

IDENTIFICATION GUIDE

Commercial Sea Cucumbers

Marie Di Simone, Arnaud Horellou,
Frédéric Ducarme and Chantal Conand



October 2022

PATRINAT

Centre d'expertise et de données sur le patrimoine naturel

A joint service of the Office français de la biodiversité, the Centre national de la recherche scientifique and the Muséum national d'Histoire naturelle



Visit the INPN website: <https://inpn.mnhn.fr/>

Cover photo: *Holothuria nobilis* (Selenka, 1867) – © Philippe Bourjon

Project Name: Identification guide – Commercialised Sea Cucumbers

Project Managers: Marie Di Simone, Arnaud Horellou

Proofreading: Jessica Thévenot

Table of contents

| | |
|--|-----|
| Acknowledgements | 5 |
| General Remarks on Sea Cucumbers..... | 10 |
| External Morphology..... | 10 |
| Ossicles..... | 12 |
| Habitat..... | 12 |
| Different orders of sea cucumbers | 12 |
| Classification of the commercialised species included in this book | 21 |
| How to use this guide? | 23 |
| Symbols Glossary | 26 |
| Challenges in Identification..... | 27 |
| What are the key pages for? | 28 |
| Different Types of Incisions | 29 |
| GENERAL TABLE OF COMMERCIALISED SPECIES, LIVE AND DRY | 30 |
| SECTION 1: Protuberances | 31 |
| SECTION 2: Lack of protuberances..... | 32 |
| SECTION 3: Dry form | 33 |
| IDENTIFICATION KEY FOR THE LIVE FORM..... | 34 |
| IDENTIFICATION KEY FOR THE DRY FORM..... | 78 |
| Species Cards | 100 |
| Holothuriida: Holothuriidae | 100 |
| Actinopyga echinites..... | 101 |
| Actinopyga lecanora | 102 |
| Actinopyga mauritiana | 104 |
| Actinopyga miliaris | 106 |
| Actinopyga palauensis..... | 108 |
| Actinopyga spinea..... | 110 |
| Actinopyga flammea | 112 |
| Bohadschia argus..... | 114 |
| Bohadschia atra | 116 |
| Bohadschia marmorata | 118 |
| Bohadschia vitiensis..... | 122 |
| Pearsonothuria graeffei | 124 |
| Holothuria arenicola..... | 126 |

| | |
|----------------------------------|-----|
| Holothuria atra | 128 |
| Holothuria cinerascens | 130 |
| Holothuria coluber..... | 132 |
| Holothuria edulis | 134 |
| Holothuria flavomaculata | 136 |
| Holothuria fuscocinerea | 138 |
| Holothuria fuscogilva | 140 |
| Holothuria fuscopunctata | 142 |
| Holothuria hilla..... | 144 |
| Holothuria impatiens | 146 |
| Holothuria kefersteinii | 148 |
| Holothuria lessoni | 150 |
| Holothuria leucospilota..... | 152 |
| Holothuria mexicana..... | 154 |
| Holothuria nobilis..... | 156 |
| Holothuria notabilis | 158 |
| Holothuria sp..... | 160 |
| Holothuria pardalis | 162 |
| Holothuria pervicax | 164 |
| Holothuria scabra | 166 |
| Holothuria spinifera..... | 168 |
| Holothuria whitmaei | 170 |
| Synallactida: Stichopodidae..... | 172 |
| Apostichopus californicus | 173 |
| Apostichopus japonicus | 175 |
| Apostichopus parvimensis..... | 177 |
| Astichopus multifidus | 179 |
| Astichopus multifidus | 180 |
| Australostichopus mollis | 181 |
| Isostichopus badionotus | 183 |
| Isostichopus fuscus..... | 185 |
| Stichopus chloronotus..... | 187 |
| Stichopus hermanni..... | 189 |
| Stichopus horrens..... | 191 |
| Stichopus monotuberculatus | 192 |
| Stichopus naso | 194 |

| | |
|--|-----|
| Stichopus ocellatus..... | 196 |
| Stichopus pseudohorrens | 198 |
| Stichopus vastus..... | 200 |
| Thelenota ananas | 202 |
| Thelenota anax..... | 204 |
| Thelenota rubralineata | 206 |
| Dendrochirotida: Cucumariidae | 208 |
| Athyonidium chilensis..... | 209 |
| Cucumaria frondosa frondosa | 212 |
| Cucumaria frondosa japonica..... | 214 |
| References | 216 |
| Glossary | 219 |
| Appendices | 221 |
| Appendix 1. The three CITES Appendices | 222 |
| Appendix 2. The Different Types of Ossicles in Sea Cucumbers..... | 223 |
| Appendix 3. Identification key for the three CITES-listed species of sea cucumbers | 224 |

Photo credits: DORIS <https://doris.ffessm.fr/>; FAO; Institut de recherche pour le développement (IRD) – Lagplon – DOI GBIF: [10.15468/wafmud](https://doi.org/10.15468/wafmud); IH-SM-WIOMSA; NOAA/MBARI; Anders Poulsen; Anne Prouzet; Beni Giraspi; Benjamin Guichard; Chami Dissanayake; Chantal Conand; Chita Guisado; Claudio Maureira; Daniel Baskar James; David Raven; David Rolla; Éric Aubry; Francisco Solis-Marin; François Michonneau; Frédéric Ducarme; Georgina Robinson; Hampus Eriksson; Icolmer; J. Zounes; Jan Haaga; Jean-Michel Sutour; John Cassell; Juan Miguel Cancino; Jun Akamine; Kuroshio; L. Zamora; L.B. Concepcion; Magali Honey-Escandon; Marique; N. Samanyan; Nick Hobgood; Peter Southwood; Philippe Bourjon; Ravinesh Ram; Ria Tan; Riaz Aumeeruddy; Steven Purcell; Véronique Lamare; Vincent Maran; Yves Herraud.

Illustration credits: spicules and distribution maps: Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive; keys, clip art and icons: Arnaud Horellou/Patrinat.

Creative Commons licenses:

CC BY SA 2.0 <https://creativecommons.org/licenses/by-sa/2.0/fr/>;

CC BY SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0/fr/>;

CC BY NC <https://creativecommons.org/licenses/by-nc/2.0/fr/>;

CC BY <https://creativecommons.org/licenses/by/2.0/fr/>;

CC BY NC SA <https://creativecommons.org/licenses/by-nc-sa/3.0/fr/>

Acknowledgements

The authors would like to thank all of the people whose support and valuable contributions allowed us to develop this guide.

This document was made possible thanks to funding provided by PatriNat.

Special thanks to the FAO and Kim Friedman for collaborating with us, and for allowing us to use the guide "Commercially important sea cucumbers of the world" as support; without it, this guide could not have existed.

We would also like to thank the participative website DORIS, which provided valuable information on the species, and Alain-Pierre Sittler, who served as intermediary between us and the owners of the photographs so we could use their images.

We thank the IRD and Sylvie Fiat for authorizing the use of the photos.

We also want to express our gratitude to all the contributors who provided us with incredible photos of the species, Steven Purcell, Jean-Michel Sutour, Benjamin Guichard, Jeff Kinch, Aymeric Desurmont, Philippe Bourjon, Frédéric Ducarme and all the other photographers who gave us permission to use their images in this guide: DORIS <https://doris.ffessm.fr/>; FAO; Institut de recherche pour le développement (IRD) – Lagplon – DOI GBIF: [10.15468/wafmud](https://doi.org/10.15468/wafmud); IH-SM-WIOMSA; NOAA/MBARI; Anders Poulsen; Anne Prouzet; Beni Giraspi; Benjamin Guichard; Chami Dissanayake; Chantal Conand; Chita Guisado; Claudio Maureira; Daniel Baskar James; David Raven; David Rolla; Éric Aubry; Francisco Solis-Marin; François Michonneau; Frédéric Ducarme; Georgina Robinson; Hampus Eriksson; Icolmer; J. Zounes; Jan Haaga; Jean-Michel Sutour; John Cassell; Juan Miguel Cancino; Jun Akamine; Kuroshio; L. Zamora; L.B. Concepcion; Magali Honey-Escandon; Marique; N. Samanyan; Nick Hobgood; Peter Southwood; Philippe Bourjon; Ravinesh Ram; Ria Tan; Riaz Aumeeruddy; Steven Purcell; Véronique Lamare; Vincent Maran; Yves Herraud.



**Food and Agriculture
Organization of the
United Nations**



Données d'Observations pour la Reconnaissance et
l'identification de la faune et la flore Subaquatiques
doris.ffessm.fr



**Institut de Recherche
pour le Développement**
FRANCE

Introduction

CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (**CITES**), also known as the Washington Convention, is an international agreement that aims to ensure that international trade in specimens¹ of wild animals and plants listed in its appendices (**Appendix 1**) is carried out in a sustainable manner and does not threaten the survival of the specimens.

To this end, each State Party legally implements in its territory the provisions prescribed by the Convention, and controls the legality of any international transaction of endangered species, by issuing export permits and verifying import permits.

The competent control authorities, within the framework of their missions, may require the support of scientific experts to assess the controlled specimens so as to solidify their procedures.

Sea Cucumber Trade

Holothuria, commonly known as sea cucumbers, are traded in more than 70 countries around the world. They are harvested throughout the tropics, polar regions and temperate zones. When processed—cooked and/or dried—they are referred to as "bêche de mer" * or "trepang"*.

Sea cucumbers have been harvested and consumed by the Malay and Chinese populations for more than a thousand years, first in the Pacific countries, then gradually expanding their search. In the 18th century, other fishermen—Macassar from Sulawesi, European, Australian and American traders—began searching for sea cucumbers to exchange them in Manila and Canton for tea, silk and spices. Thanks to the Hong Kong market, it has been possible to track fluctuations in imports and re-exports of bêche-de-mer from the beginning of the 20th century. We were able to identify a clear increase in imports since the 1980s, which corresponds to the increase in re-exports to the People's Republic of China. In fact, during that time, the consumption of this product became much more widespread ([Conand 1989](#)).

¹ For the purposes of CITES, a specimen is any animal or plant, living or dead, and any part or product obtained from the animal or plant

The problem of sea cucumbers

In 1974, the Pacific Community (SPC) published the handbook “Bêche-de-mer of the South Pacific Islands”—updated in 1979 and 1994—which described the different species, processing methods and products. The Food and Agriculture Organisation of the United Nations (FAO) published an overview of the information available from the tropical Pacific (Conand 1986, 1990). Later international meetings launched a number of working groups: in 2003, the FAO-sponsored working group in Dalian (People's Republic of China) published “Advances in sea cucumber aquaculture and management” (Lovatelli *et al.* 2004); in 2007, the Galapagos (Ecuador) group presented the publication of “Sea cucumbers: a global review of fisheries and trade” (Toral-Granda *et al.* 2008) and “Managing sea cucumber fisheries with an ecosystem approach” (Purcell 2010). Finally, in 2012, the FAO coordinated a synthesis publication “Commercially important sea cucumbers of the world” (Purcell *et al.* 2012). A new edition, including more recently harvested species (Atlantic, Mediterranean, etc.) is being developed (Lovatelli 2021).

Sea Cucumbers and CITES

In 2003, Ecuador managed to include sea cucumbers in CITES Appendix III, with their proposal for listing their national populations of *Isostichopus fuscus* (Ludwig, 1875). Following the warnings and reports of threats of international trade presented in these publications, the CITES Secretariat organised the “CITES workshop on the conservation of sea cucumbers in the families *Holothuriidae* and *Stichopodidae*” in Kuala Lumpur (Malaysia) in 2004 (NOAA, Bruckner, 2006), which resulted in three sets of recommendations: National fisheries management, Priorities for international conservation and protection, and Potential CITES implementation issues.

377 species of sea cucumbers were assessed in Colombia in 2010, sponsored by the International Union for Conservation of Nature (IUCN), with the aim of establishing a red list. Seven species were listed as Endangered (EN) and another nine as Vulnerable (VU) (IUCN 2010, Conand *et al.* 2014, Purcell *et al.* 2014).

Introduction

It was at the eighteenth Conference of the Parties to CITES (CoP18) in Geneva, 2019, that sea cucumbers were finally included in Appendix II, with three species of the genus *Holothuria*—*H. nobilis* (Selenka, 1867), *H. whitmaei* (Bell, 1887) and *H. fuscogilva* (Cherbonnier, 1980) known as “teatfish”—following the proposal of the United States of America, Kenya, Senegal, Seychelles and the European Union ([Di Simone et al. 2019, 2020](#)); still, implementation was delayed by 12 months.

Identification Guide

The listing of sea cucumbers in CITES raises the question of how to implement controls and encourage reporting on a species rarely regarded by non-specialists. Sea cucumbers are mainly exported to Asia, and fisheries, traders and customs officers must be able to identify the different species to issue CITES permits.

This user-friendly identification guide features 56² species of sea cucumbers—protected and not protected by CITES—which are traded worldwide for consumption³. It has been deliberately designed to facilitate the identification of these species, and to detect fraud.

This guide is based on the FAO's 2012 sea cucumber identification guide: "Commercially important sea cucumbers of the world". Most of the information on the species in the FAO guide has been included—and updated—in this guide.

It must be noted that any guide is obsolete by the time of its publication. There is a new proposal to list sea cucumbers—*Thelenota* genus—in CITES Appendix II, as evidenced by the upcoming second edition of the FAO guide. These are signs of a growing awareness of the danger these animals face.

² Although the FAO guide lists 58 species, we have removed *Actinopyga agassizii* (Selenka, 1867), since we did not think it useful to include it as a commercial species, and *Cucumaria japonica* (Brandt, 1835), now considered a subspecies of *Cucumaria frondosa* (Gunnerus, 1767) ([WoRMS 2022a](#))

³ Some species of sea cucumbers can also be used in aquaristics, but since there are not many, they are not included in this guide.

Introduction

This guide is therefore intended to be completed at a later stage:

- Due to the depletion of highly valuable species, the number of harvested species is increasing, that is the exploitation of new species, in new areas, such as *Actinopyga caerulea*.
- Some data is missing in this guide: photos of the dried form of some species, morphological data, similar species, etc.
- Potentially obsolete or unreliable data needs to be updated.

General Remarks on Sea Cucumbers

Sea cucumbers belong to the class Holothuroidea in the phylum Echinoderms. There are currently about 1774 species of sea cucumbers, divided into seven orders and 30 families (WoRMS 2022b). Of these 1700 species, about 70 are commercially exploited worldwide (Purcell *et al.* 2012; O'Toole & Shea 2019).

External Morphology

Sea cucumbers have an elongated body (**Figure 1**), characterised by ventral surface* (trivium*) with tube feet or podia* and a dorsal surface* (bivium*) with papillae*.

The mouth is ventral and it is surrounded by tentacles* (**Figure 1**). Their number varies between 10 and 30. The shape of the tentacles varies according to the taxonomic order and can be used as a defining trait. In the orders of Holothuriida and Synallactida, the peltate tentacles are all the same size, but the tentacles of Dendrochirofida, for example, can vary in size.

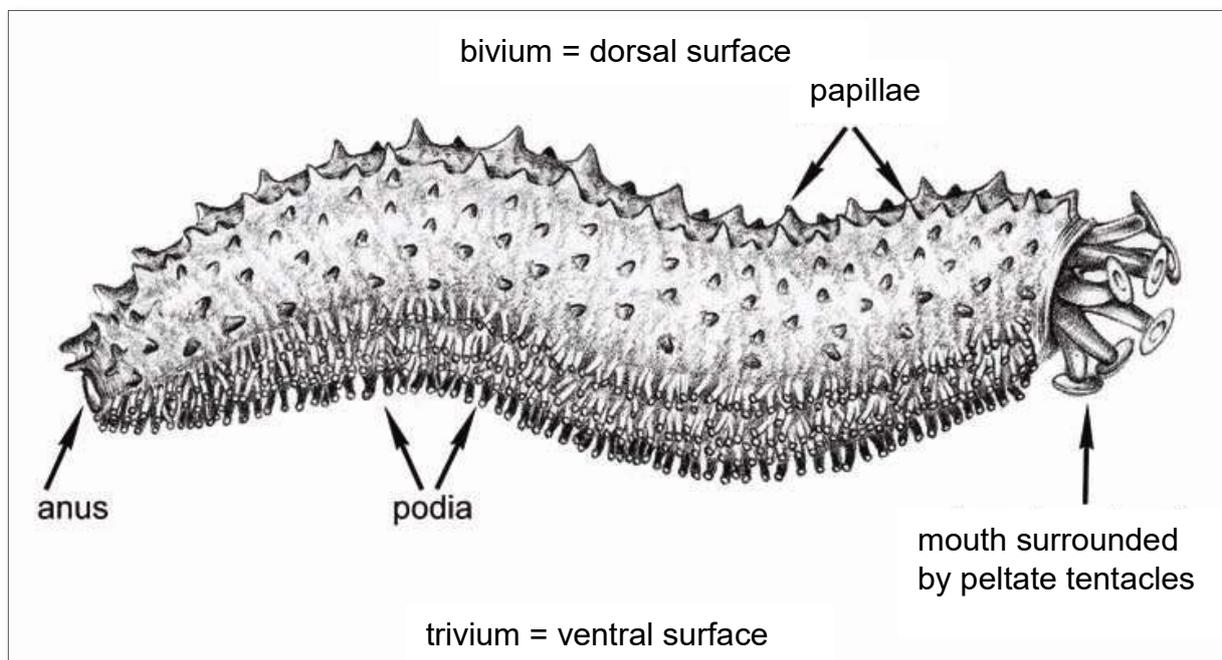


Figure 1. External anatomy of a sea cucumber (Holothuriida in this case) (Samyn *et al.* 2006).

General Remarks on Sea Cucumbers

In Dendrochirotida, tentacles are dendritic* (branching in an arborescent manner) and can reach a fairly large size when fully extended (**Figure 2**). Holothuriida and Synallactida have (with rare exceptions) peltate* tentacles, each with a central stalk and a little branching disc.

Sea cucumber tentacles are very retractile.

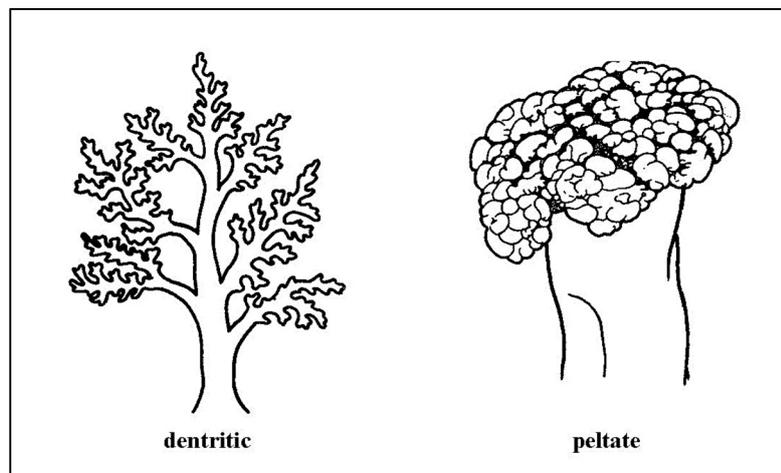


Figure 2. Different types of tentacles (Conand 1998)

Papillae can be wart-like, conical or fleshy. Podia appear on the body wall and are usually shaped like a rod with an adhesive disc at the end (**Figure 1**). Colouration varies between species and sometimes even between individuals of the same species. The ventral surface is often lighter in colour than the dorsal surface.

The morphological classification of sea cucumbers is based on the presence and/or shape of certain soft parts, including podia and oral tentacles (**Figure 1**). They help to determine their larger order (Samyn *et al.* 2006).

General Remarks on Sea Cucumbers

Ossicles

Also called spicules, ossicles are characteristic of sea cucumbers and of primary importance for identification. They are mostly microscopic in size. They come in a wide variety of shapes, from simple to complex (**Appendix 2**). The shape of the spicules differs from species to species and can be used to identify commercial species.

Habitat

Holothurians are found across all oceans and seas, at all latitudes. Adults are benthic—living on the sea bottom. Some species live on hard substrates, rocks, coral reefs; however, most of the species inhabit soft bottoms, on the sediment surface or buried in the sediment. Among the commercial coastal holothurians, the Holothuriida and Synallactida are predominant in the tropics, while the Dendrochirotida are more common in temperate regions.

Different orders of sea cucumbers

Sea cucumbers are divided into seven orders, three of which are impacted by trade (**Figure 3**). Only the five main orders will be included in this guide. Orders that are not involved in trade will not be discussed.

General Remarks on Sea Cucumbers

3 orders et 3 families are involved in trade:

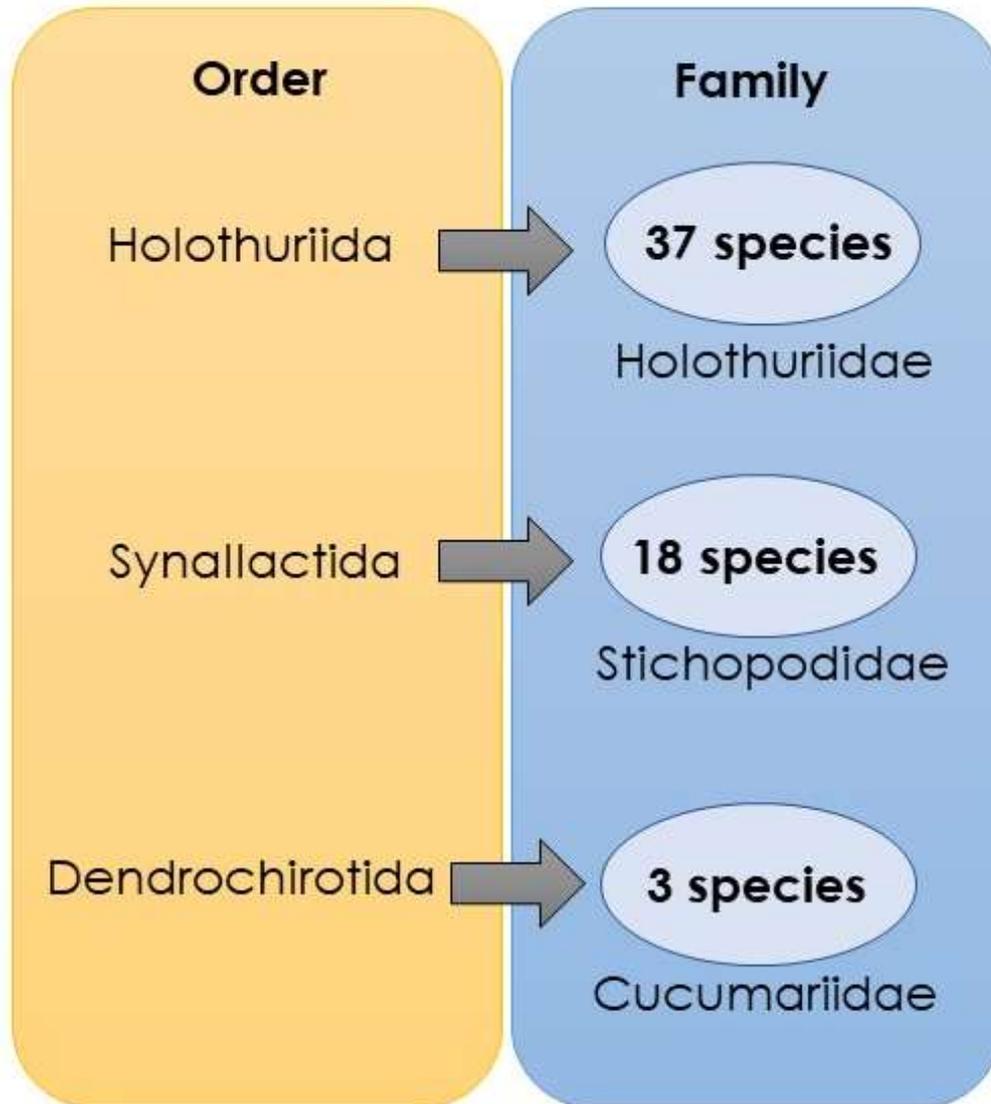
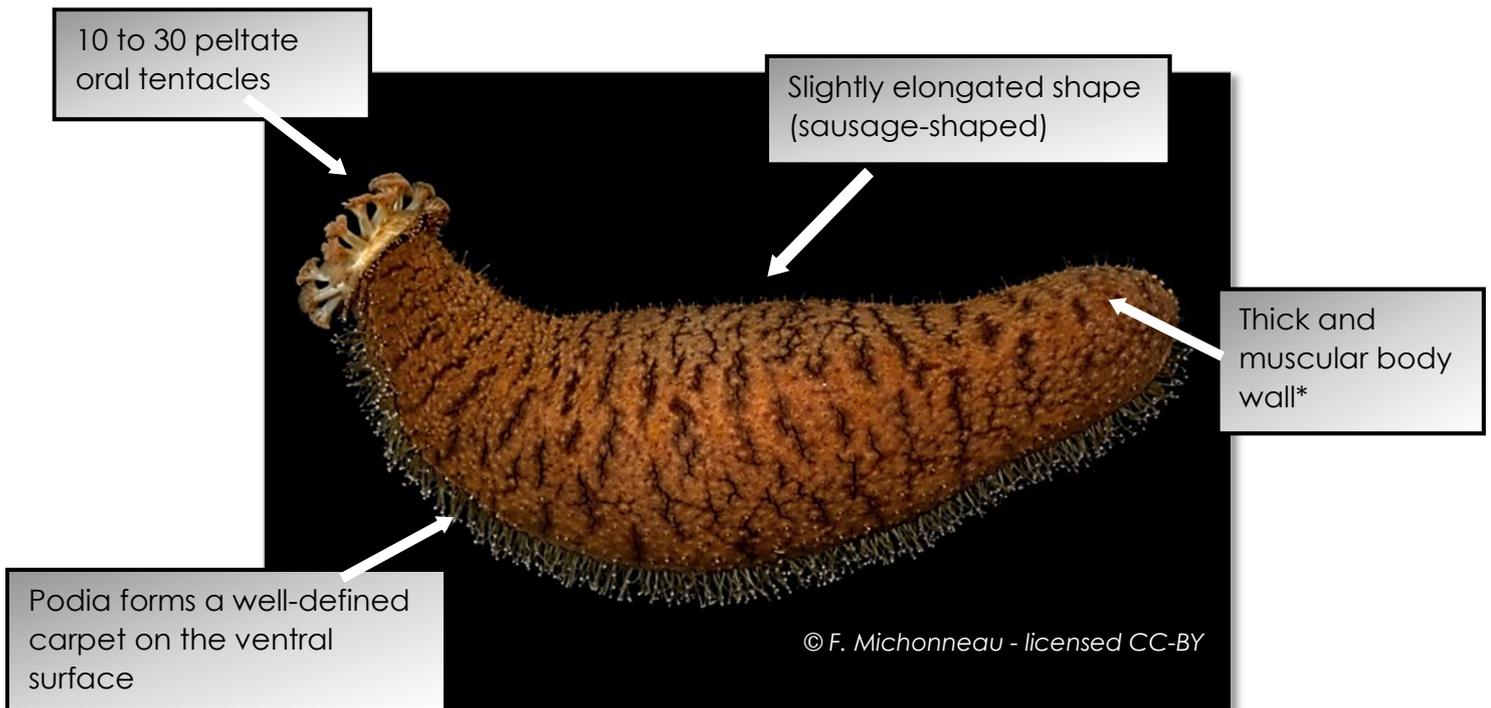


Figure 3. Orders and families of sea cucumbers involved in the trade.

General Remarks on Sea Cucumbers

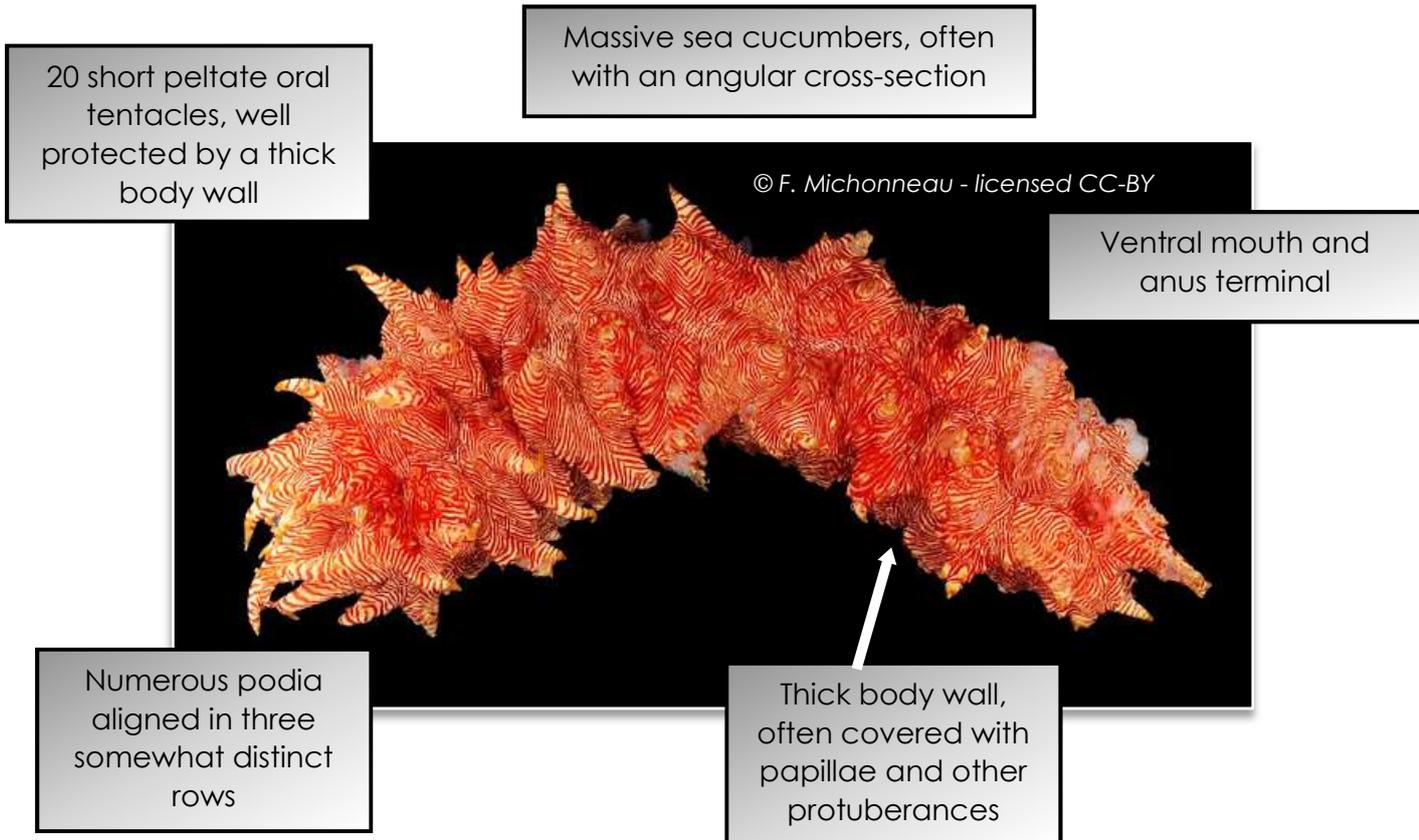
Holothuriida (formerly Aspidochirotida)



NB: Some species of this order present Cuvierian tubules and/or anal teeth**

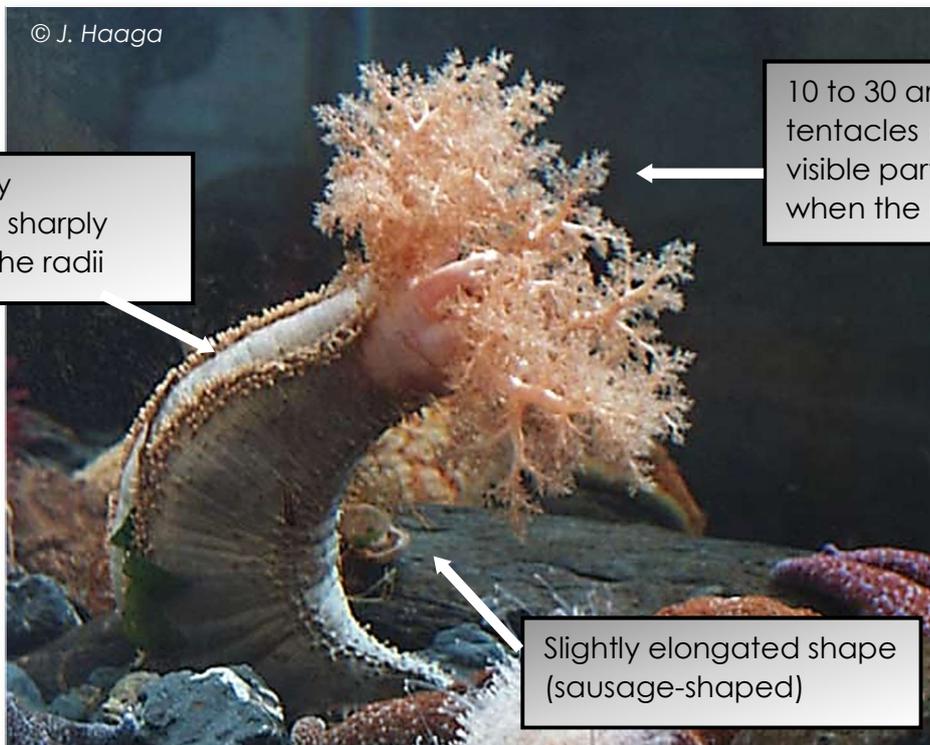
General Remarks on Sea Cucumbers

Synallactida



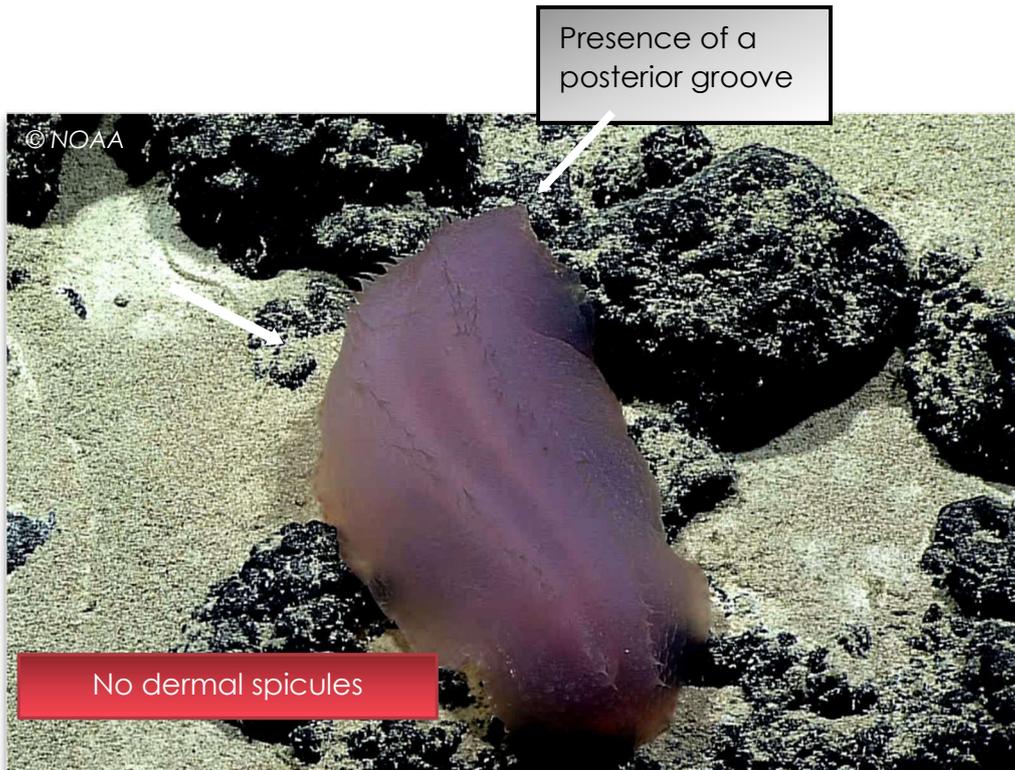
General Remarks on Sea Cucumbers

Dendrochirotida



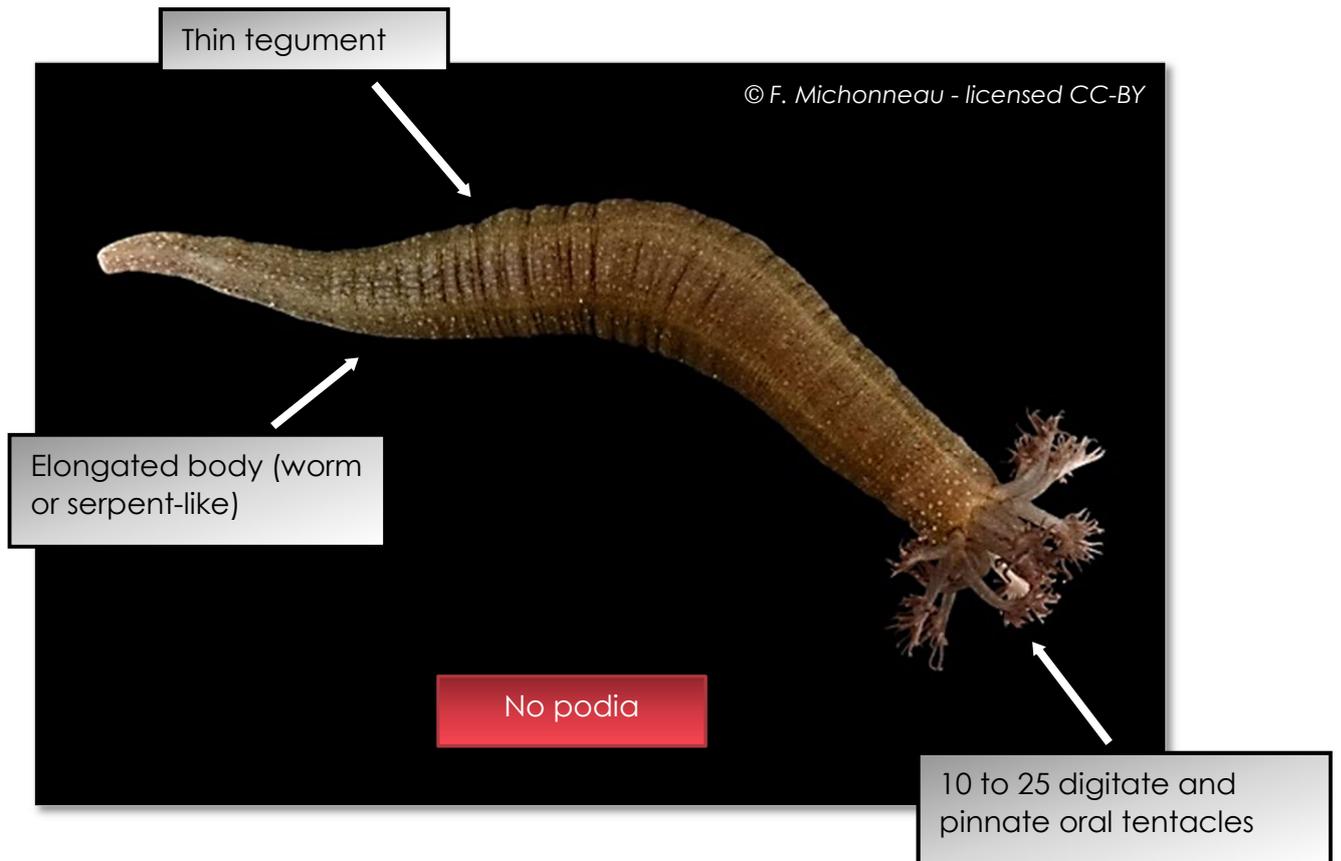
General Remarks on Sea Cucumbers

Persiculida



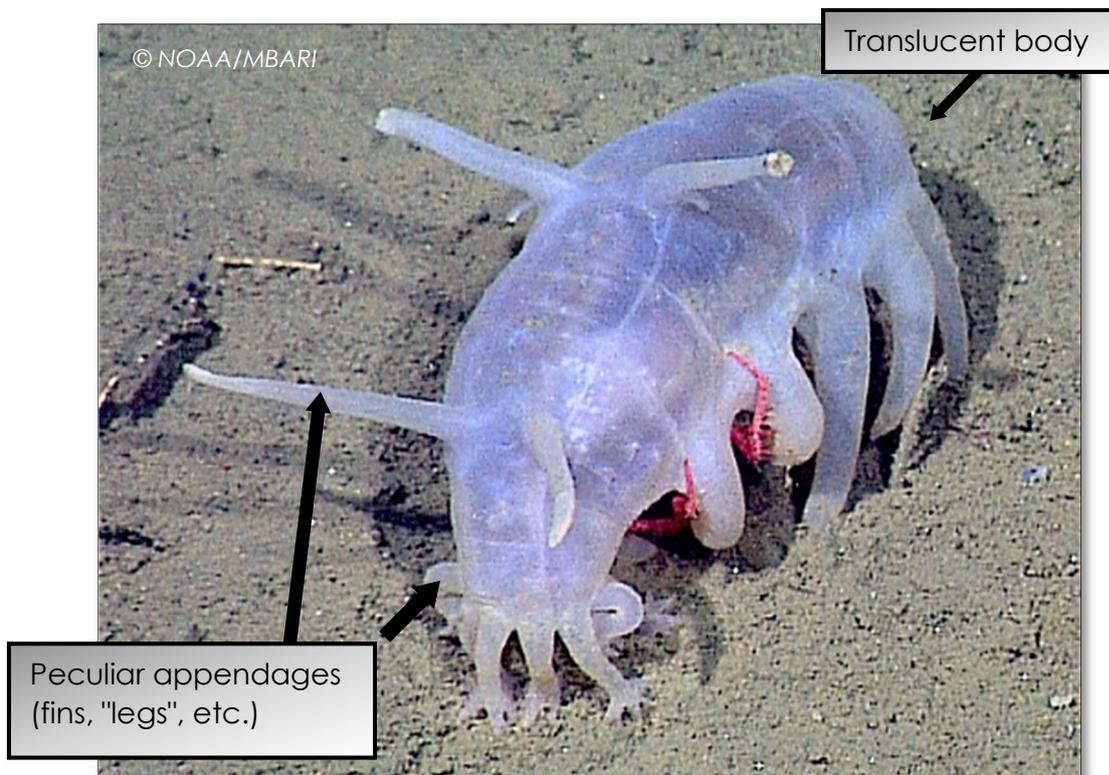
General Remarks on Sea Cucumbers

Apodida



General Remarks on Sea Cucumbers

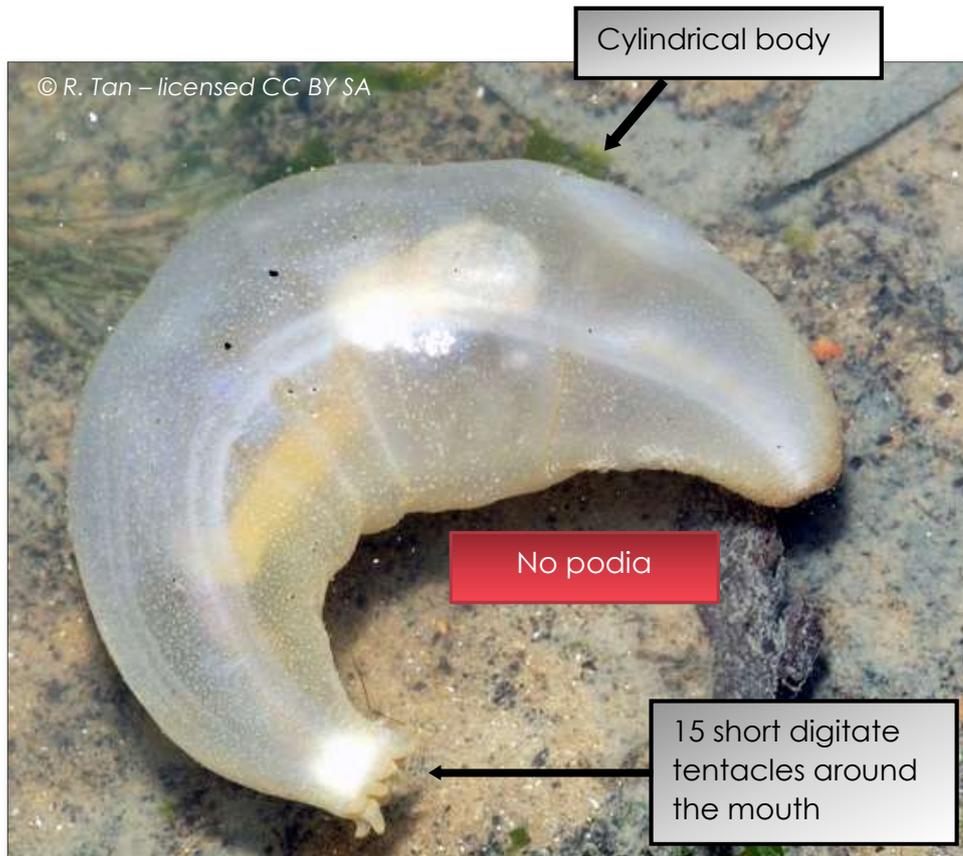
Elasipodida



NB: All species in this order are abyssal.

General Remarks on Sea Cucumbers

Molpadida



NB: Most species of this order are found buried in muddy habitats, where they are almost undetectable. Some also live at great depths.

Classification of the commercialised species included in this book

| Order | Family | Species |
|--------------|---------------|--|
| Holothuriida | Holothuriidae | <i>Actinopyga echinites</i> (Jaeger, 1833) |
| Holothuriida | Holothuriidae | <i>Actinopyga lecanora</i> (Jaeger, 1835) |
| Holothuriida | Holothuriidae | <i>Actinopyga mauritiana</i> (Quoy and Gaimard, 1833) |
| Holothuriida | Holothuriidae | <i>Actinopyga miliaris</i> (Quoy and Gaimard, 1833) |
| Holothuriida | Holothuriidae | <i>Actinopyga palauensis</i> (Panning, 1944) |
| Holothuriida | Holothuriidae | <i>Actinopyga spinea</i> (Cherbonnier, 1980) |
| Holothuriida | Holothuriidae | <i>Actinopyga flammea</i> (Cherbonnier, 1979) |
| Holothuriida | Holothuriidae | <i>Bohadschia argus</i> (Jaeger, 1833) |
| Holothuriida | Holothuriidae | <i>Bohadschia atra</i> (Massin, Rasolofonirina, Conand and Samyn, 1999) |
| Holothuriida | Holothuriidae | <i>Bohadschia marmorata</i> (Jaeger, 1833) |
| Holothuriida | Holothuriidae | <i>Bohadschia subrubra</i> (Quoy & Gaimard, 1833) |
| Holothuriida | Holothuriidae | <i>Bohadschia vitiensis</i> (Semper, 1868) |
| Holothuriida | Holothuriidae | <i>Pearsonothuria graeffei</i> (Semper, 1868) |
| Holothuriida | Holothuriidae | <i>Holothuria arenicola</i> (Semper, 1868) |
| Holothuriida | Holothuriidae | <i>Holothuria atra</i> (Jaeger, 1833) |
| Holothuriida | Holothuriidae | <i>Holothuria cinerascens</i> (Brandt, 1835) |
| Holothuriida | Holothuriidae | <i>Holothuria coluber</i> (Semper, 1868) |
| Holothuriida | Holothuriidae | <i>Holothuria edulis</i> (Lesson, 1830) |
| Holothuriida | Holothuriidae | <i>Holothuria flavomaculata</i> (Semper, 1868) |
| Holothuriida | Holothuriidae | <i>Holothuria fuscocinerea</i> (Jaeger, 1833) |
| Holothuriida | Holothuriidae | <i>Holothuria fuscogilva</i> (Cherbonnier, 1980) |
| Holothuriida | Holothuriidae | <i>Holothuria fuscopunctata</i> (Jaeger, 1833) |
| Holothuriida | Holothuriidae | <i>Holothuria hilla</i> (Lesson, 1830) |
| Holothuriida | Holothuriidae | <i>Holothuria impatiens</i> (Forsskål, 1775) |
| Holothuriida | Holothuriidae | <i>Holothuria kefersteinii</i> (Selenka, 1867) |
| Holothuriida | Holothuriidae | <i>Holothuria lessoni</i> (Massin, Uthicke, Purcell, Rowe and Samyn, 2009) |
| Holothuriida | Holothuriidae | <i>Holothuria leucospilota</i> (Brandt, 1835) |
| Holothuriida | Holothuriidae | <i>Holothuria nobilis</i> (Selenka, 1867) |
| Holothuriida | Holothuriidae | <i>Holothuria notabilis</i> (Ludwig, 1875) |
| Holothuriida | Holothuriidae | <i>Holothuria sp. (type 'Pentard')</i> |
| Holothuriida | Holothuriidae | <i>Holothuria pardalis</i> (Selenka, 1867) |
| Holothuriida | Holothuriidae | <i>Holothuria pervicax</i> (Selenka, 1867) |
| Holothuriida | Holothuriidae | <i>Holothuria scabra</i> (Jaeger, 1833) |
| Holothuriida | Holothuriidae | <i>Holothuria spinifera</i> (Théel, 1886) |

| Order | Family | Species |
|-----------------|---------------|---|
| Holothuriida | Holothuriidae | <i>Holothuria whitmaei</i> (Bell, 1887) |
| Synallactida | Stichopodidae | <i>Apostichopus californicus</i> (Stimpson, 1857) |
| Synallactida | Stichopodidae | <i>Apostichopus japonicus</i> (Selenka, 1867) |
| Synallactida | Stichopodidae | <i>Apostichopus parvimensis</i> (Clark, 1913) |
| Synallactida | Stichopodidae | <i>Astichopus multifidus</i> (Sluiter, 1910) |
| Synallactida | Stichopodidae | <i>Australostichopus mollis</i> (Hutton 1872) |
| Synallactida | Stichopodidae | <i>Isostichopus badionotus</i> (Selenka, 1867) |
| Synallactida | Stichopodidae | <i>Isostichopus fuscus</i> (Ludwig, 1875) |
| Synallactida | Stichopodidae | <i>Stichopus chloronotus</i> (Brandt, 1835) |
| Synallactida | Stichopodidae | <i>Stichopus hermanni</i> (Semper, 1868) |
| Synallactida | Stichopodidae | <i>Stichopus horrens</i> (Selenka, 1868) |
| Synallactida | Stichopodidae | <i>Stichopus monotuberculatus</i> (Quoy & Gaimard, 1834) |
| Synallactida | Stichopodidae | <i>Stichopus naso</i> (Semper, 1868) |
| Synallactida | Stichopodidae | <i>Stichopus ocellatus</i> (Massin, Zulfigar, Tan Shua Hwai and Rizal Boss, 2002) |
| Synallactida | Stichopodidae | <i>Stichopus pseudohorrens</i> (Cherbonnier, 1967) |
| Synallactida | Stichopodidae | <i>Stichopus vastus</i> (Sluiter, 1887) |
| Synallactida | Stichopodidae | <i>Thelenota ananas</i> (Jaeger, 1833) |
| Synallactida | Stichopodidae | <i>Thelenota anax</i> (Clark, 1921) |
| Synallactida | Stichopodidae | <i>Thelenota rubralineata</i> (Massin and Lane, 1991) |
| Dendrochirotida | Cucumariidae | <i>Athyonidium chilensis</i> (Semper, 1868) |
| Dendrochirotida | Cucumariidae | <i>Cucumaria frondosa</i> (Gunnerus, 1767) |
| Dendrochirotida | Cucumariidae | <i>Cucumaria frondosa japonica</i> (Semper, 1868) |

How to use this guide?

Descriptive pages

The species are presented in a simplified identification sheet with the following information:

- Scientific name and common name(s) of the species
- A photo of the species, alive and in its commercial form (dried)
- Morphological description/distinctive characteristics (size, weight, colour, shape)
- The commercial value of the species
- Illustration and description of the spicules
- Geographical distribution of the species (some distribution maps are based on personal communications, and are therefore most likely incomplete for some regions, such as Southeast Asia, due to lack of information).

When available, the above information for each species has been included. Readers are encouraged to base their identifications on a combination of morphological traits, ossicle samples from different body parts, and information about the area where the species was found. Some species are not included in this first guide because they are rarely harvested or harvested in small quantities.



Juveniles* have not been sufficiently studied and will therefore not be discussed in this guide. There is no differentiation between females and males.

How to use this guide?

Scientific name, author and year Geographical distribution

Size of the species

Pictogram indicating if the species is CITES

The commercial value of the species

Common names of the species

Live form of the species

Macroscopic morphological features (colour, weight, size, shape) in the live form

Pictograms indicating the presence of ejectable cuvierian tubules and/or anal teeth

Main distinguishing features

Commercialised form of the species

Macroscopic morphological features (colour, weight, size, shape) in the dried form

Holothuria (Microthele) fuscoailva
Cherbonnier, 1980

Noms communs : White teatfish
 Holothurie blanche à mamelles

Une seule rainure droite sur la face dorsale

6 à 8 protubérances latérales

Forme vivante

Forme séchée

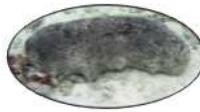
| | |
|--|--|
| 42 cm en moyenne 2,4 kg en moyenne Du brun foncé au gris foncé avec des taches blanchâtres, ou blanchâtre ou beige avec des taches <u>brunes foncées</u> | 18-24 cm Gris-brun Lisse à légèrement ridé avec des « mamelles » plus longues que les deux autres espèces, et plus pointues, qui sont blanches par rapport au reste du corps |
|--|--|

How to use this guide?

Espèces ressemblantes 



Holothuria nobilis



Holothuria whitmaei

Et pour les spécialistes ... 

Caractéristiques des spicules :

- Tentacules à grosses tiges, jusqu'à 700 µm de long, rugueux distalement.
- Paroi dorsale avec tables et boutons ellipsoïdes.
- Disque de table arrondi et ondulé, 65–100 µm de diamètre, perforé de 10–15 trous, flèche basse se terminant par une solide couronne d'épines pouvant avoir plus d'une couche dans les plus grandes tables.
- Boutons ellipsoïdes irréguliers, d'environ 65 µm de long.
- Paroi ventrale avec tables et boutons ellipsoïdes similaires à ceux de la face dorsale et, en outre, boutons légèrement bombés, de 60–80 µm de long.
- Podia ventral et dorsal avec de grandes plaques perforées.



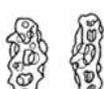
table of ventral body wall



large tables of dorsal body wall



ellipsoids of ventral body wall



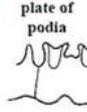
ellipsoids of dorsal body wall



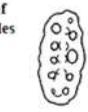
plate of podia



rod of tentacles



calcareous ring



button of ventral body wall



perforated plate of podia

Microscopic distinguishing features (description of spicules)

Similar species that might be confused with the species in question

Illustration of the spicules

How to use this guide?

Symbols Glossary



Key element for identification

Included in CITES or not?



The species is listed in CITES Appendix I, II or III: trading of the species is regulated by CITES, the required CITES permit(s) must be verified.⁴

Commercial Value



High



Medium



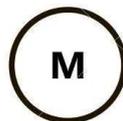
Low

Size (live form)



Small

(Less than or equal to 14 cm)



Medium

(Between 15 and 29 cm)



Large

(Equal to or larger than 30 cm)

Special characteristics



Species that ejects its
cuvierian tubules



Presence of anal teeth

⁴ Four species of sea cucumbers are listed under CITES: *Isostichopus fuscus* in Appendix III, *Holothuria fuscogilva*, *H. nobilis* and *H. whitmaei* in Appendix II. The guide will serve as a support and might include new listings in the future.

How to use this guide?

Challenges in Identification

There are no obvious macroscopic morphological features that distinguish the three families of the order Holothuriida.

The identification of a species of sea cucumber must be based on a combination of morphological characteristics (colour, shape, size, presence of certain organs, etc.), the morphology of the spicules and information on the area where the species was collected.

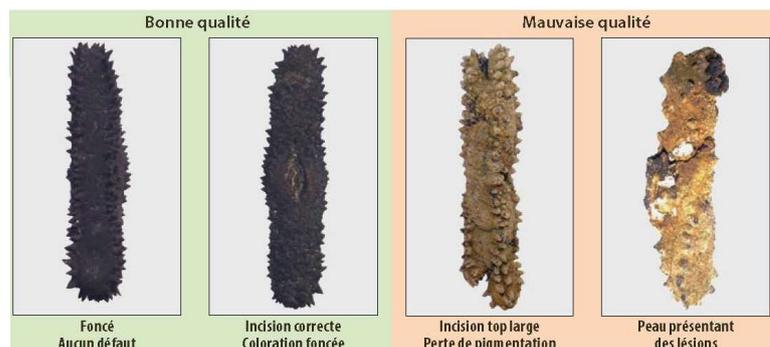
Some species are more easily identified than others, and their identification can be based on a single morphological criterion. For example, *Actinopyga lecanora* (Jaeger, 1833) can be identified solely by the white spot around its anus.

In their natural habitat, these animals are often covered with sand/sediment, which can hide their distinctive features. For others, such as *Holothuria atra* Jaeger, 1833, the manner of covering itself with sand is in itself a distinctive feature.

Sea cucumbers are mainly traded in dried form, which makes it more difficult to identify the species, since processing changes their colour, shape and size (Setyastuti & Purwati 2015; Uthicke *et al.* 2010; Purwati *et al.* 2010).

Contrary to fresh specimens, dried sea cucumbers may be in a poor state of preservation, depending on the quality of their treatment (drying, incision to remove the viscera). If the quality of the dried specimen is affected, it will not match the description offered in this sheet, and identification will be even more difficult. For example, if dried at temperatures higher than 45°C, the sea cucumber will curl or develop a rougher surface; it may even lose its colour (Purcell 2014) (Figure 4).

Figure 4. Examples of good and poor-quality specimens of *Stichopus chloronotus* Brandt, 1835. (Source: Purcell 2014)



How to use this guide?

What are the key pages for?

The identification process consists of observing the characteristics of an adult animal. The sea cucumber can be alive, fresh⁵ or dry.

There are two categories of key pages:

- 1- Key pages to identify sea cucumbers in their live form
- 2- Key pages to identify sea cucumbers in their dried form

The key does not systematically classify species, but rather according to their morphological affinities. This is what sets this identification guide apart.

These reference pages are organized according to three main distinguishing characteristics: colour, shape and the presence of protuberances* (which can sometimes be papillae or podia). As defining characteristics, these three have their limitations, especially colour. In fact, colour can vary within a species, depending on its variety and location (*Bohadschia subrubra* (Quoy & Gaimard, 1834) for example). The same applies to the bêche-de-mer, which can be of different colour within the same species. Other characteristics have also been considered, such as the presence of anal teeth and wrinkles.

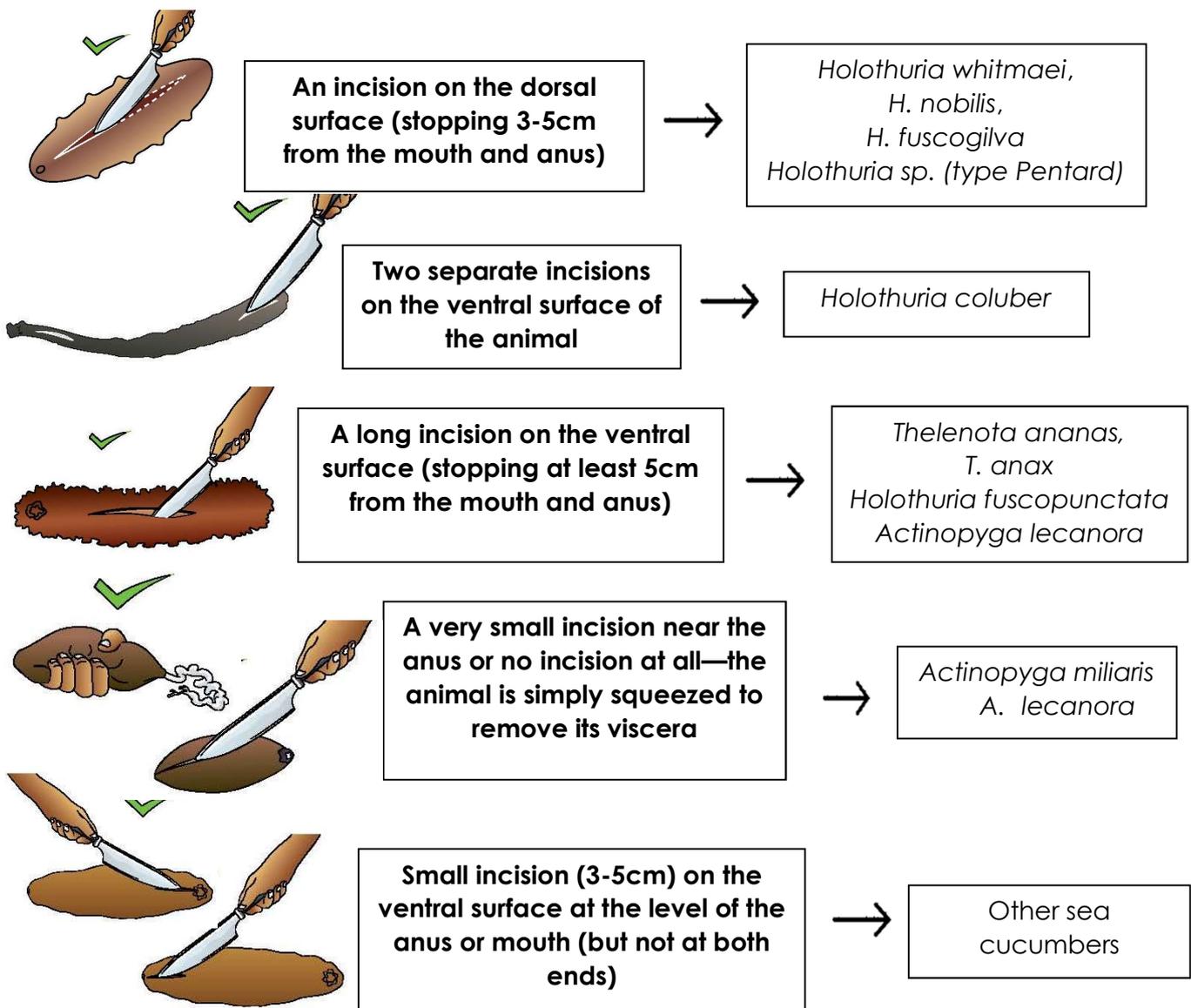


The key only covers commercialised species, both for the live and dried forms. The list of commercialised species was taken from the guide "Commercially important sea cucumbers of the world". (Purcell *et al.* 2012).

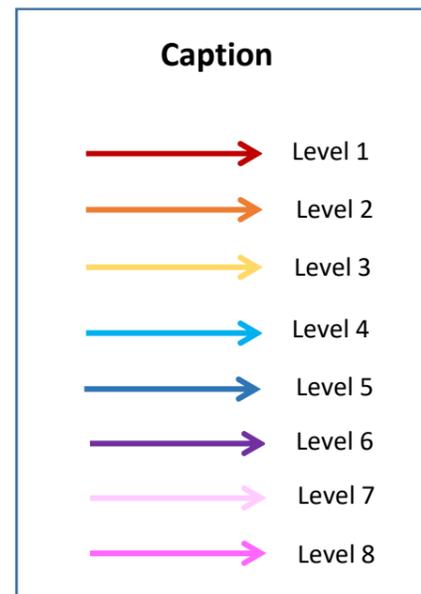
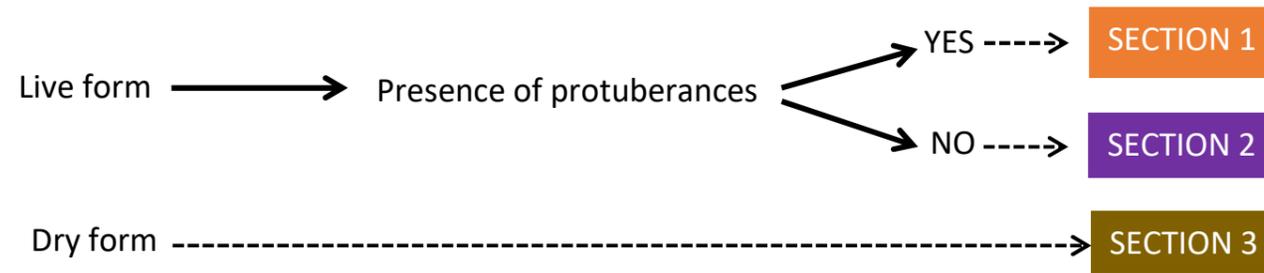
⁵ We will not cover the fresh form in the key pages.

Different Types of Incisions

Before drying the specimen, an incision is made to remove the viscera. Depending on the species, the incision, normally a straight line, is not made in the same way (Purcell 2014) and therefore could be a defining feature. However, since the incision could be made in the wrong place, it may not resemble the species-specific incision. This feature has therefore not been included in the identification key for the dried forms.



GENERAL TABLE OF COMMERCIALISED SPECIES, LIVE AND DRY

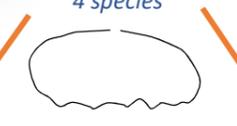


Star-shaped protuberances
 1 species
Thelenota ananas



SECTION 1: Protuberances
 53 species

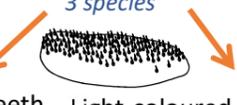
"Teat-like" protuberances
 4 species



Solid black
 1 species
Holothuria whitmaei

With white spots
 3 species
Holothuria nobilis
H. fuscogilva
H. sp. "pentard"

"Hairy" appearance
 3 species

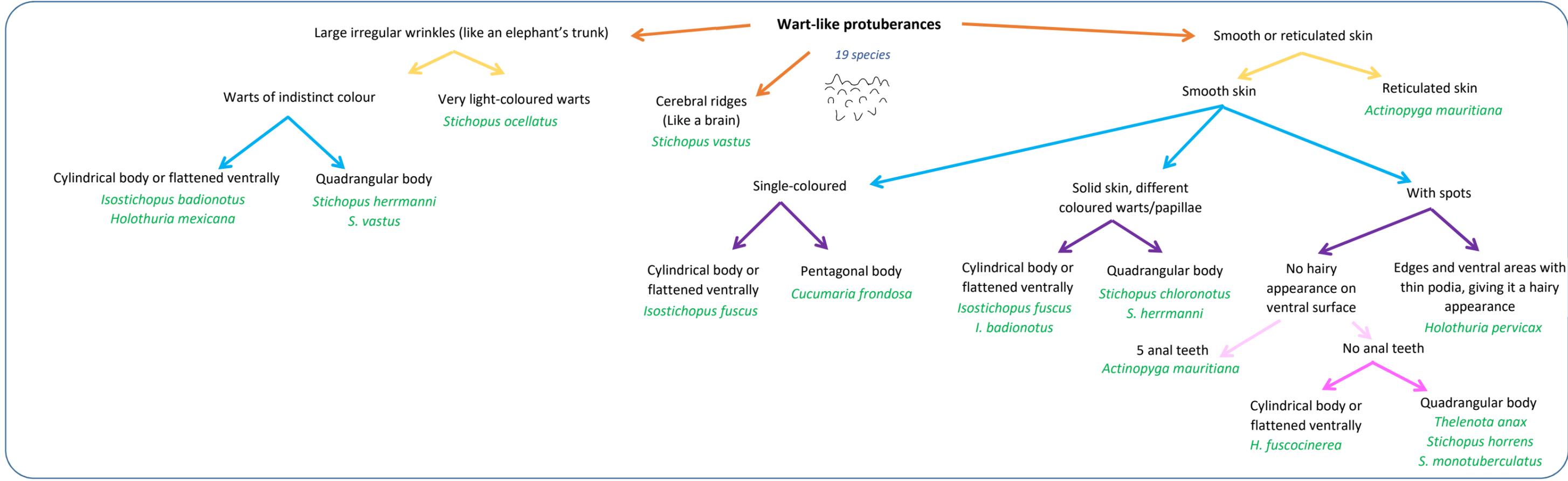
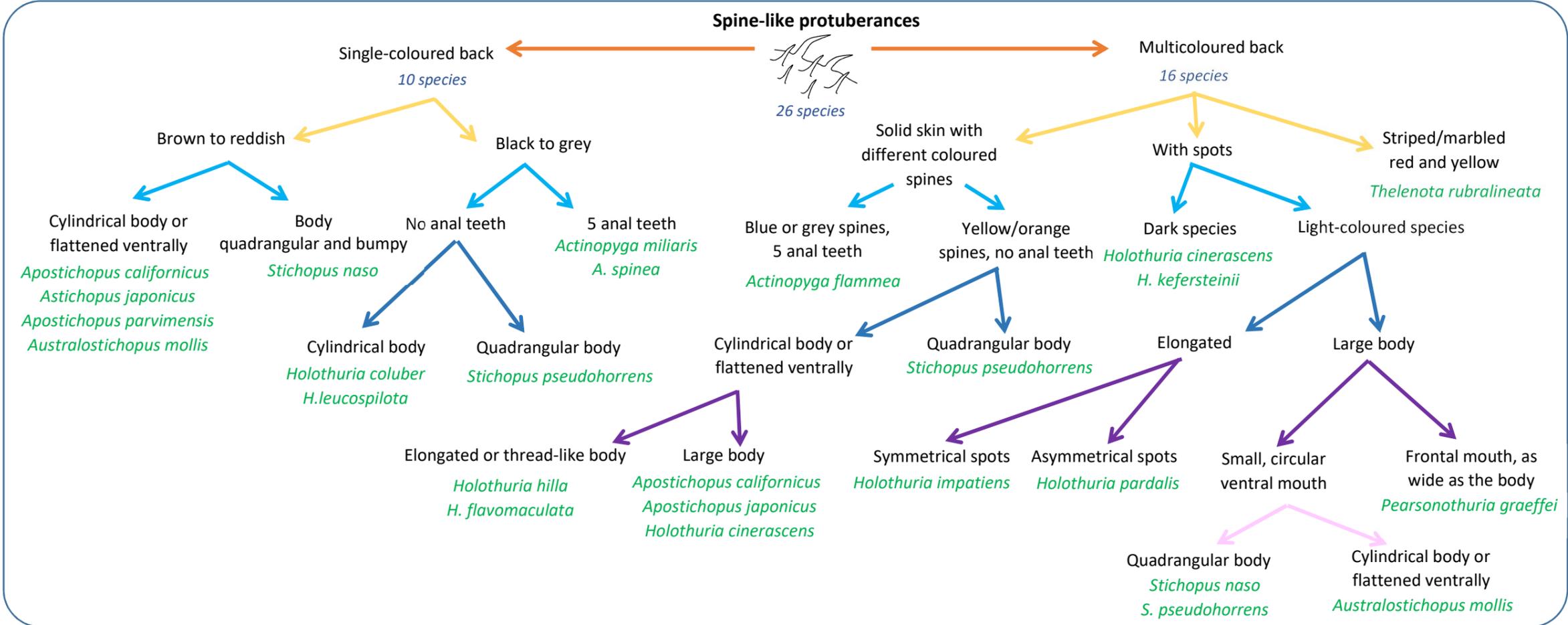


Black, 5 anal teeth
 1 species
Actinopyga miliaris

Light-coloured, no anal teeth
 2 species

Hairy appearance only on the ventral surface
Holothuria pervicax

Hairy appearance dorsally and ventrally
Astichopus multifidus



SECTION 2: Lack of protuberances

25 species

Uneven wrinkles (like an elephant's trunk) or bumps

4 species



Large wrinkles on black surface (zebra stripes)
2 species

Holothuria scabra
H. fuscopunctata

Irregular bumps
2 species

Cerebral ridges (like a brain)
Bicoloured, finely marbled or striped; no anal teeth
Stichopus vastus

Irregularly shaped grains, separated by light spots; 5 anal teeth
Actinopyga mauritiana

Smooth (apart from contraction folds and granulation)

21 species



Mostly solid dark colours (black to dark brown)

4 species

Elongated body
Holothuria atra

Large body
Athyonidium chilensis
Actinopyga palauensis
Holothuria lessoni (Black variant)

Multicolour (spots, contrasting belly and back, etc.)

17 species

With spots
11 species

White tip (anus)
Actinopyga lecanora

Back is darker than the belly, without spots
3 species

Marbled/mottled
Actinopyga echinites (Pacific Ocean)

No anal teeth

5 anal teeth

Nebulous spots
Holothuria lessoni (spotted variant)
Bohadschia marmorata
B. subrubra
B. vitiensis

Ocellated
Holothuria arenicola
H. notabilis

Dark speckled with lighter spots
Athyonidium chilensis

Rows of darker spots
Actinopyga echinites (Indian Ocean)

Brown speckled with lighter spots
Actinopyga marutiana (Pacific Ocean)

Large, brown to beige
Holothuria lessoni (beige form)
H. spinifera

Elongated and smooth (purplish pink to creamy brown)
Holothuria edulis

Black back and belly
Bohadschia atra

White belly, white or brown back
Bohadschia argus

SECTION 3: Dry form

Some species do not appear in the key, due to lack of information:



Holothuria notabilis
Holothuria pardalis < 7 cm
Holothuria pervicax < 7 cm
Stichopus pseudohorrens



Thread-like bodies

9 species

Bumpy appearance
 very grainy texture

Holothuria fuscocinerea

Regular, rather smooth or
 wrinkled surface

8 species

Little or no spots

Light-coloured

H. arenicola < 7 cm

Smooth

Holothuria edulis
H. leucospilota

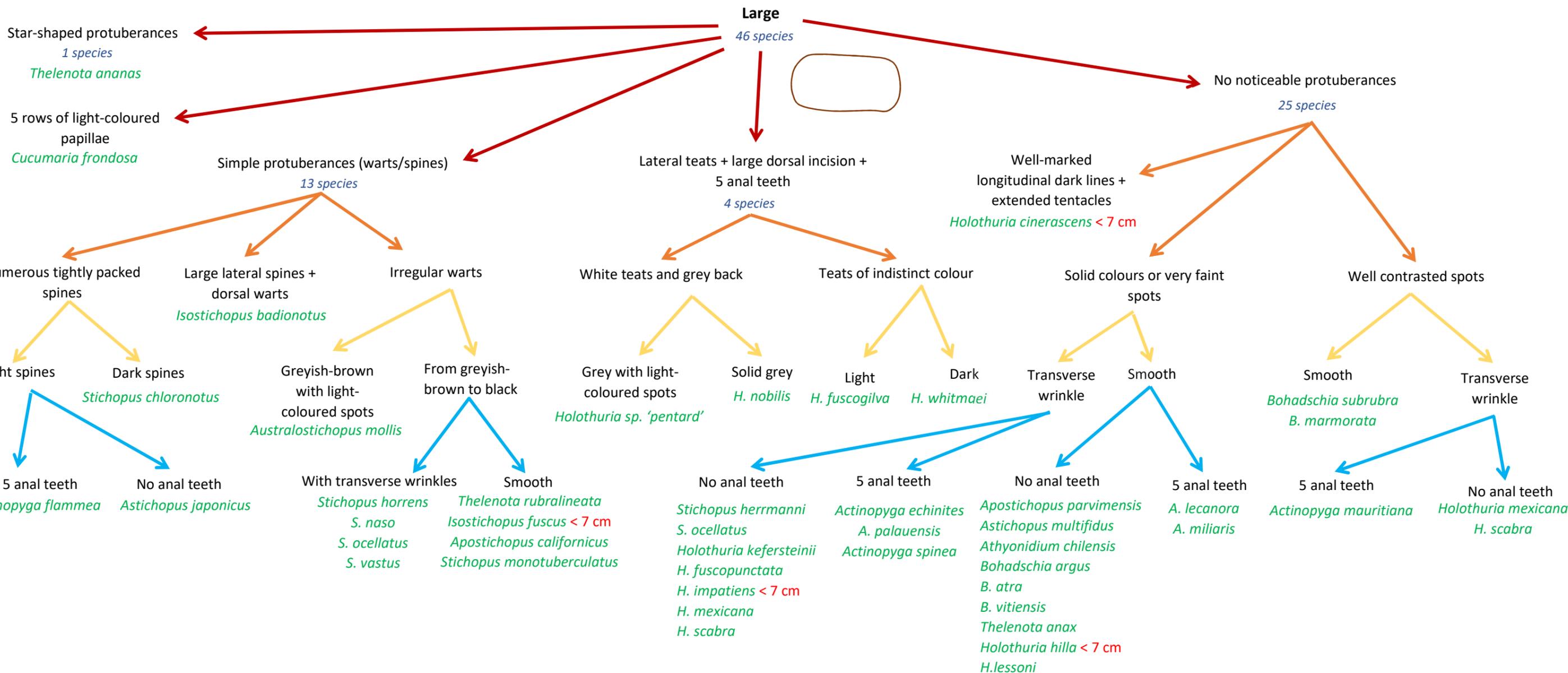
Dark colour

With transverse wrinkles

Actinopyga spinea
Holothuria atra
Pearsonothuria graeffei

Black with white spots

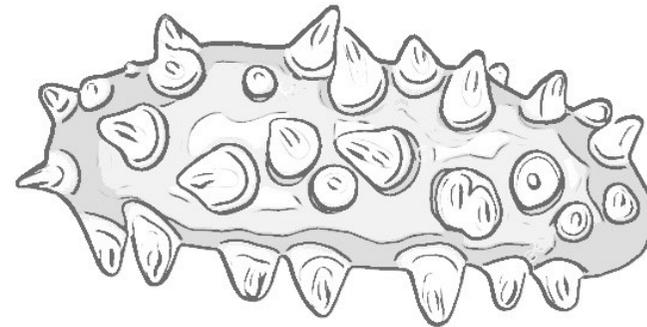
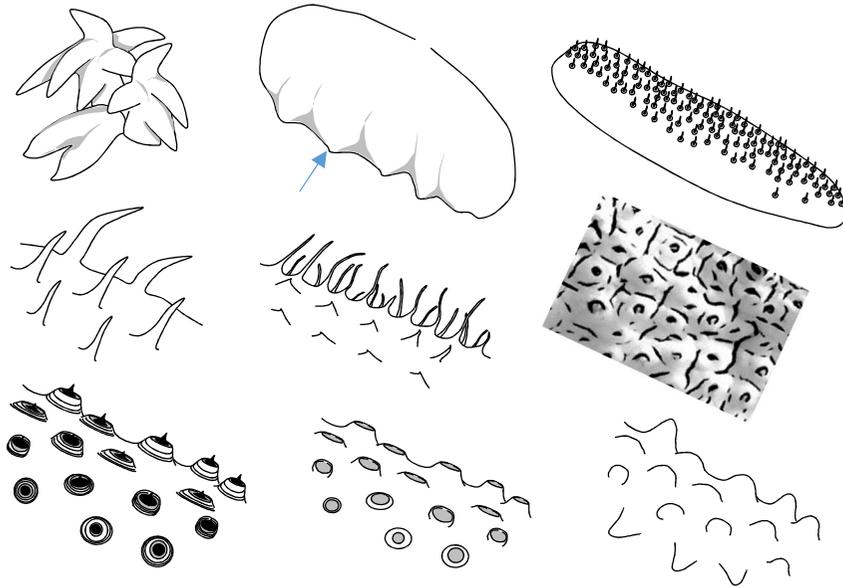
Holothuria coluber
H. flavomaculata



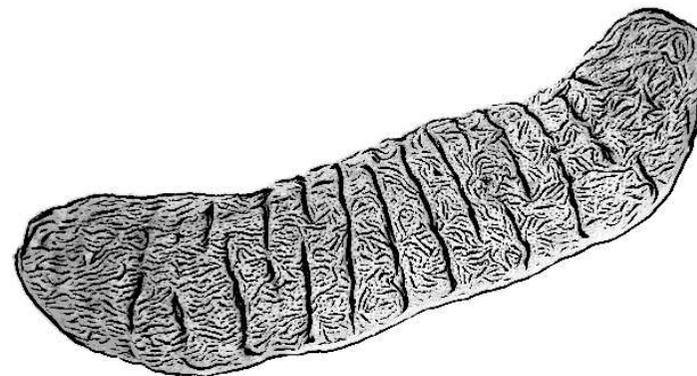
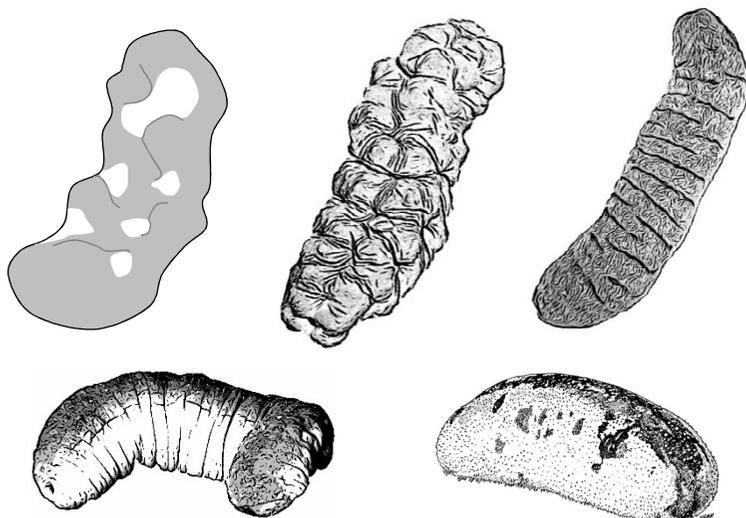
IDENTIFICATION KEY FOR THE LIVE FORM

PROTUBERANCES

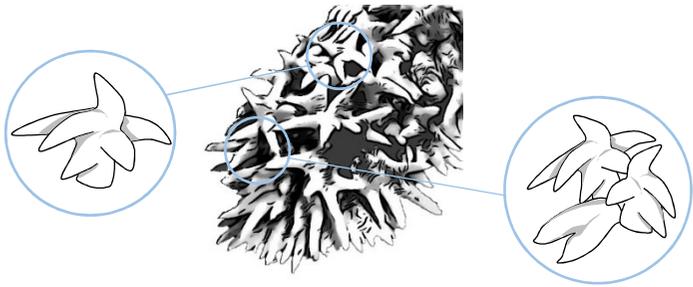
Presence of protuberances (spines, warts, teats, etc.)



Lack of protuberance (smooth, wrinkled, folded or granular skin)

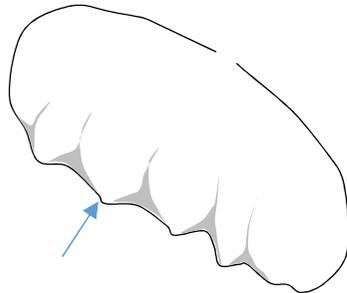


Star-shaped protuberances



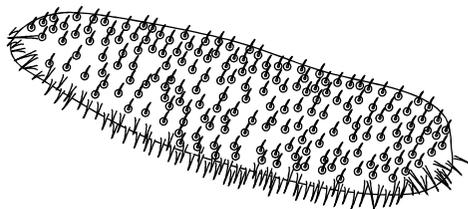
➔ *Thelenota ananas*

“Teat-like” protuberances



➔ 3

“Hairy” appearance



➔ 4

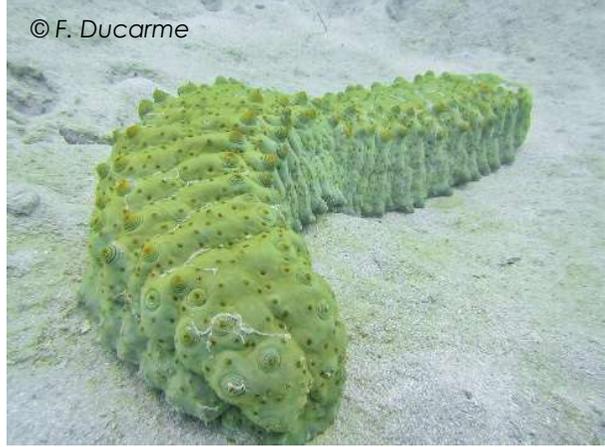
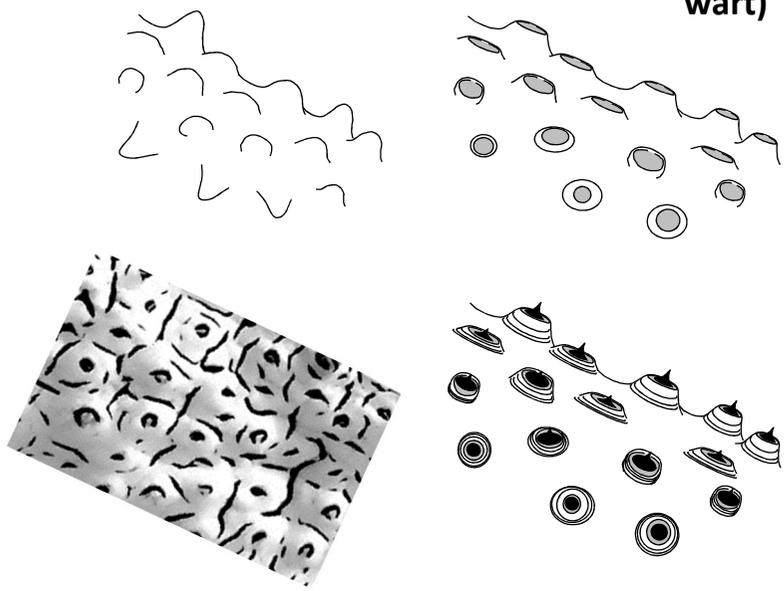
Spine-like protuberances



→ 6

Wart-like protuberances

(sometimes a pointy podium grows out of the wart)



→ 20

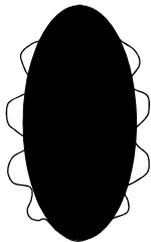
“TEAT-LIKE” PROTUBERANCES

Solid black



Holothuria whitmaei

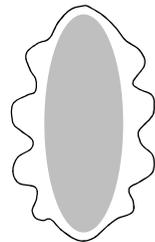
With white spots



H. nobilis



H. sp. « pentard »



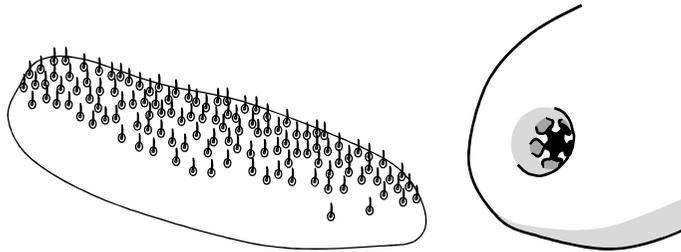
H. fuscogilva



Holothuria nobilis
Holothuria fuscogilva
Holothuria sp. “pentard”

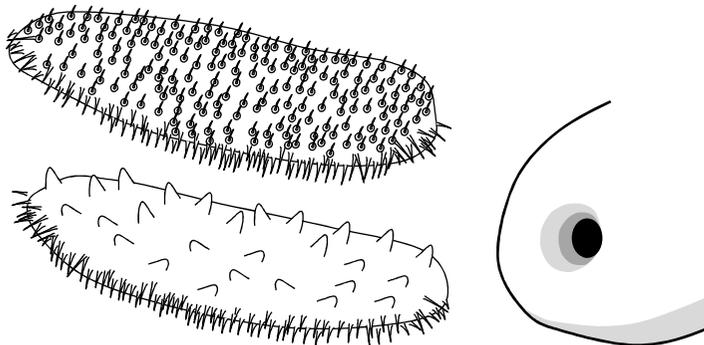
“HAIRY” APPEARANCE

Black, 5 anal teeth



→ *Actinopyga miliaris*

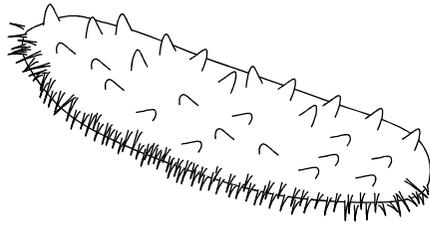
Light-coloured, no anal teeth



→ 5

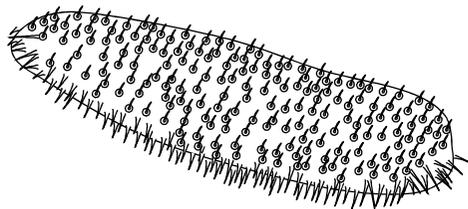
“HAIRY” APPEARANCE

Hairy appearance only on the ventral surface



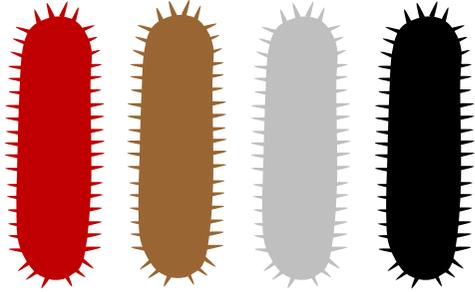
Holothuria pervicax

Hairy appearance on the ventral and dorsal surfaces

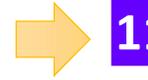
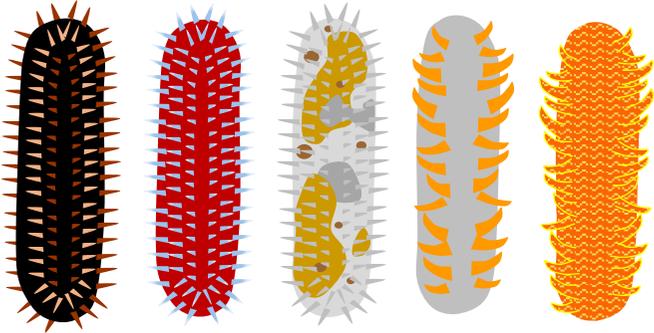


Astichopus multifidus

Single-coloured back



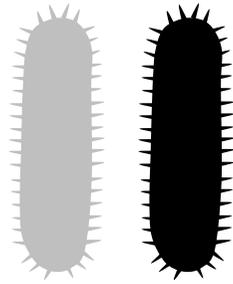
7

Multicoloured back
(stripes, spots, stripes, marbling, etc.)

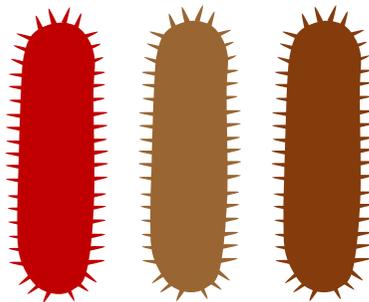
11

SPINY PROTUBERANCES: SINGLE-COLOURED BACK

Black to grey

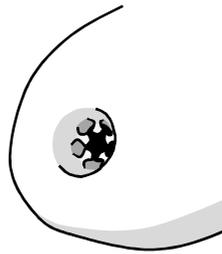


Brown to reddish



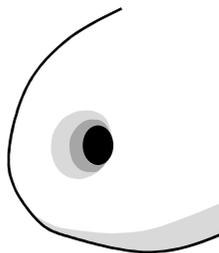
SPINY PROTUBERANCES: SOLID BLACK OR GRAY BACK

5 anal teeth



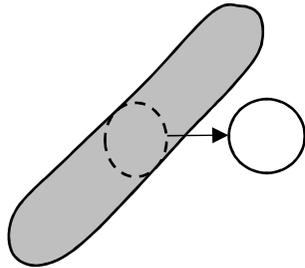
Actinopyga miliaris
Actinopyga spinea

No anal teeth



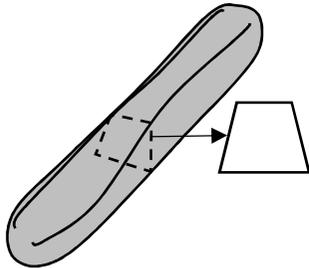
9

Cylindrical body



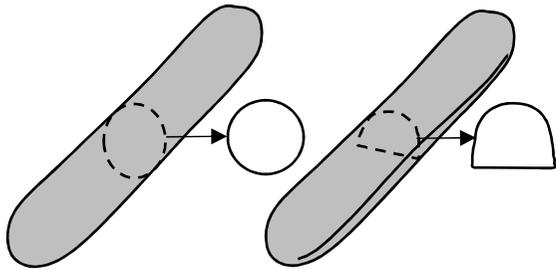
Holothuria coluber
Holothuria leucospilota

Quadrangular body



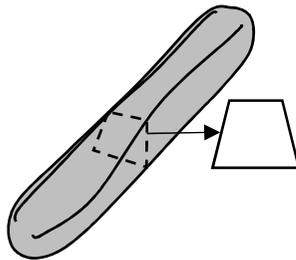
Stichopus pseudohorrens

Cylindrical body or flattened ventrally



Apostichopus californicus
Astichopus japonicus
Apostichopus parvimensis
Australostichopus mollis

Quadrangular body



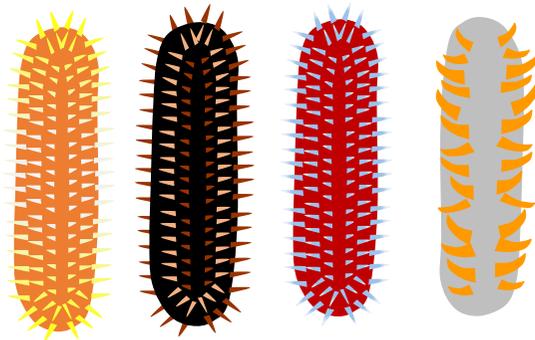
Stichopus naso

Red and yellow striped/marbled



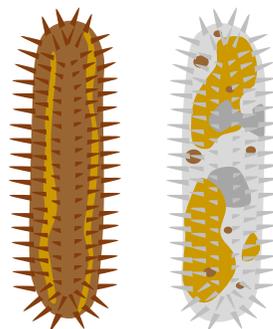
➔ *Thelenota rubralineata*

Solid skin with different coloured spines



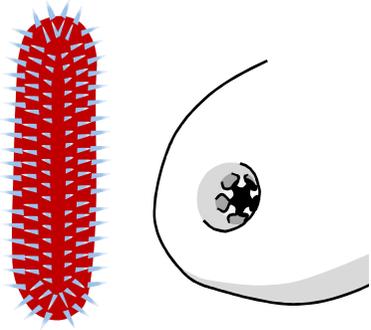
➔ 12

With spots



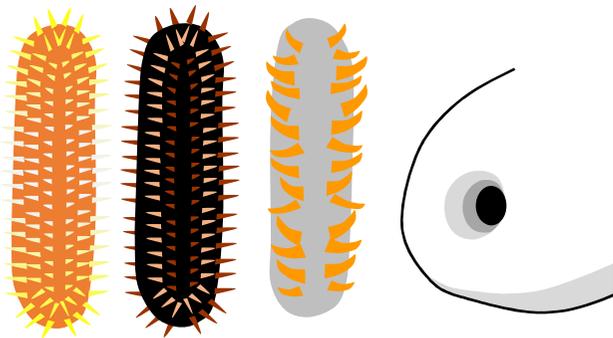
➔ 15

Blue or grey spines, 5 anal teeth



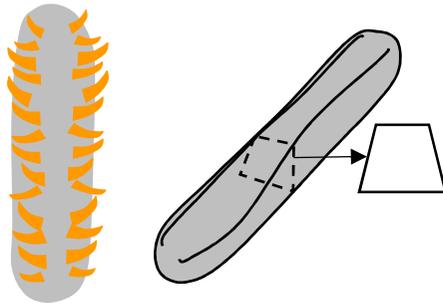
Actinopyga flammea

Quadrangular body



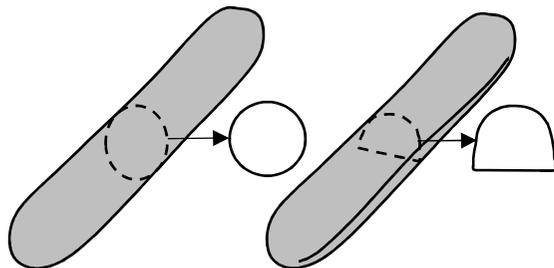
13

Yellow/orange spines, no anal teeth



Stichopus pseudohorrens

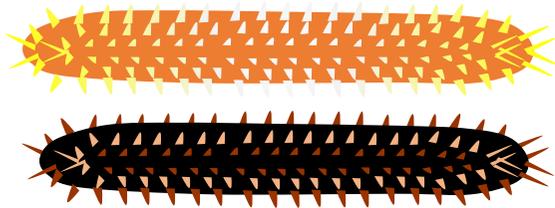
Cylindrical body or flattened ventrally



14

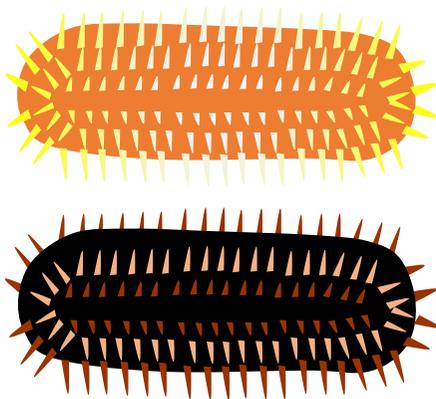
14 SOLID SKIN WITH DIFFERENT COLOURED SPINES, CYLINDRICAL BODY

Elongated or thread-like body



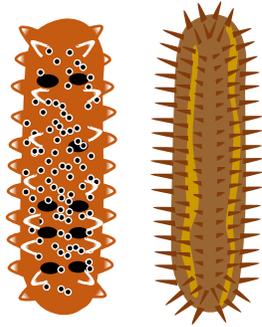
Holothuria flavomaculata
Holothuria hilla

Large body



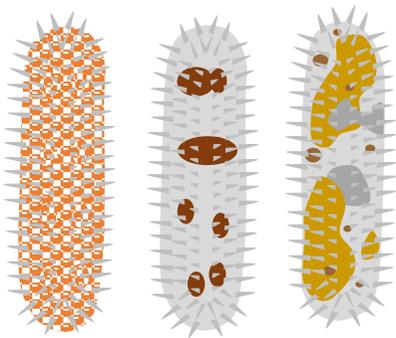
Apostichopus californicus
Apostichopus japonicus
Holothuria cinerascens

Dark species



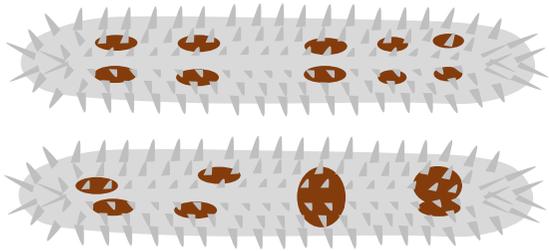
Holothuria cinerascens
Holothuria kefersteinii

Light-coloured species

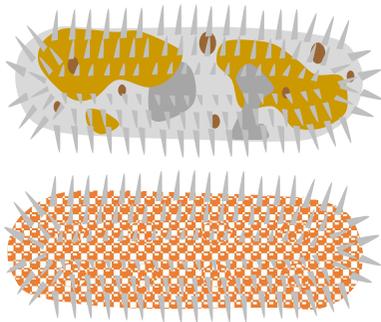


16

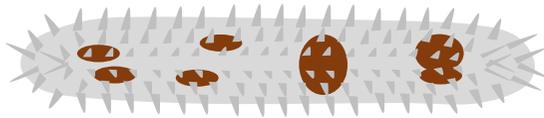
Elongated body



Large body



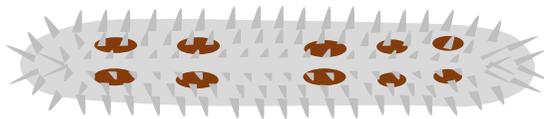
Asymmetrical spots



© F. Michonneau - licensed CC-BY

*Holothuria impatiens*

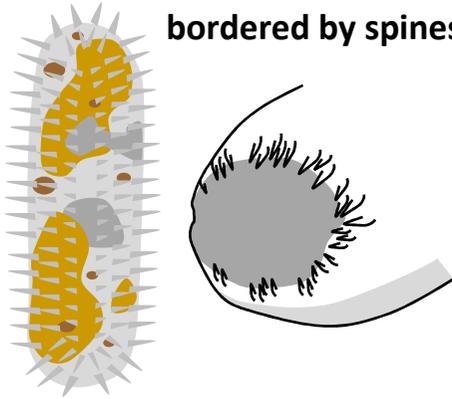
Symmetrical spots



© P. Bourjon - DORIS

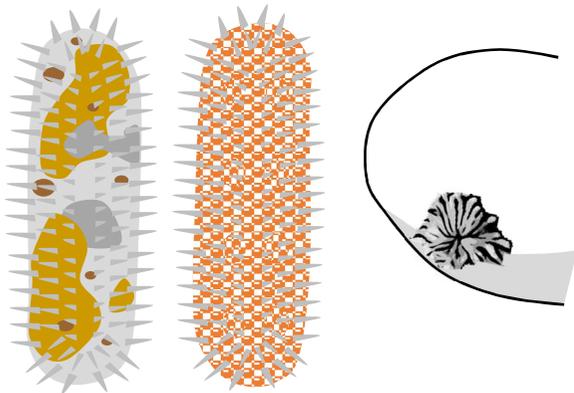
*Holothuria pardalis*

Frontal mouth, as wide as the body,
bordered by spines



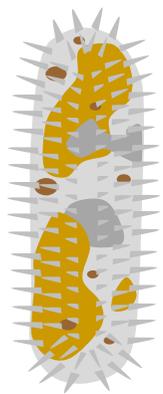
Pearsonothuria graeffei

Small, circular ventral mouth

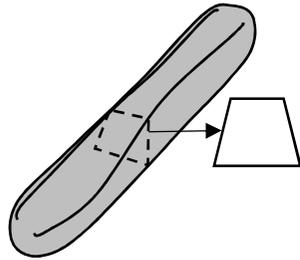


19

SPINY PROTUBERANCES: WITH LIGHT-COLOURED SPOTS

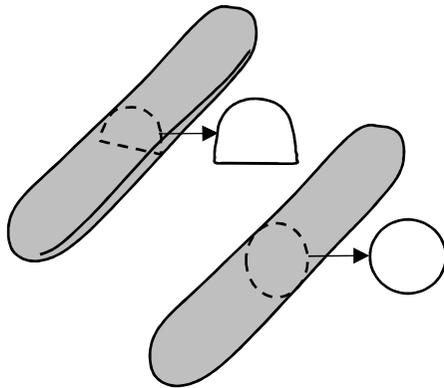


Quadrangular body



Stichopus naso
Stichopus pseudohorrens

Cylindrical body or flattened ventrally



Australostichopus mollis

Cerebral ridges (like a brain)



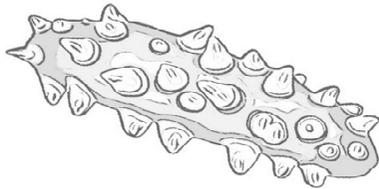
➔ *Stichopus vastus*

Large irregular wrinkles
(like an elephant's trunk)



➔ 21

Smooth or reticulated skin



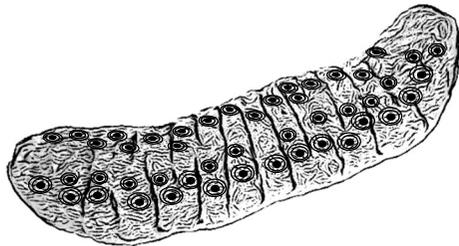
➔ 23

Very light-coloured warts



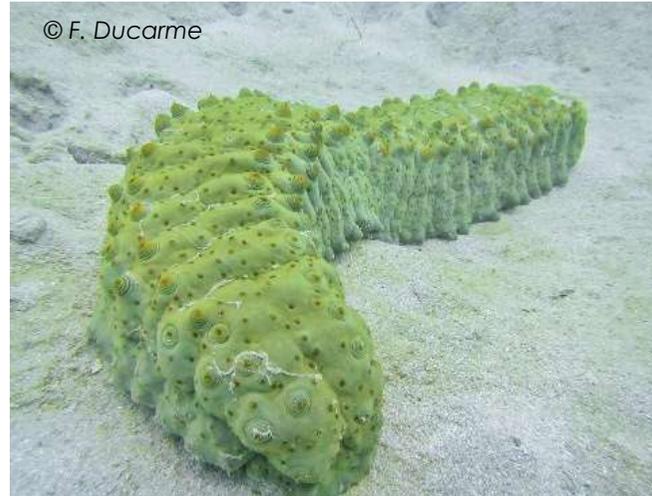
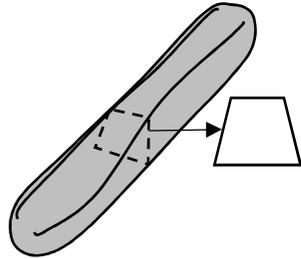
➔ *Stichopus ocellatus*

Warts of indistinct colour



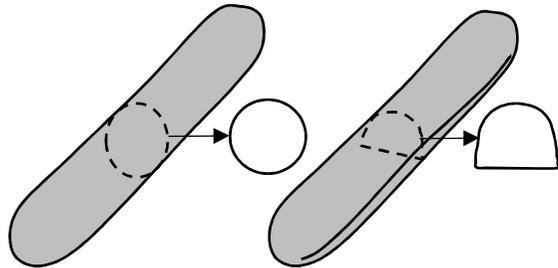
➔ 22

Quadrangular body



Stichopus vastus
Stichopus herrmanni

Cylindrical body or flattened ventrally



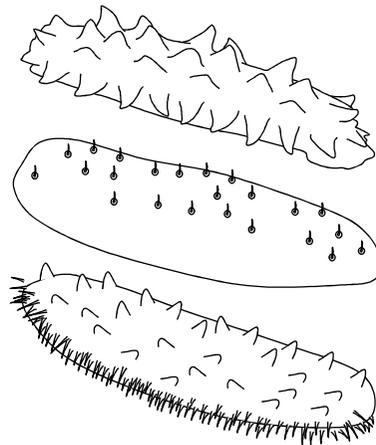
Isostichopus badionotus
Holothuria mexicana

Reticulated skin



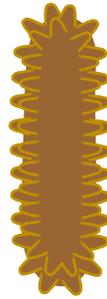
Actinopyga mauritiana

Smooth skin

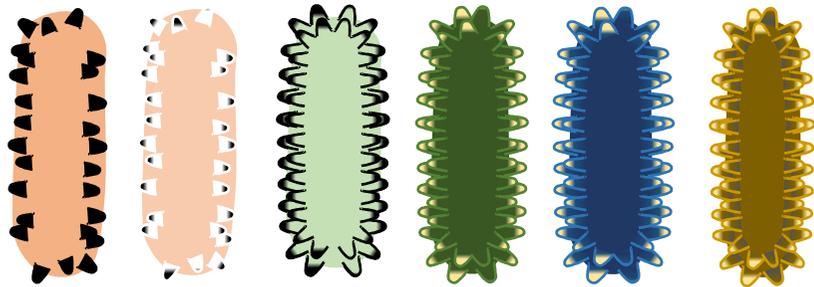


24

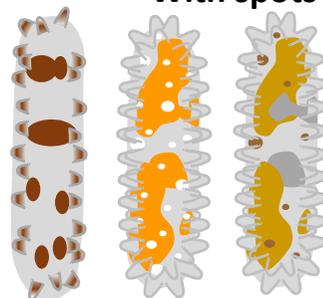
Single-coloured



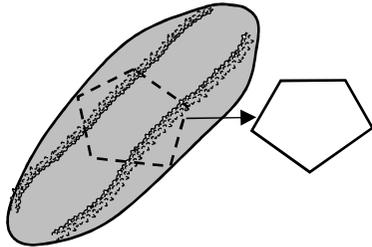
Solid skin, different coloured warts/papillae



With spots

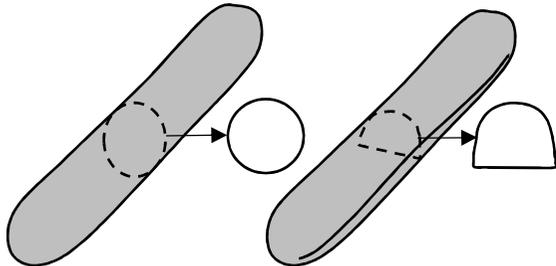


Pentagonal body



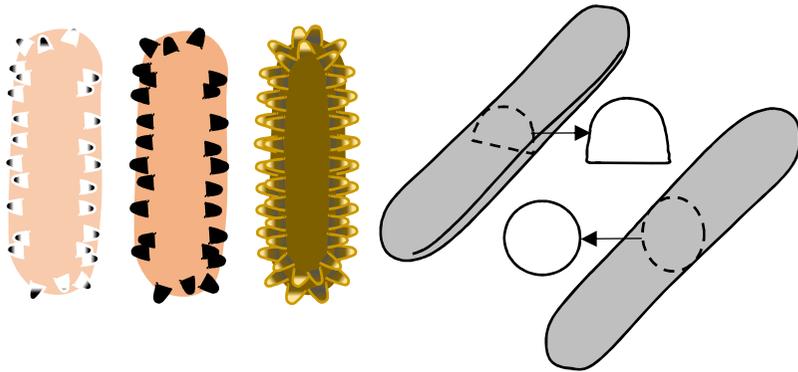
➔ *Cucumaria frondosa*

Cylindrical body or flattened ventrally



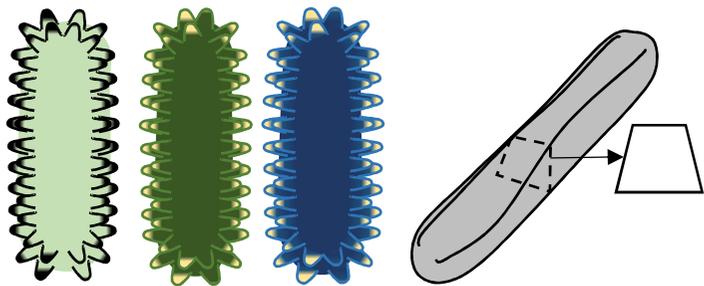
➔ *Isostichopus fuscus*

Cylindrical body or flattened ventrally



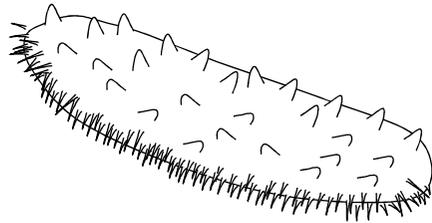
Isostichopus badionotus
Isostichopus fuscus

Quadrangular body



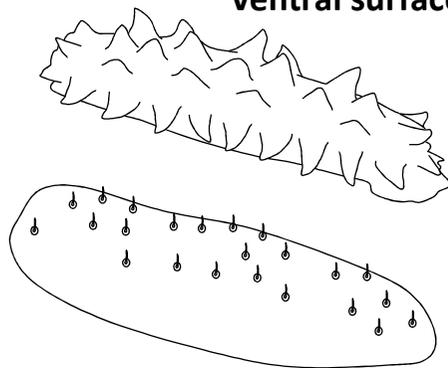
Stichopus chloronotus
Stichopus herrmanni

Rims and ventral surfaces with fine podia,
giving it a furry appearance



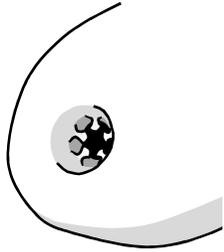
Holothuria pervicax

No hairy appearance on
ventral surface



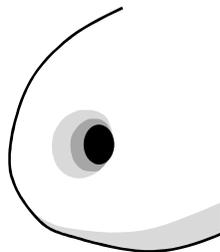
28

5 anal teeth



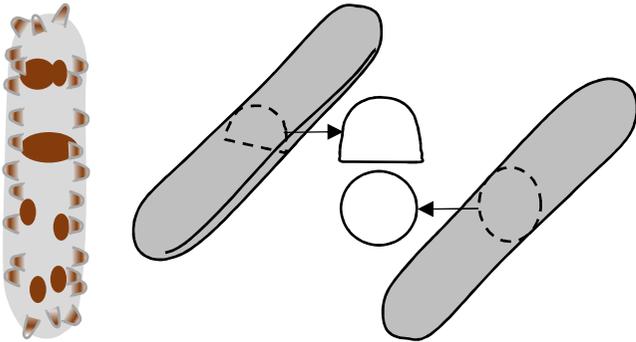
Actinopyga mauritiana

No anal teeth



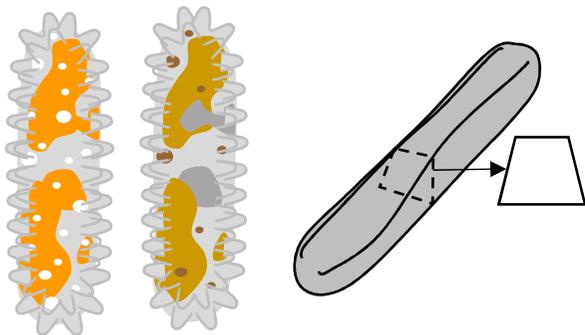
29

Cylindrical body or flattened ventrally



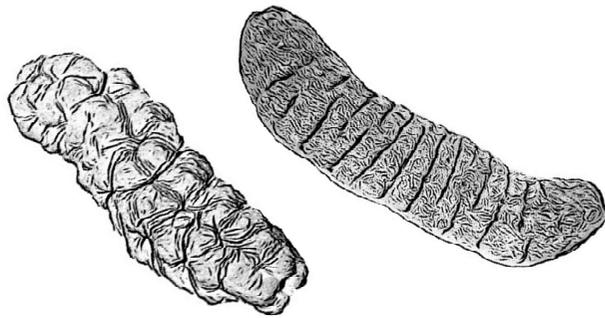
Holothuria fuscocinera

Quadrangular body

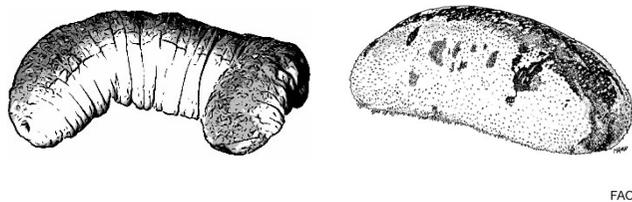


Thelenota anax
Stichopus horrens
Stichopus monotuberculatus

Uneven wrinkles (like an elephant's trunk) or bumps



Smooth (apart from contraction folds and granulation)

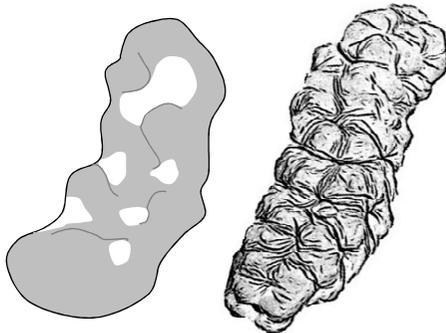


Large wrinkles on black surface
(zebra stripes)



Holothuria fuscopunctata
Holothuria scabra

Irregular bumps

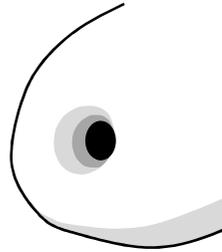


32

Cerebral ridges (like a brain)

Bicoloured, finely marbled or striped;

No anal teeth



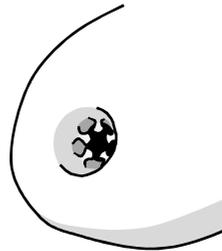
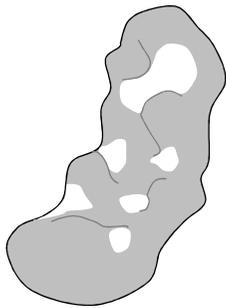
© T. Munyard – licensed CC BY NC



Stichopus vastus

Ill-defined bumps,
separated by light-coloured spots;

5 anal teeth



© B. Guichard - DORIS

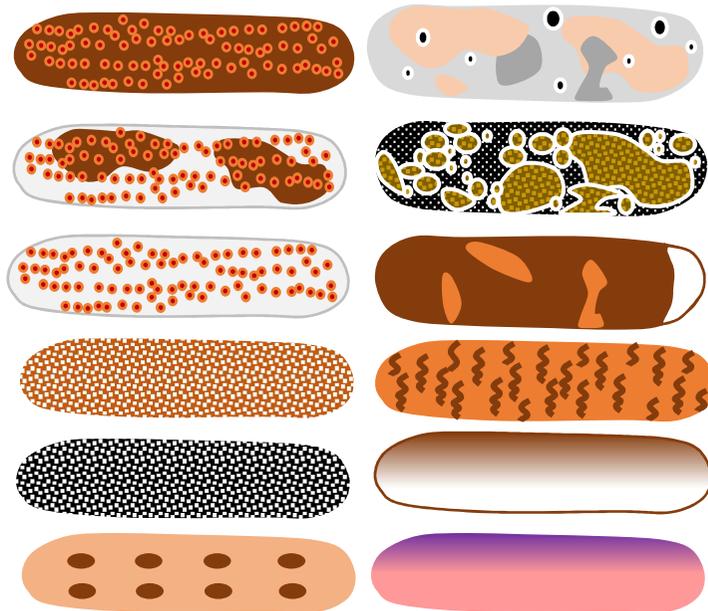


Actinopyga mauritiana

Mostly solid dark colours (black to dark brown)



Multicolour (spots, contrasting belly and back, etc.)



Elongated



Holothuria atra

Large



Athyonidium chilensis
Actinopyga palauensis
Holothuria lessoni
(Black variant)

White tip (anus)



Actinopyga lecanora

Marbled/mottled



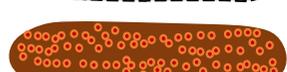
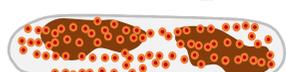
Actinopyga echinites
(Pacific Ocean variant)

Back is darker than the belly, without spots



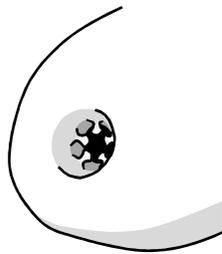
36

With spots



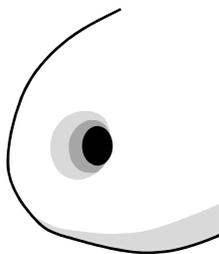
38

5 anal teeth



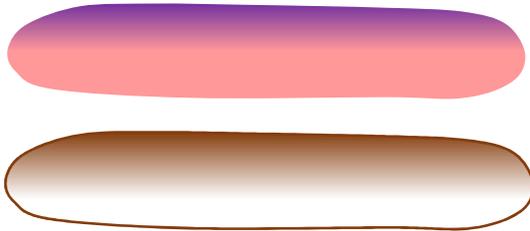
Actinopyga mauritiana
(Pacific form)

No anal teeth



37

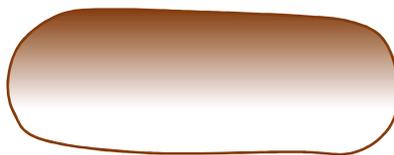
Elongated and smooth (purplish pink to brown)



Holothuria edulis

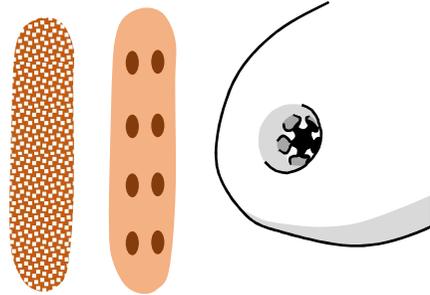


Large, brown to beige

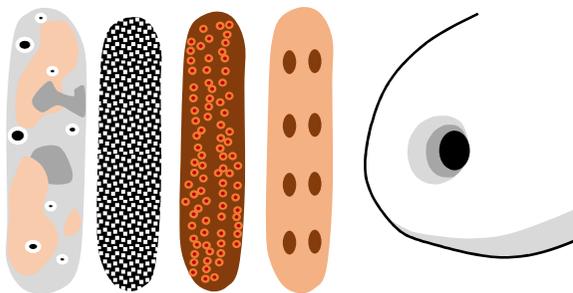


Holothuria lessoni
(beige variant)
Holothuria spinifera

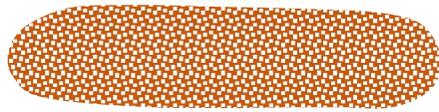
5 anal teeth



No anal teeth



Brown speckled with lighter spots



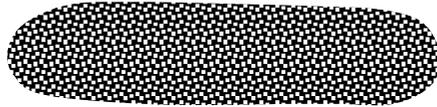
Actinopyga mauritiana
(Pacific form)

Rows of darker spots



Actinopyga echinites
(Indian Ocean variant)

Dark speckled with lighter spots



➔ *Athyonidium chilensis*

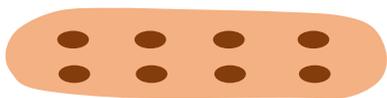
Nebulous spots



➔ *Bohadschia marmorata*
Bohadschia subrubra
Bohadschia vitiensis
Holothuria lessoni (spotted variant)

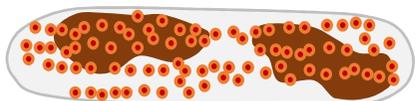
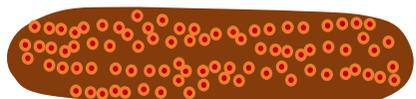


2 rows of darker spots

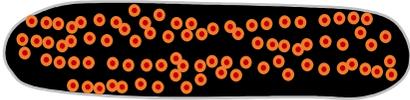


➔ *Holothuria arenicola*
Holothuria notabilis

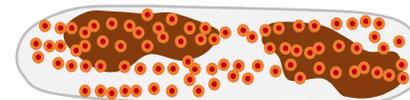
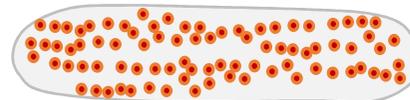
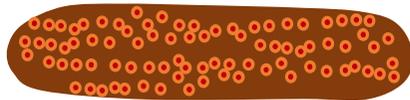
Ocellated



➔ 41

Black back and belly

➔ *Bohadschia atra*

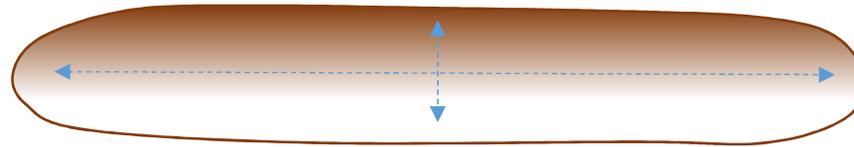
White belly, white or brown back

➔ *Bohadschia argus*



IDENTIFICATION KEY FOR THE DRY FORM

Thread-like bodies

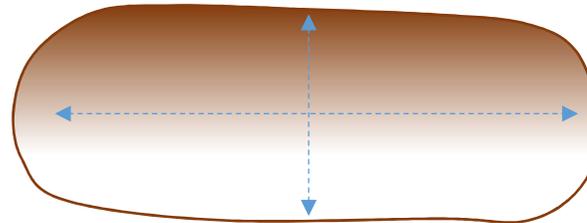


Length/width > 6



2

Large



Length/width < 6



6

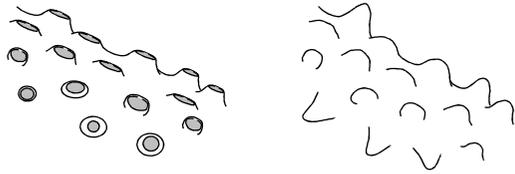
Some species do not appear in the key, due to lack of information:



Holothuria notabilis
Holothuria pardalis < 7 cm
Holothuria pervicax < 7 cm
Stichopus pseudohorrens

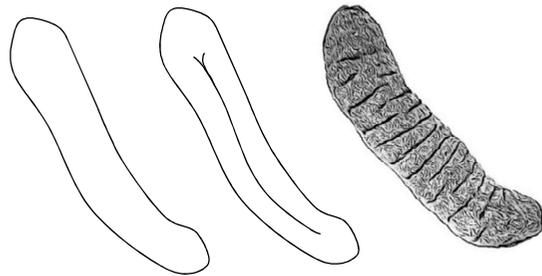
THREAD-LIKE SPECIES

**Bumpy appearance
very grainy texture**



Holothuria fuscocinerea

**Regular, rather smooth or
wrinkled surface**

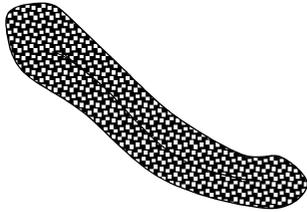


3

3

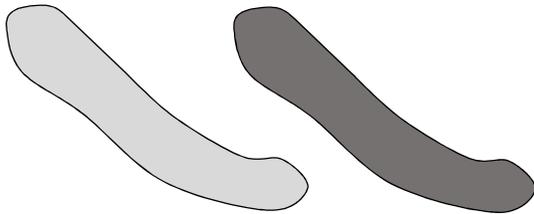
THREAD-LIKE SHAPES: REGULAR APPEARANCE

Black with white spots



Holothuria coluber
Holothuria flavomaculata

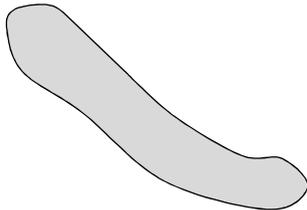
Little or no spots



4

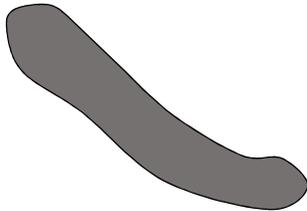
THREAD-LIKE SHAPES: LITTLE TO NO SPOTS

Light-coloured



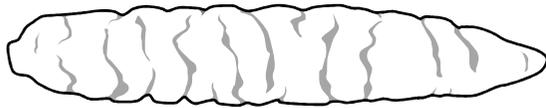
Holothuria arenicola < 7 cm

Very dark colour



5

With transverse wrinkles



Actinopyga spinea
Holothuria atra
Pearsonothuria graeffei

Smooth



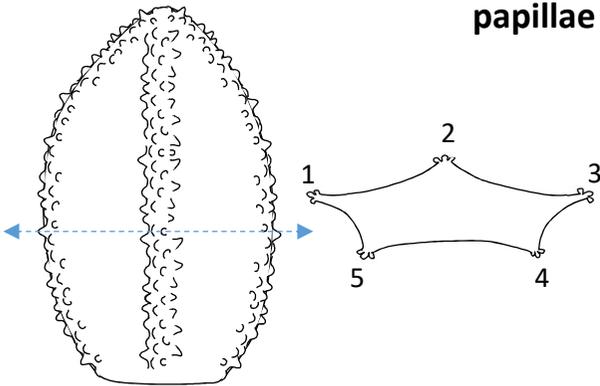
Holothuria edulis
Holothuria leucospilota

Star-shaped protuberances



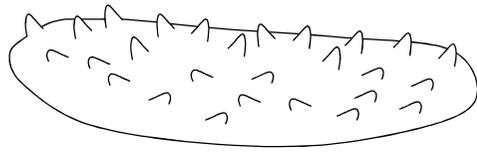
➔ *Thelenota ananas*

5 rows of light-coloured papillae

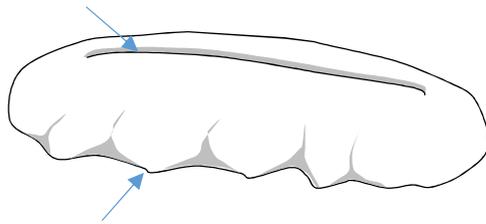


➔ *Cucumaria frondosa*

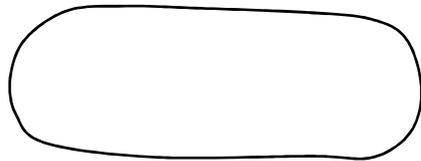
Simple protuberances
(warts/spines)



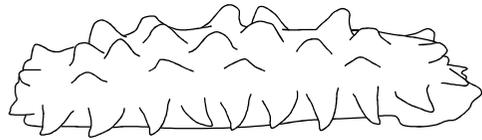
Lateral teats + big dorsal cut



No noticeable protuberances

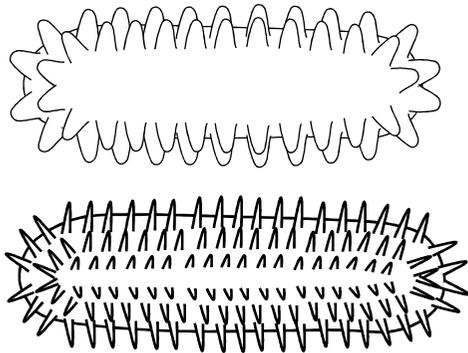


Large lateral spines + dorsal warts



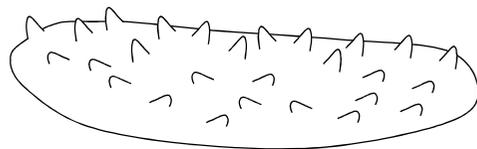
→ *Isostichopus badionotus*

Numerous tightly packed spines



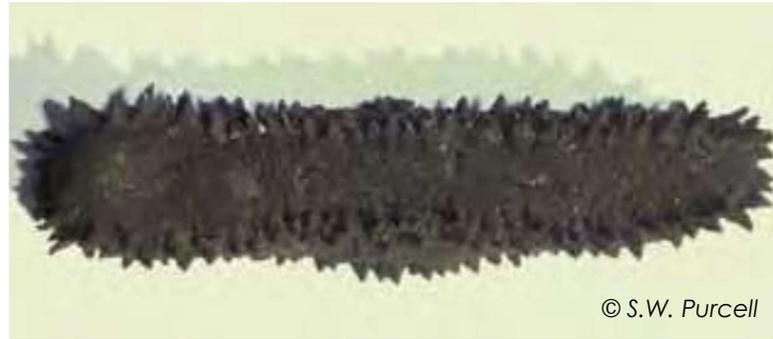
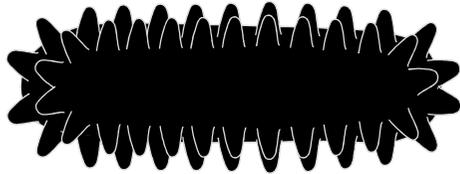
→ 8

Irregular warts



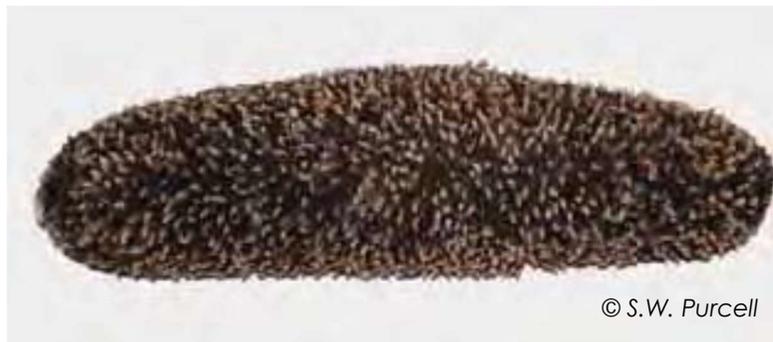
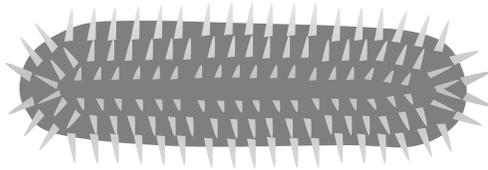
→ 10

Dark spines



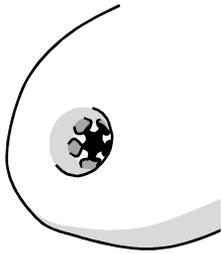
Stichopus chloronotus

Light spines



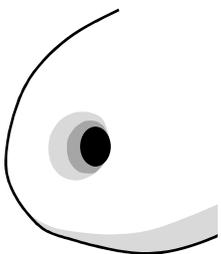
9

5 anal teeth



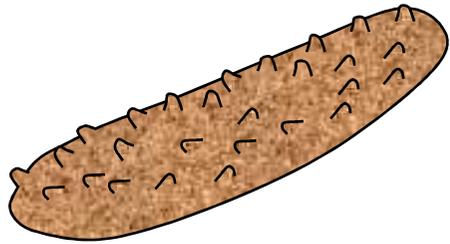
Actinopyga flammea

No anal teeth



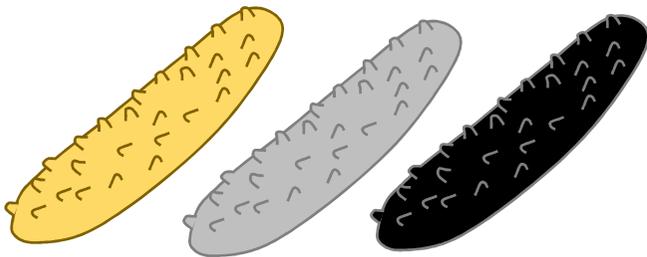
Astichopus japonicus

Greyish-brown with light-coloured spots



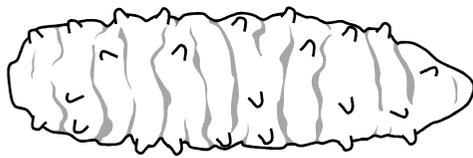
Australostichopus mollis

From greyish-brown to black, vaguely spotted



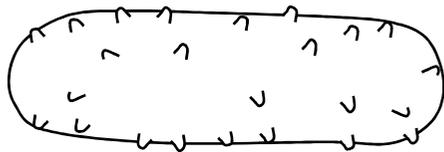
11

With transverse wrinkles

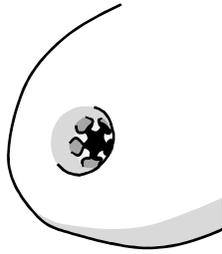


Stichopus horrens
Stichopus naso
Stichopus vastus
Stichopus ocellatus

More or less smooth

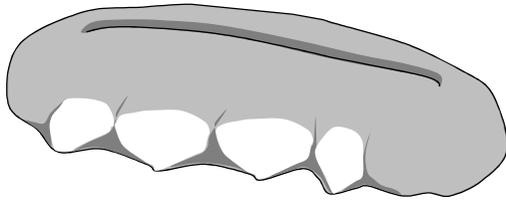


Thelenota rubralineata
Isostichopus fuscus < 7 cm
Apostichopus californicus
Stichopus monotuberculatus

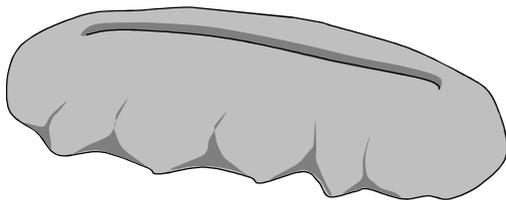


All species of this section have 5 anal teeth

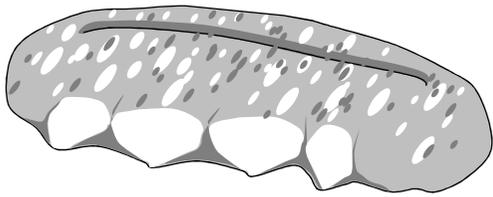
White teats and grey back



Teats of indistinct colour

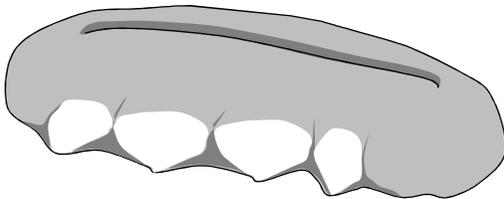


Grey with light-coloured spots



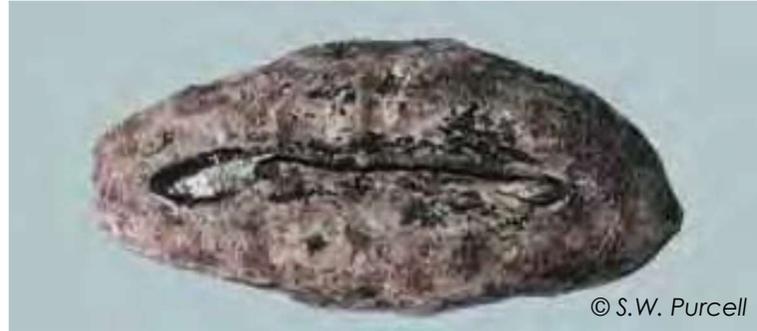
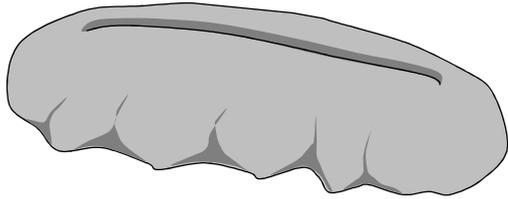
Holothuria sp. 'pentard'

Solid grey



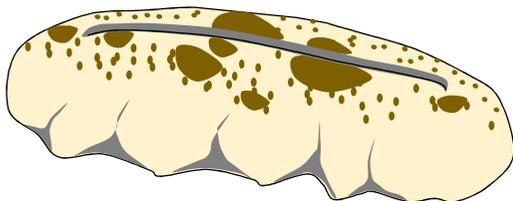
Holothuria nobilis

Dark coloured



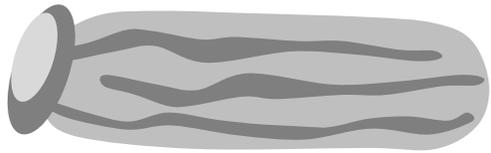
Holothuria whitmaei

Light coloured



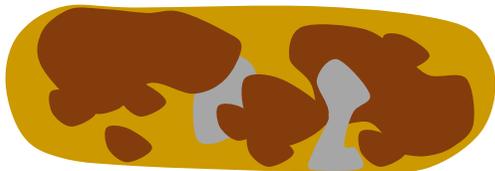
Holothuria fuscogilva

Well-marked longitudinal dark lines + extended tentacles



→ *Holothuria cinerascens* < 7 cm

Well contrasted spots



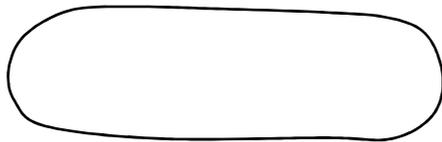
→ 16

Solid colours or very faint spots



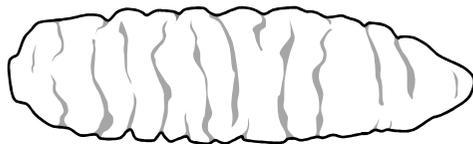
→ 18

More or less smooth



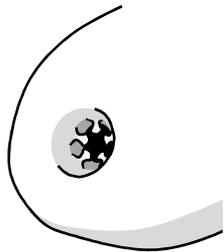
Bohadschia subrubra
Bohadschia marmorata

With transverse wrinkles

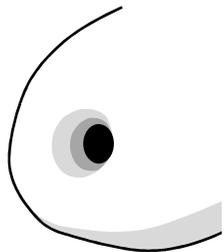


17

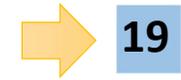
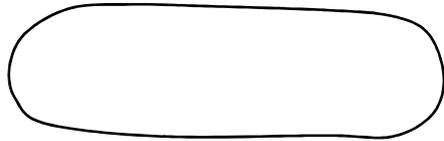
5 anal teeth

 *Actinopyga mauritiana*

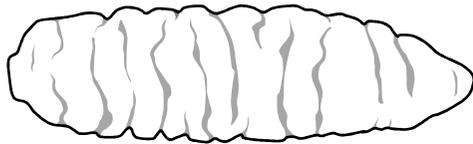
No anal teeth

 *Holothuria mexicana*
Holothuria scabra

More or less smooth



With transverse wrinkles

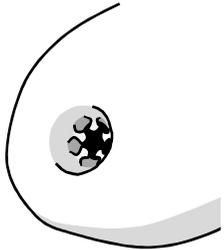


© S.W. Purcell



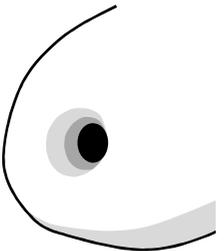
© F.A. Solis-Marin - FAO

5 anal teeth



Actinopyga lecanora
Actinopyga miliaris

No anal teeth

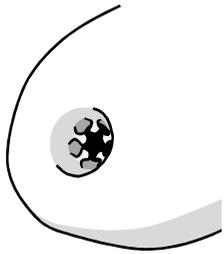


© C. Guisado - FAO



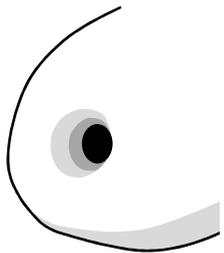
Apostichopus parvimensis
Astichopus multifidus
Athyonidium chilensis
Bohadschia argus
Bohadschia atra
Bohadschia vitiensis
Thelenota anax
Holothuria hilla < 7 cm
Holothuria lessoni

5 anal teeth



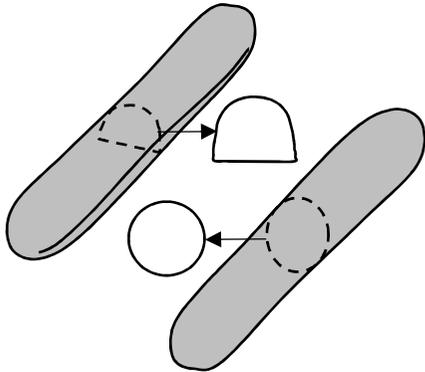
Actinopyga echinites
Actinopyga palauensis
Actinopyga spinea

No anal teeth



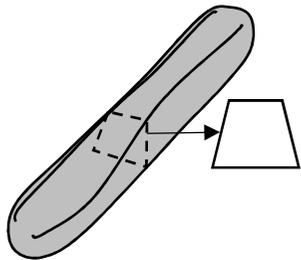
21

Cylindrical body
or ventrally flat



Holothuria kefersteinii
Holothuria fuscopunctata
Holothuria impatiens < 7 cm
Holothuria mexicana
Holothuria scabra
Holothuria spinifera

Quadrangular body



Stichopus herrmanni
Stichopus ocellatus

Species Cards

Holothuriida: Holothuriidae

Actinopyga echinites

(Jaeger, 1833)



Common names:  Deep-water redfish, brownfish
 Holothurie brune des profondeurs
Holothurie épineuse



© F. Michonneau - licensed CC-BY

Live form
(Pacific Ocean)

There may be a double row of brown spots on the dorsal surface.



© P. Bourjon - DORIS

Live form (Indian Ocean)



© S.W. Purcell

Dry form

 20 cm on average, 36 max

 Between 200 g and 500 g

 From beige to dark brown, including light brown and/or orange

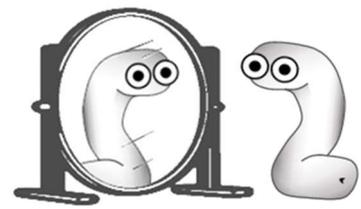
 There may be a double row of brown spots on the dorsal surface

 8-15 cm on average

 Grey-brown dorsal surface

 Rough and slightly ridged. Granular ventral surface. Small cut in the mouth

Similar species



Actinopyga lecanora



A. mauritiana



Bohadschia vitiensis

It can be the same light orange-brown colour as *A. echinites*, but the posterior end is white

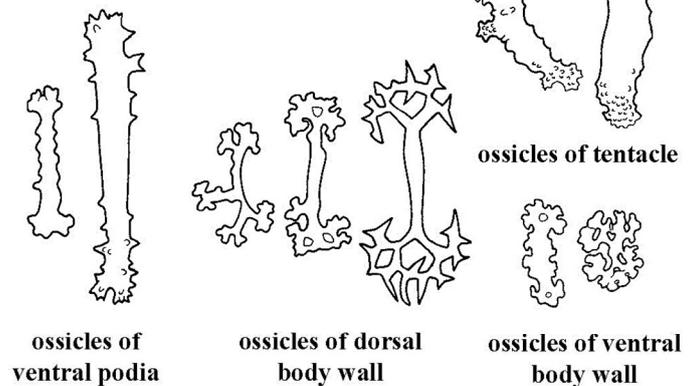
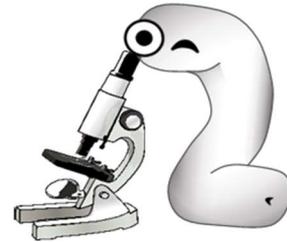
Tegument is much rougher, with white markings.

The colour is a much deeper yellow and has a small brown spot at the base of each podium. No anal teeth.

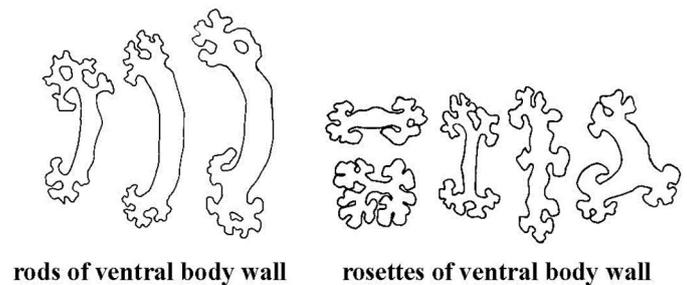
And for the experts...

Characteristics of the spicules:

| | |
|-------------------------------------|---|
| Tentacles | Rods (60-375 μm), straight or slightly curved, spiny at the extremities |
| Dorsal and ventral body wall | Rods and rosettes on the dorsal tegument (20-135 μm), the ventral wall presents even smaller rods and rosettes (25-80 μm) |
| Ventral podia | Rods and rosettes similar to those of the tegument (20-100 μm) |
| Dorsal podia | Rosettes only |



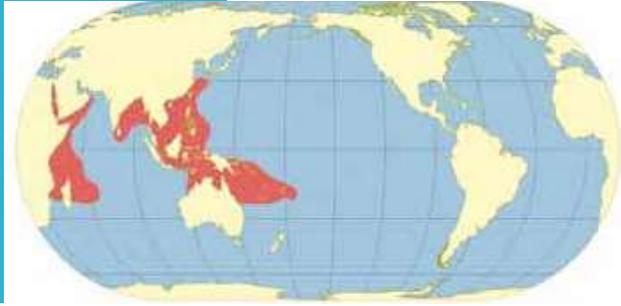
(after Féral and Cherbonnier, 1986)



(after Panning, 1944)

Actinopyga lecanora

(Jaeger, 1835)



Common names:  Stonefish

 Holothurie caillou



© IRD - Lagplan

Live form

Irregular white spot surrounding the anus



© S.W. Purcell

Dry form

 20 cm on average

 400 g on average



From beige to dark brown (almost black) including brown, solid or slightly mottled (sometimes with white spots). Irregular white spot surrounding the anus

 10-12 cm

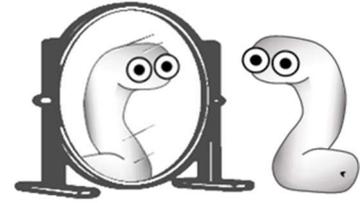


Brown-black



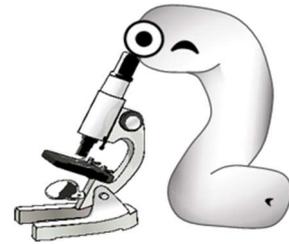
Smooth ventral surface, and dorsal surface with shallow grooves.

Similar species



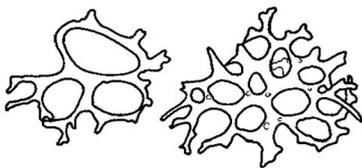
Actinopyga echinites

And for the experts...

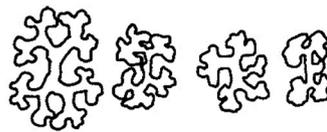


Characteristics of the spicules:

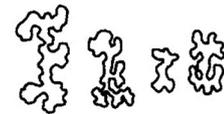
| | |
|------------------------------------|---|
| Tentacles | Rods (45-450 μm), straight or slightly curved, with extremities |
| Dorsal and Ventral Tegument | Rosettes (25-35 μm) or X-shaped rosettes (50 μm) on the dorsal tegument, the ventral wall presents even smaller rosettes (20-25 μm) |
| Ventral podia | Small rosettes (20-25 μm) like those on the tegument |
| Dorsal podia | Rosettes and rods (65-90 μm) |



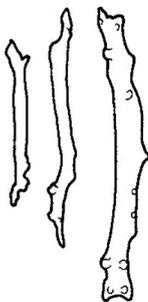
plates of dorsal papillae



rosettes of dorsal body wall



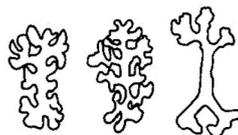
rosettes of podia



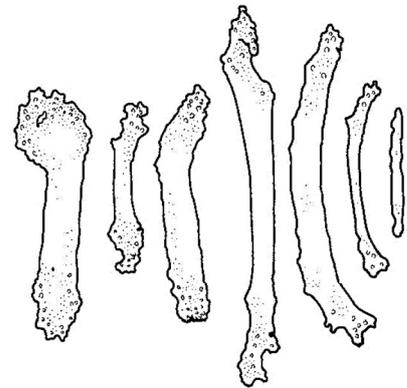
rods of dorsal papillae



rosettes of ventral body wall



rosettes of dorsal papillae



rods of tentacles

(after Massin, 1999)

Actinopyga mauritiana

(Quoy and Gaimard, 1833)



Common names:  Surf redfish

 Holothurie (brune) des brisants



NB: The precise identity of the Pacific variant is currently debated, often designated by the name *Actinopyga* varians. No recent publication has settled the matter.



Live form
(Pacific Ocean)

White spots of irregular size and location on the dorsal surface



Live form (Indian Ocean)



Dry form

 20 cm on average, 35 max.

 300 to 700 g
670 g on average in New Caledonia

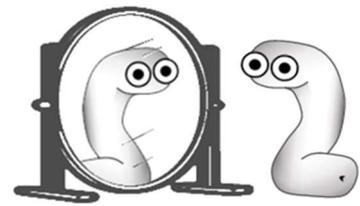
 Pacific Variant: from beige to reddish brown
Indian Ocean Variant: Marbled greenish to brownish with white patches dorsally

 8-15 cm

 Brown/black dorsal surface with white spots.
Ventral surface: from cream to brown/ light red colour

 Oval, elongated, flat and granular ventrally. Dorsal side with grooves. Ventral side: granular with a cut

Similar species

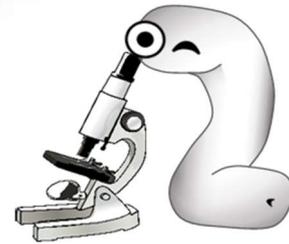


Actinopyga echinites



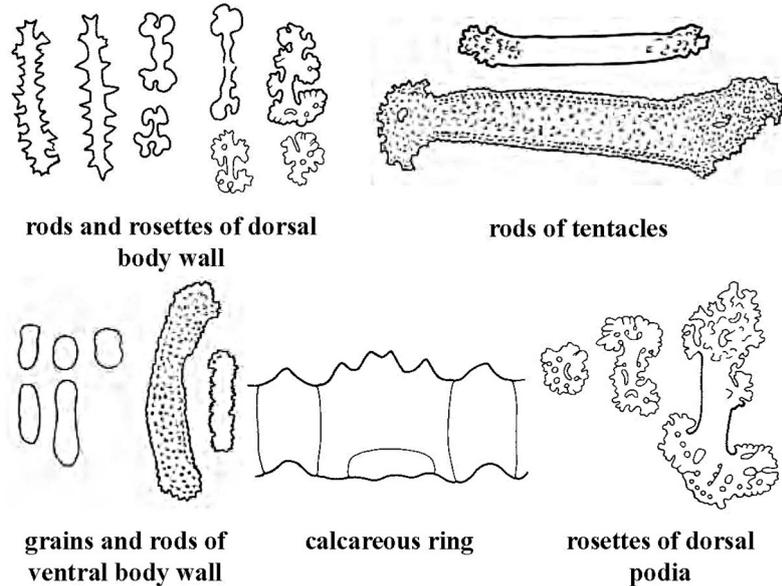
Actinopyga lecanora

And for the experts...



Characteristics of the spicules:

| | |
|--------------------------|--|
| Tentacles | Large rugose rods (165-210 μm) |
| Dorsal body wall | Spiny rods (55-90 μm) and simple rosettes (20-45 μm) |
| Ventral body wall | Small grains, elongated grains and rods that can be spiny (20-80 μm long) |
| Ventral podia | Devoid of ossicles apart from the end-plate |
| Dorsal papillae | Rods with slightly spiny or ragged sides, and large rosettes (50-60 μm) |



(after Féral and Cherbonnier, 1986)

Actinopyga miliaris

(Quoy and Gaimard, 1833)



Common names:  Hairy blackfish
 Holothurie noire



Live form

Long, thin dorsal podia make it look 'hairy'



Dry form

 25 cm on average, 35 max.

 400 g on average

 Solid black

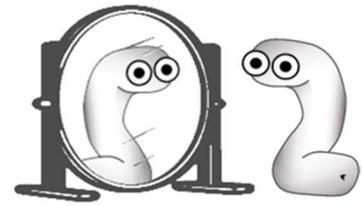
 Long, thin dorsal podia make it look 'hairy'

 10-12 cm

 Solid black

 Smooth surface. A small cut could be made through the mouth or through the ventral surface

Similar species

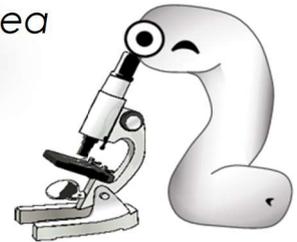


Actinopyga palauensis



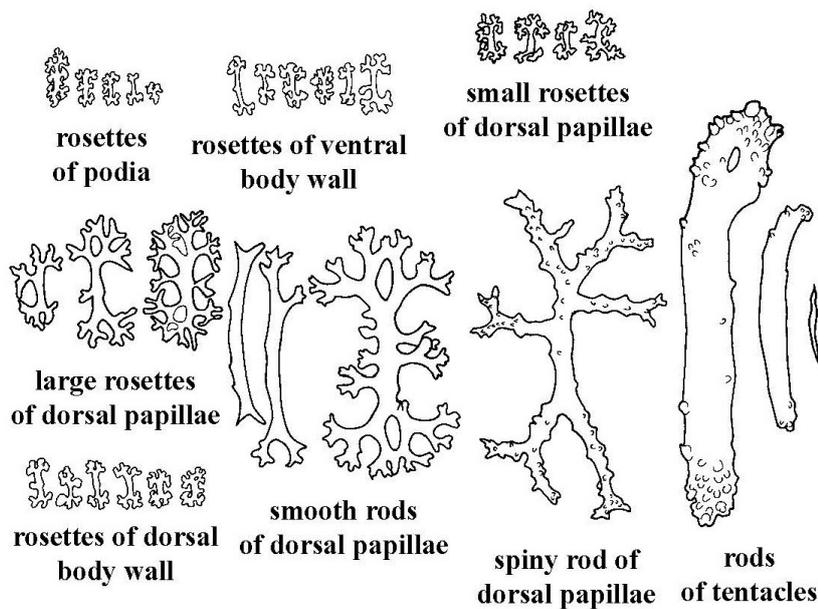
Actinopyga spinea

And for the experts...



Characteristics of the spicules:

| | |
|-------------------------------------|---|
| Tentacles | Rather large spiny rods (30–300 μm), spinier at the extremities. |
| Dorsal and ventral body wall | Rosettes ($\pm 25 \mu\text{m}$) |
| Ventral podia | Some rosettes, similar to those of the tegument |
| Dorsal papillae | Rosettes of the same size as those of the tegument, some larger (45–80 μm). Also, two types of rods: spiny (55–230 μm), often with numerous lateral spiny extensions*, and smooth (100–150 μm), some of which resemble rosettes |



(after Massin, 1996)

Actinopyga palauensis



Panning, 1944



Common names:  Panning's blackfish, Deepwater blackfish
 *Holothurie noire profonde*



Live form



Dry form

 In New Caledonia: 25 cm on average

 New Caledonia: 1.45 kg on average

 Solid dark brown/black

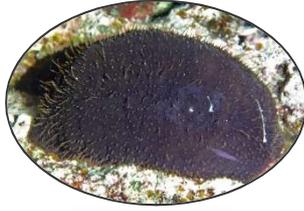
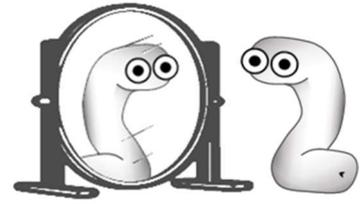
 Bumpy dorsal surface

 15-20 cm

 From dark brown to black

 Somewhat bumpy (textured) and fine wrinkles on the dorsal

Similar species

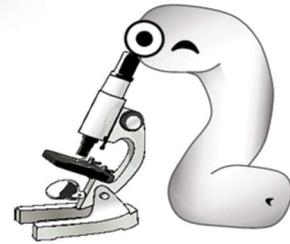


Actinopyga miliaris



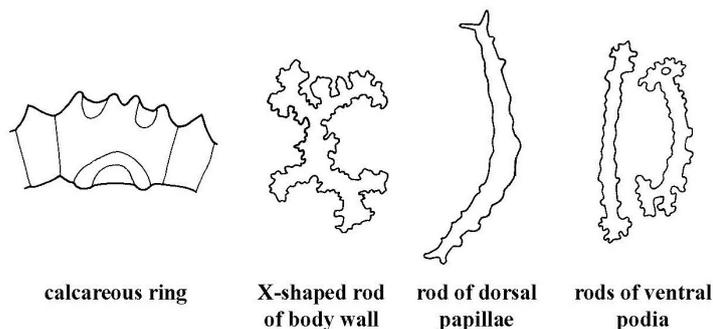
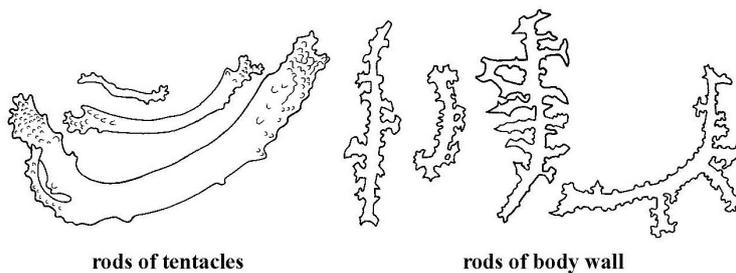
Actinopyga spinea

And for the experts...



Characteristics of the spicules:

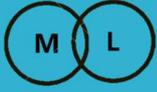
| | |
|-------------------------------------|---|
| Tentacles | Rods vary in size and roughness, the smallest (80 μm) are almost smooth; the largest (700 μm) are spiny at the ends |
| Dorsal and ventral body wall | Non-perforated, rather asymmetrical, branching rods (25-75 μm) |
| Ventral podia | Simpler ragged rods, usually slightly smaller than those in the body wall |
| Dorsal podia | Rods less ragged and more curved (up to 85 μm) |



(after Cherbonnier and Féral, 1984)

Actinopyga spinea

Cherbonnier, 1980



Common names:  Burrowing/Burying blackfish
New Caledonia blackfish

  Holothurie noire de Nouvelle-Calédonie



Live form



© S.W. Purcell

Dry form



27 cm on average,
38 max.



700 g on average



Solid dark
brown/black

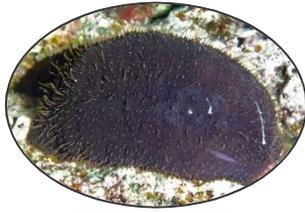
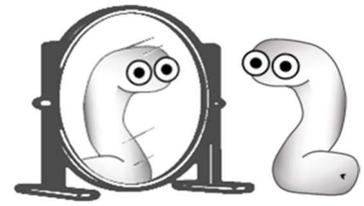


Dark brown/black



Elongated and
cylindrical

Similar species

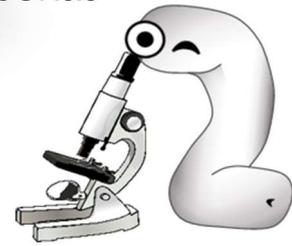


Actinopyga miliaris



Actinopyga palauensis

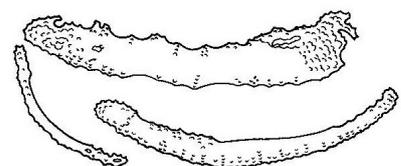
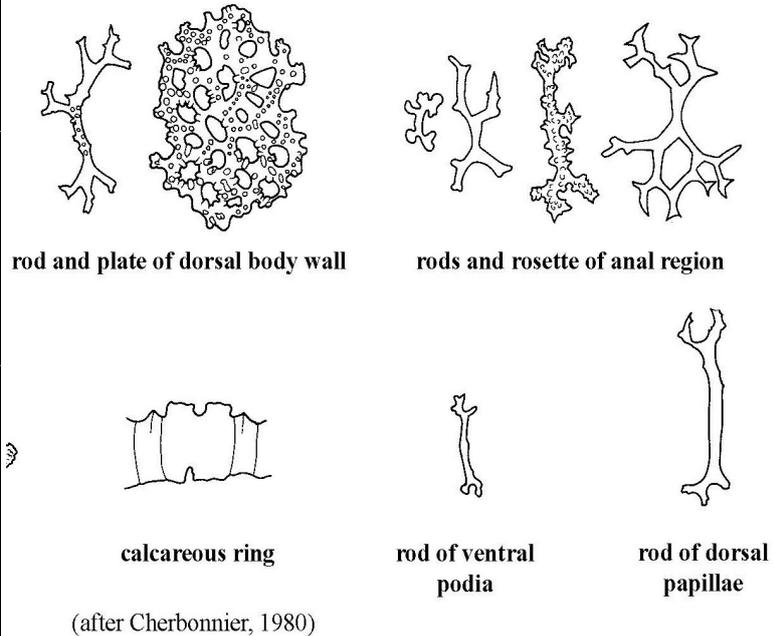
And for the experts...



Characteristics of the spicules:

Only the peristome, anal region and tentacles are rich in ossicles in this species.

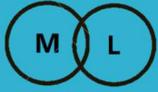
| | |
|--------------------------|---|
| Tentacles | Spiny curved rods of various size (250–500 μm) |
| Dorsal body wall | A few forked spiny rods (around 110 μm) and spiny plates of various sizes (80–130 μm) |
| Ventral body wall | No ossicles |
| Ventral podia | A few short, bifurcating rods (around 120 μm) |
| Dorsal podia | Similar rods to those of the Ventral podia but twice as long |



rods of tentacles

Actinopyga flammea

Cherbonnier, 1979



Common names:  Hérissé deep-water redfish
 Holothurie flamme



© IRD - Lagplon

From blueish to greyish conical papillae (light brown in the dried form) on the dorsal and lateral surfaces

Live form



© S.W. Purcell

Dry form



25-30 cm on average, 45 max.



Probably 2 kg



Orange/pink to flame-red



From blue to grey conical papillae on the dorsal and lateral surfaces



Dark brown

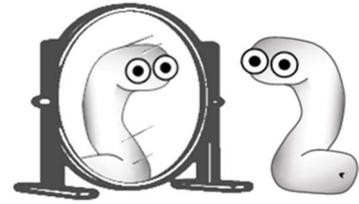
Elongated body, rounded at the ends



Light brown conical papillae on the dorsal and ventral surfaces

A small cut across mouth or along middle part of ventral surface

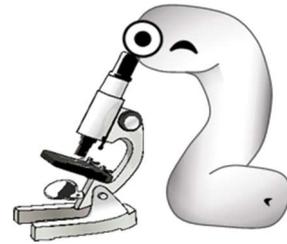
Similar species



Similar dry form, but *A. flammea*'s body is covered with light brown conical papillae

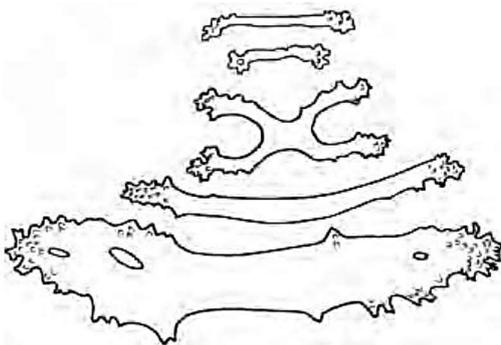
Actinopyga palauensis

And for the experts...

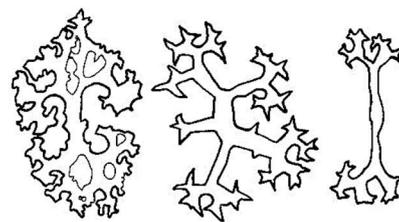


Characteristics of the spicules:

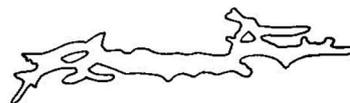
| | |
|---------------------------------|--|
| Tentacles | Tentacle stalk: massive rods, spiny at the extremities and with a few perforations (up to 300 μm long) Tentacle tips: thinner and smaller rods, (50–75 μm) |
| Dorsal body wall | Spiky plates (40–60 μm) and spiny rods (50–55 μm) |
| Ventral body wall | Small rods with rounded or spiny ends that may branch out to become X-shaped. The size of these ossicles varies from 40 to 100 μm . |
| Ventral and dorsal podia | Small rods similar to those of the ventral surface as well as rare irregularly shaped perforated rods |



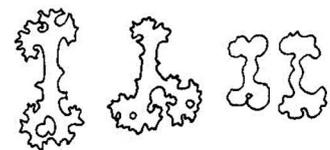
rods of tentacles



spiky rods of dorsal body wall



rod of dorsal podia

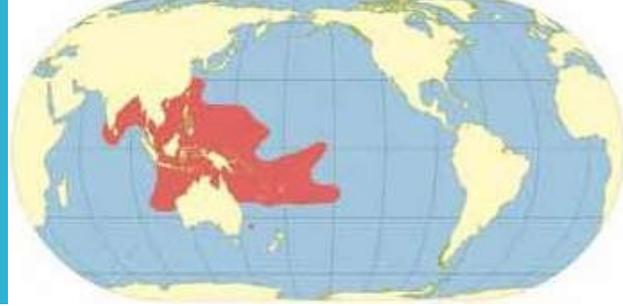


rods of ventral body wall

(after Cherbonnier, 1979)

Bohadschia argus

Jaeger, 1833



Common names:  Leopard fish

 Holothurie léopard



Numerous yellow or ochre ocelli outlined and dotted in brown, resembling the skin of a leopard



Live form

Dry form



35-40 cm on average, 60 cm max.



1.8 to 2 kg



From brown/beige to grey or light purple/mauve
Numerous yellow or ochre ocelli outlined and dotted in brown, resembling the skin of a leopard



12-18 cm

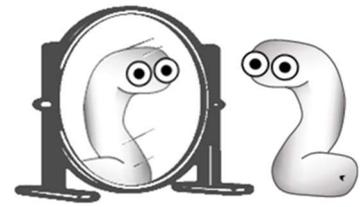


Ventral surface: Brown or grey
Dorsal surface: brown to light brown



No cut, or just a small one in the mouth

Similar species



Bohadschia atra



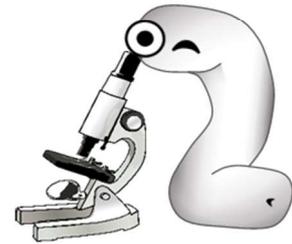
B. marmorata



B. vitiensis

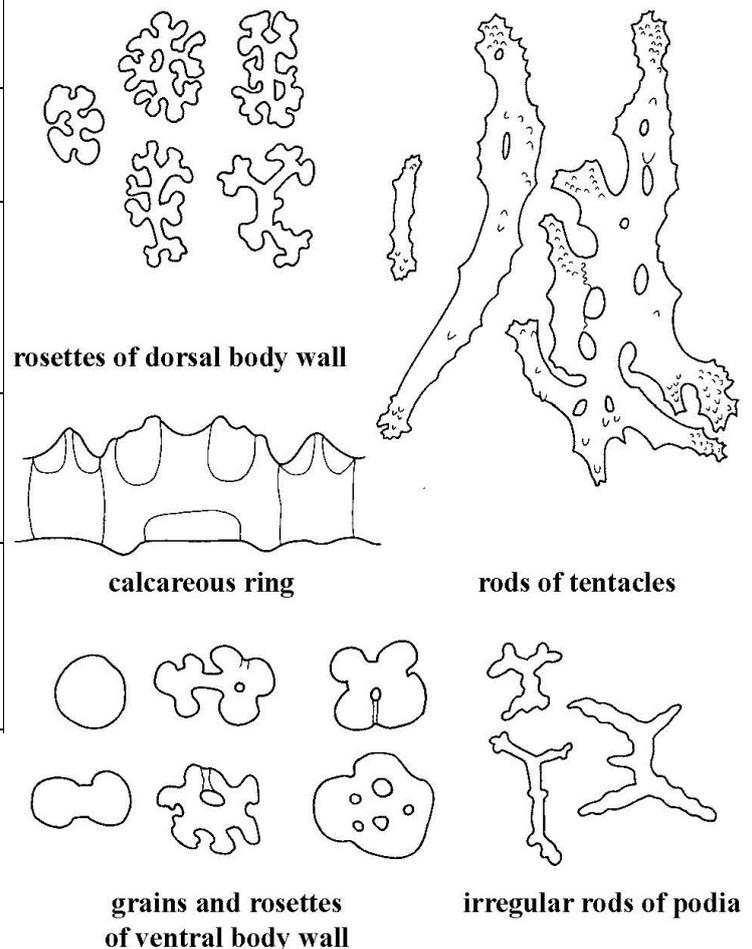
Much darker in colour

And for the experts...



Characteristics of the spicules:

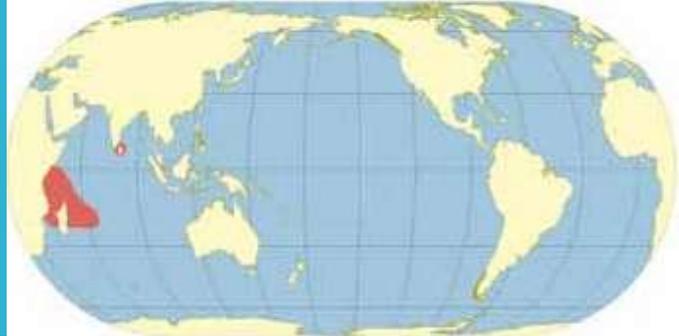
| | |
|--------------------------|--|
| Tentacles | Spiny rods (80– 300 μm) |
| Dorsal body wall | Rosettes (15– 30 μm) |
| Ventral body wall | Grains (10-30 μm) that can be perforated as well as simple rosettes (15-25 μm) |
| Ventral podia | Similar rosettes and a few rods with sharp or swollen extremities |
| Dorsal podia | Same ossicles as Ventral podia, but also rods that may be H-shaped (40 μm) |



(after Féral and Cherbonnier, 1986)

Bohadschia atra

Massin, Rasolofonirina, Conand & Samyn, 1999



Common names:  Tiger fish, leopard sea cucumber, red-eyed sea cucumber, red-spotted black sea cucumber
 Holothurie à ocelles rouges



Numerous brown to red spots (not evident on the dried form)

Live form



Dry form

 35 cm on average

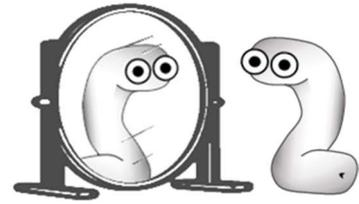
 500 g on average

 Dorsal surface dark brown to black, lighter ventral surface
Numerous brown to red spots

 Black

 Elongated, similar to the shape of salami

Similar species



Holothuria atra



Bohadschia argus



B. subrubra

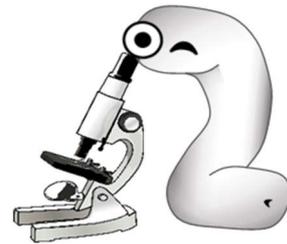


B. vitiensis

Thinner and more elongated, less regular in shape (twisted, curled, wrinkled)

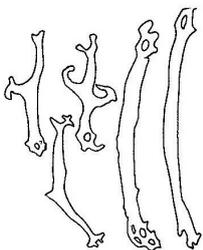
Lighter and more variable in colour

And for the experts...

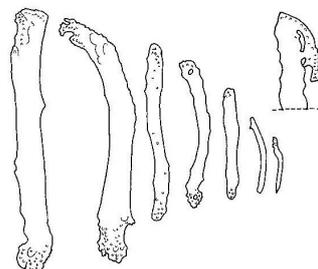


Characteristics of the spicules:

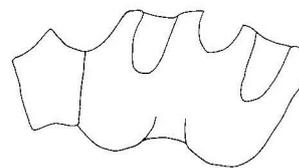
| | |
|--------------------------|---|
| Tentacles | Rods varying in size (depending on the size of the animal) between 80 and 360 μm |
| Dorsal body wall | Relatively simple rosettes |
| Ventral body wall | Rosettes similar to those of the Dorsal body wall, but with simpler rosettes and grains that can be perforated (20-50 μm) |
| Ventral podia | Rosettes similar to those of the body wall as well as straight rods |
| Dorsal podia | A few rosettes similar to those of the dorsal tegument |



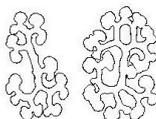
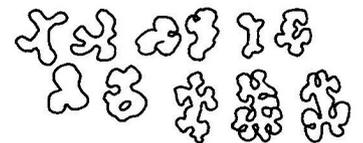
rods of podia



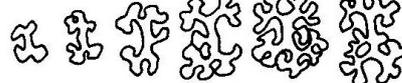
rods of tentacles



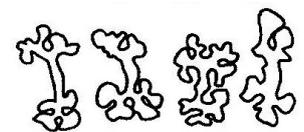
calcareous ring



rosettes of dorsal body wall



rosettes of dorsal body wall



rosettes of ventral body wall

(source: Samyn, VandenSpiegel and Massin, 2006)

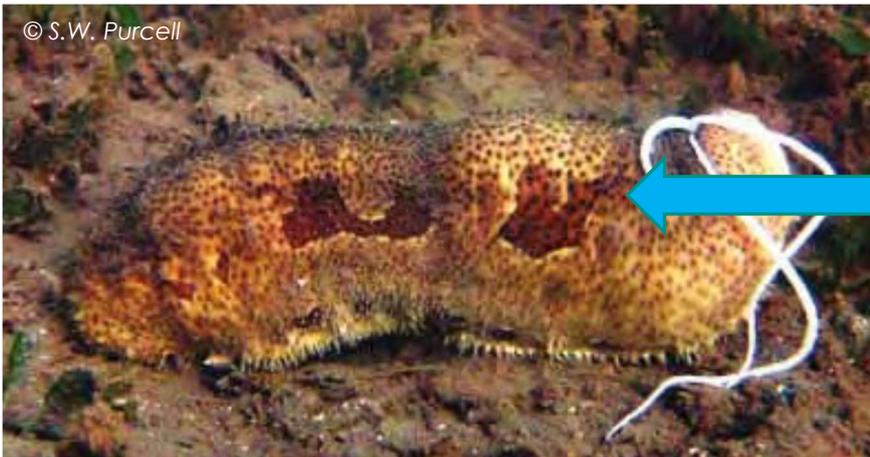
(after Massin *et al.*, 1999)

Bohadschia marmorata

Jaeger, 1833



Common names:  Brown-spotted sandfish, Chalkfish
 Holothurie de sable à tache



© S.W. Purcell

Big brown spots on the dorsal surface

Live form



© E. Aubry - FAO

Dry form



18 cm on average,
26 max.



300 g on average



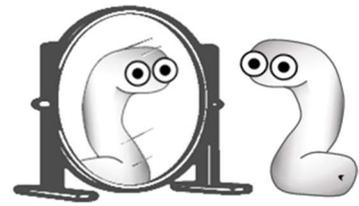
Dorsal surface: Light brown with big brown spots

Ventral surface: from white to cream colour

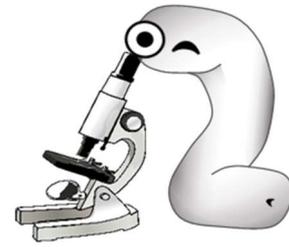


7-9 cm

Similar species



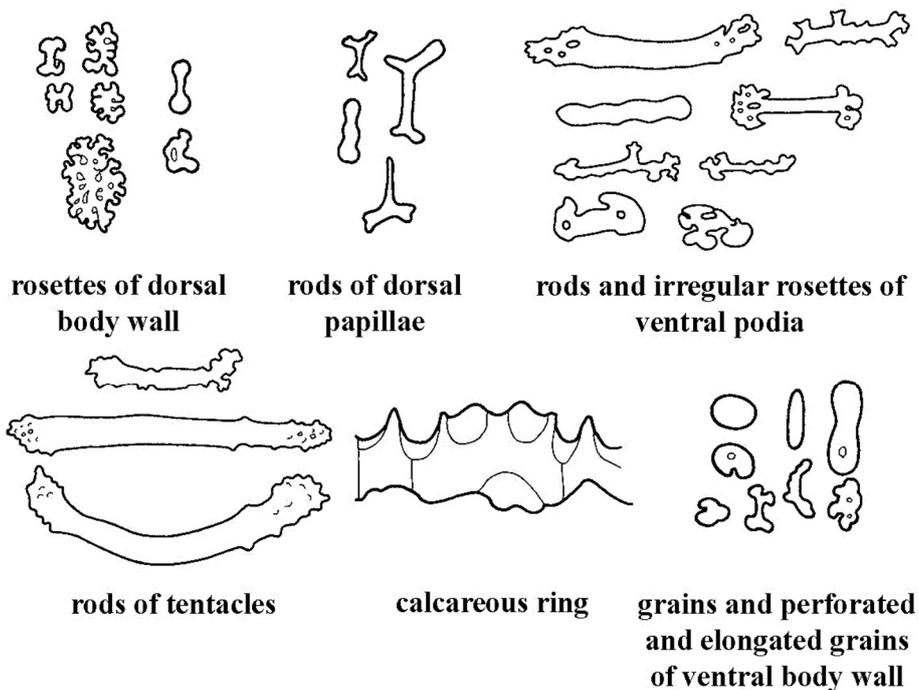
Bohadschia subrubra



And for the experts...

Characteristics of the spicules:

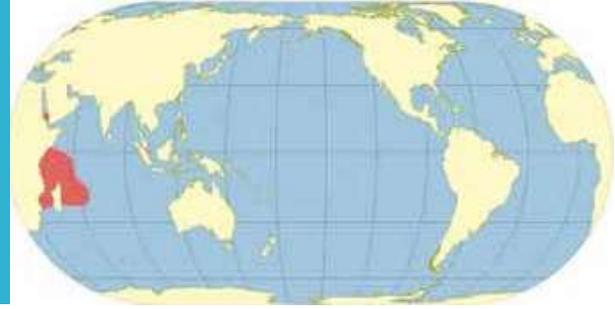
| | |
|---------------------------------|--|
| Tentacles | Thin rods varying in size (up to 220 μm) spiny at the extremities. |
| Dorsal body wall | Simple rosettes (15–20 μm) |
| Ventral body wall | Round, ellipsoid or more irregularly shaped grains (15–20 μm) and simple rosettes of the same size |
| Ventral and dorsal podia | A few simple rosettes, most of them little branched at the extremities |



(after Féral and Cherbonnier, 1986)

Bohadschia subrubra

(Quoy and Gaimard, 1833)



Common names:  Leopardfish, Falalyjaka (Madagascar)

  Holothurie terre de sienne



Black spots on the dorsal surface, which may cover more of the surface than the background colour

Live form

Dry form



Between 30 and 40 cm



500 to 800 g on average



Very variable: yellowish to bright orange and dark brown, but may also be purple or white. White ventral surface. Black spots on the dorsal surface, which may cover more of the surface than the background colour

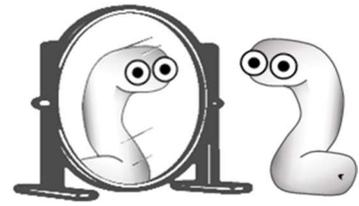


From orange brown to light or dark brown with black spots on the back



Elongated with rounded ends

Similar species



Bohadschia atra

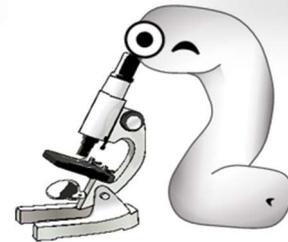


B. marmorata



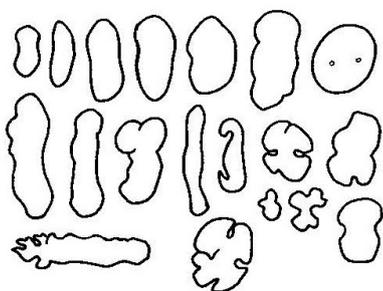
B. vitiensis

And for the experts...

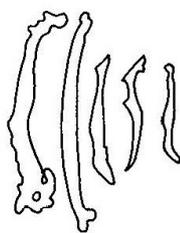


Characteristics of the spicules:

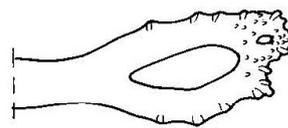
| | |
|--------------------------|--|
| Tentacles | Rods varying in size (25–540 μm), mostly spiny; largest ones forked or with perforated extremities, especially in smaller individuals. |
| Dorsal body wall | Rosettes (20– 35 μm) |
| Ventral body wall | Grains of various shapes and rosettes |
| Ventral podia | Rosettes and grains similar to those of the body wall, as well as straight, non-branched rods (20–210 μm) |
| Dorsal podia | Rods (35–230 μm) and rosettes similar to those of the body wall. |



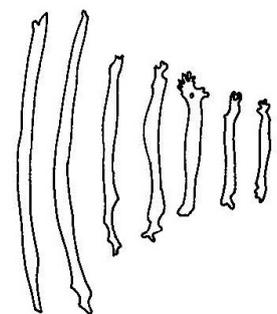
granules
of ventral body wall



rods of dorsal
podia



rod extremity
of tentacle



rods of ventral podia

(after Massin *et al.*, 1999)

Bohadschia vitiensis

(Semper, 1868)



Common names:  Brown sandfish

 Holothurie brune, Holothurie de sable brune



© P. Bourjon - DORIS

Small characteristic brown spots at the base of each podium

Live form



© S.W. Purcell

Dry form



25-35 cm on average, 40 max.



400 to 800 g in Reunion and Madagascar and 1.2 kg in Papua New Guinea



White to yellow/light orange, sometimes with darker or lighter areas

Small characteristic brown spots at the base of each podium



12-15 cm



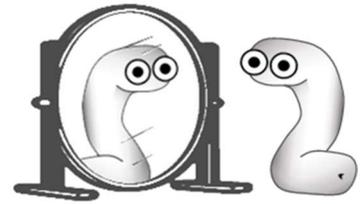
From brown to brown-black



Cylindrical body, arched and slightly wrinkled dorsally and relatively flat ventrally.

No cut, or just a small one in the mouth

Similar species



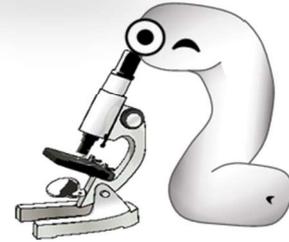
B. marmorata

Lighter ventral surface
Its morphology is
more stretched out



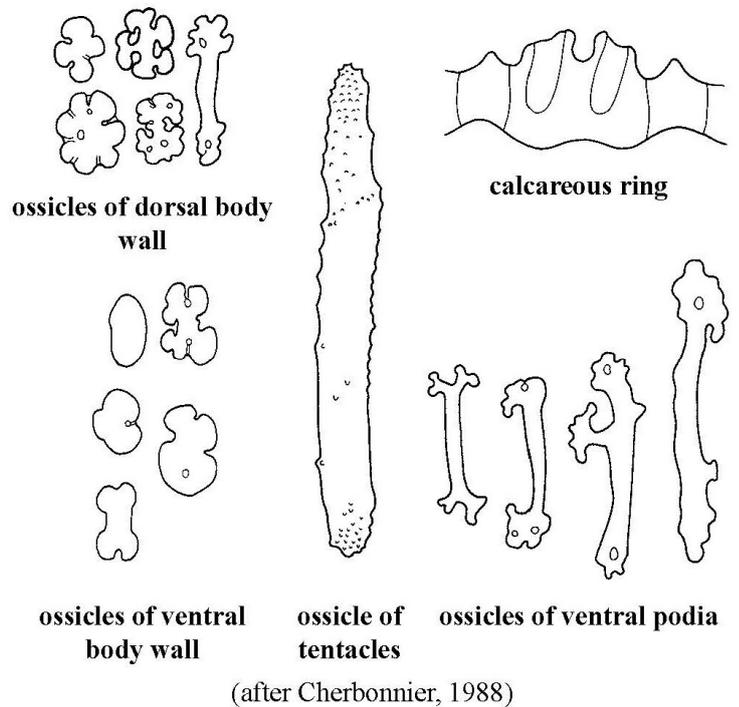
B. subrubra

And for the experts...



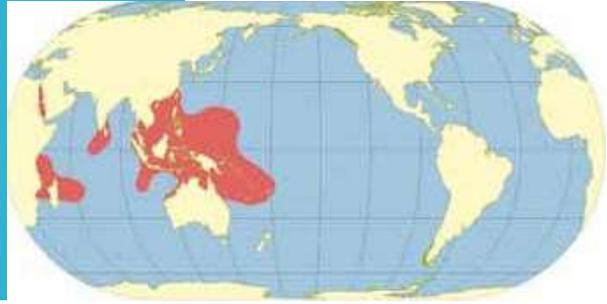
Characteristics of the spicules:

| | |
|--------------------------|---|
| Tentacles | Straight or slightly rounded rods |
| Dorsal body wall | Rather stout rosettes (15–20 μm) which can occasionally be more elongated |
| Ventral body wall | Ovoid, ellipsoid or more irregularly shaped grains; grains can be perforated (10–20 μm) |
| Ventral podia | Numerous rods of various shapes (35–75 μm) |
| Dorsal podia | Rods, similar in shape and size to the larger ones of the Ventral podia |



Pearsonothuria graeffei

(Semper, 1868)



Common names:  Blackspotted sea cucumber, Flowerfish
 Holothurie rayée, Holothurie fleur

Conical papillae with white podia on the dorsal surface



Frontal mouth, as wide as the body



Live form



Dry form



17-35 cm, 45 max.



130 to 700 g on average (1.3 kg max.)



Light beige or cream with larger brown patches and black dots



Conical papillae with white spines on the dorsal surface, mouth as wide as the body



15 cm



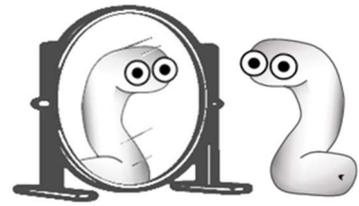
From black to brown-black



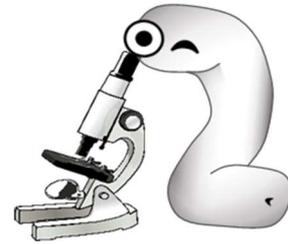
Elongated with a rectangular cross-section
No cut, or just a small one in the mouth

Not available

Similar species

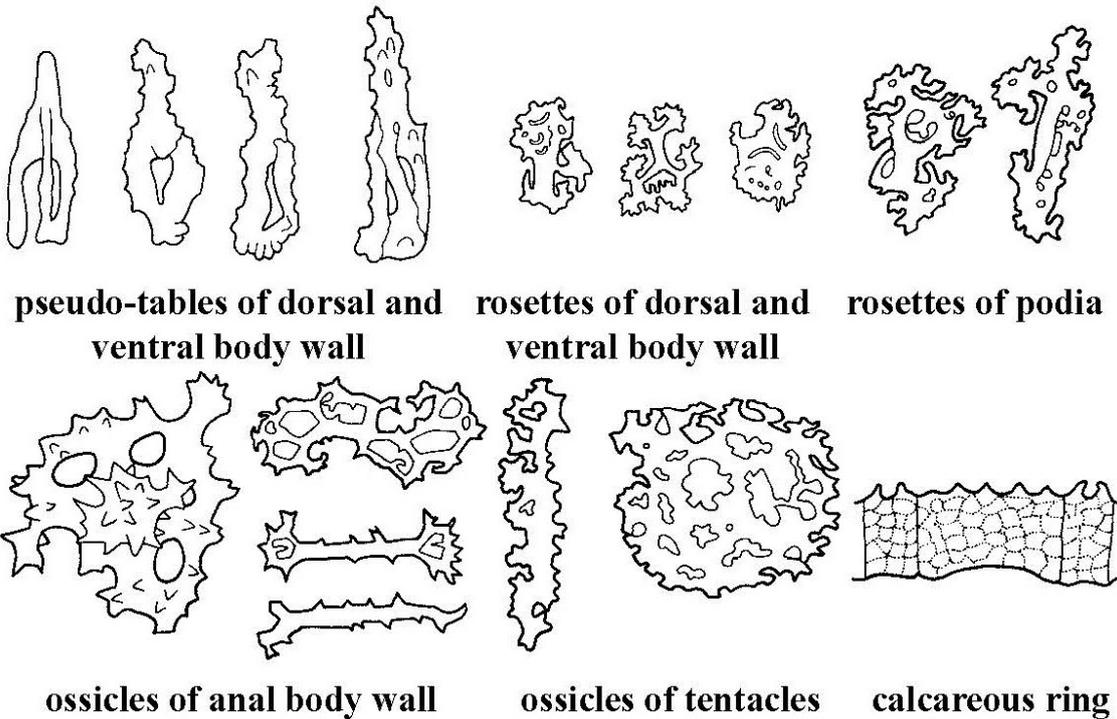


And for the experts...



Characteristics of the spicules:

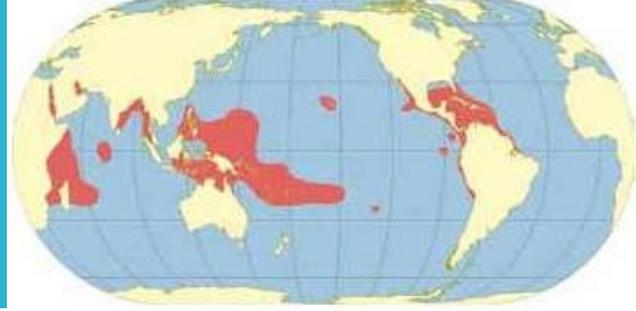
| | |
|-------------------------------------|--|
| Tentacles | Rods that might resemble rosettes (20–90 μm) |
| Dorsal and ventral body wall | Rods (20-50 μm) and knobbed pseudo-tables (30-65 μm) |
| Ventral and dorsal podia | Very complex rosettes that resemble those of the body wall. |



(after Cherbonnier and Féral, 1984)

Holothuria arenicola

Semper, 1868



Common names:  Sand sea cucumber
 Holothurie arénicole



Two rows of dark brown spots on the ventral surface

Live form



© S.W. Purcell

Dry form



10 cm on average, 30 max.



Probably less than 100 g



From cream to rusty tan. Some individuals are quite orange, becoming whitish towards its extremities. Two rows of dark brown spots on the ventral surface

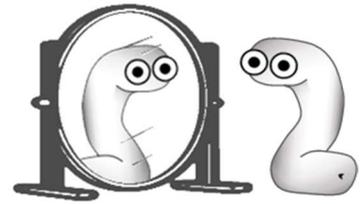


From tan to brown



The body tapers at both extremities

Similar species



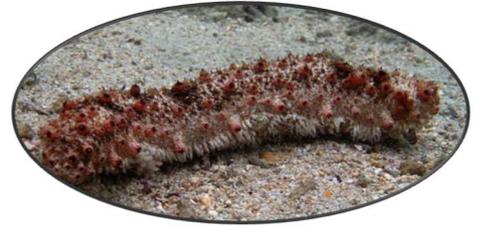
The pattern of light skin colour with two sets of dark spots is relatively common in sea cucumbers and can lead to confusion. The following are a few species that share this characteristic:



H. fuscocinerea



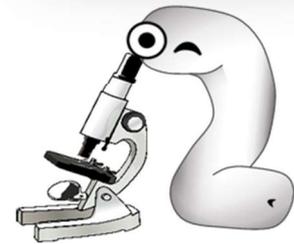
H. pardalis



H. pervicax

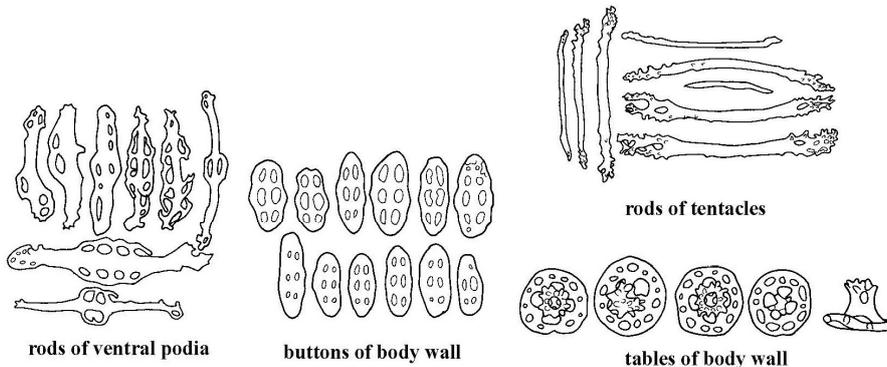
It is distinguished from *H. arenicola* by its small warts

And for the experts...



Characteristics of the spicules:

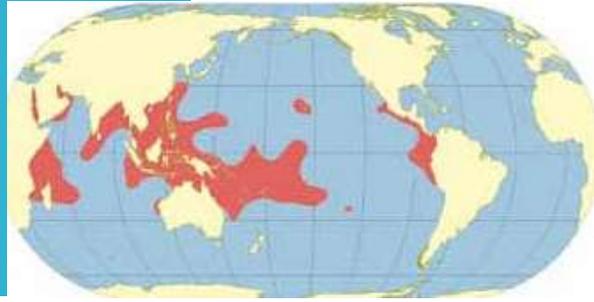
| | |
|-------------------------------------|---|
| Tentacles | Spiny rods at the extremities; the larger ones have perforated and/or forked distal ends (100-200 μm) |
| Dorsal and ventral body wall | Very small flat tables (40-55 μm), often reduced to the smooth-edged disc, perforated by 4 large central holes and 0-4 small peripheral holes with very short pillars ending in a few spines or a small crown of spines; very regular buttons (40-50 μm) with 3 pairs of holes. |
| Ventral podia | Buttons, tables and rods (up to 180 μm) |
| Dorsal podia | Tables, buttons and rods similar to those of Ventral podia; large buttons (50-225 μm), with 3-10 pairs of holes, are abundant |



(after Massin, 1996)

Holothuria atra

Jaeger, 1833



Common names:  Lollyfish

 Holothurie à ocelles noirs, Holothurie lolly



Live form



© F. Ducarme

Often covered by
substrata, except for
two rows of bare circles



© S.W. Purcell

Dry form



15 to 30 cm, 45 cm
max.



200 to 400 g



Solid black (possibly with
reddish-brown highlights)



5-12 cm



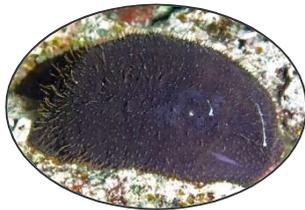
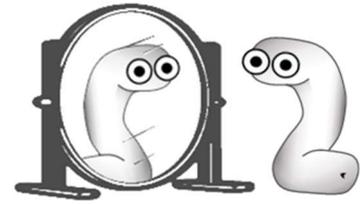
Black



Cylindrical, narrow
body

No cut, or just a small
one in the mouth

Similar species



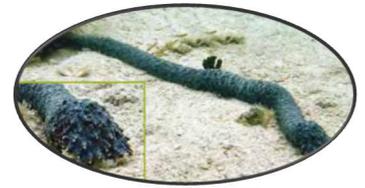
Actinopyga miliaris

Larger, shorter, higher back



Holothuria leucospilota

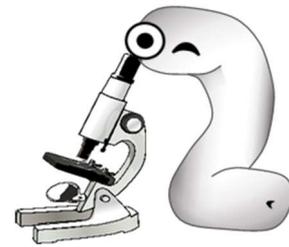
Larger, thinner, covered with podia



Holothuria coluber

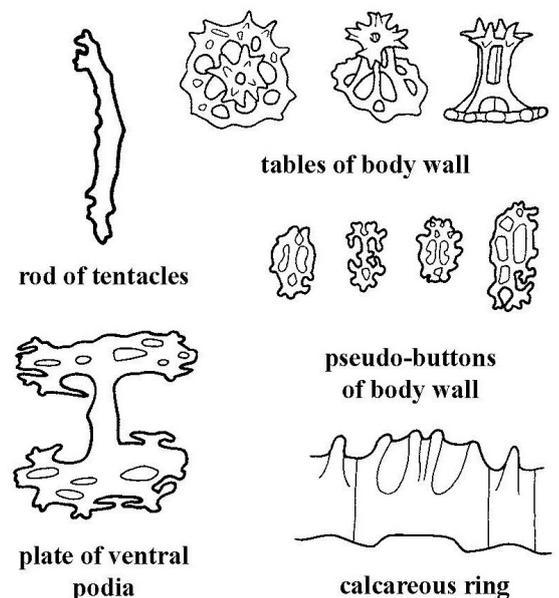
Grey, more elongated, light-coloured tentacles

And for the experts...



Characteristics of the spicules:

| | |
|-------------------------------------|---|
| Tentacles | Thin rods varying in size |
| Dorsal and ventral body wall | Tables of Ventral body wall with larger, spiner disc (up to 60 μm) than those of Dorsal body wall Table disc perforated by four central holes; spire ending in a Maltese cross. Simple rosettes (20–25 μm long) more abundant dorsally than ventrally |
| Ventral and dorsal podia | Pseudo-plates (75–100 μm) and rosettes of similar size as those in the body wall |



(after Cherbonnier, 1980)

Holothuria cinerascens

(Brandt, 1835)



Common names:  Ashy sea cucumber
 Holothurie cendrée



© P. Bourjon - DORIS

Live form

Numerous yellow podia ventrally and dorsally



© P. Bourjon - DORIS

Dendro-pelted tentacles, yellow with red-brown veins and white terminals



© C. Conand

Dry form

 10 cm on average, 16 max.

 From dark brown to red-brown with darker spots

Numerous yellow podia ventrally and dorsally.

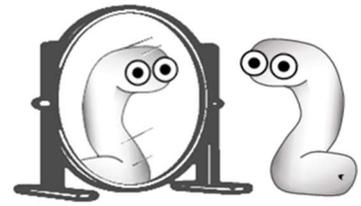
 Dendro-pelted tentacles, yellow with red-brown veins and white terminals

 Grey with brown lines ventrally

Shaped like small wooden rods

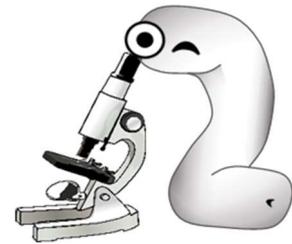
 Dendro-pelted tentacles, yellow with red-brown veins and white terminals

Similar species



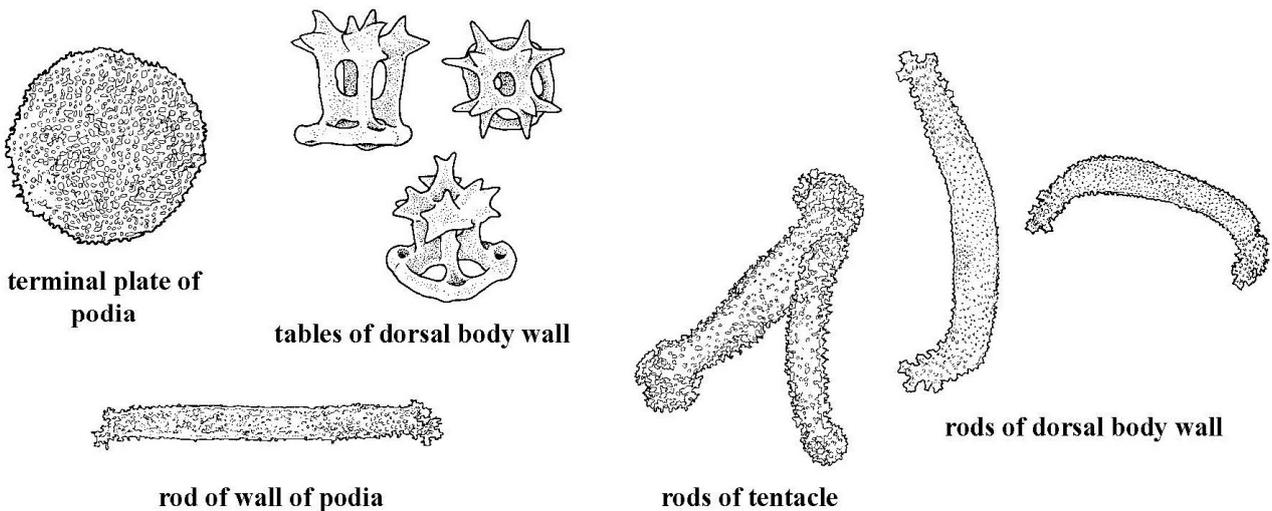
There may be some confusion with certain holothurians of the order Dendrochirotida, of which we can usually only see the tentacles. In this case, it is their colours that will allow their identification, as well as their shape.

And for the experts...



Characteristics of the spicules:

| | |
|-------------------------------------|--|
| Tentacles | Rods (60–140 μm long), finely rugose at the sides |
| Dorsal and ventral body wall | Tables more numerous in the dorsal than in the Ventral body wall. Tables with discs (35-55 μm), 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) |
| Ventral and dorsal podia | Similar ossicles to those in the body wall. Dorsal podia also with perforated plates (up to 120 μm) |



(source: Samyn, VandenSpiegel and Massin, 2006)

Holothuria coluber

Semper, 1868



Common names:  Snakefish  Holothurie serpent



Live form

Spiky yellow papillae, especially around the mouth and ventral edges. Tentacles are long and light-coloured.

Body wall covered with small whitish bumps



Dry form

 18-40 cm (60 max).

 140 to 300 g

 From dark grey to black

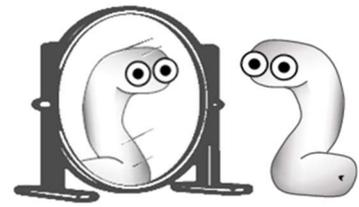
 Spiky yellow papillae, especially around the mouth and edges

 12-18 cm

 Brown

 Long irregular skinny shape. Small cut across mouth and/or in the centre of the body. Body wall covered with small whitish bumps

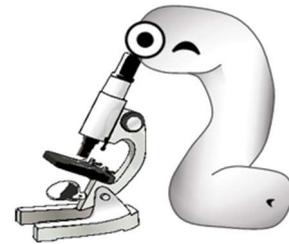
Similar species



Holothuria leucospilota

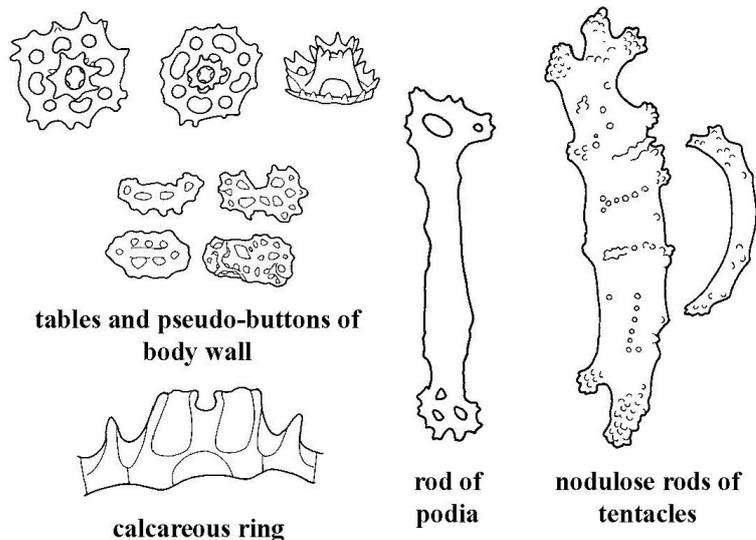
H. leucospilota has black tentacles while *H. coluber* has yellow tentacles.

And for the experts...



Characteristics of the spicules:

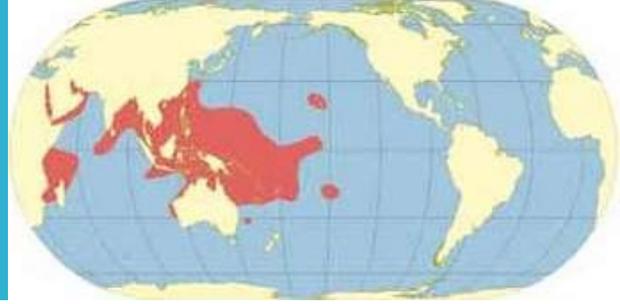
| | |
|-------------------------------------|--|
| Tentacles | Slightly rounded and spiny rods at the extremities (40–165 μm) |
| Dorsal and ventral body wall | Tables with discs (60–80 μm), perforated by a single central hole and up to 12 peripheral holes; edge spinose and often turned upwards, giving a kind of 'cup and saucer' appearance; low spire ending in a narrow crown of spines. Buttons are rare, and they have 3–5 pairs of holes, quite irregular in appearance. |
| Ventral and dorsal podia | Tables similar to the body wall, as well as perforated plates (35–140 μm), and rods with enlarged and often perforated extremities (50–110 μm) |



(after Féral and Cherbonnier, 1986)

Holothuria edulis

Lesson, 1830



Common names:  Pinkfish  Trévang rose, holothurie rose



Pink body wall



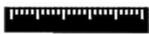
Live form

Dry form

 20-24 cm on average, 38 max.

 200 g on average

 Dark grey, chocolate brown or black dorsally, fading laterally to pink or whitish pink on the ventral surface.

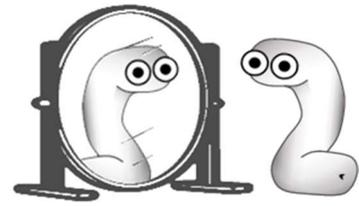
 10-14 cm

 Dark brown dorsal surface, lighter brown ventral surface

 Narrow cylindrical shape, dorsal surface with small wrinkles, smoother ventral surface

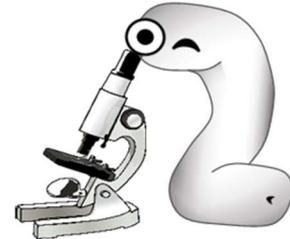
No cut, or just a small one in the mouth

Similar species



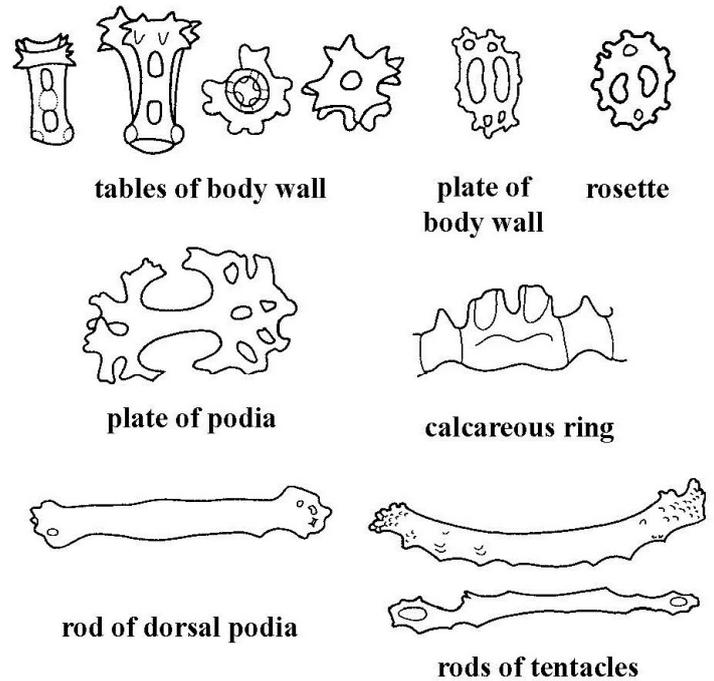
Due to its often-pink colouring and characteristic shape, it is not possible to confuse *Holothuria edulis* with any other species.

And for the experts...



Characteristics of the spicules:

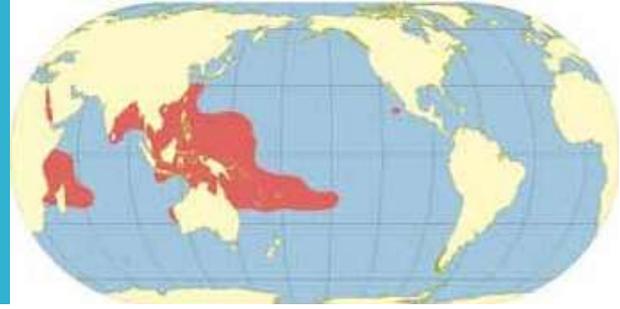
| | |
|-------------------------------------|--|
| Tentacles | Curved rods with enlarged spiny extremities (70–180 μm) |
| Dorsal and ventral body wall | Tables with greatly reduced disc (35 μm), perforated by one central hole; spire ending in a Maltese cross. Button-like rosettes perforated by 4–10 uneven holes and with an uneven rim (30–70 μm) |
| Ventral podia | Perforated plates (100–140 μm) and shorter rods |
| Dorsal podia | Large rods that might have a few perforations (135 μm) |



(after Cherbonnier, 1980)

Holothuria flavomaculata

Semper, 1868



Common names:  Red snakefish, Yellow spotted sea cucumber

 *Holothurie serpent rouge*, *Holothurie à points jaunes*



© P. Bourjon - DORIS

Short yellow ochre conical papillae

Live form



Dry form



35 cm on average,
60 max.



Solid purplish-brown
to maroon



Short yellow ochre
conical papillae



20 cm



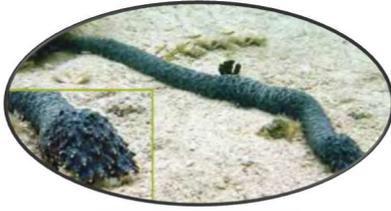
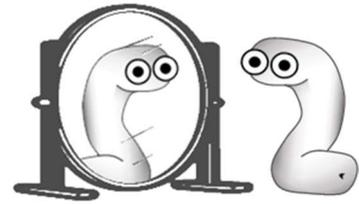
Brown covered with
lighter-coloured bumps



Similar to *Holothuria coluber*
Irregular, elongated shape,
clearly tapered at the
mouth

Small cut across mouth
and/or in the centre of the
body

Similar species



Holothuria coluber

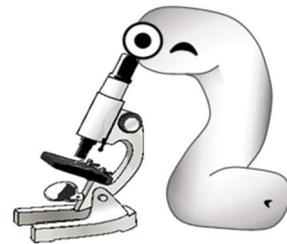
Dark grey-blue body wall



Holothuria leucospilota

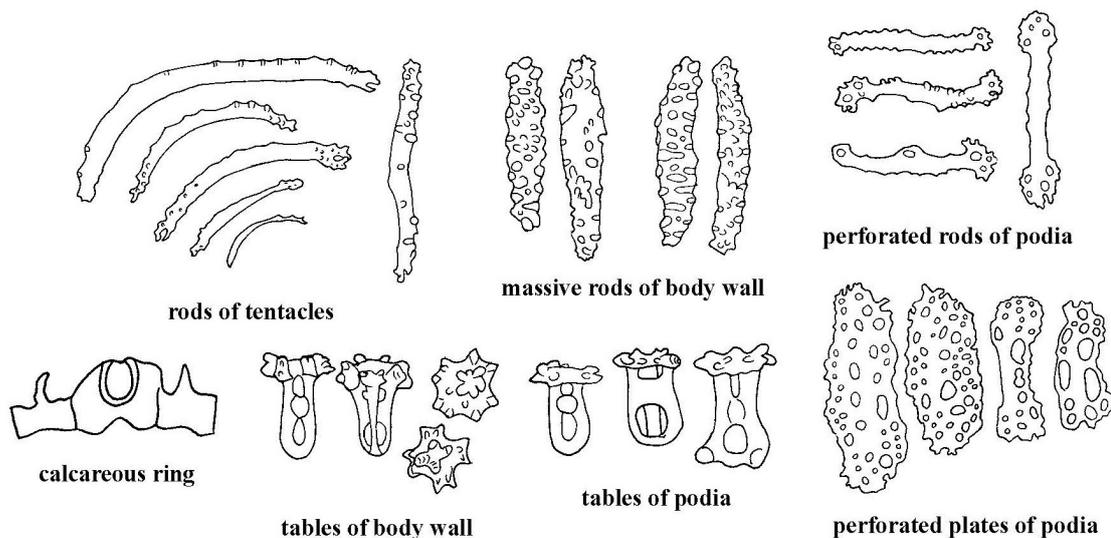
Black body wall

And for the experts...



Characteristics of the spicules:

| | |
|-------------------------------------|---|
| Tentacles | Straight or curved rods (95–355 μm) |
| Dorsal and ventral body wall | Tables without disc, spire ending in a Maltese cross. Massive spiny rods (85–105 μm) |
| Ventral and dorsal podia | Tables similar to the body wall, rods with perforated extremities (160–200 μm) and perforated plates (130–210 μm) |



(after Massin, 1999)

Holothuria fuscocinerea

Jaeger, 1833



Common names:  Ashen/ashy pink sea cucumber
 Holothurie cendre brune



Black-tipped wart-like bumps



© P. Bourjon - DORIS

Live form

3 to 7 dark transverse blotches on the dorsal surface



© J. Akamine - FAO

Dry form

 20 cm on average, 35 max.

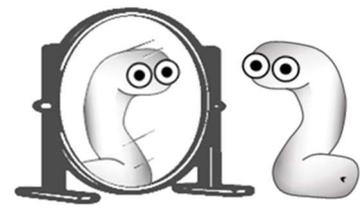
 Light brown to a pinkish beige on the dorsal surface, with 3 to 7 blackish blotches

 Black-tipped wart-like bumps

 Light brown

 Dorsal surface covered in bumps

Similar species



Holothuria pervicax

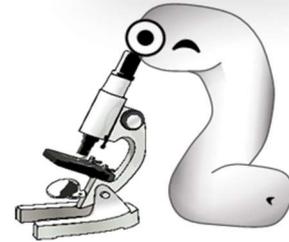


H. arenicola



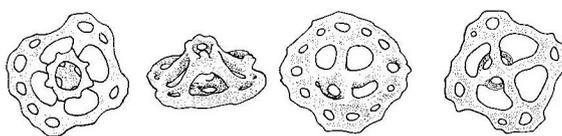
H. pardalis

And for the experts...

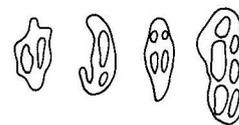


Characteristics of the spicules:

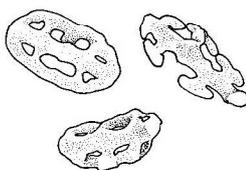
| | |
|-------------------------------------|--|
| Tentacles | Curved rods (50-400 μm) slightly rugose at the sides |
| Dorsal and ventral body wall | Tables and buttons poorly developed. Rounded, smooth table discs (25-40 μm), perforated by 4 central holes and a few peripheral holes, low spire ending in a Maltese cross. Smooth, irregular buttons (25-40 μm) with 1-3 pairs of holes |
| Ventral podia | Irregular perforated rods (up to 235 μm), large perforated plates (100-155 μm), buttons (up to 70 μm), and tables with spire reduced to knobs on disc |
| Dorsal papillae | Rods perforated at the extremities (up to 300 μm) as well as a few large tables with spire reduced to knobs |



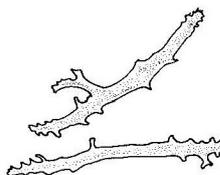
tables of body wall



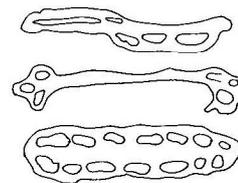
irregular buttons



buttons of body wall



rods of tentacles



supporting ossicles

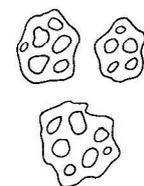


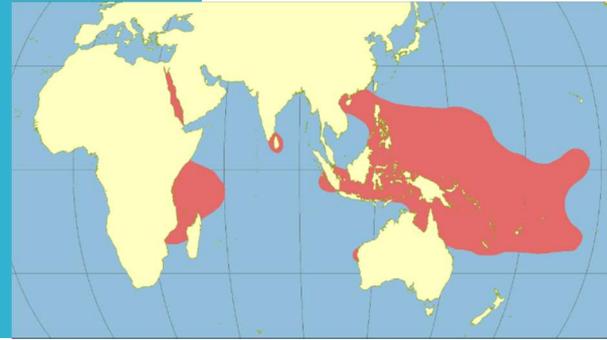
table discs

(source: Solís-Marín *et al.*, 2009)

(after Reyes-Leonardo, 1984)

Holothuria fuscogilva

Cherbonnier, 1980



Common names:  White teatfish

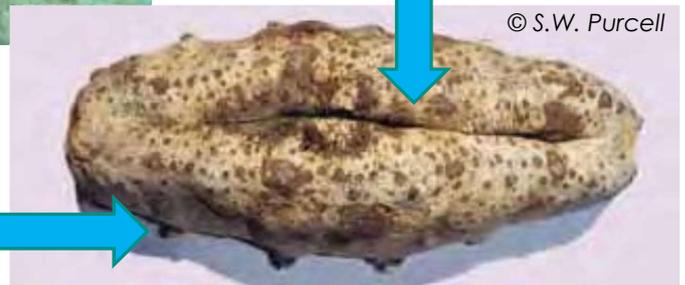
 Holothurie blanche à mamelles



Live form

6 to 8 lateral teat-like protuberances

A single straight cut on the dorsal surface



Dry form

 Between 40 and 60 cm

 2.4 to 3 kg

 From light brown, to dark grey with whitish spots, or whitish or beige with dark brown blotches.

 6 to 8 lateral teat-like protuberances

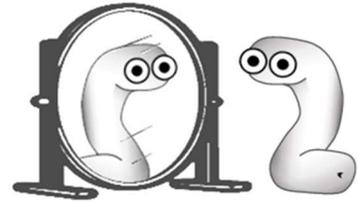
 18-24 cm

 Grey-brown

 From smooth to slightly wrinkled with longer "teats" than the other two "teatfish", and pointier; "teats" are white in contrast to the rest of the body

A single straight cut on the dorsal surface

Similar species



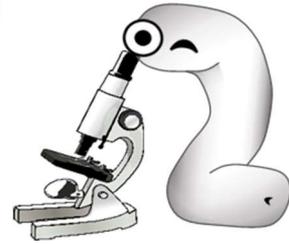
Holothuria nobilis



Holothuria whitmaei

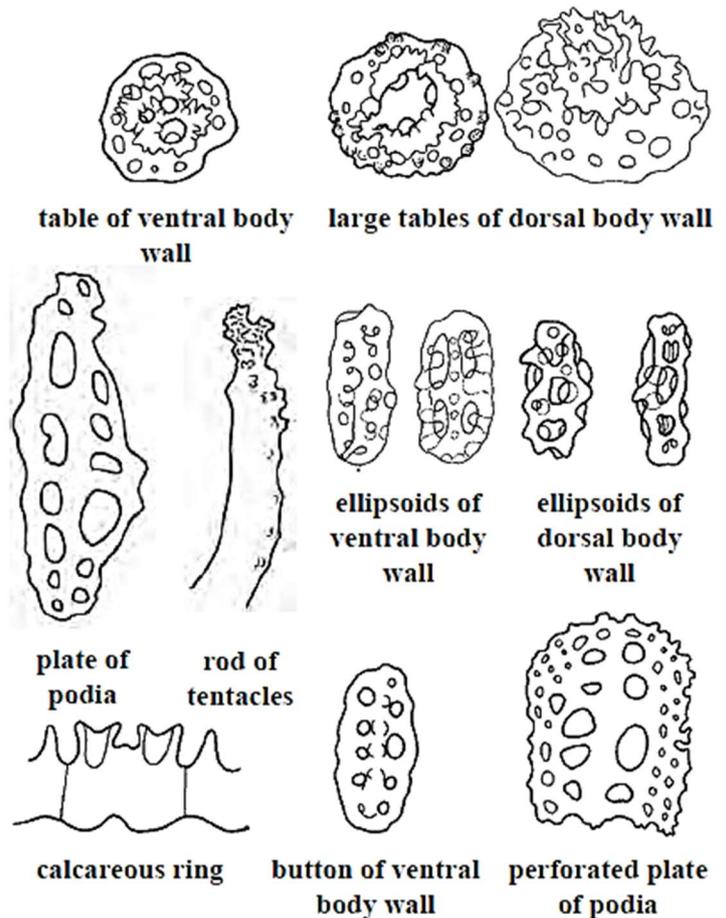
→ see **Appendix**

And for the experts...



Characteristics of the spicules:

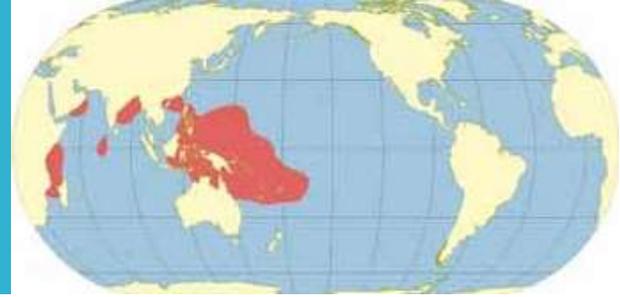
| | |
|---------------------------------|---|
| Tentacles | Large rods (up to 700 μm) rugose at the extremities |
| Dorsal body wall | Round and undulating table disc (65–100 μm), perforated by 10–15 holes, low spire ending in a stout crown of spines that can have more than one layer in the largest tables. Irregular ellipsoid buttons (around 65 μm) |
| Ventral body wall | Tables and ellipsoid buttons as those on the dorsal surface, and slightly knobbed buttons (60–80 μm long) |
| Ventral and dorsal podia | Large perforated plates |



Holothuria fuscopunctata



Jaeger, 1833



Common names:  Elephant trunkfish
 Holothurie trompe d'éléphant



© IRD - Lagplon

Live form

Deep, brown wrinkles dorsally
(like an elephant's trunk)



© S.W. Purcell

Dry form

 48 cm on average, 70 max.

 3K g on average, 5.5 kg max.

 From golden to light brown or cream on the dorsal surface with numerous brown spots, that become lighter on the ventral surface

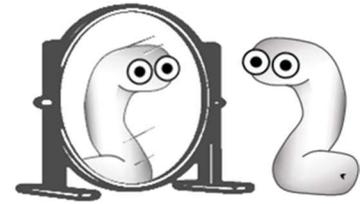
 Deep, brown wrinkles dorsally (like an elephant's trunk)

 20-25 cm

 From light brown to beige on the dorsal surface
Tiny black spots are visible all over the body

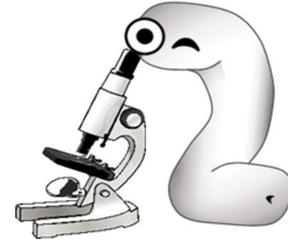
 Elongated, arched dorsally, and flattened ventrally
Small cut across mouth or large ventral cut. Deep, brown wrinkles dorsally (like an elephant's trunk)

Similar species



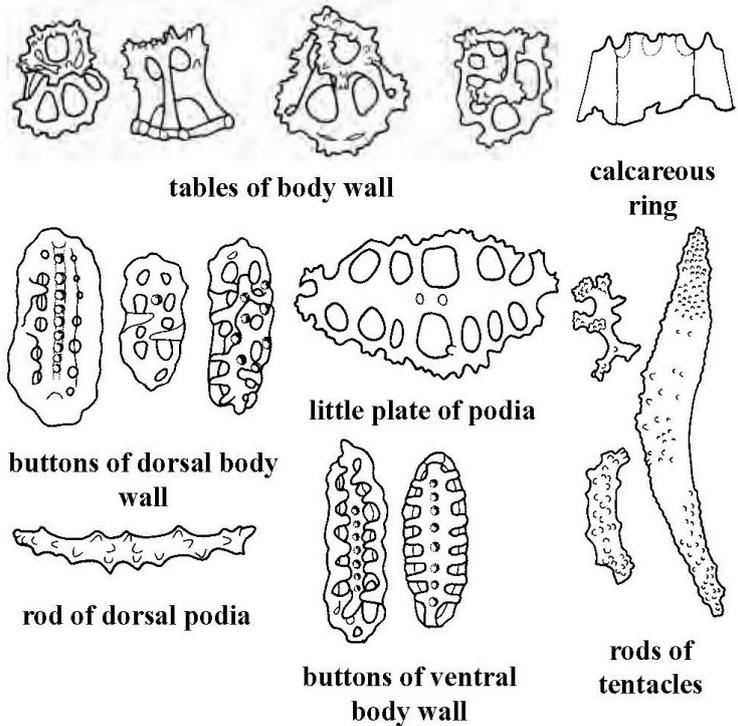
Holothuria scabra

And for the experts...



Characteristics of the spicules:

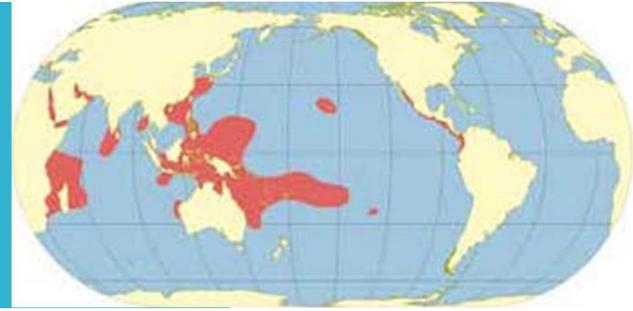
| | |
|-------------------------------------|---|
| Tentacles | Straight rods (30–150 μm) slightly spiny |
| Dorsal and ventral body wall | <p>Numerous tables and ellipsoid buttons. Some smooth and knobbed buttons ventrally</p> <p>Tables have small discs (35–55 μm) with irregular and spiny rim, perforated by 4 central holes 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)</p> |
| Ventral and dorsal podia | Spiny plates that can take the form of irregular branching rods |



(after Cherbonnier, 1980)

Holothuria hilla

Lesson, 1830



Common names:  Contractile/sand sifting sea cucumber
 Holothurie contractile



Live form

Large, flat, light-coloured, conical papillae



Dry form

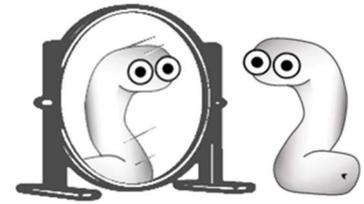
 25 cm max.

 From orange or tan to dark brown

 Large, flat, light-coloured, conical papillae

 Chestnut

Similar species



Actinopyga flammea



Holothuria impatiens



H. pardalis



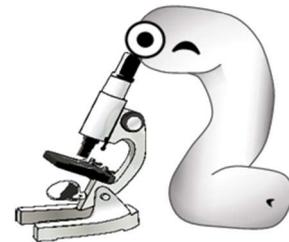
H. flavomaculata

Shorter and thicker body

More sombre colouring

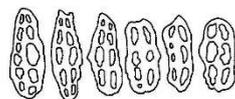
Significantly smaller

And for the experts...

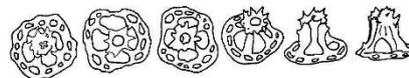


Characteristics of the spicules:

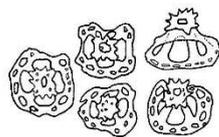
| | |
|-------------------------------------|---|
| Tentacles | Slender rods (45– 145 μm) |
| Dorsal and ventral body wall | Dorsal and ventral body wall with similar tables and rods, although there are fewer tables in the Ventral body wall. Smooth table discs (50–70 μm), with a circular to quadrangular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



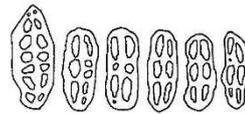
buttons of dorsal body wall



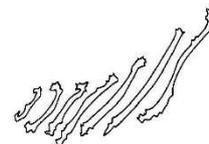
tables of dorsal body wall



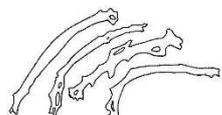
tables of ventral body wall



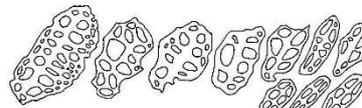
buttons of ventral body wall



rods of tentacles



rods and buttons of dorsal papillae

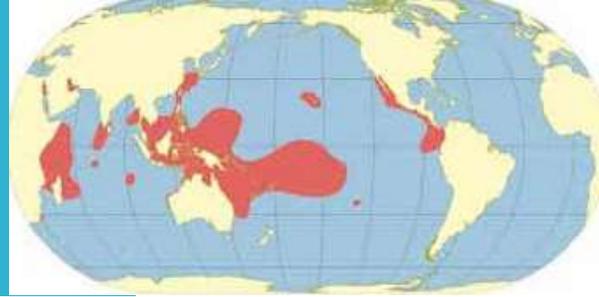


tables and buttons of ventral podia

(after Samyn and Massin, 2003)

Holothuria impatiens

(Forsskål, 1775)



- Common names:**
-  Brown spotted sea cucumber, impatient sea cucumber, Bottleneck sea cucumber
 -  Holothurie bouteille
 -  Holoturia cuello de botella

NB: This species is considered an extremely variable species complex



© F. Ducarme

Visible papillae

5 or more dark brown transverse bands on the dorsal surface

Visible mouth tentacles



© F. Michonneau - licensed CC-BY



Live form

Dry form

 20 cm (26 cm max.)

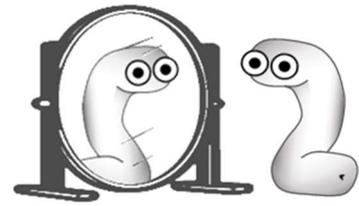
 50 g

 Light brown dorsal surface with 5 or more dark brown transverse bands. Beige ventral surface

 Visible papillae and mouth tentacles

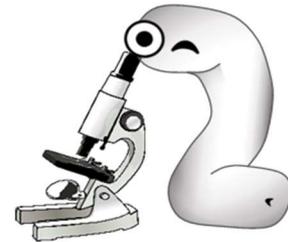
 5-7 cm

Similar species



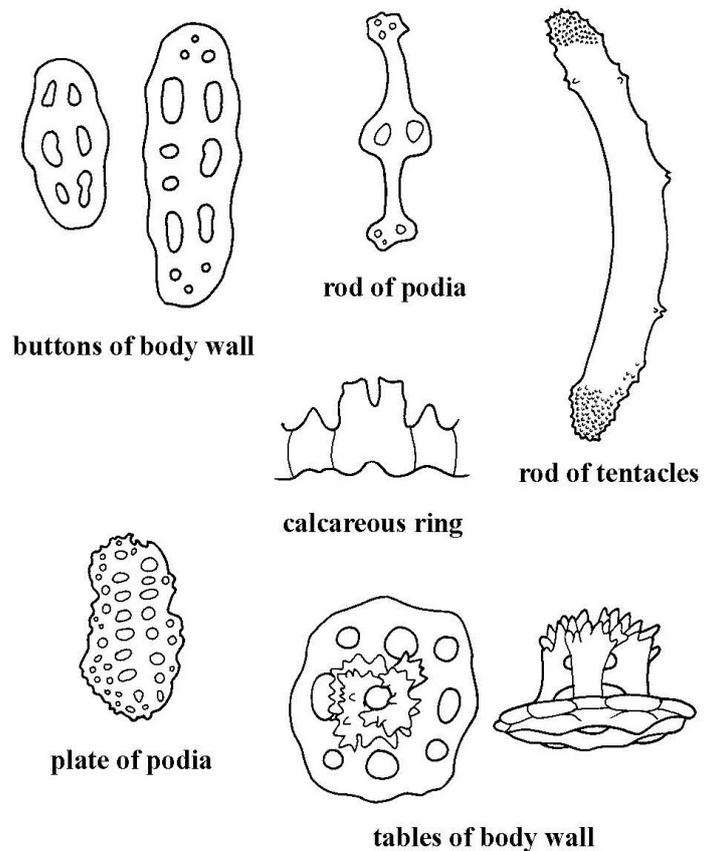
Holothuria hilla

And for the experts...



Characteristics of the spicules:

| | |
|-------------------------------------|--|
| Tentacles | Straight and curved rods (75–350 μm), spiny at the extremities |
| Dorsal and ventral body wall | Tables with round, smooth disc (80–90 μm), perforated by 4 large holes and 4–8 peripheral holes; short spire ending in a spiny crown Buttons (60–100 μm) with a smooth rim and 3–4 pairs of holes, and sometimes with a median line |
| Ventral and dorsal podia | Tables and buttons similar to those of body wall and rods (175–270 μm) with median and distal swellings and perforations |



(after Cherbonnier, 1980)

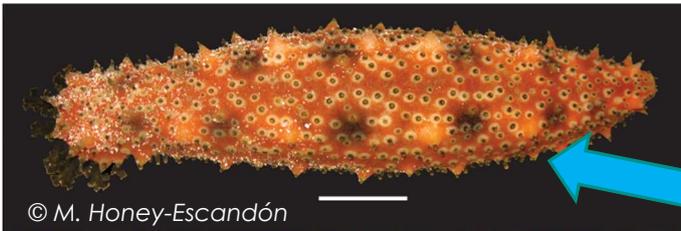
Holothuria kefersteinii

(Selenka, 1867)

M



Common names:  Sea cucumber



© M. Honey-Escandón



© F.A. Solís-Marín

B



© F.A. Solís-Marín



© S.W. Purcell

Pointy protuberances on the dorsal surface

Live form

Dry form



20 cm max.



From reddish-brown to greyish with dark-tipped papillae



Pointy protuberances on the dorsal surface



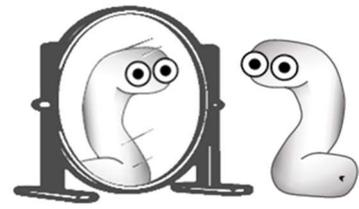
From dark brown to black



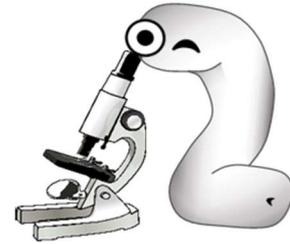
Very textured and rough dorsal surface, with multiple protrusions

Not available

Similar species

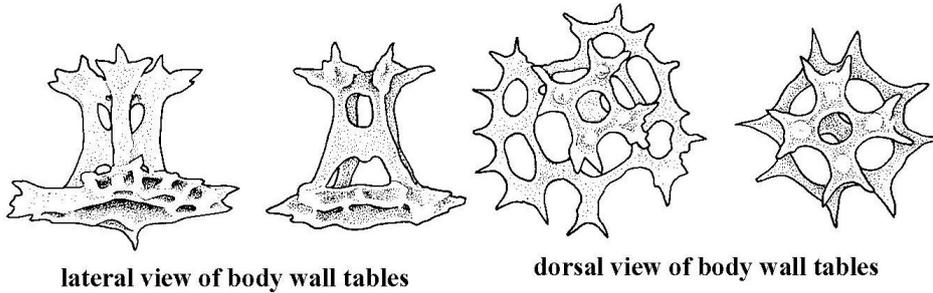


And for the experts...



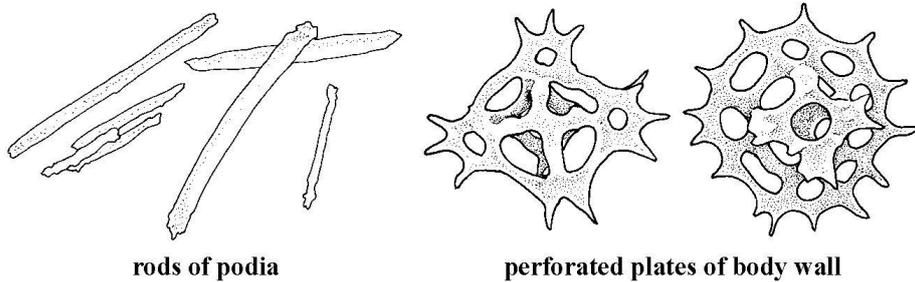
Characteristics of the spicules:

| | |
|-------------------------------------|---|
| Dorsal and ventral body wall | External layer of tables with small (40–50 μm), or completely reduced disc that often has some prominent marginal spines, and the well-developed spire ends in a Maltese cross. The inner layer of the body wall holds small (50 μm), perforated plates, mostly with 2–4 large central holes and some small terminal ones |
| Ventral podia | Rods (80 μm) with enlarged, perforated endings |
| Dorsal papillae | Straight rods with perforated ends |



lateral view of body wall tables

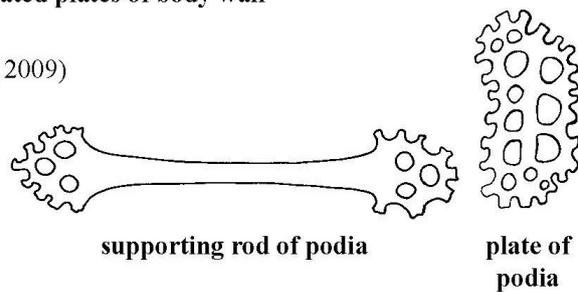
dorsal view of body wall tables



rods of podia

perforated plates of body wall

(source: Solís-Marín *et al.*, 2009)



supporting rod of podia

plate of podia

(source: Deichmann, 1958)



Holothuria lessoni

Massin, Uthicke, Purcell, Rowe & Samyn, 2009



Common names:  Golden sandfish

 Holothurie de sable versicolor



Live form (spotted variant)



Live form (black variant)



Live form (beige variant)



Dry form

 30 cm on average, 46 max.

 1.1 to 1.4 kg

Highly variable colouring: from dark greyish black to beige with black blotches and spots, or beige without black spots
 Ventral surface is whitish or grey in the black variants

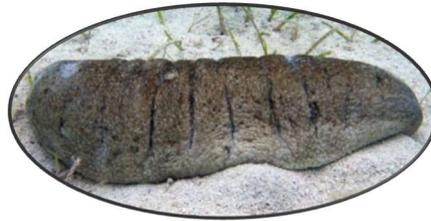
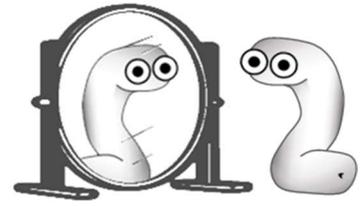


 13 cm

 Golden brown

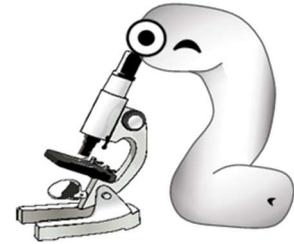
 Elongated, ends of the body are rounded, slightly arched dorsally
 Small ventral cut

Similar species



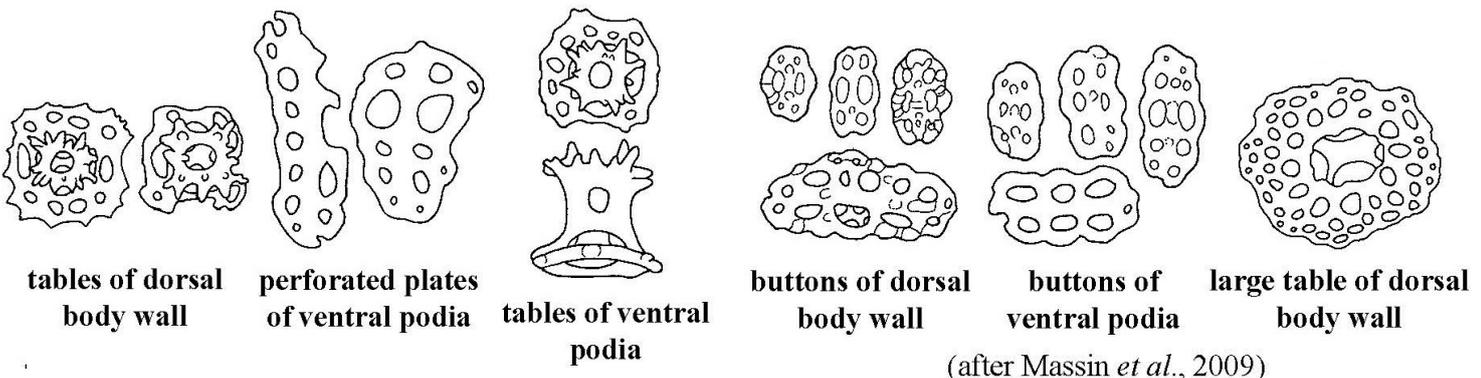
Holothuria scabra

And for the experts...



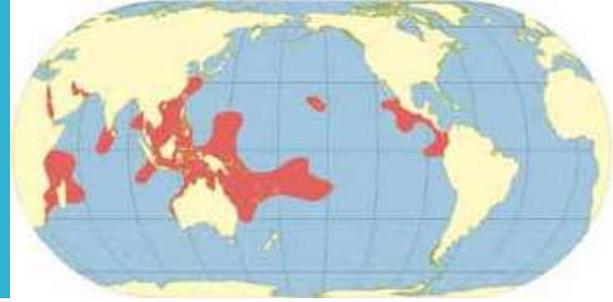
Characteristics of the spicules:

| | |
|-------------------------|--|
| Tentacles | Slightly curved rods (60– 650 μm) spiny at the extremities |
| Dorsal body wall | Tables with discs (50–110 μm), 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; knobbed buttons (40–60 μm) and 3–4 pairs of small holes. |
| Ventral podia | Tables and buttons similar to those of the body wall (but some are smooth), rods with perforated extremities (115–265 μm) and perforated plates (85–280 μm) |
| Dorsal podia | Buttons, tables and rods. Buttons are smooth or nodulous, with 3–4 pairs of holes and perforated plates (160–200 μm) with two rows of holes |



Holothuria leucospilota

Brandt, 1835



Common names:  White threadsfish

 Trévang à canaux blancs
Holothurie à filaments blancs



Large black mouth tentacles



Live form



VISUEL
INDISPONIBLE

Dry form



30 cm on average,
50 max.



335 to 900 g



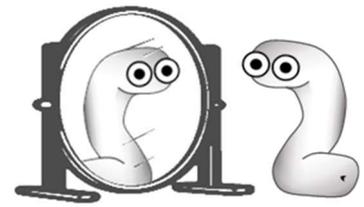
Black



Large black mouth
tentacles

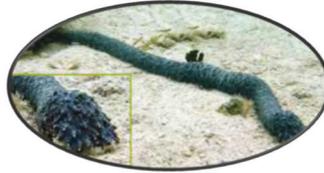
*This species can be traded
together with other low
value species*

Similar species



Actinopyga miliaris

Smaller sea cucumber



Holothuria coluber

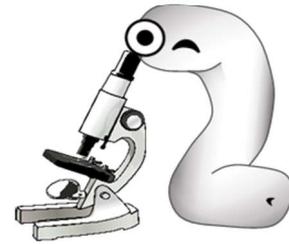
Dark grey-blue body wall



Holothuria atra

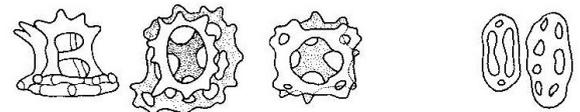
Smaller sea cucumber

And for the experts...



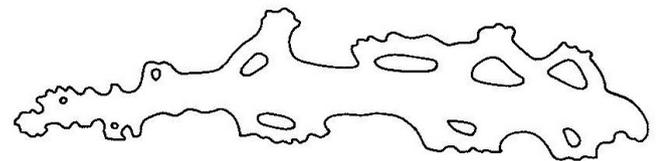
Characteristics of the spicules:

| | |
|-------------------------------------|--|
| Tentacles | No ossicles |
| Dorsal and ventral body wall | Tables with round to quadrangular discs (40–70 μm) perforated by 4 central holes and 4–12 peripheral holes; the rims of discs are smooth to spiny; spire ending in a spiny crown Irregular buttons (40–70 μm) with 2–5 pairs of irregular holes |
| Ventral podia | Tables and buttons similar to those of the body wall, large perforated plates (60–120 μm) |
| Dorsal podia | Tables and buttons similar to those of the body wall, variously perforated rods (50–190 μm) |



tables of body wall

buttons of body wall



rod of dorsal papillae



calcareous ring

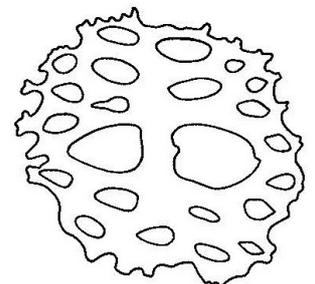
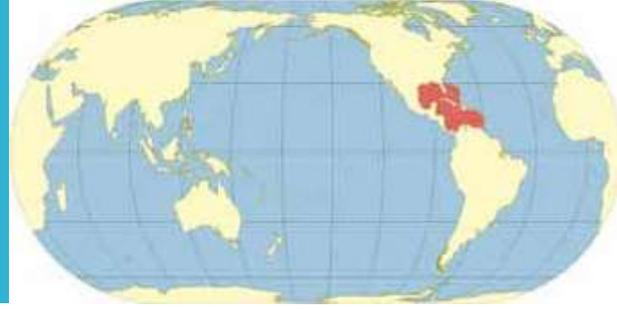


plate of ventral podia

(after Cherbonnier and Féral, 1984)

Holothuria mexicana

Ludwig, 1875

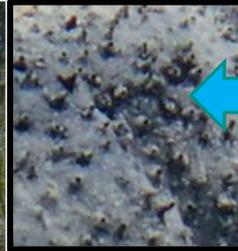


Common names:   Holothurie mexicaine



Live form

Large dorsal and lateral folds



Wart-like protuberances on the dorsal surface



© F.A. Solis-Marin - FAO

Dry form

 33 cm on average, 50 cm max.

 260 g (Panama)

 Dark brown, grey or black dorsally, becoming lighter on the lower edges
Ventral surface varies from bright red, pink, orange, white, yellowish, grey, dark purple or black

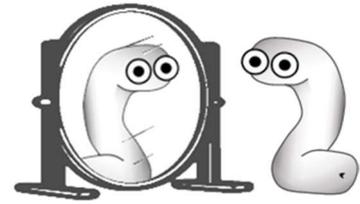
 Large dorsal and lateral folds. Wart-like protuberances on the dorsal surface

 From dark brown to blackish

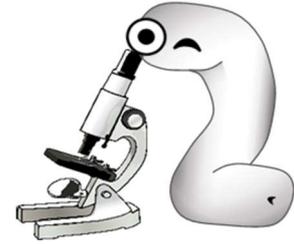
 The body becomes narrower at both ends and has a bumpy texture

Not available

Similar species

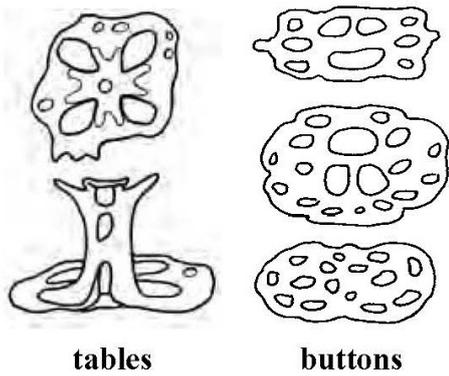


And for the experts...

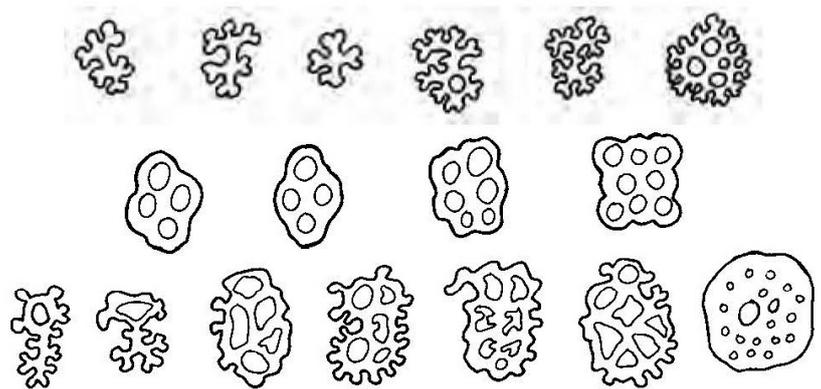


Characteristics of the spicules:

| | |
|--------------------------|--|
| Tentacles | Rods varying in size (55–190 μm) and rosettes |
| Dorsal body wall | Tables with irregular discs that have spiny extensions (50–95 μm) 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) |
| Ventral body wall | Rosettes similar to those of the Dorsal body wall, with less tables with discs (40–75 μm) |



(after Hasbún and Lawrence, 2002)

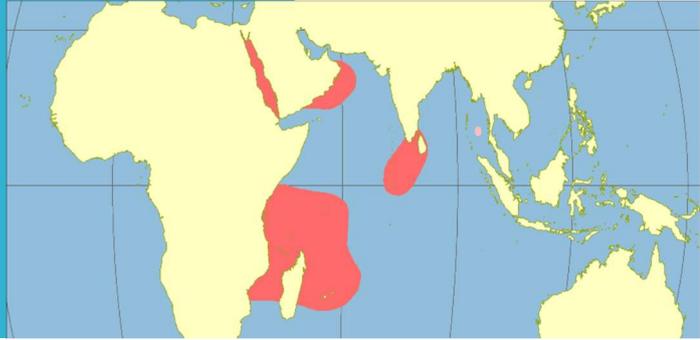


rosettes and various stages of biscuit-shaped plates

(after Deichman, 1957)

Holothuria nobilis

(Selenka, 1867)



Common names:  Black teatfish
 Holothurie noire à mamelles



© J.M Suture - DORIS

Live form

6 to 10 lateral teat-like protuberances



© S.W. Purcell

A single straight cut on the dorsal surface

Dry form



35 cm on average, 60 cm max.



1.7 to 3 kg on average, 4 kg max.



From chocolate brown to matte black, with cream-coloured spots, the largest ones surrounding the protuberances



6 to 10 lateral teat-like protuberances



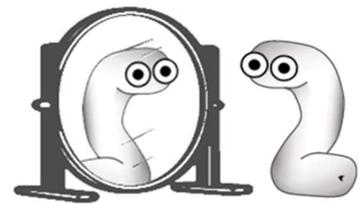
18-24 cm



Brown-grey dorsally, grey ventrally



Smooth to slightly wrinkled body surface
A single straight cut on the dorsal surface
6 to 10 lateral teat-like protuberances



Similar species



Holothuria whitmaei

This species is entirely black

→ see **Appendix 3**



H. fuscogilva

The morphology is identical but the colour is beige to white with large scattered darker patches on the dorsal surface

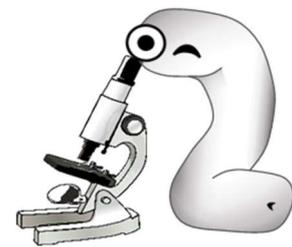


Bohadschia subrubra

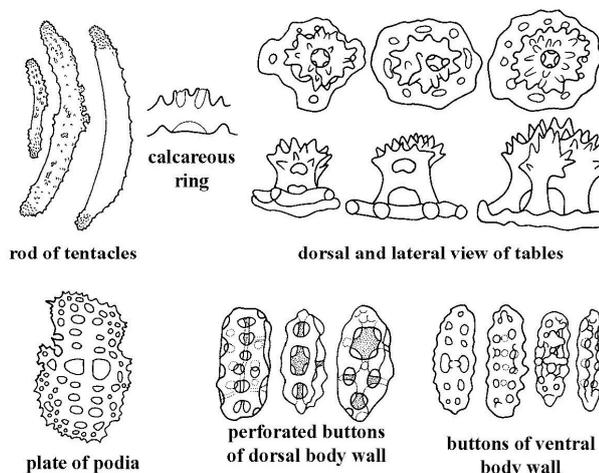
There are no "teats" and the lighter areas are generally larger

And for the experts...

Characteristics of the spicules:



| | |
|-------------------------------------|--|
| Tentacles | Spiny rods at the extremities (40–410 μm) and mostly curved |
| Dorsal and ventral body wall | Circular table discs (55–70 μm) with an undulating rim, perforated by 4 large central holes and 8–12 peripheral holes; low spire ending in a regular spiny crown or in an irregular one with fewer spines. Buttons of the Dorsal body wall are elongated or ellipsoid (on average 100 μm). Buttons of the Ventral body wall can be smooth, knobbed, or fenestrated (80–100 μm) |
| Ventral and dorsal podia | Large perforated plates with ragged sides |



(after Cherbonnier, 1988)

Holothuria notabilis

Ludwig, 1875



Common names: *Dorilisy*, *Tsimihoke* (Madagascar)



Live form

2 rows of black dots

© IH-SM-WIOMSA - FAO

Tapered near the anus



© IH-SM-WIOMSA - FAO

Dry form



18 cm on average,
32 cm max.



180 g on average, 500 g
max.



Whitish with many dark-
brown or black dots on
the dorsal surface,
forming two rows of 8 to
10 dots



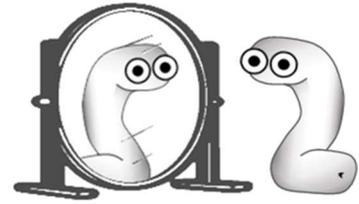
Tapered near the anus



Shaped like small
wooden rods

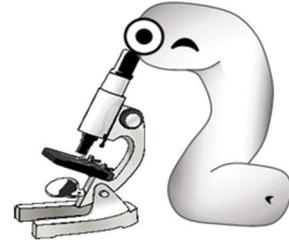
Not available

Similar species



H. arenicola

And for the experts...

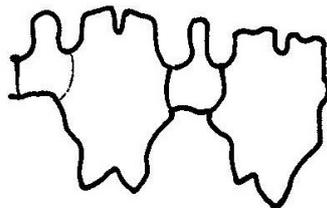


Characteristics of the spicules:

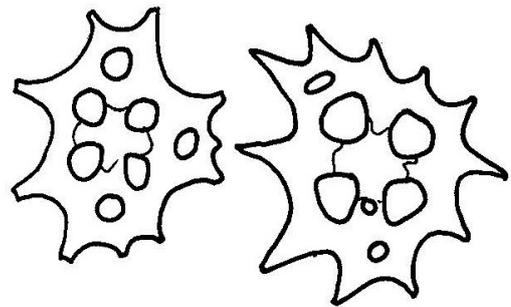
| | |
|--------------------------|--|
| Dorsal body wall | Tables with larger disc diameter than body wall and with fully developed spire. Among the two types of tables, we can find all kinds of intermediates, both in diameter of table disc and in height of spire |
| Ventral body wall | Numerous small nodulous buttons and a few tables with irregularly spined discs and with their spire reduced to 4 short pillars fused at the base |



button



calcareous ring

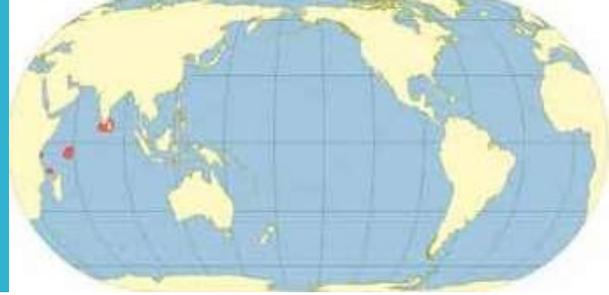


tables

(after Ludwig, 1875)

Holothuria sp.

(type "Pentard " sensu Paulay)



Common names:  Flower teatfish
 Pentard



Irregular cream colour spots on the dorsal



Live form

6 to 8 lateral teat-like protuberances



Dry form

A single straight cut on the dorsal surface

 30 cm on average

 1.6 kg on average

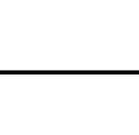
 Dark brown dorsally

 6 to 8 lateral teat-like protuberances

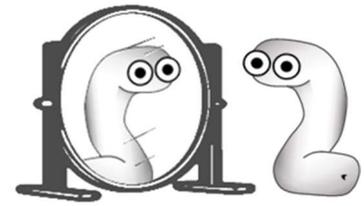
 17 cm

 Irregular cream colour spots on the dorsal surface

 6 to 8 lateral teat-like protuberances

 A single straight cut on the dorsal surface

Similar species

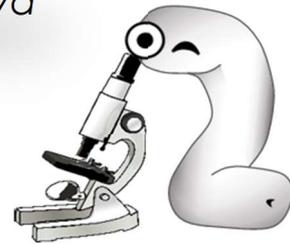


Holothuria nobilis



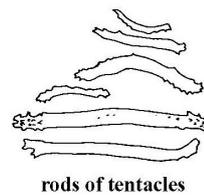
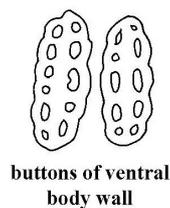
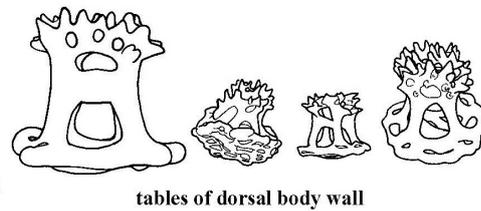
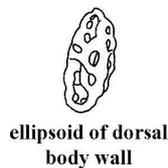
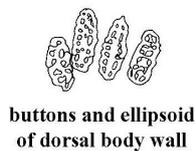
H. fuscogilva

And for the experts...



Characteristics of the spicules:

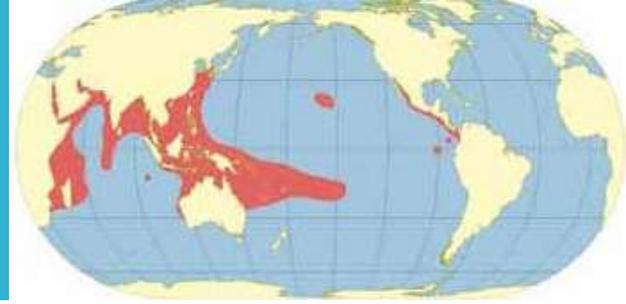
| | |
|---------------------------------|--|
| Tentacles | Spiny rods (70– 615 μm) |
| Dorsal body wall | Tables with round, smooth discs (60–75 μm) perforated by a single central hole and a ring of peripheral holes; wide spire ending in a crown of spines. Buttons can be smooth or can have a few medium-sized knobs with 4–8 pairs of holes, or can be modified into simple ellipsoid buttons (80–115 μm) |
| Ventral body wall | Tables of roughly the same form and size as the Dorsal body wall, buttons (110 μm) are smoother slightly knobbed and have 4–7 pairs of holes. |
| Ventral and dorsal podia | <i>Undocumented</i> |



(source: photos D. VandenSpiegel)

Holothuria pardalis

Selenka, 1867



Common names:  Leopard sea cucumber
 Holothurie panthère



Live form

Short conical papillae scattered on the dorsal surface

Numerous tiny dark brown spots on the dorsal surface, random shape and distribution



Dry form



12 cm on average, 25 max.



From yellowish beige to pink dorsal surface

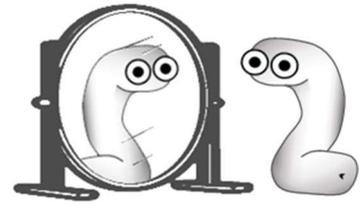
Yellowish white to yellow ventral surface Numerous tiny dark brown spots on the dorsal surface, random shape and distribution



Short conical papillae scattered on the dorsal surface

This species can be traded together with other low value species

Similar species



Holothuria pervicax

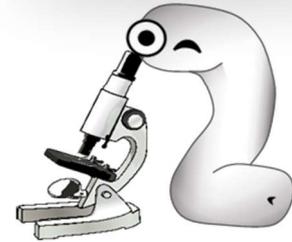


H. arenicola



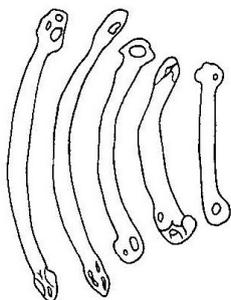
H. fuscocinerea

And for the experts...



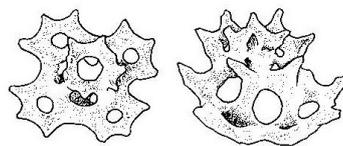
Characteristics of the spicules:

| | |
|-------------------------------------|---|
| Tentacles | Rods (up to 180 μm) |
| Dorsal and ventral body wall | Table discs (50–80 μm) with smooth or spiny edges, perforated by 4 central holes and 4–12 peripheral holes; the spire terminates in a narrow crown of spines Buttons (40–70 μm) with 3–10 rather irregular holes |
| Ventral podia | Tables and buttons similar to those of the body wall, large perforated plates (up to 150 μm) |
| Dorsal papillae | Tables and buttons similar to those of the body wall, large rods, slightly curved (90–170 μm) and perforated at the extremities |

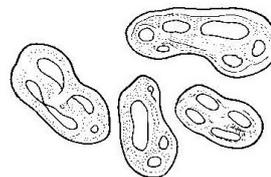


curved rods of
podia

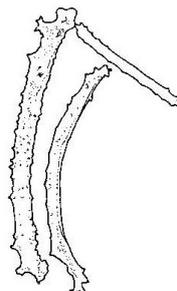
(after Massin, 1999)



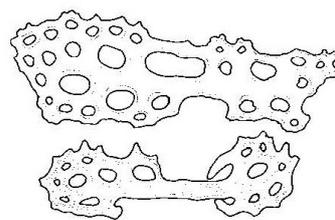
tables of body wall



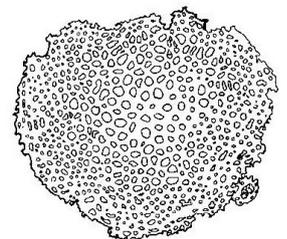
buttons of body wall



rods of tentacles



perforated plates of podia



terminal plate of podia

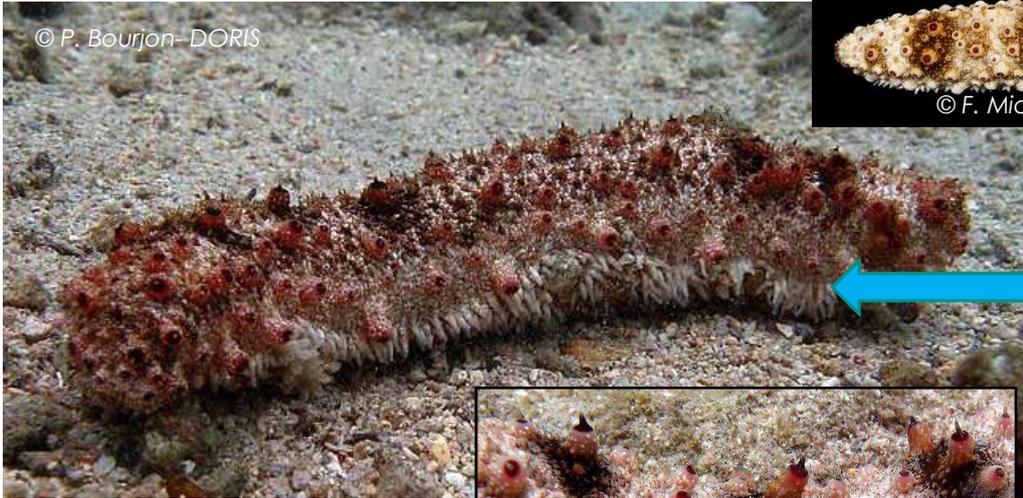
(source: Solís-Marín *et al.*, 2009)

Holothuria pervicax

Selenka, 1867



Common names:  Impatient/Stubborn sea cucumber  Holothurie tête



© P. Bourjon-DORIS



© F. Michonneau - licensed CC-BY

Clear distinction between dorsal and ventral surfaces

Live form

Ventral surface: covered in numerous cylindrical podia, long and white



Dorsal surface: Dome-shaped protuberances, light beige to bright pink. Top has a dark circle



Dry form

 35 cm max.



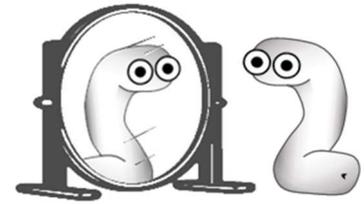
From light-brown to pinkish beige with 4 to 6 dark brown blotchy bands. White to yellowish ventral surface



Ventral surface: covered in numerous cylindrical, long, white podia. Dorsal surface: Dome-shaped protuberances, light beige to bright pink. Top has a black circle

This species can be traded together with other low value species

Similar species



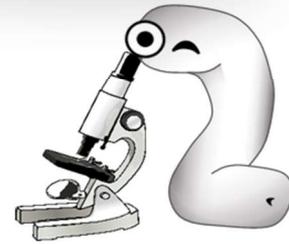
Smaller



Holothuria pardalis

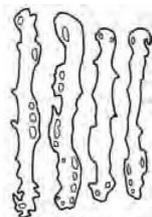
H. fuscocinerea

And for the experts...

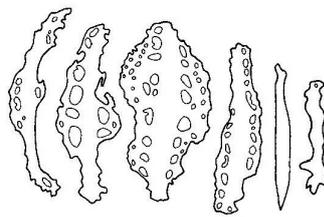


Characteristics of the spicules:

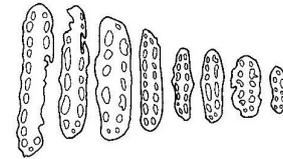
| | |
|-------------------------------------|--|
| Tentacles | Rods (150–375 μm), the largest ones are slightly spinose distally |
| Dorsal and ventral body wall | Tables with discs (30–40 μm), smooth and undulating rim, perforated by 4 central holes and 1–3 smaller peripheral holes; spire, if present, is low and ends in an ill-formed crown. Pseudo-buttons of Dorsal body wall are slightly larger (40–55 μm), while those of Ventral body wall are smaller (25–35 μm) |
| Ventral podia | Buttons, perforated plates and perforated rods |
| Dorsal papillae | Rods that can become perforated plates (up to 190 μm) |



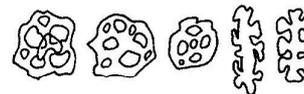
rods of ventral podia



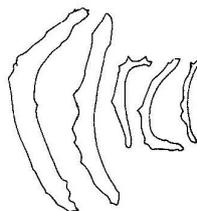
rods and plates of dorsal papillae



buttons of ventral podia



tables and pseudo-buttons of dorsal body wall



rods of tentacles



plates of ventral podia



tables and pseudo-buttons of ventral body wall

(source: Samyn, 2003)

Holothuria scabra

Jaeger, 1833



Common names:  Sandfish  Holothurie de sable



Live form

Deep transverse wrinkles on the dorsal surface



Dry form



24 cm on average, 40 max.



300 to 580 g, 2 kg max.



Colour varies according to the region: Pacific Ocean: Black to grey or light brownish green. Indian Ocean: Dark grey with white, beige or yellow transverse stripes. White or grey ventral surface with dark spots



Deep transverse wrinkles dorsally



10-15 cm

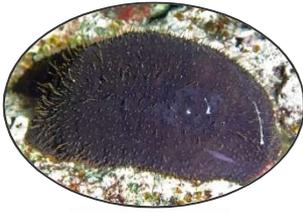
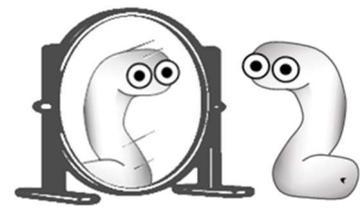


From dark brown to black. Amber-brown ventral surface



No cut, or just a small one in the mouth

Similar species



Actinopyga miliaris



A. palauensis



A. spinea

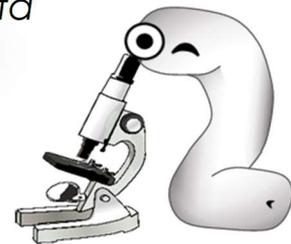


Holothuria lessoni



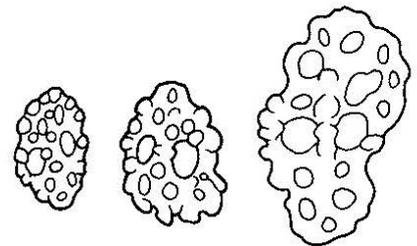
H. fuscopunctata

And for the experts...

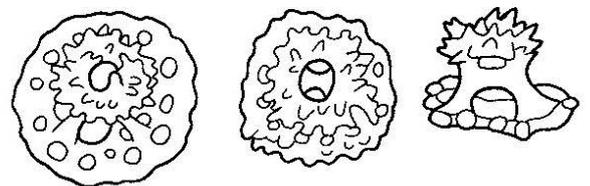


Characteristics of the spicules:

| | |
|--------------------------|---|
| Tentacles | Spiny rods (80– 440 μm) slightly curved |
| Ventral body wall | Tables are rare, quadrangular disc (60-95 μm) with smooth rim, perforated by 1 central hole and 8–16 peripheral holes; spire ending in crown of blunt spines; numerous buttons (40–75 μm) |
| Dorsal body wall | Tables similar to those of the body wall, but smaller; buttons (40–50 μm) |
| Dorsal papillae | A few rods and tables, but lots of buttons like those of the body wall |
| Ventral podia | Nodulous buttons (40–90 μm), perforated rods (110–170 μm), and tables like in the body wall |



buttons of dorsal body wall



tables of dorsal body wall

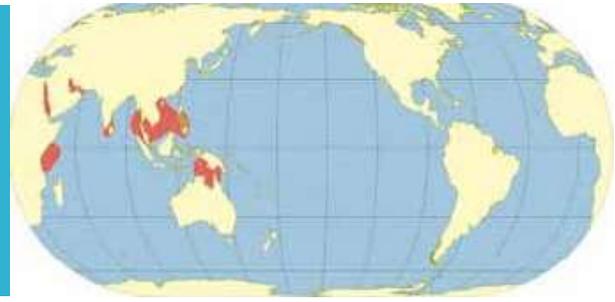


rod of podia

(after Cherbonnier, 1980)

Holothuria spinifera

Théel, 1886



Common names:  Brownfish, *Raja attai*, *Cheena attai* (India), *Galatta* ou *Weli-atta* (Sri Lanka), *Nanasi* (Zanzibar, Tanzania)



Numerous small, pointy papillae on the whole body



Live form

Dry form

 30 cm on average

 300 g on average

 Brown dorsal surface, becoming lighter on the ventral surface

 Numerous small, pointy papillae on the whole body

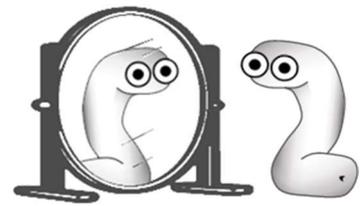
 8-10 cm

 Light brown

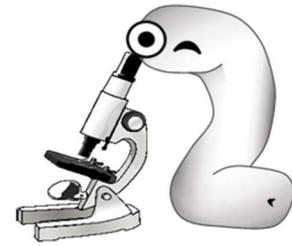
 Rugose dorsal surface
Smooth ventral surface
Small cut in the anus

Not available

Similar species

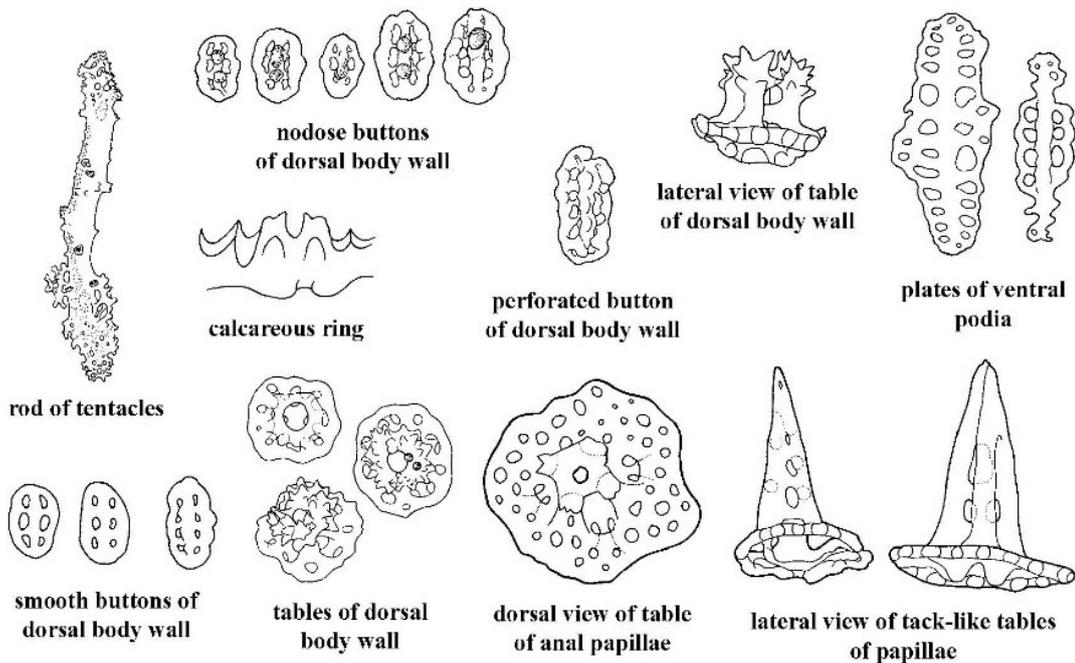


And for the experts...



Characteristics of the spicules:

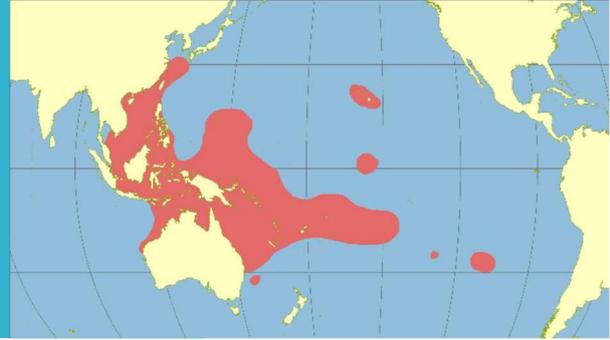
| | |
|-------------------------------------|---|
| Tentacles | Long rods with spiny extremities (500 μm) |
| Dorsal and ventral body wall | Buttons are very nodulous, generally with 3 pairs of holes, but other types are also possible Tables present a well-developed disc, perforated by 4 central holes and a circle of peripheral holes; spire is quite stout and low, ending in an open crown of spines. |
| Ventral podia | Perforated plates that may be expanded in the centre |
| Dorsal and Anal Papillae | Large tack-like tables, which can be up to 200 μm high, are characteristics of this species |



(after Cherbonnier, 1955)

Holothuria whitmaei

Bell, 1887



Common names:  Black teatfish
 Holothurie noire à mamelles



© S.W. Purcell

Live form

A single straight cut on the dorsal surface

5 to 10 lateral teat-like protuberances



© S.W. Purcell

Dry form



34 cm on average, 54 max.



1.8 kg on average in New Caledonia



Solid black dorsally and dark grey ventrally



5 to 10 lateral teat-like protuberances



15-20 cm



Dusty grey dorsally and brownish grey ventrally

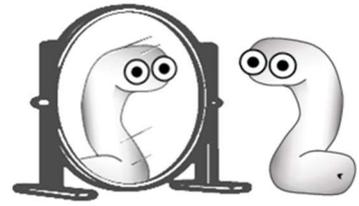


Ventral surface with fine bumps

Relatively smooth dorsal surface

A single straight cut on the dorsal surface

Similar species



Holothuria nobilis

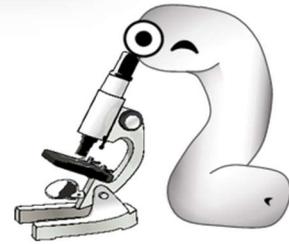
Black body with white spots while *H. whitmaei* is entirely black



H. fuscogilva

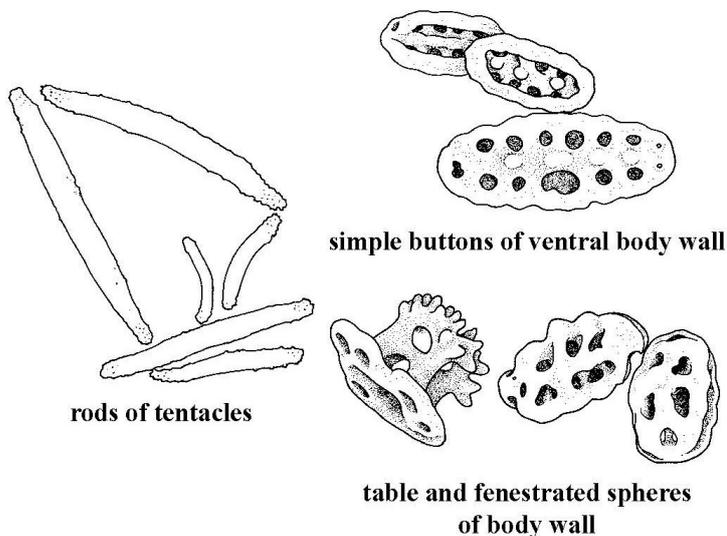
→ see **Appendix 3**

And for the experts...



Characteristics of the spicules:

| | |
|--------------------------|--|
| Tentacles | Rods varying in size (100–335 μm), spiny at the extremities, but not branching |
| Dorsal body wall | Tables and ellipsoid buttons. Table discs (70–85 μm), perforated by one central hole and a ring of peripheral holes; the stout, low spire ends in a wide spiny crown. Ellipsoid buttons (50–70 μm), rather irregular, perforated by 3-5 holes |
| Ventral body wall | Tables like those of the Dorsal body wall, ellipsoid buttons (55–85 μm) more elongated and with more occluded holes; long buttons are almost smooth |



(source: Uthicke *et al.*, 2004)

Synallactida: Stichopodidae

Apostichopus californicus

(Stimpson, 1857)



Common names:  Giant red/California sea cucumber



© D. Raven – licensed CC BY NC

Large papillae (about 40 in total) and small fleshy papillae, from yellow to orange with red tips on the dorsal surface

Live form

Large visible papillae



© J. Akamine - FAO

Dry form



25-40 cm on average, 50 max.



500 g



Mottled brown to red and yellow over the dorsal surface. Light cream coloured ventral surface



Large papillae (about 40 in total) and small fleshy papillae, from yellow to orange with red tips on the dorsal surface



10-13 cm

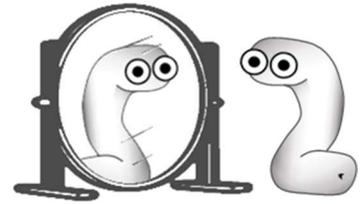


Grey



A cut on the ventral surface
Large visible papillae

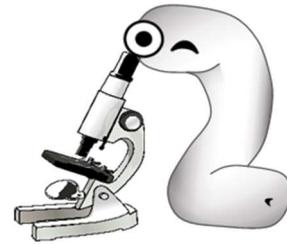
Similar species



Brownish dorsal surface, lighter ventral surface. Numerous small black-tipped papillae

Apostichopus parvimensis

And for the experts...

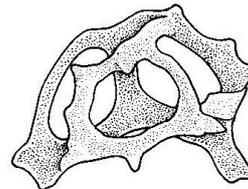


Characteristics of the spicules:

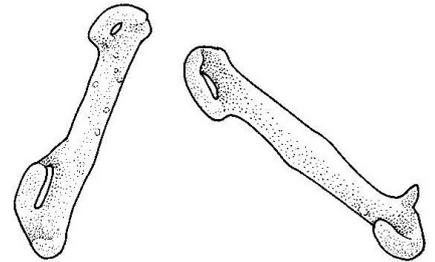
Dorsal and ventral body wall

Tables with round discs (70–95 μm), perforated by 4 central holes that alternate with 4 smaller and more distal holes, often there are smaller holes on each side of the latter; high spire ending in a spiny crown.

Irregular buttons (90 μm) with 5-7 pairs of holes



ossicle of body wall



rods of body wall

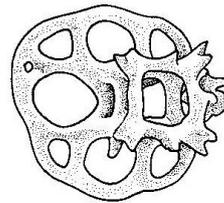
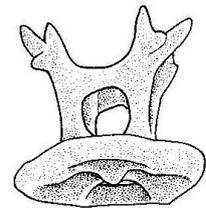


table of body wall



lateral view of body wall table

(source: Solís-Marín *et al.*, 2009)

Apostichopus japonicus

(Selenka, 1867)



Common names:



Japanese sea cucumber



Bêche-de-mer japonaise



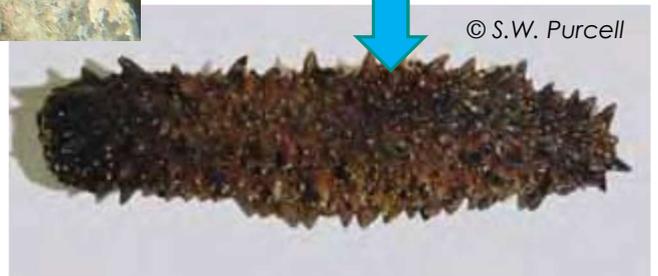
Cohombro de mar japonés



© Kuroshio – licensed CC BY-NC

Live form

2 rows of large conical papillae on the dorsal surface and 2 rows at the lateral margins of the ventral surface



© S.W. Purcell

Dry form



20 cm on average



200 g on average



From brown to grey/olive green dorsal surface; brown to grey ventral surface



2 rows of large conical papillae on the dorsal surface and 2 rows at the lateral margins of the ventral surface



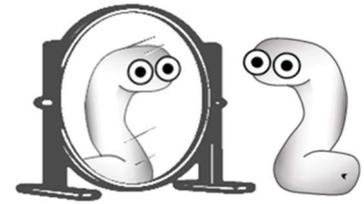
From dark grey to dark brown



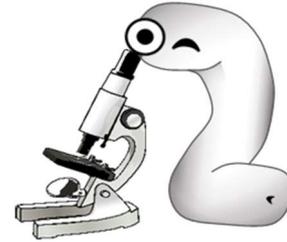
Possesses rows of characteristic, lighter grey, pointed protrusions along the body
2 rows of large conical papillae on the dorsal surface and 2 rows at the lateral margins of the ventral surface

Not available

Similar species



And for the experts...



Characteristics of the spicules:

| | |
|-------------------------------------|---|
| Tentacles | Curved, spiny rods |
| Dorsal and ventral body wall | In adults, tables are rudimentary (reduced to spiny discs) or rare in the body wall. Small individuals have better developed tables. C-shaped rods and rosettes are never present. The cloacal wall has numerous very complex plates. |
| Ventral podia | Similar tables to those in the body wall, and simple supporting rods |
| Dorsal podia | Tables with a more elaborate spire and perforated supporting rods |

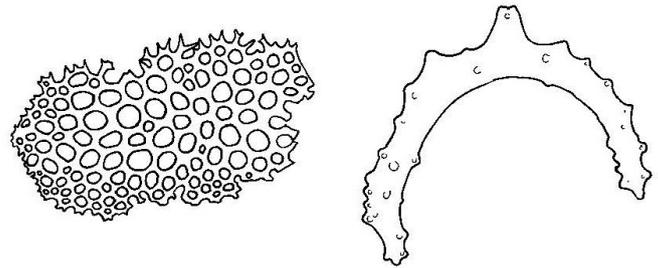
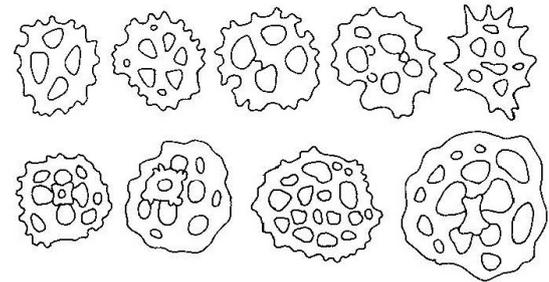


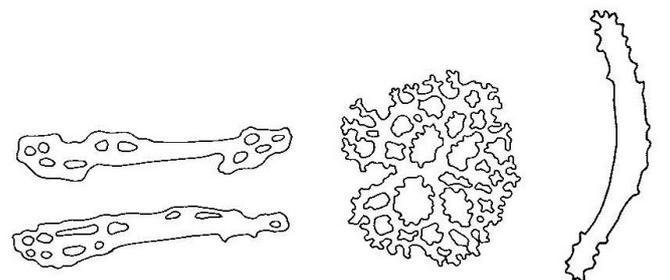
plate of cloaca

rod of tentacles

(source: photo J. Chen)



reduced tables of body wall



supporting rods

complex plate of cloacal wall

rod of tentacles

(after Liao, 1980)

Apostichopus parvimensis

L

(Clark, 1913)



Common names:  Warty sea cucumber



Live form

Dorsal surface with numerous small, black-tipped papillae that are interspersed with larger, orangish, conical papillae.



Dry form



Probably around 30-40 cm on average, 60 max.



From orange to reddish to brownish grey



Dorsal surface with numerous small, black-tipped papillae that are interspersed with larger, orangish, conical papillae

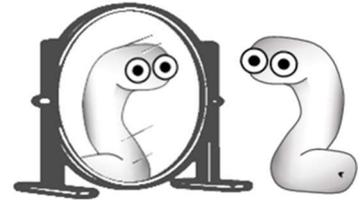


Greyish-brown



"Pimply" texture on the surface

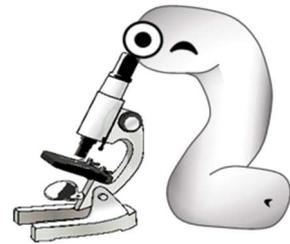
Similar species



Darker ventrally

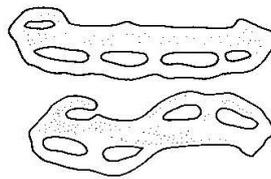
Apostichopus californicus

And for the experts...

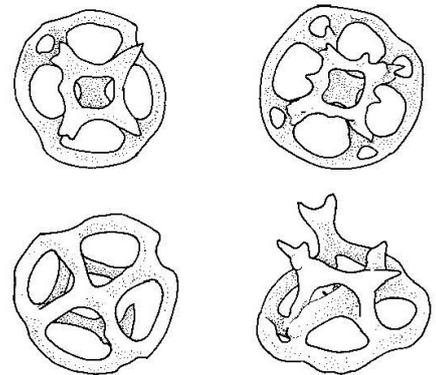


Characteristics of the spicules:

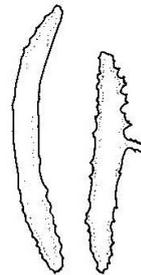
| | |
|-------------------------------------|---|
| Tentacles | Spiny rods (up to 600 μm) |
| Dorsal and ventral body wall | Tables with discs (45 μm) rarely with more than 4 perforations; spire ending in a narrow spiny crown. Buttons (around 90 μm) with 3-4 pairs of holes, quite asymmetrical |



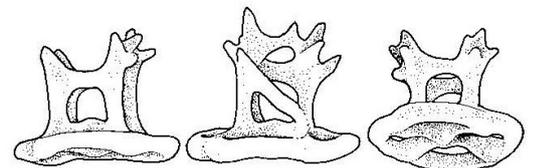
buttons of body wall



dorsal view of body wall tables



rods of tentacles



lateral view of body wall tables

(source: Solís-Marín *et al.*, 2009)

Astichopus multifidus

(Sluiter, 1910)

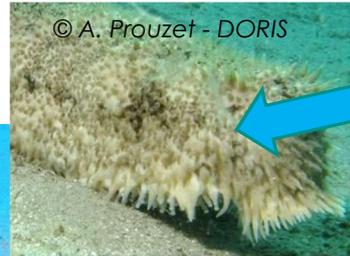


Common names:  Furry sea cucumber
 Holothurie à fourrure

Pointy papillae over 1 cm long on the dorsal surface and flanks; these papillae give the animal a furry



Live form



© A. Prouzet - DORIS



Dry form



50 cm max.



2.5 kg max.



From brown to yellowish-grey dorsal surface with numerous white spots and blotches of varying size. White ventral surface

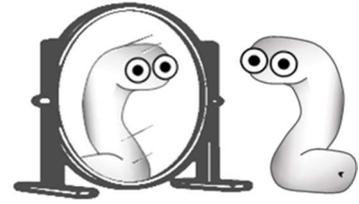


Pointy papillae over 1 cm long on the dorsal surface and flanks; these papillae give the animal a furry appearance

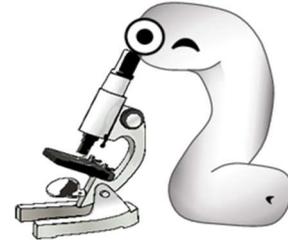
Not available

Not available

Similar species

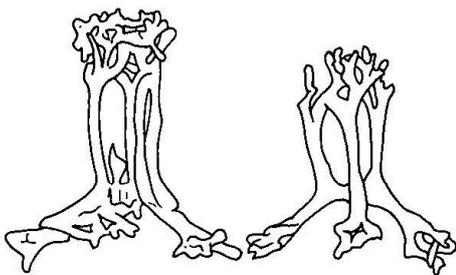


And for the experts...

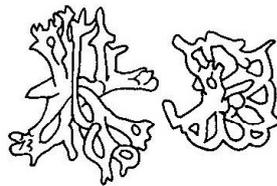


Characteristics of the spicules:

| | |
|-------------------------------------|---|
| Tentacles | In larger specimens, straight or slightly rounded rods (up to 175 μm), spiny at the ends and usually also along the shaft C-, O- and S-shaped ossicles (around 50 μm), often spiny |
| Dorsal and ventral body wall | In smaller specimens (less than 20 cm) there are large abnormal tables. In larger specimens (>20 cm), these tables are not present. Numerous C-, O- and S-shaped elements (40–80 μm) |

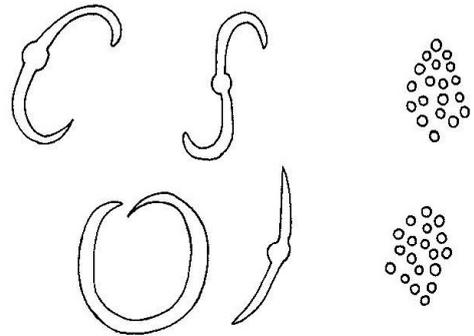


aberrant tables of dorsal body wall



aberrant tables of ventral body wall

(after Cutress, 1996)



C-, O- and S-shaped rods

miliary granules of body wall

(after Sluiter, 1910)

Australostichopus mollis

(Hutton, 1872)



Common names:  Brown mottled sea cucumber



Conical papillae on the dorsal surface and along the lateral margins, which can be lighter in colour or dark brown



Live form

Dry form

 17 cm on average

 110 g on average

 From blackish-brown to brown to yellow or cream. Lighter ventral surface

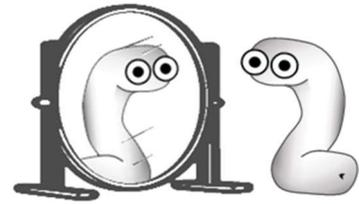
 Conical papillae on the dorsal surface and along the lateral margins, lighter or dark brown

 From light brown to greyish-brown and with a mottled colour pattern

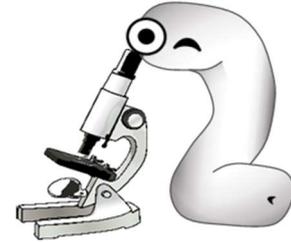
 Papillae on the dorsal surface should be evident, but much less than on a live specimen

Not available

Similar species

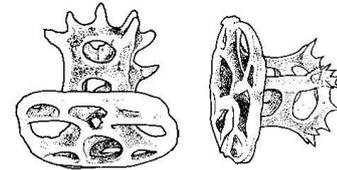


And for the experts...



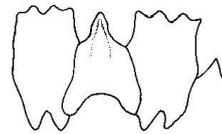
Characteristics of the spicules:

| | |
|---------------------------------|---|
| <p>Tentacles</p> | <p>Large, curved and spiny rods (around 800 μm) Small, smooth ossicles (up to 150 μm) of different sizes</p> |
| <p>Dorsal body wall</p> | <p>Tables with round discs (90–100 μm), perforated by 4 central and 4 peripheral holes (occasionally a whole circle of perforations), with a spire ending in a Maltese cross.</p> |
| <p>Ventral body wall</p> | <p>Similar tables to the Dorsal body wall, but slightly smaller, with discs (up to 70 μm), and rarely rosettes (90 μm)</p> |
| <p>Ventral podia</p> | <p>Perforated plates</p> |

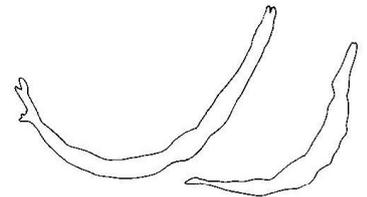


tables of body wall

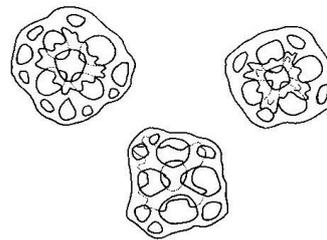
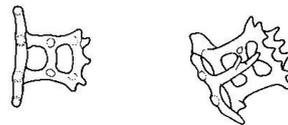
(source: photo M.A. Sewell)



calcareous ring



curved rods



tables

reticulated bilateral plates

(after Dendy, 1897)

Isostichopus badionotus

(Selenka, 1867)



Common names:  Four-sided/ three-rowed sea cucumber
 Holothurie à points

Body wall with transverse folds

Conical "warts", more or less aligned, scattered on the dorsal surface and aligned on the sides



Live form

Leg-like extensions at the lower margins



© S.W. Purcell

Dry form

 21 cm (Cuba), 45 cm max.

 276 g on average

 Beige to orange with brown spots on the "warts", or, on the contrary, brown with light spots, or very rarely solid brown

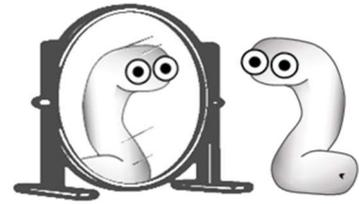
 Clear distinction between dorsal and ventral surfaces: body shape is trapezoidal. Body wall with transverse folds. Leg-like extensions at the lower margins. Conical warts scattered on the dorsal surface and aligned on the sides

 6-12 cm

 Dark brown dorsal surface, lighter ventral surface

 Rugose dorsal surface, covered in dark spots with small visible wrinkles
Granular ventral surface. Conical warts, scattered on the dorsal surface and aligned on the sides. Leg-like extensions at the lower margins

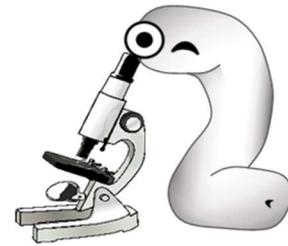
Similar species



No "warts" with contrasting spots on the dorsal surface. No clear distinction between ventral and dorsal surfaces

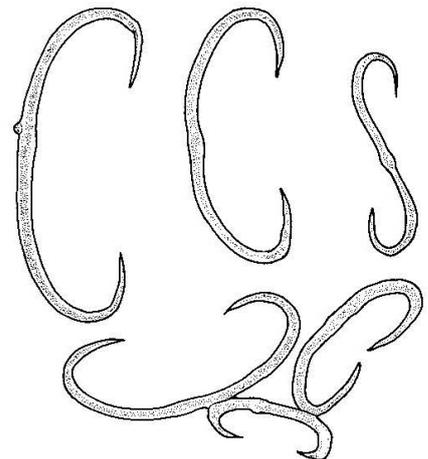
Holothuria mexicana

And for the experts...

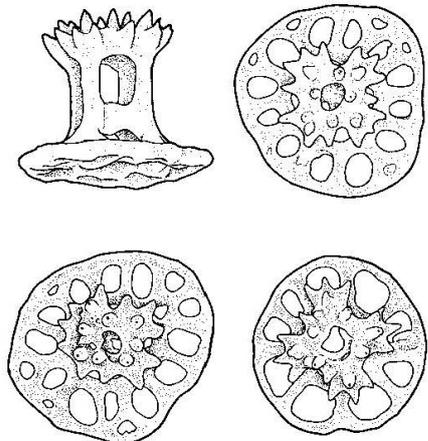


Characteristics of the spicules:

| | |
|-------------------------------------|---|
| Tentacles | In larger specimens: spiny rods (50–1100 μm), tables with discs (65–100 μm), as well as some C-shaped rods (70 μm on average) |
| Dorsal and ventral body wall | Numerous tables and C-shaped rods. Regular, smooth table discs (40–60 μm), perforated by 4 central holes and a complete ring of 10–12 peripheral holes; spire ends in a spiny crown. C-shaped ossicles (50–70 μm) |



C-shaped elements of body wall



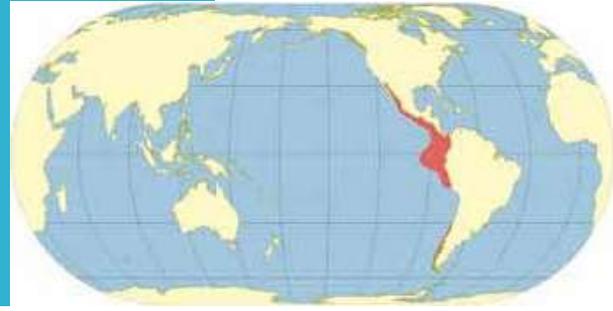
tables of body wall

(source: photo Giomar Borrero-Perez)

Isostichopus fuscus



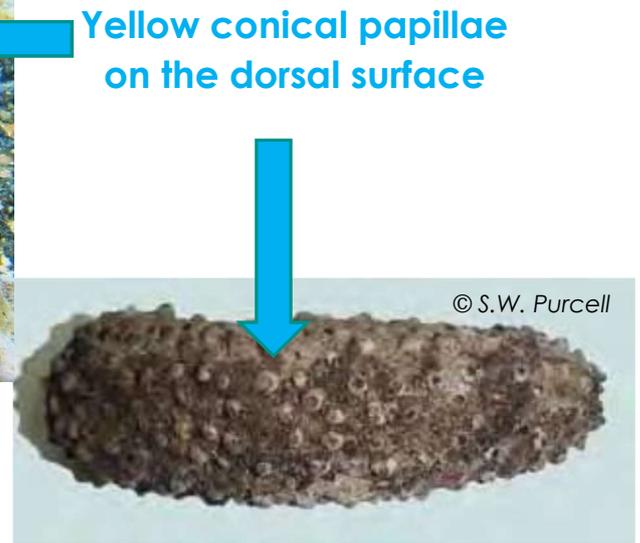
(Ludwig, 1875)



- Common names:**
-  Giant sea cucumber
 -  Concombre de mer géant
 -  Pepino de mar gigante



Live form



© S.W. Purcell

Dry form

 20-24 cm

 294 to 497 g on average

 Dark brown dorsal surface Light brown ventral surface

 Yellow conical papillae on the dorsal surface

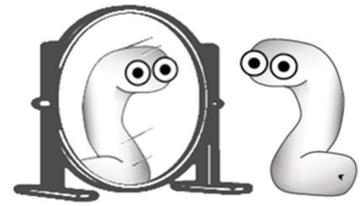
 6-10 cm

 Greyish black

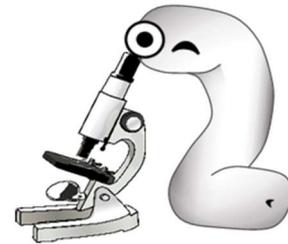
 Rounded, conical, papillae dispersed over the entire body (especially at the lower lateral margins)

Not available

Similar species



And for the experts...



Characteristics of the spicules:

| | |
|-------------------------------------|--|
| Tentacles | Curved rods (100– 400 μm) |
| Dorsal and ventral body wall | Tables and C-shaped rods; no rosettes or X-shaped rods. Smooth table discs (on average 40 μm) with a moderately high spire that ends in a spiny crown. C-shaped rods (40 μm) |

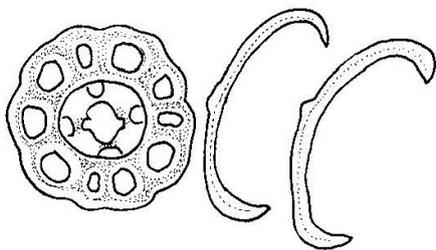
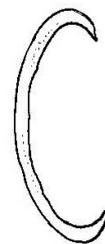
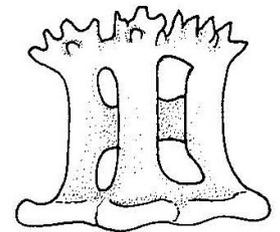
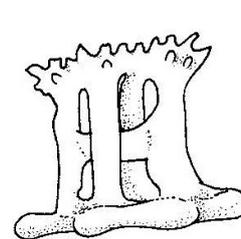


table disc and C-shaped rods

(source: photo C. Hickman)



C-shaped rod



tables

(after Deichman, 1958)

Stichopus chloronotus

Brandt, 1835



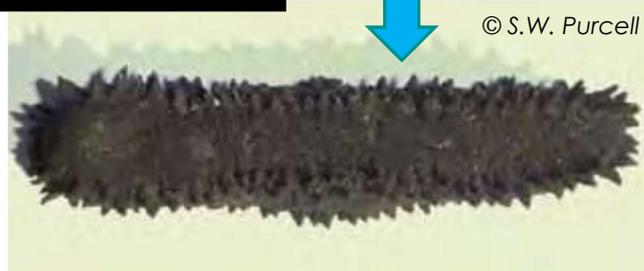
Common names:  Greenfish

 Trepang vert, Holothurie verte



Live form

Elongated conical papillae



Dry form

 20 cm on average, 35 max.

 80 to 150 g

 From dark green to blue-green to near black with bright orange papillae

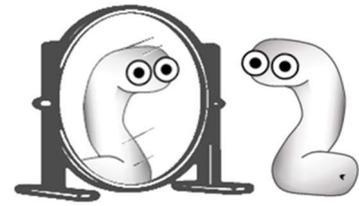
 Wart-like conical papillae

 10-12 cm

 From dark grey to black

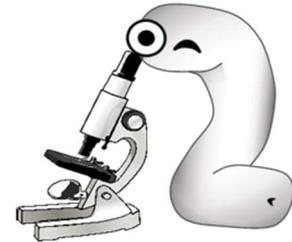
 No cut, or just a small one in the mouth
Wart-like conical papillae

Similar species



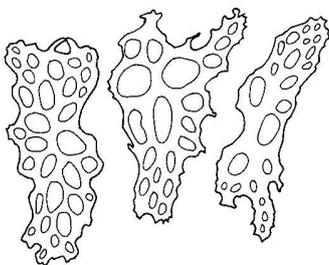
The colours of *Stichopus chloronotus*, if not its mere morphology, allow it to be differentiated from other sea cucumbers, even within its own genus, *Stichopus*.

And for the experts...

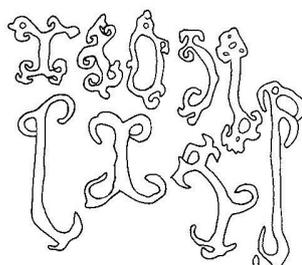


Characteristics of the spicules:

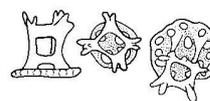
| | |
|-------------------------------------|---|
| Tentacles | Base of tentacles: tables reduced to the disc, small knobbed rods and few very long rods (up to 450 μm) Tentacle tips; spiny curved rods (65–470 μm) |
| Dorsal and ventral body wall | Ventrally, tables are larger, with 30–45 μm discs, than dorsally, discs 25–30 μm . 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. Small C-shaped rods (up to 50 μm) |
| Ventral podia | Reduced tables, a few irregular C-shaped rods (40–100 μm), rods of 270–470 μm long and perforated plates. |
| Dorsal papillae | Larger tables, with 55–80 μm discs, large C-shaped rods (up to 70 μm) and irregular rods |



large plates of podia



rosettes and rods of top of dorsal papillae



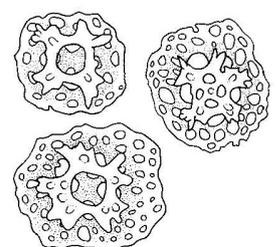
tables of dorsal body wall



C-shaped rods of dorsal body wall



C-shaped rods of podia



tables of top of dorsal papillae

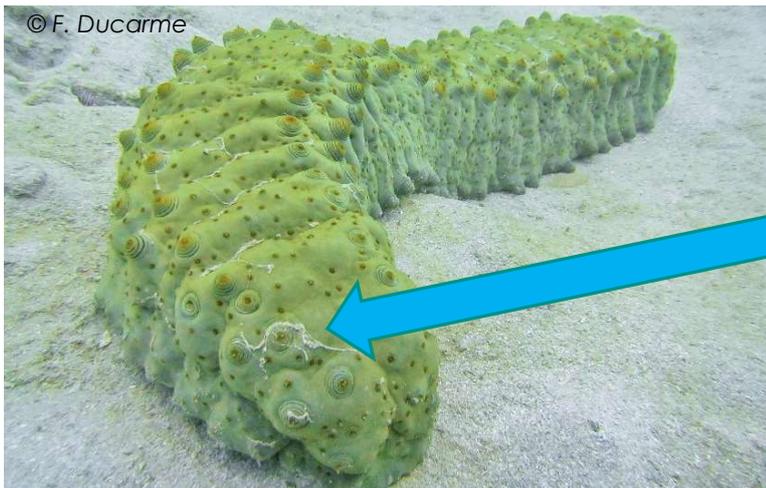
(after Massin *et al.*, 2002)

Stichopus herrmanni

Semper, 1868



Common names:  Curryfish, Herrmann's sea cucumber
 Holothurie curry



Large brown to red wart-like papillae surrounded by circles

Live form



Dry form

 20-40 cm on average

 1 to 2.5 kg

 From greyish yellow, to different shades of orange, to brown, to pale green

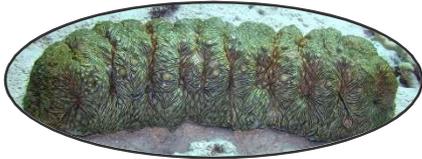
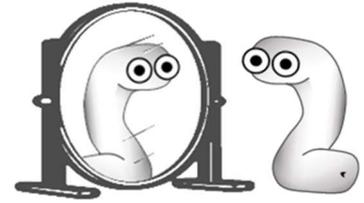
 Large brown to red wart-like papillae surrounded by circles

 12-18 cm

 From beige to brown

 No cut or just a small one in the mouth
Wrinkled dorsal surface covered with small dark bumps

Similar species



S. vastus



S. naso

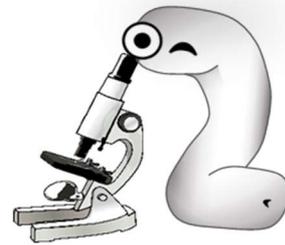


Stichopus horrens



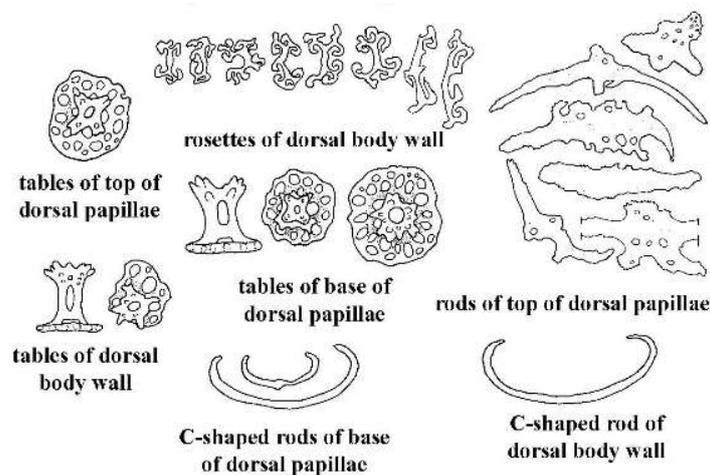
S. pseudohorrens

And for the experts...



Characteristics of the spicules:

| | |
|-------------------------------------|--|
| Tentacles | Spiny rods (60– 850 μm) slightly curved, sometimes with forked and/or perforated extremities |
| Dorsal and ventral body wall | Table discs (25–45 μm) perforated by 4 central and 4–8 peripheral holes, spire ending in a narrow, often spiny crown, rosettes (25–55 μm), and C-shaped rods (35–100 μm) |
| Ventral podia | Reduced tables (30–45 μm), large perforated plates with the middle part often enlarged and perforated, and rods (200–360 μm) |
| Dorsal papillae | Rods (up to 200 μm), C- or S-shaped ossicles similar in size and shape to those of the body wall, rosettes and tables up to twice the size of those of the body wall. |



(after Massin *et al.*, 2002)

Stichopus horrens

Selenka, 1868



Common names:  Selenka's sea cucumber
 Holothurie hérissée

NB: This species is considered a species



Live form

Long, conical or wart-like papillae on the dorsal surface, mainly in 2 rows + a row of larger papillae along the lateral margins of the ventral surface



Dry form

 12-23 cm

 110 to 200 g

 From grey to beige to dark red, dark brown or black with different coloured blotches dorsally

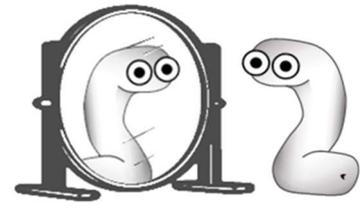
 Thick, conical or wart-like papillae on the dorsal surface, in 2 rows + a row of larger papillae along the lateral margins of the ventral surface

 8-12 cm

 In Ecuador: Black
In Papua New Guinea: From brown to brownish black

 No cut or just a small one in the mouth. Long, conical or wart-like papillae on the dorsal surface, in 2 rows + a row of larger papillae along the lateral margins of the ventral surface

Similar species



Stichopus hermanni

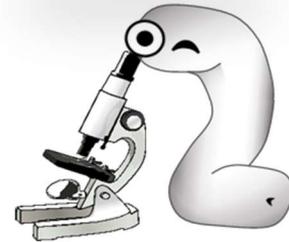


S. monotuberculatus



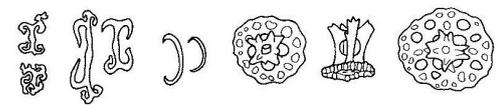
S. naso

And for the experts...

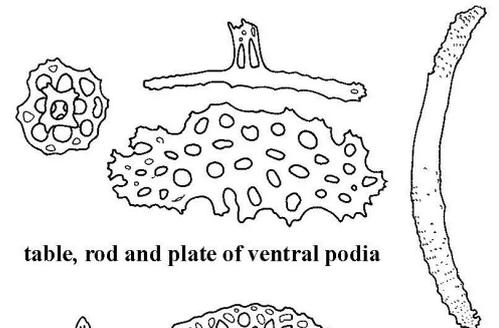


Characteristics of the spicules:

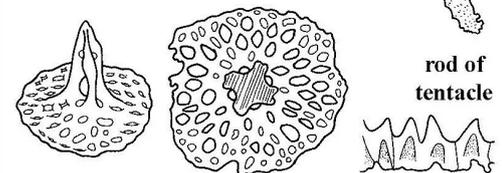
| | |
|--------------------------|---|
| Tentacles | Straight to nearly U-shaped rods (60–700 μm), some with forked extremities |
| Dorsal body wall | Numerous tables, discs (25–35 μm), with a spire ending in a Maltese cross; numerous rosettes (15–30 μm) and a few C-shaped rods (45–60 μm) |
| Ventral body wall | Tables, discs (30–55 μm) and a few C-shaped rods (55–85 μm) |
| Ventral podia | Tables (40–120 μm), large perforated plates, and rods (390–500 μm), some with huge central perforated process |
| Dorsal papillae | Papillae at their base: with similar ossicles to those of the body wall, but with huge tack like tables at the top (130–155 μm), C-shaped rods (45–80 μm), and rods with a large central perforated process |



rosettes, C-shaped rods and tables of body wall



table, rod and plate of ventral podia



tables of papillae

rod of tentacle

calcareous ring

(after Cherbonnier, 1980)

Stichopus monotuberculatus

(Quoy and Gaimard, 1833)



M

Common names:  Dragonfish

 Holothurie à taches noires



Wart-like papillae

Live form



Dry form

 12-20 cm

 110 to 200 g



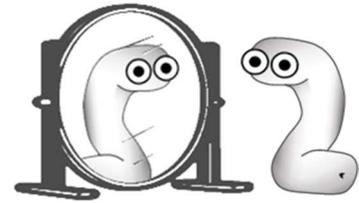
Same as *S. horrens*: grey to beige background colour, covered with dark brown, greenish, reddish, grey or black spots, which may form 2 transverse bands



Wart-like papillae

Probably similar in size and appearance to *S. horrens*

Similar species

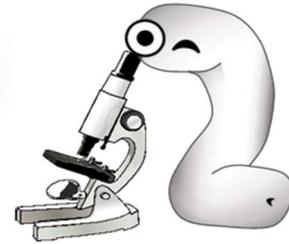


Stichopus horrens



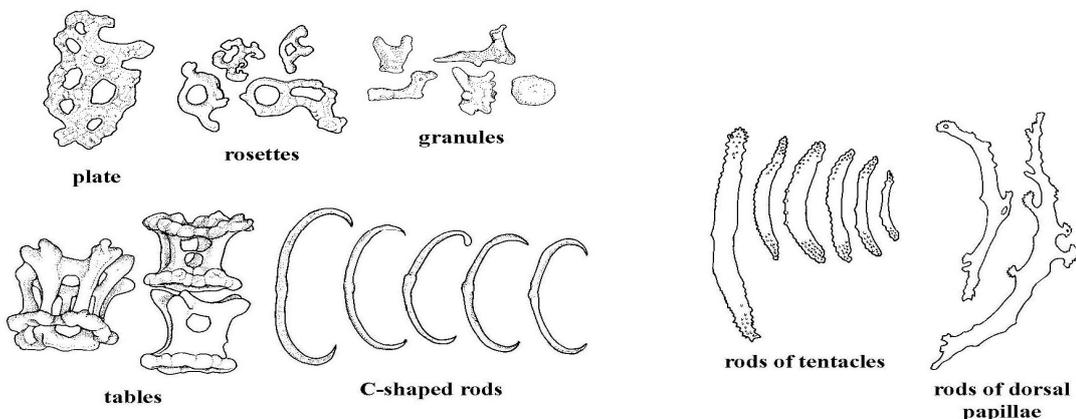
S. naso

And for the experts...



Characteristics of the spicules:

| | |
|--------------------------|---|
| Tentacles | Rods varying in size, very spiny at the extremities (145–645 μm) |
| Dorsal body wall | Tables, rosettes and C-shaped ossicles: tables (30–50 μm), rim in discs is smooth, perforated by 4 central holes and 3–6 peripheral holes; spire ending in a wide spiny crown; rosettes (20 μm) |
| Ventral body wall | Tables similar to those of the body wall, C-shaped rods (60–70 μm) |
| Ventral podia | Spiny rods (250– 415 μm) with enlarged median process, unevenly perforated; spiny plates (85–100 μm); tables with rounded yet spiny discs |
| Dorsal papillae | Tables (45–70 μm) and rods of various shapes and sizes; the largest ones (135–350 μm) have an enlarged median process. |



(Source: photo N. Soars, ossicles of the specimen #J16639, Australian Museum)

(after Massin, 1996)

Stichopus naso

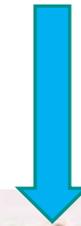
Semper, 1868



Common names: *Stichopus naso* is confused with *S. horrens*, the former is traded under the same name as the latter in its distribution range.



Very prominent conical dorsolateral papillae



Live form



Dry form

 10-20 cm

 100 to 200 g

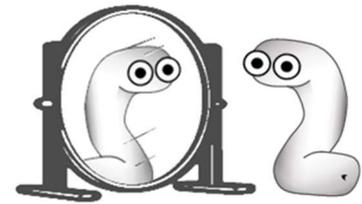
 Yellowish and mottled brown or solid light brown dorsal side

 Conical dorsolateral papillae

Probably similar in size and appearance to *S. horrens*

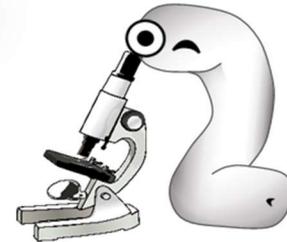
 Conical dorsolateral papillae

Similar species



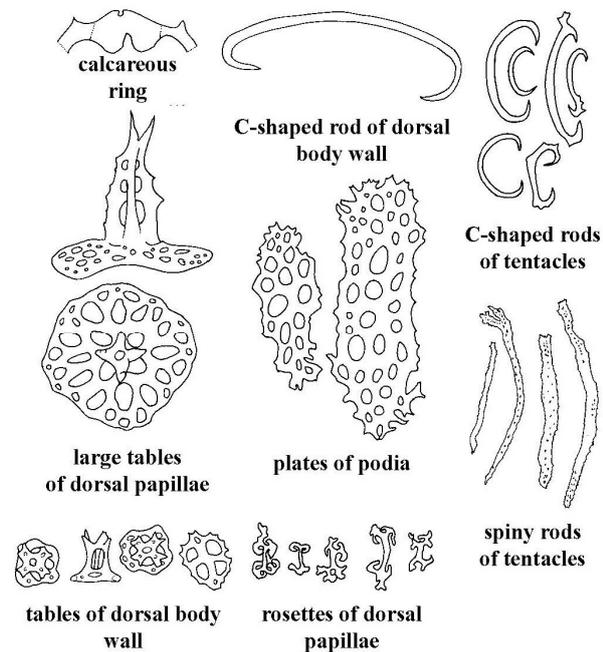
S. monotuberculatus *Stichopus horrens*

And for the experts...

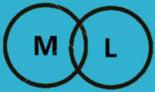


Characteristics of the spicules:

| | |
|---------------------------------|--|
| Tentacles | Spiny rods that can bifurcate at the extremities (150–620 μm), as well as C-shaped rods (25–65 μm) |
| Dorsal body wall | Tables, rosettes and C-shaped rods: tables with disc (approximately 25 μm) perforated by 4 central and 4–8 peripheral holes; spire ending in a crown of spines resembling a Maltese cross; C-shaped rods (60–180 μm) |
| Ventral body wall | Similar ossicle assemblage but C-shaped rods are smaller (60–110 μm) and rosettes (20–25 μm) are more abundant. |
| Ventral and dorsal podia | Tables similar to those of the body wall, as well as larger ones with discs perforated by up to 20 holes, narrow and spiny rods (200–400 μm), rosettes and perforated plates (100–160 μm) with spiny edges. |

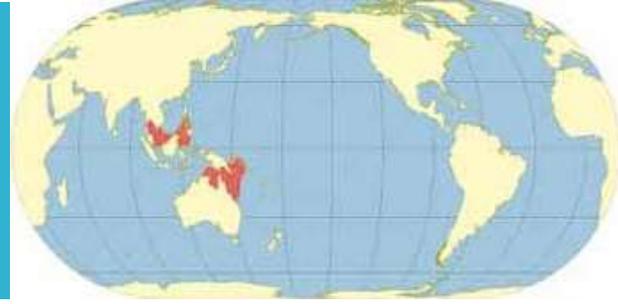


(after Massin, 2007)



Stichopus ocellatus

Massin, Zulfigar, Tan Shua Hwai & Rizal Boss, 2002



Common names: Curryfish, Ocellated sea cucumber, Hanginan (Philippines)



© S.W. Purcell

Large, circular, greenish-grey, wart-like or ocellated papillae, white around the base, distributed in 2x2 rows

Live form



© L.B. Concepcion - FAO

Dry form



23 to 29 cm, 33 cm max.



179 g to 1.3 kg



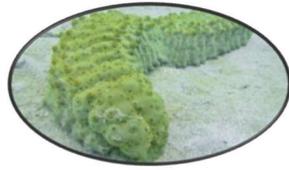
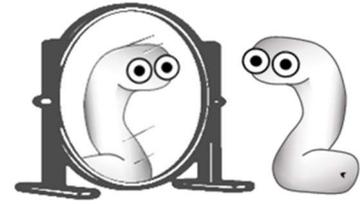
Yellow or yellowish orange on the dorsal surface. Whitish yellow ventral surface



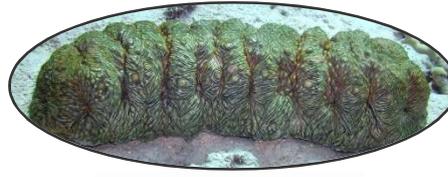
Large, circular, greenish-grey, wart-like papillae, white around the base, distributed in 4 rows

Not available

Similar species

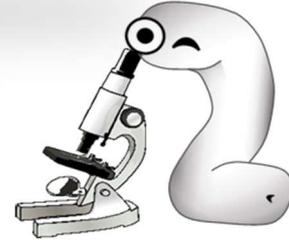


Stichopus herrmanni



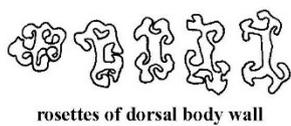
S. vastus

And for the experts...

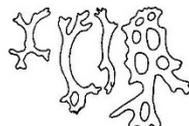


Characteristics of the spicules:

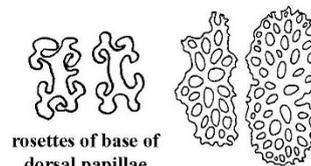
| | |
|--------------------------|---|
| Tentacles | Spiny rods (40– 600 μm) |
| Dorsal body wall | Tables (25–40 μm), rosettes (20–40 μm) and C-shaped rods (155–175 μm) |
| Ventral body wall | Similar ossicles to those of the dorsal body wall, but with smaller C-shaped rods (40–75 μm) |
| Ventral podia | Large perforated plates (140–265 μm), C-shaped rods (55–65 μm), reduced tables (25–50 μm) and rods (230–500 μm), most of them with large central perforated process |
| Dorsal papillae | At the base of the Dorsal papillae: rosettes and C-shaped rods At the top of papillae: C-shaped rods, tables, rosettes, small rods, perforated plates and curved rods with central perforated process |



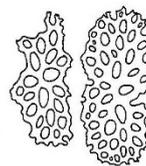
rosettes of dorsal body wall



rods and plate of top of dorsal papillae



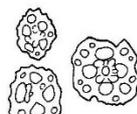
rosettes of base of dorsal papillae



large plates of top of podia



tables of dorsal body wall



tables of podia



C-shaped rod of podia

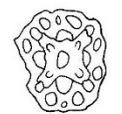
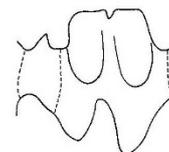
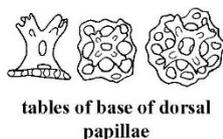


table of top of dorsal papillae



calcareous ring



tables of base of dorsal papillae

(after Massin *et al.*, 2002)

Stichopus pseudohorrens

Cherbonnier, 1967



Common names: Unknown



© IRD - Lagplon



Very long, conical papillae on the dorsal surface and lateral margins of the ventral surface



© F. Ducarme

Live form



VISUEL
INDISPONIBLE

Dry form



Probably 50 cm



3- 4 kg



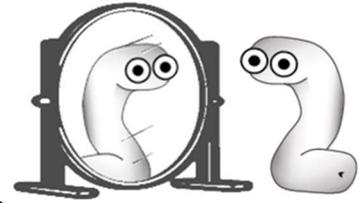
From brownish to rosy red with darker mottling



Very long, conical papillae on the dorsal surface and lateral margins of the ventral surface

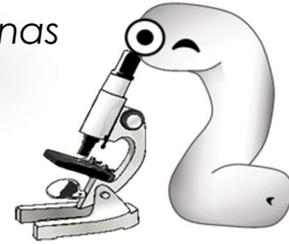
Not available

Similar species



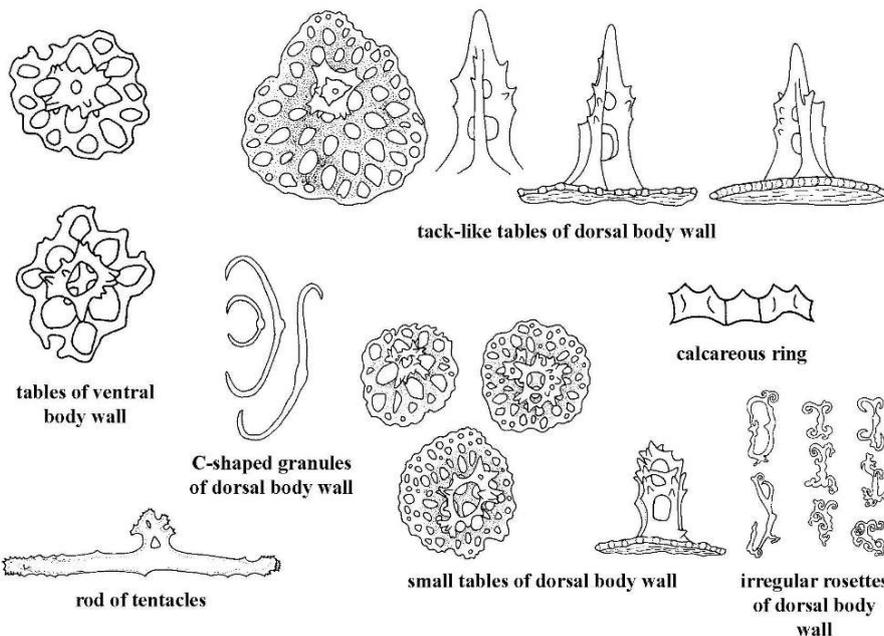
Stichopus herrmanni *Thelenota ananas*

And for the experts...



Characteristics of the spicules:

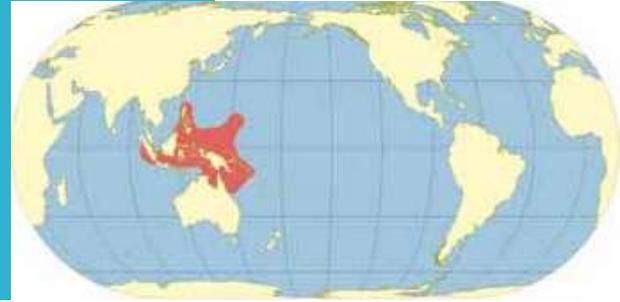
| | |
|-----------------------------------|---|
| Tentacles | Spiny curved rods of various size (up to 875 μm) |
| Dorsal body wall | Tablets, C-shaped rods and rosettes. 2 types of tables: 1) relatively few small ones, discs (50–90 μm), perforated by 4 central and many peripheral holes, and 2) very large tack-like ones (100 μm), with a spiny spire |
| Ventral body wall | Tables, C-shaped rods and rosettes: only one kind of tables, discs (40–60 μm), undulating rim, perforated by 4 central holes and a few peripheral ones; spire ending in a spiny crown. |
| Ventral podia and papillae | Tables and very large rods, with a medial enlargement that can be perforated |



(after Cherbonnier, 1967)

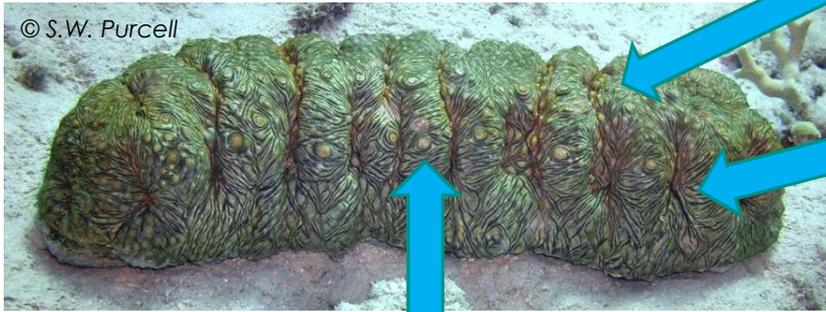
Stichopus vastus

Sluiter, 1887



Common names:  Curryfish (Australia), Zebrafish (India)

 Holothurie curry brune



© S.W. Purcell

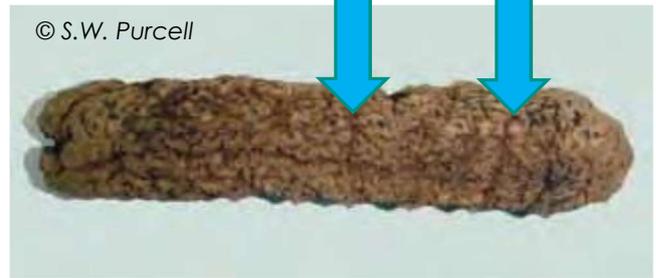
Live form

Deep transverse wrinkles on the dorsal surface

Fine dark lines surrounding the base of the large papillae on the dorsal surface

Clear short papillae

Large wart-like papillae in 5-6 rows on the dorsal surface and lateral margins. Smaller "warts" appear all over the dorsal surface.



© S.W. Purcell

 33-35 cm

 1 to 1.7 kg

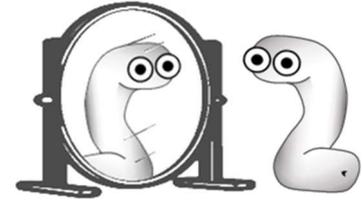
 From golden yellow to brownish to reddish yellow, olive green or greyish green. Fine dark lines surrounding the base of the large papillae on the dorsal surface

 Large wart-like papillae in 5-6 rows on the dorsal surface and lateral margins. Smaller "warts" appear all over the dorsal surface. Deep transverse wrinkles dorsally

 Light brown. Fine dark lines surrounding the base of the large papillae on the dorsal surface

 Clear short papillae

Similar species

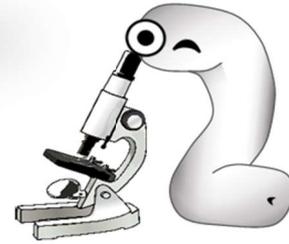


Stichopus hermanni



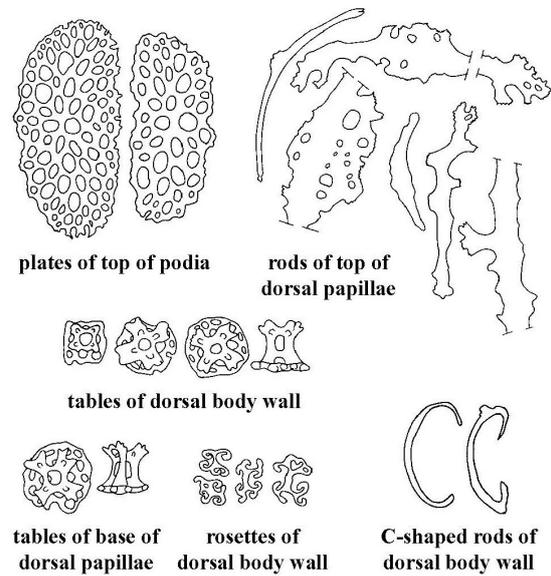
S. ocellatus

And for the experts...



Characteristics of the spicules:

| | |
|-------------------------------------|---|
| Tentacles | Curved rods with spiny extremities (60–695 μm) |
| Dorsal and ventral body wall | Tables (25–40 μm), rosettes (15–40 μm) and C-shaped rods (40–95 μm) Tables have smooth, round to quadrangular discs, perforated by 4 central and 4–10 peripheral holes; spire ends in a wide Maltese crown |
| Ventral podia | Tables (30–55 μm) with reduced or no pillars, rods (250–450 μm) that can have a very large central perforated process |
| Dorsal papillae | Top of Dorsal papillae: large tables (30–55 μm) with smooth, quadrangular to ovoid disc, perforated by 4 central and 4–25 peripheral holes; spire ending in a narrow crown of spines ($\frac{1}{2}$ of disc diameter) |



(after Massin *et al.*, 2002)

Thelenota ananas

(Jaeger, 1833)



Common names:  Prickly redfish  Holothurie ananas



© Y. Herraud - DORIS



Pointy, conical papillae, often arranged in a star shape on the dorsal surface

Live form



© J. Akamine - FAO

Dry form



45 cm on average,
80 cm max.



2.5 km on average,
7 max.



Orange-red to brown dorsally
Pale pink to red ventrally



Pointy, conical papillae, often arranged in a star shape on the dorsal surface



20-25 cm



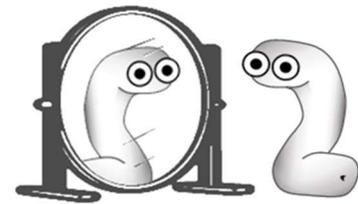
From brown to black

A cut along the ventral surface



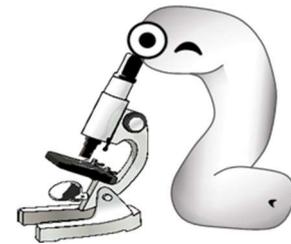
Pointy, conical papillae, often arranged in a star shape on the dorsal surface

Similar species



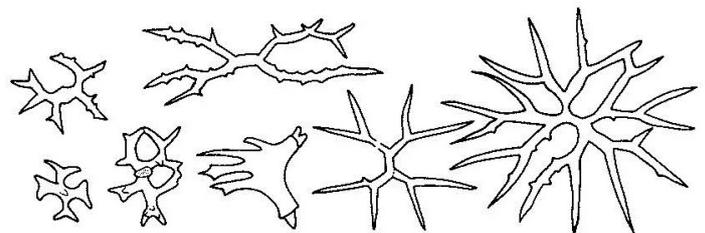
Stichopus pseudohorrens

And for the experts...

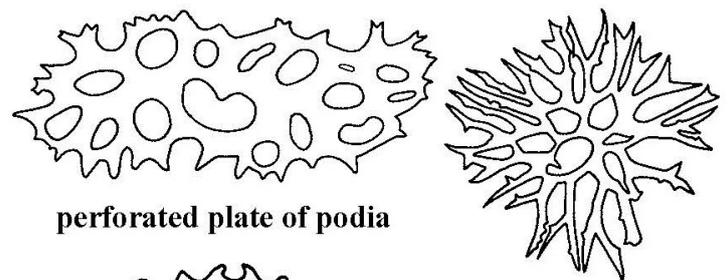


Characteristics of the spicules:

| | |
|--------------------------|---|
| Tentacles | Large plates (135 μm long and 95 μm wide), as well as smaller rods |
| Dorsal body wall | Dichotomously branched rods, which are slightly spiny (40–80 μm), and countless miliary granules (1.5–4 μm) |
| Ventral body wall | Similar rods to those of the Dorsal body wall, but smooth |
| Ventral podia | Large plates (75–135 μm) and rods similar to those of the body wall. |
| Dorsal papillae | Rods similar to those of the body wall, as well as slightly curved, spiny rods (up to 155 μm) |

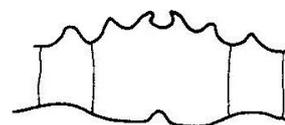


ossicles of body wall



perforated plate of podia

branched rod of tentacle



calcareous ring

(after Féral and Cherbonnier, 1986)

Thelenota anax

Clark, 1921



Common names:  Amber fish  Holothurie géante

Massive trapezoidal morphology



© N. Hobgood – licensed CC BY SA

Numerous wart-like protrusions in rows on the dorsal surface

Live form

Large white papillae along the lateral margins



© S.W. Purcell

Dry form



55 cm on average, 1 m max.



3.5 kg on average, 5 max.



Cream coloured with orange, red or beige spots



Massive trapezoidal morphology. Large white papillae along the lateral margins. Numerous wart-like protrusions in rows on the dorsal surface



15-20 cm

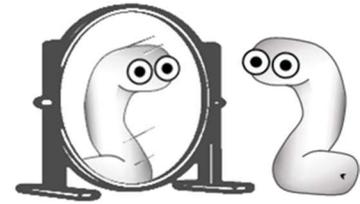


Brown



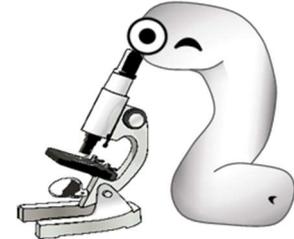
Small cut across mouth or a single ventral cut

Similar species



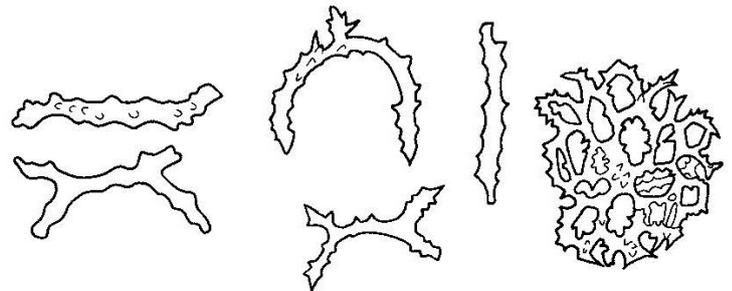
Its massive, trapezoidal morphology, combined with the presence of large papillae on its dorsal surface, allow *Thelenota anax* to be easily identified

And for the experts...



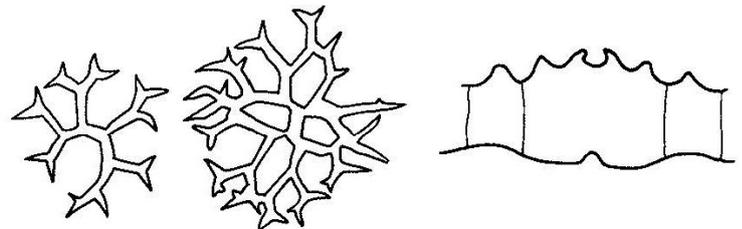
Characteristics of the spicules:

| | |
|-------------------------------------|---|
| Tentacles | Nodulous, branching buttons, perforated plates (80–100 μm) |
| Dorsal and ventral body wall | Dichotomously branched rods (70–100 μm), pseudo-tables and an infinite number of miliary granules (only a few μm) |
| Ventral podia | Rods of various shapes; branching rods and turrets |
| Dorsal papillae | Long rods, which can be branched and perforated; or more like plate-like deposits |



ossicles of podia

ossicles of tentacle



ossicles of body wall

calcareous ring



ossicle of papillae

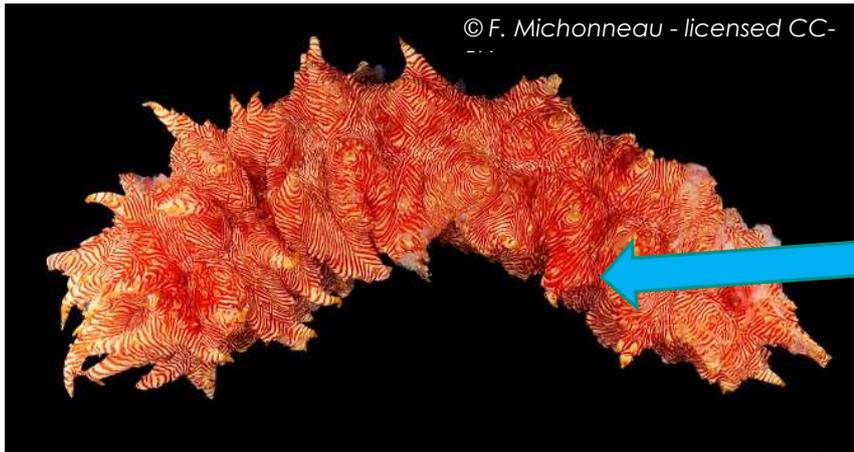
(after Féral and Cherbonnier, 1986)

Thelenota rubralineata

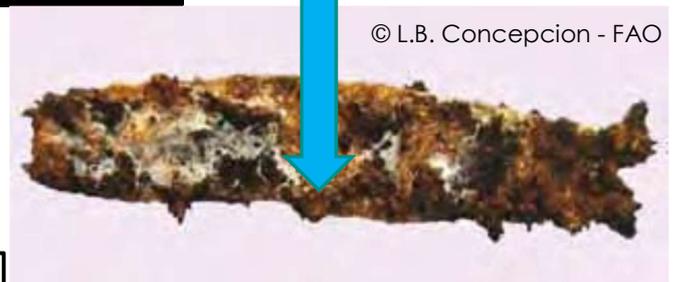
Massin and Lane, 1991



Common names:  Red-lined sea cucumber
 Holothurie à lignes rouges



Live form



Dry form



30-50 cm on average



3 kg max.



Light cream colour, with fine red lines, more or less tightly packed



Long protuberances on the dorsal surface, with yellow pointy papillae at the ends



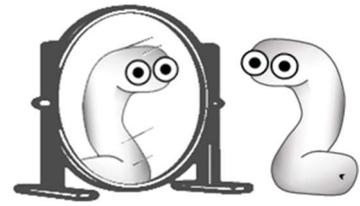
Brown



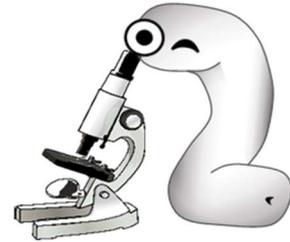
Large protuberances on the dorsal surface, with yellow pointy papillae at the ends

Not available

Similar species

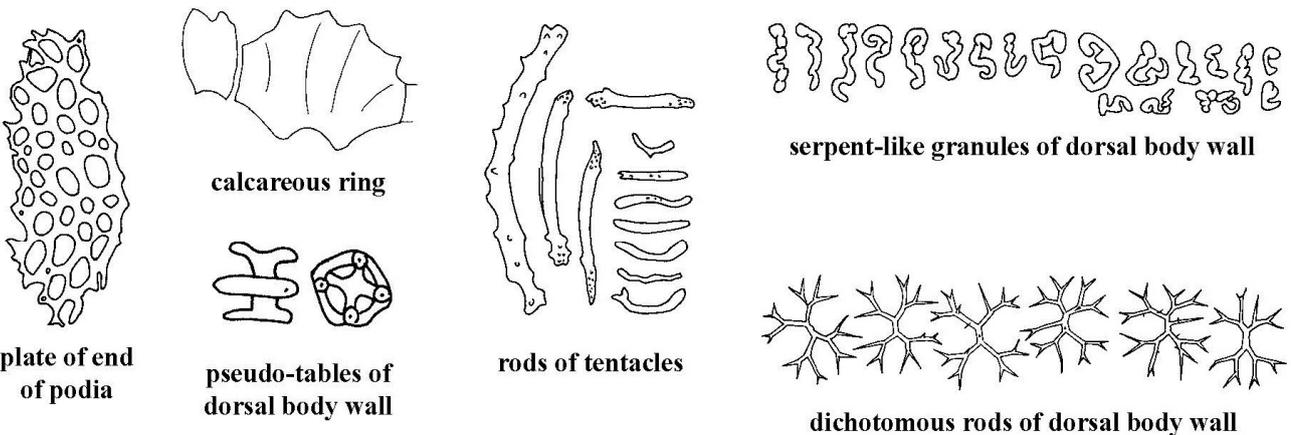


And for the experts...



Characteristics of the spicules:

| | |
|--------------------------|---|
| Tentacles | Spiny or smooth, straight or curved rods (10–150 μm) |
| Dorsal body wall | Numerous miliary granules, slender dichotomously branched spiny rods (90–135 μm) with primary, secondary, tertiary and sometimes quaternary branches; pseudo-tables (20–25 μm) with 4–5 short feet which are prolonged by 4–5 long spines |
| Ventral body wall | Dichotomous rods, pseudo-tables and serpent-like granules |
| Ventral podia | Rods, a few pseudo-tables and anastomosing plates forming the end-plate. |
| Dorsal papillae | Mostly serpent-like granules (5–20 μm) and a few dichotomous rods |



(after Massin and Lane, 1991)

Dendrochirotida: Cucumariidae

Athyonidium chilensis

(Semper, 1868)



Common names:  Sea cucumber (USA)

 Pepino arenero, Ancoco (Mexico and Peru), Meón, Ancoco blanco (Chili)



© J.M. Cancino - licensed by CC BY NC

Mouth with greenish-black branched dendritic tentacles arranged in 2 circles: 5 large outer pairs and 5 small inner pairs



© C. Maureira - licensed by CC BY NC SA

Live form



© C. Guisado - FAO

Dry form



25-30 cm on average



200-250 g on average



From brown to greyish-brown to light grey



Mouth with 5 pairs of greenish-black branched dendritic tentacles arranged in 2 circles: 5 large outer pairs and 5 small inner pairs



7-10 cm



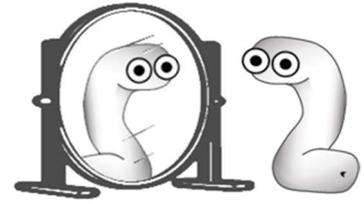
From dark brown to black



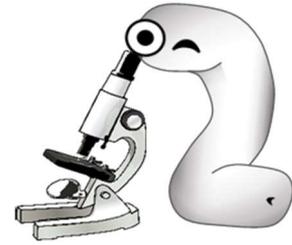
Cylindrical body, tapers at both extremities

Not available

Similar species

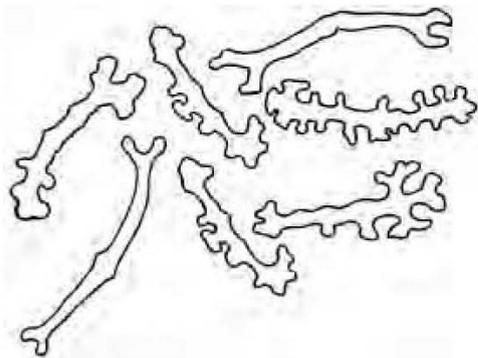


And for the experts...

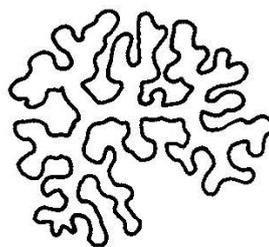


Characteristics of the spicules:

| | |
|-------------------------------------|--|
| Tentacles | Tentacles of juveniles have rods |
| Dorsal and ventral body wall | A few spiny, perforated rods that are somewhat enlarged at the extremities |
| Ventral podia | Only an end-plate |



rods of body wall



rosette of body wall

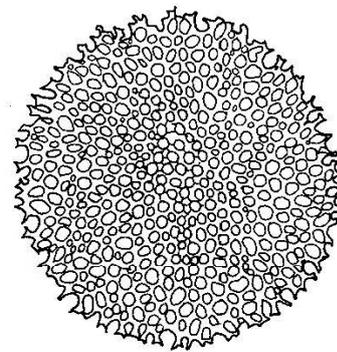


plate of body wall

(source: photo L. Amaro-Rojas)

Cucumaria frondosa frondosa

(Gunnerus, 1767)



Common names:  Orange-footed sea cucumber, Northern sea cucumber  Concombre de mer du Nord



Live form

10 orange retractable dendritic tentacles (8 large and 2 small) located around the mouth



Dry form

 25-30 cm, 50 cm max.

 500 to 850 g

 From greenish brown to dark mauve to orangey red-brown. It is possible to find individuals that are completely white

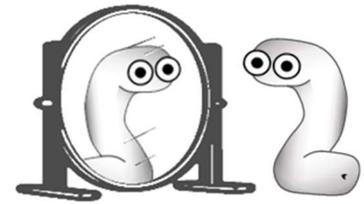
 10 orange retractable dendritic tentacles (8 large and 2 small) located around the mouth

 8-9 cm

 Dark brown

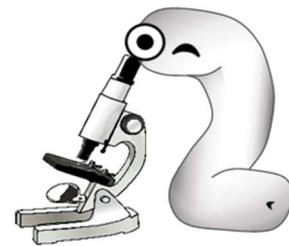
 Slightly granular surface with visible rows of podia

Similar species



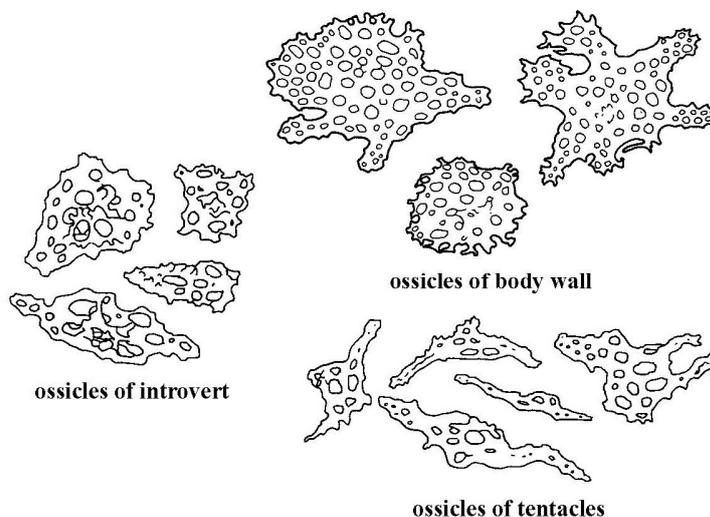
Cucumaria frondosa japonica

And for the experts...



Characteristics of the spicules:

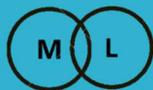
| | |
|-------------------------------------|---|
| Tentacles | Rods and plates (120– 350 μm) |
| Dorsal and ventral body wall | Perforated plates of different sizes (200–250 μm), triangular, quadrangular or subcircular with ragged edges; the surface of the plates is either smooth or with projections. |
| Body Wall around the Anus | Larger, more spiny plates that can have a secondary spiny layer (200–400 μm) |
| Ventral podia | Straight, or slightly curved perforated rods (250–300 μm) that can be smooth or nodulous |



(after Levin and Gudimova, 2000)

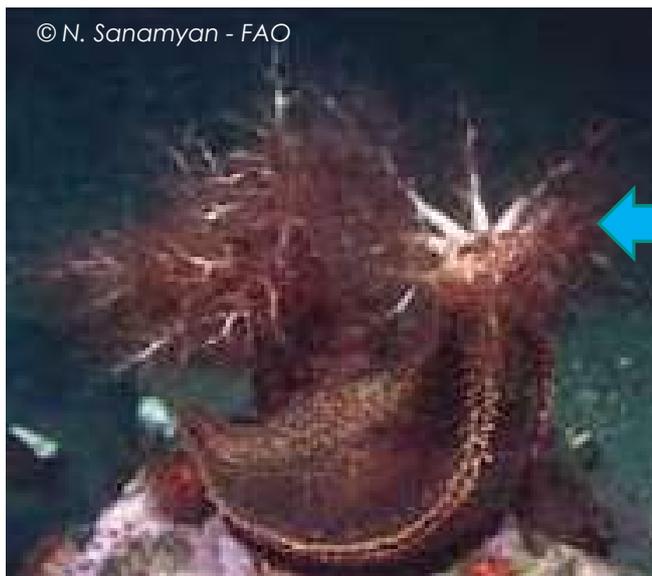
Cucumaria frondosa japonica

Semper, 1868



Common names:  Japanese cucumaria

Black sea cucumber (Canada)



© N. Sanamyan - FAO

Live form

5 pairs of dendritic tentacles around the mouth which may be reddish with whitish tips



© J. Akamine - FAO

Dry form



20 cm on average, 40 cm max.



500 g on average, 1.5-2 kg max.



Brown to brownish purple to greyish purple, and in some regions the animals may be white



5 pairs of dendritic tentacles around the mouth which may be reddish with whitish tips

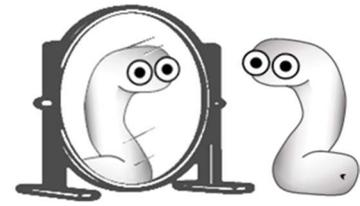


Dark beige to brown, with lighter spots arranged in 5 rows along the body



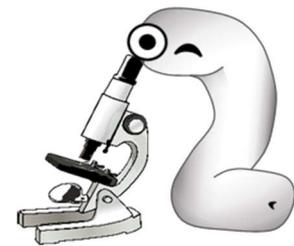
Body tapers around the anus

Similar species



Cucumaria frondosa frondosa

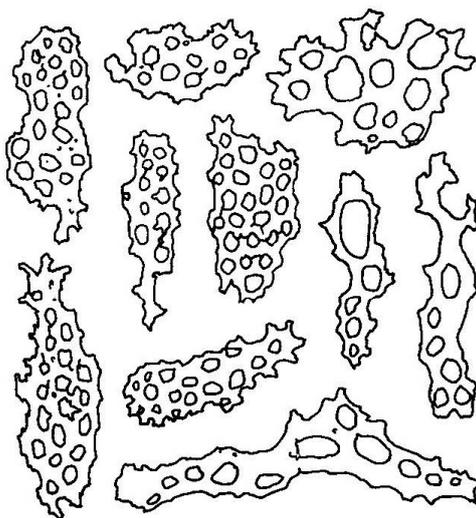
And for the experts...



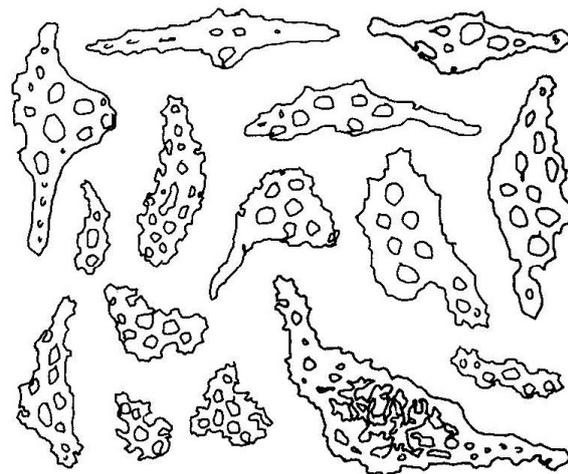
Characteristics of the spicules:

Similar in size and shape to those of *Cucumaria frondosa frondosa*, i.e., 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 frondosa*, it does not have large discoid ossicles positioned radially near the opening of the cloaca, which, according to Semper, *C. frondosa japonica* does have.



ossicles of body wall



ossicles of tentacles

(after Gudimova, 1998)

References

ASHA P.S. 2013. - *Holothuria* sp. (Type Pentard), a new teat-fish variety from Indian waters. *Marine Fisheries Information Service; Technical and Extension Series*, 217: 3.

BRUCKNER A.W, JOHNSON K.A & FIELD J.D. 2003. - Conservation des holothuries: une inscription aux listes de la CITES pour pérenniser le commerce international? *Beche-de-mer Information Bulletin* 18:24-33.
<http://coastfish.spc.int/News/BDMVF/LaBDM18/BDM18-VF.pdf>

BRUCKNER A.W. (ed) 2006. - *The Proceedings of the CITES workshop on the conservation of sea cucumbers in the families Holothuriidae and Stichopodidae*. NOAA Technical Memorandum , 244 p.

CHERBONNIER G. 1988. - *Echinodermes: holothurides, Faune de Madagascar*. Paris, ORSTOM. https://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers12-05/25111.pdf

CITES 2019. - CoP18 Prop.45 (Rev. 1): Proposition d'inscription des trois espèces appartenant au sous-genre *Holothuria* (Microthele): *Holothuria* (Microthele) *fuscogilva*, *Holothuria* (Microthele) *nobilis* et *Holothuria* (Microthele) *whitmaei* à l'Annexe II.

CONAND C., PURCELL S.W., GAMBOA R. & TORAL-GRANDA V. 2013. - *Holothuria nobilis* and *Holothuria whitmaei*. *The IUCN Red List of Threatened Species*.
<https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180326A1615368.en>.

CONAND C., POLIDORO B., MERCIER A. GAMBOA R., HAMEL J-F. & PURCELL S.W. 2014. - The IUCN Red List assessment of aspidochirotid sea cucumbers and its implications. *SPC Beche-de-mer Information Bulletin* 34: 3-7.

CONAND C. 1986. - *Les ressources halieutiques des pays insulaires du Pacifique. Deuxième partie: Les Holothuries*. F.A.O. Doc. Tech. Pêches, 272.2: 108 p.

CONAND C. 1989. - *Les Holothuries Aspidochirotes du lagon de Nouvelle-Calédonie: biologie, écologie et exploitation*. Etudes et Thèses, O.R.S.T.O.M., Paris: 393 p.

CONAND C. 1990. - *The fishery resources of Pacific island countries. Part 2: Holothurians*. F.A.O. Fisheries Tech. Paper, 272.2: 143 p.

CONAND C. 1998. – *Holothurians*, in: CARPENTER K. AND NIEM V. (eds). *FAO species identification guide. The marine living resources of the Western Central Pacific. Vol 2 Cephalopods, Crustaceans, Holothurians and Sharks*: 1157–1190.

CONAND C. 2006. - Sea cucumber biology: Taxonomy, distribution, biology, conservation status, in BRUCKNER A.W. (ed) *Proceedings of the CITES workshop on the conservation of sea cucumbers in the families Holothuriidae and Stichopodidae*. NOAA Technical Memorandum: 33-73.

- CONAND C. 2017. - Les holothuries ressource marine: du mythe à la surexploitation mondiale. Les Amis du Muséum national d'Histoire naturelle, n°271. https://www.mnhn.fr/sites/mnhn.fr/files/atoms/files/bulletin_ndeg_271-sept_2017.pdf
- DISSANAYAKE D.C.T. & NISHANTHAN G. 2016. - Fresh and Processed Sea Cucumbers of Sri Lanka-Identification Guide. ISBN 978-955-0263-07-3
- DORIS 2020. - Données d'Observations pour la Reconnaissance et l'Identification de la faune et la flore Subaquatiques. <https://doris.ffessm.fr/find/species>
- DI SIMONE M., CONAND C. & HORELLOU A. 2019. - Towards a CITES listing of teatfish. *SPC Beche-de-mer Information Bulletin* 39:76–78.
- DI SIMONE M., CONAND C. & HORELLOU A. 2020. - Three species of teatfish to be protected by CITES. *SPC Beche-de-mer Information Bulletin* 40:3-4.
- FAO 2019. - *Report of the Sixth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially Exploited Aquatic Species, Rome, 21–25 January 2019*. FAO Fisheries and Aquaculture Report No. 1255. Rome
- KHANH L.V., ANH N.T.N. & DINH T.D. 2020. - Investigating Species Compositions of Sea Cucumbers in Nam Du Island, Kien Giang Province, Vietnam. *Oceanography & Fisheries* 11(5): 555825. DOI: 10.19080/OFOAJ.2020.11.555825 <https://juniperpublishers.com/ofoaj/pdf/OFOAJ.MS.ID.555825.pdf>
- LOVATELLI A., CONAND C., PURCELL S.W., UTHICKE, S., HAMEL J.-F. & MERCIER A. eds. 2004. - *Advances in sea cucumber aquaculture and management*. FAO Fisheries Technical Paper No. 463, 425 p.
- LOVATELLI A. 2021. - Sea cucumbers are now harvested in more than 80 countries. *SPC Beche-de-mer Information Bulletin* 41: 81.
- MULOCHAU T. 2018. - Les holothuries d'intérêt commercial du Banc récifal du Geysier (Îles Eparses - Glorieuses - océan Indien). *SPC Beche-de-mer Information Bulletin* 38: 3-8.
- PURCELL S.W., SAMYN Y. & CONAND C. 2012. - *Commercially important sea cucumbers of the world*. FAO Species Catalogue for Fishery Purposes. No. 6. Rome, FAO. 150 p. <http://www.fao.org/docrep/017/i1918e/i1918e.pdf>
- PURCELL S.W. 2014. - *Processing sea cucumbers into beche-de-mer: A manual for Pacific Island fishers*. Southern Cross University, Lismore, and the Secretariat of the Pacific Community, Noumea. 44 p.
- PURCELL S.W., POLIDORO B.A., HAMEL J.-F., GAMBOA R. & MERCIER A. 2014. - The cost of being valuable: Predictors of extinction risk in marine invertebrates exploited as luxury seafood. *Proceedings of the Royal Society B-Biological Sciences*. DOI: 10.1098/rspb.2013.3296.
- PURWATI P., HARTATI R. & WIDIANINGSIH, 2010. - Eighteen sea cucumber species fished in Karimunjawa Island, Java Sea. *Marine Research in Indonesia* 35(2):23–30.

O'TOOLE M. & SHEA S., 2019. Identifying Sea Cucumbers: Implementing and enforcing an Appendix II listing of teatfish.

SAMYN Y., VANDENSPIEGEL D. & MASSIN C. 2006. - Taxonomie des holothuries des Comores, Volume 1, *Abc Taxa*, 130p.

TORAL-GRANDA V. 2005. - L'identification de l'holothurie des Galápagos *Isostichopus fuscus* vendues sur le marché international à partir des spicules calcaires. *SPC Beche-de-mer Information Bulletin* 22: 3–5.

TORAL-GRANDA V., LOVATELLI A. AND VASCONCELLOS M. 2008. - *Sea cucumbers: A global review on fishery and trade*. FAO Fisheries Technical Paper no. 516. FAO Rome. 319 p.

SETYASTUTI A. & PURWATI P. 2015. - Recensement des espèces d'holothuries pêchées et transformées en Indonésie. *SPC Beche-de-mer Information Bulletin* 35: 19-25.

UTHICKES., BYRNE M. & CONAND C. 2010. - Genetic barcoding of commercial beche-de-mer species (Echinodermata: Holothuroidea). *Molecular Ecology Resources* 10(4): 634–646.

WORLDFISH CENTER & CPS 2008. - Holothuries d'intérêt commercial du Pacifique tropical. <https://spccfpstore1.blob.core.windows.net/digitallibrary-docs/files/d0/d00cdd9d335bf340a7ac4187a7ddce51.pdf?sv=2015-12-11&sr=b&sig=1ZJOesxJ4WYWJDM1%2BNkhlo8XDvCbVv9nBoSVPdQMQ7k%3D&se=2021-06-05T10%3A10%3A18Z&sp=r&rsc=public%2C%20max-age%3D864000%2C%20max-stale%3D86400&rsct=application%2Fpdf&rscd=inline%3B%20filename%3D%22Holothuries.pdf%22>

WoRMS 2022a. *Cucumaria frondosa japonica*
<https://www.marinespecies.org/aphia.php?p=taxdetails&id=241808>

WoRMS 2022b. Holothuroidea.
<https://www.marinespecies.org/aphia.php?p=taxdetails&id=123083#>

Glossary

Bêche-de-mer: Term used to refer to the processed product of sea cucumbers (see also trepang).

Bivium: Dorsal surface of the tegument.

Transverse cut: A cut perpendicular to the main axis of the body.

Dendritic: Branching in an arborescent manner; used to describe the shape of the tentacles in Dendrochirotida

Anal teeth: Teeth around the anus, whose role is to prevent the entry of symbionts and parasites into the cloacal cavity of the animal, which needs to remain open to allow the animal to breathe. Among the commercial species, those belonging to the genus *Actinopyga* and the subgenus *Holothuria* (*Microthele*)—with the exception of *Holothuria fuscopunctata*—have anal teeth.

Dorsal: Upper surface of the animal.

Juvenile: Animal that has not yet reach sexual maturity.

Lateral: At the side of the body.

Ossicles: Or “spicules”, are microscopic carbonate skeleton particles in the body wall—tentacles, podia, papillae, and other body parts—useful for species identification; they come in various shapes.

Papillae: Small lumps on the surface of the body wall.

Peltate: a circular or lobed structure with a stalk in the middle; used to describe the shape of the end of tentacles in Holothuriida et Synallactida.

Podia (plural of podium) **or tube feet:** Small organs arranged in rows along the body, in the form of small, soft, cylindrical, hollow tubes, allowing the holothurian to adhere to the substrate for movement. In many holothurians, the Dorsal podia are transformed into papillae of various shapes.

Protuberance: A part of the body that protrudes from the main part of the body.

Tegument: The outer tissues of the animal, including the cuticle and epidermis (body wall of the animal).

Tentacles: Buccal podia located around the mouth; they serve to collect food particles.

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

Trivium: Ventral surface of the body.

Cuvierian tubules: Threads becoming sticky when ejected by certain species, used as a defence mechanism. Cuvierian tubules are only present in species of the family Holothuriidae. Some species have these organs but do not expel them (e.g., species of the genus *Actinopyga*) or very rarely, such as *Pearsonothuria graeffei*.

Ventral: Under surface of the animal.

Appendices

Appendix 1. The three CITES Appendices

| Appendix I | Appendix II | Appendix III |
|--|--|--|
| <ul style="list-style-type: none"> • Endangered species • International trade prohibited (except for exemptions: pre-Convention specimen, trophy, personal effects, approved breeding (source D), zoos, approved nurseries) • CITES permit required | <ul style="list-style-type: none"> • Vulnerable species threatened by trade • Monitored/regulated trade • CITES permit required | <ul style="list-style-type: none"> • Nationally protected species • Monitoring at the request of a country for its population • CITES permit required |

Appendix 2. The Different Types of Ossicles in Sea Cucumbers

Ossicles can be found in different parts of the body. The calcareous ossicles, which are hidden in the body wall (mainly in the dermis), papillae, podia and tentacles, are mostly just one twentieth to one tenth of a millimetre in length (Purcell *et al.* 2012). These spicules can have different shapes (Figure 5) and are present in both larvae and adults (Toral-Granda 2005). The spicules remain intact (unchanged in shape and size) whether the animal is fresh or dried (Toral-Granda 2005). Spicules differ between holothurian families (Table 1, Cherbonnier 1988) and can thus allow species identification when that is not possible with their morphological traits alone.

Table 1. Different types of spicules in Holothuriidae and Stichopodidae

| Family of Sea Cucumbers | Types of spicules |
|-------------------------|---|
| Holothuriidae | Towers, simple or nodulous buttons, sometimes transformed into hollow fenestrated ellipsoids, rods, never C- or S-shaped elements |
| Stichopodidae | Turrets, branching rods, pseudo-buttons, with (but sometimes without) many C- or S-shaped bodies |

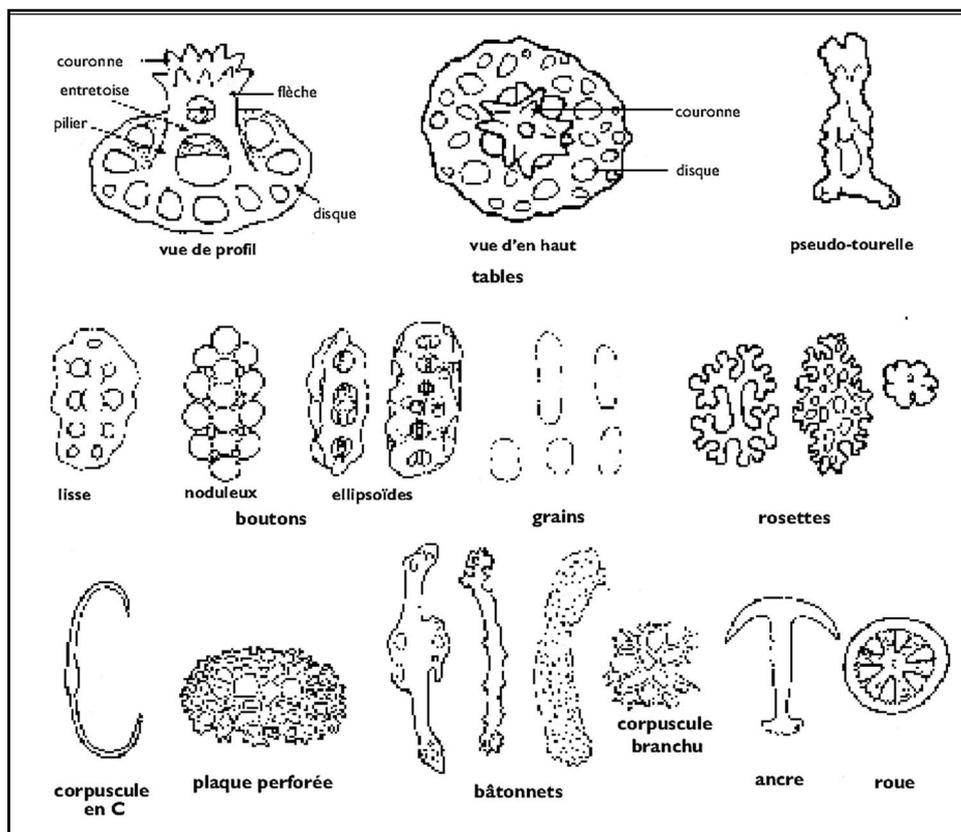
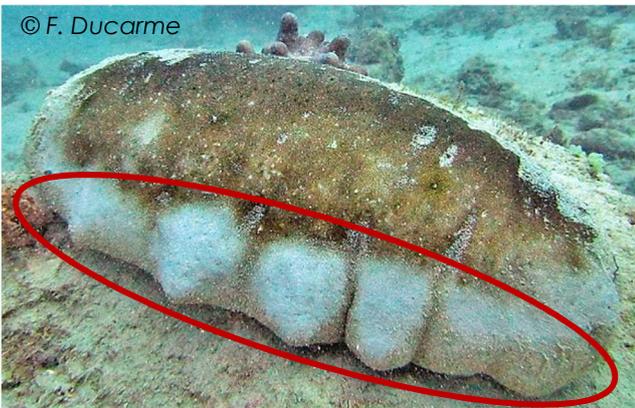


Figure 5. Diagram of the different types of spicules (Source: Conand 1998)

Appendix 3. Identification key for the three CITES-listed species of sea cucumbers

The highly commercialized teatfish are easily distinguishable from other sea cucumber species (CITES 2019 ; Di Simone *et al.* specially thanks to the two characteristics specific to these species:

The presence of lateral protuberances (5 to 10) in the form of "teats" on each side of the body



Other species may have spine-like protuberances but are easily differentiated from those of teatfish, which are thinner and more rounded. In addition, the protuberances are only found along the lower margin in the teatfish, not over the entire body as in other species (O'Toole & Shea 2019).

In their dried form, usually a single incision on the upper side, along the dorsal surface



When dried for export, sea cucumbers are prepared differently from other sea cucumber species (O'Toole & Shea 2019)

Although their protuberances are visible in both their live and dried forms, the three species of teatfish are difficult to differentiate in their dried form (FAO 2019).

The species *Holothuria whitmaei* was for a long time mistaken due to its "form" for *H. nobilis* in the Pacific; the species were separated in 2004. *Holothuria fuscogilva* was also considered the same species as *H. nobilis* until 1980 (Cherbonnier). Their morphology is identical but their colour is different.

A simple guide for identifying harvested and exploited sea cucumbers



© F. Ducarme



PatriNat (OFB-CNRS-MNHN)

Centre d'expertise et de données sur le patrimoine naturel

Muséum national d'Histoire naturelle

CP41 – 36 rue Geoffroy Saint-Hilaire

75005 Paris, France

www.patrinat.fr