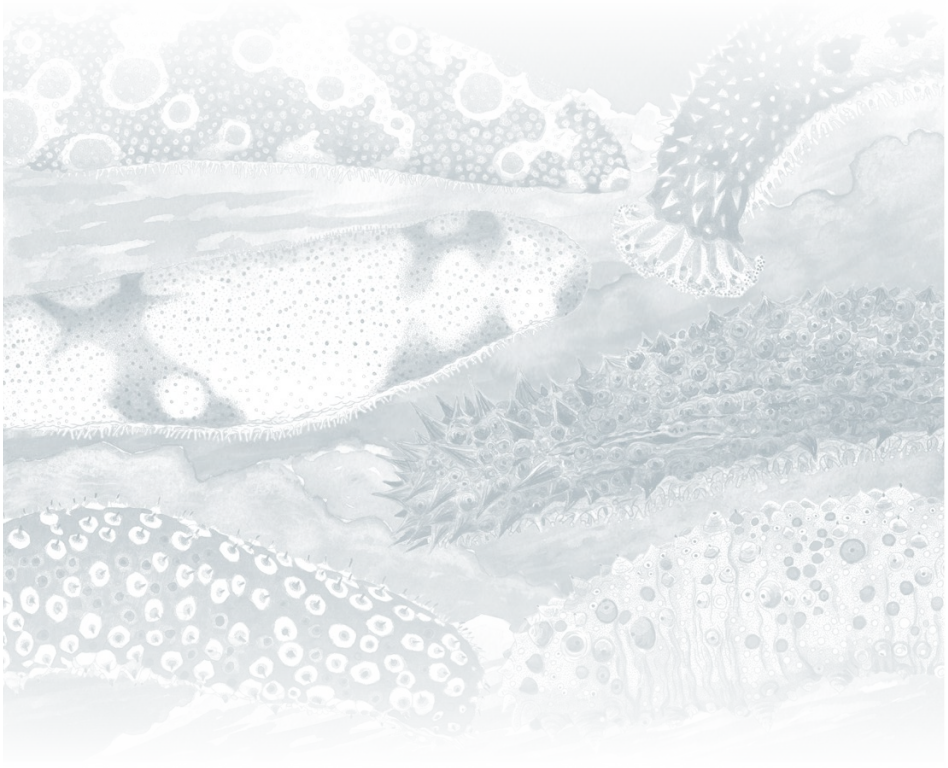
Food and Agriculture Organization of the United Nations

FAO Species Catalogue for Fishery Purposes No. 6, Rev. 1

ISSN 1020-8682

COMMERCIALLY IMPORTANT SEA CUCUMBERS OF THE WORLD

Second edition



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COMMERCIALLY IMPORTANT SEA CUCUMBERS OF THE WORLD

Second edition

by

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Rome, 2023

Required citation:
Purcell, S.W., Lovatelli, A., González-Wangüemert, M., Solís-Marín, F.A., Samyn, Y. & Conand, C. 2023. *Commercially important sea cucumbers of the world – Second edition.* FAO Species Catalogue for Fishery Purposes No. 6, Rev. 1. Rome, FAO. https://doi.org/10.4060/cc5230en

ISSN 1020-8682

ISBN 978-92-5-137793-2

PREPARATION OF THIS DOCUMENT

Sea cucumbers, just as other echinoderms, occur in all marine environments. They are harvested for subsistence and commercial purposes in at least 90 countries. Species within some taxonomic groups can appear similar, in both their live and dried forms, although they can be distinguished in most cases with knowledge and practice. Identification guides such as this one allow scientists, traders and trade officials to recognize commercially important species with greater certitude.

This second edition of the identification guidebook for commercially exploited sea cucumbers of the world updates its first edition (Purcell, Samyn and Conand, 2012) in four aspects.

First, although this guide does not attempt to be a taxonomic treatise, it adopts recent systematics. The higher systematics have been amended as proposed by Smirnov (2012, in part) and Miller *et al.* (2017), whereby the order Aspidochirotida is no longer considered valid. This guide separates species previously classified in the order Aspidochirotida into two newly established orders, Holothuriida and Synallactida. The previously recognized order Dendrochirotida has been retained.

Second, this new edition includes simplified, but illustrated and annotated, identification keys, covering live and processed specimens. The keys draw on different sources of information. For instance, coloration, texture of the body wall, external and internal anatomical characters (e.g. calcareous ring and ossicles), biogeographical and biological information.

Thirdly, it has an expanded list of species that are commercially exploited worldwide to include regions not well represented in the first edition. This increased the number of covered species from 58 to some 84 species in this edition, with additions coming mostly from the Mediterranean, West Africa and Latin America (Atlantic and Pacific side).

Fourth, to frame this taxonomic information, this edition includes a section on the process of taxonomy and importance of scientific names. For the latter the authors briefly detail how species are correctly named according to the rules of zoological nomenclature as stipulated in the 4th edition (1999) of the International Code of Zoological Nomenclature.

This second edition adopts a similar structure to the first edition by retaining introductory sections on the gross anatomy of sea cucumbers, key fisheries and conservation trends, and methods for preserving ossicles and whole animals for scientific purposes. The two-page descriptions of each species provide: (i) a list of identified common names, (ii) diagnostic features (general description, ossicle assemblage, processed appearance, size range); (iii) brief ecological and biological information; (iv) summaries about their exploitation and market value; and (v) geographical distribution.

The Food and Agriculture Organization of the United Nations (FAO) coordinated a project to produce this second edition of the guidebook. It was championed by Alessandro Lovatelli. While Mercedes González-Wangüemert and Francisco Solís-Marín compiled the accounts for species from the Mediterranean and eastern Atlantic and Latin America, the co-authors of the first edition, Steven Purcell, Yves Samyn and Chantal Conand, contributed further text and edits to these and other species. Photographs and information on the various species were solicited from researchers and sourced from published literature. This guidebook draws heavily on the contributions of Clark and Rowe (1971), Féral and Cherbonnier (1986), Massin (1999), Samyn (2003), Samyn, VandenSpiegel and Massin (2006) and Solís-Marín *et al.* (2009). Some species were excluded from this guidebook because they are seldomly exploited. Recent taxonomic works have resulted in changes to the scientific names of some species: *Actinopyga varians*, *Apostichopus californicus*, *Holothuria roseomaculata*.

The distribution maps in this book are based upon published accounts and personal communications and are certain to be incomplete for some regions (e.g. Southeast Asia) due to a lack of available and reliable accounts.

ABSTRACT

Sea cucumbers are harvested and traded in more than 90 countries worldwide. They are exploited in industrial and small-scale fisheries, nearly from pole to pole, especially in the tropics. In some fisheries, more than 20 species are exploited by fishers.

Fishers in general know how to distinguish the species they harvest, often identifying them with local names. For fishery officers and even biologists, recognizing sea cucumber species remains daunting, however, as they are confronted only with the final product: bêche-de-mer (or *trepang*) which is the processed (cooked and dried) product. This field guide offers a tool for fishery managers, scientists, trade officers and industry workers to recognize live and processed (cooked and dried) animals. This animal resource is mainly exported to Asian markets where it is sold mainly, but not exclusively, as a luxury food item.

This book provides identification information on 84 species of sea cucumbers that are commonly or opportunistically (as bycatch) exploited around the world. The list is certainly not all-encompassing, as some other sea cucumber species are also exploited. More scientific data and accounts are needed for species from some regions such as the eastern Atlantic Ocean. The accounts are based on more than 300 reports and research articles and by comments and reviews by taxonomists and field workers.

Two-page identification sheets provide selected information to enable similar species to be distinguished from each other, both in the live and processed (dried) forms. Where available, the following information for each species has been included: scientific and known common names used in different countries and regions; scientific illustrations of the body and ossicles; descriptions of ossicles present in different body parts; a colour photograph of live and dried specimens; basic information on body size, habitat, biology, fisheries, human consumption, market value and trade; and geographic distribution maps. The guide is fully indexed and contains an introduction, a glossary, simplified dichotomous keys to live animals and dried products and a dedicated bibliography. Readers are encouraged to base their identifications on a combination of morphological features, samples of ossicles from different body parts and information on what habitat and locality the species was found.

CONTENTS

ACKNOWLEDGEMENTS

The preparation of the second edition of this guide was possible thanks to funds provided by the FAO Fisheries and Aquaculture Division and the EAF-Nansen Programme "Supporting the Application of the Ecosystem Approach to Fisheries Management Considering Climate and Pollution Impacts", implemented by FAO in collaboration with the Institute of Marine Research (IMR) of Bergen, Norway, and funded by the Norwegian Agency for Development Cooperation (Norad). Extra budgetary support for content and distribution also came from the Government of France (Muséum National d'Histoire Naturelle, PatriNat) via the European Bureau for Conservation and Development (EBCD) and the Government of Japan Trust Fund GCP/GLO/173/JPN, "Programme for supporting the sustainable use of fisheries resources in the twenty-first century" coordinated by Kim Friedman.

The authors thank the staff of FAO Fisheries and Aquaculture Division, which supported the production of this field guidebook. We thank Edoardo Mostarda (FAO) for providing technical inputs and suggestions in the preparation of the identification keys. We also thank Emanuela D'Antoni and Massimiliano Lipperi for their beautiful and accurate scientific illustrations. Catalina Gucianu prepared the distribution maps for new species in this edition in addition to the maps previously prepared by Fabio Carocci. José Luis Castilla modified the graphic design and layout originally created by Enzo Luchetti.

We extend special appreciation to Gustav Paulay, Claude Massin (posthumously), François Michonneau and Alex Kerr for the review of the taxonomy of the concerned species. Anna Giles assisted with the preparation of the dichotomous keys and Miranda Altice acquired permissions for many of the photographs. We are grateful for work done by Veronica Toral-Granda on collating initial information for the first edition of the guidebook, upon which this second edition is based. Ed Butler provided investigative information on sea cucumbers of West Africa.

The retail and wholesale prices of bêche-de-mer in China, Hong Kong SAR and Guangzhou from 2016 were obtained by Steven Purcell through project FIS2010/096, funded by the Australian Centre for International Agricultural Research, in collaboration with Watisoni Lalavanua, Sailasa Tagica, Poasi Ngaluafe and Guanglin Wang. Data on prices in China, Hong Kong SAR during 2022 were collected by Stanley Shea. Data on online market prices of bêche-de-mer were collected by Ms. Li Yixue.

This book also benefited from the collaboration of sea cucumber scientists worldwide who provided the information included in the species fact sheets, without their information and support this book would not have been possible: Mohammed I. Ahmed, Jun Akamine, Irma Alfonso, Khalfan M. Alrashdi, Juan José Alvarado, Luis Amaro-Rojas, Riaz Aumeeruddy, Mark Baine, José Enrique Barraza, Milena Benavides-Serrato, Maria Byrne, Chen Jianxin, Peter Collin, Poh Sze Choo, Niki Davey, Hampus Eriksson, Vanessa Francisco, Ruth Gamboa, Beni Giraspy, Elena Gudimova, Chita Guisado, Héctor Guzmán, Jean-Francois Hamel, Maria Del Mar Otero-Villanueva, Gustav Paulay, Philip Polon, Erika Paola Ortiz, Mary A. Sewell, Timothy Skewes, Veronica Toral-Granda, Akram Tehranifard, Sven Uthicke, Didier VandenSpiegel, Erin Wylie, Giomar Borrero, Lyle Vail, Leo Zamora, David Lane, Mehmet Aydin, Karim Mezali, Mohammed Malouli Idrissi, Karim Ben Mustapha, Ragia Moussa, Gyda Christophersen, Miroslava Atanassova, Rui Freitas, Ali Enver Özsoy, Slavica Petovic, Carmelo Dorta.

INTRODUCTION

The use of sea cucumbers as food and as a commodity began in China about 1000 years ago, which encouraged the development of capture fisheries (i.e. those targeting wild stocks) in the region. However, the rising demand of the markets in Asia led to the depletion of local sea cucumber populations and prompted Asian traders to solicit sea cucumbers from locations beyond stocks available in Asia (Conand, 2004, 2006; Bruckner, 2006; Toral-Granda, Lovatelli and Vasconcellos, 2008; Purcell, 2010). Currently, sea cucumber fishing occurs nearly all over the world with some populations reportedly over-harvested (Lovatelli *et al*., 2004; Bruckner, 2006; Uthicke and Conand, 2005; Conand and Muthiga, 2007; Toral-Granda, Lovatelli and Vasconcellos, 2008; Purcell *et al*., 2013; González-Wangüemert *et al*., 2014; 2015; 2018; Conand, 2017; 2018a).

Most tropical fisheries are multispecies and at an artisanal scale or for subsistence use. In some cases, fishing evolved to target many low-value species after stocks of the more valuable species were depleted. In temperate regions, fishers commonly focus on one species harvested with industrial fishing methods such as scuba/**hookah** diving or use of dredges (Hamel and Mercier, 2008; Aydin, 2008, 2017; Purcell *et al*., 2013; González-Wangüemert *et al*., 2018; Dereli and Aydin, 2021). The vast majority of species are harvested for the "bêche-de-mer" or "trepang" market, although some species are also consumed cooked, pickled or raw (e.g. *Apostichopus japonicus, Cucumaria frondosa, Apostichopus californicus, Acaudina molpadioides*). Some domestic markets also demand the internal muscle bands (e.g. *Parastichopus regalis*), or pickled intestines and gonads (e.g. *Holothuria leucospilota* and *Bohadschia vitiensis*), while some commercial products have sea cucumber by-products (e.g. "gamat" oil from *Stichopus horrens*) while others are included in the aquarium trade (e.g. *Holothuria hilla*, *Pseudocolochirus violaceus*). Generally, sea cucumber harvesting is for export, with little domestic use, and the market is largely driven by Asian entrepreneurs who set the price for the sale (Conand, 2008; Kinch *et al*., 2008a; Toral-Granda, 2008a; Dereli and Aydin, 2021).

Since the 1980s, sea cucumber harvesting has boomed but many stocks have since collapsed. Towards the end of the "boom" part of a "boom-and-bust" fishing cycle, populations of some species had been reduced to such low levels that there was little capacity for natural recovery and replenishment, leading to their economic and ecological depletion. Consequently, Asian markets have increased demand, putting severe pressure on fishers in producing countries to supply markets with new species.

Sea cucumbers belong to the class Holothuroidea and so are referred to as holothuroids. A majority of species harvested commercially belong to the families Holothuriidae and Stichopodidae, and are mostly tropical. A few species belonging to the order Dendrochirotida, family Cucumariidae, are also fished commercially. Species in the other orders such as Apodida, Elasipodida and Molpadida are mostly not fished commercially and only one (*Acaudina molpadioides*) is presented in this field guidebook. Conand (2006) recognized about 40 species of sea cucumber under commercial harvest, while Toral-Granda, Lovatelli and Vasconcellos (2008) listed at least 47 species. Later, Purcell (2010) listed 66 species that are exploited commonly in various regions of the world. The chronological increase in the number of reported exploited species echoes the pervasive problem of serial depletion of high-value species, leading to exploitation of new species or exploitation in new territories.

Taxonomy, just as other science disciplines has become more complex, whereby new technologies and increased access to voucher specimens are fully embraced by its practicioners. Such is not different for holothuroid taxonomy. For instance, Uthicke, Byrne and Conand (2010) genetically analysed the relationships among many commercial species,

shedding new light on a few of them. Similar work was carried out with target species from the Mediterranean and Northeast Atlantic (Borrero-Pérez *et al.,* 2009; 2010). However, once processed, some sea cucumbers can be difficult to identify to species level, creating a problem for trade officials, although research has indentified species of bêche-de-mer using DNA barcoding (e.g. Wen *et al*., 2011).

This book presents a summary guide to identifying 84 sea cucumber species exploited for human consumption through photographs of the live and processed animals, morphological descriptions, biological and ecological information, and illustrations of the calcareous ossicles ("spicules") found in various body tissues. The shapes and sizes of ossicles differ among species and may be used to distinguish species in trade. Additional photographs were included where appropriate, especially for species that have alternative colour types.

This book also summarizes information on current fisheries and management measures of each species. The 3-alpha identifier codes ("Code") for reporting trade are included in the "Main market and value" sections for species where the code exists.

There are two dichotomous keys: one for live animals and one for dried products. These can be used to aid in identifying the animals in the field and dried products in trade but they are not a definitive tool for making confident identifications. Users are encouraged to use the keys but also refer to the species information sheets in this guidebook for further verification.

The dedicated bibliography at the end of this book contains references for literature (books, reports, scientific articles) that were used in its preparation. There are countless other articles that give further information about these species but these have not been used specifically in the preparation of this book.

GENERAL REMARKS

External morphology of sea cucumbers

Sea cucumbers have an orally–aborally (longitudinally) elongated body (Figure 1). The pentamerous symmetry is sometimes recognizable by the presence of 5 meridional **ambulacra** bearing **podia** (tube feet). All of the commercially exploited sea cucumbers live on the substrate of the sea floor with their ventral surface (or **trivium**). This creeping sole bears the locomotory podia, while on the dorsal surface (or **bivium**), the podia are often represented by **papillae**. This divide between the dorsal and ventral surface makes sea cucumbers look like they have a bilateral symmetry, at least for most species in this guidebook. In *Acaudina molpadioides* we see a posteriorly elongated body wall forming a short 'tail' that bears the anus.

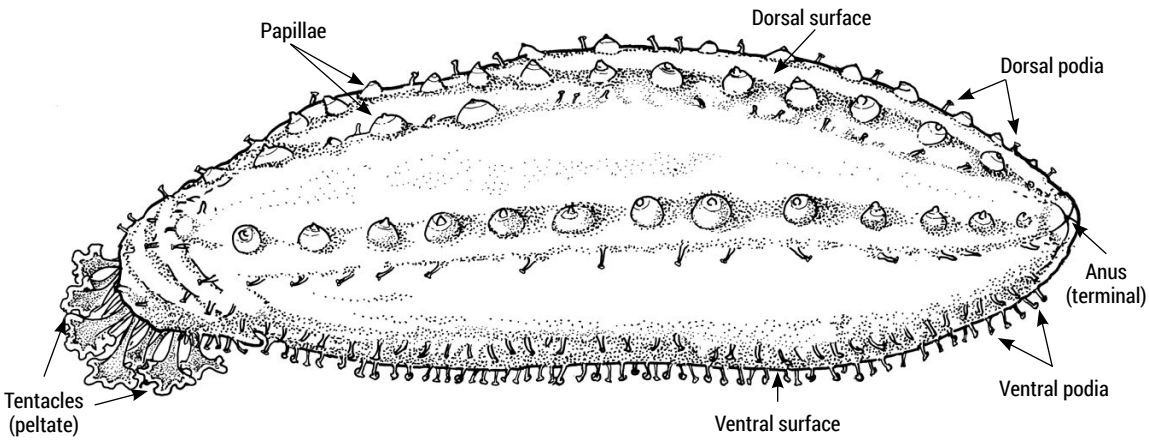


Figure 1 – Main external anatomical features of a sea cucumber in the order Holothuriida

The mouth, at the anterior end, has **tentacles** (Figure 1), which the animal extends to acquire food (mainly particulate organic matter). The **anus** is at the posterior end of the animal. Tentacles are modified buccal podia, which are extensions from the water vascular system. Their number varies between 10 and 30, generally being a multiple of 5. In **Holothuriida and Synallactida**, all tentacles are of the same size, but in **Dendrochirotida**, tentacles can be of differing size. The shape of the tentacles differs among the various taxonomic orders and is used as a key character (Figure 2). In the Dendrochirotida, they are **dendritic** (branching in an arborescent manner) and can reach a large size when extended. Holothuriida and Synallactida mostly have **peltate** tentacles, each with a central stalk and a little branching disc. Sea cucumber tentacles, in general, are very retractile, particularly in the Dendrochirotida, which have an **introvert** where the tentacles insert. The tentacles and the introvert can be contracted into the inside of the animal by 5 retractor muscles.

The body wall varies in thickness and smoothness. In many commercial species it is several mm thick, varying in roughness from slippery to rough to the touch. In some species, the dorsal and lateral body wall is marked by papillae (Figure 1), whereas in *A. molpadioides*, the **podia** and **papillae** are absent all together. **Podia** appear on the body wall and typically have the form of locomotory podia (Figure 1): hollow tubular projections terminating in a flat disc, which allows the podium to adhere to the substratum during locomotion or to adhere to the sea floor. Epidermal cells produce adhesive secretions. Internally, the disc is supported by a large skeletal ossicle: the endplate. Podia can also have the shape of papillae. Podia are rarely arranged in 5 regular rows in the ambulacral areas, but also spread into the interambulacral areas, especially dorsally. When podia are devoid of their terminal disc, they are "papillae".

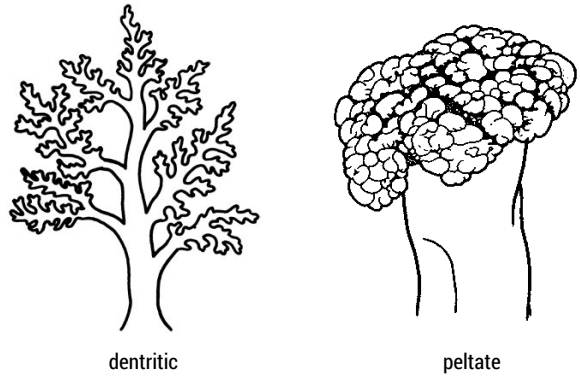


Figure 2 – Basic types of tentacles

The **anus** may be encircled by small papillae or heavily calcified papillae called **anal teeth**.

Body wall coloration is species specific. However, it has been documented that considerable variation in coloration can occur within a species; for example, with *Holothuria lessoni* and with *Isostichopus badionotus*. The ventral surface is often lighter in colour than the dorsal surface.

Body wall

The body wall is thin in Molpadida, but thicker in the other orders presented in this guidebook, particularly in the Holothuriida. The body wall is often the part of the body of a sea cucumber that is processed for human consumption. Therefore, many commercial species are characterized by having a thick body wall. Its structure consists of a thin cuticle over the epidermis and a thick dermis underneath. The dermis is composed of connective tissue, enclosing the endoskeletal **ossicles** or 'spicules' (see next section). Below the dermis, a layer of circular muscles forms a cylinder, generally interrupted by 5 longitudinal muscle bands situated in the radial positions.

Ossicles

Also called spicules, or deposits, ossicles (Figure 3) are characteristic of sea cucumbers and of primary importance for identification. They are mostly of microscopic size. There is a wide variety of simple to

complex shapes. **Rods** can be simple or branching, smooth, warty, or spiny, or can bear knobs only at their ends. They can also have a characteristic C- or S-shape. Fenestrated **plates** also come in various shapes. **Buttons** are oval ossicles, perforated with a varying number of holes arranged in two or more rows. **Tables** are more complicated; they appear as a perforated disc, bearing an erect **spire** (or tower) composed of pillars that can unite to form cross-beams or bridges and that terminate in a crown and show many variations according to the arrangement of its constituents. **Rosettes** are short rods subdivided into short branches. Miliary bodies (**grains**) can be very tiny ossicles present in some Holothuriida and Synallactida.

Apart from the body wall, ossicles are usually found in the tentacles, the podia, and often also in the internal organs. Their developmental stages can differ from the definitive shapes in the adults and thus can make species identification difficult. Moreover, the shape

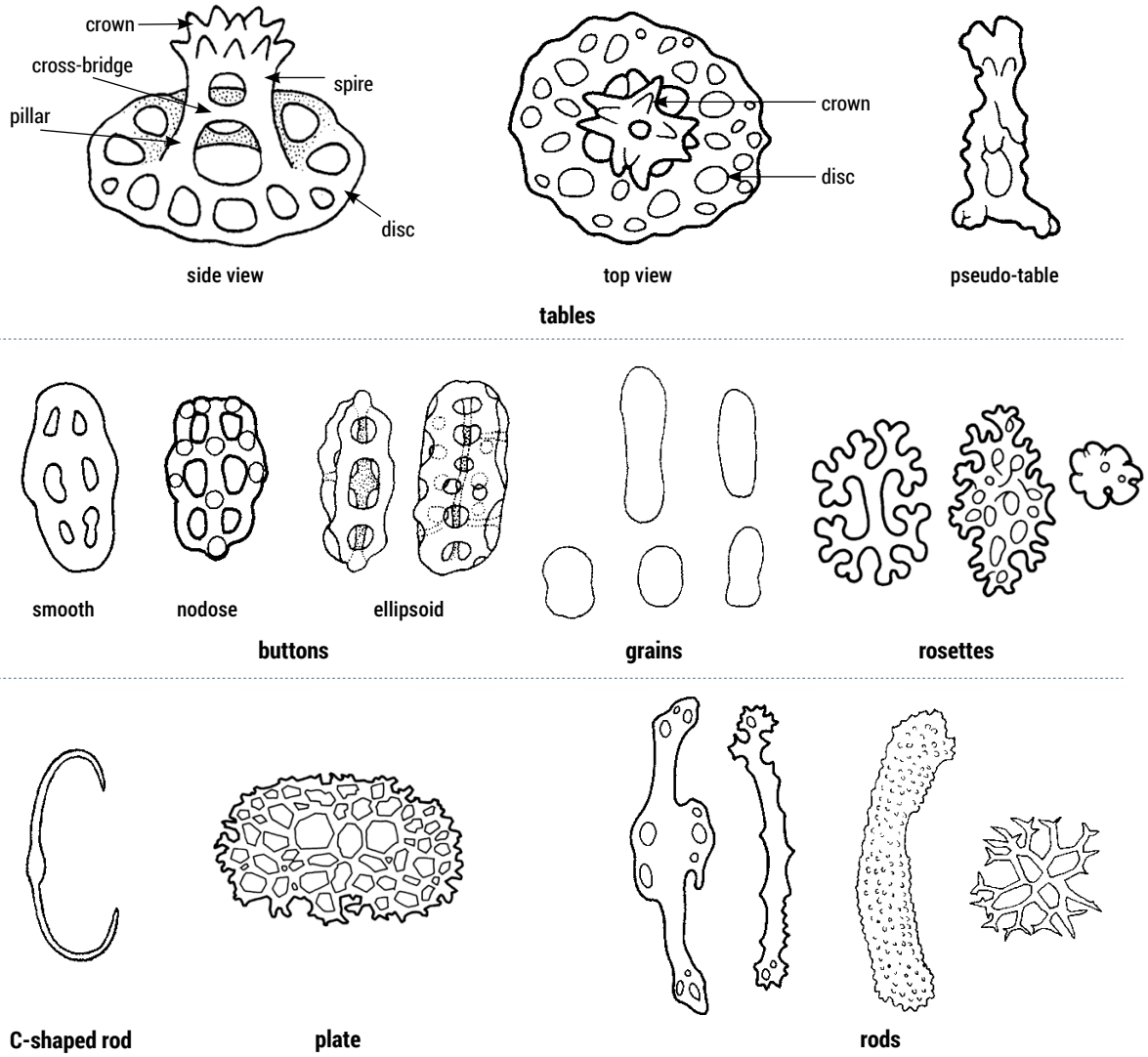
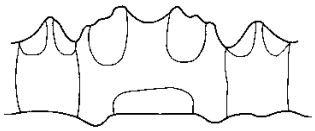


Figure 3 – Basic types of ossicles

and size of ossicles could be affected by temperature and pH of seawater, calcium carbonate ($CaCO_3$) availability, and the size and age of the sea cucumber. Nonetheless, they remain one of the basic taxonomic characters to distinguish species.

Calcareous ring

A ring of usually 10 calcified plates encircles the pharynx. It is composed of alternating larger radial plates, opposite to the ambulacra and smaller interradial plates opposing the interambulacra. The plates may be simple or composed of smaller pieces.



calcareous ring

Digestive system and connected organs

The gut is composed of a pharynx, an esophagus, a stomach, all of which are short structures, and a very long intestine (Figures 4 and 5). The intestine consists of 3 portions: a descending, an ascending and finally a descending loop that connects to both the rectum and the **cloaca** opening outwards through the anus. Where present, **respiratory trees** are connected to the cloaca. The oxygenated water enters the body by these water lungs, which are found in all orders except the Apodida and Elasipodida (cf. Miller *et al.*, 2017).

Cuvierian tubules, present in several species of Holothuriida (family Holothuriidae), are generally considered defensive structures. They are sticky tubules attached to the base of the respiratory trees and can be expelled in some *Holothuria* and *Bohadschia*

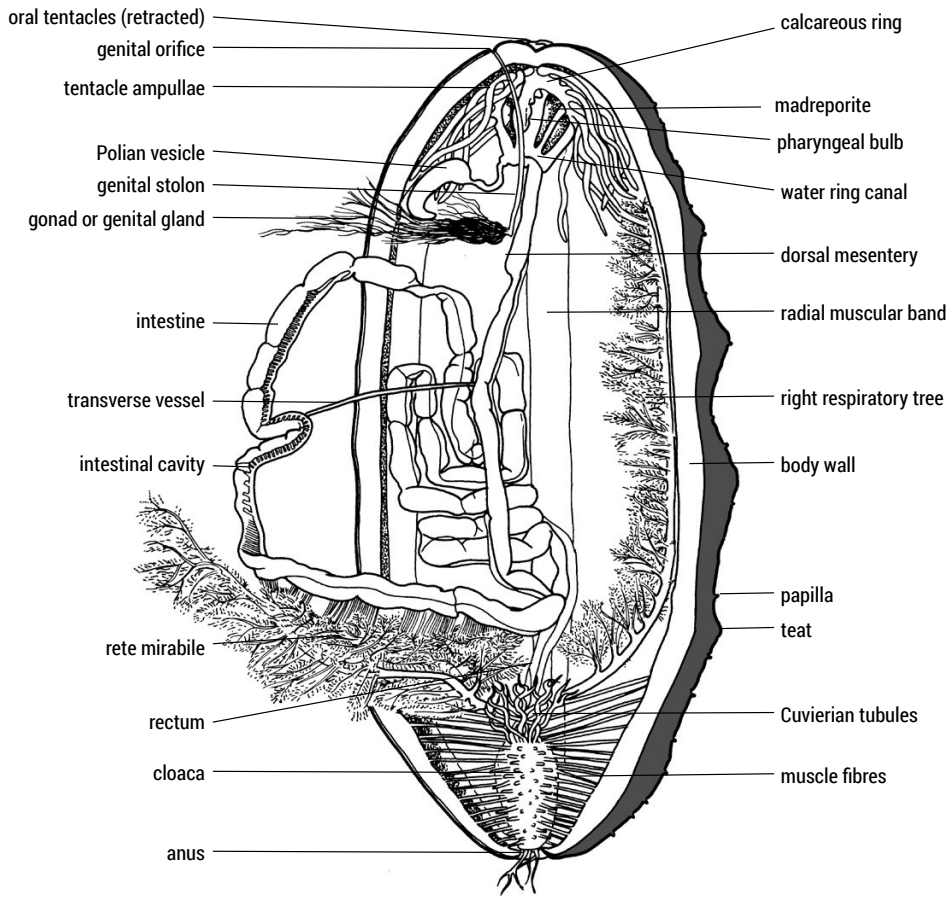


Figure 4 – Anatomy of the holothuriid sea cucumber *Holothuria whitmaei* Bell, 1887 (after Conand, 1989)

species through the cloaca towards the source of irritation. In the genus *Actinopyga*, Cuvierian tubules are present, but they seem to have lost their defensive function as they are expelled only when the animals are very disturbed.

Reproductive system

In contrast to other echinoderms, the reproductive system of holothuroids consists of a single **gonad** or genital gland (Figures 4 and 5). The gonad usually consists of numerous tubules united basally into one tuft of the dorsal mesentery or into two tufts on either side of the dorsal mesentery. Two tufts of gonad tubules are present in the Stichopodidae, while only one tuft in the Holothuriidae. The sexes are generally separate and males and females cannot usually be distinguished from one another. The gonad is attached to the dorsal mesentery through which the **gonoduct** or genital stolon opening passes, leading to the outside by the **gonopore** (genital orifice) or a genital papilla. The **gonopore** is often evident as a round bump, dorsally at the very anterior end of the animals and it swells around the time that the animals are spawning.

In most species, the mature gametes are freely released into the seawater. The spawning behaviour, observed in many Holothuriida and Synallactida species, involves an upright posture of males and females followed by a swaying back and forth, while the gametes are being released. Gonads in general increase dramatically in size with sexual maturity. Sexing of individuals can be done by taking a biopsy and making a gonad smear, at least with sexually mature individuals.

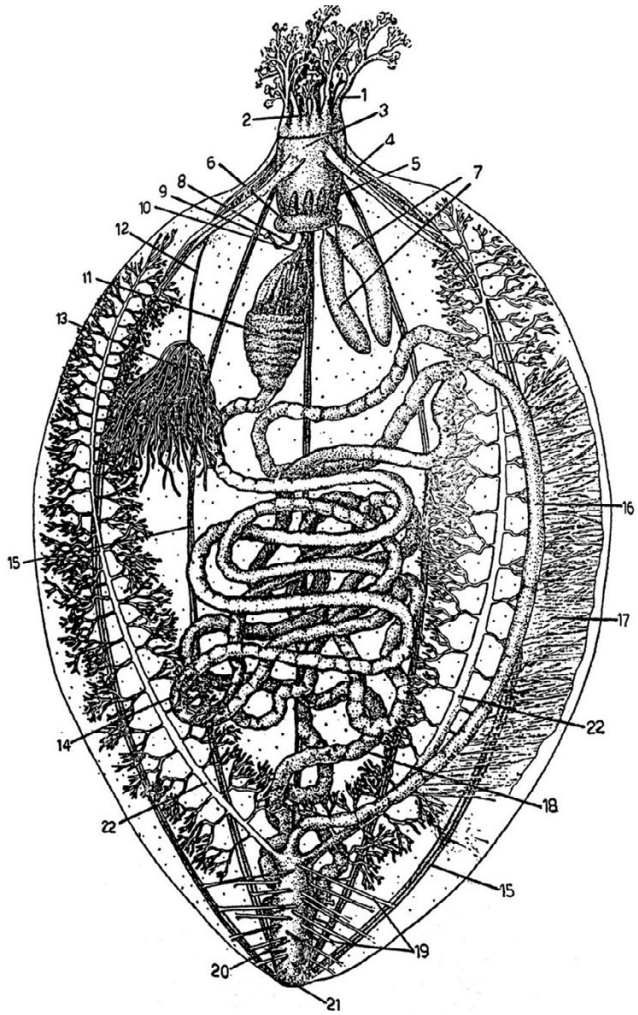


Figure 5 – Anatomy of the dendrochirotid *Sclerodactyla briareus* (after Coe, 1912). 1, tentacles; 2, short ventral tentacles; 3, aquapharyngeal bulb; 4, retractor muscles; 5, tails of pieces of calcareous ring; 6, water ring; 7, polian vesicles; 8, stone canal; 9, madreporic body; 10, esophagus; 11, stomach; 12, gonoduct; 13, gonad; 14, descending small intestine; 15, longitudinal muscle band; 16, large intestine; 17, mesentery; 18, ascending small intestine; 19, cloacal suspensors; 20, cloaca; 21, anus; 22, respiratory tree. *Source:* Hyman (1955).

Water vascular system, perivisceral coelom and hemal system

The **water vascular system** (Figure 4) is built as in other echinoderms; that is with a pentamerous radial plan. It is a coelomic space bordered by a mesothelium. It consists of the lumen of the buccal tentacles and the podia, a **water ring** (also called **ring canal**) around the esophagus, the **radial canals**, the **madreporic canal** and the **Polian vesicles** (Figures 4 and 5). The perivisceral coelom is a large cavity containing watery proteinaceous coelomic fluid and different forms of cells (coelomocytes).

The haemal system also called the "blood lacunar system" is well developed in the Holothuriida. It is composed of large haemal vessels along the gut, sinus and lacunae. The haemal vessels associated with the gut can form a complex meshwork with the left respiratory tree, the **rete mirabile**, suggesting different functions of nutrient and gas transfers.

Habitat and biology

Sea cucumbers are found throughout all oceans and seas, at all latitudes, from the shore down to the abyssal zone. The adult stages of the commercial species in this guidebook are benthic (living on the sea bottom); some species live on hard substrates, rocks, coral reefs. Most of the species inhabit soft bottoms, on the sediment surface or are partly or completely buried in the sediment.

Among the commercial coastal holothuroids, the Holothuriida and Synallactida are predominant in the tropics, while the Dendrochirotida are more common in temperate regions. Sea cucumbers within the order Holothuriida and Synallactida have **planktotrophic** larvae, i.e. that feed on microalgae in the water column during the dispersive larval phase. Within the order Dendrochirotida, the larvae of sea cucumbers described in this book are **lecithotrophic**, i.e. the dispersive larvae feed on a lipid yolk.

Fisheries

Holothuroids have been harvested commercially for centuries, occasionally for the raw body wall or viscera, but mostly in order to be processed into a dry product called **bêche-de-mer**, **trepang**, or **hai-san**, which is considered a delicacy and a medicinal food by Chinese and other Asian peoples.

Harvesting in the tropics is usually done by hand, while wading in shallow waters, or **gleaning**, at low tide or by free-diving from small boats. In both temperate and tropical fisheries, divers might use SCUBA or **hookah** gear in order to access deeper waters to collect sea cucumbers by hand. In temperate waters, sea cucumbers are sometimes harvested by trawl nets or dredges. The use of compressed-air gear or nets and dredges is considered to be a more industrial scale of fishing, because it employs sophisticated gear and vessels. By comparison, harvesting the animals using free-diving and **gleaning** is considered an artisanal scale of fishing (Conand, 2017, 2018a; Purcell *et al*., 2013).

From the FAO fisheries statistics, it is possible to follow the tonnages captured by the different countries, in the different world fishing areas. The processing techniques vary (see further below) and the final products are now different, including four commodities: (1) fresh or chilled, (2) frozen, (3) dried salted or smoked, and (4) prepared. The FAO fisheries data can be converted into fresh or dried weight and therefore analyse the changes in production over time. During the decade 2011–2020, the wild captures increased globally by nearly 30 percent (57 700 tonnes), with a slight drop in 2020 probably due to COVID. Globally, the temperate Pacific and the northwest Atlantic areas (FAO Major Fishing Area 61 and 21) have the greatest production volume, followed by the tropical Pacific and western central Atlantic (Area 31 and 71). Many countries from the eastern Atlantic and Mediterranean Sea are recent entries into the global trade statistics of sea cucumbers.

With new countries developing export fisheries, new species are targeted from new regions and new products traded. The continued growth and expansion of the global sea cucumber trade is of concern as the vulnerability of many fished species amplifies. Illegal, unreported and unregulated (IUU) trade has also developed in many regions (Conand, 2018a; 2018b).

Conservation

The public awareness of the necessity for conservation has increased since previous international and national initiatives. In 2010, the International Union for Conservation of Nature **(IUCN)** held a workshop with global experts to assess 377 sea cucumber species

to determine if they were threatened with extinction according to the Red List criteria. After extensive reviews of the workshop recommendations, seven species were listed as Endangered (EN) and nine species were listed as Vulnerable (VU) (Conand *et al*., 2014; Purcell *et al.,* 2014). An IUCN Sea Cucumber Specialist Group was established to review the Red List and advocate a global perspective on conservation.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) aims to ensure that international trade in specimens listed in its appendices is carried out in a sustainable manner and does not threaten the survival of the species. One species, *Isostichopus fuscus*, was listed on CITES Appendix III for Ecuador. Three *Holothuria* species in the subgenus *Microthele* (*H. nobilis*, *H. whitmaei*, *H. fuscogilva*) were included in Appendix II, following the the CITES CoP18 meeting in 2019. In conjunction with the CITES CoP19 meeting in 2022, an 'Identification Guide for Commercial Sea Cucumbers' (Di Simone *et al*., 2022), based on the FAO's 2012 sea cucumber identification guide (Purcell, Samyn and Conand, 2012), was published in four languages. As an outcome of the CoP19 meeting, the species *Thelenota ananas, T. anax, T. rubralineata* will be included in CITES Appendix II in 2024. According to CITES Appendix II, an Non-Detriment Finding (NDF) is required to be determined by the Scientific Authority in producing countries prior to export of the species.

Common processing techniques

The Asian markets are now accepting new product forms of sea cucumbers, such as semi-dried vacuum packed, frozen whole or as separate body parts. Processing methods to achieve the dried form (bêche-de-mer) vary depending on the species, the final product to be achieved and the market to which the product will be sold. Fully processed products are hard and not rubbery. Different processors will apply thier own techniques or change the order of the processing steps. Based on a couple of general guides (SPC, 2004; Purcell, 2014), the processing methods are summarised as follows:

METHOD 1

Suitable for species with chalky deposits when processed; e.g. *Holothuria scabra*, *H. lessoni*. Cook sea cucumbers in hot (not boiling) water for 5 minutes until it swells; remove the organs by gently squeezing the body or by making, if necessary, a very small cut in the mouth, on the ventral surface. Cook a second time in very hot or boiling water for 15–30 min until rubbery and firm. Bury in a sandpit or box with weight on top for 12–18 hours; upon retrieval, rub the outer part of the body to remove chalky deposits. Boil a third time for 5–10 min in clean water. Drain and dry in hot air. Leave to dry in the sun (generally 4–10 days, depending on moisture content).

METHOD 2

Suitable for many small and medium-sized species (e.g. *Actinopyga* and most *Holothuria*). Make a small slit at the anus, on the under-surface of the animal, and squeeze out the organs. Cook the sea cucumbers in water, starting warm then to hot (but not boiling), for 15–25 min until they are firm, then rinse with cool water and drain them. Once cooled, place in wooden boxes with coarse salt for 2–5 days. After salt-curing, cook again in very hot or boiling water for 10–30 min until rubbery firm, then rinse with cool water. Drain and dry in hot air or with smoke. Leave to dry in the sun (generally 4–10 days, depending on moisture content).

METHOD 3

For animals with thick body wall, cook in water, starting warm then increasing to hot (not boiling), until it swells (10–30 minutes). Make a long slit on either the dorsal surface (for teatfish, subgenus *Microthele*) or ventral surface (other large species with thick body wall, such as *Thelenota* species) in order to remove organs. Do not remove the five longitudinal string muscles. Wash in seawater. Boil again in clean water until hard and rubbery. Place a stick across the slit to keep it open, and smoke-cure for 12–48 hours. Sun dry for one

to two days with the slit downwards. Remove sticks and tie with string or vines. Leave to dry in the sun (from four days to two weeks depending on moisture content). Remove string/vines before packing.

METHOD 4

Suitable for soft-bodied species; e.g. *Bohadschia* and *Stichopus*. Make a small slit at the anus, on the under-surface of the animal, and squeeze out the organs. Place gutted animals in wooden boxes with coarse salt for 2–3 days. Cook the salt-cured sea cucumbers in water (starting warm, then to very hot but not boiling) for 15–25 min until they are firm, then rinse with cool water and drain them. Smoke-cure well above smouldering wood or partially dry in the sun for a couple of days, then cook again in hot or boiling water for 10–30 min. Cool in fresh water briefly, then dry the product in hot air or in the sun (from 4–10 days, depending on moisture content).

METHOD 5

Temperate species (*Cucumaria frondosa*, *C. japonica*, *Apostichopus californicus* and *Parastichopus parvimensis*) are also consumed raw, quick frozen or canned. The processing technique varies among countries and regions and the final product, which may be muscle strips, aquapharyngeal bulbs (called "flowers"), gut, gonads and respiratory trees. For detailed information on individual species, refer to Hamel and Mercier (2008). These species are normally harvested and processed industrially.

METHOD 6

Used as a general procedure for processing Mediterranean species (also effective with some species from northeast Atlantic). Make a small cut close to the anus, on the under-surface of the animals. Then cook in saltwater for around 45 minutes, starting with warm water (around 40 ºC) then increasing to near boiling. After cooling, they are put in about equal weight of salt for at least 2 days then cooked again for 5–8 minutes. After this second cooking, the products are air dried for around 4 days at 35–45 ºC, but sometimes dried in an oven for 2–3 days at 50 ºC. If the product is not drying properly, after 2–3 days, then the animals are boiled for a third time and set to dry, as described.

Preparation of ossicles

As in other echinoderms, species identification of sea cucumbers is aided by the examination of the skeletal elements (ossicles) found in various parts of the body. The calcareous ossicles, which are hidden in the body wall (mainly in the dermis tissue), papillae, podia and tentacles (and sometimes other body parts) are, in the species within this book, mostly just one-twentieth to one-tenth of a mm in length. They can be dissected out of the live, dried or preserved animals and isolated by the following method:

1. Small pieces (e.g. a few square mm) of tissue are removed with a scalpel from the dorsal and ventral body wall, as well as the tentacles and podia, and each placed into separate small labelled vials.
2. A small volume (e.g. 0.5 ml) of sodium hypochlorite (concentrated household bleach), or sodium hydroxide, is then added to each vial in order to dissolve the organic tissue away from the calcareous ossicles. The soft tissue will be dissolved/digested in 20–30 minutes, leaving the hard ossicles in the bottom of the vial.
3. After decanting, or pipetting, out the bleach, the ossicles are washed 5 times in distilled water. This step can be achieved by carefully sucking the liquid out of the vial with a pipette (while avoiding to suck up the ossicles, which would contaminate other samples), taking much care to rinse the pipette in fresh water each time so as not to contaminate a sample with the ossicles from another.
4. The ossicles can then be rinsed in alcohol and placed onto a microscope slide with a drop of a mountant (e.g. Euparal medium). They can also be put on a scanning electron microscope (SEM) stub.

5. After processing, the ossicles can be observed either on permanent slides with a light microscope or prepared for observation with a scanning electron microscope.

Preservation of whole animals

Whole animals can be preserved to allow a voucher specimen for taxonomic identification or for having body tissues from which to take samples for ossicles or for biological investigations. Readers may consult Lovatelli *et al.* (2004), Samyn *et al.* (2004) or Samyn, VandenSpiegel and Massin (2006a) for a comprehensive protocol for the preservation of sea cucumbers. Below is a summary account of key steps in this process, adapted to modern procedures that allow both molecular characterization of the concerned species, but also the long-term preservation of the voucher specimen.

1. Gain authorization or a permit for collecting and exporting the samples. Depending on the country, an import permit may be needed as well. Always consult local concerned authorities prior to any collecting. See the Access and Benefit-Sharing Clearing House of the Convention on Biological Diversity for more information (**https://absch.cbd.int/en/**).
2. Take a piece of tissue (1/2 cm^2) of internal muscle bands (preferably) or body wall and preserve it in 100 percent ethanol for molecular characterization. Separate samples of the podia (15–20) could also be taken for later use for DNA extraction.
3. Relax and anaesthetize the whole live animals in a solution of 5 percent magnesium chloride ($MgCl_2$) or magnesium sulphate ($MgSO_4$; also called Epsom salt) in seawater. The sea cucumbers will relax their tentacles out of their mouth, the podia (tube feet) will extend from the body, and the anaesthetization reduces the incidence of the animals eviscerating their organs.
4. Fix the anaesthetized animal in a solution of 10 percent formalin with adequate buffer (e.g. a couple g of sodium bicarbonate per litre of solution or some calcium carbonate). For large animals, inject some buffered formalin into the coelomic cavity of the animal. Leave for one day. Unbuffered solutions can dissolve the ossicles of the animals. Fixation can also be achieved by using ethanol. When doing so, relaxed animals should be kept in a high concentration of ethanol (e.g. 85–90 percent) for at least a day, and then be transferred to a concentration of minimal 70–75 percent ethanol. Ethanol fixation has as main advantage that the solution used is much less toxic, but also that animals fixed in this way can still be subsampled for DNA afterwards. The disadvantage is that large amounts of ethanol can be needed; making it impractical in certain remote field situations.
5. Exchange the fixative solution with 70–80 percent buffered alcohol and leave in this solution for one day. Discard this alcohol and replace with fresh 70–75 percent buffered alcohol. The animal is then preserved in the alcohol and can be left in this solution, with a label, for future reference. The waterproof label should at least have, in pencil (or archival waterproof ink), the collector's name, date, depth, location or GPS coordinates, sample code and the substrate from which the specimen was collected.

GLOSSARY OF TECHNICAL TERMS AND ACRONYMS

Ambulacra: each radially arranged bands in echinoderms where podia protrude.

Anal teeth: radial extremely calcified papillae encircling the anus, appearing tooth-like.

Anterior: at the front end of the structure or animal (e.g. mouth end).

Bêche-de-mer: widely used term for the processed product of sea cucumbers (see also trepang).

Bivium: the dorsal part of the body in the pentaradiate symmetry, with 2 radii and 3 interradii.

Buccal membrane: body wall around the mouth, which tends to be thinner than the body wall.

Bycatch: marine species (e.g. sea cucumbers) harvested unintentionally while fishing for other target species.

Calcareous ring: internal collar of plates, generally 10, surrounding the pharynx.

Cloaca: anal cavity where the intestine ends.

Code: market reference of the product.

Cuvierian tubules: threads becoming sticky when ejected out of the anus and used as a defence mechanism. Present only in the Holothuriidae.

Dendritic: branching in an arborescent manner; used to describe the shape of the tentacles in Dendrochirotida that are used for suspension feeding. A limited number of Holothuriida species also present dendritic tentacles, e.g. *Holothuria cinerascens.*

Digitations: finger-like structures, used as descriptive term for the shape of tentacles. Digitate tentacles are present only with one species treated in this guidebook: *A. molpadioides.*

Dorsal: upper surface of the animal.

Egg: a fertilized oocyte.

Fenestrated: having small window-like openings or holes. A term used to described certain ossicle types.

Fission product: half sea cucumbers, after the animal has divided in two, in the process of rebuilding new organs.

Gleaning: the process in which fishers wade in shallow waters looking for sea cucumbers on the sea floor without swimming. This is usually only done at low tide.

Hookah: equipment allowing divers to breathe compressed air from a tube attached to a compressor onboard a boat.

Interradii (or **interambulacra):** in the pentaradiate symmetry, the 5 areas between the rows of podia or papillae.

Introvert: smooth, thin collar like body wall wherein the tentacles are retracted (Dendrichirotida).

Juvenile: the young post-metamorphic (post-larval) animal, before reaching sexual maturity.

Lateral: at the side of the animal.

Lead bomb: a heavy weight, such as a ball of lead, with a barbed shaft attached at the bottom and a string attached at the top. The weight is lowered onto sea cucumbers in deep water to spear the animals and pull them to the surface.

Lecithotrophic: development in which the larva feeds on a lipid yolk remaining from the egg, rather than eating microalgae in the water column (c.f. Planktotrophic).

Longitudinal: along the body, in line with the main axis of the body.

Marine protected areas (MPAs): several definitions for MPAs exist; a generally accepted one is from the International Union for Conservation of Nature (IUCN): "…. any area of the intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment". Thus, an MPA is not necessarily completely closed to commercial or recreational fishing.

Moratorium (or **moratoria [plural]):** a general ban on fishing, often for 1 or many years.

Non-Detriment Finding (NFD): This is a scientific analysis outcome from the Scientific Authority of a country verifying, through fishery and population data, that issuance of export permits will not be detrimental to the survival of that species nor threaten to maintain that species throughout its range at a level consistent with its role in the ecosystems in which it occurs.

Nodose (or nodulose): having knobs or bumps on the surface.

Oocyte: a female gamete before it is fertilized and becomes an egg.

Ossicles: microscopic carbonate skeleton particles in the body wall, tentacles, podia, papillae, and other body parts, useful for species identification; they come in various shapes and sizes and can vary between life stages. Sometimes mistermed "spicules".

Papillae: conical lumps or small fleshy extensions on the surface of the dorsal or lateral body wall. From the papilla a conical podium (also called papillate podium) emerges.

Peltate: describing a structure that is circular or lobed with a stalk in the middle; used to describe the shape of the end of tentacles in Holothuriida that are used for deposit feeding on the sea floor.

Pentamerous: having 5 radiating parts, resulting in a pentaradiate symmetry.

Planktotrophic: development in which the larva feeds on microalgae (or other plankton) in the water column.

Podia (or **tube feet):** tiny water-filled tubes, terminating in a disc (with a calcareous endplate), used for locomotion.

Posterior: at the rear end of the structure or animal.

Protuberance: a part of the body that protrudes from the main part of the body, e.g. a knob, bulge or fleshy spine.

Radii (or **ambulacrae):** in the pentaradiate symmetry, the 5 areas with podia or papillae.

Respiratory tree: arborescent organ (1 pair), opening in the cloaca, which fills with water to enable the animals to respire.

Restocking: the act of rebuilding stocks of spawning adults in wild populations, for example by releasing hatchery-produced juveniles or adults to a depleted population.

Reticulated: having a pattern of connected lines forming a network.

Size at maturity: the length, or weight, at which most animals first possess gonads with oocytes or spermatozoa.

Spawners: reproductively mature animals in a population.

Subdorsal: appearing near, but not quite on, the very upper surface of the animal; half-way between terminal and dorsal; mostly used here to indicate the position of the anus.

Teats: large papillae at the border of the ventral surface of the animal.

Tegument: the outer tissues of the animal, including the cuticle and epidermis.

Tentacles: buccal podia extended from the mouth for feeding.

Terminal: occurring at the very posterior end, facing directly posteriorly.

Tranverse: across the body, perpendicular to the main axis of the body.

Trepang: Malaysian name for sea cucumber, also used for the processed product (see also bêche-de-mer).

Trivium: the ventral surface of body in the pentaradiate symmetry, with three radial and two interradial areas.

Ventral: on the bottom, or under surface, of the animal.

Acronyms

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CPUE: Catch per unit effort. This is a metric used in fisheries to quantify harvest rates (number or weight of sea cucumbers landed) per fisher per unit time (day or hour).

IUCN: the International Union for Conservation of Nature, a membership union of government and civil society organizations, and the global authority on the status and safeguarding measures of the natural world.

No-take zones (NTZs): sections of intertidal or subtidal terrain and overlying water delineated and legislated where no fishing or collection of certain species or groups of animals or plants can occur for a defined period. Often, an NTZ may be a special zone within an MPA.

Total allowable catch (TAC): the total number or weight of animals that are legally permitted to be collected or fished in a season or year.

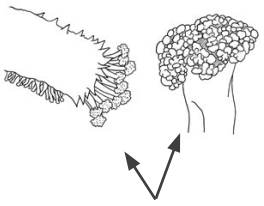
USD: United States Dollars.

VMS: Vessel Monitoring System. These usually comprise a transmitter that gives a signal of the vessel's precise geographic location.

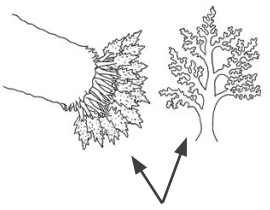
KEY TO THE ORDERS AND FAMILIES: Live animals

Class

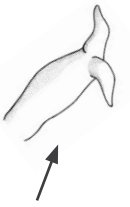
Holothuroidea



Tentacles peltate



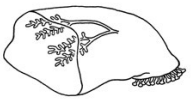
Tentacles dendritic



Tentacles digitate

Body circular or semi-circular in cross section

Body rectangular in cross section

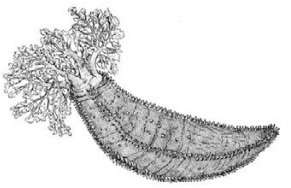


Order

Holothuriida	Synallactida	Dendrochirotida	Molpadida

Family

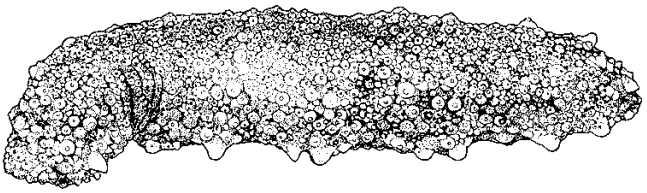
Holothuriidae p. 15	Stichopodidae p. 129	Cucumariidae p. 177	Caudinidae p. 187



Holothuriida: Holothuriidae

COMMON NAME

Pepino de mar (Costa Rica), five-footed sea cucumber.



DIAGNOSTIC FEATURES

Body coloration is mottled with brown, yellow and orange patches. Tegument is thick and leathery. The dorsal surface is rounded and covered with numerous wart-like papillae. The ventral surface is flattened, soft and contains broad rows of podia. Ventral mouth with 20 to 30 peltate tentacles. Anus with five calcareous teeth. This species possesses non-adhesive Cuvierian tubules that cannot elongate.

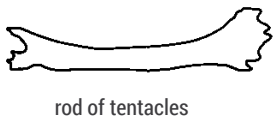
Ossicles: Tentacles with rods of various size, 15–355 µm long, and with the distal ends perforated or not, but always spiny with the sides smooth or also spiny. Dorsal and ventral body wall with the same type of ossicles, which vary from rosettes to simple "dog-biscuits", 30–60 µm long. Ventral podia with huge end-disc. Dorsal podia with X-shaped ossicles.

Processed appearance: Not available.

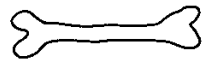
Size: Maximum length about 35 cm.

HABITAT AND BIOLOGY

Nocturnal species; during the day, it seeks refuge in coral heads, rubble or seagrass beds. *Actinopyga agassizii* can be found from 0 to 54 m deep. It forages on fine detrital sediments in algal turfs, seagrass beds and in rubble or sand-covered areas. The commensal pearl fish, *Carapus bermudensis*, is often found inside the posterior portion of the digestive tract or respiratory tree. In the Bahamas, this species reproduces annually in July and August.



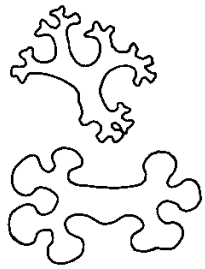
rod of tentacles



rod of ventral body wall

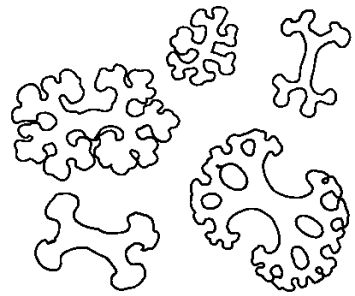
(After Hasbún and Lawrence, 2002)

dog biscuit of body wall



rosettes of body wall

(Source: photos by Hendler *et al.*, 1995)



rosettes of body wall

dog biscuit of body wall

(Source: photos by M. Benavides-Serrato)

EXPLOITATION

Fisheries: Artisanal fishery. In Nicaragua, this species is harvested, without any regulation, with other sea cucumber species. There is commercial exploitation for bêche-de-mer in Panama and Venezuela (Bolivarian Republic of) however, no recent information is available.

Regulations: In Panama, there has been a ban on commercial catches of all sea cucumbers (H. Guzman, personal communication), including *A. agassizii*. There is no management of the fishery in Costa Rica.

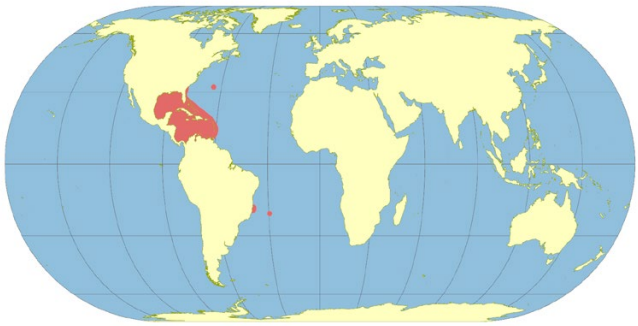
Human consumption: Consumed as bêche-de-mer.

Main markets and value: Code: **YYC**. Market price is undetermined.

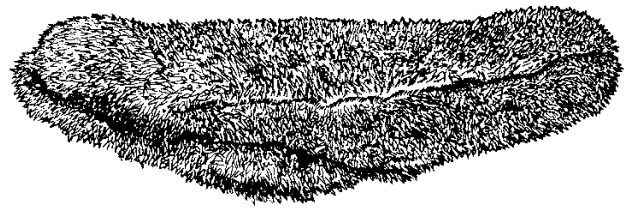
LIVE

GEOGRAPHICAL DISTRIBUTION

Caribbean coast of Florida (United States of America), Bermuda, South Carolina, Cuba, Mexico, Puerto Rico, Dominican Republic, Haiti, Jamaica, Belize, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia (Atlantic), Venezuela (Bolivarian Republic of), eastern Brazil, the Bahamas, Barbados and the United States of America.



COMMON NAMES



Deep-water redfish (**FAO**, Papua New Guinea, India, Mauritius, Indonesia, Viet Nam and Madagascar), Brownfish (Réunion), Trokena (Madagascar), Barbara (Mauritius), Pal attai (India), Hải sâm mít (Viet Nam). Also, Hud-hud, Brown beauty, Buli-buli, Khaki, Uwak (Philippines), Goma attaya (Sri Lanka), le Rouge (New Caledonia), Telehea loloto (Tonga), Dri tabua (Fiji), Spork (Seychelles), Kunyi, Ladu-ladu, Kapok (Indonesia).

DIAGNOSTIC FEATURES

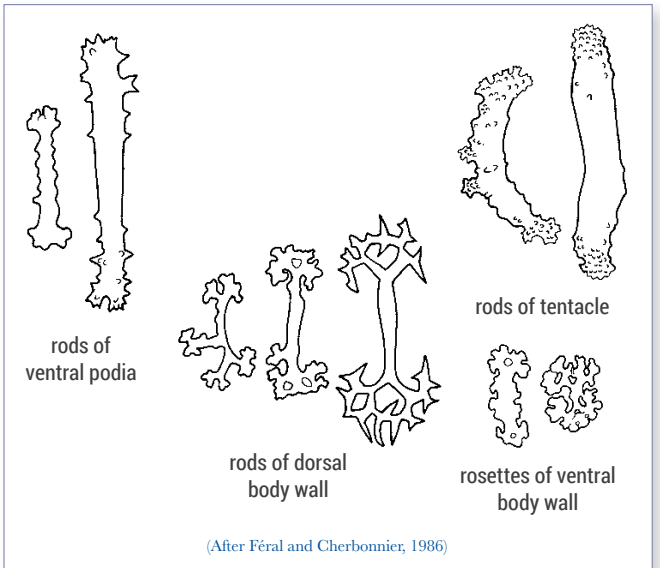
Colour variable from beige to rusty-brown or dark brown, sometimes with fine dark marks dorsally among papillae. Body moderately elongated. Dorsal surface arched, covered with "pimply" papillae, a couple mm long, sometimes wrinkled and often covered by fine sediments. Ventral surface with numerous long yellow to green podia. Body is flattened ventrally, tapering slightly towards both ends. Mouth is ventral with 20 stout, brown tentacles. Anus surrounded by five small yellow, conical anal teeth. Its small pinkish Cuvierian tubules are generally not extended.

Ossicles: Tentacles with rods, 60–375 µm long, straight or slightly arched, with the ends spiny. Roughly the same types of rods and rosettes are found in the dorsal body wall (20–135 µm long) and ventral body wall (25–80 µm long). Ventral podia with rods and rosettes similar to those of body wall, 20–100 µm long. Dorsal podia with rosettes only.

Processed appearance: Oval shape, arched dorsally and flattened ventrally; with rounded ends. Grey-brown dorsally, rough and slightly ridged, and ventral surface is lighter in colour and granular. Small cut in the mouth. Common dried size: 8–15 cm.

Remarks: Some morphological differences between Pacific and Indian Ocean populations.

Size: Maximum length to about 35 cm, commonly to about 20 cm; average fresh weight in Indian Ocean from 200 g (Mauritius) to 300 g (Réunion, Madagascar, India); average weight in New Caledonia about 345 g; average fresh length from 15 (Mauritius) to 20 cm (Réunion, Madagascar, Papua New Guinea, India).



HABITAT AND BIOLOGY

Despite being named "deep-water" redfish, the species actually lives in shallow waters, mostly on flats (reefs and seagrass beds) down to 10 m depth with relatively high densities of up to 1 ind. per square m. This species has separate sexes and is reported to live more

than 12 years. Spawning occurs in the dry season, size of maturity is reported at about 12 cm, or a weight between 45 g and 90 g.

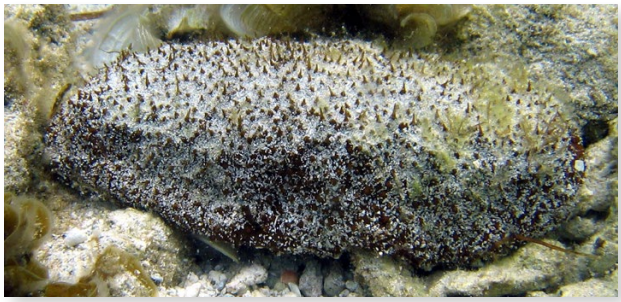
EXPLOITATION

Fisheries: Fished artisanally throughout its distribution. Collected by hand at low tide or by skin diving (e.g. United Republic of Tanzania, Zanzibar and Madagascar), through the use of lead-bombs (Papua New Guinea), using SCUBA diving (Mauritius) and hookah gear (Viet Nam). It is fished heavily in Sri Lanka and other Asian countries and throughout much of the central eastern Pacific.

Regulations: On the Great Barrier Reef (Australia), the minimum size limit (wet) is 15 cm and this species is subject to rotational zone closures and a total allowable catch (TAC) limit. Before a moratorium on the fishery in Papua New Guinea, there was a minimum size limit (25 cm live; 15 cm dry) and other regulatory measures. Fishing for this species is banned by moratoria in numerous countries.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main markets and value: Code: KUE. Main markets are Singapore, China, Hong Kong SAR, China, Taiwan Province of China. In New Caledonia (2008), this species was exported for USD 20–30 per kg dried and fishers received USD 2 per kg wet weight. It was traded at USD 28–54 per kg dried in the Philippines. Sold by fishers in Torres Strait (2022) for USD 2 per kg gutted wet or USD 53–66 per kg dried. Wholesale prices in Guangzhou (2016) were up to USD 69 per kg dried.



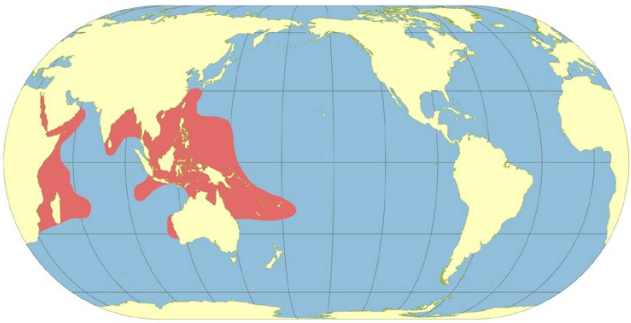
LIVE (Pacific Ocean variety) ©S.W. Purcell

LIVE (Indian Ocean variety) ©S.W. Purcell

PROCESSED (Pacific Ocean variety) ©S.W. Purcell

GEOGRAPHICAL DISTRIBUTION

Found throughout the central western Pacific, Asia, Africa and Indian Ocean region. Common in the Indo-Pacific, islands of western Indian Ocean, Mascarene Islands, East Africa, Madagascar, southeast Arabia, Sri Lanka, Bay of Bengal, East Indies, north Australia, Philippines, China, southern Japan, and South Sea Islands.

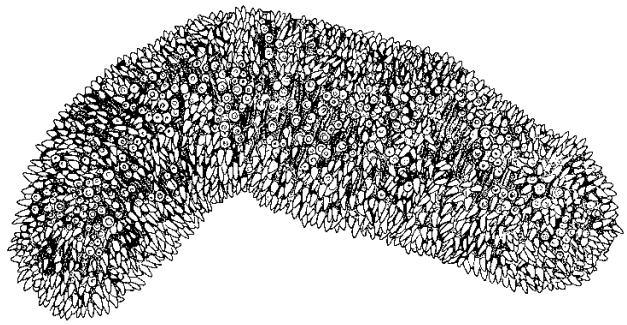


OTHER USEFUL INFORMATION

This species is widely reported as overexploited in many localities, and listed as Vulnerable on the IUCN Red List.

COMMON NAMES

Spiky deep-water redfish.



DIAGNOSTIC FEATURES

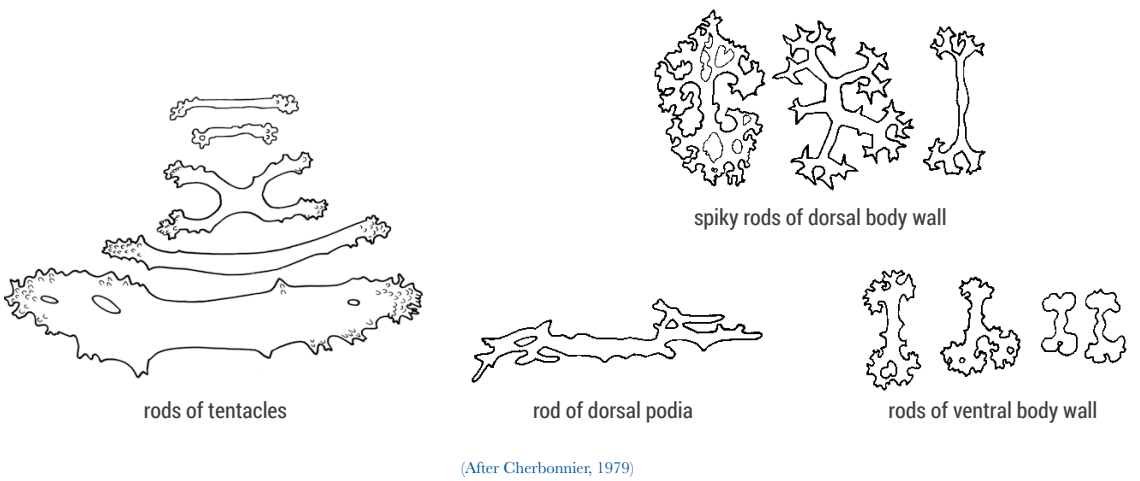
This species can attain a relatively large size. Arched dorsally and mildly flattened ventrally. Body coloration is orange to pink to flame-red with characteristic blueish to greyish conical papillae over entire dorsal and lateral surfaces of body. The body wall is relatively thick (8–10 mm). Podia are relatively sparse on the ventral surface. The mouth is ventral with 20 brown tentacles. The anus is subdorsal and surrounded by five serrated anal teeth.

Ossicles: Tentacle stalks with very massive rods that are spiny at the extremities and with few perforations, up to 300 µm long. Tentacle tips with more slender and smaller rods, 50–75 µm long. Dorsal body wall with spiky plates, 40–60 µm long, and spiny rods, 50–55 µm long. Ventral body wall with small rods with rounded or spiky ends which may branch to the extent that they become X-shaped; the size of these different ossicles varies from 40–100 µm. Ventral and dorsal podia with small rods as in the ventral body wall as well as rare irregularly shaped perforated rods.

Processed appearance: Relatively elongate and rounded at the ends. Dark coffee-brown in colour. Similar processed shape to *Actinopyga palauensis*, however, body covered with light brown conical papillae. Anal teeth should be evident, which may help to distinguish it from some processed stichopodid species. A small cut across mouth or along middle part of ventral surface.

Remarks: This species is fished in parts of the central western Pacific. Genetic samples indicate that the fished species is not *A. flammea* as described by Cherbonnier 1979, but rather a closely related species, which is here tentatively listed as *Actinopyga* cf. *flammea.* Populations appear quite sparse and may be at risk of extinction.

Size: Appears to attain at least 2 kg in weight and 45 cm in length. Average length is probably 25–30 cm.



(After Cherbonnier, 1979)

HABITAT AND BIOLOGY

It occurs in deep reef habitats. Anecdotal records suggest this species prefers outer reef slopes and deeper oceanic lagoon habitats. The type specimen was collected in waters at 40–45 m depth on dead coral pavement with brown and crustose–coralline algae. Reported to occur down to 60 m depth.

EXPLOITATION

Fisheries: It is fished commonly but in low numbers in at least Fiji and Tonga. Very seldom fished in New Caledonia, from where the type specimen was collected for the original description.

Regulations: No specific regulations, such as a species-specific size limit, exist for this species.

Human consumption: This species does not appear to be used in subsistence fisheries. The predominant use is as reconstituted bêche-de-mer.

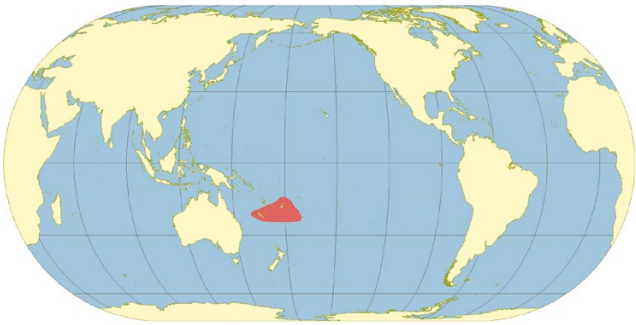
Main markets and value: Bought by processors in Fiji (2014) for about USD 5–15 per piece fresh.

GEOGRAPHICAL DISTRIBUTION

Known at least from New Caledonia, Fiji and Tonga, but does not appear to reach as far north as Kiribati. May occur in the Coral Triangle region.

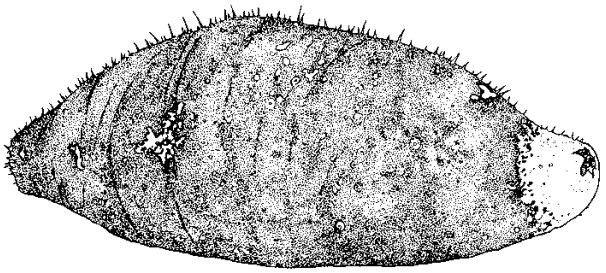
LIVE ©J. Roger

PROCESSED ©S.W. Purcell



COMMON NAME

Stonefish, Pal attai (India), Mbura (United Republic of Tanzania, Zanzibar), Buliq-buliq, Monang, Munang (Philippines), Le caillou (New Caledonia), Telehea maka (Tonga), Dri vatu (Fiji), Batu, Balibi, Hitam (Indonesia), Stonfis (Vanuatu).



DIAGNOSTIC FEATURES

Body colour can be grey, beige or chocolate brown with some lighter spots and sometimes fine dark blotches and reticulated lines. Around the anus, it is usually characteristically white or grey. The ventral surface of smaller individuals is usually beige. Body is stout and tapered at both ends. Dorsal surface is quite arched, while the ventral surface is flattened. Few papillae scattered over dorsal area. Ventral mouth with greenish-brown or brown tentacles. Anus is terminal with five strong, yellowish conical teeth. Cuvierian tubules absent.

Ossicles: Tentacles with massive rods, 45–450 µm long, straight or slightly arched, and spiny at the extremities. Dorsal body wall with small rosettes, 25–35 µm long, or larger X-shaped rosettes, 50 µm long. Ventral body wall with even smaller rosettes, 20–25 µm long. Ventral podia with tiny rosettes, 10–25 µm long. Dorsal podia with rosettes similar to those of the body wall and rods, 65–90 µm long.

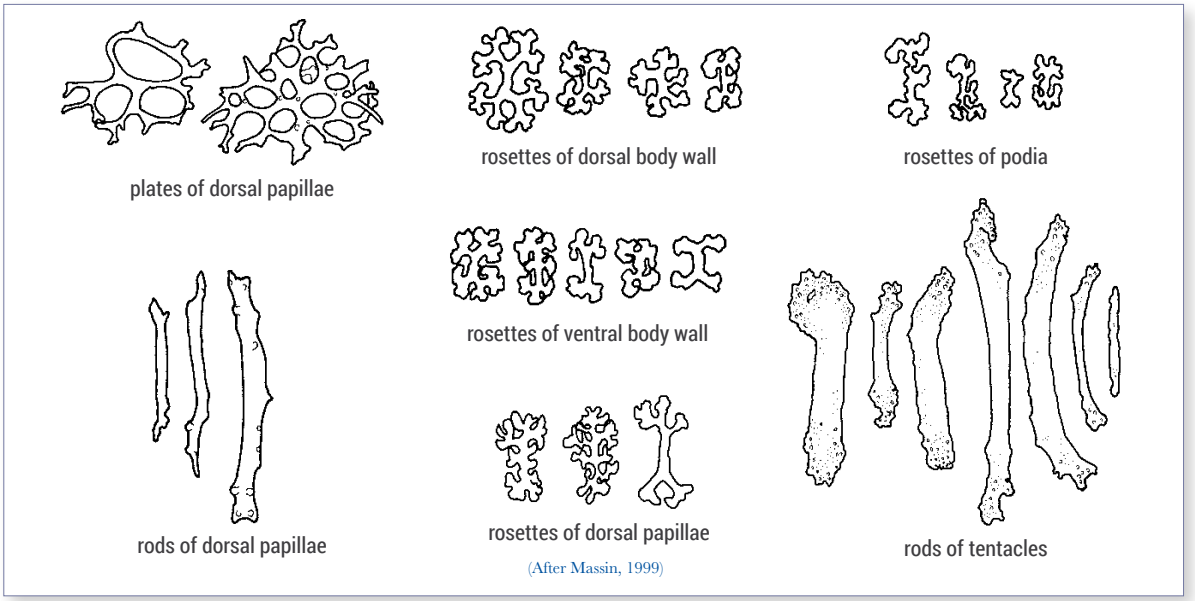
Processed appearance: Roughly oval shape; arched dorsally, mildly flattened ventrally. Brown-black; dorsally with shallow grooves, while ventral surface is smooth. Common dried size between 10 and 12 cm.

Remarks: Body is firm like a stone when handled, giving rise to its common name.

Size: Maximum length about 24 cm; average fresh weight 400 g; average fresh length about 20 cm.

HABITAT AND BIOLOGY

This species lives in coral and coral rocks and reef ledges, typically between 0.5 and 7 m depth. It prefers hard substrates (i.e. coral reefs) that are sheltered. It is a predominantly nocturnal species. During the day, it seeks



(After Massin, 1999)

shelter under large stones and reef crevices. In Papua New Guinea, it can be found in waters up to 20 m deep.

EXPLOITATION

Fisheries: Harvested in artisanal fisheries throughout its whole distribution range where it is hand collected, using lead-bombs and free-diving. In some fisheries, it is collected with torches at night by SCUBA diving or free-diving (e.g. Philippines and Viet Nam) but this practice is often banned in other fisheries.

Regulations: Before a fishery moratorium in Papua New Guinea, fishing for this species was regulated by minimum landing size limits (15 cm live; 10 cm dry) and other regulations. Minimum size limits are 20 cm wet and 10 cm dried in Vanuatu and Solomon Islands.

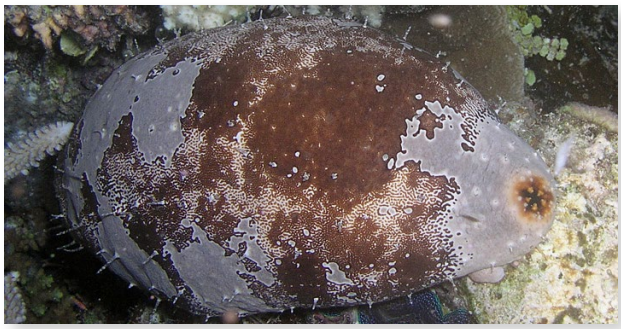
Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. Its intestine and/or gonads may be consumed as part of traditional diets.

Main markets and value: Code: **YVV**. Marketed in Singapore, India, Papua New Guinea and China; in the latter it is considered of medium low commercial importance only. It was traded (2010) at USD 64 per kg dried in the Philippines. In Papua New Guinea it was previously sold by fishers at about USD 7 per kg dried. In Fiji, fishers received USD 5–8 per piece fresh (2014). Prices in 2016 in Guangzhou markets averaged USD 76 and in China, Hong Kong SAR were USD 166 per kg dried.

GEOGRAPHICAL DISTRIBUTION

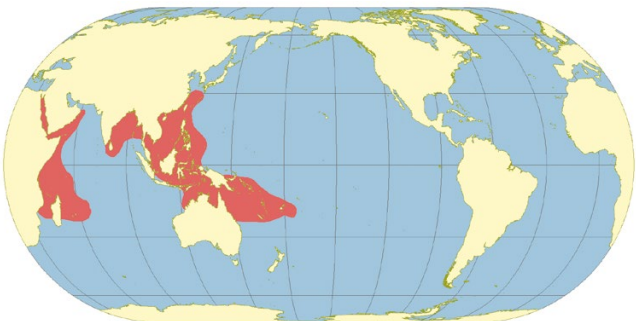
The Mascarene Islands, East Africa to the Red Sea and Oman, Madagascar, Sri Lanka, Bay of Bengal, East Indies, north Australia, the Philippines, China and southern Japan, South Pacific islands. In India, it is found only in Andamans and Lakshadweep regions.

LIVE ©S.W. Purcell



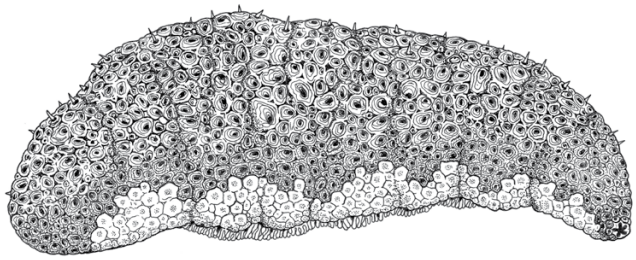
LIVE ©L. Vail

PROCESSED ©S.W. Purcell



COMMON NAMES

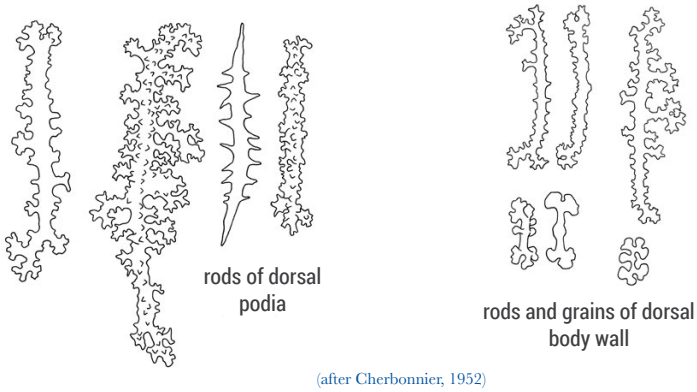
Surf brownfish (proposed here), Holothurie brune des brisants (**FAO**), Pal attai (India), Fotsisetsake (Madagascar), Kajno (Egypt), Thoot Sim (Chinese); Kijino (Swahili), Mbura (United Republic of Tanzania, Zanzibar), Yellow surfish (Seychelles), Holothurie de Maurice (Mauritius).



DIAGNOSTIC FEATURES

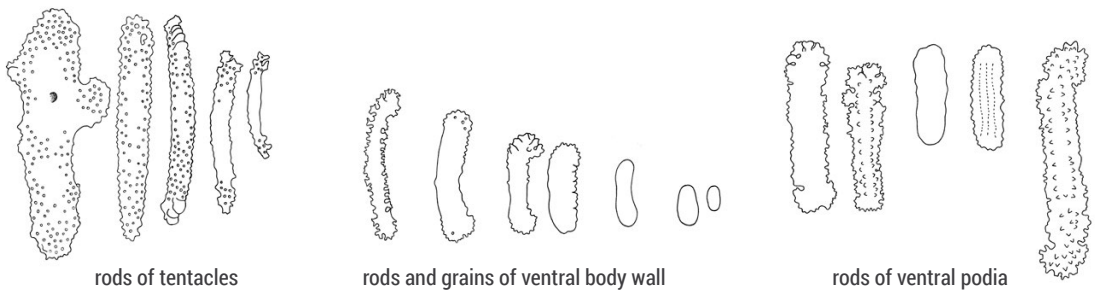
Body is smooth to the touch, quite rigid and heavily creased. Body wall is around 6 mm thick. Dorsal surface arched, ventral side flattened, ends rounded. Dorsal surface is variable, brown with more or less developed white zones, reticulated with darker irregular lines surrounding the elevated, fine, brown papillae. Ventral surface is whitish-grey, covered irregularly with densely-packed white podia. Mouth is ventral and surrounded by a distinct collar of fine, brown papillae. Anus is terminal and surrounded by five large white anal teeth. Tentacles are greenish-brown, large, usually numbering 25. Pink Cuvierian tubules are present, although only expelled when heavily disturbed.

Ossicles: Tentacles with large, unbranched, rugose rods, 165–245 µm long. Dorsal body wall with simple rosettes, 20–45 µm long and spiny, unbranched rods, 65–120 µm long. Ventral body wall with small grains, elongated grains and smooth to spiny rods, 15–120 µm long. Ventral podia with an endplate as well as small and slightly elongated grains 15–30 µm long as well rods similar in size and shape as those from the ventral body wall. Dorsal papillae with rosettes, 15–120 µm long and smooth to spiny, occasionally branching rods, 80–110 µm long. Cloacal wall with simple to complexly branched rods, 15–75 µm long. Longitudinal muscles with smooth, unbranched rods, 90–135 µm long.



(after Cherbonnier, 1952)

Processed appearance: Roughly an elongated oval shape; arched dorsally and moderately flattened ventrally. Dorsal surface with wrinkles. Notably, the ventral



(After SEM photographs from samples of a syntype in the National Museum of Natural History, Paris)

surface is much lighter in colour than the dorsal surface. Dried product length 5–12 cm.

Remarks: This species adheres tightly to wave-exposed surfaces with its numerous ventral podia.

Size: Live individuals up to 35 cm long and 10 cm wide; average fresh weight 400 g. Very similar in dimensions to its congener *Actinopyga varians* (Selenka, 1867) from the tropical Pacific.

LIVE ©S.W. Purcell

HABITAT AND BIOLOGY

A conspicuous, large species that lives on exposed shallow outer reefs, reef crests as well as in reef lagoons and occasionally even in sea grass beds. Depth of occurrence from 0–5 m. Reproduces sexually during summer months.

EXPLOITATION

Fisheries: Fished throughout the Indian Ocean and Red Sea. Harvested by hand by gleaning and by free-diving in numerous countries and territories. In Egypt, depletion of populations prompted the study and possible development of aquaculture-based restocking. In Seychelles, it was one of the most important commercial species, but now considered to be overexploited and is not collected. It has been fished heavily in Madagascar.

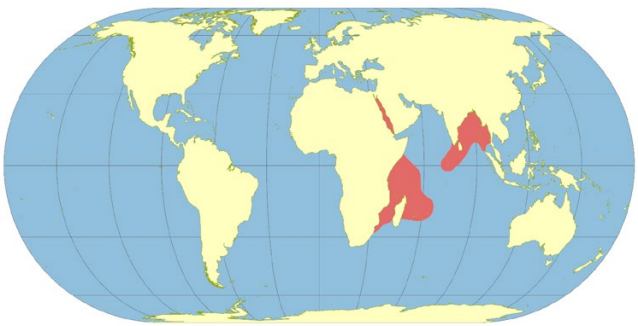
Regulations: In several countries, bans have been put on and lifted several times in recent decades. Nowadays in Mozambique for all species alive, the minimum length is 20 cm and weight 250 g. Fishing for this species (and other sea cucumbers) was temporarily banned in Madagascar but currently permitted.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Code: **KUY**. Main markets are China, Singapore, China, Hong Kong SAR, Taiwan Province of China and Ho Chi Minh City (Viet Nam) with further export to Chinese markets. It is bought by traders in producing countries at varying prices, according to the size (grade) and the dryness, from USD 30–90 per kg. Average wholesale price in Guangzhou, China, in 2016 was USD 72 per kg dried.

GEOGRAPHICAL DISTRIBUTION

Islands of western Indian Ocean, including Mauritius and La Réunion, southern Somalia, Mozambique, northern coast of South Africa, Madagascar, Red Sea, Maldives, Sri Lanka, Bay of Bengal and East Indies. In India, it is distributed in the Gulf of Mannar, the Andaman Islands and Lakshadweep archipelago.

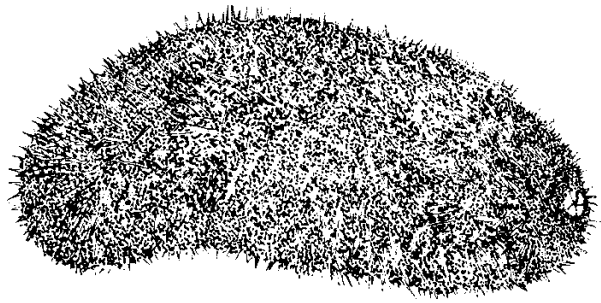


OTHER USEFUL INFORMATION

This species is widely reported as overexploited in many localities and listed as Vulnerable on the IUCN Red List.

COMMON NAMES

Blackfish, Hairy blackfish (FAO), Pal attai (India), Khaki (Philippines), Kalu attaya (Sri Lanka), La boule noire (New Caledonia), Loli fulufulu (Tonga), Dri Loli (Fiji), Kijini (United Republic of Tanzania, Zanzibar), Kapok, Kapuk, Lotong, Gamet, Sepatu, Hitam (Indonesia), Blakfis (Vanuatu).



DIAGNOSTIC FEATURES

This species is brown to blackish dorsally and lighter brown ventrally. Body stout, cylindrical, slightly arched dorsally and somewhat flattened ventrally. It has long slender podia dorsally, making it look "hairy". The dorsal surface is generally covered by mucus and may have fine sediment. Mouth ventral surrounded by 20 stout, brown to black, tentacles. Anus surrounded by 5 strong, conical or bicusped anal teeth that are yellow to orange. Cuvierian tubules not present.

Ossicles: Tentacles with large quite spiny rods, 30–300 µm long, more spiny distally. Dorsal and ventral body wall with similar rosettes of the similar length. Ventral podia with few rosettes, which are similar to those of the body wall. Dorsal papillae with rosettes of the same size as those in the body wall, and some larger ones, 45–80 µm long. Dorsal papillae also have two types of rods: spiny, 55–230 µm long, ones, often with numerous lateral spiny extensions, and smooth 100–150 µm long, sometime rosette-like ones.

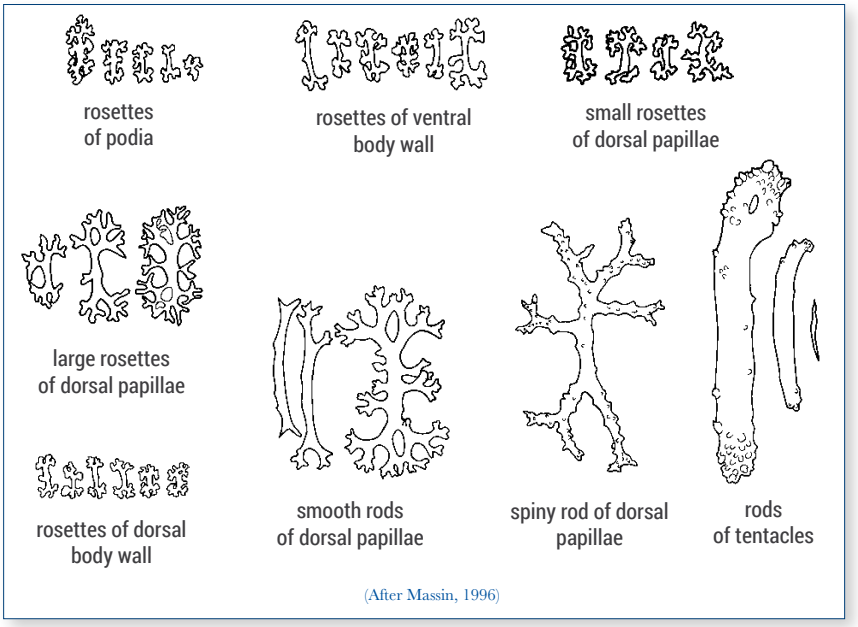
Processed appearance: Roughly oval shape with a round cross-section. Entire body surface smooth and black. A small cut may be made across the mouth or across the ventral surface. Common size 10–12 cm.

Remarks: The lighter brown ventral surface of *Actinopyga miliaris* and its simpler anal teeth distinguish it from *A. spinea* and *A. palauensis*. This species usually contracts to a sphere or stout rugby-ball shape when handled.

Size: Maximum length about 35 cm, commonly to about 25 cm; average fresh weight 400 g.

HABITAT AND BIOLOGY

It is distributed commonly between 0 and 10 m deep, on sandy beds and intertidal areas. In the western central Pacific region, found mostly on reef flats of fringing reefs and lagoon-islet reefs between 0 and 12 m depth. In the African and Indian Ocean region, it prefers reef flats and seagrass beds over coral substrate up to 20 m and it does not bury. In China, it reportedly prefers



areas affected by a strong wave action. In New Caledonia, it does bury in some localities and reproduces twice a year, with one spawning event in May and a second in November and December.

LIVE ©S.W. Purcell

PROCESSED ©S.W. Purcell

EXPLOITATION

Fisheries: In the western central Pacific region, this species is harvested in more than a dozen countries. In Fiji, *A. miliaris* was among the most important commercial species before 1988, accounting for about 95 percent of all exports. In Asia, this species is a heavily fished species in certain countries of its distribution range such as China, Indonesia and the Philippines. It is actively fished in Kenya, representing about 17 percent of total catches. In the United Republic of Tanzania, there was intense fishing of this species in the early 1980s but yields declined subsequently.

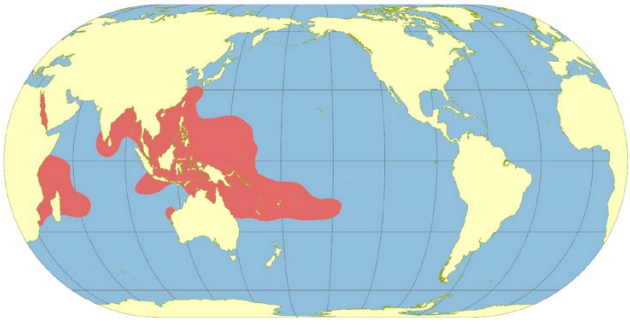
Regulations: Before a fishery moratorium in Papua New Guinea, fishing for this species was regulated by minimum landing size limits (20 cm live; 8 cm dry) and other regulations. Since late 2007, there has been a fishery moratorium in Yap for *A. miliaris*. In New Caledonia, the permissible size is 25 cm live and 12 cm dry. The minimum legal length (wet) in Vanuatu, Solomon Islands and on the Great Barrier Reef is 20 cm, whereas in Torres Strait (Australia) it is 22 cm.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. Its intestines and/or gonads may be consumed as part of traditional diets or in times of hardship, e.g. in Palau.

Main market and value: Code: **KUQ**. Main markets are Singapore, Asia. In New Caledonia, fishers received USD 2.4 per kg wet weight (2008). In Fiji, fishers received USD 1–5 per piece fresh (2014). Sold by fishers in Torres Strait (2022) for USD 2 per kg gutted wet or USD 53–66 per kg dried. Wholesale prices in Guangzhou (2016) were up to USD 69 per kg dried.

GEOGRAPHICAL DISTRIBUTION

Islands of western Indian Ocean, Mascarene Islands, East Africa to Inhaca Island (Mozambique), Madagascar, Red Sea, Sri Lanka, Bay of Bengal, East Indies, north Australia, the Philippines, China and southern Japan, south Pacific islands east to French Polynesia. In India, it is known from the Gulf of Mannar, Palk Bay, the Andamans and Lakshadweep.



OTHER USEFUL INFORMATION

This species is widely reported as overexploited in many localities and listed as Vulnerable on the IUCN Red List.

COMMON NAMES

Deepwater blackfish, Panning's blackfish (FAO), Le noir long (New Caledonia), Dipwota blakfis (Vanuatu).

DIAGNOSTIC FEATURES

Glossy brownish-black uniformly over body. Dorsal surface bumpy and the upper part of the dorsal surface is usually covered by some coarse sand (but body not completely covered in sand, cf. *Holothuria whitmaei*). Body subcylindrical, flattened slightly ventrally. Buccal cavity (mouth) often projected (trunk-like). Tentacles brown.

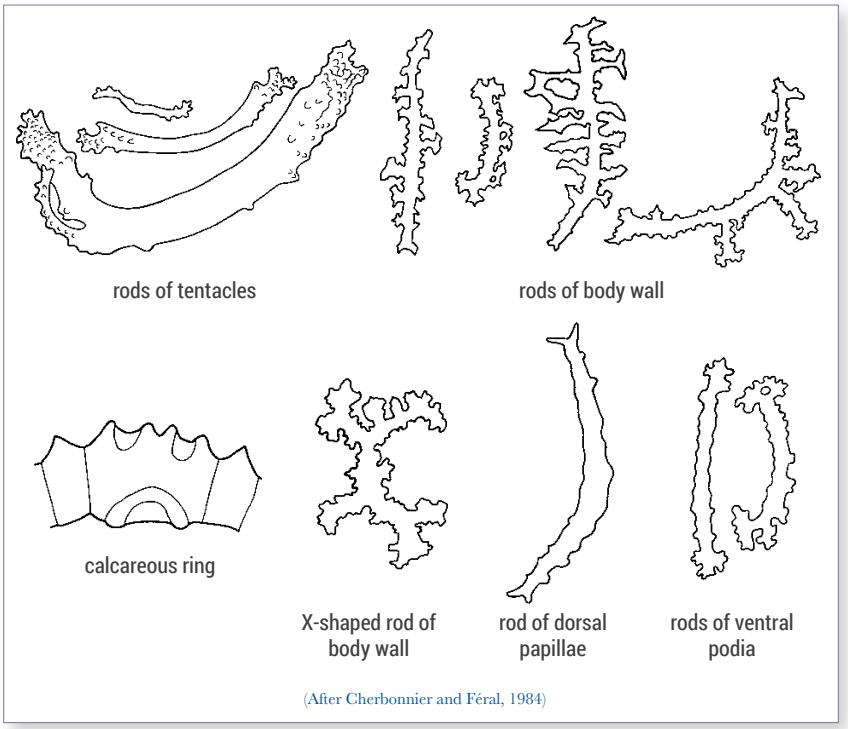
Anus terminal with five prominent multidentate teeth that may be flattened or club-shaped with small knobs. Dorsal papillae small and sparse; ventral podia relatively numerous.

Ossicles: Tentacles with rods of various size and rugosity, the smallest ones, 80 µm long, nearly smooth while the largest ones are distantly spined and up to 700 µm long. Dorsal and ventral body wall with the same type of ossicles: branching, quite asymmetrical, non-perforated rods, 25–75 µm long. Ventral podia with simpler ragged rods, generally somewhat shorter than those of the body wall. Dorsal podia with rods that are less ragged and more curved, up to 85 µm long.

Processed appearance: Dark brown to black in colour. Cylindrical in shape with relatively blunt ends, like a salami, and not particularly larger towards the middle of the body (cf. *Actinopyga miliaris*). Somewhat bumpy (textured) and finely wrinkled on the dorsal surface. Common dried size 15–20 cm.

Remarks: Often grouped with *A. spinea* by fishers and processors. Probably often misidentified as *A. miliaris* or *A. spinea* in visual surveys, so its abundance and distribution has been underestimated.

Size: Maximum length about 40 cm; average fresh weight: 1 600 g; average fresh length: 27 cm. In New Caledonia, average live weight about 1 450 g and average live length about 25 cm.



HABITAT AND BIOLOGY

Commonly found on deeper hard reef surfaces and coarse sand with coral rubble. More common on reef slopes of outer reef passes, with clear water and fore-reef pavement. It can also be found on semi-sheltered bay reefs with boulders and coral

rubble. Seldom on lagoon reefs or inshore reefs. Often on open surfaces and probably buries little. Occurs in 4 to 25 m depth and is non-cryptic.

LIVE ©S.W. Purcell

PROCESSED ©S.W. Purcell

EXPLOITATION

Fisheries: Harvested by breath-hold divers in artisanal fisheries. Also targeted in semi-industrial and industrial fisheries. This species is fished in Australia, Palau, Micronesia (Federated States of), Kiribati, Fiji, Tonga, Niue and New Caledonia. In the last, it is among the dominant species in the catches. In the State of Yap, part of Micronesia (Federated States of), there is a potential to further develop the fishery for *A. palauensis*.

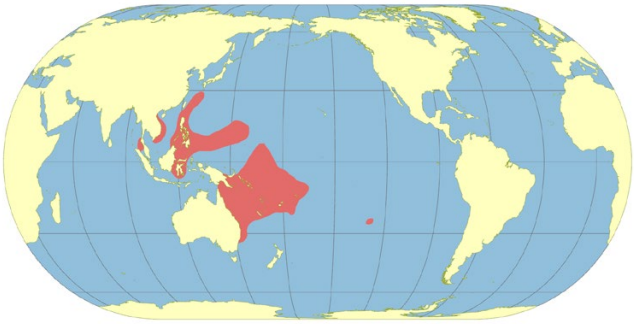
Regulations: On the Great Barrier Reef (Australia), fishing of this species is regulated by a global TAC, a rotational harvest strategy and fishing permits. In New Caledonia, fishing permits are required and SCUBA is prohibited for fishing sea cucumbers. Minimum size limits in New Caledonia are 25 cm wet and 12 cm dried; in Vanuatu they are 30 cm wet and 15 cm dried.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Code: **YGP**. In New Caledonia, it was exported (2008) for about USD 35 per kg dried and fishers received USD 2.4 per kg wet weight. In Fiji, fishers received USD 2–16 per piece fresh (2014). Sold by fishers in Torres Strait (2022) for USD 10 per kg wet gutted. Prices in Guangzhou wholesale markets (2016) averaged USD 77 per kg (dried) and were as high as USD 131 per kg. Sold at USD 145 per kg dried in China, Hong Kong SAR (2016).

GEOGRAPHICAL DISTRIBUTION

East Australia, as far south as Solitary Islands and Lord Howe Island (S. Purcell, personal observation), and the western Pacific Islands to the Pitcairn Islands; reported in various countries of Melanesia and Micronesia. Probably recorded often as *A. miliaris* or other species, leading to an under-represented distribution.



OTHER USEFUL INFORMATION

This species can be distinguished from *A. miliaris* by having relatively sparse, small, dorsal podia and it does not retract its body into a sphere when handled. It has multidentate anal teeth (whereas simple and conical in *A. miliaris*) that may have terminal serrations on an axis. It can be distinguished from *A. spinea* in being black-brown (appearing black at depth), the anus is more terminal, and the dorsal surface is noticeably bumpy.

COMMON NAMES

Burying blackfish, New Caledonia blackfish (**FAO**), Le noir long (New Caledonia).

DIAGNOSTIC FEATURES

Coloration is rusty brown to dark brown, or brownish-black, and uniform over entire body. Sometimes covered by a dusting of fine sand. Body subcylindrical and flattened slightly ventrally. It may be quite elongated compared with other species within this genus. The 20 tentacles are dark brown. Moderately long, but thin, dorsal papillae that are less numerous than the short ventral podia. Anus subdorsal with five prominent, yellowish, nodular teeth. Cuvierian tubules absent.

Ossicles: Only the peristome, the anal region and the tentacles are rich in ossicles. Tentacles with spiny curved rods of various size, 250–500 µm long. Dorsal body wall with few forked spiny rods, about 110 µm long, and spiny plates of various size, 80–130 µm long. Ventral body wall devoid of ossicles. Ventral podia with few short, approximately 120 µm long, bifurcating rods. Dorsal podia with similar rods, but twice as long.

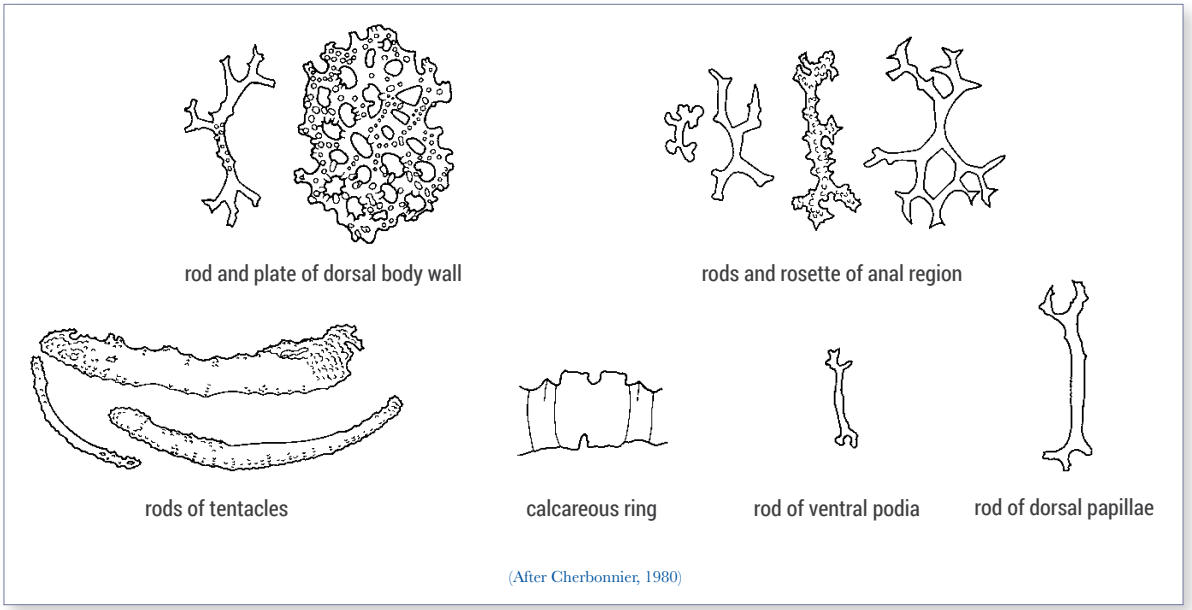
Processed appearance: Elongated and cylindrical. Colour is dark brown and texture is relatively smooth.

Remarks: Often combined with *Actinopyga miliaris* by fishers and processors and probably often misidentified as *A. miliaris* in visual resource surveys. Incorrectly combined with counts of *A. miliaris* in underwater surveys from the Pacific, so its abundance and distribution has been underestimated.

Size: Maximum length about 38 cm, commonly to about 27 cm; average fresh weight: 700 g. In New Caledonia, average live weight about 1 040 g and average live length about 25 cm.

HABITAT AND BIOLOGY

Commonly on muddy-sand habitats, where it buries. It can occur in 1 to 25 m depth in other sandy habitats alongside *A miliaris*, including sandy reef flats and protected fine sand lagoons and bays.



(After Cherbonnier, 1980)

EXPLOITATION

Fisheries: Artisanal and semi-industrial. This species is fished in the Great Barrier Reef (Australia) and New Caledonia. In the former, it is currently the dominant species in catches. Previously, from the Great Barrier Reef, more than 150 tonnes of this species were harvested annually and fishers harvested >30 kg of animals per hectare. Collection in New Caledonia is by free-diving and gleaning on reefs at low tide, whereas on the Great Barrier Reef, it is collected by divers using hookah.

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PROCESSED ©S.W. Purcell

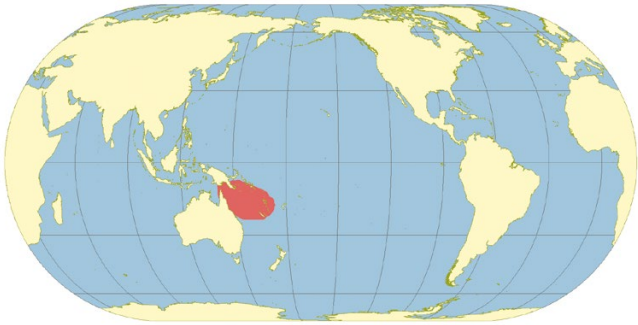
Regulations: In New Caledonia, it is managed with no-take marine reserves, a prohibition on the use of SCUBA or hookah, and fishing permits; minimum legal size is 25 cm wet and 12 cm dried. In Australia, there is a minimum size limit, a TAC and catches are carefully monitored from specified fishing plots by a small number of licensed fishers. Since 2006, *A. spinea* has been distinguished and managed by Queensland authorities separately from *A. miliaris*. It is excluded from the rotational fishing closures used for other species on the Great Barrier Reef.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. Sold also as cooked, frozen product.

Main market and value: Code: YGS. It has been sold by fishers at USD 2–4 per unit fresh and USD 20–30 per kg dried. In New Caledonia (2008), fishers received USD 2.4 per kg wet weight. Sold in Guangzhou wholesale markets (2016) for USD 110 per kg dried.

GEOGRAPHICAL DISTRIBUTION

New Caledonia and Australia. Possibly also occurs in other Melanesian countries but previously misidentified. This species has probably been recorded often as *A. miliaris* (e.g. as in SPC PROCFish/C surveys) or other species, probably leading to an under- represented distribution.

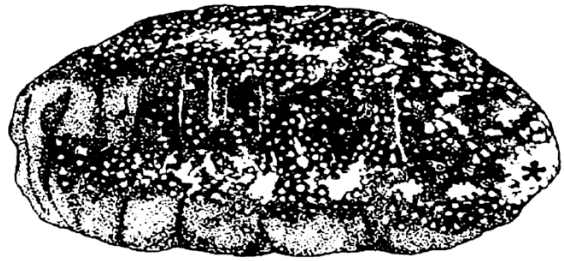


OTHER USEFUL INFORMATION

Ossicles are very sparse in the dermal tissue of this holothurian, a large surface area of dermis is needed for ossicle analysis. Somewhat difficult to distinguish from *A. miliaris*, but key identifying features are that it is often more elongated, anus is subdorsal, the ventral surface is not distinctly lighter than the dorsal surface, and it has only moderately long papillae.

COMMON NAMES

Surf redfish (**FAO**), Đồn đột dừa (Viet Nam), Bakungan, Monang (Philippines), Tripang goela (Indonesia), La mauritiana (New Caledonia), Terasea (Fiji), Tewaeura (Kiribati), Telehea kula (Tonga), Sefredfis (Vanuatu).



DIAGNOSTIC FEATURES

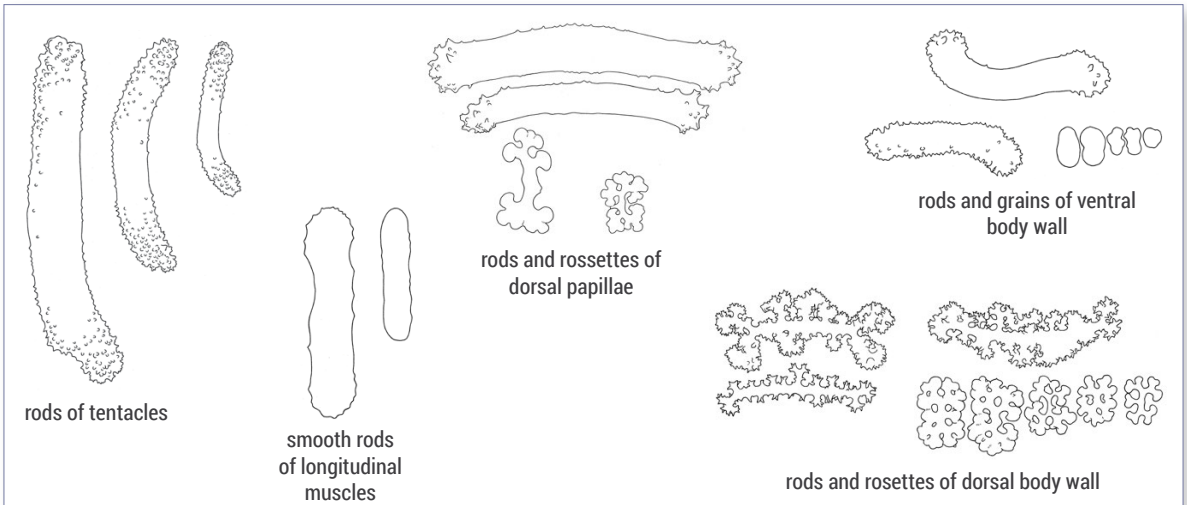
Body is slippery to the touch, quite rigid, coarsly creased, but lacking the fine creasing observed with *A. mauritiana*. Dorsal surface is arched, ventral surface is flattened, and the ends are rounded. Dorsal body wall is dark rusty or milk-chocolate brown colour, with distinct whitish circles surrounding the dark podia. Ventral body wall slightly lighter with very numerous, beige podia, not circled by white rings. Dorsal and ventral surfaces are distinct. Mouth surrounded by a collar of papillae and 25 large, beige tentacles. Anus surrounded by 5 white anal teeth. Cuvierian tubules not observed.

Ossicles: Tentacles with straight and slightly curved rods, that are unbranched, spiny at the ends, 100–190 µm long. Dorsal body wall has rosettes (20–45 µm long) and spiny, sometimes branched rods, 55–100 µm long. Dorsal papillae with simple rosettes, 20–35 µm long, unbranched, straight rods with spiny ends, 75–100 µm long. Ventral body wall with grains, 8–20 µm long, and straight to slightly curved smooth rods (50–65 µm long) with somewhat jagged ends. Ventral podia contain little to no ossicles except a fragmented end-plate.

Processed appearance: Roughly an elongated oval shape; arched dorsally and moderately flattened ventrally. Dorsal surface with grooves, blackish brown and showing the former white spots and blotches. Ventral surface is granular and characteristically cream to light reddish brown in colour. A cut on the ventral surface. Common dried size 8–15 cm.

Remarks: This species adheres tightly to wave-exposed surfaces with its numerous ventral podia.

Size: Maximum length about 35 cm, commonly to 20 cm; average fresh weight from 300 to 700 g; average fresh length from 20 to 40 cm. In New Caledonia, average live weight about 670 g and average (contracted) live length about 20 cm.



(After SEM photographs from a syntype in the collection of the Zoological Museum, Hamburg)

HABITAT AND BIOLOGY

Prefers outer-reef flats and fringing reefs, in reef crest habitats generally in 1–3 m depth. Occasionally found in seagrass beds, attached to coral stones. Can be active in both daytime and night. Size at maturity is reported at 23 cm, reached between 125 and 350 g.

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PROCESSED ©S.W. Purcell

EXPLOITATION

Fisheries: Fished throughout the western Pacific Ocean and Southeast Asia. Fished for subsistence consumption in Palau, Nauru, Wallis and Futuna Islands, Samoa, Cook Islands and French Polynesia. Commercially important in southern China, Japan, Malaysia, Indonesia and the Philippines.

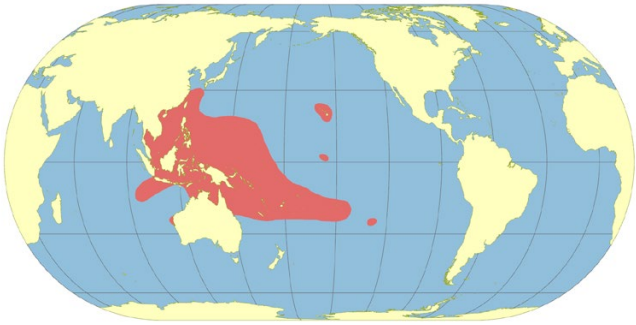
Regulations: Minimum size limits are: 20 cm wet and 8 cm dried in Papua New Guinea; 25 cm wet and 12 cm dried in Vanuatu; 25 cm wet and 10 cm dried in Solomon Islands. In New Caledonia, fishing is prohibited at night and there is a minimum size limit (25 cm, live; 10 cm, dried). On the Great Barrier Reef (Australia), regulations include a minimum size limit of 25 cm (wet/fresh), a rotational closure strategy, permits and a quota. In Torres Strait (Australia), fishing was banned in 2003 due to overexploitation and was still in effect in 2023.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. Its intestines and/or gonads may be consumed as part of traditional diets or in times of hardship.

Main market and value: Main markets are China, Singapore, China, Hong Kong SAR, Taiwan Province of China and Ho Chi Minh City (Viet Nam). It has been traded at USD 13–47 per kg dried in the Philippines, and USD 10–15 per kg dried in Papua New Guinea. In New Caledonia (2008), it was exported for USD 30 per kg dried and fishers received USD 2 per kg wet weight. In Fiji (2014), fishers received USD 2–4 per piece, fresh. Prices in Guangzhou wholesale markets (2016) were USD 72 per kg dried. Retail prices in China, Hong Kong SAR were up to USD 145 per kg dried (2011).

GEOGRAPHICAL DISTRIBUTION

Southeast Asia, northern Australia and the Pacific Islands, including Indonesia, the Philippines, Papua New Guinea, China and southern Japan, Hawaii, central western Pacific islands (see SPC PROCFish/C surveys) as far east as French Polynesia and Pitcairn Islands.

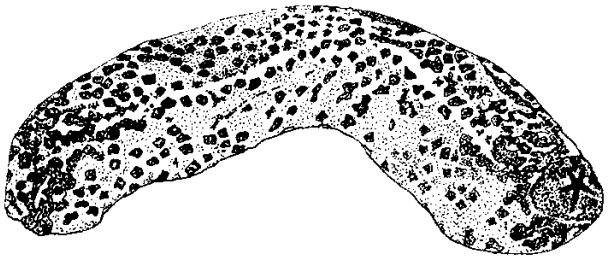


OTHER USEFUL INFORMATION

This species was previously considered as *Actinopyga mauritiana*, but that species has been shown to occur solely in the Indian Ocean region.

COMMON NAMES

Leopardfish, Holothurie léopard (**FAO**), Tigerfish, Ñoät da traên, Sam vang (Viet Nam), Nool attai (India), Leopard or Matang itik (Philippines), Tetaika (Kiribati), Mata mata (Tonga), Vulu ika (Fiji), Ular mata, Gamat bati, Bitnik, Cempedak, Patola (Indonesia), Taikafis (Vanuatu).



DIAGNOSTIC FEATURES

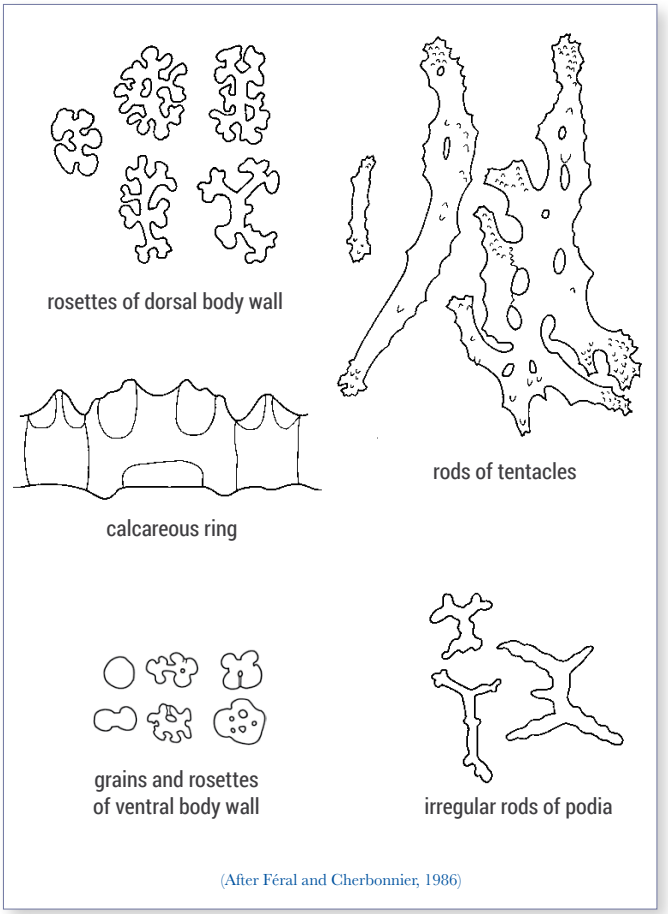
Variable colour, ranging from brown to beige or grey or violet. Dorsal surface covered with numerous large (about 1 cm) polygonal or round spots, brownish or whitish in colour with a thin black border and sometimes haloed by white. A papilla is at the centre of each spot. Brown to beige ventrally. Body is sub-cylindrical; arched dorsally and flattened ventrally. Mouth is ventral with 20 short dark-brown tentacles. Prominent subdorsal anus, no anal teeth. Readily ejects large, white Cuvierian tubules when disturbed.

Ossicles: Tentacles with spiny rods, 80–300 µm long. Dorsal body wall with rosettes, 15–30 µm long. Ventral body wall with grains, 10–30 µm long, that can be perforated as well as simple rosettes, 15–25 µm long. Ventral podia with similar rosettes and few rods with extremities that can be pointed or rounded. Dorsal podia with similar assemblage of ossicles as the ventral podia, but also with rods that can take an H-form, 40 µm long.

Processed appearance: Cylindrical shape, slightly tapered at one end (anus). Ventral surface is smooth. Dorsally brown or greyish with small spots, ventral surface is brown to light-brown. No cuts or small cut across mouth. Common dried size 12–18 cm.

Remarks: Distinguished from *Bohadschia atra* by its lighter colour, more prominent leopard spots, and its distribution.

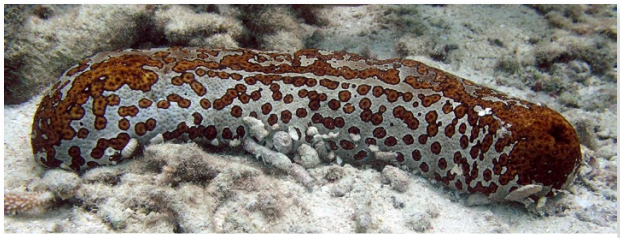
Size: Maximum length about 60 cm, commonly to about 36 cm; average fresh weight: 1 800 g (Papua New Guinea and India), 2 000 g (New Caledonia); average fresh length: 35 cm (Australia), 36 cm (Papua New Guinea), 40 cm (New Caledonia and India).



HABITAT AND BIOLOGY

A typical reef species. Generally occurs in 2–10 m depth on reef flats and back reef lagoons with clear water. Found mostly on coarse sand near reef structure and can sometimes bury into upper sediments. Populations commonly found at low densities.

In the western central Pacific, this species prefers barrier reef flats and slopes, or outer lagoons on sand down to 30 m depth. In New Caledonia, it spawns in December, while in the Great Barrier Reef it spawns in June. Research shows that *B. argus* takes 15–20 years to attain its maximum size.



LIVE ©S.W. Purcell

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EXPLOITATION

Fisheries: Fished, or has been fished, in most countries in the Pacific and Southeast Asia. Not currently commercially exploited much in Australia. Recently targeted in New Caledonia. It is part of a subsistence fishery in Wallis and Futuna Islands and Samoa. In Kiribati, fishing for this species boomed between 2000 and 2002 but it is now considered depleted. Exported for the aquarium trade from some localities. It is harvested in most of Southeast Asia. Harvested in Viet Nam by hand or using lead-bombs and is over-exploited. Heavily fished in Indonesia.

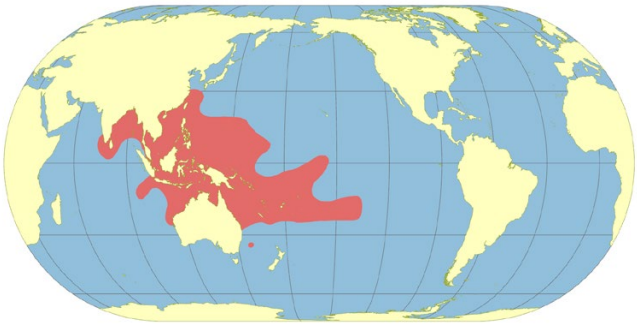
Regulations: Minimum size limits are: 20 cm wet and 10 cm dried in Papua New Guinea; 30 cm wet and 15 cm dried in Vanuatu and Solomon Islands; 30 cm wet and 12 cm dried in New Caledonia. Although exploited little in Australia, a minimum legal length of 35 cm (fresh) is imposed.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. The body wall and/or intestine and gonads may be consumed in traditional diets, e.g. some Pacific islands.

Main market and value: Code: **KUW**. Main markets are China and others in Southeast Asia. Previously traded at USD 15–27 per kg dried in the Philippines, USD 20 per kg dried in Viet Nam and USD 6 per kg in Papua New Guinea. In Fiji (2014), fishers received USD 2–4 per piece fresh. Sold by fishers in Torres Strait (2022) for USD 10 per kg gutted and salted, or USD 80 per kg dried. Prices in Guangzhou wholesale markets (2016) averaged USD 63 per kg dried.

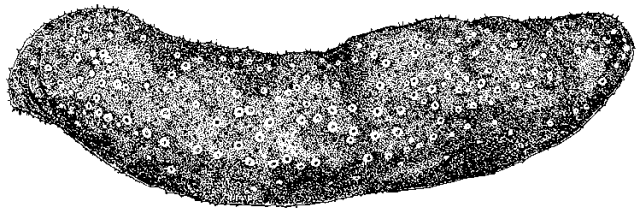
GEOGRAPHICAL DISTRIBUTION

Sri Lanka, Bay of Bengal, East Indies, north Australia, the Philippines, China and southern Japan, South Pacific islands. In India, it is distributed in the Andamans and Lakshadweep regions and occurs in the far eastern Indian Ocean to French Polynesia in the Pacific.



COMMON NAMES

Falalijaka madarasy and Papiro (Madagascar), Dole (United Republic of Tanzania, Zanzibar), Nari nool attaya (Sri Lanka), Lokol (Seychelles).



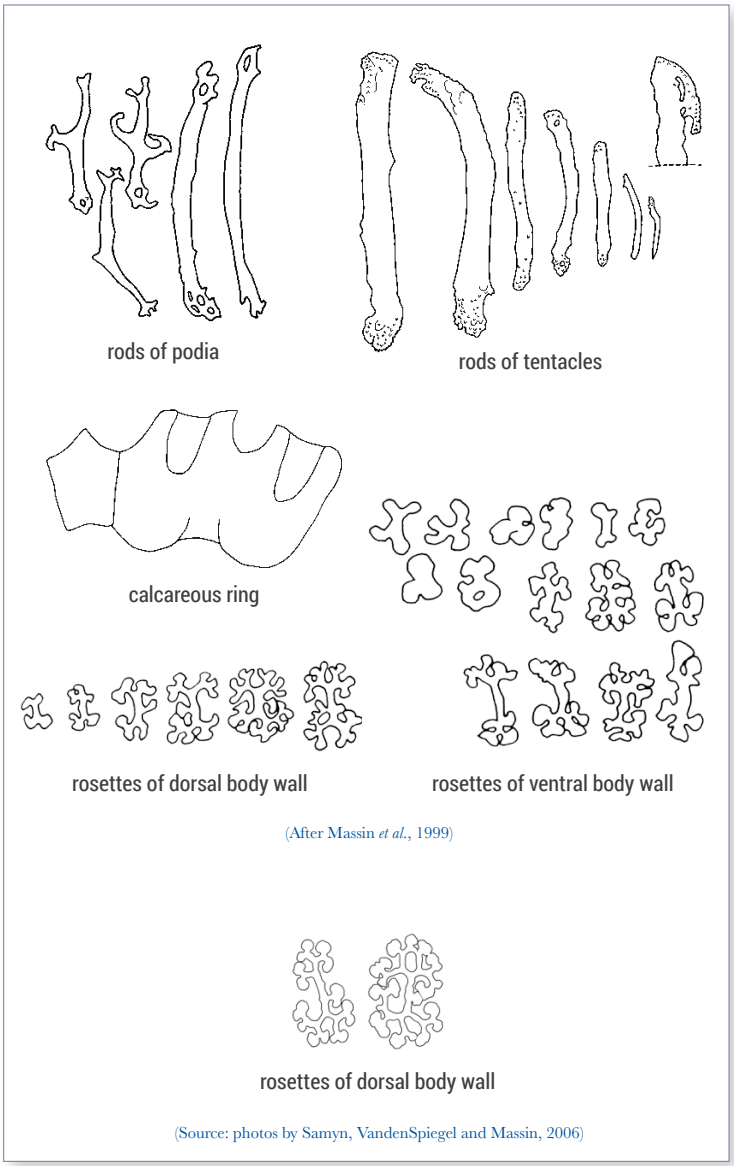
DIAGNOSTIC FEATURES

Colour is deep brown to black dorsally, with numerous brown to red spots surrounding black dorsal papillae. Larger animals may acquire transverse brownsh-red bands. The ventral surface is lighter in colour, tending brown. *Bohadschia atra* is a relatively large holothuroid. Body elongated, cylindrical, arched dorsally and flattened ventrally. Dorsal surface has relatively sparse podia and is often covered by sediment. Mouth is ventral with 20 black tentacles. Anus is dorsal, without anal teeth. Cuvierian tubules are numerous and easily expelled.

Ossicles: Tentacles with rods of various size, dependent on the size of the animal; ranging 80–360 µm in length. Dorsal body wall with relatively simple rosettes. Ventral body wall with similar but somewhat simpler rosettes and grains which can be perforated, all between 20 and 50 µm long. Ventral podia with rosettes similar to those of body wall as wall as straight rods. Dorsal podia with rosettes similar to those of dorsal body wall.

Processed appearance: Cooked and dried animals are elongate and salami shaped, with relatively blunt ends. The dried product is black, and the spots seen in live animals, are not evident. Body texture is relatively smooth. In comparison to other dried animals of similar colour and shape (e.g. *Actinopyga palauensis*, *A. spinea*, *Holothuria atra*), *B. atra* has a dorsally situated anus and no anal teeth.

Remarks: It was recorded as *B. argus* in the Indian Ocean until Massin *et al.* (1999) recognized it as a species new to science. *B. atra* is restricted to the Indian Ocean whereas *B. argus* is largely a Pacific and Southeast Asian species.



(After Massin *et al.*, 1999)

(Source: photos by Samyn, VandenSpiegel and Massin, 2006)

Size: Body length up to 40 cm. Average fresh weight: 500 g; average fresh length: 35 cm.

HABITAT AND BIOLOGY

B. atra lives in shallow waters up to 12 m depth, frequently in seagrass beds and sandy areas of coral reefs. Populations are commonly found at low densities.

EXPLOITATION

Fisheries: It is collected by fishers using free diving and SCUBA in artisanal fisheries. Targeted in multi-species fisheries in many localities of the western Indian Ocean (e.g. Kenya, Madagascar and United Republic of Tanzania, Zanzibar).

Regulations: None except for moratoria on fishing in several countries within the western Indian Ocean (e.g. United Republic of Tanzania, Mayotte, Comoros).

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

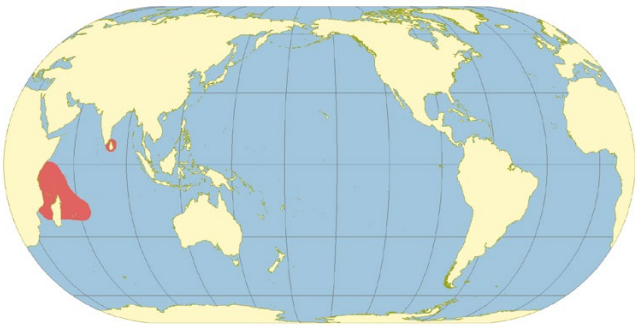
Main market and value: Code: JLZ. Main market is Singapore.

GEOGRAPHICAL DISTRIBUTION

Southwest region of the Indian Ocean although Conand (2008) states that this species can be found throughout the western Indian Ocean region. Apparently not recorded from the Red Sea, the Gulf of Aden, the Arabian Sea and the Persian Gulf.

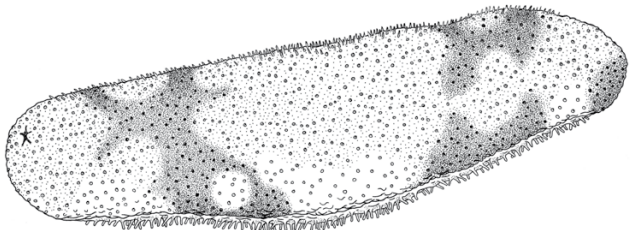
LIVE ©P. Frouin

PROCESSED ©C. Conand



COMMON NAMES

Mottled sea cucumber (**FAO**), Tagukan (Philippines).



DIAGNOSTIC FEATURES

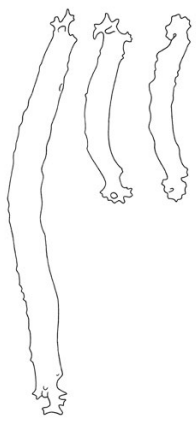
Body wall is smooth to the touch, 5–6 mm thick. Body is arched dorsally and flattened ventrally, generally light creamy-tan in colour with brown blotches not strongly demarcated (as occurs in *Bohadschia marmorata*) nor forming bands across the body (as can occur in *Bohadschia vitiensis*). Ventral surface is uniformly light beige. Dorsal and ventral podia are beige and dotted all over the body. The anus is sub-dorsal. The mouth is ventral and has 20 large, dark-beige coloured tentacles, and a collar of papillae is absent. Anus devoid of papillae. Long and numerous Cuvierian tubules are present and expelled upon the slightest provocation.

Ossicles: Tentacles with rods, straight to slightly curved and sometimes branching at the tips, 40–230 µm long. Dorsal body wall with closed grains, 10–15 µm long and simple to complex rosettes, 20–30 µm long. Ventral body wall with grains (perforated or not), 15–20 µm long and simple to elongated rosettes, 15–100 µm long. Dorsal podia with grains and rosettes as in dorsal body wall, but with, in addition, rods, 65–135 µm long. Ventral podia with grains, 15–30 µm long, compact to elongated rosettes, 20–40 µm long and rosette-like rods, 35–85 µm long.

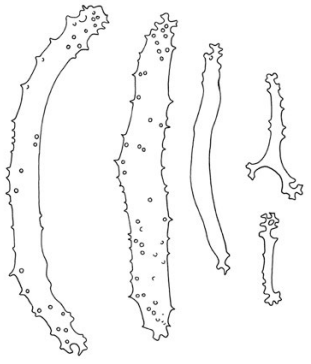
Processed appearance: Little is documented, but it would likely look similar to processed *B. marmorata* although the edges of the dark blotches would be diffuse.

Remarks: This species can be easily mistaken as *B. marmorata*, as both are beige in colour with brown blotches. The distinguishing feature of *Bohadschia koellikeri* is that the edges of the blotches are diffuse and blend in gradually with the beige background dorsal colour.

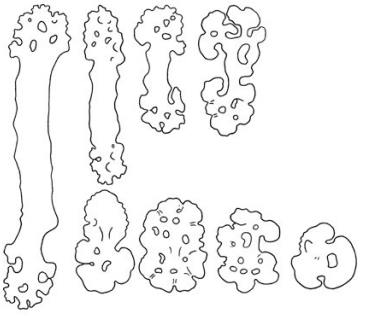
Size: Live individuals up to at least 32 cm long.



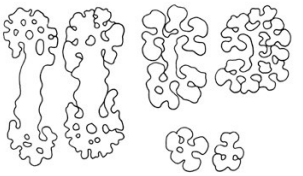
rods of dorsal podia



rods of tentacles



rods and rosettes of ventral podia



rosettes of ventral body wall

(From the type as present in the collection of Zoological Museum Hamburg)

HABITAT AND BIOLOGY

This species is known to bury in sand. It is reported as nocturnal, foraging on soft sediments on reef flats and forereef slopes to depths up to 30 m.

EXPLOITATION

Fisheries: It is fished commercially on northern Australian reefs by Indonesian fishers. Also reported to be harvested by artisanal fishers in the Philippines and by Indonesian fisheres in the Timor Sea. Likely fished in Indonesia and the Philippines and elsewhere where it is distributed such as atoll states of Micronesia.

Regulations: Subject to the same regulations as *B. marmorata* in fisheries where they both exist.

Human consumption: Mostly the processed body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Likely sold under the same trade name and value as *B. marmorata*.

GEOGRAPHICAL DISTRIBUTION

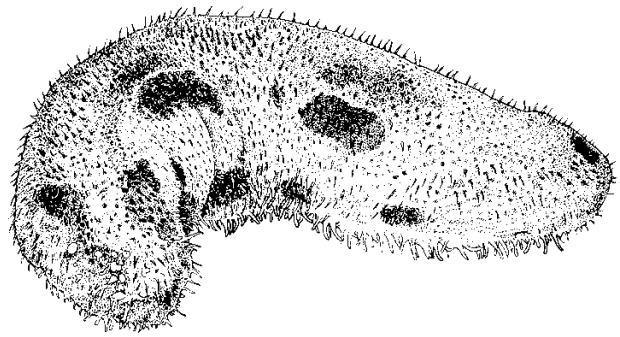
Western and central Pacific Ocean (Guam, Kiribati, Line Islands, Lizard Island, Fiji, French Polynesia, Kosrae, Yap) and northern Australia. Reported also from Madagascar, Mozambique Channel, Seychelles, India, Maldives, Viet Nam, southern Japan, Philippines, Indonesia, Timor Sea and Papua New Guinea.

LIVE ©T. Skewes

LIVE ©P. Randall

COMMON NAMES

Chalkfish (Papua New Guinea), Brown-spotted sandfish (**FAO**, New Caledonia), Bemangovitse (Madagascar), Finemotu'a (Tonga), Mundra (Fiji), Duburu nool attaya (Sri Lanka), Lakol (Seychelles), Jokfis (Vanuatu).



DIAGNOSTIC FEATURES

Normally tan with large brown blotches on the dorsal surface. Ventral surface white to cream colour. *Bohadschia marmorata* is a small to moderate-sized species with a cylindrical body, flattened ventrally and tapering at both ends. It has a very slippery texture. Ventral surface with long slender podia, prominent on the lateral margins. Anus large and nearly dorsal. Juveniles are light olive green with darker green blotches, which camouflage them in seagrass beds. May or may not readily eject Cuvierian tubules, depending on the region.

Ossicles: Tentacles with slender rods of various size, up to 220 µm long, and spiny at the extremities. Dorsal body wall with small simple rosettes, 15–20 µm long. Ventral body wall with round, ellipsoid or more irregularly shaped grains, 15–20 µm long and simple rosettes of the same size. Ventral and dorsal tubefeet with few simple rosettes and rods that are mostly little branched distally.

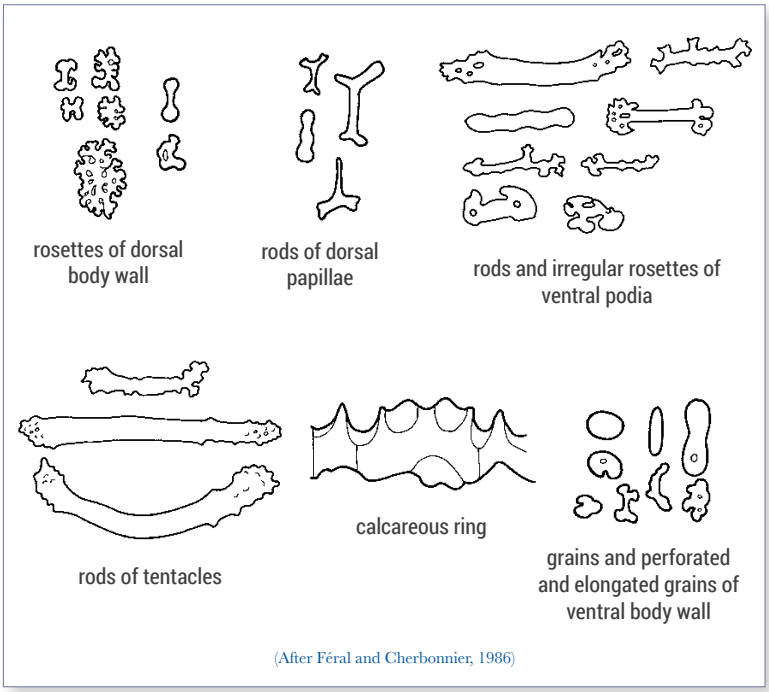
Processed appearance: Bent, narrow cylindrical shape, slightly flattened underside. Dorsal surface is granular, light beige (chalky), underside smooth, black with brown marks. No cuts or small cut across mouth. Common dried size 7–9 cm.

Remarks: Previously synonymised with *Bohadschia similis*. Information available for *B. similis* was collated to that of *Bohadschia marmorata* in light of genetic analyses by Uthicke, Byrne and Conand (2010).

Size: Maximum length about 26 cm. Average fresh weight 300 g; average fresh length 18 cm.

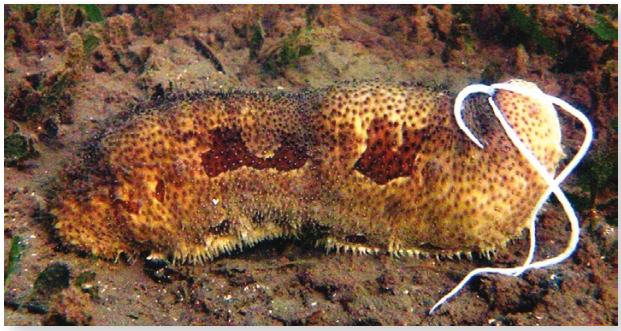
HABITAT AND BIOLOGY

Occurs in shallow water rarely deeper than 3 m. Inhabits seagrass beds in muddy-sand sediments, in sheltered or semi- sheltered sites. Predominantly buries in sediments during the day and forages on sediment surface nocturnally. It may be covered with a fine layer of mud. In the western central Pacific region, this species can be found

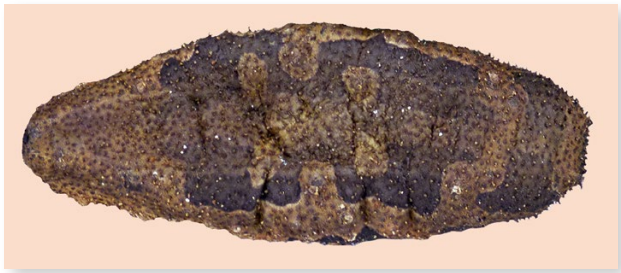


(After Féral and Cherbonnier, 1986)

in coastal lagoons and inner reef flats, often found in sandy- muddy substratum. However, in the western Indian Ocean and Africa it prefers the back reef, seagrass beds on sandy bottoms between 0 and 20 m depth. This species attains size-at-maturity at 90 g and reproduces annually between February and April.



LIVE ©S.W. Purcell



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EXPLOITATION

Fisheries: It is fished semi-industrially in Mauritius. It is harvested by free-diving and hand collecting. Not currently under commercial exploitation in New Caledonia, where it is considered too low value. This species is commercially exploited in Palau, Micronesia (Federated States of), Tonga, French Polynesia and Fiji. It is also exploited in Indonesia, Malaysia, Thailand, Viet Nam, the Philippines and China. In Seychelles, United Republic of Tanzania and Kenya, it is commercially important. Fishing in Madagascar is limited. Before a moratorium, it was one of the most valuable commercial species in India. In Maldives, a fishery started in 1986 targeting amongst others *B. marmorata*.

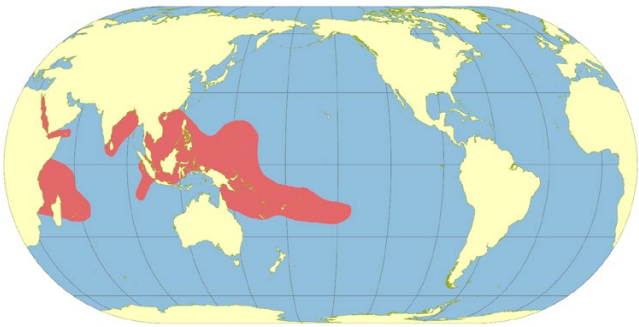
Regulations: Minimum size limits are: 25 cm wet and 7 cm dried in Papua New Guinea; 15 cm wet and 7 cm dried in Vanuatu; 20 cm wet and 10 cm dried in Solomon Islands. It is not currently of interest to commercial fishers in some countries (e.g. Australia and New Caledonia).

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. It is traded at USD 9–22 per kg dried in the Philippines. In Fiji, it is considered a delicacy or as a protein component in traditional diets, its consumption is important in times of hardship.

Main market and value: Code: **KUH**. Main markets are China and China, Hong Kong SAR. In Fiji (2014), fishers receive USD 1.4–2.0 per kg fresh gutted.

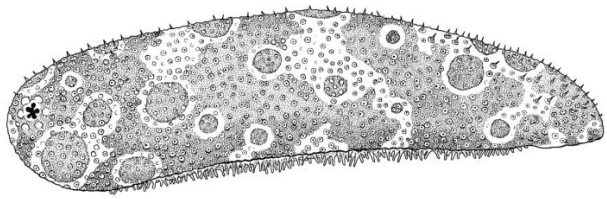
GEOGRAPHICAL DISTRIBUTION

Mascarene Islands, East Africa, Madagascar, Red Sea and the Gulf of Aden, Sri Lanka, Bay of Bengal, East Indies, north Australia, the Philippines, China and southern Japan, South Pacific islands. Widely distributed in Southeast Asia and the Pacific Islands, where its reported range extends to French Polynesia in the east. Occurs throughout the Indian Ocean to East Africa.



COMMON NAMES

Ocellated leopardfish, Polka-dotted sea cucumber.



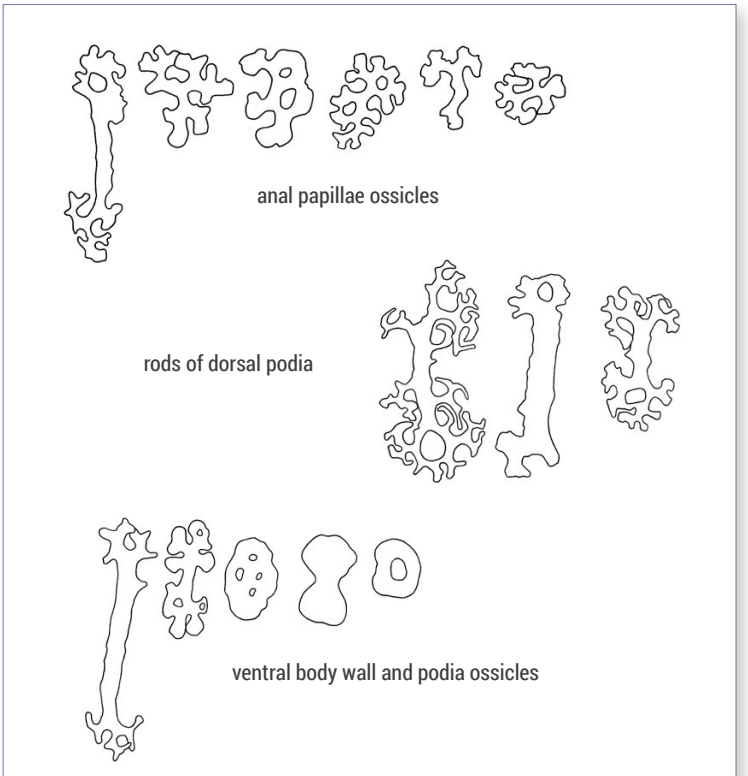
DIAGNOSTIC FEATURES

Variable colour, ranging from beige to brown or grey. Dorsal surface covered with numerous large (1–3 cm), irregularly shaped spots and blotches that are commonly yellowish, orange or brown, and can be haloed by white. Unlike *Bohadschia argus*, each spot does not have a central papilla—they are more irregular. Dorsal podia are beige. The ventral surface is whitish to light beige with podia that are brownish. Body is sub-cylindrical; arched dorsally and flattened ventrally. Mouth is ventral, with 20 short light-coloured tentacles. Prominent subdorsal anus, surrounded by a cluster of 3–5 papillae; no anal teeth. Readily ejects large, white Cuvierian tubules when disturbed.

Ossicles: Ossicle assemblage of tentacles is unknown. Dorsal body wall with plumb to open rosettes, 15–38 µm long. Ventral body wall with solid, perforated and open rosettes, 20–35 µm long. Dorsal podia with rosettes similar to those of the body wall, with additional longer and more complicated and rod-like rosettes, up to 60 µm long. Ventral podia with ossicles as in body wall and longer rod-like rosettes, 35–70 µm long. The anal papillae have ossicles of similar shape and size as in the dorsal body wall.

Processed appearance: Cylindrical shape, slightly tapered at one end (anus). Ventral surface is smooth. Dorsally brown or greyish with irregular-shaped blotches that have distinct edges. The ventral surface is brown to light-brown. No cuts or small cut across mouth. Common dried size 12–18 cm.

Remarks: This species is probably often misidentified as *B. argus* in fishery population surveys. The ossicle assemblage of this species has, surprisingly, never been documented in the literature. Jaeger's (1833) original description lacked this information and subsequent workers (cf. Panning, 1935; Liao, 1997) erroneously put *Bohadschia ocellata* in the genus *Holothuria*, making it sister to *H. kurti* Ludwig, 1891 and *H. alex* Samyn, 2016 (Samyn & VandenSpiegel, 2016). The description here provided derives from a recently recovered syntype in the collections of the Berlin Museum and will need to be re-evaluated with reliably identified other voucher specimens.



(After a syntype available in the Natural History Museum, Berlin)

Size: Body size is not well documented, but based on observations is around 20–30 cm. Unverified report of maximum size 50 cm.

HABITAT AND BIOLOGY

May occur in shallow waters but often found in water deper than inhabited by its sister-species *B. argus*. Reported to be active at night, but also found exposed on sandy habitats during the day. Can be found in deeper waters to at least 37 m.

EXPLOITATION

Fisheries: Harvested in the western Pacific Island countries, and often misidentified as *B. argus* and so pooled in the same fishery statistics. In Fiji, it was harvested towards the end of the fishery when fishers were venturing into deep waters for other species.

Regulations: Before a fishery moratorium in Papua New Guinea, fishing for this species was regulated by minimum landing size limits (20 cm live; 10 cm dry) and other regulations. Although exploited little on the Great Barrier Reef, a minimum legal length of 35 cm (fresh) is imposed.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. The body wall and/or intestine and gonads may be consumed in traditional diets, e.g. some Pacific islands.

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LIVE ©A. Hoggett

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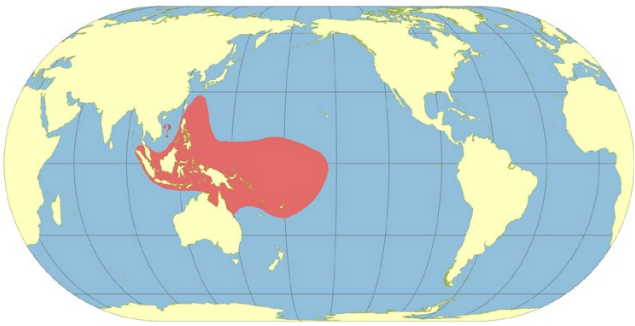
Main market and value: China would be the main market destination. This species has been exported as *B. argus* in many countries. In Fiji (2014), fishers received USD 2–4 per piece fresh. Prices in Guangzhou wholesale markets (as per *B. argus*) ranged from USD 49 to 63 per kg dried.

GEOGRAPHICAL DISTRIBUTION

Western and central Pacific Ocean, including reports from eastern Australia down to the southern Great Barrier Reef, Guam, Kiribati, Kosrae, Lizard Island, Majuro, Malaysia, Okinawa, the Philippines and Papua New Guinea.



Bohadschia subrubra (Quoy and Gaimard, 1834)

COMMON NAME

Leopardfish, Falalyjaka (Madagascar), Lakol (Seychelles).

DIAGNOSTIC FEATURES

This species is a moderately large holothuroid with a smooth body texture. Coloration is variable from brown to orange with dark areas dorsally, while the ventral surface is white and distinguished from the rest of the body by a brown line. Body elongated, cylindrical, arched dorsally, flattened ventrally. The dorsal surface is often covered by sediment or seagrass and algal pieces. There are numerous, long, white podia ventrally. Mouth is ventral with 18 stout white tentacles. Anus is dorsal, and without anal teeth. Cuvierian tubules numerous and large and readily ejected when the animals are disturbed.

Ossicles: Tentacles with rods of various size, 25–540 µm long, mostly spiny, with largest ones forked or with perforated extremities, especially in smaller individuals. Dorsal body wall with rosettes, 20–35 µm long. Ventral body wall with grains of various shapes and rosettes. Ventral podia with rosettes and granules similar to those of the body wall, and with straight non-branched rods, 20–210 µm long. Dorsal podia with rods, 35–230 µm long and rosettes similar to those of the body wall.

Processed appearance description: Elongate shape with blunt, curved ends. Coloration is from orangey-tan to light or dark brown with blotches.

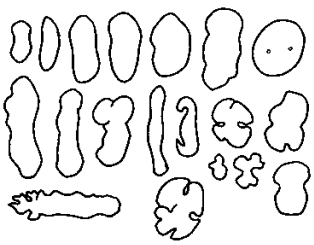
Remarks: Formerly identified as *Bohadschia argus*. Very little is known about this species, as it is exploited and is often found with *Bohadschia atra*. A detailed description is given by Massin *et al.* (1999).

Size: Body length up to about 40 cm. Average fresh weight from 500 to 800 g, average fresh length about 35 cm.

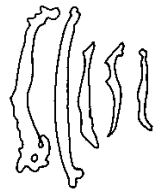
HABITAT AND BIOLOGY

This species lives in shallow waters, mostly on reef flats, sandy patches, seagrass beds and on coral rubble. It can be found in waters between 0 and 30 m deep. In Kenya, it lives in sandy patches between coral heads in reef lagoons. In the Comoros, it can be found over sand and coral rubble between 5 and 30 m depth. No studies have yet been conducted on its biology.

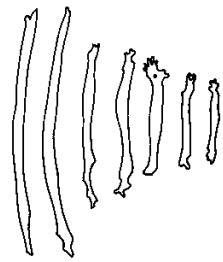
rod extremity of tentacle



granules of ventral body wall



rods of dorsal podia



rods of ventral podia

(After Massin *et al.*, 1999)

EXPLOITATION

Fisheries: Artisanal. Harvested by snorkel-diving and hand-picking. This species is part of multispecies fisheries, fished together with *B. atra, B. vitiensis, Holothuria scabra* and *H. lessoni.*

Regulations: None determined.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Code: JTQ. Main markets are mainland China, Singapore, Taiwan Province of China.

GEOGRAPHICAL DISTRIBUTION

East Africa and the Indian Ocean including Madagascar, Kenya, Seychelles, Mayotte, Mauritius, Mozambique and northeastern South Africa, the Comoros and the southern part of the Red Sea.

LIVE ©T. Skewes

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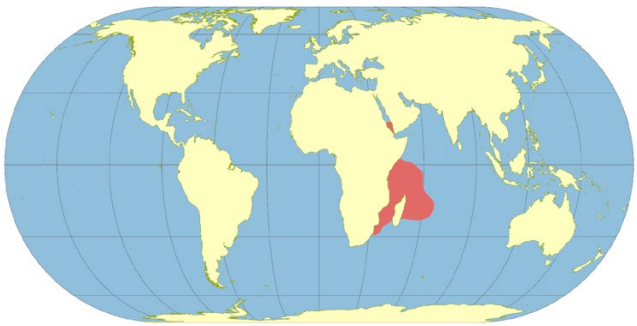
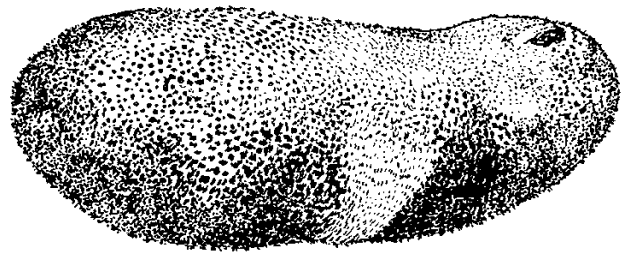


COMMON NAMES

Brown sandfish (**FAO**), Holothurie brune (**FAO**), Nool attai (India), Mangeryfoty, Falalija (Madagascar), Ñoät muû (Viet Nam), Dole (United Republic of Tanzania, Zanzibar), Pulutan (Philippines), Tekanimnim (Kiribati), Mula (Tonga), Vula (Fiji), Olok-olok, Gatta, Gama, Polos (Indonesia), Braon sanfis (Vanuatu).



DIAGNOSTIC FEATURES

Colour is variable from cream to yellow-orange to brown with numerous tiny brown dots (around podia) dorsally often with two diffuse transverse bands across the body; whitish ventrally. This species has a stout body, arched highly dorsally, flattened ventrally, often covered by fine sediment. Mouth is ventral with 20 short, yellowish tentacles. The large anus is subdorsal, without teeth. This species has numerous large Cuvierian tubules, which it readily ejects when even slightly disturbed. The juveniles appear similar to small adults.

Ossicles: Tentacles with straight or slightly curved rods. Dorsal body wall with rather stout rosettes, 15–20 µm long, which can occasionally be more elongated. Ventral body wall with grains that can be ovoid, ellipsoid or more irregularly shaped; grains can be perforated, 10–20 µm long. Ventral podia with numerous rods of various shapes, 35–75 µm long. Dorsal podia also with rods, similar in shape and size to the large ones of the ventral podia.

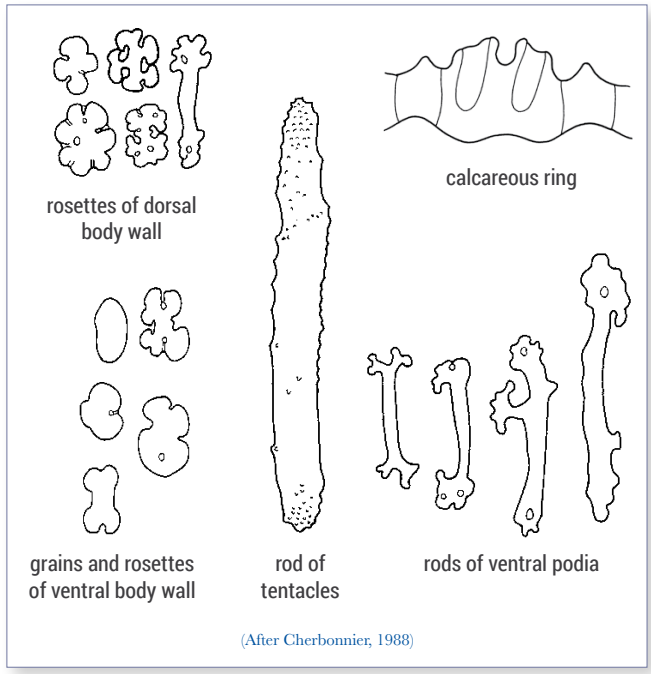
Processed appearance: Cylindrical shape, arched dorsally and moderately flattened ventrally. Brown to brown-black; dorsal surface slightly wrinkled and grainy texture. No cuts or small cut across mouth. Common dried size 12–15 cm.

Remarks: A critical integrative taxonomic review is needed as *Bohadschia vitiensis* is very close, if not identical to: *B. similis*, *B. tenuissima* and *B. bivittata*.

Size: Maximum length about 40 cm; commonly to about 32 cm. Average fresh weight from 400 and 800 (Réunion and Madagascar) to 1 200 g (Papua New Guinea); average fresh length between 25 and 35 cm.

HABITAT AND BIOLOGY

Found in shallow waters, rarely in depths of more than 20 m. Mostly in sheltered coastal lagoons and inner reef flats on sand or occasionally among rubble and coral patches. This species can also be abundant in sandy-muddy sediments where it buries during parts



of the day. It reproduces annually during the dry season. In Papua New Guinea, it reproduces sexually in December, while in Palau it reproduces in July and August. In eastern Africa and the Indian Ocean, it reproduces during the warm season.

EXPLOITATION

Fisheries: Harvested in artisanal fisheries by hand collecting and free diving (Réunion and Madagascar), occasionally using lead-bombs (Papua New Guinea) or using hookah diving gear (Viet Nam). This species is commercially exploited in most countries of the Indo-Pacific as far east as French Polynesia. It is fished for subsistence use in Samoa and Fiji. In Kiribati, a multispecies fishery that included *B. vitiensis* boomed from 2000 to 2002 but is now considered overfished. In Madagascar and New Caledonia, harvesting of this species is minimal. Stocks in Australia are probably unfished.

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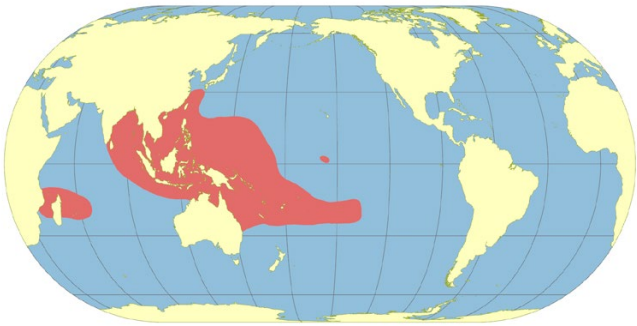
Regulations: Minimum size limits are: 20 cm wet and 10 cm dried in Papua New Guinea; 25 cm wet and 12 cm dried in Vanuatu; 25 cm wet and 10 cm dried in Solomon Islands. In Samoa, exportation of sea cucumbers is banned to safeguard remaining stocks of species like *B. vitiensis* for local consumption.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. It is considered a delicacy or as a protein component in traditional diets or eaten in times of hardship.

Main market and value: Code: **BDV**. Main markets are China, Hong Kong SAR, Singapore and Taiwan Province of China. Exported to Ho Chi Minh City (Viet Nam) for further export to Chinese markets. It was sold by fishers at USD 6 per kg dried. In Fiji (2014), fishers received USD 0.4–1.4 per piece fresh. Sold in China, Hong Kong SAR retail markets (2016) for USD 029 per kg dried. Wholesale prices in Guangzhou were up to USD 81 per kg dried.

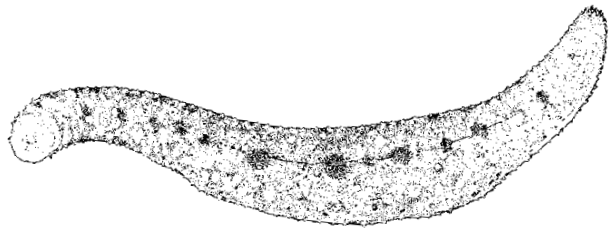
GEOGRAPHICAL DISTRIBUTION

Widely distributed in the Indo-Pacific, being reported as far east as French Polynesia and west to Madagascar and eastern Africa.



COMMON NAMES

Tripang kappallah poetih (Indonesia).



DIAGNOSTIC FEATURES

Coloration is cream to rusty tan. Some individuals are quite orange, becoming whitish towards either the mouth or anus. Dorsal surface is yellowish-white with two rows of relatively large, dark brown, spots. *Holothuria arenicola* is a slender and relatively small species. The body wall is relatively thin but is very rough to the touch. No Cuvierian tubules.

Ossicles: Tentacles with rods, spiny at their extremities; largest ones have distal ends perforated and/or forked, 100–200 µm long. Dorsal and ventral body wall with buttons and tables of the same kind and size: tables very small, 40–55 µm across, flat, often reduced to the smooth-edged disc, perforated by 4 large central holes and 0–4 small peripheral holes, with very short pillars that end in a few spines or a small crown of spines; buttons very regular, 40–50 µm long, with 3 pairs of holes. Ventral podia with buttons, tables and rods, up to 180 µm long. Dorsal podia with tables, buttons and rods similar to those of ventral podia, but large buttons, 50–225 µm long, with 3–10 pairs of holes, are abundant.

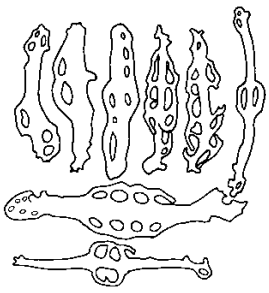
Processed appearance: Dried animals are light-brown to medium-brown and often with calcareous deposits remaining on the body wall. The body tapers at both ends.

Remarks: This species is part of a complex of species, with unrecognized forms included. Even some records from the east African coast are potentially misidentifications with other species, such as *Holothuria strigosa.*

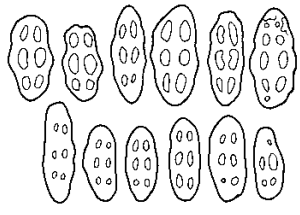
Size: Maximum length about 30 cm; commonly to about 10 cm. Average fresh weight probably <100 g.

HABITAT AND BIOLOGY

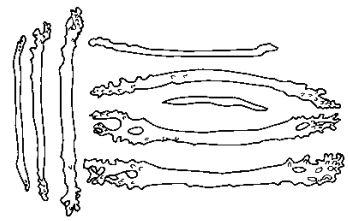
Abundant in intertidal and shallow areas but can also be found in deeper waters. It can be found under stones, in coral debris and on sand flats. Specimens have been found buried in *Thalassia* seagrass beds in 3 m of water. In Honduras, it buries in sandy substrata and seagrass beds but it has also been found under rubble



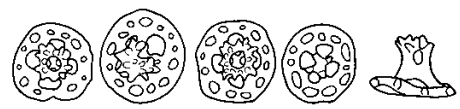
rods of ventral podia



buttons of body wall



rods of tentacles



tables of body wall

(After Massin, 1996)

and in dead conch shells. This sea cucumber can form conical mounds where it buries. This species ingests surface and subsurface sediments using a funnel that ends 15 to 20 cm below the surface.

EXPLOITATION

Fisheries: This species is believed to be fished in China, Madagascar and Egypt. The scale of fishing is mostly artisanal.

Regulations: Management regulations are generally lacking in countries in which it is fished.

Human consumption: Poorly known.

Main market and value: Code: **JCE**. It is a low-value species. Retail prices in China, Hong Kong SAR were up to USD 2 per kg dried.

GEOGRAPHICAL DISTRIBUTION

This species is believed to be found at some localities in the western Pacific, parts of Asia, and the Indian Ocean, including the Red Sea and the Comoros. Reported along the Pacific coast of Central America and is reported from the Caribbean and Brazil, but those sightings might represent different species.

OTHER USEFUL INFORMATION

This species is widely reported as overexploited in many localities, and listed as Vulnerable on the IUCN Red List.

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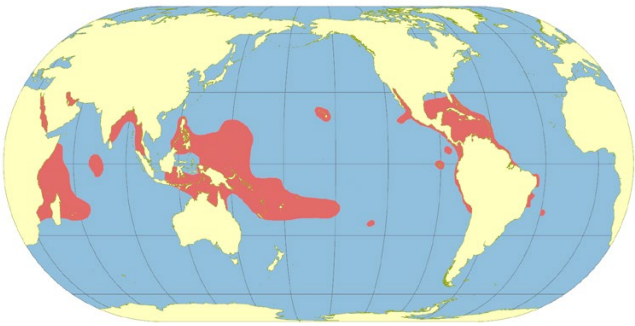
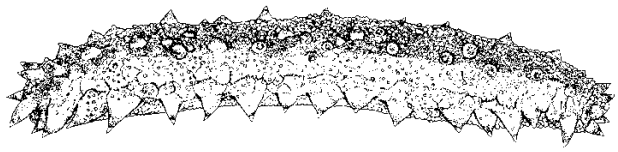


COMMON NAMES

Cohombro naranja (Spain), Orange sea cucumber (European Union).



DIAGNOSTIC FEATURES

Morphologically variable. Body is brown or reddish-brown dorsally, fading to white or yellowish towards the ventral margins. Ventral surface is flattened, whitish or yellowish. Rounded dorsally, sometimes with body wrinkles and numerous large, conical, pointed papillae, loosely arranged in six rows, more numerous anteriorly. A row of (commonly 10 to 20) large, slender conical papillae occur on both sides of the body at the ventro-lateral margin, and are lighter in colour than those of the dorsal surface. Lateral papillae are largest, pointed and brownish.

Ossicles: Tables few, mostly incomplete with 4 central openings and with or without marginal holes; rounded or angular edges. Spire with 4 rods joined to one another by a transverse bar and ending in a cluster of teeth; 60–65 µm. Ventral buttons are oval, very thick, smooth, rounded edges and they vary in size and number of holes, but the most common is 2–3 pairs of small holes; dorsal buttons are flatter than the ventral ones, toothed and very rough, with a variable number of holes. It is possible to find all the transitions between these two forms; 50–100 µm.

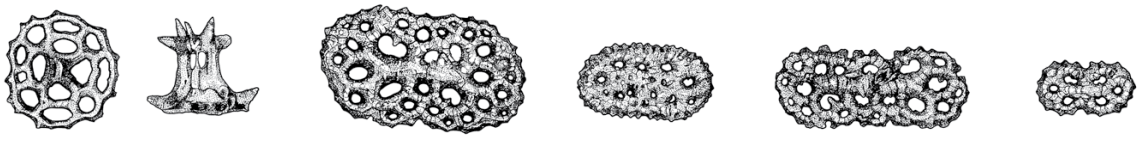
Processed appearance: The processed animals are brown dorsally and yellowish ventrally, as in the live animals. The dorsal surface is very bumpy and wrinkled, with large, conical, pointed papillae still apparent and arranged in loose rows. Ventral surface is flattened with visible brown dots corresponding to the podia. Common dried length 10–15 cm.

Remarks: Phylogenetic analyses put the allocation to the subgenus *Roweothuria* into question.

Size: Body length to a maximum of 35 cm and commonly around 20 cm. Body length up to 25 cm and body weight to 752 g in Portugal. In Spain, the upper size is somewhat smaller: up to 403 g and 22 cm in length.

HABITAT AND BIOLOGY

Occurs at depths of 0–50 m. Habitat preferences seem to vary geographically. In southern Portugal and Spain, it occurs in sand habitats and seagrass beds and in the intertidal zone, withstanding hours of aerial exposure. In Canary Islands and Cádiz (SW Spain) it is found in sandy-rocky habitats with algae. The sex ratio is close to 1:1. Spawning occurs mainly in summer months. First sexual maturity is at 21–23 cm body length and 220–260 g body weight. Fecundity is up to 10 million oocytes per female in southern Portugal.



tables | buttons of dorsal body wall | buttons of ventral body wall

(Source: photos by M. Wangüemert)

EXPLOITATION

Fisheries: Harvested by gleaning, compressed-air diving and free diving in southern and southeast Portugal, southern Spain and Canary Islands. In Spain, all commercial harvests are exported to China. Fishing in Algeria started in 2013 by gleaning but the animals are now also harvested by divers, and the smaller ones are used as fishing bait while larger individuals are processed and exported as bêche-de-mer. Commercial fishing has occurred in Morocco. Harvested in Mauritania for export using artisanal trawls in depths to 27 m and also by divers.

Regulations: A prohibition on sea cucumber fishing in Portugal was set in 2021, although some illegal harvesting still occurs. No specific regulations control fishing in Spain, where it is traded as "cohombro naranja". Harvest for subsistence purposes only is permitted in Algeria, yet it is exploited commercially. There, a 46-day seasonal closure is imposed.

LIVE ©S.W. Purcell

PROCESSED ©M. Wangüemert

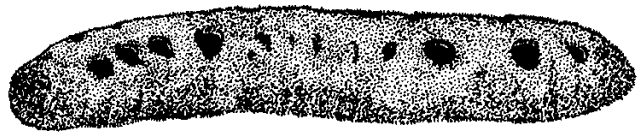
Human consumption: *Holothuria arguinensis* is consumed mainly from the reconstituted dried form.

Main market and value: Code: JHG. Although sales are prohibited in Portugal and Spain, it was sold in 2017 to 2019 to local Chinese buyers for USD 200–300 per kg dried and USD 4 per kg fresh. In 2022, Portuguese fishermen sold small fresh individuals (250–300 g) for USD 0.53–1.59 per piece. In Algeria, landing prices were reported (2020) as USD 1.5–5.3 per kg for the fresh product, and the dried product sold for USD 39–90 per kg. In Senegal (2023), exporters offered USD 180–200 per kg for dried product.

GEOGRAPHICAL DISTRIBUTION

Distributed in the Northeast Atlantic, from the Berlengas Islands (Portugal) to Morocco, southern Spain, Mauritania, and Senegal including the Canary Islands. Not reported from other Macaronesian Islands. Populations have spread into the Mediterranean Sea, and it now can be commonly found in Southeast Spain and Algeria.

COMMON NAMES



Lollyfish (**FAO**), Barbara (Mauritius), Stylo noir (Madagascar), Kuchii attai (India), Sherman (Egypt), Ñia ñen, Ñia maùu (Viet Nam), Black beauty and Mani (Philippines), Black lollyfish (Africa and Indian Ocean region), Lega (Eritrea), Kichupa (United Republic of Tanzania, Zanzibar), Loli (Tonga), Tentabanebane (Kiribati), Loliloli (Fiji), Lolifis (Vanuatu).

DIAGNOSTIC FEATURES

Uniformly black. Body is commonly covered with medium-grain sand, with characteristic bare circles in two rows along the dorsal surface. This species has three (genetically indistinguishable) morphs: a small morph (common) with a smooth dorsal surface that is covered with sand; a morph on reef crests that has a rippled dorsal surface; and a large morph with little sand on its body, occurring in deeper waters. Podia on the dorsal surface are small and sparse. Tentacles are black. Anus is terminal, without teeth or papillae. Cuvierian tubules absent. This species can also be distinguished by the reddish dye released from its body wall when rubbed.

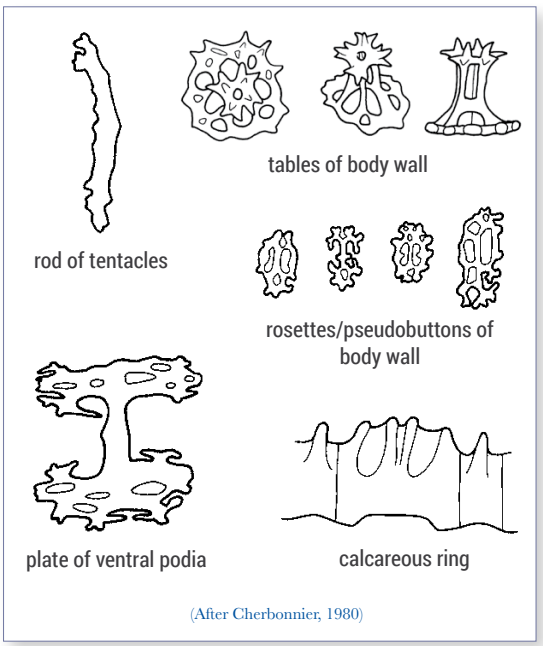
Ossicles: Tentacles with simple slender rods of various size. Dorsal and ventral body wall with same type of tables and rosettes/pseudobuttons. Tables of ventral body wall with larger, more spinose disc, up to 60 µm across, than those of dorsal body wall. Table disc perforated by four central holes; spire ending in a Maltese cross. Rosettes simple, 20–25 µm long, more abundant dorsally than ventrally. Podia with pseudo-plates, 75–100 µm long, and rosettes of similar size as those in the body wall.

Processed appearance: Narrow cylindrical shape. Entire body surface smooth and black but specimens of the larger reef variety have transverse wrinkles across the dorsal surface. No cuts or small cut across mouth. Common dried size 5–12 cm.

Size: Maximum length about 45 cm (large morph). Average fresh weight: 200 g (Papua New Guinea and India), 300 g (Egypt), 335 g (Viet Nam), 400 g (Mauritius); average fresh length: 15 cm (Mauritius), 20 cm (Papua New Guinea and India), 23 cm (Viet Nam), 30 cm (Egypt).

HABITAT AND BIOLOGY

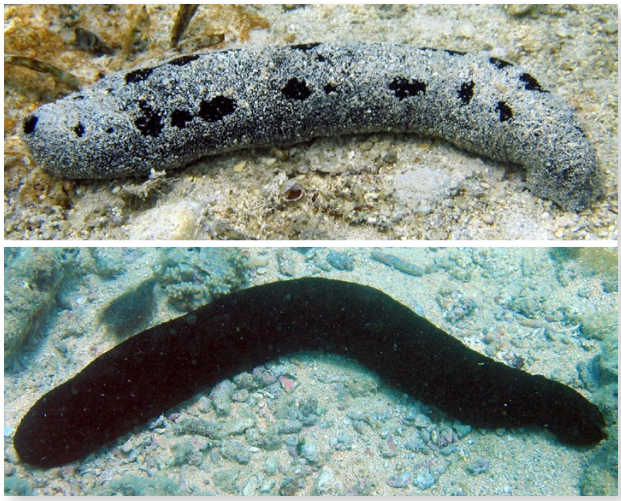
Inhabits the inner and outer reef flats, back reefs, shallow lagoons, sand-mud and rubble, and seagrass beds in 0–20 m depth. In Mauritius, it can be found in areas with the calcareous algae, *Halimeda* sp. In Mauritius, this species reaches size-at-maturity at 80 g drained weight. Reproduces sexually between February and April. In Fiji, it reproduces from September–December, while in the Great Barrier Reef (Australia) in January, May–June, and Novemebr–December. This species can reproduce asexually by fission in natural conditions, which seems to occur seasonally. In Réunion, spawning occurs in the warm season while fission occurs in the cool season.



(After Cherbonnier, 1980)

EXPLOITATION

Fisheries: Harvested throughout the Indo-Pacific artisanally (e.g. Viet Nam, Kiribati), semi-industrially (Mauritius), and industrially (Egypt). Harvested by hand collecting, free-diving, hookah diving, and SCUBA diving. Harvested for subsistence in Guam, Nauru, Samoa, Cook Islands, Nuie and French Polynesia. Exploited in Asia, including China, Indonesia, Japan, Malaysia, Philippines, Thailand and Viet Nam, and in the Indian Ocean and Red Sea, including Egypt, Eritrea, Madagascar, Mauritius, Mozambique, Seychelles, United Republic of Tanzania and Sri Lanka. In the Galápagos Islands (Ecuador), it is fished illegally.



LIVE ©S.W. Purcell

Regulations: Minimum size limits are: 30 cm wet and 15 cm dried in both Papua New Guinea and Solomon Islands; 20 cm wet and 10 cm dried in Vanuatu. Although seldom fished in Australia, a minimum live size limit is set at 15 cm in Torres Strait, the Northern Territory and Western Australia, and 20 cm on the Great Barrier Reef. In Maldives, the minimum live size limit of this species is 15 cm.

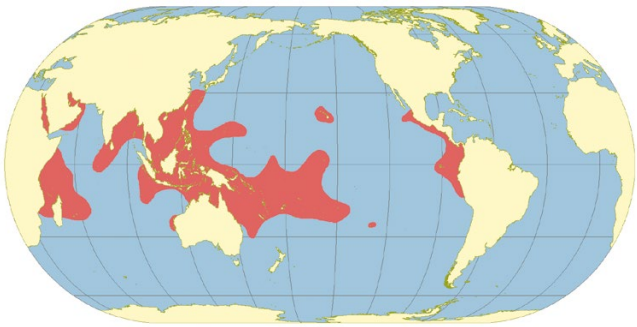
PROCESSED ©S.W. Purcell

Human consumption: In few Pacific Island nations, the body wall, intestines and/or gonads are consumed in traditional diets or in times of hardship. More often, it is dried and exported for consumption by Asians.

Main market and value: Code: **HFA**. Main market is China, Hong Kong SAR and China. Ho Chi Minh City in Viet Nam for further export to the Chinese market. Previously traded at USD 4–20 per kg dried in the Philippines and USD 2.5 per kg dried in Papua New Guinea. In Fiji (2014), fishers received USD 0.6–1.4 per kg fresh gutted. Retail prices in China, Hong Kong SAR (2011) were up to USD 210 per kg dried. Sold wholesale in Guangzhou (2016) for USD 31 per kg dried.

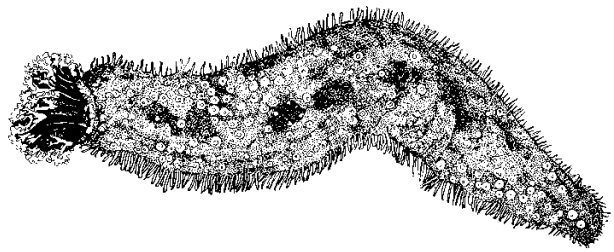
GEOGRAPHICAL DISTRIBUTION

Widespread in the Indo-Pacific, including the Mascarene Islands, East Africa, Madagascar, Red Sea, southeast Arabia, Persian Gulf, Maldives, Sri Lanka, India, Australia, the Philippines, China, Japan, Hawaiian Islands. Found in the islands in the central and eastern tropical Pacific, including Coco and Galápagos islands, Panama region, Clipperton Island and Mexico.



COMMON NAME

Zanga fleur (Madagascar).



DIAGNOSTIC FEATURES

Coloration is rusty to dark brown, with podia and tentacles lighter. Cylindrical body. The relatively long podia are abundant ventrally and numerous dorsally. Terminal mouth with 20 dendro-peltate tentacles, well developed. The terminal anus has 2 or 3 small papillae. This species does not have Cuvierian tubules.

Ossicles: Tentacles with rods, 60–140 µm long, finely rugose at the sides. Dorsal and ventral body wall with similar tables and rods. Tables more numerous in the dorsal than in the ventral body wall. Tables with discs 35–55 µm across, smooth to slightly spinose rim, perforated by 4 central holes; spire ending in a wide Maltese cross. Rods rugose, more so dorsally, 65–100 µm long. Ventral and dorsal podia with similar ossicles to those in the body wall, but dorsal ones also with perforated plates, up to 120 µm long.

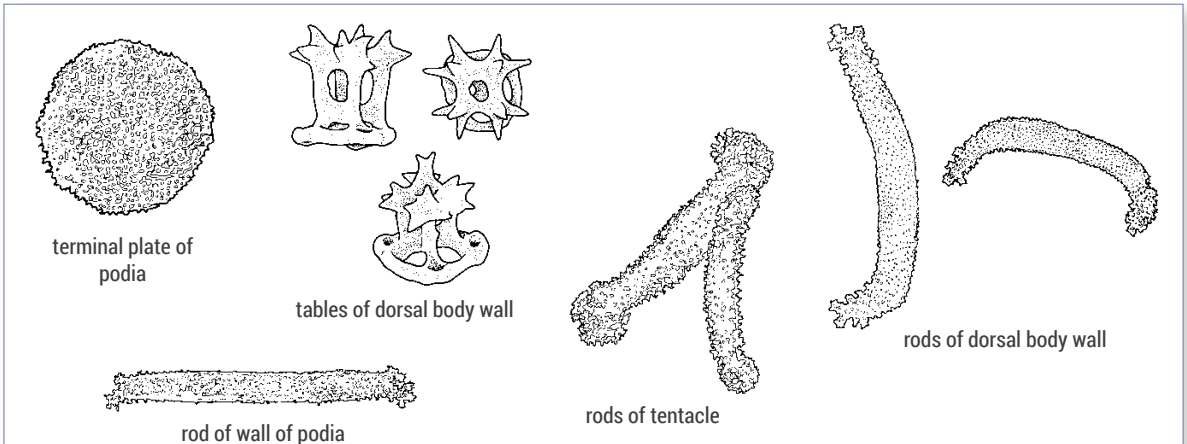
Processed appearance: Grey in colour with brown lines ventrally corresponding to rows of podia in the fresh animal. The dried product is shaped like small wooden sticks, and the buccal tentacles are extended, which is unusual in processed sea cucumbers.

Remarks: This species extends its tentacles out from sand and reef crevices where it seeks refuge.

Size: Maximum length about 16 cm. Average length is about 10 cm.

HABITAT AND BIOLOGY

In the Africa and Indian Ocean region this species lives in the outer reef over hard substratum generally between 0 and 3 m, but believed to be found at up to 20 m depth. It can be found over rocky bottoms in crevices with strong wave action where it suspension feeds on organic particles from the water column. In New Caledonia, it lives buried in coral sand with the tentacles extended for suspension feeding in sites with currents or wave action. In the Comoros, this species is found in the intertidal region. Similarly, in the Pacific it can be found on shallow reef flats. In Taiwan Province of China, it reproduces between April and June.



(Source: photos by Samyn, VandenSpiegel and Massin, 2006a)

EXPLOITATION

Fisheries: This species is fished in Guam and in the southern Cook Islands in subsistence fisheries where its gonads are eaten. It is of commercial importance in China. It is occasionally fished in Madagascar.

Regulations: There are few regulations pertaining to the harvesting of this species.

Human consumption: The gonads of this species are eaten in subsistence fisheries. The body wall is also consumed by Asians.

Main market and value: Code: JCH. Unknown, but considered a low-value species.

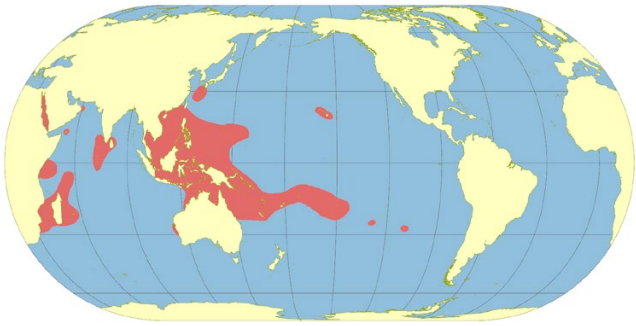
GEOGRAPHICAL DISTRIBUTION

East Africa and Indian Ocean, including the Red Sea, Soccotra Island, Oman, United Republic of Tanzania, Madagascar, Reunion Island, Mauritius, Maldives, India and Indonesia. Distribution continues into to the South China Sea, the Philippine Sea and Pacific Ocean, including Australia, China, Cook Islands, Easter Island (Chile), Guam, Hawaii (United States of America), Japan, New Caledonia and Philippines.

LIVE ©P. Bourjon

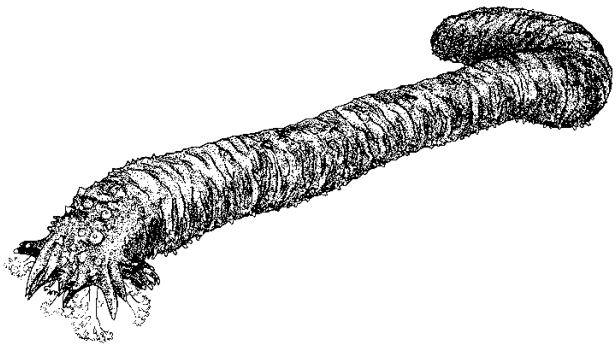
PROCESSED ©C. Conand

PROCESSED ©S.W. Purcell



COMMON NAMES

Snakefish (FAO), Holothurie serpent (FAO), Bat uwak, Tambor, Patola white (Philippines), Kichupa (United Republic of Tanzania, Zanzibar), Te'epupulu maka (Tonga), Taikokong, Talengko (Indonesia), Snekfis (Vanuatu).



DIAGNOSTIC FEATURES

Dark grey to black in colour, with distinctive yellow-tipped papillae, especially around the ventral margins and around the mouth. A very elongate holothuroid, cylindrical and narrowing near anterior end. Stiffened tegument, rough to the touch. The large mouth, which fans laterally, has large pale yellow tentacles, which also distinguish it easily from *Holothuria leucospilota* (which has black tentacles). Cuvierian tubules absent.

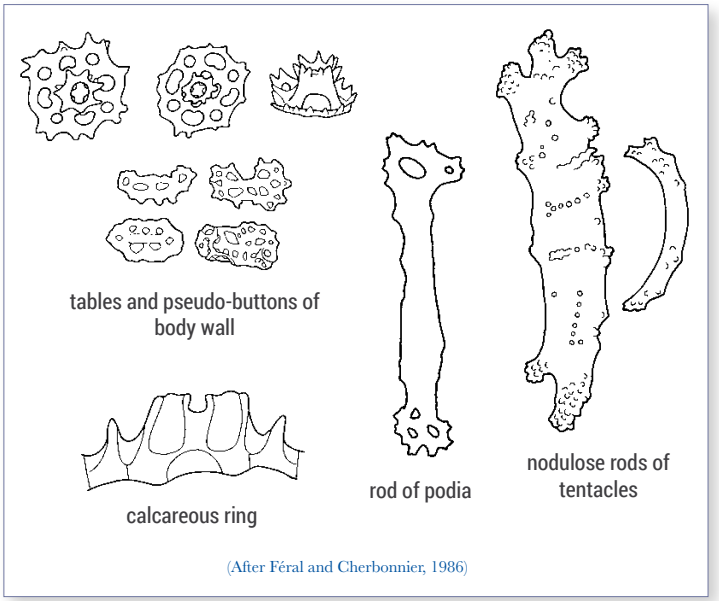
Ossicles: Tentacles with slightly curved and distally spinose rods, 40–165 µm long. Dorsal and ventral body wall with similar tables and buttons. Tables with disc 60–80 µm across, perforated by a single central and up to 12 peripheral holes, edge spinose and often turned upwards to give a so called "cup and saucer" appearance; spire low ending in a narrow crown of spines. Buttons are rare, and they have 3–5 pairs of holes and quite irregular in appearance. Podia with tables as in body wall and, in addition, perforated plates, 35–140 µm long, and rods with enlarged and often perforated extremities, 50–110 µm long.

Processed appearance: Long irregular skinny shape, clearly tapered at the anterior end. Brown body covered with tiny whitish bumps. Small cut across mouth and/or in the body middle. Common size 12–18 cm.

Size: Maximum length about 60 cm, commonly to about 40 cm. Average fresh weight from 140 g (Philippines) to 300 g (New Caledonia and Papua New Guinea); mean fresh length from 18 cm (Philippines), 26 cm (Indonesia), to 40 cm (New Caledonia and Papua New Guinea).

HABITAT AND BIOLOGY

Occurs in coastal and sheltered waters on reef flats, muddy-sand bays and reef lagoons and patch reef systems. Generally found in shallow water 0 to 8 m depth, but occasionally up to 15–25 m depth. Characteristically, this species shelters under boulders and at the edges of patch reefs, where it lodges its posterior end in hard structures, and ventures out far with its anterior end to feed on the surface of soft sediments. It reaches a size-at-maturity at 13 to 15 cm. It has an annual reproductive event.

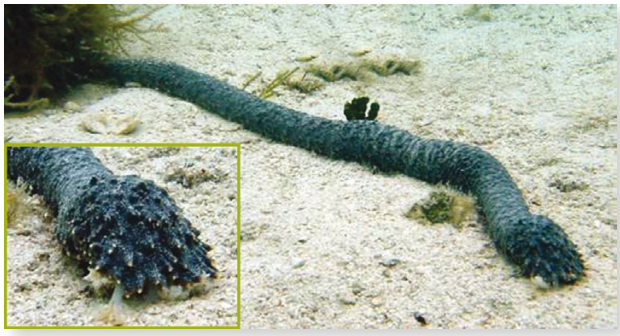


(After Féral and Cherbonnier, 1986)

EXPLOITATION

Fisheries: *H. coluber* is harvested in artisanal fisheries in much of its range. In the Philippines, Papua New Guinea, New Caledonia, Fiji and Tonga, this species is collected by hand by gleaners on reef flats, but also harvested by free diving in shallow waters. It is fished in many countries within its distribution in the western central Pacific. It is heavily exploited in Indonesia and the Philippines and sometimes fished in Madagascar. The Philippines reportedly exports this species to China to be used as a fertilizer.

Regulations: Fishing for this species in Papua New Guinea has been regulated by a fishing season, a TAC, gear restrictions and permits for storage and export. Minimum size limits are: 40 cm wet and 20 cm dried in Vanuatu; 30 cm wet and 20 cm dried in Solomon Islands.



LIVE ©S.W. Purcell

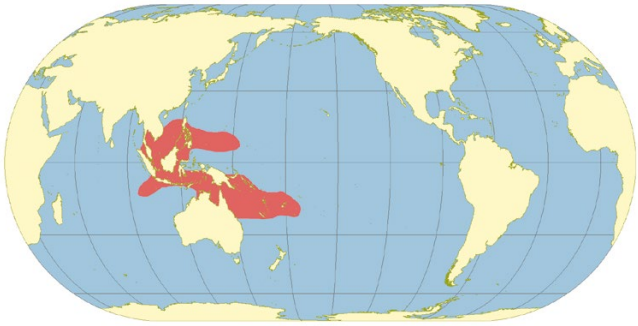
PROCESSED ©J. Akamine

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Code: **HHW**. Main market is China. In the Philippines, it has been sold at USD 4–20 per kg dried. In Fiji (2014), fishers received USD 1.4–2.5 per kg fresh gutted. Sold wholesale in Guangzhou (2016) for USD 37 per kg dried.

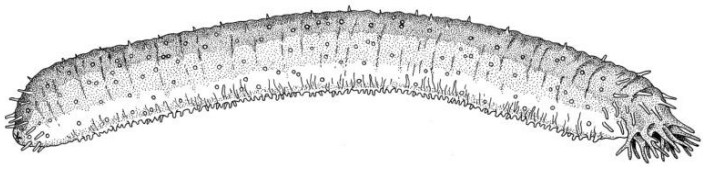
GEOGRAPHICAL DISTRIBUTION

Common in the Pacific, as far east as Tonga in the south and in the northern Pacific to Pohnpei and Kosrae in Micronesia. It is also widely distributed in Southeast Asia, including Viet Nam, Indonesia, Malaysia and Timor Sea. Apparently absent in much of the Indian Ocean, but has been recorded from western Indonesia and Cocos (Keeling) Islands.



COMMON NAMES

Lolly's mother (Fiji), Big hilla (Guam).



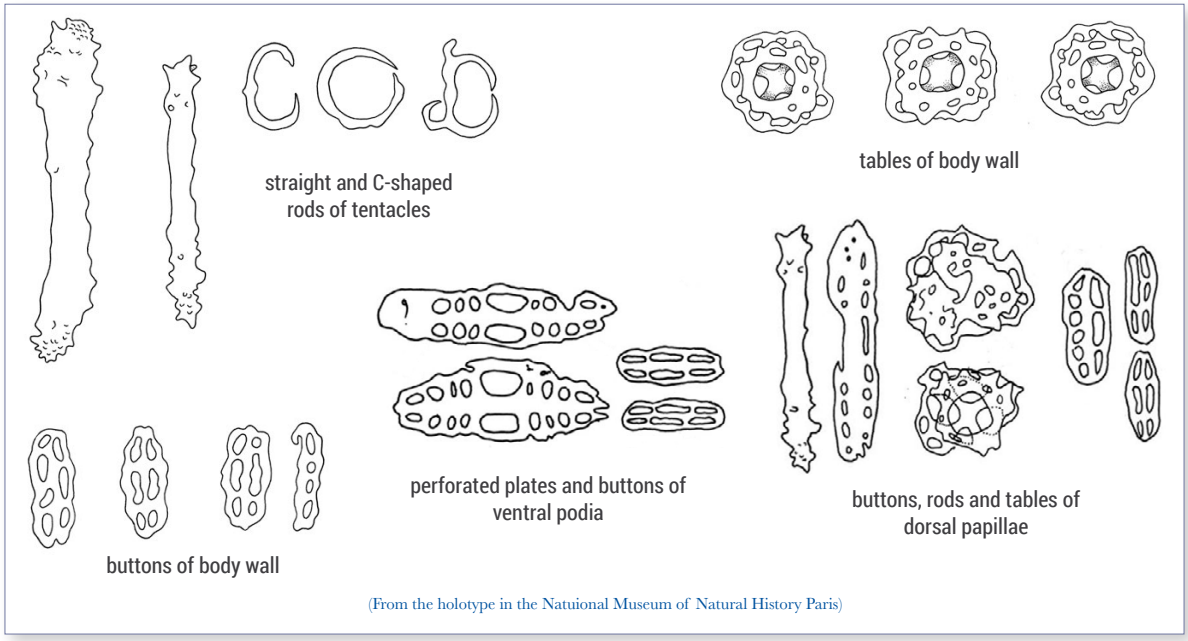
DIAGNOSTIC FEATURES

Body wall is slightly rough to the touch, 1–2 mm thick and pliable, giving a wrinkled appearance when contracted. Mouth ventral, anus sub-dorsal; not tapering at ends. Dorsal surface is arched, ventral surface is somewhat flattened. Body is orange-brown dorsally and light-peach ventrally. Dorsal papillae light to dark brown, spread over the complete surface; those at the mouth and anus are larger. Ventral podia are peach to light-brown coloured and numerous. Posesses 20 light brown tentacles. Cuvierian tubules absent.

Ossicles: Tentacles with slightly rugose rods, 55–240 µm long and small C-shaped rods, 20–32 µm long. Dorsal and ventral body wall with tables and buttons. Tables with disc, 40–50 µm wide, perforated by four central holes and one or two rings of peripheral perforations, rim of disc smooth to spiny; spire, 35–50 µm high, with four pillars united by a single cross-beam, ending in an open crown. Buttons are 55–65 µm long, rather irregular with undulating, smooth rim, perforated by 3–4 pairs of holes. Dorsal and anal papillae with tables and buttons (similar to body wall) and perforated rods, 100–270 µm long. Ventral podia with tables and buttons (similar to the body wall) and perforated plates, 110–160 µm long, and slender C-shaped rods, 30–60 µm long.

Processed appearance: Long, slender products that are somewhat rough textured. The dorsal surface of the dried products is brown with dark brown to black transferse marks, while the ventral surface is more reddish-brown. The entire body surface is often covered with white deposits (ossicles expelled from the body wall).

Remarks: DNA sequence data further suggest that *H. coronopertusa* is to be classified in the subgenus *Mertensiothuria*. Carapid fish appear to be common commensals. While Cherbonnier's (1980) original description mentioned C-shaped ossicles from the body wall, further examination showed these are from the podia and tentacles.



(From the holotype in the Natuional Museum of Natural History Paris)

Size: Uncontracted individuals range in lengths up to 1 m or more and body widths 10–15 cm, making it the second longest member of the genus *Holothuria* (second to *H. thomasi*).

HABITAT AND BIOLOGY

Reported to be found in relatively deep waters from 20 to 30 m (New Caledonia), 33 m (eastern South Africa), 35 m (Palau), 45–50 m (Okinawa), 70–90 m depth (Mayotte) to 100 m (Guam). The species forages on coralline sand, both during the day and during the night.

EXPLOITATION

Fisheries: Harvested in artisanal fisheries in much of its range. In the Solomon Islands and Fiji, it has been harvested in deep waters by divers targeting higher-value species such as *Holothuria fuscogilva* and *Thelenota anax* (K. Pakoa, personal communication).

Regulations: Not often listed in minimum size limit regulations because it is not well known by fishery officers. As it occurs in deep waters, it is subject to prohibitions on collection using scuba and hookah gear where those regulations exist.

Human consumption: Exported to Asian dried seafood markets as dried bêche-de-mer, probably mixed with other species.

Main market and value: unreported.

GEOGRAPHICAL DISTRIBUTION

Reported from the western Indian Ocean (KwaZulu-Natal, South Africa; Mayotte) and western Pacific Ocean (Okinawa, Palau, Guam, Fiji, New Caledonia (type-locality).

OTHER USEFUL INFORMATION

This species is harvested when fishers venture into deep waters with compressed-air gear. It is probably present in many other localities but not harvested yet due to its depth of occurrence, or not reported correctly in fishery statistics.

LIVE ©Association Service de Plongée Scientifique - Programme MesoMay

LIVE ©B. Van Bogaert

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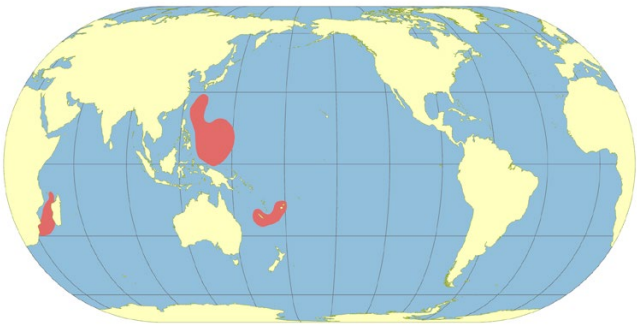
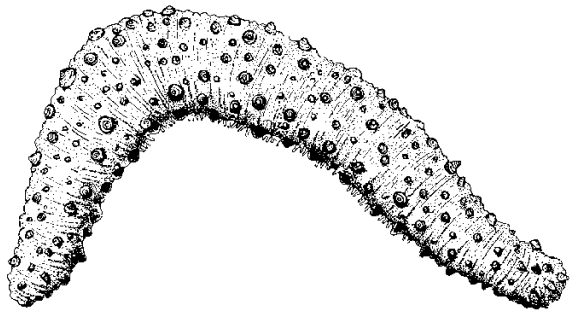


COMMON NAMES

Not available.



DIAGNOSTIC FEATURES

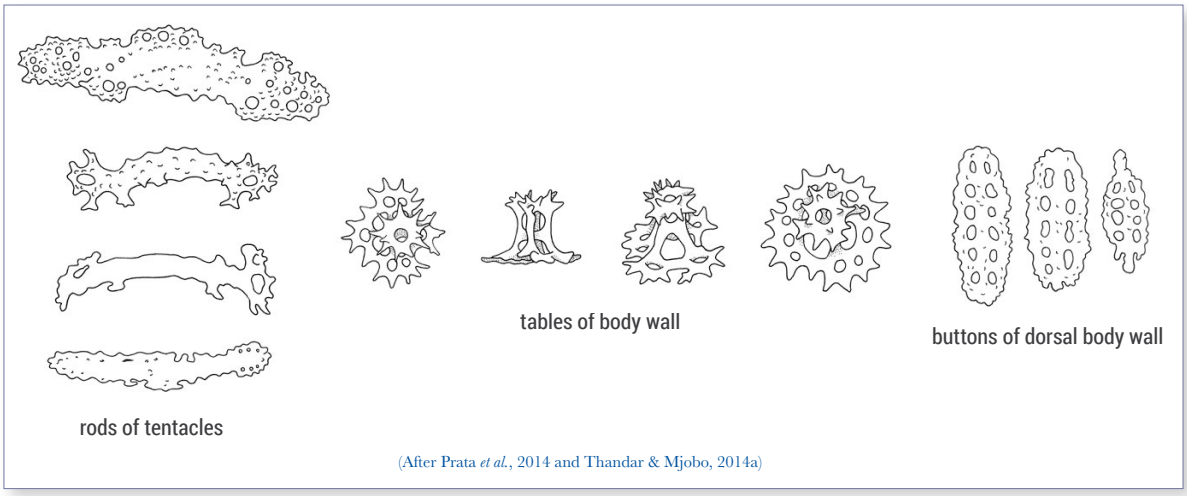
Body colour is brown or reddish-brown dorsally, fading to white or yellowish towards the ventral margins. The dorsal surface is speckled in coloration. The body is rounded dorsally, sometimes with body wrinkles, and has numerous large pointed papillae with elongate tips yellow to brown in colour that are loosely arranged in six rows. There are fewer, larger papillae on the ventro-lateral margins. The body wall is thin and rough to the touch. Numerous ventral podia are arranged in four to six rows. The anus is terminal, lacking anal teeth.

Ossicles: Ossicles from the tentacles include perforated plates (around 320 µm long), perforated rods (around 230 µm long) and simple rods (around 125 µm long). The body wall has tables of four pillars, with a disc, approximately 45–100 µm in diameter and 30–80 µm high. The buttons are about 50–160 µm long, usually with two or more series of holes. The podia possess buttons, plates similar to those of the body wall, rods about 220–240 µm long and endplate approximately 140 µm in diameter. Tables are larger in dorsal tissues. The perforated plates are longer in ventral tissues and broader in dorsal tissues. Plates of tentacles are large.

Processed appearance: Dried products are golden yellow-orange ventrally and blending to brownish orange dorsally. The dried sea cucumbers are slender, being approximately five times in length compared to their width. The body wall is heavily wrinkled and bumpy when fully dried. Some white deposits (from ossicles expelled from the body wall) can still be apparent, especially within wrinkles of the dried body wall.

Size: Reported to reach about 14 cm in length. A specimen collected in Brazil was 7.2 cm long and 2.6 cm wide. Specimens from Ghana measured 5.7 cm and 5.1 cm in length.

Remarks: Specimens from Cape Verde and the Gulf of Mexico appear similar. However, different morphotypes appear to be linked with the habitat and/or geographical distribution, differing on the dorsal/ventral coloration and size of the lateral papillae.



(After Prata *et al.*, 2014 and Thandar & Mjobo, 2014a)

HABITAT AND BIOLOGY

In West Africa, the species is often found close to or underneath rocks, on sand or mud substrates at depths ranging from 10 to 54 m. Found in Senegal and Angola at about 17 m depth. They can be found on calcareous sand and coral rubble bottoms, sometimes close to rocky reefs or partly buried in sediments, into crevices and on sand under rocks. Also recorded in muddy substrates associated to macroalgae. Its reproductive biology is unknown.

LIVE ©T. Dias

EXPLOITATION

Fisheries: Likely harvested in artisanal fisheries in West Africa, using breath-hold diving and compressed-air diving.

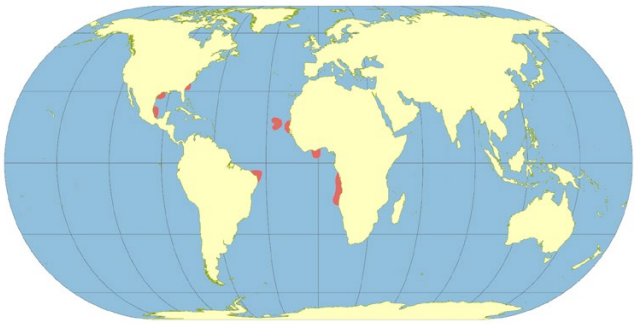
Regulations: The presence of *H. dakarensis* has been described in Cape Verde, where new legislation has allowed harvesting of sea cucumbers using compressed-air diving.

Human consumption: Exported dried to Asian seafood markets, probably China, Hong Kong SAR and mainland China. It is also consumed fresh by some local populations in southern Angola.

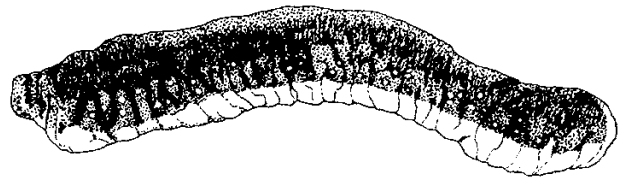
Main market and value: Sold in China, Hong Kong SAR in 2022 for USD 102 per kg dried.

GEOGRAPHICAL DISTRIBUTION

Known from Cape Verde, Senegal, Ghana and Angola. Also reported from North Carolina, Georgia and Texas (United States of America), Isla de Lobos (Mexico) and Rio Grande do Norte (east Brazil) (see Prata *et al*., 2014a).



COMMON NAMES



Pinkfish (**FAO**), Trépang rose (**FAO**), Kadal attai (India), Saâu gai (Viet Nam), Red beauty, Red-black, Hotdog (Philippines), Pink lollyfish (Africa and Indian Ocean region), Abu sanduk tina (Eritrea), Stylo rouge (Madagascar), Cera Dada, Lakling merah (Indonesia), Loli kula (Tonga), Tenautonga (Kiribati), Dri-damu (Fiji), Rathu attaya (Sri Lanka), Pinkfis (Vanuatu).

DIAGNOSTIC FEATURES

Dark grey, chocolate brown or black dorsally, fading laterally to pink or whitish pink ventrally. Ventral surface with small dark spots. A small to medium-sized, sausage-shaped holothuroid. Body subcylindrical. Tegument somewhat rough with sparse papillae on dorsal surface. Ventral podia are short but stout, numerous and light coloured. Anus terminal and Cuvierian tubules absent.

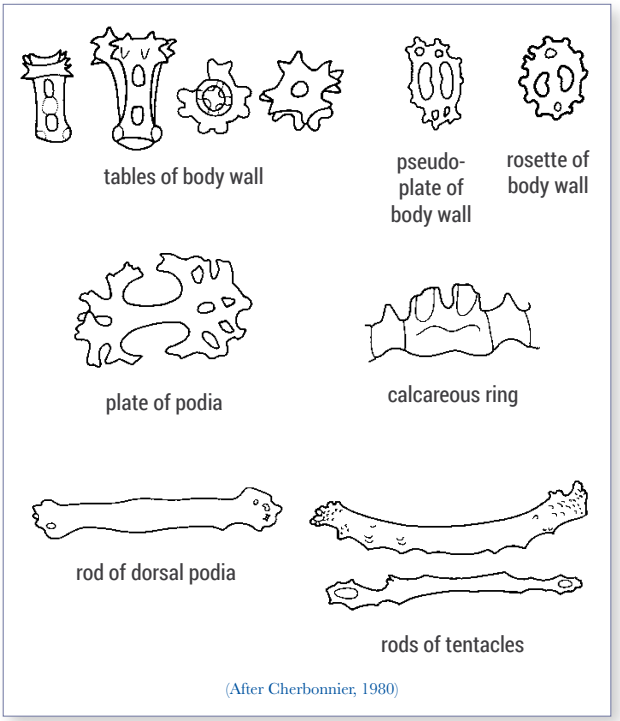
Ossicles: Tentacles with curved rods that have enlarged spiny extremities, 70–180 µm long. Dorsal and ventral body wall with similar tables and button-like rosettes. Tables with disc greatly reduced, on average 35 µm across, perforated by 1 central hole; spire ending in a Maltese cross. Button-like rosettes perforated by 4–10 uneven holes and with uneven rim, 30–70 µm long. Ventral podia with perforated plates, 100–140 µm long, and shorter rods. Dorsal podia with large rods that can have few perforations, 135 µm long on average.

Processed appearance: Narrow cylindrical shape, slightly flattened ventrally. Dorsal surface with small wrinkles, dark brown; ventral surface is smoother, light to medium brown. No cuts or small cut across mouth. Common dried size 10–14 cm.

Size: Maximum length 38 cm; commonly to about 24 cm. Average fresh weight 200 g; average fresh length 20 cm.

HABITAT AND BIOLOGY

Found mostly on silty-sand or sand mixed with coral rubble. Occupies semi-sheltered reef habitats, namely reef flats and lagoon patch reefs near the coast from 0 to 20 m depth; reported to 80 m. Also found in seagrass beds and sometimes on hard reef surfaces. Asexual reproduction by fission is annual, but the sexual reproduction cycle is uncorrelated and appears continuous. In southern Viet Nam, transverse fission has been recorded in June at the beginning of the rainy season. On the Great Barrier Reef, this species reproduces sexually between December and January.



EXPLOITATION

Fisheries: Harvested in artisanal fisheries in much of its range in the Indo-Pacific. Harvesting in Papua New Guinea involves hand collection, free diving and use of lead-bombs. In Viet Nam, this species is gathered using hookah diving. In Asia, this species is fished in China, Japan, Malaysia, Thailand, Indonesia, the Philippines and Viet Nam. In Indonesia and the Philippines, it is heavily exploited. This species is of low commercial importance in Kenya and Madagascar. It is not of commercial importance in Seychelles, New Caledonia and Australia. It is sometimes collected for the aquarium trade.

Regulations: In New Caledonia, there is a prohibition for the use of compressed air apparatus, fishers must be licensed and there are no-take reserves. In Papua New Guinea, there are minimum size limits (25 cm live; 10 cm dry), a fishing season, a TAC, gear restrictions and permits for storage and export. Minimum size limits are 20 cm wet and 10 cm dried in Vanuatu and Solomon Islands.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Code: **HFE**. Main markets are China and southeast Asia. It is a low-value species. Exported to Ho Chi Minh City (Viet Nam) for further exports to Chinese markets. It has been traded at USD 4–20 per kg dried in the Philippines.

LIVE ©S.W. Purcell

LIVE ©A. Ryanskiy

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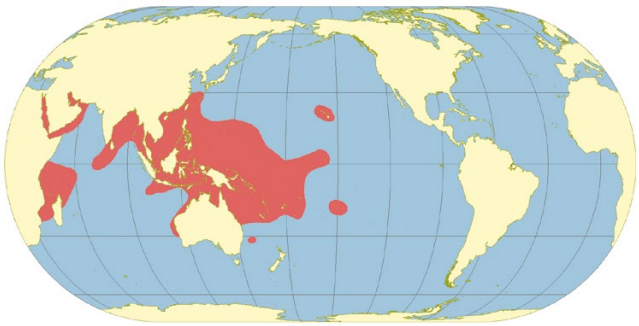
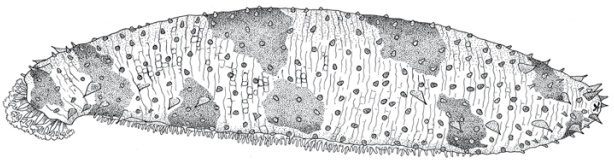
GEOGRAPHICAL DISTRIBUTION

East Africa, Madagascar, Red Sea, southeast Arabia, Sri Lanka, Bay of Bengal, East Indies, north Australia, Philippines, China and southern Japan, South Pacific islands. In India, this species is distributed in the Gulf of Mannar and the Andamans. Pacific and Southeast Asia, extending to French Polynesia in the southeast and Hawaii (United States of America) in the northeast.



COMMON NAMES

Pepino lápiz, Pepino de mar negro, Pepino de Florida (Mexico), Pencil sea cucumber, Florida sea cucumber (United States of America), Molongo (Nicaragua).



DIAGNOSTIC FEATURES

Body coloration highly variable, ranging from dark yellow, brown, grey or red. Some individuals may be speckled with yellow, brown, and white spots dorsally. Cylindrical body, narrowing towards the anterior end. The mouth is ventral and the anus is terminal. Scattered on the ventral surface are numerous, randomly situated podia, which cannot be completely retracted. The body wall is thin and smooth, although the short, cylindrical podia in the dorsal area lie on small papillae. No Cuvierian tubules.

Ossicles: Tentacles with small rods, around 100 µm long. Body wall ossicles in the form of tables and rosettes. The tables are much less numerous than the rosettes. Tables present a tall spire (50–60 µm in height) composed of four pillars, each one ending in three teeth (one vertical and two horizontal), and a small disc with a long central perforation and four marginal ones. The rosettes are small (20–30 µm in diameter) and concentrated mainly around the podia bases.

Processed appearance: Cylindrical and slender shape, often somewhat more slender at the anterior end. The body wall of the dried product is generally beige in colour and has small spots on the dorsal surface, consisting of small dark dots interspersed among smaller white dots. Wart-like bumps are prominent at the anterior and posterior ends and along the margins of the body. The dried product can be very hard.

Remarks: *H. floridana* and *H. mexicana* can hybridize and the offspring share ossicles of both parents.

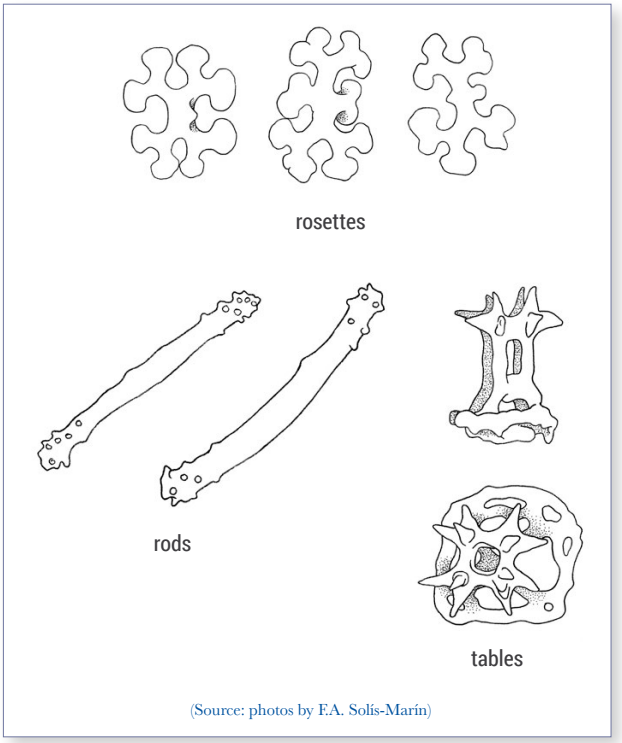
Size: Commonly body length is 25 cm, with a body weight of 400–500 g. Reported to be found up to 45 cm in length, weighing 750 g.

HABITAT AND BIOLOGY

Generally inhabits shallow waters, 0–10 m depth, mostly under rocks or in seagrass beds. Can bury in sand. It is a cryptic species. In the Gulf of Mexico, a density of 250 ind/ha has been reported. The reproductive cycle is seasonal, with a spawning period in late summer in southern Florida and the Bahamas. In the Gulf of Mexico it reproduces throughout the year, more so from December to April. Maturity is reach at 13 cm body length.

EXPLOITATION

Fisheries: Fished throughout the Caribbean in multi-species fisheries. It is collected by fishers using free-diving and SCUBA in artisanal fisheries.



(Source: photos by F.A. Solís-Marín)

This species is considered of medium-low commercial importance in fisheries, although collected alongside more valuable species when encountered.

Regulations: Harvests of this species are mostly unregulated. In Panama, there is a fishing moratorium since 2009.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: China is considered to be the main market destination. In Mexico, prices paid to fishers range from USD 30 to 35 per kg dry, depending on size and condition.

GEOGRAPHICAL DISTRIBUTION

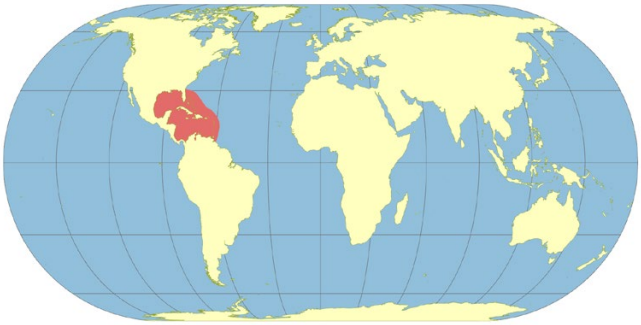
Throughout the Caribbean and Gulf of Mexico: Aruba, Bahamas, Belize, Colombia, Cuba, Dominican Republic, Florida (United States of America), Haiti, Honduras, Jamaica, Mexico, Panama, Puerto Rico and Venezuela (Bolivarian Republic of).

Other useful information: It is listed as Least Concern on the IUCN Red List.

LIVE ©K. Miller

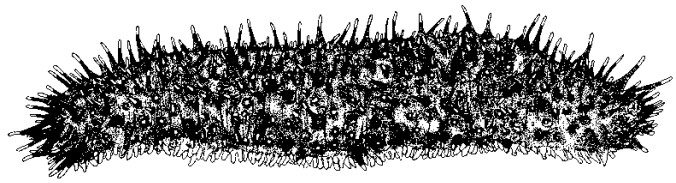
LIVE ©K. Miller

PROCESSED ©F.A. Solís-Marín



COMMON NAMES

Cotton spinner, Black sea cucumber (European Union, United Kingdom of Great Britain and Northern Ireland, Türkiye).



DIAGNOSTIC FEATURES

Cylindrical, moderately stout body with a soft texture. There are two main colour types: (1) dorsally dark brown or black with large papillae and ventrally whitish, and (2) dorsally yellowish with brown or black mottling (from deeper waters in Northeast Atlantic). The ventral surface is usually paler in colour, often yellowish. Dorsal surface and lateral margins with numerous conical papillae with white tips, irregularly arranged. Numerous podia ventrally, in three rows. Twenty light-brown or yellowish peltate tentacle.

Ossicles: Ossicles are relatively sparse and there are no buttons. Small tables with discs <50 µm in width, with four central holes and no, or a limited number of peripheral holes. Elongate, irregularly branched rods, 100–150 µm long, are present in podia and papillae. Curved rods of 200–300 µm in length occur in the tentacles.

Processed appearance: This species is commonly sold domestically in an unprocessed state. When dried, the products are dark brown or black with the small conical papillae along the body still apparent dorsally. Commonly cut in the middle of the ventral surface and 10 cm in length.

Remarks: Called the "Cotton spinner" because it readily discharges white Cuvierian tubules. Can appear similar to *H. mammata*, which lives in same habitats, but *H. forskali* has smaller papillae with white tips and it ejects Cuverian tubules readily upon slight provocation.

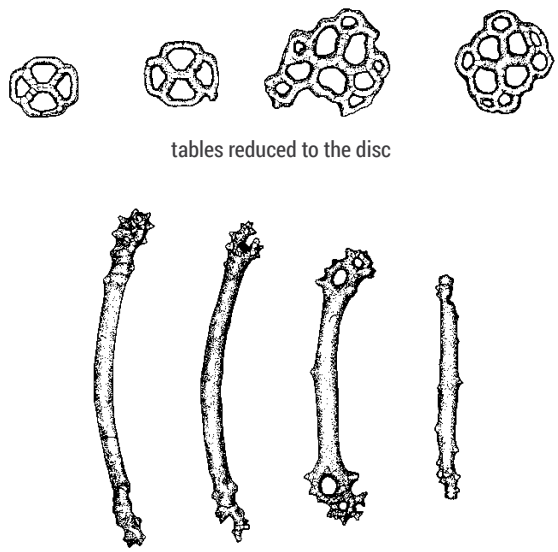
Size: Commonly 260–270 g whole weight and 28 cm length (Northwest Spain). Max. length 45 cm, max. weight 622 g. In Portugal, to 80–120 g gutted weight. In France, commonly 27 cm and 150 g gutted weight.

HABITAT AND BIOLOGY

Inhabits shallow sublittoral areas on rocky substrata, with preference for vertical rocky faces, to 300 m depth although more abundant at around 50 m depth. Reproductively inactive in spring (Northwest Spain). Gametogenesis and spawning in summer. Gonads in resting phase during autumn and winter. Sex ratio is 1:1. Maturation reported to peak in November and February (Portugal).

EXPLOITATION

Fisheries: Has been harvested in Greece, Portugal (including Azores Islands), Spain, Tunisia and Montenegro, although exploitation now prohibited in some fisheries. In Greece, it is a secondary species. Catches in Spain were highest from 2014–2016.



(Source: photo by M. Wangüemert)

Regulations: Co-managed in Spain, using seasonal closures ranging 10–125 days. Fisheries existed in Azores Islands and mainland Portugal until a ban was enacted in 2021. Harvesting in Tunisia is largely unregulated. Harvesting prohibited in Italy since 2019, in Croatia since 2018 and in Montenegro since 2006. Harvesting in Greece by licensed fishers with VMS using free-diving and hookah during daylight hours during 6-month seasons annually (November–April), and a 'basket' quota of 400 *Holothuria* spp. animals no lighter than 180 g each.

Human consumption: Almost solely traded as dried bêche-de-mer or frozen, being consumed after being reconstituted. In Galicia (Spain) and Portugal it is sold fresh (in regional markets) and later frozen.

Main market and value: In Galicia (Northwest Spain), fresh product sold for USD 1.20–9.61 per kg (2017–2021). Prior to the moratorium, landing prices for fresh animals were USD 1.20–24.1 per kg in mainland Portugal (but mixed with other species, inflating prices), and USD 0.4–6.0 per kg in Azores Islands (Portugal).

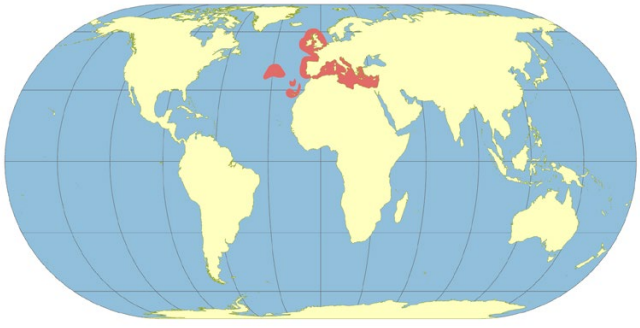
GEOGRAPHICAL DISTRIBUTION

Mediterranean Sea and Northeast Atlantic, from Scandinavia south to the coast of Morocco, including the Azores and Madeira (Portugal) and Canary (Spain) islands.

LIVE ©E. Gonçalves

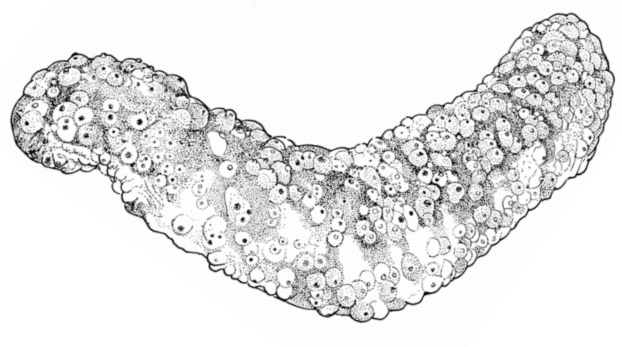
LIVE ©N. Silvestre

PROCESSED ©Porto-Muiños SL



COMMON NAME

Labuyo (Philippines), Coklat, Lakling coklat (Indonesia).



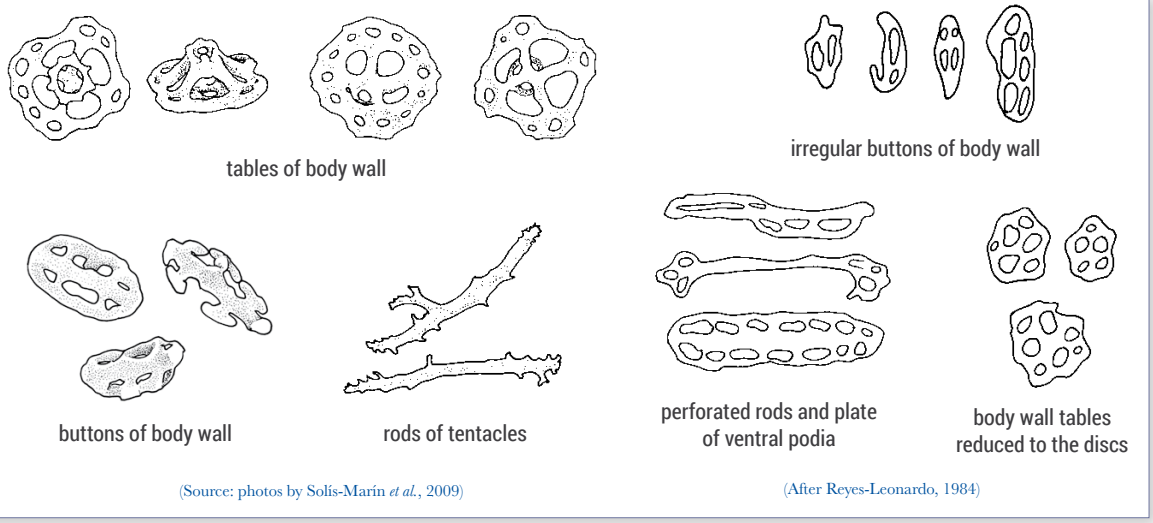
DIAGNOSTIC FEATURES

This species is greyish-brown or greyish-green dorsally and beige to brown ventrally. It may have brown blotches dorsally. It is a medium-to-large (>20 cm long), cylindrical species with a soft tegument. The brown papillae on the dorsal surface are wide at the base and narrow tipped. The podia of the ventral surface are sparse and small, but these are more numerous at the lateral flanks of the ventral surface. The ventral mouth has 20 large tentacles. Anus is dorsal and surrounded by a dark purple ring. It possesses very thick, numerous Cuvierian tubules, which are readily ejected.

Ossicles: Tentacles with curved rods, 50–400 µm long slightly rugose at extremites. Dorsal and ventral body wall with rather poorly developed tables and buttons. Table discs roundish and smooth, 25–40 µm across, perforated by 4 central and few peripheral holes, low spire ending in an ill-formed crown. Buttons, 25–40 µm long, smooth, irregular, with 1–3 pairs of holes. Ventral podia with irregular perforated rods, up to 235 µm long, large, perforated plates, 100–155 µm long, buttons up to 70 µm long, and tables with spire reduced to knobs on disc. Dorsal papillae with rods, up to 300 µm long, perforated distally and some large tables with spire reduced to knobs.

Processed appearance: Light brown in colour. The papillae on the dorsal surface should be evident as bumps in dried specimens.

Remarks: When live and unprocessed, this species can be distinguished easily from *Holothuria pervicax*. While *H. fuscocinerea* can be variable in appearance from light grey to banded with brown to dark brown, it never has pinkish bases to its papillae as *H. pervicax*, which is quite uniform in appearance. Moreover, only *H. fuscocinerea* has a dark brown ring about its anus and near the base of the ventral podia.



(Source: photos by Solís-Marín *et al.*, 2009)

(After Reyes-Leonardo, 1984)

Size: Maximum length 30 cm; average length is about 20 cm.

HABITAT AND BIOLOGY

Prefers habitats between 0 and 30 m depth. Found in lagoonal habitats, reef flats and on outer reef slopes of barrier reefs. In Kenya, it is a nocturnal species. Its reproductive biology is unknown.

EXPLOITATION

Fisheries: This species does not have a commercial value in the western central Pacific; however, it is of commercial importance in China, Malaysia and the Philippines. In China, it is of low commercial importance. It is exploited in a multispecies fishery in Sri Lanka.

Regulations: There are few regulations pertaining to the harvesting of this species.

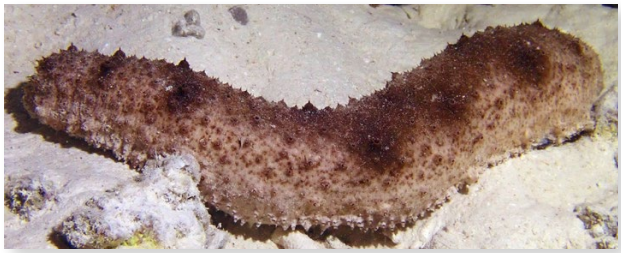
Human consumption: Not available.

Main market and value: Code: **JCJ**. Probably low value. It has been reported to have been traded at up to USD 3 per kg dried in the Philippines.

GEOGRAPHICAL DISTRIBUTION

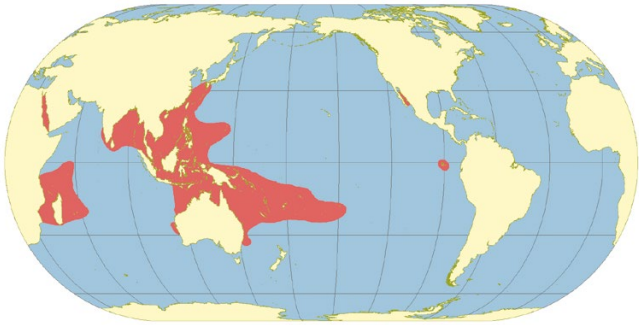
It can be found in the Indian Ocean, Red Sea, western central Pacific and Asia. Also distributed in Celebes and Amboina, Sri Lanka, Bay of Bengal, East Indies, northern Australia, the Philippines, China, southern Japan, Guam and South Pacific islands. Reported also from Galapagos Islands and Gulf of California.

LIVE ©G. Edgar

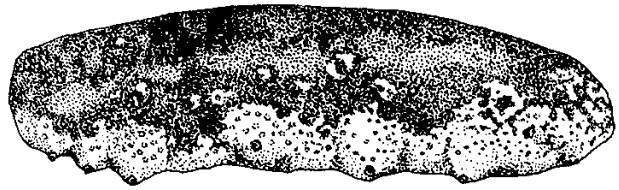


LIVE ©S.W. Purcell

PROCESSED ©J. Akamine



COMMON NAMES



White teatfish (**FAO**), White mammyfish (India), Holothurie blanche à mamelles (**FAO**), Kal attai (India), Bawny white (Egypt), Pauni myeupe (United Republic of Tanzania, Zanzibar), Benono (Madagascar), Le tété blanc (New Caledonia), Susuan (Philippines), Huhuvalu hinehina (Tonga), Temaimamma (Kiribati), Sucuwalu (Fiji), Preema attaya (Sri Lanka), Kokosier blan (Seychelles), Susu putih, Bissawa (Indonesia), Waet titfis (Vanuatu), White susu (Solomon Islands).

DIAGNOSTIC FEATURES

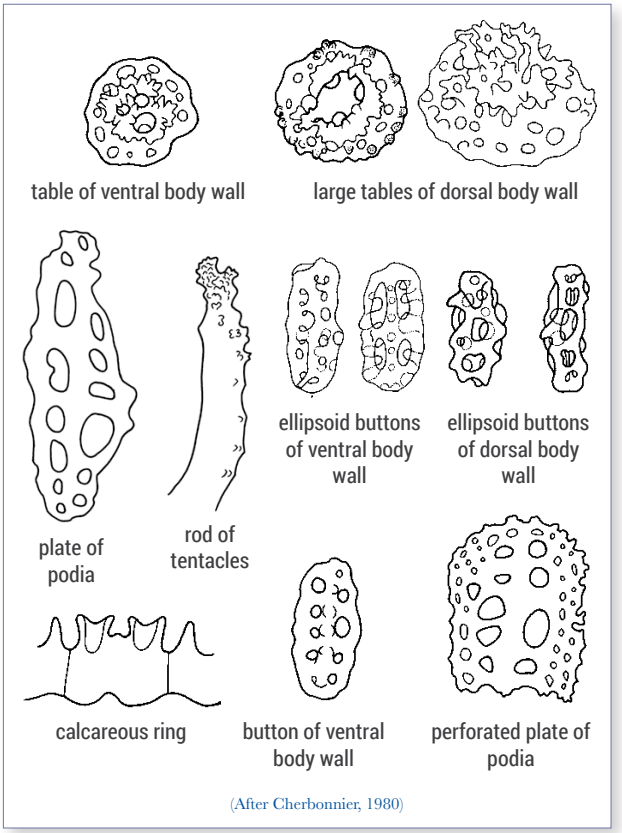
Colour variable, from completely dark brown, to dark grey, or whitish or beige with dark brown spots or blotches. In the western Indian Ocean, the dorsal colour can be reddish-brown and the anus is yellowish. Ventral surface is greyish-beige. Body is suboval, strongly flattened ventrally, stout and quite firm with a thick body wall, and has large lateral protrusions ('teats') at the ventral margins. Podia are sparse and small dorsally but numerous ventrally. Body is usually covered by fine sand. Mouth is ventral with 20 stout grey tentacles. Anus has five small, roundish, yellow teeth. No Cuvierian tubules. Juveniles are yellowish-green or beige with black blotches.

Ossicles: Tentacles with stout rods, up to 700 µm long, rugose distally. Dorsal body wall with tables and ellipsoid buttons. Table disc roundish and undulating, 65–100 µm across, perforated by 10–15 holes, low spire ending in a stout crown of spines that can have more than one layer in the largest tables. Ellipsoid buttons irregular, some 65 µm long. Ventral body wall with similar tables and ellipsoid buttons as those dorsally, and, in addition, slightly knobbed buttons, 60–80 µm long. Ventral and dorsal podia with large perforated plates.

Processed appearance: Flat and stout shape with obvious teats along sides. Surface smooth to slightly wrinkled and powdery. Entire body different shades of grey-brown. One single cut dorsally but not completely to the mouth or anus. Common size 18–24 cm.

Remarks: Uthicke, O'Hara and Byrne (2004) reports a wide Indo-Pacific distribution. The lateral "teats" may appear longer than in *H. whitmaei*.

Size: Maximum length about 57 cm. Average fresh weight from 2 400 g (Madagascar, India and Papua New Guinea) to 3 000 g (Egypt); average fresh length from 40 cm (India and Madagascar), 42 cm (Papua New Guinea) to 60 cm (Egypt). In New Caledonia, average live weight about 2 440 g and average live length about 28 cm.



HABITAT AND BIOLOGY

Commonly inhabits outer barrier reef slopes, reef passes and sandy areas in semi-sheltered reef

habitats in 10 to 50 m water depth; reported to be found as deep as 100–120 m. Can also be found in seagrass beds (Papua New Guinea and India). In Fiji, it was reported to recruit in shallow seagrass beds and the moves to deeper zones. Attains maturity at around 1.1 kg. In New Caledonia, it reproduces between November and January, while in Solomon Islands between August and October.

LIVE ©S.W. Purcell

PROCESSED ©S.W. Purcell

EXPLOITATION

Fisheries: Harvested in artisanal (e.g. the Philippines, Tonga, semi-industrial and industrial fisheries (Australia) throughout its range in the Indo-Pacific, and ranks among the top commercial species. It is harvested by hand collecting, free diving and lead-bombs and by SCUBA diving (Madagascar) and hookah (Australia). In many fisheries *H. fuscogilva* has been overexploited. In the Africa and Indian Ocean region, it is fished in the Comoros, Mozambique, Kenya, Madagascar and Seychelles. In the Seychelles, it was considered fully exploited.

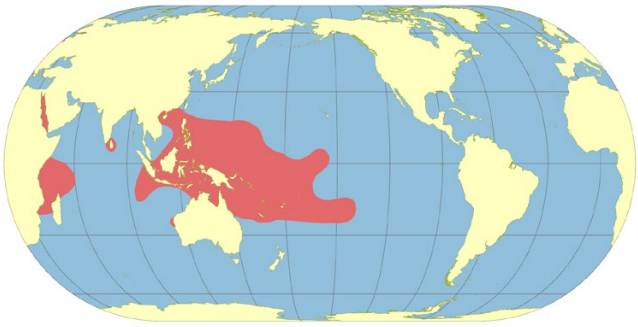
Regulations: Minimum size limits are: 35 cm wet and 15 cm dried in Papua New Guinea and Solomon Islands; 35 cm wet and 16 cm dried in Vanuatu; 32 cm wet in Torres Strait (Australia). On the Great Barrier Reef, Australia, there is an overall TAC, reviewed periodically and a size limit of 32 cm is imposed. In New Caledonia, the minimum size limit is 35 cm for live animals and 16 cm dried. Harvesting using compressed air is prohibited in New Caldonia and Maldives. Listing on CITES Appendix II has forced countries to document harvesting as non-detrimental (NDF) in order to export it.

Human consumption: Mostly, the reconstituted body wall is consumed by Asians and is highly regarded.

Main market and value: Code: **HFF**. Sold dried for USD 17–33 per kg in Papua New Guinea and USD 42–88 per kg in the Philippines. In New Caledonia, it was exported (2007) for USD 40–80 per kg dried and fishers received USD 7 per kg wet weight. In Fiji (2014), fishers received USD 30–55 per piece fresh. In Guangzhou markets (2016), average price was USD 154 per kg dried; max. USD 219 per kg dried. Prices in China, Hong Kong SAR retail markets (2022) averaged USD 294 per kg dried; max. USD 401 per kg.

GEOGRAPHICAL DISTRIBUTION

From Madagascar and the Red Sea in the west, across to Easter Island in the east and from southern China to south to Lord Howe Island (Australia). Occurs throughout much of the western central Pacific as far east as French Polynesia.

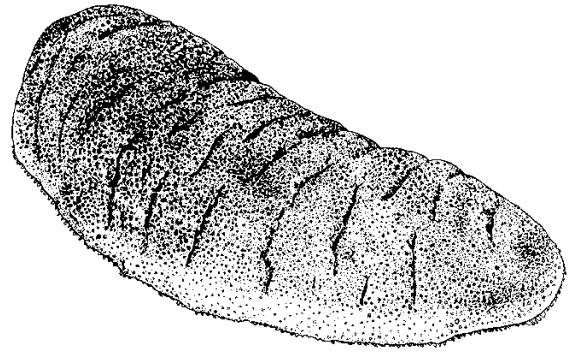


OTHER USEFUL INFORMATION

This species is listed as Vulnerable on the IUCN Red List and is listed on CITES Appendix II.

COMMON NAMES

Elephant trunkfish (**FAO**), Holothurie trompe d'éléphant (**FAO**), Betaretry (Madagascar), Barangu mwamba (United Republic of Tanzania, Zanzibar), Sapatos (Philippines), Ngoma (Kenya), Kunyi (Indonesia), L'éléphant (New Caledonia), Terebanti (Kiribati), Elefanite (Tonga), Dairo-ni-cakao (Fiji), Elephant trunkfish (Seychelles), Elefenfis (Vanuatu).

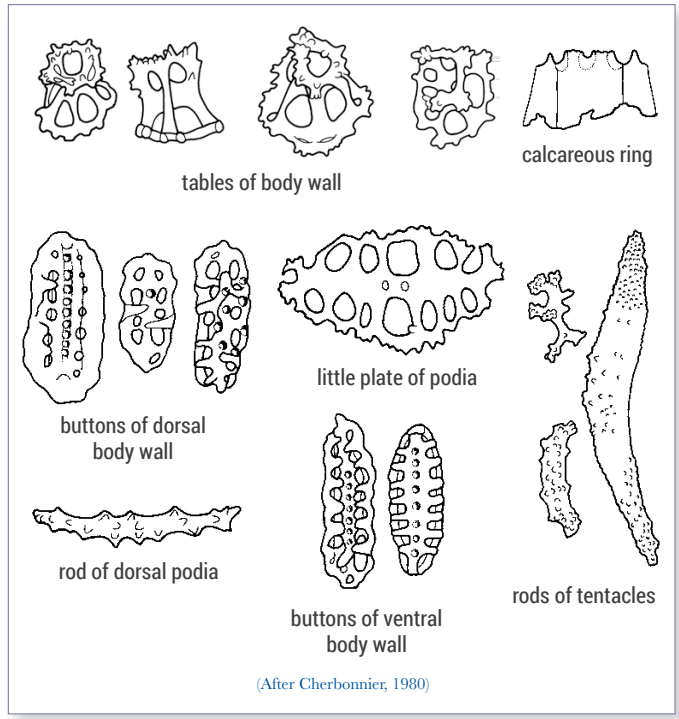


DIAGNOSTIC FEATURES

Coloration varies a little from golden to light brown or creamy dorsally with numerous brown spots (around papillae), shading to whitish ventrally. This species has characteristic deep, brown wrinkles dorsally (like part of an elephant's trunk). Body is suboval, arched dorsally and strongly flattened ventrally. A large species with a stout body and thick body wall. The body is often covered by fine sediment. Mouth ventral with 20 stout, brown, tentacles. Anus is large and black, has no teeth, and is surrounded by five groups of papillae. No Cuvierian tubules.

Ossicles: Tentacles with straight rods, 30–150 µm long, slightly spiny. Dorsal and ventral body wall with numerous tables and ellipsoid buttons, with ventrally also some smooth and knobbed buttons. Tables have small discs, 35–55 µm across, with irregular and spiny rim, perforated by 4 central and few peripheral holes, and a low spire that ends in a spiny crown. Ellipsoid buttons perforated by 4–6 pairs of holes, on average 75 µm long. Dorsal and ventral podia with spiny plates which can take the form of irregular branching rods.

Processed appearance: Processed animals are relatively elongate, arched dorsally, flattened ventrally. Light brown to beige dorsally with deep grooves. Ventral surface is smoother. Tiny black spots are noticeable over whole body. Small cut across mouth or one single long cut ventrally. Common dried size 20–25 cm.



Remarks: The body fluid is bright yellow and stains, making this species undesirable to harvest and gut.

Size: Maximum length about 70 cm; average length about 48 cm. Average adult weight 3 kg; maximum 5.5 kg.

HABITAT AND BIOLOGY

H. fuscopunctata lives in shallow waters, generally from 3 to 25 m depth; reported to 64 m. Inhabits reef slopes, lagoons and seagrass beds over sandy bottoms. Generally found on coarse sand or coral

rubble. It attains size-at-maturity at 1 200 g. On the Great Barrier Reef (Australia), this species reproduces annually in December, while in New Caledonia from December to February.

EXPLOITATION

Fisheries: This species is mostly fished artisanally. Harvested mostly by hand collecting by free-diving. Also collected using lead-bombs (e.g. Papua New Guinea) and SCUBA diving (Madagascar). In the western Pacific region, it is commercially exploited in most localities, east to Tonga. Previously harvested in Papua New Guinea, Solomon Islands and Vanuatu before a general moratorium. Harvesting is minimal in New Caledonia, Coral Sea and Torres Strait (Australia). In Tuvalu, it comprises 8 percent of the total catches. In the Seychelles, this species is currently underexploited.

LIVE ©S.W. Purcell

PROCESSED ©S.W. Purcell

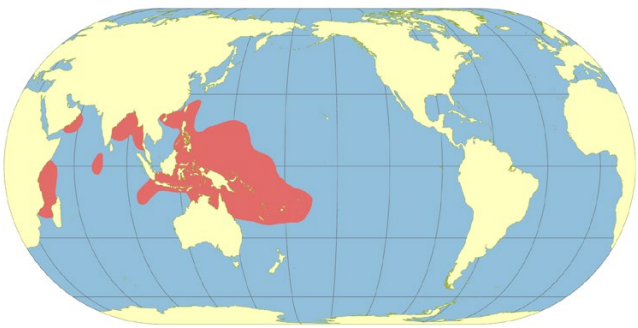
Regulations: Minimum size limits are: 45 cm wet and 15 cm dried in Papua New Guinea; 40 cm wet and 20 cm dried in both Vanuatu and Solomon Islands. In Torres Strait (Australia), there is a size limit of 24 cm live and it is part of a group of species with an annual "basket" catch quota.

Human consumption: Mostly the reconstituted body wall (bêche-de-mer) is consumed by Asians. Despite its thick body wall, the market price is relatively low because the flesh is bitter and numbs the mouth.

Main market and value: Code: HOZ. Main market is China. It has been traded at about USD 8 per kg dried in the Philippines. In Papua New Guinea it was previously sold at USD 2.7 per kg dried. In Fiji (2014), fishers received USD 0.8–1.7 per piece fresh. Sold by fishers in Torres Strait (2022) for USD 1.3 per kg wet gutted. Prices in Guangzhou wholesale markets (2016) averaged USD 22 per kg dried; max. USD 78 per kg dried.

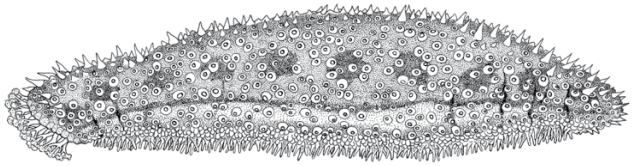
GEOGRAPHICAL DISTRIBUTION

Found in the western central Pacific, Asia and the Indian Ocean. *H. fuscopunctata* occurs at least as far east as Tonga.



COMMON NAMES

Pepino arenero (Mexico); Grey sea cucumber, Harlequin sea cucumber (United States of America).



DIAGNOSTIC FEATURES

Body colour is red or yellowish red, contrasted with brown mottling and with white papillae with yellow tips on the dorsal surface. The body is subcylindrical, with a distinctly flattened ventral surface, covered with numerous podia. The mouth is ventral; anus is terminal. Cuvierian tubules are absent.

Ossicles: Tentacles with short, cylindrical rods (200–250 µm), with unbranched or slightly branched ends and with spines along their sides. Body wall with tables, on average about 40–50 µm, with about 12 spines on the margin of the small disc and with a spire ending in 12 teeth. Regularly shaped plates with two or four central holes and sometimes smaller holes at the ends and with a series of knobs around the margins. The less abundant plates are relatively large and some may be incomplete and thus resemble rosettes (50 µm). Plates in the papillae are slightly curved, almost unbranched; there are also spinous rods.

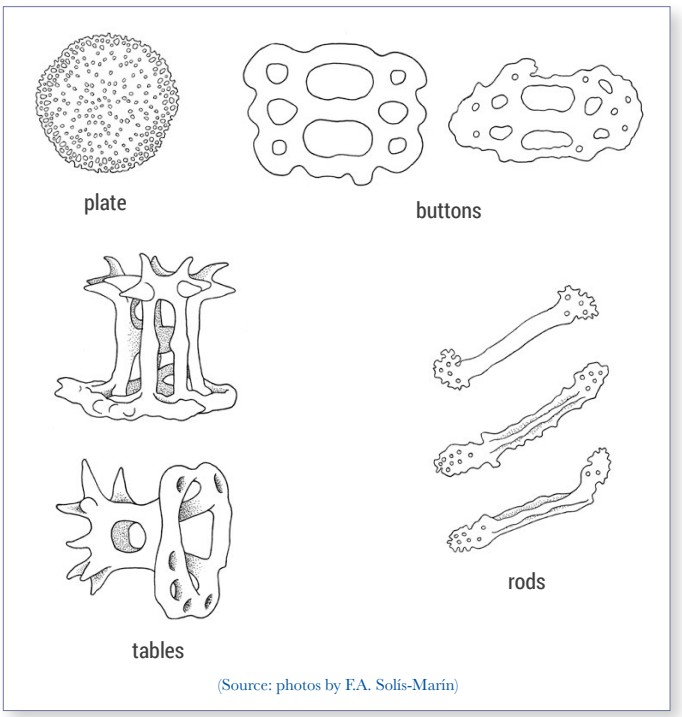
Processed appearance: Cylindrical shape with slender ends. The body wall is often very hard when processed. Small wart-like bumps are distributed all over the dorsal surface but scarce on the ventral surface. The dorsal body wall can have small white circles (1 mm in diameter) present, with a central dark spot. These features are absent on the ventral surface and in overcooked specimens.

Remarks: Resembles somewhat *H. floridana* but has a greater abundance of podia ventrally, where they form a sole-like surface.

Size: Maximum length of live animals is 30 cm. Average fresh gutted weight in the Gulf of Mexico 240 g.

HABITAT AND BIOLOGY

Generally inhabits shallow waters in tropical and subtropical waters, mostly in seagrass beds from 0 to 5 m depth. It is a cryptic species. A density of 3 000 ind/ha was found at Ilha Grande, Brazil. In Santa Catarina, Brazil densities between 1.6 and 8.0 ind/m were found, and in Colombia they have been found at densities of 4 000–10 000 ind/ha. In the northern Brazil, mature individuals are present year-round, where fecundity peaks in December–February and is lowest in June–July. First-sexual-maturity reported at 13.5 cm in east Colombia.



(Source: photos by F.A. Solís-Marín)

EXPLOITATION

Fisheries: In Veracruz, Mexico, this species is collected on a small-scale. In northern

Brazil, *H. grisea* is heavily fished and serves as a growing food source but the majority is exported to dried seafood markets in Asia.

Regulations: Fisheries involving *H. grisea* are mostly unregulated. It likely occurs in several marine protected areas within its range. There are no known major threats to this species. This species is only fished in some areas within its distributional range. In some parts of the Gulf of Mexico the species is collected on a small-scale, but it is heavily fished in northern Brazil.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians.

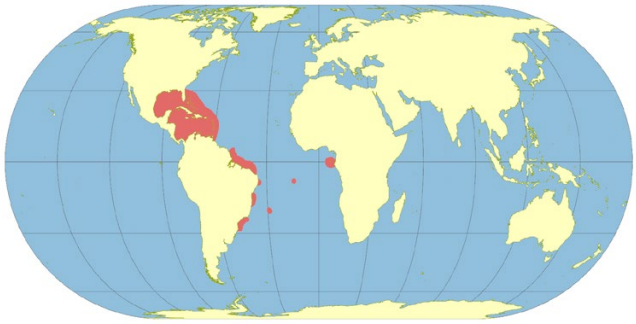
Main market and value: The Republic of Korea and China seems to be the main markets. Prices are poorly known, but it is considered a low-value species.

LIVE ©L. Martins

PROCESSED ©F.A. Solís-Marín

GEOGRAPHICAL DISTRIBUTION

Recorded from Florida, Texas, the Bahamas, Puerto Rico, Jamaica, Lesser Antillas, Curacao, Cuba, Mexico, Haiti, Dominican Republic, Belize, Panama, Colombia, Venezuela (Bolivarian Republic of) and coasts of Brazil (including Rio de Janero, Santa Catarina, Trindade and Marin Vaz Islands). Also reported from Ascension Island and the Gulf of Guinea, West Africa (Panning, 1928).

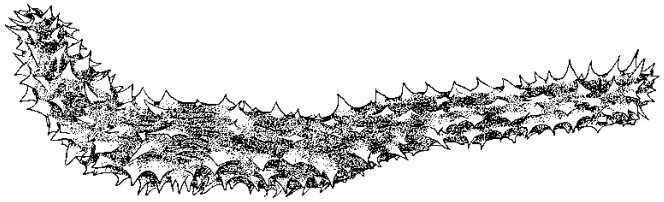


OTHER USEFUL INFORMATION

Although part of the fisheries in Mexico, Colombia and Brazil, the harvesting does not appear to be a major threat to the species. Listed as Least Concern on the IUCN Red List.

COMMON NAMES

Tiger tail, Mani-mani (Peanut-like), Bat-tuli (Philippines), Kokosier nwar (Seychelles), Batuna (Indonesia).



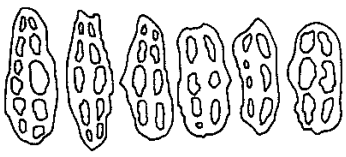
DIAGNOSTIC FEATURES

Dorsal coloration is tan to reddish-brown with large, conical, yellow-to-whitish papillae. Ventral surface is beige-brown with white-yellow spots corresponding to large podia that are distributed in three to four rows. Body is cylindrical. Body wall smooth and just a few millimetres thick. Mouth is ventral and surrounded by 20 very short tentacles. Anus is terminal. Numerous Cuvierian tubules present but never ejected.

Ossicles: Tentacles with slender rods, 45–145 µm long. Dorsal and ventral body wall with similar tables and rods, although there are fewer tables in the ventral body wall. Table discs, 50–70 µm across, smooth, circular to quadrangular in outline, perforated by four central holes and 9–13 peripheral ones; the short spire terminates in a narrow crown of spines. Buttons are 70–100 µm long, irregular, with smooth rim, and 3–6 pairs of holes. Ventral podia with buttons similar to those in the body wall and with perforated plates, up to 160 µm long and 75 µm wide. Dorsal papillae with buttons, up to 125 µm long and rods, up to 200 µm long.

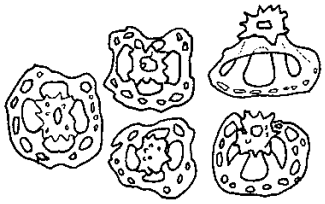
Processed appearance: Chestnut colour more defined after boiling.

Size: Maximum length about 25 cm.

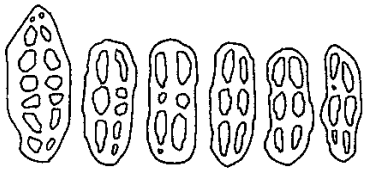


buttons of dorsal body wall

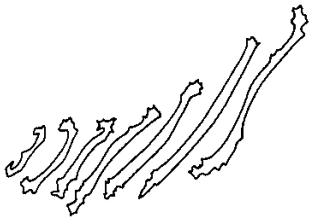
tables of dorsal body wall



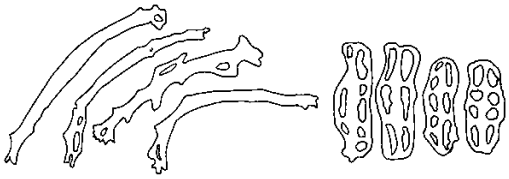
tables of ventral body wall



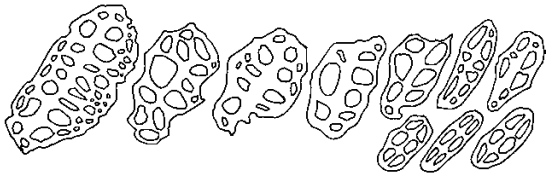
buttons of ventral body wall



rods of tentacles



rods and buttons of dorsal papillae



perforated plates and buttons of ventral podia

(After Samyn and Massin, 2003)

HABITAT AND BIOLOGY

Found under coral debris and under coral slabs within seagrass beds and on sandflats and sandy reef flats. In the Philippines, this species is found mostly in depths between 1 and 2 m. In the Comoros, it can be found mainly on rocks over coarse sandy bottoms between 0 and 20 m. Little is known of its reproductive biology.

LIVE ©S.W. Purcell

EXPLOITATION

Exploited for export as dried bêche-de-mer, and probably mixed together with other species.

Fisheries: This species is mostly fished artisanally by hand collecting by gleaners on shallow reef flats or by free diving. In the western central Pacific it is not fished commercially but occasionally it is harvested for subsistence, e.g. in Samoa and Cook Islands. *Holothuria hilla* is fished commercially in the Philippines and Indonesia; in the latter it is part of a multispecies fishery, where it is used as a filler to top up weights sales. It is commercially harvested in Madagascar. In some Pacific Island countries, it is collected for the aquarium trade.

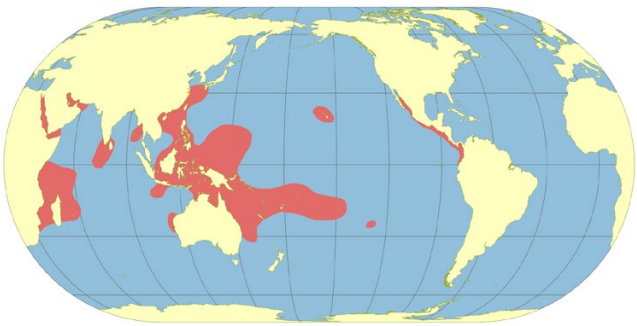
Regulations: Where it is fished, there are few, or no, regulations pertaining to the harvesting of this species.

Human consumption: Mostly the reconstituted body wall (bêche-de-mer) is consumed by Asians. Its fermented intestine (konowata) may be eaten as a delicacy or as a protein component in traditional diets. In the Philippines, it is consumed by Muslims during the Ramadan season.

Main market and value: Code: **JCK**. Poorly known, but it is a low-value species. It has been previously traded at about USD 3 per kg dried in the Philippines.

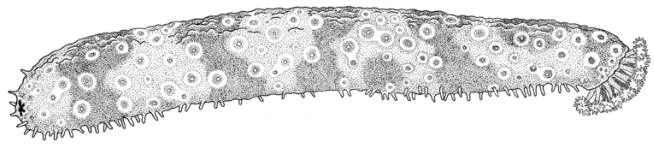
GEOGRAPHICAL DISTRIBUTION

Most countries of the western central Pacific to Pitcairn Islands and reported from eastern central America. Found in Southeast Asia, East Africa and Indian Ocean.



COMMON NAMES

Pepino de mar moteado (Mexico).



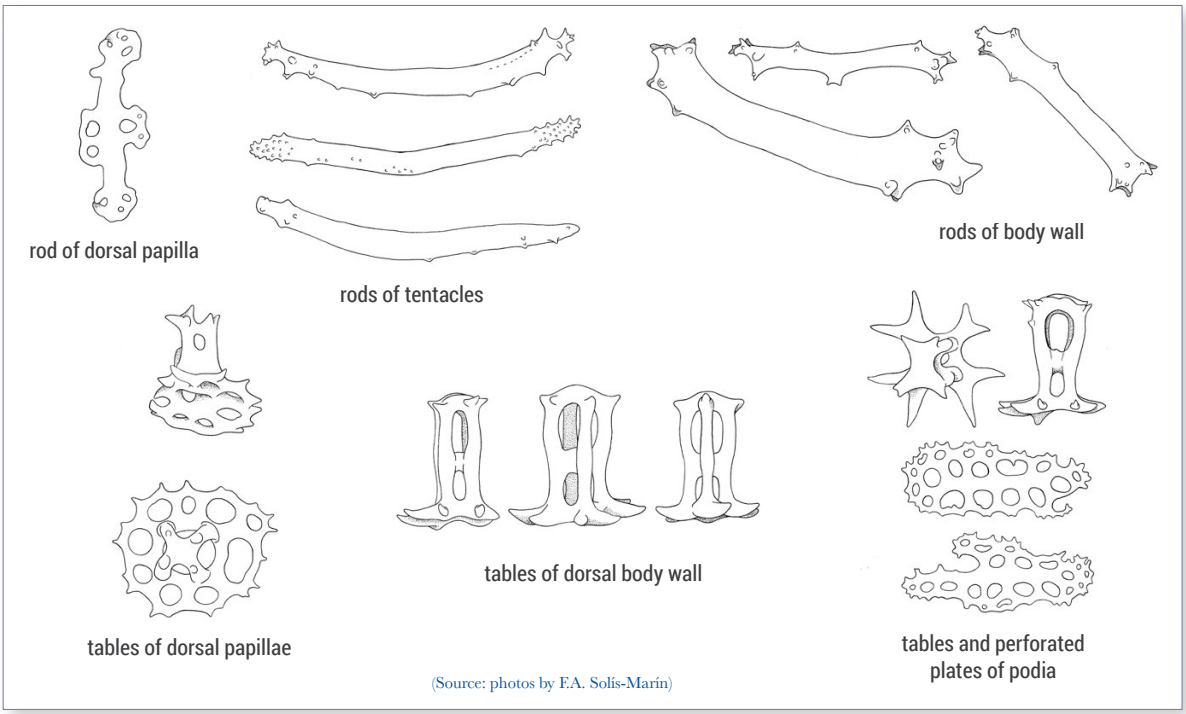
DIAGNOSTIC FEATURES

Body cylindrical but slightly thinned at the ends.
The dorsal surface is brownish with darker brown diffuse spots and has widely spaced, small pointy papillae that (apart from those on the darker blotches) are cream or yellowish coloured and bordered by a cream-coloured circle contrasting with the darker brown colour. The ventral surface is purple-brown, with light brown spots. The body wall is thin, with a rough texture. Terminal mouth and anus. Cuvierian tubules absent.

Ossicles: Tentacles possess spiny rods that are small and curved (70 µm in length). Body wall has only tables (50–60 µm height), some with an extremely reduced basal disc (45 µm in length), often cross-shaped, with or without a central hole; these tables have a high spire of four pillars that ends in a crown of eight teeth, perforated in its center; the disc can be larger, with four to six holes, with an apex ending in a crown bearing four vertical spines. In the dorsal body wall, there are much higher tables, with a large basal disc (60 µm in length), perforated with a central hole and seven or eight peripheral holes, with a strongly wavy edge. The spire is high (50–55 µm), with two or three cross-bars, and has a crown with eight small spines and four vertical ones or formed by several superimposed planes. Dorsal papillae and podia have robust rods (80 µm in length).

Processed appearance: Cylindrical and slender shape with slender ends. The product is greyish-brown in colour, with darker brown blotches. The body wall is very smooth and thin. A characteristic feature is the numerous small orange spots distributed irregularly on the dorsal surface, which are more numerous at both anterior and posterior ends.

Size: Maximum length in live animals is 10–15 cm. Average fresh weigh in the Gulf of California is 18 g.



(Source: photos by F.A. Solís-Marín)

HABITAT AND BIOLOGY

Generally, inhabit shallow waters, mostly under rocks and can bury in sand. Found in waters from the intertidal margins down to 22 m depth.

EXPLOITATION

Fisheries: Exploited in a multispecies fishery along western coasts of Mexico. Little information is documented on harvests in other countries.

Regulations: Harvests are currently unregulated.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: This species is not consumed locally and there is no domestic market. China is the main market destination, where it is believed to have a low value.

GEOGRAPHICAL DISTRIBUTION

Found on Pacific coasts of Mexico, Gulf of California, Revillagigedo Islands (Mexico), Honduras, Nicaragua, Costa Rica, Cocos Islands (Costa Rica), Panama, Colombia, Galapagos Islands (Ecuador), and Peru.

OTHER USEFUL INFORMATION

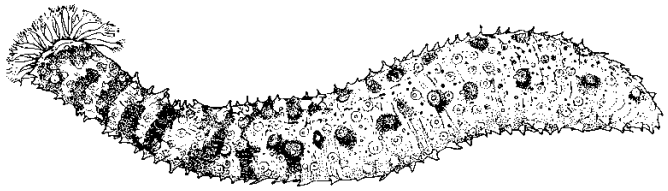
This species is listed as Least Concern on the IUCN Red List.

LIVE ©C. Galván

PROCESSED ©F.A. Solís-Marín

COMMON NAMES

Brown spotted sea cucumber, Impatient sea cucumber, Bottleneck sea cucumber (FAO), Holothurie bouteille (FAO), Holoturia cuello de botella (FAO), Sunlot (Philippines), Pulut (Indonesia).



DIAGNOSTIC FEATURES

Coloration is light brown with 5 or more dark brown transverse bands on the dorsal surface which become spots posteriorly. Ventral surface is beige. The body of this species has been described as bottle shaped and is rough to the touch. Podia are relatively sparse. The ventral mouth contains 20 tentacles. Long, white, thick Cuvierian tubules are present.

Ossicles: Tentacles with straight and curved rods, 75–350 µm long, spiny at the extremities. Ventral and dorsal body wall with similar tables and buttons. Tables with round, smooth disc, 80–90 µm across, perforated by 4 large and 4–8 peripheral holes; short spire ending in a spiny crown. Buttons are 60–100 µm long, with a smooth rim and 3–4 pairs of holes, and sometimes with median line. Ventral and dorsal podia with tables and buttons similar to those of body wall and rods, 175–270 µm long with median and distal swellings and perforations.

Processed appearance: Dried individuals are small (about 5–7 cm in length) and are generally mixed with other small low-value species.

Remarks: *Holothuria impatiens* is a complex of at least 13 species, occuring in the Indo-Pacific, the western Atlantic and the Mediterranean Sea (Michonneau, 2015).

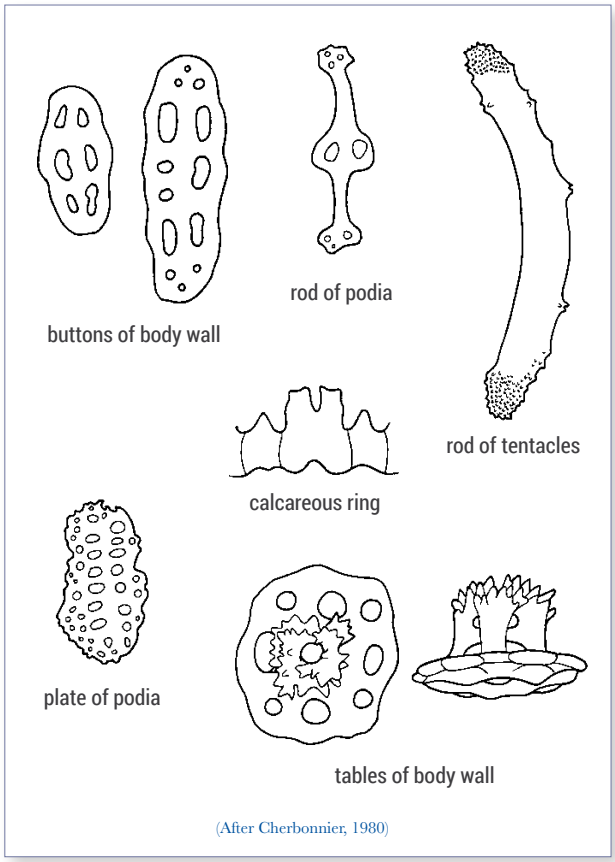
Size: Maximum length about 26 cm. Average fresh weight 50 g; average fresh length probably <20 cm.

HABITAT AND BIOLOGY

H. impatiens is a cryptic species. It lives in shallow coral reef habitats. In the Comoros and Mascarene Islands (Mauritius), it can be found under rocks in shallow waters between 0 and 2 m; however, it can be observed up to 30 m depth. Its reproductive biology is unknown.

EXPLOITATION

Fisheries: This species is harvested in artisanal fisheries, by hand collection in shallow waters. It is harvested by hookah diving in south Viet Nam. In the western central Pacific it does not have a commercial value, so it is unexploited in that region. It has commercial importance in China and



Indonesia and Mexico. In Madagascar, there is limited harvesting.

Regulations: None.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

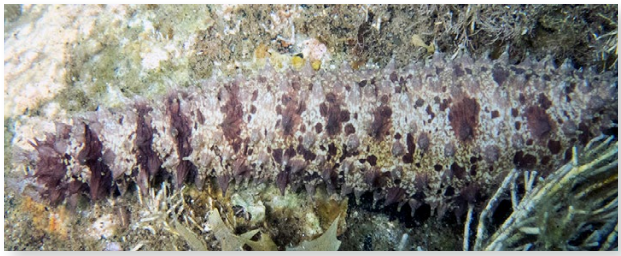
Main market and value: Code: **HFI**. This is a low-value species, principally exported to Chinese markets. It has been traded at about USD 2 per kg dried in the Philippines.

GEOGRAPHICAL DISTRIBUTION

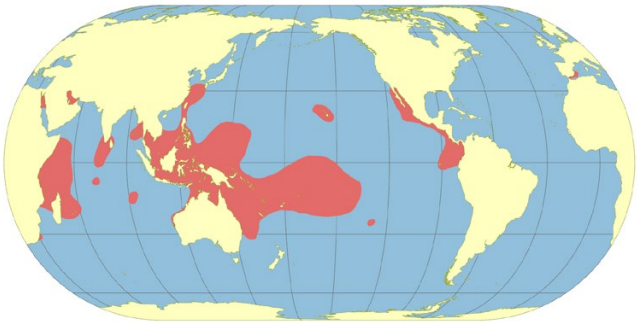
It can be found from East Africa and the Indian Ocean to the western central Pacific including Hawaii (United States of America), in the Pitcairn Islands group, and including much of the Pacific coast of Central America. Some records in eastern Mediterranean.

LIVE ©S. Ribes

LIVE ©Florida Museum Invertebrate Zoology

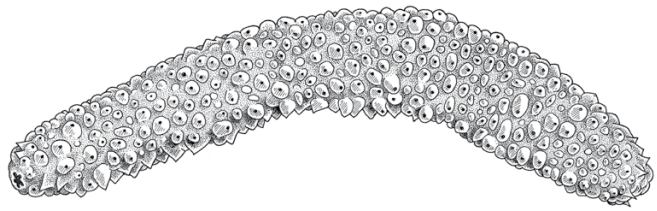


LIVE ©A. Ryanskiy



COMMON NAMES

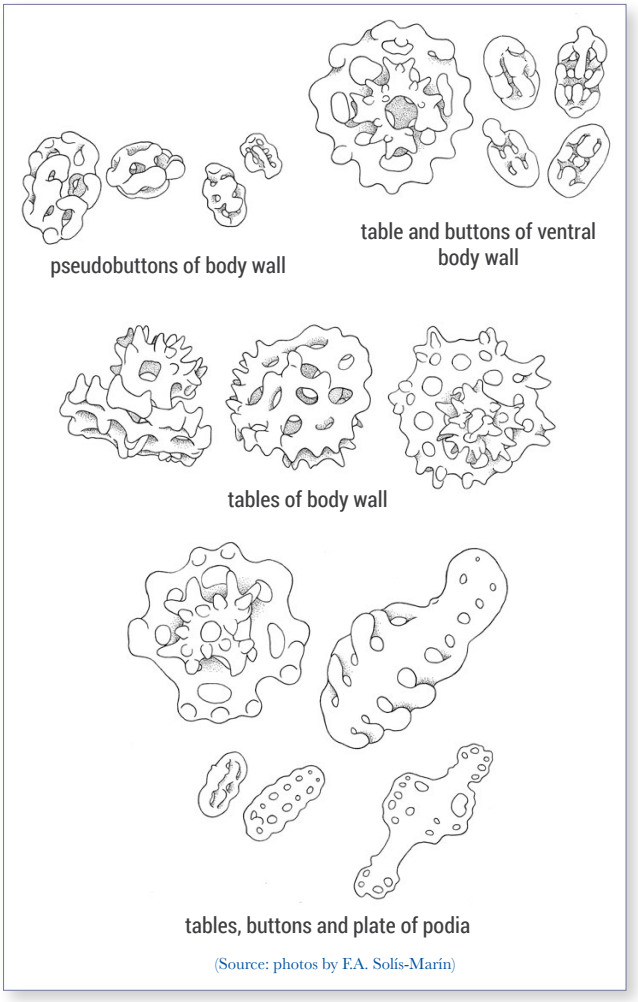
Guarache (Mexico).



DIAGNOSTIC FEATURES

The body is dark brown dorsally and light brown ventrally. Dorsal papillae are small, conical, relatively numerous, and ranging from yellowish-white to rusty in colour. Body is cylindrical, with a thick body wall that is rough in texture. The mouth is ventral, and the anus is terminal and surrounded by small papillae. Numerous, small podia on the ventral surface are arranged irregularly.

Ossicles: Tentacles with rods (150–300 µm in length) that are spiny at the ends and part of their length. Body wall ossicles are numerous, consisting of buttons and tables. Buttons of the ventral body wall are 40–60 µm in length and generally simpler than those of the dorsal wall, most with three pairs of holes and a smooth or slightly knobbed surface, and occasionally buttons with 8–16 holes. Tables from ventral tissue usually with discs 70–85 µm diameter with eight holes although some larger discs with 10–12 holes can be found. Tables have a low spiral (80 µm) of four pillars ending in a crown bearing a dozen small peripheral protrusions and 4–10 central and disorderly spines, the central foramen often irregular. Buttons on the dorsal body wall are much more knobbed reaching 50–60 µm in length. Tables of dorsal tissues have a very large disc (70–90 µm in length) that is often knobbed with 12–20 perforations and the spire usually has four pillars (sometimes 5 or 6) and ends in a large thorny crown. Tables of the dorsal papillae have a reduced terminal disc.



(Source: photos by F.A. Solís-Marín)

Processed appearance: Subcylindrical in shape with blunt ends and brown to rusty-brown in colour. Dorsal and ventral surfaces are well demarcated. Extremely hard when processed. Small warts are prominent all over the body and along the margins of the animal. Its appearance depends on the preparation method, with overcooked product lacking the bumpy outer tissues, giving a smooth appearance.

Size: Maximum length is 25–30 cm for live animals. Average fresh weigh in the Gulf of California is 350 g.

HABITAT AND BIOLOGY

Generally inhabit shallow waters, more commonly in depths of 12–20 m, on sand bottoms. Reported to a depth of 85 m. This species is cryptic.

EXPLOITATION

Fisheries: In Baja California, Mexico, this species is harvested in low numbers. The majority is exported to Asia for the food market.

Regulations: Fishing for this species is currently unregulated, except for general regulations pertaining to all species.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: In Mexico, fishers received USD 0.50 per animal (fresh) for the export market. China seems to be the main market. Product matching the appearance of *H. inhabilis* sold in China, Hong Kong SAR (2022) for USD 188 per kg dried.

GEOGRAPHICAL DISTRIBUTION

Recorded from the Gulf of California; the Revillagigedo Archipelago; Panama; El Salvador; Cocos Island; Galapagos Islands; Colombia and Peru.

OTHER USEFUL INFORMATION

This species is listed as Least Concern on the IUCN Red List.

LIVE ©C. Galván

PROCESSED ©F.A. Solís-Marín

COMMON NAME

Sandy sea cucumber (FAO), Pepino arenero (Mexico).

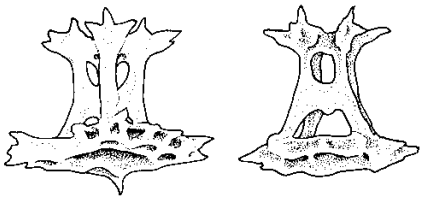
DIAGNOSTIC FEATURES

Holothuria inornata is a medium-sized species. Coloration is reddish-brown to greyish with dark-tipped papillae. Dorsal surface generally has four to six small, wart-like bumps and a number of small papillae. Mouth ventral with 20 brown to black tentacles. Body often covered with sand and detached pieces of algae.

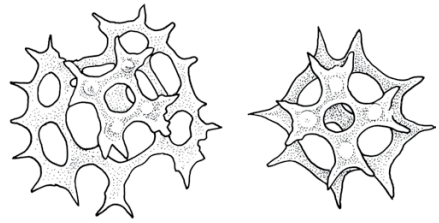
Ossicles: The rods from the podia and papillae are of two types: straight, distally multi-perforated (a key taxonomic character separating this species from *H. kefersteinii*); and curved, almost non-perforated supporting rods. The rosette-like perforated rods, sometimes present in the papillae, are also a useful taxonomic character since *H. kefersteinii* does not present them.

Processed appearance: Dark brown to black in colour. Dorsal surface highly textured and rough, with rugosities. The ends of the dried product are relatively blunt.

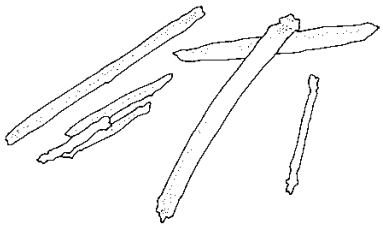
Size: Maximum live size up to 20 cm.



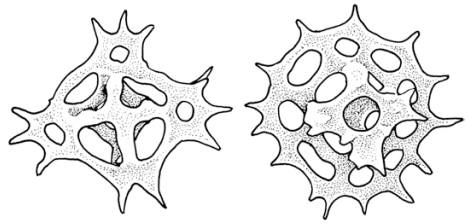
lateral view of body wall tables



dorsal view of body wall tables

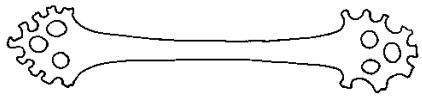


rods of podia



perforated plates of body wall

(Source: photos by Solís-Marín *et al.*, 2009)



supporting rod of podia

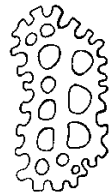


plate of podia

(Source: drawings in Deichmann, 1958)

HABITAT AND BIOLOGY

In El Salvador, this species appears to prefer rocky shores. In the Galapagos Islands (Ecuador), it can be found in the intertidal and subtidal zone, generally exposed on coral sand bottoms. It is often the most common species on sandy bottoms. It can be found to a maximum depth of 18 m. Reproductive biology is unknown.

EXPLOITATION

Fisheries: This species is fished artisanally. It is exploited illegally in the Galapagos Islands (Ecuador), El Salvador and Mexico, where it is reported to be severely over-exploited. In the Galapagos Islands, it is harvested by hand collecting using hookah diving. In El Salvador, it is part of a multispecies fishery, which probably includes *Isostichopus fuscus*.

Regulations: All species of holothuroids in El Salvador are listed under the Endangered Species list of the Ministry of Environment.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Retail prices in China, Hong Kong SAR were up to USD 126 per kg dried. Product matching the appearance of *H. inornata* sold in China, Hong Kong SAR (2022) for USD 273 per kg dried.

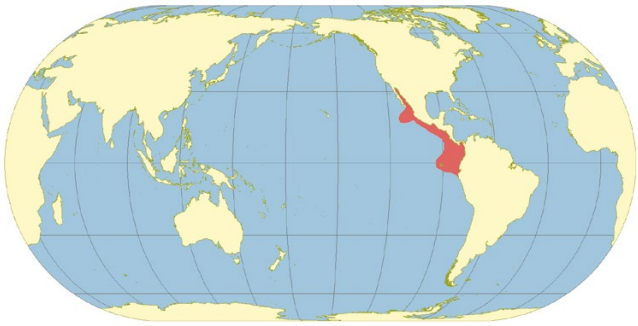
GEOGRAPHICAL DISTRIBUTION

Gulf of Baja California, Baja, Central America, Colombia, Ecuador and Peru and the oceanic islands of Revillagigedos, Galapagos Islands (Ecuador), Cocos Island (Costa Rica) and Malpelo Island (Colombia).

LIVE ©G. Edgar

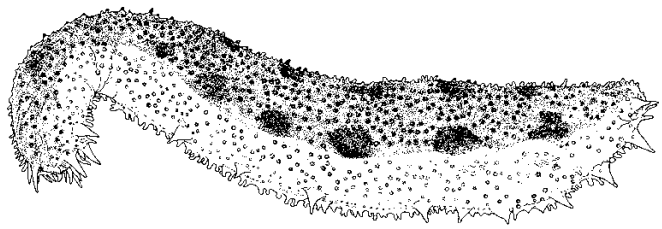
LIVE ©J. Stauffer

PROCESSED ©S.W. Purcell



COMMON NAME

Pepino do mar (Cape Verde).



DIAGNOSTIC FEATURES

Body cylindrical, flattened ventrally. Dorsally light to dark brown with 5–10 pairs of small (7–10 mm) dark brown blotches along body. Ventrally whitish or cream colour, with numerous podia in three rows and sometimes a light brown line along the centre. Mouth sub-ventral with 20 peltate tentacles. Anus is dorsal. No Cuverian tubules.

Ossicles: Tables are 45–100 µm with rounded discs, dentate or smooth, possessing four holes at centre and some at margins. Table spires of four pillars, usually with one cross-bar, ending in a spinous/toothed crown. Buttons range 45–105 µm in length and irregularly shaped and have variable perforations and small knobs. Rods in tentacles with small spines, branched at ends.

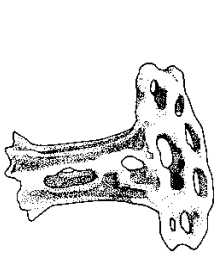
Processed appearance: Dried products usually are rather flattened and elongate. Dorsal surface is wrinkled, tending to be light brown with some darker spots still visible, while the ventral surface is light brown. Common dried size: 20 cm.

Size: Up to 45 or 50 cm long, with a total body weight of 830 g.

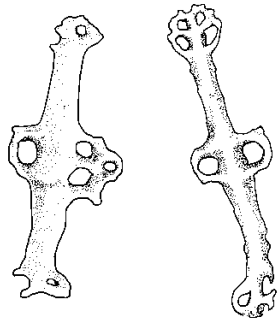
Remarks: There are two recognized subspecies of *Holothuria lentiginosa*: *lentiginosa* and *enodis*. The first, *Holothuria lentiginosa lentiginosa* is found and exploited in the northeastern Atlantic. The second, *H. (Vaneyothuria) lentiginosa enodis* thrives in the central westen Atlantic and currently not yet exploited.

HABITAT AND BIOLOGY

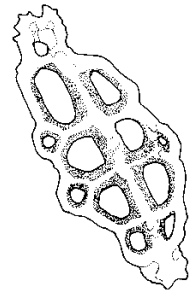
Occurs in stony habitats in Azores Islands (Portugal), in 11–22 m depth. Also reported from sandy, reef and silty bottoms. Found down to 300 m deep. Known to sometimes host pearlfish symbionts.



table



rods



button

(After Thandar & Mjobo 2014)

(After Madeira *et al.*, 2019)

EXPLOITATION

Fisheries: Has been harvested, mostly illegally, from the Canary Islands (Spain) (2017) and Cape Verde (2000–2021). Some legal harvests from Santiago Island (Cape Verde) in 2017.

Regulations: A moratorium in Cape Verde enacted in 2016, but harvests (hand collection using compressed-air devices) allowed since 2021.

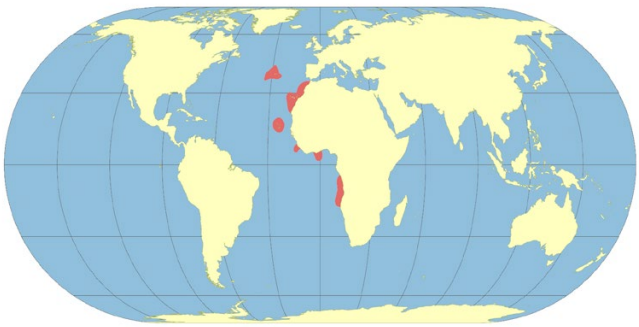
LIVE

Human consumption: Mostly traded as dried bêche-de-mer and consumed after being reconstituted.

Main market and value: Primarily exported dried to Asia. In Cape Verde, landing prices of fresh products ranged USD 20–30 per kg, while processed dried product sold for USD 100–300 per kg (pre-export).

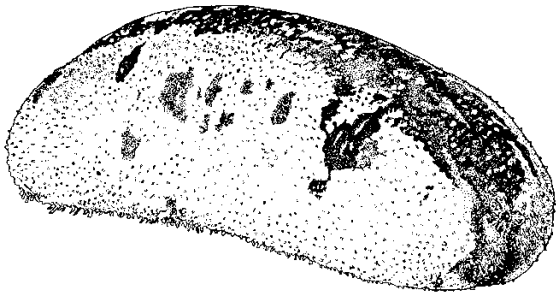
GEOGRAPHICAL DISTRIBUTION

Widely distributed in Northeast Atlantic, including the Azores Islands (Portugal), Canary Islands (Spain), Cape Verde, Morocco, Sierra Leone, Ghana, Congo, Senegal and Angola.



COMMON NAMES

Golden sandfish, Zanga mena, Chinois, Matafao (Madagascar), Barangu, Ugai, Gosok (United Republic of Tanzania, Zanzibar), Curtido-bato (Philippines), Bangkuli (Indonesia), Le mouton (New Caledonia), Nga ito (Tonga), Kolten sanfis (Vanuatu).



DIAGNOSTIC FEATURES

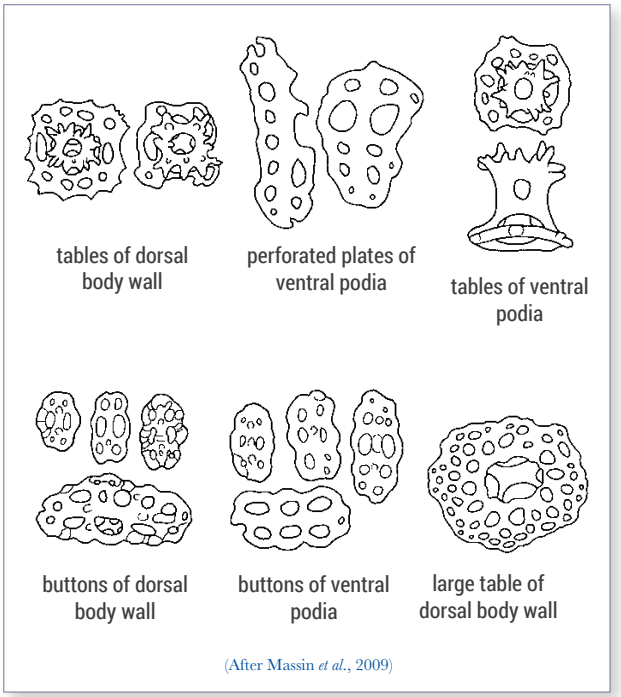
Coloration highly variable: from dark greyish black, to beige with black blotches or beige without black spots. Ventral surface is whitish, or grey in the black variants. Body is relatively stout, highly arched dorsally but flattened ventrally. Ends of the body are rounded. Body is often covered by fine sediments and mucus. Dorsal surface without deep wrinkles but with stubbly, black papillae (3 mm long). Brown podia are moderately abundant ventrally. The ventral mouth has 20 short grey tentacles. The anus is terminal, surrounded by five groups of papillae and without teeth. Cuvierian tubules absent.

Ossicles: Tentacles with rods, 60–650 µm long, slightly curved with spiny extremities. Dorsal body wall: tables with disc 50–110 µm across, that are spiny, quadrangular, and perforated by one central hole and 4–10 peripheral holes (large discs with circles of peripheral holes); spire ending in a spiny crown; buttons 40–60 µm long, knobbed, and have 3–4 pairs of small holes.Ventral podia with tables and buttons as in body wall (but some are smooth) and with perforated rods, 115–265 µm long, and perforated plates, 85–280 µm long. Dorsal podia with buttons, tables and rods. Buttons are smooth or nodulous, with 3–4 pairs of holes, while the perforated plates are 160–200 µm long and have two rows of holes.

Processed appearance: Entire body golden-brown colour, small cut ventrally. Relatively elongate with round ends, slightly arched dorsally. Common dried size 13 cm.

Remarks: Previously known as *Holothuria scabra* var. *versicolor* (Conand, 1989).

Size: Maximum length 46 cm; average length 30 cm. Average fresh weight: 1 100 g (Madagascar), 1 355 g (Australia), 1 400 g (New Caledonia); average fresh length: 30 cm (Australia, New Caledonia and Madagascar).



(After Massin *et al.*, 2009)

HABITAT AND BIOLOGY

Occurs on inner reef flats and coastal lagoons or coastal seagrass beds or sandflats between 0 and 30 m depth. It buries in sand or muddy-sand during parts of the day. In Madagascar, it can be found in the inner slopes and especially in seagrass beds. It attains size-at-maturity at 480 g (Madagascar). Sexual reproduction occurs annually; in late spring

(Australia) or in the dry season (Madagascar).

EXPLOITATION

Fisheries: Exploited in industrial, artisanal and subsistence fisheries including: Papua New Guinea, Solomon Islands, Vanuatu, New Caledonia, Fiji, Tonga, Torres Strait (rarely) and the Great Barrier Reef (Australia), Indonesia, Philippines, Madagascar and the Seychelles.

Regulations: In Australia, there is a minimum size limit of 17 cm fresh, no-take zones, strict licensing, and a rotational harvest strategy. In Tonga, it is banned from export to safeguard local consumption.Minimum size limits are: 25 cm wet and 12 cm dried in Vanuatu; 25 cm wet and 10 cm dried in Solomon Islands and New Caledonia.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians. In a small number of Pacific Island nations (e.g. Fiji and Tonga) it is consumed locally.

Main market and value: Code: **JCO**. Main market is China. In Australia, fishers received USD 8 per kg gutted weight and it was sold domestically for USD 300–700 per kg. In New Caledonia (2007), it was the second-most valuable species; fishers received USD 4–6 per kg wet (gutted) weight; export value was USD 70–80 per kg dried. In Fiji it is banned for export but fishers still sell it and receive about USD 8 per piece fresh. Prices in China, Hong Kong SAR retail markets (2022) averaged USD 503 per kg dried; max. USD 635 per kg.

GEOGRAPHICAL DISTRIBUTION

Throughout the Indo-Pacific, including India, Madagascar, Comoros, Kenya, Mayotte, the Seychelles, Indonesia, Philippines, Papua New Guinea, northern Australia and Great Barrier Reef, New Caledonia, Vanuatu, Fiji, and as far east as Tonga.

OTHER USEFUL INFORMATION

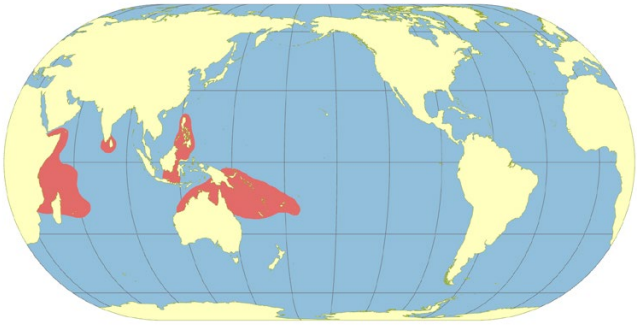
This species is widely reported as overexploited.

LIVE (blotchy variant) ©S.W. Purcell

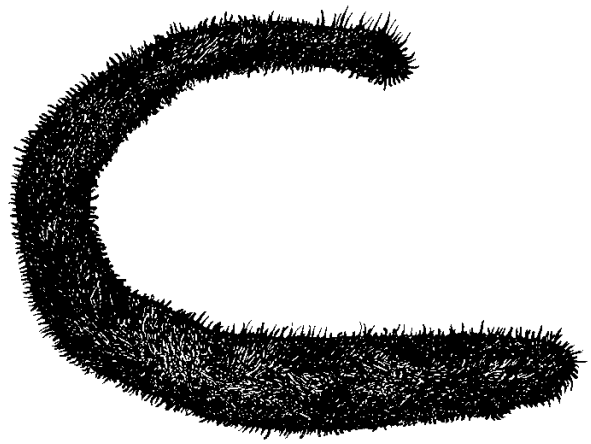
LIVE (beige variant) ©S.W. Purcell

LIVE (black variant) ©S.W. Purcell

PROCESSED ©B. Giraspi



Holothuria (Mertensiothuria) leucospilota (Brandt, 1835)



COMMON NAMES

White threadsfish (**FAO**, Réunion), Snakefish (Viet Nam), Trépang à canaux blancs (**FAO**), Patola (Philippines), Zanga kida (Madagascar), Sumu (United Republic of Tanzania), Kichupa (United Republic of Tanzania, Zanzibar), Getah (Indonesia), White snakefish (Solomon Islands).

DIAGNOSTIC FEATURES

Body is entirely black, elongated, and somewhat broader in the posterior half. Body tapers moderately at both anterior and posterior ends. Long podia and papillae are randomly distributed on the dorsal surface. Ventral podia are numerous. The tegument is sometimes covered by fine sediment and mucus. Mouth is ventral with 20 large black tentacles. Anus is terminal and this species ejects thin, long Cuvierian tubules. Juveniles have a similar appearance to adults.

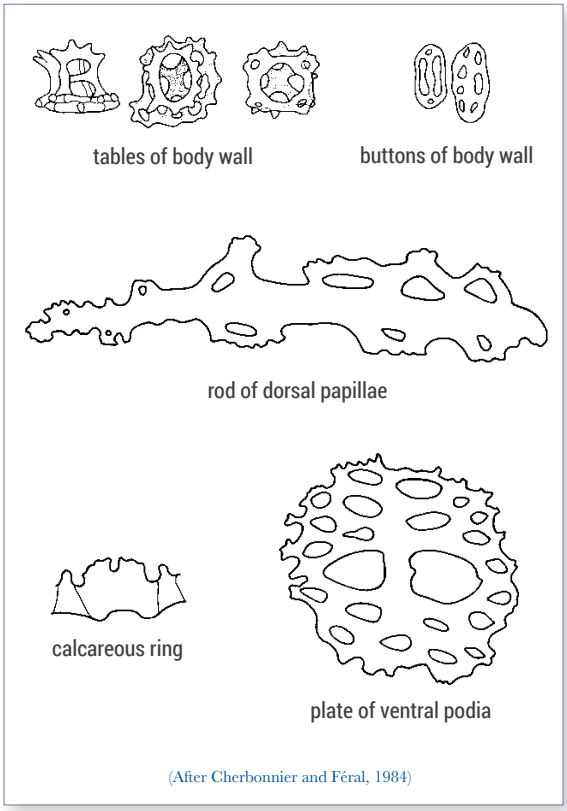
Ossicles: Tentacles devoid of ossicles. Dorsal and ventral body wall with similar tables and buttons. Tables with round to quandrangular discs, 40–70 µm across, perforated by 4 central holes and 4–12 peripheral ones, and the rims of discs are smooth to spiny; spire ending in a spiny crown. The irregular buttons are 40–70 µm long, with 2–5 pairs of irregular holes. Ventral podia with similar tables and buttons and with large perforated plates, 60–120 µm long. Dorsal podia with tables and buttons similar to those of body wall and rods, 50–190 µm long, variously perforated.

Processed appearance: This species may be traded mixed with other low-value species in the dried form.

Size: Maximum length about 50 cm; average length about 30 cm. Average fresh weight from 335 g (Viet Nam) to 400–900 g (Réunion); average fresh length from 23 cm (Viet Nam) to 35–50 cm (Réunion).

HABITAT AND BIOLOGY

Lives mostly in shallow habitats up to 10 m depth but reported to 135 m. Found mostly on outer and inner reef flats, back reefs and shallow coastal lagoons. Commonly found in seagrass beds, sandy and muddy bottoms with rubble or coral reefs. *Holothuria leucospilota* is a very common species, with its distribution extending into warm-temperate zones. Densities may be up to 5 000 ind. per ha. In Madagascar, it can be found in the inner slope, seagrass beds, microatoll and detrital fringe with higher densities on the inner reef slopes. This species attains size-at-maturity at 180 g and sexual reproduction occurs bi-annually, during the



(After Cherbonnier and Féral, 1984)

dry season. Smaller individuals may reproduce asexually by transverse fission. On the Great Barrier Reef (Australia), it reproduces sexually between November and March, while in the Northern Territory (Australia) in April. In the Cook Islands, this species reproduces from October to April. In Taiwan Province of China, it reproduces between June and September. In Réunion, it reproduces sexually twice a year; in February and in May.

LIVE ©S.W. Purcell

EXPLOITATION

Fisheries: This species is harvested in artisanal fisheries at localities where low-value species are exploited. Harvested predominantly by hand collection at low tide and by free diving. In the southern Cook Islands, it is exploited for its gonads by women and children, particularly in the summer months. The animals re-grow their organs, so this harvesting is renewable. This species is also fished for subsistence in Samoa and Tonga. In Asia, it is fished in China, Malaysia, Thailand, Indonesia, Philippines and Viet Nam. In Southeast Asia, it is known to be part of the "worm" sea cucumbers, lower-value higher-volume species. Also fished in Madagascar.

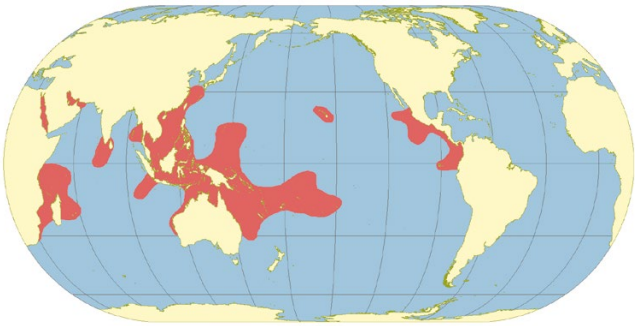
Regulations: Where it is fished, there are few, or no, regulations pertaining to the harvesting of this species. Minimum size limits in Solomon Islands are 20 cm wet and 10 cm dried.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. The whole animal or its intestine and/or gonads may be consumed as a delicacy or as protein in traditional diets or in times of hardship (i.e. following cyclones).

Main market and value: Code: HFQ. Singapore and Ho Chi Minh City (Viet Nam) for further exports to Chinese markets. In Viet Nam, it was sold for USD 1.3 per kg dried. It has been traded at about USD 5 per kg dried in the Philippines.

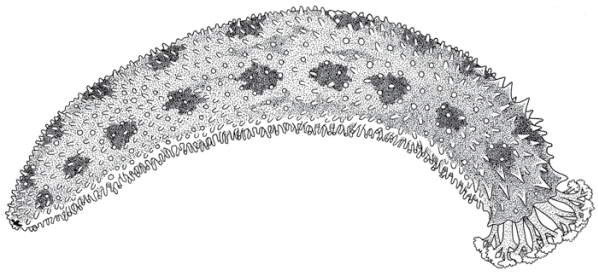
GEOGRAPHICAL DISTRIBUTION

This species has one of the broadest distributions of all holothuroids, and it can be found in most tropical localities in the western central Pacific, Asia and most Indian Ocean regions.



COMMON NAMES

Pepino liso, Pepino de mar azufre (Mexico), Sulphur sea cucumber (United States of America).



DIAGNOSTIC FEATURES

Highly variable body colour, from bright olive green to black dorsally, and generally darker anteriorly. There are sometimes two longitudinal lines of black dots dorsally. The ventral surface is lighter olive green to grey. The body is sub-cylindrical, possessing a flat ventral suface, and narrows to a blunt posterior end. The mouth and anus are terminal in orientation. Podia on the ventral surface are green or yellowish, numerous and uniformly distributed; those dorsally are smaller and more scattered. Cuvierian tubules absent.

Ossicles: Ossicles from the tentacles are spiny rods with perforated ends (60–80 µm in length). Body wall and podia with rods, generally C-shaped, with great variation in the presence and development of spines, from bars with smooth posts and rough tips, to densely spiny bars (80–100 µm in length); tips generally without perforations. The podia have perforated end plates. The are no tables or buttons in this species—commensurate with the subgenus *Selenkothuria*.

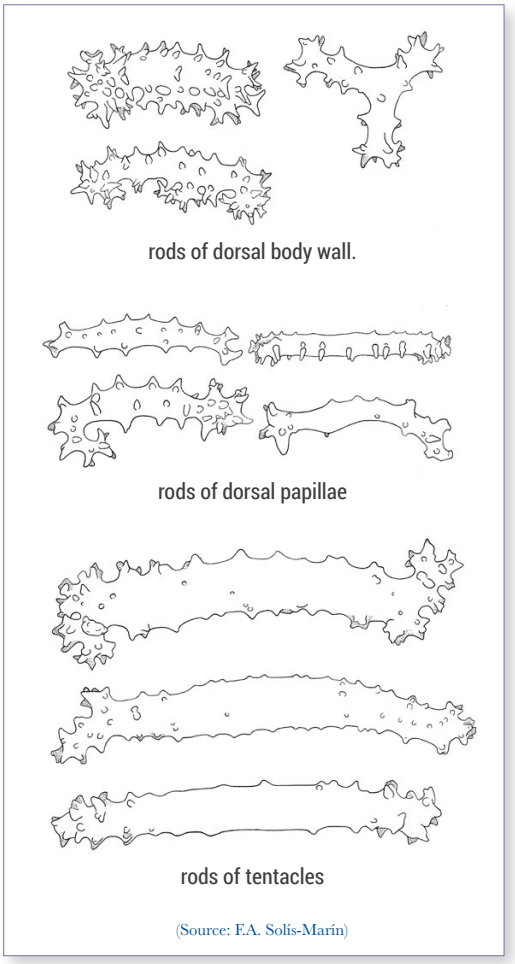
Processed appearance: Cylindrical and slender shape with blunt ends. Ventral and dorsal surfaces are demarcated, with the ventral surface having numerous podia spots and being pale yellow in colour. The dorsal surface of the products are greenish with far fewer podia spots.

Remarks: *H. lubrica* can be mistaken with *H. theeli,* but in the latter, the ossicles of the body wall are short, bifurcated flattened bars, often forming plates with four perforations. *H. lubrica* is more abundant in the tropical waters of South America, while *H. theeli* is more frequent at higher latitude.

Size: Maximum length is 20 cm. Average fresh gutted weigh in the Gulf of California 20 g.

HABITAT AND BIOLOGY

Generally inhabits shallow waters, mostly under rocks in the intertidal zone, but can be found in waters down to 10 m depth. It is a cryptic species. In the Gulf of California it has an annual reproductive cycle with a single spawning period during the summer with weight at first maturity of 27 g.



(Source: F.A. Solís-Marín)

EXPLOITATION

Fisheries: This species is exploited in a multispecies fishery in Mexico where it is added to containers with other species as a "filler" to bulk-up products for sale.

Regulations: Harvests of this species are largely unregulated.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: China seems to be the main market. The market value is unknown, but it is considered to be a low-value species.

GEOGRAPHICAL DISTRIBUTION

Pacific coasts of Mexico (including Clarion and Socorro Islands), Gulf of California, El Salvador, Nicaragua, Costa Rica, Cocos Island, Panama, Colombia, Ecuador, Galapagos Islands (Ecuador), and Peru.

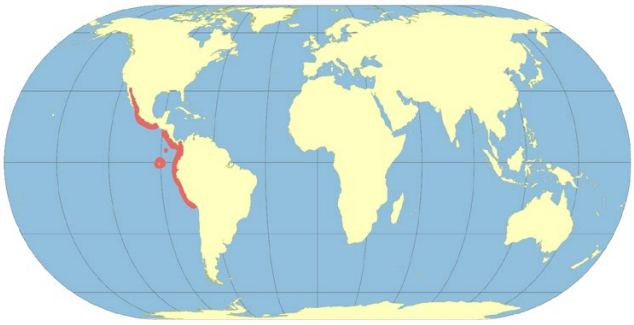
OTHER USEFUL INFORMATION

It is classified as Least Concern on the IUCN Red List.

LIVE ©F.A. Solís-Marín

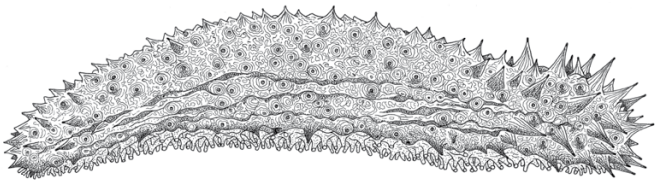
LIVE ©D. Vander Pluym

PROCESSED ©F.A. Solís-Marín



COMMON NAME

Black sea cucumber (European Union).



DIAGNOSTIC FEATURES

Cylindrical body. Dorsally a uniform dark brown or black with conspicuous papillae, most frequent at the anterior end. Ventral surface with three rows of podia. Possesses few Cuvierian tubules, which are never expelled. Mouth is sub-ventral and the anus is terminal.

Ossicles: The buttons (40–120 µm long) are thick, covered with pointy knobs and possess several pairs of small holes, although the buttons from ventral tissues can be unperforated. Tables (40–50 µm long) with discs that are smooth or spiny, perforated by four large central holes, and have four pillars forming the spire. The spires usually have two cross-beams and end in a crown of spines.

Processed appearance: Dried products are high bodied and elongate. Dark brown or black with numerous blunt conical papillae still apparent on the wrinkled dorsal surface. Dorsal papillae are shorter than those in dried *Holothuria arguinensis*. Ventral surface is showing the same coloration as dorsally, with some lines marking the ambulacral podia. Usually cut in the middle of the ventral surface. Processed product commonly 8–12 cm long.

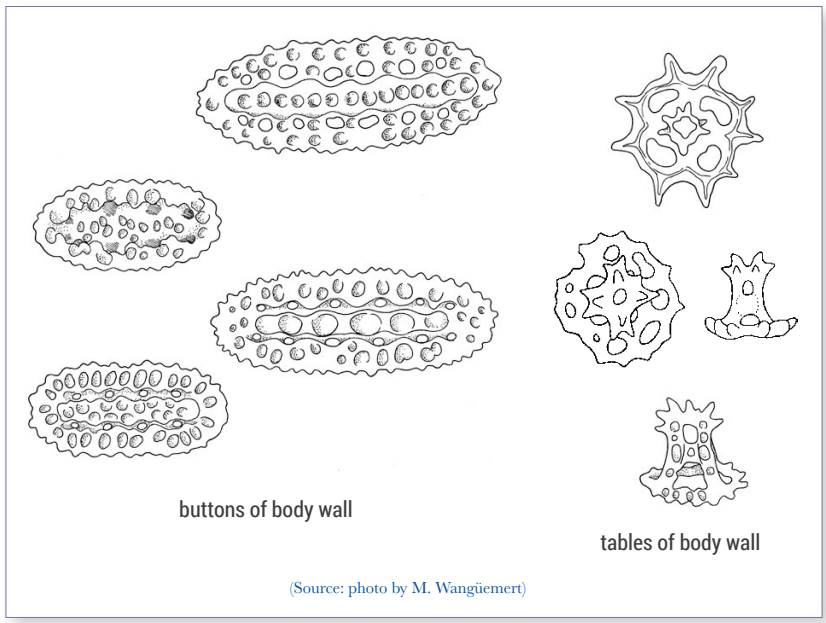
Size: In the Northeast Atlantic, Spain, western and southern Portugal, average body weight 93–161 g total weight (ungutted), and 23–24 cm in length. In Cocedores (Southeast Spain), Gran Canaria (Southwest Spain) and Olhos de Água (south Portugal) the animals weigh just 57–67 g on average with body lengths of 18–20 cm. This species tends to be smaller in the Canary Islands and the Mediterranean. Maximum length (western Portugal) reported as 43 cm.

HABITAT AND BIOLOGY

Can inhabit rocky bottoms, feeding on nearby sand bottoms at night. Also can occur in sandy and silty habitats with seagrass, where it feeds diurnally and nocturnally. Sex ratio is 1:1, with gametogenesis commencing in spring and reproduction during summer and autumn. This species can host pearlfish symbionts.

EXPLOITATION

Fisheries: Initially harvested as a secondary species by hookah divers in Türkiye since 1996. Since 2000, it is one of the main target species in Tunisia but 2017 data indicated declining stocks and animal sizes. Harvested in Greece although data are limited.



(Source: photo by M. Wangüemert)

Regulations: Exploitation is largely unregulated in Tunisia. Since 2007, Türkiye mandates licences for fishers, a rotational harvest strategy (4-year cycle) in the Aegean Sea, a 5-month seasonal closure, a daily bag limit of 40 kg per diver, a 2 500 tonnes basket quota for the fishery and no size limits. High rates of fishing infringements in Türkiye, including for the use of illegal trawl gear. Harvesting in Greece is permitted for licensed fishers, a Vessel Monitoring System (VMS) is mandated for vessels, animals only to be collected during daylight hours, a 6-month seasonal closure, vessel bag limits of 400 *Holothuria* spp. per day, and a minimum legal-size limit of 180 g whole weight. Harvests are prohibited in Italy (since 2019), Croatia (since 2018) and Montenegro (2006).

Human consumption: Eaten mainly by Asian consumers after being cooked or reconstituted.

LIVE ©M. Wangüemert

PROCESSED ©M. Aydin

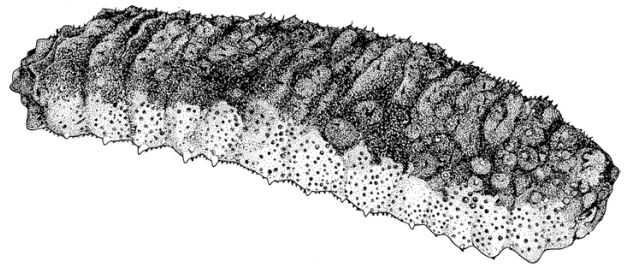
Main market and value: A majority of product is exported frozen from Türkiye, where estimated prices (in 2021) were USD 30 per kg frozen (semi-processed) and USD 120 per kg dried. Product matching the appearance of *H. mammata* sold in China, Hong Kong SAR (2022) for USD 166 per kg dried.

GEOGRAPHICAL DISTRIBUTION

Widely distributed in the Mediterranean Sea and Northeast Atlantic, including the Azores Islands and Madeira (Portugal) and Canary (Spain) islands.

COMMON NAMES

Pepino de mar (Latin American countries), Donkey dung sea cucumber (Bahamas, Florida Keys).



DIAGNOSTIC FEATURES

Dark brown, greenish, grey or black dorsally, usually becoming lighter on the lower margins. The dorsal surface is smooth and possesses bumpy, wart-like protrusions. Ventral surface varies greatly from bright red, pink, orange, white, yellowish, grey, dark purple or black. Smallest juveniles are yellowish-white with flecks of purplish-brown on dorsal papillae and few on ventral surface. *Holothuria mexicana* is a large species with a rigid body, with large dorsal and lateral folds. Both anterior and posterior ends are rounded. The ventral mouth contains 20–22 peltate tentacles. The dorsal podia tend to hold detritus, seagrass blades and algae.

Ossicles: Tentacles with rods of various sizes, 55–190 µm long as well as rosettes. Dorsal body wall with tables and rosettes. Tables with irregular discs that have spiny extensions, 50–95 µm across, and are perforated by 4 large central holes and few peripheral ones; spire ending in a spiny crown. Rosettes can be open or closed, forming biscuit-shaped ossicles, 25–50 µm long. Ventral body wall with similar rosettes and fewer tables with discs 40–75 µm across.

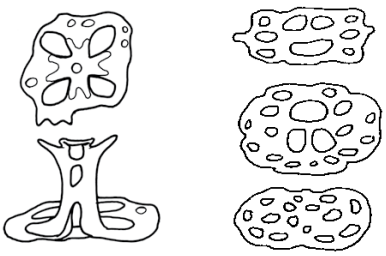
Processed appearance: Dark brown to blackish in colour. The body is tapered gradually at both end and possesses a bumpy texture.

Remarks: Studies have shown that this species may accumulate high levels of trace metals including copper, nickel, lead and zinc. The concentrations of these metals were found in the eviscerated digestive tract.

Size: Maximum length about 50 cm; average fresh length 33 cm. Average fresh weigh about 260 g (Panama).

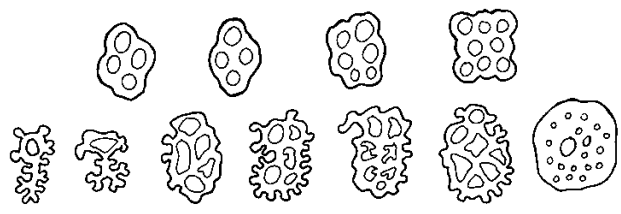
HABITAT AND BIOLOGY

In Colombia, this species prefers coral reefs, seagrass beds, sandy or rubble bottoms and mangrove habitats. In the Wider Caribbean, it inhabits shallow waters with sandy or coral patches or seagrass beds. In Panama, it reproduces between February and July, and late summer in southern Florida (United States of America). However, there are individuals with mature gametes all year long. This species has a size-at-maturity of 18 cm.



tables buttons

(After Hasbún and Lawrence, 2002)



rosettes and various stages of biscuit-shaped plates

(After Deichman, 1957)

EXPLOITATION

Fisheries: Harvested by hand collection in artisanal fisheries in the Gulf of Mexico and Caribbean, often illegally. This species is part of multispecies fisheries that often include *H. floridana*, *H. thomasi*, *Astichopus multifidus* and *Isostichopus badionotus*.

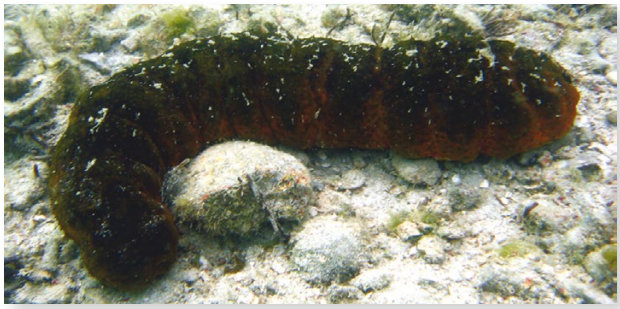
Regulations: Where it is fished, there are few, or no, regulations pertaining to harvesting, apart from no-take marine reserves.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Code: **JCQ**. Main markets are China, Hong Kong SAR, mainland China and Southeast Asia. Prices in China, Hong Kong SAR retail markets (2016) averaged USD 177 per kg dried and could be found up to USD 389 per kg. In 2022, it was found sold in China, Hong Kong SAR for USD 209 per kg dried and as high as USD 1 877, although the latter price seemed fanciful. Prices in Guangzhou markets (2016) averaged USD 80 per kg. Sold online in China (2022) for USD 165–187 per kg.

GEOGRAPHICAL DISTRIBUTION

Distributed widely along the Florida Keys (United States of America), Bahama Islands, Cuba, Puerto Rico, Jamaica, Barbados, Tobago, Panamá, Aruba, Yucatan Peninsula (Mexico), Belize, Bonaire, Venezuela (Bolivarian Republic of) and islands off Colombia, at depths from 0.5 to 20 m.



LIVE ©SIMAC-INVEMAR

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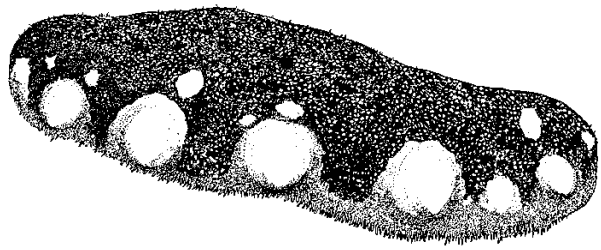
COMMON NAMES

Black teatfish (**FAO**), Holothurie noire à mamelles (**FAO**), Benono (Madagascar), Barbara (Mauritius), Bawny black (Egypt), Abu habhab aswed (Eritrea), Pauni mweusi (Kenya and United Republic of Tanzania, Zanzibar), Polanga attaya (Sri Lanka), Koro, Cera hitam (Indonesia).



DIAGNOSTIC FEATURES

This species is black dorsally with white blotches and spots on the sides of the animal and around the lateral protrusions ("teats"). Body suboval; stout and very firm, arched dorsally and strongly flattened ventrally. Body wall is thick, and possesses generally 6–10 characteristic large lateral protrusions. The body is often covered by a thin coating of fine sediment. Dorsal podia are sparse and small, while the ventral podia are numerous, short and greyish. The mouth is ventral, with 20 stout tentacles. Anus surrounded by 5 tiny calcareous teeth. Cuvierian tubules absent. Juveniles probably differ in colour from adults.

Ossicles: Tentacles with rods, 40–410 µm long, spiny at extremities and mostly curved. Dorsal and ventral body wall with the same type of tables. Table discs, 55–70 µm across, circular with an undulating rim, perforated by 4 large central holes and 8–12 peripheral ones; spire low ending in a regular spiny crown or in an irregular one with less spines. Buttons of the dorsal body wall are elongated or ellipsoid, and on average 100 µm long. Buttons of the ventral body wall can be smooth, knobbed, or fenestrated, 80–100 µm long. Ventral and dorsal podia present large perforated plates with ragged sides.

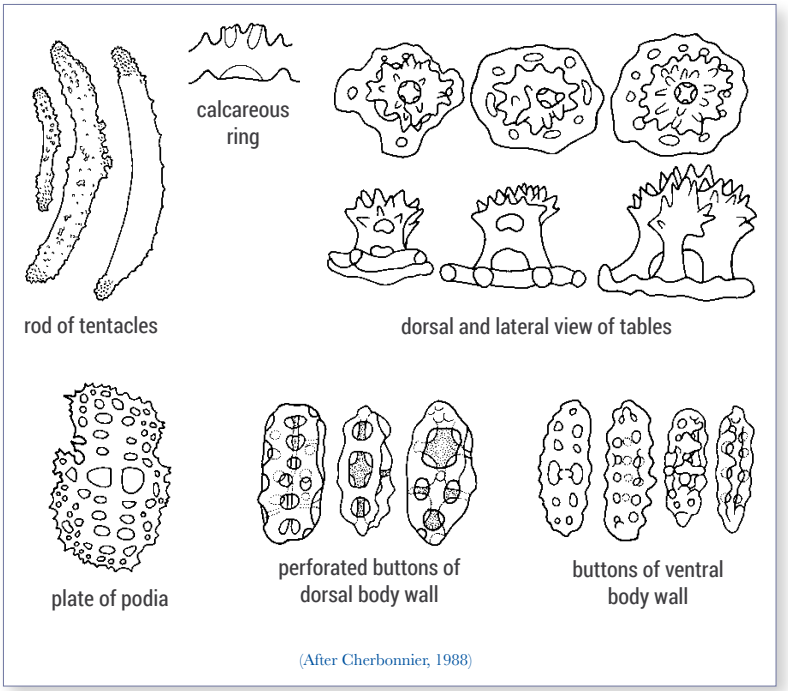
Processed appearance: Processed *Holothuria nobilis* has a flattened, stout shape with obvious teats along both sides of the body. The body surface is powdery greyish-brown, smooth to slightly wrinkled. The ventral body wall is usually dirty grey. One single cut dorsally but not completely to the mouth or anus. Common size 18–24 cm.

Remarks: This species is found on tropical reefs of the western Indian Ocean. The black teatfish of the Pacific is a separate species named *H. whitmaei* Bell, 1887.

Size: Maximum length about 60 cm; average length about 35 cm. Average fresh weight: 230 g (Mauritius), 800–3 000 g (Réunion), 1 500 g (Egypt); average fresh length: 14 cm (Mauritius), 35 cm (Réunion), 55 cm (Egypt).

HABITAT AND BIOLOGY

It lives in shallow coral reef habitats (lagoons) up to 20 m depth. In Africa and the western



Indian Ocean region, this species can be found on reef flats and slopes on coral rubble between 0 and 40 m depth. In Madagascar, it occurs in the inner slope and on seagrass beds, with higher abundance in the former. In the Comoros, it normally inhabits between 10 and 40 m depth on coarse sand. It reproduces annually during the cold season.

LIVE ©T. Skewes

PROCESSED ©S.W. Purcell

EXPLOITATION

Fisheries: *H. nobilis* has been one of the most sought-after species in the western Indian Ocean. Exploitated at an artisanal scale (e.g. United Republic of Tanzania) and industrial scale (e.g. Mauritius). This species was previously harvested by hand collecting from reef flats in Egypt. It was collected by free diving and SCUBA diving in Madagascar and Mauritius. It has been fished commercially in Eritrea, Madagascar, Egypt, Maldives, Mozambique and Seychelles. In Kenya and United Republic of Tanzania it is among the most valuable commercial species; however, in United Republic of Tanzania it is captured in low numbers due to its scarcity. This species has been depleted in most localities due to overfishing.

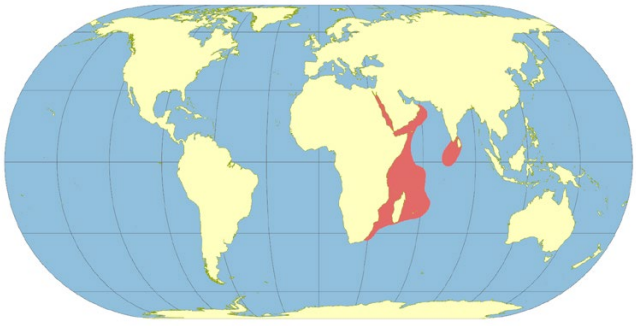
Regulations: Fishing is banned in Egypt. Listing on CITES Appendix II has forced countries to conduct non-detriment findings assessments in order to export it.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Code: **HFN**. Markets are China, China, Hong Kong SAR, Singapore, Taiwan Province of China and Malaysia. Prices in China, Hong Kong SAR retail markets in 2011 ranged from USD 106 to 139 per kg dried, and it was found on sale in China, Hong Kong SAR in 2022 for USD 338 per kg dried.

GEOGRAPHICAL DISTRIBUTION

Known from localities in the western Indian Ocean, from East Africa to possibly India and Maldives. It can also be found in the Red and Arabian Seas. This species does not appear to occur as far east as the Java Sea (e.g. western Indonesia) and South China Sea (e.g. Malaysia, Viet Nam, Philippines).

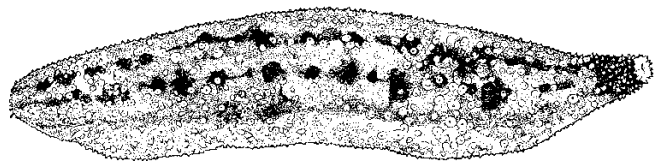


OTHER USEFUL INFORMATION

This species is widely reported as overexploited in many localities, and listed as Endangered on the IUCN Red List. It is listed on CITES Appendix II.

COMMON NAMES

Dorilisy, Tsimihoke (Madagascar).



DIAGNOSTIC FEATURES

Holothuria notabilis is a medium-sized species. It is cylindrical in shape and tapered near the anus. The mouth is ventral and possesses 20 small yellow tentacles. From the original taxonomic description, the tegument colour is whitish with many dark-brown or black "dots" on the dorsal surface, forming two rows of 8–10 dots. Podia on the ventral surface are small and scattered over the entire area. The calcareous ring is well developed. It has short white Cuvierian tubules that are rarely expelled.

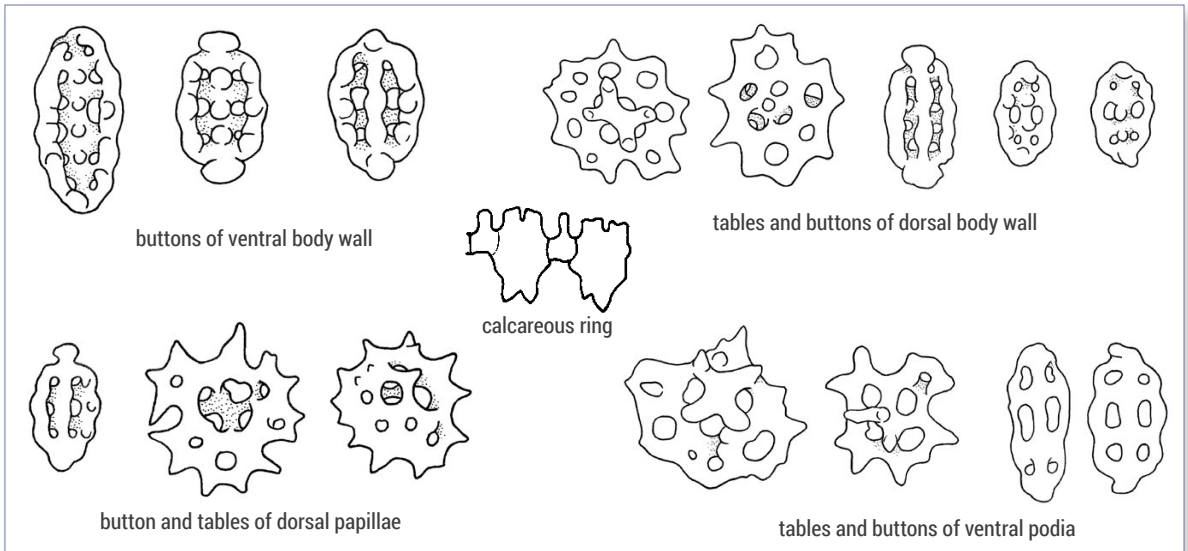
Ossicles: Numerous small nodulous buttons and few tables with their disc irregularly spined and with spire reduced to 4 short pillars that are fused at their base. Such small, reduced tables are present in the upper tissue of the ventral body wall. In the dorsal body wall tables with larger disc diameter and with fully developed spire. Between both type of tables all intermediates can be found, both in diameter of table disc and in height of spire.

Processed appearance: The specimens look like small wooden sticks. The products are grey with fine, dark, reticulated lines and may have dark blotches or large dark spots. The posterior ends of the products are noticeably tapered. The outer body wall of the dried products are relatively smooth, with no bumps or projections on the body wall. The conversion factor from live to dry is low, at around 3 percent of the original whole body weight.

Size: Average fresh weight: 180 g; average fresh length: 18 cm. Maximum weight is about 500 g and maximum length is 32 cm.

HABITAT AND BIOLOGY

In Madagascar, this species prefers lagoons and seagrass beds on sandy substrata between 0 and 10 m depth. It can be found at densities of about 200 ind. per ha (with a biomass in fresh weight of about 30 kg



(Ossicles drawn from the holotype in the Zoological Museum Hamburg. Calcareous ring after Ludwig [1875])

per ha). The size at first sexual maturity is 9 cm in length or 20 g gutted weight (or 60 g total body weight). The gonads are long branched tubules; at maturity, they are white in males and orange in females. In Madagascar, the annual reproductive cycle annual is well marked, with spawning in November–December.

EXPLOITATION

Fisheries: *H. notabilis* entered the trade in Madagascar in 2002 and is currently exploited intensively. It is collected by women and children by wading at low tide and by men snorkeolling at coastal sites from canoes. The catch per unit of effort (CPUE) in Madagascar has been reported at 3 kg per day per fisher. This species is fished together with other medium-sized or small species.

Regulations: None except for moratoria within multispecies fisheries in the western Indian Ocean.

Human consumption: This species is processed into the dried bêche-de-mer product for export and is not consumed locally.

Main market and value: Code: **JCW**. The products from Madagascar are shipped with the other species to the markets of China, Hong Kong SAR, China and Singapore.

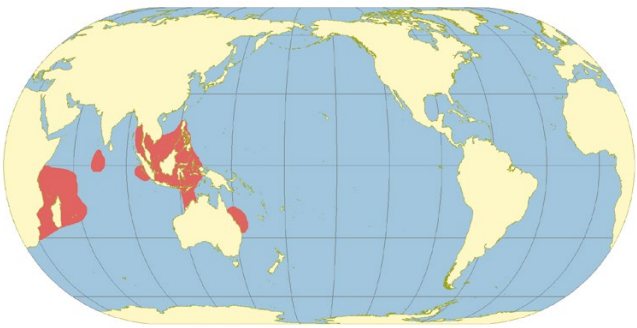
GEOGRAPHICAL DISTRIBUTION

Great Barrier Reef (Australia) and found at localities in the Indian Ocean including Madagascar, Mozambique, South Africa (KwaZulu-Natal) Malaysia, Thailand, Philippines and Indonesia.

LIVE ©IH-SM-WIOMSA

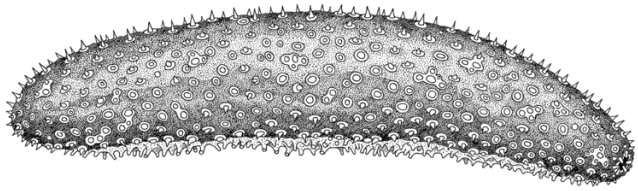
LIVE ©R. Tan

PROCESSED ©IH-SM-WIOMSA



COMMON NAMES

Pepino sal y pimienta (Mexico); Salt-and-pepper sea cucumber (United States of America).



DIAGNOSTIC FEATURES

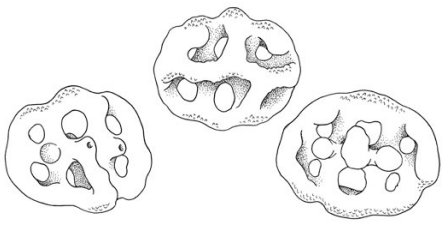
Body is sub-cylindrical in shape, being arched dorsally and flattened ventrally, and relatively stout. Dorsal body colour is brownish black, with whitish rings around the base of the slender and relatively small conical papillae. The ventral surface (trivium) has comparatively small podia, often completely retracted. The body wall is rigid to the touch. The mouth is ventral and the anus is terminal. Cuvierian tubules absent.

Ossicles: Tentacles with small, smooth rods that are sometimes perforated in one or both ends. Body wall with tables (disc diameter: 40–80 µm) with knobbed edges (knobs often bent upward) and frequently with a spire reduced to four knobs. Papillae have several huge tables (height: 300 µm) with a pointed conical spire. Button ossicles (50–90 µm long) are numerous and often incomplete, and most have six holes and vary from almost smooth to knobbed. Ventral feet have small endplates and numerous large, smooth supporting rods or plates with perforations along the sides and at the ends. Endplates are absent from the base of dorsal papillae.

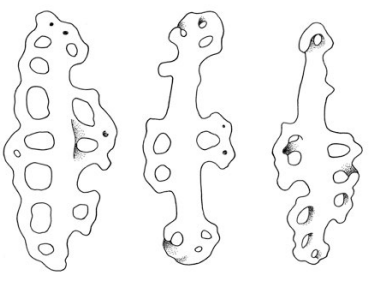
Processed appearance: Cylindrical and slender shape. The dorsal and ventral surfaces are well distinguished. The dried body wall is typified by having countless small white spots on a dark brown background all over the body. Small wart-like bumps are prominent all over the body and along the margins of the animal.

Remarks: *Holothuria paraprinceps* resembles *H. princeps* from the Atlantic Ocean. Aside from the difference in colour, the ossicles are much smoother and more regular in *H. paraprinceps* than in *H. princeps.*

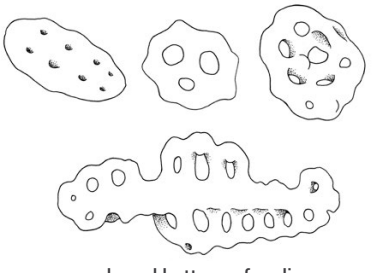
Size: Maximum length is around 30 cm for live animals, commonly between 20–25 cm. Average fresh weigh on Mexican Pacific coasts is 300 g.



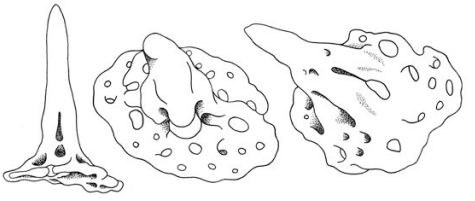
pseudobuttons of dorsal papillae and podia



rods of dorsal body wall



rods and buttons of podia



tables of dorsal papillae

(Source: F.A. Solís-Marín)

HABITAT AND BIOLOGY

Found on sandy or partially rocky bottoms. Inhabits shallow waters, mostly on sand flats down to a maximum of 65 m depth. The animals tend to be cryptic. This species has separated sexes. Preferred temperature range is 18–27 °C, but more common in waters around 22 °C.

EXPLOITATION

Fisheries: Harvested by breath-hold divers in artisanal fisheries, at least in Mexico. Also targeted in semi-industrial fisheries in the Mexican Pacific.

Regulations: There are no fishery regulations for this species.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: In Mexico, this species was exported for USD 14–16 per kg dried and fishers received USD 1 per kg wet weight.

GEOGRAPHICAL DISTRIBUTION

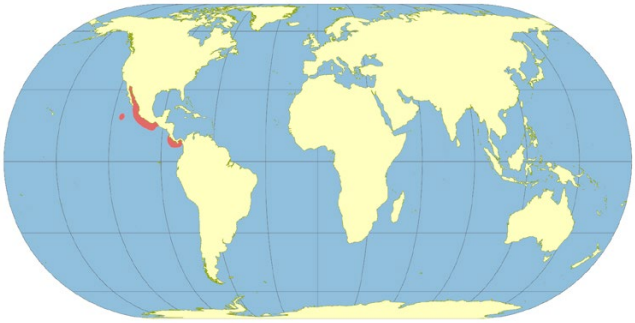
Occurs in Mexico (including Clarion Island), Panama and Costa Rica.

OTHER USEFUL INFORMATION

There are no known species-specific conservation measures for *H. paraprinceps*. More research is needed on its population status, habitat, ecology and threats.

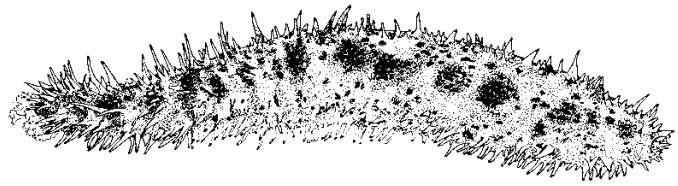
LIVE ©C. Galván

PROCESSED ©F.A. Solís-Marín



COMMON NAMES

Bantunan (Indonesia).



DIAGNOSTIC FEATURES

Body is beige to light yellowish or grey in colour, with 2 rows of large dark spots and numerous tiny dark spots. The body is covered with numerous dark brown or black, short, conical papillae with rounded or slightly conical tips, which are scattered on the dorsal surface. The ventral surface is yellowish to light brown. The body is elongate, cylindrical, and wider at the posterior end of the animal. Ventral podia are short, stout and numerous. The mouth is ventral to terminal, surrounded by a double circle of papillae, and has 18–22 cream-coloured tentacles. The anus is terminal and surrounded by conical papillae. No Cuvierian tubules.

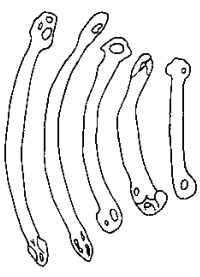
Ossicles: Tentacles with rods up to 180 µm long. Dorsal and ventral body wall with similar tables and buttons. Table discs 50–80 µm across, with smooth or spiny rims, and are perforated by 4 central holes and 4–12 peripheral ones, and the spire ends in a small spiny crown. Buttons, 40–70 µm long, with 3–10 holes, rather irregular. Ventral podia with tables and buttons similar to those of the body wall, and there are perforated plates, up to 150 µm long. Dorsal papillae with tables and buttons similar to those of the body wall and characteristic large, slightly curved rods, 90–170 µm long, that are perforated distally.

Processed appearance: Not available. This species may be traded mixed with other low-value species in the dried form.

Size: Average body length roughly 12 to 25 cm.

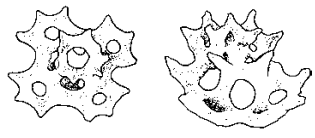
HABITAT AND BIOLOGY

In Kenya, it has been observed buried under coral rubble or coral boulders. In the Comoros, it inhabits shallow waters between 0 and 10 m depth on coral rock or buried among coral rubble. In La Réunion, it is found in crevices on reef flats. Its reproductive biology is unknown.

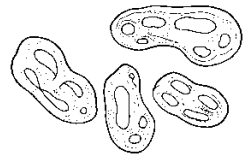


curved rods of podia

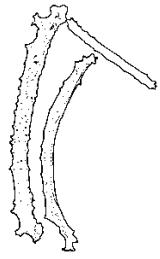
(After Massin, 1999)



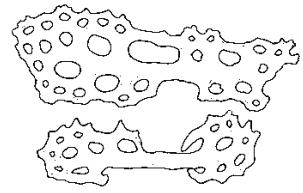
tables of body wall



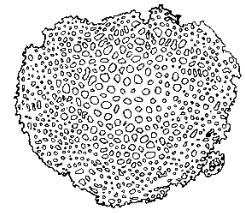
buttons of body wall



rods of tentacles



perforated plates of podia



terminal plate of podia

(Source: photos by F.A. Solís-Marín *et al.*, 2009)

EXPLOITATION

Fisheries: It is commercially exploited in China and Indonesia.

Regulations: Not available.

Human consumption: Unknown, probably exported dried and eaten by Asians after being reconstituted.

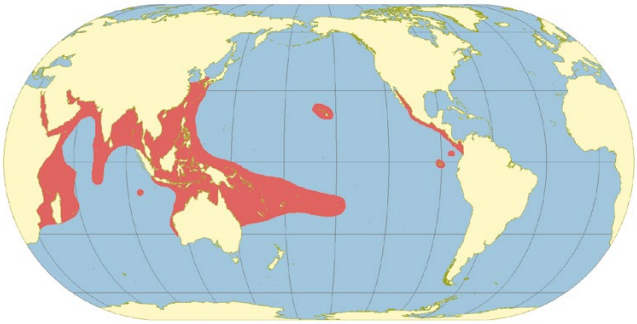
Main market and value: Code: **JDB**. Data on prices were unavailable.

GEOGRAPHICAL DISTRIBUTION

Ranges from the western central Pacific to Hawaii (United States of America), Asia and the Africa and Indian Ocean region (including the Red Sea, the Arabian Sea and the Persian Gulf). Also found on the Pacific coast of Central America.

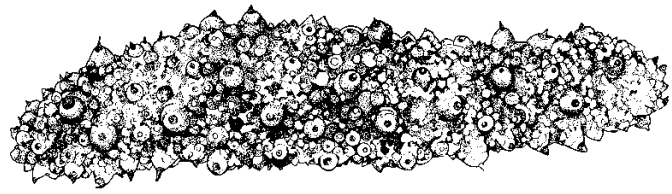
LIVE ©L. Vail

LIVE ©F. Ducarme



COMMON NAMES

Tiger spotted trepang (**FAO**, Indonesia).



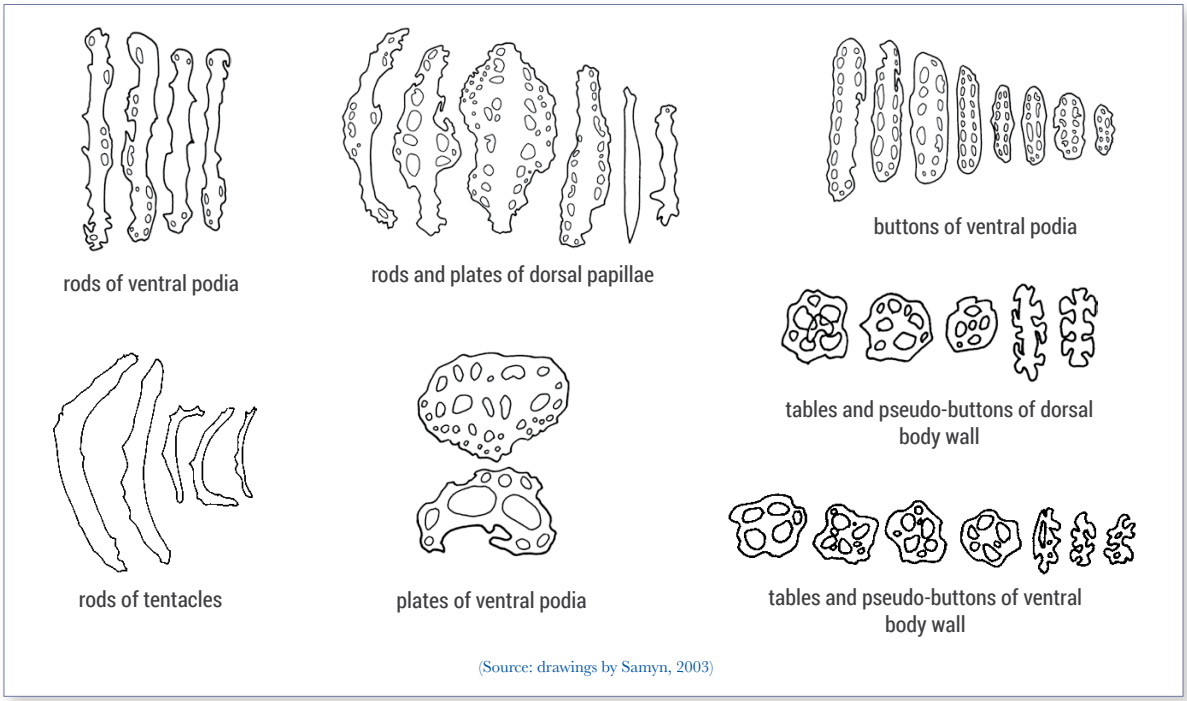
DIAGNOSTIC FEATURES

This species is grey to brown with four to six dark brown blotchy bands across the body. The dorsal surface has relatively sparse but large, yellowish protuberances ending in a brown-coloured papilla with whitish tip. The ventral surface is white to yellowish and is covered with numerous, long, cylindrical podia. The mouth is ventral, with 20 large, yellowish or greyish tentacles that have small brown spots. The anus is terminal, relatively large and surrounded by a wide dark brown ring and by five groups of small white papillae. Cuvierian tubules present, lightly bluish, and readily ejected.

Ossicles: Tentacles with rods, 150–375 µm long, the largest ones are slightly spinose distally. Dorsal and ventral body wall with similar tables and pseudo-buttons. Tables with discs 30–40 µm across, rim smooth and undulating, perforated by 4 central holes and 1–3 smaller peripheral holes; spire, if present, is low and ends in an ill-formed crown. Pseudo-buttons of dorsal body wall are 40–55 µm long, while those of ventral body wall are slightly smaller, 25–35 µm long. Ventral podia with buttons, perforated plates and perforated rods. Dorsal papillae with rods that can turn into perforated plates, up to 190 µm long.

Processed appearance: Not available. This species may be traded mixed with other low-value species in the dried form.

Remarks: The external distinction between *Holothuria pervicax* and *H. fuscocinerea* is not too easy for the untrained eye, but the ossicles of the body wall of the latter comprise true, albeit small and rather irregular, buttons whereas *H. pervicax* presents rosettes.



(Source: drawings by Samyn, 2003)

Size: Small to moderate-sized species. Maximum length about 35 cm.

HABITAT AND BIOLOGY

This species can be found on reef flats underneath coral rocks, where it generally remains hidden during the day. It occurs in shallow waters to about 10 m depth. Its reproductive biology is unknown.

EXPLOITATION

Fisheries: This species is known to be fished in China, Madagascar and Indonesia; in the latter, it is part of a multispecies fishery, where *H. pervicax* is used as a filler to top up weights during sales.

Regulations: There appear to be few regulations on the exploitation of this species.

Human consumption: Poorly known, but probably just eaten as reconstituted bêche-de-mer.

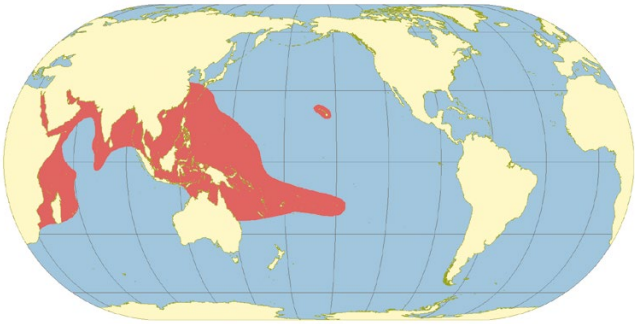
Main market and value: Code: **JDD**. Retail prices were not obtained. This species is a low-value species. Traded previously at about USD 3 per kg dried in the Philippines.

GEOGRAPHICAL DISTRIBUTION

It can be found widely from localities from the Indian Ocean (including the Red Sea, the Arabian Sea and the Persian Gulf), Southeast Asia and the Pacific, including Hawaii (United States of America).

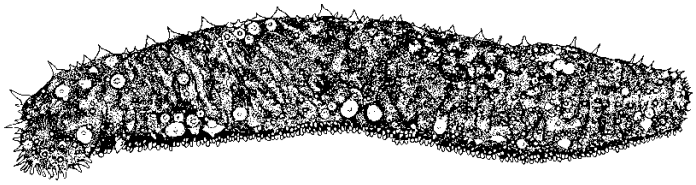
LIVE ©D. Burdick

LIVE ©G. Paulay



COMMON NAMES

White-spot sea cucumber (European Union, Türkiye).



DIAGNOSTIC FEATURES

Cylindrical and moderately elongated body. Dorsally dark or light brown and with small pointed papillae, somewhat more numerous at the anterior end. The animals commonly have sand, algae and shells stuck to the dorsal surface. Ventrally with numerous white podia. 20–22 peltate tentacles.

Ossicles: Possesses a variety of ossicle types, including buttons, tables, plates and rods. Buttons from dorsal and ventral tissues are 30–45 µm long, smooth or slightly knobbed, generally with 2–6 pairs of holes but occasionally more, which could be reduced, incomplete or twisted (mainly in the ventral tissues). Tables from dorsal tissues short, with rounded and spiny discs possessing four large central holes and sometimes 1–4 small peripheral holes. The table crown is spiny on each corner giving appearance of a Maltese cross. Ventral tables tend to be smaller. Table discs are 30–45 µm in diameter while the spire is 30–40 µm. Rods of dorsal and ventral tissues are perforated, while rods of the tentacles are spiny with few holes at ends.

Processed appearance: Dorsally dark brown with tiny raised bumps and few wrinkles. The ventral surface has noticeable tiny white spots (from podia). Animals commonly cut in the middle of the ventral surface. Common dried size 5–10 cm.

Size: It most frequently weighs 21–40 g. In parts of Spain, average weight is 56–71 g. In Italy, it can reach 19 cm in length. Individuals are lightest (average 33 g) in Crete and shortest in Torre de la Horadada (Southeast Spain) (average 12 cm). In Türkiye, the average length of gutted animals is around 10 cm, av. gutted weight 50–70 g, max. gutted weight 111 g. In Algeria, av. length is 20 cm, av. gutted weight 33 g. Body weight (gutted) commonly 30–50 g and max. 66 g in Egypt. Maximum length 36 cm.

HABITAT AND BIOLOGY

Often found in sandy/muddy bottoms associated with *Caulerpa* algae and *Cymodocea* seagrass meadows. Often covers its body with sand, algae and shells. It may inhabit hypersaline coastal lagoons. Found mostly in the sublittoral zone, mostly down to 45 m deep but occasionally to 70 m. Reproduces during the summer months. Female and male are most ripe in July, and gonads are in post-spawning stage by October. Occasionally hosts

buttons of dorsal body wall

tables

buttons of ventral body wall

(Source: photos by M. Wangüemert)

pearlfish symbionts. In Algeria, sexual maturity occurrs at 14 cm body length, at a gutted body weight of 18 g.

EXPLOITATION

Fisheries: Initially harvested in Türkiye as bycatch in trawl fisheries, and from 2002 harvested by hookah divers. Later on, it became the primary fishery target species by divers from 300+ boats. Some signals of overexploitation were detected such as an absence of large individuals and a decrease of genetic diversity. Harvested illegally in Algeria since 2013 and now collected using gleaning, free-diving and compressed-air diving and constituted about 30 percent of catches. Harvested was authorized in Tunisia since 2014, where overexploitation was also recorded, and in Greece from 2018. From 2000, it began being exploited on Mediterranean coasts of Egypt.

LIVE ©M. Wangüemert

PROCESSED ©M. Aydin

Regulations: Exploitation authorized in Algeria for subsistence only, with a 46-day seasonal closure annually. Fishing is largely unregulated in Tunisia. Since 2007, Türkiye mandates licences for fishers, a rotational harvest strategy (4-year cycle) in the Aegean Sea, a 5-month seasonal closure, a daily bag limit of 40 kg per diver, a 2 500 tonnes quota for the (entire) fishery and no size limits or species restrictions. High rates of fishing infringements in Türkiye, including for the use of illegal trawl gear. Harvesting in Greece is permitted under licence, VMS is mandated for vessels, animals only to be collected during daylight hours, a 6-month seasonal closure, vessel bag limits of 400 *Holothuria* spp. per day, and a minimum legal-size limit of 180 g gutted weight per animal (applies to all three species in the fishery). Harvests are prohibited in Montenegro (since 2006), Croatia (2018) and Italy (2019).

Human consumption: Initially consumed domestically in Algeria, but exported dried in recent years. Eaten mainly by Asian consumers after being cooked or reconstituted.

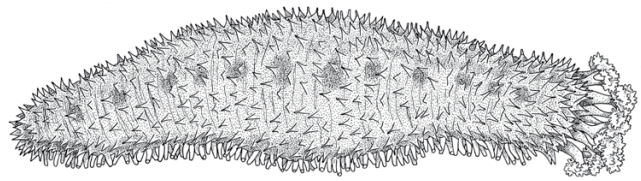
Main makets and value: In Algeria, landing prices ranged USD 1.5–5.3 per kg fresh (gutted) and dried product sold for USD 30–90 per kg. Small individuals used for bait in Algeria. In Türkiye (2021), frozen (semi-processed) product sold for USD 23 per kg and dried product for USD 90 per kg.

GEOGRAPHICAL DISTRIBUTION

Distribution is restricted to the Mediterranean Sea, with ancestral populations in the east. Its presence in the Red Sea is reported but uncertain.

COMMON NAMES

Pepino manchado (Mexico).



DIAGNOSTIC FEATURES

Cylindrical body with a broad anterior end, and a narrow yet blunt posterior end. Dorsal colour ranges from dark brown, greyish, greenish yellow to black, and often has two longitudinal rows of darker roundish spots with diffuse borders. The dorsal surface has conical, dark papillae and relatively small, dark podia. Ventral surface is light coloured and has numerous podia that are relatively large. It possesses 12 to 20 yellowish brown or brown tentacles. The mouth and anus are terminal.

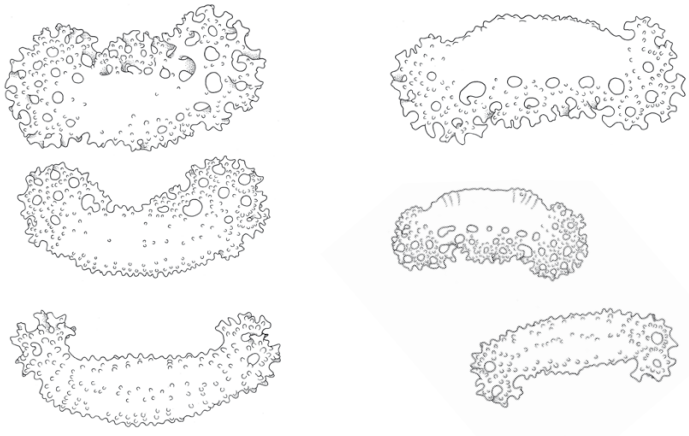
Ossicles: Ossicles vary in length, from 60–220 µm, and become longer and more complex as the animals age. Tentacles with small rods (60–70 µm in length), slightly spinous at the ends and unperforated. Body wall has flattened plates that are slightly curved and with few to many perforations at the margins (90–100 µm in length); lateral perforations often appear on one or both sides of the main axis of the bar; some bars with three axes. A low ridge occurs medially on the plates and the margins end in small spines. Occasionally, the plates develop as tri-radiated forms. Podia with end plates and a variable number of rods or plates, generally more slender than those from the body wall. Papillae may have small terminal plates.

Processed appearance: This species is externally similar in appearance to *Holothuria lubrica*. Cylindrical and tubular shape with blunt ends. Ventral and dorsal surfaces are well demarcated, with the ventral surface having numerous podia and a pale yellow colour. The dorsal surface is greenish with many fewer podia. In contrast to the processed product of *H. lubrica*, those of *H. portovallartensis* are darker in colour dorsally.

Size: *H. portovallartensis* is a medium sized species; live animals up to 26 cm long.

HABITAT AND BIOLOGY

This species is quite cryptic, living hidden under rocks and exposed for only short time. It occurs under and around boulders and rocky outcrops of the lower intertidal zone and upper margins of the subtidal zone, mostly in 0–3 m deep.



perforated plates of body wall

perforated rods of podia

(Source: F.A. Solís-Marín)

EXPLOITATION

Fisheries: Information is scant, but this species is known to be harvested, at least in Mexico.

Regulations: No regulations exist for harvesting this species.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main makets and value: In Mexico, the fresh animals are sold by fishers for around 20 Mexican pesos each (~1 USD). Fully processed (dried) products can be sold for around 80 USD per kg.

GEOGRAPHICAL DISTRIBUTION

Found on coasts of the eastern central Pacific, in the Gulf of California, Costa Rica, Panama, Colombia, Ecuador including the Galapagos Islands and Peru.

OTHER USEFUL INFORMATION

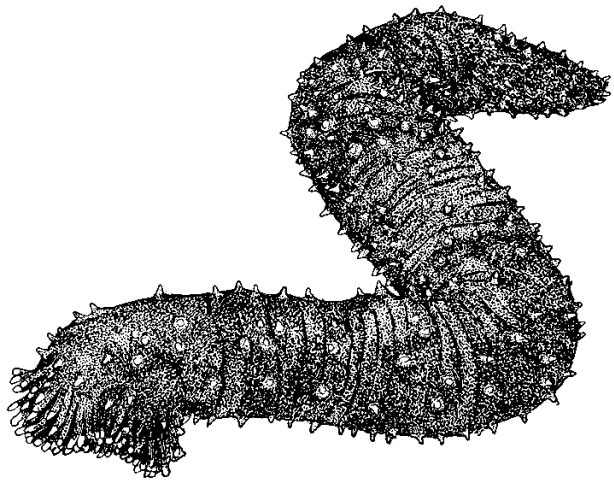
In the Galapagos Islands, *H. portovallartensis* has a soft body wall. Cuvierian tubules are not expelled. At this locality, the animals are brownish dorsally and lack the conical papillae, and the ventral surface is brownish-yellow.

LIVE ©F.A. Solís-Marín

PROCESSED ©F.A. Solís-Marín

COMMON NAMES

Red snakefish (**FAO**, Solomon Islands), Red snekfis (Vanuatu).



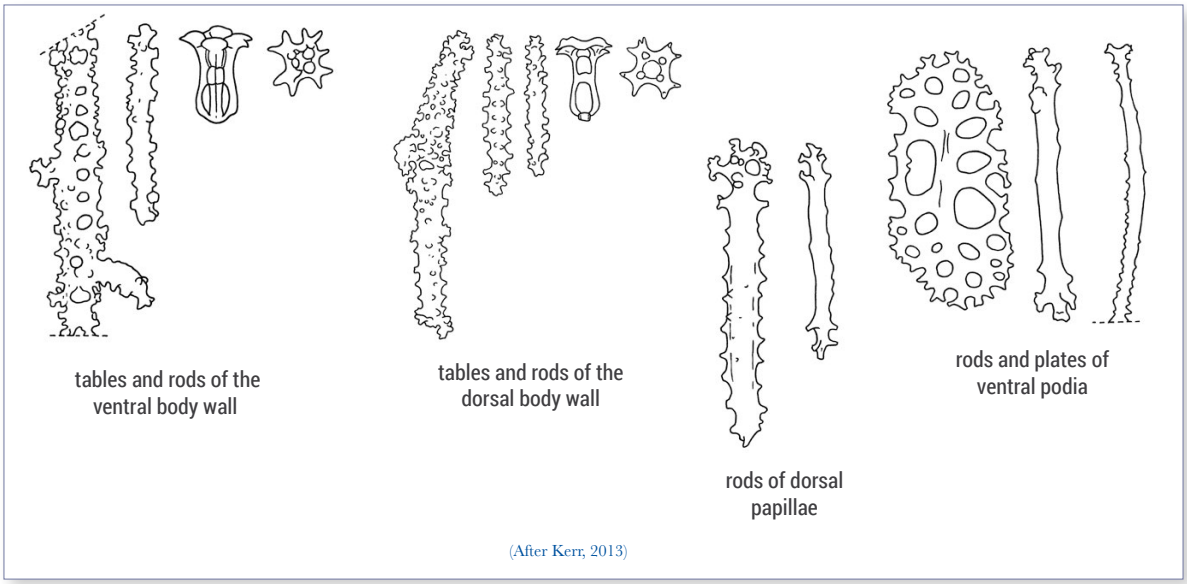
DIAGNOSTIC FEATURES

Dorsal body wall deep-reddish-brown. Ventral body wall is slightly lighter in colour. Body is quite elongated and the body wall is relatively thin and smooth to the touch. Numerous conical papillae are dispersed over the dorsal surface, and are salmon-pink in colour with white tips. Ventral podia are rose coloured fading to white towards the ends of the animal, arranged loosely in the ambulacra. Mouth is subterminal with 27 tentacles and surrounded by a collar of papillae. Anus terminal, surrounded by five groups of 2–3 anal papillae. Cuvierian tubules present, but not expelled.

Ossicles: Dorsal and ventral body wall with tables and knobby rods. Tables without discs, 35–45 µm high, with single cross-beam, and with the end of the spire around 32-µm wide and in the shape of a Maltese cross. Rods usually straight, 50–210 µm long, irregular in outline, spiny, occasionally with distal perforations. Podia and papillae with curved rods with scattered spines or knobs and knobby ends, 110–130 µm long, and perforated plates, to 120 µm in length.

Processed appearance: Similar to *Holothuria coluber*, dried *H. roseomaculata* are elongated and irregular in shape, and clearly tapered at the anterior end. Brown body covered with lighter-coloured bumps. Small cut across mouth and/or in the body middle. Common size probably about 20 cm.

Remarks: This species resembles *Holothuria* (*Halodeima*) *flavomaculata* and is possibly often mistaken for it, especially in the central Pacific where the two species overlap in distribution. In contrast, *H. flavomaculata* has creamy-yellow papillae on a brownish black body.



(After Kerr, 2013)

Size: Live individuals up to 34 cm long.

LIVE ©S.W. Purcell

HABITAT AND BIOLOGY

In New Caledonia *H.* (*S.*) *roseomaculata* lives in sheltered waters, on soft sediment, between 2 and 40 m depth. Mostly active at night, retracted in coral crevices during the day. According to Kerr (2013) in the Micronesian islands of Palau, Pohnpei and Yap, some animals are fully exposed and epibenthic, feeding diurnally, especially in shallow (1–2 m deep) seagrass meadows, while others are nocturnally epibenthic or semi-cryptic whereby only the anterior body is exposed from the crevice while feeding.

EXPLOITATION

Exploited for export to Asian markets as dried bêche-de-mer and mixed with other species.

Fisheries: In the western central Pacific, this species is commercially harvested in Palau, the Federated States of Micronesia, Solomon Islands and Vanuatu. It is probably also harvested artisanally in certain localities in Southeast Asia.

Regulations: Given that this species was only recently described, and possibly sometimes confused with its sister-species *H. flavomaculata*, no species-specific regulations yet exist. Minimum size limits are: 30 cm wet and 15 cm dried in Vanuatu; 20 cm wet and 10 cm dried in Solomon Islands.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

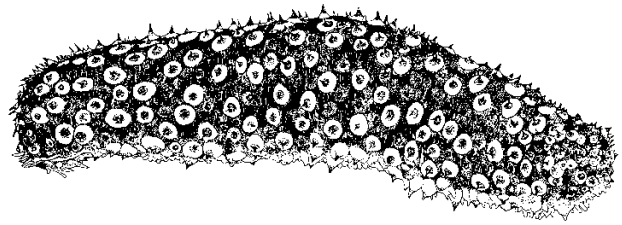
Main market and value: This species is of low value, similar to *H. coluber*. In Fiji (2014), fishers occasionally collect it and sell it to processors for about USD 2 per kg fresh gutted.

GEOGRAPHICAL DISTRIBUTION

Eastern parts of Southeast Asia and western Pacific. Reported from eastern Indonesia, southern Japan, Australia, Palau, Guam, Micronesia (Federated States of), New Caledonia, Solomon Islands, Vanuatu, Fiji.

COMMON NAMES

Dark-stewed sea cucumber (European Union, Türkiye), Variable sea cucumber (European Union), Venenosa (Cape Verde).



DIAGNOSTIC FEATURES

Body cylindrical, sometimes flattened ventrally, with a thick body wall and somewhat rough texture. Dorsally dark brown and often with few or many yellow or cream eye spots with a brown centre, and numerous small conical papillae. Ventrally uniform brown with dense podia. Mouth sub-ventral with 20 brown tentacles. Anus terminal. Well-developed Cuvierian tubules that are readily ejected upon provocation.

Ossicles: Both buttons and table discs have smooth edges. Buttons are flattened with a longitudinal ridge straddling a row of holes. Table discs slightly undulated with four central and 8–10 distal holes. Tables with four pillars of moderate height, crowned by relatively short and abundant teeth.

Processed appearance: Brown in colour and wrinkled dorsally. The body is flattened and elongate with blunt ends. Ventral surface is coloured similarly to the dorsal surface and also wrinkled and with obvious ambulacral podia. Commonly cut with a small slit ventrally. Dried products often 8–10 cm in length.

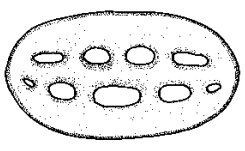
Remarks: *Holothuria sanctori* can be uniformly brown, but is still easily distinguished from *H. mammata* or *H. forskali* by having a thicker body wall with a rough texture. Unlike many other holothuroids from the region, the ossicles are relatively smooth. Like *H. forskali*, *H. sanctori* can expel Cuvierian tubules, whereas *H. mammata* does not.

Size: Average length 18 cm (both Canary Islands and Türkiye). Gutted weight averaged 102 g and max. 186 g in Türkiye. Maximum length 30 cm.

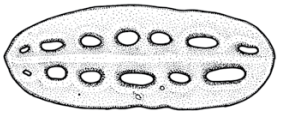
HABITAT AND BIOLOGY

Found mostly on hard substrates and they shelter under rocks and crevices during the day, often in groups of 3 or 4 individuals. A nocturnal species. Occurs at depths of 0–70 m, although more often in 5–22 m. Commonly inhabits sheltered bays in the Azores Islands (Portugal), and is a common holothuroid in Canary Islands (Spain).

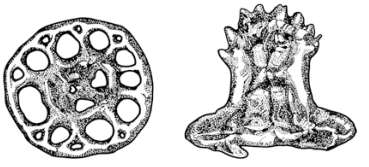
Sex ratio is 1:1 and reproduction occurs in summer months. First sexual maturity in Canary Islands (Spain)



button of dorsal body wall



button of ventral body wall



tables of dorsal body wall

(Source: photos by M. Wangüemert)

occurs at 20–21 cm body length and 176–200 g whole body weight.

EXPLOITATION

Fisheries: Not harvested much in early years of fishery in Türkiye but recently targeted more, by divers using hookah gear by divers from 300+ boats. Harvested illegally in Algeria since 2013 and now collected using gleaning, free-diving and compressed-air diving and constituted 18 percent of catches. Harvested was authorized in Tunisia since 2014 and in Greece from 2018. Some illegal fishing in Madeira Islands (Portugal). Harvested using SCUBA devices in Cape Verde.

LIVE ©M. Wangüemert

LIVE ©S.W. Purcell

PROCESSED ©M. Aydin

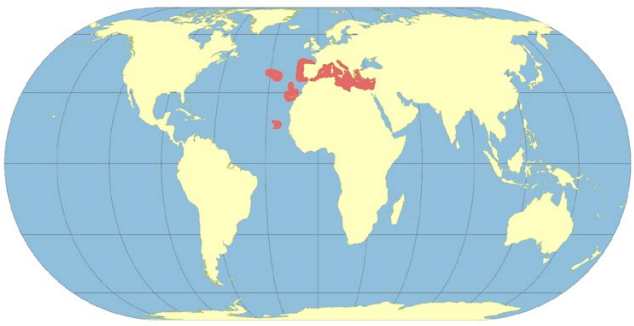
Regulations: Exploitation authorized in Algeria for subsistence only, with a 46-day seasonal closure annually. Exploitation is largely unregulated in Tunisia. Since 2007, Türkiye mandates licences for fishers, a rotational harvest strategy (4-year cycle) in the Aegean Sea, a 5-month seasonal closure, a daily bag limit of 40 kg per diver, a 2 500 tonne quota (all species) for the fishery and no size limits. High rates of fishing infringements in Türkiye, including for the use of illegal trawl gear. In Cape Verde, fishers collect them using SCUBA gear since 2021. Harvesting in Greece is permitted under licence, VMS is mandated for vessels, animals only to be collected during daylight hours, a 6-month seasonal closure vessel bag limits of 400 *Holothuria* spp. per day, and a minimum legal-size limit of 180 g gutted weight per animal. Harvests are prohibited in Montenegro (since 2006), Croatia (2018) and Italy (2019).

Human consumption: Eaten mainly by Asian consumers after being cooked or reconstituted.

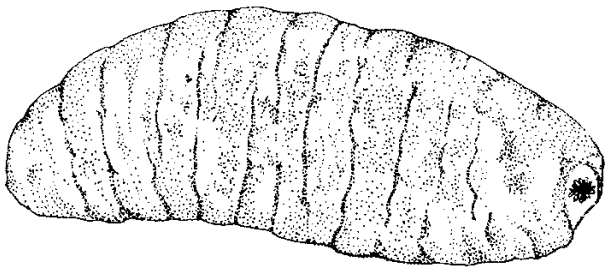
Main market and value: Often exported and sold as semi-processed frozen product. Prices in Türkiye (2021) were USD 100 per kg dried and USD 25 per kg frozen.

GEOGRAPHICAL DISTRIBUTION

Distributed in the Mediterranean Sea and Northeast Atlantic, from the Bay of Biscay to Saint Helena and Ascension, Azores, Madeira, Selvagens (Portugal), Canary Islands (Spain) and Cape Verde.



COMMON NAMES



Sandfish (**FAO**), Sand (Egypt), Ñoät traéng, Hải sâm trắng, Hải sâm cát (Viet Nam), Vella attai, Cheena attai (India), Sandfish (Mauritius, Papua New Guinea, Australia), Putian, Cortido, Curtido, Kagisan (Philippines), Hedra beyda (Eritrea), Zanga fotsy (Madagascar), Jongoo mchanga (United Republic of Tanzania), Myeupe (United Republic of Tanzania, Zanzibar), Dairo (Fiji), Le gris (New Caledonia), Jaffna attaya (Sri Lanka), Kokonm (Seychelles), Gosok, Buang kulit (Indonesia), Sanfis (Vanuatu, Solomon Islands).

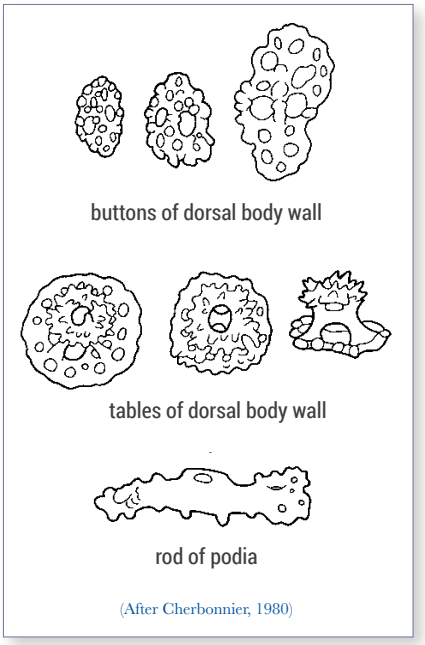
DIAGNOSTIC FEATURES

Colour variable; in the Pacific Ocean and Southeast Asia, it can be black, grey or light brownish green, sometimes with dark transverse lines. In the Indian Ocean, it is usually dark grey with white, beige or yellow transverse stripes. Ventral surface is white or light grey with fine, dark spots. Body oval; arched dorsally and moderately flattened ventrally. Dorsal surface with deep (3 mm) wrinkles and short papillae. Body often covered by muddy-sand. Mouth is ventral with 20 small, greyish, tentacles. Anus is terminal with no teeth. No Cuvierian tubules.

Ossicles: Tentacles with spiny rods, 80–440 µm long, slightly curved. Dorsal and ventral body wall with tables and buttons. Ventrally body wall: tables are rare, disc between 60 and 95 µm across, quadrangular and with smooth rim, perforated by 1 central and 8–16 peripheral holes, spire ending in crown of blunt spines; numerous buttons are 40–75 µm long. Dorsally body wall, similar tables, but smaller; buttons are 40–50 µm long. Ventral podia with nodulous buttons, 40–90 µm long, perforated rods, 110–170 µm long, and tables as in body wall. Dorsal papillae present few rods, few tables, but many buttons as those in the body wall.

Processed appearance: Cylindrical with bluntly curved ends. Coloration from dark tan to near black; ventral surface usually amber-brown. The dorsal surface retains the deep transverse wrinkles. No cuts or small cuts across mouth. Dried specimens 10–15 cm for top grade sizes.

Size: Maximum length about 40 cm; average length about 24 cm. Maximum weight 2.0 kg; average fresh weight: 300 g (Papua New Guinea, Oman, India), 335 g (Australia), 500 g (Egypt), 580 g (New Caledonia); average fresh length: 19 cm (Australia), 20 cm (New Caledonia, Oman), 22 cm (Papua New Guinea), 25 cm (India), 37 cm (Egypt).



HABITAT AND BIOLOGY

Found in shallow waters, but occasionally to about 20 m. Commonly found on inner flat reefs of fringing and lagoonal reefs, and coastal sandflats and seagrass beds with muddy sandy substrates, near mangroves. Both adults and juveniles bury in sand and sandy-mud at some localities. Attains size-at-maturity at 21 cm in Mauritius, at about 25 cm in India and northern Australia and at 16 cm in New Caledonia.

EXPLOITATION

Fisheries: Exploited heavily in artisanal and industrial fisheries throughout its range. Generally harvested by free diving and gleaning. It was over-harvested in Papua New Guinea, Solomon Islands, Torres Strait and Vanuatu, leading to moratoria. Harvested extensively in northern Australia and throughout Southeast Asia, Africa and the Indian Ocean. In India, it was an important species until a fishing moratorium in 2001.

Regulations: Minimum size limits in Papua New Guinea are 22 cm live and 10 cm dry; 20 cm live or 8 cm dried in New Caledonia; 20 cm wet and 10 cm dried in Vanuatu; 25 cm wet and 10 cm dried in Solomon Islands; 18 cm live in Torres Strait; 16 cm in Great Barrier Reef, Northern Territory and Western Australia. In Fiji, it is banned for export to preserve local consumption. In Oman, SCUBA diving gear is prohibited and there is a closed season.

Human consumption: Mostly, the body wall is consumed by Asians and is highly regarded. In parts of the western Pacific (e.g. Fiji), it is cooked and consumed in traditional diets. In Viet Nam, it is used for traditional medicinal products.

LIVE (Pacific Ocean) ©S.W. Purcell

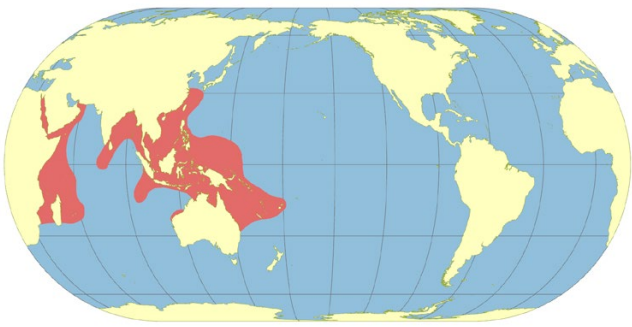
LIVE (Indian Ocean) ©D. Vaitilingon

PROCESSED (Pacific Ocean variety) ©S.W. Purcell

Main market and value: Code: **HFC**. Main markets are the United Arab Emirates, China and Singapore. Sold at USD 33–47 per kg dry in Viet Nam and USD 0.8 per piece fresh and USD 90 per kg dry in Oman and USD 42–88 per kg dry in the Philippines. Sold by fishers in Sri Lanka (2015–2017) for USD 6.70 per individual (fresh). Fishers received USD 4–6 per kg wet (gutted) weight in New Caledonia (2007), USD 3 per piece fresh in Fiji (2014), USD 6–8 per kg wet (gutted) weight in Australia. Sold wholesale in Guangzhou (2016) for up to USD 251 per kg dried. Prices in China, Hong Kong SAR retail markets in 2022 averaged USD 373 per kg dried; max. USD 1 237 per kg.

GEOGRAPHICAL DISTRIBUTION

Widespread in the tropical Indo-Pacific, between latitudes 30°N and 30°S and not presently found further east than Fiji.



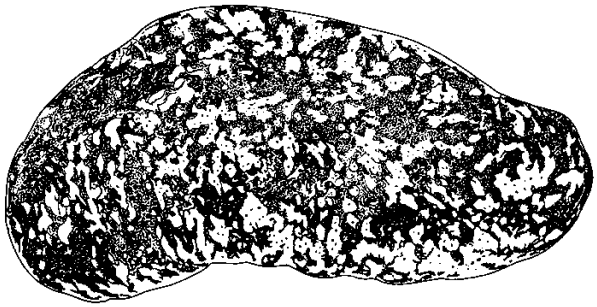
OTHER USEFUL INFORMATION

This species is widely reported as overexploited in many localities, and listed as Endangered on the IUCN Red List.

Holothuria (Microthele) sp. (type 'Pentard')

COMMON NAMES

Flower teatfish, Pentard (Seychelles), Pauni kaki (United Republic of Tanzania, Zanzibar).



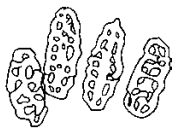
DIAGNOSTIC FEATURES

Dorsal surface is dark brown and mottled with irregular-shaped, cream coloured, blotches. Stout body; arched dorsally and flattened ventrally. Body has a thick body wall and possesses a small number of short, stout, lateral protrusions ("teats") at the ventral margins. Podia are sparse and small dorsally but numerous ventrally. Mouth is ventral with 20 tentacles. Anus has five tiny teeth. No Cuvierian tubules.

Ossicles: Tentacles with spiny rods, 70–615 µm long. Dorsal body wall with tables, buttons and simple ellipsoid buttons. Tables with round, smooth discs, 60–75 µm across, perforated by a single central hole and one ring of peripheral holes; spire wide ending in a wide crown of spines. Buttons can be smooth or with just some medium-sized knobs with 4–8 pairs of holes, or can be modified into simple ellipsoid buttons, 80–115 µm long. Ventral body wall with tables of roughly the same form and size and with buttons, 110 µm long, that are smoother slightly knobbed and have 4–7 pairs of holes. Ossicles of the podia are, at present, undocumented.

Processed appearance: Whitish body colour when skin removed. The lateral protrusions ("teats") are visible even when dried. The mottling on the dorsal surface remains visible after processing. Common dried size 17 cm.

Remarks: Not yet described taxonomically. Future studies will help decide if it is another species or simply a variety of the Indian Ocean black teatfish. Very little is known apart from its presence in the catches. Catch weights are sometimes combined with those of *Thelenota ananas* in Seychelles.

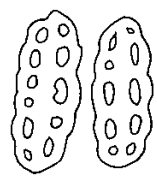


buttons and ellipsoid of dorsal body wall

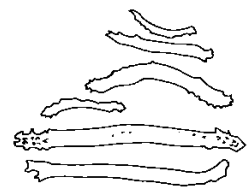
ellipsoid of dorsal body wall

tables of dorsal body wall

table of ventral body wall



buttons of ventral body wall



rods of tentacles

(Source: photos by D. VandenSpiegel)

Size: Average fresh length is 30 cm. Average fresh weight is about 1 675 g.

HABITAT AND BIOLOGY

In the Seychelles, this species prefers lagoons over sandy bottoms between 10 and 60 m deep. Its reproductive biology is unknown.

EXPLOITATION

Fisheries: Exploitation of this species is at artisanal and semi-industrial scales. *Holothuria* sp. (type "Pentard") is the main species in trade in the Seychelles where it is considered the highest value species. It is harvested by SCUBA diving. This species is part of a multispecies fishery that includes *H. fuscogilva, H. fuscopunctata, H. nobilis* and *T. ananas*. Regulations: This fishery is managed in the Seychelles by means of a restricted number of fishing permits and no-take reserves.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Main market is China, Hong Kong SAR. It is sold at USD 17–26 per kg dried. Retail prices in China, Hong Kong SAR in 2022 ranged from USD 44 to 273 per kg dried. Retail prices in China, Hong Kong SAR in 2022 averaged USD 204 per kg dried.

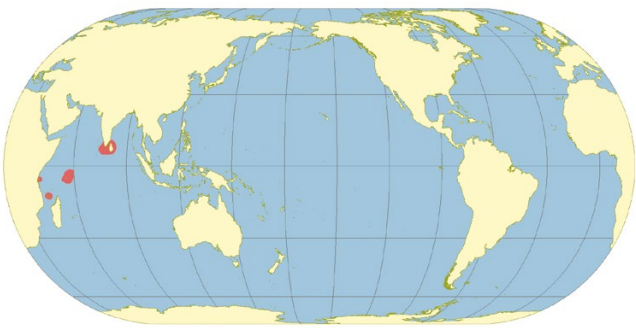
GEOGRAPHICAL DISTRIBUTION

Known from the Comoros, where it is exploited, Nosy Be Island (Madagascar), the Seychelles, United Republic of Tanzania, Zanzibar, the Maldives and Sri Lanka, where it is exploited.

LIVE ©T. Skewes

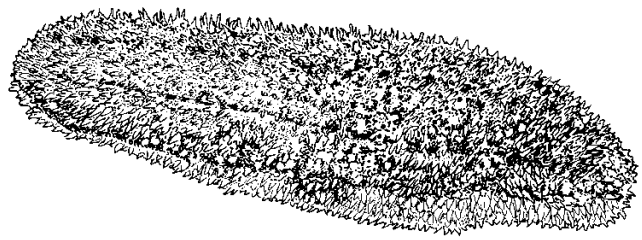
PROCESSED ©T. Skewes

PROCESSED ©C. Conand



COMMON NAMES

Brownfish, Raja attai, Cheena attai (India), Disco attaya, Weli attaya (Sri Lanka), Nanasi (United Republic of Tanzania, Zanzibar).



DIAGNOSTIC FEATURES

Dorsal surface brown, becoming lighter on the ventral surface. This species has numerous, small, pointy papillae over the entire body.

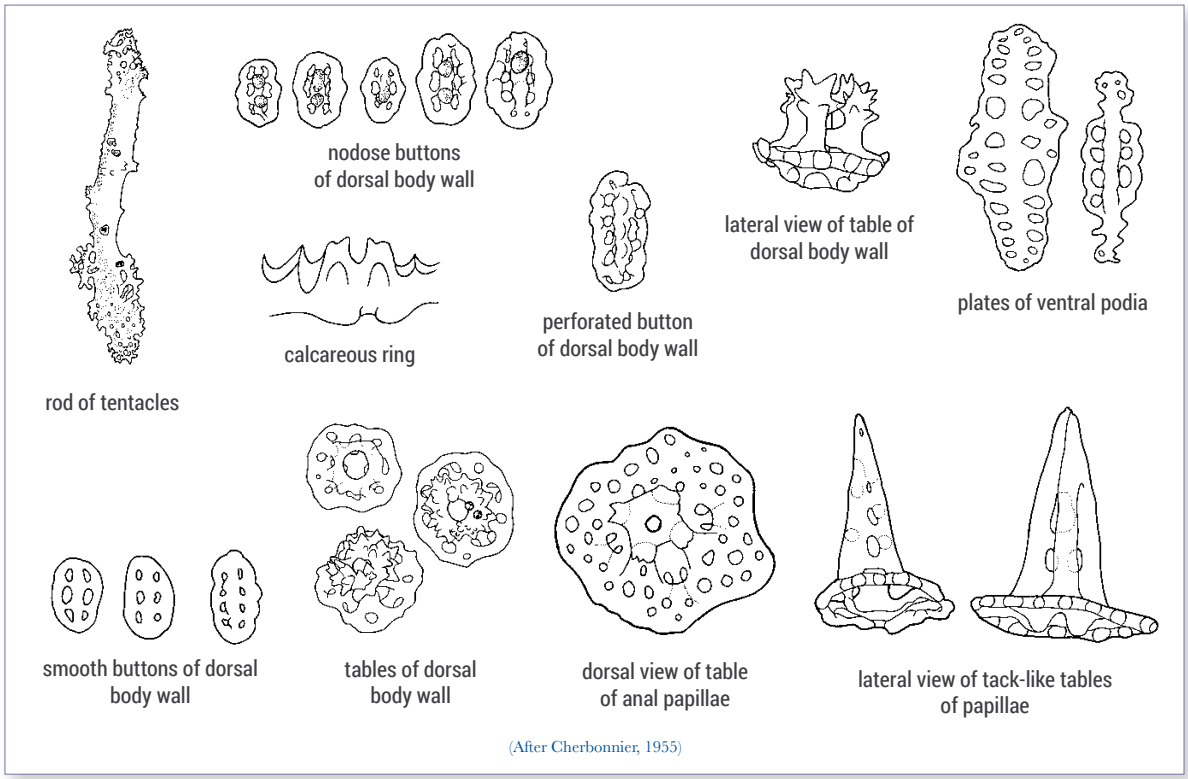
Ossicles: Tentacles with long rods with spiny extremities, up to 500 µm long. Dorsal and ventral body wall with the same types of tables and buttons. Buttons are very nodulous, generally with 3 pairs of holes, but other types also present. Tables present a well developed disc, perforated by 4 central holes and a circle of peripheral ones; spire quite stout and low, ending in an open crown of spines. Ventral podia with perforated plates that may be expanded centrally. Characteristic for this species are the large tack-like tables of the dorsal/ anal papillae, which can be up to 200 µm high.

Processed appearance: Cylindrical in shape. Dorsal surface is rough, light brown; ventral surface is smooth, light brown. Small cut at the posterior end. Common dried size 8–10 cm.

Size: Maximum length about 40 cm. Average fresh weight: 300 g; average fresh length: 20 cm.

HABITAT AND BIOLOGY

Holothuria spinifera can completely bury itself in sand in shallow waters from 2 to 10 m. Believed to never be encountered in the intertidal region. It reproduces bi-annually as it has a major peak in September and



October and a minor peak in February and March. In Tuticorin (India), it has a prolonged spawning event from November to March. Reported to commence sexual maturity at around 14 cm in length.

EXPLOITATION

Fisheries: Previously fished in India by diving and trawling. It is fished in Sri Lanka and some other islands of the Indian Ocean. In Sri Lanka, it has been the most heavily fished species and is harvested by breath-hold diving and using SCUBA. In United Republic of Tanzania, it is considered one of the most valuable species. In India, it has been an economically important species for perhaps 1 000 years.

Regulations: In India, the fishery has been banned since 2001.

LIVE ©P.S. Asha

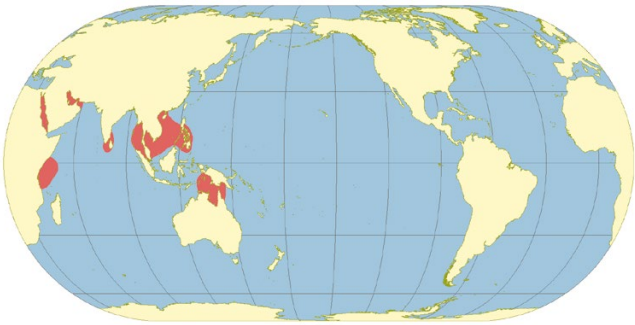
PROCESSED ©D.B. James

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Code: **JDE.** It is a moderate-value species. In Sri Lanka (2012–2017), fishers sold freshly harvested animals for around USD 1 per individual and USD 45 per kg dried. It was found sold in one shop in China, Hong Kong SAR in 2022 for USD 181 per kg dried.

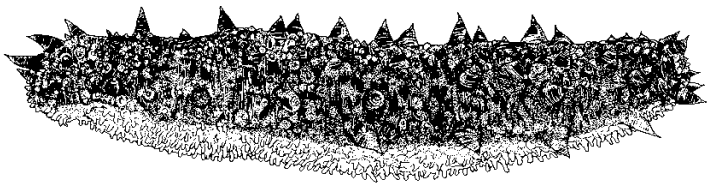
GEOGRAPHICAL DISTRIBUTION

Red Sea, Persian Gulf, Sri Lanka, northern Australia and Philippines. In India, it is known only from Gulf of Mannar and Palk Bay. Recently reported from Abrolhos Islands, Western Australia (A. Hart, unpubl. data).



COMMON NAMES

Mediterranean tubular sea cucumber (European Union, Türkiye), Cohombro tubo (Spain), Cogombre de mar (Catalonia, Spain), Cogombro de mar tubo (Galicia, Spain).



DIAGNOSTIC FEATURES

Body cylindrical. Dorsally brownish and covered with numerous dark brown, conical, pointy papillae. Ventrally light brown to whitish, sometimes with light-coloured spots, and with numerous, evident podia. There is a notable differentiation in colour between the dorsal and ventral surfaces. Cuvierian tubules absent. Mouth ventral, with 20 short and flattened tentacles. Anus is sub-ventral, surrounded by papillae.

Ossicles: Highly variable. Dorsal and ventral tissues have tables and buttons with smooth or thorny edges. Tables are small and the disc is slightly arched and generally has 4 large holes. Buttons are oval and larger size in dorsal tissues. Buttons are 50–80 µm in length, and are rough with jagged or thorny margins and have 6–12 pairs of holes. Table discs are 30–40 µm in diameter while the spires are around 30 µm long.

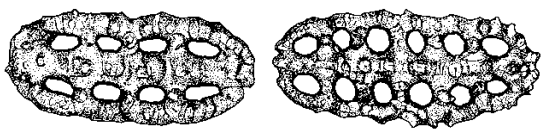
Processed appearance: The dried body wall is dorsally brown with the long, pointed papillae apparent and somewhat horn-like. The ventral surface is distinctly lighter coloured. Usually cut in the middle of the ventral surface. Dried products are generally 10–15 cm long.

Size: Maximum fresh length 38 cm. Maximum weight 291 g, gutted.

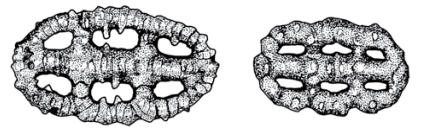
Remarks: Compared to *Holothuria mammata*, the button ossicles of the dorsal body wall of *H. tubulosa* are smaller and less elongated and the ventral buttons are smaller.

HABITAT AND BIOLOGY

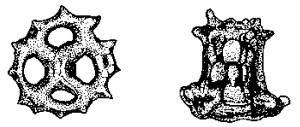
Inhabits sandy bottoms with *Posidonia*, *Cymodocea* or *Zostera* seagrasses and *Caulerpa* algae. Animals reported to be larger in deeper waters. Sex ratio 1:1 and first sexual maturity is reached at 220 g drained body weight. Fecundity commonly around 4 million oocytes. Larval stage lasts 4 weeks. Commonly hosts the parasitic umagillid worm *Anoplodium* and very occasionally (approx. 2 percent of individuals) hosts pearlfish symbionts.



button of dorsal body wall



button of ventral body wall



tables of body wall

(Source: photos by M. Wangüemert)

EXPLOITATION

LIVE ©S.W. Purcell

PROCESSED ©M. Aydin

Fisheries: Initially harvested in Türkiye as bycatch in trawl fisheries, and from 2002 harvested by hookah divers. Later on, it became one of the targeted species by divers from 300+ boats. Harvested illegally in Algeria since 2013 and now collected using gleaning, free-diving and compressed-air diving and constituted about one-quarter of catches. Harvesting was authorized in Morocco since around 2001, but banned in 2022. In Tunisia harvests were authorized since 2014 and in Greece from 2018.

Regulations: Exploitation authorized in Algeria for subsistence only, with a 46-day seasonal closure annually. Exploitation is largely unregulated in Tunisia. Since 2007, Türkiye mandates licences for fishers, a rotational harvest strategy (4-year cycle) in the Aegean Sea, a 5-month seasonal closure, a daily bag limit of 40 kg per diver, a 2 500 tonne basket quota for the fishery and no size limits. High rates of fishing infringements in Türkiye, including for the use of illegal trawl gear. Harvesting in Greece is permitted under licence, VMS is mandated for vessels, animals only to be collected during daylight hours, a 6-month seasonal closure, vessel bag limits of 400 *Holothuria* spp. per day, and a minimum legal-size limit of 180 g gutted weight per animal. Harvests are prohibited in Montenegro (since 2006), Croatia (2018) and Italy (2021).

Human consumption: Initially consumed domestically in Algeria, but exported dried in recent years. Eaten mainly by Asian consumers after being cooked or reconstituted.

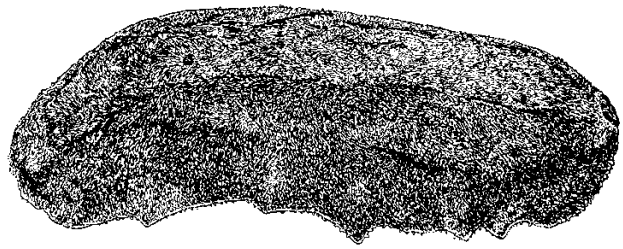
Main market and value: Code: HFT. In Algeria, landing prices ranged USD 1.5–5.3 per kg fresh (gutted) and dried product sold for USD 30–90 per kg. Small individuals used for bait in Algeria. In Türkiye (2021), frozen (semi-processed) product sold for USD 30 per kg and dried product for USD 120 per kg. In some Mediterranean countries (Spain, Italy, Tunisia, Türkiye and Greece), small specimens were used as line-fishing bait to catch sparid fishes.

GEOGRAPHICAL DISTRIBUTION

Distribution is restricted to the Mediterranean Sea, with ancestral populations in the east. Previous records of *H. tubulosa* from the Atlantic appear to have been misidentified *H. mammata* (M. Wangüemert, pers. analyses).

COMMON NAMES

Black teatfish, Bakungan, Kagisan, Sus-uan (Philippines), Le tété noir (New Caledonia, Wallis and Futuna Islands), Teromamma (Kiribati), Loaloa (Fiji), Huhuvalu uliuli (Tonga), Ñoät ñen ña, Đồn đột vuù (Viet Nam), Susu (Malaysia) Black susu (Solomon Islands), Black titfis (Vanuatu).



DIAGNOSTIC FEATURES

Body is uniformly black dorsally, and dark grey ventrally. Juveniles may have beige or white markings on the dorsal surface but ventrally are usually dark grey. It possesses 5–8 stout, pointed or rounded protrusions ("teats") at the ventro-lateral margins, wich retract when disturbed. Body generally covered by fine sand. Body suboval; stout and very firm; arched dorsally and flattened ventrally and with rounded ends. Body wall is thick. Dorsal podia are sparse and small, while the ventral podia are numerous, short and brown to grey. The mouth is ventral, with 20 stout tentacles. Anus has 5 tiny teeth. Cuvierian tubules are small and not expelled.

Ossicles: Tentacles with rods of various sizes, 100–335 µm long, spiny at extremities, but not branching. Dorsal body wall with tables and ellipsoid buttons. Table discs are 70–85 µm across, perforated by one central and a ring of peripheral holes; the stout, but low, spire ends in a wide spiny crown. Ellipsoid buttons are 50–70 µm long and quite irregular, and perforated by 3–5 holes. Ventral body wall with similar tables as those of the dorsal body wall, and with ellipsoid buttons about 55–85 µm long that are more elongated and with holes more occluded, as well as long buttons that are nearly smooth.

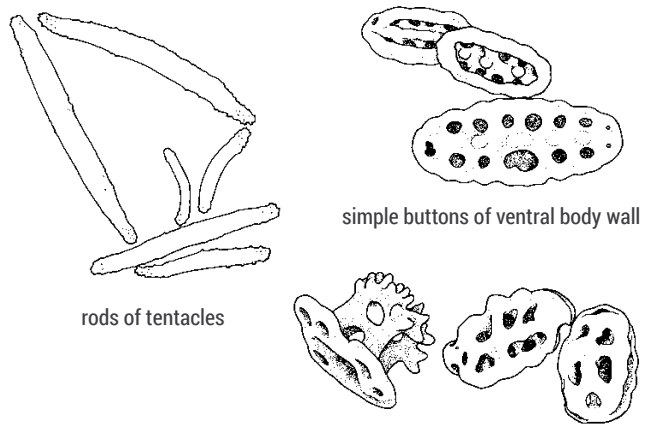
Processed appearance: A flattened, stout shape with rounded or slightly pointed teats along both sides of the body. The body surface is powdery dark grey. The ventral surface is brownish-grey with fine bumps. One straight cut along the dorsal body wall but not completely to the mouth or anus. Common processed size is 15–20 cm.

Remarks: *H. whitmaei* was considered a synonym of *H. nobilis*. Research has shown that both species are valid; *H. whitmaei* is found in the West Pacific and *H. nobilis* in the Indian Ocean.

Size: Maximum fresh length about 54 cm; average length is 34 cm. In New Caledonia, average live weight was recorded at 1 800 g and average live length about 23 cm.

HABITAT AND BIOLOGY

In the western central Pacific it occurs on reef flats, reef slopes and sandy seagrass beds between 0 and 20 m. On the Great Barrier Reef (Australia), Western Australia and New Caledonia, it has an annual reproductive event with average gonadal index reaching its maximum between April and June, and so is one of the few tropical species that reproduces sexually during the winter.



(Source: photos by Uthicke, O'Hara and Byrne, 2004)

EXPLOITATION

Fisheries: It has been commercially exploited in almost all countries within its distribution, although CITES Appendix II listing precipitated fishing bans in some countries. It was over-harvested in Australia, Papua New Guinea, Solomon Islands and Vanuatu, leading to moratoria. There are subsistence fisheries for this species in Palau and French Polynesia. In New Caledonia, it became the most heavily fished species of sea cucumber. In Asia, this species is heavily fished in Indonesia, China and Philippines.

LIVE ©S.W. Purcell

PROCESSED ©S.W. Purcell

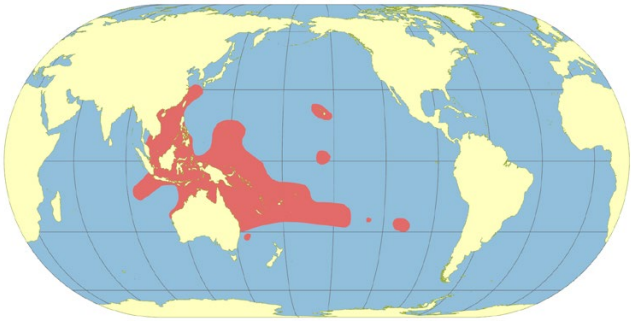
Regulations: In Papua New Guinea, there is a minimum size limit of 22 cm wet or 10 cm dry. Size limits elsewhere are: 30 cm live and 16 cm dry in New Caledonia; 25 cm live in Torres Strait; 30 cm live on the Great Barrier Reef (Australia); 26 cm live in the Northern Territory and Western Australia 30 cm wet and 15 cm dried in Vanuatu and Solomon Islands. Due to large declines in abundances, fishing was previously banned in the Great Barrier Reef fishery.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians and is highly regarded. In some Pacific islands, its intestine and/or gonads may be consumed in traditional diets or in times of hardship (i.e. following cyclones).

Main market and value: Code: **JDG**. The main market is China. It is a high-value species. Traded previuosly at USD 23–104 per kg dried in the Philippines. In New Caledonia (2007), fishers received USD 4–6 per kg wet and it was exported for about USD 40–50 per kg dried. In Fiji (2007), fishers received USD 11–18 per piece fresh. Prices in Guangzhou wholesale markets (2016) averaged USD 161 per kg dried. Prices in China, Hong Kong SAR in 2022 averaged USD 289 per kg dried; max. USD 401 per kg.

GEOGRAPHICAL DISTRIBUTION

Western Australia east to Hawaii (United States of America) and French Polynesia and southern China, south to Lord Howe Island (Australia). Records of *H. nobilis* from Pitcairn Islands and Easter Island are most probably *H. whitmaei*.



OTHER USEFUL INFORMATION

This species is widely reported as overexploited in many localities, and listed as Endangered on the IUCN Red List. It is listed on CITES Appendix II.

COMMON NAMES

Blackspotted sea cucumber (**FAO**), Flowerfish (India, Papua New Guinea, Viet Nam), Orange fish (Egypt), Ñoät daûi, Ñoät daûi ñaù, Daâu ñaù (Viet Nam), Shoab (Egypt), Nool attai (India), Trompa, Piña, Manimani or Bulaklak (Philippines), Zanga somotse, Tigre (Madagascar), Bintik merah, Gomboyok (Indonesia), Flaoasis (Vanuatu).

DIAGNOSTIC FEATURE

Coloration is cream to tan with numerous large brown patches and with fine dark speckling. Body relatively elongated, cylindrical, and with numerous transverse folds. It is flattened somewhat ventrally. Moderately long (3–5 mm) conical papillae with white tips are scattered over the dorsal surface. Ventral surface with three bands of numerous, long, brown podia. The mouth is ventral with 23–28 black tentacles with distinctive white edge. Anus terminal without teeth or papillae. Cuvierian tubules present, but not ejected. Juvenile mimic nudibranchs; white with black lines and large, conical, yellow papillae.

Ossicles: Tentacles with rods, which can take a rosette form, 20–90 µm long. Dorsal and ventral body wall with the same type of knobbed pseudo-tables, 30–65 µm long, and rosettes, 20–50 µm long. Ventral and dorsal podia with very complex rosettes that resemble those of the body wall.

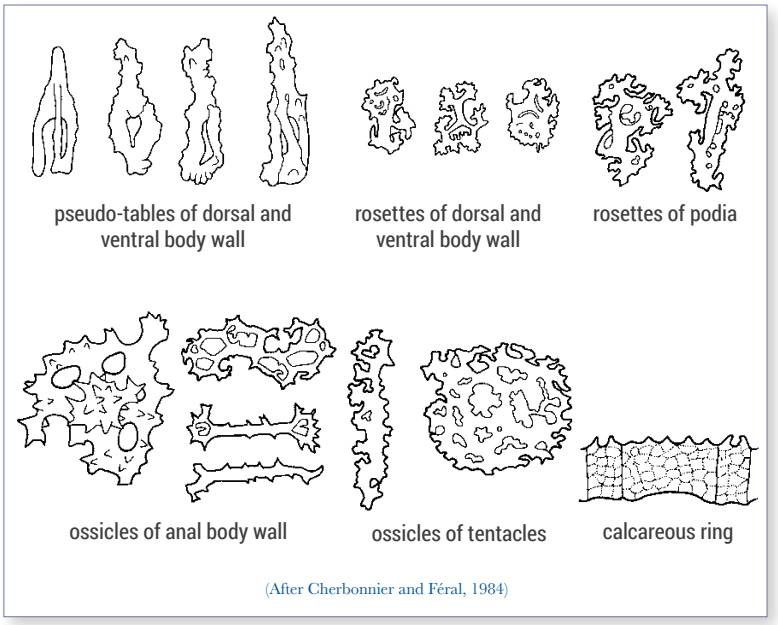
Processed appearance: Elongated with a rectangular cross-section. Black to black-brown. Dorsal surface is rough, while the ventral surface is grainy. No cuts or small cut across mouth. Common dried size 15 cm.

Remarks: Previously classified as *Holothuria graeffei* then as *Bohadschia graeffei*, with the Red Sea endemic species *B. drachi* now considered a junior synonym.

Size: Maximum fresh length about 45 cm; commonly to about 35 cm. Max weight 1 275 g. Average fresh weight: 130 g (Philippines), 300 g (Réunion), 500 g (Egypt), 600 g (India); 700 g (Australia) and 700 g (Papua New Guinea); average fresh length: 17 cm (Philippines), 30 cm (Egypt, India, Réunion, Viet Nam) and 35 cm (Papua New Guinea).

HABITAT AND BIOLOGY

Inhabits hard surfaces on coral reefs, commonly broken dead coral or reef pavement. Lives on reef slopes, commonly with live coral, in shallow



(After Cherbonnier and Féral, 1984)

waters between 0 and 25 m. It often feeds during the day and night on detritus on hard surfaces. This species does not bury. Little is known of its biology. This species is known to host the pearl fish *Carapus boraborensis*. On the Great Barrier Reef (Australia), it reproduces between November and February. Research shows that this species has a slow growth rate, a lifespan of at least 18 years and does not move far over annual timescales.

LIVE ©S.W. Purcell

EXPLOITATION

Fisheries: Generally fished artisanally. Harvested by hand collecting (Philippines, Papua New Guinea), free diving and lead- bombs (Papua New Guinea), SCUBA diving (Egypt), and hookah diving (Viet Nam). This species is commercially exploited in Guam, Micronesia (Federated States of), Kiribati, Papua New Guinea, Solomon Islands, Fiji, Malaysia, Madagascar, Philippines (referred to as *B. graeffei*) and Indonesia.

PROCESSED ©J. Akamine

Regulations: Fishing in Papua New Guinea for this species has been regulated by a fishing season, a total allowable catch (TAC), gear restrictions and permits for storage and export. Minimum size limits are 30 cm wet and 15 cm dried in both Vanuatu and Solomon Islands.

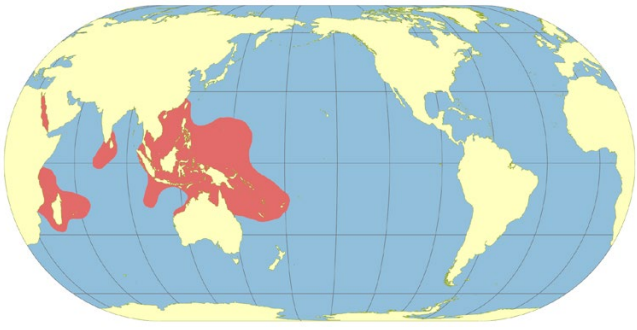
PROCESSED ©S.W. Purcell

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. Also used in traditional medicine (Egypt).

Main market and value: Code: **EHV**. In the Philippines, it was sold for USD 2–5 per kg dried. In Fiji (2014), fishers received USD 0.3–0.6 kg^{-1} fresh gutted.

GEOGRAPHICAL DISTRIBUTION

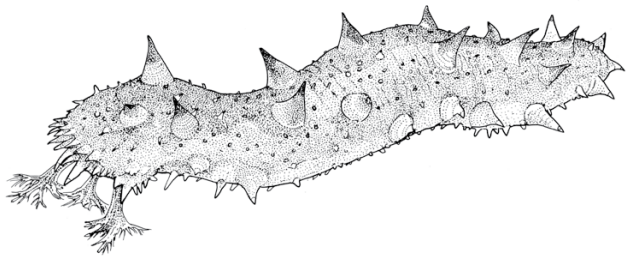
Widespread in the Indo-Pacific, including the Red Sea and the Gulf of Aqaba, Maldives, India, Philippines, and South Pacific islands as far east as Fiji.



Synallactida: Stichopodidae

COMMON NAMES

Giant red sea cucumber (FAO), Giant California sea cucumber (United States of America).



DIAGNOSTIC FEATURES

Mottled brown to red and yellow over the dorsal surface. Juveniles tend to be solid red or brown, without mottling. Body is cylindrical and quite elongated, with slightly tapered ends. Dorsal surface with both large (about 40 in total) and small fleshy papillae, which are yellow to orange in colour and red tipped. Ventral surface light cream in colour. Podia are numerous ventrally, arranged in 5 rows. Mouth ventral with 20 short tentacles.

Ossicles: Body wall with tables and buttons. Tables with round discs that are 70–95 µm across, perforated by 4 central holes with which 4 smaller and more distal holes alternate, but often there are smaller holes on each side of the latter; high spire ending in a spiny crown. The irregular buttons, some 90 µm long, have 5–7 pairs of holes.

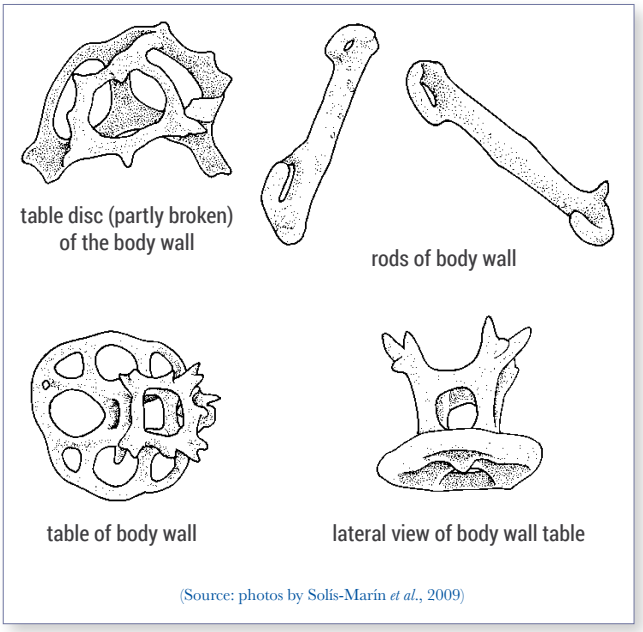
Processed appearance: Processed animals may be 10–30 cm long. Dried animals are grey, and the long papillae are still evident. A cut is normally made on the ventral surface.

Remarks: This species is somewhat similar in appearance to *Apostichopus parvimensis*, which in contrast, has a brownish colour dorsally and is lighter in colour ventrally, and has more numerous small, black-tipped papillae.

Size: Maximum length about 50 cm. Average adult fresh weight at least 500 g; average length from 25 to 40 cm.

HABITAT AND BIOLOGY

It occurs on a wide variety of substrates and current regimes, in water depths from the intertidal to 250 m. This species is most abundant in areas of moderate current on cobbles, boulders or crevassed bedrock, but avoids muddy bottoms and areas with freshwater runoff. It reproduces annually during the summer dry season (May–August) and reproduction seems to be correlated with bright sunshine days and high phytoplankton productivity.



(Source: photos by Solís-Marín *et al.*, 2009)

EXPLOITATION

Fisheries: *Apostichopus californicus* is exploited in industrial fisheries by hand collection by SCUBA diving and by trawling. The fishery of this species in Washington (United States of America) started in the 1970s, later spreading to California, Alaska and Oregon. In British Columbia (Canada), the first official landings date back to 1980. It is the only commercially harvested species on the west coast of Canada (Vancouver Island, Georgia and Johnstone Straits and Pudget Sound). Until

1997, an average of 75 percent of the annual catch was from the southern California trawl fishery. In Alaska (United States of America), *A. californicus* is one of the main species harvested for subsistence in native communities.

Regulations: In Canada, the fishery is managed by means of a fishing season (October and November), limited number of licences, no-take marine reserves, TACs, and individual transferable quotas (ITQs). In California, exploitation of this species is regulated by permits for each gear type and limited entry restrictions, but there is no TAC regulation. Trawling is prohibited in some conservation areas. There are no-take marine reserves to protect breeding populations.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians. The muscle strips of this species are also exported and consumed, and respoted to constitute the majority of products from some fisheries such as in Alaska (United States of America).

Main market and value: Code: **TKG**. The main markets are China, Hong Kong SAR, Taiwan Province of China, Mainland China and the Republic of Korea. It was sold by fishers for up to about USD 3.70 per kg wet (gutted).

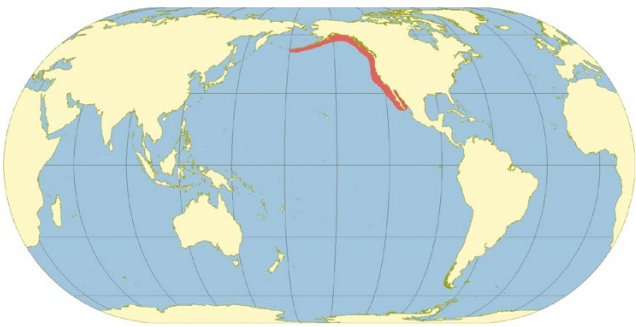
GEOGRAPHICAL DISTRIBUTION

Distributed along the Pacific coast of north America, from the Aleutians Islands, Alaska to the Gulf of California.

LIVE ©J.M. Watanabe

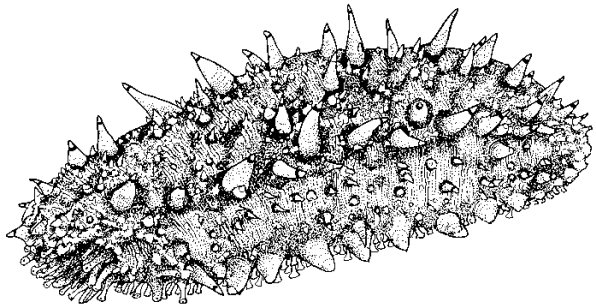
LIVE ©M. Best

PROCESSED ©J. Akamine



COMMON NAMES

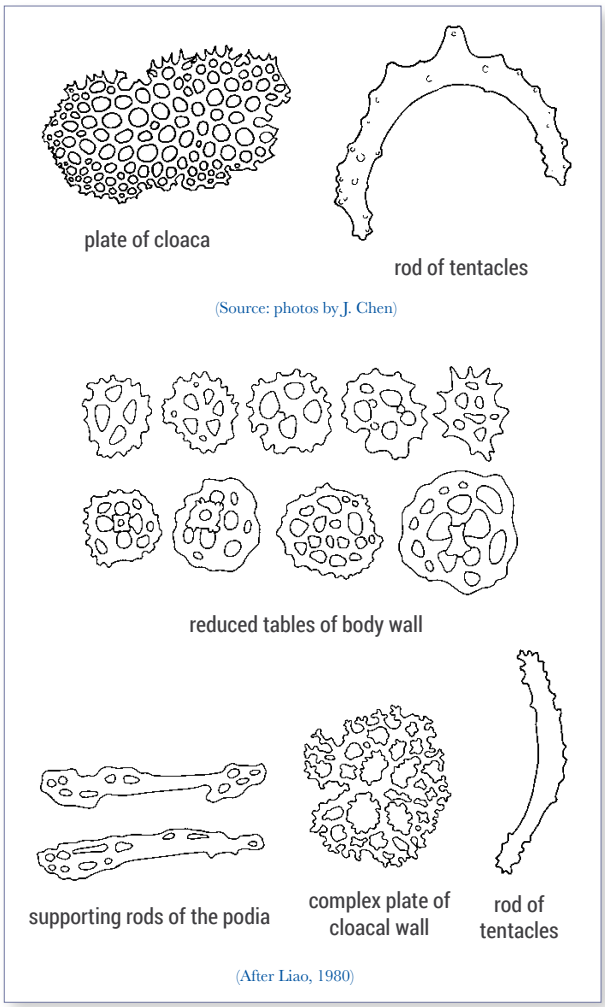
Japanese sea cucumber (**FAO**), Bêche-de-mer japonaise (**FAO**), Cohombro de mar japonés (**FAO**), Cishen (China), Manamako (Japan, also "Aka namako" for red, "Namako" for green and "Kuro namako" for black individuals), Dolgi haesam (Republic of Korea).



DIAGNOSTIC FEATURES

The body colour can be variable, with red, green, black and even white (albino) types recognized. Small brownish to greyish dots may be present dorsally, and are more numerous ventrally. Body is squarish in cross-section and tapered somewhat at anterior and posterior ends. Large conical papillae are present in two loose rows on the dorsal surface of the animals in two rows at the lateral margins of the ventral surface. Ventral podia are alined in three irregular longitudinal rows. Mouth is ventral with 20 tentacles. Anus is terminal with no teeth.

Ossicles: Tentacles with curved, spiny rods. In adults, tables are rudimentary (reduced to the spiny disc) or rare in the body wall. Small individuals have their tables better developed. C-shaped plates and rosettes are never present. The cloacal wall has numerous very complex plates. Ventral podia with similar tables as those in the body wall and with simple supporting rods. Dorsal podia with tables with more elaborate spire and perforated supporting rods.



Processed appearance: Cooked and dried animals are dark grey to dark brown and possess characteristic, lighter grey or brown pointed papillae in rows along the body. Body covered with tiny pale dots.

Size: Average fresh weight: 200 g; average fresh length: 20 cm.

HABITAT AND BIOLOGY

Occurs from the shallows of the intertidal zone to about 20 or 30 m depth. The factors affecting the presence of this species are water temperature, salinity, substratum and habitats for juveniles. It reaches size-at-maturity at 110 g. Its annual reproductive cycle coincides with the dry season, from May to July.

EXPLOITATION

Fisheries: This species is fished on an industrial scale, by SCUBA or hookah divers, or by drag nets trawled behind larger boats. It is the most important commercial species in Northeast Asia (Russian

Federation, China, Japan, Republic of Korea and Democratic People's Republic of Korea). China produces thousands of tonnes (dried) of *A. japonicus* from aquaculture each year. Japan has the highest fishery captures of this species.

Regulations: In China, exploitation of this species is regulated by fishing permits. Japan sets aside certain localities as breeding reserves where sea cucumber fishing is strictly prohibited, fishing is prohibited during the spawning season from 1 May to 15 June, with a minimum legal weight limit of 130 g.

Human consumption: Consumed either as bêche-de-mer, its intestines ("konowata") and dried gonads ("kuchiko") are eaten as delicacies, or it is eaten raw with sauce. It is commonly used in traditional medicine.

Main market and value: Code: **CUJ**. The majority of harvested animals are destined for domestic consumption. It has been sold at USD 2–3 per unit fresh, USD 120–130 per kg in brine and up to USD 400–500 per kg dried. Prices in China, Hong Kong SAR retail markets (2016) ranged from USD 225–3583 per kg dried. Prices in China, Hong Kong SAR in 2022 averaged USD 1 781 per kg. Sold online in China (2022) for USD 475 per kg.

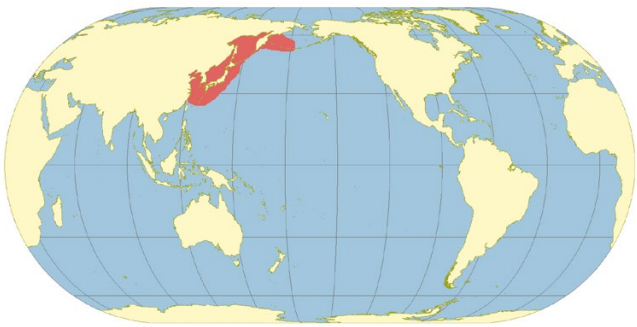
LIVE ©A. Semenov

PROCESSED ©S.W. Purcell

PROCESSED ©S.W. Purcell

GEOGRAPHICAL DISTRIBUTION

Distributed mainly in the Northwest Pacific Ocean, the Yellow Sea, the Sea of Japan, the Sea of Okhotsk. In China, it is found on the coasts of Liaoning, Hebei and Shandong Province, Yantai and Qingdao of Shandong Province. Its southern limit is Dalian Island in Lian Yungang, Jiangsu Province in China, and Tanegashima in Japan.

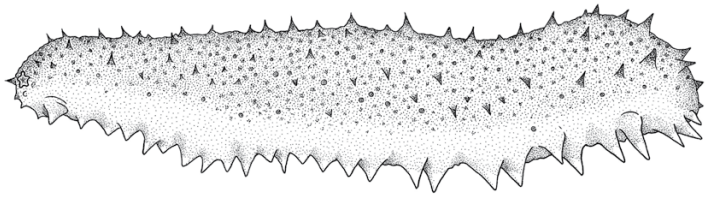


OTHER USEFUL INFORMATION

This species is widely reported as overexploited in many localities, and listed as Endangered on the IUCN Red List. A similar species, *Apostichopus armata*, might be misidentified and commonly traded as *A. japonicus*.

COMMON NAMES

Okinamako, Okiko (dried product) (Japan), Japanese red ginseng (China).



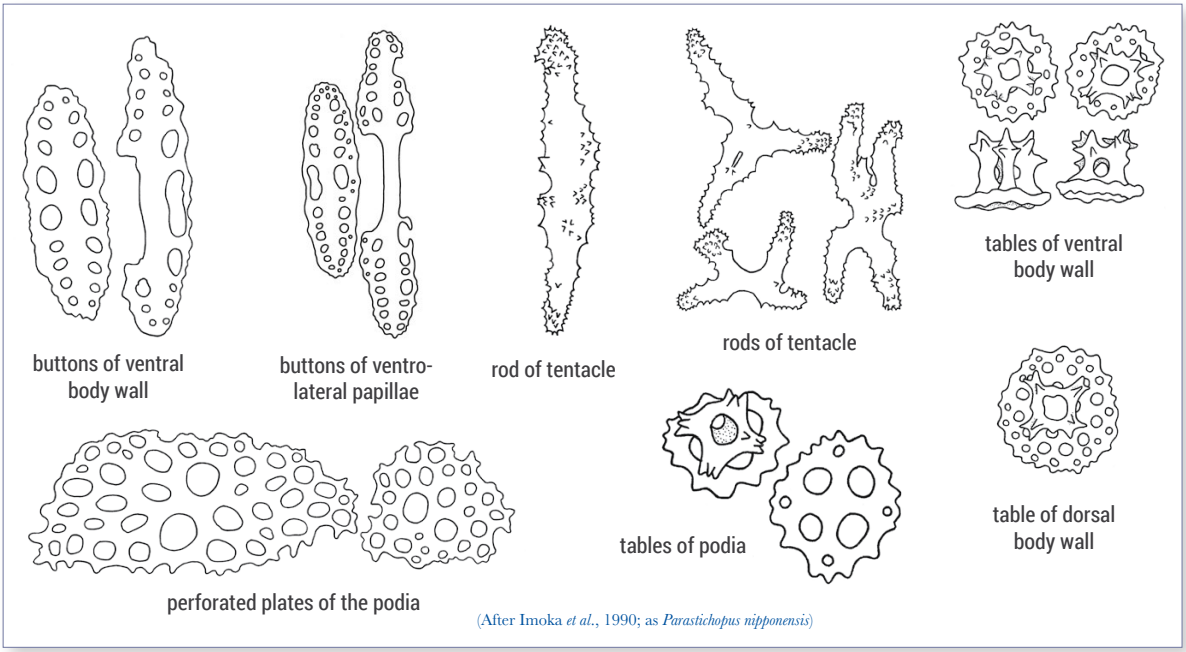
DIAGNOSTIC FEATURES

Ventral surface is distinctly flattened while the dorsal surface is rounded. Body colour can vary, but often light grey or grey-green with the body colour becoming darker near the dorsal midline. Large conical papillae with white tips occur in a distinct row along the ventro-lateral margins, numbering around 20–40; smaller conical papillae are scattered over the dorsal surface. Body covered with small, scattered black tiny dots, giving rise to the species name. No anal teeth. The subventral mouth contains 20 grey tentacles.

Ossicles: Body wall tissues contain tables and buttons. The tables have four pillars, connected by a central cross-beam, and a disc with numerous perforations. The table spire is slender and thorny. Tables from the dorsal body wall have discs generally of 60–70 µm diameter and the table pillars are 53–60 µm high. Tables from the ventral body wall are smaller; mostly discs 50–60 µm diameter and table pillars 50 µm high. Buttons are not numerous, mostly 90–160 µm in length and have 7–12 pairs of holes. The large ventro-lateral papillae have exceptionally large buttons, up to 270 µm long and with 15 pairs of holes. Large rods (100–200 µm), that are spinous and can be branching, are found in the tentacles.

Processed appearance: The dried products are slender, with the product length being 4–5 times greater than the product width. The outer layer of the body wall is greyish-tan while the inner body wall is dark grey. The outer layer is often partially eroded, leaving a patchy appearance to the products. Prominent, pointed, conical papillae along the entire ventro-lateral margin are characteristic of this species. Some other smaller, and more rounded, papillae can be present on the dorsal surface. Small dark grey dots occur over the body. The ventral surface is fairly rough and mostly tan in colour.

Size: Maximum length about 40 cm; average length unknown.



(After Imoka *et al.*, 1990; as *Parastichopus nipponensis*)

HABITAT AND BIOLOGY

Lives in habitats from 20 to 160 m depth but most commonly found in waters of 40–50 m. Little information is published about preferred habitat zones.

EXPLOITATION

Fisheries: This species has been harvested in small quantities in Japan (in 1999 total production less than 200 kg a year), although production may be increasing. Harvesting methods are unknown due to low total catch. In Japan, it may be caught as bycatch by dredge net fishers targeting *A. japonicus* or sea urchins.

Regulations: There is no mention of regulations specific to *A. nigripunctatus*. In Japan, sea cucumber fisheries in general are self-regulated by local Fisheries Cooperative Associations that control all gear regulations, catch quotas, minimum legal size limits, and fishing periods within their district leading to geographic variations in regulations.

Human consumption: In Japan the whole animal may be consumed raw or its intestine and gonads dried, or salt-fermented. Exports to Chinese markets are exclusively in the dried form.

Main market and value: Main markets are China, Hong Kong SAR, mainland China and Japan. The absence of spiky papillae in *A. nigripunctatus* leads to it having a lower value than *Apostichopus japonicus* in Chinese markets. In 2022, prices in China, Hong Kong SAR ranged from USD 422 to USD 1 062 per kg dried; average USD 639 per kg.

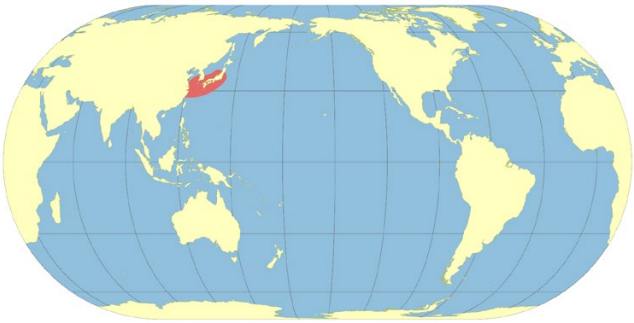
GEOGRAPHICAL DISTRIBUTION

Its distribution appears to be limited to the central and southern costs of Japan, Republic of Korea, southern parts of the Yellow Sea and northwestern parts of the East China Sea.

LIVE ©Aquarium Movies (Japan)

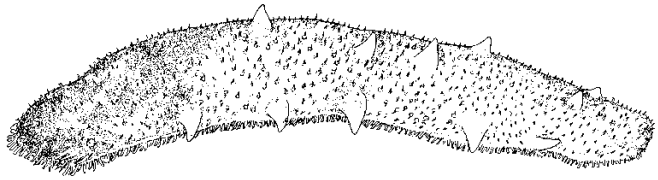
LIVE ©Mr.-F., Hatena Fotolife

PROCESSED ©S. Shea



COMMON NAMES

Warty sea cucumber (**FAO**), Pepino de mar naranja, pepino de mar ocho picos (Mexico).



DIAGNOSTIC FEATURES

Coloration is variable from orange to reddish to brownish-grey. In comparison with *Apostichopus californicus*, it is lighter in colour ventrally. Dorsal surface with numerous small, black-tipped papillae that are interspersed with larger, orangish, conical papillae. Body cylindrical. Podia are numerous on the ventral surface. Mouth ventral.

Ossicles: Tentacles with spiny rods, up to 600 µm long. Dorsal and ventral body wall with tables and buttons. Tables with discs only about 45 µm across and rarely with more than 4 perforations; spire ending in a narrow spiny crown. Buttons about 90 µm long and with 3–4 pairs of holes, quite asymmetrical.

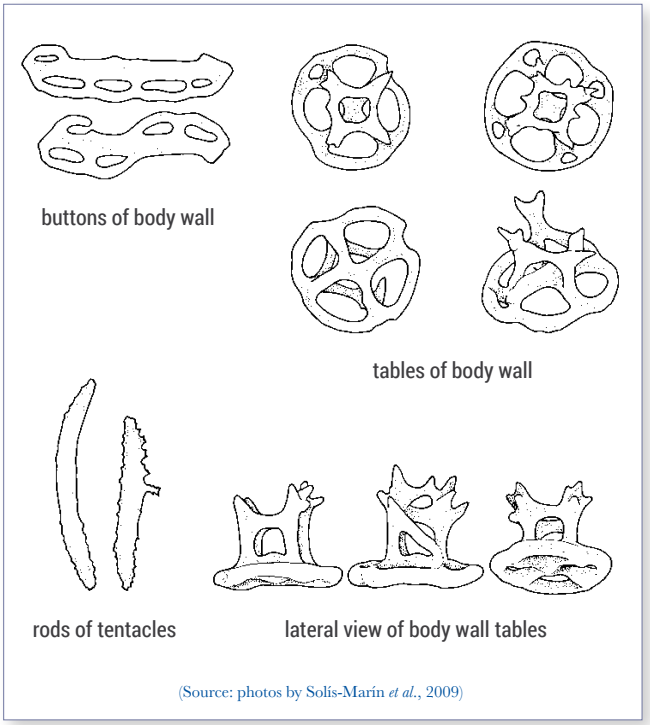
Processed appearance: Greyish-brown in colour with a pimply texture to the dried body surface. The large conical papillae are still apparent.

Remarks: See remarks for *A. californicus*.

Size: Maximum fresh length to perhaps 60 cm, but more probably about 40 cm. Average fresh length probably about 30 cm.

HABITAT AND BIOLOGY

This species prefers subtidal habitats on both rocky and soft habitats and is found in low energy environments from the intertidal zone to 30 m depth. It is most abundant in areas with high organic content; small individuals in Santa Catalina Island (California, United States of America) reported to feed on fine material from rock rubble under kelp. Juveniles between 2 and 6 cm can be found under rocks, whereas larger juveniles between 8 and 12 cm can be found both on and under rocks. Adults tend to avoid rocks and are found on sediments and feed during both day and night. The spawning peak is from February to May in Baja California. Weight at first maturity is 140 g at Isla Natividad and 120 g at Bahía Tortuga, Mexico. This species is known to undergo seasonal evisceration, which affects 60 percent of individuals in October and November.



(Source: photos by Solís-Marín *et al.*, 2009)

EXPLOITATION

Fisheries: It is under commercial exploitation on the west coast of Mexico and southern California. Similar to fisheries for *A. californicus*, this species is also exploited by hand collection, by SCUBA diving and by trawling. In California, sea urchin fishers with permits are also allowed to collect sea cucumbers, so it is collected opportunistically in that fishery. Fishing in California began in 1978, whereas it appears that this species was exploited in Mexico only from the late 1980s. The animals are caught in trawls in southern California and by SCUBA divers in northern California. Around islands in southern California, catch rates of several hundred kg per fishe per h were reported a decade ago.

Regulations: Within the fishery for this species, there are no-take marine reserves to protect breeding populations. There are permits for each gear type and limited entry restrictions. A TAC regulation is imposed in some fisheries. Trawling is prohibited in some conservation areas.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. The muscle strips of *Apostichopus parvimensis* are also consumed.

Main market and value: Code: **TKV**. It was sold by fishers for up to about USD 1 per kg wet, while the processed (dried) animals fetched about USD 9 per kg dried.

GEOGRAPHICAL DISTRIBUTION

The distribution of this species is much more restricted, and southern, compared with that of *A. californicus*. It can be found from the Gulf of California to as far north as Point Conception, California (United States of America).

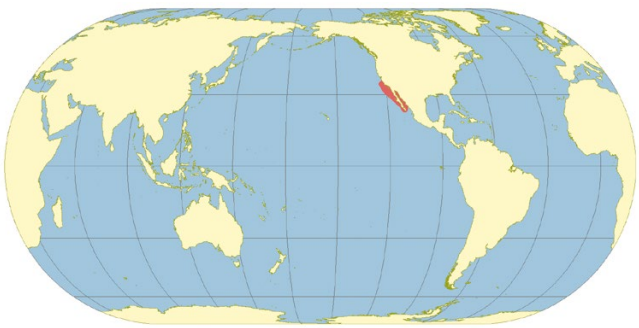
OTHER USEFUL INFORMATION

This species is listed as Vulnerable on the IUCN Red List.

LIVE ©J.M. Watanabe

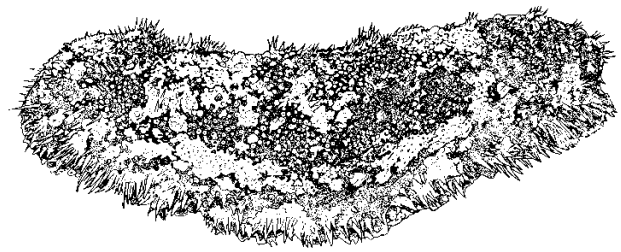
LIVE ©C. Seid

PROCESSED ©J. Akamine



COMMON NAMES

Furry sea cucumber (Caribbean, Bahamas, Florida, [United States of America]), Pepino de mar (Panama).



DIAGNOSTIC FEATURES

Dorsal surface brown to yellowish-grey with numerous white spots and white blotches. The ventral surface is usually white, with numerous stout, densely packed podia. Body wall is relatively thick but soft to the touch. The dorsal and lateral surfaces are covered with hundreds of small, conical papillae of 3–5 mm in length; these papillae give the animal a furry appearance. Body highly arched dorsally and flattened ventrally. Mouth is ventral and surrounded by a narrow, yet distinct, tentacular collar. The mouth has 20 tentacles, which have large knob-like discs.

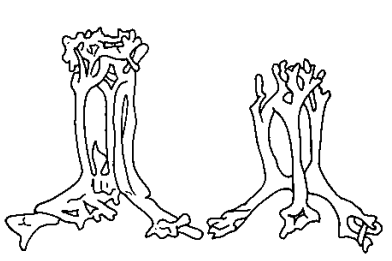
Ossicles: Tentacles of larger specimens with straight or slightly curved rods, up to 175 µm long, which are spinous at the ends and usually also along the shaft. Tentacles also with C-, O- and S-shaped ossicles, about 50 µm long, that are often spiny. The body wall of smaller individuals (less than 20 cm long) has been reported to have large, aberrant tables reminiscent somewhat to those of synallactids. In larger individuals (>20 cm) those tables are missing but numerous C-, O- and S-shaped elements, 40–80 µm long, as well as numerous miliary granules can be found in the body wall and the podia.

Processed appearance: The dried whole products are mottled brown and dark brown (near black). The external body wall is covered with fine pimply bumps and very grainy. The products are quite stout, with rounded end, and the product length is approximately 2.7–3 times a long as the product width. The ventral surface is light brown.

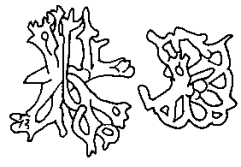
Size: Maximum fresh length to at least 50 cm; maximum weight up to 2.5 kg.

HABITAT AND BIOLOGY

It prefers soft bottoms with muddy or sandy patches, in and around seagrass beds mainly of *Thalassia* and *Syringodium*. This species prefers deeper or calmer reef environments in comparison with *Isostichopus badionotus* and *Holothuria mexicana*. It inhabits between 1 and 37 m depth in areas of calcareous algae. Its reproductive biology is unknown.

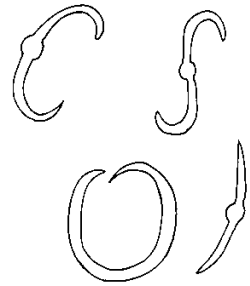


aberrant tables of dorsal body wall

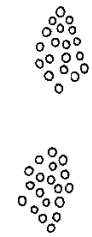


aberrant tables of ventral body wall

(After Cutress, 1996)



C-, O- and S-shaped rods



miliary granules of body wall

(After Sluiter, 1910)

EXPLOITATION

Fisheries: *Astichopus multifidus* is harvested by SCUBA and hookah diving. Previously, *A. multificus* was one of the most important species in the commercial catches of an artisanal fishery in Panama, but a moratorium on fishing was implemented because abundances in the wild populations had declined. In 1997, fishing in the Bocas del Toro region (Panama) seriously affected populations of *A. multifidus*. This species was absent in 95 percent of the protected areas around Cayo Zapatillas (Panama), which suggests that the local people may have overexploited this species from the marine park. It is commonly part of multispecies fisheries that include *I. badionotus* and *H. mexicana*.

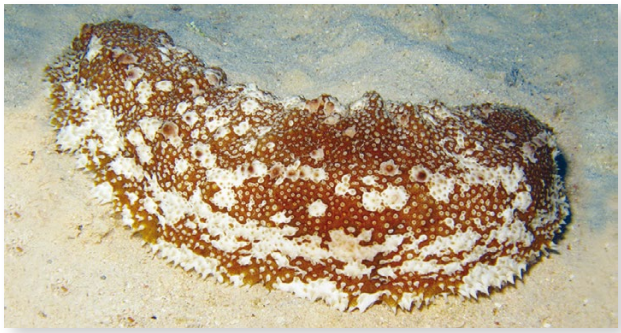
Regulations: There is a complete fishing ban in Panama as of 2003.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

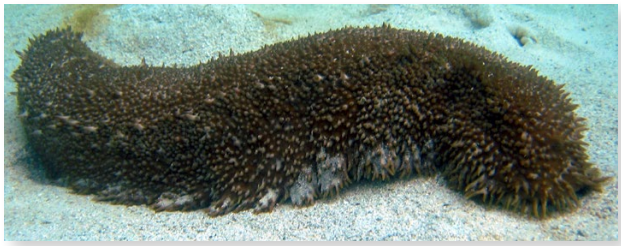
Main market and value: Code: **JPN**. The main market is China. Market value not determined.

GEOGRAPHICAL DISTRIBUTION

It can be found in the Caribbean Region, including Florida (United States of America), the Bahamas and Panama.

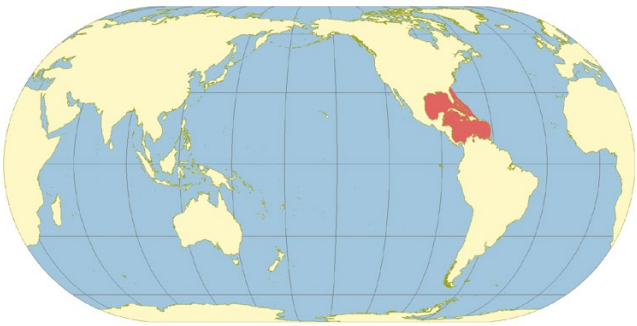


LIVE ©F. Charpin



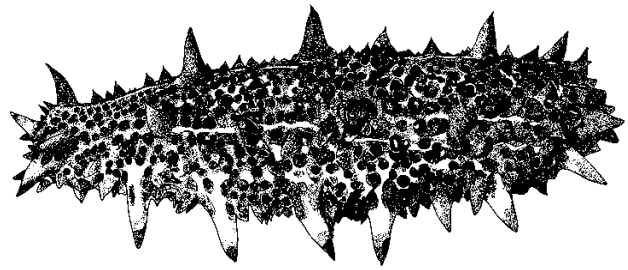
LIVE ©R. Collin

PROCESSED ©Florida Sea Cucumber Corp



COMMON NAME

Brown mottled sea cucumber, Australasian sea cucumber (proposed here), Gold-tip® sea cucumber (brand name New Zealand).



DIAGNOSTIC FEATURES

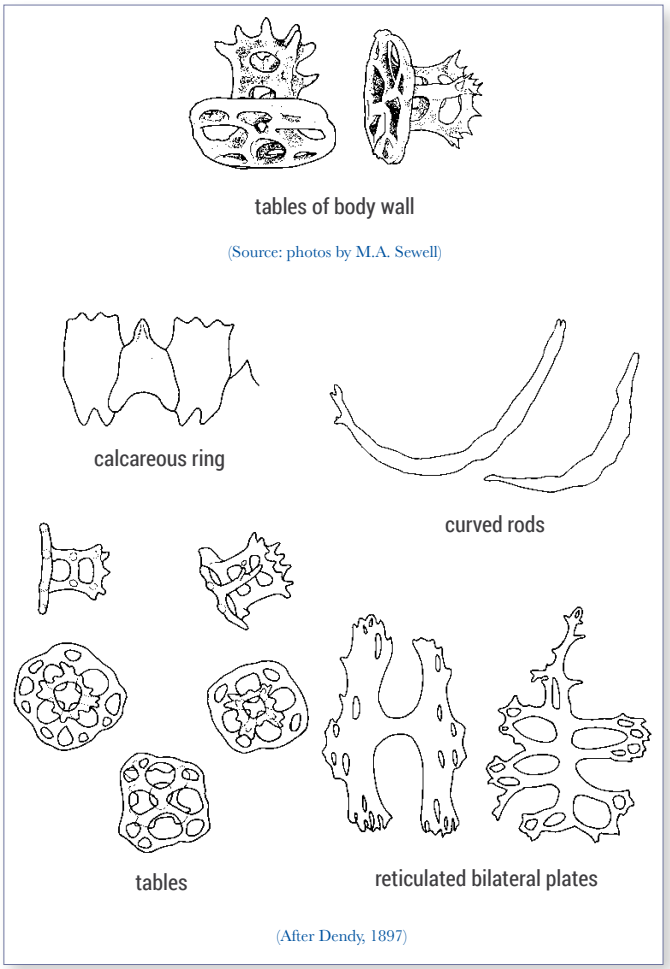
Colour may vary from blackish-brown to brown to yellow or cream. The body wall and bases of papillae are covered with countless small spots, orangy-brown to dark brown in colour. The ventral surface is lighter in colour. Numerous, long and short, conical papillae occur on the dorsal surface and along the lateral margins of the ventral surface, which may be lighter in colour (e.g. yellowish or cream) or dark brown. Mouth is ventral with 20 relatively small, near-black tentacles. Anus is terminal.

Ossicles: Tentacles with large (about 800 µm long) curved and spiny rods and small, up to 150 µm long, and smooth ossicles of different shapes. Dorsal body wall with tables with round discs, 90–100 µm across, perforated by 4 central and 4 peripheral holes (occasionally a whole circle of perforations), with a spire ending in a Maltese cross. Ventral body wall with similar tables, but slightly smaller, with discs up to 70 µm across and rarely rosettes, about 90 µm long. Ventral podia with perforated plates.

Processed appearance: Light brown to greyish-brown and with a mottled colour pattern. Papillae on the dorsal surface should be evident, but much reduced when compared to the live animals.

Remarks: Previously known as *Stichopus mollis*. The designation to the genus *Australostichopus* was based on morphological traits, such as the possession of only regular table ossicles in the body wall, and a glycoside molecule that is not found in other *Stichopus*.

Size: Average fresh weight about 110 g; average fresh length 17 cm.



HABITAT AND BIOLOGY

This species is found in depth ranges of 5–100 m. It is mostly active nocturnally. Inshore, it occurs on sandy mud, sand and in intertidal rock pools. Offshore, it is found on muddy sand and on shell deposits. Inhabits bedrock and boulders. It is also regularly found at the bases of large kelp (e.g. *Ecklonia*).

It attains size-at-maturity at 75 g, it reproduces annually from October to February.

EXPLOITATION

Fisheries: Semi-industrial commercial fisheries. It is currently fished only in New Zealand. Although mainly captured by divers, they are also caught by scallop dredges and trawl nets in other fisheries in southern New Zealand. Annual landings varied from 42–58 tonnes from 2019–2022. Local, recreational fishing for this species is poorly documented but mostly attributed to members of the Asian and Pacific Island communities. Evidence suggests significant illegal, unreported, unregulated fishing of this species in New Zealand.

Regulations: A quota management system was set in 2004, dividing the fishery into 15 quota management areas, each with different allowances for commercial, recreational, and customary purposes. Recently the total allowable catch for these purposes is 140 tonnes.

Human consumption: Mostly, the exported reconstituted body wall (bêche-de-mer) is consumed by Asians. Local consumption in New Zealand is limited to Asian and Pacific Island resident communities. It can be consumed raw.

Main market and value: Code: **JPO**. In New Zealand, there is a small fishery for this species (about 50 tonnes/year) and the average price achieved at first sale was about USD 275 per kg dried.

GEOGRAPHICAL DISTRIBUTION

Found throughout New Zealand (including Snares Islands to south), and in southeastern parts of Australia (south coast of New South Wales, Victoria and Tasmania), to as far north as Elizabeth Reef (30°S).

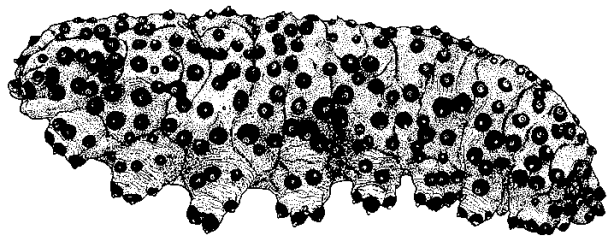
LIVE ©K. Clemments

LIVE ©S. Hartley

PROCESSED ©L. Zamora

COMMON NAMES

Four-sided sea cucumber (**FAO**), Chocolate chip cucumber (Colombia), Pepino de mar (Panama), Sea pudding (Bermuda), Cookie dough sea cucumber.



DIAGNOSTIC FEATURES

Body colour highly variable. The animals can be brown, beige, grey, pink, orange, yellow or black dorsally with or without black spots. There is a reticulated colour type and a black-and-yellow type. The body is relatively firm and moderately elongated with rounded ends; arched dorsally and flattened ventrally. The dorsal surface is covered with blunt papillae, organized randomly. Ventro-lateral papillae are long, robust and conical shaped with rounded tips. The mouth is ventral with 20 large tentacles. The anus is terminal.

Ossicles: Tentacles of largest specimens with spiny rods, 50–100 µm long, and tables with discs 65–100 µm across as well as some C-shaped rods, 70 µm long on average. Body wall with numerous tables and C-shaped rods. Table discs regular, smooth, 40–60 µm across, perforated by 4 central holes and 1 complete circle of 10–12 peripheral holes; spire ending in a spiny crown. C-shaped ossicles, 50–70 µm long. Podia with end plates, 250 µm wide, straight rods and numerous perforated rods, 200 µm long.

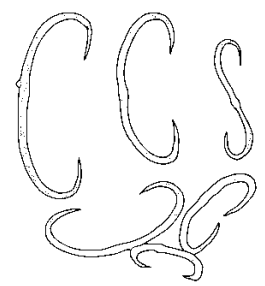
Processed appearance: Cylindrical and moderately elongated with rounded ends. Small wrinkles are evident on the dorsal surface. Dark brown dorsally; lighter coloured ventrally. The dorsal surface is rough and covered with dark spots, while the ventral surface is grainy. Common size 6–12 cm.

Remarks: Studies have shown that this species may accumulate high levels of trace metals including copper, nickel, lead and zinc in the digestive tract. Recent taxonomic research has shown that *I. badionotus* is probably a species complex (Vergara *et al*., 2018).

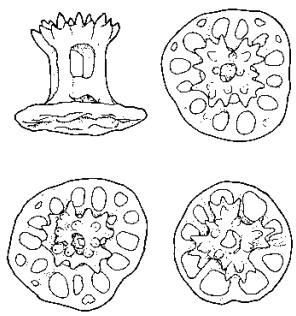
Size: Maximum fresh length about 45 cm. Average fresh weight: 276 g; average fresh length about 21 cm (Cuba).

HABITAT AND BIOLOGY

In Cuba, this species prefers sandy-muddy or sandy habitats with seagrass or algae. Found between 0.5 and 19 m deep. In Colombia, it prefers coral reefs, seagrass beds, rubble bottoms and sandy bottoms. Adults are generally non-cryptic, whereas the juveniles hide among coral rubble. It attains size-at-maturity between 170 and 250 g. In Venezuela (Bolivarian Republic of), half of the animals reach sexual maturity at 30 cm and has a continuous reproductive season. In Panama, this species reaches sexual maturity between 13 and 20 cm, and the reproductive activity peaks between July and November. In Brazil, spawning seems to occur from October to February, with a peak in January when seawater is warm.



C-shaped rods of body wall



tables of body wall

(Source: photos by G. Borrero-Perez)

EXPLOITATION

Fisheries: In the Caribbean, it is one of the most important commercial species. This species is collected in artisanal and semi- industrial fisheries. It is fished commercially in Cuba, Nicaragua and Venezuela (Bolivarian Republic of). This has been the only species fished in Cuba since 1999 despite the availabity of other species. In Colombia, there is an illegal, unregulated and non-quantified fishery for this species, and it is of potential commercial interest in Florida (United States of America), Puerto Rico and the United States Virgin Islands.

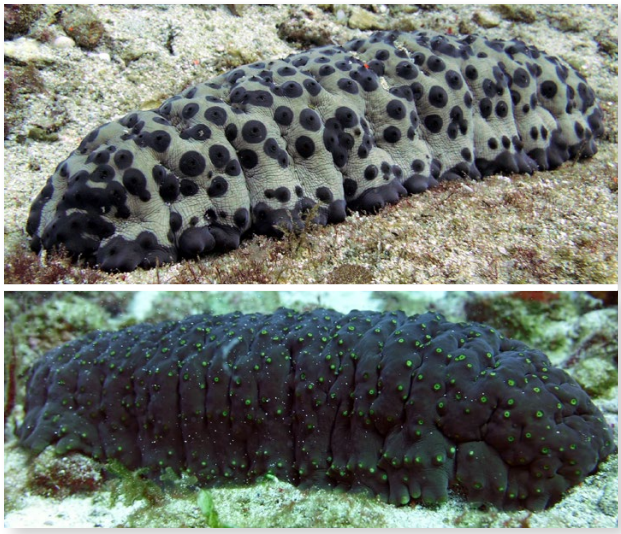
Regulations: In Cuba, the fishery is managed through a minimum legal length of 24 cm (or 22 cm ventrally), a fishing season between 1 June and 31 October, it is only open to artisanal fishers and there are no- take reserves. In Cuba, landings are closely monitored and compared with data on sale and exports; there is only one export company and logbooks must be submitted prior to shipments.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. It is occasionally consumed locally for medicinal purposes.

Main market and value: Code: HIZ. Main market is China, Hong Kong SAR. It is sold by fishers in the Caribbean at USD 22 per kg salted. Some salted product is processed to dried form in Chinese processing plants. Prices in Guangzhou markets (2016) averaged USD 219 per kg dried. It was found for sale in China, Hong Kong SAR retail markets in 2022 for USD 384 per kg dried.

GEOGRAPHICAL DISTRIBUTION

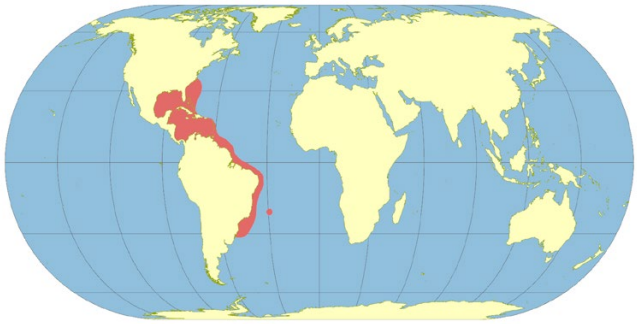
Widely distributed throughout the Caribbean Sea, from subtropical Atlantic, Brazil (to 26°S), Venezuela (Bolivarian Republic of), Colombia, Panama, Yucatan (Mexico) to the Bahamas, southern Florida and as far north as South Carolina (United States of America).



LIVE ©C. Amador

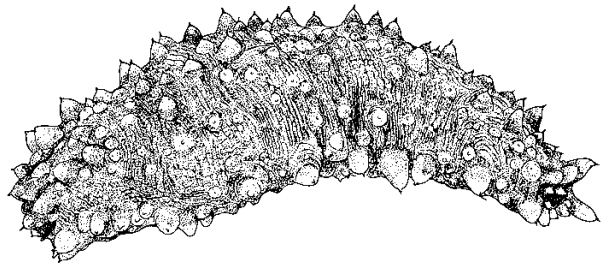
LIVE ©G. Borerro

PROCESSED ©S.W. Purcell



COMMON NAMES

Brown sea cucumber, Giant sea cucumber (**FAO**), Pepino de mar gigante (**FAO**), Concombre de mer géant (**FAO**), Pepino de mar (Ecuador).



DIAGNOSTIC FEATURES

Dorsal surface is dark brown with numerous stout, pointed, yellow papillae. Dorsal papillae are not arranged in rows. The ventral podia are arranged in a double row in the mid and in single rows along the sides. The body is subcylindrical; arched dorsally and flattened ventrally. Ventral surface lighter brown with podia in dense bands. The mouth is ventral with 20 yellow tentacles with markedly wide disc. Anus is terminal with no teeth.

Ossicles: Tentacles with curved rods, 100–400 µm long. Body wall with tables and C-shaped rods; rosettes and X-shaped rods absent. Table discs, on average 40 µm across, smooth, and with a moderately high spire that ends in a spiny crown. C-shaped rods 40 µm long.

Processed appearance: Dried *Isostichopus fuscus* are relatively stout with rounded, conical, papillae dispersed over the entire body. The papillae are especially numerous at the lower lateral margins. Coloration is greyish black. Common dried size 6–10 cm.

Remarks: Compared to dried *Isostichopus badionotus*, which is often greyish, dried *I. fuscus* tends to be brown in colour and with raised bumps over the whole dorsal surface of the products.

Size: Average fresh weight from 294 g (Ecuador) to 497 g (Mexico); average fresh length from 20 cm (Ecuador) to 24 cm (Mexico).

HABITAT AND BIOLOGY

I. fuscus can be found on rocky and coraline patches on the coastal zone from the shallow subtidal to 39 m depth. In Galapagos, it prefers rocky bottoms where the green algae *Ulva* sp. is predominant. In Baja California, it is found in coral and rocky habitats. In the Galapagos Islands (Ecuador), this species attains size-at-maturity at 160 to 170 g drained weight and has a continuous reproduction through the year. In Mexico, it attains size-at-maturity at 367 g (20 cm) and has an annual reproductive event during summer.

EXPLOITATION

Fisheries: *I. fuscus* is harvested in semi- industrial fisheries by hookah diving. This species is under commercial exploitation in Ecuador, Mexico, Panama and Peru. In Panama, it is fished illegally. In the Galapagos Islands,

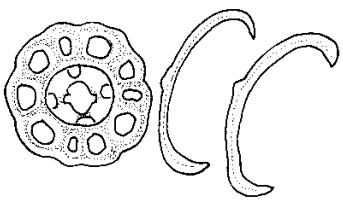
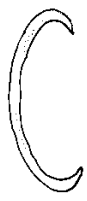
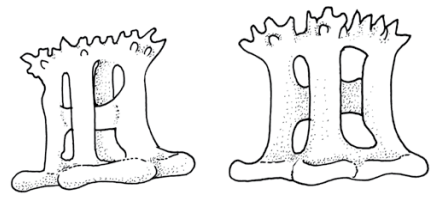


table disc and C-shaped rods



C-shaped rod



tables

(Source: photos by C. Hickman)

(After Deichman, 1958)

there was a moratorium on fishing in 2009 and 2010 as the minimum population density required to open the fishery (11 ind. per 100 square m) was not met. At mainland Ecuador, the fishery started in 1988 and fishers serially deplete the fishing grounds. The fishery in Mexico, Central and South America started after the depletion of sea cucumbers in traditional fishing grounds.

LIVE ©S.W. Purcell

PROCESSED ©S.W. Purcell

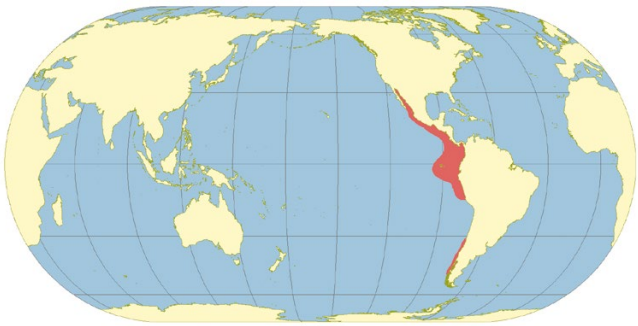
Regulations: In the Galapagos Islands (Ecuador), this fishery is managed by means of a TAC, minimum legal length (20 cm fresh or 7 cm dry), no-take reserves, a fishing season (two months), and access is only to artisanal fishers that are permanent residents of the islands. In Mexico, there is a fishing season (October–May), a minimum legal size (400 g or 20 cm) and annual permits. Additionally, no-take reserves are established where the smallest individuals are found. There is a total ban on fishing *I. fuscus* in continental Ecuador. In Mexico, adaptive management includes quotas, catch reports and stock monitoring. This species is the only commercially exploited sea cucumber, so far, that is listed on CITES Appendix III.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Code: **JCF**. Main markets are China, Hong Kong SAR and the United States of America. It was sold at USD 1.4 per unit fresh in Ecuador. Sold online in China (2022) for USD 498–527 per kg.

GEOGRAPHICAL DISTRIBUTION

Found from Baja California to mainland Ecuador, including Galapagos, Socorro Island, Cocos (Keeling) Islands, Malpelo and Revillagigedos islands. Hooker, Solís-Marín and Leellish (2005) include Peru (Islas de Lobos de Afuera) in its geographical distribution.

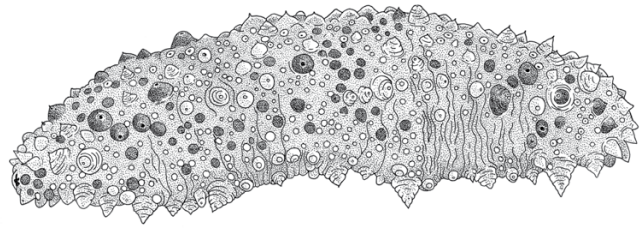


OTHER USEFUL INFORMATION

This species is widely reported as overexploited in many localities and listed as Endangered on the IUCN Red List. It is listed on CITES Appendix III.

COMMON NAMES

Pepino do mar, Jacaré (Cape Verde).



DIAGNOSTIC FEATURES

Body is smooth and opaque. Highly variable colours and colour patterns, ranging from brown, rusty, dark green, yellowish-beige, and cream with brown spots or mottling. The body wall is smooth, with bumpy papillae dorsally, up to 3 mm in height, which are numerous and larger at the ventro-lateral margins. It is characterized by whitish spot-like granules on body wall. Ventral surface is flattened, with light red and beige podia arranged in three rows. The mouth is oriented ventrally while the anus is sub-dorsal.

Ossicles: Dorsal body wall with numerous tables and very few C-shaped ossicles. Dorsal papille have tables (typical ones and modified '*maculatus*' tables), some C-shaped rods (54–90 µm long), perforated plates and larger rods. S-shaped ossicles not reported for this subspecies. The table ossicles from the dorsal papillae are relatively large, up to 79 µm high and with disc diameter up to 116 µm. There are some perforated plates, 104–121 µm across, at the tips of the papillae, possessing a few large perforations. The slightly curved rods are 228–317 µm long, occasionally perforated. Podia have tables, thin C-shaped rods, perforated plates, large curved rods and end plates.

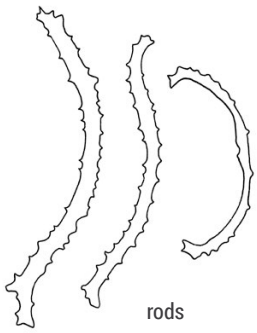
Processed appearance: Processed (dried) products commonly 3–9 cm in length. Dried products range from light greyish-brown to dark grey and have noticeable infrequent larger pimple-like papillae with light brown tips interspersed dorsally. The dorsal body wall is covered with tiny beige or whitish dots, which are characteristic of the species.

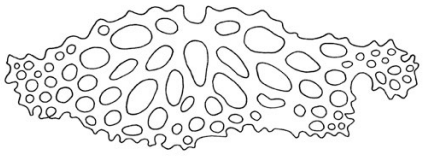
Remarks: Apart from having a different geographic distribution, this species differs from *Isostichopus* sp. *'phoenius'* by lacking the small dark spots surrounded by a clear haly and a think dark line. *Isostichopus* sp. *'maculatus'* also does not have a semi-translucent body wall as in *Isostichopus* sp. *'phoenius'*. Ongoing taxonomic work currently investigates if this variety should be given species rank.

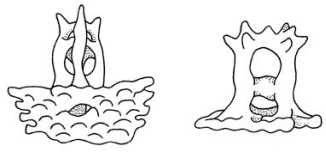
Size: In Liberia, the animals average 19 cm long and weigh an average of 180 g. Body length up to 22 cm.

HABITAT AND BIOLOGY

In Cape Verde, this species is found at 5–40 m depth, on sandy or rocky substrates and refuging under rocks and in crevices. In Liberia, they occur mostly on reefs with large boulders, at depths of 2–30 m. This species







(Source: photos by G. Borrero-Pérez)

has been reported to have mostly nocturnal habits, refuging during the day and foraging at night. Sexual reproduction appears to occur when seawater is warmest, peaking in late summer.

EXPLOITATION

Fisheries: Fished illegally in Cape Verde until 2021, when captures by scuba diving were permitted under new government regulations. Believed to be found in deeper waters, 30–40 m in Cape Verde due to fishing pressure in shallower waters. During December 2020 to April 2021, 2.7 tonnes of these animals were harvested, with an average catch rate of 37 kg per diver per night. In Liberia, they are harvested by hookah divers from inshore reefs operating under two fishing licences issued since 2021. Fishers could catch 130–150 kg per diver per night in 2016, then catch rates declined to around 50–60 kg per diver per night by 2021.

Regulations: Fishing and trade of this species in Cape Verde was permitted by government regulations in 2021. Fishing in Liberia is permitted by holders of government-issued licences.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians.

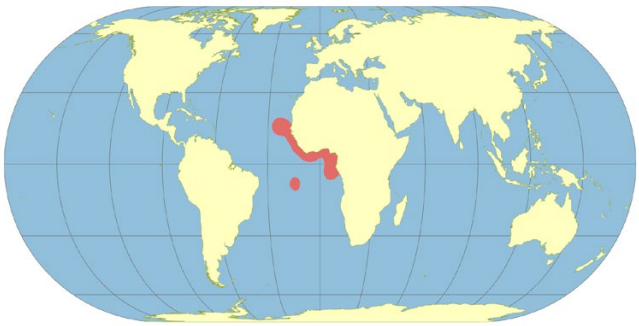
LIVE ©N.V. Rodrigues

PROCESSED ©T. Collinson

Main market and value: This is a high-value species in Asian dried seafood markets. Traded in Liberia and Sierra Leone alongside other high-value marine products such as shark fin and fish maw. In Liberia, fishers earned USD 1.75 per kg for fresh animals. Dried products reportedly sold in Sierra Leone for USD 50–150 per kg. For sale in several shops in China, Hong Kong SAR in 2022 for an average of USD 930 per kg dried; max. USD 1 237 per kg.

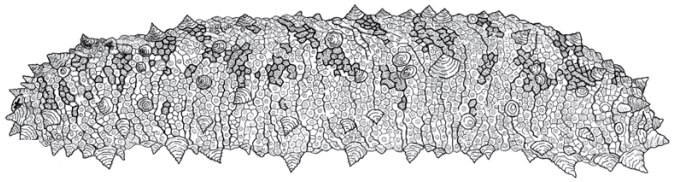
GEOGRAPHICAL DISTRIBUTION

Reported from Senegal, Liberia, Nigeria, Cape Verde, Sierra Leone, São Tomé and Príncipe islands, Ascension islands and Gabon.



COMMON NAMES

Pepino rojo (Mexico).



DIAGNOSTIC FEATURES

Body wall is relatively rugose and somewhat semi-translucent. The colour is variable. Body is covered with large and irregular-shaped cream/white and greyish-brown blotches. The body wall often has a reticulated pattern, like an irregular honeycomb. On the cream blotches are small dark spots, each surrounded by a whitish halo and a dark thin line. Rarely, animals can be uniformly brown, green or reddish, but usually have some white blotches present. Conical, stout dorsal and lateral papillae are variably arranged and have darker spiral lines around them. Ventral surface with large podia in three rows. The mouth is ventral and the anus is terminal

Ossicles: Body wall with tables and C-shaped bodies. Dorsal papillae with tables (30–40 µm high and 30–50 µm disc diam.), C-shaped (40–60 µm in length) and S-shaped rods (75–80 µm in length), perforated plates, large, curved rods (150–377 µm in length) and worm-like rods. Ventral body wall with numerous tables and a few thin C-shaped rods. Tentacles with tables (30–70 µm disc diam.), rods and numerous strongly or slightly curved spiny rods (30–700 µm length).

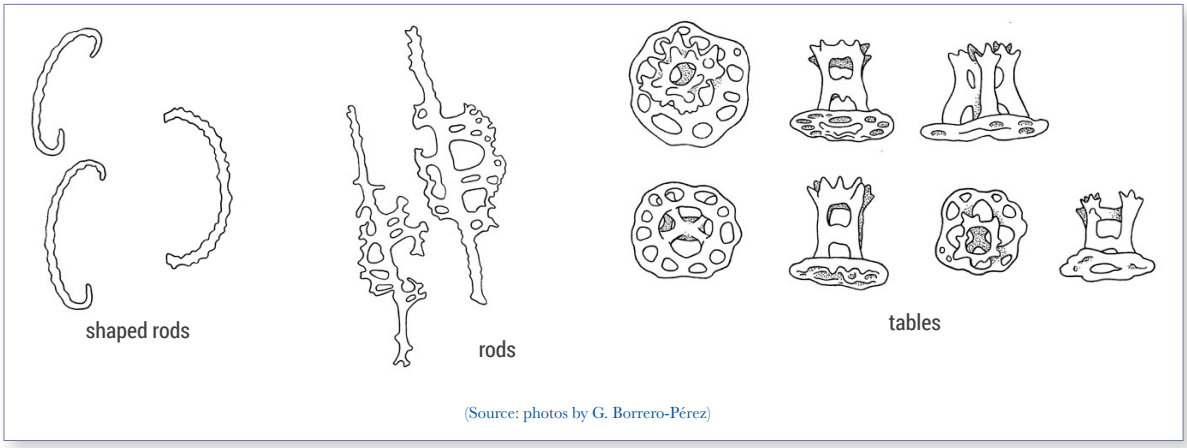
Processed appearance: The dried products are sub-cylindrical and moderately elongated with rounded ends. The colour can be dark brown to pale orange dorsally, normally with dark irregular spots. The ventral surface is lighter in colour. Small wrinkles are evident on the dorsal surface, especially around the papillae bases. The dorsal surface is rough and covered with dark spots, while the ventral surface is grainy. Common size 7–12 cm.

Remarks: This taxon is especially distinguished from *Isostichopus badionotus* by the white blotches and small black dots on the dorsal surface. Ossicles do not distinguish these taxa easily. Ongoing taxonomic work currently investigates if this variety can be risen to species rank.

Size: This is a medium-sized species, growing up to 26 cm long.

HABITAT AND BIOLOGY

This species is mostly nocturnal and relatively cryptic, hiding during the day under rocks or in crevices. Often associated with live corals, sponges, rubble and rocks. After reaching 15–20 cm in length, they can become less cryptic and can live on open sand flats. Found in reef waters from 0–20 m depth.



(Source: photos by G. Borrero-Pérez)

EXPLOITATION

Fisheries: Fished in much of the Caribbean and Gulf of Mexico. Harvested by hand by breath-hold divers and SCUBA divers in artisanal fisheries. Often collected and traded together with *I. badionotus*.

Regulations: As this taxon is traded as *I. badionotus*, it is subject to the same regulations in fisheries.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians.

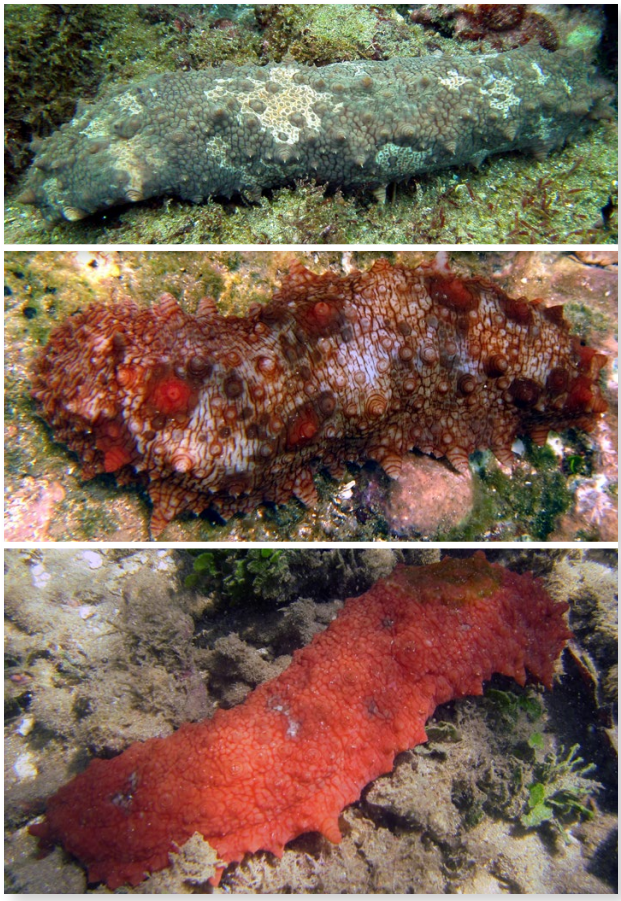
Main market and value: Market value as *I. badionotus*. China seems to be the main market. This species is considered of high commercial importance in China. Found for sale in retail shops in China, Hong Kong SAR in 2022 for USD 358 per kg dried.

GEOGRAPHICAL DISTRIBUTION

Reported from the Caribbean Sea and the Gulf of Mexico.

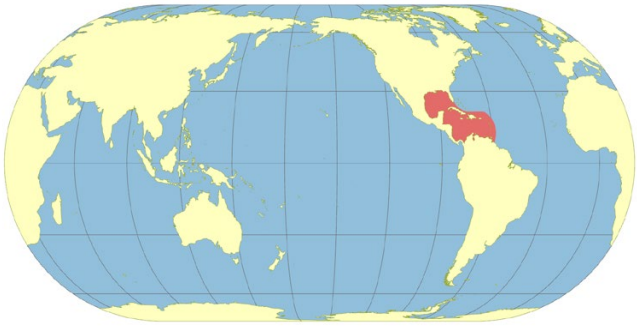
OTHER USEFUL INFORMATION

As a previously unrecognized species, overlooked and confused with *I. badionotus*, *Isostichopus* sp. '*phoenius*' was not assessed for possible inclusion on the IUCN Red List of Threatened Species. However, it fished together with *I. badionotus* and traded in China.



LIVE ©G. Borrero

PROCESSED ©F.A. Solís-Marín



COMMON NAMES

Royal cucumber (European Union), Holothurie jaune (France), Espardeña (Spain), Espardenya (Catalunya, Spain), Cohombro de mar real (Spain), Cogombro de mar real (Galiza, Spain) Königsseegurke (German), Witgevlekte zeekomkommer (Dutch).

DIAGNOSTIC FEATURES

Body moderately elongate, somewhat flattened. Body is brownish or ochre-yellow dorsally with numerous white spots, and has moderately sized white conical papillae. Ventral surface may be reddish, especially centrally, and has three rows of podia. Mouth ventral, surrounded by 20 whitish peltate tentacles in two circles.

Ossicles: Only table ossicles are present in the body wall, while C-shaped rods and other ossicles are always absent. Table discs with several rings of perforations (up to 60 holes, smaller towards the margins) and 60–105 µm wide with a moderately high spire composed of 4 spiny pillars with up to 5 crossbeams. Rods with irregular perforations and terminal plates are present in papillae and podia.

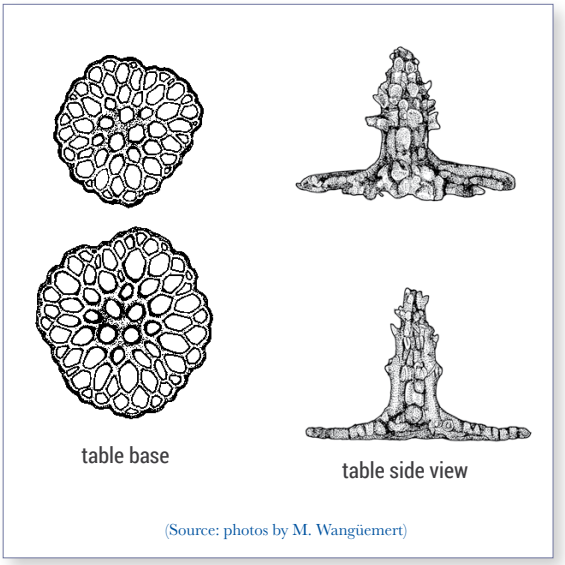
Processed appearance: In Spain, the traded product is the internal muscle bands, known as "*Espardeña*" or "llongo", which is sold unprocessed. The fresh muscle bands, in five pairs in the animals, are creamy white in colour, which is maintained after cooking. The muscle bands are elongated with tapered ends and have a soft and slightly cartilaginous texture. In Mauritania, the dried body wall is traded but its appearance is unreported.

Remarks: *Parastichopus regalis* is known to host pearlfish (*Carapus acus*) symbionts. The COI gene has shown significant genetic differentiation among some locations.

Size: Reaches 30 cm in length and 7.5 cm in width. Body size is variable in Spain. Body weight to 274 g in Mediterranean waters of Spain. In Algeria, contracted length is up to 25 cm and total weight up to 144 g.

HABITAT AND BIOLOGY

Inhabits shallow areas to abyssal depths, ranging 5–800 m deep. It tends to eviscerate when harvested from deep waters. Occurs mostly on silty, sandy and rubble substrata. Found on the continental shelf and less so on the continental slope. The sex ratio of female:male was reported as 1:1.2. It exhibits an annual sexual reproduction in the northwestern Mediterranean Sea, with gonads maturing during spring and the spawning occurring in summer.



(Source: photos by M. Wangüemert)

EXPLOITATION

Fisheries: *P. regalis* is harvested mostly by trawl nets in the Mediterranean Sea and NE Atlantic Ocean. Harvesting prohibited in Portugal from 2021. In the Azores Islands, bag limits of 20 kg/person/day for divers

and 7.5 kg/person/day by gleaning are permitted, the latter unreported. Harvested in trawl fisheries in Galicia, Murcia and Cataluña (Spain), Greece and Türkiye. Exploitation has spread to Morocco, Algeria and Mauritania, using artisanal trawls and by hand by divers. Only small quantities taken as bycatch in Tunisia.

Regulations: Harvests previously permitted in Portugal but banned from May 2021. Mainly considered as bycatch in Spain, where the fishery for this species is presently unregulated, and is traded as "espardeña". Harvesting for subsistence is allowed in Algeria, yet a 46-day seasonal closure is imposed. Harvesting has been banned in Italy from 2019 and in Croatia from 2018.

Human consumption: Harvests in Spain are mostly for regional consumption of the internal muscle bands. Around 40 individuals are needed to produce 1 kg of fresh muscle bands. Processed (dried) in Mauritania for domestic consumption and export to Asian markets as bêche-de-mer.

Main market and value: Code: **JCR**. Landing prices (whole, fresh) were USD 1.5–6.5 per kg in Portugal (2011–2020) and 0.95–1.28 € per kg in Spain. The muscle bands retailed in Spain for 130–200 € per kg fresh. Landing prices (whole, fresh) in Mauritania were USD 10 per kg in 2019; fishers were paid USD 47 per kg for dried product. Retail prices for dried product were USD 95 per kg in Japan, USD 50 per kg in China, and USD 70 per kg in China, Hong Kong SAR.

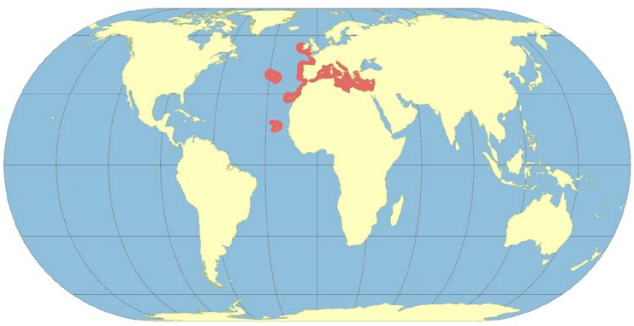
GEOGRAPHICAL DISTRIBUTION

Common in the Mediterranean Sea, where its type locality is found. Also reported from the eastern Atlantic, United Kingdom of Great Britain and Northern Ireland, Ireland, Portugal, Spain including Azores Islands (Portugal) and Canary Islands (Spain), and northwest coast of Africa and recorded as far south as Cape Verde.

LIVE ©K. Lérissel via DORIS

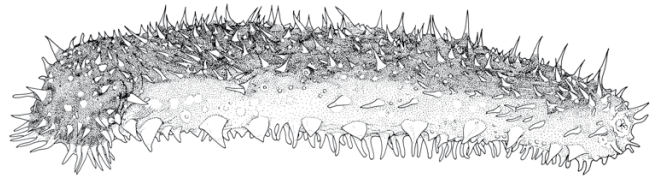
LIVE ©A. Rampon

PROCESSED muscle bands ©A.L. Hamazy



COMMON NAMES

Red sea cucumber (European Union), Red signal sea cucumber (Sweden), Rødpølse (Norway, Denmark), Norwegian Red sea cucumber (European Union).



DIAGNOSTIC FEATURES

Cylindrical body shape, slightly flattened ventrally, and a thick body wall. The body is pink or shades of red-orange dorsally, and may have small dark spots. Conical dorsal papillae of 0.5–2 cm in length, giving a spiky appearance. Ventral surface pale pink to whitish, sometimes with red markings, with three rows of podia. Entirely red or white individuals reported from the North Sea. Twenty brown, peltate tentacles.

Ossicles: Body wall ossicles mostly rods and tables and some star-shaped bodies. C-shaped rods and buttons absent. Tables have discs with serrated edges, perforated by 11–21 holes on the margins and 4 larger holes near the centre, with disc diameter ranging 97–118 µm. Table spires have four pillars linked by two cross-beams and ending on three levels of bifid spines. Rods of 50–150 µm are spinous with variable shapes, usually branched at the ends. Star-shaped bodies ranging 50–70 µm are ramified with thorn-like spines.

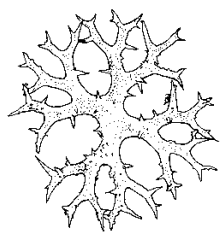
Processed appearance: Cooked animals are light brown dorsally with small dark spots and dorsal papillae are still apparent. The dried product is elongated and flattened, and the dorsal surface tends to be brown or grey colour with a wrinkled surface. The ventral surface is light (cream or tan) coloured; papillae at the ventro-lateral margins are larger than those dorsally and are light coloured. Animals are usually gutted via a cut in the middle of the ventral surface.

Size: Body length up to 35 cm and body weight to 395 g in Western Europe. In Southwest Mediterranean, body length to 21 cm and body weight to 234 g. Reported to reach 50 cm and 537 g in North Sea.

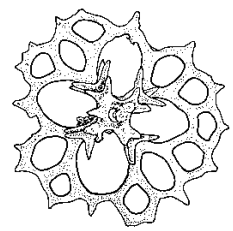
HABITAT AND BIOLOGY

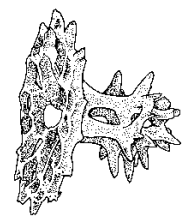
Depth range is 18–4 000 m but commonly in 50–500 m. Inhabits slopes of seamounts or sea shelfs in the Mediterranean Sea. Known from sedimentary habitats with coarse or medium-grain sands in the Gulf of Cádiz (Spain) in 500–800 m depth. Most abundant at 100–300 m depth in the North Sea. Evidence of aestivation or seasonal fasting from October to February. Predators are scavenging amphipods, shrimps, starfish and some gadoid fishes. Ratio of female to male reported as 1.3:1.0. Animals observed spawning in June and July. Gametogenesis begins in January, and gonads increase in size until May. Spawning animals were observed in June and July.

rod of body wall



star-shaped body of body wall





tables of body wall

(After Ordines *et al.*, 2019)

EXPLOITATION

Fisheries: Harvested by trawling, either targeted or as bycatch, in Norway for export to Asian markets. Part of trawl bycatch in other fisheries in the North Sea. Caught as bycatch from trawls in 300–800 m depth in Galicia (Northwest Spain).

Regulations: In Spain, the catches are largely unregulated. Fishing of *P. tremulus* in Norway is regulated to certain areas and the fishing gears must be declared and authorized. Short moratoria on fishing of the sea cucumber have been imposed in Norway.

Human consumption: Mainly exported to Asian markets dried but some as frozen product.

Main market and value: Code: **TVK**. Introduced to Asian markets in 2015 and reported as a low to medium-value species. Data on prices were lacking. The red colour of the frozen product is favoured by Asian consumers.

GEOGRAPHICAL DISTRIBUTION

Distributed in the Northeast Atlantic and deep Southwest Mediterranean Sea. Reported from the Scandinavian Peninsula and in the Fjords, Canary Islands (Spain), Iceland, Faroe Islands, Ireland and United Kingdom of Great Britain and Northern Ireland.

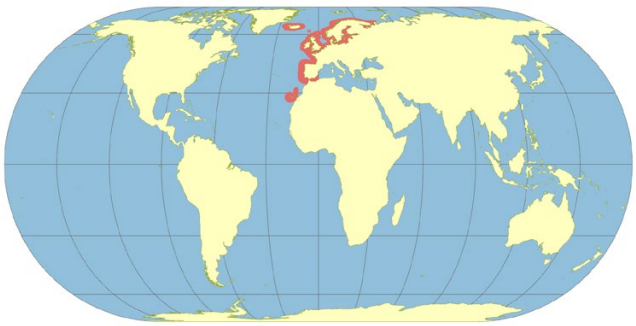
OTHER USEFUL INFORMATION

P. tremulus possesses compounds with anti-inflammatory properties.

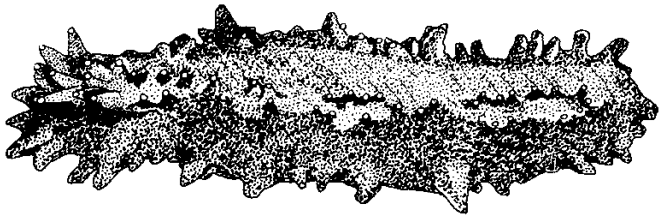
LIVE ©V. Grøtan

LIVE ©J. Sunde

PROCESSED ©J. Sunde



COMMON NAMES

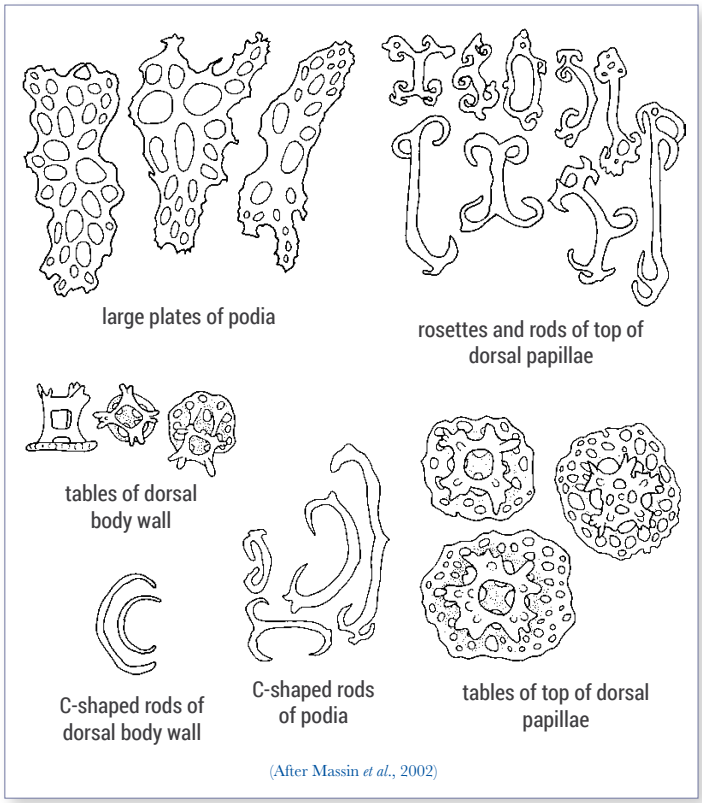


Greenfish (**FAO**), Trepang vert (**FAO**), Squarefish (**FAO**), Zanga sono, Mahitsikely (Madagascar), Barbara (Mauritius), Mullu attai, Pavaka attai (India), Saâu bieån, Ñoät beâ ô (Viet Nam), Cuatro cantos (Philippines), L'ananas vert (New Caledonia), Tekirin (Kiribati), Holomumu (Tonga), Dri-votovoto (Fiji), Dabalaya (Sri Lanka), Jepung, Japon, Jepun (Indonesia), Frenfis (Solomon Islands), Krinfis (Vanuatu).

DIAGNOSTIC FEATURES

Body colour is dark green to near black dorsally; dark green ventrally. Rows of long, conical papillae on both sides of the dorsal surface and along both lower lateral margins of the body. Papillae tips are usually, but not always, orange to yellow. Body moderately firm and squarish in cross-section. Ventral podia are long and green, in four rows. Mouth is ventral with 19 or 20, white to greyish, stout tentacles. Anus is terminal bordered by five large papillae.

Ossicles: Base of tentacles have reduced tables, small knobbed rods and few very long rods, up to 450 µm long. Tips of the tentacles have spiny curved rods, 65–470 µm long. Dorsal and ventral body wall with tables and C-shaped rods. Ventrally tables have discs 30–45 µm across while dorsal tables have discs 25–30 µm across. Table discs are smooth and perforated by 4 central and 4–10 peripheral holes with a pillar ending in a crown of spines that resembles a Maltese cross. C-shaped rods are up to 50 µm long. Dorsal papillae have characteristic larger tables, with discs 55–80 µm across, large C-shaped rods, up to 70 µm long, and irregular rods. Ventral podia have reduced tables, few irregular C-shaped rods, 40–100 µm long, and rods of 270–470 µm long, and perforated plates.



Processed appearance: Moderately elongate with a squarish cross-section; each of the four edges of the body is covered with pointy wart-like projections. The entire body is dark grey to black. No cuts or small cut across mouth. Common dried size 10–12 cm.

Remarks: The body-wall may disintegrate if the animal is held out of the water for a long time.

Size: Maximum size 35 cm, mostly 20 cm when full grown. Average fresh weight: 80 g (Mauritius), 100 g (Papua New Guinea, India), 100–400 g (Réunion), 150 g (New Caledonia); average fresh length: 8–20 cm.

HABITAT AND BIOLOGY

An inhabitant of coral reefs, in shallow waters from the intertidal to depths of 10 m. *Stichopus chloronotus* can be found on reef-flats and upper reef slopes at densities up to 1 ind. per m^2 in shallow areas. Found mostly on coarse coral sand and sheltered habitats with coral rubble. In China, it is reported in deeper water (40 to 60 m). Sexual reproduction is bi-annual during summer. It undergoes asexual reproduction (fission) mostly during the cool season.

LIVE ©S.W. Purcell

PROCESSED ©S.W. Purcell

EXPLOITATION

Fisheries: Exploited in artisanal and semi-industrial fisheries. It is harvested by hand by gleaning at low tide or by free diving in many localities throughout the Indo-Pacific, by compressed-air diving and gleaning in Mauritius and Viet Nam. It is seldom harvested in Australian fisheries. This species is harvested for subsistence consumption in Wallis and Futuna Islands and French Polynesia. In Asia, it is of commercial importance in China, Japan, Malaysia, Thailand, Viet Nam, Indonesia (heavily exploited) and Philippines. It is harvested in Kenya and Madagascar.

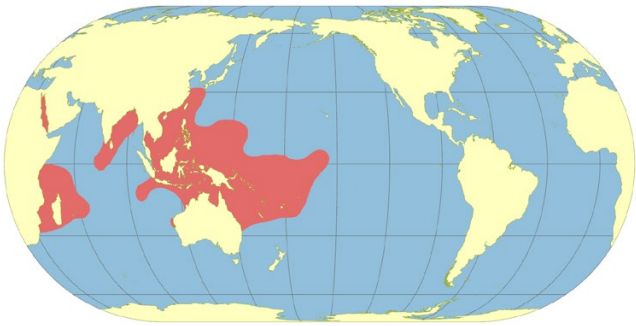
Regulations: Minimum size limits are 20 cm wet and 10 cm dried in Papua New Guinea, Solomon Islands and Vanuatu; 20 cm wet and 8 cm dried in New Caledonia. In the Great Barrier Reef fishery, the minimum legal length is 20 cm live, there are permits and limited entry regulations, and this species is subject to a rotational harvest strategy and catches are limited in a combined TAC with some other species.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. In certain Pacific islands, it is eaten as part of traditional subsistence diets.

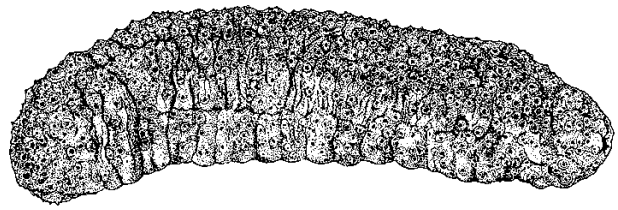
Main market and value: Code: **JCC**. Main export markets are Singapore and China, Hong Kong SAR. Traded previously at USD 60 per kg dried in the Philippines. Previously sold for USD 12–17 per kg dried in Papua New Guinea, and for USD 17–20 per kg in Viet Nam. In New Caledonia (2007), it was exported for about USD 25 per kg dried. In Fiji (2014), fishers received USD 0.4–0.7 per piece fresh. Prices in Guangzhou wholesale markets averaged USD 100 per kg dried; max. USD 125 per kg.

GEOGRAPHICAL DISTRIBUTION

Islands of western Indian Ocean, Mascarene Islands, East Africa, Madagascar, Maldives, Sri Lanka, Bay of Bengal, Australia, Philippines, China and southern Japan, most of the islands of the central western Pacific but apparently absent from the Marshall Islands.



COMMON NAMES



Curryfish (**FAO**), Mul attai (India), Marhm (Egypt), Ñoät ngaän ñaù, Ñoät ngaän tröôøng (Viet Nam), Trakitera, Crampon (Madagascar), Tairi (United Republic of Tanzania, Zanzibar), La curry (New Caledonia), Lomu (Tonga), Tekare (Kiribati), Laulevu (Fiji), Sani attaya (Sri Lanka), Gamet emas, Gamet kacang, Taikongkong (Indonesia), Karifis (Vanuatu).

DIAGNOSTIC FEATURES

Body colour varies from light mustard-yellow to orangey-brown or brown or olive green. Colour tends to be lighter ventrally. Numerous dark brown to black spots scattered over the entire body; two double- rows of larger wart-like papillae, bordered by fine dark rings. Podia are numerous ventrally. Body relatively firm, moderately elongate and squarish in cross-section. Mouth is ventral with 8–16 stout greenish tentacles. Anus is terminal, with no teeth nor surrounding papillae.

Ossicles: Tentacles with spiny, slightly curved rods, some times forked and/or perforated distally, 60–850 µm long. Dorsal and ventral body wall with the same type of tables, C-shaped rods and rosettes. Table discs 25–45 µm across, perforated by 4 central and 4–8 peripheral holes, spire ending in a narrow, often spiny crown. Rosettes 25–55 µm long. C-shaped rods 35–100 µm long. Ventral podia have reduced tables, 30–45 µm across, large perforated plates with the median part often enlarged and perforated, and rods, 200–360 µm long. Dorsal papillae with rods up to 200 µm long, C- or S-shaped ossicles similar in size and shape as those of the body wall, rosettes and tables up to twice the size as those of the body wall.

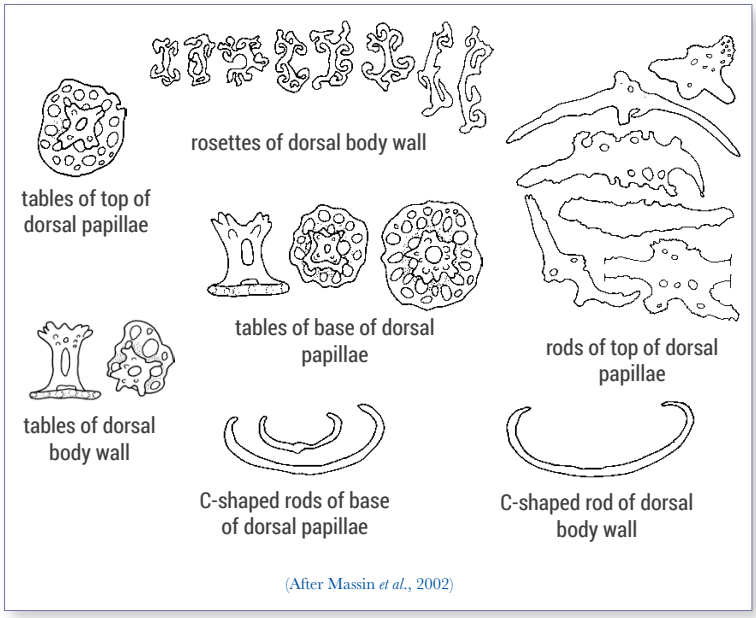
Processed appearance: Relatively elongate and squarish in cross-section. Body tends to be various shades of beige to brown. Dorsal surface wrinkled and covered with small, dark, bumps, while the underside is smoother. No cuts or small cut across mouth. Common dried size 12 to 18 cm.

Remarks: Previously known as *Stichopus variegatus*. The body wall disintegrates if heavily disturbed.

Size: Maximum size 55 cm, mostly 20–40 cm. Average fresh weight: 1 000 g (Papua New Guinea, Egypt, India), 1 100 g (Viet Nam), 1 680 g (New Caledonia) and 1 000–2 500 (Réunion).

HABITAT AND BIOLOGY

In the western central Pacific, it prefers seagrass beds, rubble and sandy-muddy bottoms between 0 and 25 m. In the Indian Ocean region, it lives in lagoons, seagrass beds and rubble over sandy-muddy bottoms between 0 and 5 m. Size-at-maturity is about 31 cm and it reproduces annually during summer. In Réunion,



it reproduces during the dry season.

EXPLOITATION

Fisheries: Mostly exploited artisanally. Collected by gleaners and breath-hold divers in most localities throughout its distribution, and sometimes harvested using scuba or hookah. In Australia, it is harvested extensively in the southern Great Barrier Reef. Collected for subsistence in Palau, Wallis and Futuna Islands and French Polynesia. Harvested throughout Southeast Asia. In Malaysia, this species is used commercially for the preparation of traditional medicinal products.

Regulations: Minimum size limits are: 25 cm wet and 10 cm dried in Papua New Guinea; 35 cm wet and 15 cm dried in Solomon Islands and Vanuatu; 35 cm wet and 13 cm dried in New Caledonia. On the Great Barrier Reef (Australia), there is a minimum landing size of 35 cm fresh, no-take reserves, strict licensing, and a rotational harvest strategy.

LIVE (Indian Ocean) ©S.W. Purcell

LIVE (Pacific) ©S.W. Purcell

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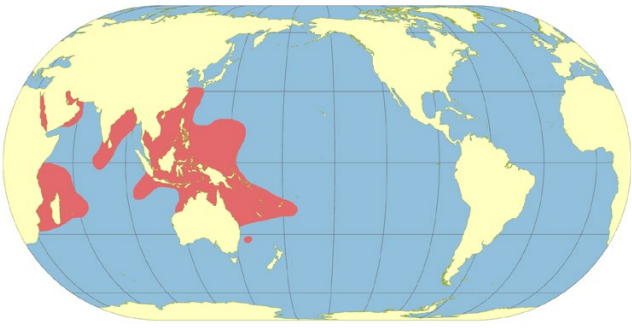
Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. In some Pacific islands, the body and/or organs are consumed in traditional diets or in times of hardship. Used in some countries for the preparation of traditional medicinal products.

Main market and value: Code: **JNG**. Main markets are Singapore, China, Hong Kong SAR, Egypt and Republic of Korea. Previously traded for USD 35–58 per kg dried in Philippines, USD 20 per kg dried in Viet Nam, and USD 12 per kg dried in Papua New Guinea. In New Caledonia (2007), it was exported for USD 20–30 per kg dried. In Fiji (2014), fishers received USD 1–5 per piece fresh. Sold by fishers in Torres Strait (2022) for USD 100 per kg dried. Prices in Guangzhou wholesale markets (2016) averaged USD 145 per kg dried; prices in China, Hong Kong SAR averaged USD 350 per kg dried in 2016 and USD 311 per kg dried in 2022.

GEOGRAPHICAL DISTRIBUTION

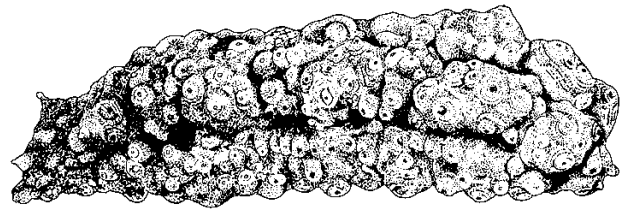
Mascarene Islands, East Africa and Madagascar, Red Sea, southeast Arabia, Gulf of Aqaba, Persian Gulf, Maldives, Sri Lanka, Bay of Bengal, East Indies, north Australia, Philippines, China and southern Japan. It occurs in the western Pacific as far east as about Tonga and as far south as Lord Howe Island.



OTHER USEFUL INFORMATION

This species is widely reported as overexploited in many localities and listed as Vulnerable on the IUCN Red List.

COMMON NAMES



Selenka's sea cucumber (**FAO**), Warty sea cucumber (Ecuador), Dragonfish (India, Papua New Guinea, **FAO**), Pepino de mar (Ecuador), Mul attai (India), Hanginan and Loaf bread (Philippines), Smurf (Madagascar), Sankude (United Republic of Tanzania, Zanzibar), Kacang goreng (Indonesia), Pinatfis (Vanuatu).

DIAGNOSTIC FEATURES

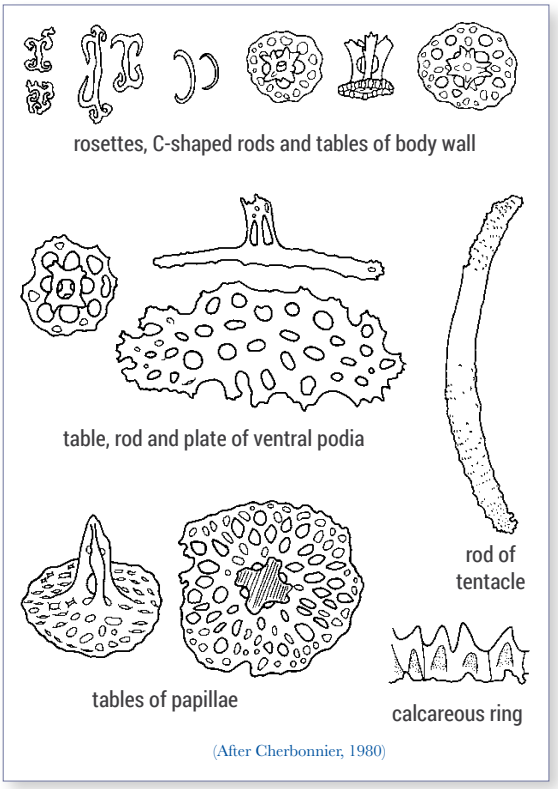
Coloration is highly variable, from grey to beige to dark red, dark brown or black with different coloured blotches dorsally. In India, it may be greenish-brown. Dorsal surface lightly arched with long and conical, or wart-like, papillae mostly in two rows along the upper dorsal surface and a row of larger papillae along the lateral margins of the flattened ventral surface. This species is relatively small. Numerous, large podia occur on the ventral surface. The mouth is ventral with 20 tentacles.

Ossicles: Tentacles with straight to nearly U-shaped rods, 60–700 µm long, some with forked extremities. Dorsal body wall with numerous tables, discs 25–35 µm across, and with a spire ending in a Maltese cross; numerous rosettes, 15–30 µm long; and few C-shaped rods, 45–60 µm long. Ventral body wall with tables, discs 30–55 µm across, and few C-shaped rods, 55–85 µm long. Ventral podia with tables 40–120 µm across, large perforated plates, and rods, 390–500 µm across, some with huge central perforated process. Dorsal papillae at their base with similar ossicles as those of the body wall, but with at their top huge tack like tables, 130–155 µm across, C-shaped rods, 45–80 µm long, and rods with a large central perforated process.

Processed appearance: Dried animals are slender with a squarish cross-section; the dorsal surface retains the wart-like bumps and the ventral surface is smoother. In Ecuador, dried *Stichopus horrens* are smoky black with spiky papillae. Ventral surface flattened with podia visible. In Papua New Guinea, the dried animals tend to be brown to brownish-black. No cuts or small cut across mouth. Common dried size 8–12 cm.

Remarks: It can be mistaken for *Stichopus monotuberculatus*, *S. naso* or *S. quadrifasciatus*. One distinguishing feature from other species is the huge "thumb-tack" shaped table ossicles of the dorsal papillae. Certain sightings of this species may be other species, so distribution records may be in error.

Size: Average fresh weight from 110 g (Philippines) to 200 g (India, Papua New Guinea); average fresh length 12 cm (Philippines), 20 cm (India, Papua New Guinea) and 23 cm (Ecuador).



HABITAT AND BIOLOGY

This species can be found mostly on rocky bottoms interspersed with sandy patches, between 2 and 20 m depth. In the western central Pacific, it can be found in reef flats and upper slopes. In East Africa and in the Indian Ocean, it appears to prefer lagoons and seagrass beds over sand and rubble between 0 and 5 m deep. In Madagascar, it can be found abundant on inner reef slopes, but also in seagrass beds, microatolls, and the detrital fringe and outer reef flat. In the Galapagos Islands (Ecuador), it prefers rocky substrates between 5 and 20 m depth. This species is usually active nocturnally; during the day, it remains hidden in reef crevices. It attains size-at-maturity at 16–18 cm. It undergoes asexual reproduction by fission in Japan.

LIVE ©D. Burdick

PROCESSED ©S.W. Purcell

EXPLOITATION

Fisheries: This species is exploited in semi-industrial (Ecuador) and artisanal fisheries (e.g. Philippines, Malaysia). In western Pacific, it has been fished in many localities. In Asia, it is of commercial importance in China, Malaysia, Indonesia (heavily exploited) and Philippines (one of the most sought-after species). In the Philippines, it is consumed by Muslims during the Ramadan season. This species is heavily exploited in Madagascar and collected illegally in the Galapagos Islands (Ecuador).

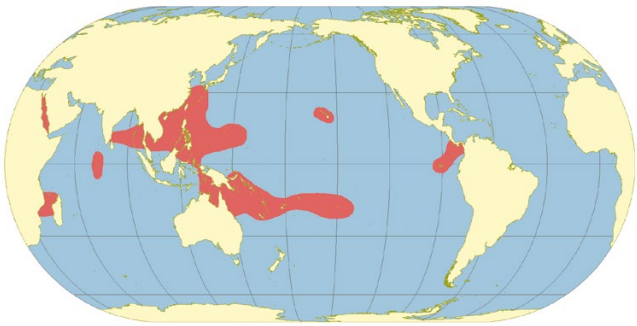
Regulations: In Moreton Bay (Australia), a mostly inactive fishery, there is a minimum legal length of 17 cm live. Minimum size limits are: 15 cm wet and 10 cm dried in Solomon Islands; 20 cm wet and 10 cm dried in Vanuatu.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. Its intestine and/or gonads are consumed in traditional diets. In Malaysia, it is used commercially for the preparation of traditional medicinal products and for the medicinal properties of its coelomic fluid or "gamat" and with medicinal purposes in China. These raw products are traditionally processed into gamat oil and gamat water, and into medicated balm, toothpaste and soap.

Main market and value: Code: **KUN**. Main markets are China, Hong Kong SAR and China. In the Philippines, it was sold at USD 39 per kg dried. Sold in China, Hong Kong SAR in 2022 for USD 273 per kg dried.

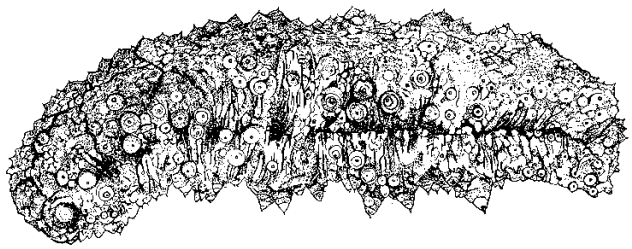
GEOGRAPHICAL DISTRIBUTION

Red Sea, East Africa, Maldives, East Indies, north Australia, Philippines, China and southern Japan, and islands of the Pacific, including the Galapagos Islands (Ecuador) and Hawaii (United States of America).



COMMON NAMES

Because *Stichopus monotuberculatus* is often confused with *S. horrens*, it has often been traded under the same common names (see *S. horrens*), Gamet pace (Indonesia).



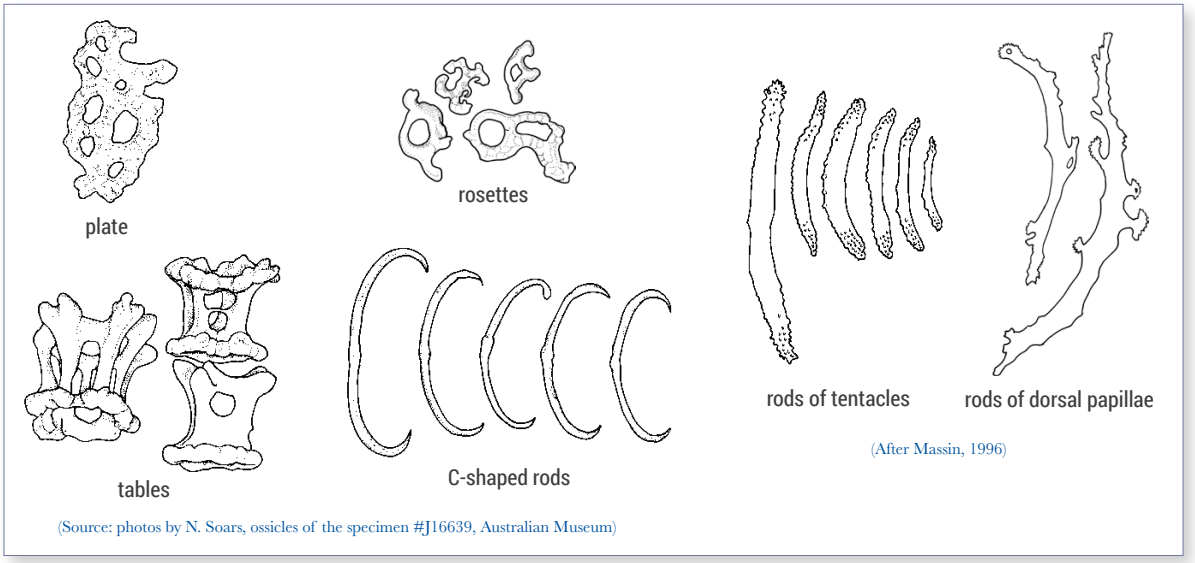
DIAGNOSTIC FEATURES

Coloration is highly variable, from completely black, to mottled grey, brown, beige, yellowish or various mottled patterns with these colours. Body covered with irregularly arranged wart-like papillae, which can be somewhat pointed, especially at the ventro-lateral margins and at night. Papillae are mostly retracted during the day. Some of the papillae can have thin dark lines but these are not as pronounced as in *S. horrens*. The body is trapezoidal to rectangular in cross-section. Ventral surface is mottled similar to dorsal surface, with three longitudinal rows of large podia. The mouth is ventral with 20 tentacles.

Ossicles: Tentacles with rods of varying size, very spiny at ends, 145–645 µm long. Dorsal body wall with tables, rosettes and C-shaped ossicles: tables 30–50 µm across, rim of discs is smooth, perforated by 4 central holes and 3–6 peripheral holes; spire ending in a wide spiny crown; rosettes some 20 µm long. Ventral body wall with tables similar to those found dorsally, and C-shaped rods, 60–70 µm long. Ventral podia with spiny rods, 250–415 µm long, with enlarged median process, unevenly perforated; spiny plates, 85–100 µm long; and tables with rounded but spiny disc. Dorsal papillae with tables, 45–70 µm across, and rods of various shapes and size; the largest ones are 135–350 µm long, have an enlarged median process.

Processed appearance: Similar to *S. horrens*, perhaps more bumpy and brown to black in colour. Dried animals are slender with a squarish cross-section; the dorsal surface retains the wart-like bumps and the ventral surface is smoother. Ventral surface flattened with podia visible. No cut or a small cut across mouth. Common dried size 8–12 cm.

Remarks: The species presented here might differ from the original holotype from the western Indian Ocean and probably is a complex of subspecies. Often mistaken for *S. horrens*, *S. naso* or *S. quadrifasciatus*. This



species lacks the huge "thumb-tack" shaped table ossicles of the dorsal papillae that are present in *S. horrens* and *S. naso*.

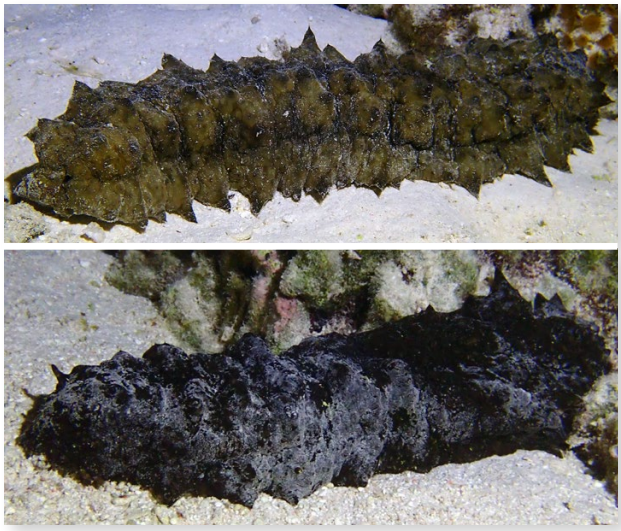
Size: Probably the same as *S. horrens* where they both occur: average fresh weight from 110 g (Philippines) to 200 g (India, Papua New Guinea); average fresh length 12 cm (Philippines), 20 cm (India, Papua New Guinea). In eastern Australia, individuals vary from 15 to 25 cm in length and weigh 120–760 g.

HABITAT AND BIOLOGY

It hides under coral heads and coral rocks, or in crevices, during the day, emerging around sunset and feeding on fine deposits until around sunrise. Found mostly on the reef flat, lagoons and reef slope from 1 m to at least 30 m depth. Reproduces sexually and via binary fission, at least on the Great Barrier Reef (Australia).

EXPLOITATION

Fisheries: As this species is seldom recognized, the extent of exploitation is uncertain. It is probably exploited in artisanal fisheries in the Philippines and Malaysia, and for subsistence use in some Pacific Island countries.



LIVE ©S.W. Purcell

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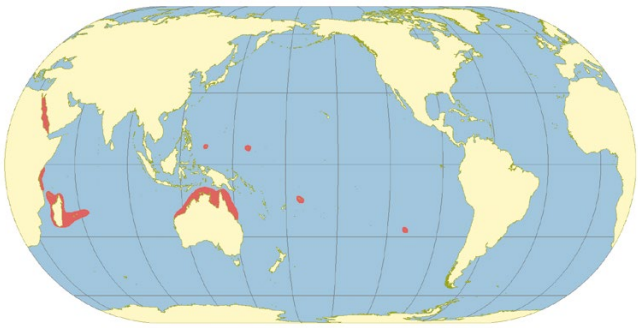
Regulations: Because of its similarity in appearance to *S. horrens*, this species is inadvertently regulated and reported along with the latter species.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. Its intestine and/or gonads are consumed in traditional diets; local consumption is the same as for *S. horrens*.

Main market and value: Code **JPO**. Previously traded in the Philippines for USD 39 per kg dried. In Fiji (2014), it was exported for USD 11–16 per kg dried. Found for sale in retail shops in China, Hong Kong SAR in 2022 for USD 220 per kg dried.

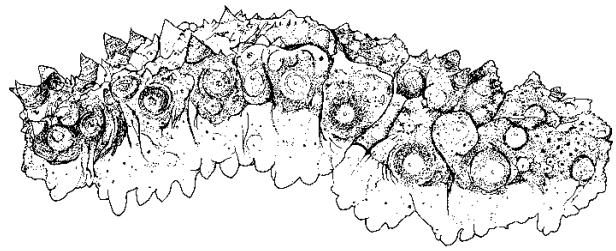
GEOGRAPHICAL DISTRIBUTION

The species described here may have a rather patchy, but wide distribution through the Indo-Pacific. It probably occurs in more localities than presented here. It is known from Réunion, probably also in the Comoros, Madagascar and other places in the western Indian Ocean.



COMMON NAMES

Because *Stichopus naso* continues to be confused with *S. horrens*, the species has been traded under the same common name of the latter species in areas where it occurs.



DIAGNOSTIC FEATURES

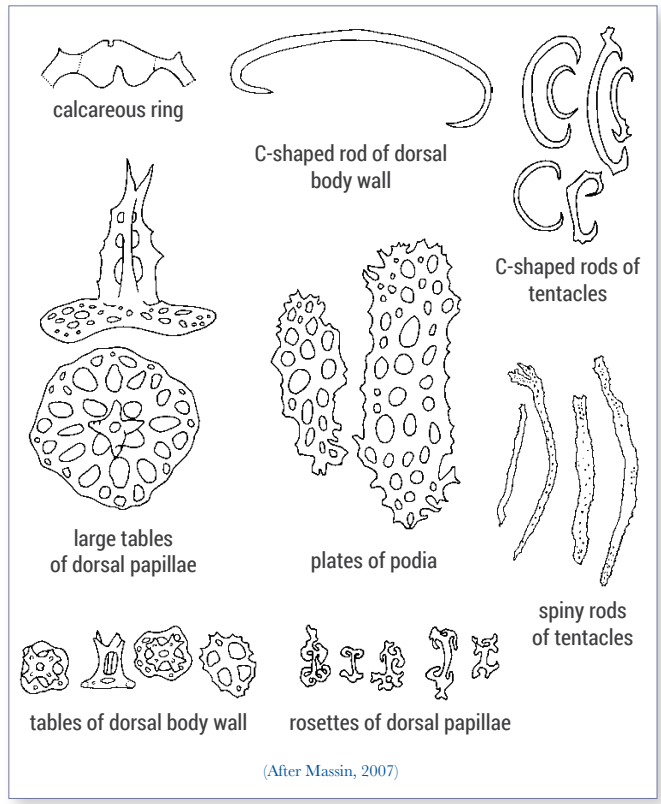
Dorsally, yellowish-tan and mottled with brown, or uniformly light brown and with characteristic dark spots over the body. Laterally, somewhat lighter. Ventral surface with a brown central longitudinal band running between the rows of podia. Tips of podia and dorsal papillae are dark brown. Small specimens nearly uniformly grey, sometimes with a pair of reddish dorsolateral papillae. Trapezoidal to rectangular in cross-section; fission products appear truncate anteriorly or posteriorly. Dorsal surface lightly arched with squat, conical dorsolateral papillae. Individuals of this species are usually relatively small. Numerous, large podia arranged in longitudinal rows occur on the ventral surface. The mouth is ventral with 18–20 tentacles. Anus terminal.

Ossicles: Tentacles with spiny rods that can bifurcate distally, 150–620 µm long, as well as C-shaped rods, 25–65 µm long. Dorsal body wall with tables, rosettes and C-shaped rods: tables with disc approximately 25 µm across, perforated by 4 central and 4–8 peripheral one; spire ending in a crown of spines resembling a Maltese cross; C-shaped rods 60–180 µm long. Ventral body wall with similar ossicle assemblage but C-shaped rods are smaller, 60–110 µm long and rosettes, 20–25 µm long, are more abundant. Ventral and dorsal podia with tables similar to those of the body wall, but also with larger ones with discs perforated with up to 20 holes, narrow and spiny rods, 200–400 µm long, rosettes, and perforated plates 100–160 µm long with spiny edges.

Processed appearance: Probably similar in size and appearance to *S. horrens*. Prominent lateral papillae on the ventral margins should be evident in processed specimens.

Remarks: Often mistaken for *S. horrens*, *S. monotuberculatus* or *S. quadrifasciatus*, the latter two species however do not present tack-like tables. The genetic and morphological boundaries of these four *Stichopus* are currently uncertain and likely to change in future.

Size: Individuals of this species are usually relatively small. Fresh length from 10 to 20 cm, hence, probably from 100 g to 200 g fresh weight.



HABITAT AND BIOLOGY

In shallow water from 1 to 20 m, usually on finer sediments, often associated with seagrass where it lies exposed both day and night,

unlike the similar *S. horrens*, which hides under rubble during the day. Exhibits a characteristic undulating motion in an apparent effort to escape when prodded. This species, but not *S. horrens* reproduces asexually via fission, at least in the Great Barrier Reef (Australia).

EXPLOITATION

Fisheries: Exploitation is moderate in Madagascar. As this species is seldom recognized in the bêche-de-mer trade, the full extent of exploitation is uncertain.

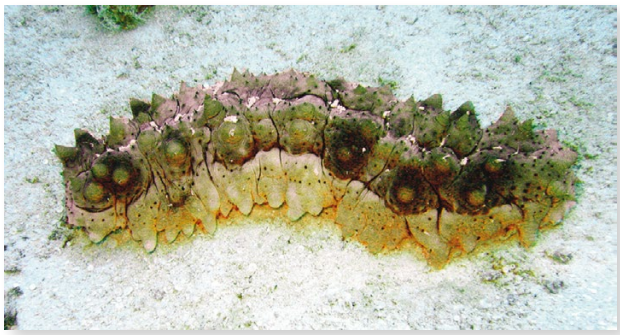
Regulations: Because of its similarity in appearance to *S. horrens*, this species may be inadvertently regulated along with the latter species.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. Its intestine and/or gonads are eaten in traditional diets; local consumption is the same as for *S. horrens*.

Main market and value: Code: **JPR**. It is apparently sold along with *S. horrens* in China, Hong Kong SAR and China. In the Philippines, it has been sold at USD 39 per kg dried. Sold by fishers in Sri Lanka (2015–2017) for USD 0.25 per individual (fresh). Found for sale in retail shops in China, Hong Kong SAR in 2022 for USD 209 per kg dried.

GEOGRAPHICAL DISTRIBUTION

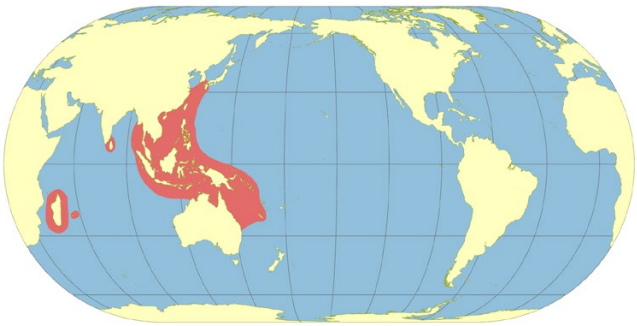
Wide Indo-Pacific distribution. It is recorded from the Philippines to Madagascar, including Mauritius, Sri Lanka, Thailand, Indonesia, Borneo, Australia (from the northwestern through southeastern coasts), New Caledonia, South China Sea, China, Japan, and Papua New Guinea.



LIVE ©S.W. Purcell

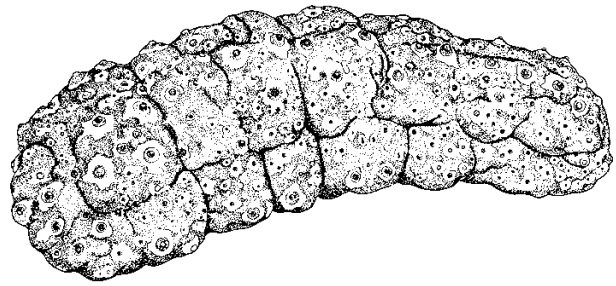
LIVE ©L. Vail

PROCESSED ©S.W. Purcell



COMMON NAMES

Curryfish, Ocellated sea cucumber, Hanginan (Philippines), Ñoät ngaän (Viet Nam).

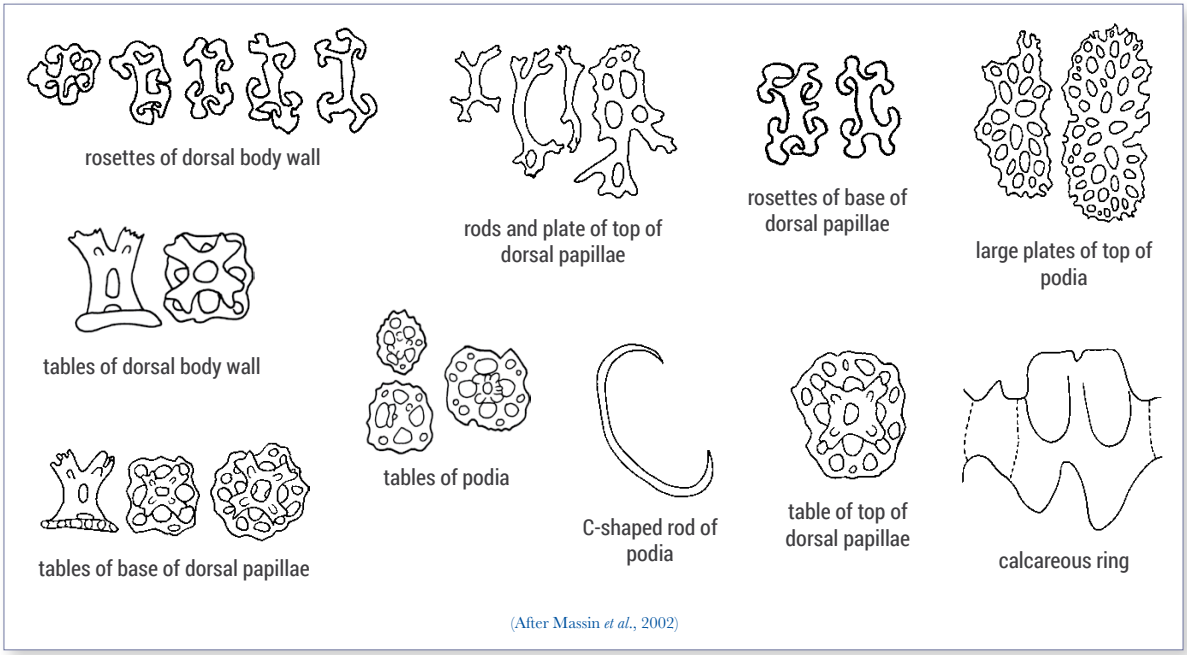


DIAGNOSTIC FEATURES

Dorsal surface is yellow or yellowish-orange with prominent, large, circular, greenish-grey, wart-like papillae that are white around the base. The large papillae occur in four rows and are arranged in a zig-zag pattern. Dorsal surface rounded. Ventral surface is flattened and whitish yellow. Podia on the ventral surface are numerous and greenish-brown, only on the ambulacral areas, and terminating with large suckers (up to 1.5 mm diameter). Mouth is ventral. Anus is terminal with no teeth.

Ossicles: Tentacles with spiny rods, 40–600 µm long. Dorsal body wall with tables, 25–40 µm across, rosettes, 20–40 µm long and C-Shaped rods, 155–175 µm long. Ventral body wall with similar ossicles, but with smaller C-shaped rods, 40–75 µm long. Ventral podia with large perforated plates, 140–265 µm long, C-shaped rods, 55–65 µm long, reduced tables, 25–50 µm across, and rods, 230– 500 µm long, most of them with large central perforated process. At the base of the dorsal papillae, rosettes and C-shaped rods; at the top C-shaped rods, tables, rosettes, small rods, perforated plates and curved rods with central perforated process.

Processed appearance: Relatively elongate and squarish in cross-section, although may be curved dorsally. Processed colour tan to orangy brown, with light coloured spots of about 5 mm diam. Dorsal surface wrinkled and covered with small bumps, while the underside is smoother. No cuts or small cut across mouth. Common dried size probably 10 to 15 cm.



(After Massin *et al.*, 2002)

Remarks: In comparison with *Stichopus herrmanni*, Massin *et al.* (2002) noted that *S. ocellatus* has smaller C-shaped rod ossicles of the ventral body wall and larger (60–100 µm) perforated plates at the top of the dorsal papillae.

Size: Maximum fresh size at least 33 cm. Average fresh weight from 179 g (Viet Nam) to 1 310 g (Australia); average fresh length from 23 cm (Viet Nam) to 29 cm (Australia).

HABITAT AND BIOLOGY

S. ocellatus occurs mostly in seagrass beds on sandy or muddy-sand substrata on nearshore reef flats and sandflats, bivalve beds and mixed seagrass-algae beds. Massin *et al.* (2002) note that this species is often found associated with *S. herrmanni* in Malaysia and Papua New Guinea, so it may have some similar habitat preferences to that species. Its reproductive biology is unknown.

LIVE ©T. Skewes

PROCESSED ©L.B. Concepcion

EXPLOITATION

Fisheries: This species is primarily fished artisanally (e.g. Philippines, Malaysia, Viet Nam), but some collection at semi-industrial scales may occur in Australia. It is harvested by hookah divers (south Viet Nam, Australia) and by free diving and hand collecting (e.g. Philippines). In Australian waters, it is quite uncommon and collected only in minor quantities in Torres Strait and the Great Barrier Reef. Where it is exploited, this species is collected alongside other closely related species (*S. vastus* and *S. herrmanni*).

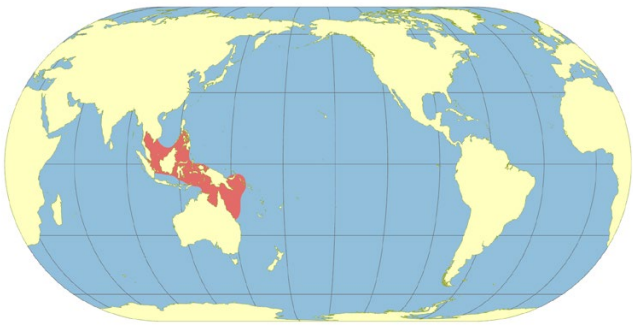
Regulations: In Australia, it is managed by means of permits (limited entry), no-take reserves, a combined global quota, and it is part of a rotational harvest strategy. In countries of Southeast Asia where it is fished, there are often no regulations on exploitation of this species.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Code: **JPT**. Main markets are China, Hong Kong SAR and China. Traded previously at USD 35–58 per kg dried in the Philippines. Sold wholesale prices in Guangzhou (2016) for USD 78 per kg dried.

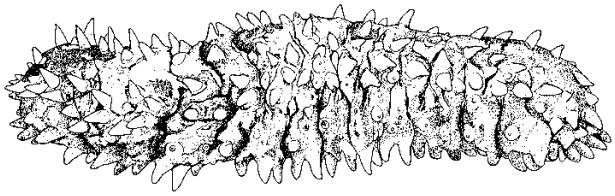
GEOGRAPHICAL DISTRIBUTION

Papua New Guinea, northern Great Barrier Reef and Torres Strait (Australia), Malaysia, Singapore, the Philippines, Viet Nam, and probably Indonesia.



COMMON NAMES

Tubercule sea cucumber (**FAO**), Teripang duri (Indonesia).



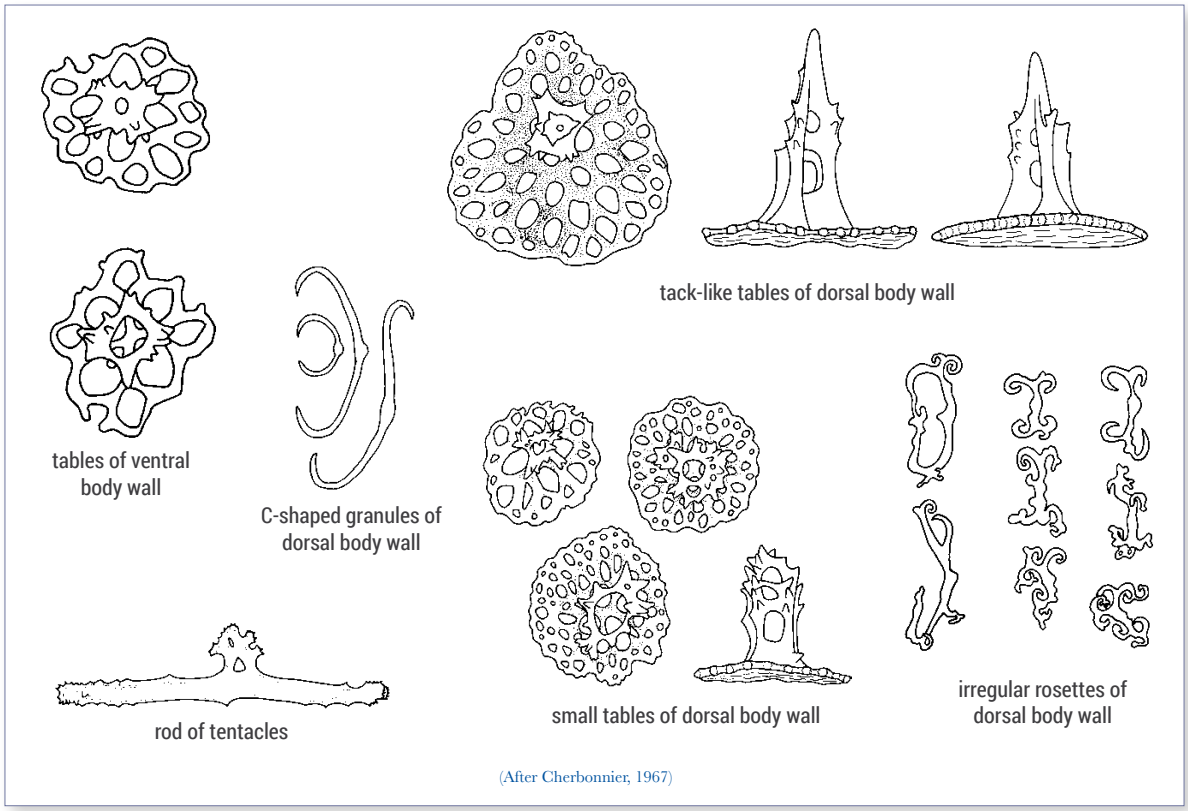
DIAGNOSTIC FEATURES

Stichopus pseudohorrens is a large species. Coloration is brownish-yellow to rosy red or brown with darker mottling. Body is arched dorsally and flattened ventrally, making it trapezoidal in cross-section. Very long, large conical papillae are present dorsally. Long papillae also occur along the lateral margins of the ventral surface. The mouth is ventral, with 20 long dark brown tentacles, and surrounded by large papillae. The anus is terminal.

Ossicles: Tentacles with spiny rods of various sizes, up to 875 µm long. Dorsal body wall with tables and C-shaped rods and rosettes. Tables comprise two types: (i) relatively few small ones, discs 50–90 µm across, perforated by 4 central and many peripheral holes, and (ii) very large tack-like ones, roughly 100 µm across, with the spire with spines. Ventral body wall with tables, C-shaped rods and rosettes: tables of one type only, disc 40–60 µm across, rim undulating, perforated by 4 central holes and few peripheral ones; spire ending in a spiny crown. Ventral podia and papillae with tables and huge rods, with a medial enlargement that can be perforated.

Processed appearance: Not available.

Remarks: Although this species has been recorded from New Caledonia by Féral and Cherbonnier (1986), those individuals differ from Cherbonnier's (1967) original description in several ways. Therefore, populations in the



Pacific may represent a different, undescribed species. For this reason, Purcell, Gossuin and Agudo (2009) referred to one individual found in New Caledonia as *Stichopus* sp. type *pseudohorrens*. The occurrence in the South China Sea needs to be validated with a voucher specimen and taxonomic description. Samyn (2003) pictures a fresh, non-preserved specimen from northern United Republic of Tanzania (Pemba Island) that possibly also is *S. pseudohorrens*.

LIVE ©D. VandenSpiegel

Size: Probably attains 50 cm and more than 3 or 4 kg in weight.

LIVE ©L. Clements

HABITAT AND BIOLOGY

In the Comoros, it inhabits over coral sand up to 20 m depth. Its reproductive biology is unknown.

EXPLOITATION

Fisheries: Populations in Southeast Asia and the Pacific may represent a different, as yet undescribed, species. It is probably fished artisanally and semi-industrially in localities in the western Indian Ocean.

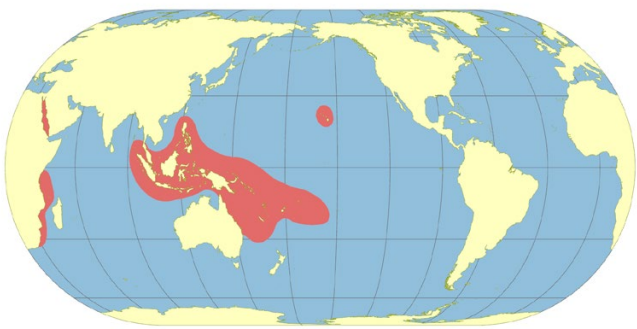
Regulations: None.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. It may be included in shipments of other species, such as *Thelenota ananas*.

Main market and value: Code: **JPU**. Sale prices were not obtained.

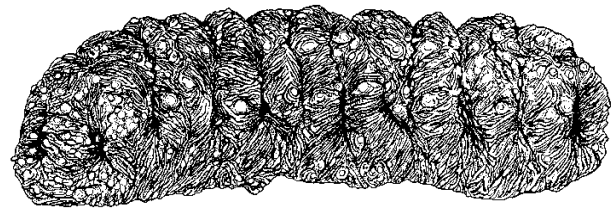
GEOGRAPHICAL DISTRIBUTION

The Comoros (off East Africa), United Republic of Tanzania, South Africa and the Red Sea. Reported and photographed from parts of Southeast Asia (including Philippines) and from western and central Pacific (including Australia down to Elizabeth and Middleton Reefs, New Caledonia, Cook Islands and Hawaii [United States of America]), and these records might represent a separate species.



COMMON NAMES

Curryfish (Australia), Zebrafish (India), Mul attai (India), Hanginan (Philippines), TKK, Gamet pace, Kacang goreng (Indonesia), Braon karifis (Vanuatu), Brown curryfish (Solomon Islands), Curryfish vastus (Torres Strait).



DIAGNOSTIC FEATURES

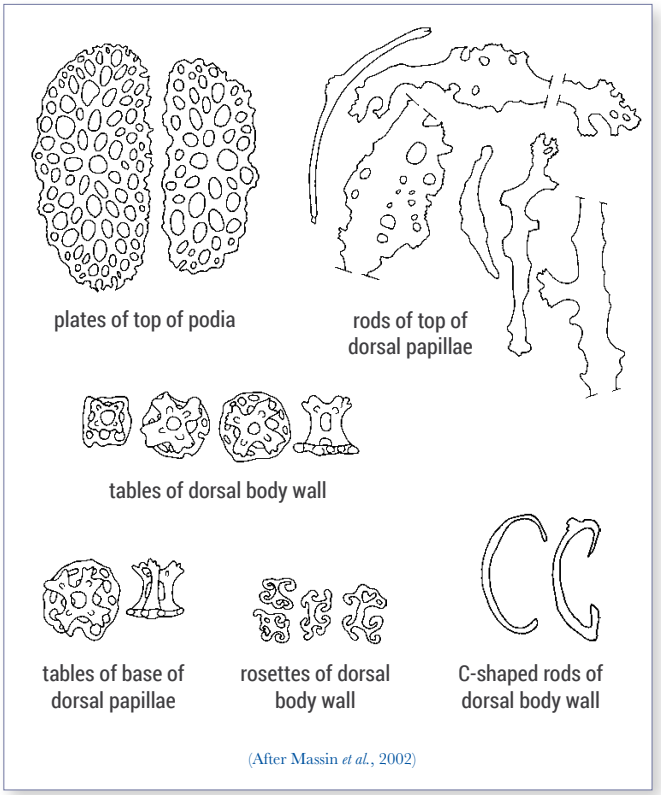
Coloration is variable from goldish-yellow, to brownish-yellow, or reddish or greyish-green. Fine, dark lines surround the base of wart-like papillae on the dorsal surface. The papillae are present in 5–6 rows on the upper dorsal surface and along the lateral margins of the ventral surface. Smaller bumpy papillae occur all over the dorsal surface. Deep transverse wrinkles may be present dorsally. Ventral surface is brown and the interambulacral areas are yellow-orange. The body is highly arched dorsally, flattened ventrally, and may be squarish in cross-section. Large podia are numerous on the ventral surface. The mouth is ventral with 18–20 tentacles, surrounded by a collar of papillae. The anus is terminal, without teeth.

Ossicles: Tentacles with curved rods with spiny extremities, 60–695 µm long. Dorsal and ventral body wall with tables, 25–40 µm across, rosettes, 15–40 µm long, and C-shaped rods, 40–95 µm long. Tables have round to quadrangular, smooth discs, perforated by 4 central and 4–10 peripheral holes; spire ends in a wide Maltese crown. Ventral podia with tables, 30–55 µm across, with reduced or no pillars and rods, 250–450 µm long, that can have a very large central perforated process. Top of dorsal papillae with large tables, 30–55 µm across, with quadrangular to ovoid disc, smooth, perforated by 4 central and 4–25 peripheral holes; spire ending in a narrow (½ to ⅓ of disc diameter) crown of spines.

Processed appearance: Light brown in colour and cylindrical in shape. Dorsal surface textured with short papillae evident. Dark lines should be visible on the dorsal surface.

Remarks: The body wall of the animals may disintegrate when handled and held out of water for a long time.

Size: Average fresh weight from 1 000 g (India) to 1 700 g (Australia); average fresh length from 33 cm (Australia) to 35 cm (India).



HABITAT AND BIOLOGY

This species is found on inshore reefs edges on sand, coral rubble or muddy sand in shallow waters, generally to about 8 m depth. On the Great Barrier Reef (Australia), it may be found on sandy or coral rubble substrates at the base of semi-sheltered reefs. Its reproductive biology is unknown.

EXPLOITATION

Fisheries: This species is exploited in artisanal (Federated States of Micronesia) and semi-industrial fisheries (Australia). On the Great Barrier Reef (Australia), it is less common than *Stichopus herrmanni* and is occasionally collected by divers using hookah. In the western central Pacific, it is commercially harvested in Palau, Micronesia (Federated States of) and Torres Strait (Australia). This species was harvested in Papua New Guinea, Solomon Islands and parts of Vanuatu prior to national moratoria. The subsistence fishery in Palau targets the gonads and/or intestines. It is believed to be heavily exploited in Indonesia. This species is probably collected and processed alongside *S. herrmanni* in places where it is fished.

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PROCESSED ©S.W. Purcell

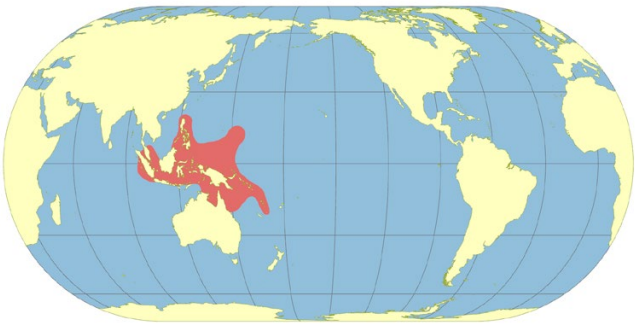
Regulations: In Australia, exploitation of this species is regulated by fishing permits (limited entry), no-take reserves, a combined TAC, and is subject to a rotational harvest strategy on the Great Barrier Reef fishery. Minimum size limits in both Solomon Islands and Vanuatu are 20 cm wet and 10 cm dried. The minimum wet size in Torres Strait is 15 cm.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Code: **JPW**. Main markets are China, Hong Kong SAR and China. Previously traded at USD 35–58 per kg dried in the Philippines. Sold by fishers in Torres Strait, Australia (2022), for USD 100 per kg dried. Found for sale in China Hong Kong SAR in 2022 for USD 358 per kg dried.

GEOGRAPHICAL DISTRIBUTION

Indonesia, Philippines, Papua New Guinea, Palau Islands, Yap (Federated States of Micronesia) and northeastern Australia. Although also reported from Uri Island (Vanuatu), it does not appear to occur in New Caledonia.



COMMON NAMES

Prickly redfish (**FAO**), Hải sâm lựu, Đồn đột lựu, Ñoät ñieàu (Viet Nam), Zanga borosy, Rasta (Madagascar), Barbara (Mauritius), Ananas attai (India), Subinho (Mozambique), Tinikan, Talipan, Taripan, Pinya-pinya (Philippines), Abu mud (Eritrea), Pandan, Plum flower trepang, Nanas (Indonesia), Spinyo mama (United Republic of Tanzania), Baba (United Republic of Tanzania, Zanzibar), Teburere (Kiribati), Pulukalia (Tonga), Sucudrau (Fiji), Annasi attaya (Sri Lanka), Sanpye (Seychelles), Pineapplefish (Solomon Islands), Paenapolfis (Vanuatu).

DIAGNOSTIC FEATURES

Colour variable dorsally from reddish-orange to brown or burgundy. Dorsal surface is covered in large papillae, which may be conical, star-shaped or somewhat branched. Ventral surface is light pink, with brown to pink podia. Body is firm and arched dorsally and flattened ventrally. Body wall is thick. Mouth ventral with 20 large, brown tentacles. Anus is terminal, and often hidden by large papillae. Cuvierian tubules are absent.

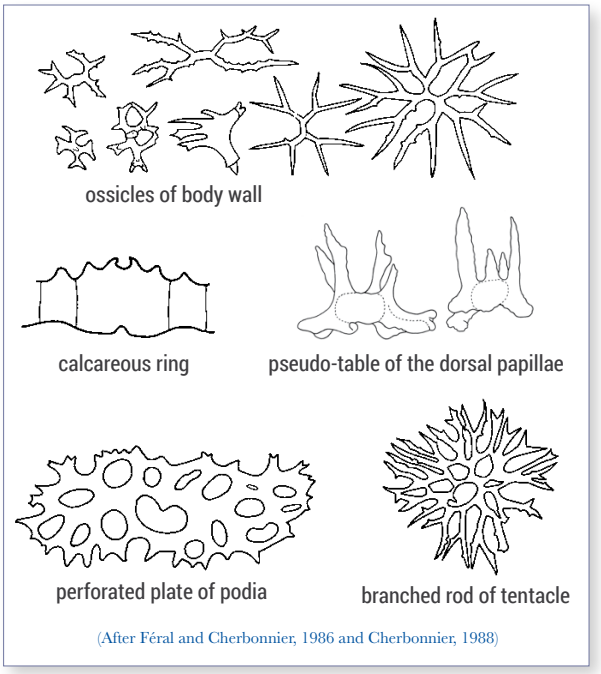
Ossicles: Tentacles with large plates, 135 µm long and 95 µm wide, and some smaller rods. Dorsal body wall with slightly spiny branched rods, 40–80 µm long, and countless miliary granules, 1.5–4 µm long. Ventral body wall with similar, though smooth, rods. Ventral podia with large plates, 75–135 µm long, and rods similar to those of the body wall. Dorsal papillae with branched rods slightly curved, spiny rods, up to 155 µm long, and pseudo-tables with their base consisting of divergent extensions that are pointed upwards.

Processed appearance: Relatively elongate and brown to black in colour. The dorsal surface is covered with brown to black-brown spiky papillae, often in a star shape. The ventral surface is granular and lighter brown. One long cut along the ventral surface. Common processed size 20–25 cm.

Size: Maximum live length 80 cm; average length about 45 cm. Average fresh weight: 1 000 g (Mauritius), 2 000 g (Réunion), 2 500 g (Papua New Guinea), 2 600 g (New Caledonia), 3 000 g (India); average fresh length: 34 cm (New Caledonia), 35 cm (Mauritius), 45 cm (India, Papua New Guinea), 45 cm (Réunion).

HABITAT AND BIOLOGY

It prefers reef slopes and passes, hard bottoms with large coral rubble and coral patches in waters between 1 and 25 m. Reported to 70 m depth. It attains size-at-maturity at 1 200 g and reproduces during the summer. In Guam, it reproduces almost all year long, with the exception of March, September and October; and in New Caledonia, it has an annual reproductive cycle from January to March. It has a late sexual maturity.



(After Féral and Cherbonnier, 1986 and Cherbonnier, 1988)

EXPLOITATION

LIVE ©S.W. Purcell

PROCESSED ©J. Akamine

Fisheries: Exploited in artisanal (e.g. Mozambique, Tonga), semi-industrial (e.g. Viet Nam) and industrial fisheries (e.g. Australia). Exploited in all fisheries throughout its Indo-Pacific distribution, and is a valuable species. In Viet Nam and Australia, it is harvested by hand by divers using hookah. It has been heavily exploited in Papua New Guinea, Solomon Islands and Vanuatu. It is harvested in subsistence fisheries in Samoa and Cook Islands. In Asia, it is exploited in China, Japan, Malaysia, Thailand, Indonesia, Philippines and Viet Nam. It is fished in Madagascar, Kenya, Maldives, Eritrea and Seychelles. Juveniles are sometimes collected for the aquarium trade.

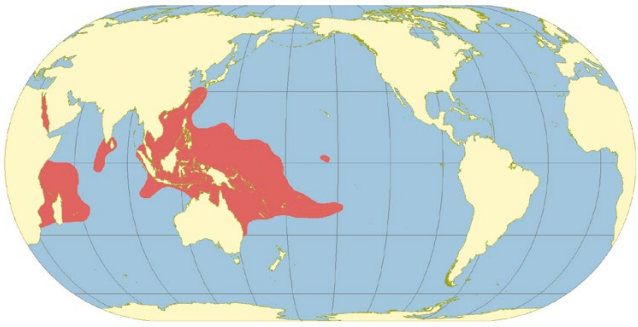
Regulations: Minimum size limits are: 25 cm wet and 10 cm dried in Papua New Guinea; 35 cm wet and 17 cm dried in Vanuatu; 35 cm wet and 15 cm dried in Solomon Islands. In New Caledonia, the legal minimum length is 45 cm live and 14 cm dry; collection using compressed air diving is prohibited. The minimum legal length in Northern Territory and Western Australia is 30 cm live, whereas it is 50 cm live on the Great Barrier Reef and 35 cm wet in Torres Strait. On the Great Barrier Reef, there is a TAC, limited entry and permits, and this species is subject to a rotational harvest strategy.

Human consumption: The reconstituted body wall (bêche-de-mer) is consumed by Asians. In some localities in the Pacific, the body wall and/or organs are consumed in traditional diets.

Main market and value: Code: **TFQ**. Main markets are China, Singapore, China, Hong Kong SAR, Ho Chi Minh City (Viet Nam) for re-export to Chinese markets. Exported at about USD 50 per kg dried in Viet Nam. Traded previously at USD 35–63 per kg dried in the Philippines. Previously sold at USD 12–17 per kg (dried) in Papua New Guinea. In New Caledonia (2007), it was exported for USD 40–50 per kg dried. In Fiji (2014), fishers received USD 11–18 per piece fresh. Sold by fishers in Torres Strait (2022) for USD 40–56 per kg gutted wet. Prices in Guangzhou wholesale markets (2016) averaged USD 107 per kg dried; max. USD 219 per kg.

GEOGRAPHICAL DISTRIBUTION

Red Sea, Mascarene Islands, Maldives, Southeast Asia, north Australia, Philippines, Indonesia, China and southern Japan, and islands of the central western Pacific as far east as French Polynesia.

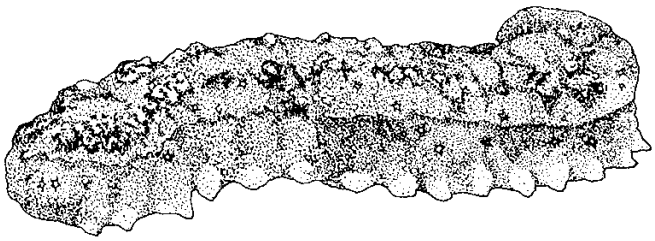


OTHER USEFUL INFORMATION

This species is widely reported as overexploited in many localities and listed as Endangered on the IUCN Red List and will be listed on CITES Appendix II in 2024 (declared 2022).

COMMON NAMES

Amberfish (**FAO**), Legs (Philippines), Le géant (New Caledonia), Saieniti (Tonga), Drivolavola (Fiji), Teaintoa (Kiribati), Poona attaya (Sri Lanka), Donga, Duyung, Babi (Indonesia), Ambafis (Vanuatu).



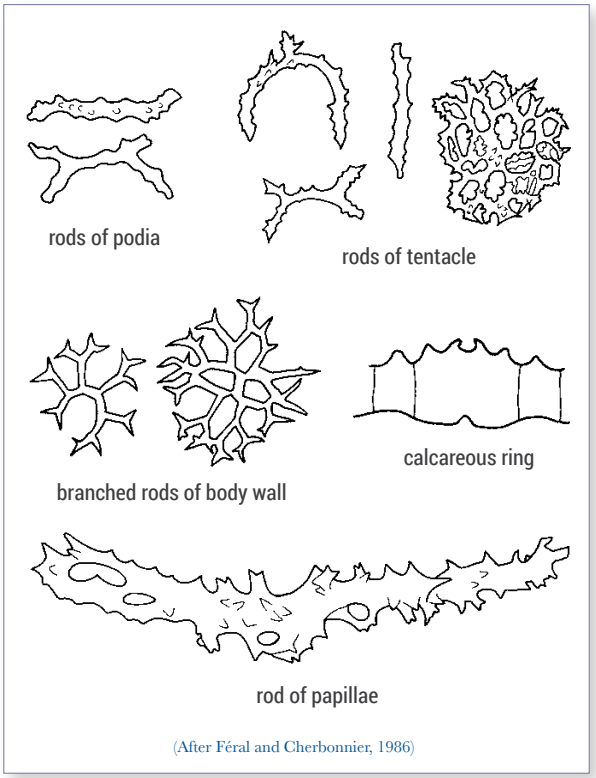
DIAGNOSTIC FEATURES

Thelenota anax is a very large species. Colour varies from creamy white beige to grey or light brown with dark brown and/or reddish spots and blotches dorsally. Those in the Indian Ocean may lack the reddish blotches. Numerous, light coloured, wart-like bumps occur mostly in rows along either side of the dorsal surface. Large, white papillae are located along the ventro-lateral margins. It has a thick body wall. Body is rather quadrangular in cross-section. The flat ventral surface is densely covered with fine, long podia. The mouth is ventral with 18–20 peltate tentacles. The anus is terminal to subdorsal. Cuvierian tubules are absent.

Ossicles: Tentacles with nodulous and branched rods, and perforated plates, 80–100 µm long. Ventral and dorsal body wall with dichotomously branched rods, 70–100 µm long, pseudo-tables and an infinite number of miliary granules only a few µm across. Ventral podia with rods of various form; straight to arms inter-joining as well as turrets. Ossicles of dorsal papillae are long rods, which can be branched and perforated; or more plate-like deposits. Pseudo-tables, as occur in *T. ananas*, are always absent in the papillae.

Processed appearance: Relatively elongate with a squarish cross-section. Body may be various shades of brown. Dorsal surface is rough and covered with wart-like bumps. The ventral surface is grainy. A small cut across mouth or a single cut ventrally. Common processed size is 15–20 cm.

Size: Maximum length: 89 cm; average length: 63 cm. In Papua New Guinea, average fresh weight was about 3 500, and average fresh length 35 cm. At Lizard Island, Great Barrier Reef (Australia), average length about 51 cm and average drained weight about 3 340 g. Average length of 55 cm and an average weight of 4 370 g from New Caledonia.



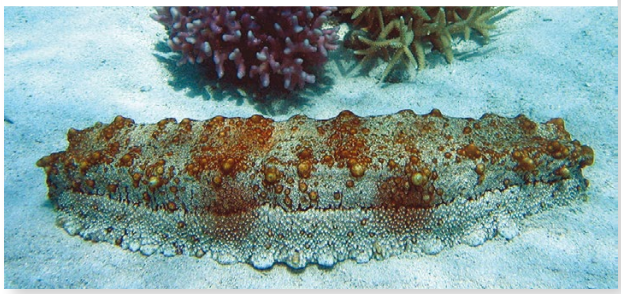
HABITAT AND BIOLOGY

It primarily inhabits reef slopes and outer lagoons on sandy bottoms between 10 and 30 m. It may be found less commonly in shallower waters to about 4–5 m depth, and on hard bottoms or on coral rubble. Generally found at low density, the populations are usually sparse. Its reproductive biology is unknown.

EXPLOITATION

Fisheries: This species is mainly exploited artisanally. In many fisheries in the western central

Pacific, Southeast Asia and the Indian Ocean, it is collected by hand by breath-hold divers or divers using compressed air (SCUBA or hookah). In Papua New Guinea, it has been collected by free divers using lead-bombs. In the Philippines, it is harvested by divers using hookah and SCUBA. Harvested extensively in Northwest Sri Lanka (2015–2019) by SCUBA divers.



LIVE ©S.W. Purcell

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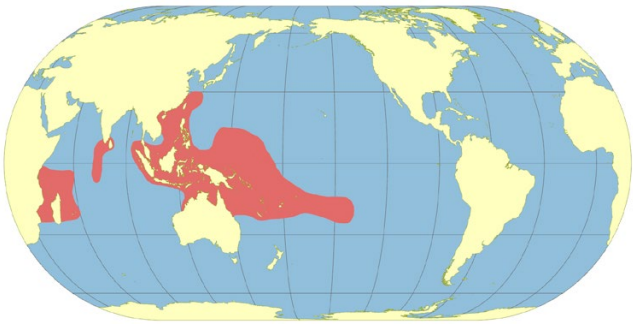
Regulations: Minimum size limits are: 20 cm wet and 10 cm dried in Papua New Guinea; 40 cm wet and 15 cm dried in Vanuatu and Solomon Islands and Vanuatu; 55 cm wet and 24 cm dried in New Caledonia. On the Great Barrier Reef (Australia), there is a minimum legal length of 50 cm live, limited entry of fishers, who are licensed, a combined TAC (with other species), no-take marine reserves, and this species is subject to a rotational harvest strategy.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

Main market and value: Code: **HLX**. Primarily sold in China, Hong Kong SAR and other import hubs of Southeast Asia. It has been sold at about USD 3–4 per kg dried in some localities, but probably at much higher prices in others. Sold by fishers in Sri Lanka (2015–2017) for USD 1.80 per individual (fresh). It has been traded at about USD 13 per kg dried in the Philippines. Prices in Guangzhou wholesale markets (2016) averaged USD 31per kg dried.

GEOGRAPHICAL DISTRIBUTION

Tropical Indo-West Pacific. In the Indian Ocean, this species is known from East Africa, the Comoros and Glorioso Islands. It is present in much of Southeast Asia, including Indonesia, Philippines and the South China Sea. In the tropical Pacific, from northwestern Australia to Enewetok, Guam, and the Ryukyu Islands (Japan) southwards to most of the islands of the western central Pacific and as far east as French Polynesia.

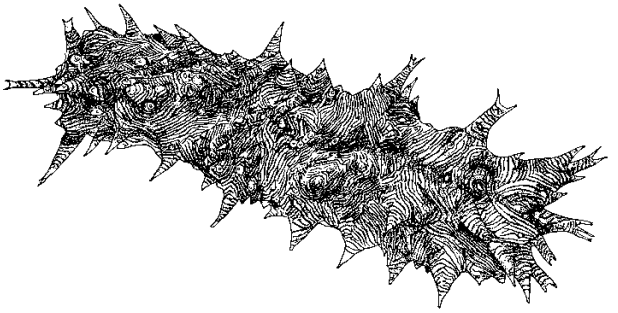


OTHER USEFUL INFORMATION

This species will be listed on CITES Appendix II in 2024 (declared 2022).

COMMON NAMES

Red-lined sea cucumber, Lemonfish (Solomon Islands) (**FAO**), Bati (Indonesia), Candy cane fish, Candy cane sea cucumber (Philippines).



DIAGNOSTIC FEATURES

This species is whitish coloured with a striking and complex pattern of crimson lines, which form a maze-like arrangement. The crimson lines are less abundant and more irregular ventrally. The dorsal surface has two rows of 13–15 large, conical, fleshy protuberances with pointed papillae at the ends, with yellowish brown tips. The body is roughly square or trapezoid in transverse section. The posterior part of the body tapers slightly. The ventral surface is flattened and has numerous greenish-yellow or brownish-yellow podia scattered randomly. The mouth is ventral with 20 dull-red tentacles. The anus is terminal.

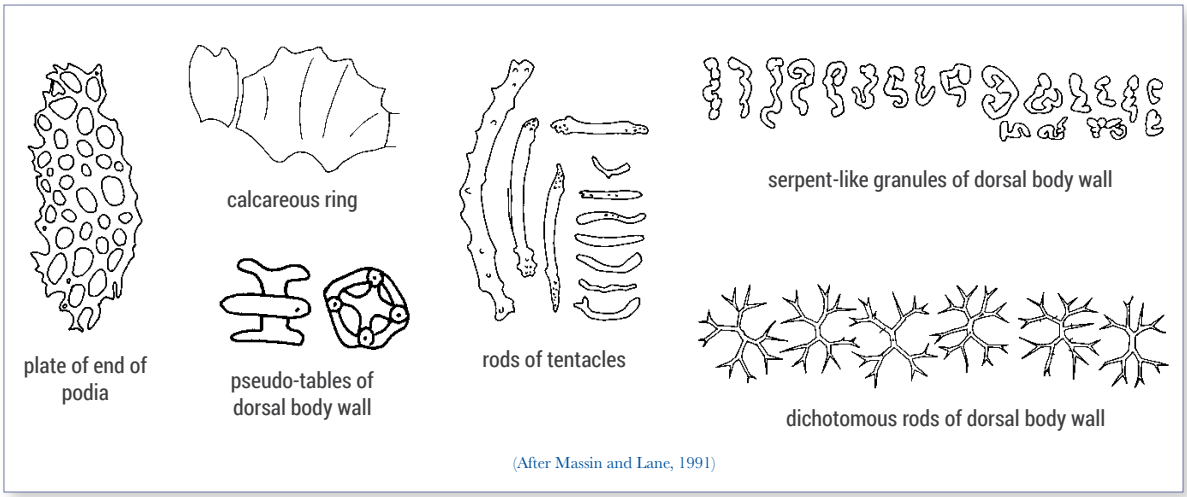
Ossicles: Tentacles with only rods, which are spiny or smooth, straight or curved, 10–150 µm long. Dorsal body wall with numerous miliary granules, slender dichotomously branched rods, 90–135 µm long, that are spiny, with primary, secondary, tertiary and sometimes quaternary branches, and pseudo-tables, 20–25 µm across with 4–5 short feet which are prolonged by 4–5 long spines. Ventral body wall with dichotomous rods, pseudo-tables and serpent-like granules. Ventral podia with rods, a few pseudo-tables and anastomosing plates forming the end-plate. Dorsal papillae with mostly serpent-like granules, 5–20 µm long, and a few dichotomous rods.

Processed appearance: Poorly known. From few samples: coloration is brown, body is relatively elongate with the characteristic large, pointed protuberances retained on the dorsal surface.

Size: Maximum weight about 3 kg. Average length is 30–50 cm.

HABITAT AND BIOLOGY

Found on reef slopes and spur zones. Its reproductive biology is unknown.



(After Massin and Lane, 1991)

EXPLOITATION

Fisheries: In the western central Pacific it was commercially harvested in Papua New Guinea and Solomon Islands prior to moratoria.

Regulations: It seems there are few regulations for the exploitation of this species within its distributional range. In Solomon Islands, there is a minimum size limit of 30 cm wet and 15 cm dried.

Human consumption: In the Philippines, it is consumed by Muslims during the Ramadan season.

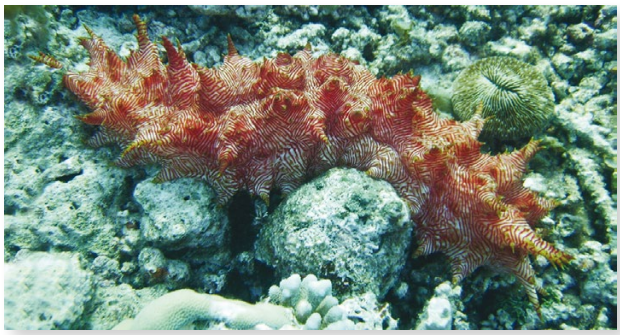
Main market and value: Code: **JDZ**. *Thelenota rubralineata* has a moderately low value by weight. It has been traded at about USD 13 per kg dried in the Philippines.

GEOGRAPHICAL DISTRIBUTION

This species has been found in the "Coral Triangle" and extends into the Pacific Ocean. In Southeast Asia it has been recorded from Indonesia, the Philippines, East Malaysia, islands of the South China Sea; and from the Pacific region, Guam, Solomon Islands, Papua New Guinea, and it has been sighted (but rarely) in New Caledonia, French Polynesia (Tenarunga and Matureivavao atolls) and possibly Fiji.

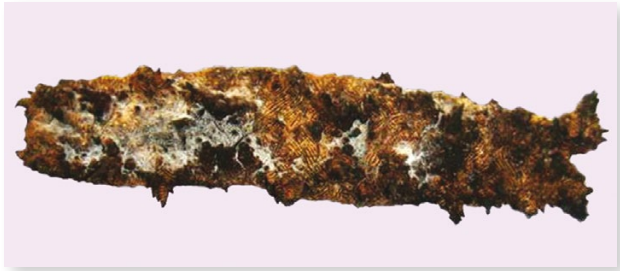
OTHER USEFUL INFORMATION

This species will be listed on CITES Appendix II in 2024 (declared 2022).



LIVE ©K. Friedman

LIVE ©A. Ryanskiy



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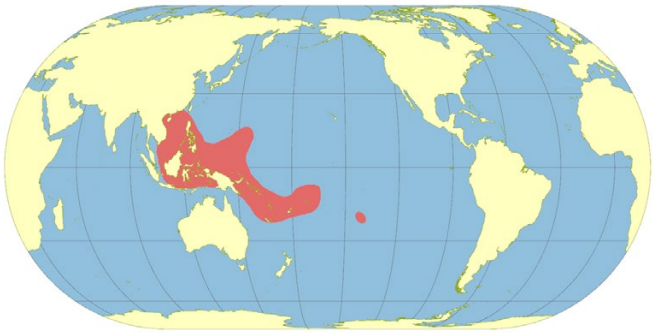
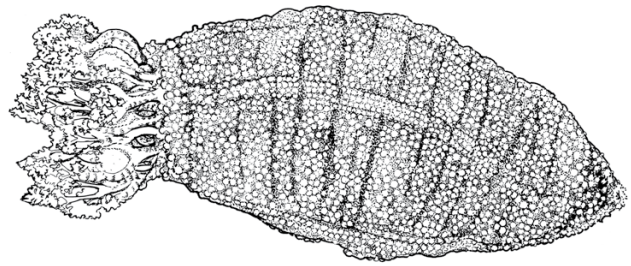


Dendrochirotida: Cucumariidae

COMMON NAMES

Sea cucumber (United States of America), Pepino de mar, Pepino arenero, Ancoco (Mexico and Peru), Meón, Ancoco blanco, Pepino excavante velludo (Chile).



DIAGNOSTIC FEATURES

Body is brown to greyish-brown or light grey. Juveniles can be greenish. The body of this species is cylindrical and tapers gently at both ends. Podia are found in longitudinal rows along the body wall. The mouth is terminal with five pairs of greenish-black, branched dendritic tentacles arranged in two circles: five large external pairs, and five small inner pairs.

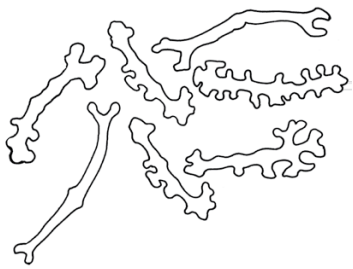
Ossicles: Tentacles of juveniles with rods. Dorsal and ventral body wall with few spiny, perforated rods that are somewhat enlarged at the extremities. Ventral podia only have an end-plate. Except for the presence of some rods and a few rosettes on the tentacles, the ossicles are so rare that they are often difficult to find.

Processed appearance: Dark brown to near black in colour. Processed body shape is similar to the description of the live animal: cylindrical and tapers gently at both ends. Body surface somewhat rough. Common dried size 7–10 cm.

Size: Average fresh weight: 200–250 g; average fresh length: 25–30 cm.

HABITAT AND BIOLOGY

This species lives partially, or fully, buried in the intertidal zone to 7 m depth, or in areas with rocks with great quantity of organic matter. It feeds on microalgae and detritus. It is possible to find some invertebrates in its digestive tract. It has a continuous reproductive period. In Peru, *Athyonidium chilensis* spawning starts in spring and lasts for four to six months.



rods of body wall

rosette of body wall

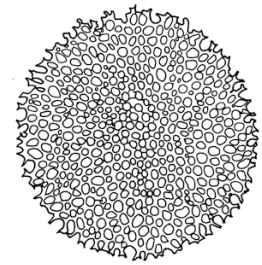


plate of body wall

(Source: photos by L. Amaro-Rojas)

EXPLOITATION

Fisheries: This species is harvested artisanally by hookah diving and hand collecting. It is commercially exploited in Peru and Chile. Historical information states that it was traditionally eaten in the Department of Lambayeque (Peru).

Regulations: None.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians.

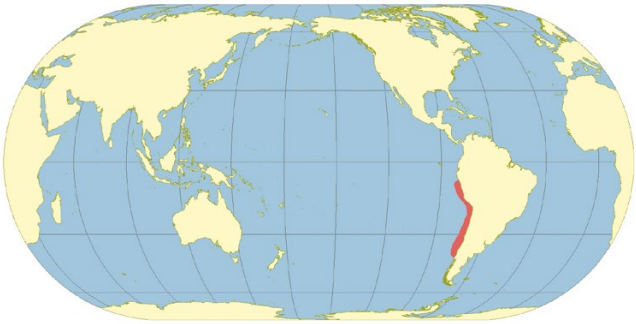
Main market and value: Code: **KZA**. The United States of America, China, Mexico, Taiwan Province of China. It is sold at USD 10 per kg dried.

GEOGRAPHICAL DISTRIBUTION

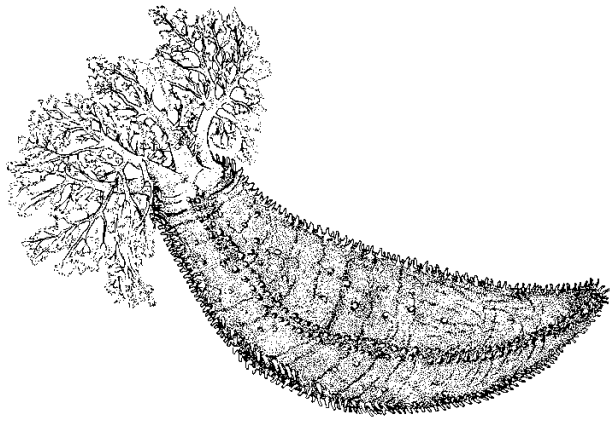
From Ancon (Peru) 12º 02.3'S; 75º 19.4'W) to Chiloé (Chile) (42º 48'S; 74º 21'W).

LIVE ©C. Merino

PROCESSED ©C. Guisado



Cucumaria frondosa (Gunnerus, 1767)



COMMON NAMES

Orange-footed sea cucumber, Northern sea cucumber, Phenix sea cucumber (Canada), Atlantic sea cucumber (United States of America, Russian Federation), Brimbútur (Iceland).

DIAGNOSTIC FEATURES

Body is mostly dark brown, grey-brown or purplish-brown; occasionally much lighter in colour, such as light orange or cream. Coloration tends to become paler/creamy coloured near the mouth and tentacles. The ventral surface is lighter in colour. Body is cylindrical, relatively stout and barrel-shaped, and tapering at both ends. Podia are located primarily in five rows on the body. The body contracts to become almost spherical when the animal is handled. The mouth is terminal, with 10 dendritic tentacles, up to 10 cm in length, which the animal extends for suspension feeding. The anus is terminal.

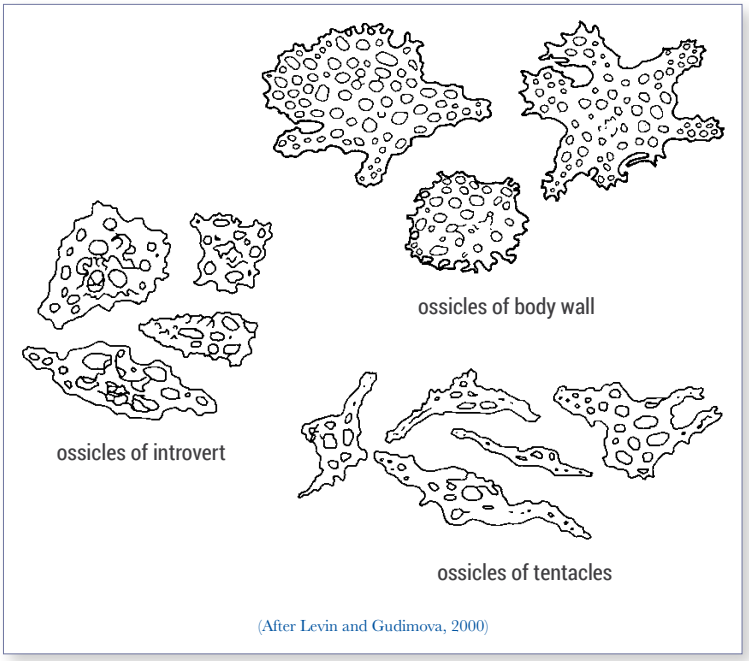
Ossicles: Tentacles with rods or plates, 120–350 µm long. The ossicles of the body wall are perforated plates of different sizes, 200–250 µm long, triangular, quadrangular or subcircular with ragged edge; the surface of the plates is either smooth or with projections. The body wall around the anus holds larger, more spiny plates that can have a secondary spiny layer, 200–400 µm long. Ventral podia with straight, or slightly curved perforated rods, 250–300 µm long, that can be smooth or nodulous.

Processed appearance: Dark brown. The body has a slightly grainy surface with visible rows of podia, which are often more defined in the underside. Common dried size 8–9 cm.

Size: Maximum body weight: 1 000 g. Average fresh weight: 500 g (Barents Sea and United States of America), 850 g (Canada); average fresh length: 25–30 cm.

HABITAT AND BIOLOGY

Coastal, offshore in the Barents Sea; coastal in Maine (United States of America). It can be found on rocky or pebbly substratum and gravel bottoms from low tide mark down to about 500 m. This species lives solely on the surface of the sea floor, mostly comprised of gravel, pebbles and (mostly) rocky substrata. This species has an annual reproductive cycle with a generally highly synchronized gamete release, between the months of February and June depending on the region. It reaches size-at-maturity



(After Levin and Gudimova, 2000)

at 50 g, in the Barents Sea (Russian Federation) and at 9–12 cm in Canada.

EXPLOITATION

Fisheries: Exploitation is industrial in Canada and semi-industrial in the Barents Sea. It is harvested by trawling (Canada) and dredging (Barents Sea and Maine). In Maine, catches increased in the 1990s then declined since 2007. In southern Newfoundland (Canada), catches have increased and were 5 550 tonnes (wet) in 2018. Harvested also in Nova Scotia and Quebec. In Iceland, 5 564 tonnes (wet) were caught in 2019. Harvested in Russia Federation, where catches are a couple of hundred tonnes annually, but data are scarce.

LIVE ©V. Maran

PROCESSED ©S.W. Purcell

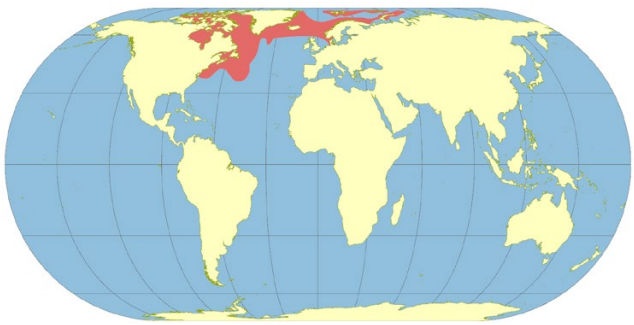
Regulations: In Canada, the mesh size of bottom trawl gear is regulated, limiting the catch of small individuals. On the St. Pierre Bank, Newfoundland, fishing is allowed from June to December and vessels have individual quotas and are only allowed one bottom trawl ("sea cucumber drag"). Some fisheries in Canada regulate the depth of fishing. Fishing in Maine is permitted from October through to June. In both Canada and Maine, there are limited-entry rules and mandated logbooks. In Iceland, a TAC quota is applied.

Human consumption: Consumed by Inuit communities in the Canadian Actic. Exported to Asian markets as bêche-de-mer and as frozen (undried) product. Muscle bands and the aquapharyngeal bulb (called "flower") may be removed from the animals and also exported to Asian markets. This species is used commercially for the preparation of traditional medicinal products and as extracts for pharmaceutical and nutraceutical products.

Main market and value: Code: KHG. The main market is China. In Canada, it is exported, and the fishers in 2021 received USD 0.32 per kg (fresh). Sold online in China (2022) for USD 150 per kg.

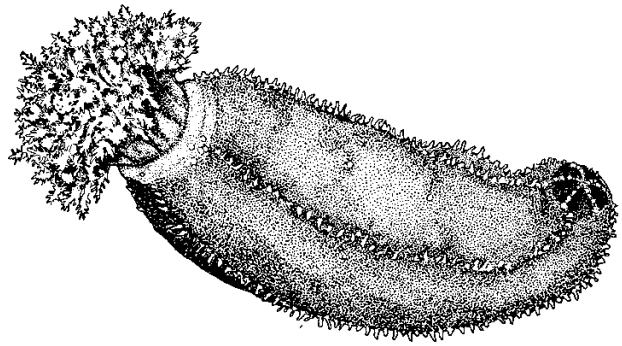
GEOGRAPHICAL DISTRIBUTION

North Atlantic, from the Arctic to Cape Cod, and in the northern latitudes of the United Kingdom of Great Britain and Northern Ireland (Scotland and Orkney Islands). It is found in Iceland, in the Barents Sea along the coast of the Russian Federation, Scandinavia, and along the coast of Greenland (Gianasi *et al.*, 2021).



COMMON NAMES

Japanese cucumaria, Black sea cucumber (Canada), Kinko (Japan).



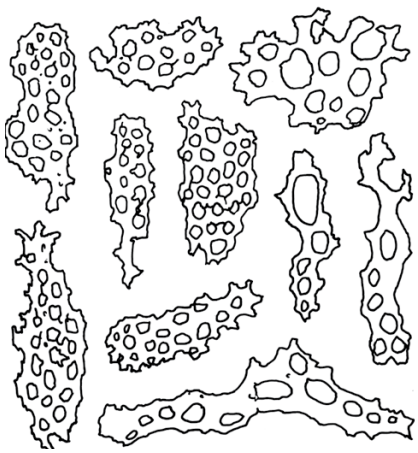
DIAGNOSTIC FEATURES

Body colour is brown to brownish-purple or greyish-purple, greyish or yellowish, and in some regions the animals can be white. The ventral surface is distinctly lighter in colour than the dorsal surface. Podia and small papillae occur on the body in five, thin, longitudinal rows, and may be yellowish in colour. Podia on the dorsal surface are less developed than those ventrally. Body is cylindrical, relatively stout and barrel-shaped, curved dorsally, and tapering gently at both ends. The body contracts to become almost spherical when the animal is handled. The mouth is terminal, with 5 pairs of dendritic tentacles, which may be reddish with whitish tips. The anus is terminal.

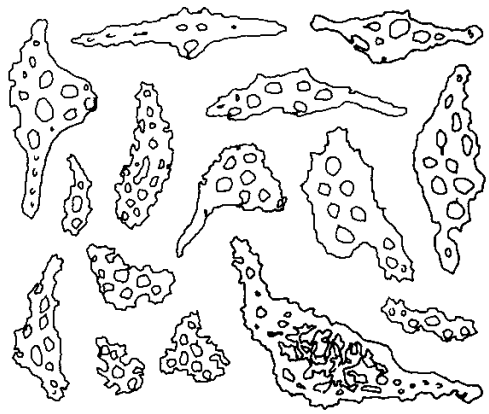
Ossicles: Similar in size and shape to *Cucumaria frondosa*, i.e. with irregular perforated plates with spiny margins in the body wall and tentacles, some bearing knobs or short spines on their surface. However, unlike *C. frondosa*, according to Semper, *C. japonica* also has large discoid ossicles positioned radially near the opening of the cloaca.

Processed appearance: Body is dark tan to brown in colour, with lighter dots occuring in five rows along the body. The mouth may be absent from dried specimens. The body is stout and tapers thin at the anus.

Remarks: Can be mistaken for *C. frondosa* and some authors consider *C. japonica* to be a subspecies of *C. frondosa*. However, Levin and Gudimova (2000) argued that these are two distinct species, since there are differences in the form of body parts, reproductive cells and body chemicals of the two species. Therefore, these are presented as two species in this book.



ossicles of body wall



ossicles of tentacles

(After Levin and Gudimova, 2000)

Size: Maximum weight 1.5–2 kg; maximum length: 40 cm. Average fresh weight 500 g; average fresh length: 20 cm.

HABITAT AND BIOLOGY

This species inhabits from the intertidal zone to about 300 m depth with highest density between 30 and 60 m. Adults found on various substrates (gravel, shell debris, rock and mud), while juveniles are believed to occur more in kelp forests. It reproduces bi-annually in April–June and September–October.

LIVE ©N. Sanamyan

PROCESSED ©J. Akamine

EXPLOITATION

Fisheries: This species is exploited in industrial and semi-industrial fisheries. It is commercially harvested by trawling in Japan along the coast of the Sea of Japan and north of Ibaraki Prefecture to Hokkaido. It is also fished along the Pacific coast of the Russian Federation, although the fishery information is unclear.

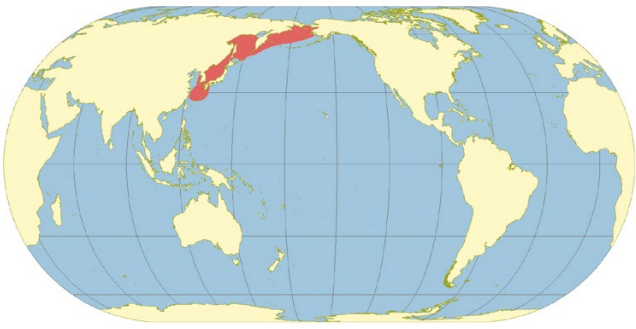
Regulations: Exploitation is managed by a seasonal fishing closure, no-take marine reserves and gear limitations.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians, or the undried body wall is sold frozen.

Main market and value: Code: KHE. Republic of Korea and China are the main markets. Local trade price in Japan is around USD 9.40 per kg fresh.

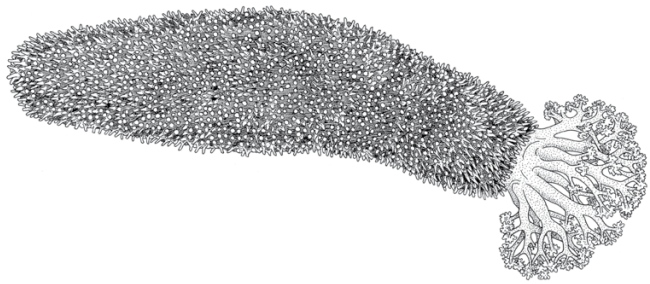
GEOGRAPHICAL DISTRIBUTION

It inhabits the northeastern region of the Yellow Sea, the northeastern coast of the Honshu Island, the coast of the Russian Federation in the Sea of Japan, the Sea of Okhotsk, the Kuril Islands (Japan), the Kamchatka Peninsula and the Bering Sea. However, it is argued that *C. okhotensis* is indeed present in the Kamchatka and Kuril Islands areas instead of *C. japonica*.



COMMON NAMES

Ancoco, Ancoco negro (Peru), Black sea cucumber (China and Japan).



DIAGNOSTIC FEATURES

Body is cylindrical and relatively elongated. Body colour varies from green olive, reddish purple, or bright purple to dull black. Large animals (20 cm long, or more) have up to 20 large tentacles of similar size and, in some individuals, the tentacles appear to be arranged in two concentric circles of five pairs each. Tentacles are always the same colour as the body wall, but paler. Body wall is thick and podia are numerous. Mouth and anus terminal. The calcareous ring (internal) has five tall rectangular radials, with rounded corners at the posterior end; interradial pieces have a broad and low basal part, and a long anterior tooth often hidden in thick tissue.

Ossicles: There are no ossicles in the body wall. Tentacles with a small number of small branching rods, 40–50 µm in length and endplates are about 60–70 µm in diameter. Podia have large terminal plates.

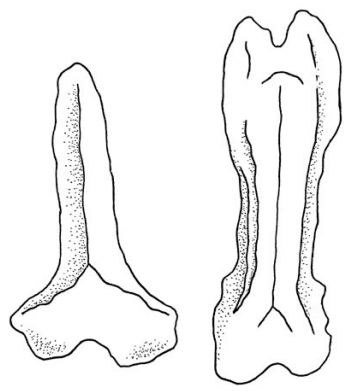
Processed appearance: Cylindrical shape with blunt ends. Very hard when processed. Intense black or purple colour. Skin thin but rough, there are small but dense bumps, corresponding to the podia, over the body. Normally the tentacles are removed from the animal when processed. Product can be up to 14 cm long.

Remarks: *P. mollis* has been mistaken for some other species such as *Athyonidium chilensis* and *Euthyonidium ovulum*. Probably due to the absence of ossicles in its body wall, information on this species in the taxonomic literature has been terribly confused.

Size: Average live length 15–20 cm; maximum, 20 cm. Average adult fresh weight roughly 250 g.

HABITAT AND BIOLOGY

Found in shallow waters, mostly in rocky bottoms. Lives hidden, under rocks, and sometimes seen completely exposed for short periods yet clinging rocks. Occurs in waters 0–8 m deep. Population densities in Peru ranged 13–66 ind. per m^2. Often associated with cold coastal habitats where average sea surface temperature is in the range of 14–16 °C. Reproduction appears to occur in September, October, and June.



calcareus ring pieces

(Source: photos by F.A. Solís-Marín)

EXPLOITATION

Exploitation rates in Peru have been decreasing. Annual catches in the region declined by 92 percent from 2008 to 2017 and averaged 61 to 715 tonnes per year, with a sharp decline in catches between 2015 and 2017.

Fisheries: Reported to be fished in Chile and central to southern Peru. Harvested in artisanal fisheries by hand collecting, free diving or using hookah diving gear. The main regions where it has been fished in Peru are around the ports of Chimbote, Casma, and Culebras. This species is considered of high commercial value in China.

Regulations: No normative regulations for exploitation of this species exist, neither in Chile nor Peru. Management authorities have applied a "precautionary approach" to harvests. The stocks have been subject to intense fishing in the intertidal and shallow subtidal zones on the Peruvian coast. Biological and demographic data for planning regulations are lacking.

Human consumption: Mostly, the reconstituted body wall (bêche-de-mer) is consumed by Asians. No domestic consumption is reported.

Main market and value: Retail market value can vary from USD 300 to 500 per kg (dried). The main markets are China, Republic of Korea and Japan. This species can also be traded frozen.

LIVE ©Y. Hooker

PROCESSED ©F.A. Solís-Marín

GEOGRAPHICAL DISTRIBUTION

Peru and northern Chile.

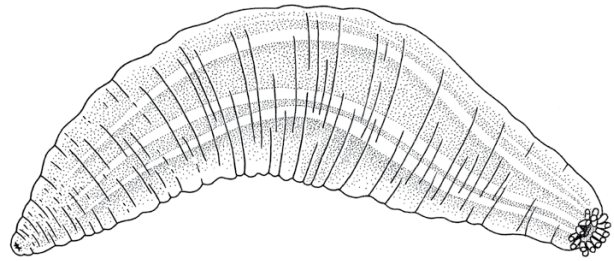
OTHER USEFUL INFORMATION

As this species has few ossicles, it is convenient to use the calcareous ring for taxonomic identification. Research demonstrated that polysaccharides of the body wall have anti-inflammatory effects.

Molpadida: Caudinidae

COMMON NAMES

Sea potato, Uru attaya (Sri Lanka), Beronok (Malaysia).



DIAGNOSTIC FEATURES

Body colour ranges from brownish to grey-brown or pinkish-brown, and reported to fade to transleucent light brown after exposure to air. Body can be covered by mustard-coloured dots on the body wall. Stout body, tapering especially at the posterior end (a characteristic feature), and smooth to the touch. There are no true podia (tube feet). The anus is surrounded by five sets of papillae. There are 15 short digitate tentacles, each possessing a pair of lateral digits and lacking a terminal digit.

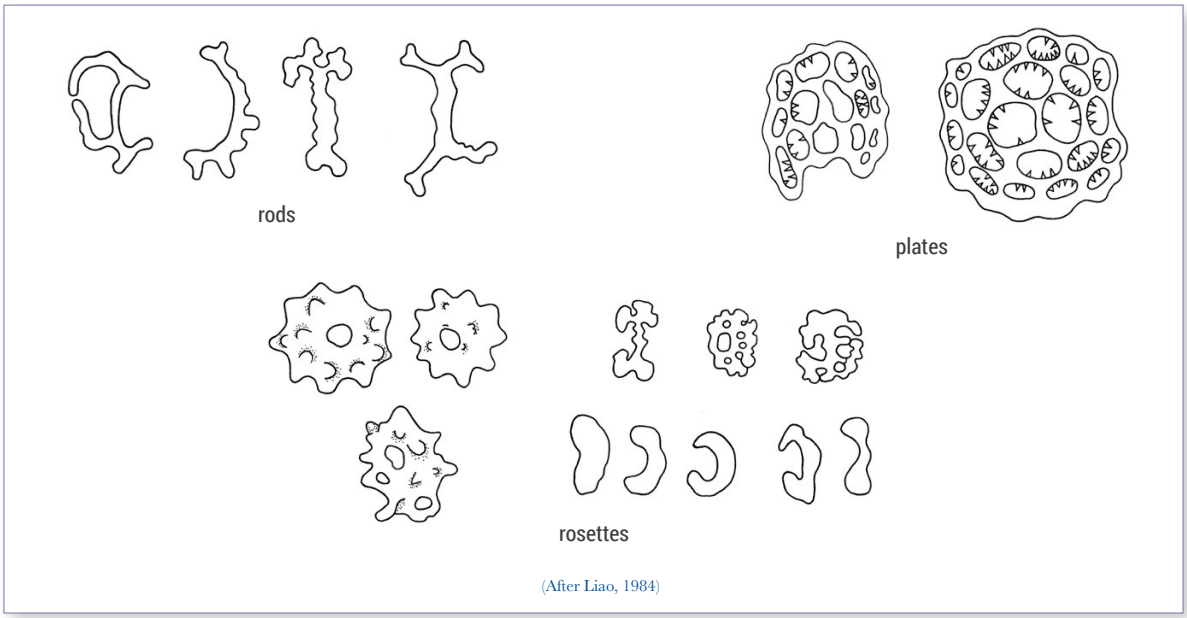
Ossicles: Body wall with dumbbell-shaped rods (15–25 µm in length), perforated plates (20 µm in diameter) and C-shaped rods (25–35 µm long).

Processed appearance: In Malaysia, the whole raw product is pinkish brown in colour, and stout in shape with tapering ends. The body wall is somewhat transparent, showing muscle bands and internal organs inside.

Size: Average live length is around 12–15 cm. Reported to 20 cm.

HABITAT AND BIOLOGY

Found in sandy to muddy habitats, from 0 to 33 m depth. Reported to live in somewhat brackish inshore waters, although also harvested or collected in deep offshore waters. Members of this order (Molpadida) of holothuroids live in U-shaped burrow in soft sediments. They are generally sedentary and do not often move once they have excavated their burrow.



(After Liao, 1984)

EXPLOITATION

Fisheries: Harvested as bycatch in trawl fisheries, including India. Also collected by hand by divers in inshore waters, such as in Malaysia. In Malaysia, they can be landed in huge numbers in trawlers but often have little economic value, as they have a thin body wall and not very suitable for processing into dried products. In Malaysia, it is also harvested by divers by hand, in small quantities for local consumption.

Regulations: No specific known regulations.

Human consumption: Reported to have a place in traditional Chinese cuisine, at banquets and festive dinners. In Malasyia, it is eaten in raw in a "beronok" salad, which is affordable for consumption in villages. In the salad, it has a crunchy and chewy texture.

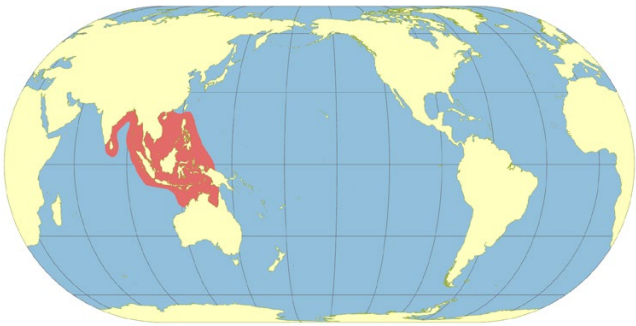
Main market and value: Low value.

GEOGRAPHICAL DISTRIBUTION

India (including Palk Bay, Gulf of Mannar and Andaman and Nicobar islands), Thailand, Singapore, South China Sea, Malaysia, Philippines, Indonesia, northwest Australia.

LIVE ©C. Conand

PROCESSED ©C. Poh Sze



Taxonomy describes, and classifies biodiversity through various scientific methods. Nomenclature on the other hand is not a scientific method but rather, a set of predefined and universally accepted rules that ensures that the naming of taxa is done unambiguously. Taxonomy, because it depends on the chosen scientific methods, is subjective whereas nomenclature is by definition objective and thus not open to interpretation.

Taxonomy and nomenclature work in succession to arrive at meaningful and unambiguous scientific names given to different taxonomic ranks. The core ranks used are the kingdom, phylum, class, order, family, genus and species. Each of these ranks can be further divided in intermediate levels, which are then indicated with prefixes such as "supra" and "super" for above and "infra" or "sub" for below (e.g. the subphylum Echinozoa grouping the classes Holothuroidea and Echinoidea within the phylum Echinodermata). This ranking system (also called the Linnean system) is hierarchical in its organization whereby species are grouped with their congeners into genera, genera into families, families into orders and so on. This grouping is not arbitrary (e.g. based on colour, size, general similarity), but instead is based on evolutionary relationship. As such, two or more species will be classified in the same genus only if they have the same, most recent, common evolutionary ancestor. It is the science of taxonomy that determines the evolutionary relatedness between taxa and that based on this knowledge assigns the correct scientific names. But how does this process work?

The first step in the taxonomic process is with the discovery of biodiversity. Detection can be done by classical collection of specimens in nature but also by studying already sampled "voucher" specimens that are stored in natural history collections.

Once samples are collected, the second step in the taxonomic process is the delineation of the composing units. Here a battery of scientific methods exist, ranging from comparative morphological examination to DNA-barcoding employing different models to identify distinct species. The result of taxon assignment will be a list of operational taxonomic units such as species, which need to be named. In many cases, the species found will already have a scientific name attributed to them. It is the taxonomist who will assign the correct, valid name from the available scientific names. This seems trivial, but not only are the existing names scattered through a vast amount of, sometimes difficult to get, literature, but often more than one scientific name has been given to a single species. Such duplicate scientific names are called *synonyms*.

The number of synonyms that exist depends on the species, whereby it is not uncommon that wide-spread sea-cucumber species have many different synonyms. The species *Holothuria* (*Mertensiothuria*) *hilla* Lesson, 1830 for instance has 9 synonyms according to the World Register of Marine Species (WoRMS, www.marinespecies.org). It is nomenclature that will determine which of the synonyms is to be used as the valid name for the detected species. The choice will be the result of the application of the so-called "Principle of Priority", which is detailed in Article 23 of the International Code of Zoological Nomenclature (the Code from hereon). This principle will select the oldest available scientific name as the valid one, if it was given according to the rules of nomenclature (binomial in structure, published in a binominal work, post 1758, not re-occupied by yet another name, etc..., rules that are again stipulated in detail in the Code). This name will be called the *senior synonym*, whereas the other, younger, or more recently established, scientific names will be called the *junior synonyms*.

Note that it is also possible that the same scientific name is given twice or more to a different species. Such identical scientific names are called *homonyms*. If such is the case, the same rule of thumb applies: the oldest homonym will be considered the valid name of the species, if and only if, it was again given according to the rules of nomenclature as stipulated

in the Code. The youngest or junior scientific name will be considered invalid and will have to be replaced by a new name, a replacement name, also known as a *nomen novum*.

Nomenclature thus always follows taxonomy and ensures that there can be no confusion about which taxon is indicated by the scientific name. Scientific names must therefore be both universal and stable. These conditions are achieved by using the complex set of rules that determine the formation and use of scientific names as laid down in the Code. Samyn *et al.* (2010) already detailed the main nomenclatural issues, and this by using sea cucumbers as examples. For this work, it suffices to recapitulate how a scientific name at species or subspecies level is composed and why it can change.

The first issue to note is that the Code clearly specifies that scientific names are spelled in the 26 letters of the (ISO basic) Latin alphabet, and that numbers, diacritical, and other marks such as apostrophes or hyphens may not be employed. If such marks have been used in the original spelling, subsequent taxonomists correct these and this in accordance with the rules expressed in the Code (e.g. Mülleria Jaeger, 1833 is changed automatically to Muelleria Jaeger, 1833)

Taxonomic ranks higher up than the species rank (e.g. the order and family) and always begins with an upper-case letter. At the species rank the scientific name is generally binominal (i.e. two names); the first name is the genus and the second is the specific name. The genus name always commences with an upper-case letter, while the specific name never has an upper-case letter, regardless of the original spelling or regardless of whether that name was derived from a person's or a locality name (e.g. *Holothuria Dofleini* Augustin, 1908 named after the German zoologist Franz Theodor Doflein is corrected automatically to *Holothuria dofleini* Augustin, 1908). In some cases when it is deemed important, the subgenus is interpolated in parentheses between the genus and the species names. Subgenus names are presented in this way in this guidebook for species in the genus *Holothuria*. Like the genus name, the subgenus name is capitalized. Addition of a subgenus name does not make the name a trinomen though. Names do become trinominal (i.e. three names) at the subspecies rank and subspecies names, like species names, begin with a lower-case letter.

The author of the scientific name of a taxon is placed without intervening mark or punctuation after the scientific name, except when a species name is combined with a different genus name than what was originally designated. In such cases, the author's name is placed in parentheses. For example, *Pearsonothuria graeffei* (Semper, 1868) was first described as *Holothuria Gräffei* Semper, 1868, then its name was changed automatically to *Holothuria graeffei* Semper, 1868 to deal with the upper-case letter and the diacritical on the "a", and placed in the genus *Bohadschia* to accustom the ossicle assemblage, giving the name *Bohadschia graeffei* (Semper, 1868). Its name was later designated to the genus *Pearsonothuria* Levin in Levin *et al.*, (1984) to accustom its chemical composition giving its current name *Pearsonothuria graeffei* (Semper, 1868). The year of publication of the name may also be appended after the author's name, separated by a comma, and included within parentheses when the author's name is so delineated.

In general, when a species name is being used for the first time in a paper it is written in full (e.g. *Holothuria* (*Mertensiothuria*) *hilla* Lesson, 1830), but when used subsequently in the same text the genus and even the subgenus may be abbreviated and the author's name omitted (e.g. *H.* (*M.*) *hilla*). To draw attention to species names mentioned in the scientific literature they are also generally written in italics or underlined (the latter often being the case in older literature).

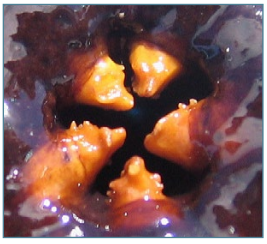
USE OF THIS KEY

This dichotomous key is intended as a tool to aid in the correct identification of live animals observed or collected in the field. Unlike the keys in taxonomic monographs, this key is intentionally simplified to focus on external features that can be distinguished by fishery workers and non-specialist scientists. As such, this key is not proposed as a definitive tool to distinguish species from each other. Users are advised to use this key to confirm or refine identifications based on the earlier species information sheets, or as a departure point for starting their identification. Bear in mind that only the commonly exploited species are included. Users should, in any case, see if the outcomes from the key are corroborated by the photos, descriptions and distribution of the species found in the earlier species sheets. This key includes only species that are represented in this guidebook, and not all species within these genera.

Key to the genera of Holothuriidae

1a. Body stout; anus has five prominent teeth, either conical or knobbly; ossicles consist of rods (spiny or smooth) and rosettes; lacking table, button and plate ossicles ➜ ***Actinopyga*** (p. 195)

1b. Body elongated or stout; anal teeth are either absent or tiny and not obvious ➜ 2



Anal teeth of *Actinopyga*

2a. Body cylindrical or sub-cylindrical and flattened ventrally; podia usually scattered irregularly on the ventral surface; table and button ossicles usually present ➜ ***Holothuria*** (p. 197)

2b. Body cylindrical; ossicles include rods and rosettes; table and button ossicles are absent . . . . . ➜ 3

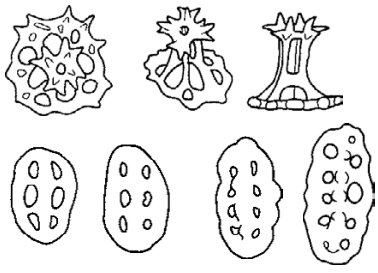
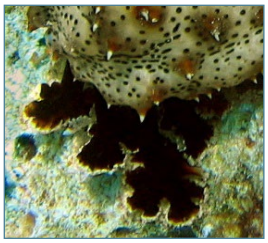


Table ossicles

Button ossicles

3a. Body relatively wide and smooth to the touch; anus is dorsal or sub-dorsal in orientation; tentacles lack distinctively white borders; distributed in tropical and sub-tropical waters of the Indian Ocean, Southeast Asia or the western central Pacific ➜ ***Bohadschia*** (p. 196)

3b. Body is slender and covered in small spiky papillae, so is rough to the touch; anus is terminal; tentacles are black with white edges . . . . . ➜ ***Pearsonothuria graeffei***



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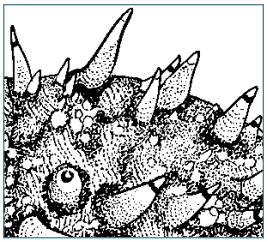
Tentacles of *Pearsonothuria*

Key to the genera of Stichopodidae

1a. Distributed in waters of the northern Pacific Ocean and neighbouring seas; body somewhat stout to relatively slender and has prominent large conical papillae interspersed on the dorsal surface . . . . . ➜ ***Apostichopus*** (p. 202)

1b. Distributed in the central eastern central Pacific, Gulf of Mexico, Caribbean, Mediterranean or north-eastern Atlantic . . . . . ➜ 2

1c. Distributed in the Indian Ocean, Southeast Asia and western Pacific . . . . . ➜ 4



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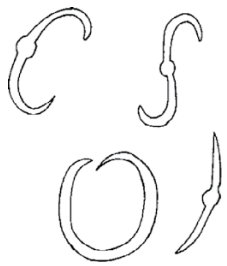
Conical papillae of *Apostichopus*

2a. Body with countless slender conical papillae, giving a furry appearance; body wall with aberrant table ossicles; numerous C-, O- and S-shaped rods in the tentacles and body wall; found in the Gulf of Mexico and the Caribbean . . . . . ➜ ***Astichopus multifidus***

2b. Numerous short, stout, conical (spiky) or bumpy papillae are distributed irregularly on the dorsal surface and are longer along the ventro-lateral margins . . . . . ➜ 3



©M. Lipperi

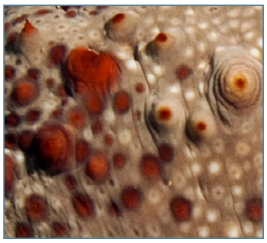
C-, S- and O-shaped rod ossicles of *Astichopus*

3a. Numerous short, stout, conical papillae or bumpy papillae are distributed irregularly on the dorsal surface and are longer along the ventro-lateral margins; distributed on the coasts of the eastern central Pacific, tropical and subtropical waters of Latin America (including the Gulf of Mexico and the Caribbean) and the eastern central Atlantic ➜ ***Isostichopus*** (p. 202)

3b. Numerous short, conical papillae are distributed irregularly on the dorsal surface and the ventro-lateral margins; distributed in the north-east Atlantic (and neighbouring seas) and the Mediterranean Sea . . . . . ➜ ***Parastichopus*** (p. 203)

4a. Long and short conical papillae are mostly arranged in two rows on the dorsal surface and along the ventro-lateral margins of the body; distributed in temperate and warm-temperate waters of the western Pacific . . . . . ➜ ***Australostichopus mollis***

4b. Body covered with bumpy, wart-like or conical papillae; found in tropical and subtropical waters of the Indian Ocean, Southeast Asia and western central Pacific . . . . . ➜ 5

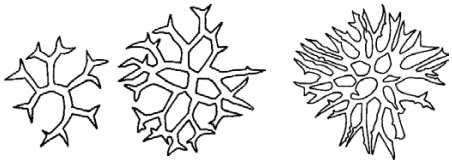


©N. Vasco

Bumpy and wart-like papillae of *Isostichopus* sp. *maculatus*

5a. The ossicles include proper tables, and C- and S-shaped rods; most species have rosette ossicles, but no branching rods . . . . . ➜ ***Stichopus*** (p. 203)

5b. The ossicles lack proper tables (but pseudo-tables may be present), and include highly branched rods, like simple snowflakes; C-shaped and S-shaped ossicles are absent; numerous minute miliary granules (<20 µm) are present in papillae and/or dorsal body wall . . . . . ➜ ***Thelenota*** (p. 204)



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Branched rods of *Thelenota*

Key to the genera of Cucumariidae

1a. Podia in longitudinal rows along the body, which is smooth . . . . . ➜ ***Cucumaria*** (p. 201)

1b. Body is covered with small bumps . . . . . ➜ 2

2a. Mouth with five pairs of tentacles, arranged in two circles . . . . . ➜ ***Athyonidium*** (p. 202)

2b. Mouth generally with more than five pairs of tentacles . . . . . ➜ ***Pattalus*** (p. 202)

Key to the commercial species in the genus *Actinopyga*

1a. Distributed solely in the Atlantic (Caribbean); large species (live individuals up to 35 cm long), mottled or variegated with a brown, orange and yellow coloration; podia (tube feet) and tentacles white to yellowish . . . . . ➜ ***Actinopyga agassizii***

1b Distributed in the Indian and/or Pacific; anal teeth not evident . . . . . ➜ 2

2a. Distributed in the Pacific Ocean and not the Indian Ocean . . . . . ➜ 3

2b. Distributed in the Indian Ocean with some or no spreading into the Pacific Ocean ➜ 5

3a. Body brownish to reddish . . . . . ➜ 4

3b. Body entirely black; bumpy dorsal surface; anal teeth have spiky projections . . . . . ➜ ***Actinopyga palauensis***

3c. Body pink to flame-red, with numerous characteristic bluish to greyish papillae . . . . . ➜ ***Actinopyga flammea***

4a. Body brownish, lighter on the ventral surface, and moderately slender; anus sub-dorsal; numerous bumps on the five anal teeth which are large and yellow coloured. . . . . ➜ ***Actinopyga spinea***

4b. Stout shaped body; rusty brown to reddish body with numerous papillae ventrally; body often covered with small white spots, notably around the anus; sometimes with a white blotch around the anus . . . . . ➜ ***Actinopyga varians***

Bumpy anal teeth of *Actinopyga spinea*

5a. No white or grey blotch around anus . . . . . ➜ 6

5b. White or grey blotch around the anus; rugby ball shaped and brown or grey body colour; sometimes with fine reticulated dark lines on body . . . . . ➜ ***Actinopyga lecanora***

6a. Body not uniformly coloured; with distinct dorsal papillae . . . . . ➜ 7

6b. Body uniformly coloured dark-brown to black, with long, slender (hair-like) dorsal papillae . . . . . ➜ ***Actinopyga miliaris***

7a. Twenty-five tentacles; fine reticulated pattern on body and chocolate brown colour with short, fine conical papillae; ventrally coloured white-grey to brownish; ventral surface densely covered with large brown to greenish podia ➜ ***Actinopyga mauritiana***

7b. Twenty tentacles; whole body coloured light brown to brownish green; pimply dorsal papillae present . . . . . ➜ ***Actinopyga echinites***

©P. Bourjon

Reticulated colour pattern of *Actinopyga mauritiana*

Key to the commercial species in the genus *Bohadschia*

1a. Distribution restricted to the Indian Ocean and the Red Sea . . . . . ➜ 2

1b. Distributed from the western Indian Ocean to the Central Pacific . . . . . ➜ 3

2a. Body blackish brown, with inconspicuous eye spots; restricted to the southwestern Indian Ocean . . . . . ➜ ***Bohadschia atra***

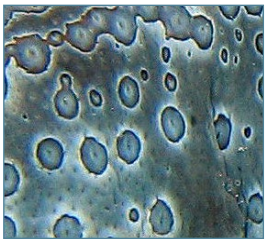
2b. Body coloured variably with yellow, rusty to black-brown blotches dorsally; ventrally coloured whitish with numerous closely spaced podia; restricted to the southwestern Indian Ocean . . . . . ➜ ***Bohadschia subrubra***

3a. Distinct eye spots on the body dorsally and/or blotches present . . . . . ➜ 4

3b. No distinct eye spots on the body, with or without distinct blotches . . . . . ➜ 5

4a. Body coloured grey to brown with circular eye spots surrounding a central papilla; species restricted to the western and central Pacific Ocean, with some spreading into the eastern and central Indian Ocean . . . . . ➜ ***Bohadschia argus***

4b. Body coloration is variable, commonly brown with eye spots and irregular blotches encompassing more than one papilla; restricted to the western and central Pacific Ocean . . . . . ➜ ***Bohadschia ocellata***



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Eye spots on the body of *Bohadschia argus*

5a. Distinct blotches present on body . . . . . ➜ 6

5b. No distinct blotches on body; coloured beige to brown and sometimes with two faint darker transverse bands . . . . . ➜ ***Bohadschia vitiensis***

6a. Body creamy-tan colour with distinct brown blotches that are not clearly demarcated; distributed in the Western Pacific . . . . . ➜ ***Bohadschia koellikeri***

6b. Body creamy-tan colour with brown blotches of variable shape that have distinct edges; restricted to the Western Pacific . . . . . ➜ ***Bohadschia marmorata***

Note with this key: the monotypic genus *Pearsonothuria*, represented by the species *Pearsonothuria graeffei* was long time classified in the genus *Bohadschia*. Taxonomic scrutinization, based on the chemicals in the body tissues, but also on the distinct shape of the ossicle assemblage (pseudo-tables and complex rosettes) and phylogentic analysis based on COI sequences warrants the species *graeffei* to be placed in its own genus. (see also Kim *et al*, 2013). *P. graeffei* can easily be recognized by its sausage-shape, it's distinctive black tentacles with white rim. It has Cuvierian tubules, but these are not ejected upon provocation.

Key to the commercial species in the genus *Holothuria*

1a. Body rugby ball shaped with five small, roundish anal teeth . . . . . ➜ 2

1b. Anal teeth absent . . . . . ➜ 4

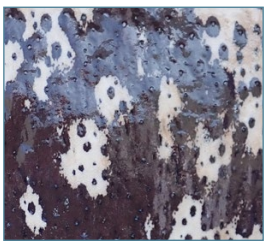
2a. Restricted to the Indian Ocean (albeit some records recorded from the western Pacific) ➜ 3

2b. Restricted to the Pacific Ocean and Southeast Asia; body coloured uniform black in adults . . . . . ➜ ***Holothuria (Microthele) whitmaei***

3a. Body coloured black with white blotches, mainly at the lateral margins; 5–6 prominent white lateral teats; also reported from the Red Sea . . . ➜ ***Holothuria (Microthele) nobilis***

3b. Body coloured dark brown, mottled with irregular cream-coloured blotches; not reported from the Red Sea. . . . . ➜ ***Holothuria (Microthele)* sp. (type "Pentard")**

3c. Body wall white-beige; irregularly mottled with light brown dorsally. . . . . ➜ ***Holothuria (Microthele) fuscogilva***



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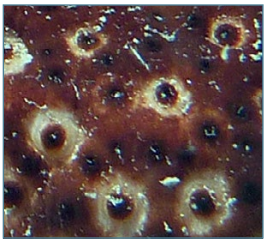
Irregular brown mottling on the dorsal surface of *Holothuria fuscogilva*

4a. Restricted to the northeastern Atlantic and/or the Mediterranean . . . . . ➜ 5

4b. Present in the Atlantic, the Pacific and the Indian Ocean . . . . . ➜ 10

5a. Distinct white eye spots absent. . . . . ➜ 6

5b. Body coloured brown, dorsally with distinct white eye spots around brown podia; white Cuvierian tubules are readily ejected from the anus when disturbed . . . . . ➜ ***Holothuria (Platyperona) sanctori***



White eye spots of *Holothuria sanctori*

6a. Lateral papillae, if present, not distinctly larger than dorsal papillae . . . . . ➜ 7

6b. Prominent lateral papillae present, much larger than the dorsal ones . . . . . ➜ ***Holothuria (Vaneyothuria) lentiginosa lentiginosa***

7a. Body coloured reddish to brown or black; dorsal papillae few or numerous but without white tips . . . . . ➜ 8

7b. Whitish ventrally, variable dorsally; dark brown/black or yellowish with brown mottling. Numerous irregular conical papillae with white tips . . . . . ➜ ***Holothuria (Panningothuria) forskali***

7c. Dorsal body wall coloured light to dark brown, with small-pointed papillae . . . . . ➜ ***Holothuria (Roweothuria) poli***

8a. Body colored brownish, either uniformly or distinctly with distinct difference between the ventral and dorsal surface, with numerous papillae . . . . . ➜ 9

8b. Body coloured reddish to brown, with some large, well-developed pointy conical papillae, well-developed at the lower lateral margins ➜ ***Holothuria (Roweothuria) arguinensis***

Conical papillae of *Holothuria arguinensis*

9a. Body dark brown to black and covered with conical papillae of the same colour; ventral podia are darkly coloured; occurs in the Mediterranean Sea and the northeastern Atlantic . . . . . ➜ ***Holothuria (Holothuria) mammata***

9b. Dorsal body surface coloured distinctly darker than ventral surface; no Cuvierian tubules; restricted to the Mediterranean Sea . . . . . ➜ ***Holothuria (Holothuria) tubulosa***

10a. Pronouncedly elongate body shape . . . . . ➜ 11

10b. Body sub-cylindrical, curved dorsally, flattened ventrally . . . . . ➜ 13

10c. Cylindrical body shape . . . . . ➜ 20

11a. Papillae most numerous around the lateral margins of the body and mouth . . . . ➜ 12

11b. Body beige, light yellow or grey coloured with two rows of large dark spots and numerous tiny dark spots; dark brown short conical papillae present . . . . . ➜ ***Holothuria (Lessonothuria) pardalis***

11c. Entirely black body with long randomly spaced papillae and long random podia, more numerous on ventral surface; 20 large black tentacles; readily ejects Cuvierian tubules . . . . . ➜ ***Holothuria (Mertensiothuria) leucospilota***

12a. Body dark grey/black or reddish brown to black with pinkish papillae and yellowish tentacles . . . . . ➜ ***Holothuria (Semperothuria) roseomaculata***

12b. Dark grey/black body with large pale-yellow tentacles and yellow-tipped papillae . . . . . ➜ ***Holothuria (Acanthotrapeza) coluber***

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Yellow-tipped papillae and yellow tentacles of *Holothuria coluber*

13a. Evident or subtle body wrinkles present . . . . . ➜ 14

13b. No body wrinkles . . . . . ➜ 17

14a. Subtle or infrequent body wrinkles, or only noticeable when moving . . . . . ➜ 15

14b. Deep, pronounced body wrinkles . . . . . ➜ 16

15a. Dark brown-grey body, lighter on the lateral margins; variably coloured ventral surface; bright red, pink, orange, white, yellow, dark purple or black. 20–22 peltate tentacles; small papillae are white with yellow tips . . . . . ➜ ***Holothuria (Halodeima) mexicana***

15b. Body only wrinkled when moving; body is orange-brown, with a light peach ventral surface and peach to light-brown podia; light to dark brown papillae cover the whole body; 20 light-brown peltate tentacles with stalk present . . . . . ➜ ***Holothuria (Stichothuria) coronopertusa***

16a. Blackish grey to light-brownish grey body, which sometimes has grey or white traverse lines across body; body often covered in muddy sand; 20 small, grey tentacles present, and short papillae . . . . . ➜ ***Holothuria (Metriatyla) scabra***

16b. Body looks similar to an elephants trunk; golden to light-brown or cream coloured with numerous brown spots around papillae, which are very small; body often covered in fine sediments; 20 short brown tentacles present ➜ ***Holothuria (Microthele) fuscopunctata***

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Deep wrinkles in body and brown spots of *Holothuria fuscopunctata*

17a. Conical or stubbly papillae . . . . . ➜ 18

17b. Pointy papillae . . . . . ➜ 19

18a. Nearly all-black body, with white rings around the base of small conical papillae, appearing like eye spots; small retractable podia . . . . . ➜ ***Holothuria (Theelothuria) paraprinceps***

18b. Body is grey-brown in colour with 4–6 brown botches and white to yellowish coloured ventrally; body covered in yellowish wart-like bumps ending in papillae that are brown with a blunt white tip; 20 large yellowish or grey tentacles with small brown spots . . . . . ➜ ***Holothuria (Stauropora) pervicax***

18c. Body colour is variable; dark grey-black or beige with black spots or blotches; body often covered in fine sediment or mucus; stubbly black papillae present, with five groups of papillae around the anus and 20 short, grey tentacles ➜ ***Holothuria (Metriatyla) lessoni***

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Wart-like papillae of *Holothuria pervicax*

19a. Variable body colour; bright-olive green to black, darker at anterior; green-yellow podia are numerous and uniform; numerous yellowish small spiky papillae; yellowish tentacles . . . . . ➜ ***Holothuria (Selenkothuria) lubrica***

19b. Red to yellowish-red body with brown mottling; numerous podia and numerous small pointy papillae, with some larger ones around the anterior and lateral margins of body . . . . . ➜ ***Holothuria (Halodeima) grisea***

19c. Brown body with a subtly darker longitudinal band along the middle compared to the lateral margins, and lighter ventral surface; numerous small, pointy papillae present all over the body; distributed in the Red Sea, Persian Gulf, Sri Lanka, Philippines, northern Australia and parts of India . . . . . ➜ ***Holothuria (Theelothuria) spinifera***

20a. Body with rows of dark brown dots . . . . . ➜ 21

20b. Body with randomly spaced blotches . . . . . ➜ 22

20c. Body with five dark brown traverse lines that become spots posteriorly; note: also reported from the Mediterranean . . . . . ➜ ***Holothuria (Thymiosycia) impatiens***

20d. Body without noticeable blotches or dots . . . . . ➜ 24

21a. Dark brown, grey, yellow green or black body with a lighter ventral surface; large numerous podia and conical dark, relatively small papillae; body shaped broader at the anterior with a narrow, blunt posterior . . ➜ ***Holothuria (Selenkothuria) portovallartensis***

21b. Whitish body with 8–10 rows of dark brown dots and white Cuvierian tubules; podia are small and scattered. 20 small yellow tentacles; body tapers to anus . . . . . ➜ ***Holothuria (Theelothuria) notabilis***

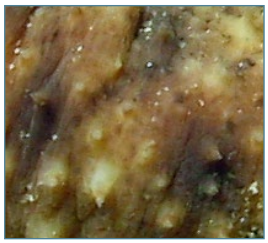
21c. Body creamy-rusty tan colour, sometimes orange then white towards mouth and yellowish white ventral surface; small, spiky, numerous papillae present . . . . . ➜ ***Holothuria (Thymiosycia) arenicola***

22a. Body with white spots/blotches, small papillae and numerous podia; body sometimes speckled yellow-brown; light spots on top of wart-like papillae . . . . . ➜ ***Holothuria (Halodeima) floridana***

22b. Brown spots or blotches present . . . . . ➜ 23

23a. Brown body with diffuse brown spots and a purple ventral surface with brown spots; small, dark, pointy papillae on blotches and cream/yellow papillae bordered by a cream circle on dorsal surface of body . . . . . ➜ ***Holothuria (Semperothuria) imitans***

23b. Greyish brown-green body with anus surrounded by a dark purple ring; beige to brown ventral surface; brown, wide base and narrow-tipped papillae and sparse podia which are more numerous on lateral margins of the body; 20 tentacles and Cuvierian tubules that are readily ejected . . . . . ➜ ***Holothuria (Stauropora) fuscocinerea***



Diffuse spots on body of *Holothuria imitans*

24a. Body often covered in sand, debris or algae . . . . . ➜ 25

24b. Body not covered in any sand . . . . . ➜ 27

25a. Body with distinct bare circles devoid of sand in 2 rows along dorsal surface; black body and tentacles that are small and sparse . . . . . ➜ ***Holothuria (Halodeima) atra***

25b. Uniform sand/ debris randomly on body . . . . . ➜ 26

26a. Body coloured rusty to dark-brown with lighter papillae; body tapered to anus; 20 dentro-peltate tentacles and podia which are lighter than the body, long and more abundant ventrally . . . . . ➜ ***Holothuria (Semperothuria) cinerascens***

26b Body reddish brown to grey with 4–6 wart-like bumps and small dark-tipped papillae; 20 brown to black tentacles . . . . . ➜ ***Holothuria (Halodeima) inornata***

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Dendro-peltate tentacles of *Holothuria cinerascens*

27a. Body colour is pink to whitish pink ventrally with small dark spots, dark grey to chocolate-brown dorsally; rough body surface with some wrinkles across the body; sparse papillae; short, fine podia . . . . . ➜ ***Holothuria (Halodeima) edulis***

27b. Body colour is light brown ventrally . . . . . ➜ 28

28a. Twenty very short tentacles are visible; body is tan to reddish-brown with large triangular, flattened, yellow-white papillae . . . . . ➜ ***Holothuria (Mertensiothuria) hilla***

28b. Tentacles usually not extended and visible . . . . . ➜ 29

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Flattened papillae of *Holothuria hilla*

29a. Dark brown body with a rough texture and small, conical papillae that are numerous, yellow-white to rusty coloured papillae . . . . . ➜ ***Holothuria (Cystipus) inhabilis***

29b Body light-brown and speckled dorsally; papillae are numerous, small and conical, with a few larger papillae on the lateral margins of the body ➜ ***Holothuria (Holothuria) dakarensis***

Key to the commercial species in the family *Cucumariidae*

1a. Body somewhat star-shaped body in cross-section; stout and cylindrical with tapering ends; 5 longitudinal rows of podia . . . . . ➜ 2

1b. Distributed on the eastern coast of South America . . . . . ➜ 3

2a. Body star-shaped, cylindrical and stout; body colour variable, brown to brownish-purple or greyish-purple or white. Papillae are yellowish and in 5 longitudinal rows; dendritic tentacles are reddish with white tips; distributed in Northeast Yellow Sea, Northeast Japan and north-western Pacific . . . . . ➜ ***Cucumaria japonica***

2b. Body subtly star-shaped in cross-section; cylindrical and stout body; body colour variable, ranging from dark brown, grey brown or purplish brown, occasionally lighter, yellowish near mouth and tentacles; body smooth with podia in five longitudinal rows; long, orange, dendritic tentacles; distributed in the North Atlantic . . . . . ➜ ***Cucumaria frondosa***

3a. Body brown to grey brown or light grey; five pairs of greenish black dentritic tentacles arranged in two circles; grainy body texture; podia in longitudinal rows . . . . . ➜ ***Athyonidium chilensis***

3b. Body shape elongate, large and cylindrical; body colour is variable, from olive green, reddish purple, bright purple, or dull black; twenty large tentacles which are sometimes arranged in 2 concentric circles of 5 pairs each; tentacles are always the same colour as the body but lighter; numerous podia . . . . . ➜ ***Pattalus mollis***

Key to the commercial species in the family *Stichopodidae*

1a. Distributed in waters of the north-western Pacific Ocean . . . . . ➜ 2

1b. Distributed in waters of the north-eastern Pacific Ocean . . . . . ➜ 3

2a. Body elongate; papillae on the ventro-lateral margins are closely packed in a row and are generally much larger than those on the dorsal surface; body covered in tiny black dots . . . . . ➜ ***Apostichopus nigripunctatus***

2b. Body stout to moderately elongate; large papillae occur on both the dorsal surface and on the ventro-lateral margins, roughly of similar size . . . . . ➜ ***Apostichopus japonicus***

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Conical papillae of *Apostichopus (Apostichopus japonicus)*

3a. Body is reddish to brown or yellow dorsally with both large and small fleshy papillae, which are yellow to orange in colour and red tipped.; the large papillae are numerous and usually interspersed evenly . . . . . ➜ ***Apostichopus californicus***

3b. Body is reddish to brown or yellow dorsally with both large and small fleshy papillae, which are yellow to red in colour and with black tips; the small papillae are very numerous and the large papillae are usually interspersed unevenly and not very numerous . . . . . ➜ ***Apostichopus parvimensis***

©C. Seid

Black-tipped papillae of *Apostichopus parvimensis*

Key to the commercial species in the genus *Isostichopus*

1a. Twenty large tentacles, that are prominent . . . . . ➜ 2

1b. Tentacles are not very prominent . . . . . ➜ 3

2a. Sub-cylindrical, moderately elongate body with rounded ends. Variable in colour; brown, orange, beige, grey, pink, yellow or black also reticulated black-yellow; body sometimes with dark, round spots; numerous blunt, randomly spaced papillae on dorsal surface; ventro-lateral papillae long and conical with rounded tips . . ➜ ***Isostichopus badionotus***

2b. Body dark brown-grey and sub-cylindrical; ventral surface of body is light brown; numerous stout, yellow conical papillae, and yellow tentacles with markedly wide disks; podia are dense and in bands . . . . . ➜ ***Isostichopus fuscus***

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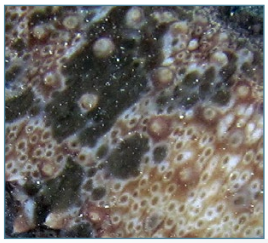
Blunt papillae of *Isostichopus badionotus*

3a. Body is brown to reddish-body colour, and somewhat semi-transparent; stout and conical papillae dorsally and laterally, which are randomly placed and sometimes with darker spiral lines around them; body covered with large irregularly shaped blotches of white/cream with a dark thin line on them and grey/brown; body also has small dark spots with a white halo around them; large podia in three rows . . . ➜ ***Isostichopus* sp. *'phoenius'***

3b. Body is sub-cylindrical with blunt ends; body colour is variable, from brown, rusty, dark green, yellow beige and cream; body is smooth and opaque; whitish spot-like granules on body, along with sometimes dark spots or mottling; bumpy dorsal papillae and large numerous papillae on lateral margins; light red/beige podia in three rows . . . . . ➜ ***Isostichopus* sp. *'maculatus'***



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Blotches on body of *Isostichopus* sp. *'phoenius'*

Key to the commercial species in the genus *Parastichopus*

1a. Moderately elongate and somewhat flattened body that is brownish ochre-yellow in colour; ventrally often reddish, particularly in the centre; numerous white dots on body and white conical, spiky papillae, some larger than others; 20 whitish peltate tentacles in two circles . . . . . ➜ ***Parastichopus regalis***

1b. Pink, red or orange body; ventrally whitish pale pink, which sometimes has red markings; small dark spots on body often present; papillae are conical and spiky, and podia are in 3 rows; 20 brown peltate tentacles . . . . . ➜ ***Parastichopus tremulus***

Key to the commercial species in the genus *Stichopus*

1a. Body is fairly stout; body colour is brown or yellowish or orangey-brown . . . . . ➜ 2

1b. Body is relatively elongated; variable in colour but often mottled . . . . . ➜ 4

1c. Body colour is dark green, sometimes velvety green/black; relatively slender conical papillae with orange tips are arranged solely in the rows on either side of the dorsal surface . . . . . ➜ ***Stichopus chloronotus***

2a. Body without eye spots . . . . . ➜ 3

2b. Wart-like papillae all over dorsal surface of body; papillae with dark borders; body is stout; body colour varies from orangey-yellow to brown or greenish-brown . . . . . ➜ ***Stichopus herrmanni***

2c. Body with large (5–10 mm) white eye spots; wart-like papillae, white around their base . . . . . ➜ ***Stichopus ocellatus***

Wart-like papillae of *Stichopus herrmanni*

3a. Body reddish to brown with long, large, slender papillae in two rows dorsally . . . . . ➜ ***Stichopus pseudohorrens***

3b. Fine dark lines over whole dorsal surface of body; smaller, greenish brown coloured papillae all over the dorsal surface; deep transverse wrinkles dorsally . . . . . ➜ ***Stichopus vastus***

Dorsal surface and papillae of *Stichopus vastus*

4a. Body surface with dark blotches dorsally; wart-like, broad, spiky papillae in two rows dorsally; thumb-tack shaped large table ossicles in dorsal papillae ➜ ***Stichopus horrens***

4b. Body is yellowish to black or brownish green and covered with irregular-sized and shaped bumps; colour variable, ventral surface similar to dorsal; without large thumb-tack shaped table ossicles in dorsal papillae . . . . . ➜ ***Stichopus* cf. *monotuberculatus***

4c. Body is tan and mottled with brown, lighter at ventro-lateral margins; ventral surface with a central brown band between the rows of podia; tips of podia and papillae are dark brown . . . . . ➜ ***Stichopus naso***

Key to the commercial species in the genus *Thelenota*

1a. Body without star-shaped or branched papillae . . . . . ➜ 2

1b. Body reddish to brown, ventral surface sometimes pinkish; body with large star-shaped and conical long papillae . . . . . ➜ ***Stichopus ananas***

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Conical and star-shaped papillae of *Thelenota ananas*

2a. Body is beige or greyish on dorsal surface with brown or pinkish spots and blotches; numerous wart-like bumps . . . . . ➜ ***Thelenota anax***

2b. Dorsal surface of body is whitish with complex crimson-red lines forming a maze, more irregular ventrally; dorsal body surface with two primary rows of 13–5 large pointed papillae; numerous scattered yellowish podia ventrally . . . . ➜ ***Thelenota rubralineata***

Note with this keys above: the *Acaudina* species present in this guidebook, *A. molpadioides* (Molpadida: Caudinidae) was not keyed out as it is the sole species in its genus that is commercially exploited. *A. molpadioides* can be recognized by a stout body shape tapering at both ends, most distinctively at the posterior end, and a smooth body wall. This species does not have podia. It does often have mustard coloured dots on the body, and has 15 short digitate tentacles. Body colour of this species varies from brownish to grey brown or pinkish brown, and fades to translucent when exposed to air.

USE OF THIS KEY

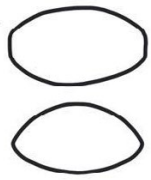
This dichotomous key is intended as a tool to aid in the correct identification of dried sea cucumbers in producing countries or end markets. It is intended for fishery workers and trade officers with a basic scientific background. This key is not proposed as a definitive tool, on its own, to determine the species of dried products. Users are advised to use this key to confirm or refine identifications based on the text and photographs in the earlier species information sheets, or as a departure point for starting their identification. Bear in mind that only the commonly exploited species are included.

1a. Has evident anal teeth . . . . . ➜ ***Actinopyga,*** 2

1b. No evident anal teeth . . . . . ➜ 10

2a. Stout, oval or rugby ball shaped . . . . . ➜ 3

2b. Elongate . . . . . ➜ 8



Examples of rugby-ball/oval body shape

Examples of stout body shapes

Examples of elongate body shapes

3a. Spots on dorsal surface are present . . . . . ➜ 4

3b. No spots on dorsal surface . . . . . ➜ 6

4a. Large black spots or blotches on body; distributed in the Caribbean and Gulf of Mexico . . . . . ➜ ***Actinopyga agassizii***

4b. Spots or blotches on body are yellow or white . . . . . ➜ 5

5a. Stout body; yellowish/white spots more common towards anus and on ventral surface; ventral surface very grainy, and usually has a cut along it; dorsal surface can have some wrinkles . . . . . ➜ ***Actinopyga varians***

5b. Stout body with some white/ish spots present; reticulated and distinctively light ventral surface, distinctly wrinkled dorsal surface, dorsally arched and ventrally flattened; blunt ends . . . . . ➜ ***Actinopyga mauritiana***

6a. Stout body; dorsally rough with distinct fine bumps, brown body colour . . . . . ➜ ***Actinopyga echinites***

6b. Dorsally smooth . . . . . ➜ 7

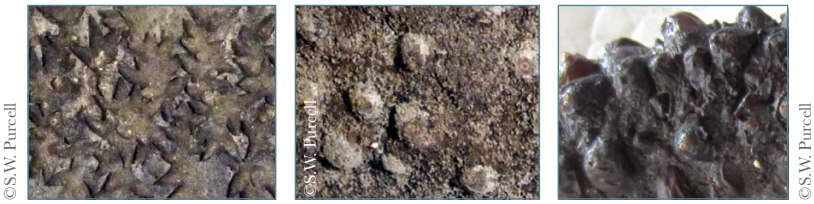
7a. Rugby ball shaped body; to cream coloured around anus, can have fine reticulated lines or marks covering surface . . . . . ➜ ***Actinopyga lecanora***

7b. Rugby ball shaped, no wrinkles evident, black colour . . . . . ➜ ***Actinopyga miliaris***

8a. Stout to moderately elongate; brown body with multitude of distinct slender conical papillae . . . . . ➜ ***Actinopyga* cf. *flammea***

8b. No visible papillae . . . . . ➜ 9

Example of a multitude of conical papillae (example taken from image of *Apostichopus japonicus*)



Examples of different types of obvious conical papillae (examples taken from images of *Thelenota ananas, Isostichopus fuscus and Holothuria mammata* [from left to right])

9a. Body moderately elongate; shallow body wrinkles dorsally, black body . . . . . ➜ ***Actinopyga palauensis***

9b. Elongate body; smooth dark brown body with no wrinkles . . . . . ➜ ***Actinopyga spinea***

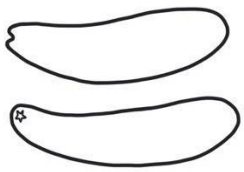
10a. Anus likely prominent, open and star shaped; anus pulled slightly up dorsally; smooth or grainy dorsal surface, possible small papillae along body margins ➜ ***Bohadschia*** ➜ 11

10b. Tentacles removed when processed, stout to moderately stout and generally with a large cut on the dorsal surface or large open anterior end; tapering end/s . . . . . ➜ 16

10c. Body rugby ball shaped; distinctively oval with slightly tapering ends . . . . . ➜ 17

10d. Body moderately to completely stout . . . . . ➜ 21

10e. Body somewhat to extremely elongate . . . . . ➜ 28



Example of *Bohadschia* sp. body shape

Example of *Thelenota* sp. Body shape

11a. Body stout to moderately stout . . . . . ➜ 12

11b. Body moderately elongate with blunt curved ends . . . . . ➜ 15

12a. Papillae visible as small, dark, hair-like (~1 mm) features, sometimes seen as dark spots . . . . . ➜ 13

12b. Papillae not prominent and not wart-like . . . . . ➜ 14

13a. Body brown in colour with two possible darker traverse bands that are very diffuse; stubbly papillae (1–2 mm) . . . . . ➜ ***Bohadschia vitiensis***

13b. Body colour fairly light, with distinct dark patches . . . . . ➜ ***Bohadschia marmorata***

14a. Body with distinctly noticeable spots that are round and irregular shaped . . . . . ➜ ***Bohadschia ocellata***

14b. Body with diffuse and irregular dark blotches . . . . . ➜ ***Bohadschia koellikeri***

14c. Body with distinct eye spots with dark spot at center . . . . . ➜ ***Bohadschia argus***

15a. Fine white dots all over body; dark blotches on body margins/ ventral surface . . . . . ➜ ***Bohadschia subrubra***

15b. Dark grey to brown dorsal body surface with slightly lighter spots and/or traverse lines . . . . . ➜ ***Bohadschia atra***

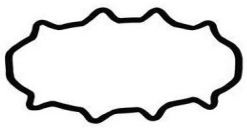
16a. Tan to brown body with five rows of lighter dots along the body; distributed in the northeast Yellow Sea and north Japan . . . . . ➜ ***Cucumaria japonica***

16b. Blackish purple colour and rough with small, dense bumps; distributed in Peru and northern Chile . . . . . ➜ ***Pattalus mollis***

16c. Body is brown to black with five rows of lighter dots; grainy texture; distributed in the North Atlantic, including waters of North America, United Kingdom of Great Britain and Northern Ireland, Iceland and the Russian Far East . . . . . ➜ ***Cucumaria frondosa***

17a. No visible teats, warts or projections . . . . . ➜ ***Athyonidium chilensis***

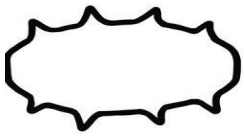
17b. Four to six teats/projections on the lateral margins, which can be subtle or obvious ➜ 18



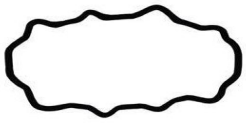
Example of obvious 4-6 teats on lateral margins

18a. Teats on the lateral margins of the body are distinctively pointed in most specimens ➜ 19

18b. Teats on the lateral margins of the body are rounded and mostly not very pronounced ➜ 20



Example of distinctively pointed teats



Example of rounded, not pronounced teats

19a. Creamy dorsal surface with dark brown blotches and irregular spots . . . . . → ***Holothuria fuscogilva***

19b. Dark brown dorsal surface with creamy white spots or blotches . . . . . → ***Holothuria* sp. type "Pentard"**

20a. Chalky grey colour, some white blotches surrounding teats . . . . . → ***Holothuria nobilis***

20b. Charcoal grey body; no white blotches . . . . . → ***Holothuria whitmaei***

21a. Tapering ends with a rough, furry texture . . . . . → ***Astichopus multifidus***

21b. Blunt ends . . . . . → 22

22a. Prominent conical papillae that project laterally from ventral margins are present → 23

22b. No prominent papillae projecting laterally . . . . . → 24

23a. Rounded warty bumps, rough surface between bumps; warty bumps are often lighter in colour; body wrinkles absent . . . . . → ***Isostichopus fuscus***

23b. Light irregularly shaped blotches on body; rough body surface with small wrinkles; dark brown to orange colour . . . . . → ***Isostichopus* sp. *'phoenius'***

23c. Body texture is grainy, with dark brown to black spots/warts, sometimes with a central light-coloured circle . . . . . → ***Isostichopus badionotus***

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Example of wart-like bumps
(example taken from image of *Thelenota anax*)

24a. Deep body wrinkles but smooth body . . . . . → ***Holothuria scabra***

24b. Subtle or no body wrinkles . . . . . → 25

25a. Numerous small white spots on body dorsally . . . . . → 26

25b. No spots on body . . . . . → 27

26a. Larger pimple-like papillae with light brown tips; body is also covered in tiny white/beige dots; body colour is light grey/brown to dark grey; specimens are small (3–9 cm long) . . . . . → ***Isostichopus* sp. *'maculatus'***

26b. Dark brown body with white, circular and well-defined spots, which can appear as lines along the dorsal surface; distributed in Mexico and Central America . . . . . → ***Holothuria paraprinceps***

26c. White spots on body are not well defined; brown body colour and warty all over; widely distributed, from California and down the west coast of Central and South America to Peru . . . . . ➜ ***Holothuria inhabilis***

27a. The tentacles are sometimes cut off during processing; body surface is subtly rough and has subtle body wrinkles; ventrally yellow with numerous podia . . . . . ➜ ***Holothuria portovallartensis***

27b. Body with obvious wrinkles and numerous bumps; dark brown/grey colour . . . . . ➜ ***Holothuria inornata***

28a. Tentacles are at all noticeable and extended . . . . . ➜ 29

28b. Tentacles are not prominently extended . . . . . ➜ 31

29a. Irregular small orange spots on dorsal surface; dark colouring with some brown blotches . . . . . ➜ ***Holothuria imitans***

29b. Body without spots; rough and bumpy surface . . . . . ➜ 30

30a. Three longitudinal rows of darker bumps on the ventral side; grey and brown vertical lines on the dorsal surface . . . . . ➜ ***Holothuria cinerascens***

30b. Ventral surface of body has numerous podia spots; dorsal surface has some bumps . . . . . ➜ ***Holothuria lubrica***

30c. Wrinkled body, grainy on ventral surface; grey colour . . . . . ➜ ***Pearsonothuria graeffei***

31a. Papillae are evident . . . . . ➜ 32

31b. Papillae are not evident . . . . . ➜ 44

32a. Blunt, warty, conical shaped papillae . . . . . ➜ 33

32b. Papillae are somewhat to very pointy . . . . . ➜ 36

33a. No spots on body . . . . . ➜ 34

33b. Body with spots present . . . . . ➜ 35

34a. Rough, entirely black body, occasionally translucent at ends; usually with a cut in the middle of the ventral surface . . . . . ➜ ***Holothuria mammata***

34b. Papillae have white tips; usually with a cut in the middle of the ventral surface . . . . . ➜ ***Holothuria forskali***

34c. Light-coloured papillae, mouth in a flange . . . . . ➜ ***Holothuria roseomaculata***

35a. Small, dark coloured spots; body light brown/grey and can be wrinkled . . . . . ➜ ***Parastichopus tremulus***

35b. Very small white spots on top of the papillae; papillae are more distinctive along body margins . . . . . ➜ ***Apostichopus parvimensis***

36a. Body wrinkles criss-crossing body . . . . . ➜ 37

36b. No body wrinkles . . . . . ➜ 38

37a. Black body colour, tapering at both ends.; papillae are located on body wrinkles (more prominent in small specimens) . . . . . ➜ ***Holothuria mexicana***

37b. Body is brown dorsally and yellow ventrally; conical papillae are arranged in loose rows; ventrally flattened, with brown spots of podia visible on ventral surface . . . . . ➜ ***Holothuria arguinensis***

37c. Papillae are subtle, small, thin and visible on lateral margins; brown to black traverse marks on dorsal surface, ventrally reddish-brown; body often covered in white chalky deposits . . . . . ➜ ***Holothuria coronopertusa***

38a. Visible spots or blotches on dorsal surface of body . . . . . ➜ 39

38b. No visible spots or blotches on dorsal surface of body . . . . . ➜ 40

39a. Four to six dark blotches on dorsal surface . . . . . ➜ ***Holothuria pervicax***

39b. Fine white spots interspersed between prominent spiky papillae; ventral surface covered in lighter-coloured podia . . . . . ➜ ***Apostichopus japonicus***

39c. Chocolate brown spots and mottling on brown dorsal surface of body; cream-coloured margins of body . . . . . ➜ ***Australostichopus mollis***

39d. Small grey dots over a tan coloured body, with outer layer often partially eroded; a closely-packed row of prominent pointy conical papillae on ventro-lateral margins and smaller rounded papillae present dorsally; quite long and slender body; rough ventral surface . . . . . ➜ ***Apostichopus nigripunctatus***

40a. Chestnut-brown body with cream-coloured spiky papillae . . . . . ➜ ***Holothuria hilla***

40b. Prominent lateral papillae on ventral margins of body; grainy dorsal surface with warty bumps; body yellowish in colour with blunt ends . . . . . ➜ ***Stichopus naso***

40c. Dark brown/black dorsally, prominent spiky papillae . . . . . ➜ 41

40d. Body dorsal surface is brownish-grey . . . . . ➜ 43

41a. Body is dark brown/black dorsally, ventrally distinctively lighter; prominent spiky papillae sometimes curved . . . . . ➜ ***Holothuria tubulosa***

41b. Body is rectangular in cross-section . . . . . ➜ 42

42a. Four edges of body covered with pointy wart-like papillae; entire body dark grey to black . . . . . ➜ ***Stichopus chloronotus***

42b. Brown body colour; spaced-out large papillae with a rough pimply surface between wart-like bumps . . . . . ➜ ***Thelenota rubralineata***

42c. Star-shaped and large slender papillae in multitudes covering the dorsal surface; body brown/ black with lighter ventral surface . . . . . ➜ ***Thelenota ananas***

43a. Numerous papillae on body; distributed on the coast of southern California and the west coast of Mexico . . . . . ➜ ***Apostichopus californicus***

43b. Papillae are long, slender and not densely packed; distributed on the east and south coast of Africa and in the Red Sea to western central Pacific ➜ ***Stichopus horrens***

44a. Spots are evident on the dorsal or ventral surface of body . . . . . ➜ 45

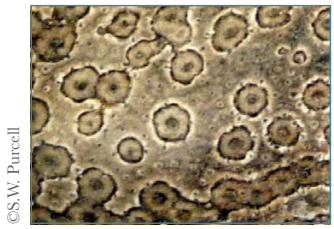
44b. No spots are evident on body . . . . . ➜ 52

45a. A few larger spots on the body on top of warts/wrinkles; fine reticulated dark lines present . . . . . ➜ ***Stichopus vastus***

45b. Visible eye spots on either the dorsal or ventral surface of body . . . . . ➜ 46

45c. Numerous fine dark spots on body . . . . . ➜ 47

45d. White/ light spots on either the dorsal or ventral surface of the body; dark spots absent . . . . . ➜ 50



Examples of visible eye spots (examples taken from images of *Bohadschia argus* and *Stichopus ocellatus*)

46a. Haphazard body wrinkles; orange-brown body colour . . . . . ➜ ***Stichopus ocellatus***

46b. Wart-like bumps on dorsal surface of body; dark brown body colour ➜ ***Holothuria grisea***

47a. Wart-like bumps present on body . . . . . ➜ 48

47b. Wart-like bumps absent on body . . . . . ➜ 49

48a. Wart-like bumps at each end of the body and along body margins; fine white spots present alongside dark spots; distributed from United States of America to South America . . . . . ➜ ***Holothuria floridana***

48b. Randomly arranged wart-like bumps and wrinkles; distributed from East Africa to the Central Pacific . . . . . ➜ ***Stichopus herrmanni***

49a. Deep wrinkles and golden-brown body colour; distributed along the west coast of the Pacific, and in Asia, Africa and India . . . . . ➜ ***Holothuria fuscopunctata***

49b. Body light-brown in colour, with wrinkles; distributed in the Northeast Atlantic . . . . . ➜ ***Holothuria lentiginosa lentiginosa***

50a. Mouth splayed into a flange; body often appears twisted; body dark grey . . . . . ➜ ***Holothuria coluber***

50b. Mouth not splayed into a flange . . . . . ➜ 51

51a. Dark brown or black body colour; body with a rough texture and slightly tapered ends; white spots are mainly on the ventral surface . . . . . ➜ ***Holothuria poli***

51b. Lighter spots are present, due to the distinct wart-like bumps; body brown and ventral surface grainy; small cut across mouth or ventrally . . . . . ➜ ***Thelenota anax***

52a. Body is almost to completely smooth . . . . . ➜ 53

52b. Body somewhat to very rough, pimply or warty . . . . . ➜ 56

53a. Dark brown to black body colour . . . . . ➜ ***Holothuria atra***

53b. Chalky white deposits on the body . . . . . ➜ 54

53c. Light grown to brown body colour . . . . . ➜ 55

54a. Semi-translucent golden honey-brown colour . . . . . ➜ ***Holothuria lessoni***

54b. Very chalky, with the chalky white sometimes appearing as bands across the body; light to medium brown colour . . . . . ➜ ***Holothuria arenicola***

55a. Many small wrinkles covering the dorsal surface of body; small specimens (<10 cm); anus tapering to a point . . . . . ➜ ***Holothuria notabilis***

55b. Light brown to pink ventrally; sometimes with small subtle wrinkles ➜ ***Holothuria edulis***

56a. Subtle to very evident body wrinkles . . . . . ➜ 57

56b. No visible body wrinkles . . . . . ➜ 60

57a. Body with somewhat translucent, deposits on it (crystalline or chalky) . . . . . ➜ 58

57b. Body not translucent . . . . . ➜ 59

58a. Body light to dark brown and very wrinkled; crystalline deposits on the body, somewhat translucent; blunt ends with small cut at posterior end . . . . . ➜ ***Holothuria spinifera***

58b. Brownish orange dorsally and golden yellow-orange ventrally; somewhat to relatively translucent across whole body; slender and heavily wrinkled, with bumps; some chalky white deposits, mainly in wrinkles . . . . . ➜ ***Holothuria dakarensis***

59a. Wrinkles on body caused by the numerous wart-like bumps; brown body colour with light coloured bumps, often with a central dark spot; body tapers towards anus . . . . . ➜ ***Holothuria fuscocinerea***

59b. Large wrinkles and possible body twisting, along with numerous very small wrinkles covering the body surface; obvious podia with blunt ends . . . . . ➜ ***Holothuria sanctori***

60a. Body is relatively (<12 cm) with grainy, pimply warts and brown bands . . . . . ➜ ***Holothuria impatiens***

60b. Brown body colour with dark brown warts, highly elongate shape ➜ ***Holothuria pardalis***

60c. Brown to black body with numerous bumpy warts; mostly on the dorsal surface; rectangular body that is squarish in cross-section; ventral surface flattened with podia visible . . . . . ➜ ***Stichopus monotuberculatus***

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INDEX OF SCIENTIFIC AND VERNACULAR NAMES

EXPLANATION OF THE SYSTEM

Italics : Valid scientific names (double entry by genera and species)

Italics : Synonyms and misidentifications

ROMAN : Family names

ROMAN : Names of orders, class, subclass, superfamilies

Roman : FAO names

Roman : Local names

Y

Z

Sea cucumbers are exploited and traded in more than 90 countries worldwide. This second edition of this book provides identification information on 84 species of sea cucumbers that are commonly exploited in artisanal and industrial fisheries around the world. Not all exploited species are included. It is intended for fishery managers, scientists, trade officers and industry workers. This book gives essential information to enable species to be distinguished from each other, both in the live and processed (dried) forms. Where available for each species, the following information has been included: nomenclature together with FAO names and known common names used in different countries; scientific illustrations of the body and ossicles; descriptions of ossicles present in different body parts; colour photographs of live and dried specimens; basic information on body size, habitat, biology, fisheries, human consumption, market value and trade; geographic distribution maps. This edition features dichotomous keys to assist in the identification of live and dried specimens. Species and common names are indexed and this guidebook contains an introduction, a glossary and bibliography.

ISBN 978-92-5-137793-2 ISSN 1020-8682

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CC5230EN/1/04.23