PROspection for BIOactive compounds in the North Sea

Deliverable 1.3. Bioprospection Index Cards
Date: July 2020, with selected update February 2022
Author: Flanders Marine Institute (VLIZ)

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BLAUWE CLUSTER
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UNIVERSITEIT GENT

Project name	PROspection for BIOactive compounds in the North Sea
Project acronym	PROBIO
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Funding	VLAIO – De Blauwe Cluster
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Contents

1. Summary

Marine environments offer a wide variety of bioresources containing potential bioactive compounds. The potential of bioactive compounds from these marine bioresources is currently hugely underexplored in our seas and oceans, and will offer a 'sea of opportunities' in several sectors involved with the research, development and production of functional additives and products. Primary and secondary metabolites in marine organisms are of particular interest because they have unique properties and a broad valorisation potential in e.g. pharma, cosmetics, agriculture, nutraceuticals, chemicals and functional bio-based materials. The **PROspection for BIOactive compounds in the North Sea (PROBIO) project** is focusing on the discovery and characterisation of new bioactive compounds derived from local North Sea species.

The identification and selection of 50 North Sea species with a commercial potential for bioactive compounds is the starting point for further sampling and screening activities in the PROBIO-project. This species list is a subset of the **D1.1. Longlist North Sea Species** published in December 2019.

The compilation of the **species shortlist** was based on an assessment of the relevant scientific literature, with regard to marine taxonomic groups and compounds with potential biological activity. This **D1.2. Shortlist of North Sea Species** was published in June 2020.

The deliverable presented here contains a **'bioprospection index card'** for each of the selected species. These Bioprospection Index Cards provide information on spatial distribution, habitat and substrate preferences, potential compounds and cultivation opportunities based on a comprehensive literature study.

2. PROBIO project

At present, the Flemish sector of blue biotechnology is immature and needs fundamental research to make smart choices, mainly in the context of the selection of species/bioresources in the Belgian part of the North Sea and economic strengths of Flemish companies. Marine environments offer a wide variety of bioresources containing potential bioactive compounds. The potential of bioactive compounds from these marine bioresources is currently hugely underexplored in our seas and oceans, and will offer a 'sea of opportunities' in several sectors involved with the research, development and production of functional additives and products. Primary and secondary metabolites in marine organisms are of particular interest because they have unique properties and a broad valorisation potential in e.g. pharma, cosmetics, agriculture, nutraceuticals, chemicals and functional bio-based materials.

Nevertheless, the biodiscovery of new bioactive compounds has so far been limited in the North Sea region. Through a value chain approach, the project wants to stimulate the upscaling of aquaculture and the expansion of biorefinery sectors and biotech markets at the same time. This by focusing on the discovery and characterisation of new bioactive compounds derived from local North Sea species. The establishment of a reproducible and scalable high-throughput analytic screening of extracts with multi-target bioactivity screening and toxicity assessments is a unique workflow established within PROBIO, combining the strengths of leading research groups of four different institutes in Flanders:

- Flanders Marine Institute (VLIZ)
- VIB-Metabolomics Core Ghent (VIB - MCG)
- Laboratory of Toxicology and Pharmacology at KU Leuven (KU Leuven – LTP)
- Laboratory of Pharmaceutical Microbiology (LPM) at UGent (UGent – LPM)

This should be regarded as a critical first step, providing a knowledge base, which will trigger further innovation to foster new commercial developments in various sectors. As such, the expertise gained holds potential for future marine biotech valorisation and innovation projects.

The specific project objectives, linked to the knowledge gaps described in the 5 research work packages are:

1) The identification and collection of **50 North Sea Species** possibly containing bioactive compounds with a commercial potential and the development of "**Bioprospection Index cards**" summarizing existing information of these species on potential compounds, cultivation opportunities and spatial/seasonal distribution (VLIZ).
2) The **high-throughput screening** of extracted compounds and the establishment of an **open-source comprehensive database**, combining structural, (analytical) mass spectral, biological activity information of the compounds and other metadata dedicated to marine organisms, which will be of great value for both the industrial and research community (VIB – MCG).
3) The **identification of pharmacological targets** for the selected bioactive compounds with a commercial potential by performing high-throughput bioassays (KU Leuven – LTP).
4) The **high-throughput screening of the antimicrobial activity** of extracts recovered from North Sea species, showing biofilm-inhibitory and -eradicating activity (UGent – LMP).
5) The identification of **promising applications** of marine bioactive compounds and the stimulation of new **follow-on innovation projects** for biorefinery, aquaculture and biotech applications in Flanders, by the integration of actors from industry and knowledge institutions (VLIZ).

3. Overview of PROBIO shortlist species

The species shortlist consists of 50 species occurring in the Belgian part of the North Sea. The species can be attributed to 13 different phyla (Table 1 and Figure 1 of *D1.2 Shortlist of North Sea species*). The species are listed in the table below and more detailed information is provided in *4. Bioprospection Index cards*.

Phylum	Genus	Species	Common Name	Dutch Name
Annelida	*Nephtys*	*spp.*		
Annelida	*Lagis*	*koreni*	Trumpet worm	Goudkammetje
Annelida	*Lanice*	*conchilega*	Sand mason worm	Zandkokerworm
Arthropoda	*Semibalanus*	*balanoides*	Common rock barnacle	Gewone zeepok
Arthropoda	*Perforatus*	*perforatus*	Perforated barnacle	Vulkaantje
Arthropoda	*Crangon*	*crangon*	Brown shrimp	Grijze garnaal
Arthropoda	*Pagurus*	*bernhardus*	Common hermit crab	Gewone Heremietkreeft
Arthropoda	*Liocarcinus*	*depurator*	Harbour crab	Blauwpootzwemkrab
Arthropoda	*Liocarcinus*	*holsatus*	Flying crab	Gewone zwemkrab
Arthropoda	*Thia*	*scutellata*	Thumbnail crab	Nagelkrab
Bryozoa	*Flustra*	*foliacea*	Hornwrack	Breedbladig mosdiertje
Bryozoa	*Tricellaria*	*inopinata*		Onverwacht mosdiertje
Chordata, Vertebrata	*Echiichthys*	*vipera*	Lesser weever	Kleine pieterman
Chordata, Tunicata	*Botrylloides*	*violaceus*	Colonial sea squirt	Gewone slingerzakpijp
Chordata, Tunicata	*Styela*	*clava*	Rough sea squirt	Knotszakpijp
Cnidaria	*Metridium*	*senile*	Plumose anemone	Zeeanjelier
Cnidaria	*Sagartia*	*spp.*		
Cnidaria	*Sagartiogeton*	*undatus*	Small snakelocks anemone	Weduweroos
Cnidaria	*Alcyonium*	*digitatum*	Dead man's fingers	Dodemansduim
Cnidaria	*Ectopleura*	*larynx*	Ringed tubularian	Orgelpijppoliep
Cnidaria	*Tubularia*	*indivisa*	Tall tubularian	Penneschaft
Cnidaria	*Cyanea*	*lamarckii*	Blue jellyfish	Blauwe haarkwal
Cnidaria	*Chrysaora*	*Hysoscella*	Compass jellyfish	Kompaskwal
Cnidaria	*Aurelia*	*aurita*	Moon jellyfish	Oorkwal
Ctenophora	*Pleurobrachia*	*pileus*	Sea gooseberry	Zeedruif
Echinodermata	*Asterias*	*rubens*	Common starfish	Gewone zeester
Echinodermata	*Echinocardium*	*cordatum*	Sea potato	Zeeklit
Echinodermata	*Psammechinus*	*miliaris*	Green sea urchin	Kleine zeeappel
Echinodermata	*Ophiura*	*albida*	Serpent's table brittle star	Kleine slangster
Echinodermata	*Ophiura*	*ophiura*	Serpent brittle star	Gewone slangster
Echinodermata	*Acrocnida*	*brachiata*	Sand burrowing brittle star	Ingegraven slangster
Mollusca	*Adapedonta*	*spp.*	Atlantic jackknife clam	Amerikaanse zwaardschede
Mollusca	*Cardiida*	*alba*	White furrow shell	Witte dunschaal
Mollusca	*Cardiida*	*balthica*	Baltic tellin	Nonnetje
Mollusca	*Cardiida*	*vittatus*	Banded wedge-shell	Zaagje
Mollusca	*Mytilida*	*edulis*	Blue mussel	Blauwe mossel
Mollusca	*Venerida*	*spp.*		... strandschelp
Mollusca	*Venerida*	*corrugata*	Pullet carpet shell	Tapijtschelp
Mollusca	*Myopsida*	*subulata*	European common squid	Dwergpijlinktvis

Phylum	Genus	Species	Common Name	Dutch Name
Mollusca	*Sepiida*	*atlantica*	Atlantic bobtail squid	Gewone dwerginktvis
Mollusca	*Littorinimorpha*	*fornicata*	Slipper shell	Muiltje
Mollusca	*Neogastropoda*	*reticulata*	Netted dogwhelk	Gevlochten fuikhoorn
Porifera	*Haliclona*	*oculata*	Mermaid's glove	Geweispons
Porifera	*Halichondria*	*bowerbanki*	Bowerbank's horny sponge	Sliertige broodspons
Porifera	*Halichondria*	*panicea*	Breadcrumb sponge	Gewone broodspons
Ochrophyta	*Sargassum*	*muticum*	Strangleweed	Japans bessenwier
Chlorophyta	*Bryopsis*	*hypnoides*		Onregelmatig vederwier
Chlorophyta	*Codium*	*fragile*	Forked felt alga	Viltwier
Chlorophyta	*Ulva*	*pseudocurvata*		Gekromde zeesla
Rhodophyta	*Chondrus*	*crispus*	Irish moss	Iers mos

4. Bioprospection Index Cards

The **Bioprospection Index Cards** include a general description of the species together with an overview of spatial distribution, habitat and substrate preferences, proposed sampling methods and information on potential compounds and cultivation opportunities derived from a comprehensive literature study. These cards will be used as input for the valorisation pathways in WP5.

A first compilation was finalised in July 2020. An update for 4 species (*Asterias rubens, Ophiura albida, Ophiura ophiura, Sargassum muticum*) is included in the current version, based on the increased interest for follow-up trajectories, as a result of the hits from the bioactivity assays.

Nephtys spp.

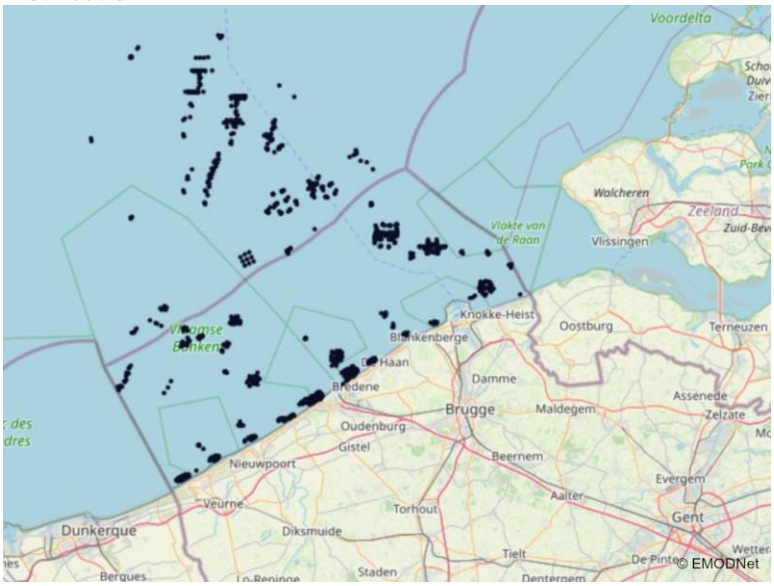
Aphia ID #129370

Kingdom: Animalia
Phylum: Annelida
Class: Polychaeta
Order: Phyllodocida
Family: Nephtyidae
Genus: Nephtys
Species: spp.

INFORMATION PANEL

Observations: 3801

Distribution:



Habitat type: Benthic zone
Substrate: Sand, mud

DESCRIPTION

Size: 0 - 100 mm

Brief description:
Nephtys species are thin, smooth, segmented worms, up to 10 cm in length. Their head is small, with four small antennae. Nephtys sp. have a large proboscis, covered in prominent papillae, that they project and use to dig into the sediment. They are oval in cross section but, may appear flattened (when viewed from above) owing to bristled lobes (parapods) which extend from the body. They are lustrous white colour with golden bristled parapods. Nephtys species are active worms which demonstrate the characteristic swimming motion (a rapid lateral wriggling, starting from the rear and increasing in amplitude towards the head) of the Nephtyidae.

Sampling method: van Veen grab
Dutch name: NA

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Ability to minimise metal uptake	Antioxidant	*Propensity to metal accumulation and oxidative stress responses of two benthic species (Cerastoderma edule and **Nephtys hombergii**): are tolerance processes limiting their responsiveness? (https://link.springer.com/article/10.1007/s10646-016-1625-y)*	*Overall, the present study contributed to improve the lack of fundamental knowledge of two widespread and common estuarine species, providing insights of the metal accumulation profiles under a scenario of chronic contamination. Finally, this work provided useful information that can be applied in the interpretation of future environmental monitoring studies.*	Marques, A., Piló, D., Araújo, O., Pereira, F., Guilherme, S., Carvalho, S., ... & Pereira, P.	2016
2	BIO	Fatty acid	NA	*Effect of sinking spring phytoplankton blooms on lipid content and composition in suprabenthic and benthic invertebrates in a cold ocean coastal environment (https://www.int-res.com/articles/meps2009/391/m391p033.pdf)*	***Nephtys incisa** did not show extreme values for any of the major individual fatty acids. Over half of the total fatty acid amount was accounted for by just 9 fatty acids: the short-chain saturates 14:0 and 16:0, the monoenes 16:1ω7, 18:1ω9, 18:1ω7, and 20:1ω9 and the long-chain PUFAs 20:4ω6, 20:5ω3 and 22:6ω3. These 3 PUFAs are essential nutrients in marine food webs.*	Parrish C., Deibel D., Thompson R.	2009
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Lagis koreni

Trumpet worm

Aphia ID #130595

Kingdom:	Animalia
Phylum:	Annelida
Class:	Polychaeta
Order:	Terebellida
Family:	Pectinariidae
Genus:	Lagis
Species:	koreni

INFORMATION PANEL

Observations: 342

Distribution:

Habitat type: Benthic zone
Substrate: Muddy sand, sandy mud

DESCRIPTION

Size: 0 - 50 mm

Brief description:
Lagis koreni is an infaunal segmented worm growing up to 5 cm in length. It is white in colour with pink iridescence, red gills, and a red ventral vessel which is visible owing to its overall transparency. The tube is slightly curved and always has a mucous extension. Golden bristles at mouth.

Sampling method: van Veen grab
Dutch name: Goudkammetje

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
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Lanice conchilega

Sand mason worm

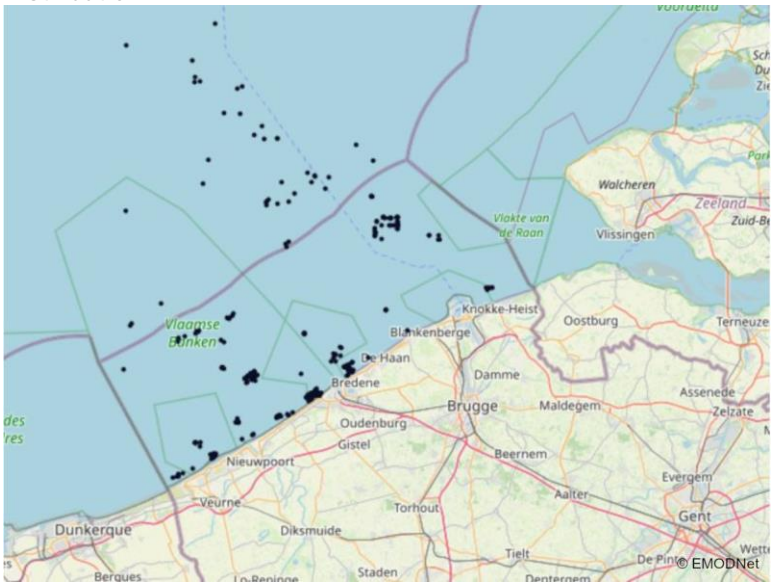
Aphia ID #131495

Kingdom:	Animalia
Phylum:	Annelida
Class:	Polychaeta
Order:	Terebellida
Family:	Terebellidae
Genus:	Lanice
Species:	conchilega

INFORMATION PANEL

Observations: 391

Distribution:



Habitat type: Benthic zone
Substrate: Sand

DESCRIPTION

Size: 0 - 300 mm

Brief description:
Lanice conchilega is a polychaete worm up to 30 cm in length and yellow, pink and brownish in colour. Its body is divided into between 150 and 300 segments, with 17 segments (chaetigers) in the front region. Lanice conchilega has 3 pairs of bushy gills that are blood red in colour. It makes a tube out of sand grains and shell fragments, which has a characteristic frayed end that protrudes above the sand. Lanice conchilega uses its crown of white tentacles to trap particles of food.

Sampling method: van Veen grab
Dutch name: Schelpkokerworm

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Fatty acid bioconversion and lipid homeotasis	NA	*You are not always what you eat—Fatty acid bioconversion and lipid homeostasis in the larvae of the sand mason worm Lanice conchilega. (https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0218015)*	*Qualitative and quantitative estimates of carbon (C) transfer between trophic levels and of fatty acid (FA)—specific assimilation, biosynthesis, and bioconversion can be obtained by compound-specific stable isotope analysis of FA. The present work tested the hypothesis that the concept of fatty acid trophic markers (FATM), widely used for studies on holoplankton with intermediate to high lipid contents, is also applicable to lipid-poor organisms such as meroplanktonic larvae. The incorporation of isotopically-enriched dietary C by L. conchilega larvae was traced, and lipid assimilation did not follow FA-specific relative availabilities in the diet. Furthermore, FAs that were unavailable in the diet, such as 22:5(n-3), were recorded in L. conchilega, suggesting their bioconversion by the larvae. The results indicate that L. conchilega larvae preferentially assimilate certain FAs and regulate their FA composition (lipid homeostasis) independently of that of their diet. Their quasi-homeostatic response to dietary FA availability could imply that the concept of FATM has limited application in lipid-poor organisms such as L. conchilega larvae*	Franco-Santos R.M., Auel H., Boersma M., De Troch M., Graeve M., Meunier C.L., Niehoff B.	2019
2	BIO	Organochlorines	Vinyl chloride, Chloromethanes, Pesticides, Insulators	*The bioaccumulation pattern of organochlorine residues in Lanice conchilega (polychaeta) and its geographical variation between the English channel and the German bight. (https://doi.org/10.1016/S0045-6535(98)00126-X)*	*PCBs, p,p'-DDE, HCB, α-HCH and γ-HCH were analysed in Lanice conchilega from the French, Dutch and German coasts. The annelid exhibited a species-specific PCB pattern. It showed lower and higher chlorinated congeners in more balanced quantities than the polychaete Nereis diversicolor and also the bivalve Mytilus galloprovincialis used in the French mussel watch programme RNO. The PCB pattern in L. conchilega was influenced by the geographical location, probably by changes of the environmental PCB composition from SW to NE.*	Goerke H., Weber K;	1998
3	BIO	Organochlorines and heavy metals	Vinyl chloride, Chloromethanes, Pesticides, Insulators	*Organochlorines and heavy metals in benthic invertebrates and fish from the back barrier of Spiekeroog.*	*Concentrations of organochlorines (PCB, DDT, HCH, HCB, musk xylene, bromocyclen, octachlorostyrene; dry and fat weight basis) and heavy metals (Hg, Pb, Cd; dry weight basis) were determined in Cerastoderma edule, Mytilits edulis, Mya arenaria, Hydrobia nlvae, Nereis diversicolor, Arenicola marina, Lanice conchilega, Carcimuts maenas, Crangon crangon, Zoarces viviparus, Pleuronectes platessa, Clupea harengus and Ammodytes lancea. Maximum concentrations of Σ-PCB, Σ-DDT and Hg were found in the fish species. The concentrations on dry weight basis were positively correlated with the fat content. Maximum concentrations of Σ-HCH, HCB and Cd were found in Lanice conchilega.*	Mattig F.R., Ballin U., Bietz H., Gießing K., Kruse R., Becker, P.H.	1998
4	BIO	Brominated phenols	NA	*Locality-dependent concentrations of bromophenols in Lanice conchilega (Polychaeta: Terebellidae).*	*The concentrations of four brominated phenols in Lanice conchilega were determined. Concentrations in worms of the southern North Sea were generally below 1 µg/g wet wt. Levels were slightly raised in*	Goerke H., Weber K;	1990

				(https://doi.org/10.1016/0305-0491(90)90116-B)	*worms of sheltered shores, those of 3,5-dibromo-4-hydroxybenzaldehyde were increased in subtidal populations. The reasons for the conspicuous differences are hitherto unknown; three explanations are suggested.*		
5	BIO	Brominated phenols	NA	*Occurrence of brominated phenols in the marine polychaete Lanice conchilega. (https://link.springer.com/article/10.1007%2FBF00368575)*	*Occurrence of brominated phenols in the marine polychaete Lanice conchilega.*	Weber K., Ernst W.	1978
6	BIO	Nonprotein component of crude extract	Antitumor	*Antitumor Activity in Mice of Tentacles of Two Tropical Sea Annelids. (https://science.sciencemag.org/content/170/3954/181/tab-pdf)*	*Crude extracts of tentacles of two polychaetous annelids completely inhibit growth of Erlich ascites tumor in 60 to 100 percent of treated mice. Dialyzed extracts of one of these annelids, Lanice conchilega, show activity in the retentate after pronase digestion, suggesting that antitumor activity is associated with a nonprotein component of the crude tentacle extract.*	Tabrah F., Kashiwagi M., Norton T.	1970
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Semibalanus balanoides

Common rock barnacle

Aphia ID #106210

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Hexanauplia
Order:	Sessilia
Family:	Archaeobalanidae
Genus:	Semibalanus
Species:	balanoides

INFORMATION PANEL

Observations: 10

Distribution:

Habitat type: Tidal zone
Substrate: Rock, hard substrate

DESCRIPTION

Size: 5 - 25 mm

Brief description:
Semibalanus balanoides is the most widespread intertidal barnacle in the North Sea. It has 6 calcified grey-white shell plates. It may be distinguished from other barnacles by the presence of a diamond shaped opercular aperture and a membranous shell base. The barnacle feeds on zooplankton when immersed, by extending the thoracic appendages (cirri). It is a cross fertilizing hermaphrodite and may live for up to 8 years, depending on its position on the shore.

Sampling method: Hand collection
Dutch name: Gewone zeepok

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Arhropodin (settlement-inducing protein complex or SIPC), waterbone cue and cypris temporary adhesive	Glycoprotein	*Nature and perception of barnacle settlement pheromones (https://www.tandfonline.com/doi/abs/10.1080/08927010009386298)*	*An adult glycoprotein, arthropodin (now known as settlement-inducing protein complex or SIPC), was once thought to be the sole pheromone involved in the induction of cypris larval settlement. At least two other pheromones are now known to be involved, a waterborne cue originating from the adult and the cypris temporary adhesive. The latter is related, immunologically, to SIPC. In keeping with many other examples of chemical communication, the available evidence suggests that barnacle settlement induction involves receptor-ligand interactions and a signal transduction pathway(s) that translates into attachment and metamorphosis.*	Clare A.S., Matsumura K.	2000
2	BIO	Hydroxy fatty acids	Lipoxygenase activity	*Identification of novel hydroxy fatty acids in the barnacle Balanus balanoides (https://www.sciencedirect.com/science/article/abs/pii/000527609090522Y?via%3Dihub)*	*GC-MS analysis of an active HPLC fraction from the trihydroxy fatty acid band on TLC revealed the presence of a number of trihydroxy fatty acids and two compounds which were tentatively identified as chlorinated dihydroxy fatty acids. The formation of these compounds is evidence of lipoxygenase activities in Balanus balanoides and their identification will facilitate the understanding of the roles eicosanoids play in barnacle physiology, especially with regard to the larval hatching process.*	Song W-C., Holland D.L., Gibson K.H., Clayton E., Oldfield A.	1990
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Perforatus perforatus

Perforated barnacle

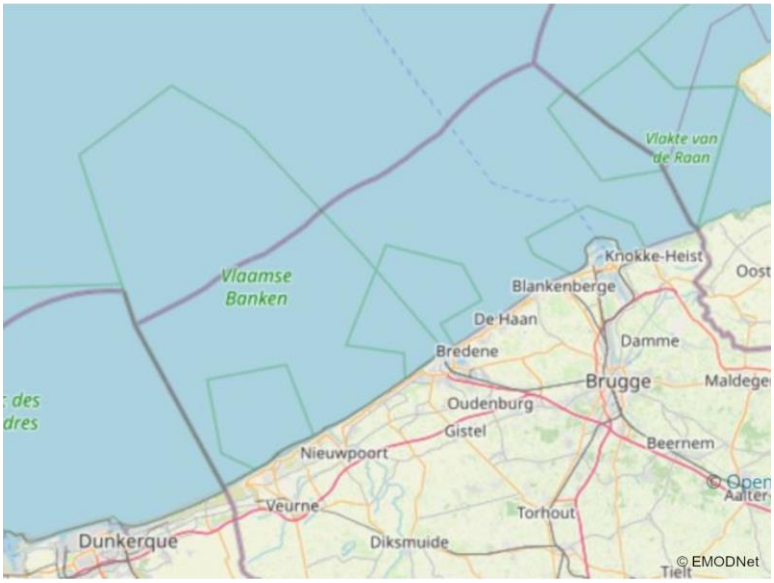
Aphia ID #535477

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Hexanauplia
Order:	Sessilia
Family:	Balanidae
Genus:	Perforatus
Species:	perforatus

INFORMATION PANEL

Observations: NA

Distribution:



Habitat type: Tidal zone
Substrate: Rock, hard substrate

DESCRIPTION

Size: 0 - 55 mm

Brief description:
Perforatus perforatus is recognised by its tapered, volcano-like shape. The shell wall consists of 6 purplish plates that are often vertically ridged, and sometimes separated at the apex leaving a jagged lip. Inside the operculum aperture, the tissue is marked with bright colours of pink, purple and blue. The tergoscutal flaps are brown to purple in colour, with blue and white spots.

Sampling method: Hand collection
Dutch name: Vulkaantje

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
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Crangon crangon

Brown shrimp

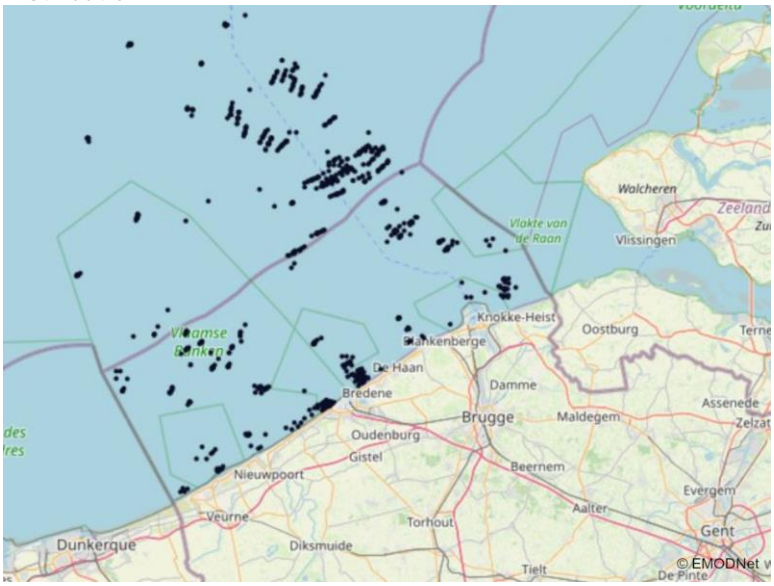
Aphia ID #107552

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Malacostraca
Order:	Decapoda
Family:	Crangonidae
Genus:	Crangon
Species:	crangon

INFORMATION PANEL

Observations: 1178

Distribution:



Habitat type: Benthopelagic zone
Substrate: Sand, gravel, mud

DESCRIPTION

Size: 0 - 90 mm

Brief description:
The brown shimp, Crangon crangon is a long thin animal, mottled brown in colour, narrowing from a wide anterior end to a fanned tail. It is up to 9 cm in length and can be distinguished from most other shrimps and prawns by the short blunt-ended rostrum between the eyes. The colour can be varied by chromatophores depending on the colour of the substratum. It is somewhat dorsoventrally flattened compared to most other shrimps and prawns. The main antennae are almost as long as the body.

Sampling method: Beam trawl
Dutch name: Grijze garnaal

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	CULT	Larvae cultivation under laboratory conditions	NA	*Improvements in larviculture of Crangon crangon as a step towards its commercial aquaculture (https://onlinelibrary.wiley.com/doi/abs/10.1111/are.14048)*	*In this study, they have optimized design and operation procedures of a small-scale static larval rearing system for the culture of C. crangon larvae. Focus was on optimizing larval survival via water temperature, feed selection, feeding regime and density. This is the first report that shows that C. crangon larvae can be reared at high densities of 300 larvae L-1 with high survival of 73.5 (± 5.4)% under laboratory conditions. The information gathered during this research can be applied to further optimize larval development in either flow-through or recirculation systems.*	Van Eynde, B., Vuylsteke, D., Christiaens, O., Cooreman, K., Smagghe, G., & Delbare, D.	2019
2	BIO	Protein hydrolysates	Peptide	*Bioactive peptides from shrimp shell processing discards: Antioxidant and biological activities (https://www.sciencedirect.com/science/article/pii/S1756464617302025)*	*Protein hydrolysates (protein, chitin, carotenoids and glycosaminoglycans) show antioxidant activity, potential for high blood pressure treatment.*	APA Ambigaipalan, P., & Shahidi, F.	2017
3	CULT	Experimental rearing techniques	NA	*Rearing European brown shrimp (Crangon crangon, Linnaeus 1758): A review on the current status and perspectives for aquaculture (https://onlinelibrary.wiley.com/doi/abs/10.1111/raq.12068)*	*This review is based on a comprehensive literature search and reflects on the current status of experimental rearing techniques used for this species, identifies the problems that compromise the closing of the life cycle in captivity and provides examples on how these problem issues were solved in the culture of commercial shrimp species or other crustaceans.*	Delbare, D., Cooreman, K., Smagghe, G.	2015
4	BIO	Glucosamine re-purposed into feed	Peptide	*Shrimp Shell Processing Facility to be Established with Support from Provincial Government (https://www.releases.gov.nl.ca/releases/2011/fishaq/0126n06.htm)*	*The facility will dry and compact shrimp waste to produce two products: dried shrimp shells for shipment to China, to be processed into contamination-free glucosamine (a non-vitamin, non-mineral dietary supplement), and a protein by-product to be targeted to the aquaculture industry as a component of feedstock. By processing the shrimp waste, Eastern Star will redirect refuse that would normally be dumped at sea or sent to the area landfill.*	Luke Joyce, Lori Lee Oates, Debbie Reynolds	2011
5	BIO	Chitosan	Additive	*Potency of Chitosan as a Bioactive Edible Coating for Preservation of Meat of Common Shrimps (Crangon crangon) (http://ediss.sub.uni-hamburg.de/volltexte/2010/4749/)*	*The results of microbiological and biochemical parameters assessments of shrimp meat coated with chitosan-garlic extract demonstrated that chitosan-garlic extract coating solution can maintain the quality and shelf life of shrimp meat during a 30 d of storage at refrigerator and room temperature. Chitosan is a polysaccharide obtained by deacetylation of chitin, which is the major constituent of the exoskeleton of Crustacea.*	Tri Erny Dyahningtyas	2010
6	CULT	Laboratory cultivation	NA	*Effects of food supply on the growth and survival of the common shrimp, Crangon crangon (Linnaeus, 1758)(Decapoda, Caridea) (http://www.springerlink.com/index/X708P887111813NN.pdf)*	*Crangon crangon was reared in the laboratory under controlled conditions (15°C; 34‰; 12/12LD), using natural food: frozen muscle of Nephrops and prawns. In both sexes a food reduction both lengthened the duration of the intermoult period and reduced the moult increment. Consequently, this led to a lower growth rate with reduced feeding. The relative importance of extended intermoults and reduced increments in limiting the growth of crustaceans is discussed.*	Oh, C. W., & Hartnoll, R. G.	2000

7	BIO	Organochlorines and heavy metals	Vinyl chloride, Chloromethanes, Pesticides, Insulators	*Organochlorines and heavy metals in benthic invertebrates and fish from the back barrier of Spiekeroog.*	*Concentrations of organochlorines (PCB, DDT, HCH, HCB, musk xylene, bromocyclen, octachlorostyrene; dry and fat weight basis) and heavy metals (Hg, Pb, Cd; dry weight basis) were determined in Cerastoderma edule, Mytilits edulis, Mya arenaria, Hydrobia nlvae, Nereis diversicolor, Arenicola marina, Lanice conchilega, Carcimuts maenas, Crangon crangon, Zoarces viviparus, Pleuronectes platessa, Clupea harengus and Ammodytes lancea. Maximum concentrations of Σ-PCB, Σ-DDT and Hg were found in the fish species. The concentrations on dry weight basis were positively correlated with the fat content.*	Mattig F.R., Ballin U., Bietz H., Gießing K., Kruse R., Becker, P.H.	1998
8	CULT	Larvae cultivation under laboratory conditions	NA	*Experimental studies on the larval development of the shrimps Crangon crangon and C. allmanni (https://hmr.biomedcentral.com/articles/10.1007/BF01983735)*	*Larvae were reared in the laboratory from hatching through metamorphosis. Effects of rearing methods (larval density, application of streptomycin, food) and of temperature and salinity on larval development were tested. Best results were obtained when larvae were reared individually, with a mixture of Artemia sp. and the rotifer Brachionus plicatilis as food. Streptomycin had partly negative effects and was thus not adopted for standard rearing techniques. All factors tested in this study influenced not only the rates of larval survival and moulting, but also morphogenesis. A high degree of variability in larval morphology and in developmental pathways was observed. Unsuitable conditions, e.g. crowding in mass culture, application of antibiotics, unsuitable food (rotifers, phytoplankton), extreme temperatures and salinities, tend to increase the number of larval instars and of morphological forms. The frequency of moulting is controlled mainly by temperature.*	Criales, M.M., Anger, K.	1986
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Pagurus bernhardus

Common hermit crab

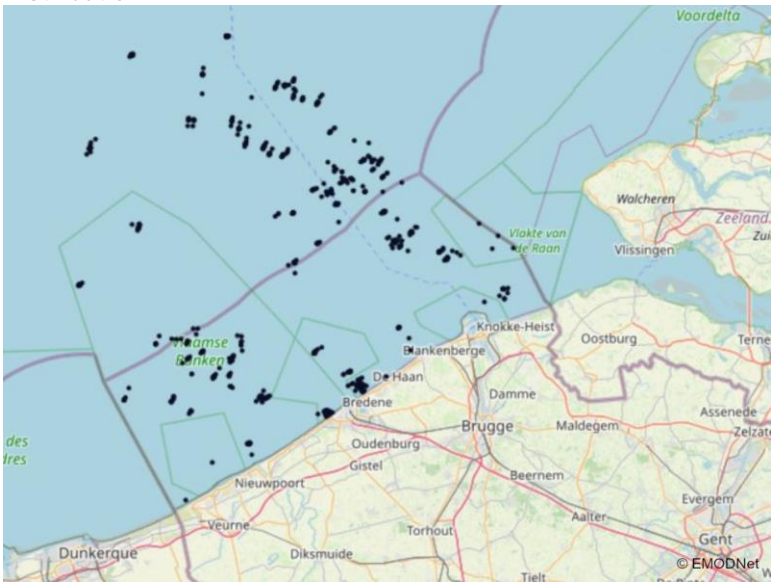
Aphia ID #107232

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Malacostraca
Order:	Decapoda
Family:	Paguridae
Genus:	Pagurus
Species:	bernhardus

INFORMATION PANEL

Observations: 853

Distribution:



Habitat type: Benthic zone
Substrate: Rock, shell, sand

DESCRIPTION

Size: 0 - 35 mm

Brief description:
A large hermit crab with a carapace length that reaches 35mm. It is reddish in colour and will occupy any suitable shell such as Buccinum undatum and Tritia recticulata. Both pincers are covered with thick, pointed protrusions, the massive right pincer has two rows of large protrusions and is devoid of bristles.

Sampling method: Beam trawl
Dutch name: Gewone heremietkreeft

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Peptide related to the moult-inhibiting hormone	Peptide	*New insights into evolution of crustacean hyperglycaemic hormone in decapods - First characterization in Anomura (https://febs.onlinelibrary.wiley.com/doi/abs/10.1111/j.1742-4658.2007.06245.x)*	*The neuropeptides of the crustacean hyperglycaemic hormone (CHH) family are encoded by a multigene family and are involved in a wide spectrum of essential functions. In order to characterize CHH family peptides in one of the last groups of decapods not yet investigated, CHH was studied in two anomurans: the hermit crab Pagurus bernhardus and the squat lobster Galathea strigosa. Using RT-PCR and 3' and 5' RACE methods, a preproCHH cDNA was cloned from the major neuroendocrine organs (X-organs) of these two species. Hormone precursors deduced from these cDNAs in P. bernhardus and G. strigosa are composed of signal peptides of 29 and 31 amino acids, respectively, and CHH precursor-related peptides (CPRPs) of 50 and 40 amino acids, respectively, followed by a mature hormone of 72 amino acids.*	Nicolas Montagné, Daniel Soyez, Dominique Gallois, Céline Ollivaux, Jean-Yves Toullec	2008
2	BIO	NA	Antibacterial, lysozyme and haemolytic activity	*Antibacterial activity in four marine crustacean decapods (https://doi.org/10.1006/fsim.2001.0378)*	*A search for antibacterial activity in different body-parts of Pandalus borealis (northern shrimp), Pagurus bernhardus (hermit crab), Hyas araneus (spider crab) and Paralithodes camtschatica (king crab) was conducted. Dried samples were extracted with 60% (v/v) acetonitrile, containing 0.1% (v/v) trifluoroacetic acid, and further extracted and concentrated on C18 cartridges. Eluates from the solid phase extraction were tested for antibacterial, lysozyme and haemolytic activity. Antibacterial activity against Escherichia coli, Vibrio anguillarum, Corynebacterium glutamicum and Staphylococcus aureus was detected in extracts from several tissues in all species tested, but mainly in the haemolymph and haemocyte extracts. V. anguillarum and C. glutamicum were generally the most sensitive micro-organisms. In P. borealis and P. bernhardus most of the active fractions were not affected by proteinase K treatment. In P. bernhardus the active fractions were generally heat labile, whereas in H. araneus the activities were resistant to heat. Differences between active extracts regarding hydrophobicity and sensitivity for heat and proteinase K treatment indicate that several compounds are responsible for the antibacterial activities detected. Lysozyme-like activity could be detected in some fractions and haemolytic activity against human red blood cells could be detected in haemolymph/haemocyte and exoskeleton extracts from all species tested.*	Haug T., Kjuul A.K., Stensvåg K., Sandsdalen E., Styrvold O.B.	2002
3	BIO	Antibacterial activity	Antibacterial activity	*Antibacterial activity in four marine crustacean decapods (https://www.sciencedirect.com/science/article/pii/S105046480190378X)*	*A search for antibacterial activity in different body-parts of Pandalus borealis (northern shrimp), Pagurus bernhardus (hermit crab), Hyas araneus (spider crab) and Paralithodes camtschatica (king crab) was conducted. Dried samples were extracted with 60% (v/v) acetonitrile, containing 0·1% (v/v) trifluoroacetic acid, and further extracted and*	Tor Haug, Anita K. Kjuul, Klara Stensvåg, Erling Sandsdalen, Olaf B. Styrvold	2001

					concentrated on C18 cartridges. Eluates from the solid phase extraction were tested for antibacterial, lysozyme and haemolytic activity. Antibacterial activity against Escherichia coli,Vibrio anguillarum , Corynebacterium glutamicum and Staphylococcus aureus was detected in extracts from several tissues in all species tested, but mainly in the haemolymph and haemocyte extracts		
4	BIO	Cyclic organochlorines	Vinyl chloride, Chloromethanes, Pesticides, Insulators	*Organochlorine compounds in marine organisms from the international North Sea incineration area*	*The samples consisted of dab (Limanda limanda), whiting (Merlangius merlangus) and the benthic organisms hermit crab (Pagurus bernhardus), swimming crab (Liocarcinus holsatus), whelk (Buccinum undatum), helmet crab (Corystes cassivelaunus), sea mouse (Aphrodite aculeata) and sea urchin (Psammechinus miliaris). Tissues of these organisms were analysed using capillary gas chromatography. The predominant residues were congeners of polychlorinated biphenyls (PCBs) and the second largest proportion was represented by the sum of p,p'-DDT and its metabolites. Concentrations of DDT were below the detection limit. Furthermore, residues of the following substances were found: pentachlorobenzene (QCB, formerly PeCB), hexachlorobenzene (HCB), octachlorostyrene (OCS) and isomers of hexachlorocyclohexane (α-HCH and γ-HCH = lindane).*	Dethlefsen V., Söffker K., Büther H., Damm U.	1996
5	BIO	Cyclic organochlorines	Vinyl chloride, Chloromethanes, Pesticides, Insulators	*Concentrations of organochlorine compounds in the hermit crab Pagurus bernhardus from the German bight, December 1988 -May 1989 (https://doi.org/10.1016/0077-7579(90)90044-H)*	*The contamination of Pagurus bernhardus with PCB (as the sum of concentrations of 36 individual components), p,p'-DDE, HCB, α-HCH and Lindane (γ-HCH) was determined in samples collected between December 1988 and May 1989 in the German Bight. Consistent values of congener composition were shown to exist in the abdomens when individual congener levels were expressed as percentages of total composition. The body burdens of cyclic organochlorines changes with time, but this change was different for different compounds at the same sampling station, and also at different sampling stations for the same compound. These changes were not correlated to natural seasonal events or changing lipid content of the tissues, but were strongly influenced by their sources.*	Knickmeyer R., Steinhart H.	1990
6	BIO	Cyclic organochlorines	Vinyl chloride, Chloromethanes, Pesticides, Insulators	*Cyclic organochlorines in the hermit crabs Pagurus bernhardus and P. pubescens from the North Sea. A comparison between winter and early summer situation (https://www.sciencedirect.com/science/article/abs/pii/0077757988900270?via%3Dihub)*	*The body burdens of 5 cyclic organochlorine compounds were determined in abdomens of Pagurus bernhardus and P. pubescens from the North Sea during two seasons. The seasonal bioaccumulation of ΣPCB (as the sum of concentrations of 24 individual components) is influenced by the substances associated with food originated from the spring plankton bloom and the resuspended sediments during the winter. Pagurus pubescens probably possesses a mixed-function oxygenase (MFO)-system different from that of Pagurus bernhardus because the congeners 2,2', 3,3', 4,5,6'-heptachlorobiphenyl (174) and 2,2', 3,3', 4', 5,6-heptachlorobiphenyl (177) were absent in all samples of the former species but were always present in the latter.*	Knickmeyer R., Steinhart H.	1988
7	BIO	Cyclic	Vinyl chloride,	*Seasonal differences of cyclic*	*The content of five cyclic organochlorine compounds was determined*	Knickmeyer R.,	1988

		organochlorines	Chloromethanes, Pesticides, Insulators	*organochlorines in eggs of the hermit crab Pagurus Bernhardus L. from the North Sea (https://www.tandfonline.com/doi/abs/10.1080/00364827.1988.10413416)*	*in eggs of Pagurus bernhardus taken from the North Sea during two seasons. The seasonal pattern of the 24 PCB congeners is influenced by the uptake of food from the spring plankton bloom in early summer and the lipid reserves from the hepatopancreas in winter. Eggs show higher concentrations of ∑ PCB, p, p'-DDE, α-HCH, Lindane, and HCB than abdomens, based on the analysis of n-hexane extractable lipids; no correlation was on the basis of dry weight.*	Steinhart H.	
8	BIO	Organochlorine compounds	Lipid	*Organochlorine compounds in several marine organisms from the North Sea and the Dutch Wadden Sea (https://www.sciencedirect.com/science/article/pii/0077757974900040)*	*This paper presents a survey of the content of organochlorine compounds in several marine organisms in the North Sea and the Duth Wadden Sea. The most striking result is the small difference, on a lipid weight basis, in the content of organochlorine compounds between the different species.*	Ten Berge, W. F., & Hillebrand, M.	1974
9	BIO	Arginine kinase	Enzyme	*Characteristics of Arthropod Arginine Kinases (https://pubs.acs.org/doi/abs/10.1021/bi00846a015)*	*Arginine kinase has been purified from the muscle of two crustaceans, the hermit crab, Pagurus bernhardus, and the blue crab, Callinectus sapidus. The molecular weights of the purified enzymes, measured by sedimentation equilibrium, were about 38,000, and the molecular weights found for crude preparations using gel filtration ranged from 34,000 to 38,000. The amino acid compositions of the purified enzymes were relatively similar, and they contained 5 moles of cysteine/mole of protein.*	Blethen S.L., Kaplan N.O.	1968
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Liocarcinus depurator

Harbour crab

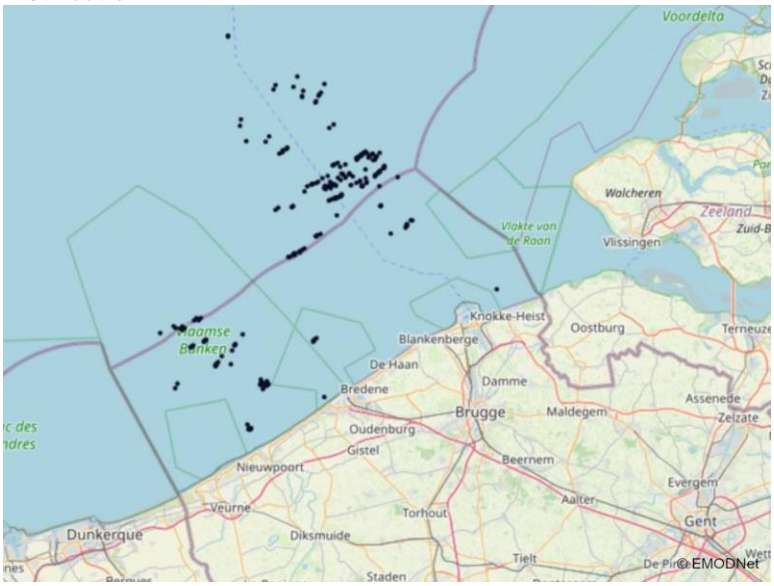
Aphia ID #107387

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Malacostraca
Order:	Decapoda
Family:	Polybiidae
Genus:	Liocarcinus
Species:	depurator

INFORMATION PANEL

Observations: 456

Distribution:



Habitat type: Demersal zone
Substrate: Muddy sand, gravel

DESCRIPTION

Size: 0 - 100 mm

Brief description:
The carapace of Liocarcinus depurator is wider than long, about 51 mm wide and 40 mm long. The species is immediately recognised by the violet-tinted paddle of the fifth leg in larger crabs. The rest of the body is pale reddish-brown with transverse rows of hairs on the carapace, most conspicuous towards the rear.

Sampling method: Beam trawl
Dutch name: Blauwpootzwemkrab

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	CULT	Monolayer culture of hyaline haemocytes	NA	*Primary culture of the hyaline haemocytes from marine decapods (https://www.sciencedirect.com/science/article/pii/S105046489890184X)*	*A simple method has been devised for the maintenance of crab, Liocarcinus depurator hyaline haemocytes in monolayer culture in vitro for a minimum of 14 days.*	Walton, A., Smith, V.J.	1999
2	BIO	Lectin	Peptide	*The Lectin from the Crustacean Liocarcinus depurator Recognizes O-acetylsialic Acids (https://www.sciencedirect.com/science/article/pii/S0305049197001892)*	*Lectin that can agglutinate and stimulate human lymphocytes, mouse erythrocytes, specific gram-negative bacteria; is inhibited by E. coli lipopolysaccharide*	Fragkiadakis, G. A., & Stratakis, E. K.	1997
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Liocarcinus holsatus

Flying crab

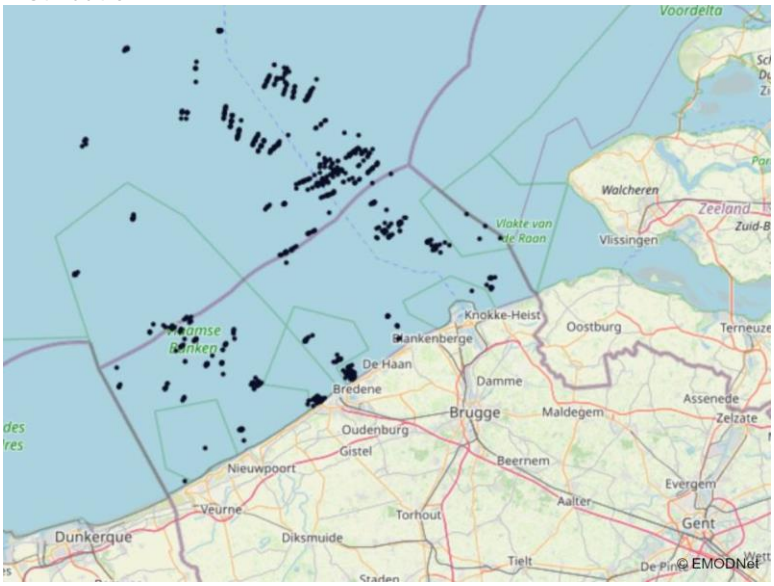
Aphia ID #107388

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Malacostraca
Order:	Decapoda
Family:	Polybiidae
Genus:	Liocarcinus
Species:	holsatus

INFORMATION PANEL

Observations: 2056

Distribution:



Habitat type: Demersal zone
Substrate: Sand, gravel, rock

DESCRIPTION

Size: 0 - 60 mm

Brief description:
Very similar to Liocarcinus depurator but lacking any ridges. The body is brownish-grey, tinged with green and grows up to 4 cm long. It is longer than it is wide, more or less smooth, without bristles. It has three blunt teeth between the eyes, the middle one sometimes shortest. It is host to the parasitic barnacle Sacculina carcini in some areas.

Sampling method: Beam trawl
Dutch name: Gewone zwemkrab

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Cyclic organochlorines	Vinyl chloride, Chloromethanes, Pesticides, Insulators	*Organochlorine compounds in marine organisms from the international North Sea incineration area*	*The samples consisted of dab (Limanda limanda), whiting (Merlangius merlangus) and the benthic organisms hermit crab (Pagurus bernhardus), swimming crab (Liocarcinus holsatus), whelk (Buccinum undatum), helmet crab (Corystes cassivelaunus), sea mouse (Aphrodite aculeata) and sea urchin (Psammechinus miliaris). Tissues of these organisms were analysed using capillary gas chromatography. The predominant residues were congeners of polychlorinated biphenyls (PCBs) and the second largest proportion was represented by the sum of p,p'-DDT and its metabolites. Concentrations of DDT were below the detection limit. Furthermore, residues of the following substances were found: pentachlorobenzene (QCB, formerly PeCB), hexachlorobenzene (HCB), octachlorostyrene (OCS) and isomers of hexachlorocyclohexane (α-HCH and γ-HCH = lindane).*	Dethlefsen V., Söffker K., Büther H., Damm U.	1996
2	CULT	Laboratory cultivation	NA	*Accumulation and loss of biomass in Liocarcinus holsatus larvae during growth and exuviation (https://link.springer.com/article/10.1007/BF01313257)*	*Liocarcinus holsatus (Fabricius) larvae, of females originating from the Elbe Estuary, FRG, were reared in the laboratory at constant 15°C in May 1988. Patterns of growth and elemental composition are compared with literature data and a high degree of similarity in the growth characteristics of decapod larvae is seen.*	Harms, J.	1990
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Thia scutellata

Thumbnail crab

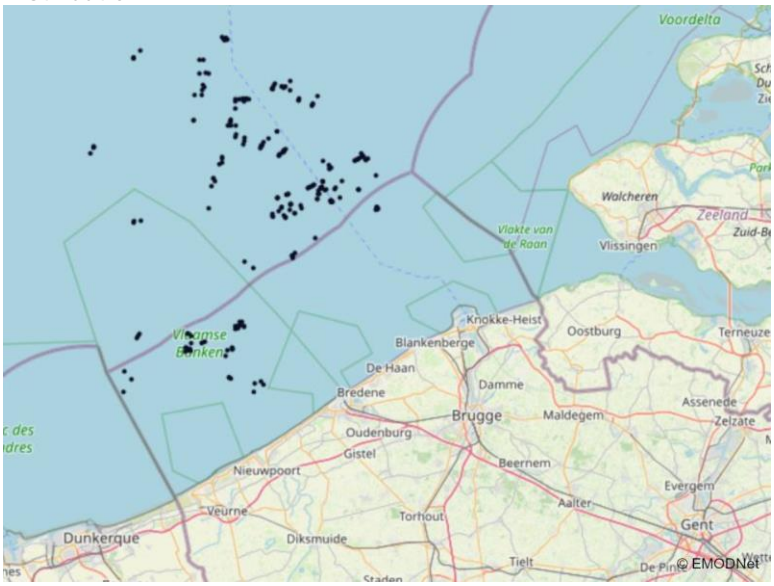
Aphia ID #107281

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Malacostraca
Order:	Decapoda
Family:	Thiidae
Genus:	Thia
Species:	scutellata

INFORMATION PANEL

Observations: 306

Distribution:



Habitat type: Benthic zone
Substrate: Sand, mud

DESCRIPTION

Size: 0 - 20 mm

Brief description:
A small, flat crab with a heart shaped carapace, up to 20 mm long, distinctly notched around the edge with a dense fringe of long hairs. Pale pink in colour with red to brown markings. Found in small numbers, found outside the coastal zone. Up to 45 m, burrowing species.

Sampling method: van Veen grab
Dutch name: Nagelkrab

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
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Flustra foliacea

Hornwrack

Aphia ID #111367

Kingdom:	Animalia
Phylum:	Bryozoa
Class:	Gymnolaemata
Order:	Cheilostomatida
Family:	Flustridae
Genus:	Flustra
Species:	foliacea

INFORMATION PANEL

Observations: 7

Distribution:

Habitat type: Benthic zone
Substrate: Coarse sediment, rocky substrate

DESCRIPTION

Size: 0 - 200 mm

Brief description:
Flustra foliacea forms a stiff but flexible bushy clump 6 -10 cm high, occasionally up to 20cm high. Flustra foliacea is much divided into fronds that are usually broadly lobed, occasionally strap-like, and made up of zooids (individuals) on both sides (bilaminar). Fronds are light grey to brown in colour. Zooids are tongue shaped, 0.4 mm long and 0.2 - 0.28 mm wide. They bear 4 to 5 marginal club-like spines at the broad (distal) end of each zooid. The fronds have a distinct smell of lemons when freshly collected. Hornwrack is sometimes found washed ashore after storms.

Sampling method: Beam trawl
Dutch name: Breedbladig mosdiertje

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	N1-alkylindole-3-ylalkylammonium compounds	Nicotinic acetylcholine receptor ligands	*Synthesis and evaluation of N1-alkylindole-3-ylalkylammonium compounds as nicotinic acetylcholine receptor ligands (https://doi.org/10.1016/j.bmc.2012.04.050)*	*In this study thirty-three novel indole derivatives were designed and synthesized based on the structure of deformylflustrabromine B (1), a metabolite isolated from the marine bryozoan Flustra foliacea L. The syntheses were carried out using standard methodologies and in good yields. The molecules were tested for their affinities for the α4β2*, α3β 4*, α7* and (α1)2β1γδ nicotinic acetylcholine receptor (nAChR) subtypes. Binding assays showed that, among these ligands, compound 7c exhibited the highest affinity with K i = 136.1, 93.9 and 862.4 nM for the α4β2*, α3β4*, and α7* nAChRs subtypes, respectively. These results indicated that the indole core might be a useful scaffold for the development of new potent and selective nAChR ligands.*	Pérez E.G., Cassels B.K., Eibl C., Gündisch D.	2012
2	BIO	Flustramine family of alkaloids	Anti-biofilm agents	*Flustramine inspired synthesis and biological evaluation of pyrroloindoline triazole amides as novel inhibitors of bacterial biofilms (https://pubs.rsc.org/en/content/articlelanding/2011/OB/c1ob05605k#!divAbstract)*	*Anti-biofilm agents have been developed based upon the flustramine family of alkaloids isolated from Flustra foliacea. A Garg interrupted Fischer indolization reaction was employed to access a core pyrroloindoline scaffold that was subsequently employed to create a pyrroloindoline triazole amide library. Screening for the ability to modulate biofilm formation against strains of Gram-positive and Gram-negative bacteria identified several compounds with low micromolar, non-toxic IC 50 values.*	Bunders C., Cavanagh J., Melander, C.	2011
3	BIO	(±)-debromoflustramine A	Medicinal drugs	*Step-economic synthesis of (±)-debromoflustramine A using indole C3 activation strategy (https://doi.org/10.1016/j.tetlet.2011.01.020)*	*A concise and practical strategy to obtain C3 reverse-prenylated pyrrolidinoindoline scaffold has been executed in 28.8% overall yield. The key conjugative step involved a Booker-Milburn-Feudoloff reaction involving an NCS-mediated activation of indole, followed by coupling to C5 dimethylallylalcohol. This linchpin step proceeded in 74% yield. The overall sequence proceeded in five steps from commercially available N-methyltryptamine with a single protection-deprotection operation and a single redox manipulation. Mechanistic insights of NCS activation, and an ensuing rearrangement of the isoprene unit were gained by rationally varying the C3 substituent.*	Ignatenko V.A., Zhang P., Viswanathan R.	2011
4	BIO	Debromoflustramine B	Medicinal drugs	*In silico ligand-receptor docking of potentially selective butyrylcholinesterase inhibitors structurally related to the marine natural product debromoflustramine B (https://doi.org/10.2174/1573406411006030141)*	*Selective human butyrylcholinesterase (BChE) inhibitors such as cymserine have shown considerable promise for restoring cognition in Alzheimer's disease. Recently, (-)-debromoflustramine B, 1, a hexahydropyrrolo-[2,3-b]indole natural product isolated from the marine bryozoan Flustra foliacea, has demonstrated micromolar potency as a selective BChE inhibitor. Since (±)-demethyldebromoflustramine B, (±)-2, has an even lower IC50, and the active enantiomer is (-)- 2, derivatives of (-)-2 were constructed in silico and docked into the active site of BChE. Several compounds exhibited improved inhibitor potency and could be candidates for future synthesis and in vitro enzyme inhibition study.*	Mitchell M.O., Figliozzi R.W., Guzel M.	2010

5	BIO	Flustramine	Medicinal drugs	*Further studies on the chemistry of the flustra alkaloids from the bryozoan Flustra foliacea (https://doi.org/10.1021/np900282j)*	*Since 1980, over a dozen novel brominated alkaloids, named flustramines, have been isolated from Scandinavian and Canadian collections of the marine bryozoan Flustra foliacea. This paper describes the reisolation of the known compound dihydroflustramine C (1) and the isolation of 11 new flustramines (2-4, 6-13), including two dimers (12, 13) that may be isolation artifacts. Together these compounds, some with an unexpected aryl substitution pattern, reveal an intricate network of metabolites present in the extracts of the bryozoan. The structures of these metabolites were solved using a variety of spectroscopic techniques and chemical derivatization and modification. This work also led to the recognition of an unusual rearrangement reaction that occurred slowly over a number of years.*	Rochfort S.J., Moore S., Craft C., Martin N.H., Van Wagoner R.M., Wright J.L.C.	2009
6	BIO	Brominated indole alkaloids	Medicinal drugs	*Synthesis of marine indole alkaloids from Flustra foliacea (https://doi.org/10.1177/1934578x0800300421)*	*Brominated natural indoles are frequently reported metabolites of marine seaweeds. The bryozoan Flustra foliacea has been a rich source of brominated indole alkaloids bearing prenyl or isoprenyl substituents at various positions. Because interest in the chemistry of these marine alkaloids is steadily growing and shows unique promise in the discovery of new important medicinal drugs, the methods which have been employed towards their total synthesis are reviewed in detail.*	Morales-Ríos M.S., Suárez-Castillo O.R.	2008
7	BIO	Deformylflustrabomine	Medicinal drugs	*Synthesis of desformylflustrabromine and its evaluation as an α4β2 and α7 nACh receptor modulator (https://doi.org/10.1016/j.bmcl.2007.06.047)*	*Desformylflustrabromine (dFBr; 1) and desformylflustrabromine-B (dFBr-B; 2) have been previously isolated from natural sources, and the former has been demonstrated to be a novel and selective positive allosteric modulator of α4β2 nicotinic acetylcholine (nACh) receptors. The present study describes the synthesis of water-soluble salts of 1 and 2, and confirms and further investigates the actions of 1 and 2 using two-electrode voltage clamp recordings.*	Kim J.-S., Padnya A., Weltzin M., Edmonds B.W., Schulte M.K., Glennon R.A.	2007
8	BIO	Flustramine C	Medicinal drugs	*Total synthesis of flustramine C via dimethylallyl rearrangement (https://doi.org/10.1021/ol0627348)*	*(Chemical Equation Presented) The marine natural product flustramine C from the bryozoan Flustra foliacea was synthesized in five steps and 38% yield starting from Nb-methyltryptamine. The key step is the biomimetic oxidation of the natural product deformylflustrabromine causing selective 1,2-rearrangement of the inverse prenyl group. By 1H, 15N HMBC experiments, it is unambiguously shown that the reaction with t-BuOCl commences with chlorination of the side chain nitrogen. Deformylflustrabromine itself was synthesized via Danishefsky inverse prenylation.*	Lindel T., Bräuchle L., Golz G., Böhrer P.	2007
9	BIO	Deformylflustrabromine	Medicinal drugs	*Potentiation of human α4β2 neuronal nicotinic receptors by a Flustra foliacea metabolite (https://doi.org/10.1016/j.neulet.2004.10.002)*	*The effects of various Flustra foliacea metabolites on different types of human neuronal nicotinic acetylcholine receptors (nAChRs) expressed in Xenopus oocytes were investigated. Whereas most of the compounds tested had a small blocking effect, one of them, deformylflustrabromine, selectively increased the current obtained in α4β2 receptors when co-applied with acetylcholine (ACh). The current increase was reversible and concentration-dependent. This potentiating effect was still present at saturating concentrations of acetylcholine, and no changes in single-channel conductance or*	Sala F., Mulet J., Reddy K.P., Bernal J.A., Wikman P., Valor L.M., Peters L., König G.M., Criado M., Sala S.	2005

					reversal potential were observed, thus suggesting a modification in the gating of α4β2 receptors. Dwell time analysis of single channel records indicates that the mechanism of action of deformylflustrabromine could be both an increase of the opening rate constant and a decrease of the closing rate constant on α4β2 receptors. Thus, deformylflustrabromine may constitute an excellent starting point for the future development of related agents able to potentiate human neuronal nicotinic receptor function.		
10	BIO	Brominated indole alkaloids and diterpene	Medicinal drugs	*Prenylated indole alkaloids from Flustra foliacea with subtype specific binding on NAChRs (https://doi.org/10.1055/s-2004-832610)*	*Several brominated indole alkaloids and a diterpene (1-7) were isolated from the dichloromethane extract of the North Sea Bryozoan Flustra foliacea. Alkaloid 4 is a new natural product, whose structure was elucidated by interpretation of spectroscopic dat*	Peters L., Wright A.D., Kehraus S., Gündisch D., Tilotta M.C., König G.M.	2004
11	BIO	Brominated indole alkaloids and diterpene	Medicinal drugs	*Variation of brominated indoles and terpenoids within single and different colonies of the marine bryozoan Flustra foliacea (https://doi.org/10.1023/B:JOEC.0000030270.65594.f4)*	*The variation of the brominated indole and diterpenoid content within single and different colonies of the bryozoan Flustra foliacea was investigated. The secondary metabolite profile and concentrations of individual components of F. foliacea samples were*	Peters L., Wright A.D., Krick A., König G.M.	2004
12	BIO	Brominated indole alkaloids and diterpene	Medicinal drugs	*Secondary metabolites of Flustra foliacea and their influence on bacteria (https://doi.org/10.1128/AEM.69.6.3469-3475.2003)*	*The North Sea bryozoan Flustrafoliacea was investigated to determine its secondary metabolite content. Gas chromatography-mass spectrometry analysis of a dichloromethane extract of the bryozoan enabled 11 compounds to be identified. Preparative high-perfo*	Peters L., König G.M., Wright A.D., Pukall R., Stackebrandt E., Eberl L., Riedel K.	2003
13	BIO	Brominated indole alkaloids and diterpene	Medicinal drugs	*Four new bromotryptamine derivatives from the marine bryozoan Flustra foliacea (https://doi.org/10.1021/np0105984)*	*Ten brominated alkaloids, 6-bromo-2-(1,1-dimethyl-2-propenyl)-1H-indole-3-carbaldehyde (1), N-(2-[6-bromo-2-(1,1-dimethyl-2-propenyl)-1H-indol-3-yl]ethyl) -N-methylmethanesulfonamide (2), deformylflustrabromine (3), flustrabromine (4),(3aR*,8aS')-6-bromo-*	Peters L., König G.M., Terlau H., Wright A.D.	2002
14	BIO	Deformylflustrabromine	Medicinal drugs	*Isolation and structure elucidation of deformylflustrabromine from the North Sea bryozoan Flustra foliacea (https://doi.org/10.1515/znc-2002-11-1218)*	*The brominated pyrrolo[2,3-b]indole deformylflustrabromine was isolated as a new natural product from the bryozoan Flustra foliacea, collected in the North Sea. Deformylflustrabromine appears to be the missing link in the biosynthetic sequence from flustr*	Lysek N., Rachor E., Lindel T.	2002
15	BIO	Indole alkaloids	Medicinal drugs	*Total syntheses of five indole alkaloids from the marine bryozoan Flustra foliacea (https://doi.org/10.1021/jo0012647)*	*A general, efficient, and conceptually new approach to the total syntheses of marine-derived indole alkaloids, including (±)-flustramines A (1) and B (2), (±)-flustramides A (3) and B (4), and (±)-debromoflustramine B (5), is outlined. The key step in the*	Morales-Ríos M.S., Suárez-Castillo O.R., Trujillo-Serrato J.J., Joseph-Nathan P.	2001
16	BIO	Debromoflustramines A and B	Medicinal drugs	*General approach to the synthesis of marine bryozoan Flustra foliacea alkaloids: Total syntheses of debromoflustramines A and B (https://doi.org/10.1021/jo982090k)*	*General approach to the synthesis of marine bryozoan Flustra foliacea alkaloids: Total syntheses of debromoflustramines A and B*	Morales-Ríos M.S., Suárez-Castillo O.R., Joseph-Nathan P.	1999
17	BIO	Physostigmine	Medicinal drugs	*New physostigmine related bromoalkaloids from the marine bryozoan Flustra foliacea*	*Methylene chloride extracts of the bryozoan Flustrafoliaceae show strong antimicrobial activity. Chemical investigation of the metabolites has led to the identification of a series of new*	Laycock M.V., Wright J.L.C., Findlay J.A., Patil	1986

				(https://doi.org/10.1139/v86-218)	*bromoalkaloids belonging to the physostigmine class, which are resp*	A.D.	
18	BIO	Bromoindole alkaloids and brominated quinoline.	Medicinal drugs	*Secondary metabolites from marine bryozoans. A review. (https://www.researchgate.net/publication/19255166_Secondary_metabolites_from_marine_bryozoans_A_review)*	*Secondary metabolites from marine bryozoans are reviewed. Two ctenosome bryozoans are dealt with, one, Alcyonidium gelatinosum containing a sulfoxonium ion acting as hapten in an allergic contact dermatitis and the other, Zoobotryon verticillatum yielding*	Christophersen C.	1985
19	BIO	Bromo-quinoline alkaloid	Dyes, food colors, pharmaceutical reagents	*Marine alkaloids-6. The first naturally occurring bromo-substituted quinoline from Flustra foliacea (https://doi.org/10.1016/0305-0491(82)90421-7)*	*The isolation and structure elucidation of the first naturally occurring bromo-quinoline alkaloid, 7-bromo-4-(2-ethoxyethyl)quinoline (1) from the marine bryozoan Flustra foliacea (L.) is reported.*	Wulff P., Carlé J.S., Christophersen C.	1982
20	BIO	Brominated alkaloid	Medicinal drugs	*Marine alkaloids. Part 4. A formamide, flustrabromine, from the marine bryozoan Flustra foliacea (https://doi.org/10.1039/P19810002895)*	*The isolation and structure elucidation of a marine alkaloid from the bryozoan Flustra foliacea is described. The alkaloid, 6-bromo-2-(1,1-dimethylallyl)-Nb-formyl-Nb-methyltryptamine (1), has been shown to consist of two rotameric forms reflecting hinde*	Wulff P., Carlé J.S., Christophersen C.	1981
21	BIO	Brominated alkaloid	Medicinal drugs	*Marine Alkaloids. 2. Bromo Alkaloids from the Marine Bryozoan Flustra foliacea. Isolation and Structure Elucidation (https://doi.org/10.1021/jo01297a007)*	*Flustramines A and B., two bromo-substituted alkaloids, were isolated from the marine bryozoan Flustra foliacea. The isolation procedure and detailed assignment of all 13C and 1H NMR data are reported. Nuclear Overhauser enhancement difference spectroscop*	Carié J.S., Christophersen C.	1980
22	BIO	Brominated alkaloid	Medicinal drugs	*Bromo-Substituted Physostigmine Alkaloids from a Marine Bryozoa Flustra foliacea (https://doi.org/10.1021/ja00508a073)*	*Among the ever-increasing number of organic structures emerging from marine natural products research, extremely few belong to the alkaloids. This has given rise to the assumption that marine organisms have evolved no biosynthetic pathways comparable to t*	Carlé J.S., Christophersen C.	1979
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Tricellaria inopinata

Aphia ID #111254

Kingdom:	Animalia
Phylum:	Bryozoa
Class:	Gymnolaemata
Order:	Cheilostomatida
Family:	Candidae
Genus:	Tricellaria
Species:	inopinata

INFORMATION PANEL

Observations: 1

Distribution:

Habitat type: Benthic zone
Substrate: Hard substrate

DESCRIPTION

Size: 0 - 80 mm

Brief description:
T. inopinata colonies are whitish to cream in colour and arborescent in form, up to 6-8 cm in length. Adult colonies are formed by branches, dividing dichotomously and composed of alternating series of autozooids (5-10 per internode) of 0.40 - 0.65 mm in length, usually tapering at the proximal part and becoming wider at the distal part (0.16-0.20 mm in width).

Sampling method: Hand collection
Dutch name: Onverwacht mosdiertje

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Antibacterial compound in species of same genus	Antibacterial, antifouling activity	*Antibacterial activity of two species of bryozoans from northern Puget Sound (https://research.libraries.wsu.edu/xmlui/handle/2376/1225)*	*For the first time, bryozoan species from northern Puget Sound have been shown to contain antibacterial compounds. The antibacterial activity of two local marine cheilostome species was tested against six strains of local marine bacteria and against stock cultures of Vibrio anguillarium, Bacillus subtilis, Staphylococcus aureus, and Escherichia coli. A crude extract made from the bryozoan Tricellaria occidentalis inhibited the growth of B. subtilis. Preliminary scanning electron microscopy data indicate that **Tricellaria occidentalis** had higher densities of surface bacteria than Bugula pacifica. This inverse relationship between antibacterial activity and surface fouling may indicate an antifouling role for these bryozoan secondary metabolites. The presence of antibacterial compounds may allow bryozoans to manipulate the microbial film growing on them, and may influence the types of organisms that are able to settle near or on them. The ability to manipulate microbial films may also enable bryozoans to make the substrate nearby more suitable for the settlement of their own larvae.*	Shellenberger J.S., Ross J.R.P.	1998
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Echiichthys vipera

Lesser weever

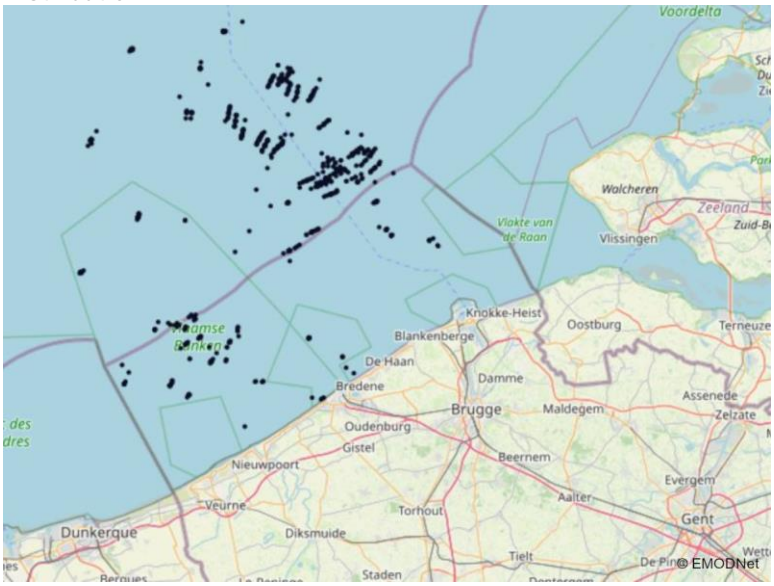
Aphia ID #150630

Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Perciformes
Family:	Trachinidae
Genus:	Echiichthys
Species:	vipera

INFORMATION PANEL

Observations: 834

Distribution:



Habitat type: Demersal zone
Substrate: Sand

DESCRIPTION

Size: 0 - 150 mm

Brief description:
The lesser weever fish has a short stout body and grows up to 15 cm in length. It has a large sloping mouth and pointed snout with eyes high on the head. The first dorsal fin is triangular and entirely black with an elongated first spine on the male. The second dorsal and anal fins extend almost to the tail and the pectoral fins are large and paddle shaped. The gill covers have a long spine pointing backwards. The fish is yellowish brown with a paler underside. The spines of the first dorsal fin and gill covers release a poison that give an extremely painful sting.

Sampling method: Beam trawl
Dutch name: Kleine pieterman

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Cytolysins, trachinine and dracotoxin	Cytotoxicity	*The venoms of the lesser (Echiichthys vipera) and greater (Trachinus draco) weever fish– A review (https://doi.org/10.1016/j.toxcx.2020.100025)*	*In comparison with other animal venoms, fish venoms remain relatively understudied. This is especially true for that of the lesser Echiichthys vipera and greater weever fish Trachinus draco which, apart from the isolation of their unique venom cytolysins, trachinine and dracotoxin, respectively, remain relatively uncharacterised. Envenomation reports mainly include mild symptoms consisting of nociception and inflammation. However, like most fish venoms, if the venom becomes systemic it causes cardiorespiratory and blood pressure changes. Although T. draco venom has not been studied since the 1990's, recent studies on E. vipera venom have discovered novel cytotoxic components on human cancer cells, but due to the scarcity of research on the molecular make-up of the venom, the molecule(s) causing this cytotoxicity remains unknown. This review analyses past studies on E. vipera and T. draco venom, the methods used in the, the venom constituents characterised, the reported symptoms of envenomation and compares these findings with those from other venomous Scorpaeniformes.*	Gorman L.M., Judge S.J., Fezai M., Jemaà M., Harris J.B., Caldwell G.S.	2020
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Botrylloides violaceus

Colonial sea squirt

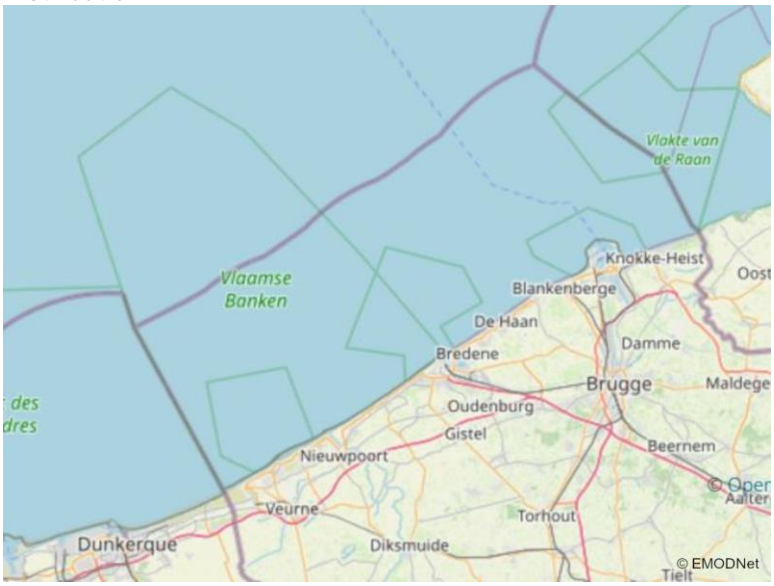
Aphia ID #148715

Kingdom:	Animalia
Phylum:	Chordata
Class:	Ascidiacea
Order:	Stolidobranchia
Family:	Styelidae
Genus:	Botrylloides
Species:	violaceus

INFORMATION PANEL

Observations: NA

Distribution:



Habitat type: Benthic zone
Substrate: Hard substrate

DESCRIPTION

Size: 0 - 2 mm

Brief description:
B. violaceus is a compound ascidian (tunicate or sea squirt) and belongs to the subfamily Botryllinae. It is made up of individual genetically identical zooids (measuring ~2 mm in diameter) and ampullae that are connected by an internal vascular system. Zooids are arranged in loose circles or rows and are embedded in a transparent tunic.

Sampling method: Hand collection
Dutch name: Gewone slingerzakpijp

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
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Styela clava

Rough sea squirt

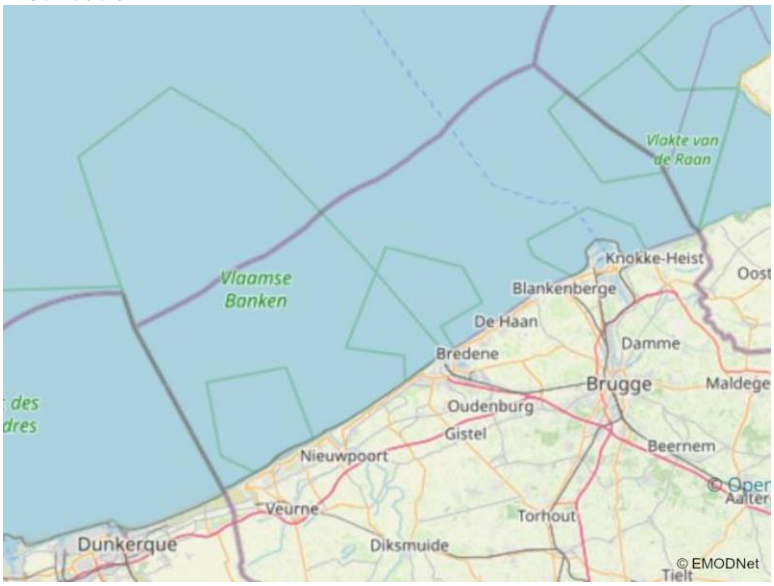
Aphia ID #103929

Kingdom:	Animalia
Phylum:	Chordata
Class:	Ascidiacea
Order:	Stolidobranchia
Family:	Styelidae
Genus:	Styela
Species:	clava

INFORMATION PANEL

Observations: NA

Distribution:



Habitat type: Benthic zone
Substrate: Hard substrate

DESCRIPTION

Size: 0 - 120 mm

Brief description:
Styela clava is a solitary sea squirt with a long club-shaped body, tapering to a slender and tough stalk. The overall height of the sea squirt can reach 12cm and the stalk can be a 1/3 of the total length. The surface of the sea squirt can be leathery with folds and swellings. The siphons at the top (anterior) end are close together. Styela clava is found in shallow water on hard surfaces and occurs abundantly in sheltered warm water docks and harbour installations.

Sampling method: Hand collection
Dutch name: Japanse knotszakpijp

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Antioxidant peptide	Antihypertensive effect	*Structural Evidence for Antihypertensive Effect of an Antioxidant Peptide Purified from the Edible Marine Animal Styela clava (https://doi.org/10.1089/jmf.2019.4415)*	*This study investigated the antihypertensive effects of an antioxidant peptide, Leu-Trp-His-Thr-His (LWHTH), purified from Styela clava peptic hydrolysate, to assess the bioactivity of the peptide and verify the value of S. clava as a health-promoting food. Also, the study presented structural evidence for the effects of LWHTH. The inhibitory effect of LWHTH on angiotensin I-converting enzyme (ACE) was assessed using enzyme reaction methods and the simulation methods in computational space. LWHTH inhibited ACE with an IC50 value of 16.42 ± 0.45 μM. The LWHTH structure was stable, and its ACE inhibitory effect was retained under simulated gastrointestinal conditions. In silico simulations revealed that LWHTH binds the active site of ACE, with residues LW making the ACE-LWHTH complex stable and residues HTH making the complex strong. Furthermore, LWHTH significantly reduced blood pressure in spontaneously hypertensive rats. These results demonstrate that LWHTH has the potential to be a healthy functional food with antihypertensive effects. Therefore, S. clava consumption may be beneficial for human health. © Copyright 2020, Mary Ann Liebert, Inc., publishers, and Korean Society of Food Science and Nutrition 2020.*	Kang N., Ko S.-C., Kim H.-S., Yang H.-W., Ahn G., Lee S.-C., Lee T.-G., Lee J.-S., Jeon Y.-J.	2020
2	BIO	Liquid bandage prepared with cellulose	Therapeutic effect	*Therapeutic effects of a liquid bandage prepared with cellulose powders from Styela clava tunics and Broussonetia kazinoki bark: Healing of surgical wounds on the skin of Sprague Dawley rats (https://doi.org/10.3892/mmr.2018.9668)*	*Cellulose in different forms has extensively been applied in biomedical treatments, including scaffolding, tissue engineering and tissue formation. To evaluate the therapeutic effects of a liquid bandage (LB) prepared with cellulose powders from Styela clava tunics (SCT) and Broussonetia kazinoki bark (BSLB) for healing cutaneous wounds, the remedial effects of a low concentration (LoBSLB) and a high concentration (HiBSLB) of BSLB on skin regeneration and toxicity in Sprague Dawley rats. Results indicated that the total area of skin involved in the surgical wound was lower in the BSLB-treated group compared with the Vehicle-treated group at days 4-12, although some variations were observed in the HiBSLB-treated group. In addition, the BSLB-treated group showed significantly enhanced width of the re-epithelialization region and epidermal thickness when compared with the Vehicle-treated group. Furthermore, significant stimulation in the expression level of collagen-1 and the signaling pathway of VEGF after topical application of BSLB was indicated. No liver or kidney toxicities were detected for either doses of BSLB. Overall, the results of the present study suggest that BSLB accelerates the process of wound healing in surgical skin wounds of Sprague Dawley rats through stimulation of re-epithelialization and connective tissue formation, without any accompanying significant toxicity. © Spandidos Publications. All*	Park J.J., Kim J.E., Yun W.B., Lee M.R., Choi J.Y., Song B.R., Son H.J., Lim Y., Kang H.-G., An B.S., Yang S.Y., Seo S.B., Hwang D.Y.	2019

					rights reserved.		
3	BIO	Isolates from bacteria	Antimicrobial, antiproliferative activity	*Phylogenetic Analysis and Screening of Antimicrobial and Antiproliferative Activities of Culturable Bacteria Associated with the Ascidian Styela clava from the Yellow Sea, China (https://doi.org/10.1155/2019/7851251)*	*Over 1,000 compounds, including ecteinascidin-743 and didemnin B, have been isolated from ascidians, with most having bioactive properties such as antimicrobial, antitumor, and enzyme-inhibiting activities. In recent years, direct and indirect evidence has shown that some bioactive compounds isolated from ascidians are not produced by ascidians themselves but by their symbiotic microorganisms. Isolated culturable bacteria associated with ascidians and investigating their potential bioactivity are an important approach for discovering novel compounds. In this study, a total of 269 bacteria were isolated from the ascidian Styela clava collected from the coast of Weihai in the north of the Yellow Sea, China. Phylogenetic relationships among 183 isolates were determined using their 16S rRNA gene sequences. Isolates were tested for antimicrobial activity against seven indicator strains, and an antiproliferative activity assay was performed to test for inhibition of human hepatocellular carcinoma Bel 7402 and human cervical carcinoma HeLa cell proliferation. Our results showed that the isolates belonged to 26 genera from 18 families in four phyla (Firmicutes, Actinobacteria, Proteobacteria, and Bacteroidetes). Bacillus and Streptomyces were the most dominant genera; 146 strains had potent antimicrobial activities and inhibited at least one of the indicator strains. Crude extracts from 29 strains showed antiproliferative activity against Bel 7402 cells with IC50 values below 500 μg·mL-1, and 53 strains showed antiproliferative activity against HeLa cells, with IC50 values less than 500 μg·mL-1. Our results suggest that culturable bacteria associated with the ascidian Styela clava may be a promising source of novel bioactive compounds. © 2019 Lei Chen et al.*	Chen L., Wang X.-N., Fu C.-M., Wang G.-Y.	2019
4	BIO	Bromotryptophan	Therapeutic effect	*Bromotryptophan and its analogs in peptides from marine animals (https://doi.org/10.2174/0929866526666190119170020)*	*Bromotryptophan is a nonstandard amino acid that is rarely incorporated in ribosomally synthesized and post-translationally modified peptides (ribosomal peptides). Bromotryptophan and its analogs sometimes occur in non-ribosomal peptides. This paper presents an overview of ribosomal and non-ribosomal peptides that are known to contain bromotryptophan and its analogs. This work further covers the biological activities and therapeutic potential of some of these peptides. © 2019 Bentham Science Publishers.*	Jimenez E.C.	2019
5	BIO	SCW extract	Angiotensin converting enzyme (ACE) inhibitory activity, antioxidant activity, and acetylcholinesterase (AChE)	*Preparation of subcritical water extract with improved physiological activity of styela clava (https://doi.org/10.3746/jkfn.2018.47.11.1112)*	*For diverse application of Styela clava (Korean name: miduduck) as a food material, subcritical water (SCW) extract was prepared and its physiological activity was evaluated. To accomplish this, S. clava powder (0.1 g) was placed in a stainless vessel containing 10 mL of distilled water, after which SCW extraction was carried out at 50, 100, 200, and 300°C for 10, 30, and 60 min. SCW treatment significantly increased important physiological properties of the extract such as angiotensin converting enzyme (ACE) inhibitory activity, antioxidant activity, and acetylcholinesterase (AChE) inhibitory activity. The*	Jo M.-J., Han J.-K., Sung S.-C., Lee S.-C.	2018

			inhibitory activity.		*highest ACE inhibitory activity was found in samples subjected to SCW extraction at 200°C for 60 min; however, the activity decreased at higher temperature (300°C). The SCW extract of S. clava prepared at 300°C for 30 min showed the highest antioxidant activity [1,1-diphenyl-2-picrylhydrazyl and 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) radical scavenging activities] and AChE inhibitory activity. These results indicate that SCW extraction might be a useful method for increasing the physiological activity of S. clava. © 2018, Korean Society of Food Science and Nutrition. All rights reserved.*		
6	BIO	Hydrolysate	Sport medicine, supplement to cell culturesn, anti-inflammatory effect	*Physical and functional properties of tunicate (Styela clava) hydrolysate obtained from pressurized hydrothermal process (https://doi.org/10.1186/s41240-017-0060-1)*	*In this study, marine tunicate Styela clava hydrolysate was produced by an environment friendly and green technology, pressurized hot water hydrolysis (PHWH) at different temperatures (125-275 °C) and pressure 50 bar. A wide range of physico-chemical and bio-functional properties such as color, pH, protein content, total carbohydrate content, reducing sugar content, and radical scavenging activities of the produced hydrolysates were evaluated. The appearance (color) of hydrolysates varied depending on the temperature; hydrolysates obtained at 125-150 °C were lighter, whereas at 175 °C gave reddish-yellow, and 225 °C gave dark brown hydrolysates. The L* (lightness), a* (red-green), and b* (yellow-blue) values of the hydrolysates varied between 35.20 and 50.21, -0.28 and 9.59, and 6.45 and 28.82, respectively. The pH values of S. clava hydrolysates varied from 6.45 (125 °C) to 8.96 (275 °C) and the values were found to be increased as the temperature was increased. The hydrolysis efficiency of S. clava hydrolysate was ranged from 46.05 to 88.67% and the highest value was found at 250 °C. The highest protein, total carbohydrate content, and reducing sugar content of the hydrolysates were found 4.52 mg/g bovine, 11.48 mg/g and 2.77 mg/g at 175, and 200 and 200 °C, respectively. Hydrolysates obtained at lower temperature showed poor radical scavenging activity and the highest DPPH, ABTS, and FRAP activities were obtained 10.25, 14.06, and 10.91 mg trolox equivalent/g hydrolysate (dry matter basis), respectively. Therefore, S. clava hydrolysate obtained by PHWH at 225-250 °C and 50 bar is recommended for bio-functional food supplement preparation. © 2017 The Author(s).*	Lee H.-J., Chae S.-J., Saravana P.S., Chun B.-S.	2017
7	BIO	PSP toxins	NA	*Development and validation of an accurate and sensitive LC-ESI-MS/MS method for the simultaneous determination of paralytic shellfish poisoning toxins in shellfish and tunicate (https://doi.org/10.1016/j.foodcont.2017.02.034)*	*An analytical method using liquid chromatography-tandem mass spectrometry has been developed for the determination of 5 paralytic shellfish poisoning (PSP) toxins (saxitoxin, gonyautoxin1-4) in shellfish and tunicate. The tested parameters included extraction solvent, clean-up method, mobile phase and mass spectrometric detection parameters including multiple reaction monitoring (MRM) conditions. The PSP toxins were extracted with 0.1 N hydrochloric acid and cleaned up using C18 SPE cartridges. Chromatographic separation of the 5 PSP toxins was carried out on a TSK-gel Amide-80 column with gradient elution. The developed method was validated according to the requirements of SANCO 12571/2013. The average*	Shin C., Jang H., Jo H., Kim H.-J., Kim D.-S., Hong J.-H.	2017

					recoveries of the PSP toxins ranged from 82.7% to 110.7%, the intra-day precisions were in the range of 0.3–10.9%, the inter-day precisions were in the range of 0.8–10.0% and the limits of quantification (LOQs) were in the range of 25–100 µg/kg, depending on the analytes and matrices. The validated method was successfully applied for the determination of 5 PSP toxins in real shellfish and tunicate samples, including mussel, oyster, ark shell, sea squirt and styela clava. © 2017 Elsevier Ltd		
8	BIO	Clavanin A	Antimicrobial	*Exploration of the Innate Immune System of Styela clava: Zn2+ Binding Enhances the Antimicrobial Activity of the Tunicate Peptide Clavanin A (https://doi.org/10.1021/acs.biochem.6b01046)*	*Tunicates have been used as primitive models for understanding cell-mediated and humoral immunity. Clavanin A (ClavA) is one member of a family of antimicrobial peptides produced by the solitary tunicate Styela clava. In this work, we demonstrate that ClavA utilizes Zn2+ ions to potentiate its antimicrobial activity not only by reducing the concentration at which the peptide inhibits the growth of bacteria but also by increasing the rate of killing. Membrane depolarization, β-galactosidase leakage, and potassium leakage assays indicate that ClavA is membrane active, forms small pores, but induces cell death by targeting an intracellular component. ClavA and ClavA-Zn2+ added to Escherichia coli and imaged by confocal microscopy translocate across the cell membrane. E. coli mutants lacking the functional Zn2+ import system are less susceptible to ClavA, suggesting that the synergistic activity between ClavA and Zn2+ has a cytoplasmic target, which is further supported by its nucleolytic activity. Overall, these studies identify a remarkable new mechanism by which zinc contributes to the immune response in the tunicate S. clava. © 2017 American Chemical Society.*	Juliano S.A., Pierce S., Demayo J.A., Balunas M.J., Angeles-Boza A.M.	2017
9	BIO	Thirteen new compounds	Antiprotozoal, antimicrobial and cytotoxic activities	*Isolation and biological evaluation of the isolated compounds from the Red Sea Marine Tunicate Styela clava (https://www.researchgate.net/publication/314176099_Isolation_and_Biological_Evaluation_of_the_isolated_Compounds_from_the_Red_Sea_Marine_Tunicate_*	*Three new compounds, clavaside A [methyl 2-O-(1,3-dihydroxypropyl)-xylopyranoside] (1), 3β,8-dimethylnonan-1-ol (2) and 1-(2-methylpropoxy)-13-methyltetradeca-3,6-diene (3) along with the ten known compounds, namely 3-decen-1-ol (4), methoxy α-D-glucose (5), thymidine (6), uridine (7), palmitic acid (8), 9-hexadecenoic acid (9), 1,3-di(9-hexadecenoyl)-2-tetradecanoylglycerol (10), 1,3-ditetradecanoyl-2-(9-hexadecenoyl)-glycerol (11), cholesterol (12) and 24-methylene cholesterol (13) have been isolated from the Marine Tunicate Styela clava collected from the Red Sea. Acetylation of compounds 6, 7, 12 and 13 yielded thymidine 3`,5`-diacetate (6-Ac), uridine 2`,3`,5`-triacetate (7-Ac), cholesterol-3-acetate (12-Ac) and 24-methylene cholesterol-3-acetate (13-Ac), respectively. All compounds were tested for their antiprotozoal, antimicrobial and cytotoxic activities. © 2017, Pharmainfo Publications. All rights reserved.*	Raslan A.E., Radwan M.M., Ahmed S.A., Nafady A.M., Wanas A.S., Hassanean H.A., Elsohly M.	2017
10	BIO	Ethanol extracts	Inhibition of hepatic apoptosis inflammation	*Ethanol extracts collected from the Styela clava tunic alleviate hepatic injury induced by carbon tetrachloride (CCl4) through inhibition of hepatic apoptosis,*	*The Styela clava tunic (SCT) is known as a good raw material for preparing anti-inflammatory compounds, wound healing films, guided bone regeneration, and food additives. To investigate whether ethanol extracts of the SCT (EtSCT) could protect against hep*	Koh E.K., Kim J.E., Song S.H., Sung J.E., Lee H.A., Kim K.S., Hong J.T.,	2017

			and fibrosis	*inflammation, and fibrosis (https://doi.org/10.1293/tox.2017-0021)*		Hwang D.Y.	
11	BIO	Antioxidant extract	Skin aging related-enzyme inhibitory effects	*Protective effects of the antioxidant extract collected from Styela clava tunics on UV radiation induced skin aging in hairless mice (https://doi.org/10.3892/ijmm.2016.2740)*	*Ultraviolet (UV) radiation is considered a primary cause of skin damage, which is characterized by deep wrinkles, roughness, laxity and pigmentation through oxidative stress and oxidative photodamage. To examine the therapeutic effects of ethanol extract*	Koh E.K., Kim J.E., Go J., Song S.H., Sung J.E., Son H.J., Jung Y.J., Kim B.H., Jung Y.S., Hwang D.Y.	2016
12	BIO	Antihypertensive peptide	Glucose uptake stimulation	*Antihypertensive peptide purified from Styela clava flesh tissue stimulates glucose uptake through AMP-activated protein kinase (AMPK) activation in skeletal muscle cells (https://doi.org/10.1007/s00217-015-2526-7)*	*Previously, our group described an antihypertensive peptide (Ala-His-Ile-Ile-Ile, MW: 565.3 Da) with angiotensin I-converting enzyme inhibitory and vasodilatory effects that was purified from Styela clava flesh tissue. In the present study, we investigate*	Ko S.-C., Kim J.-I., Park S.-J., Jung W.-K., Jeon Y.-J.	2016
13	BIO	Different solvent extracts	Cosmetic and antioxidant activities	*Stalked sea squirt (Styela clava) tunic waste as a valuable bioresource: Cosmetic and antioxidant activities (https://doi.org/10.1016/j.procbio.2015.07.018)*	*The aim of this study was to assess the skin aging related-enzyme inhibitory effects and antioxidant effects of different solvent extracts of the tunics of the solitary ascidian tunicate Styela clava, which are regarded as fishery waste. All extracts dose*	Lee S.-M., Lee Y.-R., Cho K.-S., Cho Y.-N., Lee H.A., Hwang D.-Y., Jung Y.-J., Son H.-J.	2015
14	BIO	Clavanin A	Antimicrobial	*Clavanin a improves outcome of complications from different bacterial infections (https://doi.org/10.1128/AAC.03732-14)*	*The rapid increase in the incidence of multidrug-resistant infections today has led to enormous interest in antimicrobial peptides (AMPs) as suitable compounds for developing unusual antibiotics. In this study, clavanin A, an antimicrobial peptide previou*	Silva O.N., Fensterseifer I.C.M., Rodrigues E.A., Holanda H.H.S., Novaes N.R.F., Cunha J.P.A., Rezende T.M.B., Magalhães K.G., Moreno S.E., Jerônimo M.S., Bocca A.L., Franco O.L.	2015
15	BIO	Hydrolysate	Anti-inflammatory effect	*Anti-inflammatory effect of enzymatic hydrolysates from Styela clava flesh tissue in lipopolysaccharide-stimulated RAW 264.7 macrophages and in vivo zebrafish model (https://doi.org/10.4162/nrp.2015.9.3.219)*	*Background/Objectives: In this study, potential anti-inflammatory effect of enzymatic hydrolysates from Styela clava flesh tissue was assessed via nitric oxide (NO) production in lipopolysaccahride (LPS) induced RAW 264.7 macrophages and in vivo zebrafish*	Ko S.-C., Jeon Y.-J.	2015
16	BIO	Crude extract	Immunomodulatory activity	*Purification and characterization of bioactive compounds from styela clava (https://doi.org/10.1155/2014/525141)*	*The immunomodulatory activity of extract from Styela clava was studied systematically based on activity tracking in vitro in order to find out novel-structured secondary metabolite. The proliferation rates of mouse splenic lymphocytes and peritoneal macro*	Ju B., Chen B., Zhang X., Han C., Jiang A.	2014
17	BIO	Cellulose	Skin aging related-enzyme	*Cellulose film regenerated from Styela clava tunics have biodegradability, toxicity and biocompatibility in the skin of SD rats*	*Cellulose is one of the most widespread biomolecules in nature and has been exploited in various applications including scaffolding, tissue engineering, and tissue formation. To evaluate the*	Song S.H., Kim J.E., Lee Y.J., Kwak M.H., Sung G.Y., Kwon	2014

			inhibitory effects	*(https://doi.org/10.1007/s10856-014-5182-8)*	*biocompatibility of cellulose film manufactured from Styela clav*	S.H., Son H.J., Lee H.S., Jung Y.J., Hwang D.Y.	
18	BIO	Antioxidative peptide	Antioxidative effect	*Purification of antioxidative peptide from peptic hydrolysates of Mideodeok (Styela clava) flesh tissue (https://doi.org/10.1007/s10068-013-0112-y)*	*In this study, an antioxidative peptide was obtained by hydrolyzation of mideodeok (Styela clava) flesh tissue with various proteases and purified through gel filtration chromatography and reverse phage-HPLC (RPHPLC), and then antioxidant activity was inv*	Kang N., Ko S.-C., Samarakoon K., Kim E.-A., Kang M.-C., Lee S.-C., Kim J., Kim Y.-T., Kim J.-S., Kim H., Jeon Y.-J.	2013
19	BIO	Antihypertensive peptide	ACE inhibition and NO production	*Marine natural antihypertensive peptides from styela clava having multifunctions of ACE inhibition and NO production in endothelial cells (https://doi.org/10.1201/b13904)*	*Bioactive peptides can be obtained from a variety of marine bioresource proteins (Byun and Kim, 2001). Improved nutritional and potent bioactive peptides have been shown to be generated by the enzymatic hydrolysis of proteins (Ondetti, 1997). Bioactive pe*	Ko S.-C., Kim S.-K., Jeon Y.-J.	2013
20	BIO	Antihypertensive peptide	ACE inhibition and NO production	*Purification and characterization of angiotensin I-converting enzyme inhibitory peptide from enzymatic hydrolysates of Styela clava flesh tissue (https://doi.org/10.1016/j.procbio.2011.10.005)*	*Angiotensin I-converting enzyme (ACE) inhibitory peptide was isolated from the Styela clava flesh tissue. Nine proteases (Protamex, Kojizyme, Neutrase, Flavourzyme, Alcalase, pepsin, trypsin, α-chymotrypsin and papain) were used, and their respective enzy*	Ko S.-C., Lee J.-K., Byun H.-G., Lee S.-C., Jeon Y.-J.	2012
21	BIO	Carotenoids	Antioxidative effect	*Antioxidative activity of carotenoids in mideodeok styela clava (https://doi.org/10.5657/FAS.2011.0243)*	*Carotenoids were found in high levels in both muscle and tunic samples, with the highest and lowest values observed in March and January, respectively. The average values in muscle (GM) and tunic (GT) harvested in Geoje were 49.1 mg/100g and 56.7 mg/100g,*	Nacional L.M., Kang S.-J., Choi B.-D.	2012
22	BIO	Hydrolysate	Antioxidant and anticancer activities	*Antioxidant and anticancer activities of enzymatic hydrolysates of solitary tunicate (Styela clava) (https://doi.org/10.1007/s10068-011-0146-y)*	*The antioxidant and anticancer activities of solitary tunicate (Styela clava) hydrolysate manufactured with different proteases (Alcalase 2.4 L FG, Thermoase PC10F, and pepsin) and optimized by response surface methodology (RSM) were investigated. The hyd*	Jumeri, Kim S.M.	2011
23	BIO	Ten compounds	NA	*Identification of active components in Styela clava by HPLC-ESI-TOF/MS and the study on their HPLC specific chromatograms (https://www.researchgate.net/publication/50194520_Identification_of_active_components_in_Styela_clava_by_HPLC-ESI-TOFMS_and_the_stud*	*A new method based on high performance liquid chromatography-electrospray ionization time of flight-mass spectrometry (HPLC-ESI-TOF/MS) was developed for the rapid identification of active compounds in Styela clava and the development of its specific chro*	Cheng H.-Y., Chen J.-H., Yang H.-H., Zhao H.-Q., Zhang D.-L., Wang X.-R.	2010
24	BIO	Ethanol extracts	Antioxidant potential, oxidative DNA damage and DNA repair	*Effects of ethanol extracts from stalked sea squirt (Styela clava) on antioxidant potential, oxidative DNA damage and DNA repair (https://doi.org/10.1007/s10068-010-0145-4)*	*The aim of this study was to assess the total radical trapping antioxidant potential and antigenotoxic effects by comet assay of ethanol extracts of stalked sea squirt, Styela clava, (tunic, substrate, and whole). All extracts of stalked sea squirt effect*	Park J.-H., Seo B.-Y., Lee S.-C., Park E.	2010
25	BIO	Sphingomyelins	NA	*Sphingomyelins in four ascidians, Ciona intestinalis, Halocynthia roretzi, Halocynthia aurantium, and Styela clava*	*Sphingomyelin is rarely found in lower animals, while sphingophospholipid is a characteristic of higher animals. In this study, sphingomyelin was first isolated and characterized from*	Ito M., Yokoi K., Inoue T., Asano S., Hatano R.,	2009

				(https://doi.org/10.5650/jos.58.473)	*ascidian Ciona intestinalis. Ascidian sphingomyelin was prepared using*	Shinohara R., Itonori S., Sugita M.	

Metridium senile

Plumose anemone

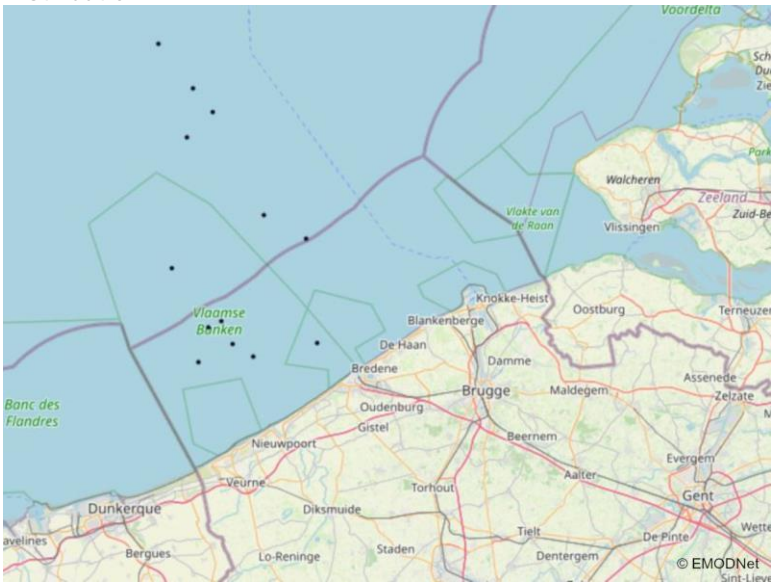
Aphia ID #100982

Kingdom:	Animalia
Phylum:	Cnidaria
Class:	Anthozoa
Order:	Actiniaria
Family:	Metridiidae
Genus:	Metridium
Species:	senile

INFORMATION PANEL

Observations: 43

Distribution:



Habitat type: Benthic zone
Substrate: Hard substrate

DESCRIPTION

Size: 0 - 500 mm

Brief description:
Metridium senile is an anemone of very variable form. The base is wider than the column and often irregular. When expanded, the numerous tentacles form a 'plume' above a conspicuous parapet at the top of the smooth column. The colour is plain, commonly white orange or dark green but brown, grey or occasionally red or yellow varieties occur. Attached to any suitable hard substratum in overhangs, caves and beneath boulders on the lower shore, and on pier piles and rock faces to at least 100 m.

Sampling method: Hand collection
Dutch name: Zeeanjelier

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Peptide	Analgesic effect	*Peptide from sea anemone Metridium senile affects transient receptor potential ankyrin-repeat 1 (TRPA1) function and produces analgesic effect (http://www.jbc.org/content/292/7/2992.short)*	*Peptide from sea anemone metridium senile affects transient receptor potential ankyrin-repeat 1 (TRPA1) function and produces analgesic effect. The novel peptide producing a significant potentiating effect on allyl isothiocyanate- and diclofenac-induced currents of TRPA1 was isolated from the venom of sea anemone Metridium senile.*	Logashina, Y. A., Mosharova, I. V., Korolkova, Y. V., Shelukhina, I. V., Dyachenko, I. A., Palikov, V. A., ... & Andreev, Y. A.	2017
2	BIO	Peptides	Neurotoxic and cytolitic properties	*Cnidarian neurotoxic peptides affecting central nervous system targets (https://doi.org/10.2174/1871524915666150722120915)*	*Natural products from animal venoms have been used widely in the discovery of novel molecules with particular biological activities that enable their use as potential drug candidates. The phylum Cnidaria (jellyfish, sea anemones, corals zoan-thids, hydrozoans, etc.) is the most ancient venomous phylum on earth. Its venoms are composed of a complex mixture of peptidic compounds with neurotoxic and cytolitic properties that have shown activity on mammalian systems despite the fact that they are naturally targeted against fish and invertebrate preys, mainly crustaceans. For this reason, cnidarian venoms are an interesting and vast source of molecules with a remarkable activity on central nervous system, targeting mainly voltage-gated ion channels, ASIC channels, and TRPV1 receptors. In this brief review, we list the amino acid sequences of most cnidarian neurotoxic peptides reported to date. Additionally, we propose the inclusion of a new type of voltage-gated sea anemone sodium channel toxins based on the most recent reports. © 2016 Bentham Science Publishers.*	Lazcano-Pérez F., Hernández-Guzmán U., Sánchez-Rodríguez J., Arreguín-Espinosa R.	2016
3	BIO	Polypeptide cytolytic toxins (e.g. acidic metridiolysin)	Cytolitic proporties	*Cytolytic peptide and protein toxins from sea anemones (Anthozoa: Actiniaria) (https://www.sciencedirect.com/science/article/pii/S004101010100191X)*	*More than 32 species of sea anemones have been reported to produce lethal cytolytic peptides and proteins.These peptides form pores in phosphatidylcholine containing membranes. Biological, structure–function, and pharmacological characteristics of these cytolysins are reviewed.*	Anderluh, G., & Maček, P.	2002
4	BIO	Enzyme	Glycolytic	*Anaerobiosis and the regulation of glycolytic enzymes in the sea anemone Metridium senile (https://onlinelibrary.wiley.com/doi/abs/10.1002/jez.1402560205)*	*Changes in glycolytic function during anaerobiosis in sea anemones are mediated by covalent modifications of the regulatory enzymes as well as changes in the levels of F2,6P2 and other metabolite effectors of the enzymes*	Michaelidis, B., & Storey, K. B.	1990
5	BIO	Secoadenochromine, cysteinyl-dopas and 5-hydroxydopa	Peptide	*Biochemical basis for adrenergic neurotransmission in coelenterates (https://link.springer.com/article/10.1007/BF00685220)*	*Secoadenochromine, cysteinyl-dopas and 5-hydroxydopa. These are known to be formed by tyrosinase, which was recently shown to be present in the sea anemone Metridium senile*	Carlberg, M., & Rosengren, E.	1985
6	BIO	Calmodulin	Peptide	*The amino acid sequence of the calmodulin obtained from sea anemone (Metridium senile) muscle*	*The amino acid sequence of the calmodulin obtained from sea anemone muscle was determined. The calmodulin was composed of 148 amino acid residues and its amino terminal was blocked. When*	Takagi, T., Nemoto, T., Konishi, K., Yazawa, M., & Yagi,	1980

				(https://www.sciencedirect.com/science/article/pii/0006291X80912255)	*compared with bovine brain calmodulin, the number of amino acid residues per molecule was the same and there were 3 replacements at residues 99 (Tyr→ Phe), 143 (Gln→ Lys) and 147 (Ala→ Ser).*	K.	
7	BIO	Lipids	Fatty acid	*Isolation and characterization of the lipids of the sea anemone, Metridium senile (https://www.sciencedirect.com/science/article/abs/pii/0005276072901336)*	*The total lipid content of the East Coast sea anemone Metridium senile has been studied in detail and found to be composed primarily of phosphatidylcholine, phosphatidylethanolamine, and cholesterol with a small amount of phosphatidyl serine and other minor components.*	Mason, W. T.	1972
8	BIO	Chymoytrypsin-like proteases	Enzyme	*Chymotrypsin-like proteases from the sea anemone, Metridium senile (https://www.nature.com/articles/222753a0)*	*Proteases from the sea anemone have the same zymogen activation and active site chemistry as the proteases of the mammalian pancreas. One of them has kinetic properties remarkably similar to chymotrypsin. The findings suggest a common ancestry for the digestive process of mammals and coelenterates.*	Gibson, D., & DIXON, G. H.	1969
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Sagartia spp.

Aphia ID #100776

Kingdom:	Animalia
Phylum:	Cnidaria
Class:	Anthozoa
Order:	Actiniaria
Family:	Sagartiidae
Genus:	Sagartia
Species:	spp.

INFORMATION PANEL

Observations: 208

Distribution:

Habitat type: Benthic zone
Substrate: Sand, gravel, rocks

DESCRIPTION

Size: 0 - 120 mm

Brief description:
A graceful sea anemone with long tentacles arranged in multiples of six. It grows up to 12 cm tall and 6 cm across the base which is strongly adherent. The disc and tentacles are translucent pale greyish in colour, while the disc is variegated with cream, and with a regular but not striking pattern. The tentacles have lateral dark lines down their length. The column is tall in extension with no suckers and pale yellowish buff in colour, with regular vertical stripes of brown flecks of variable intensity. Typically found buried in sand or gravel, attached to a stone or shell 10-15 cm into the sediment or in crevices or holes in rocks. Found on the lower shore and sublittoral to a depth of at least 100 m.

Sampling method: Hand collection
Dutch name: (Slibanemoon

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Derivative of 2,6-diaminopurine	NA	*Isolation and x-ray crystal structure of a derivative of 2,6-diaminopurine from a sea anemone (https://pubs.acs.org/doi/abs/10.1021/np50053a017)*	*A trimethyl derivative of 2,6-diaminopurine has been isolated from the sea anemone Sagartia troglodytes. The structure was determined on spectral grounds and by X-ray analysis. © 1987, American Chemical Society. All rights reserved.*	De Rosa S., de Stefano S., Puliti R., Mattia C.A., Mazzarella L.	1987
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Sagartiogeton undatus

Small snakelocks anemone

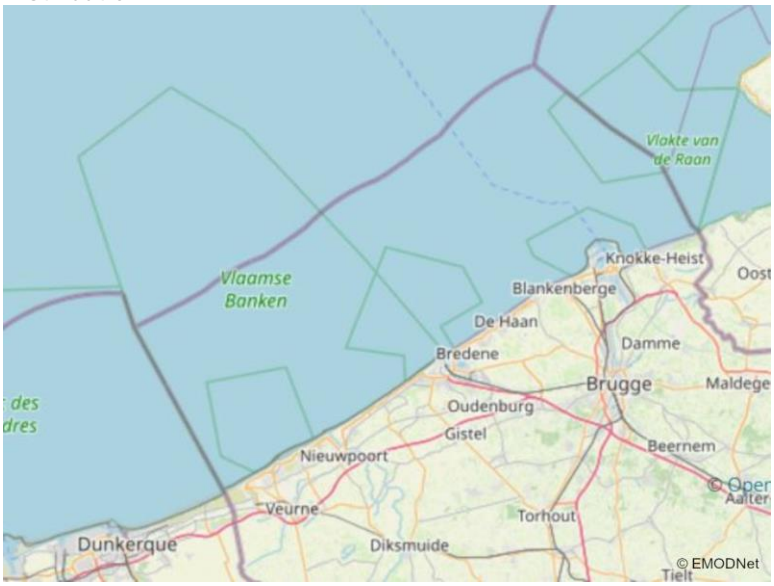
Aphia ID #101002

Kingdom:	Animalia
Phylum:	Cnidaria
Class:	Anthozoa
Order:	Actiniaria
Family:	Sagartiidae
Genus:	Sagartiogeton
Species:	undatus

INFORMATION PANEL

Observations: NA

Distribution:



Habitat type: Benthic zone
Substrate: Sand, gravel, rocks, shells

DESCRIPTION

Size: 0 - 120 mm

Brief description:
A graceful sea anemone with long tentacles arranged in multiples of six. It grows up to 12 cm tall and 6 cm across the base which is strongly adherent. The disc and tentacles are translucent pale greyish in colour, while the disc is variegated with cream, and with a regular but not striking pattern. The tentacles have lateral dark lines down their length. The column is tall in extension with no suckers and pale yellowish buff in colour, with regular vertical stripes of brown flecks of variable intensity.

Sampling method: Hand collection
Dutch name: Weduweroos

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
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Alcyonium digitatum

Dead man's fingers

Aphia ID #125333

Kingdom:	Animalia
Phylum:	Cnidaria
Class:	Anthozoa
Order:	Alcyonacea
Family:	Alcyoniidae
Genus:	Alcyonium
Species:	digitatum

INFORMATION PANEL

Observations: 34

Distribution:

Habitat type: Benthic zone
Substrate: Rocks, shells

DESCRIPTION

Size: 0 - 200 mm

Brief description:
Mature colonies form thick, fleshy masses of irregular shape, typically of stout, finger-like lobes that usually exceed 20 mm in diameter. Young, developing colonies form encrustations about 5 -10mm thick. The height and breadth of colonies are up to 200 mm. Colonies are white or orange in colour, but may appear reddish or brownish during periods of inactivity when the polyps are withdrawn into the colony, owing to the development of a film of epibiota. Attached to rocks, shells and stones where the otherwise dominant algae are inhibited by a lack of light and occasionally on living crabs and gastropods. Generally found in situations where strong water movement prevails. Occasionally on the lower shore but more common sublittorally, down to about 50 m.

Sampling method: Hand collection
Dutch name: Dodemansduim

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Bacteria associated with Alcyonium digitatum	Antimicrobial	*Diversity and antimicrobial potential of bacterial isolates associated with the soft coral Alcyoniumdigitatum from the Baltic Sea (https://link.springer.com/article/10.1007/s10482-015-0613-1)*	*The biodiversity of bacteria associated with the soft coral Alcyonium digitatum, which is abundant in the Baltic Sea. In order to increase the cultured diversity, bacteria were isolated using four different media, identified with support of 16S rRNA gene sequences and screened for antimicrobial activity using two different media. It became obvious during this study that the production of antibiotic substances not only is strain-specific, but in many cases also depends on the media composition and growth conditions. In addition, the antimicrobial potential of bacteria associated with A. digitatum may represent a promising source for antimicrobial substances.*	Pham, T. M., Wiese, J., Wenzel-Storjohann, A., & Imhoff, J. F.	2016
2	BIO	α-proteobacterial, bacteriodete, actinobacterial and firmicute lineages	NA	*Microbial diversity of Alcyonium digitatum (https://doi.org/10.1007/s11101-012-9229-5)*	*Marine multi-cellular organisms are described as sources of many newly discovered bioactive compounds. Meanwhile, it has been demonstrated repeatedly for several natural products of reputed multicellular origin that they are, in fact, produced by endophytic unicellular organisms - such as microbial fungi or bacteria. Consequently, while studying compounds isolated from a living organism, it is essential to ensure that the sample integrity is not compromised. To test the diversity of the endobiome from Alcyonium digitatum, a cold water coral found along the Atlantic coasts of the northern hemisphere, we performed a culture dependent surveyed using a phylogenetic approach. A 1 cm3 cube from the interior tissue of A. digitatum was excised under aseptic conditions, homogenized, spread onto agar-based growth medium plates and incubated in 22 C to promote microbial growth. Colonies were transferred to secondary medium plates, incubated, and after harvesting lysed using sterile water to release DNA. 16S and 23S rDNA regions were amplified using PCR, and sequenced for systematic evaluation using phylogenetic analysis. From this survey we identified a broad selection of bacteria, predominantly of the α-proteobacterial, bacteriodete, actinobacterial and firmicute lineages, demonstrating a significant biodiversity of the coral bacterial endobiome. © 2012 Springer Science+Business Media B.V.*	Alsmark C., Strese A., Wedén C., Backlund A.	2013
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Ectopleura larynx

Ringed tubularian

Aphia ID #157933

Kingdom:	Animalia
Phylum:	Cnidaria
Class:	Hydrozoa
Order:	Anthoathecata
Family:	Tubulariidae
Genus:	Ectopleura
Species:	larynx

INFORMATION PANEL

Observations: 7

Distribution:

Habitat type: Benthic zone
Substrate: Hard substrate

DESCRIPTION

Size: 20 - 60 mm

Brief description:
The colony appears as a collection of pale, straw-colored stems. The stems are often branched, in contrast to the yellow, unbranched stem of the similar Tubularia indivisa. The colonies are usually no more than 6 cm high. Each hydrant is often rose-red and has two circles of tentacles. The inner circle consists of 14-20 white oral tentacles. The outer circle includes approximately 20 tentacles.

Sampling method: Hand collection
Dutch name: Gorgelpijppoliep

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Pathogenic endobacteria	Chemical defence	*Endobacteria in the tentacles of selected cnidarian species and in the cerata of their nudibranch predators (https://doi.org/10.1007/s10152-011-0245-4)*	*This is the first genetic analysis comparing cultured endobacteria discovered in the tentacles of cnidarian species (Tubularia indivisa, Tubularia larynx, Corymorpha nutans, Sagartia elegans) with those found in the cerata tips of selected nudibranch species (Berghia caerulescens, Coryphella lineata, Coryphella gracilis, Janolus cristatus, Polycera faeroensis, Polycera quadrilineata, Doto coronata, Dendronotus frondosus). Shared pathogenic activities were found among other microorganisms in the Pseudoalteromonas tetraodonis group (TTX), and the Vibrio splendidus group (haemolytic, septicaemic, necrotic activity). Specific autochthonous endobacteria of extremely low similarity to their next neighbours were detected in nudibranch cerata. These organisms are regarded as new and unknown endobacteria; among them were Pseudoalteromonas luteoviolacea (95%), Orientia tsutsugamushi (84%), Gracilimonas tropica (96%), Balneola alkaliphia (95%), Loktanella rosea (97%). SEM micrographs provide insight into endobacterial aggregates in cnidarian tentacles and nudibranch cerata. Since certain nudibranch predators prey on cnidarian species, it is assumed that cnidarian tentacle bacteria are directly transferred to nudibranch cerata. The pathogenic endobacteria may contribute to the chemical defence of both the nudibranch and cnidarian species investigated. © 2011 Springer-Verlag and AWI.*	Doepke H., Herrmann K., Schuett C.	2012
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Tubularia indivisa

Tall tubularian

Aphia ID #117994

Kingdom:	Animalia
Phylum:	Cnidaria
Class:	Hydrozoa
Order:	Anthoathecata
Family:	Tubulariidae
Genus:	Tubularia
Species:	indivisa

INFORMATION PANEL

Observations: 26

Distribution:

Habitat type: Benthic zone
Substrate: Hard substrate

DESCRIPTION

Size: 30 - 150 mm

Brief description:
A large hydroid 10-15 cm in height with a solitary polyp. The polyp and tentacles have a diameter of about 1.5 cm. Stems are erect, clustered together and fuse with each other towards the base of the colony, which has a tough yellowish coloured natural outer layer. The polyps are conical or flask shaped and richly coloured with various shades of pink to red. The polyp looks flower-like and consists of a central circlet of about 40 oral tentacles surrounded by about 20-30 paler but larger aboral tentacles. Polyps are often present only in the spring and are eaten by nudibranchs leaving the stems. Tubularia indivisa grows on various hard substrata in a wide range of water depths from rocks in the intertidal, or in shallow water near shore, and at great depths. It is particularly abundant on exposed to strong tidal currents.

Sampling method: Hand collection
Dutch name: Penneschaft

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Pathogenic endobacteria	Chemical defence	*Endobacteria in the tentacles of selected cnidarian species and in the cerata of their nudibranch predators (https://doi.org/10.1007/s10152-011-0245-4)*	*This is the first genetic analysis comparing cultured endobacteria discovered in the tentacles of cnidarian species (Tubularia indivisa, Tubularia larynx, Corymorpha nutans, Sagartia elegans) with those found in the cerata tips of selected nudibranch species (Berghia caerulescens, Coryphella lineata, Coryphella gracilis, Janolus cristatus, Polycera faeroensis, Polycera quadrilineata, Doto coronata, Dendronotus frondosus). Shared pathogenic activities were found among other microorganisms in the Pseudoalteromonas tetraodonis group (TTX), and the Vibrio splendidus group (haemolytic, septicaemic, necrotic activity). Specific autochthonous endobacteria of extremely low similarity to their next neighbours were detected in nudibranch cerata. These organisms are regarded as new and unknown endobacteria; among them were Pseudoalteromonas luteoviolacea (95%), Orientia tsutsugamushi (84%), Gracilimonas tropica (96%), Balneola alkaliphia (95%), Loktanella rosea (97%). SEM micrographs provide insight into endobacterial aggregates in cnidarian tentacles and nudibranch cerata. Since certain nudibranch predators prey on cnidarian species, it is assumed that cnidarian tentacle bacteria are directly transferred to nudibranch cerata. The pathogenic endobacteria may contribute to the chemical defence of both the nudibranch and cnidarian species investigated. © 2011 Springer-Verlag and AWI.*	Doepke H., Herrmann K., Schuett C.	2012
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Cyanea lamarckii

Blue jellyfish

Aphia ID #135302

Kingdom:	Animalia
Phylum:	Cnidaria
Class:	Scyphozoa
Order:	Semaeostomeae
Family:	Cyaneidae
Genus:	Cyanea
Species:	lamarckii

INFORMATION PANEL

Observations: 28

Distribution:

Habitat type: Pelagic zone
Substrate: NA

DESCRIPTION

Size: 60 - 300 mm

Brief description:
The bell of the blue jellyfish can grow up to 30 cm in diameter. Hollow marginal tentacles arise from underneath the bell. These are arranged in eight horseshoe or rectangular shaped groups each with 40-60 tentacles. Beneath the bell is a short thick manubrium merging onto four wide membranous and folded curtain like oral lips. The oral lips may be yellowish and fade to white at their extremities. It has thick and frilly oral arms that are slightly shorter than the diameter of the bell. The sense organs in the bell are protected by a long exumbrellar extension which forms a hood. Its colour varies from translucent through pale yellow, pale brown, pale grey to light blue or purple.

Sampling method: Beam trawl, Plankton net
Dutch name: Blauwe haarkwal

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Neuropeptide	Peptide	*Isolation of Three Novel Neuropeptides, the Cyanea-RFamides I–III, from Scyphomedusae (https://www.sciencedirect.com/science/article/pii/S0006291X97970224)*	*Characterisation of novel neuropeptides. The Cyanea-RFamides are neuropeptides and form a peptide family with other known neuropeptides isolated fromHydraand hydromedusae (belonging to the class Hydrozoa), and various sea anemones and sea pansies (belonging to the class Anthozoa).*	AngelikaMoosler, Kenneth L.Rinehart, Cornelis J.P.Grimmelikhuijzen	1997
2	BIO	Neuropeptide	Peptide	*Comparative study on the cell toxicity and enzymatic activity of two northern scyphozoan species Cyanea capillata (L.) and Cyanea lamarckii (Péron & Léslieur) (https://www.sciencedirect.com/science/article/pii/S0041010107000736)*	*Purified cnidocyst extracts were tested for their enzymatic, cytotoxic and haemolytic potency. The haemolytic activity was documented for the first time. Fishing tentacle cnidocysts showed a less potent haemolytic activity compared to extracts of mesenteric tentacles. In vitro studies with permanent cells of a hepatoma cell line have shown a time and concentration dependent loss of cell vitality up to 90% at 33.3 µgprotein/mL (10 µgprotein/105 cells). Supplementing the cell based toxicity tests an enzyme assay was performed to measure a phospholipase A2 (PLA2) activity. A PLA2-like activity could be demonstrated in cnidocysts extracts prepared from mesenteric and fishing tentacles of both jellyfish species.*	Heike Helmholz, Christiane Ruhnau, Christian Schütt, Andreas Prange	2007
3	BIO	Glycoprotein	Cytotoxicity	*Isolation of a cytotoxic glycoprotein from the Scyphozoa Cyanea lamarckii by lectin-affinity chromatography and characterization of molecule interactions by surface plasmon resonance (https://doi.org/10.1016/j.jchromb.2008.06.040)*	*A biospecific lectin-affinity-based isolation process for a novel glycoprotein (ClGp1) from the venom of the pelagic jellyfish Cyanea lamarckii, is described and the isolated glycoprotein is chemically and biologically characterized according to size, molecular interaction and toxicity. The molecular mass of the isolated protein is 25.7 kDa as determined by matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF). The carbohydrate content was calculated after enzymatic deglycosylation as 6.85 kDa. The glycoprotein is cytotoxic and could be isolated from cnidocysts of mesenteric and fishing tentacles. The binding behaviour of the glycoprotein to the lectins Concanavalin A (ConA) and Wheat Germ Agglutinin (WGA) was analyzed by surface plasmon resonance (SPR) and affinity constants in the range of KD = 3.0 × 10-7 M for ConA and 2.1 × 10-6 M (pH 5.0) and 2.6 × 10-6 M (pH 7.4) for WGA were obtained. © 2008 Elsevier B.V. All rights reserved.*	Helmholz H., Naatz S., Lassen S., Prange A.	2008
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Chrysaora hysoscella

Compass jellyfish

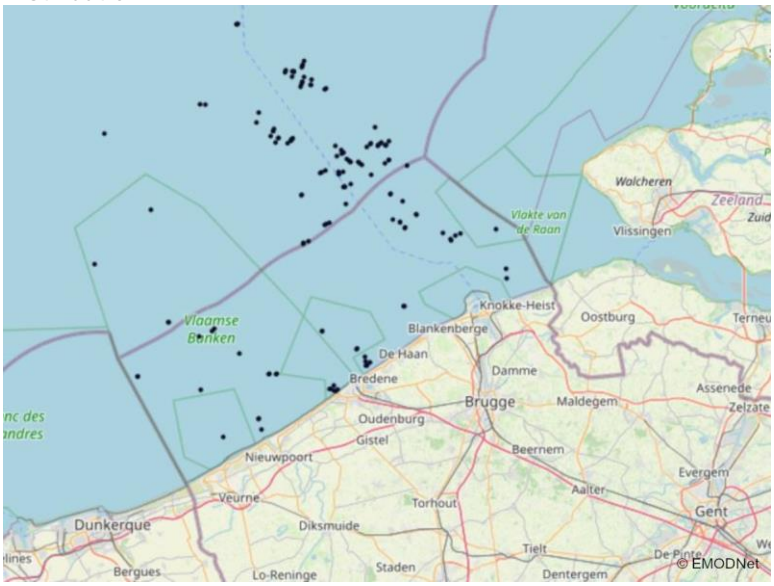
Aphia ID #135304

Kingdom:	Animalia
Phylum:	Cnidaria
Class:	Scyphozoa
Order:	Semaeostomeae
Family:	Pelagiidae
Genus:	Chrysaora
Species:	hysoscella

INFORMATION PANEL

Observations: 148

Distribution:



Habitat type: Pelagic zone
Substrate: NA

DESCRIPTION

Size: 0 - 300 mm

Brief description:
Chrysaora hysoscella has a thickened bell (manubrium) that can grow up to 30 cm in diameter. The edges of the bell are developed into 32 lobes and bear 24 marginal tentacles. These are arranged in eight groups of three which alternate with eight sensory organs and are capable of great elongation. The marginal tentacles are conical in shape with a flattened thicker base giving the jellyfish a fluted appearance. They are also covered with clusters of stinging cells (nematocysts). It has a long and slender manubrium which leads onto 4 oral arms that are fused for a short distance at its base. Typically Chrysaora hysoscella is yellowish white in colour with a highly distinctive brown pattern like the radii of a compass.

Sampling method: Beam trawl, Plankton net
Dutch name: Kompaskwal

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Proteins	Toxicity	*Characterization and Pharmacological Activities of Jellyfish, Chrysaora hysoscella Captured in Bushehr Port, Iran (http://ijt.arakmu.ac.ir/browse.php?a_id=508&sid=1&slc_lang=fa)*	*This study reports isolation of the Chrysaora hysoscella nematocysts and evaluating its pharmacological activities during a bloom in 2013. The venom of C. hysoscella captured in Jofre area in Bushehr port was analyzed. The electrophoretic profile was assessed by SDS-PAGE (12.5%) and the crude sample was analyzed using reverse phase HPLC. Caseinase activity was also determined. After separation of tentacles and isolation of their nematocysts, three different major protein components were revealed at 72-250 kDa with SDS-PAGE, signifying the presence of peptides in its venom. Two major peaks at 8.62 and 11.23 min were observed in reverse phase HPLC of the crude venom denoting protease peptide structural identities. Caseinase activity of C. hysoscella's venom was extremely low as compared with other jellyfish venoms.*	Somayyeh Gharibi, Iraj Nabipour, Euikyung Kim, Seyede Maryam Ghafari, Seyed Mehdi Hoseiny, Mostafa Kamyab, Ramin Seyedian	2016
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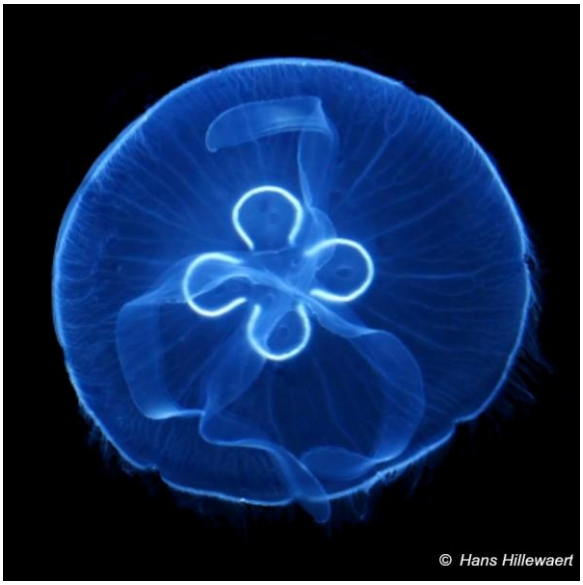
Aurelia aurita

Moon jellyfish

Aphia ID #135306

Kingdom:	Animalia
Phylum:	Cnidaria
Class:	Scyphozoa
Order:	Semaeostomeae
Family:	Ulmaridae
Genus:	Aurelia
Species:	aurita



INFORMATION PANEL

Observations: 13

Distribution:

Habitat type: Pelagic zone
Substrate: NA

DESCRIPTION

Size: 50 - 400 mm

Brief description:
Aurelia aurita has a smooth, flattened saucer-shaped bell (the umbrella) with eight simple marginal lobes. The umbrella is colourless, while the radial canals, oral arms and gonads are typically mauve, violet, reddish, pink or yellowish in colour. Aurelia aurita usually grows to approximately 25 cm in diameter but can reach 40 cm. The umbrella is quite thick, thinning towards the edge, with numerous short, hollow tentacles forming a fringe around the edge. These short tentacles are ringed by numerous stinging cells (nematocysts). There are four interfolded gonads that form a horseshoe or near circle shape in the centre of the umbrella. Eight branched and eight un-branched canals connect to the marginal ring-canal of the umbrella. The mouth is formed on a projection on the underside of the umbrella (the manubrium).

Sampling method: Beam trawl, Plankton net
Dutch name: Oorkwal

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Six nematocyst types	Toxicity	*Nematocyst types and venom effects of Aurelia aurita and Velella velella from the Mediterranean Sea (https://doi.org/10.1016/j.toxicon.2019.12.155)*	*Natural substances produced by venomous marine organisms are thought to be possible sources of useful compounds and new drugs having the potential to open new ways for pharmacology, nutrition and environmental applications. In this framework, cnidarians are very interesting being widely distributed and all are venomous organisms; so, a deep knowledge of their occurrence, morphology of venomous structures and of effects of venoms at cellular level is fundamental to evaluate the possible utilization of venomous compounds or extracts. In this research, the morphology and occurrence of nematocysts in two cnidarian species (Aurelia aurita, Velella velella), and the preliminary evaluation of the cytotoxicity of V. velella crude extract, of which cytotoxicity on cell cultures at present is unknown, were considered. The specimens were sampled in Güllük Bay, Southwestern coast of Turkey, and in the Gulf of Genova, Northwestern coast of Italy. Six nematocyst types (a-isorhiza, A-isorhiza, O-isorhiza, eurytele, polyspiras, birhopaloid) having different sizes, were observed in A. aurita, and two types (eurytele and stenotele) in V. velella. The crude extract from V. velella showed cytotoxic activity against cultured fibroblasts L929 at high doses, while inducing cell proliferation at low doses. The protein content in the extract increased remarkably after disruption of nematocysts. © 2019 Elsevier Ltd*	Killi N., Bonello G., Mariottini G.L., Pardini P., Pozzolini M., Cengiz S.	2020
2	BIO	Phenols, alakoids, steriods	Antioxidant, antidiabetic activities	*Protective effect of Aurelia aurita against free radicals and streptozotocin-induced diabetes (https://doi.org/10.3329/bjp.v13i3.36907)*	*The present work was carried out to identify the anti-oxidant and antidiabetic activities of Aurelia aurita. The chemical profiling analysis showed that it possess different biologically active secondary metabolites like phenols, alakoids, steroids etc. The methanolic extract showed different free radical scavenging activity as ascorbic acid with IC50 values 202, 205, 153 µg on DPPH, hydroxyl and superoxide free radicals. The extract significantly reduced the hyperglycemic conditions with percentage of reduction 18.7 ± 1.3 to 53.5 ±1.5 of streptozotocin-induced animals and the positive result of in-vitro aldose reductase enzyme inhibition with IC50 value 163 µg suggests that A. aurita have potential to cure the diabetic complications. © 2018, Bangladesh Pharmacological Society. All rights reserved.*	Talluri M.R., Ketha A., Battu G.R., Tadi R.S., Tatipamula V.B.	2018
3	BIO	Cytotoxins and enzymes	Toxicity	*The dynamically evolving nematocyst content of an Anthozoan, a scyphozoan, and a hydrozoan (https://doi.org/10.1093/molbev/msu335)*	*Nematocytes, the stinging cells of cnidarians, are the most evolutionarily ancient venom apparatus. These nanosyringelike weaponry systems reach pressures of approximately 150 atmospheres before discharging and punching through the outer layer of the prey or predator at accelerations of more than 5 million g, making them one of the fastest biomechanical events known. To gain*	Rachamim T., Morgenstern D., Aharonovich D., Brekhman V., Lotan T., Sher D.	2015

					better understanding of the function of the complex, phylum-specific nematocyst organelle, and its venom payload, we compared the soluble nematocyst's proteome from the sea anemone Anemonia viridis, the jellyfish Aurelia aurita, and the hydrozoan Hydra magnipapillata, each belonging to one of the three basal cnidarian lineages which diverged over 600 Ma. Although the basic morphological and functional characteristics of the nematocysts of the three organisms are similar, out of hundreds of proteins identified in each organism, only six are shared. These include structural proteins, a chaperone which may help maintain venon activity over extended periods, and dickkopf, an enigmatic Wnt ligand which may also serve as a toxin. Nevertheless, many protein domains are shared between the three organisms' nematocyst content suggesting common proteome functionalities. The venoms of Hydra and Aurelia appear to be functionally similar and composed mainly of cytotoxins and enzymes, whereas the venom of the Anemonia is markedly unique and based on peptide neurotoxins. Cnidarian venoms show evidence for functional recruitment, yet evidence for diversification through positive selection, common to other venoms, is lacking. The final injected nematocyst payload comprises a mixture of dynamically evolving proteins involved in the development, maturation, maintenance, and discharge of the nematocysts, which is unique to each organism and potentially to each nematocyst type. © The Author 2014. Published by Oxford University Press on behalf of the Society for Molecular Biology and Evolution. All rights reserved.		
4	BIO	Toxins	Hemolytic, cytotoxic, neurotoxic or enzymatic activities	*Bioactive toxins from stinging jellyfish (https://doi.org/10.1016/j.toxicon.2014.09.010)*	*Jellyfish blooms occur throughout the world. Human contact with a jellyfish induces a local reaction of the skin, which can be painful and leave scaring. Systemic symptoms are also observed and contact with some species is lethal. A number of studies have evaluated the in vitro biological activity of whole jellyfish venom or of purified fractions. Hemolytic, cytotoxic, neurotoxic or enzymatic activities are commonly observed. Some toxins have been purified and characterized. A family of pore forming toxins specific to Medusozoans has been identified. There remains a need for detailed characterization of jellyfish toxins to fully understand the symptoms observed in vivo. © 2014 Elsevier Ltd. All rights reserved.*	Badré S.	2014
5	BIO	Immunoreactive to antibodies against serotonin	NA	*Pattern of serotonin-like immunoreactive cells in scyphozoan and hydrozoan planulae and their relation to settlement (https://doi.org/10.1111/azo.12023)*	*The planulae of almost all investigated cnidarian species possess neuron-like cells. The distribution of these cells is usually uneven throughout the long axis of the planula. The majority of these cells are located in the anterior half of the planula body. Scyphozoan planulae, as well as anthozoan planulae, have a sensory structure at the anterior pole called an apical organ, which is believed to take part in metamorphosis induction. Hydrozoan planulae also possess sensory cells. It has been previously shown in several cnidarian larvae that their neuronal cells contain the neurotransmitter, serotonin. The present study describes the peculiarities of serotonin-like*	Mayorova T., Kach J., Kosevich I.	2014

					immunoreactive cells in Aurelia aurita (Scyphozoa) and Gonothyraea loveni (Hydrozoa) planulae. We show that several cells in the presumptive apical organ of A. aurita are immunoreactive to antibodies against serotonin, while G. loveni planulae have an accumulation of serotonin-positive cells near the anterior pole. Additional serotonin-like immunoreactive cells are found in the lateral ectoderm of both planulae. Treatment of A. aurita and G. loveni planulae with serotonin or its blockers show that serotonin is likely involved in the initiation of planula settlement. © 2013 The Royal Swedish Academy of Sciences.		
6	BIO	Proteins	Neurotoxic effect	*Preliminary results of the in vivo and in vitro characterization of a tentacle venom fraction from the jellyfish Aurelia aurita (https://doi.org/10.3390/toxins5122420)*	*The neurotoxic effects produced by a tentacle venom extract and a fraction were analyzed and correlated by in vivo and in vitro approaches. The tentacle venom extract exhibited a wide range of protein components (from 24 to >225 kDa) and produced tetanic reactions, flaccid paralysis, and death when injected into crabs. Two chromatography fractions also produced uncontrolled appendix movements and leg stretching. Further electrophysiological characterization demonstrated that one of these fractions potently inhibited ACh-elicited currents mediated by both vertebrate fetal and adult muscle nicotinic acetylcholine receptors (nAChR) subtypes. Receptor inhibition was concentration-dependent and completely reversible. The calculated IC50 values were 1.77 µg/µL for fetal and 2.28 µg/µL for adult muscle nAChRs. The bioactive fraction was composed of a major protein component at ~90 kDa and lacked phospholipase A activity. This work represents the first insight into the interaction of jellyfish venom components and muscle nicotinic receptors. © 2013 by the authors; licensee MDPI, Basel, Switzerland.*	Ponce D., López-Vera E., Aguilar M.B., Sánchez-Rodríguez J.	2013
7	BIO	Jellyfish Tentacle Extract (JFTE)	Anticoagulant and fibrinogenolytic activity	*Anticoagulant activity of Moon jellyfish (Aurelia aurita) tentacle extract (https://doi.org/10.1016/j.toxicon.2012.05.008)*	*Moon jellyfish (Aurelia aurita) tentacle extract was studied for its anticoagulant activity in vitro. The Jellyfish Tentacle Extract (JFTE) showed very strong fibrinogenolytic activity by cleaving Aα and Bβ chain of fibrinogen molecule. The fibrinogenolytic activity was found to be stronger than some snake venom derived anticoagulants. JFTE also completely liquefied fibrin clots in 24 h. JFTE was found to contain both high and low molecular weight proteins/peptides. The fibrinogenolysis appears to be caused by high molecular weight fractions of the extract. It has been also noted that PMSF significantly reduced fibrinogenolytic activity and heating totally abolished it. Autolytic degradation of the high molecular weight protein was also noted. Autolysis slowed down, but did not abolish the fibrinogenolytic activity of the extract. © 2012 Elsevier Ltd.*	Rastogi A., Biswas S., Sarkar A., Chakrabarty D.	2012
8	BIO	Lysins	Haemolytic potency	*Selective toxin-lipid membrane interactions of natural, haemolytic Scyphozoan toxins analyzed by surface plasmon resonance (https://doi.org/10.1016/j.bbamem.2010.06.*	*A comparison of the molecular interaction of natural Scyphozoan lysins with their bioactivity in a haemolytic assay was performed by establishing an efficient, automatable and reproducible procedure for the measurement of protein-membrane interactions. The toxin-membrane interactions were analyzed utilising a chip-based*	Helmholz H.	2010

				014)	*technology with immobilized liposomes as artificial cell membranes. The technique was established with streptolysin O as a cholesterol-selective model toxin and its cholesterol-selectivity has been proven. The haemolytic potency of protein fractions derived from the venom of the jellyfish Aurelia aurita and Cyanea capillata was tested and EC50 values of 35.3µg/mL and 43.1µg/mL against sheep and 13.5µg/mL and 8.8µg/mL against rabbit erythrocytes were measured. Cell membrane binding as a first step in the haemolytic process was analyzed using the Biacore® technology. Major cell membrane lipids (cholesterol, sphingomyelin and phosphatidylcholine) were immobilized as pure liposomes and in binary mixtures. A preference for cholesterol and sphingomyelin of both jellyfish species was demonstrated. The specificity of the method was proven with a non-haemolytic A. aurita protein fraction that did not express a lipid binding. Additionally, an inactivated C. capillata lysine with negligible haemolytic activity showed a remaining but reduced adsorption onto lipid layers. The binding level of the lytic venom fraction of these dominant boreal jellyfish species increased as a function of protein concentration. The binding strength was expressed in RU50 values ranging from 12.4µg/mL to 35.4µg/mL, which were in the same order of magnitude as the EC50 values in the haemolytic assay. © 2010 Elsevier B.V.*		
9	BIO	Aurelin	Antimicrobial	*Aurelin, a novel antimicrobial peptide from jellyfish Aurelia aurita with structural features of defensins and channel-blocking toxins (https://doi.org/10.1016/j.bbrc.2006.07.078)*	*A novel 40-residue antimicrobial peptide, aurelin, exhibiting activity against Gram-positive and Gram-negative bacteria, was purified from the mesoglea of a scyphoid jellyfish Aurelia aurita by preparative gel electrophoresis and RP-HPLC. Molecular mass (4296.95 Da) and complete amino acid sequence of aurelin (AACSDRAHGHICESFKSFCKDSGRNGVKLRANCKKTCGLC)1The protein sequence data reported in this paper will appear in the UniProt Knowledge base under the Accession No. P84891 and in the GenBank under the Accession No. DQ837210.1 were determined. Aurelin has six cysteines forming three disulfide bonds. The total RNA was isolated from the jellyfish mesoglea, RT-PCR and cloning were performed, and cDNA was sequenced. A 84-residue preproaurelin contains a putative signal peptide (22 amino acids) and a propiece of the same size (22 amino acids). Aurelin has no structural homology with any previously identified antimicrobial peptides but reveals partial similarity both with defensins and K+ channel-blocking toxins of sea anemones and belongs to ShKT domain family. © 2006 Elsevier Inc. All rights reserved.*	Ovchinnikova T.V., Balandin S.V., Aleshina G.M., Tagaev A.A., Leonova Y.F., Krasnodembsky E.D., Men'shenin A.V., Kokryakov V.N.	2006
10	BIO	Neuropeptides	Immunoreactivity	*Neuropeptides and photic behavior in Cnidaria (https://doi.org/10.1007/s10750-004-2689-x)*	*Peptides of the RFamide family occur in neurosecretory cells of all nervous systems of Cnidaria so far studied. Photoreceptive organs - if evolved in a cnidarian species - are always associated with neural cells showing RFamide immunoreactivity. Experimen*	Plickert G., Schneider B.	2004
11	BIO	Crude extract	Cytotoxic	*Cytotoxic effects of some animal and*	*To study, the cytotoxic effects of some biological and chemical agents*	Bayazit V.	2004

			effect	*vegetable extracts and some chemicals on liver and colon carcinoma and myosarcoma (https://doi.org/)*	*on G1, S, G2, M and G0 phases of liver and colon carcinomas and myosarcoma cells obtained with chemical carcinogens dimethylbenzanthracene (DMBA) and cadmium chloride. Eight rabbit liv*		
12	BIO	Epicoccamide	NA	*Epicoccamide, a novel secondary metabolite from a jellyfish-derived culture of Epicoccum purpurascens (https://doi.org/10.1039/b208588g)*	*From the inner tissue of the jellyfish Aurelia aurita a marine strain of the fungus Epicoccum purpurascens was obtained. After mass cultivation the fungus was investigated for its secondary metabolite content and found to contain the new, and most unusual*	Wright A.D., Osterhage C., König G.M.	2003
13	BIO	Sphingophosphonolipids	NA	*Sphingophosphonolipids, phospholipids, and fatty acids from Aegean jellyfish Aurelia aurita (https://doi.org/10.1007/s11745-001-0840-3)*	*The goal of this study is to elucidate and identify several sphingophosphonolipids from Aurelia aurita, an abundant but harmless Aegean jellyfish, in which they have not previously been described. Total lipids of A. aurita were 0.031-0.036% of fresh tissu*	Kariotoglou D.M., Mastronicolis S.K.	2001
14	BIO	Organoarsenicals	NA	*Occurrence of a few organo-arsenicals in Jellyfish (https://doi.org/)*	*Water-soluble fractions containing arsenic compounds were extracted with chloroform-methanol (2:1) from two kinds of jellyfish, Aurelia aurita and Carybdea rastonii. After defatting, each water-soluble fraction was subjected to analysis by HPLC-GFAA (colu*	Hanaoka K., Goessler W., Kaise T., Ohno H., Nakatani Y., Ueno S., Kuehnelt D., Schlagenhaufen C., Irgolic K.J.	1999
15	BIO	Sterols	NA	*Sterols from black sea invertebrates-I. Sterols from Scyphozoa and Anthozoa (Coelenterata) (https://doi.org/10.1016/0305-0491(80)90424-1)*	*Rhizostoma pulmo, Aurelia aurita and Actinia equina, the most widespread representatives of Coelenterata in Black Sea have been analysed and the occurrence of 20 sterols has been found. Dinosterol and demethyldinosterol as well as a number of short side c*	Milkova Ts.S., Popov S.S., Marekov N.L., Andreev St.N.	1980
16	BIO	Thyroxine	NA	*Thyroxine in early strobilation in Aurelia aurita (https://doi.org/10.1093/icb/14.2.825)*	*Radiochromatographic studies of 131I-treated Aurelia polyps revealed synthesis of three compounds tentatively identified as monoiodotyrosine (MIT), diiodotyrosine (DIT), and thyroxine (T4). One compound, MIT, is found within 8 hr after 131I administration*	Spangenberg D.B.	1974
17	BIO	Carotenoids	NA	*Some carotenoids in the jelly-fish Aurelia aurita (Scyphozoa: Discomedusae) (https://doi.org/10.1007/BF00352597)*	*The author investigated the carotenoids in the jelly-fish Aurelia aurita (L.), from the Baltic Sea. By means of columnar and thin-layer chromatography, the following carotenoids were found to be present in that species: β-carotene, echinenone isocryptoxan*	Czeczuga B.	1970
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Pleurobrachia pileus

Sea gooseberry

Aphia ID #106386

Kingdom:	Animalia
Phylum:	Ctenophora
Class:	Tentaculata
Order:	Cydippida
Family:	Pleurobrachiidae
Genus:	Pleurobrachia
Species:	pileus

INFORMATION PANEL

Observations: 104

Distribution:

Habitat type: Pelagic zone
Substrate: NA

DESCRIPTION

Size: 0 - 30 mm

Brief description:
Pleurobrachia pileus is a small, oval to spherical comb jelly, up to 1-3 cm high with two long fishing tentacles. The fishing tentacles are up to 15-20 times the length of the body (up to 50 cm long), bear lateral filaments, and can be completely retracted into the body. It swims with eight longitudinal combs, arranged in four paired rows, that give the comb jellies (ctenophores) their characteristic shimmering appearance. These combs consist of plates of transverse rows of hairs that beat in waves downwards, which produces the shimmering effect. These plates are phosphorescent at night. The gut may bear some colour. Newly hatched specimens are pear-shaped and bear only short rows of combs.

Sampling method: Plankton net
Dutch name: Zeedruif

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	CULT	Laboratory cultivation	NA	*Bioenergetics and growth in the ctenophore Pleurobrachia pileus (https://link.springer.com/chapter/10.1007/978-90-481-9541-1_13)*	*In laboratory experiments, we assessed feeding, respiration and growth of the ctenophore, Pleurobrachia pileus, and constructed carbon budgets. We conclude that the predation rates of P. pileus depend on ctenophore size, prey species, prey density and experimental container volume. Because the specific growth rates, respiration, assimilation and net growth efficiencies all were affected by food availability, knowledge of the ambient prey field is critical when evaluating the role of P. pileus in the carbon flow in coastal waters.*	Møller, L.F., Canon, J.M., Tiselius, P.	2010
2	CULT	Cultivation devices	NA	*Cultivation experiments on North Sea ctenophores (https://hmr.biomedcentral.com/articles/10.1007/BF01609908)*	*The development of new cultivation devices, the double kuvette and the phytoplanktonkreisel, made it possible to culture the 4 species of ctenophores occurring in the southern North Sea:Pleurobrachia pileus, Bolinopsis infundibulum, Beroe cucumis andBeroe gracilis. These ctenophores are holoplanktonic organisms of great ecological importance in local marine food chains.*	Greve, W.	1970
3	BIO	Bacterial communities	NA	*Bacterial communities associated with four ctenophore genera from the German Bight (North Sea) (https://doi.org/10.1093/femsec/fiu006)*	*Intense research has been conducted on jellyfish and ctenophores in recent years. They are increasingly recognized as key elements in the marine ecosystem that serve as critical indicators and drivers of ecosystem performance and change. However, the bacterial community associated with ctenophores is still poorly investigated. Based on automated ribosomal intergenic spacer analysis (ARISA) and 16S ribosomal RNA gene amplicon pyrosequencing, we investigated bacterial communities associated with the frequently occurring ctenophore species Mnemiopsis leidyi, Beroe sp., Bolinopsis infundibulum and Pleurobrachia pileus at Helgoland Roads in the German Bight (North Sea). We observed significant differences between the associated bacterial communities of the different ctenophore species based on ARISA patterns.With respect to bacterial taxa, all ctenophore species were dominated by Proteobacteria as revealed by pyrosequencing. Mnemiopsis leidyi and P. pileus mainly harboured Gammaproteobacteria, with Marinomonas as the dominant phylotype of M. leidyi. By contrast, Pseudoalteromonas and Psychrobacter were the most abundant Gammaproteobacteria in P. pileus. Beroe sp. was mainly dominated by Alphaproteobacteria, particularly by the genus Thalassospira. For B. infundibulum, the bacterial community was composed of Alpha- proteobacteria and Gammaproteobacteria in equal parts, which consisted of the genera Thalassospira and Marinomonas. In addition, the bacterial communities associated with M. leidyi display a clear variation over time that needs further investigation. Our results indicate that the bacterial communities associated with ctenophores*	Hao W., Gerdts G., Peplies J., Wichels A.	2015

					are highly species- specific. © FEMS 2015.		
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Asterias rubens

Common starfish

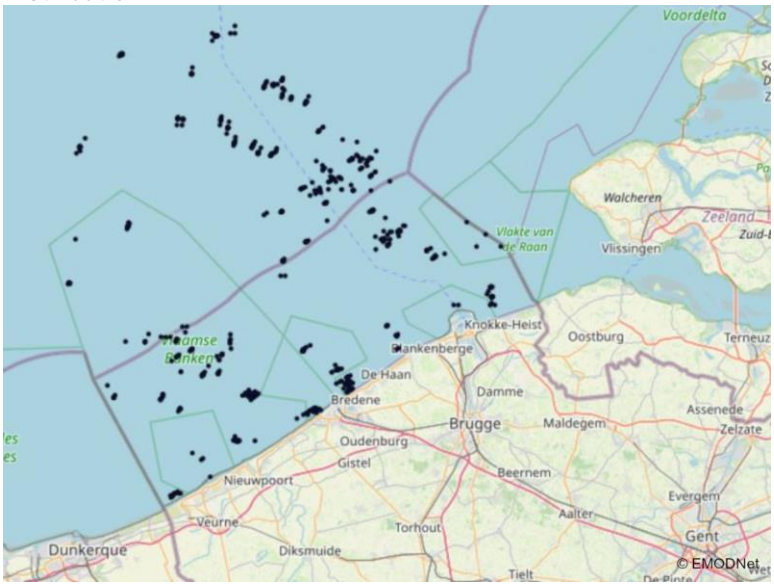
Aphia ID #123776

Kingdom:	Animalia
Phylum:	Echinodermata
Class:	Asteroidea
Order:	Forcipulatida
Family:	Asteriidae
Genus:	Asterias
Species:	rubens

INFORMATION PANEL

Observations: 847

Distribution:



Habitat type: Benthic zone
Substrate: Rock, shelly gravel, sand

DESCRIPTION

Size: 100 - 520 mm

Brief description:
Asterias rubens is the most common and familiar starfish in the north-east Atlantic region. Asterias rubens may grow up to 52 cm in diameter, but commonly 10-30 cm. Asterias rubens is variable in colour, though usually orange, pale brown or violet. Deep-water specimens are pale. It has five tapering arms, broad at the base that are often slightly turned up at the tip when active. Asterias rubens occurs in varying abundance upon a variety of substrata that include coarse and shelly gravel and rock.

Sampling method: Beam trawl, hand collection
Dutch name: Gewone zeester

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Somatostatin (SS) and allatostatin-C (ASTC)	Neuropeptide	*Molecular and functional characterization of somatostatin-type signalling in a deuterostome invertebrate (https://doi.org/10.1098/rsob.200172)*	*Somatostatin (SS) and allatostatin-C (ASTC) are structurally and evolutionarily related neuropeptides that act as inhibitory regulators of physiological processes in mammals and insects, respectively. Here, we report the first molecular and functional characterization of SS/ASTC-type signalling in a deuterostome invertebrate-the starfish Asterias rubens (phylum Echinodermata). Two SS/ASTC-type precursors were identified in A. rubens (ArSSP1 and ArSSP2) and the structures of neuropeptides derived from these proteins (ArSS1 and ArSS2) were analysed using mass spectrometry. Pharmacological characterization of three cloned A. rubens SS/ASTC-type receptors (ArSSR1-3) revealed that ArSS2, but not ArSS1, acts as a ligand for all three receptors. Analysis of ArSS2 expression in A. rubens using mRNA in situ hybridization and immunohistochemistry revealed stained cells/fibres in the central nervous system, the digestive system (e.g. cardiac stomach) and the body wall and its appendages (e.g. tube feet).*	Zhang, Y; Guerra, LAY; Egertova, M; Zampronio, CG; Jones, AM; Elphick, MR	2020
2	BIO	Muscle relaxant neuropeptides	Neuropeptide	*Biochemical, Anatomical, and Pharmacological Characterization of Calcitonin-Type Neuropeptides in Starfish: Discovery of an Ancient Role as Muscle Relaxants (https://doi.org/10.3389/fnins.2018.00382)*	*Characterisation of a CT-type neuropeptide in the starfish Asterias rubens. A CT-type precursor cDNA (ArCTP) was sequenced and the predicted structure of the peptide (ArCT) derived from ArCTP was confirmed using mass spectrometry.*	Cai, W; Kim, C-H; Go, H-J; Egertová, M; Zampronio, CG; Jones, AM; Park, NG; Elphick, MR	2018
3	BIO	Orthologs of NPS-type peptides - anxiolytic qualities	Peptide	*Characterization of NGFFYamide Signaling in Starfish Reveals Roles in Regulation of Feeding Behavior and Locomotory Systems (https://doi.org/10.3389/fendo.2018.00507)*	*Characterisation of the NG peptide signaling system in the starfish Asterias rubens. The neuropeptide NGFFYamide was identified as the ligand for an A. rubens NPS/CCAP-type receptor, providing further confirmation that NG peptides are orthologs of NPS/CCAP-type neuropeptides. Analysis of the effects of in vivo injection of NGFFYamide on starfish locomotor activity revealed that it causes a significant reduction in mean velocity and distance traveled. Interestingly, experimental studies on mammals have revealed that NPS is an anxiolytic that suppresses appetite and induces hyperactivity in mammals.*	Tinoco, AB; Semmens, DC; Patching, EC; Gunner, EF; Egertová, M; Elphick, MR	2018
4	BIO	Muscle relaxant pedal peptides and orcokinins	Neuropeptide	*Functional characterization of a second pedal peptide/orcokinin-type neuropeptide signaling system in the starfish Asterias rubens (https://doi.org/10.1002/cne.24371)*	*Molluscan pedal peptides (PPs) and arthropod orcokinins (OKs) are prototypes of a family of neuropeptides that have been identified in several phyla. Recently, starfish myorelaxant peptide (SMP) was identified as a PP/OK-type neuropeptide in the starfish Patiria pectinifera (phylum Echinodermata). Furthermore, analysis of transcriptome sequence data from the starfish Asterias rubens revealed two PP/OK-type precursors: an SMP-type precursor (A. rubens PP-like neuropeptide precursor 1; ArPPLNP1) and a second precursor (ArPPLNP2). We reported previously a detailed analysis*	Lin, M; Egertova, M; Zampronio, CG; Jones, AM; Elphick, MR	2018

					of ArPPLNP1 expression in A. rubens and here we report the first functional characterization ArPPLNP2-derived neuropeptides.		
5	BIO	Muscle relaxant pedal peptides and orcokinins	Neuropeptide	*Pedal peptide/orcokinin-type neuropeptide signaling in a deuterostome: The anatomy and pharmacology of starfish myorelaxant peptide in Asterias rubens (https://doi.org/10.1002/cne.24309)*	*A PP/OK-type neuropeptide (starfish myorelaxant peptide, SMP) was recently identified as a muscle relaxant in the starfish Patiria pectinifera. Here mass spectrometry was used to identify five neuropeptides (ArPPLN1a-e) derived from the SMP precursor (PP-like neuropeptide precursor 1; ArPPLNP1) in the starfish Asterias rubens. Analysis of the expression of ArPPLNP1 and neuropeptides derived from this precursor in A. rubens using mRNA in situ hybridization and immunohistochemistry revealed a widespread pattern of expression, with labeled cells and/or processes present in the radial nerve cords, circumoral nerve ring, digestive system (e.g., cardiac stomach) and body wall-associated muscles (e.g., apical muscle) and appendages (e.g., tube feet and papulae). Furthermore, our data provide the first evidence that neuropeptides are present in the lateral motor nerves and in nerve processes innervating interossicular muscles. In vitro pharmacological tests with SMP (ArPPLN1b) revealed that it causes dose-dependent relaxation of apical muscle, tube foot and cardiac stomach preparations from A. rubens.*	Lin, M; Egertová, M; Zampronio, CG; Jones, AM; Elphick, MR	2017
6	BIO	Muscle relaxant neuropeptides	Neuropeptide	*Identification of a Novel Starfish Neuropeptide That Acts as a Muscle Relaxant (https:// doi.org/10.1111/jnc.13543)*	*A hexadecapeptide with the amino acid sequence Phe-Gly-Lys-Gly-Gly-Ala-Tyr-Asp-Pro-Leu-Ser-Ala-Gly-Phe-Thr-Asp was identified and designated starfish myorelaxant peptide (SMP). Cloning and sequencing of a cDNA encoding the SMP precursor protein revealed that it comprises 12 copies of SMP as well as 3 peptides (7 copies in total) that are structurally related to SMP . Analysis of the expression of SMP precursor transcripts in P. pectinifera using qPCR revealed the highest expression in the radial nerve cords and lower expression levels in a range of neuromuscular tissues, including the apical muscle, tube feet and cardiac stomach. Consistent with these findings, SMP also caused relaxation of tube foot and cardiac stomach preparations. Furthermore, SMP caused relaxation of apical muscle preparations from another starfish species – Asterias amurensis . Collectively, these data indicate that SMP has a general physiological role as a muscle relaxant in starfish.*	Kim, C-H; Kim, EJ; Go, H-J; Oh, HY; Lin, M; Elphick, MR; Park, NG	2016
7	BIO	Feed ingredient	Proteins	*Starfish (Asterias rubens) as feed ingredient for piglets (https://doi.org/10.1016/j.anifeedsci.2015.11 .012)*	*The effects of including starfish meal (SM) as an alternative protein source in diets for piglets on performance, faeces characteristics and plasma parameters were investigated. Four diets were formulated to contain different protein sources: fish meal (FM), extruded soybean meal (ESBM) and two levels of SM (SM50 and SM100).*	Sorensen, P; Norgaard, JV	2016
8	BIO	Potential novel sea star adhesive	Peptide	*An integrated transcriptomic and proteomic analysis of sea star epidermal secretions identifies proteins involved in*	*The proteomes of mucous and adhesive secretions from the sea star A. rubens were analyzed. 34 adhesive and 244 mucus-specific proteins were identified. 20 proteins are potential novel marine*	Hennebert, E; Leroy, B; Wattiez, R; Ladurner, P	2015

		proteins - Sea star footprint proteins (Sfps)		*defense and adhesion (https://doi.org/10.1016/j.jprot.2015.07.002)*	*adhesive proteins.*		
9	BIO	Starfish by-product as feed	Proteins	*Turning pests into protein – starfish by-product management in the Danish mussel industry (https://orbit.dtu.dk/en/publications/turning-pests-into-protein-starfish-by-product-management-in-the-)*	*Starfish predation on mussel cultures in Denmark. From pest to protein.*	Fitridge, I; Nielsen, CF; Gislason, H; Saurel, C; Petersen, JK	2015
10	BIO	Potential novel sea star adhesive proteins - Sea star footprint proteins (Sfps)	Peptide	*Sea star tenacity mediated by a protein that fragments, then aggregates (https://doi.org/10.1073/pnas.1400089111)*	*This report describes the first sequence of a protein, Sea star footprint protein 1 (Sfp1), a primary constituent of the adhesive footprints secreted by sea star tube feet. Sfp1 is unusually large and complex compared with other marine adhesive proteins.*	Hennebert, E; Wattiez, R; Demeuldre, M; Ladurner, P; Hwang, DW; Waite, JH; Flammang, P	2014
11	BIO	SALMFamide	Neuropeptide	*Bioactivity and structural properties of chimeric analogs of the starfish SALMFamide neuropeptides S1 and S2 (https://doi.org/10.1016/j.bbapap.2014.08.001)*	*The starfish SALMFamide neuropeptides S1 (GFNSALMFamide) and S2 (SGPYSFNSGLTFamide) are the prototypical members of a family of neuropeptides that act as muscle relaxants in echinoderms. Comparison of the bioactivity of S1 and S2 as muscle relaxants has r*	Jones, CE; Otara, CB; Younan, ND; Viles, JH; Elphick, MR	2014
12	BIO	SALMFamide	Neuropeptide	*SALMFamide salmagundi: The biology of a neuropeptide family in echinoderms (https://doi.org/10.1016/j.ygcen.2014.02.012)*	*The SALMFamides are a family of neuropeptides that occur in species belonging to the phylum Echinodermata. The prototypes for this neuropeptide family (S1 and S2) were discovered in starfish but subsequently SALMFamides were identified in other echinoderm*	Elphick, MR	2014
13	BIO	Muscle relaxant neuropeptides	Neuropeptide	*Structural analysis of the starfish SALMFamide neuropeptides S1 and S2: The N-terminal region of S2 facilitates self-association (https://doi.org/10.1016/j.bbapap.2013.10.013)*	*The related neuropeptides S1 and S2 both act as muscle relaxants in starfish. S2 (SGPYSFNSGLTFamide) is ~ 10 × more potent than S1 (GFNSALMFamide). S2, unlike S1, adopts a well-defined conformation in aqueous solution.*	Otaraa, CB; Jones, CE; Younana, ND; Viles, JH; Elphick, MR	2014
14	BIO	Orthologs of NPS-type peptides - anxiolytic qualities	Peptide	*Discovery of a novel neurophysin-associated neuropeptide that triggers cardiac stomach contraction and retraction in starfish (https://doi.org/10.1242/jeb.092171)*	*Investigation of the pharmacological actions of NGFFYamide in starfish revealed that it is a potent stimulator of cardiac stomach contraction in vitro and that it triggers cardiac stomach retraction in vivo. Thus, discovery of NGFFYamide provides a novel*	Semmens, DC; Dane, RE; Pancholi, MR; Slade, SE; Scrivens, JH; Elphick, MR	2013
15	BIO	Potential oncological markers	Peptide	*Revealed «Oncologic Markers» in the Sea Star Antibody Response to Horse-Radish Peroxydase (https://doi.org/10.3844/ajisp.2013.130.131)*	*At least two genes found in the genome of Asterias rubens after immunizations to the antigen HRP, (Horse-radish Peroxydase), could play the role of oncologic markers.*	Leclerc, M; Otten, P	2013
16	BIO	Lysosomal proteins homologous to mammalian	Peptide	*Purification and biochemical characterization of a lysosomal α-fucosidase from the deuterostomia Asterias rubens (https://doi.org/10.1016/j.biochi.2012.02.007)*	*α-Fucosidase affinity purified and biochemically characterized. Enzyme interacts specifically with Mannose 6-phosphate receptor (MPR300 protein). Enzyme is structurally related to mammalian enzyme.*	Visa, M; Hammer, E; Völker, U; Koliwer-Brandl, H; Kelm, S; Nadimpalli, SK	2012

17	BIO	Potential novel sea star adhesive proteins - Sea star footprint proteins (Sfps)	Peptide	*Characterization of the protein fraction of the temporary adhesive secreted by the tube feet of the sea star Asterias rubens (https://doi.org/10.1080/08927014.2012.672645)*	*11 protein bands, comprising the most abundant proteins, were not identified and might correspond to novel adhesive proteins. They were named 'Sea star footprint proteins' (Sfps).*	Hennebert, E; Wattiez, R; Waite, JH; Flammang, P	2012
18	BIO	Antibacterial	Peptide	*A comparative study on the influence of manganese on the bactericidal response of marine invertebrates (https://doi.org/10.1016/j.fsi.2009.07.001)*	*Coelomocytes increased as bacteriocidal response, more study possible*	Oweson, C; Hernroth, B	2009
19	BIO	PAH detoxification	Peptide	*Effects of the Erika Oil Spill on the Common Starfish Asterias rubens, Evaluated by Field and Laboratory Studies (https://doi.org/10.1007/s00244-008-9176-8)*	*This study confirms benzo(a)pyrene hydroxylase activity (BPH) in A. rubens and demonstrates the influence of CYP1A in the conversion of insoluble PAHs into soluble derivatives in this species for the first time.*	Joly-Turquin, G; Dubois, P; Coteur, G; Danis B; Leyzour, S; Le Menach, K; Budzinski, H; Guillou, M	2009
20	BIO	SALMFamide	Neuropeptide	*Identification of novel SALMFamide neuropeptides in the starfish Marthasterias glacialis (https://doi.org/doi: 10.1016/j.cbpa.2007.02.002)*	*The SALMFamides are a family of neuropeptides found in species belonging to the phylum Echinodermata and which act as muscle relaxants. The first two members of this family to be identified were both isolated from the starfishes Asterias rubens and Asteri*	Yun, SS; Thorndyke, MC; Elphick, MR	2007
21	BIO	SALMFamide and nitric oxide	Neuropeptide and nitric oxide	*Comparative analysis of nitric oxide and SALMFamide neuropeptides as general muscle relaxants in starfish (https://doi.org/10.1242/jeb.00197)*	*Previous studies have established that the gaseous signalling molecule nitric oxide (NO) and the SALMFamide neuropeptides S1 and S2 cause cardiac stomach relaxation in the starfish Asterias rubens. Here we show that S1, S2 and the NO donor SNAP also cause*	Melarange, R; Elphick, MR	2003
22	BIO	Antibacterial	Peptide	*Antibacterial activity in Strongylocentrotus droebachiensis (Echinoidea), Cucumaria frondosa (Holothuroidea), and Asterias rubens (Asteroidea) (https://doi.org/10.1016/S0022-2011(02)00153-2)*	*Antibacterial activity was detected in extracts from several tissues, but mainly in the coelomocyte and body wall extracts. Relatively high antibacterial activity could also be detected in gastrointestinal organs and eggs from A. rubens. Lysozyme-like act*	Haug, T; Kjuul, AK; Styrvold, OB; Sandsdalen, E; Olsen, ØM; Stensvåg, K	2002
23	BIO	SALMFamide and nitric oxide	Neuropeptide and nitric oxide	*Neural control of muscle relaxation in echinoderms (https://doi.org/10.1242/jeb.204.5.875)*	*Smooth muscle relaxation in vertebrates is regulated by a variety of neuronal signalling molecules, including neuropeptides and nitric oxide (NO). The mechanisms by which the nervous system controls muscle relaxation in echinoderms were, until recently, u*	Elphick, MR; Melarange, R	2001
24	BIO	Nitric oxide	Nitric oxide	*Nitric oxide function in an echinoderm (https://doi.org/10.2307/1543096)*	*In vertebrates, nitric oxide (NO) is synthesized from L-arginine by NO synthase (NOS) and regulates relaxation of smooth muscle by activating the cyclic-GMP (cGMP) generating enzyme soluble guanylyl cyclase (SGC). Here we show that the NO-cGMP pathway med*	Elphick, MR; Melarange, R	1998
25	BIO	SALMFamide	Neuropeptide	*Distribution and action of SALMFamide neuropeptides in the starfish Asterias*	*The SALMFamides S1 and S2 are two structurally related neuropeptides that are present in starfish, and which share the C-*	Elphick, MR; Newman, SJ;	1995

				rubens (https://doi.org/10.1242/jeb.198.12.2519)	*terminal amino acid sequence SXLXFamide, where X is variable. Here we describe the production and characterisation of an S2-specific a*	Thorndyke, MC	

Echinocardium cordatum

Sea potato

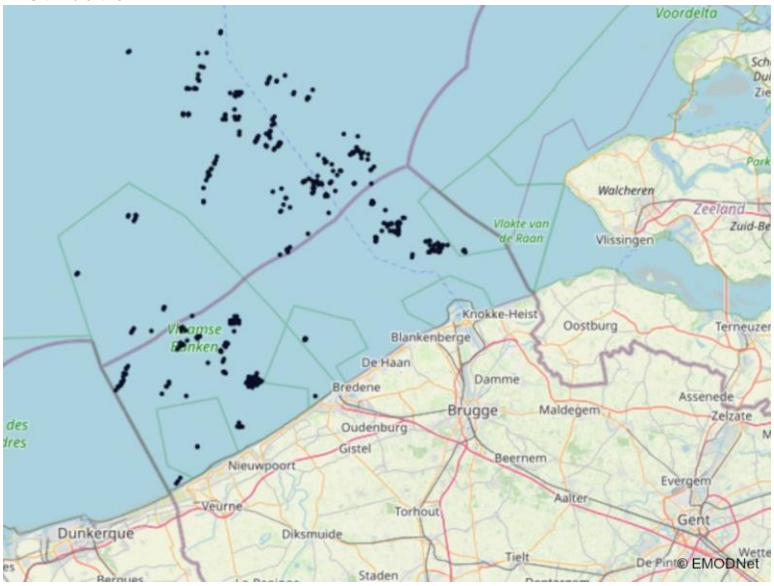
Aphia ID #124392

Kingdom:	Animalia
Phylum:	Echinodermata
Class:	Echinoidea
Order:	Spatangoida
Family:	Loveniidae
Genus:	Echinocardium
Species:	cordatum

INFORMATION PANEL

Observations: 600

Distribution:



Habitat type: Benthic zone
Substrate: Sand

DESCRIPTION

Size: 0 - 100 mm

Brief description:
A heart shaped urchin covered in a dense felt of yellow spines, mostly directed backwards. Yellow-brown in colour and usually 6 cm in length although can grow up to 9 cm long. Echinocardium cordatum lives in a permanent burrow buried about 8 cm deep (to 15 cm) in sandy sediments. The species is found from the intertidal to the subtidal and offshore to about 200 m.

Sampling method: van Veen grab, beam trawl
Dutch name: Zeeklit

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Mannan-binding lectin	Antibacterial activity	*Mannan-binding lectins in the coelomic fluid of various species of Far Eastern echinoderms (https://link.springer.com/article/10.1134/S1063074009020096)*	*A mannan-binding lectin activity was revealed in the coelomic fluid of the following echinoderm species inhabiting the coastal areas of the Sea of Japan, the holothurian Eupentacta fraudatrio, sea urchins Echinocardium cordatum, Strongylocentrotus nudus and S. intermedius, brittle star Amphipholis kochii, sea stars Asterina pectinifera, Lethasterias fusca, Lysastrosoma anthosticta, and Distolasterias nipon. It was shown that, concurrently with the general pattern of lectin interaction with branched bacterial mannans, there were also distinctions caused by the fine carbohydrate specificity of lectins. The obtained data preconditioned the further study of physical and chemical properties and structural features of the echinoderm MBL and the revelation of their role in the formation of the adaptive immune response and in other biological processes.*	I. Yu. Petrova, A. A. Bulgakov, E. L. Nazarenko, E. V. Shamshurina, S. S. Kobelev, M. G. Eliseikina	2009
2	CULT	Laboratory culture method	NA	*Cultivation of the heart urchin Echinocardium cordatum and validation of its use in marine toxicity testing for environmental risk assessment (https://www.sciencedirect.com/science/article/pii/S0022098108002682)*	*The present study describes a culture method for the heart urchin Echinocardium cordatum under controlled laboratory conditions, providing organisms with a low biological variation.*	Schipper, C.A., Dubbeldam, M., Feist, S.W., Rietjens, I.M.C.M., Murk, A.T.	2008
3	BIO	Hedathiosulfonic acids A and B	Toxicity	*Hedathiosulfonic acids A and B, novel thiosulfonic acids from the deep-sea urchin Echinocardium cordatum (https://doi.org/10.1016/S0040-4020(02)00654-3)*	*Hedathiosulfonic acids A and B were isolated from the deep-sea urchin Echinocardium cordatum and were determined to be novel 6-undecanethiosulfonic acids by 2D NMR, HRMS, and methylation reaction. The stereostructure of hedathiosulfonic acid A was determined by the analysis of its degradation product, a cyclic β-hydroxysulfone. Hedathiosulfonic acids exhibited acute toxicity. We carried out various model reactions of the olefinic compounds with thiosulfonic acids and proved that, as is the case with natural products, synthesized thiosulfonic acid possessing a carbon-carbon double bond was converted into β-hydroxysulfone in the presence of oxygen. © 2002 Elsevier Science Ltd. All rights reserved.*	Kita M., Watanabe M., Takada N., Suenaga K., Yamada K., Uemura D.	2002
4	BIO	Hedathiosulfonic acids A and B	Toxicity	*Isolation and structures of hedathiosulfonic acids A and B, novel thiosulfonic acids from the deep-sea urchin Echinocardium cordatum (https://doi.org/10.1016/S0040-4039(01)01314-4)*	*Hedathiosulfonic acids A and B were isolated from the deep-sea urchin Echinocardium cordatum, and were determined to be novel 6-undecanethiosulfonic acids by 2D NMR, HRMS, and methylation reaction. Hedathiosulfonic acids exhibited acute toxicity. © 2001 Elsevier Science Ltd. All rights reserved.*	Takada N., Watanabe M., Suenaga K., Yamada K., Kita M., Uemura D.	2001
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Psammechinus miliaris

Green sea urchin

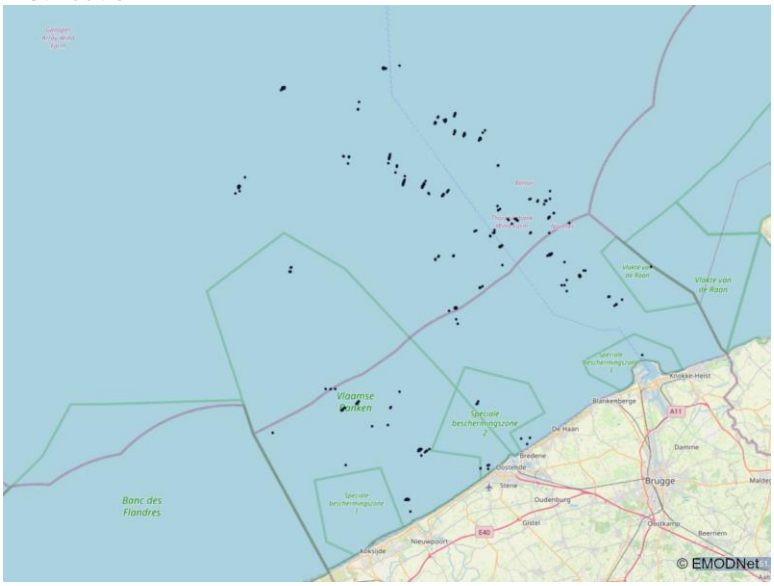
Aphia ID #124319

Kingdom:	Animalia
Phylum:	Echinodermata
Class:	Echinoidea
Order:	Camarodonta
Family:	Parechinidae
Genus:	Psammechinus
Species:	miliaris

INFORMATION PANEL

Observations: 337

Distribution:



Habitat type:	Benthic zone
Substrate:	Muddy sand, gravel, rocks

DESCRIPTION

Size: 0 - 57 mm

Brief description:
An almost round, slightly flattened urchin that grows up to 57 mm in diameter (although more typically to 35 mm diameter). It is greenish in colour with distinctive violet tips to the spines. The spines are robust, short and closely packed.

Sampling method:	Beam trawl
Dutch name:	Gewone zeeappel

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Polyhydroxynaphthoquinone pigments	Antioxidant	*Extraction and identification of antioxidant polyhydroxynaphthoquinone pigments from the sea urchin, Psammechinus miliaris (https://doi.org/10.1016/j.lwt.2014.05.016)*	*Pigments were extracted from tests of individual sea urchins, Psammechinus miliaris, collected from a sea loch in Scotland. The extracts were red brown-to-orange in colour and yielded UV spectra with maxima at 475, 320 and 270nm characteristic of polyhydroxylated naphthoquinone pigments (PHNQs) identified in other sea urchins. The yield of total phenols from the tests was relatively low (1-2mg/g dry weight) but in line with levels found in tests from other sea urchin species. The extracts displayed reasonable antioxidant capacity assayed using the FRAP assay. After selection by solid phase extraction, the extracts were analysed by liquid chromatography-mass spectrometry (LC-MS). The LC-MS data suggested that the pigmentation was due to a range of spinochrome and echinochrome PHNQ components. Most of these components have been noted previously but there was evidence for sulphated forms which have not been identified before. The role and potential utility of these pigments in food applications is discussed. © 2014 Elsevier Ltd.*	Powell C., Hughes A.D., Kelly M.S., Conner S., McDougall G.J.	2014
2	BIO	Carotenoids	NA	*Carotenoids in the gonad and gut of the edible sea urchin Psammechinus miliaris (https://doi.org/10.1016/j.aquaculture.2008.11.018)*	*The carotenoid content and composition of the gonad and gut of the edible sea urchin Psammechinus miliaris were determined. The dominant carotenoid of the gut wall was fucoxanthinol, indicating the degradation of the main carotenoid found in the Phaeophycean algae. Also present in the gut wall was the carotenoid echinenone, a pigment absent from the diet of wild urchins. Its presence in the gut wall indicates that this is a site for metabolism of dietary, algal, β-carotene. Fucoxanthinol and related products are not found in the gonad and instead this organ was found to selectively accumulate echinenone and β-carotene together with a small number of related compounds. Both echinenone and β-carotene were found in two geometric forms, namely all-trans and 9′-cis or 9-cis respectively. Echinenone is predominantly deposited in the gonad as the 9′-cis form, whilst β-carotene is mainly found in the same form as that seen in the algae that, in part, make up its diet in the wild, i.e., all-trans. This indicates that isomerisation of dietary β-carotene occurs as part of the process of accumulating echinenone in the gonad. The colour and overall appearance of the gonads of this wild and food limited population were generally poor. No correlation between CIE L*a*b chromameter readings or a visual assessment of gonad colour with carotenoid content as determined by HPLC was observed. © 2009 Elsevier B.V. All rights reserved.*	Symonds R.C., Kelly M.S., Suckling C.C., Young A.J.	2009
3	CULT	Antibiotics use	Cultivation	*Impact and residence time of oxytetracycline in the sea urchin,*	*Previous work has shown that it is possible to grow the sea urchin, Psammechinus miliaris, alongside Atlantic salmon, Salmo salar, in a*	Campbell D.A., Pantazis P., Kelly	2001

				Psammechinus miliaris, a potential aquaculture species (https://doi.org/10.1016/S0044-8486(01)00600-7)	*polyculture system. The intensive nature of salmon farming demands the use of antibiotics, such as oxytetracycline (OTC), administered with the feed, which has the potential to accumulate within the edible part of the urchin, the gonad. There is little information on the effect and potential for accumulation of antibiotics in echinoderms. Thus, accumulation and residue elimination of OTC in the gonads of the echinoid, P. miliaris, following oral administration were evaluated in urchins of high and low nutritional status, under laboratory conditions. A commercially prepared, medicated salmon food (29 mg OTC g-1) was fed to urchins ad lib for 12 days. Gonad tissue was sampled at intervals during the medication period (5th, 8th, and 12th day) and after its cessation (20th, 40th and 70th day). OTC analyses were carried out by high performance liquid chromatography (HPLC), after solid phase extraction (SPE). OTC significantly reduced gonadal growth rates (g day-1) in urchins conditioned on salmon feed. Individual urchins demonstrated considerable variation in amount of OTC accumulated. On day 12, mean OTC residue concentrations were 69.9 µg g-1 ± SD 35.7 and 57.95 µg g-1 ± SD 26.9 in urchins conditioned on salmon food and L. saccharina, respectively. At day 70, mean OTC residue concentrations were above 8 µg g-1 in both treatments, indicating a long residence time of the drug within gonadal tissue. A linear model was used to describe OTC uptake and elimination kinetics in the gonad of P. miliaris. No significant differences in accumulation and residue depletion of OTC in the gonads were observed between urchins of different nutritional status. The OTC half-life (t1/2) of the elimination phase in gonad tissue was 24.6 days (at 11-13°C). These results reflect a 'worse case scenario' for the uptake and elimination of OTC in the gonads of P. miliaris maintained with finfish receiving medicated feed ©2001 Elsevier Science B.V. All rights reserved.*	M.S.	
4	BIO	Eicosapentaenoic acid	NA	*Biosynthesis of eicosapentaenoic acid in the sea urchin: Psammechinus miliaris (https://doi.org/10.1007/s11745-001-0671-2)*	*The sea urchin Psammechinus miliaris "Gmelin" "Echinodermata: Echinoidea" was shown by using a deuterated tracer "D5-18:3n-3" and quantitation by negative chemical ionization gas chromatography-mass spectrometry to convert 18:3n-3 to 20:5n-3. The rate of conversion was very slow, corresponding to 0.09 µg/g tissue/mg 18:3n-3 eaten over 14 d. Deuterated arachidonic acid "D8-20:4n-6" was also included in the diet to give a measure of the relative amounts of diet eaten by the different animals. The recovery of this fatty acid in tissue lipids was 33.7% compared with only 0.95% recovery of D5-18:3n-3 and its anabolites, indicating that the majority of the D5-tracer was catabolized. Considerable elongation of D5-18:3n-3 into 20:3n-3 and a trace of 22:3n-3 was found, and these were accompanied by minor amounts of the intermediates 18:4n-3 and 20:4n-3. No deuterated 22:6n-3 was found.*	Bell M.V., Dick J.R., Kelly M.S.	2001
5	BIO	Cyclic organochlorines	Vinyl chloride, Chloromethan	*Organochlorine compounds in marine organisms from the international North*	*The samples consisted of dab (Limanda limanda), whiting (Merlangius merlangus) and the benthic organisms hermit crab (Pagurus*	Dethlefsen V., Söffker K., Büther	1996

			es, Pesticides, Insulators	*Sea incineration area*	*bernhardus), swimming crab (Liocarcinus holsatus), whelk (Buccinum undatum), helmet crab (Corystes cassivelaunus), sea mouse (Aphrodite aculeata) and sea urchin (Psammechinus miliaris). Tissues of these organisms were analysed using capillary gas chromatography. The predominant residues were congeners of polychlorinated biphenyls (PCBs) and the second largest proportion was represented by the sum of p,p'-DDT and its metabolites. Concentrations of DDT were below the detection limit. Furthermore, residues of the following substances were found: pentachlorobenzene (QCB, formerly PeCB), hexachlorobenzene (HCB), octachlorostyrene (OCS) and isomers of hexachlorocyclohexane (α-HCH and γ-HCH = lindane).*	H., Damm U.	
6	BIO	Guanidino kinases	Energy metabolism of tissues	*Re-evaluation of the structure and physiological function of guanidino kinases in fruitfly (Drosophila), sea urchin (Psammechinus miliaris) and man (https://doi.org/10.1042/bj3090255)*	*Purification and biophysical characterization of mitochondrial creatine kinase (Mi-CK) from sperm of the sea urchin Psammechinus miliaris, as well as gel-permeation chromatography of human heart Mi-CK demonstrate that these two Mi-CK isoenzymes form highly symmetrical octameric molecules with an M(r) of approx. 350 000, a value similar to that found for all other Mi-CK isoenzymes investigated so far. The absolute evolutionary conservation of this oligomeric form from sea urchins to mammals points both to its essentiality for M1-CK function and to an important role of octameric M1-CK in the energy metabolism of tissues and cells with high and fluctuating energy demands. To investigate whether a similar physiological principle also operates in an even more distantly related animal phylum, the arginine kinase (ArgK) isoenzyme system of Drosophila flight muscle was investigated with two independent subcellular fractionation procedures and subsequent analysis of the fractions by SDS/PAGE, immunoblotting and native isoenzyme electrophoresis. In contrast with a previous report strong evidence against the occurrence of a Mi-ArgK isoenzyme in Drosophila was obtained. The findings of the present study are discussed in the context of CK and ArgK function in general and of structural and bioenergetic differences between vertebrate striated muscles and arthropod flight muscles.*	Wyss M., Maughan D., Wallimann T.	1995
7	BIO	Carotenoids and echinenone	NA	*Animal carotenoids-XIV carotenoids of Psammechinus miliaris (sea-urchin) (https://doi.org/10.1016/0305-0491(78)90126-8)*	*Previously reported carotenoids from sea-urchins are compiled. By modern techniques, including mass spectrometry, adult Ps. miliaris were shown to contain β,β-carotene (1, 10% of total), β, ε{lunate}-carotene (2, 5%), echinenone (4, 10%), lutein (6, 8%) and fucoxanthinol (8, 68%); whereas unfed larvae were enriched in echinenone (4, 92%) as well as bicyclic carotenes. An overall picture showing the preferential localization of individual carotenoids-in particular organs of sea-urchins-is presented. Echinenone appears to be a specific metabolic product and may, possibly as a protein complex, play a functional role in the reproduction of sea-urchins. © 1978.*	Hallenstvet M., Ryberg E., Liaaen-Jensen S.	1978
8							

Ophiura albida

Serpent's table brittle star

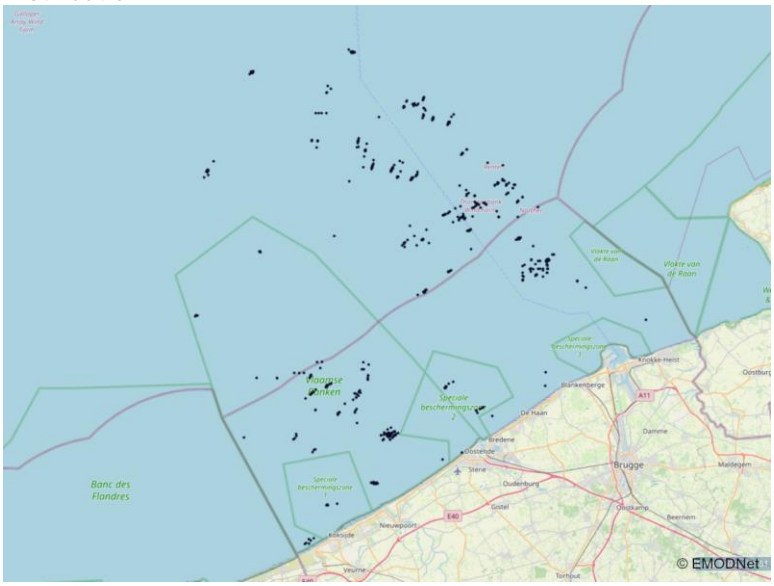
Aphia ID #124913

Kingdom:	Animalia
Phylum:	Echinodermata
Class:	Ophiuroidea
Order:	Ophiurida
Family:	Ophiuridae
Genus:	Ophiura
Species:	albida

INFORMATION PANEL

Observations: 728

Distribution:



Habitat type: Benthic zone
Substrate: Muddy sand

DESCRIPTION

Size: 0 - 60 mm

Brief description:
A red-brown brittlestar with a disc up to 15 mm in diameter, smaller than Ophiura ophiura. The arms are about four times the diameter of the disc which is covered, on the upper surface, with coarse scales. The arm spines lie almost flat against the arms. Found sublittorally on a variety of soft substrata but mainly fine muddy sands.

Sampling method: van Veen grab, beam trawl
Dutch name: Kleine slangster

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Hydroxybenzene compounds	Antioxidant	*Pharmacological and chemical properties of some marine echinoderms (http://www.scielo.br/scielo.php?pid=S0102-695X2018000500575&script=sci_arttext)*	*Hydroxybenzene compounds found in echinoderms, with antioxidant and antibiotic activity*	Marmouzi, I; Tamsouri, N; El Hamdani, M; Attar, A; Kharbach, M; Alami, R; El Jemli, M; Cherrah, Y; Ebada, SS; Faouzi, MEA	2018
2	#N/A	#N/A	#N/A	*#N/A*	*#N/A*	#N/A	#N/A
3	#N/A	#N/A	#N/A	*#N/A*	*#N/A*	#N/A	#N/A
4	#N/A	#N/A	#N/A	*#N/A*	*#N/A*	#N/A	#N/A
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9	#N/A	#N/A	#N/A	*#N/A*	*#N/A*	#N/A	#N/A
10	#N/A	#N/A	#N/A	*#N/A*	*#N/A*	#N/A	#N/A
11	#N/A	#N/A	#N/A	*#N/A*	*#N/A*	#N/A	#N/A
12	#N/A	#N/A	#N/A	*#N/A*	*#N/A*	#N/A	#N/A
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19	#N/A	#N/A	#N/A	*#N/A*	*#N/A*	#N/A	#N/A
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25	#N/A	#N/A	#N/A	*#N/A*	*#N/A*	#N/A	#N/A

Ophiura ophiura

Serpent brittle star

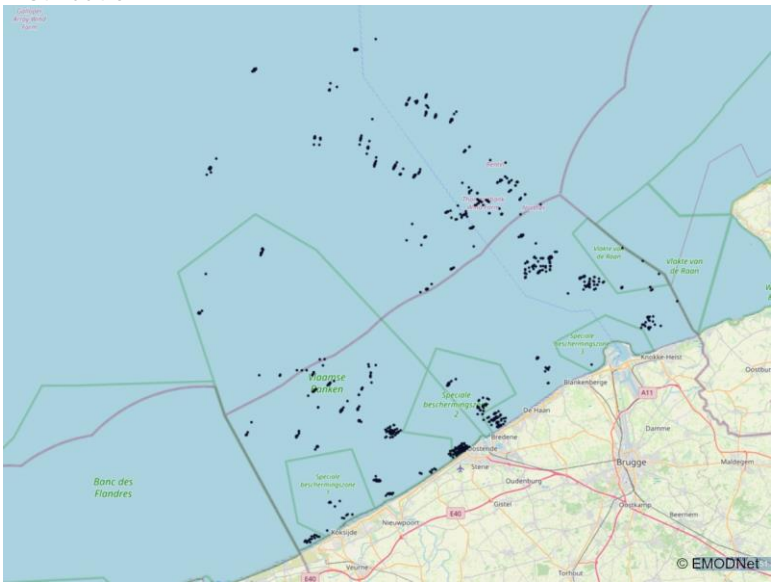
Aphia ID #124929

Kingdom:	Animalia
Phylum:	Echinodermata
Class:	Ophiuroidea
Order:	Ophiurida
Family:	Ophiuridae
Genus:	Ophiura
Species:	ophiura

INFORMATION PANEL

Observations: 1240

Distribution:



Habitat type: Benthic zone
Substrate: Sand, muddy sand

DESCRIPTION

Size: 0 - 120 mm

Brief description:
The colour of the brittlestar Ophiura ophiura varies from dull brown to sandy orange. The disc is up to about 35 mm in diameter and the arms are about four times as long as the diameter of the disc. The dorsal and ventral surfaces of the disc is covered with plates. The arms are made of articulating calcareous pieces that allow considerable twisting in the lateral plane. Ophiura ophiura can be distinguished from similar species by having pores between the ventral plates at the base of each arm and by having combs of about 30 fine papillae at each base. It is red to brown in colour above, and paler below. Common over sand and muddy-sand. It extends from the lower shore to depths of about 200 m.

Sampling method: van Veen grab, beam trawl
Dutch name: Gewone slangster

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Paralytic Shellfish Toxins	Toxin	*Multiple New Paralytic Shellfish Toxin Vectors in Offshore North Sea Benthos, a Deep Secret Exposed (https://doi.org/10.3390/md18080400)*	*An analysis of the benthic epifauna using two independent PST testing methods identified a 'hot spot' of toxic organisms in the Southern Bight, with a mean toxicity of 449 g STX eq./kg. PSTs were quantified in sea chervil (Alcyonidium diaphanum), the first known detection in the phylum bryozoan, as well as eleven other new vectors (>50 g STX eq./kg), namely the opisthobranch Scaphander lignarius, the starfish Anseropoda placenta, Asterias rubens, Luidia ciliaris, Astropecten irregularis and Stichastrella rosea, the brittlestar Ophiura ophiura, the crustaceans Atelecyclus rotundatus and Munida rugosa, the sea mouse Aphrodita aculeata, and the sea urchin Psammechinus miliaris.*	Dean, KJ; Hatfield, RG; Lee, V; Alexander, RP; Lewis, AM; Maskrey, BH; Teixeira Alves, M; Hatton, B; Coates, LN; Capuzzo, E; Ellis, JR; Turner, AD	2020
2	BIO	Asterosaponins	Polar steriods	*New Polar Steroids from Starfish (https://doi.org/10.1177%2F1934578X0800301005)*	*A short review concerning new polar steroids isolated from starfish with 75 citations is given. This review covers the literature published from 2001 through 2007. The emphasis is on new structures, together with their relevant biological activities, source organisms, and localities of collections.*	Stonik, VA; Ivanchina, NV; Kicha, AA	2008
3	BIO	SALMFamide S1 and Rfamide	Neuropeptides	*Localization of neuropeptides in the nervous system of the brittle star Ophiura ophiura (https://doi.org:10.1098/rstb.1994.0160)*	*Immunocytochemical investigations using antisera against the SALMFamide neuropeptide S1 and RFamide were carried out on whole mounts of the radial nerve cord and circumoral ring of the brittle star Ophiura ophiura.*	Ghyoot, M; Cobb, JLS; Thorndyke, MC	1994
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Acrocnida brachiata

Sand burrowing brittle star

Aphia ID #236130

Kingdom:	Animalia
Phylum:	Echinodermata
Class:	Ophiuroidea
Order:	Amphilepidida
Family:	Amphiuridae
Genus:	Acrocnida
Species:	brachiata

INFORMATION PANEL

Observations: 41

Distribution:

Habitat type: Benthic zone
Substrate: Sand

DESCRIPTION

Size: - 200 mm

Brief description:
Acrocnida brachiata displays the characteristic brittle star body plan with a flat central disc and five distinctly demarcated thin arms. As a member of the order Ophiurida, its arms are usually moved horizontally and the discs and arms are covered with scales. The circular disc can reach 12 mm in diameter and it has very long, thin and flexible arms. Like similar species, it has only one outer mouth papilla, clearly detached from the infradental papillae. It can be differentiated by the presence of two tentacle scales, ventral scales and radial shields with a transverse furrow. It is brown-grey in colour.

Sampling method: van Veen grab
Dutch name: Ingegraven slangster

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
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Ensis spp.

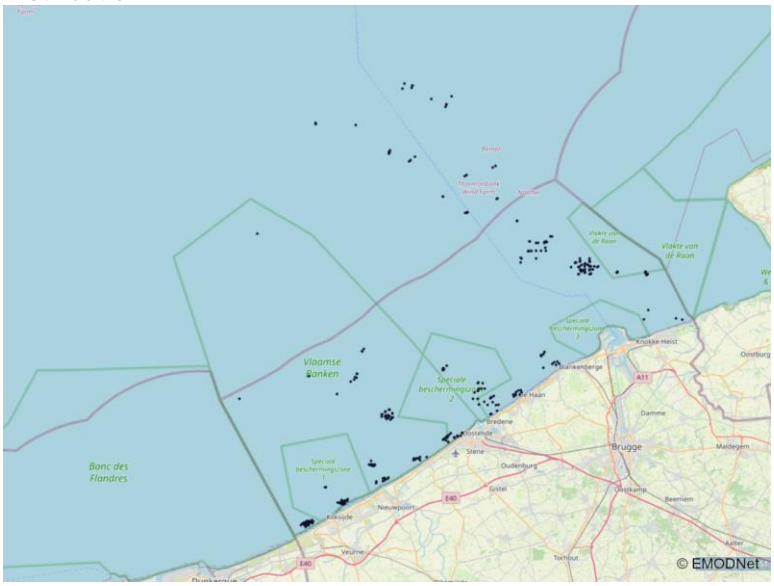
Aphia ID #138333

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Bivalvia
Order:	Adapedonta
Family:	Pharidae
Genus:	Ensis
Species:	spp.

INFORMATION PANEL

Observations: 414

Distribution:



Habitat type: Benthic zone
Substrate: Sand

DESCRIPTION

Size: 0 - 170 mm

Brief description:

Razor shells have an elongate and fragile shell with valves gaping at both ends. The shell is smooth on the outside and whitish in colour with vertical and horizontal reddish-brown or purplish-brown markings separated by a diagonal line. The periostracum is olive-green. The inner surface is white with a purple tinge and the foot is pale red-brown. The presence of razor shells in sand is indicated by keyhole-shaped openings made by the short, united siphons which extend just above the sediment surface when the animal is suspension feeding.

Sampling method: van Veen grab, beam trawl
Dutch name: Zwaardschede

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

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Abra alba

White furrow -shell

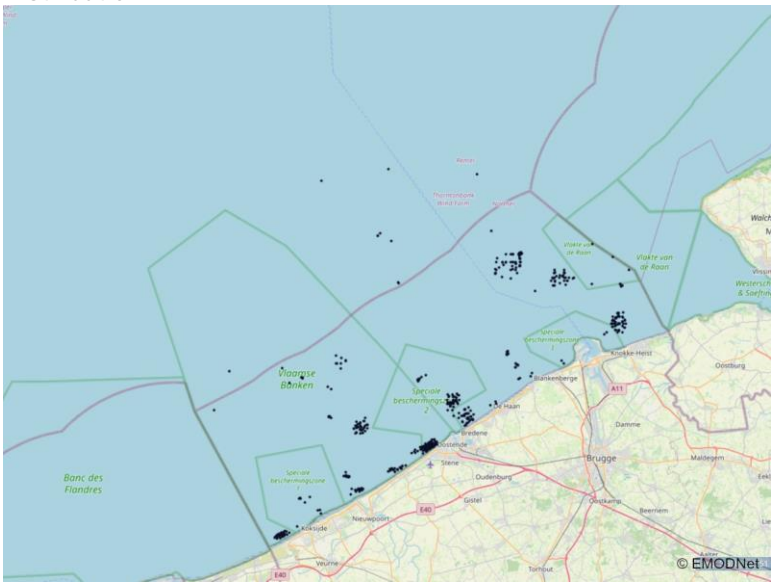
Aphia ID #141433

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Bivalvia
Order:	Cardiida
Family:	Semelidae
Genus:	Abra
Species:	alba

INFORMATION PANEL

Observations: 917

Distribution:



Habitat type: Benthic zone
Substrate: Fine sand, silty sand, gravel, mud

DESCRIPTION

Size: 0 - 25 mm

Brief description:
The valves have a sculpture of fine concentric lines and the growth stages of the animal are visible. Inhabits sandbanks and inshore areas. Is common in near-coastal zone, rarely further than 30 km off the coast. Found buried deep in almost all sediment types but prefer fine-grained to muddy substrates; rare in coarse substrates to a depth of 200 m. Feeds through its long, individually separated and stretchable siphons; known as a surface deposit feeder.

Sampling method: van Veen grab
Dutch name: Witte dunschaal

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

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Limecola balthica

Baltic tellin

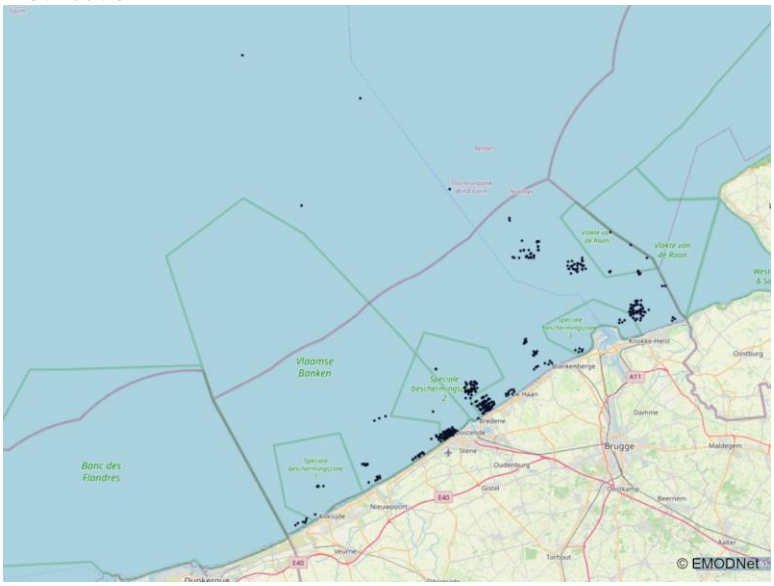
Aphia ID #880017

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Bivalvia
Order:	Cardiida
Family:	Tellinidae
Genus:	Limecola
Species:	balthica

INFORMATION PANEL

Observations: 1015

Distribution:



Habitat type:	Benthic zone
Substrate:	Sand, mud, muddy sand

DESCRIPTION

Size: 20 - 25 mm

Brief description:
Equivalve and broadly oval. Colour varies between pink, purple, yellow, white and may be blackened in sulphide-rich sediments; uniform throughout the shell or in concentric bands. Burrows in soft substrata, particularly in estuaries and on tidal flats, where it may be abundant; intertidal only.

Sampling method:	van Veen grab
Dutch name:	Nonnetje

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Nodularin-like compounds	Neurotoxicity	*Accumulation of nodularin-like compounds from the cyanobacterium Nodularia spumigena and changes in acetylcholinesterase activity in the clam Macoma balthica during short-term laboratory exposure (https://doi.org/10.1016/S0166-445X(03)00101-2)*	*In this laboratory study the effects of the cyanobacterium Nodularia spumigena (strain AV1) that produces hepatotoxic nodularin (NODLN), non-toxic Nodularia sphaerocarpa (strain UP16f) and purified NODLN on the infaunal clam Macoma balthica from the Baltic Sea were examined. The results show that M. balthica readily ingests toxic N. spumigena and that accumulation of peptides takes place rapidly, which has potential food chain effects through toxin enrichment. However, it appears that M. balthica is at least partly able to metabolise NODLN. In addition to hepatotoxicity, NODLN seems to induce concentration-dependent neurotoxic effects; this must be taken into consideration when applying AChE activity as a biomarker of specific anthropogenic contamination (e.g. organophosphate and carbamate pesticides). © 2003 Elsevier Science B.V. All rights reserved.*	Lehtonen K.K., Kankaanpää H., Leiniö S., Sipiä V.O., Pflugmacher S., Sandberg-Kilpi E.	2003
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Donax vittatus

Banded wedge-shell

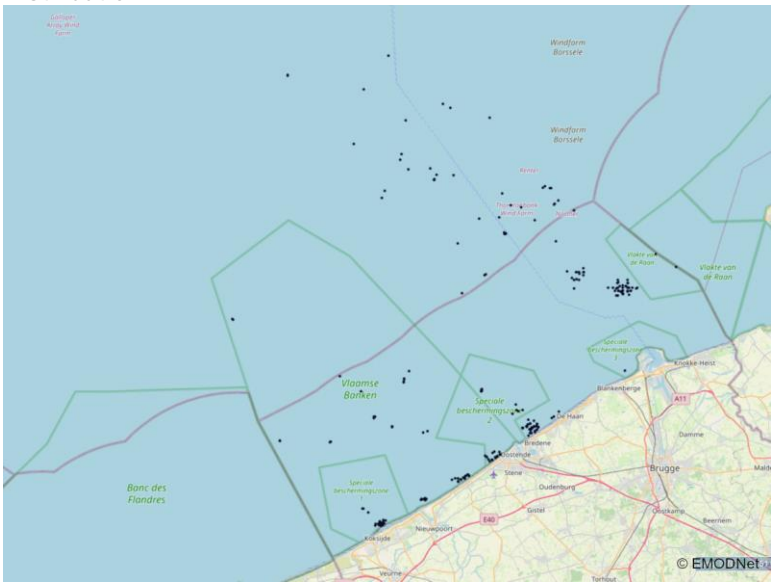
Aphia ID #139604

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Bivalvia
Order:	Cardiida
Family:	Donacidae
Genus:	Donax
Species:	vittatus

INFORMATION PANEL

Observations: 323

Distribution:



Habitat type: Benthic zone
Substrate: Sand

DESCRIPTION

Size: 0 - 38 mm

Brief description:
Donax vittatus has a roughly wedge-shaped shell up to 3.8 cm long with the umbones close to the posterior end. The outer shell is shiny and white, yellowish, brown or purple, with the colour often running in bands across the shell. The outer surface has numerous, fine concentric ridges and grooves, and fine lines radiating from the umbones. The inner surface is shiny and white, often with areas tinted pale yellow, orange or purple. The margin of the shell is strongly ridged (crenulate).

Sampling method: van Veen grab, beam trawl
Dutch name: Zaagje

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
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Mytilus edulis

Blue mussel

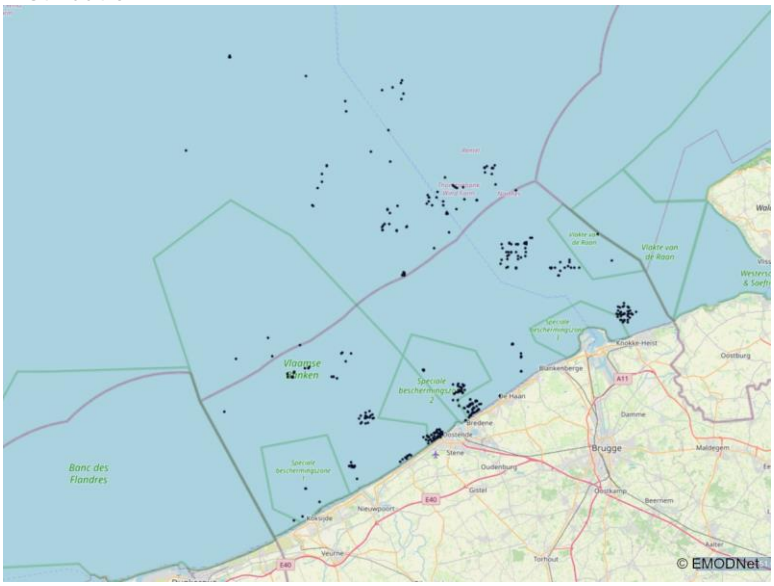
Aphia ID #140480

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Bivalvia
Order:	Mytilida
Family:	Mytilidae
Genus:	Mytilus
Species:	edulis

INFORMATION PANEL

Observations: 572

Distribution:



Habitat type: Tidal zone
Substrate: Rock

DESCRIPTION

Size: 20 - 100 mm

Brief description:
Shell is smooth with a sculpturing of concentric lines but no radiating ribscolour varies; usually purple or blue but sometimes brown; equivalve, inequilateral and approximately triangular in outline. May be confused with Mytilus galloprovincialis and Mytilus trossulus, and may hybridize with them. Occurs from the high intertidal to the shallow subtidal attached by fibrous byssus threads to suitable substrata. Found on the rocky shores of open coasts attached to rocky surfaces and in crevices, and on rocks and piers in sheltered harbours and estuaries, often occurring as dense masses.

Sampling method: van Veen grab, beam trawl, hand collection
Dutch name: Blauwe mossel

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	A potent anticoagulant oligopeptide	Peptide	*Isolation and characterisation of an anticoagulant oligopeptide from blue mussel, Mytilus edulis*	*A potent anticoagulant oligopeptide was isolated from the edible parts of blue mussel (Mytilus edulis). This study elucidated that M. edulis anticoagulant peptide (MEAP) prolonged blood clotting by inhibiting activation of FX in the intrinsic tenase complex (FIXa/VIIIa/PLs) and conversion of FII to FIIa in the prothrombinase complex (FXa/FVa/PLs).*	APA Jung, W. K., & Kim, S. K.	2009
2	BIO	Antimicrobial peptide	Peptide	*The Flow of Antimicrobial Peptide Genes Through a Genetic Barrier Between Mytilus edulis and M. galloprovincialis*	*Population genetics of two antimicrobial peptide (AMP) loci, called Mytilin B and Mytilus galloprovincialis defensin 2 (MGD2), in the secondary contact mosaic hybrid zone between Mytilus edulis and M. galloprovincialis.*	Boon, E., Faure, M. F., & Bierne, N.	2009
3	BIO	Glycerophosphatidylcholine (PC), lysophosphatidylcholine (LPC) and a number of other unidentified metabolites	0	*Metabolomic analysis of sex specific metabolites in gonads of the mussel, Mytilus edulis*	*Glycerophosphatidylcholine (PC) and lysophosphatidylcholine (LPC) metabolites. A number of other unidentified metabolites, including those putatively identified as conjugated sterols, were also differentially expressed between male and female mantle/gonadal tissue*	APA Cubero-Leon, E., Minier, C., Rotchell, J. M., & Hill, E. M.	2012
4	BIO	Antimicrobial peptide	Peptide	*The Preparation and Antimicrobial Activity of Peptide Fractions from Blue Mussel (Mytilus edulis) Protein Hydrolysate*	*The blue mussel protein hydrolysates were separated using the consecutive chromatographic methods including ion exchange, gel filtration, high performance liquid chromatography to identify a potent antimicrobial activity. The fraction (MAMP) separated by HPLC, exhibiting strong activity against Gram-positive (E. coli, P. aeruginosa, S. dysenteriae, P. vuigaris, E. aerogenes) with the minimal inhibitory concentrations (MIC) from 15.63 to 31.25 μg/mL, and Gram-negative bacteria (S. aureus, B. subtilis and M. lysodeikticus) with MIC from 31.25 to 62.5 μg /mL. MAMP had good thermal and pH stability, and consisted of three main amino acids (Ser, Pro and Cys). The antimicrobial activity of MAMP was possibly related to its higher cysteine residues and contents of hydrophobic amino acid. Therefore, MAMP could be a natural antimicrobial source suitable for use as a food additive.*	Dong, S. Y., Song, H. X., Zhao, Y. H., Liu, Z. Y., Wei, B. B., & Zeng, M. Y.	2012
5	BIO	Peptide with angiotensin-i-converting enzyme (ACE) inhibitory activity	Peptide	*Preparation and characterization of mussel (mytilus edulis) protein hydrolysates with angiotensin-i-converting enzyme (ace) inhibitory activity by enzymatic hydrolysis.*	*Mussel Protein Hydrolysates could serve as a source of peptides with ACE inhibitory activity. enzymatic hydrolysis was proven to be an efficient way to modify mussel protein. The hydrolysates obtained under the optimal hydrolysis condition showed strong ACE inhibitory activity. It is expected that the mussel protein hydrolysates with strong ACE inhibitory activity could be used as new additives in a wide range of functional foods to enhance their therapeutic properties, for instance, anti-hypertension.*	A DAI, Z. Y., ZHANG, Y. P., Zhang, H., & LU, Y. B.	2012
6	BIO	Hypotaurine and	Acids	*Polyphenol oxidase inhibitor from blue*	*An inhibitor found in the expressed liquid from blue mussel shows*	Schulbach, K. F.,	2013

		other sulfinic acid analogs (methane and benzene sulfinic acids)		*mussel (Mytilus edulis) extract.*	*very good inhibition on enzymatic browning. Since this enzyme is responsible for losses to the fruit and vegetable industry, natural inhibitors that prevent browning would be valuable. Finding alternative chemistries that inhibit browning and understanding their mode of action would be beneficial to the fruit and vegetable industries and their segments such as pre-cuts, juices, and so on. Inhibitors from products ingested by consumers are more acceptable as natural ingredients. Hypotaurine and other sulfinic acid analogs (methane and benzene sulfinic acids) from M. edulis extract showed very good inhibition for apple polyphenol oxidase (cf. browning)*	Johnson, J. V., Simonne, A. H., Kim, J. M., Jeong, Y., Yagiz, Y., & Marshall, M. R.	
7	BIO	Antioxidant peptide	Peptide	*Purification and characterisation of a novel antioxidant peptide derived from blue mussel (Mytilus edulis) protein hydrolysate*	*A novel antioxidant peptide derived from M. edulis protein hydrolysate using neutrase*	A Wang, B., Li, L., Chi, C. F., Ma, J. H., Luo, H. Y., & Xu, Y. F.	2013
8	BIO	By-products with anti-proliferative and active agents	0	*Evidence of anti-proliferative activities in blue mussel (Mytilus edulis) by-products*	*M. edulis by-products should be viewed as high-valued products with strong potential as anti-proliferative agent and promising active ingredients in functional foods*	Beaulieu, L., Thibodeau, J., Bonnet, C., Bryl, P., & Carbonneau, M. E.	2013
9	BIO	Bioactive potential of mussel primary metabolites, i.e. proteins, lipids, and carbohydrates	0	*Bioactive compounds from marine mussels and their effects on human health.*	*This review highlights the bioactive potential of mussel components from species of the genus Mytilus (e.g. M. edulis) and Perna (e.g. P. canaliculus). In particular, the bioactivity related to three major chemical classes of mussel primary metabolites, i.e. proteins, lipids, and carbohydrates, is evaluated. Within the group of proteins the focus is mainly on mussel peptides e.g. those obtained by bio-transformation processes, such as fermentation. In addition, mussel lipids, comprising polyunsaturated fatty acids (PUFAs), are discussed as compounds that are well known for prevention and treatment of rheumatoid arthritis (RA). Within the third group of carbohydrates, mussel polysaccharides are investigated. Furthermore, the importance of monitoring the mussel as food material in respect to contaminations with natural toxins produced by microalgae is discussed.*	Grienke, U., Silke, J., & Tasdemir, D.	2014
10	BIO	Hydrolysates and its fractions with potent antioxidant and anti-inflammatory activities	Peptide	*Antioxidant and Anti-Inflammatory Activities of Protein Hydrolysates from Mytilus Edulis and Ultrafiltration Membrane Fractions*	*In this study, we produced bioactive peptides from M. edulis by gastrointestinal digestion, and further fractionated using ultrafiltration membrane. The present results indicated that the M. edulis hydrolysates and its fractions exhibited the potent anti*	Park, S. Y., Ahn, C. B., & Je, J. Y.	2014
11	BIO	MAP-5 and similar proteins or polymers may be capable of inhibiting corrosion	0	*Investigations of Mussel Adhesive Proteins as Flash Rust Inhibitors*	*Several proteins found in the adhesive system of the common blue mussel Mytilus edulis have chemical properties which may enable them to inhibit the flash rusting of steels. In this work, Mytilus edulis foot proteins (MAPs) 1, 3, and 5 were isolated and a*	Nelson, W. F., & Hansen, D. C.	2016

12	BIO	Anti-inflammatory hydrolysates	Peptide	*Anti-inflammatory action of high molecular weight Mytilus edulis hydrolysates fraction in LPS-induced RAW264. 7 macrophage via NF-κB and MAPK pathways*	*Anti-inflammatory peptide fraction was generated from M. edulis by peptic hydrolysis*	Kim, Y. S., Ahn, C. B., & Je, J. Y.	2016
13	BIO	Antioxidant peptides	Peptide	*Partial purification and identification of three antioxidant peptides with hepatoprotective effects from blue mussel (Mytilus edulis) hydrolysate by peptic hydrolysis*	*Antioxidant peptides were purified from Mytilus edulis hydrolysates by peptic hydrolysis using consecutive chromatographic techniques*	Park, S. Y., Kim, Y. S., Ahn, C. B., & Je, J. Y.	2016
14	BIO	Bacicyclin, a new antibacterial cyclic hexapeptide	Peptide	*Bacicyclin, a new antibacterial cyclic hexapeptide from Bacillus sp. strain BC028 isolated from Mytilus edulis*	*Bacicyclin, a new antibacterial cyclic hexapeptide from Bacillus sp. strain BC028 isolated from Mytilus edulis with bacterial activity against the clinically relevant strains Enterococcus faecalis and Staphylococcus aureus*	Wiese, J., Abdelmohsen, U. R., Motiei, A., Humeida, U. H., & Imhoff, J. F.	2018
15	BIO	Thrombin inhibitory peptides (anti-coagulant)	Peptide	*Food-derived antithrombotic peptides: Preparation, identification, and interactions with thrombin*	*Thromboembolism and its sequelae have been the leading causes of morbidity and mortality throughout the world. Food-derived antithrombotic peptides, as potential ingredients in health-promoting functional foods targeting thrombus, have attracted increasin*	Cheng, S., Tu, M., Liu, H., Zhao, G., & Du, M.	2019
16	BIO	The effects of mussel peptides on protecting against aging by regulating glucose and lipid metabolism	Peptide	*Supplementation of mussel peptides reduces aging phenotype, lipid deposition and oxidative stress in D-galactose-induce aging mice*	*Mussel peptides protect against lipid metabolic disorders associated with aging via maintaining oxidative stress homeostasis and elevated expression levels of peroxisome proliferator activated receptors*	Zhou, Y., Xu, Q., Dong, Y., Zhu, S., Song, S., & Sun, N.	2017
17	BIO	Antioxidant and cytoprotective effect of hydrolysate	0	*Amino Acid Composition, Antioxidant, and Cytoprotective Effect of Blue Mussel (Mytilus edulis) Hydrolysate through the Inhibition of Caspase-3 Activation in Oxidative Stress-Mediated Endothelial Cell Injury (https://www.mdpi.com/1660-3397/17/2/135)*	*Antioxidant and cytoprotective effect of hydrolysate through the inhibition of caspase-3 activation in oxidative stress-mediated endothelial cell injury*	Oh, Y., Ahn, C. B., Nam, K. H., Kim, Y. K., Yoon, N. Y., & Je, J. Y.	2019
18	BIO	Osteogenic peptides for the functional-foods industry	Peptide	*Isolation and Characterization of Peptides from Mytilus edulis with Osteogenic Activity in Mouse MC3T3-E1 Preosteoblast Cells (https://pubs.acs.org/doi/abs/10.1021/acs.jafc.8b06530)*	*In this study, a novel peptide, YPRKDETGAERT, was identified from NHA-2 of Mytilus edulis by capillary-electrophoresis electrospray ionization-quadrupole-time of flight (CESI-Q-TOF). Results provide theoretical and practical insights for the preparation*	A Xu, Z., Chen, H., Wang, Z., Fan, F., Shi, P., Tu, M., & Du, M.	2019
19	BIO	Anticoagulant peptides	Peptide	*Identification and In Silico Prediction of Anticoagulant Peptides from the Enzymatic Hydrolysates of Mytilus edulis Proteins. (https://www.mdpi.com/1422-0067/19/7/2100)*	*This study optimized a screening and identification method of bioactive peptides from enzymatic hydrolysates of different tissues in Mytilus edulis*	Qiao, M., Tu, M., Chen, H., Mao, F., Yu, C., & Du, M.	2018
20	BIO	Novel Adhesive Containing L-	Peptide	*Polyphenolic substance of Mytilus edulis: novel adhesive containing L-dopa and*	*The fouling marine mussel Mytilus edulis attaches itself to various substrates by spinning byssal threads, the adhesive discs of which*	APA Waite, J. H., &	1981

		Dopa and Hydroxyproline		*hydroxyproline (https://science.sciencemag.org/content/212/4498/1038.short)*	*are rich in the amino acid 3,4-dihydroxyphenylalanine (dopa). An acid-soluble protein was extracted and purified from th*	Tanzer, M. L.	
21	CULT	Cultivation of mussels	NA	*Determining optimal duration of seed translocation periods for benthic mussel (Mytilus edulis) cultivation using physiological and behavioural measures of stress (https://www.sciencedirect.com/science/article/pii/S0044848614004153)*	*This work has practical implications for the benthic cultivation industry and based on the results it is recommended that mussels are held out of water for less than 24 h prior to relaying to ensure physiological health and resultant condition is preserve*	Calderwood, J., O'Connor, N. E., Sigwart, J. D., & Roberts, D.	2014
22	BIO	α-amylasic activity	Ethanol production	*A kinetic and autoradiographic study of the direct assimilation of amino acids and glucose by organs of the mussel Mytilus edulis. (https://link.springer.com/article/10.1007%2FBF02097143)*	*An important α-amylasic activity has been detected in the gills. The gill epithelium shows a strong positive reaction with mixtures used for the histochemical detection of chymotrypsin. This suggests that the digestion of small particles as well as the ab*	Péquignat, E.	1973
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Spisula spp.

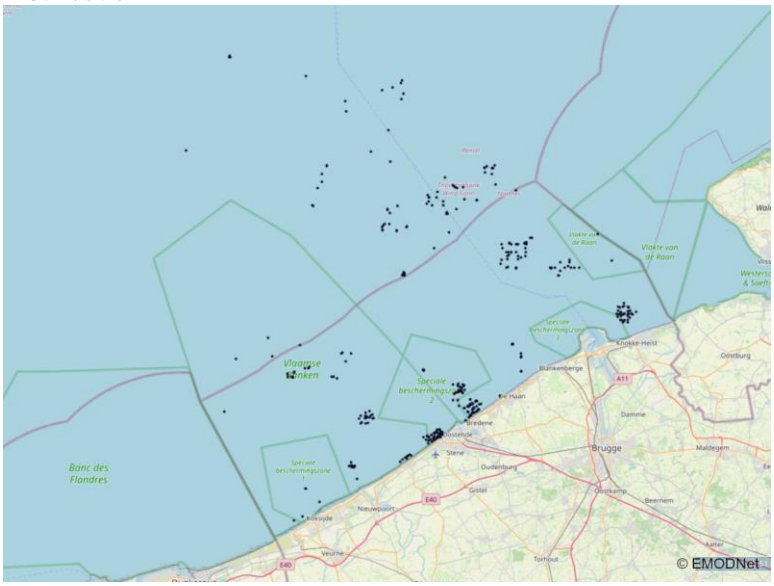
Aphia ID #138159

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Bivalvia
Order:	Venerida
Family:	Mactridae
Genus:	Spisula
Species:	spp.

INFORMATION PANEL

Observations: 170

Distribution:



Habitat type: Benthic zone
Substrate: Sand, mud

DESCRIPTION

Size: 0 - 30 mm

Brief description:
Very variable. The shell shape of the still native specimens living along the coast is more or less triangular and more rounded on one side than on the other. The top is almost in the middle. Fresh specimens are creamy white, with a greyish yellow upper layer. The animals live buried in a moderately coarse to finer sandy bottom from just below the low tide line to depths of several tens of meters.

Sampling method: van Veen grab, beam trawl
Dutch name: Strandschelp

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	CULT	Spatial distribution, population dynamics and productivity	NA	*Spatial distribution, population dynamics and productivity of Spisula subtruncata: Implications for Spisula fisheries in seaduck wintering areas (https://link.springer.com/article/10.1007/s00227-007-0740-y)*	*Bivalves are important in shallow marine habitats, not at least being the major food resource for seaducks such as the common scoter (Melanitta nigra), thousands of which are wintering on the Western Coastal Banks, near the Belgian-French border (North Sea). Next to this ecological importance, fishable stocks of one of these bivalves, Spisula subtruncata, occur in the area. This study aimed at investigating S. subtruncata's spatial distribution, population dynamics and productivity and its implications for a sustainable Spisula fishery in seaduck wintering areas.*	Degraer, S., Meire, P., Vincx, M.	2007
2	BIO	Spisulosine	Anticancer	*Total synthesis and the anticancer activity of (+)-spisulosine (https://doi.org/10.1016/j.carres.2016.09.010)*	*The total synthesis of the anticancer agent (+)-spisulosine has been accomplished. The strategy involved a substrate-controlled aza-Claisen rearrangement to establish the erythro-configured amino-alcohol motif followed by deoxygenation to create a methyl side-chain. Subsequent Wittig olefination then permitted the construction of the carbon backbone of the target molecule. To investigate the antiproliferative effect of 1, its biological profile was examined on a panel of 6 human malignant cell lines and demonstrated the significant anticancer activity of 1 on at least five of the evaluated lines with IC50 < 1 μM (MCF-7, HTC-116, Caco-2, Jurkat and HeLa). © 2016 Elsevier Ltd*	Fabišíková M., Martinková M., Hirková S., Gonda J., Pilátová M.B., Gönciová G.	2016
3	BIO	Spisulosine	Anticancer	*The marine compound spisulosine, an inhibitor of cell proliferation, promotes the disassembly of actin stress fibers (https://pubmed.ncbi.nlm.nih.gov/10754202/)*	*Spisulosine is a novel antiproliferative (antitumoral) compound of marine origin. In this work the molecular target for this toxic agent has been analyzed. In the presence of spisulosine, cultured cells change their morphology, first acquiring a fusiform morphology, and later becoming rounded without focal adhesions. Analysis of the cytoskeleton of treated cells indicate the absence of actin stress fibers.*	Cuadros R., Montejo de Garcini E., Wandosell F., Faircloth G., Fernandez-Sousa J.M., Avilla J.	2000
4	BIO	Decarbamoyl toxins	Toxins	*Profiles of paralytic shellfish poisoning toxins in shellfish from Portugal explained by carbamoylase activity (https://www.sciencedirect.com/science/article/pii/S002196730700670X)*	*Clams such as Spisula solida contained a simple PSP toxin profile consisting of mainly decarbamoyl toxins. In vitro incubation of S. solida digestive glands with PSP standards revealed a rapid transformation of carbamate and N-sulfocarbamoyl toxins into their corresponding decarbamate analogues.*	Mireia LaraArtigas, Paulo João VieiraVale, Susana SousaGomes, Maria João Botelho, Susana Margarida Rodrigues, Ana Amorim	2007
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Venerupis corrugata

Pullet carpet shell

Aphia ID #181364

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Bivalvia
Order:	Venerida
Family:	Veneridae
Genus:	Venerupis
Species:	corrugata

INFORMATION PANEL

Observations: 67

Distribution:

Habitat type: Benthic zone
Substrate: Sand, gravel

DESCRIPTION

Size: - 50 mm

Brief description:
An oval, bivalve shell that reaches 5 cm in length. The exterior is sculptured with concentric ridges and faint radiating lines. White, cream or grey in colour, sometimes with purple or brown markings.

Sampling method: van Veen grab, beam trawl
Dutch name: Gewone tapijtschelp

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	CULT	NA	Hatchery	*Hatchery culture of European clam species (family Veneridae) (10.1007/s10499-020-00552-x)*	*Aquaculture and capture production of clam species have great economic value in Europe. The production is dominated by the introduced species, Manila clam, Ruditapes philippinarum, which has displaced some of the native species of clams. In Europe, landings of autochthonous clams have decreased in the recent years due to overfishing, failure in recruitment, abiotic stress and diseases. Due to aforementioned factors, seed production in hatcheries has become essential to ensure the sustainability of the fisheries and aquaculture production of European native clams. Many studies have focused on the different steps involved in hatchery rearing, but the volume of seed of native species produced in commercial hatcheries is still relatively low in comparison to the exotic Manila clam. Presently, in European hatcheries, seeds from only two native species, Ruditapes decussatus and Venerupis corrugata, are produced at industrial scale. The present review analyses the state of hatchery culture of European native clam species, and the aims are to transfer information to the industry and identify critical gaps that might be impeding the development of hatchery production. © 2020, Springer Nature Switzerland AG.*	da Costa F., Cerviño-Otero A., Iglesias Ó., Cruz A., Guévélou E.	2020
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Alloteuthis subulata

European common squid

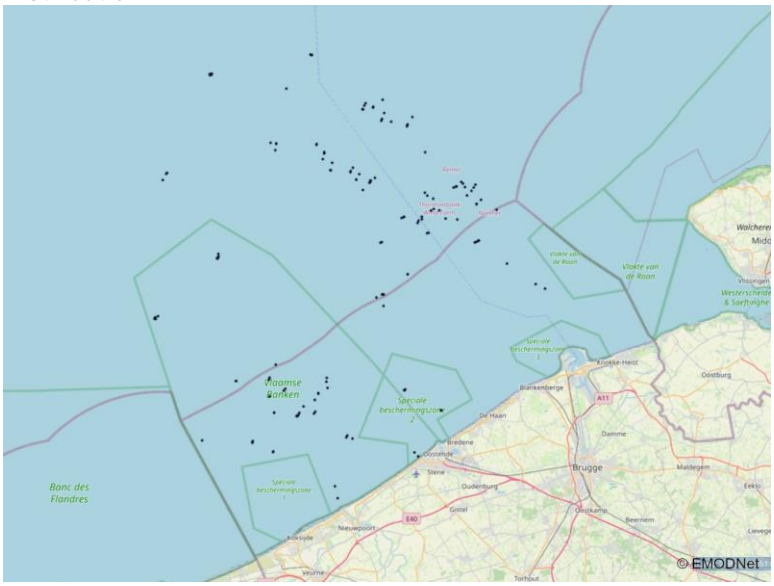
Aphia ID #153131

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Cephalopoda
Order:	Myopsida
Family:	Loliginidae
Genus:	Alloteuthis
Species:	subulata

INFORMATION PANEL

Observations: 166

Distribution:



Habitat type: Pelagic zone
Substrate: Sand, hard bottoms

DESCRIPTION

Size: 0 - 210 mm

Brief description:
Similar to Loligo but much smaller with males reaching up to 20 cm in length. Body tapered posteriorly, forming a slender pointed tail. Fins rounded forming a heart shape in dorsal view. The colour varies from pale grey with brown - purple spots.

Sampling method: Beam trawl
Dutch name: Dwergpijlinktvis

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
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Sepiola atlantica

Littel cuttlefish

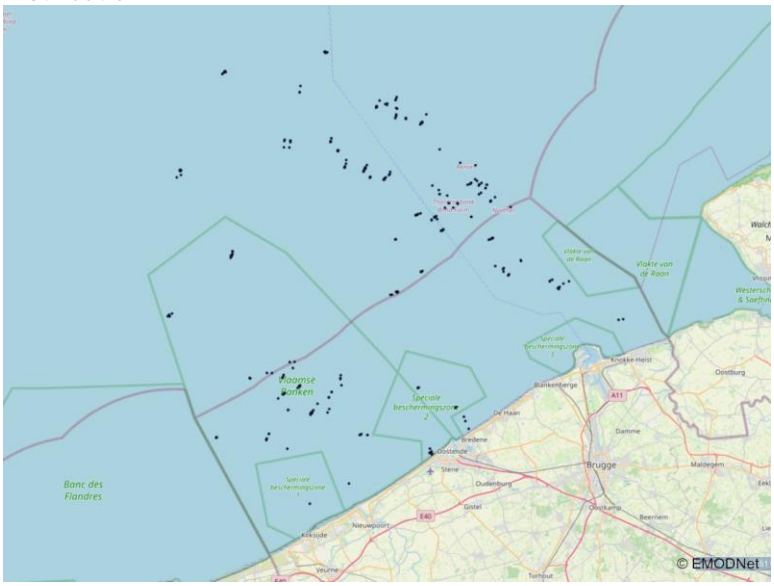
Aphia ID #141454

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Cephalopoda
Order:	Sepiida
Family:	Sepiolidae
Genus:	Sepiola
Species:	atlantica

INFORMATION PANEL

Observations: 319

Distribution:



Habitat type: Demersal zone
Substrate: Sand, gravel

DESCRIPTION

Size: 0 - 50 mm

Brief description:
A plump, rounded cuttlefish small in size of up to 6 cm, with rounded fins that do not run along its entire length. The colour varies from black-brown to pale dorsally and pale ventrally. It is rarely striped. Often found in rockpools, subtidally and offshore. Swims over or burrows in sand and gravel.

Sampling method: Beam trawl
Dutch name: Gewone dwerginktvis

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	CULT	Laboratory culture, growth and life cycle	NA	*Laboratory culture, growth, and the life cycle of the little cuttlefish sepiola atlantica (Cephalopoda: Sepiolidae) (https://bioone.org/journals/Journal-of-Shellfish-Research/volume-29/issue-1/035.029.0121/Laboratory-Culture-Growth-and-the-Life-Cycle-of-t*	*Pairs of Sepiola atlantica maintained in aquaria at ~17°C successfully mated in the "male parallel position" for between 21 min and 77 min. Over a period of several weeks after mating, female S. atlantica laid egg masses containing 8–161 eggs. At 14.4°C, embryonic development took 33 days and the hatching phase lasted for 23 days (mean hatching success, 32%).,...*	Jones, N.J.E., Richardson, C.A.	2010
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Crepidula fornicata

Slipper limpet

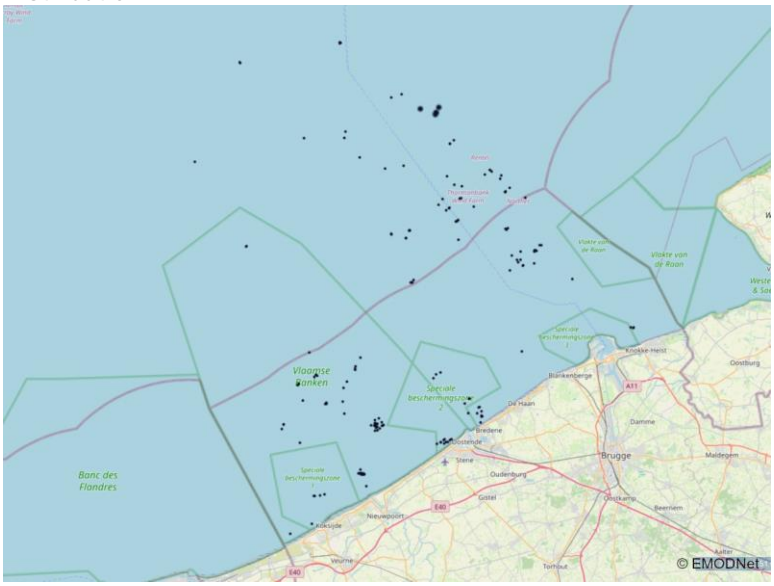
Aphia ID #138963

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Gastropoda
Order:	Littorinimorpha
Family:	Calyptraeidae
Genus:	Crepidula
Species:	fornicata

INFORMATION PANEL

Observations: 226

Distribution:



Habitat type:	Benthic zone
Substrate:	Shells, stones, soft subtrata

DESCRIPTION

Size: 0 - 50 mm

Brief description:

The shell is oval, up to 5 cm in length, with a much reduced spire. The large aperture has a shelf, or septum, extending half its length. The shell is smooth with irregular growth lines and white, cream, yellow or pinkish in colour with streaks or blotches of red or brown. Slipper limpets are commonly found in curved chains of up to 12 animals. Large shells are found at the bottom of the chain, with the shells becoming progressively smaller towards the top. Crepidula fornicata is typically found attached to shells and stones on soft substrata around the low water mark and the shallow sublittoral. It is often attached to the shells of mussels Mytilus edulis and oysters Ostrea edulis.

Sampling method:	Beam trawl, hand collection
Dutch name:	Muiltje

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Antimicrobial activity	Antimicrobial	*Screening for antibacterial and antiviral activities in three bivalve and two gastropod marine molluscs (https://www.sciencedirect.com/science/article/abs/pii/S0044848609003056?via%3Dihub)*	*Anti-microbial studies, C. fornicata not the highest performer but does have the relevant activity.*	Diane Defer, Nathalie Bourgougnon, Yannick Fleury	2009
2	BIO	Transparent exopolymer particles (TEP) for biomaterials	0	*Production of transparent exopolymer particles (TEP) by benthic suspension feeders in coastal systems (https://www.sciencedirect.com/science/article/pii/S0022098106005442?via%3Dihub)*	*Biopolymer production in the form of Transparent exopolymer particles (TEP), causing enhanced flocculation of organic matter and carbon deposition*	K.B. Heinonen, J.E. Ward, B.A. Holohan	2007
3	BIO	Neuroendocrine mitogenic factor	Peptide	*Partial purification of the neuroendocrine mitogenic factor in the mollusc Crepidula fornicata L. (https://www.sciencedirect.com/science/article/pii/0305049187903117?via%3Dihub)*	*The neuroendocrine mitogenic factor, a cerebral-specific substance, controls the cell multiplication in the gonad and in the regenerative tentacle of the gastropod Crepidula. Cerebral ganglia (CG) or cerebral ganglia homogenate (CGH) initiates mitosis and subsequent outgrowth of regenerative tentacle blastema in vitro. The mitogenic action of CGH is dose dependent: 0.25 animal-equivalent CGH is active and the maximum effective dose is below one animal-equivalent. The mitogenic factor is heat-stable and pronase-resistant. The brain-specific origin and the gel filtration behaviour of the bioactive fraction suggest that the extracted factor might be a peptide.*	Solange Le Gal, Colette Feral, Catherine Lengronne, Maurice Porchet	1987
4	CUL	Marine aggregate feed size	Feed	*The role of marine aggregates in the ingestion of picoplankton-size particles by suspension-feeding molluscs (https://link.springer.com/article/10.1007%2Fs00227-007-0852-4)*	*Marine aggregates significantly enhance the ingestion of 1.0- and 0.5-µm beads by all species of bivalves, and enhance the ingestion of bacteria (greatest cell dimension ca. 0.6 µm) by all suspension feeders examined.*	Dustin J. Kach, J. Evan Ward	2007
5	CUL	Diatom feed for larvae	Feed	*Importance of bacterivory and preferential selection toward diatoms in larvae of Crepidula fornicata (L.) assessed by a dual stable isotope (13C, 15N) labeling approach (https://www.sciencedirect.com/science/article/abs/pii/S1385110112000214?via%3Dihub)*	*Feeding in larvae of C. fornicata was studied using dual stable isotope labeling. Larvae of C. fornicata incorporated bacteria. Larvae of C. fornicata used preferentially diatoms when supplied both sources. Considering in situ abundances, bacteria may be a complementary resource for larvae.*	Fanny Leroy, Pascal Riera, Christian Jeanthon, Frédérique Edmond, Cédric Leroux, Thierry Comtet	2012
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Tritia reticulata

Netted dogwhelk

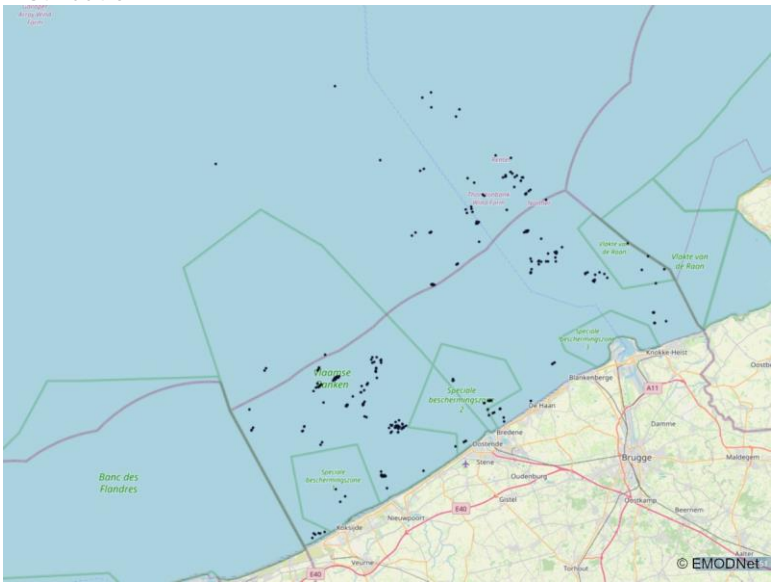
Aphia ID #0

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Gastropoda
Order:	Neogastropoda
Family:	Nassariidae
Genus:	Tritia
Species:	reticulata

INFORMATION PANEL

Observations: 350

Distribution:



Habitat type: Benthic zone
Substrate: Sand, mud, rocks

DESCRIPTION

Size: 0 - 30 mm

Brief description:
A small creamy-brown whelk (up to 3 cm in height) it has a pointed, straight sided spire. The criss-crossing of longitudinal and spiral ridges gives the whelk its characteristic netted (reticulate) pattern. It has an oval aperture with an outer lip that is thickened and toothed in mature animals. The inner lip extends over the body-whorl and the siphonal canal is deep and at an oblique angle.

Sampling method: Beam trawl, van Veen grab
Dutch name: Gevlochten fuikhoorn

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

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Haliclona oculata

Mermaid's glove

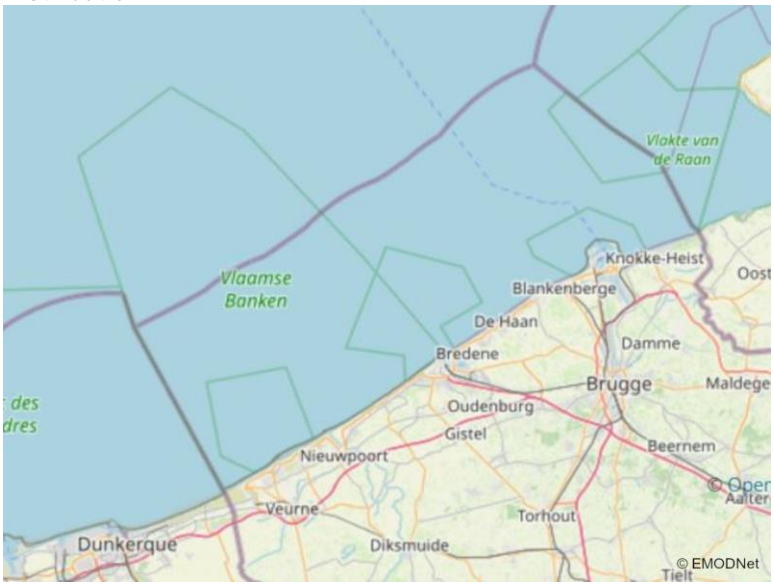
Aphia ID #132833

Kingdom:	Animalia
Phylum:	Porifera
Class:	Demospongiae
Order:	Haplosclerida
Family:	Chalinidae
Genus:	Haliclona
Species:	oculata

INFORMATION PANEL

Observations: NA

Distribution:



Habitat type: Benthic zone
Substrate: Hard substrate

DESCRIPTION

Size: 100 - 300 mm

Brief description:
An elegantly branching, soft sponge with a rose-brown or yellow-brown colour. The height may be up to 30 cm. The branches are somewhat flattened. The surface is velvety. It occurs in shallow subtidal, occasionally intertidal habitats, often associated with rather silted water.

Sampling method: Hand collection
Dutch name: Geweispons

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Methanolic extracts	Anticancer	*Selective toxicity of persian Gulf sea cucumber (Holothuria parva) and sponge (Haliclona oculata) methanolic extracts on liver mitochondria isolated from an animal model of hepatocellular carcinoma (https://doi.org/10.5812/hepatmon.33073)*	*Natural products isolated from marine environments are well known for their pharmacodynamic potential in diverse disease treatments, such as for cancer or inflammatory conditions. Many studies have shown that sea cucumbers and sponges contain antioxidants and anti-cancer compounds. This study was designed to determine the selective toxicity of Persian Gulf sea cucumber (Holothuria parva) and sponge (Haliclona oculata) methanolic extracts on liver mitochondria isolated from an animal model of hepatocellular carcinoma, as part of a national project that hopes to identify novel potential anticancer candidates among Iranian Persian Gulf flora and fauna. To induce hepatocarcinogenesis, rats were given diethylnitrosamine (DEN) injections (200 mg/kg i.p. by a single dose), and then the cancer was promoted with 2-acetylaminofluorene (2-AAF) (0.02 w/w) for two weeks. Histopathological evaluations were performed, and levels of liver injury markers and a specific liver cancer marker (alpha-fetoprotein), were determined for confirmation of hepatocellular carcinoma induction. Finally, mitochondria were isolated from cancerous and non-cancerous hepatocytes. Our results showed that H. parva methanolic extracts (250, 500, and 1000 µg/mL) and H. oculata methanolic extracts (200, 400, and 800 µg/mL) increased reactive oxygen species (ROS) formation, mitochondrial membrane potential (MMP), mitochondrial swelling, and cytochrome c release in the mitochondria obtained from cancerous hepatocytes, but not in mitochondria obtained from non-cancerous liver hepatocytes. These extracts also induced caspase-3 activation, which is known as a final mediator of apoptosis, in the hepatocytes obtained only from cancerous, not non-cancerous, rat livers. Our results suggest that H. parva and H. oculata may be promising therapeutic candidates for the treatment of HCC, following further confirmatory in vivo experiments and clinical trials. © 2015, Kowsar Corp.*	Seydi E., Motallebi A., Dastbaz M., Dehghan S., Salimi A., Nazemi M., Pourahmad J.	2015
2	BIO	Steriods and brominated lipids	Cytotoxic	*Cytotoxic constituents from Vietnamese marine sponge Haliclona oculata (Linnaeus, 1759) (https://doi.org/10.2174/1570178612999150923120855)*	*Using various chromatography methods, five steroids and two brominated lipids (1-7), 3β-hydroxy-5-cholenic acid methyl ester, stigmasta-5,24(28)-dien-3β,29-diol, 24-methylenecholest-4-en-3β,6β-diol, cholest-5-en-3β,7β-diol, 24-vinylcholest-5-en-3β,24-diol, xestospongiene A, and xestospongiene J, respectively, were isolated from the methanol extract of Vietnamese marine sponge Haliclona oculata (Linnaeus, 1759). Their structures were elucidated by 1D-, 2D-NMR, and ESI-MS spectra and in comparison with those reported in the literature. Compounds 1-4, 6, and 7 were reported from Chalinidae family for the first time. In addition, all compounds*	Van Kiem P., Thanh N.T.V., Hang D.T.T., Cuc N.T., Nhiem N.X., Yen P.H., Le Tuan Anh H., Tai B.H., Thao D.T., Van Minh C.	2015

					were evaluated for eight human cancer cell lines as HepG-2, KB, LU-1, MCF-7, LNCaP, HL-60, SK-Mel2, and PC-3. As shown in results, compound 2 showed significant cytotoxic activities on KB and LU-1 cancer cell lines with the IC50 values ranging from 8.74 to 9.32 μM. © 2015 Bentham Science Publishers.		
3	BIO	7,7-bis(3-indolyl)-p-cresol, cyclo-(S-Pro-R-Leu) and cyclo-(S-Pro-R-Val)	Antimicrobial	*Antimicrobial constituents from the bacillus megaterium lc isolated from marine sponge Haliclona oculata (http://kpubs.org/article/articleMain.kpubs?articleANo=E1HSBY_2014_v20n3_202)*	*Three compounds including 7,7-bis(3-indolyl)-p-cresol (1), cyclo-(S-Pro-R-Leu) (2) and cyclo-(S-Pro-R-Val) (3) were isolated from the strain of Bacillus megaterium LC derived from the marine sponge Haliclona oculata. All the isolated compounds showed antimicrobial activity at MIC values ranging from 0.005 to 5 μg/mL against Gram-negative bacteria Vibrio vulnificus and V. parahaemolyticus, gram-positive bacteria Bacillus cereus and Micrococcus luteus, and the dermatophyte Trichophyton mentagrophytes. The results suggested that these compounds might have potential to be developed as agents treating dermatosis and controlling vibriosis in aquaculture. © 2014, Korean Society of Pharmacognosy. All rights reserved.*	Cuong P.V., Cuc N.T.K., Quyen V.T., Binh P.T., Van Kiem P., Nam N.H., Dat N.T.	2014
4	BIO	Methanolic extracts	Antifilarial	*Antifilarial activity of marine sponge Haliclona oculata against experimental Brugia malayi infection (https://doi.org/10.1016/j.exppara.2012.01.009)*	*The present study incorporates the findings on in vitro and in vivo antifilarial activity in the marine sponge, Haliclona oculata using an experimental rodent infection of human lymphatic filarial parasite, Brugia malayi. The in vitro antifilarial action was determined on both adult female worms as well as microfilariae using two parameters viz. adverse effect on motility and inhibition in MTT reduction by the treated adult parasite over control worm. The antifilarial activity could be located in the methanol extract and one of its four fractions (chloroform). Bioactivity guided fractionation of chloroform fraction led to localization of in vitro activity in one of its eight chromatographic fractions. Methanol extract, chloroform fraction and one of the chromatographic fractions revealed IC 50 values of 5.00, 1.80, and 1.62μg/ml, respectively when adult B. malayi were exposed to these test samples for 72h at 37°C. Under similar exposure conditions, the IC 50 values for microfilariae were 1.88, 1.72 and 1.19μg/ml, respectively. The active test samples were found to be safe revealing >10 selectivity indices (SI) on the basis of cytotoxicity to Vero cells (monkey kidney cells) and therefore selected for in vivo evaluation against primary (adult B. malayi intraperitoneal transplanted jird) and secondary (subcutaneous infective larvae induced mastomys) screens. In primary jird model, the three test samples at 100mg/kg for five consecutive days by subcutaneous route demonstrated significant macrofilaricidal efficacy to the tune of 51.3%, 64% and 70.7% by methanol extract, chloroform and chromatographic fraction, respectively. The three samples demonstrated 45-50% macrofilaricidal activity with moderate embryostatic effect in secondary model at 5×500, 5×250 and 5×125mg/kg by oral route. Chromatographic fraction possessing highest antifilarial action was primarily found to be a mixture of four alkaloids Mimosamycin, Xestospongin-C, Xestospongin-D and*	Gupta J., Misra S., Mishra S.K., Srivastava S., Srivastava M.N., Lakshmi V., Misra-Bhattacharya S.	2012

					Araguspongin-C in addition to few minor compounds. © 2012 Elsevier Inc.		
5	BIO	Crude extract	Cytotoxic activity	*Cytotoxic activity of extracts of marine sponges from NW Spain on a neuroblastoma cell line (https://doi.org/10.1016/j.etap.2011.08.012)*	*Six species of marine sponges collected at intertidal and sublittoral sites of the coast of Galicia (NW Spain) were screened for potential cytotoxic properties on Neuroblastoma BE(2)-M17 cell line. Exposure to Halichondria panicea, Pachymatisma johnstonia, Ophlitaspongia seriata and Haliclona sp. aqueous extracts strongly affected cell appearance, inducing loss of neuron-like morphology and the formation of clumps. Extracts from these species also caused significant rates of cell detachment and decrease of mitochondrial membrane potential. Incubation with P. johnstonia, O. seriata and Suberites massa extracts also decreased the rate of cell proliferation. The increase of incubation time enhanced propidium iodide uptake by neuroblastoma cells. Toxic responses triggered by sponge extracts are compatible with apoptotic phenomena in neuroblastoma cells, even though increasing propidium uptake at long periods of exposure might indicate the induction of secondary necrosis. The cytotoxic properties of the tested extracts suggest the presence of compounds with potential pharmacological or biotechnological applications in the screened sponge species. © 2011 Elsevier B.V.*	Ferreira M., Cabado A.G., Chapela M.-J., Fajardo P., Atanassova M., Garrido A., Vieites J.M., Lago J.	2011
6	BIO	Salicylihalmide A, alkaloids	Cytotoxic	*Towards commercial production of sponge medicines (https://doi.org/10.3390/md7040787)*	*Sponges can provide potential drugs against many major world-wide occurring diseases. Despite the high potential of sponge derived drugs no sustainable production method has been developed. Thus far it is not fully understood why, when, where and how these metabolites are produced in sponges. For the near future sea-based sponge culture seems to be the best production method. However, for controlled production in a defined system it is better to develop in vitro production methods, like in vitro sponge culture or even better sponge cell culture, culture methods for symbionts or the transfer of production routes into another host. We still have insufficient information about the background of metabolite production in sponges. Before production methods are developed we should first focus on factors that can induce metabolite production. This could be done in the natural habitat by studying the relation between stress factors (such as predation) and the production of bioactive metabolites. The location of production within the sponge should be identified in order to choose between sponge cell culture and symbiont culture. Alternatively the biosynthetic pathways could be introduced into hosts that can be cultured. For this the biosynthetic pathway of metabolite production should be unraveled, as well as the genes involved. This review discusses the current state of sponge metabolite production and the steps that need to be taken to develop commercial production techniques. The different possible production techniques are also discussed. © 2009 by the authors; licensee Molecular Diversity Preservation International.*	Koopmans M., Martens D., Wijffels R.H.	2009

7	BIO	Oculatol, oculatolide, A-nor sterols	NA	*Oculatol, oculatolide, and A-nor sterols from the sponge Haliclona oculata (https://doi.org/10.1021/np0600494)*	*Chemical investigation of the marine sponge Haliclona oculata resulted in the isolation of eight new compounds including oculatol (1) and oculatolide (2) and six unusual A-nor steroids, 2-ethoxycarbonyl-2β-hydroxy-A-nor-ergosta- 5,24(28)-dien-4-one (3), 2-ethoxycarbonyl-24-ethyl-2β-hydroxy-A-nor- cholesta-5-en-4-one (4), 2-ethoxycarbonyl-2β,7β-dihydroxy-A-nor- ergosta-5,24(28)-dien-4-one (5), 2-ethoxycarbonyl-2β,7β-dihydroxy-A- nor-cholesta-5-en-4-one (6), 2-ethoxycarbonyl-2β,7β-dihydroxy-24-methyl-A-nor-cholesta-5,22(E)-dien-4-one (7), and 2-ethoxycarbonyl-2β, 7β-dihydroxy-A-norcholesta-5,22(E)-dien-4-one (8), along with 16 known steroids and indole derivatives. Their structures were unambiguously determined on the basis of extensive spectroscopic analyses. © 2006 American Chemical Society and American Society of Pharmacognosy.*	Yu S., Deng Z., Proksch P., Lin W.	2006
8	BIO	Ergosterol derivative	NA	*Complete structural assignments of an ergosterol derivative from entandrophragma utile (https://doi.org/10.1021/np50073a011)*	*On the basis of extensive structural analysis, a 3β,7α-dihydroxyergosta-5,24(28)-diene structure [1] was assigned to a compound isolated from Entandrophragma utile. This result necessitates the revision of a previously misassigned structure of a product isolated from the sponge Haliclona oculata. © 1991, American Chemical Society. All rights reserved.*	Garcia J., Morin C., Nyasse B., Sondengam B.-L., Tchouankeu J.-C., Tsamo E.	1991
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Halichondria bowerbanki

Bowerbank's horny sponge

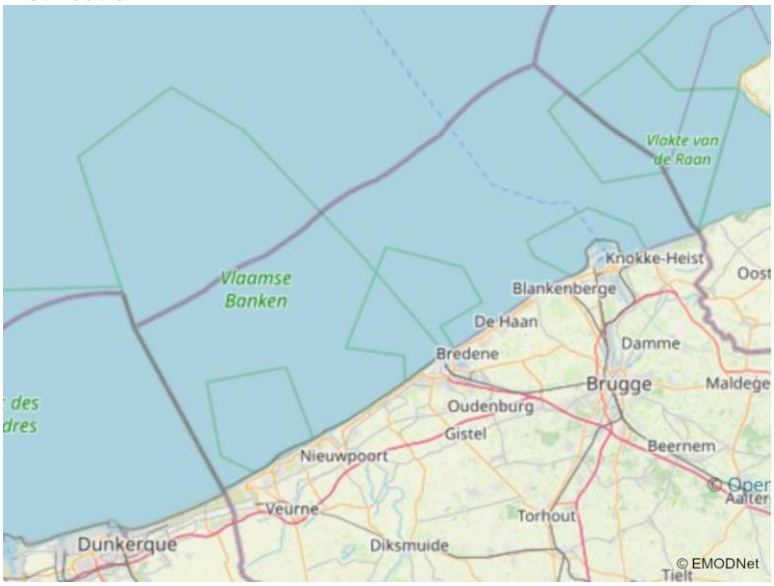
Aphia ID #165801

Kingdom:	Animalia
Phylum:	Porifera
Class:	Demospongiae
Order:	Suberitida
Family:	Halichondriidae
Genus:	Halichondria
Species:	bowerbanki

INFORMATION PANEL

Observations: NA

Distribution:



Habitat type: Benthic zone
Substrate: Hard substrate

DESCRIPTION

Size: 0 - 250 mm

Brief description:
Beige or dull brownish grey in summer, light grey yellow or whitish in winter. Growth form variable, thinly to somewhat massively encrusting, with long outgrowths, irregular tassel-like branches which anastomose to form irregularly flattened masses. Occasionally bush-like. Size up to 25 cm across and branches may reach 12 cm. Surface smooth or uneven, often with a translucence. Parchment-like skin. Consistency soft, compressible. Texture crumb-of-bread like.

Sampling method: Hand collection
Dutch name: Sliertige broodspons

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Crude extract and spicules	Defense mechanism	*Anti-predator defenses in western North Atlantic sponges with evidence of enhanced defense through interactions between spicules and chemicals (http://www.int-res.com/abstracts/meps/v291/p93-102/)*	*Crude extracts, spicules and a combination of spicules and crude extract isolated from Halichondria bowerbanki all significantly reduced crab feeding rates compared to consumption of control food. The data involving M. prolifera, H. bowerbanki, and C. celata indicate that temperate sponges use chemical and structural defenses against potential predators, and that structural and chemical defenses interact in M. prolifera. Results of this and other studies indicate that it may be fruitful to look for additive and synergistic defenses in other sponge species, especially those found to be chemically undefended when compounds were tested in isolation.*	Hill M.S., Lopez N.A., Young K.A.	2005
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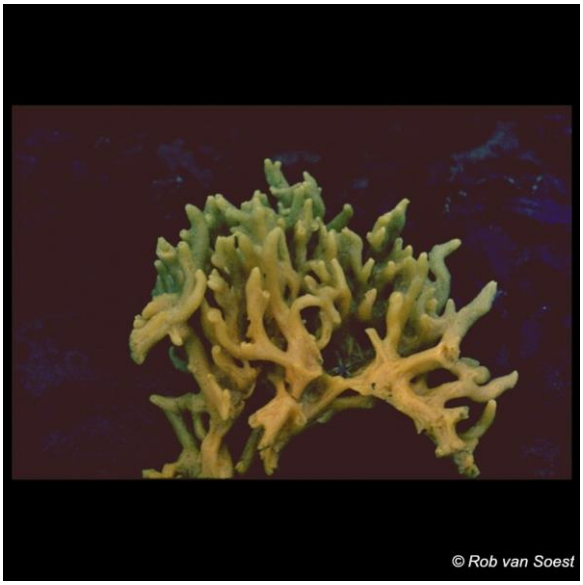
Halichondria panicea

Breadcrumb sponge

Aphia ID #165853

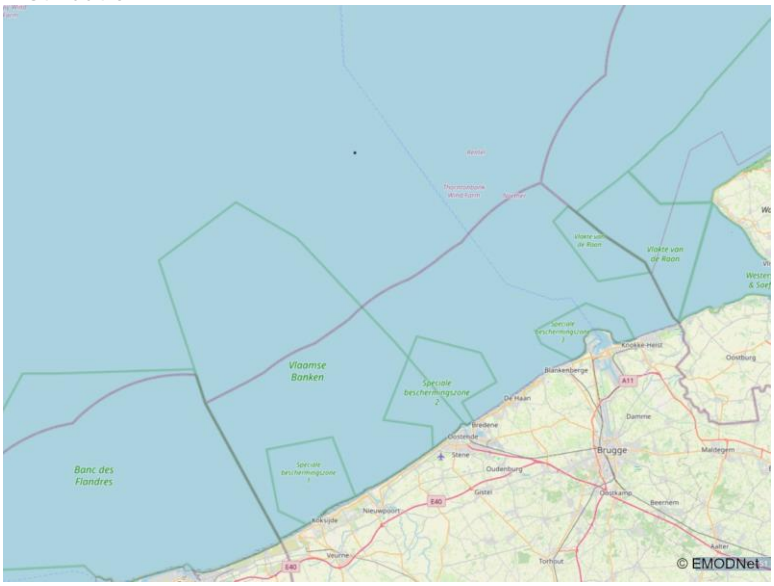
Kingdom:	Animalia
Phylum:	Porifera
Class:	Demospongiae
Order:	Suberitida
Family:	Halichondriidae
Genus:	Halichondria
Species:	panicea



INFORMATION PANEL

Observations: 1

Distribution:



Habitat type: Benthic zone
Substrate: Hard substrate

DESCRIPTION

Size: 0 - 600 mm

Brief description:
An intertidal or shallow-subtidal, thickly encrusting, massive or occasionally branching sponge, with typical volcanoe-shaped oscular chimneys. Colour green or yellow. Surface smooth. Consistency firm, texture crumb-of-bread. Quite variable in shape, related to exposure to water movement. Specimens growing in intertidal localities exposed to the full oceanic surf may be entirely smooth with barely visible oscular chimneys. More intermediate environments show the typical volcanoe-shaped chimneys up to 4 or 5 cm high. Oscules are relatively large, conspicuous, 2-4 mm in diameter. Sponge body may be up to 25 cm thick and 60 cm across, but much smaller specimens are the rule.

Sampling method: Hand collection
Dutch name: Gewone broodspons

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	CULT	Host dependency	Cultivation	*Co-cultivation of the marine sponge Halichondria panicea and its associated microorganisms (https://doi.org/10.1038/s41598-019-46904-3)*	*Marine sponges host bacterial symbionts with biotechnological potential, yet isolation of true sponge symbionts remains difficult due to their host dependency. Moreover, attempts to grow sponges for their pharmacologically-active compounds outside of their habitat often results in a shift of their microbial community. In this study we evaluate suitable sponge cultivation methods that allow maintenance of both the marine sponge Halichondria panicea and its associated bacteria in an ex situ environment. In addition, we present a method for co-cultivation of sponge explants and microbes separated by a membrane in a multi-chamber device. Tests on ex situ cultivation of H. panicea under different controlled conditions showed that only high water exchange rates in the aquarium enabled maintenance of its dominant symbiont "Candidatus Halichondribacter symbioticus" at a high relative abundance in the sponge body, a prerequisite for co-cultivation. The bacterial enrichment retrieved from co-cultivation contained bacteria from nine different classes in addition to sequences corresponding to "Ca. H. symbioticus". This represents an increase of the cultivable bacterial classes from H. panicea compared to standard isolation techniques on solid media plates. The current study provides insights into sponge-microbe maintenance under ex situ conditions and proposes a new method for the isolation of sponge-associated bacteria. © 2019, The Author(s).*	Knobloch S., Jóhannsson R., Marteinsson V.	2019
2	BIO	Crude extract	Cytostatic activity	*Cytostatic activity in the hydrophilic fraction of the crude extract from the White Sea sponge Halichondria panicea (https://doi.org/10.21638/spbu03.2019.105)*	*Halichondria panicea, commonly known as the breadcrumb sponge, is an ecologically aggressive and widespread species in the coastal waters of North Atlantic and North Pacific. Cytostatic activity of the water-soluble extract fraction from the White Sea sponge Halichondria panicea was tested using organotypic cultures of rat liver fragments. The study shows a pronounced negative dose-dependent effect of the extract on the development of tissue explants of the test animals. Our results confirm toxicity of the White Sea Halichondria panicea, which was revealed earlier toward marine epibenthic organisms. The chemical nature of a substance or substances responsible for toxic effect is discussed. Copyright: © 2019 Khalaman et al. This is an open-access article distributed under the terms of the License Agreement with Saint Petersburg State University, which permits to the authors unrestricted distribution, and self-archiving free of charge.*	Khalaman V., Chalisova N., Krasnov K., Alexandrova M.	2019
3	BIO	Biosurfactant-producing bacteria	Biosurfactant	*The demosponge Halichondria (Halichondria) panicea (Pallas, 1766) as a novel source of biosurfactant-producing bacteria*	*The Mediterranean sponge Halichondria (Halichondria) panicea was explored as a novel matrix for the isolation of biosurfactant-producing bacteria. A total of 38 (out of 56) isolates gave a good response to the employed screening tests (e.g., stable emulsion*	Rizzo C., Syldatk C., Hausmann R., Gerçe B., Longo C., Papale M., Conte A.,	2018

				(https://doi.org/10.1002/jobm.201700669)	*detection, surface tension measurement, hemolytic activity, and blue agar plate assay) and were selected for further analyses. The thin layer chromatography revealed a possible glucidic composition of biosurfactants. Most promising strains, i.e., those able to produce stable emulsion with percentage higher than 30% and yellow spots on TLC plates, were affiliated to the genera Pseudovibrio, Acinetobacter, and Bacillus. The biosurfactant production by two isolates (i.e., Acinetobacter sp. SpN134 and Pseudovibrio sp. SpE85) was evaluated under different culture conditions, in terms of temperature, NaCl concentration, and pH. Surface tension reduction ability was more stable than the emulsification, and resulted differently influenced by salinity, temperature, and pH. Acinetobacter sp. SpN134 resulted particularly efficient and competitive if compared with other well-known biosurfactant producers. Data suggest that sponges may represent a promising matrix for the isolation of biosurfactant-producing bacteria, reinforcing the growing interest towards filter-feeding organisms as underexplored sources of specialized bacteria. © 2018 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim*	De Domenico E., Michaud L., Lo Giudice A.	
4	BIO	Bacteria	Antimicrobial and antiproliferative activity	*Identification and bioactive potential of marine microorganisms from selected Florida coastal areas (https://doi.org/10.1002/mbo3.448)*	*The ocean, with its rich untapped chemical biodiversity, continues to serve as a source of potentially new therapeutic agents. The evaluation of the diversity of cultivable microorganisms from the marine sponge Halichondria panicea and ocean sediment samples were examined and their potential as sources of antimicrobial and antiproliferative agents were investigated. The marine sponge and sediments were collected at different depths (0.9–6 meters) and locations in Florida, including Florida Keys, Port St. Joe in Pensacola, Pensacola Bay, Pensacola Beach, and Fort Pickens. Twenty-one cultivatable isolates were grouped according to their morphology and identified using 16S rRNA molecular taxonomy. The bacterial community identified consisted of members belonging to the Actinobacteria, Bacteroidetes, Proteobacteria (Alpha- and Gamma-classes) and Firmicutes phylogeny. Seven of the microbes exhibited mild to significant cytotoxic activities against five microbial indicators but no significant cytotoxic activities were observed against the pancreatic (PANC-1) nor the multidrug-resistant ovarian cancer cell lines (NCI/ADR). This work reaffirms the phyla Actinobacteria and Proteobacteria as sources of potential bioactive natural product candidates for drug discovery and development. © 2017 The Authors. MicrobiologyOpen published by John Wiley & Sons Ltd.*	Christensen A., Martin G.D.A.	2017
5	BIO	3-alkyl pyridine alkaloids	Cytotoxic activity	*Metabolic profiling as a screening tool for cytotoxic compounds: Identification of 3-alkyl pyridine alkaloids from sponges collected at a shallow water hydrothermal vent site North of Iceland (https://doi.org/10.3390/md15020052)*	*Twenty-eight sponge specimens were collected at a shallow water hydrothermal vent site north of Iceland. Extracts were prepared and tested in vitro for cytotoxic activity, and eight of them were shown to be cytotoxic. A mass spectrometry (MS)-based metabolomics approach was used to determine the chemical composition of the extracts. This analysis highlighted clear differences in the metabolomes of three sponge specimens, and all of them were*	Einarsdottir E., Magnusdottir M., Astarita G., Köck M., Ögmundsdottir H.M., Thorsteinsdottir M., Rapp H.T.,	2017

					identified as Haliclona (Rhizoniera) rosea (Bowerbank, 1866). Therefore, these specimens were selected for further investigation. Haliclona rosea metabolomes contained a class of potential key compounds, the 3-alkyl pyridine alkaloids (3-APA) responsible for the cytotoxic activity of the fractions. Several 3-APA compounds were tentatively identified including haliclamines, cyclostellettamines, viscosalines and viscosamines. Among these compounds, cyclostellettamine P was tentatively identified for the first time by using ion mobility MS in time-aligned parallel (TAP) fragmentation mode. In this work, we show the potential of applying metabolomics strategies and in particular the utility of coupling ion mobility with MS for the molecular characterization of sponge specimens. © 2017 by the authors. Licensee MDPI, Basel, Switzerland.	Omarsdottir S., Paglia G.	
6	BIO	Haliclonadiamine derivatives and 6-epi-Monanchorin	Cytotoxic activity	*Haliclonadiamine Derivatives and 6-epi-Monanchorin from the Marine Sponge Halichondria panicea Collected at Iriomote Island (https://doi.org/10.1021/acs.jnatprod.6b00095)*	*Four new haliclonadiamine analogues, (10Z,12E)-haliclonadiamine (1), (10E,12Z)-haliclonadiamine (2), and halichondriamines A (3) and B (4), were isolated from the Okinawan marine sponge Halichondria panicea together with haliclonadiamine (5) and papuamine (6). The structures of 1-4 were elucidated on the basis of their spectroscopic data by comparisons with those for 5 and 6. Further separation of the remaining fraction led to the isolation of a new bicyclic guanidine alkaloid, 6-epi-monanchorin (7), along with monanchorin (8). Compound 7 is the epimer of 8 at the 6 position. Compounds 1-6 inhibited the growth of Mycobacterium smegmatis with inhibition zones of 12, 7, 8, 7, 16, and 12 mm at 10 µg/disc, respectively. Compounds 2-4 exhibited weak cytotoxicities against the Huh-7 (hepatoma) human cancer cell line and were 2-fold less active than 5 and 6. Compounds 7 and 8 were not active against M.Â smegmatis at 20 µg/disc or the cancer cell line at 10 µM. © 2016 The American Chemical Society and American Society of Pharmacognosy.*	Abdjul D.B., Yamazaki H., Kanno S.-I., Takahashi O., Kirikoshi R., Ukai K., Namikoshi M.	2016
7	BIO	Streptophenazines	Antibacterial activity	*Nature's lab for derivatization: New and revised structures of a variety of streptophenazines produced by a sponge-derived Streptomyces strain (https://doi.org/10.3390/md12041699)*	*Eight streptophenazines (A-H) have been identified so far as products of Streptomyces strain HB202, which was isolated from the sponge Halichondria panicea from the Baltic Sea. The variation of bioactivities based on small structural changes initiated further studies on new derivatives. Three new streptophenazines (I-K) were identified after fermentation in the present study. In addition, revised molecular structures of streptophenazines C, D, F and H are proposed. Streptophenazines G and K exhibited moderate antibacterial activity against the facultative pathogenic bacterium Staphylococcus epidermidis and against Bacillus subtilis. All tested compounds (streptophenazines G, I-K) also showed moderate activities against PDE 4B. © 2014 by the authors; licensee MDPI.*	Kunz A.L., Labes A., Wiese J., Bruhn T., Bringmann G., Imhoff J.F.	2014
8	BIO	Crude extract	Cytotoxic activity	*Cytotoxic activity of extracts of marine sponges from NW Spain on a neuroblastoma cell line (https://doi.org/10.1016/j.etap.2011.08.012)*	*Six species of marine sponges collected at intertidal and sublittoral sites of the coast of Galicia (NW Spain) were screened for potential cytotoxic properties on Neuroblastoma BE(2)-M17 cell line. Exposure to Halichondria panicea, Pachymatisma johnstonia, Ophlitaspongia*	Ferreira M., Cabado A.G., Chapela M.-J., Fajardo P., Atanassova M.,	2011

					seriata and Haliclona sp. aqueous extracts strongly affected cell appearance, inducing loss of neuron-like morphology and the formation of clumps. Extracts from these species also caused significant rates of cell detachment and decrease of mitochondrial membrane potential. Incubation with P. johnstonia, O. seriata and Suberites massa extracts also decreased the rate of cell proliferation. The increase of incubation time enhanced propidium iodide uptake by neuroblastoma cells. Toxic responses triggered by sponge extracts are compatible with apoptotic phenomena in neuroblastoma cells, even though increasing propidium uptake at long periods of exposure might indicate the induction of secondary necrosis. The cytotoxic properties of the tested extracts suggest the presence of compounds with potential pharmacological or biotechnological applications in the screened sponge species. © 2011 Elsevier B.V.	Garrido A., Vieites J.M., Lago J.	
9	BIO	γ-pyrones	NA	*Nocapyrones A-D, γ-pyrones from a Nocardiopsis strain isolated from the marine sponge Halichondria panicea (https://doi.org/10.1021/np100312f)*	*Four new γ-pyrones, nocapyrones A-D (1-4), were isolated from an organic extract of the Nocardiopsis strain HB383, which was isolated from the marine sponge Halichondria panicea. These are the first γ-pyrones reported from a Nocardiopsis strain. The structures were elucidated on the basis of one- and two-dimensional NMR experiments and supported by HPLC-UV/MS and HRESIMS analyses. The biosynthesis of nocapyrone A was investigated by feeding experiments with 13C-labeled compounds. In addition, one diketopiperazine, which was only known as a synthetic compound before, was isolated. The bioactivies of 1, 2, and the diketopiperazine were evaluated in a panel of assays. © 2010 The American Chemical Society and American Society of Pharmacognosy.*	Schneemann I., Ohlendorf B., Zinecker H., Nagel K., Wiese J., Imhoff J.F.	2010
10	BIO	Mayamycin	Cytotoxic activity	*Mayamycin, a cytotoxic polyketide from a streptomyces strain isolated from the marine sponge halichondria panicea (https://doi.org/10.1021/np100135b)*	*A new benz[a]anthracene derivative called mayamycin (1) was identified in cultures of Streptomyces sp. strain HB202, which was isolated from the marine sponge Halichondria panicea and selected because of its profound antibiotic activity. The ability to pr*	Schneemann I., Kajahn I., Ohlendorf B., Zinecker H., Erhard A., Nagel K., Wiese J., Imhoff J.F.	2010
11	BIO	Methanol, chloroform-methanol (2:1) and aqueous extracts	Hemolytic, immunostimulating and angiogenic activities	*Bioactivities of extracts from the marine sponge Halichondria panicea (https://doi.org/10.1590/S1678-91992009000300007)*	*In the present study, we screened the biological activity of extracts from the marine sponge Halichondria panicea collected in the Arabian Sea. Crude toxin was obtained by methanol, chloroform-methanol (2:1) and aqueous extraction. Subsequently, the prote*	Purushottama G.B., Venkateshvaran K., Pani Prasad K., Nalini P.	2009
12	BIO	2-methyl branched unsaturated very long fatty acids	NA	*Isolation of 2-methyl branched unsaturated very long fatty acids from marine sponge Halichondria panicea and identification of them by GC-MS and NMR (https://doi.org/10.1016/j.chemphyslip.2004.01.002)*	*In order to study the biomarker fatty acids of symbionts in the marine sponge Halichondria panicea, purification and structural identification of two new 2-methyl branched monoenoic very long fatty acids (2-Me-24:1 n-7 and 2-Me-26:1 n-9) were performed fo*	Imbs A.B., Rodkina S.A.	2004
13	BIO	Fatty acids	NA	*Fatty Acids from the Sea of Japan Sponge Halichondria panicea*	*The fatty acid (FA) composition of total lipids isolated from the marine sponge Halichondria panicea inhabiting Peter the Great Bay of the Sea*	Rod'kina S.A., Latyshev N.A., Imbs	2003

				(https://doi.org/10.1023/A:1024957403078)	*of Japan was studied. GC and GC-MS techniques were used in identification of 63 FAs, with the main attention bei*	A.B.	
14	BIO	Brominated organic compounds, Tribromophenol	Flame retardant, fungicide	*Preliminary study on the occurrence of brominated organic compounds in Dutch marine organisms (https://doi.org/10.1016/S1389-0344(03)00072-8)*	*The extracts of three marine organisms; the ascidian Ciona intestinalis, the brown seaweed Sargassum muticum and the sponge Halichondria panicea, all elicited a number of brominated compounds, some of which were tentatively identified. Tribromophenol was*	Kotterman M., Van Der Veen I., Van Hesselingen J., Leonards P., Osinga R., De Boer J.	2003
15	BIO	Stanols, Δ5-sterols, C27-sterols	NA	*Sterol composition of the Black Sea sponges Hymeniacidon sanguinea (Grant) and Halichondria panicea (Pallas) (https://doi.org/10.1515/znc-1999-1119)*	*The sterol composition of Hymeniacidon sanguinea and Halichondria panicea from the Black Sea was investigated. Both sponges contain similar mixtures of stanols and of dietary Δ5-sterols. Main sterols appeared to be C27-sterols, which could be connected wi*	Elenkov I., Popov S., Andreev S.	1999
16	BIO	NA	Neuroactivity	*Neuroactive compounds produced by bacteria from the marine sponge Halichondria panicea: Activation of the neuronal NMDA receptor (https://doi.org/10.1016/S1382-6689(98)00028-3)*	*Previous studies revealed that the marine sponge Halichondria panicea habors symbiotic- and commensalic bacteria (. Marine Biol. 130, 529-536). In the present study the hypothesis was tested whether some of those bacteria synthesize neuroactive compounds.*	Perovic S., Wichels A., Schütt C., Gerdts G., Pahler S., Steffen R., Müller W.E.G.	1998
17	BIO	Dimethyl di- and, trisulfide and methyl benzyl sulfide	NA	*Source of a nauseating stench from the marine sponge, Halichondria panicea, collected at Clever Bank in the North Sea (https://doi.org/10.1016/0305-1978(89)90024-0)*	*The volatile components of the marine sponge,Halichondria panicea, collected at Clever Bank in the North Sea were investigated by combined gas chromatography-mass spectrometry. The penetrating stench of the sponge is explained by identification of three s*	Christophersen C., Anthoni U., Nielsen P.H., Jacobsen N., Tendal O.S.	1989
18	BIO	Terpenoids	NA	*Terpenoids from a black sea bryozoan conopeum seuratum (https://doi.org/10.1515/znc-1987-9-1001)*	*In the Bryozoan Conopeum seuratum six esterified monoterpene alcohols, three free monoterpene alcohols, three monoterpene ketones, two monoterpene aldehydes, four esters of diterpene acids, two diterpene acids and one triterpene acid were identified, most*	Hadjieva P., Bankova B., Dyulgerov D., St Andreev	1987
19	BIO	(Z)-17-tetracosenal	NA	*Isolation of (Z)-17-tetracosenal from the marine sponge halichondria panicea (https://doi.org/10.1016/0009-3084(86)90118-0)*	*The isolation and characterization from Halichondria panicea of the long chain aldehyde (Z)-17-tetracosenal (1), one of the longest ever isolated from a marine sponge, is described. Structural assignment of the compound was confirmed by spectroscopy (1H-N*	Carballeira N.M.	1986
20	BIO	Paniceins	NA	*Paniceins, unusual aromatic sesquiterpenoids linked to a quinol or quinone system from the marine sponge Halichondria panicea (https://doi.org/10.1016/0040-4020(73)80174-7)*	*Five new substances, panicein-A, -B1, -B2, -B3 and C, containing an aromatic sesquiterpenoid moiety linked to a quinol or a quinone system, have been isolated from the sponge Halichondria panicea. The structures of these compounds were elucidated from the*	Cimino G., De Stefano S., Minale L.	1973
21							
22							
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24							
25							

Sargassum muticum

Wireweed

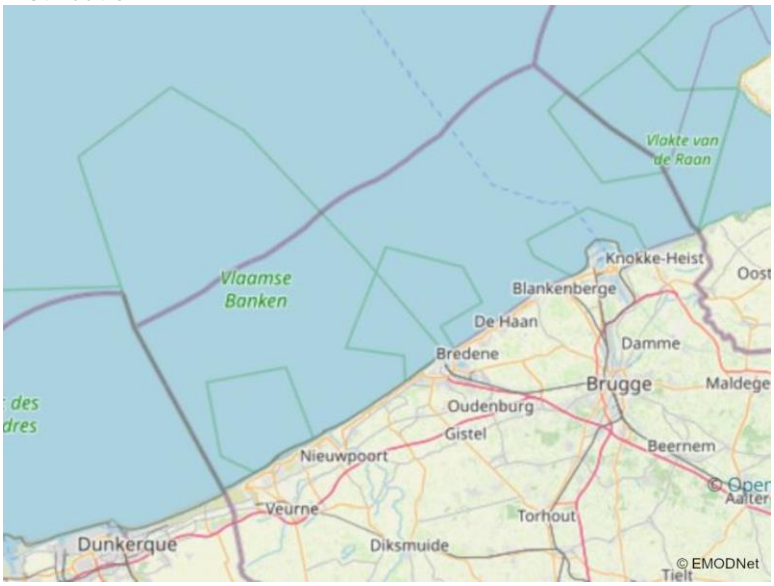
Aphia ID #494791

Kingdom:	Chromista
Phylum:	Ochrophyta
Class:	Phaeophyceae
Order:	Fucales
Family:	Sargassaceae
Genus:	Sargassum
Species:	muticum

INFORMATION PANEL

Observations: NA

Distribution:



Habitat type: Tidal zone
Substrate: Hard substrata

DESCRIPTION

Size: 0 - 1000 mm

Brief description:
A large brown seaweed (with a frond often over 1m long), the stem has regularly alternating branches with flattened oval blades and spherical gas bladders. It is highly distinctive and olive-brown in colour. Wireweed is an invasive species from the Pacific. It competes with native species such as seagrasses and is considered a nuisance in harbours, beaches and shallow waters.

Sampling method: Hand collection
Dutch name: Japans bessenwier

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Lipids, fatty acids	Lipidome and antioxidant activity	*Unraveling the lipidome and antioxidant activity of native bifurcaria bifurcata and invasive sargassum muticum seaweeds: A lipid perspective on how systemic intrusion may present an opportunity (https://doi.org/10.3390/antiox9070642)*	*Brown seaweeds are known to present components with appealing bioactive properties eliciting great interest for industrial applications. However, their lipid content is generally disregarded beyond their fatty acid (FA) composition. This study thoroughly characterized the lipid profile of two brown seaweeds collected from Portuguese coast, the native Bifurcaria bifurcata and the invasive Sargassum muticum species, and bioprospecting for antioxidant activity. An integrated state-of-the-art approach including gas chromatography-mass spectrometry (GC–MS) and liquid chromatography-mass spectrometry (HILIC–ESI-MS/MS), allowed a comprehensive picture of FA and polar lipid content. Polar lipid profile of B. bifurcata and S. muticum included 143 and 217 lipid species respectively, distributed between glycolipids, phospholipids, and betaine lipids. Some of the lipid species found have been assigned biological activity and contain of n-3 and n-6 FA. Sargassum muticum presented the highest n-3 FA content. Low concentrations of extracts of both seaweeds displayed antioxidant activity, with S. muticum presenting more promising results. These findings contribute to the nutritional and industrial exploitation of both seaweeds, highlighting their relevance as viable sources of bioactive and added-value compounds. Sargassum muticum presented interesting lipid composition and bioactivity, which may represent an accessible opportunity for the exploitation of this invasive seaweed, especially taking advantage of Sargassum blooms. © 2020 by the authors.*	Santos, F; Monteiro, JP; Duarte, D; Melo, T; Lopes, D; da Costa, E; Domingues, MR	2020
2	BIO	Different extracts	Antioxidant and antitumoral properties	*Antioxidant and Antitumoral Properties of Aqueous Fractions from Frozen Sargassum muticum (https://doi.org/10.1007/s12649-018-0456-x)*	*A novel multistage water-based process was evaluated for the production of sap and other liquid fractions from frozen Sargassum muticum in an attempt to propose an integral and yearly-around utilization of this invasive alga. Three aqueous extracts including (i) the defrosting liquid phase, (ii) the sap liquid obtained by pressing and (iii) the autohydrolysis extract from the solid residue remaining after pressing were characterized for yield, phenolic content, reducing power and antiradical properties. Alginate precipitation and a further liquid–liquid extraction stage using ethyl acetate were assayed to concentrate the phenolic fraction. Alginate exhibited similar viscoelastic features to those commercial available. The aqueous extracts contained 3–12 g phloroglucinol equivalents (PGE)/100 g extract, whereas the ethyl acetate extracts contained up to 55 g PGE/100 g extract and 1 g was as potent ABTS+ radical scavenger as 0.5 g Trolox. The aqueous phase produced by autohydrolysis of the solids were cytotoxic against HCT 116 cells*	Pérez-Larrán, P; Balboa, EM; Torres, MD; Domínguez, H	2020

					(IC50 < 50 µg mL) without noxious effect on normal cells. © 2018, Springer Nature B.V.		
3	BIO	Fucoidan	Antioxidant activity	*Antioxidant activity of tropical seaweed sargassum muticum fucoidan (https://www.researchgate.net/publication/267036918_Antioxidant_activity_of_brown_algae_Sargassum_species_extract_from_the_coastline_of_Java_Island)*	*Synthetic antioxidants can have toxic and carcinogenic effects, thus an alternative source of natural antioxidants is needed. Fucoidan from seaweed is a source of natural antioxidants. The objective of this research was to determine the antioxidant activity of fucoidan from Sargassum muticum (Yendo) Fensholt from Alor Island, East Nusa Tenggara. Fucoidan extraction was carried out using distilled water at 85°C. The test parameters observed included: yield, total sugar content, sulfate content, functional group analysis and antioxidant activity with Radical Scavenging Activity (RSA) of the 1,1-diphenyl2picrylhydrazyl (DPPH), ferric Reducing Antioxidant Potential (FRAP), and reducing power methods. The results showed that the fucoidan extract from S. muticum had a yield of 3.87±0.13%, the total sugar content of 64.34±2.10% and the sulfate content of 17.72±0.92%. FTIR analysis showed that fucoidan from S. muticum had functional group similarities compared to commercial fucoidan from Fucus vesiculosus. The DPPH inhibition activity of S. muticum fucoidan at concentrations of 500, 1,000, 2,000, 3,000 and 4,000 ppm was 35.67±0.96, 39.40±0.66, 42.88±1.46, 45.58±3.66, and 53.57±4.59%, respectively. The IC50 DPPH value was 3.75 ppm, and the FRAP value at a concentration of 1,000 ppm was 126.58±5.39 µM g-1. The antioxidant activity of S. muticum fucoidan was lower than that of vitamin C, but not significantly different from that of commercial fucoidan. © 2020, BIOFLUX SRL. All rights reserved.*	Kurnialahi, ID; Husni, A; Sinurat, E; Isnansetyo, A	2020
4	BIO	Different extracts	Neurotoxicity	*Seaweeds' neuroprotective potential set in vitro on a human cellular stress model (https://doi.org/10.1007/s11010-020-03824-5)*	*Neurodegenerative diseases, such as Parkinson's disease, represent a biggest challenge for medicine, imposing high social and economic impacts. As a result, it is of utmost importance to develop new therapeutic strategies. The present work evaluated the neuroprotective potential of seaweeds extracts on an in vitro dopamine (DA)-induced neurotoxicity cellular model. The neuroprotective effects on SH-SY5Y cells' viability were estimated by the MTT assay. Changes in mitochondrial membrane potential (MMP), caspase-3 activity, and hydrogen peroxide (H2O2) production were determined. DA (30–3000 µM; 24 h) treatment decreased SH-SY5Y cells' viability in concentration and time-dependent manner, increasing the H2O2 production, MMP depolarization, and caspase-3 activity. On the other hand, DA (1000 µM; 24 h) toxicity was reduced (10–15%) with Sargassum muticum and Codium tomentosum extracts (1000 µg/mL; 24 h). The highest neuroprotective activity was exhibited by a methanolic extract obtained from Saccorhiza polyschides, which completely blunted DA effects. Results show that the marine seaweed S. polyschides contain substances with high neuroprotective potential against the toxicity induced by DA, exhibiting anti-apoptotic effects associated*	Silva, J; Alves, C; Pinteus, S; Mendes, S; Pedrosa, R	2020

					with both mitochondrial protection and caspase-3 inhibition. S. polyschides reveals, therefore, to be an excellent source of bioactive molecules, for new drugs development aiming PD therapeutics. © 2020, Springer Science+Business Media, LLC, part of Springer Nature.		
5	BIO	Natural colorants	Fabric dyeing	*Harnessing natural colorants from algal species for fabric dyeing: a sustainable eco-friendly approach for textile processing (https://doi.org/10.1007/s10811-019-01848-z)*	*Little information regarding the utilization of algal-based pigments in textile industry is available despite their abundance in aquatic ecosystems, varying color nature, and relatively fast-growing habit than other photosynthetic organisms. The aim of the current study is to optimize the conditions in order to harness the colorants from selected marine algal species and evaluating their dye yielding potential for fabric dyeing. Cotton fabrics were dyed with aqueous, alkaline, acidic or organic extracts of four algal species, the brown algae Iyengaria stellata, Sargassum muticum, Colpomenia sinuosa, and the red alga Laurencia obtusa under varying conditions of temperature, pH, and exhausting agent concentration. Results showed that 4% KOH and 80% acetone extraction produced maximum color strength of dyed cotton fabric. Among the four species of algae used in the study, L. obtusa showed the highest yield of colorant. However, all four species extract behaved differently to dyeing conditions. Mordanting experiments results revealed that iron sulphate and tannic acid were excellent pre- and post-mordanting agents for producing darker color shades of cotton fabrics dyed with all the four algal species used in the study. FTIR analysis indicated that the dominant coloring agents in all four algal species were phenolics in nature. The fabric dyed with extract of I. stellata, C. sinuosa, and L. obtusa showed creamy white shade, while S. muticum-treated fabric produced light brown shade. Pre- and post-mordanting of algal powder dyed fabric with chemical mordants, particularly the tannic acid produced other shades, such as light and dark brown. © 2019, Springer Nature B.V.*	Azeem, M; Iqbal, N; Mir, RA; Adeel, S; Batool, F; Khan, AA; Gul, S	2019
6	BIO	Nanoparticles (NPs)	Photocatalytic and anti-microfouling potential	*Biocompatible nanoparticles with enhanced photocatalytic and anti-microfouling potential (https://doi.org/10.1016/j.ibiod.2019.104790)*	*Biocompatible green synthesized nanoparticles (NPs) were investigated for their use in improving the photocatalytic efficacy of methylene blue (MB) dye and anti-microfouling activity. Silver nanoparticles (AgNPs) synthesized using seaweed extract of Sargassum muticum (SM) as reducing agent and their structural, textural features were characterized by various analytical techniques. SM-AgNPs under UV-light irradiation attained a photocatalytic activity of MB dye up to 94.6% for 60 min in addition to anti-microfouling performance of MBF bacteria achieved 96% inhibition within 20 min. Kinetics study of MB removal followed a pseudo first order kinetics and the apparent constant rate value was calculated as 0.0365 min−1 showing higher catalytic activity under UV-light irradiation. Anti-microbial screening against 16S rDNA confirmed MBF (n = 3) strains such as Gram Positive -*	Harinee, S; Muthukumar, K; Dahms, H-U; Koperuncholan, M; Vignesh, S; Banu, RJ; Ashok, M; James, RA	2019

					Bacillus flexus (NCBI Accession No: MBF1 AB894825), Bacillus megaterium (NCBI Accession No: AB894828) and Gram Negative - Pseudomonas sp., (NCBI Accession No: AB894829) were studied. SM-AgNPs showed a maximum inhibition zone (18 mm) in Pseudomonas sp., and minimal inhibition zone (12 mm) in Bacillus flexus. These results signified that SM-AgNPs employed a biphasic phenomenon persuading by osmotic shock and thymine-dimer formation on microbial cells that cause microbial destruction. © 2019 Elsevier Ltd		
7	BIO	Crude extracts, sulfated polysaccharides and purified compounds	Anti-inflammatory properties	*Sargassum seaweed as a source of anti-inflammatory substances and the potential insight of the tropical species: A review (https://doi.org/10.3390/md17100590)*	*Sargassum is recognized both empirically and scientifically as a potential anti-inflammatory agent. Inflammation is an important response in the body that helps to overcome various challenges to body homeostasis such as microbial infections, tissue stress, and certain injuries. Excessive and uncontrolled inflammatory conditions can affect the pathogenesis of various diseases. This review aims to explore the potential of Sargassum's anti-inflammatory activity, not only in crude extracts but also in sulfated polysaccharides and purified compounds. The tropical region has a promising availability of Sargassum biomass because its climate allows for the optimal growth of seaweed throughout the year. This is important for its commercial utilization as functional ingredients for both food and non-food applications. To the best of our knowledge, studies related to Sargassum's anti-inflammatory activity are still dominated by subtropical species. Studies on tropical Sargassum are mainly focused on the polysaccharides group, though there are some other potentially bioactive compounds such as polyphenols, terpenoids, fucoxanthin, fatty acids and their derivatives, typical polar lipids, and other groups. Information on the modulation mechanism of Sargassum's bioactive compounds on the inflammatory response is also discussed here, but specific mechanisms related to the interaction between bioactive compounds and targets in cells still need to be further studied. © 2019 by the authors.*	Saraswati; Giriwono, PE; Iskandriati, D; Tan, CP; Andarwulan, N	2019
8	BIO	Multiple	Food, cosmetic and pharmaceutical applications	*Green technologies for cascade extraction of Sargassum muticum bioactives (https://doi.org/10.1007/s10811-018-1725-6)*	*Sargassum muticum is an invasive brown seaweed which could not be eradicated from the Atlantic coasts. Therefore, periodic collection and valorization of its components has been suggested. Efficient multistage and multiproduct processes for the obtaining of valuable fractions from this seaweed, which also could be applicable to other brown seaweeds, were developed. This review discusses the potential of conventional and emerging technologies for the sequential extraction of S. muticum bioactives of interest for food, cosmetic, and pharmaceutical applications. © 2019, Springer Nature B.V.*	Pérez-Larrán, P; Torres, MD; Flórez-Fernández, N; Balboa, EM; Moure, A; Domínguez, H	2019
9	BIO	Hydrothermal extract	Antioxidant activity	*Sargassum muticum hydrothermal extract: Effects on serum parameters*	*Sargassum muticum was processed by hydrothermal extraction under previously optimized non-isothermal conditions (up to 187*	Balboa, EM; Millán, R; Domínguez, H;	2019

				and antioxidant activity in rats (https://doi.org/10.3390/app9122570)	*°C). The alginate free crude hydrolysate was further concentrated by ultrafiltration, operating in diafiltration mode to produce an extract (SmE) enriched in the fucoidan and the phlorotannin fractions and with low mineral content and antiradical capacity equivalent to that of Trolox. In order to explore the potential of this concentrated product for food or feed additive, the in vivo antioxidant potential was assessed. Male Sprague-Dawley rats were fed SmE dissolved in distilled water at doses of 0.5, 1.0 or 2.0 g kg-1, administered via an intragastric tube daily for three weeks. The weight and organ gain was not significantly affected in the different groups in relation to the control group fed a standard diet. Serum glucose was significantly lowered in the groups receiving the higher SmE doses, liver GPx levels were reduced and liver TBARS levels decreased in rats administered the extract, but no effect on SOD activity in either liver or erythrocytes was observed. © 2019 by the authors.*	Taboada, C	
10	BIO	Carotenoids	Antioxidant activity	*Efficient Extraction of Carotenoids from Sargassum muticum Using Aqueous Solutions of Tween 20 (https://doi.org/10.3390/md17050310)*	*The replacement of synthetic compounds by natural products witnesses an increasing demand from the pharmaceutical, cosmetic, food and nutraceutical industries. Included in the set of natural raw materials that are poorly explored are the macroalgae. Despi*	Vieira, FA; Ventura, SPM	2019
11	BIO	Polyphenol-rich compounds	Antioxidant and anti-inflammatory activities	*Anti-oxidant and anti-inflammatory activities of ultrasonic-assistant extracted polyphenol-rich compounds from Sargassum muticum (https://doi.org/10.1007/s00343-019-8138-5)*	*Polypehnol is an important, potentially bioactive component of Sargassum muticum. In this study, ultrasonic assisted extraction of polyphenol-rich substances was performed using a 38% ethanol solution at a solid:liquid ratio of 1:30 at 68°C for 32 min, de*	Yu, Y; Wang, L; Fu, X; Wang, L; Fu, X; Yang, M; Han, Z; Mou, H; Jeon, Y-J	2019
12	BIO	Different extracts	Biofertilizer	*Production of bio-fertilizer from Ascophyllum nodosum and Sargassum muticum (Phaeophyceae) (https://doi.org/10.1007/s00343-019-8109-x)*	*Oceans and seas form a large body of water that contains a natural biodiversity. For humans, represents a resource, which makes this a point of interest, from researches to improve the economy. Seaweeds produce many compounds and secondary metabolites tha*	Silva, LD; Bahcevandziev, K; Pereira, L	2019
13	BIO	Different extracts	Antioxidant activity, phenolic content	*Ecofriendly extraction of bioactive fractions from Sargassum muticum (https://doi.org/10.1016/j.procbio.2018.12.021)*	*An ecofriendly process based on an enzyme-assisted extraction coupled with ultrasound extraction was proposed to obtain soluble bioactive fractions from Sargassum muticum. Whole algae (Sm) and residual algae from alginate production (AESm) were employed a*	Casas, MP; Conde, E; Domínguez, H; Moure, A	2019
14	BIO	Different extracts	Anti-arthritis effect	*Anti-arthritis effect through the anti-inflammatory effect of sargassum muticum extract in collagen-induced arthritic (CIA) Mice (https://doi.org/10.3390/molecules24020276)*	*Rheumatoid arthritis is a chronic autoimmune disease that causes progressive articular damage and functional loss. It is characterized by synovial inflammation that leads to progressive cartilage destruction. For this reason, research on functional foods*	Jeon, H; Yoon, W-J; Ham, Y-M; Yoon, S-A; Kang, SC	2019
15	BIO	Enzymatic extracts	Cytotoxic activity	*Sargassum muticum and osmundea pinnatifida enzymatic extracts:Chemical,*	*Seaweeds, which have been widely used for human consumption, are considered a potential source of biological compounds, where*	Rodrigues, D; Costa-Pinto, AR;	2019

				structural, and cytotoxic characterization (https://doi.org/10.3390/md17040209)	*enzyme-assisted extraction can be an efficient method to obtain multifunctional extracts. Chemical characterization of Sargassum*	Sousa, S; Vasconcelos, MW; Pintado, MM; Pereira, L; Rocha-Santos, TAP; Da Costa, JP; Silva, AMS; Duarte, AC; Gomes, AMP; Freitas, AC	
16	BIO	Green-synthesized zinc oxide nanoparticles	Antiangiogenic and antiapoptotic effects	*Antiangiogenic and antiapoptotic effects of green-synthesized zinc oxide nanoparticles using Sargassum muticum algae extraction (https://doi.org/10.1186/s12645-018-0037-5)*	*Background: Algae are one of the natural materials used to green synthesis of nanoparticles. This method leads to minimize the toxicity of the chemical materials used to nanoparticle synthesis. Methods: In this study, zinc oxide nanoparticles (ZnO NPs) sy*	Sanaeimehr, Z; Javadi, I; Namvar, F	2018
17	BIO	0	0	*Marine invasive macroalgae: Turning a real threat into a major opportunity - the biotechnological potential of Sargassum muticum and Asparagopsis armata (https://doi.org/10.1016/j.algal.2018.06.018)*	*Marine invasive species are widely recognized as one of the worst threats to marine ecosystems integrity, unbalancing native communities, which may lead to paramount ecological and economic impacts. Within invasive seaweeds, Sargassum muticum and Asparago*	Pinteus, S; Lemos, MFL; Alves, C; Neugebauer, A; Silva, J; Thomas, OP; Botana, LM; Gaspar, H; Pedrosa, R	2018
18	BIO	Neutral lipds, glycolipids and phospholipids	Antioxidant activity	*Radical scavenging activity of lipids from seaweeds isolated by solid-liquid extraction and supercritical fluids (https://doi.org/10.1051/ocl/2018054)*	*In vitro antioxidant activities of the lipid fractions from two selected seaweeds, Solieria chordalis and Sargassum muticum were investigated according to the extraction methods. The activity of neutral lipids, glycolipids and phospholipids, thanks to ext*	Terme, N; Boulho, R; Kucma, J-P; Bourgougnon, N; Bedoux, G	2018
19	BIO	Carotenoids	Antioxidant activity	*Recovery of carotenoids from brown seaweeds using aqueous solutions of surface-active ionic liquids and anionic surfactants (https://doi.org/10.1016/j.seppur.2017.05.006)*	*Carotenoids are lipophilic compounds and their production is one of the most challenging, yet rewarding, activities in algal biotechnology. Some carotenoids (fucoxanthin included) have antioxidant activity and many studies have confirmed their health bene*	Vieira, FA; Guilherme, RJR; Neves, MC; Rego, A; Abreu, MH; Coutinho, JAP; Ventura, SPM	2018
20	BIO	NA	Neuroprotective effects	*Neuroprotective effects of seaweeds against 6-hydroxidopamine-induced cell death on an in vitro human neuroblastoma model (https://doi.org/10.1186/s12906-018-2103-2)*	*Parkinson's disease (PD) is a progressive neurodegenerative disorder of the central nervous system. Although the causes of PD pathogenesis remain incomplete, some evidences has suggested that oxidative stress is an important mediator in its pathogenesis.*	Silva, J; Alves, C; Pinteus, S; Mendes, S; Pedrosa, R	2018
21	BIO	Fatty acids	Nutraceutical potential	*Fatty acid composition and nutraceutical perspectives of brown seaweeds from the Atlantic coast of Morocco (https://www.researchgate.net/publication/320347616_Fatty_acid_composition_and_nutraceutical_perspectives_of_brown_seaweeds_from_the_Atlantic_coast_*	*Seaweeds are currently considered to be a promising source of polyunsaturated fatty acids (PUFA). However, PUFA content and their composition can vary greatly depending on species and environmental conditions. In this study fatty acid (FA) profiles have b*	Belattmania, Z; Engelen, AH; Pereira, H; Serrão, EA; Custódio, L; Varela, JC; Zrid, R; Reani, A; Sabour, B	2018

22	BIO	Different extracts	Agriculture	*Sargassum muticum and Jania rubens regulate amino acid metabolism to improve growth and alleviate salinity in chickpea (https://doi.org/10.1038/s41598-017-07692-w)*	*The present study evaluates the potential of Sargassum muticum (Sar) and Jania rubens (Jan) seaweeds for enhancing growth and mitigating soil-salinity in chickpea (Cicer arietinum L.). Under control conditions, Sar and Jan extracts improved chickpea growt*	Abdel Latef, AAH; Srivastava, AK; Saber, H; Alwaleed, EA; Tran, L-SP	2017
23	BIO	Hydrothermal extract	Antiradical and cytotoxic effect	*Feasibility of posthydrolysis processing of hydrothermal extracts from Sargassum muticum (https://doi.org/10.1016/j.algal.2017.08.002)*	*The posthydrolysis of the crude fucoidan extracted during hydrothermal treatment of Sargassum muticum was carried out with mineral acid or without added acid and aided by microwave or by ultrasound processing during short periods. The liquors produced und*	Flórez-Fernández, N; González-Muñoz, MJ; Domínguez, H	2017
24	BIO	Crude extracts	Cytoprotective effects	*An insight into Sargassum muticum cytoprotective mechanisms against oxidative stress on a human cell in vitro model (https://doi.org/10.3390/md15110353)*	*Sargassum muticum is a brown seaweed with strong potential to be used as a functional food ingredient, mainly due to its antioxidant properties. It is widely used in traditional oriental medicine for the treatment of numerous diseases. Nevertheless, few s*	Pinteus, S; Lemos, MFL; Silva, J; Alves, C; Neugebauer, A; Freitas, R; Duarte, A; Pedrosa, R	2017
25	BIO	Different extracts	Antileishmanial drugs	*Marine algae as source of novel antileishmanial drugs: A review (https://doi.org/10.3390/md15110323)*	*Leishmaniasis is a vector-borne neglected tropical disease caused by protozoan parasites of the Leishmania genus and transmitted by the female Phlebotomus and Lutzomyia sand flies. The currently prescribed therapies still rely on pentavalent antimonials,*	Yamthe, LRT; Appiah-Opong, R; Fokou, PVT; Tsabang, N; Boyom, FF; Nyarko, AK; Wilson, MD	2017

Bryopsis hypnoides

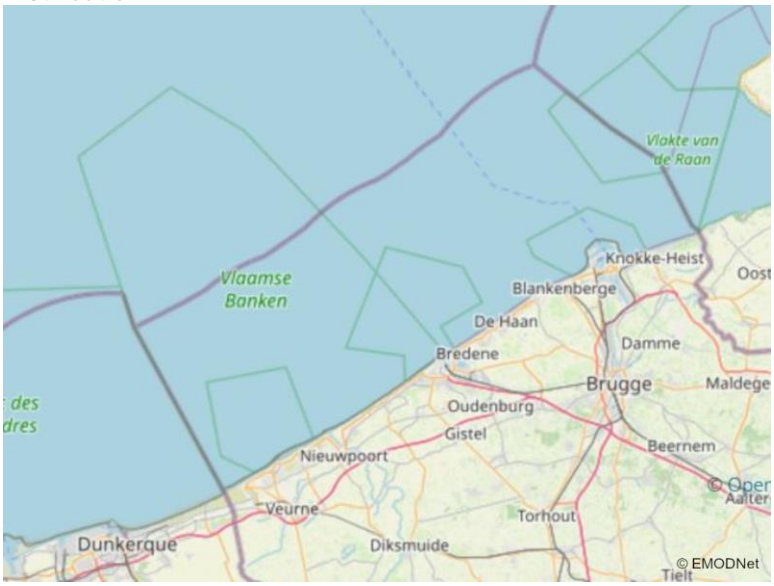
Aphia ID #144452

Kingdom:	Plantae
Phylum:	Chlorophyta
Class:	Ulvophyceae
Order:	Bryopsidales
Family:	Bryopsidaceae
Genus:	Bryopsis
Species:	hypnoides

INFORMATION PANEL

Observations: NA

Distribution:



Habitat type: Tidal zone
Substrate: Rocks

DESCRIPTION

Size: 0 - 100 mm

Brief description:
Bryopsis hypnoides is a large, feathery species of green seaweed. The thalli are erect, feather-like and may reach up to 10 cm in height. It is easily recognised by its delicate branches. Branches are irregularly arranged on the central filament. The lengths of the branches decrease gradually from the base of the plant. It is usually dark to mid-green in colour. Confusable with Bryopsis plumosa.

Sampling method: Hand collection
Dutch name: Onregelmatig vederwier

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Polyphenols and diphenol	Antioxidant activity in species of same genus	*Antioxidant potential, polyphenols and diphenol content of seaweed available at veraval coast, saurashtra region - Gujarat (https://doi.org/10.17485/ijst/2016/v9i4/78665)*	*Seaweeds are the known sources of pharmacological compounds and food additives with health effects due to their antioxidative properties. The present studied to measure in vitro antioxidant activity, polyphenols and diphenol content of the dominant seaweed available during survey. During the investigations seaweed from intertidal zones were collected fortnightly from August-2012 to March-2013. The collected species were identified taxonomically and classified. Seaweed extract was prepared with methanol @ of 1:1 w/v. The antioxidant property of the seaweeds extracts were tested using DPPH Radical Scavenging Assay. Polyphenols content was determined using Folin-Phenol reagent method, while diphenol content was estimated by spectrophotometric method described by Rabadia. During the investigation 32 species of seaweed, out of these 5 were from Chlorophyceae, 9 from Phaeophyceae and 18 from Rhodophyceae group were tested. The highest antioxidant potential was exhibited by Padina tetrastomatica (25.67+1.75 mM eq. ascorbic acid/g DW), which also showed higher amount of polyphenols and diphenol content 42.25+4.67 and 7.42+0.52 mg/g DW, respectively. Cystoseira indica ranked second with (22.17+0.38 mM Eq. ascorbic acid/g DW) in Phaeophyceae. Among Chlorophyceae, Boodlea composite showed the highest DPPH scavenging activity followed by **Bryopsis plumosa**. While in red algae, Sarconema filiforma and Rhodomenia australis were most potent species in the group which showed almost equal value of DPPH scavenging activity. The results indicated that there are significant difference among all the species studied for antioxidant potential, poly phenol and di-phenol content. The antioxidative potential of seaweeds would elevate their beneficial value as food and feed. Antioxidant activity of potent seaweeds species would elevate their beneficial value as natural source of antioxidant in pharmaceuticals, anti ageing agent feed industries, etc.*	Ishakani A.H., Joshi N.H., Ayaz M., Sumara K., Vadher K.H.	2016
2	BIO	Crude methanol extracts	Antioxidant activity in species of same genus	*Antioxidant activity and phytochemical analysis of a few Indian seaweed species (https://www.researchgate.net/publication/267035725_Antioxidant_activity_and_phytochemical_analysis_of_a_few_Indian_seaweed_species)*	*Antioxidant activities of crude methanol extracts and fractions of the seaweed species viz. **Bryopsis plumosa** (BP), Dictyopteris australis (DA) and Gracilaria pudumadamensis (GP) of Indian waters were evaluated and correlated with their phytochemical contents. In DPPH assays the most promising antioxidant sample was the crude methanol extract (BPM), which was comparable with standard antioxidant BHT. In the superoxide radical activity assays no sample in the group was as active as BHT, however the promising ones were DAM, DAE and GPM, GPE, GPH (subscripts M, E and H stand for the respective methanol extracts and their ethyl acetate and hexane fractions). In the Fe2+ chelating activity assays EDTA showed far*	Chejara D.R., Kondaveeti S., Meena R., Siddhanta A.K.	2014

					stronger activity than those of the promising samples. In reducing power assays BPM, BPE, and BPH showed comparable activity with BHT at a concentration 0.5 mg/mL. Thus these seaweed species would be of potential utility as a source of natural antioxidants.		
3	BIO	Lectin, Bryohealin, BPL (Bryopsis plumosa lectin)	Found in species of same genus	*Purification and characterization of a lectin, BPL-3, from the marine green alga **Bryopsis plumosa** (https://doi.org/10.1007/s10811-010-9575-x)*	*A novel lectin was isolated and characterized from **Bryopsis plumosa** (Hudson) Agardh and named BPL-3. This lectin showed specificity to N-acetyl-d-galactosamine as well as N-acetyl-d-glucosamine and agglutinated human erythrocytes of all blood types, showing slight preference to the type A. SDS-PAGE and MALDI-TOF MS data showed that BPL-3 was a monomeric protein with molecular weight of 11. 5 kDa. BPL-3 was a non-glycoprotein with pI value of ~7.0. It was stable in high temperatures up to 70°C and exhibited optimum activity in pH 5.5-10. The N-terminal and internal amino acid sequences of the lectin were determined by Edman degradation and enzymatic digestion, which showed no sequence homology to any other reported proteins. The full sequence of the cDNA encoding this lectin was obtained from PCR using cDNA library, and the degenerate primers were designed from the N-terminal amino acid sequence. The size of the cDNA was 622 bp containing single ORF encoding the lectin precursor. This lectin showed the same sugar specificity to previously reported lectin, Bryohealin, involved in protoplast regeneration of B. plumosa. However, the amino acid sequences of the two lectins were completely different. The homology analysis of the full cDNA sequence of BPL-3 showed that it might belong to H lectin group, which was originally isolated from Roman snails. © 2010 Springer Science+Business Media B.V.*	Han J.W., Yoon K.S., Klochkova T.A., Hwang M.-S., Kim G.H.	2011
4	BIO	Lectin, Bryohealin, BPL (Bryopsis plumosa lectin)	Found in species of same genus	*Characterization of carbohydrate combining sites of Bryohealin, an algal lectin from **Bryopsis plumosa** (https://doi.org/10.1007/s10811-010-9521-y)*	*Bryohealin is a lectin involved in the wound-healing process of the marine green alga **Bryopsis plumosa.** In the previous purification study, it has been shown that lectin was composed of two identical subunits of 27 kDa, cross-linked by disulfide bond, and showed binding specificity to N-acetyl-d-glucosamine and N-acetyl-d-galactosamine (GlcNAc and GalNAc, respectively). To determine if the lectin recognize the two different sugars at the same binding domain, the carbohydrate binding sites of Bryohealin was analyzed using chromatography and chemical modification methods. Results showed that the same binding site of the lectin was responsible for the recognition of two sugars, GalNAc as well as GlcNAc. Chemical modification studies showed that hemagglutinating activities of Bryohealin were not affected by modification of histidine, tryptophan, aspartic acid, and glutamic acid. When arginine residues were modified with 1,2-cyclohexanedione, the activity of Bryohealin rapidly decreased. The sugar binding sites remained intact when the lectin was treated with inhibitory sugars (0.2 M GalNAc and/or GlcNAc) prior to 1,2-cyclohexanedione treatment. The sugar binding domain of Bryohealin was predicted from the MALDI-TOF analysis and the full cDNA sequence of the lectin gene. © 2010 Springer Science+Business*	Jung M.G., Lee K.P., Choi H.-G., Kang S.-H., Klochkova T.A., Han J.W., Kim G.H.	2010

					Media B.V.		
5	BIO	D-mannose specific lectin, BPL (Bryopsis plumosa lectin)	Found in species of same genus	*Purification and characterization of a D-mannose specific lectin from the green marine alga, **Bryopsis plumosa** (https://doi.org/10.1111/j.1440-1835.2010.00572.x)*	*A d-mannose specific lectin was purified from the green marine alga, **Bryopsis plumosa** (Huds.) Ag. The lectin agglutinated horse and sheep erythrocytes. Matrix assisted laser desorption/ionization time of flight mass spectrometry, size exclusion chromatography, sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) and two dimensional gel electrophoresis (2DE) results showed that the lectin was a monomer with molecular weight of 17 kDa and pI 7.3. The agglutinating activity was inhibited by d-mannose (1 mM), α-methyl-D-mannose (4 mM) and l-fucose (8 mM). d-glucose (125 mM) showed weak inhibition. The lectin did not need divalent cations for agglutinating activity. N-terminal amino acid sequence of the lectin was analyzed. As the lectin was novel, we named it BPL-2 (Bryopsis plumosa lectin 2). Full cDNA sequence of BPL-2 was obtained using cDNA library. It was comprised of 624 bp of open reading frame and 167 bp/57 bp of 3'/5' untranslated regions as well as N-terminal signal peptide. No antimicrobial activity of BPL-2 was observed in four bacteria strains tested. © 2010 Japanese Society of Phycology.*	Han J.W., Jung M.G., Kim M.J., Yoon K.S., Lee K.P., Kim G.H.	2010
6	BIO	Lectin, Bryohealin, BPL (Bryopsis plumosa lectin)	Found in species of same genus	*Molecular characterization of the lectin, bryohealin, involved in protoplast regeneration of the marine alga B**ryopsis plumosa** (Chlorophyta) (https://doi.org/10.1111/j.1529-8817.2007.00457.x)*	*When a coenocytic cell of the green alga **Bryopsis plumosa** (Hudson) C. Agardh was cut open and the cell contents expelled, the cell organelles agglutinated rapidly in seawater to form protoplasts. This process was mediated by a lectin, Bryohealin. The full sequence of the cDNA encoding Bryohealin was obtained, which consisted of 1,101 base pairs (bp), with 24 bp of 5' untranslated region (UTR) and 201 bp of 3' UTR. It had an open reading frame (ORF) of 771 bp encoding 257 amino acid residues. A signal peptide consisted of 22 amino acids presented before the start codon of Bryohealin, indicating that this lectin was a vacuolar (storage) protein. The C-terminal sequence of Bryohealin was composed of antibiotic domains, suggesting that this lectin could perform two functions: (i) aggregation of cell organelles in seawater and (ii) protection from bacterial contamination for successful protoplast regeneration. The BLAST search result showed that Bryohealin had little sequence homology with any known plant lectins, but rather resembled animal lectins with fucolectin domains. The expression of recombinant Bryohealin (rBryohealin) was obtained in the Escherichia coli system. © 2008 Phycological Society of America.*	Yoon K.S., Lee K.P., Klochkova T.A., Kim G.H.	2008
7	BIO	Different extracts	Antimicrobial activity in species of same genus	*Antimicrobial activity of seaweeds extracts against multiresistant pathogens (https://doi.org/10.1007/BF03175554)*	*Fourteen seaweeds collected from the intertidal zone of Southwest coast of India were tested against ten human pathogen bacteria and one human pathogen fungus using the well diffusion test in the casitone agar medium. The species used in the present study include five Chlorophyta (**Bryopsis plumosa**, Ulva fasciata, Acrosiphonia orientalis, Chaetomorpha antennina, Grateloupia filicina), five Rhodophyta (Hypnea pannosa, Gracilaria corticata, Centroceras clavulatum, Portieria hornemannii, Cheilosporum spectabile) and*	Shanmughapriya S., Manilal A., Sujith S., Selvin J., Kiran G.S., Natarajaseenivasan K.	2008

					four Phaeophyta (Padina tetrastromatica, Sargassum wightii, Stocheospermum marginatum, Chnoospora bicanaliculata). Of these, seven species were determined to be highly bioactive and screened on the multiresistant pathogens. We found that drying process has eliminated the active principles in the seaweeds. In the present study, methanoktoluene (3:1) was found to be the best solvent for extracting the antimicrobial principles from fresh algae. However, the ethanolic extract showed no antibacterial activity. Acrosiphonia orientalis showed activity against 70% of the tested organisms. Stocheospermum marginatum was the only seaweed that showed activity against Klebsiella pneumoniae. The extract from Gracilaria corticata was highly active against Proteus mirabilis, a Gram negative pathogenic bacterium. The present findings revealed that the tested seaweeds were highly active against Gram negative bacteria than Gram positive bacteria. The antimicrobial principle from seaweed was found to be a lipophilic compound. The compound was stable over a wide range of temperature (30-60 °C). The active principles of highly active seaweeds Acrosiphonia orientalis and Stocheospermum marginatum were bactericidal.		
8	BIO	Lectin, Bryohealin, BPL (Bryopsis plumosa lectin)	Found in species of same genus	*Purification and characterization of a lectin, bryohealin, involved in the protoplast formation of a marine green alga **Bryopsis plumosa** (Chlorophyta) (https://doi.org/10.1111/j.1529-8817.2006.00162.x)*	*When the coenocytic green alga **Bryopsis plumosa** (Huds.) Ag. was cut open and the cell contents were expelled, the cell organelles agglutinated rapidly in seawater to form protoplasts. Aggregation of cell organelles in seawater was mediated by a lectin-carbohydrate complementary system. Two sugars, N-acetyl-d-glucosamine and N-acetyl-d-galactosamine inhibited aggregation of cell organelles. The presence of these sugars on the surface of chloroplasts was verified with their complementary fluorescein isothiacyanate-labeled lectins. An agglutination assay using human erythrocytes showed the presence of lectins specific for N-acetyl-d-galactosamine and N-acetyl-d-glucosamine in the crude extract. One-step column purification using N-acetyl-d-glucosamine-agarose affinity chromatography yielded a homogeneous protein. The protein agglutinated the cell organelles of B. plumosa, and its agglutinating activity was inhibited by the above sugars. Sodium dodecyl sulfate polyacrylamide gel electrophoresis results showed that this protein might be composed of two identical subunits cross-linked by two disulfide bridges. Enzyme and chemical deglycosylation experiments showed that this protein is deficient in glycosylation. The molecular weight was determined as 53.8 kDa by matrix-assisted laser desorption/ionization time-of-flight mass spectrometry. The N-terminal 15 amino acid sequence of the lectin was Ser-Asp-Leu-Pro-Thr-X-Asp-Phe-Phe-His-Ile-Pro- Glu-Arg-Tyr, and showed no sequence homology to those of other reported proteins. These results suggest that this lectin belongs to a new class of lectins. We named this novel lectin from B. plumosa "bryohealin." © 2005 Phycological Society of America.*	Kim G.H., Klochkova T.A., Yoon K.-S., Song Y.-S., Lee K.P.	2006

9	BIO	Ethanol and hexane extracts	Antibacterial activity in species of same genus	*Antibacterial activity of selected seaweeds from kovalam south west coast of India (http://www.envirobiotechjournals.com/article_abstract.php?aid=3878&iid=141&jid=1)*	*Bioassays were carried out with extracts of nine algae viz., **Bryopsis plumosa**, Caulerpa racemosa, Ulva fasciata, Centroceras clavulatum, Cheliosporium spectabilis, Gracilaria corticata,. Padina tetrastromatica, Sargassum wightii and Chnoospora minima Crude extracts with hexane and ethanol were prepared and tested against gram positive and gram negative bacteria. The ethanol fraction showed considerable activity against gram positive. Staphylococcus aureus and gram negative Escherichia coli and Klebsiella pneumoniae, while the hexane extracts of Phaeophyta registered activity against S. aureus the hexane extract of P. tetrastromatica among Phaeophyta alone recorded activity against K. pneumoniae. The hexane extracts of Rhodophyta, S. insignis and H. nigrescens exhibited inhibitory effect against E. coli. However, the study revealed that algae with high phenolic content registered high antibiotic activity against gram positive and gram negative bacteria, that caused different kinds of diseases in human beings. Progression of studies in this field will help in the isolation and identification of bioactive compounds from seaweeds responsible for antibacterial activity.*	Bushra Beegum N.R., Ganga Devi T.	2003
10	BIO	Ethanolic extracts	Antibacterial activity in species of same genus	*Antibacterial activity of ethanolic extracts of marine algae from central coast of Peru (https://www.researchgate.net/publication/324222168_Antibacterial_activity_of_ethanolic_extracts_of_marine_algae_from_central_coast_of_Peru)*	*Antibacterial activity of ethanolic extracts from 12 macroalgae were evaluated. Extracts were obtained according to the protocol of Vlachos et al. (1996). Ethanolic extract of **B. plumosa** presented the highest antibacterial activity against S. aureus strains.*	Magallanes C., Córdova C., Orozco R.	2003
11	BIO	Different extracts	Ichthyotoxicity	*Ichthyotoxic propensities of some Indian marine green algae (Chlorophytes) (http://nopr.niscair.res.in/handle/123456789/35825)*	*Twenty three extracts of chlorophytes have been assayed for ichthyotoxicity against the common mosquito fish Gambusia affinis. The extracts generally have exhibited a wide range of effects. **Bryopsis plumosa** was highly toxic.*	Beni Giraspy D.A., Natarajan P.	1998
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Codium fragile

Forked felt alga

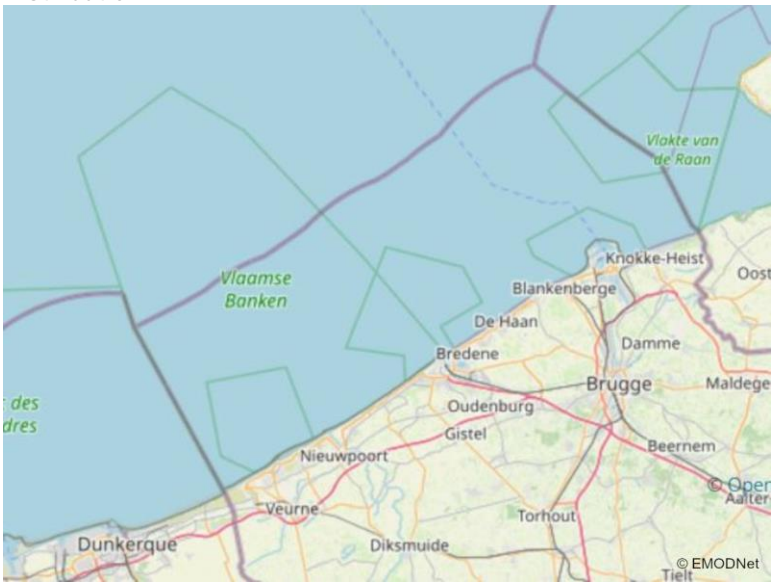
Aphia ID #145086

Kingdom:	Plantae
Phylum:	Chlorophyta
Class:	Ulvophyceae
Order:	Bryopsidales
Family:	Codiaceae
Genus:	Codium
Species:	fragile

INFORMATION PANEL

Observations: NA

Distribution:



Habitat type: Tidal zone
Substrate: Hard substrata

DESCRIPTION

Size: 0 - 300 mm

Brief description:
Codium fragile is a dark green seaweed composed of erect, dichotomously branched fronds. The branches are round in cross section but may be flattened beneath dichotomies of branches. The branches are soft with a velvety texture. The fronds usually arise from a spongy disc-shaped holdfast.

Sampling method: Hand collection
Dutch name: Viltwier

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Sulfated polysaccharides	Protective effects against oxidative stress	*Protective effects of sulfated polysaccharides isolated from the enzymatic digest of Codium fragile against hydrogen peroxide-induced oxidative stress in in vitro and in vivo models (https://doi.org/10.1016/j.algal.2020.101891)*	*In the present study, the sulfated polysaccharides obtained from Codium fragile (CFCE-PS) were prepared by enzymatic digestion and ethanol precipitation, and the antioxidant properties of CFCE-PS were evaluated using both in vitro and in vivo models. CFCE-PS contained 76.84% sulfated polysaccharides, which comprised 55.78 ± 3.00% of carbohydrate and 21.06 ± 1.07% of sulfate. CFCE-PS scavenged hydroxyl, alkyl, and DPPH radicals with IC50 values of 1.21 ± 0.01, 1.42 ± 0.17, and 6.14 ± 0.78 mg/mL, respectively. CFCE-PS remarkably protected Vero cells against hydrogen peroxide (H2O2)-induced damage by reducing the intracellular ROS level, increasing cell viability, and suppressing apoptosis in a dose-dependent manner. Furthermore, CFCE-PS significantly attenuated H2O2-mediated oxidative stress in vivo in zebrafish. CFCE-PS dose-dependently improved the survival rate and normalized the heartbeat, as well as reduced ROS, cell death, and lipid peroxidation in H2O2-stimulated zebrafish. Taken together, these results demonstrated that CFCE-PS possesses strong in vitro and in vivo antioxidant activities, and it could be used as an ingredient in the functional food, pharmacy, and cosmetic industries. © 2020 Elsevier B.V.*	Wang L., Oh J.Y., Je J.G., Jayawardena T.U., Kim Y.-S., Ko J.Y., Fu X., Jeon Y.-J.	2020
2	BIO	Polysaccharide	Cancer immunotherapy	*Cancer immunotherapy using a polysaccharide from Codium fragile in a murine model (https://doi.org/10.1080/2162402X.2020.1772663)*	*Natural polysaccharides have shown immune modulatory effects with low toxicity in both animal and human models. A previous study has shown that the polysaccharide from Codium fragile (CFP) promotes natural killer (NK) cell activation in mice. Since NK cell activation is mediated by dendritic cells (DCs), we examined the effect of CFP on DC activation and evaluated the subsequent induction of anti-cancer immunity in a murine model. Treatment with CFP induced activation of bone marrow-derived dendritic cells (BMDCs). Moreover, subcutaneous injection of CFP promoted the activation of spleen and lymph node DCs in vivo. CFP also induced activation of DCs in tumor-bearing mice, and combination treatment with CFP and ovalbumin (OVA) promoted OVA-specific T cell activation, which consequently promoted infiltration of IFN-γ-and TNF-α-producing OT-1 and OT-II cells into the tumors. Moreover, combination treatment using CFP and cancer self-antigen efficiently inhibited B16 tumor growth in the mouse model. Treatment with CFP also enhanced anti-PD-L1 antibody mediated anti-cancer immunity in the CT-26 carcinoma-bearing BALB/c mice. Taken together these data suggest that CFP may function as an adjuvant in the treatment of cancer by enhancing immune activation. Abbreviations: CFP: Codium fragile polysaccharide; NK: natural killer; IFN: interferon; TNF: tumor*	Park H.-B., Lim S.-M., Hwang J., Zhang W., You S., Jin J.-O.	2020

					necrosis factor; IL: interleukin; tdLN: tumor draining lymph node; BMDC: bone marrow-derived dendritic cell; OVA: ovalbumin; Ab: antibody; Ag: antigen; DC: dendritic cell; CTL: cytotoxic T lymphocyte; APC: antigen-presenting cell; pDC: plasmacytoid dendritic cell; mDC: myeloid dendritic cell; MHC: major histocompatibility complex; CR3: complement receptor type 3; TLR: Toll-like receptor; LPS: lipopolysaccharide; SP: sulfated polysaccharide; TRP2: tyrosinase-related protein 2; SR-A: scavenger receptor-A. © 2020, © 2020 The Author(s). Published with license by Taylor & Francis Group, LLC.		
3	BIO	Sulfated polysaccharides	Immuno-stimulatory effects	*Immuno-stimulatory effects of sulfated polysaccharides isolated from Codium fragile in olive flounder, Paralichthys olivaceus (https://doi.org/10.1016/j.fsi.2019.02.002)*	*Sulfated polysaccharides isolated from Codium fragile have been previously demonstrated to possess immune-stimulating effects on murine cell lines and the fraction F2 (F2) isolated by ion exchange chromatography was the most effective. In this study, the effects of the fraction F2 were evaluated on the expressions of immune genes including IL-1β TNF-α IL-8, IFN-γ and lysozyme in vitro and in vivo as well as lysozyme and complement activities in serum of olive flounder, Paralichthys olivaceus. In vitro, these gene expressions were up-regulated by F2 in head kidney cells. In vivo, IL-1β and IL-8 gene expressions were up-regulated in peritoneal cells, head kidney, liver, gill and spleen, while TNF-α IFN-γ and lysozyme gene expressions were mostly up-regulated but varied depending on tissue types or time points. Indeed, lysozyme and complement activities in serum were increased. Overall, these results indicate that the sulfated polysaccharides from C. fragile have immuno-stimulatory effects on olive flounder and may be used to enhance immunity during aquaculture. © 2019 Elsevier Ltd*	Yang Y., Park J., You S.G., Hong S.	2019
4	BIO	Mannanase	Food, feed an pulp industries	*Characterization of mannanase from Bacillus sp., a novel Codium fragile cell wall-degrading bacterium (https://doi.org/10.1007/s10068-017-0210-3)*	*Seaweeds are considered as a health food partly due to the polysaccharide composition of the cell wall. Because conventional extraction methods have low yields and lead to environmental pollution, enzymatic methods have been proposed. In this study, a new strain of Bacillus sp. was isolated from cattle feces that produced a mannanase, a polysaccharide-degrading enzyme active against the green seaweed Codium fragile. The purified 39-kDa mannanase exhibited maximum activity at 55 °C and pH 6.0, and maintained its catalytic activity stably at temperatures up to 60 °C and at a broad pH range (5.0–11.0). Enzymatic activity was slightly enhanced by Cu2+ and Na+ but strongly inhibited by Fe2+, Ag+, and EDTA. The mannanase showed the highest specificity to the inexpensive substrates such as konjac powder and locust bean gum, and efficiently released various manno-oligosaccharides. This novel mannanase can thus be applicable in the food, feed, and pulp industries. © 2017, The Korean Society of Food Science and Technology and Springer Science+Business Media B.V.*	Kim S., Lee M.-H., Lee E.-S., Nam Y.-D., Seo D.-H.	2018
5	BIO	Isopropyl alcohol -	Antileishmanial drugs	*Marine algae as source of novel antileishmanial drugs: A review*	*Leishmaniasis is a vector-borne neglected tropical disease caused by protozoan parasites of the Leishmania genus and transmitted by*	Yamthe L.R.T., Appiah-Opong R.,	2017

		Chloroform/methanol extract		*(https://doi.org/10.3390/md15110323)*	*the female Phlebotomus and Lutzomyia sand flies. The currently prescribed therapies still rely on pentavalent antimonials, pentamidine, paromomycin, liposomal amphotericin B, and miltefosine. However, their low efficacy, long-course treatment regimen, high toxicity, adverse side effects, induction of parasite resistance and high cost require the need for better drugs given that antileishmanial vaccines may not be available in the near future. Although most drugs are still derived from terrestrial sources, the interest in marine organisms as a potential source of promising novel bioactive natural agents has increased in recent years. About 28,000 compounds of marine origin have been isolated with hundreds of new chemical entities. Recent trends in drug research from natural resources indicated the high interest of aquatic eukaryotic photosynthetic organisms, marine algae in the search for new chemical entities given their broad spectrum and high bioactivities including antileishmanial potential. This current review describes prepared extracts and compounds from marine macroalgae along with their antileishmanial activity and provides prospective insights for antileishmanial drug discovery. © 2017 by the authors. Licensee MDPI.*	Fokou P.V.T., Tsabang N., Boyom F.F., Nyarko A.K., Wilson M.D.	
6	BIO	Steroids	Inhibit acetylcholinesterase	*Steroids from an Endophytic Eurotium rubrum Strain (https://doi.org/10.1007/s10600-017-2089-x)*	*A new steroid, 3β,5α-dihydroxy-10α-methyl-6β-acetoxy-ergosta-7,22-diene (1), and ten known steroids (2–11), were isolated from the cultures of Eurotium rubrum, an endophytic fungus isolated from the marine green alga Codium fragile. Structures of these compounds were unambiguously established by spectroscopic techniques and by comparison with literature values. These steroids exhibited low activity to inhibit acetylcholinesterase and no activity against plant pathogenic fungi Colletotrichum lagenarium and Fusarium oxysporium. © 2017, Springer Science+Business Media, LLC.*	Qiao M.-F., Yi Y.-W., Deng J.	2017
7	BIO	Sulfated polysaccharides	Cytotoxicity	*Structural effects of sulfated polysaccharides from Codium fragile on NK cell activation and cytotoxicity (https://doi.org/10.1016/j.ijbiomac.2017.01.108)*	*The effects of sulfates and proteins of the sulfated polysaccharide-F2 (SP-F2) from Codium fragile on the NK cell activation and cytotoxicity were systematically investigated. The SP-F2 treatment significantly increased both NK cell proliferation (129%/100 μg/mL) and their potent cytotoxic effects against HeLa cells (46%). The SP-F2 treatment appeared to enhance NK cell activation through the expression of the activating receptor, NKp30; the secretion of the cytokine, IFN-γ and the release of the lysing proteins, perforin and granzyme-B. However, the treatment of the SP-F2 derivatives, deproteinated and desulfated-F2 (DP-F2 and DS-F2), markedly lowered the mRNA expression levels of IFN-γ, granzyme-B, NKp30 and FasL, suggesting that the proteins and sulfates were essential for the interaction between the SP-F2 and NK cells. The antibody neutralization test revealed that CR3 might be a critical receptor involved in SP-F2 NK cell activation. © 2017 Elsevier B.V.*	Surayot U., You S.	2017
8	BIO	Siphonaxanthin	Angiosuppres	*Angiosuppressive properties of marine-*	*Angiogenesis, formation of new blood vessels from preexisting one,*	Yue P.Y.K., Leung	2017

			sive proporties	*derived compounds—a mini review (https://doi.org/10.1007/s11356-015-5536-x)*	*is a critical step of tumorgenesis of solid tumors. Therefore, antiangiogenic therapy is one of the promising approaches to control tumor growth. In the past 20 years, a lot of compounds have been tested for their antiangiogenic properties. Bevacizumab, Avastin®, the first antiangiogenic drug approved by the US FDA, has been widely used in clinic for treating cancer. Indeed, many synthetic compounds are highly toxic and exert side effects even though they are effective in inhibiting neovessel formation and cancer cell growth. Using natural compounds or their derivatives is one of the ways to solve these problems. Sinomenine and ginsenosides are common antiangiogenic and anticancer compounds that are extracted from herbal medicines. Recent findings suggested that marine algae-derived natural pigments also possess similar activities. It has been reported that fucoxanthin from Undaria pinnatifida, Siphonaxanthin from Codium fragile, can inhibit angiogenesis and cancer growth effectively. In conclusion, natural compounds derived from marine algae could provide a novel and safe source for new drug development in anticancer and antiangiogenic properties in the future. © 2015, Springer-Verlag Berlin Heidelberg.*	H.M., Li A.J., Chan T.N.C., Lum T.S., Chung Y.L., Sung Y.H., Wong M.H., Leung K.S.Y., Zeng E.Y.	
9	BIO	Phenolic compounds	Mineralogenic and antioxidant activities	*Marine green macroalgae: a source of natural compounds with mineralogenic and antioxidant activities (https://doi.org/10.1007/s10811-016-0968-3)*	*Marine macroalgae represent a valuable natural resource for bioactive phytochemicals with promising applications in therapeutics, although they remain largely under-exploited. In this work, the potential of two marine green macroalgae (Cladophora rupestris and Codium fragile) as a source of bioactive phenolic compounds was explored, and antioxidant, mineralogenic, and osteogenic activities were evaluated. For each species, a crude hydroalcoholic extract (CE) was prepared by solid/liquid extraction and fractionated by liquid/liquid purification into an ethyl acetate fraction (EAF) enriched in phenolic compounds and an aqueous fraction (AF). Antioxidant activity, assessed through radical scavenging activity and reducing power assay, was increased in EAF fraction of both species and closely related to the phenolic content in each fraction. Mineralogenic activity, assessed through extracellular matrix mineralization of a fish bone-derived cell line, was induced by EAF fractions (up to 600 % for C. rupestris EAF). Quantitative analysis of operculum formation in zebrafish larvae stained with alizarin red S further confirmed the osteogenic potential of EAF fractions in vivo, with an increase of more than 1.5-fold for both C. fragile and C. rupestris fractions, similar to vitamin D (control). Our results demonstrated a positive correlation between phenolic fractions and biological activity, suggesting that phenolic compounds extracted from marine green macroalgae may represent promising molecules toward therapeutic applications in the field of bone biology. © 2016, Springer Science+Business Media Dordrecht.*	Surget G., Roberto V.P., Le Lann K., Mira S., Guérard F., Laizé V., Poupart N., Cancela M.L., Stiger-Pouvreau V.	2017
10	BIO	Fucoxanthin, 2,2-diphenyl-1-	Antioxidant activity	*Assessment of antioxidant activity in Victorian marine algal extracts using high*	*The aim of this study was to develop and validate a rapid and simple high performance thin layer chromatographic (HPTLC) method to*	Agatonovic-Kustrin S., Morton D.W.,	2016

		picrylhydrazyl (DPPH[rad]) and ferric chloride (FeCl3)		*performance thin-layer chromatography and multivariate analysis (https://doi.org/10.1016/j.chroma.2016.09.041)*	*screen for antioxidant activity in algal samples. 16 algal species were collected from local Victorian beaches. Fucoxanthin,*	Ristivojević P.	
11	BIO	Methanolic and aqueous extracts	Antioxidant activity	*Antioxidant activity and lipid profile of three seaweeds of Faro, Portugal (https://doi.org/10.1007/s40415-015-0200-8)*	*Three seaweeds, Codium fragile (Suringar) Hariot, Ulva lactuca (Linn.) members and Eisenia arborea (Areschoug) (Phaeophyta) were assessed for their antioxidant activities and lipid profile. Antioxidant activities of methanolic and aqueous extracts were an*	Raja R., Hemaiswarya S., Arunkumar K., Carvalho I.S.	2016
12	BIO	Sulfated glycoproteins	Nitric Oxide Releasing Capacity from RAW264.7 Cells	*Structure-Activity Relationships of Sulfated Glycoproteins from Codium fragile on Nitric Oxide Releasing Capacity from RAW264.7 Cells (https://doi.org/10.1007/s10126-015-9615-2)*	*The effects of sulfate and protein contents as well as molecular weights of the sulfated glycoproteins (NF2) from Codium fragile on the immunomodulation were systematically investigated. The obtained NF2 derivatives displayed various amounts of proteins (*	Tabarsa M., Park G.-M., Shin I.-S., Lee E.J., Kim J.-K., You S.G.	2015
13	BIO	Glycine betaine, dimethylsulfonio propionate	Cardioprotecti ve potential	*Cardioprotective potential of irish macroalgae: Generation of glycine betaine and dimethylsulfoniopropionate containing extracts by accelerated solvent extraction (https://doi.org/10.1055/s-0035-1546018)*	*Accelerated solvent extraction (ASE®) was used to generate 18 macroalgal extracts from Irish seaweeds. The glycine betaine and dimethylsulfoniopriopionate content of the generated ASE® extracts were estimated using 1H-NMR and confirmed for selected extrac*	Valverde J., Hayes M., McLoughlin P., Rai D.K., Soler-Vila A.	2015
14	BIO	Enzyme	Cytotoxicity	*Enzyme-assisted extraction of bioactive material from Chondrus crispus and codium fragile and its effect on Herpes simplex virus (HSV-1) (https://doi.org/10.3390/md13010558)*	*Codium fragile and Chondrus crispus are, respectively, green and red seaweeds which are abundant along the North Atlantic coasts. We investigated the chemical composition and antiviral activity of enzymatic extracts of C. fragile (CF) and C. crispus (CC).*	Kulshreshtha G., Burlot A.-S., Marty C., Critchley A., Hafting J., Bedoux G., Bourgougnon N., Prithiviraj B.	2015
15	BIO	Ergosteriod derivatives	Antibacterial activity	*Ergosteroid derivatives from an algicolous strain of Aspergillus ustus (https://doi.org/10.1080/14786419.2014.923996)*	*One new ergosteroid derivative, isocyathisterol (1), and eight known compounds (2-9) were isolated from the culture of an algicolous strain (cf-42) of Aspergillus ustus obtained from the fresh tissue of marine green alga Codium fragile. The structure and*	Liu X.-H., Miao F.-P., Liang X.-R., Ji N.-Y.	2014
16	BIO	Methanol, dichloromethane and hexane extracts	Antibacterial activity	*Antibacterial activity of Codium fragile on common fish pathogens (https://www.researchgate.net/publication/286309869_Antibacterial_activity_of_Codium_fragile_on_common_fish_pathogens)*	*Methanol, dichloromethane and hexane extracts of Codium fragile (Suringar) Hariot (Chlorophyta) were tested for antibacterial activity against common fish pathogens (Aeromonas hydrophila, Yersinia ruckeri, Streptococcus agalactia and Enterococcus faecalis*	Dulger G., Dulger B.	2014
17	BIO	Different extracts	Antioxidant activity	*Antioxidant activity and phenolic content of pressurised liquid and solid-liquid extracts from four Irish origin macroalgae (https://doi.org/10.1111/ijfs.12512)*	*The efficiency of solid-liquid extraction (SLE) and pressurised liquid extraction (PLE) for the recovery of antioxidant and polyphenols from the Irish macroalgae, Fucus serratus, Laminaria digitata, Gracilaria gracilis and Codium fragile, was assessed usi*	Heffernan N., Smyth T.J., Fitzgerald R.J., Soler-Vila A., Brunton N.	2014
18	BIO	Siphonaxanthin	Anti-angiogenic effect	*Siphonaxanthin, a green algal carotenoid, as a novel functional compound (https://doi.org/10.3390/md12063660)*	*Siphonaxanthin is a specific keto-carotenoid in green algae whose bio-functional properties are yet to be identified. This review focuses on siphonaxanthin as a bioactive compound and outlines the evidence associated with functionality. Siphonaxanthin has*	Sugawara T., Ganesan P., Li Z., Manabe Y., Hirata T.	2014

19	BIO	Polysaccharides	Anticoagulant activity	*Polysaccharides from codium species: Chemical structure and biological activity. their role as components of the cell wall (https://doi.org/10.1016/B978-0-12-408062-1.00009-3)*	*Polysaccharides from Codium species have drawn attention due to their high anticoagulant activity. However, many different mechanisms of action have been proposed and the structure of the active compounds was usually not elucidated. Recently, structural d*	Fernández P.V., Arata P.X., Ciancia M.	2014
20	BIO	Crude extracts	Multiple	*Molecular characteristics and biological activities of anionic macromolecules from Codium fragile (https://doi.org/10.1016/j.ijbiomac.2013.04.022)*	*Water-soluble anionic macromolecules isolated from Codium fragile and fractionated using ion-exchange chromatography were investigated to determine their molecular characteristics and immunostimulating activity. The crude molecules and fractions (F1, F2,*	Tabarsa M., Karnjanapratum S., Cho M., Kim J.-K., You S.	2013
21	BIO	Crude extracts	Anti-oxidative, anti-inflammatory and anticancer activities	*Marine algal natural products with anti-oxidative, anti-inflammatory, and anti-cancer properties (https://doi.org/10.1186/1475-2867-13-55)*	*For their various bioactivities, biomaterials derived from marine algae are important ingredients in many products, such as cosmetics and drugs for treating cancer and other diseases. This mini-review comprehensively compares the bioactivities and biologi*	Lee J.-C., Hou M.-F., Huang H.-W., Chang F.-R., Yeh C.-C., Tang J.-Y., Chang H.-W.	2013
22	BIO	Cold water and ethanol extracts	α-amylase and α-glucosidase inhibitory effects	*The α-amylase and α-glucosidase inhibitory effects of Irish seaweed extracts (https://doi.org/10.1016/j.foodchem.2013.04.123)*	*To date, numerous studies have reported on the antidiabetic properties of various plant extracts through inhibition of carbohydrate-hydrolysing enzymes. The objective of this research was to evaluate extracts of seaweeds for α-amylase and α-glucosidase in*	Lordan S., Smyth T.J., Soler-Vila A., Stanton C., Paul Ross R.	2013
23	BIO	Different extracts	Antimicrobial and antifouling activities	*Antimicrobial and antifouling activities achieved by extracts of seaweeds from Gulf of California, Mexico (https://www.researchgate.net/publication/225183424_Antimicrobial_and_antifouling_activities_achieved_by_extracts_of_seaweeds_from_Gulf_of_California*	*Six species of common seaweed extracts were tested in laboratory assays: Dictyota flabellata, Padina concrescens, Laurencia johnstonii, Gymnogongrus martinensis, Ulva lactuca and Codium fragile for potential industrial applications through evaluation of t*	Águila-Ramírez R.N., Arenas-González A., Hernández-Guerrero C.J., González-Acosta B., Borges-Souza J.M., Véron B., Pope J., Hellio C.	2012
24	BIO	Methanol extract	Anti-inflammatory effects	*Anti-inflammatory effects of methanol extract of Codium fragile in lipopolysaccharide-stimulated RAW 264.7 cells (https://doi.org/10.1089/jmf.2010.1540)*	*The methanol extract of Codium fragile (MECF) has been reported to possess bioactive properties such as antidegranulation in eosinophils, as well as anti-edema, antibacterial, and antiviral activities. However, little is known about the molecular effects*	Kang C.-H., Choi Y.H., Park S.-Y., Kim G.-Y.	2012
25	BIO	Sesquiterpene	NA	*A new sesquiterpene from an endophytic Aspergillus versicolor strain (https://doi.org/10.1177/1934578x1200700702)*	*A new sesquiterpene, albican-11,14-diol (1), and seven known compounds, including sterigmatocystin (2), 3-hydroxy-5-(hydroxymethyl)-4-(4′- hydroxyphenoxy) pyrrolidin-2-one (3), (1H-indol-3-yl) oxoacetamide (4), indole-3-carboxylic acid (5), indole-3-ac*	Liu X.-H., Miao F.-P., Li X.-D., Yin X.-L., Ji N.-Y.	2012

Ulva pseudocurvata

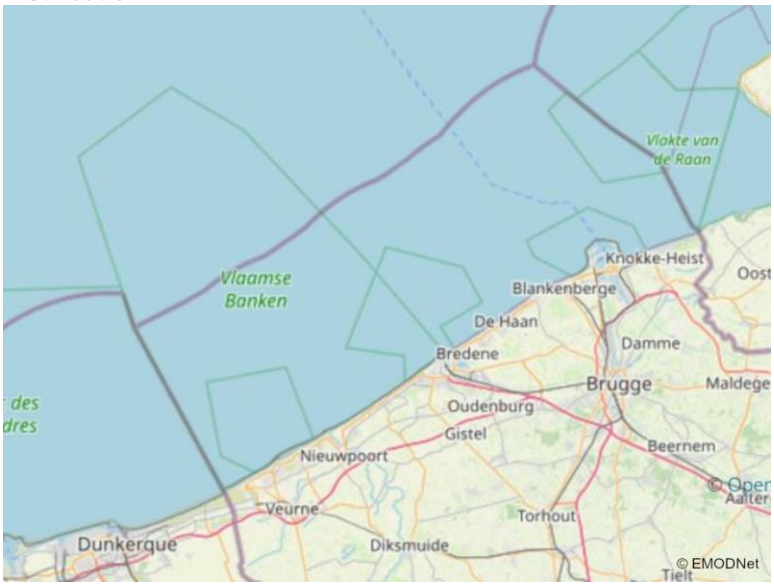
Aphia ID #145988

Kingdom:	Plantae
Phylum:	Chlorophyta
Class:	Ulvophyceae
Order:	Ulvales
Family:	Alvaceae
Genus:	Ulva
Species:	pseudocurvata

INFORMATION PANEL

Observations: NA

Distribution:



Habitat type: Tidal zone
Substrate: Rocks

DESCRIPTION

Size: 0 - 600 mm

Brief description:
A green alga with a broad, crumpled frond that is tough, translucent and membranous. It is attached to rock via a small hold-fast. The sea lettuce is found at all levels of the intertidal, although in more northerly latitudes and in brackish habitats it is found in the shallow sublittoral. In very sheltered conditions, plants that have become detached from the substrate can continue to grow, forming extensive floating communities. The plant tolerates brackish conditions and can be found on suitable substrata in estuaries.

Sampling method: Hand collection
Dutch name: Gekromde zeesla

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
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Chondrus crispus

Carrageen

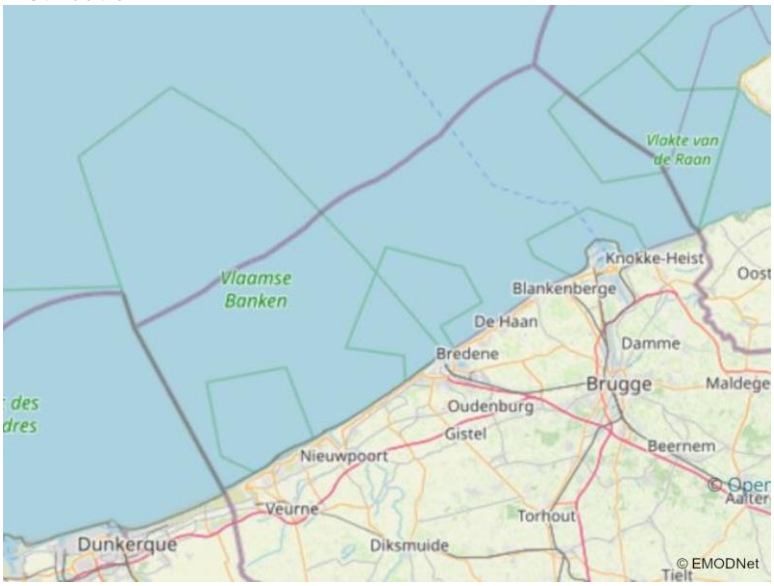
Aphia ID #145625

Kingdom:	Plantae
Phylum:	Rhodophyta
Class:	Florideophyceae
Order:	Gigartinales
Family:	Gigartinaceae
Genus:	Chondrus
Species:	crispus

INFORMATION PANEL

Observations: NA

Distribution:



Habitat type: Tidal zone
Substrate: Rocks

DESCRIPTION

Size: 0 - 150 mm

Brief description:
Chondrus crispus is a small purplish-red seaweed found on rocky shores and in pools. The fronds grow dichotomously from a narrow, unbranched stipe and are flat and wide with rounded tips. This seaweed is highly variable in appearance depending on the level of wave exposure of the shore and has a tendency to turn green in strong sunlight. Underwater, the tips of the frond can be iridescent.

Sampling method: Hand collection
Dutch name: lers mos

PROBIO

LITERATURE (non-exhaustive)

Cat. – Category; App. – Application; BIO - Bioactivity; CULT – Cultivation

#	Cat.	Compound / Method	App.	Title	Summary	Authors	Year
1	BIO	Proteins	Na	*Extraction of protein from four different seaweeds using three different physical pre-treatment strategies (https://doi.org/10.3390/molecules25082005)*	*Seaweeds are a rich source of protein and can contain up to 47% on the dry weight basis. It is challenging to extract proteins from the raw biomass of seaweed due to resilient cell-wall complexes. Four species of macroalgae were used in this study-two brown, Fucus vesiculosus and Alaria esculenta, and two red, Palmaria palmata and Chondrus crispus. Three treatments were applied individually to the macroalgal species: (I) high-pressure processing (HPP); (II) laboratory autoclave processing and (III) a classical sonication and salting out method. The protein, ash and lipid contents of the resulting extracts were estimated. Yields of protein recovered ranged from 3.2% for Fucus vesiculosus pre-treated with high pressure processing to 28.9% protein recovered for Chondrus crispus treated with the classical method. The yields of protein recovered using the classical, HPP and autoclave pre-treatments applied to Fucus vesiculosus were 35.1, 23.7% and 24.3%, respectively; yields from Alaria esculenta were 18.2%, 15.0% and 17.1% respectively; yields from Palmaria palmata were 12.5%, 14.9% and 21.5% respectively, and finally, yields from Chondrus crispus were 35.2%, 16.1% and 21.9%, respectively. These results demonstrate that while macroalgal proteins may be extracted using either physical or enzymatic methods, the specific extraction procedure should be tailored to individual species. © 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).*	O' Connor J., Meaney S., Williams G.A., Hayes M.	2020
2	BIO	Carrageenan	Food, feed	*Biochemical and Nutritional Composition of Industrial Red Seaweed Used in Carrageenan Production (https://doi.org/10.1080/10498850.2019.1664693)*	*The main four seaweed species for carrageenan production used in industry are Eucheuma denticulatum, Kappaphycus alvarezii, Chondrus crispus, and Sarcothalia crispata. In addition, a fifth red seaweed, Furcellaria lumbricalis, is a source of furcellaran, which is very similar to carrageenan. In this study, the chemical composition including total lipid, fatty acid profile, tocopherol content, total protein, amino acid profile, and total phenolic content of the five semi-dried industrial red seaweeds were analyzed. The obtained results indicated that when considering the total commercial production of carrageenan, there is potential to develop a method to extract protein before the main process for carrageenan extraction. Protein was the most considerable compound in the selected seaweed, and it varied from 4% for E. denticulatum up to 28% for F. lumbricalis. In the future, this may lead to a multi-product extraction (biorefinery) approach to result in more than one product instead of the traditional single-product procedure. © 2019, © 2019 Taylor & Francis Group, LLC.*	Naseri A., Holdt S.L., Jacobsen C.	2019

3	BIO	Sulfated polysaccharides	Immune-stimulant activity	*Assessment of the effects of sulfated polysaccharides extracted from the red seaweed Irish moss Chondrus crispus on the immune-stimulant activity in mussels Mytilus spp. (https://doi.org/10.1016/j.fsi.2018.02.014)*	*Seaweeds contain a number of health enhancing and antimicrobial bioactive compounds including sulfated polysaccharides (SP). In the present study, SP extracted from a European red seaweed Irish moss Chondrus crispus was chemically analyzed, SP content extracted and the immune-response effect on wild Irish mussels Mytilus spp. investigated for the first time. A high percent yield of SP was extracted from C. crispus and the immune-stimulant activity of SP was assessed in a laboratory trial with mussels exposed to three different treatments of low (10 µg mL−1), medium (20 µg mL−1) and high (50 µg mL−1) SP dose concentrations and a control mussel group with no exposure to SP. An initial mussel sample was processed prior to the trial commencing and mussels were subsequently sampled on Days 1, 2, 3, 4, 7, and 10 post SP exposure. Both cell, humoral and immune related gene responses including haemocyte cell viability, haemocyte counts, lysozyme activity and expression of immune related genes (defensin, mytimycin and lysozyme mRNA) were assessed. No mussel mortalities were observed in either the treated or non-treated groups. Mussels exposed with SP showed an increase in haemocyte cell viability and the total number of haemocytes compared to control mussels. Lysozyme activity was also higher in treated mussels. Additionally, up-regulated expression of defensin, mytimycin and lysozyme mRNA was observed in SP treated mussels shortly after exposure (on Days 1, 2, and 3) to SP. These results indicate that a high quality yield of SP can be readily extracted from C. crispus and more importantly based on the animal model used in this study, SP extracted from C. crispus can rapidly induce health enhancing activities in Mytilus spp. at a cellular, humoral and molecular level and with a prolonged effect up to ten days post treatment. © 2018 Elsevier Ltd*	Rudtanatip T., Lynch S.A., Wongprasert K., Culloty S.C.	2018
4	BIO	Ethanol extract	Antileishmanial drugs	*Marine algae as source of novel antileishmanial drugs: A review (https://doi.org/10.3390/md15110323)*	*Leishmaniasis is a vector-borne neglected tropical disease caused by protozoan parasites of the Leishmania genus and transmitted by the female Phlebotomus and Lutzomyia sand flies. The currently prescribed therapies still rely on pentavalent antimonials, pentamidine, paromomycin, liposomal amphotericin B, and miltefosine. However, their low efficacy, long-course treatment regimen, high toxicity, adverse side effects, induction of parasite resistance and high cost require the need for better drugs given that antileishmanial vaccines may not be available in the near future. Although most drugs are still derived from terrestrial sources, the interest in marine organisms as a potential source of promising novel bioactive natural agents has increased in recent years. About 28,000 compounds of marine origin have been isolated with hundreds of new chemical entities. Recent trends in drug research from natural resources indicated the high interest of aquatic eukaryotic photosynthetic organisms, marine algae in the search for new chemical entities given their broad spectrum and high bioactivities*	Yamthe L.R.T., Appiah-Opong R., Fokou P.V.T., Tsabang N., Boyom F.F., Nyarko A.K., Wilson M.D.	2017

					including antileishmanial potential. This current review describes prepared extracts and compounds from marine macroalgae along with their antileishmanial activity and provides prospective insights for antileishmanial drug discovery. © 2017 by the authors. Licensee MDPI.		
5	BIO	Different extracts	Antioxidant activity	*Biochemical composition, nutritional value, and antioxidant properties of seven seaweed species from the Madeira Archipelago (https://doi.org/10.1007/s10811-017-1074-x)*	*Biochemical composition and antioxidant activity were assessed in seven seaweeds from Madeira Archipelago, namely, the chlorophyte (Ulva lactuca), the rhodophytes (Asparagopsis taxiformis, Chondrus crispus, Galaxaura rugosa, Grateloupia lanceola and Nemalion elminthoides), and the phaeophyte (Zonaria tournefortii). Seaweed mineral content varied from 16.60 to 84.16 g (100 g)-1 dry weight (dw). Organic matter, composed by fiber and matrix polysaccharides (8.33 to 54.04 g (100 g)-1 dw), starch (1.95 to 25.41 g (100 g)-1 dw), protein (2.80 to 17.55 g (100 g)-1 dw), and fat (1.46 to 12.04 g (100 g)-1 dw), was also determined. Asparagopsis taxiformis was found to have substantial quantities of protein, fat, fiber, and matricial polysaccharides, compared to the other analyzed seaweeds. Analysis of antioxidant components included the measurement of chlorophyll a (28.81 to 244.3 g (100 g)-1 dw), total carotenoids (0 to 297.8 g (100 g)-1 dw), total phenolic compounds (0 to 2154 mg GAE (100 g)-1 dw), and total flavonols (7.27 to 604.8 mg QE (100 g)-1 dw). Zonaria tournefortii was found to possess the highest contents of chlorophyll a, total carotenoids, total phenolic content (TPC), and antioxidant activity, determined through ferric reduction antioxidant potential (FRAP), ferrous ion chelating (FIC), free radical-scavenging assay (FRSA), and β-carotene bleaching (β-CB). Statistical analysis showed 38 significant correlations between various biochemical and antioxidant parameters or activity and determined that fat content showed the highest number of correlations. Overall, this study gives a better understanding of Madeira autochthonous seaweeds in their potential of being introduced as a raw material for nutrient supplementation in various food products or to produce functional foods using seaweed natural properties. © 2017, Springer Science+Business Media Dordrecht.*	Nunes N., Ferraz S., Valente S., Barreto M.C., Pinheiro de Carvalho M.A.A.	2017
6	BIO	Polysaccharide-rich fractions	Anticoagulant effect	*Evaluation of the anticoagulant potential of polysaccharide-rich fractions extracted from macroalgae (https://doi.org/10.1080/14786419.2017.1278595)*	*The aim of this study was to evaluate the potential anticoagulant activity of sulphated polysaccharide-containing extracts of six french edible marine macroalgae. Aqueous extracts of brown (Himanthalia elongata, Laminaria digitata, Ascophyllum nodosum, Fucus vesiculosus), green (Ulva lactuca) and red (Chondrus crispus) macroalgae were prepared and their biochemical properties were determined, including major biomolecules, sulphate and ash contents. The anticoagulant activity of each extract was investigated using different scales from the specific antithrombin-dependent pathway (anti-Xa and anti-IIa) to the intrinsic and/or common (Activated Partial Thromboplastin Time, APTT), extrinsic (Prothrombin Time, PT) or common (Thrombin Time, TT) anticoagulant*	Adrien A., Dufour D., Baudouin S., Maugard T., Bridiau N.	2017

					pathways, and compared with those of commercial anticoagulants, heparin and Lovenox®. Laminaria digitata, Fucus vesiculosus and Chondrus crispus extracts showed a significant APTT anticoagulant capacity, only 5-fold lower than that of Lovenox®, which is a pure low molecular weight heparin used as an anticoagulant agent to prevent pulmonary embolism in patients undergoing surgery. © 2017 Informa UK Limited, trading as Taylor & Francis Group.		
7	BIO	Different extracts	Protective effects	*Red seaweeds Sarcodiotheca gaudichaudii and chondrus crispus down regulate virulence factors of salmonella enteritidis and induce immune responses in Caenorhabditis elegans (https://doi.org/10.3389/fmicb.2016.00421)*	*Red seaweeds are a rich source of unique bioactive compounds and secondary metabolites that are known to improve human and animal health. S. Enteritidis is a broad range host pathogen, which contaminates chicken and poultry products that end into the human food chain. Worldwide, Salmonella outbreaks have become an important economic and public health concern. Moreover, the development of resistance in Salmonella serovars toward multiple drugs highlights the need for alternative control strategies. This study evaluated the antimicrobial property of red seaweeds extracts against Salmonella Enteritidis using the Caenorhabditis elegans infection model. Six red seaweed species were tested for their antimicrobial activity against S. Enteritidis and two, Sarcodiotheca gaudichaudii (SG) and Chondrus crispus (CC), were found to exhibit such properties. Spread plate assay revealed that SG and CC (1%, w/v) significantly reduced the growth of S. Enteritidis. Seaweed water extracts (SWE) of SG and CC, at concentrations from 0.4 to 2 mg/ml, significantly reduced the growth of S. Enteritidis (log CFU 4.5–5.3 and log 5.7–6.0, respectively). However, methanolic extracts of CC and SG did not affect the growth of S. Enteritidis. Addition of SWE (0.2 mg/ml, CC and SG) significantly decreased biofilm formation and reduced the motility of S. Enteritidis. Quantitative real-time PCR analyses showed that SWE (CC and SG) suppressed the expression of quorum sensing gene sdiA and of Salmonella Pathogenesis Island-1 (SPI-1) associated genes sipA and invF, indicating that SWE might reduce the invasion of S. Enteritidis in the host by attenuating virulence factors. Furthermore, CC and SG water extracts significantly improved the survival of infected C. elegans by impairing the ability of S. Enteritidis to colonize the digestive tract of the nematode and by enhancing the expression of C. elegans immune responsive genes. As the innate immune response pathways of C. elegans and mammals show a high degree of conservation, these results suggest that these SWE may also impart beneficial effects on animal and human health. © 2016 Kulshreshtha, Borza, Rathgeber, Stratton, Thomas, Critchley, Hafting and Prithiviraj.*	Kulshreshtha G., Borza T., Rathgeber B., Stratton G.S., Thomas N.A., Critchley A., Hafting J., Prithiviraj B.	2016
8	BIO	Methanol extract	Protective effects	*A cultivated form of a red seaweed (Chondrus crispus), suppresses β-amyloid-induced paralysis in caenorhabditis elegans (https://doi.org/10.3390/md13106407)*	*We report here the protective effects of a methanol extract from a cultivated strain of the red seaweed, Chondrus crispus, against β-amyloid-induced toxicity, in a transgenic Caenorhabditis elegans, expressing human Aβ1-42 gene. The methanol extract of C. crispus (CCE), delayed β-amyloid-induced paralysis, whereas the water*	Sangha J.S., Wally O., Banskota A.H., Stefanova R., Hafting J.T., Critchley A.T.,	2015

					extract (CCW) was not effective. The CCE treatment did not affect the transcript abundance of amy1; however, Western blot analysis revealed a significant decrease of Aβ species, as compared to untreated worms. The transcript abundance of stress response genes; sod3, hsp16.2 and skn1 increased in CCE-treated worms. Bioassay guided fractionation of the CCE yielded a fraction enriched in monogalactosyl diacylglycerols (MGDG) that significantly delayed the onset of β-amyloid-induced paralysis. Taken together, these results suggested that the cultivated strain of C. crispus, whilst providing dietary nutritional value, may also have significant protective effects against β-amyloid-induced toxicity in C. elegans, partly through reduced β-amyloid species, up-regulation of stress induced genes and reduced accumulation of reactive oxygen species (ROS). © 2015 by the authors; licensee MDPI, Basel, Switzerland.	Prithiviraj B., Perry G.	
9	BIO	Long-chain aliphatic alcohols and monoglycerides	NA	*Chlorophyta and Rhodophyta macroalgae: A source of health promoting phytochemicals (https://doi.org/10.1016/j.foodchem.2015.03.006)*	*A detailed study of the lipophilic composition of Codium tomentosum, Ulva lactuca, Gracilaria vermiculophylla and Chondrus crispus macroalgae cultivated in the Portuguese coast was carried out by gas chromatography-mass spectrometry before and after alkaline hydrolysis. Their long-chain aliphatic alcohols and monoglycerides compositions are reported for the first time. Additionally, other new compounds were also identified: phytol and neophytadiene in C. tomentosum, U. lactuca and G. vermiculophylla and stigmasterol, α-tocopherol and 24-methylenecholesterol in C. tomentosum. The lipophilic fraction of the studied macroalgae are mainly constituted by fatty acids (110.1-1030.5 mg kg-1 of dry material) and sterols (14.8-1309.1 mg kg-1 of dry material). C. tomentosum showed to be a valuable source of stigmasterol (1229.0 mg kg-1 of dry material) and α-tocopherol (21.8 mg kg-1 of dry material). These results are a relevant contribution for the valorisation of these macroalgae species as sources of valuable phytochemicals. © 2015 Elsevier Ltd. All rights reserved.*	Santos S.A.O., Vilela C., Freire C.S.R., Abreu M.H., Rocha S.M., Silvestre A.J.D.	2015
10	BIO	Lipid extracts	Anti-inflammatory effect	*The anti-inflammatory effect of algae-derived lipid extracts on lipopolysaccharide (LPS)-stimulated human THP-1 macrophages (https://doi.org/10.3390/md13085402)*	*Algae contain a number of anti-inflammatory bioactive compounds such as omega-3 polyunsaturated fatty acids (n-3 PUFA) and chlorophyll a, hence as dietary ingredients, their extracts may be effective in chronic inflammation-linked metabolic diseases such*	Robertson R.C., Guihéneuf F., Bahar B., Schmid M., Stengel D.B., Fitzgerald G.F., Ross R.P., Stanton C.	2015
11	BIO	Different extracts	Neuroprotective effects	*Neuroprotective effects of the cultivated Chondrus crispus in a C. elegans model of Parkinson's disease (https://doi.org/10.3390/md13042250)*	*Parkinson's disease (PD) is the second most common neurodegenerative disorder in the elderly people, currently with no cure. Its mechanisms are not well understood, thus studies targeting cause-directed therapy or prevention are needed. This study uses th*	Liu J., Banskota A.H., Critchley A.T., Hafting J., Prithiviraj B.	2015
12	BIO	Enzyme	Cytotoxicity	*Enzyme-assisted extraction of bioactive material from Chondrus crispus and codium fragile and its effect on Herpes*	*Codium fragile and Chondrus crispus are, respectively, green and red seaweeds which are abundant along the North Atlantic coasts. We investigated the chemical composition and antiviral activity of*	Kulshreshtha G., Burlot A.-S., Marty C., Critchley A.,	2015

				simplex virus (HSV-1) (https://doi.org/10.3390/md13010558)	*enzymatic extracts of C. fragile (CF) and C. crispus (CC).*	Hafting J., Bedoux G., Bourgougnon N., Prithiviraj B.	
13	BIO	Phycobiliproteins , carotenoids, volatile compounds	Antioxidant activity	*An evaluation of edible red seaweed (Chondrus crispus) components and their modification during the cooking process (https://doi.org/10.1016/j.lwt.2013.08.006)*	*In this study, phycobiliproteins, carotenoids (β-carotene and lutein), volatile compounds and antioxidant activity were determined in dried, hydrated, boiled and steamed Chondrus crispus seaweed. Significant changes in phycoerythrin, phycocyanin, β-carote*	Pina A.L., Costa A.R., Lage-Yusty M.A., López-Hernández J.	2014
14	BIO	Lipids	NO inhibitory activity	*Lipids isolated from the cultivated red alga Chondrus crispus inhibit nitric oxide production (https://doi.org/10.1007/s10811-013-0174-5)*	*A MeOH extract of cultivated Chondrus crispus showed dose-dependent nitric oxide (NO) inhibition of lipopolysaccharide-induced NO production in macrophage RAW264.7 cells. NO inhibition-guided fractionation of the extract led to identification of eicosapen*	Banskota A.H., Stefanova R., Sperker S., Lall S., Craigie J.S., Hafting J.T.	2014
15	BIO	Water extract	Enhanced immunity	*Components of the cultivated red seaweed Chondrus crispus enhance the immune response of Caenorhabditis elegans to Pseudomonas aeruginosa through the pmk-1, daf-2/daf-16, and skn-1 pathways (https://doi.org/10.1128/AEM.01927-13)*	*Marine macroalgae are rich in bioactive compounds that can, when consumed, impart beneficial effects on animal and human health. The red seaweed Chondrus crispus has been reported to have a wide range of health-promoting activities, such as antitumor and*	Liu J., Hafting J., Critchley A.T., Banskota A.H., Prithiviraj B.	2013
16	BIO	Lipids	Antimicrobial activitiy	*Antimicrobial activity and lipid profile of seaweed extracts from the North Portuguese Coast (https://www.researchgate.net/publication/259850285_Antimicrobial_activity_and_lipid_profile_of_seaweed_extracts_from_the_North_Portuguese_Coast)*	*Seaweeds or marine macroalgae are a potential renewable resource in the marine environment and can represent a source of new natural compounds for human nutrition. This experimental work focused on the selection of a suitable extraction method, using Grac*	Mendes M., Pereira R., Sousa Pinto I., Carvalho A.P., Gomes A.M.	2013
17	BIO	Methanol extract	Enhanced oxidative stress tolerance	*Bioactive components of the edible strain of red alga, Chondrus crispus, enhance oxidative stress tolerance in Caenorhabditis elegans (https://doi.org/10.1016/j.jff.2013.04.001)*	*Seaweeds are rich sources of bioactive compounds with potential health benefits. Anti-stress effects of the cultivated red alga, Chondrus crispus, were investigated in the Caenorhabditis elegans model. Methanolic extracts of C. crispus (CCME) enhanced C.*	Sangha J.S., Fan D., Banskota A.H., Stefanova R., Khan W., Hafting J., Craigie J., Critchley A.T., Prithiviraj B.	2013
18	BIO	Cold water and ethanol extracts	Antidiabetic properties	*The α-amylase and α-glucosidase inhibitory effects of Irish seaweed extracts (https://doi.org/10.1016/j.foodchem.2013.04.123)*	*To date, numerous studies have reported on the antidiabetic properties of various plant extracts through inhibition of carbohydrate-hydrolysing enzymes. The objective of this research was to evaluate extracts of seaweeds for α-amylase and α-glucosidase in*	Lordan S., Smyth T.J., Soler-Vila A., Stanton C., Paul Ross R.	2013
19	BIO	Multiple	Multiple	*Bioactive compounds in seaweed: Functional food applications and legislation (https://doi.org/10.1007/s10811-010-9632-5)*	*Seaweed is more than the wrap that keeps rice together in sushi. Seaweed biomass is already used for a wide range of other products in food, including stabilising agents. Biorefineries with seaweed as feedstock are attracting worldwide interest and includ*	Holdt S.L., Kraan S.	2011
20	BIO	Organic extracts	Antiprotozoal activities	*Antiprotozoal activities of organic extracts from french marine seaweeds (https://doi.org/10.3390/md9060922)*	*Marine macrophytes contain a variety of biologically active compounds, some reported to have antiprotozoal activity in vitro. As a part of a screening program to search for new natural antiprotozoals, we screened hydroalcoholic and ethyl acetate extracts*	Vonthron-Sénécheau C., Kaiser M., Devambez I., Vastel	2011

						A., Mussio I., Rusig A.-M.	
21	BIO	Methanol extract	Antioxidant and antimicrobial activity	*An assessment of the antioxidant and antimicrobial activity of six species of edible Irish seaweeds (https://www.researchgate.net/publication/254585284_An_Assessment_of_the_Antioxidant_and_Antimicrobial_Activity_of_Six_Species_of_Edible_Irish_Seaweeds)*	*Six species of edible Irish seaweeds; Laminaria digitata, Laminaria saccharina, Himanthalia elongata, Palmaria palmata, Chondrus crispus and Enteromorpha spirulina were screened for potential bioactivity. Extraction of secondary metabolites was carried ou*	Cox S., Abu-Ghannam N., Gupta S.	2010
22	BIO	Hot water extracts	Anticoagulant effect	*Simple separation of anticoagulant sulfated galactan from marine red algae (https://doi.org/10.1007/s10811-007-9306-0)*	*In this study, hot water extracts of 22 red algal species were evaluated for their potential anticoagulant activities. The extracts from eight species (Grateloupia elliptica, Sinkoraena lancifolia, Halymenia dilatata, Grateloupia lanceolata, Lomentaria ca*	Lee S.-H., Athukorala Y., Lee J.-S., Jeon Y.-J.	2008
23	BIO	Different extracts	NA	*In vitro screening of seaweed extract on the proliferation of mouse spleen and thymus cell (https://doi.org/10.1007/BF02931901)*	*A total number of 31 types of seaweed were assessed with regard to their effects on the proliferation of mouse spleen and thymus cells in a culture, using an MTT reduction assay. Acetone:dichloromethane (1:1) extracts of three seaweed plants: Derbesia mar*	Seo Y., Kang S.-H., Lee H.-J., Kim Y.A., Youn H.J., Lee B.-J., Chung H.	2006
24	BIO	Crude extracts	Antifouling activity	*Inhibitory effects of red algal extracts on larval settlement of the barnacle Balanus improvisus (https://doi.org/10.1007/s00227-003-1093-9)*	*We examined the chemical antifouling properties of four sublittoral red algae, Chondrus crispus, Delesseria sanguined, Osmundea ramosissima, and Polyides rotundus, which are all rarely fouled in the field. Two different approaches were used. Firstly, we t*	Nylund G.M., Pavia H.	2003
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