*Coloquios de Paleontología*
1999, 50, 151-160

ISSN: 1132-1660

# New record of *Meoma ventricosa grandis* GRAY, 1851 (Echinodermata, Echinoidea: Brissidae) from the Lower Pliocene of Baja California, Mexico

# *Nuevo registro de* Meoma ventricosa grandis *GRAY, 1851 (Echinodermata, Echinoidea: Brissidae) del Plioceno inferior de Baja California, México*

Blanca Estela BUITRÓN-SÁNCHEZ [1], Alfredo LAGUARDA-FIGUERAS [2] y Francisco Alonso SOLÍS-MARÍN [2]

## ABSTRACT

A single specimen of the species *Meoma ventricosa grandis* GRAY, 1851, from the lower Pliocene-Marcos Formation beds of Carmen Island in the Gulf of California was studied. It constitutes a new fossil record of the subspecies in the early Pliocene of Mexico. The specimen was found associated with calcareous algae, corals, bivalves (*Pecten* and *Chione*) and other echinoids. The paleontological setting for this fauna was that of a shallow and tropical sea.

**Key words:** Echinodermata, Echinoidea, Brissidae, *Meoma*, lower Pliocene, Baja California, Mexico.

## RESUMEN

Se estudia un ejemplar de la especie *Meoma ventricosa grandis* GRAY, 1851 procedente de capas de la Formación San Marcos de edad Plioceno temprano, que floran en la Isla Carmen en el Golfo de California. Este hallazgo constituye un nuevo registro de la subespecie de el Plioceno temprano de México. El especimen se contró asociado

[1] Depto. de Paleontología, Instituto de Geología (IG), Universidad Nacional Autónoma de México (UNAM), Cd. Universitaria, Delegación Coyoacán, CP. 04510, D. F., México. E-mail: blancab@servidor.unam.mx.

[2] Laboratorio de Sistemática y Ecología de Equinodermos, Instituto de Ciencias del Mar y Limnología, UNAM, Cd. Universitaria, Delegación Coyoacán, Apdo. Post. 70-305, 04510 D. F., México. E-mail: fasolis@mar.icmyl.unam.mx.

con algas clacáreas, coralc, vivalvos (*Pecten* y *Chione*) y otros equinoides. La fauna se desarrolló en un mar tropical somero.

**Palabras clave:** Echinodermata, Echinoidea, Brissidae, *Meoma*, Plioceno inferior, Baja California, México.

## INTRODUCCIÓN

The fossil record of the genus *Meoma* GRAY has been little studied. MORTENSEN (1951) mentioned the existence of two recent species of this genus for the American coasts: *Meoma ventricosa* (LAMARK) *and Meoma grandis* GRAY. CHESHER (1970) expanded the genus *Meoma* by including a new species. He also considered the formally known Recent species as two subspecies of *Meoma ventricosa: Meoma ventricosa* s.s. and *Meoma ventricosa grandis*. Although the taxonomic status of these subspecies has been reviewed, some aspects of the classification at this level have not yet been completely resolved. SOLÍS-MARÍN *et al.* (1997) studied the morphology, systematics and distribution of *Meoma ventricosa grandis* and *M. ventricosa ventricosa* along Mexican recient coasts.

The purpose of this paper is to document a newly discovered *Meoma ventricosa grandis* of early Pliocene age of the San Marcos Formation (ANDERSON, 1950). There are few papers about fossil species of *Meoma ventricosa* in Mexico. WILSON (1948) studied one especimen that was collected in outcrops of the Infierno Formation (upper Pliocene) located in Santa Rosalía. Baja California.

DURHAM (1950) reported the presence of one poorly preserved and crushed specimen of *Meoma* sp. at the San Marcos Formation (lower Pliocene) of Carmen Island, Baja California. BUITRÓN (1968, p. 40; 1978, p. 110) and BUITRÓN & SOLÍS-MARÍN (1993, p. 223) mentioned the existence of *Meoma ventricosa* s.s. in Mexico.

The fossil material was collected in 1985 by students of Geology of the Facultad de Ingeniería, UNAM, during their field trip in Baja California.

## LOCATION AND STRATIGRAPHIC SUMMARY

The material is from Carmen Island, located between Coronado and Danzante Islands, in the Gulf of California (26° 04' N and 111° 05' W) and was collected on the outcrops of the San Marcos Formation (lower Pliocene), immediately to the north of Arroyo Blanco (Fig. 1).

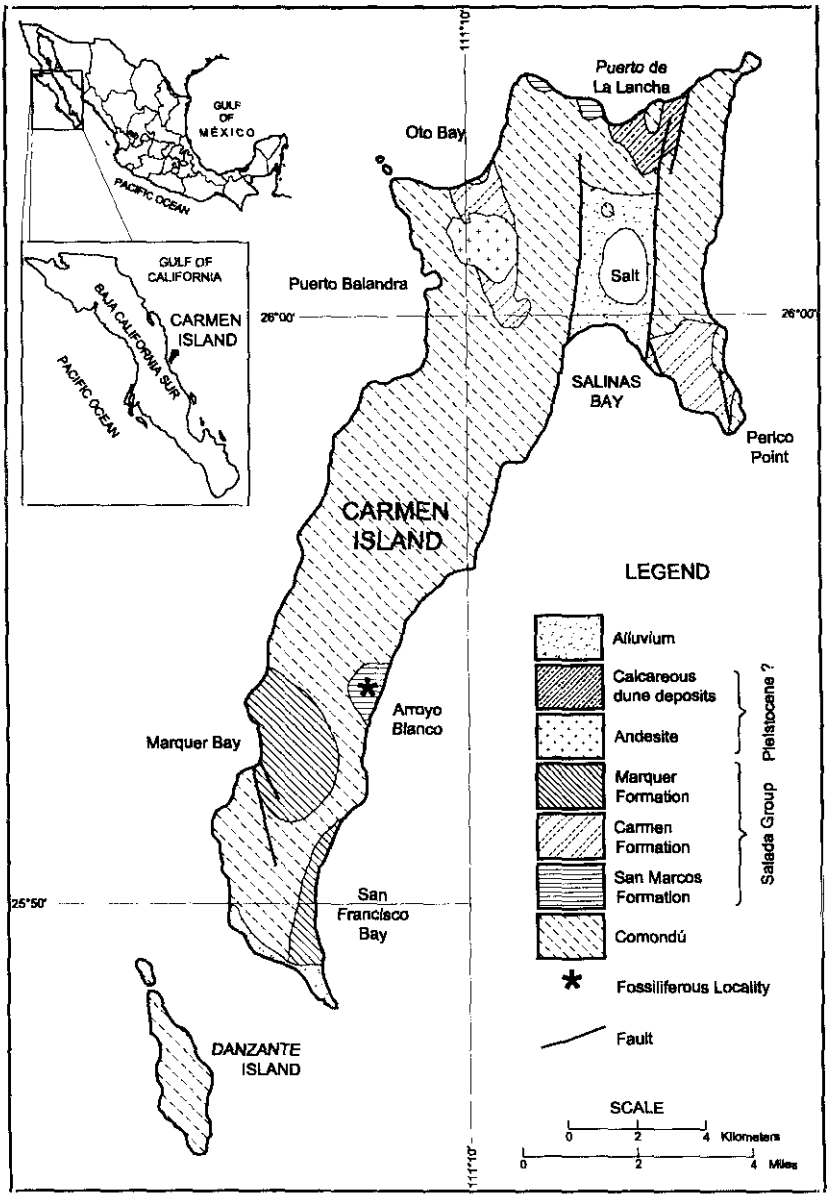


Figura. 1.–*Mapa geológico de la Isla Carmen (ligeramente modificado de* ANDERSON, *1950).*
Figure. 1.–*Geologic map of Carmen Island (slightly modified from* ANDERSON, *1950).*

Stratigraphic classification in the region was established by ANDERSON (1950) based in the observations made on the 1940 expedition in the Gulf of California (Islands, States of Baja California and Sonora) sponsored by the Scripps Institution and The Geological Society of America.

The stratigraphic column from bottom to top includes volcanic breccias and lava flows of the Comondú Formation of middle to late Miocene age, overlain uncomformably by Pliocene conglomerates, sandstones, and limestones of Salada Group. These include three formations: the lower Pliocene San Marcos Formation, that consits of volcanic gravels, sandstone, and siltstone with some fossil invertebrates; the middle Pliocene Carmen Formation is composed of conglomerate, sandstone, marl and siltstone, and the upper Pliocene Marquer Formation that consists of conglomerate, calcareous sandstone, marl and limestone with many fossils. In the upper part there are andesite deposits, calcareous dune deposits of Pleistocene age, and alluvium. However, this author (ANDERSON, 1950, p. 12) considered that the San Marcos Formation and Boleo Formation (WILSON, 1948) both of Baja California «are of sufficient lithologic similarity and proximity to indicate that they are the same formations».

The echinoid specimen came from the finer clastics of the San Marcos Formation (lower Pliocene) at Carmen Island, Gulf of California, Mexico.

## SYSTEMATIC PALEONTOLOGY

Phylum ECHINODERMATA BRUGUIÈRE, 1789
Class ECHINOIDEA LESKE, 1778
Order Spatangoida CLAUS, 1876
Family Brissidae GRAY, 1855
Genus *Meoma* GRAY, 1851

*Diagnosis:* Large echinoids, with peripetalous fasciole markedly indented between the paired petaloids, forming an acute angle in interambulucra 2 and 3. Test oval, broad, with highest point almost central. Oral surface flat. Posterior end obliquely directed downward truncated. Frontal ambulacrum slightly depressed, with small pores in regular rows distally. Paired ambulacra sunken, narrow, straight; only the anterior ones are slightly curved backward at their distal ends. The interporiferous zones are narrow, and densely covered by small tubercles. Aplical system, with 4 genital pores; madreporite prolongued backwards so as to separate the posterior genital and ocular plates, the apical

system being of the ethmolytic type. Peristome anteriorly situated, wide, semilunar, slyhtly sunken. Anteriorly extended labrum, densely covered with tubercles. Large periproct, located at truncated posterior end of the test and overhung. Short and narrow sternum, densely covered with large tubercles. Long episternum (nearly half the length of the sternum). Anal fasciole absent. Subanal fasciole bilobed in *Meoma frangibilis* and *Meoma cadenati*, aborally degenerate in adults of *Meoma ventricosa* s.s. and *Meoma ventricosa grandis* (only the adoral transverse branch remains differentiated). Five types of pedicellariae: globiferous, tridentate, ophicephalous, trifoliate and rostrate. In Mexico, this genus is represented by two recent subspecies: *Meoma ventricosa grandis* (at the West Coast) and *Meoma ventricosa ventricosa* (at the East Coast) (SOLÍS-MARÍN *et al.*, 1997).

*Range:* Eocene to Recent (FISCHER, 1966, p. U592).

*Meoma ventricosa grandis* GRAY, 1851
Figs. 2A, B

Type species: *Meoma grandis* (=*Meoma ventricosa grandis* GRAY, 1851).

1851 *Meoma grandis* GRAY, p. 132; AGASSIZ, 1872-1874, p. 142; CLARK, H. L., 1917, p. 220; BOONE, 1928, p. 12; ZIESENHENNE, 1937, p. 236; GRANT & HERTLEIN, 1938, p. 130; CLARK, H. L., 1940, p. 344; STEINBECK & RICKETTS, 1941, p. 401; CLARK, H. L., 1948, p. 344; WILSON, 1948, p. 1738; CASO, 1949, p. 354; DURHAM, 1950, p. 51; MORTENSEN; 1951, p. 526; MADSEN, 1957, p. 476; FISCHER, 1966, p. U592; BUITRÓN, 1968, p. 40; CASO, 1983, p. 66; BUITRÓN, 1978, p. 110; SOLÍS-MARÍN *et al.*, 1997, p. 301.
1863-69 *Kleinia nigra* AGASSIZ, p. 27; 1870, p. 93.
1867 *Meoma nigra* (AGASSIZ); VERRILL, p. 251; p. 93.
1959 *Macropneustes grandis* (GRAY); COOKE, p. 83.
1970 *Meoma ventricosa grandis* (GRAY); CHESHER, p. 745.

*Diagnosis:* Test with broad outline. Peristone broad, periproct almost circular. Distance from lower portion of periproct to adoral portion of subanal fasciole usually less than the vertical diameter of the periproct.

*Description:* Test wide and oval (total length 105.87 mm; total width 94.5 mm; high 48.85 mm), anteriorly emarginated; the posterior test contour is almost truncated and oblique. Apical system anterior (not preserved). Large tu-

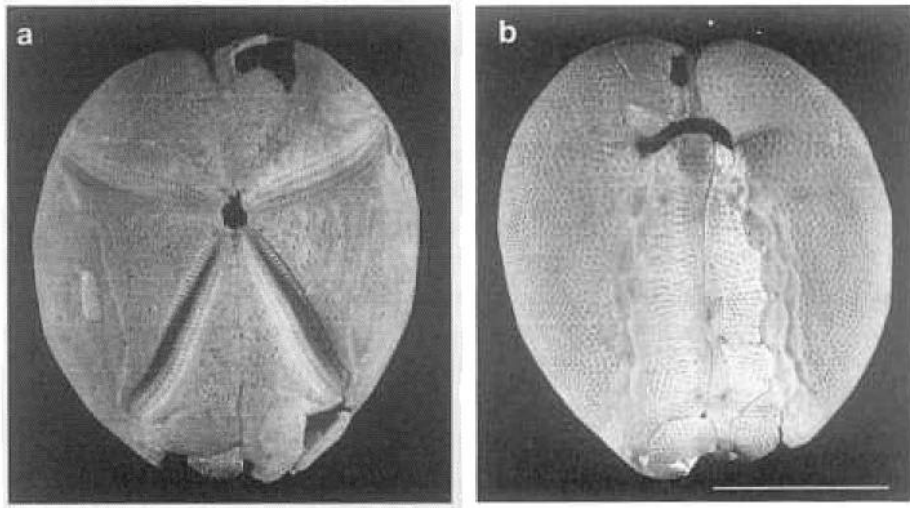


Figura. 2.–*A, B* Meoma ventricosa grandis. *Vista dorsal; B. Vista ventral. Longitud de la testa 105,87 mm. Formación San Marcos (Plioceno inferior), Isla Carmen, Golfo de California, México. Colección Paleontológica (UNAM-FI-3219). Barra de escala: 45 mm.*
Figure. 2.–*A, B* Meoma ventricosa grandis. *A. Dorsal view; B. Ventral view. Test lengh 105.87 mm. San Marcos Formation (lower Pliocene), Carmen Island, Gulf of California, México. Paleontological Collection (UNAM-FI-3219). Scale bar: 45 mm.*

bercles on the aboral surface scant and widely dispersed, distributed within the peripetalous fasciole. Small, numerous tubercles, distributed over all the surface. The oral surface tubercles are relatively enlarged and irregularly distributed (they are more closely packed towards the anterior). Anterior and posterior ambulacral grooves wide, compared to those of recent *Meoma ventricosa ventricosa*. The anterior ambulacral grooves are curves backward. The posterior ambulacral grooves are slightly longer than the anterior ones. On the external edge of the poriferous zone, between pairs of pores, occur scarce, small miliary granules. Peristome broad (18% of TL), anterior, sunken. Labrum prominent, semicircular, not keeled, the posterior prolongation short. One part of the marginal line of the periproct is preserved and is interpreted as almost circular (Fig. 2B).

*Material examined:* One well preserved specimen collected in outcrops San Marcos Formation (lower Pliocene), Carmen Island, Gulf of California, Mexico. The fossils are deposited in the Paleontological Collection (under number UNAM-FI-3219) of the División de Ingeniería en Ciencias de la Tie-

rra, Facultad de Ingeniería, UNAM, Cd. Universitaria, Delegación Coyoacán, Méxcio D. F. 04510.

*Holotype: Meoma grandis (=Meoma ventricosa grandis* GRAY, 1851), The Natural History Museum, London, Catalogue number 1949. 10.24.6.

*Type locality:* Australia (locality taken from original label, the label no longer exists. The species is Western Mexican and the locality «Australia» is therefore wrong (S. Halsey pers. comm. 1996). The original material was not labeled «Acapulco, Mexico» as pointed out by CHERSHER (1970).

*Discussion:* The only mention of fossil *Meoma* of Carmen Island was made by DURHAM (1950, p. 51, pl. 47, fig. 1). Durham's specimen is crushed and probably corresponds to *Meoma ventricosa grandis,* because the principal features of this species is present. *Meoma ventricosa grandis* was found associated with calcareous algae, corals, bivalves (*Pecten* and *Chione*) and others echinoids.

*Recent distribution:* Species of the Order Spatangoida live on muddy and sandy bottoms in all oceans, exhibiting a wide bathymetric distribution, from the intertidal zone, down to 5000 m (CHESHER, 1970). *Meoma ventricosa* is the most widely distributed species of brissid in Mexican waters: *Meoma ventricosa grandis* GRAY, 1851 is distributed along the Mexican Pacific coast and *Meoma ventricosa* s.s. is abundant in the Mexican Caribbean Sea, while *Meoma ventricosa grandis* is scarce within Mexican waters (CASO, 1949, 1983). Their thin test and borrowing habits make them difficult to collect and preserve using conventional sampling methods. As pointed out by DURHAM (1951), the presence of this species suggests, as the presence of the Pliocene fauna associated, that the fossil material was deposited in a «small local coast-line embayments, similar to the small bays and other indentations now existing along the Western shore of the Gulf of California».

In Mexican waters it has been collected in Punta Arena, Punta Gorda, Cabo San Lucas, Canal Angeles to Punta Choco, Bahía Santa Inés, Bahía Concepción, Baja California; on the seaward side of Laguna de Yávaros, Sonora; Bahía Tenacatita, Jalisco; Revillagigedo Islands, Colima; Playa Las Gatas, Zihuatanejo and Acapulco, Guerrero; Bahía Tangola-Tangola and Bahía Santa Cruz, Oaxaca (CASO, 1949, 1983). CHESHER (1970) reports it for Gulf of California; Manzanillo, Colima; Acapulco, Guerrero and Huatulco, Oaxaca. This author noticed the presence of this species in Puerto Utria, Colombia and Galapagos Island. MORTHENSEN (1951) mentioned the presence of the species in the Gulf of Panama, outside Tortolita and Taboguilla Islands, at depths of 0.5-10 m.

*Remarks:* During the late Eocene to Miocene period, the genus *Meoma* inhabited a wide geographic range, including New Zeland (*Meoma tuberculata*

HUTTON, 1873), Java (*Meoma declives* [HERKLOTS]), and the Americas (*Meoma antillarum* and *Meoma clevei* [COTTEAU]). The history of the genus is not American, as might be inferred from the distribution of Recent species but had its beginning in the European area, as pointed out by CHESHER (1971). The genus became extinct everywhere except in the Americas during the Miocene. *Meoma frangilis* CHESHER, 1970, that was considered congeneric with *Peripneustes antillarum* (COTTEAU) from the Eocene of the Caribbean, was finally a closely allied also to *Meoma cadenati* MADSEN, 1957 from the Recent of West Africa.

## CONCLUSIONS

This discovery constitutes a new fossil record of *Meoma ventricosa grandis* GRAY, 1851 in the early Pliocene of Marcos Formation beds from Carmen Island, Gulf of California, Mexico. The sepecimen was found associated with calcareous algae, corals, bivalves and other echinoids that corresponds to a shallow tropical sea. The fossil locality is induced into the recent distribution of the subspecies in the Gulf of California.

## ACKNOWLEDGMENTS

We are grateful to Dr. R. Mooi (California Academy of Sciences, San Francisco California, U.S.A.) and Dra. Dolores Gil Cid (Universidad Complutense de Madrid, España) for the revision and helpful comments on this manuscript. To M. en C. Alicia de La Luz Durán-González for her technical assistance. D. G. Jorge A. Ornelas Ibáñez fixed the figures and arrange. Ing. Geól. Sergio Yussim (Facultad de Ingeniería, UNAM) draw the map.

Recibido el día 1 de diciembre de 1998
Aceptado el día 8 de marzo de 1999

## REFERENCES

AGASSIZ, A. 1863-1869. Preliminary report on the echini and starfishes dredged in deep water between Cuba and the Florida Reef. *Bulletin of the Museum of Comparative Zoology*, **1** (1-13): 253-308.

— 1872-1874. Revision of the Echini. *Illustrated Catalogue of the Museum of Comparative Zoology at Harvard University*, **7** (1): 1-242; (3): 381-629.

ANDERSON, C. A. 1950- 1940 E. W. Scripps Cruise to the Gulf of California, Part I, Geology of islands and neighboring Island areas. *Geological Society of America, Memoir*, **43:** 1-52.

BOONE, L. 1928. Echinoderms from the Gulf of California and the Perlas Islands. *Bulletin of the Bingham Oceanographic Collection*, **2** (6): 1-14.

BUITRÓN, B. E. 1968. Catálogo de equinoides fósiles de México. *Universidad Nacional Autónoma de México, Instituto de Geología, Paleontología Mexicana*, **26:** 1-50.

— 1978. Distribución de los equinoides terciarios en la Planicie Costera del Golfo de México, en América Central, en el norte de América del Sur y en las Antillas. *Boletín del Instituto de Geología de la Universidad Nacional Autónoma de México*, **101:** 66-113.

BUITRÓN, B. E. & SOLÍS-MARÍN, F. A. 1993. La biodiversidad en los equinodermos fósiles y recientes de México. *Revista de la Sociedad Mexicana de Historia natural* Vol. Especial, **44:** 209-231.

CASO, M. E. 1949. Contribución al conocimiento de los equinodermos litorales de México. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México*, **20:** 351-354.

— 1983. Los equinoideos del Pacífico de México. Parte cuarta, órdenes Cassiduloida y Spatangoida. *Anales del Instituto de ciencias del Mar y Limnología. Universidad Nacional Autónoma de México, Publicación Especial*, **6:** 66-71.

CHESHER, R. H. 1969. Contribution to the biology of *Meoma ventricosa* (Echinoidea: Spatangoida). *Bulletin of Marine Science*, **19** (1): 72-110.

— 1970. Evolution in the genus *Meoma* (Echinoidea: Spatangoida) and a description of a new species from Panama. *Biological Results of the University of Miami Deep-Sea Expedition*, **68:** 731-761.

CLARK, H. L. 1917. Hawaiian and other Pacific Echini. The Echinoneidae, Nucleolitidae, Echinocorythidae, Calymnidae, Pourtalesilidae, Palaeostomatidae, Aeropsidae, Palaeopneustidae, Hemiasteridae and Spatangidae. *Memoirs of the Museum of Comparative Zoology at Harvard College*, **46** (2): 85-283.

— 1940. Notes on echinoderms from the west coast of Central America. *Eastern Pacific Expeditions of the New York Zoological Society*, n.º 21, **25:** 331-352.

— 1948. A report of the echini of the warmer eastern Pacific, based on the collection of the «Velero» III. *Allan Hancock Pacific Expedition*, **8** (5): 225-351.

COOKE, C. W. 1959. Cenozoic echinoids of eastern United State. *United State Geological Survey, Professional Paper*, **321:** 1-106.

DURHAM, J. W. 1950. Megascopic paleontology and marine stratigraphy. Part 2 of 1940 E. Scrpps cruise to the Gulf of California. *Geological Society of America, Memoir*, **43** (2): 1-216.

FISCHER, A. G. 1966. Spatangoids. In *Treatise on Invertebrate Paleontology*. Part U. Echinodermata 3, R. C. MOORE (Ed.): U543-U628.

FONTAINE, A. 1953. The shallow-water echinoderms of Jamaica, part. 3. The sea urchins (Class Echinoidea). *Natural History Notes*, **61:** 3-9.

GRANT, U. S. & HERTLEIN, L. G. 1938. The west American Cenozoic Echinoidea. *University of California Publication in Mathematical and Physical Sciences*, **2:** 1-225.

GRAY, J. E. 1851. Description of some new genera and species of Spatangidae in the British Museum. *Annals and Magazine of Natural History*, **2** (7): 130-134.

— 1855. An arrangement of the families of Echinida, with descriptions of some new genera and species. *Proceedings of the Zoological Society of London*, **185**: 35-39.

LESKE, N. G. 1778. *Additamenta ad Jacob Theodory Klein naturalem dispositionem Echinodermatum et lucubratiunculam de aculeis Echinorum marinorum*, 216 págs. Upsala.

MADSEN, F. J. 1957. On a new species of *Meoma*, and on a few other echinoids from tropical West Africa. *Bulletin of the Institute of the Africa Noire*, Serie A **19** (2): 474-481.

MORTENSEN, T. 1951. *A monograph of the Echinoidea. vol. 2. Spatangoida 2*, 593 págs. Reitzel, Copenhagen.

SOLÍS-MARÍN, F. A., LAGUARDA-FIGUERAS, F. A. & LEIJA TRISTÁN, A. 1997. Morphology, systematics, and distribution of *Meoma ventricosa grandis* and *Meoma ventricosa ventricosa* (Echinodermata: Echinoidea: Brissidae) along Mexican coasts. *Proceeding of The Biological Society of Washington*, **110** (2): 301-309.

STEINBECK, J. & RICKETTS, E. F. 1941. *Sea of Cortez. A leisurely journal of travel and research*, , 598 págs. The Vicking Press, New York.

VERRILL, A. E. 1867. The echinoderms of Panama and West coast of America. *Transactions of the Connecticut Academy of Arts and Sciences*, **1** (2): 251-322.

— 1870. Descriptions of echinoderms and corals from the Gulf of California. *American Journal of Science*, **49** (2): 93-100.

WILSON, I. F. 1948. Buried topography, initial structures, and sedimentation in Santa Rosalia area, Baja California, Mexico. *Bulletin of the American Association and Petroleum Geologists*, **32** (9): 1762-1807.

ZIESENHENNE, F. C. 1937. The Templeton Crocker Expedition X. Echinoderms from the west coast of Lower California and Clarion Island. *Bulletin of the Museum of Comparative Zoology*, **15**: 209-239.