

## Echinoderms (Echinodermata) from the Central Mexican Pacific

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### ABSTRACT

**Introduction:** The echinoderms from the Central Mexican Pacific are of high scientific interest and, prior to this present work, there was a lack of basic information that included incomplete checklists with inconsistencies in systematics and spatial distribution. **Objective:** To provide a historical review, and an updated checklist with a more complete richness of echinoderms for each state and island of the region. **Methods:** A checklist was elaborated based on an exhaustive literature search of the Echinodermata, and was complemented with taxonomical revisions of Ophiuroidea scientific collections. All the geographical coordinates of the records were validated. **Results:** The region harbors 187 species of Echinodermata: three Crinoidea, 35 Asteroidea, 67 Ophiuroidea, 32 Echinoidea, and 50 Holothuroidea. We detected 52 records in the literature that must be considered as invalid and five as doubtful. We provide 16 new records of Ophiuroidea from different states and islands; of them, four are new records for the region. Jalisco presented the highest number of species (84), followed by the coast of Nayarit (74), Michoacán (63), and Colima (55); among the islands, Revillagigedo showed the major number of species (85) followed by Mariás (81), Marietas (48), and Isabel (44). **Conclusions:** The numbers of species known in the region are mostly related to both sampling effort and environmental characteristics that promote high biodiversity. The Central Mexican Pacific is an oceanographic region with mixed conditions from the North and South of the Mexican Pacific, and therefore, with a biogeographical importance reflected in its species richness.

**Key words:** Echinodermata; biodiversity; checklist; historical review; new records.



The Central Mexican Pacific (CMP) region comprises the states of Nayarit, Jalisco, Colima and Michoacán as well as their coastal (Isabel and Marietas) and oceanic islands (Marias and Revillagigedo). The region is characterized by numerous geographic features such as bays, archipelagos and islands, as well as a heterogeneous bottom that combines hard and soft components. The CMP is located in the Tropical Eastern Pacific Province nearby to the Warm Temperate Northeast Pacific Province (Spalding et al., 2007) and for this reason, it shelters northern and southern fauna of the Mexican Pacific (Arriaga-Cabrera et al., 1998). Due to its relevant flora and fauna, most of the islands of the CMP are catalogued as Natural Protected Areas (CONANP, 2005; CONANP, 2007a; CONANP, 2007b; CONANP, 2019).

The study regarding the Echinodermata in the CMP began in 1840 when Gray (1840) reported the asteroids *Astropecten regalis* and *Luidia columbia* in Nayarit. Until 1891, efforts in the collection of echinoderms mostly from deep-waters were performed by foreign expeditions such as Albatross and Challenger. As a result, many new records and new species of Crinoidea (Hartlaub, 1895), Asteroidea (Sladen, 1889), Ophiuroidea (Lütken & Mortensen, 1899), Echinoidea (Agassiz, 1872; Agassiz, 1898), and Holothuroidea (Ludwig, 1894) were described.

The 20<sup>th</sup> century was very productive in terms of the number of published works (75). During this period, numerous foreign expeditions (Albatross, Velero, and Zaca) collected samples from shallow and deep-waters along the region resulting in new records, new species and extensive taxonomic monographs (e.g. Ludwig, 1905; Fisher, 1928a; Fisher, 1928b; Deichmann, 1937; Ziesenhenné, 1937; Ziesenhenné, 1940; Mortensen, 1948a; Mortensen, 1948b). The first national work regarding echinoderms from the CMP was the master's thesis of Caso (1943) who worked with the Asteroidea from México. Caso published dissertations and numerous manuscripts regarding taxonomy (Caso, 1948a; Caso, 1951; Caso, 1961; Caso, 1962a; Caso, 1965; Caso, 1966;

Caso, 1974a; Caso, 1974b; Caso, 1978b; Caso, 1980; Caso, 1983b), including descriptions of new species (Caso, 1954; Caso, 1983a; Caso, 1986a), and general accounts on the biodiversity of the CMP (e.g. Caso, 1948b; Caso, 1962b). Their findings helped to better understand the echinoderm fauna from shallow-waters of the region and inspired other Mexican researchers to work with echinoderms from Revillagigedo Islands (Villalobos, 1992; Chacón-Torres et al., 1993; Bautista-Romero, Reyes-Bonilla, Lluch-Cota, & Lluch-Cota, 1994), Marietas Islands (Nepote-González, 1998), Colima (Espino-Barr, Cibrián-Rodríguez, & García-Boa, 1996) and even, with species collected in several areas from the CMP that resulted as new taxa (Solís-Marín & Laguarda-Figueras, 1999). At the end of the 20<sup>th</sup> century, the first ecological studies in the CMP were published (Holguin-Quiñones, 1994; Reyes-Bonilla, 1995; Espino-Barr et al., 1996).

The first two decades of the 21<sup>st</sup> century have produced a vast number of works (55) regarding topics such as new distribution records (Frontana-Uribe, Hernández-Alcántara, & Solís-Weiss, 2000; Sotelo-Casas, Cupul-Magaña, Solís-Marín, & Rodríguez-Troncoso, 2015; Valdés de Anda, Hendrickx, & Solís-Marín, 2018), description of new species (Honey-Escandón, Solís-Marín, & Laguarda-Figueras, 2011; Solís-Marín, Arriaga-Ochoa, Galván-Villa, & Laguarda-Figueras, 2018), ecology (Holguin-Quiñones & Michel-Morfin, 2006; López-Urriarte et al., 2009; Hermosillo-Núñez et al., 2015; Herrero-Pérezrul, Ramírez-Ortiz, Rosales-Estrada, & Reyes-Bonilla, 2015; Hermosillo-Núñez, Rodríguez-Zaragoza, Ortiz, Calderon-Aguilera, & Cupul-Magaña, 2016; Sotelo-Casas, Cupul-Magaña, Rodríguez-Zaragoza, Solís-Marín, & Rodríguez-Troncoso, 2018), and reproduction (Sotelo-Casas, Cupul-Magaña, Solís-Marín, & Rodríguez-Troncoso, 2016). It is important to emphasize that most of these studies are focused in the compilation of species of echinoderms inhabiting in different areas of the CMP (Chávez-Dagostino, Nepote-González, Solís-Marín, & Medina-Rosas, 2000; Fuentes-Farías, Villarroel-Melo,

& Solís-Marín, 2005; Honey-Escandón, Solís-Marín, & Laguarda-Figueras, 2008; Ríos-Jara, Galván-Villa, & Solís-Marín, 2008a; Ríos-Jara et al., 2008b; Santos-Beltrán & Salazar-Silva, 2011; Ríos-Jara et al., 2013; Rodríguez-Troncoso et al., 2013; Solís-Marín et al., 2013a; Granja-Fernández, Herrero-Pérezrul, López-Pérez, Hernández-Morales, & Rangel-Solís, 2015a; Solís-Marín, Laguarda-Figueras, & Durán-González, 2016b; Granja-Fernández et al., 2017; Padilla-Pérez, Rodríguez-Troncoso, Sotelo-Casas, & Cupul-Magaña, 2017; Ríos-Jara, Juárez-Carrillo, & Galván-Villa, 2017; Nava-Bravo et al., 2019).

Despite the above, the records have shown many inconsistencies such as: 1) the names of some species have been mentioned (written or registered) incorrectly across time (e.g. misspelling), 2) many of the recorded species for the CMP are invalid, and 3) the generated checklists are not complete because they are based only in museum records or material collected mostly in shallow-waters. Thus, the aim of the present manuscript is to provide an accurate and updated checklist of the valid names and synonyms of the Echinodermata from the CMP according to literature, including new distribution records of Ophiuroidea. Moreover, we provide a historical review of the study of each class of Echinodermata, as well as an updated number of species for each state and island in the region.

## MATERIALS AND METHODS

An exhaustive search of published literature for the CMP regarding the classes Crinoidea, Asteroidea, Ophiuroidea, Echinoidea, and Holothuroidea was performed (records dating from 1840 to 2019). Moreover, we visited reference collections in order to taxonomically identify specimens of Ophiuroidea: ICML-UNAM: Colección de Equinodermos “Dra. Ma. Elena Caso”, Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, Ciudad de México, México; LACM: Natural History Museum, Los Angeles County Museum, Los Angeles, United

States of America (USA); and, MCZ: Museum of Comparative Zoology, Harvard University, Cambridge, USA.

When available, the geographical coordinates of the provided localities in the literature were validated using ArcMap 10.4.1 software, to corroborate distribution within the CMP maritime zone. Records were assigned to any of the following areas: coastlines of the states of Colima (COL), Jalisco (JAL), Michoacán (MICH), and Nayarit (NAY), and the islands Isabel (ISA), Marias (MAR), Marietas (MAT), and Revillagigedo (REV).

With this information, a checklist of the valid names and synonyms of Echinodermata from the CMP was constructed. The list includes those synonyms used exclusively in this area, yet some species may have larger synonym lists for other geographic areas. Systematics arrangements and valid names agree with Kroh and Mooi (2020), Mah (2020), Messing (2020), Stöhr, O’Hara, and Thuy (2020), and WoRMS (2020).

## RESULTS AND DISCUSSION

### Historical review

**Crinoidea:** Six references documented the Crinoidea from the CMP; one during the 19<sup>th</sup>, one in the 20<sup>th</sup>, and four in the 21<sup>st</sup> century. Among the Echinodermata, Crinoidea represents the less studied class of the CMP. The study of the Crinoidea from the CMP began in 1895 when Hartlaub (1895) recorded the species *Florometra tanneri* (as *Antedon rhomboidea*) for MAR at 1236 m depth. Several years later, using a submersible, Roux (2004) collected one specimen of *Hyocrinus foelli* in COL at 3030 m depth. Finally, during deep-water dredging by the TALUD cruises aboard the R/V “El Puma” of the Universidad Nacional Autónoma de México, *Florometra serratisima* was collected in two stations located in COL between 1040 and 1106 m depth (Valdés de Anda et al., 2018).



**Asteroidea:** 57 references addressed the Asteroidea distributed along the CMP. During the 19<sup>th</sup> century only two works were published, meanwhile the 20<sup>th</sup> and 21<sup>st</sup> centuries presented similar numbers of works, 28 and 27, respectively. The 19<sup>th</sup> century represents the era with the lowest addition of Asteroidea. The first reported Asteroidea for the CMP were *Luidia columbia* and *Astropecten regalis*, both collected in San Blas, NAY (Gray, 1840).

The 20<sup>th</sup> century was the period with the highest addition of Asteroidea to the CMP (25 species). Ludwig (1905) described *Ampheraster marianus*, *Henricia gracilis*, and *Sarkaster validus* (= *Lophaster furcilliger*) for MAR and other areas of the Eastern Pacific. According to samples from the Albatross, Fisher (1911) recorded *Hippasteria lepidonotus* and *Henricia clarki* for deep-waters from MAR and REV, respectively. Clark (1916) provided the original descriptions of *Saraster insignis* (= *Nearchaster* (*Nearchaster*) *aciculosus*) and *Cyllaster seminuda* (= *Henricia seminudus*) from Clarion Island, REV. In 1936, the Templeton Crocker Expedition collected echinoderms during the expedition of the Zaca along the north of México and as a result, Ziesenhenné (1937) mentioned *Astropecten armatus*, *Acanthaster ellisii* (= *Acanthaster planci*), *Linckia columbicae*, *Pauliella aenigma* (= *Paulia horrida*), and *Sclerasterias heteropaes* for shallow-waters (up to 100 m depth) from Clarion Island. During 1937-1938, the Zaca continued performing collections of shallow-water echinoderms, and Clark (1940) reported *Luidia bellonae* (Manzanillo, COL and Chamela Bay, JAL), *Luidia foliolata*, *Pharia pyramidata*, and *Phataria unifascialis* (Tenacatita Bay, JAL). Later, Caso (1943) reported the species *Heliaster microbrachius* and *Luidia superba* for Manzanillo, COL, as well as *Nidorellia armata* for the same locality and MAR. In later years, the addition of species for the CMP was sporadic, with mentions of just one species per work: *Patiria miniata* (Socorro Island, REV; Adem et al., 1960), *Astropecten californicus* (Manzanillo, COL; Caso, 1961), *Mithrodia bradleyi* (REV; Caso, 1962b), *Pentacaster cumingi* (Socorro

and Clarion Islands, REV; Hertlein, 1963), and *Asteropsis carinifera* (REV; Maluf, 1991).

During the 21<sup>st</sup> century, only eight new records for the CMP have been documented. Fuentes-Farías et al. (2005) provided a list of echinoderms for MICH including the new records of *Luidia tessellata* and *Heliaster helianthus*. Two years later, the Mexican government decreed the MAR as a Biosphere Reserve, publishing a management and conservation program (CONANP, 2007a), which provided lists of the marine and terrestrial flora and fauna, and included the record of *Echinaster* (*Othilia*) *tenuispina* for the area. Honey-Escandón et al. (2008) and Solís-Marín et al. (2013b) provided the most-complete checklist of echinoderms for the Mexican Pacific and the Eastern Pacific, respectively, including the new records of *Heliaster polybrachius* (JAL), *Mediaster transfuga* and *Meridiastra modesta* (REV), and *Narcissia gracilis* (NAY). Recently, Nava-Bravo et al. (2019) included the record of *Astropecten verrilli* for MICH.

**Ophiuroidea:** 59 references have been published regarding this class. The 19<sup>th</sup> century was the least productive since only one work was published. During the 20<sup>th</sup> and 21<sup>st</sup> centuries, similar numbers of manuscripts were published, 30 and 28, respectively. In 1891, the Albatross conducted an expedition along the Eastern Pacific, and as a result, Lütken and Mortensen (1899) described the first species and subspecies of ophiuroids from deep-waters of the CMP (MAR): *Amphiura serpentina*, *Astrodia excavata*, *Dougaloplus notacanthus*, *Ophiacantha costata*, *Ophiacantha hirta*, *Ophiacantha moniliformis*, *Ophiernus adspersus annectens*, *Ophiomitra granifera*, *Ophiomitra partita*, *Ophiosphalma variabile*, and *Ophiura* (*Ophiura*) *scutellata*.

During the 20<sup>th</sup> century a total of 30 species were added to the list of ophiuroids of the CMP, representing the highest number, in comparison to the other two centuries accounted for in this review. Döderlein (1911) conducted a revision of the world's Euryalida, reporting *Asteroschema sublaeve* for MAR.

With specimens collected in shallow-waters of Clarion Island, Ziesenhenné (1937) described *Ophiacantha pyriformis*, and reported for the first time in the CMP, the presence of *Ophiactis savignyi*, *Ophiocoma aethiops*, *Ophioderma variegatum*, *Ophionereis annulata*, and *Ophiothrix galapagensis*. Later, Clark (1940) found the conspicuous *Diopederma daniana*, *Ophiolepis variegata*, and *Ophiothrix* (*Ophiothrix*) *spiculata* in JAL and COL. In the same year, Ziesenhenné (1940) published the results obtained by the cruise Velero III performed in 1938, and described *Amphichondrius laevis*, *Amphiodia sculptilis*, *Ophiolepis plateia*, and *Ophiophragmus lonchophorus*, all of them collected in Tenacatita Bay, JAL. Later, the additions of new records of ophiuroids per work were reduced: *Ophiocomella alexandri* (REV; Steinbeck & Ricketts, 1941), *Ophioderma teres* and *Ophiolepis pacifica* (Puerto Vallarta, JAL; Caso, 1951), *Ophioderma panamense* (REV; Ziesenhenné, 1955), *Ophiomyxa panamensis* (REV; Hertlein, 1963), *Ophiostigma tenue* (ISA; Clark, 1970), *Ophiomusa lymani*, *Ophiothela mirabilis*, and *Ophiuroglypha irrorata irrorata* (JAL and REV; Luke, 1982), *Amphichondrius unamexici* (= *Amphichondrius granulatus*; NAY; Caso, 1983a), *Amphiura seminuda* and *Ophiophragmus marginatus* (JAL and NAY; Caso, 1986b), *Amphiura* (*Amphiura*) *assimilis* and *Gymnophiura mollis* (MAR; Maluf, 1988), *Ophiactis simplex* (REV; Maluf, 1991), and *Ophiuroconis bispinosa* (REV; Hendler, 1996).

The addition of new records of ophiuroids (22) during the 21<sup>st</sup> century has been important. Frontana-Urbe et al. (2000) collected specimens of *Ophiocomella schmitti* associated with coral rubble in localities from Socorro Island (REV). Fuentes-Farías et al. (2005) included the record of *Ophiothrix* (*Ophiothrix*) *rudis* for MICH; in the same year, Maluf and Brusca (2005) published a checklist of the echinoderms from the Gulf of California, including the general distribution of the species, and the new records of *Amphipholis elevata*, *Astrocaeneum spinosum*, *Microphiopholis puntarenae*, *Ophiocomella sexradia*, *Ophiocnida hispida*, *Ophiolepis crassa*, *Ophiopholis bakeri*, and

*Ophiophthalmus diplasia* (MAR and REV). The genus *Ophiophthalmus* is an invalid junior synonym and a new assignment is needed (Hendler, 1996), but in the present work we kept this temporary genus in order to avoid systematic confusions. Later, Honey-Escandón et al. (2008) reported 33 species of ophiuroids for the CMP, of which, the amphiuroids *Amphiodia occidentalis*, *Amphiodia platyspina*, *Amphiodia violacea*, *Amphiodia* (*Amphisipina*) *digitata*, *Amphiodia* (*Amphisipina*) *urtica*, *Amphipholis pugetana*, and *Microphiopholis platydisca*, represented new records in several states and islands from the CMP. In 2011, *Astrodictyum panamense* (Ayala-Bocos, Reyes-Bonilla, Herrera-Pérezrul, Walther-Mendoza, & Castañeda-Fernández de Lara, 2011) and *Hemipholis gracilis* (Hendler, 2011) were reported in REV and JAL, respectively. García-Hernández et al. (2014) compared the ecological diversity and species composition of benthic macroinvertebrates in rocky reefs of JAL and MAT, finding new records for *Amphipholis squamata* and *Ophionereis perplexa*. Finally, Granja-Fernández et al. (2017) provided a checklist of ophiuroids from the CMP, adding the new record of *Ophiophragmus papillatus*.

**Echinoidea:** 73 references documented the presence of the Echinoidea from the CMP, representing the major number of works among all the classes. The 19<sup>th</sup> century is represented only by two publications, the 20<sup>th</sup> century for 39, and the 21<sup>st</sup> century for 32 works. In the 19<sup>th</sup> century all the work regarding Echinoidea was published by Alexander Agassiz whom documented for the first time in the CMP the species *Eucidaris thouarsii* and *Echinometra vanbrunti*, both collected in Manzanillo, COL (Agassiz, 1872), and who described *Brisaster townsendi* and *Plexechinus cinctus* for stations located in deep-waters of MAR (Agassiz, 1898).

The 20<sup>th</sup> century was by far the most productive in terms of new addition of echinoids (27) in the CMP. Clark described *Hesperocidaris perplexa* and *Echinometra insularis* (Clark, 1907; Clark, 1912), and reported *Echinometra*

*oblonga* and *Tripneustes gratilla* from REV (Clark, 1912). With specimens collected by the Zaca, Ziesenhenne (1937) reported *Clypeaster europacificus*, *Diadema mexicanum*, and *Tripneustes depressus* in shallow-waters of Socorro and Clarion, REV. In 1938, was published an important work regarding fossil and living Echinoidea from the west American Cenozoic, in which were mentioned the new records of *Astropyga pulvinata* (JAL) and *Toxopneustes roseus* (ISA) (Grant & Hertlein, 1938). Posteriorly, Clark (1940) added *Clypeaster ochrus* and *Clypeaster speciosus* from ISA and NAY, respectively, and Caso (1948a) included *Arbacia stellata* to NAY. Clark (1948) reported the highest number of new records of echinoids for the CMP (*Brissopsis pacifica*, *Clypeaster rotundus*, *Encope micropora*, *Encope micropora insularis*, *Lovenia cordiformis*, *Meoma ventricosa grandis*, and *Rhyncholampas pacificus*), based on the collections of the Velero III along the Eastern Pacific during the years 1931-1941; *E. micropora insularis* was described in this work and its holotype corresponds to Socorro Island, REV. The records in posterior works were sporadic: *Hesperocidaris asteriscus* (JAL and REV; Caso, 1961), *Heterocentrotus mamillatus* (REV; Chan, 1974), *Dendraster excentricus* and *Lanthonia longifissa* (ISA and COL, respectively; Caso, 1980), *Agassizia scrobiculata* (NAY; Caso, 1983b), and *Mellita notabilis* (MICH; Harold & Telford, 1990).

Despite the number of published works during the 21<sup>st</sup> century is similar to the previous century, only three new records for the area have been documented during the present era. These records correspond to species observed during field work and documented in the management and conservation programs of the National Park ISA (*Centrostephanus coronatus*; CONANP, 2005) and the Reserve of the Biosphere MAR (*Brissus obesus*; CONANP, 2007a). Finally, Ríos-Jara et al. (2008a) performed collections of echinoderms in ISA at different depths finding *Brissus latecarinatus* in shallow-waters (< 20 m depth).

**Holothuroidea:** 53 references mention holothuroids from the CMP. During the 19<sup>th</sup> century only one work was published, 19 during the 20<sup>th</sup> century, and 33 during the 21<sup>st</sup> century. In the 19<sup>th</sup> century only one work was published and therefore, the number of records was low. Despite, *Laetmophasma fecundum* (= *Pannychia moseleyi*), *Psolus pauper*, and *Ypsilothuria bitentaculata* were first mentioned in Ludwig (1893), it was until 1864 when Ludwig (1894) provided an extended description of the species, reporting them in deep waters from MAR; moreover, *Molpadia musculus* was recorded in this work too, for the same locality.

The 20<sup>th</sup> century was the most productive in terms of the addition of new records (28). In 1926, the Templeton Crocker expedition aboard the Zaca performed dredges in order to obtain echinoderms along the Eastern Pacific, and collected *Holothuria (Cystipus) inhabilis* and *Holothuria (Platyperona) difficilis* in REV (Deichmann, 1937). From 1932 to 1938, the Allan Hancock Expedition aboard the Velero III collected several specimens of holothuroids and Deichmann (1941) found that *Thyone bidentata* and *Thyone parafusus*, both discovered in Tenacatita, JAL corresponded to new species, and that *Leptopentacta panamica*, *Neothyone gibber*, and *Pentamera chierchiae* were new records of species for the CMP (JAL and REV). Caso (1954) collected for the first time *Holothuria (Selenkothuria) lubrica* in Puerto Vallarta, JAL and found a similar species which was designated as a new species: *Holothuria (Selenkothuria) portovallartensis*. The biggest contribution of new records of holothuroids for the CMP (*Holothuria (Halodeima) kefersteinii*, *Holothuria (Lessonothuria) pardalis*, *Holothuria (Mertensiothuria) hilla*, *Holothuria (Mertensiothuria) leucospilota*, *Holothuria (Semperothuria) imitans*, *Holothuria (Semperothuria) languens*, *Holothuria (Theelothuria) paraprinceps*, *Holothuria (Thymiosycia) arenicola*, *Holothuria (Thymiosycia) impatiens*, and *Isostichopus fuscus*) was made by Deichmann (1958) which correspond to a continuation and expansion of the material collected by the Velero III and

IV in JAL, as well as in ISA, MAR and REV. The new records per work during the rest of this century were reduced: *Holothuria (Halodeima) inornata* (Caso, 1961), *Leptosynapta albicans* (Caso, 1962b), *Abyssocucumis abyssorum* (Luke, 1982), *Holothuria (Stauropora) fuscocinerea* (Hickman, 1998), all of them collected in REV and NAY. Nepote-González (1998) conducted a research about the diversity of holothuroids of MAT, finding the new records of *Chiridota rigida*, *Holothuria (Cystipus) rigida*, *Labidodemas americanum*, and *Pseudocnus californicus*. Later, Solís-Marín and Laguarda-Figueras (1999) performed collections in several localities of the CMP (COL, NAY, MAT) and described a new species, *Cucumaria flamma*.

The addition of new records of holothuroids to the CMP has been important during the 21<sup>st</sup> century. As part of the first program of management and conservation of REV National Park, CONANP (2004) documented *Euapta godeffroyi*. Fuentes-Farías et al. (2005) and Honey-Escandón et al. (2008) provided one of the most complete checklists of echinoderms in México and added the records of *Neothyone gibbosa* and *Labidodemas maccullochi* for MICH, and *Euthyonidiella zacae*, *Holothuria (Halodeima) atra*, *Holothuria (Mertensiothuria) viridiaurantia* (= *Holothuria (Mertensiothuria) hilla*), *Lissothuria ornata*, *Neocucumis veleronis*, and *Trachythyone peruana* for several areas of the Mexican Pacific. *Holothuria (Mertensiothuria) viridiaurantia* is a recently described species which was previously assigned to *H. (Mertensiothuria) hilla* (Borrero-Pérez & Vanegas-González, 2019). According to a preliminary revision of the material (unpublished data) and to Borrero-Pérez and Vanegas-González (2019), in the CMP, *H. (Mertensiothuria) viridiaurantia* inhabits in NAY, JAL, MICH

and MAT. On the other hand, based on a taxonomical review of the material, we confirm that *H. (Mertensiothuria) hilla* inhabits in REV, but a taxonomic confirmation of the material from ISA and MAR is required (F.A. Solís-Marín, personal communication, 01 April 2020). Honey-Escandón et al. (2011) described *Holothuria (Selenkothuria) carere*, collected in shallow-waters of MICH and other states of the Mexican Pacific. Santos-Beltrán and Salazar-Silva (2011) provided images and an identification key of the holothuroids from Bahía de Banderas, NAY adding the record of *Afrocucumis ovulum*. Ríos-Jara et al. (2013) described the taxonomic composition of the echinoderms from shallow-waters in several localities of Bahía Chamela, JAL, adding *Neopentamera anexigua*, *Pachythyone lugubris*, and *Pachythyone pseudolugubris* to the CMP, and Solís-Marín, Arriaga-Ochoa, Galván-Villa, and Laguarda-Figueras (2018) described *Lissothuria imbricata* after the collection of material from the same area. In recent years, Nava-Bravo et al. (2019) elaborated the most complete checklist of echinoderms from MICH adding the records of *Chiridota aponocrita*, *Epitomapta tabogae*, and *Thyonella mexicana*.

**Checklist:** The present updated checklist includes 187 species of Echinodermata (three Crinoidea, 35 Asteroidea, 67 Ophiuroidea, 32 Echinoidea, and 50 Holothuroidea; Table 1) resulted from the revision of 137 literature references (3 445 records) and the taxonomic revision of Ophiuroidea deposited at museum collections. Additionally, we detected 57 records in the literature (two Crinoidea, 21 Asteroidea, 14 Ophiuroidea, 15 Echinoidea, and five Holothuroidea) considered as invalid and which were removed from the updated checklist.



TABLE 1

Checklist of valid names (in bold) and synonyms of the Echinodermata from the Central Mexican Pacific based on literature review and museum records. All taxa are listed exactly as originally registered in the literature. Numbers refers to literature where taxa were listed, see References section. \* = New distribution records

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Phylum **Echinodermata** Bruguière, 1791  
 Class **Crinoidea** Miller, 1821  
 Order **Comatulida** A.H. Clark, 1908  
 Family **Antedonidae** Norman, 1865  
 Genus **Florometra** A.H. Clark, 1913  
   **Florometra serratissima** (A.H. Clark, 1907) **COL** <sup>132</sup>  
   **Florometra tanneri** (Hartlaub, 1895) **MAR** <sup>90, 92</sup>  
   *Antedon rhomboidea* Hartlaub, 1895 <sup>68</sup>

Orden **Hyocrinida** Rasmussen, 1978  
 Familia **Hyocrinidae** Carpenter, 1884  
 Genus **Hyocrinus** Thomson, 1876  
   **Hyocrinus foelli** Roux & Pawson, 1999 **COL** <sup>81, 114</sup>

Class **Asteroidea** de Blainville, 1830  
 Order **Paxillosida** Perrier, 1884  
 Family **Luidiidae** Sladen, 1889  
 Genus **Luidia** Forbes, 1839  
   **Luidia bellonae** Lütken, 1864 **JAL, COL, MICH, REV** <sup>13, 39, 104</sup>  
   *Luidia bellona* Lütken, 1864 <sup>7, 92</sup>  
   *Luidia (Alternaster) bellona* Lütken, 1864 <sup>91</sup>  
   **Luidia columbia** (Gray, 1840) **NAY, COL, MICH, REV** <sup>13, 15, 92, 104, 126, 135</sup>  
   *Luidia brevispina* Lütken, 1871 <sup>8, 13</sup>  
   *Luidia columbiae* (Gray, 1840) <sup>7, 117</sup>  
   *Luidia (Petalaster) columbia* (Gray, 1840) <sup>58, 81, 91</sup>  
   *Petalaster Columbia* Gray, 1840 <sup>66</sup>  
   **Luidia foliolata** Grube, 1866 **JAL** <sup>39</sup>  
   **Luidia superba** A.H. Clark, 1917 **COL, MICH** <sup>8, 10, 13, 30, 124</sup>  
   *Luidia (Alternaster) superba* A.H. Clark, 1917 <sup>58, 81, 91</sup>  
   **Luidia tessellata** Lütken, 1859 **NAY, MICH, ISA** <sup>104</sup>  
   *Luidia (Petalaster) tessellata* Lütken, 1859 <sup>58, 81, 109, 110</sup>

Family **Astropectinidae** Gray, 1840  
 Genus **Astropecten** Gray, 1840  
   **Astropecten armatus** Gray, 1840 **NAY, COL, MICH, REV** <sup>7, 8, 13, 15, 28, 30, 39, 58, 81, 92, 104, 124, 135</sup>  
   **Astropecten regalis** Gray, 1840 **NAY, COL, MICH** <sup>8, 13, 58, 66, 81, 104, 117, 124</sup>  
   **Astropecten californicus** Fisher, 1906 **NAY, COL** <sup>13, 81, 124</sup>  
   **Astropecten verilli** de Loriol, 1899 **MICH** <sup>104</sup>

Genus **Psilaster** Sladen, 1885  
   **Psilaster armatus** Ludwig, 1905 **MAR** <sup>86, 90, 92</sup>

Order **Valvatida** Perrier, 1884  
 Familia **Acanthasteridae** Sladen, 1889  
 Genus **Acanthaster** Gervais, 1841  
   **Acanthaster planci** (Linnaeus, 1758) **NAY, COL, MAR, ISA, MAT, REV** <sup>7, 32, 33, 41, 44, 45, 81, 107, 108, 120, 124</sup>  
   *Acantaster planci* (Linnaeus, 1758) <sup>126</sup>

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- Acantaster plansii* (Linnaeus, 1758) <sup>31</sup>  
*Acanthaster elissi* (Gray, 1840) <sup>134</sup>  
*Acanthaster elisii pseudoplanci* Caso, 1962 <sup>79</sup>  
*Acanthaster ellisi* (Gray, 1840) <sup>43, 45</sup>  
*Acanthaster ellisii* (Gray, 1840) <sup>14, 15, 19, 41, 42, 72, 81, 92, 109, 110, 124, 135</sup>  
*Acanthaster ellisii pseudoplanci* Caso, 1962 <sup>14, 15, 41, 69</sup>  
*Acanthaster pseudoplanci* Caso, 1962 <sup>19</sup>
- Family **Asterinidae** Gray, 1840  
Genus *Meridiastra* O'Loughlin, 2002  
*Meridiastra modesta* (Verrill, 1867) **REV** <sup>81, 124</sup>  
*Asterina agustincasoi* Caso, 1977 <sup>45</sup>
- Genus *Patiria* Gray, 1840  
*Patiria miniata* (Brandt, 1835) **REV** <sup>120</sup>  
*Asterina miniata* (Brandt, 1835) <sup>1, 7, 15, 41, 45, 81</sup>  
*Patiria minata* (Brandt, 1835) <sup>126</sup>
- Family **Asterodiscididae** Rowe, 1977  
Genus *Paulia* Gray, 1840  
*Paulia horrida* Gray, 1840 **REV** <sup>41, 45, 91, 92, 126</sup>  
*Pauliella aenigma* Ludwig, 1905 <sup>7, 13, 15, 77, 135</sup>
- Family **Asteropseidae** Hotchkiss & A.M. Clark, 1976  
Genus *Asteropsis* Müller & Troschel, 1840  
*Asteropsis carinifera* (Lamarck, 1816) **JAL, ISA, REV** <sup>41, 45, 91, 92, 126</sup>  
*Asteropsis spinosa* (Gray, 1840) <sup>81</sup>  
*Gymnasteria spinosa* Gray, 1840 <sup>109, 110</sup>
- Family **Goniasteridae** Forbes, 1841  
Genus *Hippasteria* Gray, 1840  
*Hippasteria lepidonotus* (Fisher, 1905) **MAR**  
*Cryptopeltaster lepidonotus* Fisher, 1905 <sup>13, 54, 90, 92</sup>  
*Hippasteria pacifica* Ludwig, 1905 <sup>54</sup>
- Genus *Mediaster* Stimpson, 1857  
*Mediaster transfuga* Ludwig, 1905 **REV** <sup>45, 120</sup>
- Family **Ophidiasteridae** Verrill, 1870  
Genus *Linckia* Nardo, 1834  
*Linckia columbiae* Gray, 1840 **NAY, JAL, MAR, REV** <sup>1, 7, 8, 13, 15, 41, 43, 45, 81, 91, 92, 126, 135</sup>
- Genus *Narcissia* Gray, 1840  
*Narcissia gracilis* A.H. Clark, 1916 **NAY** <sup>81</sup>
- Genus *Pharia* Gray, 1840  
*Pharia pyramidata* (Gray, 1840) **NAY, JAL, COL, MICH, MAR, ISA, MAT, REV** <sup>7, 8, 13, 15, 39, 44, 73, 91, 92, 96, 104, 107, 113, 120, 129</sup>  
*Pharia piramidata* (Gray, 1840) <sup>42</sup>  
*Pharia pyramidatus* (Gray, 1840) <sup>33, 43, 45, 58, 72, 109, 110, 111, 112, 121, 124, 126</sup>  
*Pharia pyramidatus pyramidatus* (Gray, 1840) <sup>81</sup>  
*Pharia pyrimidata* (Gray, 1840) <sup>87</sup>
- Genus *Phataria* Gray, 1840  
*Phataria unifascialis* (Gray, 1840) **NAY, JAL, COL, MICH, MAR, ISA, MAT, REV** <sup>7, 15, 22, 29, 33, 39, 42, 43, 44, 45, 58, 72, 73, 81, 84, 87, 91, 92, 96, 104, 107, 109, 110, 111, 112, 113, 120, 121, 124, 126, 129</sup>  
*Phataria unifacialis* (Gray, 1840) <sup>8, 13</sup>
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Family **Mithrodiidae** Viguier, 1878

Genus **Mithrodia** Gray, 1840

*Mithrodia bradleyi* Verrill, 1867 NAY, COL, MICH, MAR, ISA, MAT, REV 7, 15, 33, 41, 43, 44, 45, 58, 79, 81, 87, 91, 92, 104, 107, 108, 109, 110, 120, 124, 126, 129, 134

Family **Oreasteridae** Fisher, 1908

Genus **Nidorellia** Gray, 1840

*Nidorellia armata* (Gray, 1840) JAL, COL, MICH, MAR, ISA, MAT, REV 58, 81, 104, 107, 108, 109, 110, 129

*Nidoriella armata* (Gray, 1840) 7, 8, 13

Genus **Pentacaster** Döderlein, 1916

*Pentacaster cumingi* (Gray, 1840) NAY, JAL, COL, MICH, ISA, MAT, REV 58, 81, 91, 92, 104, 107, 109, 110, 111, 113, 124, 126

*Oreaster occidentalis* Verrill, 1867 7, 77

Family **Solasteridae** Viguier, 1878

Genus **Lophaster** Verrill, 1878

*Lophaster furcilliger* Fisher, 1905 MAR

*Lophaster validus* (Ludwig, 1905) 90, 91

*Sarkaster validus* Ludwig, 1905 86

Order **Forcipulatida** Perrier, 1884

Family **Asteriidae** Gray, 1840

Genus **Sclerasterias** Perrier, 1891

*Sclerasterias heteropaes* Fisher, 1924 REV 7, 13, 15, 90, 92, 126, 135

Family **Heliasteridae** Viguier, 1879

Genus **Heliaster** Gray, 1840

*Heliaster helianthus* (Lamarck, 1816) NAY, MICH 58, 81, 104

*Heliaster microbrachius* Xantus, 1860 JAL, COL 8, 13, 81

*Heliaster polybrachius* H.L. Clark, 1907 JAL 81

Family **Pedicellasteridae** Perrier, 1884

Genus **Ampheraster** Fisher, 1923

*Ampheraster marianus* (Ludwig, 1905) MAR 13, 55, 56, 90

*Sporasterias mariana* Ludwig, 1905 86

Order **Spinulosida** Perrier, 1884

Family **Echinasteridae** Verrill, 1867

Genus **Echinaster** Müller & Troschel, 1840

Subgenus **Othilia** Gray, 1840

*Echinaster (Othilia) tenuispina* Verrill, 1871 MAR

*Echinaster tenuispina* Verrill, 1871 43

*Echinaster (Othilia) tenuispinus* Verrill, 1871 81

Genus **Henricia** Gray, 1840

*Henricia clarki* Fisher, 1910 REV 7, 13, 15, 45, 54, 56, 74, 81, 90, 92, 120, 124

*Henricia gracilis* (Ludwig, 1905) MAR 90, 91, 92

*Cribrella gracilis* Ludwig, 1905 86

*Henricia seminudus* (A.H. Clark, 1916) REV 45, 81, 120, 124

*Cyllaster seminuda* A.H. Clark, 1916 13, 15, 34

*Henricia seminuda* (A.H. Clark, 1916) 90

Order **Notomyotida** Ludwig, 1910

Family **Benthopectinidae** Verrill, 1899

Genus **Nearchaster** Fisher, 1911

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Subgenus *Nearchaster* Fisher, 1911

*Nearchaster (Nearchaster) aciculosus* (Fisher, 1910) **REV**

*Nearchaster aciculosus* (Fisher, 1910) 7, 90, 120

*Saraster insignis* A.H. Clark, 1916 13, 15, 34

Class **Ophiuroidea** Gray, 1840

Order **Euryalida** Lamarck, 1816

Family **Asteronychidae** Ljungman, 1867

Genus *Astrodia* Verrill, 1899

*Astrodia excavata* (Lütken & Mortensen, 1899) **MAR** 64, 92, 106

*Asteronyx excavata* Lütken & Mortensen, 1899 13, 38, 50, 52, 63, 81, 88

Family **Euryalidae** Gray, 1840

Genus *Asteroschema* Örsted & Lütken in Lütken, 1856

*Asteroschema sublaeve* Lütken & Mortensen, 1899 **MAR** 50, 63, 64

Family **Gorgonocephalidae** Ljungman, 1867

Genus *Astrocanium* Döderlein, 1911

*Astrocanium spinosum* (Lyman, 1875) **MAR** 63, 64

*Asterocanium spinosum* (Lyman, 1875) 92

Genus *Astrodictyum* Döderlein, 1927

*Astrodictyum panamense* (Verrill, 1867) **REV** 6, 45, 63, 76

Order **Ophiurida** Müller & Troschel, 1840, restricted *sensu* O'Hara, Hugall, Thuy, Stöhr, & Martynov, 2017

Family **Ophiosphalmidae** O'Hara, Stöhr, Hugall, Thuy, & Martynov, 2018

Genus *Ophiosphalma* H.L. Clark, 1941

*Ophiosphalma variable* (Lütken & Mortensen, 1899) **JAL, COL, MAR, REV**

*Ophiomusium variable* Lütken & Mortensen, 1899 45, 63, 64, 81, 88, 92, 120, 123, 124

Family **Ophiomusidae** O'Hara, Stöhr, Hugall, Thuy, & Martynov, 2018

Genus *Ophiomusa* Hertz, 1927

*Ophiomusa lymani* (Wyville-Thomson, 1873) **MAR**

*Ophiomusium lymani* Wyville-Thomson, 1873 63, 64, 87

Family **Ophiuridae** Müller & Troschel, 1840

Genus *Ophiura* Lamarck, 1801

Subgenus *Ophiura* Lamarck, 1801

*Ophiura (Ophiura) scutellata* (Lütken & Mortensen, 1899) **MAR** 63, 64

*Homalophiura scutellata* (Lütken & Mortensen, 1899) 38, 52

*Ophioglypha scutellata* Lütken & Mortensen, 1899 88

*Ophiura scutellata* (Lütken & Mortensen, 1899) 90, 92

Genus *Ophiuroglypha* Hertz, 1927

*Ophiuroglypha irrorata irrorata* (Lyman, 1878) **MAR**

*Ophiura (Ophiuroglypha) irrorata irrorata* (Lyman, 1878) 63, 64

*Ophiura irrorata* (Lyman, 1878) 87

Family **Ophiopyrgidae** Perrier, 1893

Genus *Gymnophiura* Lütken & Mortensen, 1899

*Gymnophiura mollis* Lütken & Mortensen, 1899 **MAR** 63, 64, 90, 91, 92

Order **Ophioscolecida** O'Hara, Hugall, Thuy, Stöhr, & Martynov, 2017

Family **Ophioscolecidae** Lütken, 1869

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Genus *Ophiuroconis* Matsumoto, 1915

*Ophiuroconis bispinosa* Ziesenhenné, 1937 **JAL, COL, REV** 45, 63, 64, 70, 81, 92, 120, 123, 124

Order **Ophiacanthida** O'Hara, Hugall, Thuy, Stöhr, & Martynov, 2017

Family **Ophiotomidae** Paterson, 1985

Genus *Ophiomitra* Lyman, 1869

*Ophiomitra granifera* Lütken & Mortensen, 1899 **NAY, MAR** 63, 64, 87, 88

*Ophiacantha granifera* (Lütken & Mortensen, 1899) <sup>13</sup>

*Ophioplinthaca granifera* (Lütken & Mortensen, 1899) 38, 52, 92

*Ophiomitra partita* Lütken & Mortensen, 1899 **MAR** 63, 64, 88

*Ophiacantha partita* (Lütken & Mortensen, 1899) <sup>13</sup>

*Ophioplinthaca partita* (Lütken & Mortensen, 1899) 38, 52, 92

Family **Ophiacanthidae** Ljungman, 1867

Genus *Ophiacantha* Müller & Troschel, 1842

*Ophiacantha costata* Lütken & Mortensen, 1899 **MAR** 13, 38, 52, 63, 64, 83, 88, 92

*Ophiacantha hirta* Lütken & Mortensen, 1899 **MAR** 52, 63, 64, 81, 88, 92

*Ophiacantha moniliformis* Lütken & Mortensen, 1899 **MAR, REV** 38, 45, 52, 63, 64, 81, 88, 92, 120, 123, 124

*Ophiacantha pyriformis* Ziesenhenné, 1937 **REV** 7, 13, 15, 45, 52, 63, 90, 135

Genus *Ophiophthalmus* Matsumoto, 1917 (temporary genus)

*Ophiophthalmus diplasia* (H.L. Clark, 1911) **REV**

*Ophiacantha diplasia* H.L. Clark, 1911 45, 63, 92

Family **Ophiidermatidae** Ljungman, 1867

Genus *Ophioderma* Müller & Troschel, 1840

*Ophioderma panamense* Lütken, 1859 **NAY, JAL, COL, MICH, MAR, ISA, MAT, REV** 7, 41, 42, 77, 79, 81, 84, 91, 92, 104, 109, 110, 111, 123, 124, 137

*Ophiocryptus granulatus* Nielsen, 1932 <sup>81</sup>

*Ophioderma panamensis* Lütken, 1859 45, 62, 63, 64

*Ophioderma teres* (Lyman, 1860) **NAY, JAL, COL, MAR, REV\*** 11, 13, 62, 63, 64, 81, 92

*Ophioderma variegatum* Lütken, 1856 **NAY, JAL, COL, MAR, ISA\***, **REV** 7, 11, 13, 15, 27, 29, 39, 41, 45, 77, 79, 81, 84, 91, 92, 111, 120, 124, 134, 135

*Ophioderma variegata* Lütken, 1856 63, 64, 123, 137

Genus *Diopederma* H.L. Clark, 1913

*Diopederma daniana* (Verrill, 1867) **JAL, MICH** 63, 64, 104

*Diopederma danianum* (Verrill, 1867) 11, 39, 58, 81

Family **Ophiomyxidae** Ljungman, 1867

Genus *Ophiomyxa* Müller & Troschel, 1842

*Ophiomyxa panamensis* Lütken & Mortensen, 1899 **REV** 7, 63, 77, 91, 92

Family **Ophiocomidae** Ljungman, 1867

Genus *Ophiocoma* L. Agassiz, 1836

*Ophiocoma aethiops* Lütken, 1859 **NAY, JAL, COL, MICH, MAR, ISA, MAT, REV** 7, 11, 13, 15, 29, 41, 42, 43, 44, 45, 58, 59, 62, 63, 64, 79, 81, 84, 87, 91, 92, 104, 109, 110, 111, 120, 121, 122, 123, 124, 130, 134, 135

Genus *Ophiocomella* A.H. Clark, 1939

*Ophiocomella alexandri* (Lyman, 1860) **NAY, JAL, COL, MICH, MAR, ISA, MAT, REV**

*Ophiocoma alexandri* Lyman, 1860 7, 11, 13, 15, 29, 41, 42, 43, 44, 45, 49, 58, 59, 62, 63, 64, 79, 81, 84, 87, 91, 92, 104, 109, 110, 111, 120, 121, 123, 124, 130, 134

*Ophiocomella schmitti* A.H. Clark, 1939 **NAY, COL, MAR\***, **REV** 45, 57, 63, 64, 81, 123, 124

*Ophiocomella sexradia* (Duncan, 1887) **MAR, REV** 45, 63, 64, 92

Order **Ophioleucida** O'Hara, Hugall, Thuy, Stöhr, & Martynov, 2017

Family **Ophiernidae** O'Hara, Stöhr, Hugall, Thuy, & Martynov, 2018

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Genus *Ophiernus* Lyman, 1878

*Ophiernus adpersus annectens* Lütken & Mortensen, 1899 **MAR** 63, 64, 89

*Ophiernus adpersus adpersus* Lyman, 1883 81

*Ophiernus polyporum* Lütken & Mortensen, 1899 38, 52

*Ophiernus polyporus* Lütken & Mortensen, 1899 88

Order **Amphilepidida** O'Hara, Hugall, Thuy, Stöhr, & Martynov, 2017

Family **Ophiolepididae** Ljungman, 1867

Genus *Ophiolepis* Müller & Troschel, 1840

*Ophiolepis crassa* Nielsen, 1932 **COL\***, **MAR**, **ISA\***, **MAT** 63, 64, 92

*Ophiolepis pacifica* Lütken, 1856 **NAY**, **JAL**, **MICH\***, **MAR**, **MAT**, **REV\*** 62, 63, 64, 81

*Ophiozonia pacifica* (Lütken, 1856) 11, 13, 29, 92

*Ophiolepis plateia* Ziesenhenné, 1940 **JAL**, **ISA\*** 13, 52, 63, 64, 81, 115, 136

*Ophiolepis variegata* Lütken, 1856 **NAY**, **JAL**, **COL**, **MAR** 11, 39, 63, 64, 81, 87, 92, 123, 124

Family **Ophionereididae** Ljungman, 1867

Genus *Ophionereis* Lütken, 1859

*Ophionereis annulata* (Le Conte, 1851) **NAY**, **JAL**, **COL**, **MICH**, **MAR**, **ISA**, **MAT**, **REV** 7, 13, 15, 45, 58, 59, 61, 62, 63, 64, 81, 91, 92, 104, 109, 110, 111, 120, 123, 124, 130, 135

*Ophiocoma annulata* (Le Conte, 1851) 43

*Ophionereis dictyota* Ziesenhenné, 1940 41

*Ophionereis dictyota* Ziesenhenné, 1940 11, 45, 104, 123, 124, 134

*Ophionereis perplexa* Ziesenhenné, 1940 **JAL**, **MAT** 59

Family **Amphiuridae** Ljungman, 1867

Genus *Amphiura* Forbes, 1843

*Amphiura seminuda* Lütken & Mortensen, 1899 **NAY**, **REV** 28, 63, 92

*Amphiura serpentina* Lütken & Mortensen, 1899 **MAR** 52, 63, 64, 92, 131

*Amphiura serpentina* var. a Lütken & Mortensen, 1899 88

Subgenus *Amphiura* (*Amphiura*) Forbes, 1843

*Amphiura* (*Amphiura*) *assimilis* Lütken & Mortensen, 1899 **MAR**

*Amphiodia assimilis* (Lütken & Mortensen, 1899) 63, 64, 90

*Amphiura assimilis* Lütken & Mortensen, 1899 92

Genus *Amphichondrius* Nielsen, 1932

*Amphichondrius granulatus* (Lütken & Mortensen, 1899) **NAY**

*Amphichondrius unamexici* Caso, 1983 25, 28, 90, 92

*Amphichondrius laevis* Ziesenhenné, 1940 **JAL** 52, 63, 64, 81, 87, 115, 136

Genus *Amphiodia* Verrill, 1899

*Amphiodia occidentalis* (Lyman, 1860) **NAY** 63, 64, 81

*Amphiodia platyspina* Nielsen, 1932 **NAY** 63, 64, 81

*Amphiodia psara* H.L. Clark, 1935 **NAY\***

*Amphiodia sculptilis* Ziesenhenné, 1940 **JAL** 52, 63, 64, 81, 136

*Amphiodia tabogae* Nielsen, 1932 **NAY\***

*Amphiodia violacea* (Lütken, 1856) **NAY** 63, 64, 81

Subgenus *Amphispina* Nielsen, 1932

*Amphiodia* (*Amphispina*) *digitata* Nielsen, 1932 **NAY** 63, 64, 81

*Amphiodia* (*Amphispina*) *urtica* (Lyman, 1860) **NAY**, **MAR** 63, 64, 81

Genus *Amphipholis* Ljungman, 1866

*Amphipholis elevata* Nielsen, 1932 **MAR** 63, 64, 92

*Amphipholis pugetana* (Lyman, 1860) **NAY**, **REV\*** 63, 64, 81

*Amphipholis squamata* (Delle Chiaje, 1828) **NAY**, **JAL**, **COL**, **MAT**, **ISA\*** 59, 63, 64

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Genus *Dougaloplus* A.M. Clark, 1970

*Dougaloplus notacanthus* (Lütken & Mortensen, 1899) MAR<sup>63, 64, 92</sup>

*Amphiura notacantha* Lütken & Mortensen, 1899<sup>52, 81, 88</sup>

Genus *Microphiopholis* Turner, 1985

*Microphiopholis geminata* (Le Conte, 1851) NAY\*

*Microphiopholis platydisca* (Nielsen, 1932) NAY, COL<sup>63, 64</sup>

*Amphipholis platydisca* Nielsen, 1932<sup>81</sup>

*Microphiopholis puntarenae* (Lütken, 1856) MAR<sup>63, 64</sup>

*Amphipholis puntarenae* (Lütken, 1856)<sup>92</sup>

Genus *Ophiocnida* Lyman, 1865

*Ophiocnida hispida* (Le Conte, 1851) NAY\*, JAL, COL, MAR, MAT<sup>59, 62, 63, 64, 92</sup>

Genus *Ophiophragmus* Lyman, 1865

*Ophiophragmus lonchophorus* Ziesenhenné, 1940 NAY, JAL<sup>13, 52, 63, 64, 90, 136</sup>

*Ophiophragmus marginatus* (Lütken, 1856) NAY, JAL<sup>28, 63, 64, 81, 111</sup>

*Ophiophragmus papillatus* Ziesenhenné, 1940 NAY, JAL, MICH, MAT, REV\*<sup>64, 104</sup>

*Ophiophragmus paucispinus* Nielsen, 1932 MAR\*

Genus *Ophiostigma* Lütken, 1856

*Ophiostigma tenue* Lütken, 1856 JAL, MAR, ISA, MAT<sup>35, 63, 64, 92</sup>

Family *Ophiactidae* Matsumoto, 1915

Genus *Ophiactis* Lütken, 1856

*Ophiactis savignyi* (Müller & Troschel, 1842) NAY, JAL, COL, MICH, MAR, ISA, MAT, REV<sup>7, 11, 13, 23, 29, 45, 58, 59, 62, 63, 64, 81, 91, 104, 111, 120, 121, 122, 123, 124, 130, 135</sup>

*Ophiactis simplex* (Le Conte, 1851) NAY, JAL, COL, MICH, MAR, ISA, MAT, REV<sup>58, 59, 62, 63, 64, 81, 91, 92, 104, 111</sup>

Genus *Hemipholis* Lyman, 1865

*Hemipholis gracilis* Verrill, 1867 NAY, JAL<sup>63, 64, 71</sup>

Family *Ophiopholidae* O'Hara, Stöhr, Hugall, Thuy, & Martynov, 2018

Genus *Ophiopholis* Müller & Troschel, 1842

*Ophiopholis bakeri* McClendon, 1909 REV<sup>63, 92</sup>

Family *Ophiotrichidae* Ljungman, 1867

Genus *Ophiotrix* Müller & Troschel, 1840

*Ophiotrix galapagensis* Lütken & Mortensen, 1899 MAR, REV<sup>7, 13, 15, 45, 63, 64, 91, 92, 135</sup>

Subgenus *Ophiotrix* A.M. Clark, 1966

*Ophiotrix (Ophiotrix) rudis* Lyman, 1874 NAY, JAL, MICH, MAR, MAT, REV<sup>62, 63, 64</sup>

*Ophiotrix rudis* Lyman, 1874<sup>58, 81, 92, 104</sup>

*Ophiotrix rudis* Lyman, 1874<sup>44</sup>

*Ophiotrix (Ophiotrix) spiculata* Le Conte, 1851 NAY, JAL, COL, MICH, MAR, ISA, MAT, REV<sup>62, 63, 64, 104</sup>

*Ophiotrix spiculata* Le Conte, 1851<sup>11, 13, 29, 39, 58, 59, 81, 87, 91, 92, 111, 123, 124</sup>

Genus *Ophiothela* Verrill, 1867

*Ophiothela mirabilis* Verrill, 1867 NAY, JAL, COL, MICH, ISA, MAT<sup>58, 59, 62, 63, 64, 81, 104, 109, 110, 111</sup>

*Ophiotrix mirabilis* (Verrill, 1867)<sup>87</sup>

Class *Echinoidea* Leske, 1778

Order *Cidaroida* Claus, 1880

Family *Cidaridae* Gray, 1825

Genus *Euclidaris* Pomel, 1883

*Euclidaris thouarsii* (L. Agassiz & Desor, 1846) NAY, JAL, COL, MICH, MAR, ISA, MAT, REV<sup>7, 9, 13, 15, 21, 32, 33, 39, 41, 42, 43, 44, 45, 59, 65, 72, 73, 75, 77, 81, 84, 87, 92, 104, 107, 108, 109, 110, 111, 112, 113, 120, 121, 124, 126, 129, 134, 135</sup>

*Cidaris Thouarsii* L. Agassiz & Desor, 1846<sup>2</sup>

*Euclidaris Thouarsii* (L. Agassiz & Desor, 1846)<sup>40</sup>

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*Eucidaris thourarsii* (L. Agassiz & Desor, 1846)<sup>91</sup>

*Eucidaris thourarsii* (L. Agassiz & Desor, 1846)<sup>79</sup>

Genus *Hesperocidaris* Mortensen, 1928

*Hesperocidaris asteriscus* H.L. Clark, 1948 JAL, MICH, ISA, REV 7, 13, 15, 21, 45, 58, 92, 104, 111, 113, 126

*Hesperocidaris perplexa* (H.L. Clark, 1907) REV 7, 13, 15, 21, 45, 65, 81, 92, 97, 120, 124, 135

*Tretocidaris perplexa* H.L. Clark, 1907<sup>36, 51</sup>

Order **Diadematoida** Duncan, 1889

Family **Diadematidae** Gray, 1855

Genus *Astropyga* Gray, 1825

*Astropyga pulvinata* (Lamarck, 1816) JAL, COL, MICH, MAR, MAT, REV 9, 21, 33, 41, 44, 45, 58, 65, 73, 81, 87, 91, 92, 104, 107, 113

*Astropygia pulvinata* (Lamarck, 1816)<sup>126</sup>

Genus *Centrostephanus* Peters, 1855

*Centrostephanus coronatus* (Verrill, 1867) JAL, COL, MICH, MAR, ISA, MAT<sup>42, 43, 44, 72, 73, 81, 96, 107, 109, 110, 111, 112, 113, 124, 129</sup>

Genus *Diadema* Gray, 1825

*Diadema mexicanum* A. Agassiz, 1863 NAY, JAL, COL, MICH, MAR, ISA, MAT, REV 1, 5, 7, 13, 15, 21, 22, 29, 31, 33, 41, 42, 43, 44, 45, 53, 58, 72, 73, 74, 75, 79, 81, 84, 91, 92, 96, 98, 104, 107, 108, 109, 110, 111, 112, 113, 120, 121, 124, 126, 129, 134

*Centrechinus mexicanus* (A. Agassiz, 1863)<sup>7, 9, 40, 65, 77, 135</sup>

*Diadema mexicanus* A. Agassiz, 1863<sup>31</sup>

Order **Arbacioida** Gregory, 1900

Family **Arbaciidae** Gray, 1855

Genus *Arbacia* Gray, 1835

*Arbacia stellata* (Blainville, 1825; ?Gmelin, 1788) NAY, JAL, MAR, ISA

*Arbacia incisa* (A. Agassiz, 1863)<sup>9, 13, 21, 42, 43, 81, 84, 109, 110, 111, 113</sup>

Order **Camarodonta** Jackson, 1912

Family **Echinometridae** Gray, 1855

Genus *Echinometra* Gray, 1825

*Echinometra insularis* H.L. Clark, 1912 REV<sup>37, 51, 100</sup>

*Echinometra oblonga* (Blainville, 1825) REV<sup>1, 7, 13, 15, 21, 31, 37, 40, 41, 45, 74, 79, 81, 91, 92, 95, 120, 124, 126, 134, 135</sup>

*Echinometra mathei oblonga* (Blainville, 1825)<sup>75</sup>

*Echinometra vanbrunti* A. Agassiz, 1863 NAY, JAL, COL, MICH, MAR, ISA, MAT, REV<sup>1, 7, 15, 31, 33, 41, 42, 43, 44, 45, 58, 73, 79, 81, 84, 87, 91, 92, 104, 107, 108, 109, 110, 111, 113, 120, 121, 124, 126, 129, 134</sup>

*Echinometra van brunti* A. Agassiz, 1863<sup>13, 21, 22, 29</sup>

*Echinometra Van brunti* A. Agassiz, 1863<sup>2, 9</sup>

*Echinometra van-brunti* A. Agassiz, 1863<sup>77</sup>

*Echinometra VanBrunti* A. Agassiz, 1863<sup>40</sup>

*Echinometra vanbruntii* A. Agassiz, 1863<sup>80</sup>

*Heliocidaris stenopora* H.L. Clark, 1912<sup>9</sup>

Genus *Heterocentrotus* Brandt, 1835

*Heterocentrotus mamillatus* (Linnaeus, 1758) REV<sup>7, 32, 108</sup>

Family **Toxopneustidae** Troschel, 1872

Genus *Toxopneustes* L. Agassiz, 1841

*Toxopneustes roseus* (A. Agassiz, 1863) NAY, JAL, COL, MICH, MAR, ISA, MAT, REV<sup>7, 13, 15, 21, 22, 29, 33, 40, 41, 42, 43, 44, 45, 58, 65, 73, 79, 81, 87, 91, 92, 96, 104, 107, 109, 110, 111, 112, 113, 121, 124, 126, 129</sup>

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Genus *Tripneustes* L. Agassiz, 1841

*Tripneustes depressus* A. Agassiz, 1863 **JAL, COL, MICH, MAR, ISA, MAT, REV** 1, 7, 13, 15, 18, 20, 21, 31, 33, 40, 41, 42, 43, 44, 45, 65, 73, 75, 79, 80, 81, 91, 92, 99, 104, 107, 108, 109, 110, 111, 113, 120, 121, 124, 126, 129, 130, 134, 135

*Tripneustes gratilla* (Linnaeus, 1758) **REV** 37

Order **Cassiduloidea** Claus, 1880

Family **Cassidulidae** L. Agassiz & Desor, 1847

Genus *Rhyncholampas* A. Agassiz, 1869

*Rhyncholampas pacificus* (A. Agassiz, 1863) **MAR, REV** 93

*Cassidulus pacifica* (A. Agassiz, 1863) 7, 91, 92

*Cassidulus pacificus* (A. Agassiz, 1863) 13, 15, 26, 40, 101

Order **Clypeasteroidea** A. Agassiz, 1872

Family **Clypeasteridae** L. Agassiz, 1835

Genus *Clypeaster* Lamarck, 1801

*Clypeaster europacificus* H.L. Clark, 1914 **REV** 7, 13, 15, 24, 40, 51, 81, 92, 120, 124, 135

*Clypeaster (Alexandria) europacificus* H.L. Clark, 1914 102

*Clypeaster ochrus* H.L. Clark, 1914 **MAR, ISA, REV** 13, 24, 39, 81, 92, 93, 120, 124, 126

*Clypeaster (Stolonoclypus) ochrus* H.L. Clark, 1914 91

*Clypeaster rotundus* (A. Agassiz, 1863) **JAL, MAR, ISA, REV** 7, 15, 24, 40, 43, 77, 92

*Clypeaster (Stolonoclypus) rotundus* A. Agassiz, 1863 91, 102

*Clypeaster speciosus* Verrill, 1870 **NAY, COL, REV** 7, 13, 15, 24, 39, 40, 41, 45, 77, 92, 126

*Clypeaster (Stolonoclypus) speciosus* Verrill, 1870 91, 102

Family **Dendrasteridae** Lambert, 1900

Genus *Dendraster* L. Agassiz in Agassiz & Desor, 1847

*Dendraster excentricus* (Eschscholtz, 1831) **ISA** 24

Family **Mellitidae** Stefanini, 1912

Genus *Mellita* L. Agassiz, 1841

*Mellita notabilis* H.L. Clark, 1947 **MICH** 58, 67, 81, 104

Genus *Encope* L. Agassiz, 1840

*Encope micropora* L. Agassiz, 1841 **JAL, MICH**

*Encope fragilis* H.L. Clark, 1948 40

*Encope micropora fragilis* H.L. Clark, 1948 24

*Encope perspectiva* L. Agassiz, 1841 40, 58, 81, 104

*Encope wetmorei* A.H. Clark, 1946 58, 81, 104

*Encope micropora insularis* H.L. Clark, 1948 **REV** 24, 102

*Encope insularis* H.L. Clark, 1948 13, 15, 40, 51

Genus *Lanthonia* Coppard, 2016

*Lanthonia longifissa* (Michelin, 1858) **COL**

*Mellita longifissa* Michelin, 1858 24, 81, 124

Order **Holasteroidea** Durham & Melville, 1957

Family **Plexechinidae** Mooi & David, 1996

Genus *Plexechinus* A. Agassiz, 1898

*Plexechinus cinctus* A. Agassiz, 1898 **MAR** 3, 4, 13, 26, 51, 90, 92

Order **Spatangoida** L. Agassiz, 1840

Family **Schizasteridae** Lambert, 1905

Genus *Brisaster* Gray, 1855

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- Brisaster townsendi*** (A. Agassiz, 1898) **MAR**  
*Briaster townsendi* (A. Agassiz, 1898) <sup>81</sup>  
*Brisaster townsendi* (A. Agassiz, 1898) <sup>13, 26</sup>  
*Schizaster townsendi* A. Agassiz, 1898 <sup>51</sup>  
*Schizaster Townsendi* A. Agassiz, 1898 <sup>3, 4</sup>
- Family **Prenasteridae** Lambert, 1905  
Genus ***Agassizia*** Valenciennes, 1846  
*Agassizia scrobiculata* Valenciennes, 1846 **NAY** <sup>26, 81</sup>
- Family **Brissidae** Gray, 1855  
Genus ***Brissopsis*** L. Agassiz, 1840  
*Brissopsis pacifica* (A. Agassiz, 1898) **REV** <sup>7, 13, 15, 26, 40, 91, 92</sup>  
Genus ***Brissus*** Gray, 1825  
*Brissus latecarinatus* (Leske, 1778) **ISA** <sup>109, 110</sup>  
*Brissus obesus* Verrill, 1867 **MAR** <sup>43</sup>
- Genus ***Meoma*** Gray, 1851  
*Meoma ventricosa grandis* Gray, 1851 **JAL, REV** <sup>81, 91, 93, 120</sup>  
*Meoma grandis* Gray, 1851 <sup>7, 26, 40, 77, 92, 103</sup>  
*Meoma ventricosa* (Lamarck, 1816) <sup>45, 124, 126</sup>
- Family **Loveniidae** Lambert, 1905  
Genus ***Lovenia*** Desor in Agassiz & Desor, 1847  
*Lovenia cordiformis* A. Agassiz, 1872 **REV** <sup>13, 15, 26, 40, 41, 45, 77, 81, 92, 93, 124</sup>  
*Lovenia cardiformis* A. Agassiz, 1872 <sup>7</sup>  
*Lovenia (Lovenia) cordiformis* A. Agassiz, 1872 <sup>91</sup>
- Class **Holothuroidea** Selenka, 1867  
Order **Dendrochirotida** Grube, 1840  
Family **Psolidae** Burmeister, 1837  
Genus ***Lissothuria*** Verrill, 1867  
*Lissothuria imbricata* Solís-Marín, Arriaga-Ochoa, Galván-Villa, & Laguarda-Figueras, 2018 **JAL** <sup>125</sup>  
*Lissothuria ornata* Verrill, 1867 **JAL, MICH, MAT** <sup>104, 111, 113, 125, 127</sup>  
*Thyonepsolus beebei* Deichmann, 1937 <sup>81</sup>
- Genus ***Psolus*** Oken, 1815  
*Psolus pauper* Ludwig, 1893 **MAR** <sup>85, 94</sup>
- Family **Sclerodactylidae** Panning, 1949  
Genus ***Afrocucumis*** Deichmann, 1944  
*Afrocucumis ovulum* (Selenka, 1867) **NAY, JAL, MICH, MAT** <sup>104, 113, 116, 127</sup>
- Genus ***Neothyone*** Deichmann, 1941  
*Neothyone gibber* (Selenka, 1867) **NAY, JAL, MICH, MAT, REV** <sup>7, 44, 47, 81, 84, 90, 104, 105, 111, 112, 113, 128</sup>  
*Thyone gibber* (Selenka, 1867) <sup>13, 15</sup>  
*Neothyone gibbosa* Deichmann, 1941 **JAL, MICH** <sup>58, 81, 104, 111, 113</sup>
- Genus ***Pachythyone*** Deichmann, 1941  
*Pachythyone lugubris* (Deichmann, 1939) **JAL** <sup>111, 113</sup>  
*Pachythyone pseudolugubris* Deichmann, 1941 **JAL, MICH, MAT** <sup>104, 111, 113, 127</sup>
- Genus ***Neopentamera*** Deichmann, 1941  
*Neopentamera anxigua* Deichmann, 1941 **JAL** <sup>111, 113</sup>
- Genus ***Euthyonidiella*** Heding & Panning, 1954  
*Euthyonidiella zacaе* (Deichmann, 1938) **REV** <sup>120</sup>  
*Phyllophorus zacaе* Deichmann, 1938 <sup>45, 81, 124</sup>
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Family **Phyllophoridae** Östergren, 1907

Genus **Pentamera** Ayres, 1852

**Pentamera chierchia** (Ludwig, 1886) **JAL, MICH, MAT, REV**

*Pentamera chierchia* (Ludwig, 1886) 7, 13, 15, 45, 47, 81, 91, 92, 104, 111, 113, 124, 126, 128

Genus **Thyone** Oken, 1815

**Thyone bidentata** Deichmann, 1941 **JAL** 13, 47, 113, 119

**Thyone parafusus** Deichmann, 1941 **JAL** 13, 47, 90, 92, 119, 130

Family **Cucumariidae** Ludwig, 1894

Genus **Abyssocucumis** Heding, 1942

**Abyssocucumis abyssorum** (Théel, 1886) **NAY** 87

Genus **Cucumaria** de Blainville, 1830

**Cucumaria flamma** Solís-Marín & Laguarda-Figueras, 1999 **NAY, JAL, COL, MICH, MAT** 44, 58, 73, 81, 104, 107, 111, 113, 118, 121, 124, 128, 129

*Pattalus mollis* Selenka, 1868 44, 105

Genus **Neocucumis** Deichmann, 1944

**Neocucumis veleronis** (Deichmann, 1941) **JAL, COL, MICH, MAT** 81, 104, 111, 113, 124, 127

Genus **Pseudocnus** Panning, 1949

**Pseudocnus californicus** (Semper, 1868) **NAY, JAL, COL, MICH, MAT** 44, 58, 81, 104, 105, 111, 113, 116, 124, 128

Genus **Trachythyone** Studer, 1876

**Trachythyone peruana** (Semper, 1868) **NAY, JAL** 81, 113

Genus **Thyonella** Verrill, 1872

**Thyonella mexicana** (Deichmann, 1941) **MICH** 104

Genus **Leptopentacta** H.L. Clark, 1938

**Leptopentacta panamica** Deichmann, 1941 **JAL** 13, 47, 90

Family **Ypsilothuriidae** Heding, 1942

Genus **Ypsilothuria** Perrier, 1886

**Ypsilothuria bitentaculata** (Ludwig, 1893) **MAR** 92, 94

*Shpaerothuria bitentaculata* Ludwig, 1893 85

Order **Holothuriida** Miller, Kerr, Paulay, Reich, Wilson, Carvajal & Rouse, 2017

Family **Holothuriidae** Burmeister, 1837

Genus **Holothuria** Linnaeus, 1767

Subgenus **Cystipus** Haacke, 1880

**Holothuria (Cystipus) inhabilis** Selenka, 1867 **REV** 91, 126

*Holothuria inhabilis* Selenka, 1867 7, 46, 92, 130

*Holothuria parinhabilis* Cherbonnier, 1951 15

*Jaegerothuria inhabilis* (Selenka, 1867) 77

**Holothuria (Cystipus) rigida** (Selenka, 1867) **NAY, JAL, COL, MICH, MAT** 44, 58, 81, 104, 105, 113, 124

*Holothuria rigida* (Selenka, 1867) 44, 84, 111

Subgenus **Halodeima** Pearson, 1914

**Holothuria (Halodeima) atra** Jaeger, 1833 **NAY, JAL, ISA** 81

*Holothuria atra* Jaeger, 1833 109, 110

**Holothuria (Halodeima) inornata** Semper, 1868 **NAY, JAL, MICH, ISA, MAT, REV** 104, 107, 113, 116, 119, 120, 126, 127

*Holothuria inornata* Semper, 1868 13, 15, 111, 112, 129

**Holothuria (Halodeima) kefersteini** (Selenka, 1867) **NAY, JAL, MICH, MAR, ISA, MAT, REV** 104, 107

*Holothuria kefersteini* (Selenka, 1867) 43

*Holothuria kefersteini* (Selenka, 1867) 44, 45, 84, 92

*Holothuria kefersteini* (Selenka, 1867) 129

*Holothuria kefersteni* (Selenka, 1867) 7

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- Holothuria (Halodeima) kefersteini* (Selenka, 1867) <sup>58, 81, 91, 105, 109, 110, 116, 119, 120, 124, 126</sup>  
*Holothuria (Paraholothuria) riojai* Caso, 1963 <sup>58</sup>  
*Ludwigothuria kefersteini* (Selenka, 1867) <sup>48, 77</sup>
- Subgenus **Lessonothuria** Deichmann, 1958
- Holothuria (Lessonothuria) pardalis*** Selenka, 1867 **JAL** <sup>91, 113</sup>  
*Holothuria pardalis* Selenka, 1867 <sup>13, 90</sup>  
*Lessonothuria pardalis* (Selenka, 1867) <sup>48</sup>
- Subgenus **Mertensiothuria** Deichmann, 1958
- Holothuria (Mertensiothuria) hilla*** Lesson, 1830 **MAR, ISA, REV** <sup>120, 126</sup>  
*Brandtothuria gyrifer* (Selenka, 1867) <sup>48</sup>  
*Holothuria gyrifer* (Selenka, 1867) <sup>13, 16</sup>  
*Holothuria hilla* Lesson, 1830 <sup>45, 111</sup>  
*Holothuria (Thymiosycia) hilla* Lesson, 1830 <sup>81, 109, 110, 124</sup>
- Holothuria (Mertensiothuria) leucospilota*** (Brandt, 1835) **COL, MAR, REV** <sup>81, 91, 120, 124, 126</sup>  
*Holothuria leucospilota* (Brandt, 1835) <sup>7, 13, 15, 31, 41, 45, 79, 90, 92</sup>  
*Mertensiothuria leucospilota* (Brandt, 1835) <sup>48</sup>
- Holothuria (Mertensiothuria) viridiaurantia*** Borrero-Pérez & Vanegas-González, 2019 **NAY, JAL, MICH, MAT**  
*Holothuria hilla* Lesson, 1830 <sup>111, 129</sup>  
*Holothuria (Mertensiothuria) hilla* Lesson, 1830 <sup>104, 113, 116, 127</sup>  
*Holothuria (Thymiosycia) hilla* Lesson, 1830 <sup>81</sup>
- Subgenus **Platyperona** Rowe, 1969
- Holothuria (Platyperona) difficilis*** Semper, 1868 **NAY, JAL, MICH, MAR, MAT, REV** <sup>81, 91, 104, 116, 120, 124, 126, 127</sup>  
*Holothuria difficilis* Semper, 1868 <sup>7, 13, 15, 45, 46, 112, 129, 130</sup>  
*Microthele difficilis* (Semper, 1868) <sup>48</sup>
- Subgenus **Selenkothuria** Deichmann, 1958
- Holothuria (Selenkothuria) carere*** Honey-Escandón, Solís-Marín, & Laguarda-Figueras, 2011 **MICH** <sup>82, 104</sup>  
***Holothuria (Selenkothuria) lubrica*** Selenka, 1867 **NAY, JAL, MICH, MAR, ISA, REV** <sup>58, 81, 91, 104, 109, 110, 113, 116, 120, 124, 126</sup>  
*Holothuria lubrica* Selenka, 1867 <sup>7, 12, 13, 15, 45, 58, 92, 111, 112, 121</sup>  
*Holothuria pseudolubrica* Cherbonnier, 1951 <sup>15</sup>  
*Selenkothuria lubrica* (Selenka, 1867) <sup>41, 48</sup>
- Holothuria (Selenkothuria) portovallartensis*** Caso, 1954 **NAY, JAL, MICH, REV** <sup>58, 81, 91, 104, 116, 119, 126</sup>  
*Holothuria portovallartensis* Caso, 1954 <sup>12, 13, 92</sup>  
*Selenkothuria portovallartensis* (Caso, 1954) <sup>48</sup>
- Subgenus **Semperothuria** Deichmann, 1958
- Holothuria (Semperothuria) imitans*** Ludwig, 1875 **NAY, JAL, COL, MICH, ISA, MAT, REV** <sup>81, 91, 104, 105, 109, 110, 116, 120, 124, 126</sup>  
*Holothuria imitans* Ludwig, 1875 <sup>7, 13, 15, 44, 45, 92, 129</sup>  
*Holothuria imitans* var. *polymorpha* Caso, 1962 <sup>15</sup>  
*Semperothuria imitans* (Ludwig, 1875) <sup>48, 77</sup>
- Holothuria (Semperothuria) languens*** Selenka, 1867 **JAL, MICH, MAR** <sup>81, 104</sup>  
*Holothuria languens* Selenka, 1867 <sup>13</sup>  
*Semperothuria languens* (Selenka, 1867) <sup>48</sup>
- Subgenus **Stauropora** Rowe, 1969
- Holothuria (Stauropora) fuscocinerea*** Jaeger, 1833 **JAL, MICH, MAR, ISA, REV**  
*Holothuria fuscocinerea* Jaeger, 1833 <sup>45, 73, 78</sup>  
*Holothuria fuscocinerea* Jaeger, 1833 <sup>43</sup>  
*Holothuria (Mertensiothuria) fuscocinerea* Jaeger, 1833 <sup>81, 109, 110, 124</sup>  
*Holothuria (Stauropora) pluricuriosa* Deichmann, 1937 <sup>120, 126</sup>
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Subgenus *Theelothuria* Deichmann, 1958

*Holothuria (Theelothuria) paraprinceps* Deichmann, 1937 **REV** <sup>126</sup>

*Holothuria paraprinceps* Deichmann, 1937 <sup>92</sup>

*Theelothuria paraprinceps* (Deichmann, 1937) <sup>48, 77</sup>

Subgenus *Thymiosycia* Pearson, 1914

*Holothuria (Thymiosycia) arenicola* Semper, 1868 **NAY, JAL, COL, MICH, MAR, ISA, MAT, REV** <sup>44, 58, 81, 91, 104, 105, 107, 109, 110, 113, 116, 119, 120, 124, 126</sup>

*Brandtothuria arenicola* (Semper, 1868) <sup>42, 48, 77</sup>

*Holothuria arenicola* Semper, 1868 <sup>7, 15, 44, 45, 73, 84, 92, 111, 121, 129</sup>

*Holothuria (Thymiosycia) impatiens* (Forskål, 1775) **NAY, JAL, COL, MICH, MAR, ISA, MAT, REV** <sup>58, 81, 91, 104, 105, 107, 109, 110, 113, 116, 120, 124</sup>

*Brandtothuria impatiens* (Forskål, 1775) <sup>42, 48, 77</sup>

*Holothuria impatiens* (Forskål, 1775) <sup>7, 15, 43, 44, 45, 58, 84, 92, 111, 112, 124, 129</sup>

Genus *Labidodemas* Selenka, 1867

*Labidodemas americanum* Deichmann, 1938 **NAY, JAL, COL, MICH, MAT, REV** <sup>44, 45, 81, 104, 105, 113, 116, 120, 124, 126, 129</sup>

*Labidodemas americanus* Deichmann, 1938 <sup>58</sup>

*Labidodemas maccullochi* (Deichmann, 1958) **JAL, COL, MICH** <sup>111, 113</sup>

*Holothuria (Irenothuria) maccullochi* (Deichmann, 1958) <sup>58</sup>

*Labidodemas maccullochi* (Deichmann, 1958) <sup>81, 124</sup>

Order **Synallactida** Miller, Kerr, Paulay, Reich, Wilson, Carvajal, & Rouse, 2017

Family **Stichopodidae** Haeckel, 1896

Genus *Isostichopus* Deichmann, 1958

*Isostichopus fuscus* (Ludwig, 1875) **NAY, JAL, COL, MICH, MAR, ISA, MAT, REV** <sup>7, 42, 43, 44, 45, 48, 58, 72, 73, 81, 84, 91, 92, 104, 105, 107, 109, 110, 111, 112, 113, 119, 120, 121, 124, 126, 129, 133</sup>

*Isostichopus fuscus* (Ludwig, 1875) <sup>96</sup>

*Stichopus fuscus* Ludwig, 1875 <sup>15, 17, 78</sup>

Order **Elasipodida** Théel, 1882

Family **Laetmogonidae** Ekman, 1926

Genus *Pannychia* Théel, 1882

*Pannychia moseleyi* Théel, 1882 **JAL, COL, MAR** <sup>92, 94</sup>

*Laetmophasma fecundum* Ludwig, 1893 <sup>85</sup>

Order **Molpadida** Haeckel, 1896

Family **Molpadiidae** Müller, 1850

Genus *Molpadia* Cuvier, 1817

*Molpadia musculus* Risso, 1826 **MAR** <sup>92</sup>

*Ankyroderma danielsseni* Théel, 1886 <sup>85</sup>

Order **Apodida** Brandt, 1835

Family **Chiridotidae** Östergren, 1898

Genus *Chiridota* Eschscholtz, 1829

*Chiridota aponocrita* A.H. Clark, 1920 **MICH** <sup>104</sup>

*Chiridota rigida* Semper, 1867 **NAY, MICH, MAT** <sup>44, 81, 104, 105</sup>

Family **Synaptidae** Burmeister, 1837

Genus *Epitomapta* Heding, 1928

*Epitomapta tabogae* Heding, 1928 **MICH** <sup>104</sup>

Genus *Euaпта* Östergren, 1898

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COL = Colima; ISA = Isabel Island; JAL = Jalisco; MAR = Marias Islands; MAT = Marietas Islands; MICH = Michoacán; NAY = Nayarit; REV = Revillagigedo Islands.

**Invalid and doubtful records:** The records considered as invalid (52) or doubtful (five) are based on: 1) erroneous or doubtful distributions, 2) incorrect taxonomic identifications, or 3) entries in faunal list not backed up by records in the primary literature.

There are some records considered invalid because of inconsistencies in their geographical distributions. The ophiuroids *Ophiocomella ophiactoides* and *Astrophyton muricatum*, and the holothuroid *Isostichopus badionotus* have been reported in the CMP (Honey-Escandón et al., 2008; Solís-Marín et al., 2016b; CONANP, 2019), yet the species distribution range is exclusively for the Caribbean and the Gulf of México (Hendler, Miller, Pawson, & Kier, 1995; Solís-Marín et al., 2013a), meanwhile the echinoids *Echinothrix calamaris* and *Echinothrix diadema* inhabits the Indian Ocean, but have been reported in REV (Sotelo-Casas & Rodríguez-Troncoso, 2014). The holothuroid *Pentamera chiloensis* is reported in Barra de Navidad, JAL (Rodríguez-Troncoso et al., 2013); this species distributes only in South America (Perú and Chile; Solís-Marín et al., 2013a). Records previously mentioned correspond to erroneous records and must be invalid (R.C. Sotelo-Casas and F.A. Solís-Marín, personal communication, 01 March 2020).

The crinoid *Hyocrinus foelli* (Solís-Marín et al., 2013a; Solís-Marín et al., 2013b; Solís-Marín, Laguarda-Figueras, & Honey-Escandón, 2014) and the holothuroid *Psychronaetes hanseni* (Maluf, 1991; Bautista-Romero et al., 1994; Massin & Hendrickx, 2011) have been reported in Clarion Island, REV, but according to their original descriptions (Pawson, 1983; Roux & Pawson, 1999) and the validation of the geographical coordinates, all the records corresponds to the Clarion-Clipperton Fracture Zone which is located approximately 1 200 km

far away from REV. The echinoids *Aporocidaris milleri* and *Kamptosoma asterias* were reported in NAY (station 96, 2988-3001 m depth) by Parker (1963), yet the validation of the geographic coordinates revealed that this station is located in the entrance of the Gulf of California, and far away from the maritime zone of NAY. Moreover, *K. asterias* is distributed in the Central Pacific Ocean, Chile and the Antarctica (Mooi, Constable, Lockhart, & Pearse, 2004).

Furthermore, some records had inconsistencies in their taxonomic identifications. *Ophionereis albomaculata* (ophiuroid) has records in ISA and MAR (Caso, 1961; Maluf, 1991; Maluf & Brusca, 2005; Granja-Fernández et al., 2015a; Granja-Fernández et al., 2017); during our revision of museum collections, we taxonomically reviewed all the material known for *O. albomaculata* (Galápagos Islands and Panamá), and none corresponded to México. The material identified as *O. albomaculata* from México must relate to another species of *Ophionereis*. The collected material of the holothuroid *Holothuria (Lessenothuria) pardalis* from REV (Solís-Marín et al., 2013a; Sotelo-Casas & Rodríguez-Troncoso, 2014), was previously identified as *H. (Lessenothuria) pardalis*, yet it corresponds to a new species in process of description (F.A. Solís-Marín, personal communication, 01 April 2020). It is important to mention that in the CMP, the species only distributes in Tenacatita, JAL (Deichmann, 1958).

Most of the entries are based on unbacked up records of primary references. Bautista-Romero et al. (1994) constructed a checklist of echinoderms from REV according to previous records (Fisher, 1911; Ziesenhenné, 1937; Caso, 1962b; Maluf, 1988), and reported: *Florometra serratissima* (crinoid); *Amphiaster insignis*,

*Astropecten verrilli*, *Echinaster (Othilia) tenuispina*, *Heliaster kubiniji*, *Henricia aspera*, *Henricia asthenactis*, *Henricia leviuscula*, *Henricia polyacantha*, *Leiaster teres*, *Luidia foliolata*, *Luidia phragma*, *Mediaster aequalis*, *Narcissia gracilis*, *Odontaster crassus*, *Tethyaster canaliculatus*, and *Thrissacanthias penicillatus* (asteroids); *Amphiodia (Amphispi-na) urtica*, *Amphipholis squamata*, *Amphiura arcystata*, *Astrocanium spinosum*, *Diopederma daniana*, *Ophiolepis crassa*, *Ophionereis eurybrachiplax*, *Ophiopaepale diplax* and *Ophiura luetkenii* (ophiuroids); and *Arbacia stellata* (as *Arbacia incisa*), *Centrostephanus coronatus*, *Encope grandis*, *Encope micropora*, *Lytechinus pictus*, and *Strongylocentrotus fragilis* (echinoids). We consulted the previous literature and we did not find these records on them or in other literature references, therefore these records are invalid.

Based on literature records, *Lophaster furcilliger* (asteroid), *Astrocanium spinosum* (ophiuroid), and *Centrostephanus coronatus* (echinoid) have been recorded in the program of management and conservation of REV (CONANP, 2019). The only records of *L. furcilliger* in the CMP correspond to MAR (Ludwig, 1905; Maluf, 1988; Maluf, 1991), therefore their inclusion in REV is incorrect. Despite it is very probable that *A. spinosum* and *C. coronatus* distributes in REV, we did not find any record in publications to back it up. Other species reported in a program of management and conservation (ISA; CONANP, 2005) are the echinoids *Clypeaster europacificus* and *Lovenia cordiformis*, but again no primary references supporting these records were found, and therefore are considered as invalid records.

Finally, based on a revision of literature, the asteroids *Paulia horrida* and *Luidia bellonae* were reported in MAR by Maluf (1988) and Maluf and Brusca (2005), respectively; nevertheless, we did not find any record of these species for MAR but for REV. Similarly, the asteroid *Cnemidaster nudus* has only one mention for COL (Solís-Marín et al., 2016b), but it corresponds to an erroneous record (F.A. Solís-Marín, personal communication, 01 April

2020). For these reasons, we consider both records as invalid.

The following records were considered as doubtful. The ophiuroid *Amphiodia periercta* inhabits in the North Pacific Ocean (from Aleutian Islands, Alaska to central California; Lambert & Austin, 2007), yet it has a report in Clarion Island, REV (Maluf, 1988; Bautista-Romero et al., 1994). Due to the northern affinity of *A. periercta*, its distribution in REV is unlikely. The record of *Hymenaster pentagonalis* in REV was obtained by the Expedition Ocean Exploration Trust/Nautilus Live 2017 (CONANP, 2019), yet this species distributes only in Hawaii (Mah, 2020).

The echinoids *Caenocentrotus gibbosus* (Clark, 1925; Grant & Hertlein, 1938; Maluf, 1988; Maluf, 1991; Bautista-Romero et al., 1994) and *Lytechinus semituberculatus* (Clark, 1925; Clark, 1948; Mortensen, 1943b; Caso, 1962b; Maluf, 1988; Bautista-Romero et al., 1994) have many mentions in Clarion Island, REV, yet in all these references the locality is treated as doubtful. It is important to emphasize that both species inhabit in South America (Galápagos Islands, Perú, and Chile; Grant & Hertlein, 1938; Solís-Marín et al., 2013a), thus their distribution in México is unlikely. Similarly, the holothuroid *Holothuria (Selenkothuria) theeli* is recorded from REV as doubtful (Hertlein, 1963; Maluf, 1991; Maluf & Brusca, 2005). In the Eastern Pacific, *H. (Selenkothuria) theeli* inhabits in lower latitudes (i.e. Costa Rica-Perú; Solís-Marín et al., 2013a) and in México it has been collected only in Guerrero (Honey-Escandón et al., 2008). For these reasons, we determined these records as doubtful.

**New records:** Following review of museum material, we add 16 new records of Ophiuroidea to different states (four NAY, one COL, and one MICH) and islands (two MAR, four ISA, and four REV) from the CMP (appendix 1). All the species were previously recorded in areas from the CMP (Table 1), excepting *Amphiodia psara*, *Amphiodia tabogae*, *Microphiopholis geminata*, and *Ophiophragmus paucispinus*, which represent new records for the CMP.

*Amphiodia psara* has previous records in USA (California; Clark, 1935) and México (Gulf of California and Guerrero; Maluf, 1988; Maluf & Brusca, 2005; Granja-Fernández et al., 2015b). After the taxonomic revision of *A. psara* in different museum collections, we did not find material from Guerrero, but for the Pacific of Baja California and Baja California Sur, the Gulf of California (Ángel de la Guarda Island, Tiburón Island, Consag Rock, and Sonora), and NAY. The records from Baja California, Baja California Sur and NAY are new, being Punta Mita, Nayarit, the southernmost area of its geographical distribution.

*Amphiodia tabogae*, *M. geminata*, and *O. paucispinus* distribute along the Eastern Pacific (México to Galápagos Islands; Solís-Marín et al., 2013a). Specifically, in México, the three species inhabit the Gulf of California; *A. tabogae* has been reported also in Guerrero (Granja-Fernández et al., 2015b). The finding of these species in Punta Mita, NAY (*A. tabogae* and *M. geminata*), and in MAR (*O. paucispinus*), represents new records in the CMP, and fills the distribution gap along the Mexican Pacific.

**Diversity and distribution:** The diversity of the Echinodermata from the CMP is represented by 187 species of echinoderms belonging to 27 orders, 63 families, 110 genera, and 16 subgenera (Table 2). Compared to the total number of echinoderm species worldwide (7 437 species; WoRMS, 2020), the CMP shelters 2.5 %. The orders with the highest number of species in the CMP were Amphilepidida (Ophiuroidea, 40 species), Holothuriida and Dendrochirotida (Holothuroidea, 21 species,

respectively), Ophiacanthida (Ophiuroidea, 16 species), and Valvatida (Asteroidea, 15 species), meanwhile the best represented families were Amphiuiridae (Ophiuroidea, 26 species), and Holothuriidae (Holothuroidea, 21 species) (Table 1). On the other hand, the orders Ophiurida (45 species), Aspidochirotida (22 species), and Dendrochirotida (22 species) were the best represented in the Southern Mexican Pacific (SMP; Granja-Fernández et al. 2015b). Differences in the numbers of recorded orders between the CMP and the SMP are due to recent changes in the systematics of the Ophiuroidea (O’Hara, Stöhr, Hugall, Thuy & Martynov, 2018) in which most of the members previously included in the order Ophiurida, now are in Amphilepidida, and in the Holothuroidea, where most of the members of Aspidochirotida were changed to Holothuriida (Miller et al., 2017). If we compare both faunas in the same classification system, similar trends are shown, suggesting that both areas possess similar faunas in terms of orders and families of echinoderms.

In the CMP, the class Ophiuroidea was the most numerous with 67 species, followed by Holothuroidea (50), Asteroidea (35), Echinoidea (32), and Crinoidea (three) (Table 2). In general, the number of species of Holothuroidea, Asteroidea and Echinoidea were similar between the CMP and the SMP, but Ophiuroidea was represented by more species in the CMP (67) than to the SMP (46); meanwhile, the class Crinoidea had not records in the SMP (Granja-Fernández et al., 2015b). Differences on the Ophiuroidea are related to the recent sampling effort directed in the

TABLE 2  
Taxonomic categories of echinoderms from the Central Mexican Pacific

Class	Orders	Families	Genera	Subgenera	Species
Crinoidea	2	2	2	0	3
Asteroidea	5	16	24	2	35
Ophiuroidea	6	20	35	4	67
Echinoidea	8	14	23	0	32
Holothuroidea	6	11	26	10	50
TOTAL	27	63	110	16	187



CMP (Granja-Fernández et al., 2017), and the extensive revision of samples from museum collections (reflected in the new records of species in this work). Nine species of Crinoidea from México to Perú (Solís-Marín et al., 2013a) and at least seven in the northern part of the American continent (Lambert & Austin, 2007) are reported in the literature therefore, finding crinoids in the CMP and SMP is likely. Despite the above, a null to a scarce number of species of Crinoidea are reported in both areas. We consider that the explanation of this pattern (and in general of the Eastern Pacific) is not due to the natural biogeographic distribution of the Crinoidea in the Eastern Pacific, yet to the scarce prospection in deep waters (the natural environment of the class in the Eastern Pacific), as well as to the low interest and lack of taxonomical specialists in the class.

As previously mentioned, the CMP is represented by 187 species of echinoderms; of those, 122 inhabit in ~ 640 km of the coastline of the studied states, and 142 in an extensive maritime area of the islands (~ 155 000 km<sup>2</sup>). The SMP has not extensive islands such as the CMP, therefore if only their coastlines are compared, the latter possesses a lower number of echinoderms species than the SMP (162 species; Granja-Fernández et al., 2015b). In order to have a better comprehension of the number of species between both areas, a standardization per area is required, therefore considering the whole CMP (~ 640 km) has 5.2 species/km, and the SMP (~ 1 200 km) possesses 7.4

species/km. The collecting effort in more areas, habitats, and depths could explain higher biodiversity of echinoderms in the coastline of CMP, but further collections of material and biogeographic analysis are required in order to better understand their distribution pattern.

In terms of spatial distribution, the coast of the state of JAL presented the highest number of species (84), followed by the coast of NAY (74), MICH (63), and COL (55); among the islands, REV showed the major number of species (85) followed by MAR (81), MAT (48), and ISA (44) (Table 3). Compared to the most complete and recent works of echinoderms by states (Honey-Escandón et al., 2008; Rodríguez-Troncoso et al., 2013; Solís-Marín et al., 2016b; Granja-Fernández et al., 2017; Ríos-Jara et al., 2017; Nava-Bravo et al., 2019) and islands (CONANP, 2005; CONANP, 2007a; CONANP, 2007b; CONANP, 2019; Honey-Escandón et al., 2008; Solís-Marín et al., 2013a; Granja-Fernández et al., 2017), this work increases the number of recorded species in 27 % for NAY, 49 % for JAL, 1.5 % for MICH, 70 % for MAR, 64 % for ISA, 48 % for MAT, 38 % for REV, and finally 45 % for the entire CMP region. We found the same number of species for COL as its most recent account of echinoderms (Solís-Marín et al., 2016b). Differences in the numbers of species among previous studies and the present one is attributed to a more intense literature review, the validation of geographical coordinates, the correction of records, and the addition of new ones.

TABLE 3  
Number of species of echinoderms from the Central Mexican Pacific

	NAY	JAL	COL	MICH	MAR	ISA	MAT	REV
Crinoidea	0	0	2	0	1	0	0	0
Asteroidea	13	10	13	11	12	8	6	19
Ophiuroidea	33	27	18	12	39	13	16	25
Echinoidea	7	12	9	10	14	12	7	21
Holothuroidea	21	35	13	30	15	11	19	20
TOTAL	74	84	55	63	81	44	48	85

COL = Colima; ISA = Isabel Island; JAL = Jalisco; MAR = Marias Islands; MAT = Marietas Islands; MICH = Michoacán; NAY = Nayarit; REV = Revillagigedo Islands.





JAL, MAR and REV were the areas with the highest number of species and have been prospected in several shallow and deep-water localities/stations since late 1800's by foreign (Albatross, Veleró, and Zaca; e.g. Agassiz, 1898; Clark, 1940; Deichmann, 1958) and national expeditions (e.g. Caso, 1943b; Caso, 1961; Caso, 1962b). In contrast, the state of COL, as well as ISA and MAT islands have the lowest number of species, and their poor prospections initiated in the late 1900's (e.g. Caso, 1961; Caso, 1980), and have been mostly performed during the 2000's, strictly in shallow-waters (e.g. Chávez-Dagostino et al., 2000; Ríos-Jara et al., 2008a, Ríos-Jara et al., 2013; Sotelo-Casas et al., 2018). On the other hand, MAR and REV (the unique oceanic islands of the CMP) display unique characteristics such as particular oceanographic and topographic conditions, high productivity, mesophotic reefs, great depths, among others, which promote high levels of general marine biodiversity and endemism (CONANP, 2007a; CONANP, 2019), explaining their highest number of echinoderms in the region. In conclusion, the obtained data shows that the number of species of echinoderms in the CMP region is mostly associated with a sampling effort, yet specific conditions of particular areas (i.e. MAR and REV) can be influencing their high biodiversity, but more collections of material and further biogeographic analysis are required in order to sustain this statement.

**Final considerations:** The CMP is located in an oceanographic transitional zone, therefore fauna from the North and South regions of the Mexican Pacific (Arriaga-Cabrera et al., 1998), the Eastern Pacific (e.g. Solís-Marín et al., 2013a), and even of higher latitudes (e.g. Lambert & Austin, 2007), can inhabit in the region. In this sense, MAR and REV are important as they are considered a stepping stone to import organisms from the Indo-Pacific species into the Tropical Eastern Pacific (Reyes-Bonilla & López-Pérez, 1998), as well as in the connection for dispersal species to and from northern

(Gulf of California) and the mainland CMP (López-Pérez et al., 2015).

All the islands considered in the present work possess their own programs of management and conservation (CONANP, 2005; CONANP, 2007a; CONANP, 2007b; CONANP, 2019) in which detailed descriptions of geographical, physical, demographical, social and environmental characteristics (among others) are provided. Despite the above, we detected that all these programs underestimated the number of species of echinoderms since they reported 16 species for ISAB (CONANP, 2005), 24 for MAR (CONANP, 2007a), 25 for MAT (CONANP, 2007b), and 52 for REV (CONANP, 2019). The inclusion of all the species reported in the present work on the lists of these natural protected areas will further emphasize the importance of the islands.

Due to the importance of the islands of the CMP, most of the research of echinoderms in the region have been conducted on them (e.g. Ríos-Jara et al., 2008a; Sotelo-Casas et al., 2018) relegating the mainland of the states of NAY, JAL, COL, and MICH, which remain almost unstudied and which have a high potential of finding numerous species of echinoderms since they have complex environments (extensive bays, coastal lagoons, estuaries, mangroves and coral reefs; Arriaga-Cabrera et al., 1998). Regardless the differences on the diversity of echinoderms and exploration of the mainland and islands from the CMP, all of them are important due to 34 species collected in the region have been described as new species (five Asteroidea, 16 Ophiuroidea, five Echinoidea, and eight Holothuroidea; Table 4). This highlights the potential of the CMP in finding more new species. Although the present manuscript provides the most-completed checklist of the echinoderms in the CMP, we encourage to intensify research in shallow and deep-waters and across different habitats of all the islands and mainland of the states of the region in order to better understand its biodiversity and distributional patterns. Finally, the preservation of the marine fauna of the entire CMP is key in the maintenance of the entire Mexican and Tropical Pacific; therefore, we encourage ensuring



TABLE 4

Described species and subspecies of Echinodermata based on material collected in the Central Mexican Pacific

Class	Species	Locality	Reference
Asteroidea	<i>Ampheraster marianus</i>	Mariás Islands	Ludwig, 1905
	<i>Astropecten regalis</i>	San Blas, Nayarit	Gray, 1840
	<i>Henricia gracilis</i>	Mariás Islands	Ludwig, 1905
	<i>Henricia seminudus</i>	Revillagigedo Islands	Clark, 1916
	<i>Psilaster armatus</i>	Mariás Islands	Ludwig, 1905
Ophiuroidea	<i>Amphichondrius laevis</i>	Tenacatita Bay, Jalisco	Ziesenhenne, 1940
	<i>Amphiodia sculptilis</i>	Tenacatita Bay, Jalisco	Ziesenhenne, 1940
	<i>Amphiura serpentina</i>	Mariás Islands	Lütken & Mortensen, 1899
	<i>Astrodia excavata</i>	Mariás Islands	Lütken & Mortensen, 1899
	<i>Dougalophus notacanthus</i>	Mariás Islands	Lütken & Mortensen, 1899
	<i>Ophiacantha costata</i>	Mariás Islands	Lütken & Mortensen, 1899
	<i>Ophiacantha hirta</i>	Mariás Islands	Lütken & Mortensen, 1899
	<i>Ophiacantha moniliformis</i>	Mariás Islands	Lütken & Mortensen, 1899
	<i>Ophiacantha pyriformis</i>	Revillagigedo Islands	Ziesenhenne, 1937
	<i>Ophiernus adpersus annectens</i>	Mariás Islands	Lütken & Mortensen, 1899
	<i>Ophiolepis plateia</i>	Tenacatita Bay, Jalisco	Ziesenhenne, 1940
	<i>Ophiomitra granifera</i>	Mariás Islands	Lütken & Mortensen, 1899
	<i>Ophiomitra partita</i>	Mariás Islands	Lütken & Mortensen, 1899
	<i>Ophiophragmus lonchophorus</i>	Tenacatita Bay, Jalisco	Ziesenhenne, 1940
	<i>Ophiosphalma variabile</i>	Mariás Islands	Lütken & Mortensen, 1899
	<i>Ophiura (Ophiura) scutellata</i>	Mariás Islands	Lütken & Mortensen, 1899
	Echinoidea	<i>Brisaster townsendi</i>	Mariás Islands
<i>Echinometra insularis</i>		Revillagigedo Islands	Clark, 1912
<i>Encope micropora insularis</i>		Revillagigedo Islands	Clark, 1948
<i>Hesperocidaris perplexa</i>		Revillagigedo Islands	Clark, 1907
<i>Plexechinus cinctus</i>		Mariás Islands	Agassiz, 1898
Holothuroidea	<i>Cucumaria flamma</i>	Colima, Nayarit, Marietas Islands	Solis-Marín & Laguarda-Figuera, 1999
	<i>Lissothuria imbricata</i>	Jalisco	Solis-Marín et al., 2018
	<i>Holothuria (Selenothuria) carere</i>	Michoacán	Honey-Escandón et al., 2011
	<i>Holothuria (Selenothuria) portovallartensis</i>	Puerto Vallarta, Jalisco	Caso, 1954
	<i>Psolus pauper</i>	Mariás Islands	Ludwig, 1894
	<i>Thyone bidentata</i>	Tenacatita Bay, Jalisco	Deichmann, 1941
	<i>Thyone parafusus</i>	Tenacatita Bay, Jalisco	Deichmann, 1941
	<i>Ypsilothuria bitentaculata</i>	Mariás Islands	Ludwig, 1894

its effective protection through inventories of marine and coastal species.

**Ethical statement:** authors declare that they all agree with this publication and made significant contributions; that there is no

conflict of interest of any kind; and that we followed all pertinent ethical and legal procedures and requirements. All financial sources are fully and clearly stated in the acknowledgements section. A signed document has been filed in the journal archives.

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## RESUMEN

### Equinodermos (Echinodermata) del Pacífico Central mexicano

**Introducción:** Los equinodermos del Pacífico Central mexicano poseen un alto interés científico, pero anterior al presente trabajo existía un vacío en la información básica como listados de especies incompletos con inconsistencias sistemáticas y de distribución espacial. **Objetivo:** Proporcionar una revisión histórica y un listado de especies actualizado con la riqueza completa de equinodermos para cada estado e islas de la región. **Métodos:** Se elaboró un listado de especies basado en una búsqueda exhaustiva de Echinodermata, y fue complementada con la revisión taxonómica de Ophiuroidea de colecciones científicas. Todas las coordenadas geográficas de los registros fueron validadas. **Resultados:** La región posee 187 especies de Echinodermata: tres Crinoidea, 35 Asteroidea, 67 Ophiuroidea, 32 Echinoidea, y 50 Holothuroidea. Detectamos 52 registros en la literatura considerados como inválidos y cinco como dudosos. Proveemos 16 nuevos registros de Ophiuroidea para diversos estados e islas; de estos, cuatro son nuevos registros para la región. Jalisco presentó el mayor número de especies (84), seguido por las costas de Nayarit (74), Michoacán (63), y Colima (55); entre las islas, Revillagigedo presentó el mayor número de especies (85) seguido por Mariás (81), Marietas (48), e Isabel (44). **Conclusiones:** Los números de especies de la región están mayormente relacionados tanto con el esfuerzo de muestreo como con características ambientales que promueven una alta biodiversidad. El Pacífico Central mexicano es una región oceanográfica con condiciones mixtas del norte y sur del Pacífico mexicano, y por lo tanto con una importancia biogeográfica reflejada en la riqueza de la región.

**Palabras clave:** Echinodermata; biodiversidad; listado de especies; revisión histórica; nuevos registros.

## REFERENCES

Numbers in brackets refer to literature where the taxa were recorded (Table 1)

- Adem, J., Cobo, E., Blásquez, L., Miranda, F., Villalobos, A., Herrera, T., . . . Vázquez, L. (1960). La Isla Socorro. Archipiélago de Revillagigedo. *Monografías del Instituto de Geofísica. Universidad Nacional Autónoma de México*, 2, 1-234. [1]
- Agassiz, A. (1872). Revision of the Echini. Part I. *Illustrated catalogue of the Museum of Comparative Zoölogy at Harvard College*, 7, 1-242. [2]
- Agassiz, A. (1898). Reports on the dredging operations off the West coast of Central America to the Galapagos, to the West coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U.S. Fish Commission Steamer "Albatross", during 1891, Lieut. Commander Z.L. Tanner, U.S.N., commanding. XXIII. Preliminary report on the Echini. *Bulletin of the Museum of Comparative Zoölogy at Harvard College*, 32(5), 71-86. [3]
- Agassiz, A. (1904). Reports on an exploration off the West coast of Mexico, Central and South America and off the Galapagos Islands, in charge of Alexander Agassiz by the U.S. Fish Commission Steamer "Albatross", during 1891, lieut. Commander Z.L. Tanner, U.S.N. commanding. XXXII. The Panamic deep sea Echini. *Memoirs of the Museum of Comparative Zoölogy at Harvard College*, 31, 1-243. [4]
- Alvarado, J.J., Reyes-Bonilla, H., & Benítez-Villalobos, F. (2015). *Diadema mexicanum*, erizo de mar clave en los arrecifes coralinos del Pacífico Tropical Oriental: lo que sabemos y perspectivas futuras (Diadematoidea: Diademataidae). *Revista de Biología Tropical*, 63(2), 135-157. [5]
- Arriaga-Cabrera, L., Vázquez-Domínguez, E., González-Cano, J., Jiménez-Rosenberg, R., Muñoz-López, E., & Aguilar-Sierra, V. (1998). *Regiones marinas prioritarias de México*. México: Comisión Nacional para el Conocimiento y uso de la Biodiversidad.
- Ayala-Bocos, A., Reyes-Bonilla, H., Herrero-Pérezrul, M.D., Walther-Mendoza, M., & Castañeda-Fernández de Lara, V. (2011). New records and range extensions of *Astrodictyum panamense* (Ophiuroidea: Gorgonocephalidae) in the eastern Pacific Ocean. *Marine Biodiversity Records*, 4(46), 1-3. [6]
- Bautista-Romero, J., Reyes-Bonilla, H., Lluch-Cota, D.B., & Lluch-Cota S.E. (1994). Aspectos generales de la fauna marina. In A. Ortega-Rubio & A. Castellanos-Vera (Eds.), *La Isla Socorro, Reserva de la Biósfera Archipiélago de Revillagigedo, México* (pp. 247-275). La Paz, México: Centro de Investigaciones Biológicas del Noroeste S.C. [7]



- Borrero-Pérez, G.H., & Vanegas-González, M.J. (2019). *Holothuria (Mertensiothuria) viridiaurantia* sp. nov. (Holothuriida, Holothuriidae), a new sea cucumber from the Eastern Pacific Ocean revealed by morphology and DNA barcoding. *ZooKeys*, 893, 1-19.
- Caso, M.E. (1943). *Contribución al conocimiento de los astéridos de México* (Master's thesis). Universidad Nacional Autónoma de México, México. [8]
- Caso, M.E. (1948a). Contribución al conocimiento de los equinoideos de México. II. Algunas especies de equinoideos litorales. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México*, 19(1), 183-231. [9]
- Caso, M.E. (1948b). Datos históricos y estado actual de los conocimientos de la fauna de astéridos de México. *Sociedad Mexicana de Historia Natural*, 1, 21-32. [10]
- Caso, M.E. (1951). Contribución al conocimiento de los ofiuroideos de México. I. Algunas especies de ofiuroideos litorales. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México*, 22(1), 219-312. [11]
- Caso, M.E. (1954). Contribución al conocimiento de los holoturoideos de México. Algunas especies de holoturoideos litorales y descripción de una nueva especie *Holothuria portovallartensis*. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México*, 25, 417-422. [12]
- Caso, M.E. (1961). *Los Equinodermos de México* (Doctoral thesis). Universidad Nacional Autónoma de México, México. [13]
- Caso, M.E. (1962a). Estudios sobre Astéridos de México. Observaciones sobre especies pacíficas del género *Acanthaster* y descripción de una subespecie nueva, *Acanthaster ellisii pseudoplanci*. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México*, 32(1-2), 313-331. [14]
- Caso, M.E. (1962b). Estudios sobre equinodermos de México. Contribución al conocimiento de los equinodermos de las Islas Revillagigedo. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México*, 33(1-2), 293-330. [15]
- Caso, M.E. (1965). Estudios sobre equinodermos de México. Contribución al conocimiento de los holoturoideos de Zihuatanejo y de la Isla de Ixtapa (primera parte). *Anales del Instituto de Biología, Universidad Nacional Autónoma de México*, 36, 253-291. [16]
- Caso, M.E. (1966). Contribución al estudio de los holoturoideos de México. Morfología interna y ecología de *Stichopus fuscus* Ludwig. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México*, 37, 175-182. [17]
- Caso, M.E. (1974a). Contribución al estudio de los equinoideos de México. Morfología de *Tripneustes depressus* Agassiz y estudio comparativo entre *T. ventricosus* y *T. depressus*. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México*, 1(1), 25-40. [18]
- Caso, M.E. (1974b). Morfología externa de *Acanthaster planci* (Linnaeus). *Symposium on Indian Ocean and Adjacent Seas. Journal of the Marine Biological Association of India*, 16(1), 83-93. [19]
- Caso, M.E. (1978a). Ciencia y técnica de los equinodermos en relación con el hombre. Primera parte. Aspecto científico. *Anales del Centro de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México*, 5(1), 255-286. [20]
- Caso, M.E. (1978b). Los equinoideos del Pacífico de México. Parte primera. Órdenes Cidaroida y Aulodonta. Parte segunda. Órdenes Stiridonta y Camarodonta. *Publicaciones Especiales, Centro de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México*, 1, 1-244. [21]
- Caso, M.E. (1979a). Los equinodermos de la Bahía de Mazatlán, Sinaloa. *Anales del Centro de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, Publicación Especial*, 6(1), 197-368. [22]
- Caso, M.E. (1979b). Los equinodermos (Asteroidea, Ophiuroidea y Echinoidea) de la Laguna de Términos, Campeche. *Centro de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, Publicación Especial*, 3, 1-186. [23]
- Caso, M.E. (1980). Los equinoideos del Pacífico de México. Parte tercera. Orden Clypeasteroida. *Publicaciones Especiales, Centro de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México*, 4, 1-252. [24]
- Caso, M.E. (1983a). Especies del género *Amphichondrius* de la costa del Pacífico Americano. Descripción de una nueva especie del género *Amphichondrius*. *Amphichondrius unamexici* sp. nov. (Ophiuroidea). *Anales del Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México*, 10(1), 209-230. [25]
- Caso, M.E. (1983b). Los equinoideos del Pacífico de México. Parte cuarta. Órdenes Cassiduloidea y Spatangoida. *Publicaciones Especiales, Centro de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México*, 6, 1-200. [26]
- Caso, M.E. (1986a). Descripción de una nueva especie de ofiuroideo de la Bahía de Mazatlán, Sin. *Ophioderma sodipallaresi* sp. nov. y comparación con *Ophioderma variegatum* Lütken. *Anales del Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México*, 13(2), 223-248. [27]

- Caso, M.E. (1986b). Los equinodermos del Golfo de California colectados en las campañas SIPCO I-II-III a bordo del B/O "El Puma". *Anales del Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México*, 13(1), 91-184. [28]
- Caso, M.E. (1992). Los equinodermos (Asteroideos, ofiuroides y equinoideos) de la Bahía de Mazatlán, Sinaloa. *Anales del Centro de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, Publicación Especial*, 11, 1-214. [29]
- Caso, M.E. (1994). Estudio morfológico, taxonómico, ecológico y distribución geográfica de los asteroideos colectados durante las campañas oceanográficas Cortés 1, 2, 3. *Anales del Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, Publicación Especial*, 12, 1-111. [30]
- Chacón-Torres, A., Villaroel-Melo, M., Arceo-Zataray, M., Carrillo-Orea, M.P., Corona-García J.M., Chavarría-Guillén, M.P., . . . Villegas-Sandoval, R.E. (1993). Reconocimiento ecológico de la Isla Socorro, Archipiélago Revillagigedo, Colima, México. *Revista Trimestral de Ciencia, Arte y Cultura, Universidad Michoacana*, 9, 11-30. [31]
- Chan, G.L. (1974). *Report on biological observations of the Revillagigedos expeditions*. Kentfield, USA: NAUI Bio-marine Exploration Seminar, College of Marin. [32]
- Chávez-Dagostino, R.M., Nepote-González, A.C., Solís-Marín, F.A., & Medina-Rosas, P. (2000). Listado preliminar sobre equinoideos y asteroideos (Echinodermata: Echinoidea y Asteroidea) de las Islas Marietas, Nayarit, México. *Mexico*, 2(1), 69-72. [33]
- Clark, A.H. (1916). Six new starfishes from the Gulf of California and adjacent waters. *Proceedings of the Biological Society of Washington*, 29, 51-62. [34]
- Clark A.M. (1970). Notes on the family Amphiuroidae (Ophiuroidea). *Bulletin of the British Museum (Natural History) Zoology*, 19(1), 1-81. [35]
- Clark, H.L. (1907). The Cidaridae. *Bulletin of the Museum of Comparative Zoölogy*, 51(7), 165-230. [36]
- Clark, H.L. (1912). Hawaiian and other Pacific Echini. The Pedinidae, Phymosomatidae, Stomopneustidae, Echinidae, Temnopleuridae, Strongylocentrotidae, and Echinometridae. *Memoirs of the Museum of Comparative Zoölogy at Harvard College*, 34(4), 209-383. [37]
- Clark, H.L. (1915). Catalogue of recent ophiurans: based on the collection of the Museum of Comparative Zoölogy. *Memoirs of the Museum of Comparative Zoölogy at Harvard College*, 25(4), 164-376. [38]
- Clark, H.L. (1925). *A catalogue of the recent sea-urchins (Echinoidea) in the collection of the British Museum (Natural History)*. London, United Kingdom: The British Museum (Natural History).
- Clark, H.L. (1935). Some new echinoderms from California. *The Annals and Magazine of Natural History*, 10(15), 120-129.
- Clark, H.L. (1940). XXI. Notes on Echinoderms from the West Coast of Central America. Eastern Pacific Expeditions of the New York Zoological Society. *Zoologica*, 25(22), 331-352. [39]
- Clark, H.L. (1948). A report on the Echini of the warmer Eastern Pacific, based on the collections of the Velero III. *Allan Hancock Pacific Expeditions*, 8(5), 225-360. [40]
- CONANP. (2004). *Programa de conservación y manejo Reserva de la Biosfera Archipiélago de Revillagigedo, México*. Ciudad de México, México: Comisión Nacional de Áreas Naturales Protegidas, Secretaría de Medio Ambiente y Recursos Naturales. [41]
- CONANP. (2005). *Programa de conservación y manejo del Parque Nacional Isla Isabel, México*. Ciudad de México, México: Comisión Nacional de Áreas Naturales Protegidas, Secretaría de Medio Ambiente y Recursos Naturales. [42]
- CONANP. (2007a). *Programa de conservación y manejo, Reserva de la Biosfera Islas Marietas, México*. Ciudad de México, México: Comisión Nacional de Áreas Naturales Protegidas, Secretaría de Medio Ambiente y Recursos Naturales. [43]
- CONANP. (2007b). *Programa de conservación y manejo, Parque Nacional Islas Marietas, México*. Ciudad de México, México: Comisión Nacional de Áreas Naturales Protegidas, Secretaría de Medio Ambiente y Recursos Naturales. [44]
- CONANP. (2019). *Programa de manejo, Parque Nacional Revillagigedo*. Ciudad de México, México: Comisión Nacional de Áreas Naturales Protegidas, Secretaría de Medio Ambiente y Recursos Naturales. [45]
- Deichmann, E. (1937). The Templeton Crocker Expedition. IX. Holothurians from the Gulf of California, the West Coast of Lower California and Clarion Island. *Zoologica*, 22, 161-176. [46]
- Deichmann, E. (1941). The Holothuroidea collected by the Velero III during the years 1932 to 1938. Part I, Dendrochirota. *Allan Hancock Pacific Expeditions*, 8, 61-195. [47]
- Deichmann, E. (1958). The Holothuroidea collected by the Velero III and IV during the years 1932 to 1954. Part



- II Aspidochirota. Allan Hancock Pacific Expeditions, *11*(2), 253-348. [48]
- Devaney, D.M. (1970). Studies on Ophiocomid brittlestars. I. A new genus (*Clarkcoma*) of Ophiocominae with a reevaluation of the genus *Ophiocoma*. *Smithsonian Contributions to Zoology*, *51*, 1-41. [49]
- Döderlein, L. (1911). Beiträge zur Naturgeschichte Ostasiens. Über Japanische und andere Euryalae. *Abhandlungen der Bayerischen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Abteilung*, *2*(5), 1-123. [50]
- Downey, M.E. (1968). Catalog of recent Echinoid type specimens in the U.S. National Museum Smithsonian Institution and the Museum of Comparative Zoology Harvard University. *United States National Museum Bulletin*, *264*, 1-99. [51]
- Downey, M.E. (1969). Catalog of recent ophiuroid type specimens in major collections in the United States. *United States National Museum Bulletin*, *293*, 1-239. [52]
- Espino-Barr, E., Cibrián-Rodríguez, R., & García-Boa, A. (1996). Estructura y densidad de la población del erizo tinta *Diadema mexicanum* en el litoral rocoso del estado de Colima. *Ciencia Pesquera*, *12*, 60-67. [53]
- Fisher, W.K. (1911). Asteroidea of the North Pacific and adjacent waters. Part 1. Phanerozonia and Spinulosa. *Smithsonian Institution, United States National Museum Bulletin*, *76*, 1-419. [54]
- Fisher, W.K. (1928a). Asteroidea of the North Pacific and adjacent waters. Part 2. Forcipulata (part). *Smithsonian Institution, United States National Museum Bulletin*, *76*, 1-245. [55]
- Fisher, W.K. (1928b). Asteroidea of the North Pacific and adjacent waters. Part 3. Forcipulata (concluded). *Smithsonian Institution, United States National Museum Bulletin*, *76*, 1-356. [56]
- Frontana-Uribe, S.C., Hernández-Alcántara, P., & Solís-Weiss, V. (2000). *Ophiocomella schmitti* (Echinodermata: Ophiuroidea) from Socorro Island, Mexican Pacific. *Revista de Biología Tropical*, *49*(2), 766. [57]
- Fuentes-Farías, A.M., Villarroel-Melo, M.D., & Solís-Marín, F.A. (2005). Los invertebrados marinos. Anexo 4.20 y 4.21. Listado de especies de equinodermos del Estado de Michoacán. In L.E. Villaseñor-Gómez (Ed.), *La biodiversidad en Michoacán, Estudio de Estado* (pp. 85-88). México: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Secretaría de Urbanismo y Medio Ambiente, Universidad Michoacana de San Nicolás de Hidalgo. [58]
- García-Hernández, V.C., Reyes-Bonilla, H., Balart, E.F., Ríos-Jara, E., Lluch-Cota, S.E., & Serviere-Zaragoza, E. (2014). Comparison of ecological diversity and species composition of macroalgae, benthic macroinvertebrates, and fish assemblages between two tropical rocky reefs. *Revista de Biología Marina y Oceanografía*, *49*, 477-491. [59]
- Granja-Fernández, R., Antonio-Pérez, V., & López-Pérez, R. A. (2013a). *Euapta godeffroyi* (Holothuroidea: Synaptidae): Filling the distribution gap between Mexico and Costa Rica, eastern tropical Pacific. *Hidrobiología*, *23*(1), 130-132. [60]
- Granja-Fernández, R., Hernández-Moreno, P., & Bastida-Zavala, R. (2013b). First record of the association between *Malmgreniella cf. variegata* (Polychaeta, Polynoidae) and *Ophioneis annulata* (Echinodermata, Ophioneuridae) in the Mexican Pacific. *Symbiosis*, *60*, 85-90. [61]
- Granja-Fernández, R., Herrero-Pérezrul, M.D., López-Pérez, R.A., Hernández, L., Rodríguez-Zaragoza, F.A., Jones, R.W., & Pineda-López, R. (2014). Ophiuroidea (Echinodermata) from coral reefs in the Mexican Pacific. *Zookeys*, *406*, 101-145. [62]
- Granja-Fernández, R., Herrero-Pérezrul, M.D., López-Pérez, R.A., Hernández-Morales, A., & Rangel-Solis, P.D. (2015a). A literature review of the Ophiuroidea (Echinodermata) from the Pacific coast of Mexico. *Revista de Biología Tropical*, *63*(2), 37-47. [63]
- Granja-Fernández, R., Solís-Marín, F.A., Benítez-Villalobos, F., Herrero-Pérezrul, M.D., & López-Pérez, A. (2015b). Checklist of echinoderms (Echinodermata) from the Southern Mexican Pacific: a historical review. *Revista de Biología Tropical*, *63*(2), 87-114.
- Granja-Fernández, R., Rodríguez-Troncoso, A.P., Herrero-Pérezrul, M.D., Sotelo-Casas, R.C., Flores-Ortega, J.R., Godínez-Domínguez, E., . . . Cupul-Magaña, A.L. (2017). Ophiuroidea (Echinodermata) from the Central Mexican Pacific: an updated checklist including new distribution records. *Marine Biodiversity*, *47*, 167-177. [64]
- Grant, U.S., & Hertlein, L.G. (1938). The West American Cenozoic Echinoidea. *Publications of the University at Los Angeles in Mathematical and Physical Sciences*, *2*, 1-225. [65]
- Gray, J.E. (1840). XXII. A synopsis of the genera and species of the class Hypostoma (Asterias, Linnaeus). *The Annals and Magazine of Natural History*, *6*, 175-184. [66]
- Harold, A.S., & Telford, M. (1990). Systematics, phylogeny and biogeography of the genus *Mellita* (Echinoidea: Clypeasteroidea). *Journal of Natural History*, *24*(4), 987-1026. [67]

- Hartlaub C. (1895). Reports on the dredging operations off the west coast of Central America to the Galapagos, to the west coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U. S. Fish Commission steamer "Albatross", during 1891, Lieut. Commander Z. L. Tanner, U. S. N., commanding. 13. Die Comatuliden. *Bulletin of the Museum of Comparative Zoölogy at Harvard College*, 27, 129-152. [68]
- Haszprunar, G., & Spies, M. (2014). An integrative approach to the taxonomy of the crown-of-thorns starfish species group (Asteroidea: *Acanthaster*): A review of names and comparison to recent molecular data. *Zootaxa*, 3841, 271-284. [69]
- Hendler, G. (1996). *Taxonomic atlas of The Benthic Fauna of the Santa Maria Basin and Western Santa Barbara Channel. Class Ophiuroidea* (Vol. 14). Santa Barbara, USA: Santa Barbara Museum of Natural History. [70]
- Hendler, G. (2011). New light on the nomenclature, taxonomy, and biology of *Hemipholis* species (Echinodermata: Ophiuroidea: Ophiactidae). *Zootaxa*, 3048, 44-52. [71]
- Hendler, G., Miller, J.E., Pawson, D.L., & Kier, P.M. (1995). *Sea stars, sea urchins, and allies. Echinoderms of Florida and the Caribbean*. Washington, USA: Smithsonian Institution.
- Hermosillo-Núñez, B.B., Rodríguez-Zaragoza, F.A., Ortiz, M., Galván-Villa, C., Cupul-Magaña, A., & Ríos-Jara, E. (2015). Effect of habitat structure on the most frequent echinoderm species inhabiting coral reef communities at Isla Isabel National Park (Mexico). *Community Ecology*, 16(1), 125-134. [72]
- Hermosillo-Núñez, B.B., Rodríguez-Zaragoza, F.A., Ortiz, M., Calderon-Aguilera, L.E., Cupul-Magaña, A.L. (2016). Influence of the coral reef assemblages on the spatial distribution of echinoderms in a gradient of human impacts along the tropical Mexican Pacific. *Biodiversity and Conservation*, 25, 2137-2152. [73]
- Herrero-Pérezrul, M.D., Reyes-Bonilla, H., González-Azcárraga A., Cintra-Buenrostro, C.E., & Rojas-Sierra, A. (2007). Echinodermos. In G.D. Danemann & E. Ezcurra (Eds.), *Bahía de los Ángeles: recursos naturales y comunidad, Línea base 2007* (pp. 339-361). México: Secretaría de Medio Ambiente y Recursos Naturales, Instituto Nacional de Ecología, Pronatura Noroeste A.C., San Diego Natural History Museum. [74]
- Herrero-Pérezrul, M.D., Ramírez-Ortiz, G., Rosales-Estrada, M., & Reyes-Bonilla, H. (2015). Densidad poblacional y distribución espacial de erizos de mar (Echinodermata: Echinoidea) en Isla Socorro, Archipiélago de Revillagigedo, México. *Revista de Biología Tropical*, 63(2), 221-232. [75]
- Herrero-Pérezrul, M.D., Reyes-Bonilla, H., & Granja-Fernández, R. (2017). Effects of environmental factors on the abundances of the basket stars *Astrocanium spinosum* and *Astrodictyum panamense* (Ophiuroidea: Gorgonocephalidae) in the northern Gulf of California, Mexico. *Marine Biology Research*, 13(2), 210-219. [76]
- Hertlein, L.G. (1963). Contribution to the biogeography of Cocos Island, including a bibliography. *Proceedings of the California Academy of Sciences*, 32(8), 219-289. [77]
- Hickman, C.P. (1998). *A field guide to sea stars and other echinoderms of Galápagos*. Virginia, USA: Sugar Spring Press. [78]
- Holguín-Quiñones, O.E. (1994). Comunidades bentónicas marinas. In A. Ortega-Rubio & A. Castellanos-Vera (Eds.), *La Isla Socorro, Reserva de la Biósfera Archipiélago de Revillagigedo, México* (pp. 225-245). La Paz, México: Centro de Investigaciones Biológicas del Noroeste, S.C. [79]
- Holguín-Quiñones, O.E., & Michel-Morfin, J.E. (2006). Population structure and accompanying biota of the snail *Turbo (Callopoma) funiculosus* (Gastropoda: Turbinidae), on Socorro Island, Revillagigedo Archipiélago, Mexico. *Revista de Biología Tropical*, 54(4), 1079-1084. [80]
- Honey-Escandón, M., Solís-Marín F.A., & Laguarda-Figuera A. (2008). Equinodermos (Echinodermata) del Pacífico Mexicano. *Revista de Biología Tropical*, 56(3), 57-73. [81]
- Honey-Escandón M., Solís-Marín, F.A., & Laguarda-Figuera, A. (2011). *Holothuria (Selenkothuria) carere*, a new species of sea cucumber (Echinodermata: Holothuroidea) from the Mexican Pacific. *Zootaxa*, 2922, 27-33. [82]
- Koehler, R. (1907). Révision de la Collection des Ophiures du Museum D'Histoire Naturelle de Paris. *Bulletin Scientifique de la France et de la Belgique*, 61, 279-370. [83]
- Kroh, A., & Mooi, R. (2020). *World Echinoidea Database*. Retrieved from <http://www.marinespecies.org/echinoidea> on 2020-06-13
- Lambert, P., & Austin, W. (2007). *Brittle stars, sea urchins and feather stars of British Columbia, Southeast Alaska and Puget Sound*. Victoria, Canada: Royal BC Museum Handbook.
- López-Pérez, A., Cupul-Magaña, A., Ahumada-Sempoal, M., Medina-Rosas, P., Reyes-Bonilla, H., Herrero-Pérezrul, M.D., . . . Lara-Hernández, J. (2015). The coral communities of the Islas Marias archipelago, Mexico: structure and biogeographic relevance to the Eastern Pacific. *Marine Ecology*, 37, 679-690.



- López-Urriarte, E., Ríos-Jara, E., Galván-Villa, C.M., Juárez-Carrillo, E., Enciso-Padilla, I., Robles-Jarero, E.G., & Pérez-Peña, M. (2009). Macroinvertebrados béticos del litoral somero de Punta La Rosada, Bahía Chamela, Jalisco. *Scientia-CUCBA*, 11(1-2), 57-68. [84]
- Ludwig, H. (1893). Vorläufiger Bericht über die erbeuteten Holothurien. Reports on the Dredging Operations off the West Coast of Central America to the Galapagos, etc., by the U. S. Fish Commission Steamer "Albatross". IV. *Bulletin of the Museum of Comparative Zoology at Harvard College*, 24(4), 105-114.
- Ludwig, H. (1894). Reports on an exploration off the west coasts of Mexico, central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U.S. Fish Commission Steamer "Albatross" during 1891, Lieut. Commander Z.L. Tanner, U.S.N., commanding. XII. The Holothurioidea. *Memoirs of the Museum of Comparative Zoology at Harvard College*, 17(3), 1-183. [85]
- Ludwig, H. (1905). VII. Asteroidea. Reports on an exploration off the West Coast of Mexico, Central and South America, and off the Galapagos islands in charge of Alexander Agassiz, by the U.S. Fish Commission steamer "Albatross", during 1891, lieut. Commander Z.L. Tanner, U.S.N., commanding. XXXV. Reports on the scientific results of the expedition to the Tropical Pacific, in charge of Alexander Agassiz on the U.S. Fish Commission Steamer "Albatross", from August 1899, to March, 1900, commander Jefferson F. Moser, U.S.N., commanding. *Memoirs of the Museum of Comparative Zoology at Harvard College*, 32, 1-292. [86]
- Luke, S.R. (1982). *Catalog of the benthic invertebrate collections of the SCRIPPS Institution of Oceanography, Echinodermata*. California, USA: SCRIPPS Institution of Oceanography Reference Series, no. 82-5, University of California. [87]
- Lütken, C.F., & Mortensen, T. (1899). The Ophiuridae. *Memoirs of the Museum of Comparative Zoology*, 23, 93-208. [88]
- Madsen, F.J. (1977). The Ophioleucidae (Ophiuroidea). *Galathea Report. Scientific Results of the Danish Deep-Sea Expedition Round the world 1950-52*, 14, 109-122. [89]
- Mah, C.L. (2020). *World Asteroidea Database*. Retrieved from <http://www.marinespecies.org/asteroidea>
- Maluf, L.Y. (1988). Composition and distribution of the Central Eastern Pacific echinoderms. *Natural History Museum of Los Angeles County. Technical Report*, 2, 1-242. [90]
- Maluf, L.Y. (1991). Echinoderm fauna of the Galápagos Islands. In M.J. James (Ed.), *Galápagos marine invertebrates: taxonomy, biogeography, and evolution in Darwin's Islands* (pp. 345-367). New York, USA: Plenum press. [91]
- Maluf, L.Y., & Brusca, R.C. (2005). Echinodermata. In M.E. Hendrickx, R.C. Brusca, & L.T. Findley (Eds.), *A distributional checklist of the macrofauna of the Gulf of California, Mexico. Part I. Invertebrates* (pp. 327-343). Tucson, USA: Arizona-Sonora Desert Museum. [92]
- Martínez-Melo, A., Solís-Marín, F.A., Buitrón-Sánchez, B.E., & Laguarda-Figueroa, A. (2015). Taxonomía y biogeografía ecológica de los equinoideos irregulares (Echinoidea: Irregularia) de México. *Revista de Biología Tropical*, 63(2), 59-75. [93]
- Massin, C., & Hendrickx, M.E. (2011). Deep-water Holothuroidea (Echinodermata) collected during the TALUD cruises off the Pacific coast of Mexico, with the description of two new species. *Revista Mexicana de Biodiversidad*, 82, 413-443. [94]
- McCartney, M.A., Keller, G., & Lessios, H.A. (2000). Dispersal barriers in tropical oceans and speciation in Atlantic and eastern Pacific sea urchins of the genus *Echinometra*. *Molecular Ecology*, 9, 1391-1400. [95]
- Messing, C. (2020). *World List of Crinoidea*. Crinoidea. Retrieved from <http://www.marinespecies.org/aphia.php?p=taxdetails&id=123081> on 2020-06-13
- Miller, A.K., Kerr, A.M., Paulay, G., Reich, M., Wilson, N.G., Carvajal, J.I., & Rouse, G.W. (2017). Molecular phylogeny of extant Holothuroidea (Echinodermata). *Molecular Phylogenetics and Evolution*, 111, 110-131.
- Miranda, A., Ambriz, G., Valencia, D., Sánchez, M., & Szekely, A. (2011). *Programa de Manejo del santuario de las Islas de la Bahía de Chamela: Islas La Pajarera, Cocinas, Mamut, Colorada, San Pedro, San Agustín, San Andrés y Negrita, e islotes Los Anegados, Novillas, Mosca y Submarino, Jalisco, México*. Ciudad de México, México: Comisión Nacional de Áreas Naturales Protegidas. [96]
- Mooi, R., Constable H., Lockhart, S., & Pearse, J. (2004). Echinothurioid phylogeny and the phylogenetic significance of *Kamptosoma* (Echinoidea: Echinodermata). *Deep-Sea Research II*, 51, 1903-1919.
- Mortensen, T. (1928). *A monograph of the Echinoidea I. Cidaroida*. Copenhagen, Denmark: C.A. Rietzel publisher, Oxford University press. [97]
- Mortensen, T. (1940). *A monograph of the Echinoidea. III. I. Aulodonta. With additions to Vol. II (Lepidocentroida and Stirodonta)*. Copenhagen, Denmark: C.A. Reitzel publisher. [98]



- Mortensen, T. (1943a). *A monograph of the Echinoidea. III. 2. Camarodonta. I. Orthopsidae, Glyphocyphidae, Temnopleuridae and Toxopneustidae*. Copenhagen, Denmark: C.A. Reitzel publisher. [99]
- Mortensen, T. (1943b). *A monograph of the Echinoidea. III. 3. Camarodonta. II. Echinidae, Strongylocentrotidae, Parasalenidae, Echinometridae*. Copenhagen, Denmark: C.A. Reitzel publisher. [100]
- Mortensen, T. (1948a). *A monograph of the Echinoidea. IV. 1. Holoctypoida, Cassiduloida*. Copenhagen, Denmark: C.A. Reitzel publisher. [101]
- Mortensen, T. (1948b). *A monograph of the Echinoidea. IV. 2. Clypeastroidea. Clypeastridae, Arachnoididae, Fibulariidae, Laganidae and Scutellidae*. Copenhagen, Denmark: C.A. Reitzel publisher. [102]
- Mortensen, T. (1951). *A monograph of the Echinoidea. V. 2. Spatangoida II. Amphisternata, II. Spatangidae, Loveniidae, Pericosmidae, Schizasteridae, Brissidae*. Copenhagen, Denmark: C.A. Reitzel publisher. [103]
- Nava-Bravo, H.H., Solís-Marín, F.A., Fuentes-Farías, A.L., Cruz-Barraza, J.A., Bastida-Zavala, J.R., Laguarda-Figueras, A., ... Conejeros-Vargas, C.A. (2019). Invertebrados marinos. Apéndice 35. In A. Cruz-Angón, K.C. Nájera-Cordero, & E.D. Melgarejo (Coords.), *La biodiversidad en Michoacán. Estudio de Estado 2, vol. II* (pp. 291-306). México: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. [104]
- Nepote-González, A.C. (1998). *Holoturias (Echinodermata: Holothuroidea) de las islas Marietas, Bahía de Banderas, Jalisco-Nayarit, México* (Bachelor thesis). Universidad de Guadalajara, México. [105]
- O'Hara, T.D., Stöhr, S., Hugall, A.F., Thuy, B., & Martynov, A. (2018). Morphological diagnoses of higher taxa in Ophiuroidea (Echinodermata) in support of a new classification. *European Journal of Taxonomy*, 416, 1-35.
- Okanishi, M., & Fujita, T. (2014). A taxonomic review of the genus *Astrodia* (Echinodermata: Ophiuroidea: Asteronychiidae). *Journal of the Marine Biological Association of the United Kingdom*, 94(1), 187-201. [106]
- Padilla-Pérez, M.S., Rodríguez-Troncoso A.P., Sotelo-Casas R.C., & Cupul-Magaña A.L. (2017). Equinodermos del Parque Nacional Islas Marietas: Generalidades, importancia e identificación visual como herramienta para su protección. *Áreas Naturales Protegidas Scripta*, 3(2), 51-92. [107]
- Parker, R.H. 1963. *Zoogeography and ecology of some macro-invertebrates, particularly mollusks, in the Gulf of California and continental slope off Mexico*. Massachusetts, USA: Woods Hole.
- Pawson, D. (1983). *Psychronaetes hanseni*, a new genus and species of Elaspodan sea cucumber from the Eastern Central Pacific (Echinodermata: Holothuroidea). *Proceedings of the Biological Society of Washington*, 96(1), 154-159.
- Reyes-Bonilla, H. (1995). Asteroidea and Echinoidea (Echinodermata) of Isla San Benedicto, Revillagigedo Archipelago, México. *Revista de Investigación Científica Sección Ciencias del mar, UABCS*, 6(1), 29-38. [108]
- Reyes-Bonilla, H., & López-Pérez, A. (1998). Biogeografía de los corales pétreos (Scleractinia) del Pacífico de México. *Ciencias Marinas*, 24(2), 211-224.
- Ríos-Jara, E., Galván-Villa, C.M., & Solís-Marín, F.A. (2008a). Equinodermos del Parque Nacional Isla Isabel, Nayarit, México. *Revista Mexicana de Biodiversidad*, 79, 131-141. [109]
- Ríos-Jara, E., López-Urriarte, E., Pérez-Peña, M., Enciso-Padilla, I., Arreola-Robles, J.L., Hermosillo-González, A., & Galván-Villa, C.M. (2008b). *Listados taxonómicos de la biota marina del Parque Nacional Isla Isabel (invertebrados, peces y macroalgas)*. Zapopan, México: Universidad de Guadalajara. [110]
- Ríos-Jara, E., Galván-Villa, C.M., Rodríguez-Zaragoza, F.A., López-Urriarte, E., Bastida-Izaguirre, D., & Solís-Marín, F.A. (2013). Los equinodermos (Echinodermata) de bahía Chamela, Jalisco, México. *Revista Mexicana de Biodiversidad*, 84, 263-279. [111]
- Ríos-Jara, E., Juárez-Carrillo, E., & Galván-Villa, C.M. (2017). Invertebrados marinos. In CONABIO (Ed.), *La biodiversidad en Jalisco. Estudio de Estado* (Vol. 2, pp. 251-269). México: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Secretaría de Medio Ambiente y Desarrollo Territorial. [112]
- Rodríguez-Troncoso, A.P., Sotelo-Casas, R.C., Galván-Villa, C.M., Godínez-Domínguez, E., Flores-Ortega, J.R., del Castillo-Fernández, K.M., ... Solís-Marín, F.A. (2013). Equinodermos de la Costa Sur de Jalisco y Colima. In E. Godínez-Domínguez & M.C. Franco-Gordo (Eds.), *Inventario de biodiversidad de la costa Sur de Jalisco y Colima*, (Vol. 2 pp. 46-60). México: Universidad de Guadalajara. [113]
- Roux, M. (2004). New hyocrinid crinoids (Echinodermata) from submersible investigations in the Pacific Ocean. *Pacific Science*, 58(4), 597-613. [114]
- Roux, M., & Pawson, D.L. (1999). Two new Pacific Ocean species of Hyocrinid crinoids (Echinodermata), with comments on presumed giant-dwarf gradients related to seamounts and abyssal plains. *Pacific Science*, 53(3), 289-298.
- Rowe, F.W.E., & Pawson, D.L. (1977). A catalogue of echinoderm type-specimens in the Australian Museum,



- Sydney. *Records of The Australian Museum*, 30(14), 337-364. [115]
- Santos-Beltrán, C., & Salazar-Silva, P. (2011). Holoturoideos (Echinodermata: Holothuroidea) de playas rocosas, zona norte de Bahía de Banderas, Nayarit, México. *Ciencia y Mar*, 15(45), 3-11. [116]
- Sladen, W.P. (1889). Report on the Asteroidea collected by the H. M. S. Challenger during the years 1873-1876. *The Voyage of H. M. S. Challenger, Zoology*, 30, 1-893. [117]
- Solis-Marín, F.A., & Laguarda-Figueras, A. (1999). *Cucumaria flamma*, a new species of sea cucumber from the central eastern Pacific (Echinodermata: Holothuroidea). *Proceedings of the Biological Society of Washington*, 112(4), 778-786. [118]
- Solis-Marín, F.A., Arriaga-Ochoa, J.A., Laguarda-Figueras, A., Frontana-Uribe, S.C., & Durán-González, A. (2009). *Holoturoideos (Echinodermata: Holothuroidea) del Golfo de California*. México: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Instituto de Ciencias del Mar y Limnología, UNAM. [119]
- Solis-Marín, F.A., Alvarado, J.J., Abreu-Pérez, M., Aguilera, O., Alió, J., Bacallado-Aránega, J.J., ... Williams, S.M. (2013a). Appendix. In J.J. Alvarado Barrientos & F.A. Solis-Marín (Eds.), *Echinoderm Research and diversity in Latin America* (pp. 543-658). Berlin, Germany: Springer-Verlag. [120]
- Solis-Marín, F.A., Honey-Escandón, M.B.I., Herrero-Pérezrul, M.D., Benítez-Villalobos, F., Díaz-Martínez, J.P., Buitrón-Sánchez, B.E., ... Durán-González, A. (2013b). The echinoderms of Mexico: Biodiversity, distribution and current state of knowledge. In J.J. Alvarado & F.A. Solis-Marín (Eds.), *Echinoderm Research and diversity in Latin America* (pp. 11-65). Berlin, Germany: Springer-Verlag. [121]
- Solis-Marín, F.A., Laguarda-Figueras, A., & Honey-Escandón, M. (2014). Biodiversidad de equinodermos (Echinodermata) en México. *Revista Mexicana de Biodiversidad*, 85, S441-S449. [122]
- Solis-Marín, F.A., Durán-González, A., & Hernández-Herrejón, L.A. (2016a). Ofiuros (Ophiuroidea). In CONABIO (Ed.), *La Biodiversidad en Colima. Estudio de Estado* (pp. 305-308). México: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. [123]
- Solis-Marín, F.A., Laguarda-Figueras, A., & Durán-González, A. (2016b). Estrellas, erizos y pepinos de mar (Echinodermata). Apéndice 1. Lista de equinodermos. In CONABIO (Ed.), *La Biodiversidad en Colima. Estudio de Estado* (pp. 295-304, 203-205). México: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. [124]
- Solis-Marín, F.A., Arriaga-Ochoa, J.A., Galván-Villa, C.M., & Laguarda-Figueras, A. (2018). *Lissothuria imbricata* sp. nov., a new species of sea cucumber (Echinodermata: Holothuroidea) from the central-eastern Pacific Ocean. *Zootaxa*, 4438(2), 373-380. [125]
- Sotelo-Casas, R.C., & Rodríguez-Troncoso, A.P. (2014). Los equinodermos: invertebrados esenciales dentro de la estructura de la comunidad coralina. In J.L. Cifuentes-Lemus & F.G. Cupul-Magaña (Coords.), *Temas sobre investigaciones costeras* (pp. 56-81). México: Universidad de Guadalajara. [126]
- Sotelo-Casas, R.C., Cupul-Magaña, A.L., Solis-Marín, F.A., & Rodríguez-Troncoso, A.P. (2015). New records of sea cucumbers (Echinodermata: Holothuroidea) at Islas Marietas, Central Mexican Pacific. *Marine Biological Association of the United Kingdom*, 8, 1-8. [127]
- Sotelo-Casas, R.C., Cupul-Magaña, A.L., Solis-Marín, F.A., & Rodríguez-Troncoso, A.P. (2016). Recruitment patterns of 2 sea cucumber species in a Central Mexican Pacific coral reef community. *Revista Mexicana de Biodiversidad*, 87, 86-91. [128]
- Sotelo-Casas, R.C., Cupul-Magaña, A.L., Rodríguez-Zaragoza, F.A., Solis-Marín, F.A., & Rodríguez-Troncoso, A.P. (2018). Structural and environmental effects on an assemblage of echinoderms associated with a coral community. *Marine Biodiversity*, 48, 1401-1411. [129]
- Spalding, M.D., Fox, H.E., Allen, G.R., Davidson, N., Ferdaña, Z.A., Finlayson, M., ... Robertson, J. (2007). Marine ecoregions of the world: A bioregionalization of coastal and shelf areas. *BioScience*, 57(7), 573-583.
- Steinbeck, J., & Ricketts, E.F. (1941). *Sea of Cortez. A leisurely journal of travel and research*. New York, USA: Viking Press. [130]
- Stöhr, S., O'Hara, T., & Thuy, B. (2020). *World Ophiuroidea database*. Retrieved from <http://www.marinespecies.org/ophiuroidea>
- Tommasi, L.R. (1976). Ophiuroidea collected in the Peru-Chile trench by the USNS "Eltanin" during Cruise III. *Papeis Avulsos de Zoologia*, 29(8), 281-318. [131]
- Valdés de Anda, M., Hendrickx, M.E., & Solis-Marín, F.A. (2018). New records of *Florometra serratissima* (A.H. Clark, 1907) (Echinodermata: Crinoidea) from the Gulf of California and the Pacific Coast of Mexico. *Cashiers de Biologie Marine*, 59, 167-173. [132]
- Vergara-Chen, C., Guerra, Z., & Collado, G.N. (2015). El pepino de mar, *Isostichopus fuscus*, recurso marino

- en peligro con altas necesidades de manejo. *Tecnología*, 17(2), 21-41. [133]
- Villalobos, A.F. (1992). La Isla Socorro. Notas acerca del aspecto hidrobiológico de la parte sur de la Isla. (tomando de Monografías del Instituto de Geofísica 2: 155-180). *Hidrobiológica*, 2(1-2), 65-91. [134]
- WoRMS (2020). *World Register of Marine Species*. Retrieved from <http://www.marinespecies.org/aphia.php?p=search>
- Ziesenhenné, F.C. (1937). The Templeton Crocker Expedition. X. Echinoderms from the West Coast of Lower California, the Gulf of California and Clarion Island. *Zoologica, New York Zoological Society*, 22(15), 209-239. [135]
- Ziesenhenné, F.C. (1940). New Ophiurans of the Allan Hancock Pacific Expeditions. *Allan Hancock Pacific Expeditions*, 8(2), 9-52. [136]
- Ziesenhenné, F.C. (1955). A review of the genus *Ophioderma* Müller and Troschel. In *Essays in the Natural Sciences in honor of Captain Allan Hancock, on the occasion of his birthday, July 26, 1955* (pp. 185-201). Los Angeles, USA: University of Southern California Press. [137]

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