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Contents

Preface

This book is designed to serve as a compact field guide to the commonly encountered echinoderms of the Galápagos Islands. It is intended primarily for interested visitors who wish to explore the fascinating variety of Galápagos life in tide pools and on beaches while walking the shoreline, or those that may don mask and flippers—or scuba gear—to view the vastly different underwater world beyond the beaches. I trust it also will serve as a convenient reference book for scientists engaged in marine research.

The need to identify Galápagos marine invertebrates, and the absence of a handy means for doing so, became obvious to me when, in 1989, I began conducting annual spring censuses of the Galápagos intertidal fauna with the help of students from Washington and Lee University. To construct a provisional field guide for student use I first had to locate and consult the scattered reports and monographs of numerous investigators of past expeditions to the Galápagos. This effort quickly revealed that the published literature treated certain groups comprehensively— molluscs and crustaceans, for example—but that the coverage of other groups was too sketchy or scattered to be useful for field work. The first makeshift field guide for students, created and illustrated largely from the literature, provided the impetus to develop a field guide describing and illustrating with color photographs all the common (and many not-so-common) Galápagos seashore invertebrates. Scientists at the Charles Darwin Research Station urged me to begin with the echinoderms, especially the sea cucumbers, which of all echinoderms were the most troublesome to identify, and later to extend the project to other groups.

This ambitious project has necessitated many trips to the Galápagos Islands to collect and photograph invertebrates from the intertidal and subtidal environments throughout the archipelago. The result is this book, in which species descriptions are brought together with original color photographs of the living animals, many of which are presented in published form for the first time.

Acknowledgments

The preparation of a field guide like this requires the assistance and cooperation of many people. William C. Ober has accompanied me on several trips to the Galápagos to help with collecting and underwater photography. Assisted by Claire Garrison, he also painted color illustrations of many of the echinoderms and prepared the line art. A guide book of this kind would be impossible without the support of authorities who made or verified identifications of numerous specimens. David Pawson of the Smithsonian Institution provided assistance with the troublesome sea cucumbers on several occasions. Gordon Hendler of the Los Angeles County Museum of Natural History repeatedly contributed his expertise on brittle stars. Others who read sections and offered suggestions were Chris Mah (sea stars) and Rich Mooi (echinoids), both of the California Academy of Sciences, and Harris Lessios, (echinoids) Smithsonian Tropical Research Institute. Gerard Wellington's 1975 unpublished report to the Department of National Parks and Wildlife, Quito, the result of an extensive two-year study of the Galápagos coastal marine environment, was a rich source of information on the distribution and ecology of many of the species described herein.

It is also a pleasure to acknowledge the cooperative assistance of the personnel of the Charles Darwin Research Station who made arrangements for collecting trips and offered encouragement and support throughout the project. The National Park Service provided the required permits for visiting and collecting specimens at study sites throughout the archipelago. Although many have helped in countless ways, I especially wish to thank Rodrigo Bustamante who, with Priscilla Martinez, helped in getting the field guide through its gestation by making available work space and facilities in the BioMarine laboratory at the Darwin Station, arranged boat charters, provided diving equipment, and assisted in field research—all accompanied by sound advice and cheerful sense of humor. Others who accompanied me on one or more dive trips and helped in the collecting of specimens include George Branch, Robert Day, Jorge Gomezjurado, Scott Henderson, Hugh Jarrard, Shannon Jones, Joshua Nitsche, Jimmy Peñaherrera, Juan Carlos Ricuarte, Will Shepherd, Rita Spadafora, and Robert Van Syoc. Larry Roberts offered detailed helpful advice on the manuscript, and my daughter, Diane Hickman Liss, meticulously proofed the final draft. My wife Rae accompanied me on several trips and exercised commendable patience while I was preoccupied with this project.

Finally, I will always be grateful to the many students from Washington and Lee University, whose involvement in an intertidal censusing program begun in 1989 convinced me of the need for a field guide such as this one.

How To Use This Field Guide

This field guide to the Galápagos echinoderms illustrates and describes in some detail the common sea stars, brittle stars, sea urchins, and sea cucumbers that occur in the intertidal zone and in shallow water down to about 30 m (100 feet). Species accounts include descriptions of diagnostic features, habitat, geographic range, depth range, comments on biology of the species, and ways to distinguish similar species. With few exceptions, photographs were taken of living animals, either photographed against a black background in an aquarium, or in their natural habitats. Because some specialized terminology is often required to describe aspects of an animal's morphology, key anatomical features are shown in labeled drawings that appear at the beginning of each chapter.

Most species can be identified by simply thumbing through the book to find the photograph depicting the animal in question. However, since some species closely resemble one another, it is important to read the diagnostic field characters in the description to confirm your identification. Also, be sure to note whether or not the animal's described habitat matches the habitat in which you found the animal. Most species can be identified without using magnification, but it is often necessary to examine the anatomy of brittle stars closely to verify an identification. For this purpose a simple hand lens is handy.

Sea cucumbers present a special challenge for identification. Although many sea cucumbers can be identified by external characteristics such as color patterns and surface features, others are almost impossible to identify with certainty except by examining the microscopic ossicles embedded in the cucumber's body wall. This is an option not available to most readers, but for the benefit of scientists who have access to a compound microscope, I have included in Appendix A descriptions of the ossicles for all the sea cucumbers included in this field guide, together with directions for preparing the body-wall ossicles for examination.

Each species is listed by its two-part Latinized scientific name, called a binomial. The first part of the name is the genus, which is capitalized, and the second part is the species epithet, which is not capitalized. The scientific name is always printed in italics. Following the scientific name is the name of the individual (called the authority) who first described the species, and the date of the original publication. Often on the basis of subsequent research it is decided that a particular species should be assigned to a different genus. When this happens, the original author's name is placed in parentheses.

I've included common names where these are known, but unlike the Galápagos fishes, which bear well-recognized common names in most international languages, the majority of echinoderm species in Galápagos have not been named by laymen. In some instances I have created a common name when

Sea Stars

CLASS ASTEROIDEA

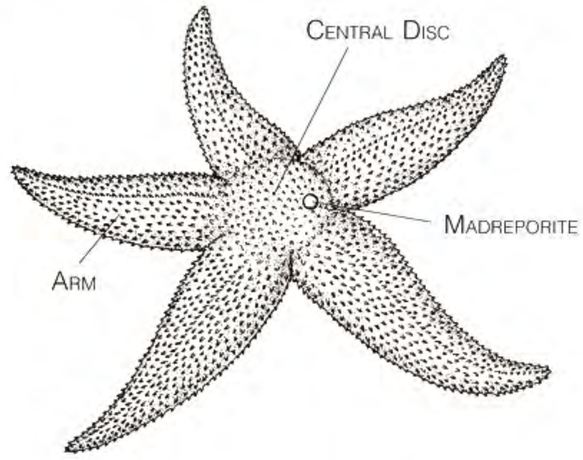
Sea stars are the "prima donnas" of echinoderms, familiar to many people as beautifully symmetrical symbols of marine life. In Galápagos, however, sea stars (often called starfish) are much less common than sea urchins and brittle stars. Like all echinoderms, they are strictly bottom dwellers. Despite their striking coloration and large size that make them conspicuous on the sea bottom, they seem to have few enemies, suggesting that sea stars produce something that repels would-be predators. They are diverse feeders. Some sea stars are particle feeders but most are predators of sedentary or sessile prey since sea stars are themselves slow-moving animals. Carnivorous forms prey on molluscs (their favorite food), crabs, corals, worms, or other echinoderms. Others are scavengers that feed on decaying fish and invertebrates. Still others are deposit feeders, filling their stomachs with mud from which they extract organic material.

Forty-four sea stars are reported from the Galápagos Islands, most of which are deep water species that are collected by dredging. Of the 14 species reported from the intertidal and shallow water, only six or seven are at all common. Most sea stars occurring in Galápagos are of tropical East Pacific distribution; only two (possibly three) of the shallow-water sea stars are endemic to Galápagos.

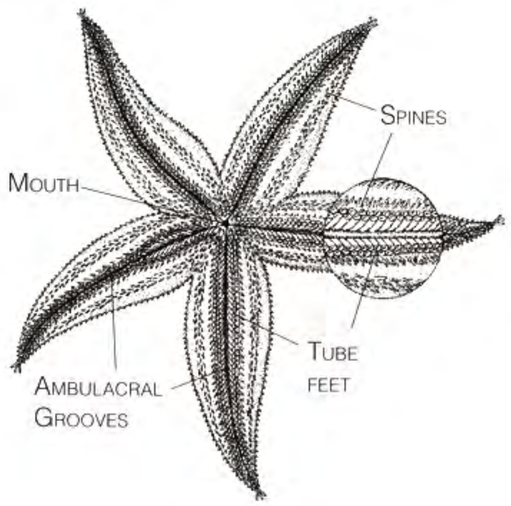
Sea Star Body Plan

Sea stars typically have 5 arms (sometimes more) radiating from a central disc that bears the mouth on the lower (oral) surface and an inconspicuous anus on the upper (aboral) surface. A circular, sieve-like madreporite, also on the upper surface, leads to the water vascular system. The upper surface of most sea stars is covered with blunt or sharp spines, although in some the spines are flattened so that the surface appears smooth. Around the bases of the spines of many sea stars are small pincer-like structures, the pedicellariae, that are used to keep the body surface free of debris and prevent marine larvae from settling there. The surface is also provided with small, delicate, retractile projections, the dermal gills, which function in respiration. The surface of some sea stars is covered with paxillae, tiny skeletal columns with brushlike crowns. When viewed from above with magnification, the paxillae look like a field of flowers. On the under side of the sea star long ambulacral grooves radiate out along the arms from the mouth; from these grooves project two rows of tube feet.

The size of sea stars is expressed as the radius—the distance between the center of the disc to the tip of an arm—for an average-sized star.



External anatomy of a sea star, aboral (dorsal) view.



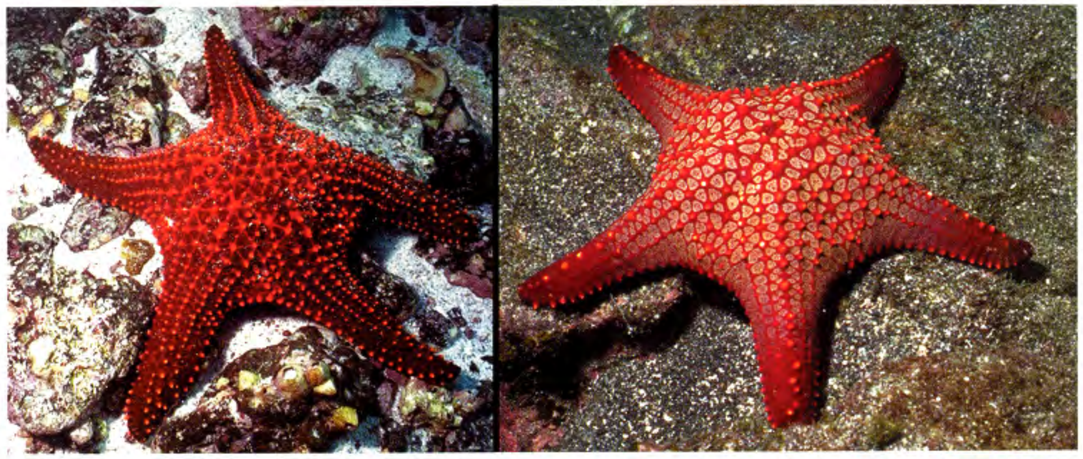
External anatomy of a sea star, oral (ventral) view.

Pentaceraster cumingi (Gray, 1840) — Panamic Cushion Star

Radius 17 cm (6.7 in)

The upper surface of this large sea star is covered with blunt, immobile spines. The dorsal plates and spines are bright red, the spaces between greenish-brown, but there is considerable variation in color. This species feeds on microorganisms on sea grass and algal substrates. It also may feed on sea urchins and other echinoderms by extraoral feeding, that is, by everting the stomach to cover and digest the prey, then absorbing the nutrients.

Habitat & range: Sandy bottoms, extreme low intertidal to 180 m (590 ft); seldom seen above 4 m (13 ft) depth. Often quite numerous at common snorkeling and dive sites in the central archipelago. When viewed from the surface this sea star appears black in color because of the absorption of red light in sea water. Gulf of California to Peru and Galápagos Islands, also Hawaii.



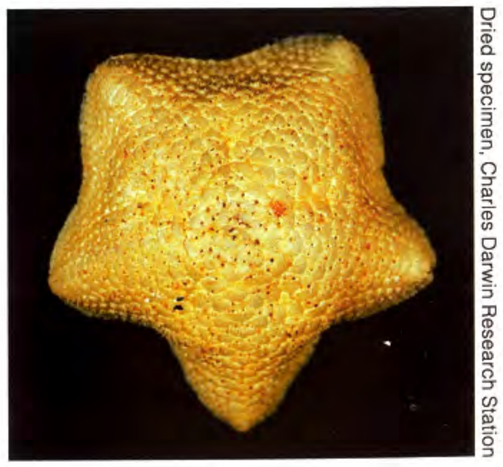
Family Asterinidae

Asterina sp., cf. *Asterina modesta* Verrill, 1870 — Blunt-rayed Sea Star

Radius 1.5 cm (0.6 in)

This very small, 5-rayed star bears extremely blunt, broad rays which protrude only slightly from the elevated central disc. No protruding spines. Color variable with tan or brown predominating. Because this genus is in need of thorough revision, the species of the Galápagos representative is uncertain. The genus contains about 30 species of cosmopolitan distribution; all are confined to the littoral zone.

Habitat & range: Under rocks in intertidal zone of sheltered areas, common but not easily seen because of small size and habit of clinging securely to underside of stones. *A. chilensis* is reported from Peru and Chile; the range of the Galápagos species is not known.



Dried specimen, Charles Darwin Research Station

Family Asteropseidae

Asteropsis carinifera (Lamarck, 1816) — Keeled Sea Star

Radius 16 cm (6.3 in)

The arms of this large sea star are acutely triangular in cross section, with a mid-radial ridge emphasized by a series of spines and pores in small groups. The body is covered with a thick, smooth skin, giving the animal a wet or slimy appearance. The oral side is flat, the aboral side very convex. The edges of the arms are armed with prominent conical spines. Coloration is tan with brick red pigment splotches on the central disc and arms.

Habitat & range: Rocky reefs, coral rubble, and underside of large rocks and coral slabs. Intertidal to about 35 m (115 ft). Uncommon except in certain areas such as Rabida Island. Throughout the Indo-Pacific and from the Gulf of California to Panama and Galápagos.

Family Ophidiasteridae

Linckia columbiae Gray, 1840 — Variable Sea Star

Radius 3.5 cm (1.4 in)

This is a small, narrow-rayed sea star normally with five arms but often with fewer or more than five. The central disc is small, the arms are rounded, and the upper surface of arms and disc is leathery and pitted and without spines or pedicellaria. Coloration is variable, from mottled red or orange-brown to tan and purple. This species is variable in appearance and is often found with one or more missing or partly regenerated arms. It is a ciliary feeder that ingests the film of microorganisms adhering to hard surfaces.

Habitat & range: Low rocky intertidal under stones and in crevices, and subtidal to 150 m (490 ft). More common in the western archipelago. Southern California to Peru and Galápagos Islands.

"Comet" form of *L. columbiae* (*above*), formed from asexual fission of adults (*right*) that voluntarily detached their arms. Arm stubs will grow complete arms.

Brittle Stars

CLASS OPHIUROIDEA

Brittle stars are the most abundant echinoderms in Galápagos, yet they are seldom seen by the casual observer. They are secretive animals that hide under and between intertidal and subtidal rocks by day to escape predation by fish. Even at night they may cautiously extend only their arms from hiding places to feed. Brittle stars are the most agile of echinoderms and if disturbed (for example, by lifting the rock under which they are hiding) they move rapidly, using quick rowing movements of the arms to scuttle to safety.

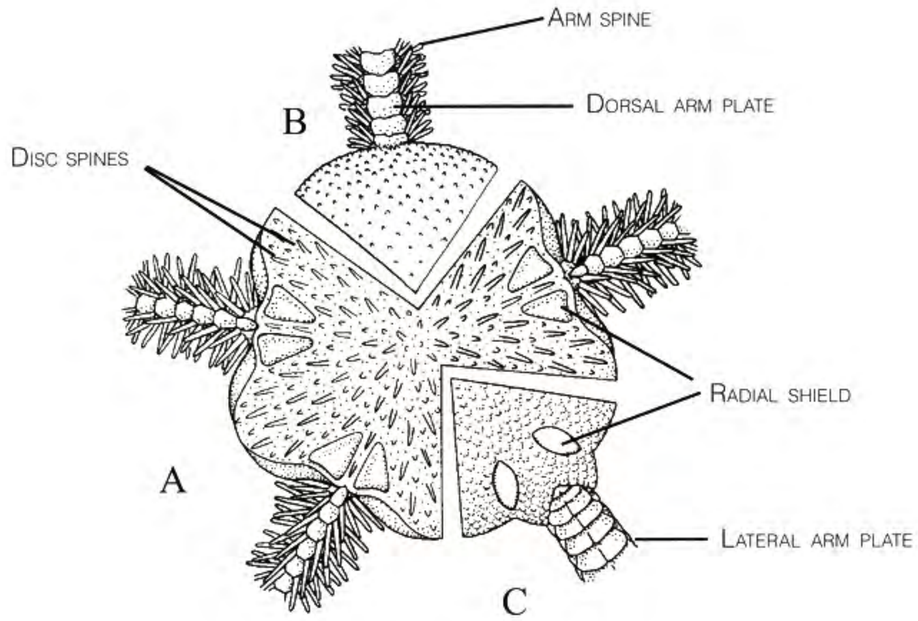
Brittle stars feed on a variety of small organic particles suspended in the water or lying on the bottom. Food is trapped on mucous strands and transferred to the mouth by the podia (tube feet) or by coils of the arms. They also feed by absorbing dissolved compounds through their skin. Brittle stars have the notorious ability to break off their arms, a defensive response to attack by a predator. It is common to find individuals with missing or partly regenerated arms.

Of the approximately 2000 described species of brittle stars, 74 have been recorded from Galápagos, 28 of which occur in water less than 20 m (65 feet) deep. Of the 12 species listed here, four are believed to be endemic to the Galápagos Islands.

Brittle Star Body Plan

The arms of brittle stars are slender, sharply set off from the central disc, and lack the pedicellariae and dermal gills characteristic of sea stars. The jointed arms consist of articulated ossicles (called "vertebrae") connected by muscles and covered with dermal plates. The ambulacra are closed in brittle stars. The tube feet, important in locomotion and in obtaining food, are small, lack suckers, and project laterally from the skeletal plates.

Measurements of disc diameter and arm length, given in metric units and their U.S. equivalents, refer to average dimensions of adult specimens.



Composite external anatomy of the dorsal surface of the disc and arms of brittle stars, with sectors showing the typical features of A, *Ophiothrix spiculata*; B, *Ophiocoma alexandri*; and C, *Ophioderma teres*.

Family Ophiotrichidae

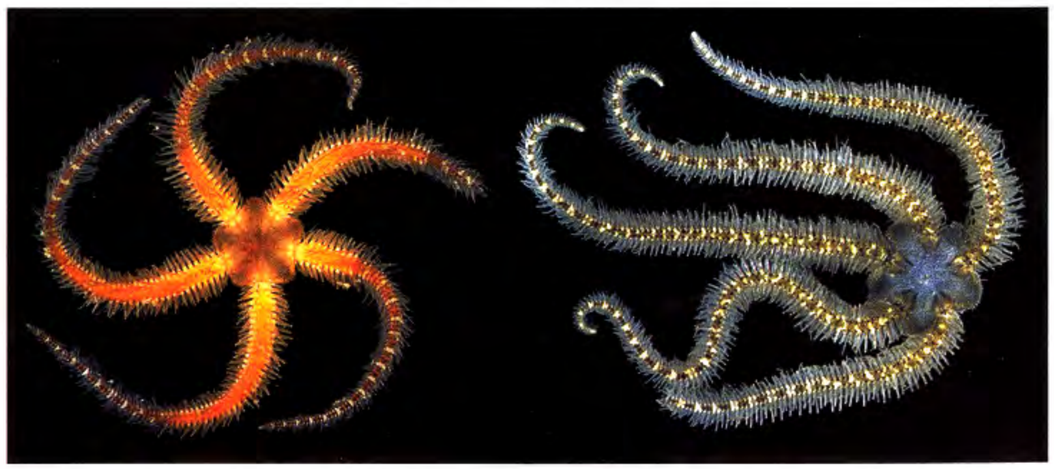
Ophiothrix spiculata LeConte, 1851 — Glass-spined Brittle Star

Disc 14 mm (0.55 in), arm length 64 mm (2.5 in)

This small brittle star, the most commonly seen brittle star in Galápagos, both intertidally and subtidally, is easily recognized by the long, glasslike spines that extend laterally from the arms. The spines are blunt at the tip, flattened, about as wide at the tip as at the base, and bear distinct, thornlike teeth. The smallest spines of the disc are multifid (ends split into two or three minute spinelets). This last character, which requires a hand lens to be seen, is crucial in separating this species from its close relative *Ophiothrix magnifica. O. magnifica,* which lacks multifid spines on the disc, occurs in Peru and probably in Galápagos, but all the specimens of *Ophiothrix* that I have examined belong to the ubiquitous species *O. spiculata*. According to ophiuroid specialist Gordon Hendler, specimens resembling *O. magnifica* may be variants of *O. spiculata*; the taxonomy requires clarification. Coloration is highly variable, ranging from blue or gray-green to violet, arms nearly always banded at intervals. Intertidal specimens tend toward dark, cryptic colors; subtidal specimens are often brightly colored. This species feeds by capturing food on sticky secretions of the arm spines and tube feet.

Habitat & range: Very common mid and low intertidal under rocks and on large sponges, or clinging to algae; also common subtidally under rocks. Often abundant among roots of red mangrove in association with estuarine sponges. California to Peru and the Galápagos Islands.

O. spiculata from an intertidal habitat.



Two color morphs of *O. spiculata* from a subtidal habitat where coloration tends to be more vivid. This most common of Galapagos brittle stars is variable in coloration.

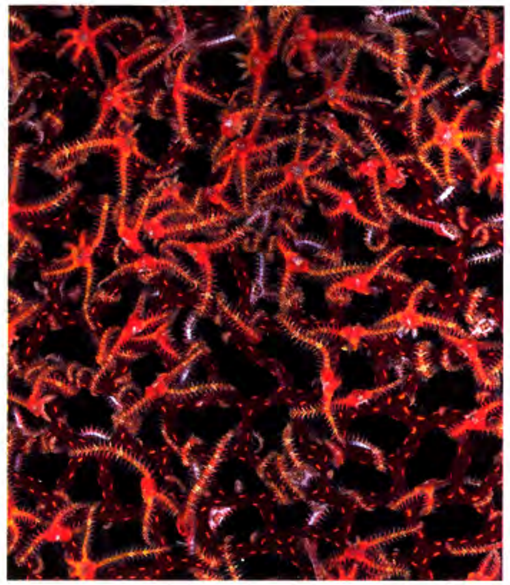
Ophiothela mirabilis (Verrill, 1867) — Epizoic Brittle Star

Disc 2.4 mm (0.1 in), arm length 12.5 mm (0.5 in)

This tiny, six-armed brittle star is most easily identified by its habitat. It is epizoic, clinging tightly to the spines of the pencil urchin (*Eucidaris thouarsii)* or the branches of gorgonians. The disc, ranging in size to 5 mm, but seldom larger than 2 mm in the Galápagos specimens examined, is mostly covered with large radial shields which may reach nearly to the center of the disc and are narrow and blunt at their outer ends. The lateral arm plates bear five or six (usually six) spines. The uppermost spine is very small, the second or third spines are the longest, and the others decrease in size to the lowest, which is very small. It reproduces asexually by dividing across the disc, so it is common to find specimens with partly regenerated arms. The disc may be distorted, wide at the base of the long arms, and compressed at the bases of the short, regenerating arms. Species of *Ophioactis* also are sometimes epizoic and could be confused with *O. mirabilis*.

Habitat & range: Epizoic on pencil urchins and gorgonians, and possibly on sponges. It has been reported from the Pearl Islands, Bay of Panama, Malpelo Island, and now from the Galápagos Islands (new record).

Several *Ophiothela mirabilis* on the spines of a pencil urchin. The epizoic brittle stars keep the spines clear of marine life that would settle there.



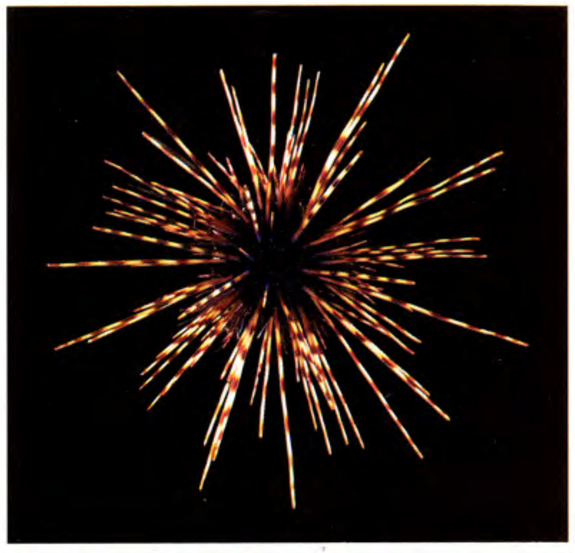
Numerous *O. mirabilis* adhere tightly to the branches of a gorgonian. The brittle stars do not harm the gorgonian but use it as a feeding station to trap plankton passing by in the current.

Two spines removed from a pencil urchin with epizoic brittle stars tightly wrapped around them.

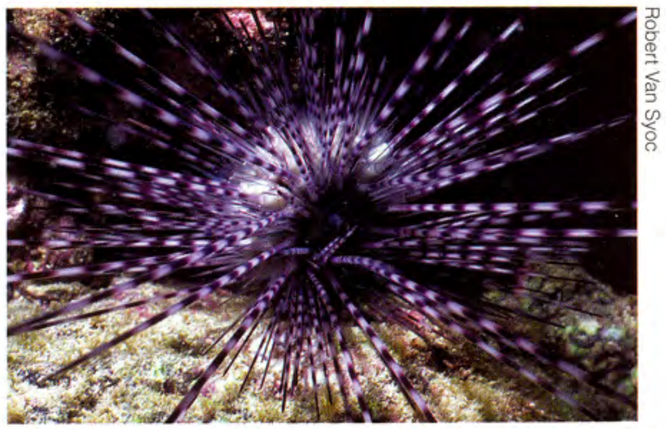
Centrostephanus coronatus (Verrill, 1867) — Crowned Sea Urchin

Overall diameter 25 cm (9.9 in)

This is an attractive brown urchin with long, acute spines that are distinctly banded with alternating dark and light purple (sometimes almost white) pigment bands; banding is more distinct in small specimens. The uppermost interambulacral plates bear short spines with bright reddish purple tips. The five pairs of oral plates surrounding the mouth bear slender, blunt, light-colored spinelets. The primary spines are not poisonous but are very sharp and brittle and easily penetrate the skin.



Habitat & range: Rock and sand sheltered substrates, usually found in round depressions in rocks that it may excavate. Common. Low intertidal to 125 m (410 ft). Gulf of California to northern Peru and the Galápagos.



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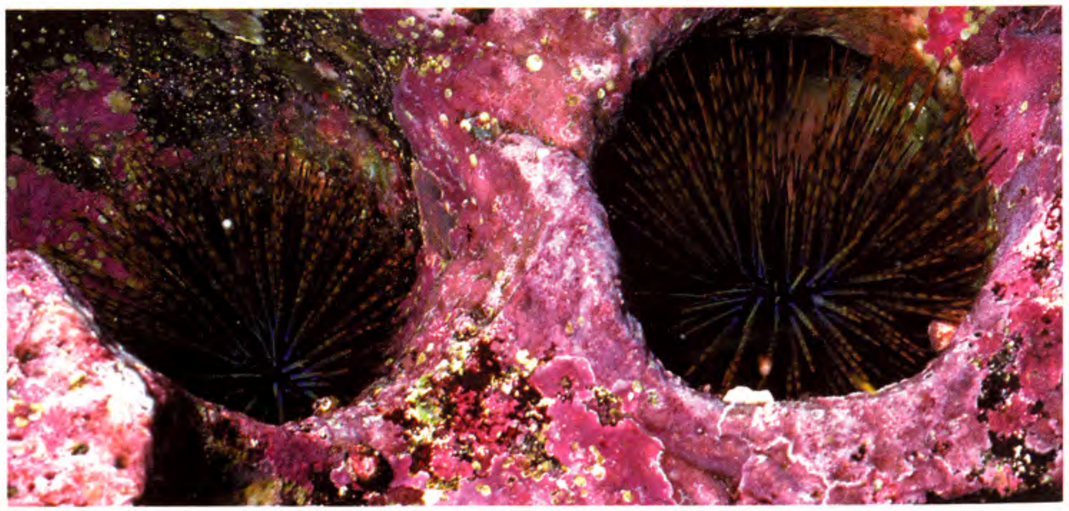


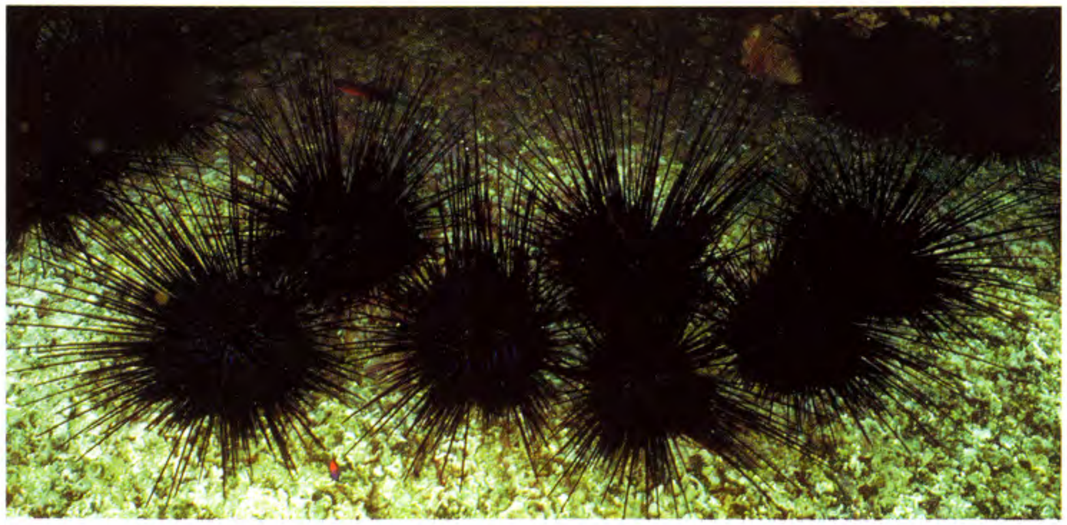
Two crowned sea urchins living in recesses hollowed in a lava rock wall.

Diadema mexicanum A. Agassiz, 1863 — Hatpin Urchin

Overall diameter 50 cm (20 in)

The hatpin urchin is a large, black or deep purple sea urchin with very long, acutely pointed, poisonous spines. The primary spines may exceed twice the diameter of the test and are very fragile. Spines are absent from the area around the peristome. In very young specimens the spines are banded with white, but this is replaced with black or dark brown pigment as the urchin ages. Adults are virtually uniformly black or very dark brown, although the spines may be encrusted with white bryozoan colonies. The spines are covered with a thin poisonous membrane that produces somewhat painful, although seldom dangerous, wounds. (The use of vinegar and antihistamines are standard treatments for spine punctures.) This species, along with the other two diadematids, is primarily herbivorous but also feeds on animals and occasionally on coral.

Habitat & range: Rocky low intertidal (tide pools) and subtidal in rocky recesses; a nocturnal feeder. Spotty distribution in Galápagos, occasionally abundant. Mid-Gulf of California to Colombia and Galápagos Islands.

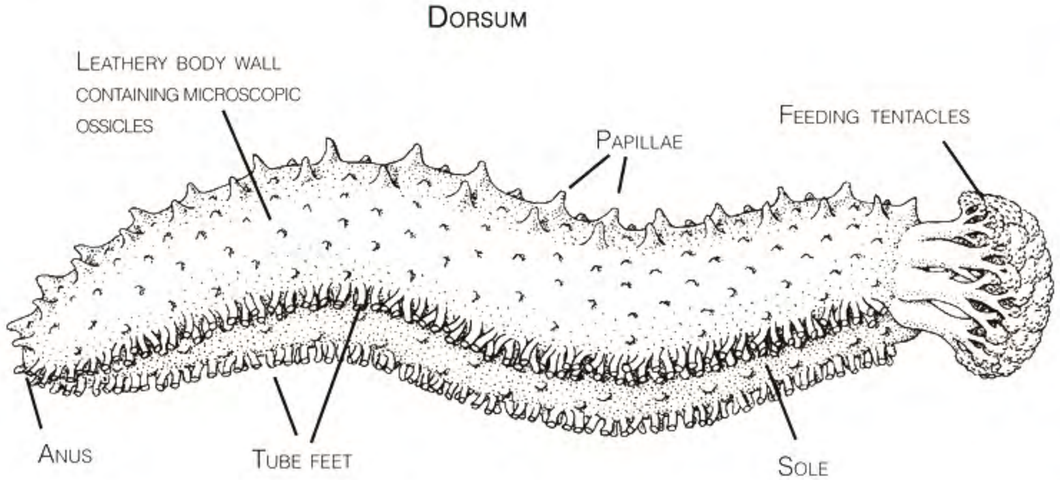


Group of hat-pin urchins clustered in a community at Beagle Rocks. Such clusters are common throughout the archipelago.

Sea Cucumber Body Plan

Sea cucumbers have elongate, cylindrical, bilaterally symmetrical bodies with a mouth at one end encircled by 10 to 30 retractile feeding tentacles. The five ambulacral areas, so prominent in sea stars and sea urchins, are obscured in most sea cucumbers. Sea cucumbers lie on one side, the sole, which embraces three ambulacral areas and bears all the locomotory tube feet. The tube feet in many species lack suckers and are called papilliform; these have a nipple-like shape. The upper, or dorsal, surface (also called the dorsum) embraces the remaining two ambulacra. Here the tube feet are characteristically modified into warts and papillae. The body wall is soft or leathery because the endoskeletal plates, typical of their more calcified sister classes, are reduced to a profusion of microscopic ossicles. These minute ossicles, in curious geometric shapes, are important in the classification of sea cucumbers (see Appendix A).

The length measurements given in the species descriptions apply to relaxed specimens as they appear in their habitat.



External anatomy of a sea cucumber.

Family Holothuridae

Holothuria difficilis Semper, 1868

Length 10-12 cm (4-4.7 in)

The body of this sea cucumber is stout, soft-walled, and covered with conspicuous pointed papillae irregularly spaced on the dorsal surface (these collapse when the animal is removed from the water). The ventral surface of larger specimens is flattened into a well-developed sole. This species is active at night and usually concealed under rocks during the day. It ejects sticky threads when handled. Body color is rich brick red with irregular black pigment blotches on the dorsum; some specimens are almost black. The ossicles (see Appendix A) consist of stout tables and large buttons. Because of its nocturnal habit, distinctive appearance, and ability to extrude sticky threads when handled, this species can hardly be confused with any other Galápagos sea cucumber.

Habitat & range: Subtidal under rocks, exposed on rock surfaces at night, down to approximately 100 m (330 ft). Rarely occurs intertidally and in tide pools. Populations are of low density in the central archipelago but locally abundant in the western archipelago where it replaces *Stichopus horrens* as the dominant nocturnal species. From the eastern coast of Africa westward to Central America and Mexico and the Galápagos Islands.

H. difficilis foraging at night at Espinosa Point, Fernandina, 4 m (13 ft) depth

H. difficilis releasing sticky threads when disturbed, a characteristic that helps to identify this species.

Juvenile *H. difficilis*, 7 cm (2.8 in) long

32 *Lytechinus semituberculatus*, (upper) Roca Blanca (near Punta Albemarle); (lower) Pinta, 3 m.
33 *Toxopneustes roseus*, Punta Cormorant, Floreana, 6 m; (lower) *Tripneustes depressus*, Tagus Cove, 8 m.
34 *Caenocentrotus gibbosus*, Punta Vicente Roca, 1 m, rock wall; *Echinometra vanbrunti*, Punta Vicente Roca, 1 m, rock wall.
35 *Echinometra oblongata*, near CDRS, low littoral; *Encope galapagensis*, Gardner Bay, Española, 2 m.
36 *Agassizia scrobiculata,* Gardner Island at Española, 17 m; *Brissus obesus,* Gardner Bay, Española, 2 m.
37 *Lovenia cordiformis*, Roca Blanca (near Punta Albemarle); *Cassidulus pacifica,* Roca Blanca (near Punta Albemarle), 8-10 m on sand.
38 *Clypeaster rotundus*, Tagus Cove, 14 m, sand bottom; *Clypeaster ochrus*, Banks Bay, 12 m, sand bottom.
43 *Holothuria difficilis*, (upper) Punta Espinosa, Fernandina, night dives, 5-7 m; (middle) Elizabeth Bay, 12 m; (lower) Piedras Blancas, Marchena, 4 m.
44 *Holothuria arenicola*, (upper) Punta Suarez, Española, 10 m, under rock; (middle) Punta Espinosa, Fernandina, 7 m, under rock; (lower) Genovesa, NW side, 5 m.
45 *Holothuria impatiens,* Gardner Island, Española, 18 m; (lower right) Kicker Rock, San Cristobal, 21 m.
46 *Holothuria atra*, Cartago Bay, 3 m.
47 *Holothuria hilla*, (upper) Darwin Bay, Genovesa, 9 m; (lower) Tortuga Island, 8 m.
48 *Holothuria pardalis*, (upper and middle) Elizabeth Bay, 12 m; and Banks Bay, 15 m; (lower) Tortuga Bay, Santa Cruz, intertidal.
49 *Holothuria leucospilota*, all from Cape Marshall, Isabela, 5-7 m.
50 *Holothuria fuscocinerea*, (upper) Rabida, 7 m; (lower) Isla Wolf, 5 m.
51 *Holothuria imitans*, (upper) Banks Bay, Isabela, 12 m; (lower) Eden, 7 m.
52 *Holothuria kefersteini*, (upper) Cape Marshall, Isabela, 5-7 m; (lower) Roca Este, San Cristobal, 21 m.
53 *Holothuria theeli*, all from Academy Bay near Charles Darwin Research Station, low littoral.
54 *Holothuria portovallartensis*, (upper) Academy Bay, low littoral; (lower) Tortuga Bay, Santa Cruz, low littoral.
55 *Holothuria maccullochi*, Punta Suarez, Española, 11 m; *Holothuria rigida*, Elizabeth Bay, 12 m.
56 *Stichopus fuscus*, (upper) Marchena; (lower) Punta Suarez, Española, 12 m.
57 *Stichopus horrens*, (upper) Punta Estrada, Santa Cruz, 10 m; (lower left), Rabida, 7 m; (lower right), Punta Vicente Roca, Isabela.
58 *Neothyone gibber*, James Bay, 6 m; (lower) *Pentamera* sp., Punta Suarez, Española, 12 m.

Appendix C

Guide to Further Reading

Following is a selection of references provided for those seeking additional information on the species included in this field guide. The Maluf number following each entry refers to numbered listings in L.Y. Maluf, 1988, in which geographic and depth ranges are given, as well as additional references.

Sea Stars

Astropecten armatus Gray, 1840. Maluf #2013
Boone (1928, as *Astropectin erinaceus*), Brusca (1980), Caso (1943, 1961), H. L. Clark (1910, 1913, 1940), Fisher (1906), Hopkins and Crozier (1966), Maluf (1988, 1991), Sladen (1889), Verrill (1867a, 1867b), Ziesenhenne (1937).

Luidia foliolata Grube, 1866. Maluf #2009
Caso (1961, 1979), Fisher (1911), Hopkins and Crozier (1966, as *Petalaster foliolata*).

Luidia bellonae Lütcken, 1864. Maluf #2002
Caso (1979a), H.L. Clark (1902), Steinbeck & Rickets (1941), Verrill (1867a, 1867b), Ziesenhenne (1937).

Nidorellia armata (Gray, 1840). Maluf #2073
Boone (1933), Brusca (1980), Caso (1943, 1961), H. L. Clark (1910, 1920a), Ely (1942), Maluf (1988, 1991), Sladen (1889), Verrill (1867a), Ziesenhenne (1937).

Pentaceraster cumingi (Gray, 1840) (Formerly *Oreaster occidentalis* Verrill, 1867). Maluf #2074
Brusca (1980), Caso (1943 as *Oreaster occidentalis*, 1961), H. L. Clark (1910), Fisher (1906), Maluf (1988, 1991), Sladen (1889), Verrill (1867a, 1867b), Ziesenhenne (1937).

Asterina sp.
Clark (1910), Madsen (1956), Sladen (1889).

Asteropsis carinifera (Lamarck, 1816). Maluf #2079
Caso (1961), Clark & Rowe (1971), Ely (1942), Kerstitch (1989), Ludwig (1905), Maluf (1988, 1991), Sladen (1889), Verrill (1867b).

Linckia columbiae Gray, 1840. Maluf #2082
Boone (1933), Brusca (1980), Caso (1948, 1961), H. L. Clark (1913, 1940), Hopkins and Crozier (1966), Maluf (1988, 1991), Sladen (1889), Verrill (1867b), Ziesenhenne (1937).

Leiaster teres (Verrill, 1871). Maluf #2081
Downey (1976), Jangoux (1980), Steinbeck & Ricketts (1941), Verrill (1867a, 1867b), Ziesenhenne (1937).

Pharia pyramidata (Gray, 1840). Maluf #2086
Boone (1933), Brusca (1980), Caso (1943), H. L. Clark (1910, 1913, 1920, 1940), Maluf (1988, 1991), Sladen (1889), Verrill (1867a), Ziesenhenne (1937).

the H.M.S. "Challenger" 1873-76, **30**:1-893, 117 pls.
Steinbeck, J., and E.F. Ricketts. 1941. Sea of Cortez. A leisurely journal of travel and research. New York: Viking Press, 598 pp.
Théel, H. 1886. Report on the Holothurioidea dredged by H.M.S. "Challenger" during the years 1873-1876, II. Report of the Scientific Results of the Voyage of H.M.S. "Challenger" 1873-76, **14**(39):1-290, 16 pls.
Verrill, A.E. 1867a. Notes on the echinoderms of Panama and west coast of America, with descriptions of new genera and species. Transactions of the Connecticut Academy of Arts and Sciences, **1**(2):251-322, pl. 10.
Verrill, A.E. 1867b. On the geographical distribution of the echinoderms of the west coast of America. Transactions of the Connecticut Academy of Arts and Sciences, **1**(2):323-338.
Verrill, A.E. 1867c. Notes on the Radiata in the Museum of Yale College, with descriptions of new genera and species. Transactions of the Connecticut Academy of Arts and Sciences, **1**(2):247-251.
Wellington, G.M. 1975. The Galápagos coastal marine environment. A resource report to the Department of National Parks and Wildlife, Quito. Unpublished manuscript, 357 pp.
Ziesenhenne, F. C. 1935. A new brittle star from the Galapagos Islands. Allan Hancock Pacific Expeditions, **2**(l):1-4, 1 pl.
Ziesenhenne, F.C. 1937. Echinoderms from the west coast of Lower California, the Gulf of California and Clarion Island. Zoologica (New York), **22**(15):209-239.
Ziesenhenne, F.C. 1940. New ophiurans of the Allan Hancock Pacific Expeditions. Allan Hancock Pacific Expeditions, **8**(2):9-42, 9 pls.
Ziesenhenne, F.C. 1955. A review of the genus *Ophioderma* M.&T. Essays in the natural sciences in honor of Captain Allan Hancock. Los Angeles: University of California Press, pp. 185-201.

Index to Scientific Names