

Benthic Megafauna from the North Pacific Abyss

Phylum **Ctenophora**

Phylum **Bryozoa**

Phylum **Annelida**

Phylum **Chaetognatha**

Phylum **Nemertea**

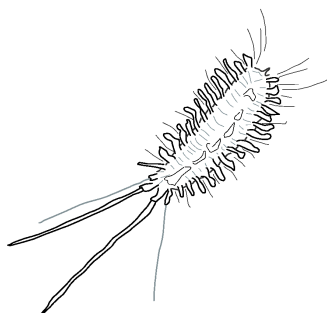
Phylum **Mollusca**

Phylum **Platyhelminthes**

Phylum **Brachiopoda**

Phylum **Hemichordata**

Phylum **Chordata**



Abyssal Pacific seafloor image-based megafauna morphotype catalogue v.1

Phylum **Ctenophora; Bryozoa; Annelida; Nemertea; Chaetognatha; Platyhelminthes; Mollusca; Brachiopoda; Hemichordata; and Chordata**

Erik Simon-Lledó^{1*}, Diva J. Amon^{2,3}, Guadalupe Bribiesca-Contreras⁴, Daphne Cuvelier⁵, Jennifer M. Durden¹, Sofia P. Ramalho⁶, Katja Uhlenkott^{7,8}, Pedro Martinez Arbizu⁷, Noëlie Benoist¹, Jonathan Copley⁹, Thomas G. Dahlgren^{10,11}, Adrian G. Glover⁴, Bethany Fleming^{9,1}, Tammy Horton¹, Se-Jong Ju^{12,13}, Alejandra Mejia-Saenz¹, Kirsty McQuaid¹⁴, Ellen Pape¹⁵, Chailinn Park^{12,13}, Craig R. Smith¹⁶, and Daniel O. B. Jones¹

*corresponding author: erimon@noc.ac.uk

¹National Oceanography Centre, Southampton, UK

²SpeSeas, D'Abadie, TTO

³Marine Science Institute, University of California, Santa Barbara, USA

⁴Natural History Museum, London, UK

⁵Institute of Marine Sciences - Okeanos, University of the Azores, Horta, POR

⁶Centre for Environmental and Marine Studies & Department of Biology, University of Aveiro, Aveiro, POR

⁷German Centre for Marine Biodiversity Research, Senckenberg am Meer, Wilhelmshaven, GER

⁸Institute for Biology and Environmental Sciences, Carl von Ossietzky University, Oldenburg, GER

⁹Ocean & Earth Science, University of Southampton, Southampton, UK

¹⁰NORCE Climate and Environment, Bergen, NOR

¹¹Department of Marine Sciences, University of Gothenburg, Göteborg, SWE

¹²Korea Institute of Ocean Science and Technology, Busan, KOR

¹³Ocean Science Major, University of Science and Technology, Daejeon, KOR

¹⁴University of Plymouth, Plymouth, UK

¹⁵Marine Biology Research Group, Ghent University, Ghent, BEL

¹⁶Department of Oceanography, University of Hawai'i at Manoa, Honolulu, USA

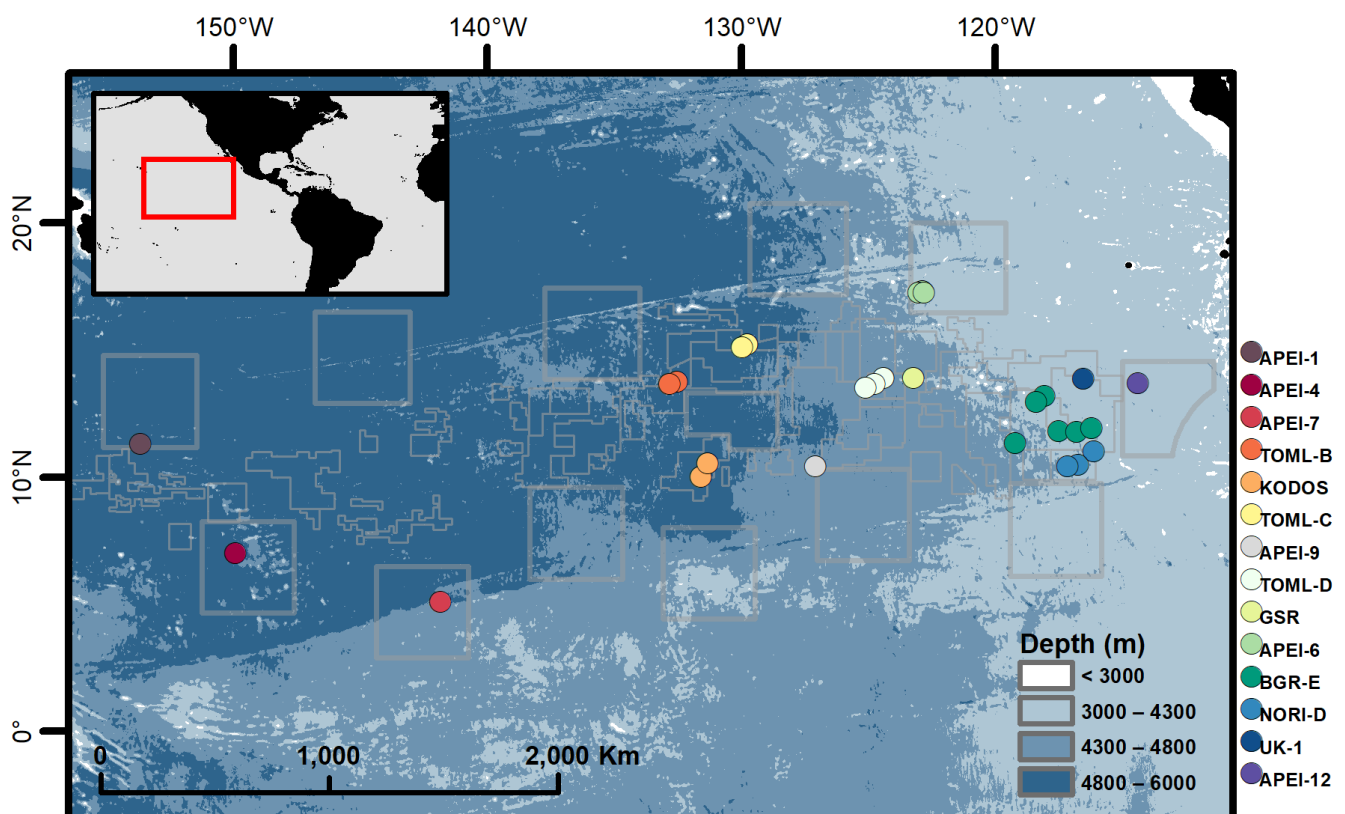
Standardised taxonomic field guide used to develop (please cite as): Simon-Lledó, et al. (2023).

Carbonate compensation depth drives abyssal biogeography in the northeast Pacific. *Nature Ecology & Evolution*; doi:10.1038/s41559-023-02122-9

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The APSMA image-based taxonomical catalogue

This code-based abyssal megafauna (invertebrates > 1 cm) catalogue was developed by morphological and taxonomical alignment of specimens encountered in seabed imagery collected across multiple seabed locations across the Clarion Clipperton Fracture Zone, in the NE Pacific basin (see map below and main study, Simon-Lledó et al. 2023, for further details). This work was conducted during a range of scientific workshops held between 2016 and 2021, in collaboration with taxonomic experts (see acknowledgements section) and by reference to existing literature (e.g. where available, links to studies describing physically collected specimens are provided in taxon descriptions). The catalogue follows the Horton et al. 2021 open nomenclature (e.g. 10.3389/fmars.2021.620702) to report the taxonomic resolution reached in the identification of each classified metazoan morphotype. Each morphotype was assigned a unique 7 character identification code (i.e. “XXX_nnn”). All taxa identified were deemed as sufficiently different morphologically by taxonomic experts to be confidently considered separate species. Note the catalogue is periodically revised, as new photographed and collected specimens get described, and hence some taxonomic identifications may vary in subsequent versions of this guide. The latest version of the APSMA catalogue is available as label tree for image/video annotation on BIIGLE (biigle.de; please contact the authors for more detail).



Map of the Clarion Clipperton Zone in the North Pacific basin with detail on locations surveyed with photographic and video cameras mounted on autonomous underwater vehicles (AUVs), remotely operated vehicles (ROVs), and towed cameras; between 2010 and 2021. Areas managed by the International Seabed Authority: Thick polygons, Areas of Particular Environmental Interest, and; Thin polygons, polymetallic nodule exploration licensed sites.

Phylum **Ctenophora**

Class Tentaculata

CTE_018

Cydippida fam. indet.

Morphology: ovoid, compressed and semi transparent; with 4 meridional canals (thin white lines; can flash colours) per side, extending from the aboral pole to near the oral pole, where the internal pharynx is visible (dark violet triangle in the oral pole).



CTE_016

Cydippida fam. indet.

Morphology: ovoid and semi transparent; with 4 meridional canals (thin white lines; can flash colours) per side, extending from the aboral pole to near the oral pole.



CTE_002

Cydippida fam. indet.

Morphology: ovoid and semi transparent; with 4 meridional canals (thick white lines; can flash colours) per side, extending from the aboral pole to near the oral pole, generating a small external constriction (across both epidermia)

Notes: uncertain morphotype; oral pole is not visible (top image) or missing (bottom image) in the only 2 observations of this taxon.



CTE_004

Lobata gen. indet.

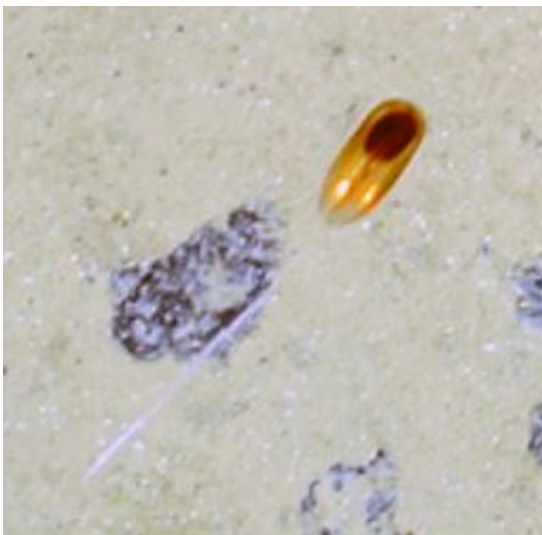
Morphology: ovoid, compressed in the tentacular plane and expanded in the sagittal plane into a rounded oral lobe on each side of the mouth; mostly transparent; 4 white meridional canals (thin white lines, thickening aborally) per side sometimes visible.

CTE_010

Platyctenida fam. indet.

Morphology: ovoid and oral-aborally flattened, translucent. Large tentacle sheath between the lobes and tentacles edged with tentilla. Violet stomach visible in the centre to oral side of the body.

Notes: they cling to and creep on sponge stalks by everting the pharynx and using it as a muscular "foot"



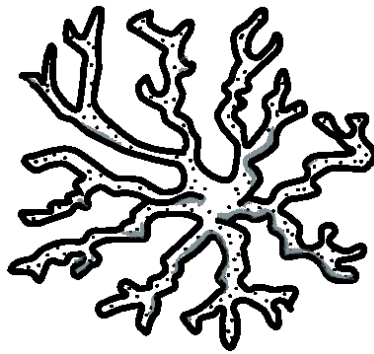
CTE_014

Cydippida fam. indet.

Morphology: ovoid and orange to reddish body; pharynx pigmented deep red, less than half length of body .

Phylum **Bryozoa**

Class **Gymnolaemata**



BRY_001

Smithsonius sp. indet.

Morphology: white colonies; thick and strongly convoluted branches with many nodes (short branching distance). Branches radiating in all directions, growing from a central point (no clear central branch).

Notes: typically found attached to nodules.

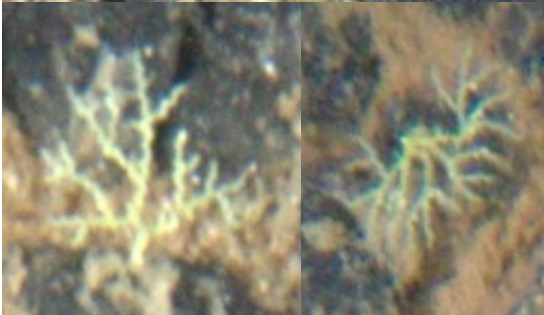


BRY_007

Cheilostomatida fam. indet.

Morphology: pale yellow colonies; thick and strongly convoluted branches with many nodes (short branching distance). Branches radiating in all directions, growing from a central point (no clear central branch).

Notes: typically found attached to nodules.



BRY_014

Cheilostomatida fam. indet.

Morphology: white colonies with thick convoluted branches. Few (>3) lateral branches growing dichotomously from a vertical central branch.

Notes: typically found attached to nodules.



BRY_012

Bifaxariidae fam. inc.

Morphology: white colonies with relatively thick and slightly convoluted long branches, dividing in few nodes. Branches growing vertically around a central branch and along the same plane.

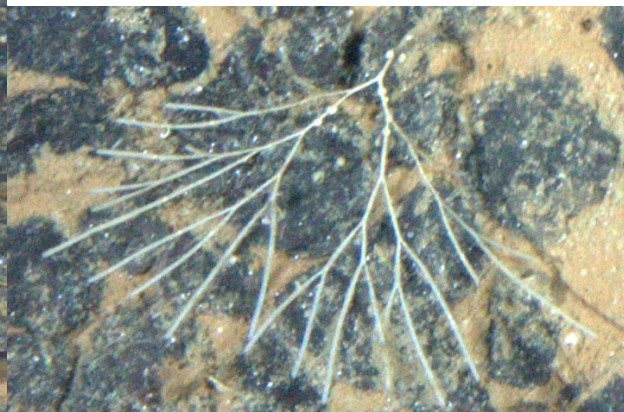
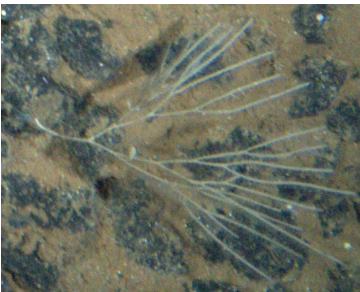
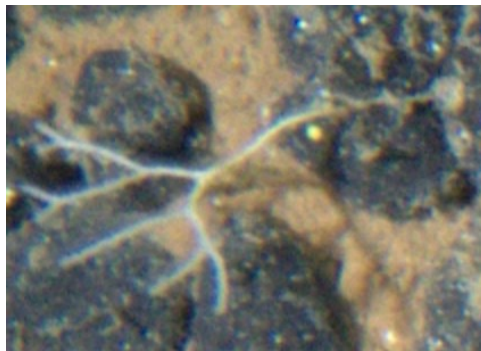
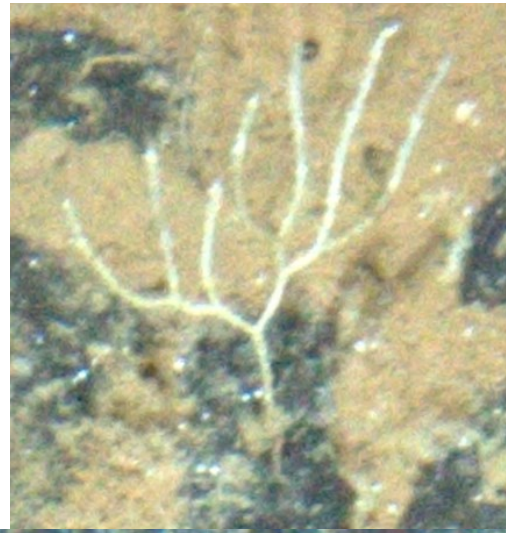
Notes: typically found attached to nodules

BRY_003

Columnella sp. indet.

Morphology: white, vertically growing colonies. Long branching distance; thin branches and few branching nodes (<3) growing dichotomously and along the same plane from a central branch.

Notes: typically found attached to nodules



BRY_005

Cheilostomatida fam. indet.

Morphology: white, vertically growing colonies. Very long branching distance; long thin branches with several nodes (>3) growing along the same plane from a long central branch.

Notes: typically found attached to nodules

BRY_006

Cheilostomatida fam. indet.

Morphology: bright white colonies. Long branching distance; thick branches with few (~3) nodes, growing (non-dichotomously) along the same plane from one or two thicker vertical central branches.

Notes: typically found attached to nodules



BRY_009

Cyclostomatida fam. indet.

Morphology: white; with several branches (8+) growing vertically, along the same plane, and in parallel from a horizontal central branch

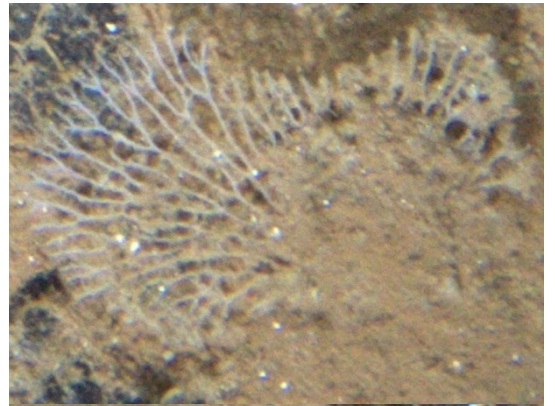
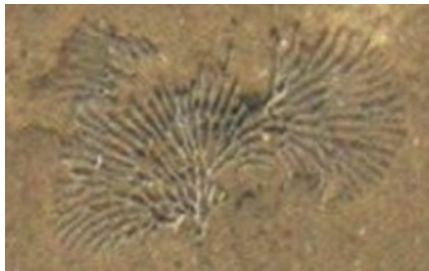
Notes: typically found attached to nodules

BRY_002

Notoplites sp. indet.

Morphology: very thin pale white to greyish branches (short branching distance); growing horizontally, along the same plane, and radiating from a central short branch.

Notes: typically found attached to nodules



BRY_008

Cyclostomatida fam. indet.

Morphology: very thin pale white to greyish branches; growing laterally, along the same plane, from a long central branch

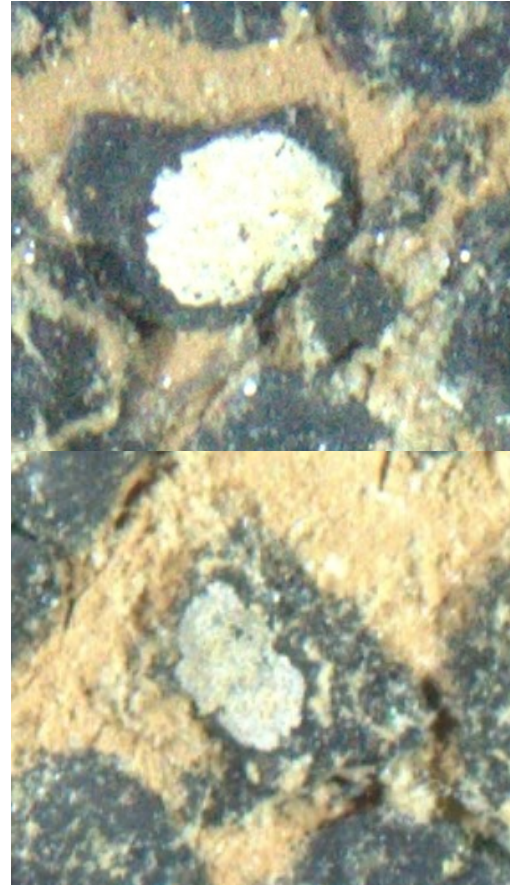
Notes: typically found attached to nodules

BRY_016

Flustrina fam. indet.

Morphology: white, unbranched colony; flat-shaped (nodule-encrusting) and somewhat rounded extending over a continuous surface.

Notes: typically found attached to nodules



BRY_017

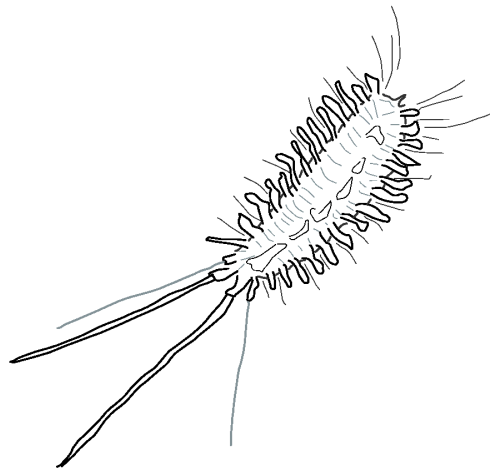
Cheilostomatida fam. indet.

Morphology: white colonies. Thick branches with few and sparse branching nodes, growing irregularly -in many directions along different planes- without a clear central branch.

Notes: typically found attached to nodules

Phylum **Annelida**

Class **Polychaeta**



ANN_002

Acrocirridae gen. indet.

Morphology: swimming scale worm; greyish to pale orange body, with many thin lateral chaetae and a pair of short forward-facing palps in reduced prostomium



ANN_004

Acrocirridae gen. indet.

Morphology: swimming scale worm; grey to brown body, with many lateral chaetae and a pair of short forward-facing palps in reduced prostomium

ANN_017

Acrocirridae gen. indet.

Morphology: swimming scale worm; reddish body, with few thick lateral chaetae (widely spaced) and a pair of short forward-facing palps in reduced prostomium



ANN_003

Polynoidae gen. indet.

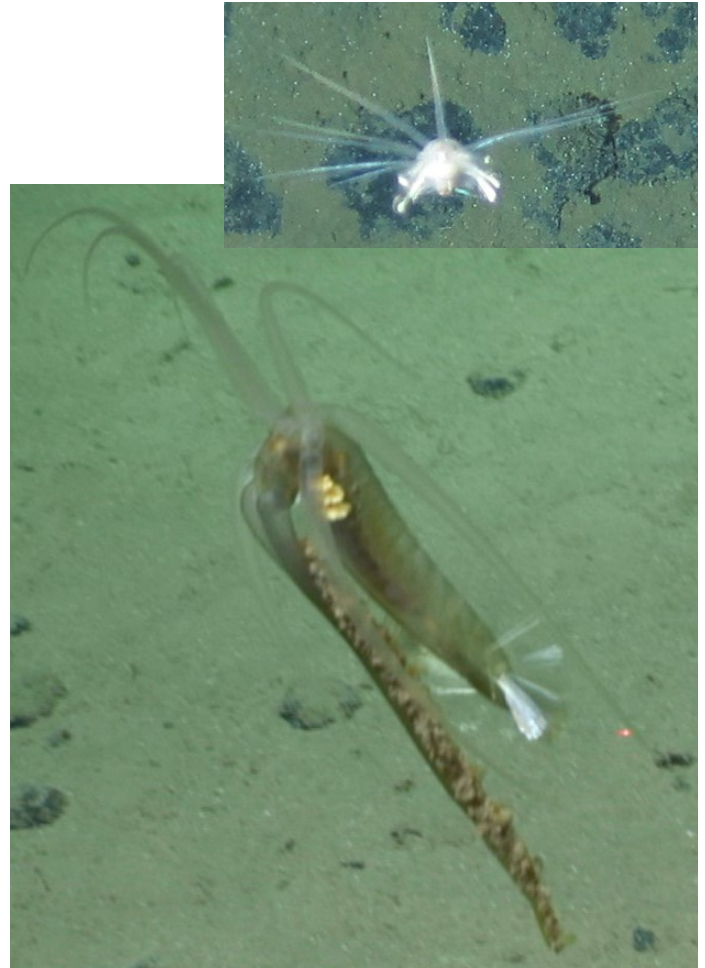


Morphology: scale worm; greyish to blue dorsoventrally flattened body; with many thick lateral chaetae and a pair of long forward-facing palps and antennae in reduced prostomium

ANN_018

Teuthidodrillus sp. indet.

Morphology: swimming “squid-worm”; prostomium supporting five pairs of long and thick, tapering appendages, 2 of which large palps. Many pairs of large flattened paddle-shaped notopodia along the body



ANN_034

Polychaeta order. indet.



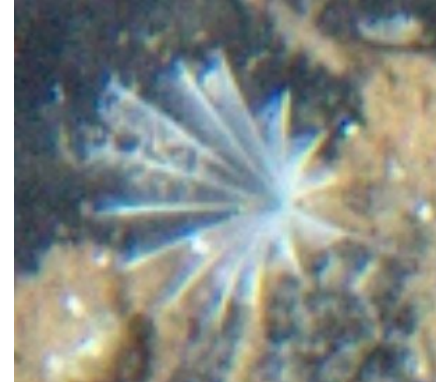
Morphology: scale worm, white body; with pairs of lateral chaeta and visible grey proboscis and long thin pairs of anal cirrus

Notes: always found half buried in small open caves they likely carve themselves into the sediment surface

ANN_029

Sabellidae fam. indet.

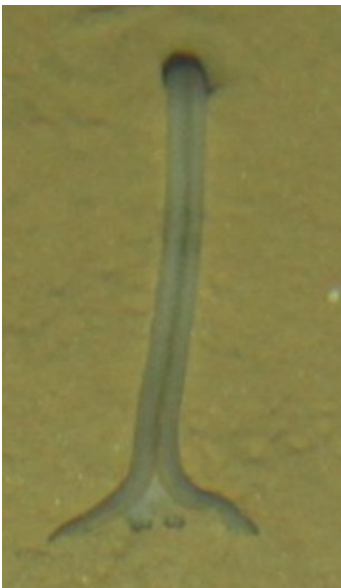
Morphology: partially buried sabellid worm; exposing 12-16 white radioles in crown extended horizontally over the seabed surface



ANN_013

Echiura order. indet.

Morphology: spoon worm living in a hole, usually only exposing its long, flattened, blueish proboscis with a bifid terminal end.



Phylum **Nemertea**

NEM_001

Neonemertea class indet.

Morphology: white ribbon worm; elongated and dorsoventrally flattened, with semi-transparent skin.

Notes: usually found crawling on top of nodules or sediment.



NEM_002

Neonemertea class indet.

Morphology: white ribbon worm; elongated and dorsoventrally flattened

Notes: usually found swimming

NEM_006

Neonemertea class indet.

Morphology: greyish ribbon worm; elongated and dorsoventrally flattened, with semi-transparent skin and brighter white cephalic area (anterior end). Nerve cords often visible dorsally.

Notes: usually found crawling on top of nodules or dwelling (e.g. half buried) in the sediment surface



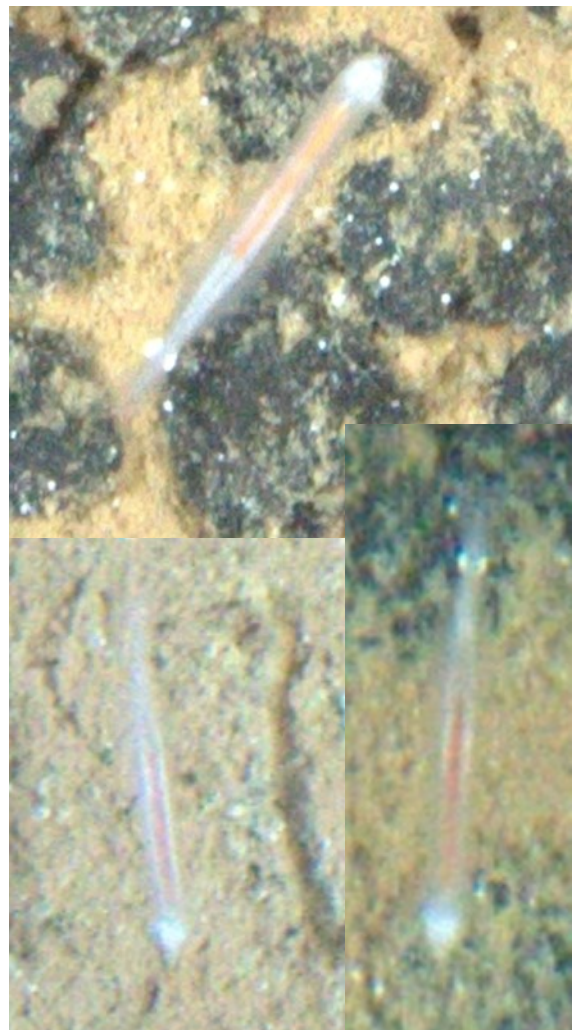
Phylum

Chaetognatha

CHA_001

Sagittoidea order indet.

Morphology: elongated arrow worm with semi-transparent skin. Whitish head, reddish trunk and whitish tail with seminal vesicles pair visible (brighter coloured), laterally growing towards the mid posterior end of the tail



Phylum

Platyhelminthes

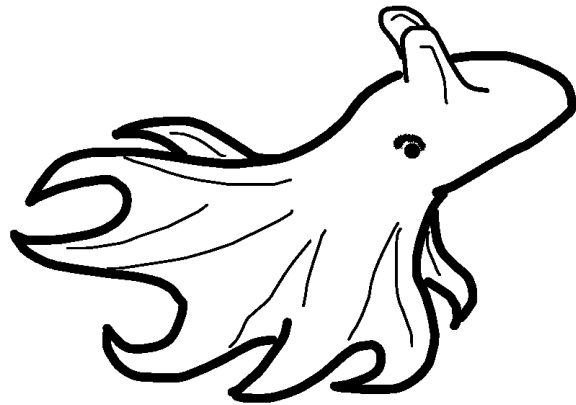
PLA_001

Polycladida fam. indet.

Morphology: dark brown, wide and dorso-ventrally flattened body. With 3 white areas along the dorsal semi-transparent skin (dorsal nerve cords visible)



Phylum Mollusca



MOL_002

Leptochitonidae gen. indet.

Morphology: chiton with brown to pale orange dorsal shell plates and slightly brighter coloured girdle.

Notes: typically found dwelling on nodules



MOL_021

Bathyarca sp. indet.

Morphology: equilateral ark clam with pale white to brownish (i.e. sediment-coated) valves. Translucent to blueish (i.e. light-reflecting) gills forming a central channel usually visible in vertical imagery.

Notes: typically found with slightly open valves ($\sim 30^\circ$), exposing internal organs.



MOL_022

Trochoidea fam. indet.

Morphology: pale orange to whitish sediment-coated shell;
with long tentacles (more than half the length of the shell).
White to blueish body.



MOL_017

Fasciolariidae gen. indet.

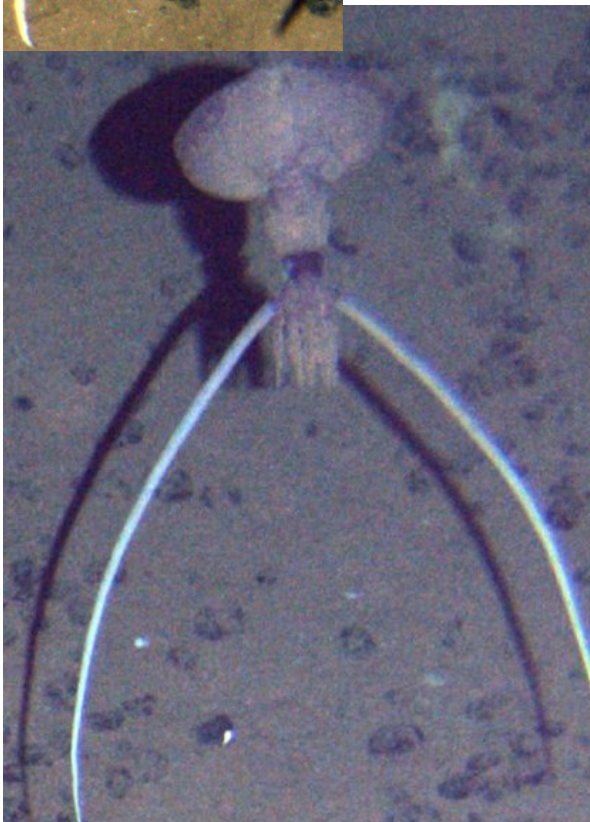
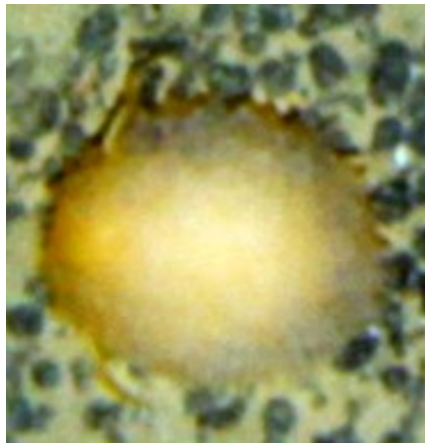
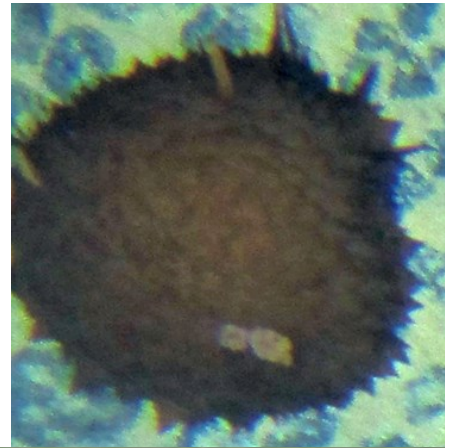
Morphology: white shell with elongated columella. White to
blueish body.



MOL_016

Bathydoris sp. indet.

Morphology: orange to dark red, ovoid-shaped body covered in short conical cerata. With few (2-3 times) longer cerata towards the sides of the body. Dorsally, brighter coloured short rhinophores around the top anterior area and external gills sometimes visible, towards the posterior end of the body.



MOL_006

Mastigoteuthidae gen. indet.

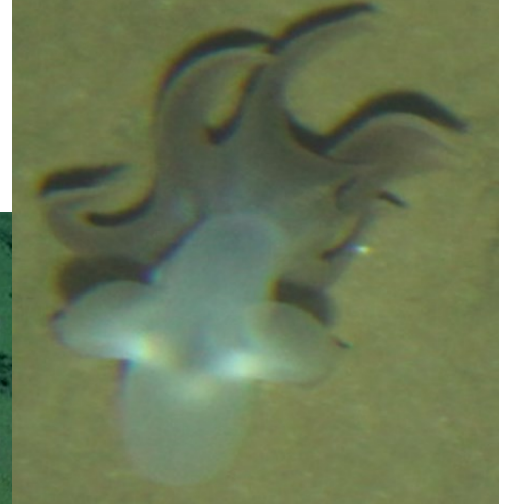
Morphology: brownish whip-lash squid with wide elliptical fins, longer than the width of the head. With 8 relatively short arms (length ~ fin length) and 2 bright white, very long tentacles (about 7 times longer than the arms).

MOL_008

Cirroteuthis muelleri sp. inc.

Morphology: whitish to pale purple octopus, with wide elliptical fins, longer than the width of the head. Arms nearly equal in length; semi translucent webs join the dorsal and ventral sides of the arms together leaving a long portion of each arm exposed. Arms often darker coloured than the head and fins.

Notes: largely variable body shapes (e.g. 'bell' or extended for swimming in the water column; 'umbrella' or retracted when on the seabed)



MOL_010

Grimpoteuthis sp. indet.

Morphology: white to pale blue octopus, with narrow elliptical fins, shorter than the width of the head. Arms nearly equal in length; semi translucent webs join the dorsal and ventral sides of the arms together leaving a moderate portion of each arm exposed. Bright (head and fins) to dark (arm contours) body colour gradient.

Notes: largely variable body shapes.



MOL_009

Octopodidae gen. indet.

Morphology: white octopus, with large wide globular head (no fins) and dark contrasting eyes. Long arms, equal in length; webs join the dorsal and ventral sides of arms leaving very long portion of each arm exposed. Somewhat translucent depending on imagery lighting and angle.

Notes: undescribed species, informally named “Casper” octopus; more detail:
[doi:10.1016/j.cub.2016.10.052](https://doi.org/10.1016/j.cub.2016.10.052).



Phylum

Brachiopoda

BRA_001

Rhynchonellata order indet.

Morphology: 'clam' shaped brachiopod with whitish to brown (when sediment coated) wide valves and very short pedicle



Phylum

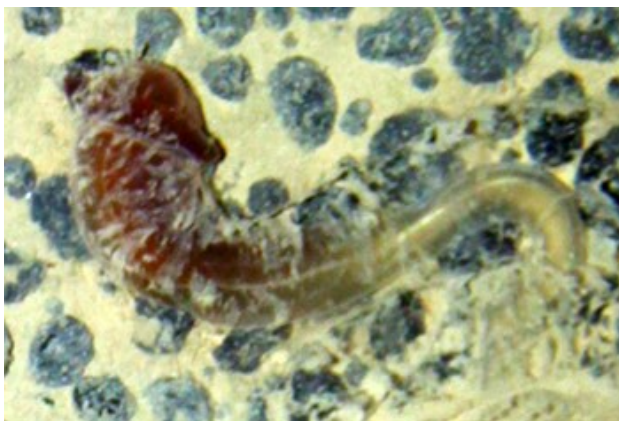
Hemichordata

HEM_005

Torquaratoridae gen. indet.

Morphology: dark red semi-spherical proboscis surrounded by thicker short collar. Semi translucent trunk tapering distally, brighter coloured towards the abdomen, where thin midventral ridge lines (extending to the anus) are visible.

Notes: can generate long (>2m) bioturbated sediment trails.



Phylum Chordata

SubPhylum Tunicata

CHO_001

Megalodicopia sp. indet.

Morphology: elliptical body with wide oral aperture and long slim tubular peduncle; fully transparent. Smaller atrial aperture and bright white saclike structure (internal) visible dorsally, around the lower central part of the main body.



CHO_012

Octacnemidae gen. indet.

Morphology: elliptical body with very wide oral aperture and very short slim peduncle; fully transparent.

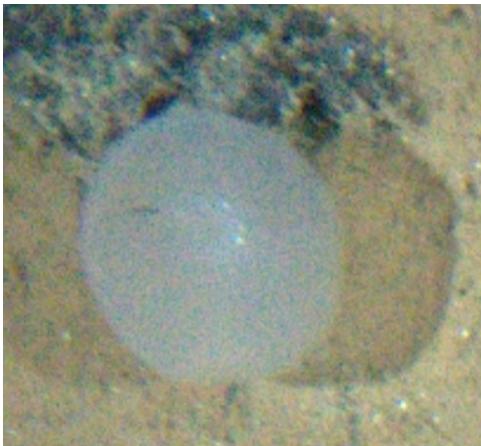


CHO_016

Octacnemidae gen. indet.

Morphology: globular body with very wide peduncle; translucent to greyish. Smaller atrial aperture and bright white saclike structure (internal) sometimes visible dorsally.

Notes: usually found attached to nodules or rocks



CHO_020

Octacnemidae gen. indet.

Morphology: globular body with largely reduced peduncle; translucent to whitish. Atrial aperture sometimes visible dorsally.

Notes: usually found attached to nodules or rocks

CHO_003

Dicopia sp. indet.

Morphology: ovoid body with very wide oral aperture (e.g. resembling two “valves”) and short peduncle fused with body; fully transparent. White saclike structure (internal) visible dorsally, close to the peduncle.

Notes: usually found attached to nodules or rocks



CHO_021

Ascidiacea order. indet.

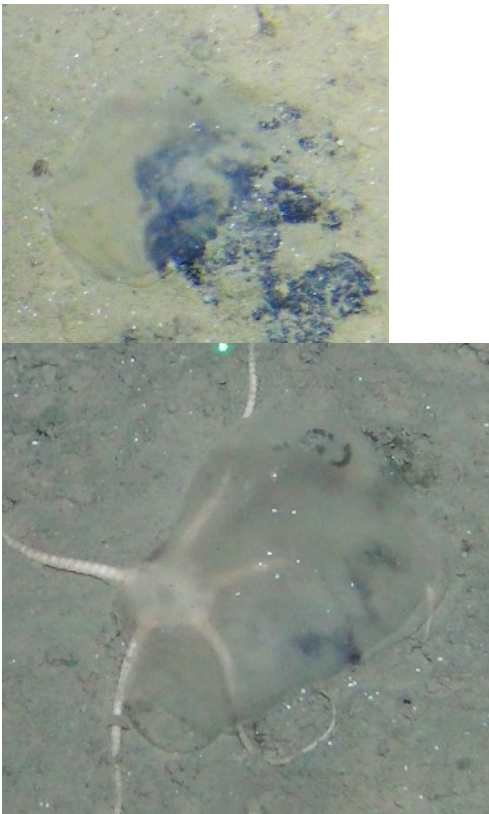
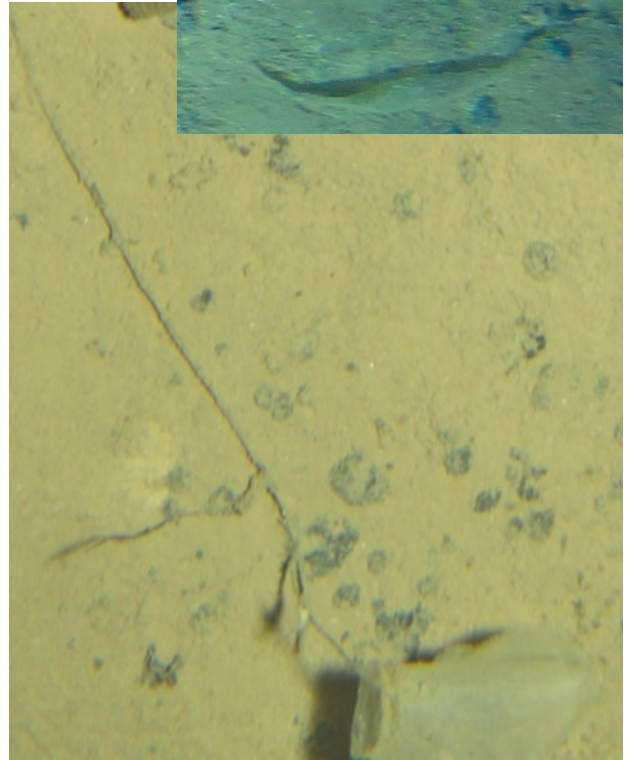
Morphology: irregularly rounded, globular body; fully transparent with visible internal organs. Very large (length $\sim 3/4$ body) white saclike structure (internal) visible dorsally.

Notes: usually found attached to nodules or rocks

CHO_006

Pyuridae gen. indet.

Morphology: globular semi translucent body with slender but very long peduncle and wide rounded oral aperture



CHO_018

Ascidiacea order. indet.

Morphology: irregularly rounded, globular body; fully transparent without visible internal organs. Wide rounded oral aperture.

Notes: usually found attached to nodules or rocks

CHO_025

Stolidobranchia fam. indet.



Morphology: greyish elliptical body apically flattened, with folded pharyngeal basket; siphoned oral and atrial apertures in opposite ends of the body.

CHO_009

Octacnemus sp. indet.



Morphology: somewhat discoid body with prolonged margin forming eight tapering processes.



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