett. 2001:141.

***Megastraea turbanica*.** Figures 1a & 1b illustrate the holotype of *Pomaulax turbanicus* described by Dall, 1910. [Holotype: USNM 111242] Fish Commission station # 2989, in 36 fathoms, in coral, off Magdalena Bay, Lower California. The holotype has a height of 37.5 mm, and basal diameter (BD) of 41.0 mm, the shell is wider than tall; there are six remaining whorls, the protoconch and part of the first whorl are missing. The holotype appears to be the only known specimen of this species. With six whorls the BD of *M. turbanica* is approximately one-half the size of either *M. undosa* or *M. rupicollina* with the same number of whorls, suggesting that *M. turbanica* is a smaller species.

Original Description of *Pomaulax turbanicus* Dall 1910:

“Shell moderately large, rather thin, brilliantly pearly inside, covered with a reddish brown periostracum which becomes olivaceous on the base; form rather depressed, with turgid whorls, about six in all, the nucleus white, blunt, imperfect;

base flattened, bordered by a sparsely nodulous carina; sculpture on the spire of slightly protractive, rounded, short, rather elevated riblets reaching about half way forward on the whorl from the suture (17 on the last whorl), ending in or barely separated from the same number of stout nodules at the periphery, with a marked sulcus separating them from a similar row of nodules on the margin of the base; base with four somewhat undulated spiral ridges separated by subequal interspaces, except the inner pair which are smaller and closer to each other; base imperforated, swollen at the base of the pillar; aperture ample; surface of the body erased, leaving visible pearly and white substance; the pillar arcuate, pearly; with no anterior prominence or tooth; outer lip base simple, sharp; operculum white, rounded, shelly, with three partly gyrate, very prominent, granose, narrow ribs, the space between them excavated and smooth. Height of shell 37.5 mm; of last whorl 30.0; of aperture (vertical) 37.5; max. diameter 41.0 mm.”

Dall, 1910 stated the shell was thin, the authors would add the word fragile. The operculum (Figure 5a) had been previously broken and repaired. Unfortunately, a missing fragment would have revealed an important diagnostic character regarding the nature and angle of the three structural ribs on the exterior of the operculum.

Figures 1-4 illustrate the shells of *M. turbanica*, *M. rupicollina*, *M. undosa*, each with six whorls or nearly so, except *M. petrothauma* with five whorls, and are accompanied with a comparative diagnosis. In the case of *M. rupicollina* and *M. undosa* changes are noted regarding the radial cords, and the height to width ratio of older shells (Tuskes & Tuskes 2023). Hence the reason for comparing shells with similar numbers of whorls.

With only one small specimen of *A. turbanica* known, McLean (1970) assumed that the large specimens of *A. rupicollina* represented mature *A. turbanica*, and incorrectly made *M. rupicollina* a junior synonym. The most distinctive features of *M. turbanica* are: the enlarged-elevated axial ribs that give the shell a bulbus-stepped profile; the large projecting subaxial nodules; the lack of a continuous radial cord, even on the sixth whorl,

instead, there are two parallel rolls of non-connected nodules (Figures 1a & 1b).

Megastraea rupicollina (Figures 2a & 2b) has two prominent continuous radial cords well developed by the fourth whorl, which are separated by a notable imperforation; shell profile is conical with the imperforations contributing to a jointed appearance. The diagnosis and illustrations provide more details. For an additional comparison, Figures 7b -7c illustrate two small *M. rupicollina* with basal diameters less than one centimeter larger than that of the *P. turbanicus* holotype (Figure 1a.). The difference in shell morphology between these two species is striking. The species currently called *M. turbanica* (Dall, 1910) in the literature is *M. rupicollina* of Stohler, 1959, not *Megastraea turbanica* (Dall, 1910).

Megastraea rupicollina (Stohler, 1959)
(Figures 2a & 2b, 5b, 6a-6c, 7a & 7d)

Astraea (Uvanilla) rupicollina Stohler, 1959:423-439, figs. 1-7.

Astraea (Megastraea) turbanica (Stohler, 1959), McLean 1970:71-72.

Megastraea rupicollina (Stohler, 1959) Taniguchi & Rogers-Bennett. 2001: 140-141.

Not: *Astraea turbanica* (Dall, 1910). Gluyas-Millan, M.G. & D.Z. Martinez-Quiroz. 2010 18(1):5-12. Turrubiates-Morales, J. R. & M. G. Gluyas-Millan. 2007. (40):62.

Not: *Astraea (Megastraea) turbanica* (Dall, 1910). McLean, 1970:71-72. *Megastraea turbanica* (Stohler, 1959). Keen 1971:354-355, fig. 151. Abbott, 1974:60, fig. 48 (refigured from Stohler, 1959). [= *Megastraea rupicollina* (Stohler, 1959)]. Myers, B. W. 1989: 21(3):22-25.

Not: *Megastraea turbanica* (Stohler, 1959). Trego, K. D. 2005. 37(3):36. Berschauer & Clark, 2018:49, figs. E-F. Alf, 2019:79, fig. 16. Tuskes & Tuskes, 2023:40-42, 45, 50, fig. 8a-8c. 1-7.

***Megastraea rupicollina*.** Figures 6a – 6b illustrate the holotype of *Astraea (Uvanilla) rupicollina* in the USNM # 610331. Type locality: “Rockpile approximately eight miles southeast of southern tip of South Coronado Island, Lower California,

Mexico.” Regarding the type locality of *M. rupicollina*, in the text, Stohler incorrectly calls it “Lower” California Mexico. Baja California, the northern territory, became a state in 1952. The southern territory was called Lower California and became the state of Baja California Sur in 1974. In the description, the GPS coordinates for the type locality are in Baja California and approximately 25 Km south of the U.S.-Mexican border. That location is consistent with the reference point of Isla Coronado Sur. The Baja California Sur boundary is approximately 525 Km south of the type locality for this species. Figures 2a & 2b, are moderate sized shells (6 whorls) and diagnosis.

Keen, 1958 in the first addition of Sea Shells of Tropical West America, illustrated *Astraea turbanica* (copied from Grant & Gale, 1931) and although not stated in the text, it is a photo of the *P. turbanicus* holotype in the USNM collection. The shell illustrated by Keen (1971) in the second edition is the holotype of *M. rupicollina*, as designated by the numbered tag in the aperture.

In the second edition of Sea Shells of Tropical West America, Keen 1971 acknowledges in the preface numerous individuals for their contribution, including Dr. James McLean for his contribution to much of the Archaeogastropoda that included the Turbinidae. In Keen 1971, McLean repeated his incorrect assumption [from his 1970 paper] that large *M. rupicollina* simply represented mature *M. turbanica*. Differences in shell characteristics are presented in the comparative diagnosis (Figures 2a-2b) and Figures 7b-7c illustrate two small *M. rupicollina* similar in size to *M. turbanica* (Figure 1a).

The description of *M. rupicollina* by Stohler 1959, included the shell, animal, habitat, and measurements of *M. rupicollina* and *M. undosa*, and sparse information regarding *M. petrothauma*. Dall was not cited by Stohler (1959), possibly because *Pomaulax turbanicus* was found 800 Km south in a different marine province and different genus.

Megastraea rupicollina is the largest member of the genus. The holotype at USNM (Figures 6a & 6b) has a height of 149 mm and BD of 134 mm. The authors have found that shells of that size off San Diego may exceed 800 grams in gross weight and have measured shells with a BD approaching 160 mm. Currently, the only known specimen of *M. turbanica* has a BD of 41 mm.

Among *M. rupicollina*, the first radial cord (lower) sits above the suture, the upper radial cord is generated by the linear extension/fusion of the subaxial nodules immediately below the axial ribs. Thus, two parallel radial cords occur from approximately the fourth through seventh or eighth whorls. In larger shells (BD >115 mm) the upper radial cord is often more protruding than the lower cord, which may be encroached upon by the suture, as in the holotype (Figures 6a - 6b). Among shells 120 mm and greater in BD, both radial cords may begin to regress, as illustrated by the holotype, leaving two parallel rows of large rounded isolated nodules with little or no imperforations between.

With the development of the *Megastraea* fishery on the west coast of Baja California in the mid- 1980s, biologists and regulators have followed the guidance in Keen 1971, which incorporated the synonym published the prior year by Mclean (1970). Regulations in Mexico address both the closure of the *Megastraea* harvest during the reproductive period, sets the annual take, and minimum size limit related to the basal diameter of *M. undosa* and “*M. turbanica*” (OJF item 12, 2023). The recognition of *M. rupicollina* as a distinct species may generate some unfortunate administrative consequences. But it is important that subsequent biological and taxonomic papers, and regulatory standards address the correct species. The illustrations (Figures 1 & 2), and accompanying diagnosis may be used to easily separate these two distinctive species.

Megastraea undosa (Wood, 1815)
(Figures 3a-b, 5c)

Trochus undosus Wood, 1828:16, pl. 5, fig. 1.
Trochus balaenarum Valenciennes, 1846: pl. 3, figs. 1-1c.

Imperator undosa (Wood, 1828). Tryon, 1883:307-308.

Astraliium (Pomaulax) undosum (Wood, 1828). Tryon, 1888:243, pl. 58, figs. 69-70.

straea (Pomaulax) undosus (Wood, 1828). Oldroyd, 1927:164, pls. 102-103.

Astraea (Pomaulax) undosa (Wood, 1828). Keep, 1935:165, fig. 137. Grant & Gale, 1931:818, pl. 31, figs. 6a-6b, 7. Abbott, 1954:124-125, pl. 18, fig. P. (as *Astraea undosa*). Under (Pomulax) heading.

straea undosa Wood, 1828: Morris, 1966:65, pl. 4, fig. 6, pl. 32, figs. 25-26. Abbott, 1968:76-77, fig. 5. McLean, 1978:24, fig. 10.5. Abbott & Haderlie, 1980:256-257, fig. 13.39 + 1 unnumbered fig. Abbott & Dance, 1982:50, unnumbered fig.

straea (Megastraea) undosa (Wood, 1828). McLean, 1970:71-72. *Megastraea undosa* (Wood, 1828).

Taniguchi & Rogers-Bennett, 2001:140-141. Bertsch & Aguilar Rosas, 2016:185, 1 unnumbered fig.

Berschauer & Clark, 2018:49, figs. A-B. Alf, 2019:77, 79, figs. 14-15. Tuskes & Tuskes, 2023:40-51, figs. 1a-7.

[ot: *Astraea (Pomaulax) undosa* (Wood, 1828). Palmer, 1958:149-150, pl. 19, figs.16-17 (holotype of *Imperator sulcus*). [= *Astraea* sp? not a *Megastraea*].

***Megastraea undosa*.** Holotype: location unknown. Type Locality: California. Figures 3a-3b illustrate *Megastraea undosa* and includes a comparative diagnosis as it has been confused with *M. rupicollina*. *Megastraea undosa* has been accepted based on Wood, 1828 listing the name *Trochus undosus* under a column heading *Trochus* (p. 16) and a drawing (Figure 1a, plate 5) in Index Testaceologicus, 1828. The type locality is “California”, which at the time included what is now known as California USA, Baja California, and Baja California Sur, Mexico. The location of the holotype that the drawing was based on is unknown. The species is harvested commercially, especially on the Pacific coast of Baja California, Mexico. The meat is canned. and the shells can be found in curio shops around the world. It is so well known that a lectotype seems unnecessary.

The shells are variable in color and sculpture within a single population as illustrated by Tuskes & Tuskes 2023. The identifying characteristics of *M.*

undosa shells include the triangular conical profile and single protruding radial cord that is typically undulated, (Figures 3a & 3b). The operculum is oblong and has a tapering shape, and structural ribs (Figure 5c) fuse near the apex and reflex approximately 90 degrees. The operculum of *M. rupicollina*, and that of the fossil of *M. petrothauma* are more oval with a rounded apex and the structural ribs fuse and reflex approximately 180 degrees (Figure 5b-5d). The broken operculum of *Pomaulax turbanicus* (Figure 5a) also appears oval, but with the partly repaired operculum, the configuration of the three ribs near the apex is uncertain.

Tuskes and Tuskes (2023) reviewed the diet, reproduction, growth rate, trend in shell size and depth, shell variation, commercial fishery, change in length to width ratio with size, and provided additional information on age, basal diameters, growth rate, and operculum length related to each age class, the details of which are not repeated here.

The length to width ratio of the shell changes with age, but not as drastically as that of *M. rupicollina*. There is no change in the structure of the single radial cord with age, as there is with large *M. rupicollina*.

Megastraea petrothauma (Berry, 1940)
(Figures 4a & 4b, 5d)

Astraea (Pomaulax) petrothauma Berry, 1940:156-158, pl. 18, figs. 2-3.

Astraea turbanica (Berry, 1940), McLean 1970:71-72. Keen 1971:354-355, fig. 151.

Magastraea rupicollina (Stohler, 1959) Taniguchi & Rogers-Bennett. 2001.

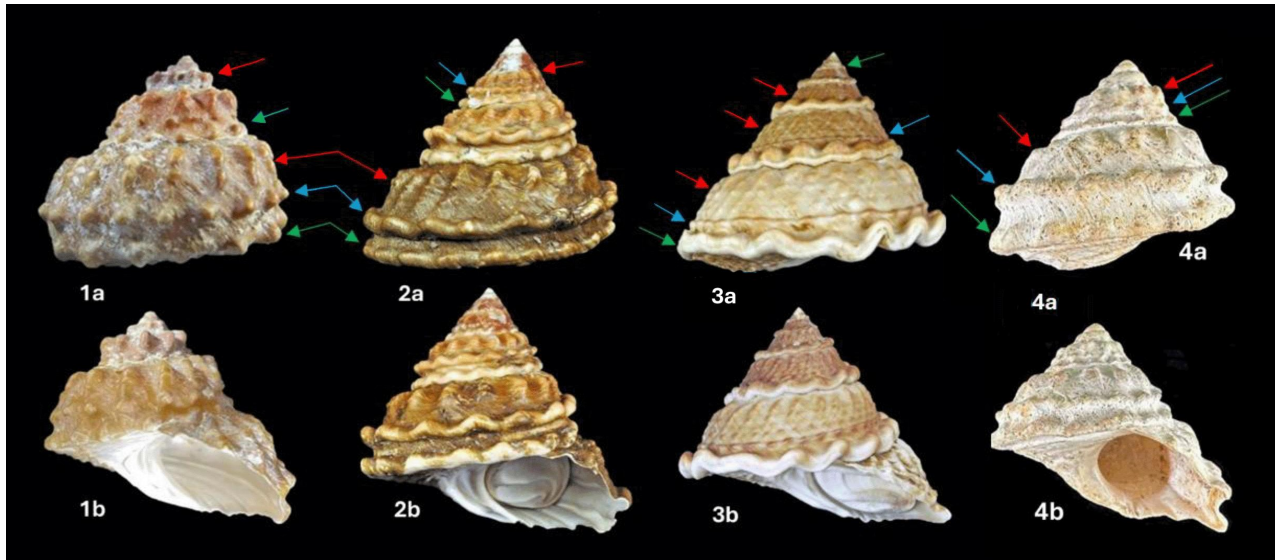
***Megastraea petrothauma*.** Figures 4a-4b illustrate the holotype of *Astraea (Pomaulax) petrothauma* SBMNH 34508 and has a height of 49.2 mm and BD of 39.2 mm. Type locality: Hilltop Quarry, San Pedro, California, Los Angeles County, California, lower Pleistocene. Berry retained the holotype (Berry #7701) and one paratype (Berry #7702) in his collection.

While visiting the SBMNH malacology collection the authors mentioned an interest regarding *M. petrothauma*. Vanessa Delnavaz, Associate Curator located the holotype and provided photos (Figure 4a & 4b) and the Berry paratype (not illustrated). Paratypes and non-type material were also examined at the USNM and SDNHM paleo collections to understand variability.

In addition to *A. rupicollina*, McLean (1970) also made *Astraea petrothauma* a junior synonym of *Astraea (Megastraea) turbanica*. His opinion regarding *A. petrothauma* was based on his assessment of similarity to *M. turbanica*. Compared to *M. turbanica*, the type of *M. petrothauma* does not have as strong of a stepped profile, the axial ribs and subaxial nodes are also more bulbous and broad, and in later whorls they fuse forming an additional continuous radial cord above the lower radial cord (Figures 4a & 4b). A paratype (USNM #498567) (Figure 7d) with a basal diameter of only 29.0 mm, already exhibits two well developed continuous radial cords. A smaller paratype with a BD of 26.3 mm (SBMNH 34509) has a well-developed basal cord and developing upper, second cord. These fused cords are not present on the larger holotype of *M. turbanica*. The holotype measurements are as follows: *Astraea petrothauma* height 49.2 mm, BD 39.3 mm with 5 whorls, H/W ratio =1.24; *Pomaulax turbanicus* height 37.5, BD 40 mm, with six whorls. H/W ratio = 0.94. The difference in BD between these two holotypes is less than 1 mm.

Based on the illustrations of these holotypes, measurements, and the diagnoses provided, the current authors believe that the fossil *M. petrothauma* is distinct from *M. turbanica*, and warrants return to species status.

After we examined specimens in several paleo collections, it is possible that material labeled as *Astraea pethrothauma* may include more than one species. Fossils represent a snapshot of evolution over hundreds of thousands or millions of years. As such, various locations over a broad area may represent divergent isolated populations that may or may not become distinct species. As of yet, the



Figures 1-4. Images of *Megastraea* (images_not to scale). Illustrated shells are in their sixth whorl, except *M. petrothrauma* holotype with five whorls. **Captions below. Diagnosis** applies to shells with basal diameters approximately 30 mm and greater.

Figure 1a-b. Holotype *Pomaulax turbanicus* Dall 1910, holotype USNM 111242 = *Megastraea turbanica*.

1. Axial ribs dominant and protruding on third whorl and beyond, extending to the height of suture above, giving the profile a stepped appearance. **2. Subaxial nodules** below axial ribs are independent, pyramidal, with rounded apex. **3. Radial cord** absent, nodules similar in appearance to subaxial nodules, not fused, not forming continuous f cord. *Megastraea rupicollina*. *M. undosa* and *M. petrothrauma* have prominent fused radial cords by fourth whorl. **4. Shell** fragile, profile stepped. Height 37 mm, width 40 mm.

Figure 2a-b. *Astraea (Unvanilla) rupicollina* Stohler, 1959, holotype USNM 610331 = *Megastraea*

rupicollina. **1. Axial ribs** globular on third to fifth whorl. On the fifth and subsequent whorls ribs are low, broad, become more angular. **2. Subaxial nodules** enlarging and fusing to form second (upper) undulating radial cord no later than fourth whorl, becoming as/or more dominant than lower radial cord; both cords separated by strong imperforation. **3. Radial cord** (lower) above suture minute but present on third whorl, undulating and prominent on subsequent whorls. Cords regress on shells >125 mm BD. **4. Shell** sturdy, profile conical, slightly jointed appearance. Height 86 mm, width 82 mm. Holotype figures 6a-6b.

Figure 3a-b. *Astraea undosus* (Wood, 1828), holotype locality unknown = *Megastraea undosa*.

1. Axial ribs present on third and subsequent whorls, low fused nodules and/or individual nodules in linear pattern. **2. Subaxial nodules** present on 3th and subsequent whorls, low and globular, slightly elongated forming a radial linear chain; Rarely fused or nearly so in later whorls to form a low, thin diminutive (upper) radial cord-like structure above the lower primary radial cord, as illustrated. **3. Radial cord** (lower) above suture present on third whorl, larger and prominent on subsequent whorls. Cord projecting, typically undulating; when cord is smooth, undulation reduced or absent. Primary radial cord present even on largest of shells. **4. Shell**. Sturdy and triangular. Height 76.5 mm, width 79.5 mm.

Figure 4a-4b. *Astraea (Pomaulax) petrothrauma* Berry 1940, holotype SBMNH 34508 = *Megastraea*

petrothrauma. **1. Axial ribs** globular present on third or fourth whorl. **2. Subaxial nodules** appear on third or fourth whorl, fusing to form upper radial cord on fifth or sixth whorl. **3. Radial cord** (lower) present on fourth to fifth whorl, well developed on fifth whorl; nodules fuse forming strong continuous cord smooth or undulated, with imperforation between upper and primary radial cord **4. Shell** moderate to sturdy, profile slightly bulbous/broad. Height 49.2 mm, width 39.3 mm.

variation observed in collections has not approached the phenotype of *M. turbanica*.

Collectively Chance, 1958 and Stohler, 1959 mentioned acquiring three live specimens of *M. petrothauma*, but neither author illustrated the shells, nor identified where they were deposited. All three specimens were eventually located, photographed and illustrated in this paper. Without doubt, all are *M. rupicollina* (Figures 7a-7c). The specimen identified by Chance, 1958 as *M. petrothauma* is from Isla Guadalupe, Baja California, and in the marine invertebrate collection of the SDNHM (#10395). It has a height of 131 mm, and BD of 115 mm (Figure 7a) and its appearance is typical *M. rupicollina*, a species not described until the following year by Stohler 1959.

Stohler 1959 discussed two live specimens of *M. petrothauma* also from Baja California, one from Sacramento reef near Isla San Jeronimo (Figure 7b), and the other from Isla Coronado Sur, Baja California (Figure 7c), both are immature specimens. The disposition of those two shells was not mentioned in his paper. The specimens of Stohler were eventually located at UCMIP at Berkeley in November of 2024. Dr. Ashley Dineen, responding to the author's request, located the material. Shortly thereafter, the authors visited the collection to examine and photograph the shells (Figures 7b & 7c). Figure 7d illustrates a small *M. petrothauma* paratype in much better condition than the holotype (Figure 4a-4b) for comparison with *M. rupicollina* on the same plate. Note the difference in profile, and the development of the radial cord(s) or lack thereof, between these two species.

SUMMARY

This paper focuses on *M. rupicollina* (Stohler, 1959) and *M. turbanica*, (Dall, 1910), but includes information regarding *M. undosa* (Wood, 1828) and the fossil *M. petrothauma* (Berry, 1940). A comparative diagnosis of all four species is provided, holotypes are illustrated, as are other relevant specimens.

Megastraea rupicollina and the fossil *M. petrothauma* were treated by McLean (1970) as junior synonymies of *M. turbanica*. The commercial harvest of *M. undosa* and "*M. turbanica*" began on the west coast of the Baja California peninsula during the 1980s, and these names are entrenched in both the literature and commercial fishing regulations of Mexico.

In the first addition of Sea Shells of Tropical West America, Keen, (1958) illustrated *Astraea turbanica* and although not stated in the text, it is a photo of the holotype in the USNM collection. The shell illustrated by Keen (1971) in the second edition is the holotype of *M. rupicollina* (Stohler, 1959). Both of these holotypes (Figures 1a & 1b & 7a & 7b) are illustrated. The decision to make the synonym was based on the incorrect assumption that the large *M. rupicollina* represented a mature *M. turbanica* (McLean, 1970, and illustrated in Keen (1971).

During our study of *M. turbanica* off San Diego, California, the description of *M. turbanica* by Dall 1910 was reviewed. The current authors realized the description did not apply to the species currently called *M. turbanica*. A subsequent visit to the USNM allowed the examination of the holotypes of both *M. turbanica* and *M. rupicollina*, which are two very different species (review diagnosis). The regulations in Mexico apply to *M. turbanica*, but that is not the species in the commercial catch, the species harvested are *M. rupicollina* and *M. undosa*.

Reports of the fossil species *M. petrothauma* being collected live in the late 1950s are incorrect. The specimens reported by Chance 1958 and Stohler 1959, as *M. petrothauma* were located and illustrated in this paper; they are specimens of *M. rupicollina* (review diagnosis).

Based on information presented in this paper, *Megastraea rupicollina* and the fossil *M. petrothauma* are returned to species status. The recognition that *M. rupicollina* and *M. undosa* are the two species harvested commercially, not *M. turbanica*, may generate some unfortunate

administrative consequences, but it is important that subsequent biological and taxonomic papers and regulatory standards address the correct species.

RESUMEN

Este artículo se centra en *M. rupicollina* (Stohler, 1959) y *M. turbanica*, (Dall, 1910), pero incluye información sobre *M. undosa* (Wood, 1828) y el fósil *M. petrothauma* (Berry, 1940). Se proporciona un diagnóstico comparativo de las cuatro especies, se ilustran los holotipos, así como otros especímenes relevantes.

Megastraea rupicollina y el fósil *M. petrothauma* fueron tratados por McLean (1970) como sinonimias menores de *M. turbanica*. La captura comercial de *M. undosa* y "*M. turbanica*" comenzó en la costa oeste de la península de Baja California durante la década de 1980, y estos nombres están arraigados tanto en la literatura como en las regulaciones de pesca comercial de México.

En la primera adición de *Sea Shells of Tropical West America*, Keen, (1958) ilustró *Astraea turbanica* y aunque no se menciona en el texto, es una foto del holotipo en la colección de la USNM. La concha ilustrada por Keen (1971) en la segunda edición es el holotipo de *M. rupicollina* (Stohler, 1959). Ambos holotipos (Figuras 1a y 1b y 7a y 7b) están ilustrados. La decisión de hacer el sinónimo se basó en la suposición incorrecta de que la *M. rupicollina* grande representaba una *M. turbanica* madura (McLean, 1970, e ilustrado en Keen (1971).

Durante nuestro estudio de *M. turbanica* en San Diego, California, se revisó la descripción de *M. turbanica* realizada por Dall en 1910. Los autores actuales se dieron cuenta de que la descripción no se aplicaba a la especie que actualmente se llama *M. turbanica*. Una visita posterior a la USNM permitió examinar los holotipos de *M. turbanica* y *M. rupicollina*, que son dos especies muy diferentes (diagnóstico de revisión). La normativa en México se aplica a *M. turbanica*, pero esa no es la especie en la captura comercial, las especies capturadas son *M. rupicollina* y *M. undosa*.

Los informes de la especie fósil *M. petrothauma* recolectada en vivo a finales de la década de 1950 son incorrectos. Los especímenes reportados por Chance 1958 y Stohler 1959, como *M. petrothauma* fueron localizados e ilustrados en este trabajo, son especímenes de *M. rupicollina* (diagnóstico revisado).

Con base en la información presentada en este artículo, *Megastraea rupicollina* y el fósil *M. petrothauma* vuelven a la condición de especie. El reconocimiento de que *M. rupicollina* y *M. undosa* son las dos especies que se capturan comercialmente, y no *M. turbanica*, puede generar algunas consecuencias administrativas desafortunadas, pero es importante que los documentos biológicos y taxonómicos posteriores y las normas reglamentarias aborden las especies correctas.

ACKNOWLEDGEMENTS

The authors thank the following museums and individuals for hosting our visits, providing assistance, and locating material. Without their assistance this paper could not have been completed: SDNHM, Pam Horsely Entomology Collection Manager/Collection Administrator for museum assistance, and Dr. Tom Deméré Curator of Paleontology for access to fossil *Astraea*; LACM, Lindsey T. Groves, Collection Manager for reviewing the manuscript prior to submission, assistance with synonymies, and museum access; David Waller, Carlsbad, California, for also reviewing the draft; SBMNH, Vanessa Delnavaz Associate Curator and Dr. Henry Chaney Director of Collections and Research for providing photos of the *M. petrothauma* holotype and museum assistance; UCMIP, Berkeley, Dr. Ashley Dineen Senior Museum Specialist for locating "lost" material, photographs, and assistance during our visit; CAS Science, Christina Piotrowski Senior Collection Manager Paleobiology and Elizabeth Kools Senior Curatorial Assistant Invertebrate Zoology for examining their collection; USNM Yolanda Villacampa, Research Assistant Invertebrate Zoology and Dr. Christopher Meyer, Chair Department of Invertebrate Zoology, for

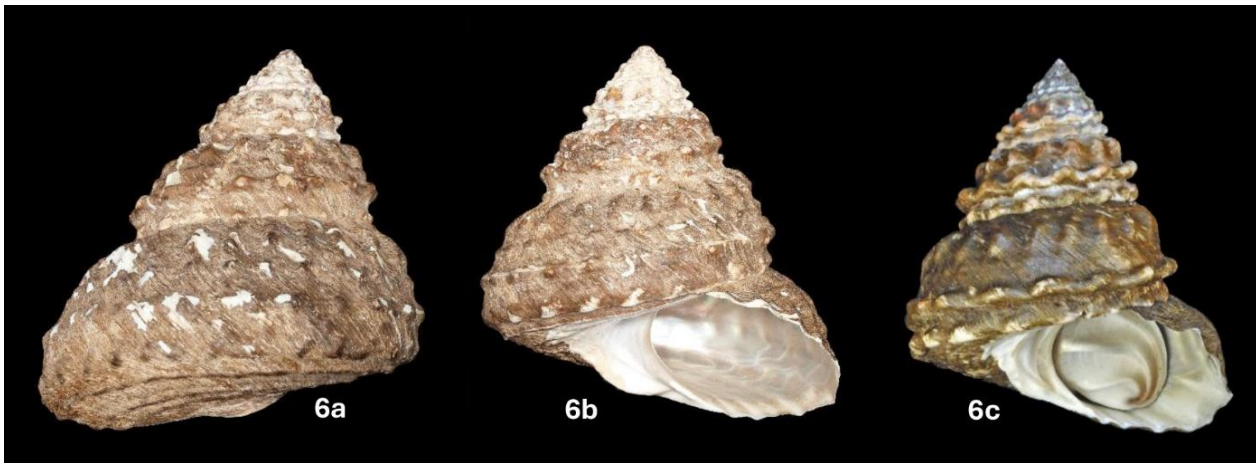
access to holotypes and photographs, and Dr. Stewart Edie Curator of Fossil Mollusca, Paleobiology, for access to fossil paratypes of *M. petrothauma*; and professor Esteban Felix Pico Center for Marine Sciences, National Polytechnic Institute La Paz, Baja California Sur, Mexico for locating the current Federal Fishery standards, and Ms. Marica Teresa Madruga of San Diego for confirming the translation of the abstract and summary to Spanish.

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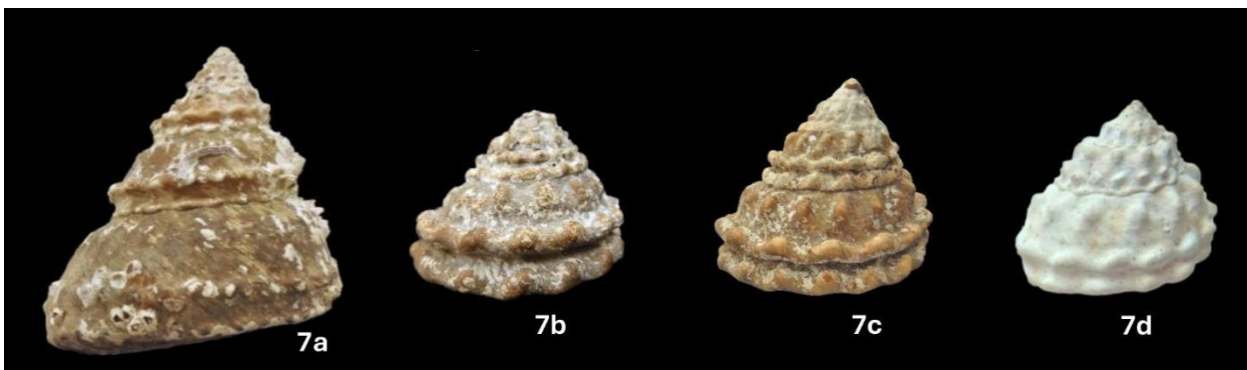
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Figure 5. *Megastraea opercula*. Length to width ratio (L:W) and external ribs orientation. **5a** *Megastraea turbanica*, USNM holotype repaired, one portion missing, L/W=1.21. Sculpture poorly defined compared to other species. **5b.** *M. rupicollina*, USNM holotype L/W = 1.32. **5c.** *M. undosa* L/W = 1.58. **5d** *M. petrothauma* (fossil) USNM paratype L/W = 1.23.



Figures 6. *Megastraea rupicollina*. **6a & b.** Holotype *Astraea rupicollina* Stohler (1959) USNM (610331), height 149 mm, BD 134 mm. Suture encroaching on lower radial cord. Note reduction of cords, compared to adjoining smaller shell. **6c.** *Megastraea rupicollina*, height 104 mm, BD 90 mm. Periostracum treated to maintain integrity, Suture below lower radial cord. Currently, San Diego is the only location in the USA where this species can be found.



Figures 7a-c. Shells of *M. rupicollina* incorrectly identified in the literature as living specimens of the fossil *Megastraea petrothauma*. Note, all have multiple double rows of radial cords starting on early whorls and differences in profile compared to fossil **7d.** *M. petrothauma*. **7a.** *M. rupicollina* from Isla Guadalupe, Baja California, Mexico. SDNHM (10395) height 136 mm, BD 116 mm. **7b.** *M. rupicollina*, San Jeronimo Reef, Baja California, Mexico. UCMIP (E2297), apex missing, BD 47.4 mm. **7c.** *M. rupicollina* SE of Isla Coronado Sur, Baja California, Mexico. UCMIP (E3231) height 53.2, BD 49.4 mm. **7d.** *M. petrothauma* paratype USNM (498567) height 30.5 mm, BD 29.0 mm.