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Phylum Echinodermata

Chapter · June 2018

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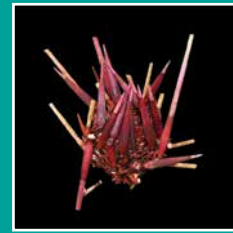
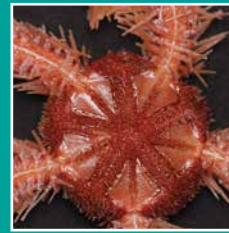
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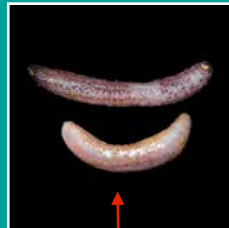
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PHYLUM: ECHINODERMATA

Authors:

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xxx

Citation:

Atkinson LJ, Mah C, Filander Z, Olbers J and Thandar A. 2018. Phylum
Echinodermata In: Atkinson LJ and Sink KJ (eds) Field Guide to Offshore
Marine Invertebrates of South Africa, Malachite Marketing and Media,
Pretoria, pp. X-Y.

¹ xxx South African Environmental Observation Network, Egagasini Node, Cape Town

² xxx Smithsonian Institution National Museum of Natural History, Washington DC

³ Department of Environmental Affairs Branch Oceans and Coasts

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⁵ University of KwaZulu-Natal, School of Biological and Conservation Sciences, Durban

Phylum: ECHINODERMATA

Starfish, basket stars, brittle stars, sea urchins, feather stars and sea cucumbers

Echinoderms, meaning 'spiny skin', are easily recognised by their distinctive adult radial symmetry (five-point or multiples of five), calcareous projections (spiny or warty) and the absence of a clear anterior end or head. They occur exclusively in marine environments and are found at all known depths and habitats. Echinoderm larvae are free-living, with growth occurring on the left side of the body at the expense of the right side, arranging itself into five parts either in a simple contour, rounded to cylindrical or star-like with arms radiating from a central disc. Some classes include specialised skeletal elements such as sea urchins, which make use of an "Aristotle's lantern" for grinding food, and sea cucumbers, which make use of a "calcareous ring" for feeding.

Many echinoderms have significant regeneration rates which are used for regular replacement of damaged limbs, spines or internal organs that may be released in response to predation. Regeneration can also occur during asexual reproduction in all classes except Crinoidea (feather stars). Some echinoderms also reproduce sexually and release sperm and egg cells into the water column where fertilisation takes place. This event is often synchronised according to lunar cycles and some species will often aggregate during this time.

The primary form of locomotion in echinoderms involves the use of tube feet shaped like suction pads, often with some stickiness caused by mucus secreted to aid adhesion. This locomotion is assisted by a water vascular system. Feeding modes vary within the echinoderm classes, ranging from filter feeding and grazing to active hunters and scavengers. Echinoderms are often preyed upon by crabs, sharks, sea birds and even other echinoderms. They employ several defensive strategies including the presence of spines and toxins to protect themselves.

Class Asteroidea (Starfish)

Class Asteroidea includes all starfish or sea star species which are easily identified as star-shaped organisms, with five arms (sometimes more) which join to a central disc, however should not be confused with brittle stars (Class Ophiuroidea). On the ventral side of the body of the Asteroidea, the arms and body

cavity are open with tube feet protruding, while in the brittle stars, these are closed. Asteroidea may be smooth, granular or spiny and can be covered with overlapping plates. Skeletal support is provided by the ossicles of the body wall that often combine with those of the central disc, providing the starfish arms with a broad attachment area to the disc. These organisms are mostly opportunistic feeders preying on other benthic invertebrates. Some starfish are predators which feed by expelling their stomach and digesting prey externally. Some starfish species feed on coral, sea fans or other anthozoa species and have been known to cause extensive damage to coral reefs and commercial oyster beds.

Class Crinoidea (Feather stars)

Crinoidea, also known as feather stars or sea lilies, are characterised by the mouth being located on the top surface surrounded by several (often more than five) feeding arms. Crinoids often have stems (cirri) that allow them to attach and detach themselves from a substrate. Crinoids feed by filtering seawater using their feather-like arms, which are covered with sticky tube feet that trap food particles and carry them to the mouth area. Feather stars are preyed upon by sea urchins and some fish species.

Class Echinoidea (Sea urchins)

Echinoidea, commonly called sea urchins, are superficially categorised into 'regular' and 'irregular' forms. 'Regular' sea urchins have a globular test, with their mouth (having a set of teeth known as Aristotle's lantern) situated on the ventral side of the animal. Most 'regular' sea urchins are grazers thus evolution of a ventral mouth ensures successful feeding. Most sea urchins cling onto hard substrates although many species live in unconsolidated sediment habitats and are known as burrowing urchins. 'Irregular' sea urchin forms generally have a more flattened test and tend to burrow in soft sediments. Echinoids are preyed on by several species including lobsters, crabs, starfish, certain linefish and octopus. The eggs and larvae of sea urchins are preyed upon by zooplankton and suspension-feeding invertebrates like hydroids, anemones, and bivalves. Echinoids have developed defensive mechanisms such as spines and toxins to prevent extensive damage to individuals.

Echinoids contribute ecological value to benthic ecosystems as grazing by sea urchins maintains algal populations, which allow reef ecosystems to thrive, while the burrowing species facilitate the release of nutrients from benthic sediments.

Class Holothuroidea (Sea cucumbers)

The class Holothuroidea includes all sea cucumbers, identified by their calcified endoskeleton and radial symmetry. Sea cucumbers are often slow-moving animals, only able to move by burrowing through the sand, creeping along the surface with short tube feet, or “swimming” via rhythmically contracting and flexing their body. Most sea cucumbers are deposit or suspension feeders, while others consume large amounts of sediment, absorbing the organic matter, while the rest is excreted. Many sea cucumbers spend most of their lives in cracks, hollows and burrows and will often not move far after settling. Holothuroidea have several predators such as crabs, fish, crustaceans, sea turtles and sea stars. As a defensive mechanism, some sea cucumbers expel their gut, including their cuvierian tubules which entangle and permanently disable its attacker. These internal organs are regrown shortly after.

Class Ophiuroidea (Basket and brittle stars)

Brittle and basket stars are closely related to starfish and can be identified by their five or more long, simple or branching arms which are sharply marked off from the central body disc. They are highly mobile and crawl across the seabed by means of their supple

arms, unlike starfish that use tube feet. Brittle and basket stars have various modes of feeding, with most being scavengers, detritus feeders or filter feeders. The mouth is located on the underside of the disc, which has a complex toothed-jaw formed from skeletal plates. Ophiuroids play an important role within the marine ecosystem, often forming symbiotic relationships with other marine species such as corals, gorgonians and algae.

Collection and preservation

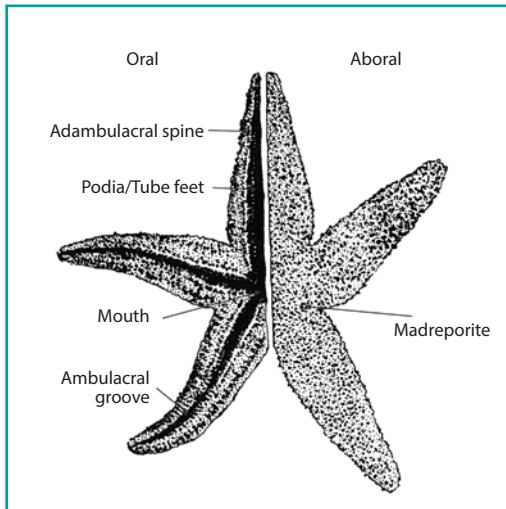
Specimens should be preserved in 80-90% ETOH and 96% ETOH for molecular studies. If the climate is not excessively humid, specimens can be preserved in 96% ethanol and later dried for storage.

Although not always necessary, but if possible, specimens can be relaxed before preservation by placing them in a mixture of seawater and magnesium chloride or menthol crystals, for a few hours. Caution should be taken when handling these animals as they readily detach their arms as a defence mechanism, thus damaging the specimen. Holothuroidea specimens should be relaxed by placing the specimen in a mixture of seawater and magnesium chloride. The solution must have a weak concentration of magnesium chloride to prevent the organisms from eviscerating their organs. The solution can be made stronger over time, which will ultimately kill the animal. Specimens can be stored and preserved wet or dry. Specimens should initially be preserved in 70-96% ethanol.

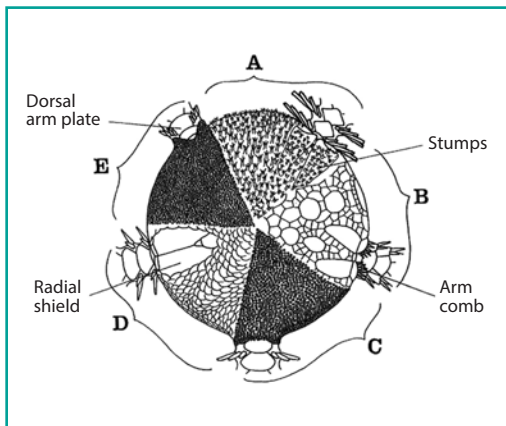
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- Nichols D. 1962. *Echinoderms*. Hutchinson & Co LTD, London.
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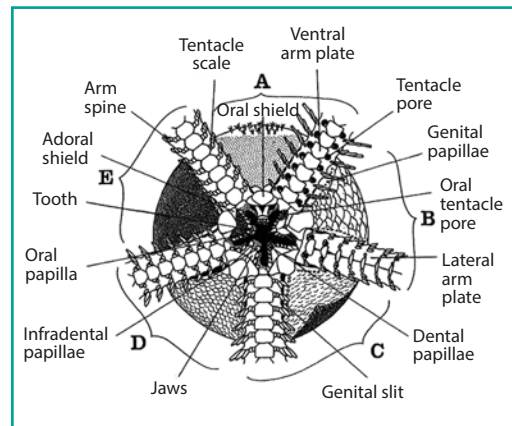
Asteriodea body plan (General FB code STARFS):



Ophiuroidea body plan (General FB code OPHIUR):



Composite diagram showing characters of the **dorsal** surface of the disc in the following families: A) Ophiotrichidae, B) Ophiuridae, C) Ophiocomidae, D) Amphiuroidae and E) Ophiodermatidae. Adapted from Clark and Rowe (1971).

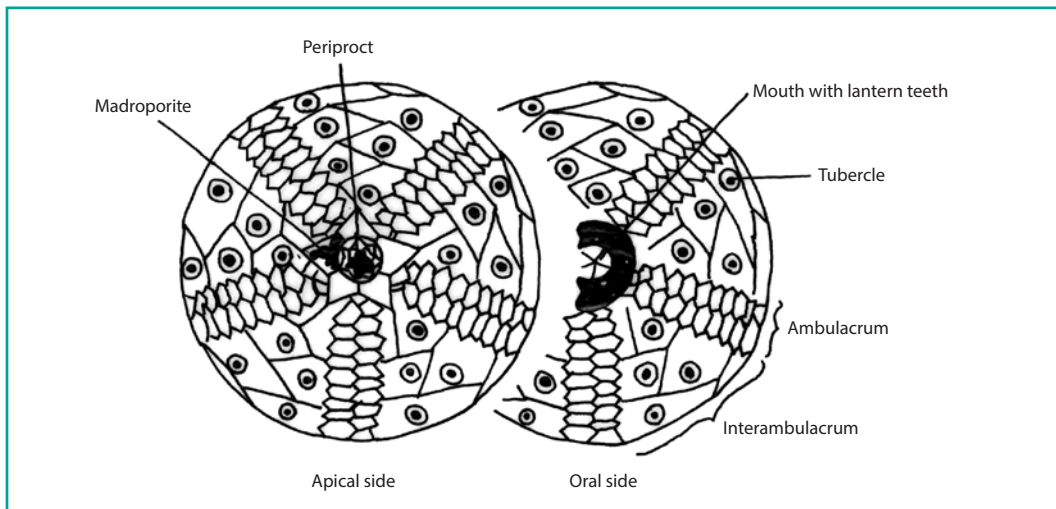


Composite diagram showing characters of the **ventral** surface of the disc in the following families: A) Ophiotrichidae, B) Ophiuridae, C) Ophiocomidae, D) Amphiuroidae and E) Ophiodermatidae. Adapted from Clark and Rowe (1971).

Reference:

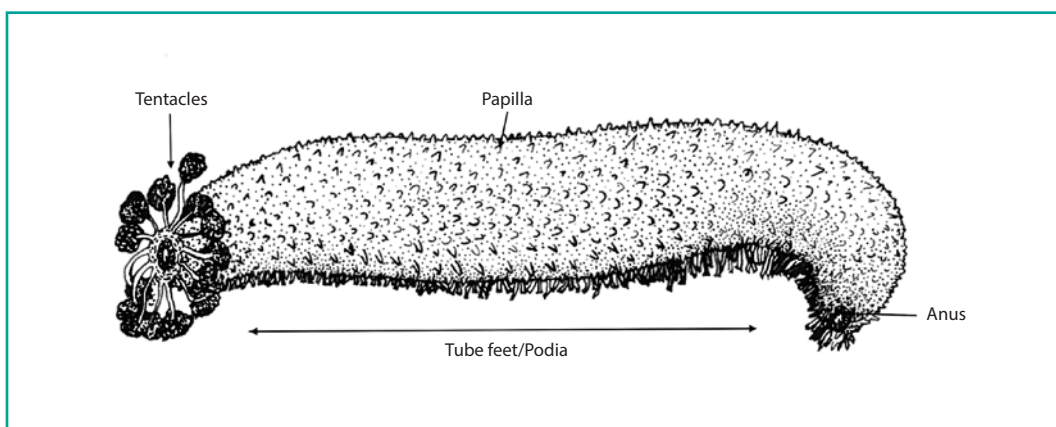
Clark AM and Rowe FWE. 1971. *Shallow-water Indo-West Pacific Echinoderms*. Pitman Press, Bath. 238 pp.
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Echinoidea body plan (General FB code URCHIN):



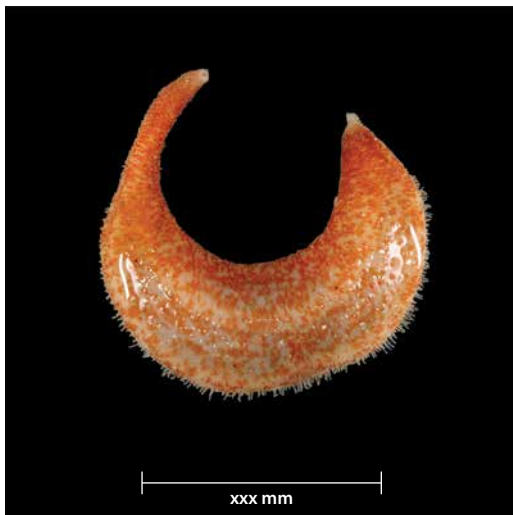
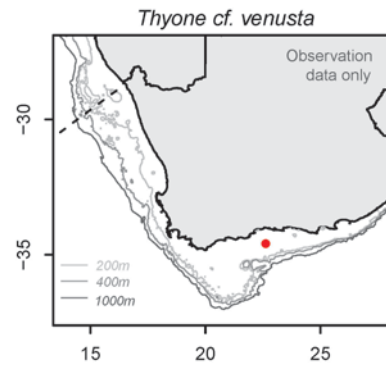
Composite diagram showing features of the dorsal and ventral surfaces of a general Echinoidea body plan.

Holothuroidea body plan (General FB code CUMBER):



Thyone venusta (ThyVen)

Phylum:	Echinodermata
Class:	Holothuroidea
Order:	Dendrochirotida
Family:	Thyonidae
Genus:	<i>Thyone</i>
Species:	<i>venusta</i>
Common name:	Orange and white speckled sea cucumber



Distinguishing features

U-shaped body, cylindrical, with posterior end turned upward. Skin smooth, but appears 'hairy' due to numerous scattered tube feet (podia). Speckled orange and white colour, darker dorsally.

Colour

White, speckled with orange.

Size

90-100 mm in length, width 8-10 mm.

Distribution

South Coast of South Africa, extending to southern East Coast.

Similar species

Juvenile *Thyone aurea* on West Coast.

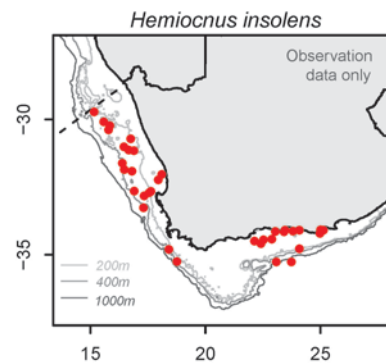
References

Thandar AS and Rambaran R. 2015. On some sea cucumbers (Echinodermata: Holothuroidea) from off the south and west coasts of South Africa collected by the South African Environmental and Observation Network (SAEON). *Zootaxa* 3999 (1): 041-061.

Species identification by Ahmed Thandar.

***Hemiocnus insolens* (PseIns)**

Phylum:	Echinodermata
Class:	Holothuroidea
Order:	Dendrochirotida
Family:	Cucumariidae
Genus:	<i>Hemiocnus</i>
Species:	<i>insolens</i>
Common name:	Red-chested sea cucumber (sometimes other colours)

**Distinguishing features**

Small, solid sea cucumber distinguished by its bright colours red or yellow, although white variations are also common, especially on the West Coast. Solid, slightly gelatinous texture. Tube feet scattered all round. Ten irregularly branched tentacles. Usually occurs in dense colonies, especially on the West Coast.

Colour

Usually bright red, yellow or white, but can vary.

Size

25-60 mm in length.

Distribution

West and South Coasts of South Africa as far east as Port Elizabeth. Intertidal to 110 m.

Similar species

Pseudocnella sykion and *P. sinorbis* in shallow intertidal waters.

References

Thandar AS. 2008. Additions to the holothuroid fauna of the southern African temperate faunistic provinces, with descriptions of new species. *Zootaxa* 1697: 1-57.

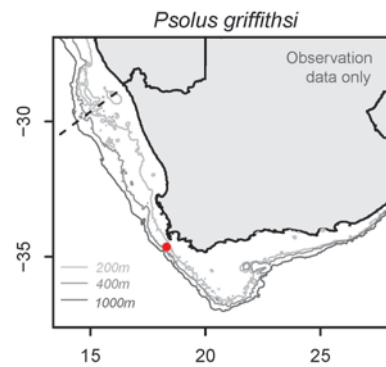
Thandar AS and Rambaran R. 2015. On some sea cucumbers (Echinodermata: Holothuroidea) from off the south and west coasts of South Africa collected by the South African Environmental and Observation Network (SAEON). *Zootaxa* 3999 (1): 041-061.

Mjobo S and Thandar AS. 2016. A new genus and a new species in the sea cucumber subfamily Colochirinae (Echinodermata: Holothuroidea: Dendrochirotida: Cucumariidae) in the Mediterranean Sea. *Zootaxa* 4189 (1): 156-164.

Species identification by Ahmed Thandar.

Psolus griffithsi (PsoGric)

Phylum:	Echinodermata
Class:	Holothuroidea
Order:	Dendrochirotida
Family:	Psolidae
Genus:	<i>Psolus</i>
Species:	<i>griffithsi</i>
Common name:	Scaled sea cucumber



Distinguishing features

Distinct species identifiable by the dorsal scales covering the body and the sucker-like ventral surface forming a sole. Scales overlapping and covered with minute granules. Tentacles are bushy when visible. Tube feet (podia) present on ventral sole in two rows; outer row minute and inner row much larger.

Colour

Beige scales with orange/brown centres, ventral sole grey to brown.

Size

20-25 mm length.

Distribution

West Coast of South Africa.

Similar species

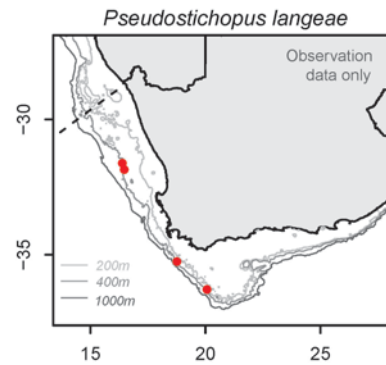
Psolus agulhasicus.

References

Thandar AS. 2009. New species and a new record of sea cucumbers from deep waters of the South African temperate region (Echinodermata: Holothuroidea). *Zootaxa* 2013: 30–42.

Pseudostichopus langeae (Mesoth)

Phylum:	Echinodermata
Class:	Holothuroidea
Order:	Aspidochirotida
Family:	Synallactidae
Genus:	<i>Pseudostichopus</i>
Species:	<i>langeae</i>
Common name:	Sand covered sea cucumber



Distinguishing features

Cylindrical body form with ventral surface slightly flattened and dorsal surface slightly arched. Thick, leathery and smooth body wall, usually encrusted with sand grains, broken shells, coral debris, echinoid spines and foraminifera, but no pteropod shells or sponge spicules. Tiny tube feet (podia) mostly along dorso-lateral edges. Retains firm shape out of water. Mouth located on ventral surface with between 18 and 20 peltate (leaf- or shield-shaped) projecting tentacles, cream to brown in colour. Anus located sub-ventrally in a distinct pygal furrow.

Colour

Skin is covered in sand grains, but when the encrustations are washed off, the skin is opaque, off-white to cream in colour.

Size

Up to 60 mm in length, 8-10 mm diameter.

Distribution

West and South Coasts of South Africa, ranging in depth from ~ 100-400 m.

Similar species

Pseudostichopus echinatus from the East Coast.

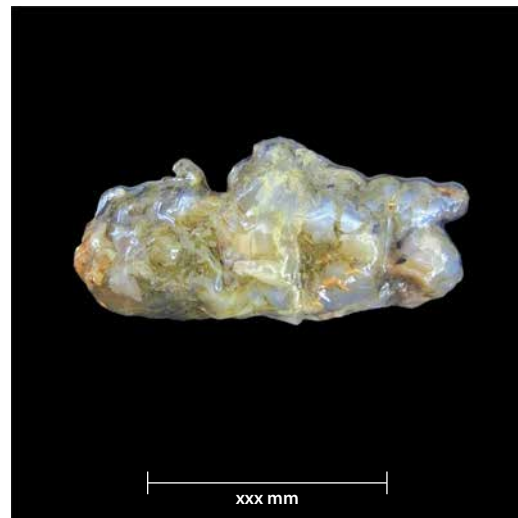
References

Thandar AS. 2009. New species and a new record of sea cucumbers from deep waters of the South African temperate region (Echinodermata: Holothuroidea). *Zootaxa* 2013: 30-42.

Species identification by Ahmed Thandar.

Zygothuria lactea (MesLac)

Phylum:	Echinodermata
Class:	Holothuroidea
Order:	Aspidochirotida
Family:	Mesothuriidae
Genus:	<i>Zygothuria</i>
Species:	<i>lactea</i>
Common name:	Slimy deep-water sea cucumber



Distinguishing features

Very slimy, soft body wall with folded outer skin that readily disintegrates off main body. Has 20 pink to orange-coloured tentacles visible at mouth. Tube feet greatly reduced and difficult to detect.

Colour

Light brown to mud-coloured outer skin layer, with pale pink to white body wall.

Size

140 mm in length.

Distribution

Deeper waters – three individual specimens captured at 369, 617 and 907 m on West coast of South Africa.

Similar species

Mesothuria murrayi on the East Coast.

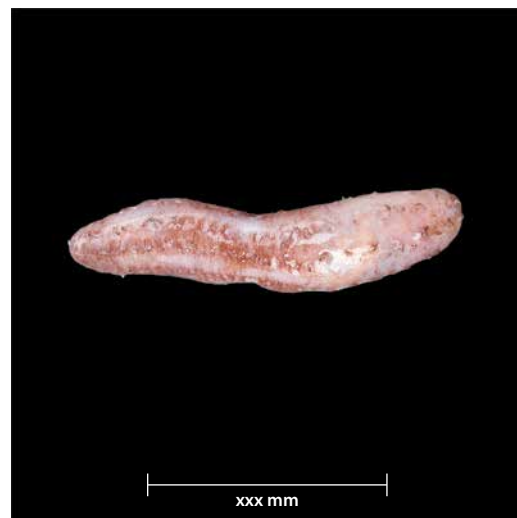
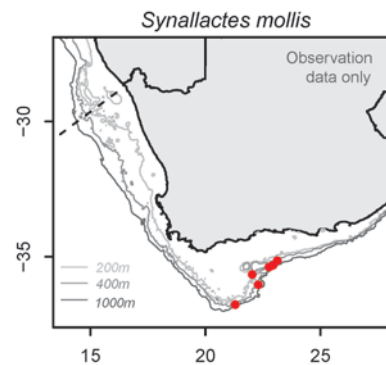
References

Thandar AS and Rambaran R. 2015. On some sea cucumbers (Echinodermata: Holothuroidea) from off the south and west coasts of South Africa collected by the South African Environmental and Observation Network (SAEON). *Zootaxa* 3999 (1): 041-061.

Species identification by Ahmed Thandar.

***Synallactes mollis* (SynMol)**

Phylum:	Echinodermata
Class:	Holothuroidea
Order:	Aspidochirotida
Family:	Synallactidae
Genus:	<i>Synallactes</i>
Species:	<i>mollis</i>
Common name:	South coast purple sea cucumber

**Distinguishing features**

Gelatinous, slimy body wall with thin outer brown skin layer (frequently torn) covering pale purple body wall beneath. Maintains shape on trawl deck but not rigid. Tube feet variable in size, decreasing in size posteriorly. A double ring of 16 to 22 tentacles present.

Colour

Brown outer skin to purple body wall with darker tube feet.

Size

Up to 120-150 mm in length.

Distribution

South Coast of South Africa.

Similar species

Synallactes viridilimus, which is larger in size and usually occurs on West Coast.

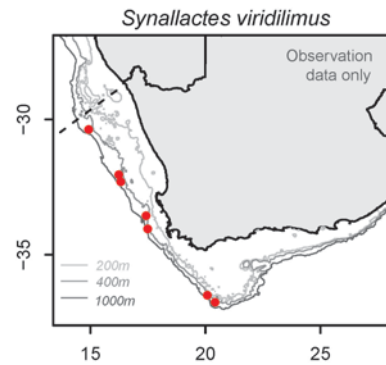
References

Thandar AS and Rambaran R. 2015. On some sea cucumbers (Echinodermata: Holothuroidea) from off the south and west coasts of South Africa collected by the South African Environmental and Observation Network (SAEON). *Zootaxa* 3999 (1): 041-061.

Species identification by Ahmed Thandar.

Synallactes viridilimus (PurCuc)

Phylum:	Echinodermata
Class:	Holothuroidea
Order:	Aspidochirotida
Family:	Synallactidae
Genus:	<i>Synallactes</i>
Species:	<i>viridilimus</i>
Common name:	Purple sea cucumber



Distinguishing features

Large gelatinous body, often slimy. Thin body wall. Mouth with 20 peltate (leaf- or shield-shaped) crown of tentacles, orange to yellow in colour. Upper tentacles in single row, lower tentacles in double row. Vento-lateral tube feet (podia) more prominent and longer than mid-ventral tube feet.

Colour

Brown to pale purple in colour. Tube feet darker purple.

Size

Up to 450 mm in length.

Distribution

West Coast of South Africa.

Similar species

Synallactes mollis is smaller in size and usually occurs on the South Coast.

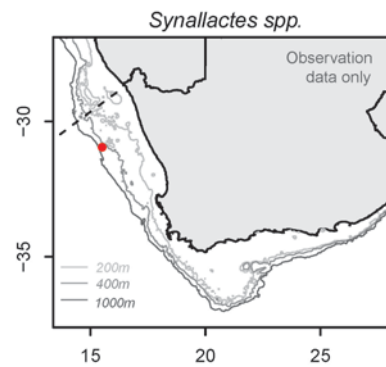
References

Thandar AS and Rambaran R. 2015. On some sea cucumbers (Echinodermata: Holothuroidea) from off the south and west coasts of South Africa collected by the South African Environmental and Observation Network (SAEON). *Zootaxa* 3999 (1): 041-061.

Species identification by Ahmed Thandar.

***Synallactes* sp. (Synall)**

Phylum:	Echinodermata
Class:	Holothuroidea
Order:	Aspidochirotida
Family:	Synallactidae
Genus:	<i>Synallactes</i>
Species:	sp.
Common name:	Large lilac sea cucumber

**Distinguishing features**

Large gelatinous body wall coated in substantial slime that is readily rubbed off along with body wall tissue. Retains shape out of water, but body wall tissue not very robust to handling and is easily damaged. Only one specimen recorded to date.

Colour

Pale purple/lilac colour with darker oral and anal areas.

Size

Approximately 300 mm in length.

Distribution

Only one specimen recorded from trawl 710 m depth on West Coast of South Africa.

Similar species

Benthodytes spp.

References

Tentative generic identification by Ahmed Thandar, but may turn out to be a species of *Benthodytes*. Further taxonomic study is required, hence all specimens found should be retained.