# sea squirts

## common to the ports & harbours of New Zealand

Version 2

Mike Page & Michelle Kelly

with Blayne Herr

NIWA
Taihoro Nukurangi

# about this guide

Sea squirts are amongst the more common marine invertebrates that inhabit our coasts, our harbours, and the depths of our oceans.

*SEA SQUIRTS* is a fully illustrated invertEguide designed to provide a simple introduction to living sea squirts, and to distinguish between introduced and native species common to a majority of the ports and harbours around New Zealand. It is designed for New Zealanders like you who live near the sea, dive and snorkel, explore our coasts, make a living from it, and for those who educate and are charged with kaitiakitanga, conservation and management of our marine realm. It is one in a series of electronic guides on New Zealand marine invertebrates that NIWA's Coasts and Oceans centre is presently developing.

The invertEguide starts with a simple introduction to living sea squirts, followed by a colour index, species index, detailed individual species pages, and finally, icon explanations and a glossary of terms. As new species are discovered and described, new species pages will be added and an updated version of this invertEguide will be made available online.

Each sea squirt species page illustrates and describes features that enable you to differentiate the species from each other. Species are illustrated with high quality images of the animals in life. As far as possible, we have used characters that can be seen by eye or magnifying glass, and language that is non technical. Information is provided in descriptive text or quick reference icons that convey information without words. Icons are fully explained at the end of this document and a glossary explains unfamiliar terms.

The guide is not definitive in that it only contains 24 species, but it is dynamic in that new species will be added as they are discovered, and the guide will be updated on NIWA's website

# how to identify your sea squirt

Click on an image of a sea squirt in the **colour index** that you think looks most like your unknown species. This will bring you to the **species page** that provides information on that species. To help confirm your identification work through the **identify your sea squirt flowcharts**, using a magnifying glass to find the anatomical features where needed. As a last resort, thumb your way through the species pages looking for your animal, then confirm it by examining the characters described in the flowcharts. If you already know what the species is, click on the **taxonomic name** in the **species index** to bring you to the species page that describes the animal. If you are really keen, you can then use the **taxonomic reference** at the bottom of each species page to double check your identification.

Note that sea squirts are preserved in 10% formalin after relaxation in seawater and menthol. This process may cause changes to the colour and texture of the body.

Mike Page is New Zealand's only professional sea squirt taxonomist; he has a working interest in taxonomy, systematics, chemical ecology and aquaculture. For any ID advice on sea squirts you find, please email Mike your photo's ... (mike.page@niwa.co.nz)

Remember to check out

http://www.niwa.co.nz/coasts-and-oceans/marine-identification-guides-and-fact-sheets

for any updated versions!

# about sea squirts

Sea squirts (ascidians) are amongst the most common fouling animals in ports and harbours around the world. They settle and grow in great abundance on artificial substrates such as wharf piles, seawalls, ship hulls and aquaculture structures. While most native (endemic) species are found in relatively low numbers in intertidal and most subtidal environments around New Zealand, reefs at the entrance of harbours and estuaries with high tidal flow, and cave walls, often support a rich and diverse fauna.

Introduced (invasive) species are usually highly successful, invading in great abundance and often in densities that preclude other species. They have abundant, highly mobile larvae that settle and grow quickly, competing with other species for food and space. The potential consequences of this biology, for the shellfish aquaculture industry in particular, can be serious.

Sea squirts are animals that feed by filtering the water through their body via an **inhalant** and **exhalent siphon**. Some are **solitary** animals, and some live in groups (**colonial**), some are **stalked**, and some **encrust** the substrate. Individual animals are enclosed within a leathery or gelatinous test which can be translucent. Fertilisation may be internal or external with embryos brooded in colonial and some solitary species, followed by a very short-lived free-living larval stage before settlement.

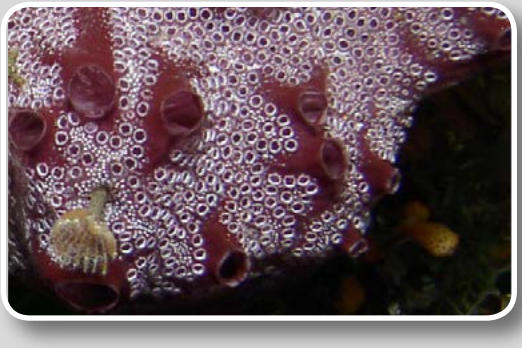
Fish, flatworms, sea urchins and sea stars are the sea squirts' primary predators, although, in Chile, Japan, Korea , Europe and parts of Aboriginal Australia, some sea squirts are eaten by humans!

## solitary sea squirt

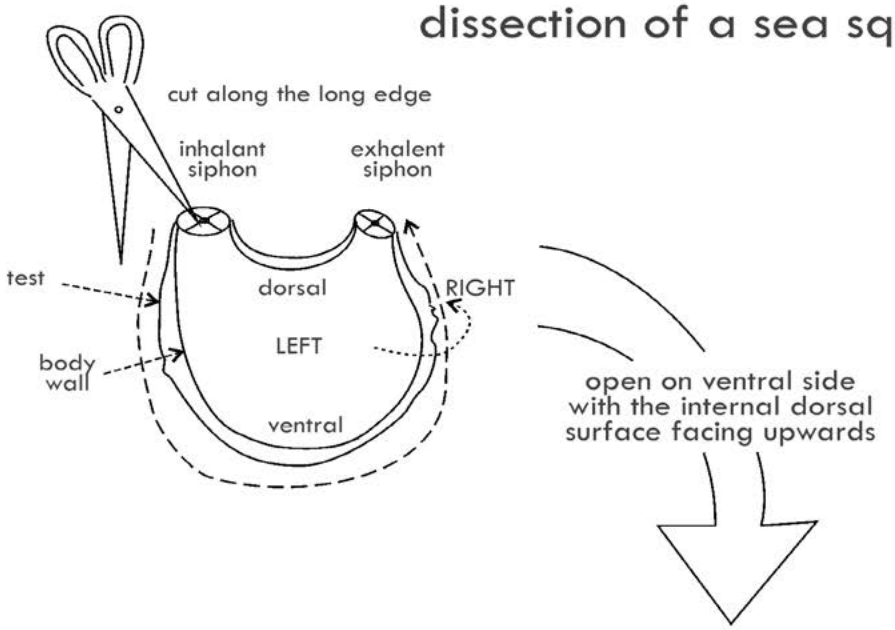
Individual animals with an inhalant siphon and an exhalent siphon, often with a thick leathery test that encloses the body of the animal.

## colonial sea squirt

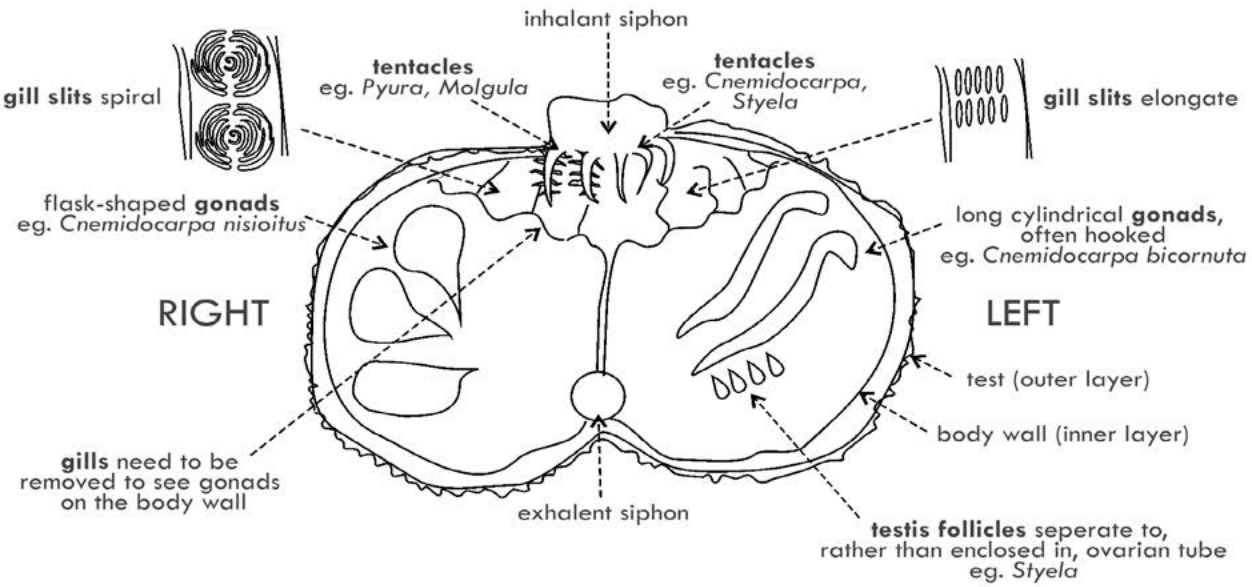
Groups of small animals (zooids) are embedded in a gelatinous test as a colony. Zooids can be arranged in circular or linear systems, sharing common exhalent canals and apertures. Other types can have zooids opening independently or on stalks connected to a common basal test.



### dissection of a sea squirt




### composite schematic of a solitary sea squirt



# a typical species page layout

the information you can expect to see on each species page

**taxonomic name of species**

**taxonomic authority**
person(s) who first described this species

**species classification**
see species index for arrangement

**species images**
Inset images show variations

**image icons**
highlighting whether native or introduced, solitary or colonial, and size (scale bar)

**bar icons**
highlighting shape, surface detail, habitat, and environment

**depth range**
common depth range around New Zealand

**abundance**

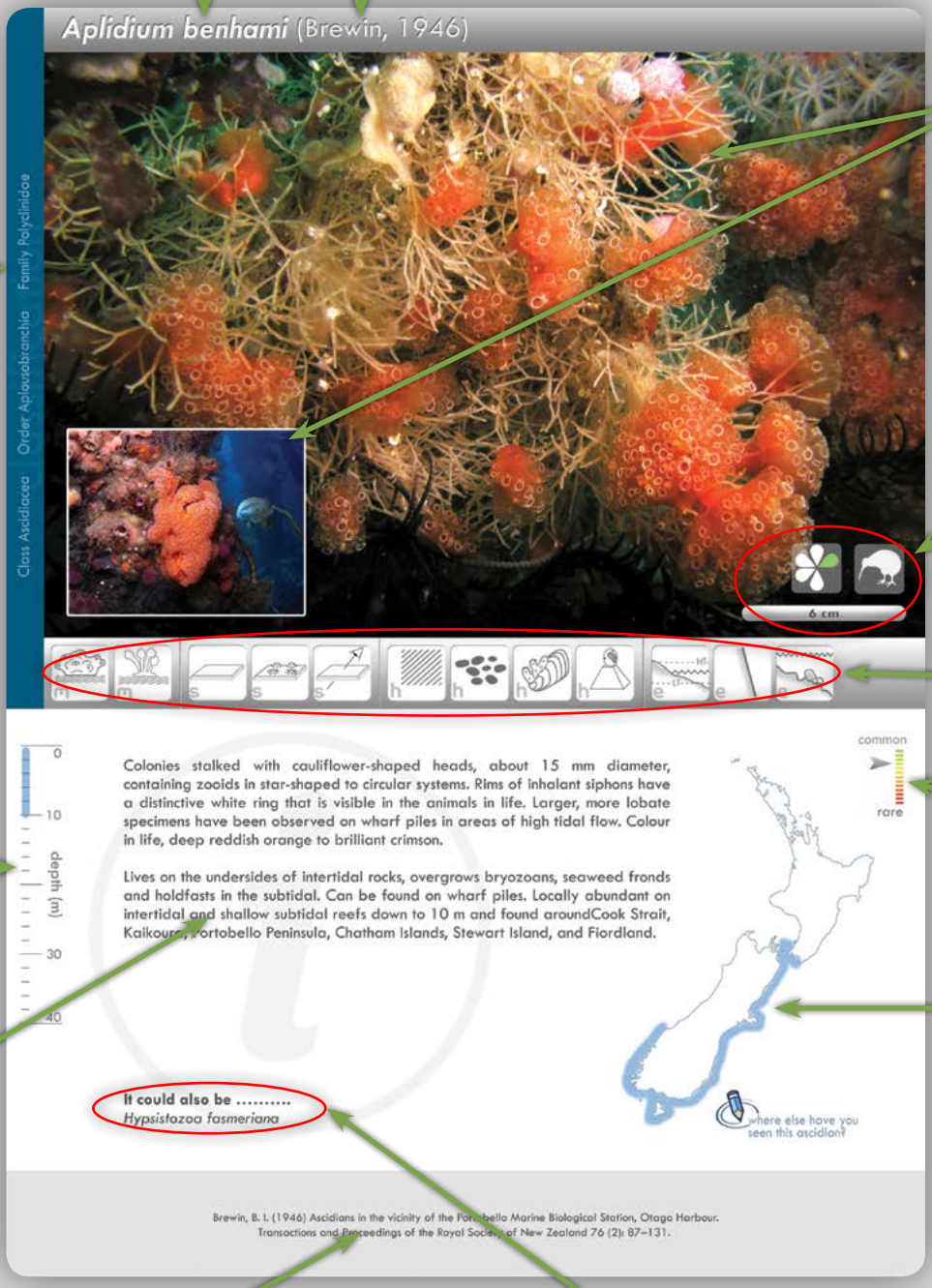
**information**
details on external and internal characters and habitat

**distribution**
section of coastline where species is most commonly found

make notes of where you encountered this species and let us know if you find it at a new location

**key taxonomic references**

**it could also be ...**
some species are difficult to tell apart without careful identification, so check the species listed here to make sure that you have the correct species



# colour index

*Corella eumyota*

*Ciona* spp

*Molgula manhattensis*

*Molgula mortenseni*

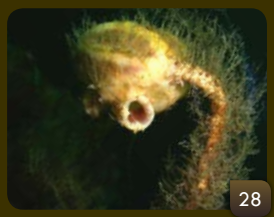
*Diplosoma listerianum*

*Ascidiella aspersa*

*Didemnum* species complex

*Eudistoma elongatum*

*Didemnum vexillum*



*Pyura pachydermatina*

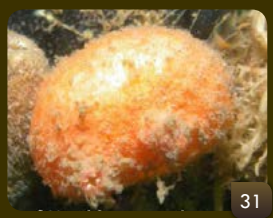
*Styela canopus*

*Aplidium phortax*

*Clavelina lepadiformis*

*Botryllus schlosseri*

*Pyura* species complex



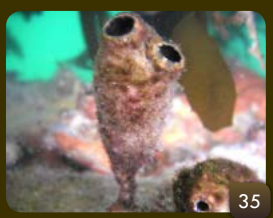
*Asterocarpa humilis*

*Cnemidocarpa bicornuta*

*Styela plicata*

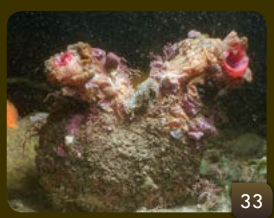
*Microcosmus squamiger*

*Botryllus tuberatus*

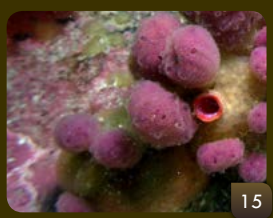


*Styela clava*

*Botrylloides leachii*



*Cnemidocarpa nisiotus*



*Hypsistozoa fasmeriana*

*Botrylloides leachii*

*Lissoclinum notti*

*Pyura doppelgangera*

*Botrylloides leachii*

# species index

Phylum Chordata
Subphylum Tunicata
Class Ascidiacea

## Order Aplousobranchia



## Order Phlebobranchia



## Order Stolidobranchia

Introduced species
Native species
Since first described in NZ, this species has been recorded elsewhere

# identify your sea squirt

Solitary

Colonial

see next page

Stalked

Unstalked

Stalk long smooth, siphons 1/3 body length apart

*Pyura pachydermatina*

28

Stalk short deep longitudinal folds, siphons close together

*Styela clava*

35

Test translucent, slightly see-through

Test smooth

Test rough with warty processes

*Ascidiella aspersa*

18

Test not translucent, opaque

Test cartilaginous, tough yet flexible

*Corella eumyota*

21

Test soft

Yellow pigment spots on siphon rim

*Ciona intestinalis*

19

Orange pigment spots on siphon rim

*Ciona savigny*

20

Tentacles branched

Tentacles NOT branched

Gill slits spiral, small globular individuals, test with no ridges

Gill slits elongate

Numerous gonads in paired blocks on each side of body

Gonads in a few large blocks, left gonad crosses over the gut loop

Test thick, cartilaginous (tough yet flexible), sandy

*Pyura doppelgangera*

29

Test leathery, tough, wrinkled

*Pyura* species complex

30

Test irregular with ridges and swellings, elongate

*Microcosmus squamiger*

27

Test white, papery, translucent

*Molgula manhattensis*

25

Test coated in fine sand

*Molgula mortenseni*

26

Test white or gray

Test brown, wrinkled, leathery

Test inflexible, cream thick, warty and pleated

*Styela plicata*

36

Test flexible

Body small, oval, siphons with warty processes

*Asterocarpa humilis*

31

Body upright, siphons close together

*Styela canopus*

34

Body ovoid, siphons about ½ a body length apart

*Cnemidocarpa nisiotus*

33

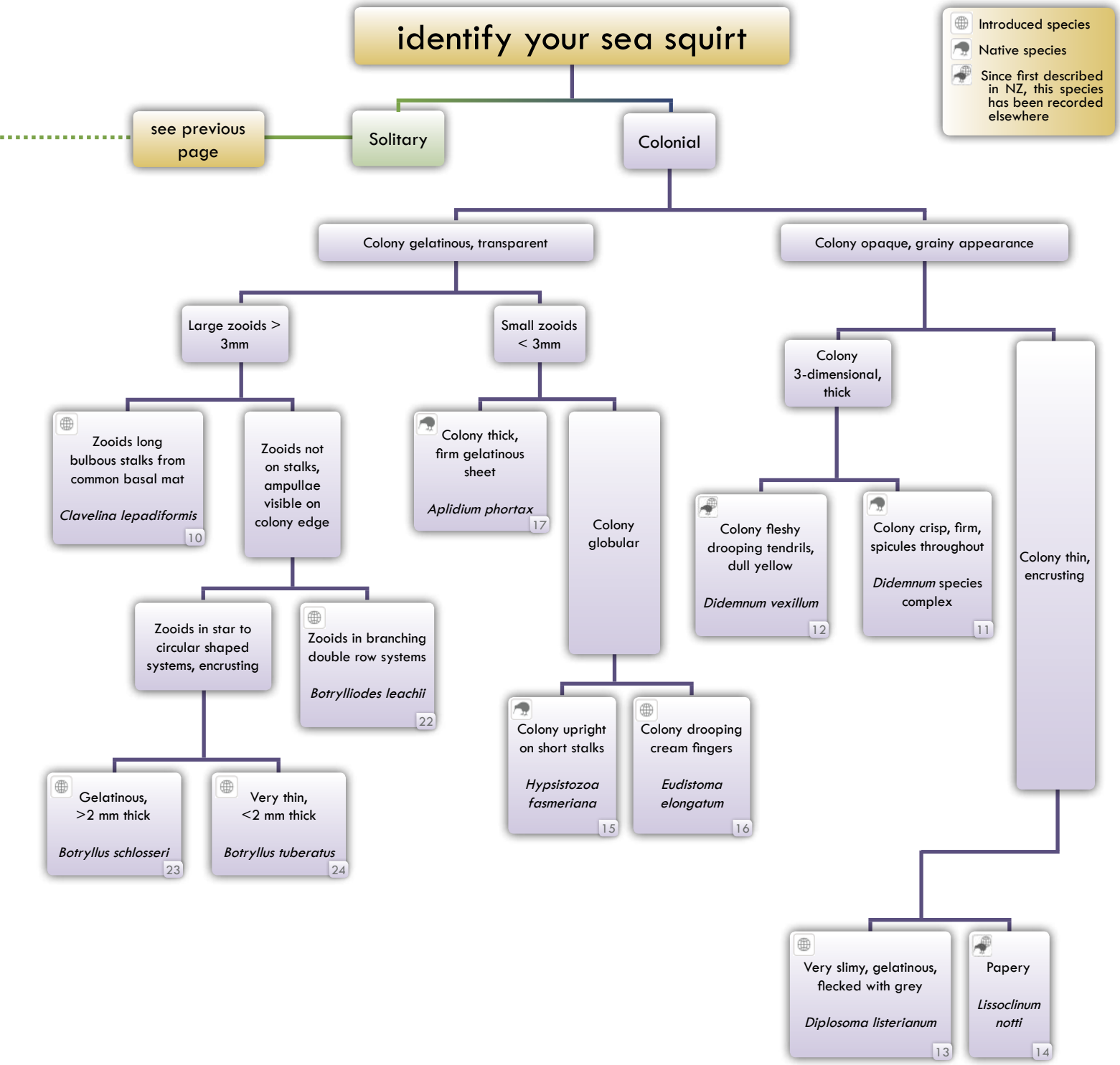
Body elongate, with a saddle between siphons

*Cnemidocarpa bicornuta*

32

# identify your sea squirt

Introduced species
Native species
Since first described in NZ, this species has been recorded elsewhere



# *Clavelina lepadiformis* (Müller, 1776)

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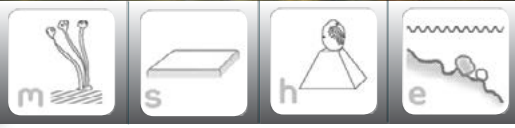



Colonies have a distinctive medusoid shape in which multiple elongate zooids are joined by a thin common basal test and protrude as individual heads opening separately to the outside. Inhalant gill sac and stomach are clearly visible through the transparent test. The endostyle and tentacles are pigmented either white or yellow giving the appearance of a light bulb with a glowing filament.

Fouls the underside of floating moorings, restricted at present to Nelson Harbour.

**It could also be .....**
*Pycnoclavella kottae*


North Atlantic Ocean and Seas

Millar, R.H. (1966) Tunicata. *Ascidiacea Marine invertebrates of Scandinavia*. 1.

Hayward P.J., Ryland, J.S. (1947) Introduction to protozoans and arthropods.
*The marine fauna of the British Isles amd Northwest Europe*. Clarendon Press, Oxford: 627.

# *Didemnum* species complex

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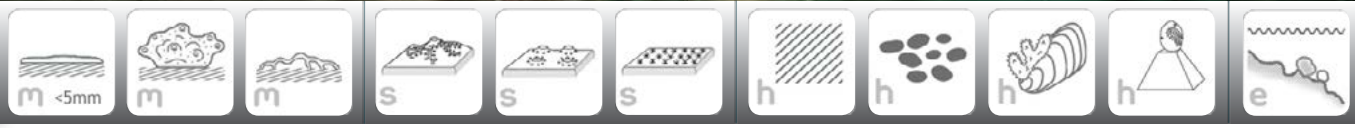
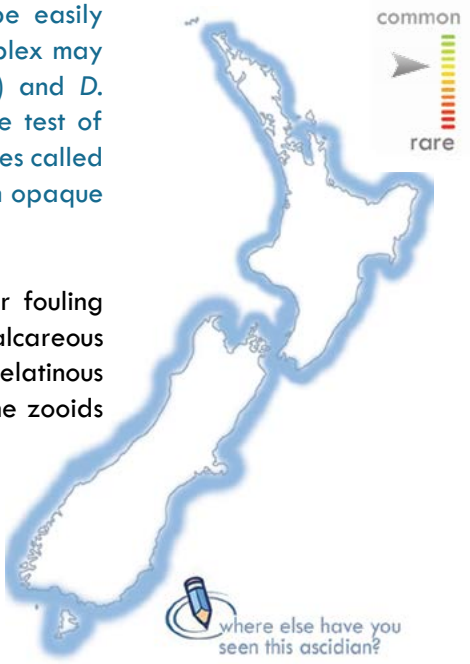




A 'species complex' is a group of closely related species that cannot be easily distinguished in the field due to their physical similarity. Species in the complex may include *Didemnum incanum* (Herdman, 1899), *D. maculatum* (Nott, 1892) and *D. lambitum* (Sluiter, 1900). They often vary by only the smallest details. The test of most species of *Didemnum* is crowded with minute calcite star-shaped structures called spicules. High abundance of spicules can give many species of this genus an opaque appearance.

Colonies can vary greatly in shape from lobate forms overgrowing other fouling organisms to thin encrustations. Test is opaque due to a heavy coating of calcareous spicules. The spicules can be found just in the surface layer of tests with a gelatinous centre, or throughout, giving the colony a very crisp, friable consistency. The zooids are usually small (< 2.0 mm) long and can be very difficult to remove from the surrounding test. There are usually canals or cavities below the surface of the test that connect the zooids to a common water circulation system.

Common fouling boat hulls, undersides of floating structures, marine farm lines, sea cages and wharf piles around New Zealand.




**It could also be .....**
*Didemnum vexillum*
*Lissoclinum notti*
encrusting sponges

Kott, P. (2001) The Australian ascidiacea Part 4: Aplousobranchia (3), Didemnidae. *Memoirs of the Queensland Museum*, *47* (1): 1–410.

# *Didemnum vexillum* Kott, 2001

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m <20mm | s | h | h | h | h | e


The test of most species of *Didemnum* is crowded with minute calcite star-shaped structures called spicules. High abundance of spicules can give many species of this genus an opaque appearance.

Colonies of this species form extensive sheets on vertical surfaces. Cylindrical or frond-like outgrowths can often arise off the main colony. These can form extremely long dripping tendrils, sometimes meters long. Outgrowths of the colony encrust algae, hydrozoans, tube worms and mussels. The colonies are pale yellow to cream coloured and firm yet gelatinous to the touch. Common exhalent openings are obvious at the end of lobes and a fine open network of canals can be seen below the surface. Spicules are sparse throughout most of the test; making it more gelatinous than other *Didemnum* species.

Can be locally abundant, fouling boat hulls, the undersides of floating structures, marine farm lines and sea cages.

**It could also be .....**
*Didemnum* species complex
Encrusting sponges


Northern North Pacific

Kott, P. (2001) The Australian ascidiacea Part 4: Aplousobranchia (3), Didemnidae. *Memoirs of the Queensland Museum*, 47 (1): 1–407.

Kott, P. (2002) A complex didemnid ascidian from Whangamata, New Zealand. *Journal of the marine Biological Association of the United Kingdom*, 82: 625–628.

# *Diplosoma listerianum* (Milne-Edwards, 1841)

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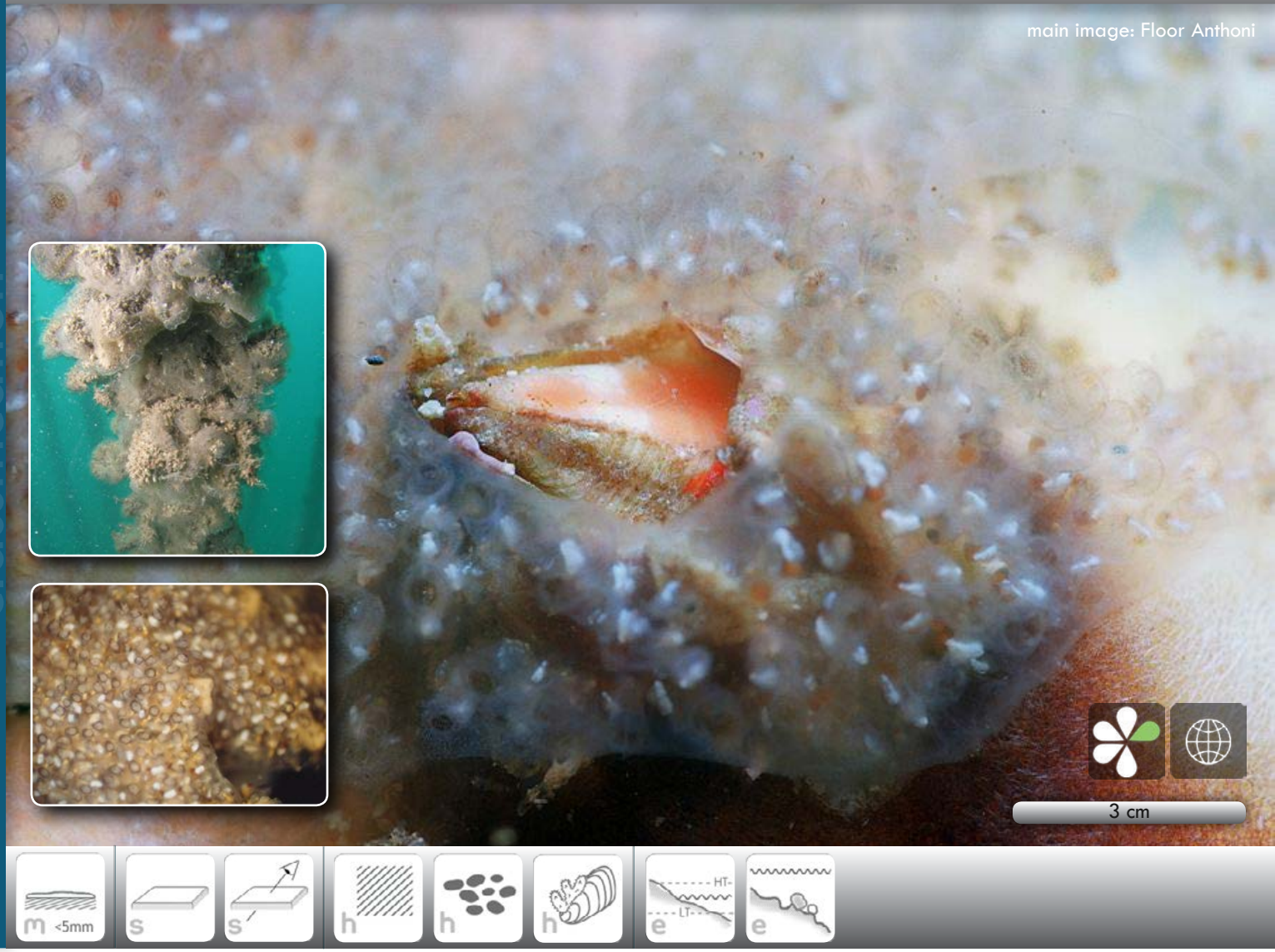
main image: Floor Anthoni








Colony forms extensive thin gelatinous sheets in which individual zooids can be seen as white or grey spots densely crowded around large common exhalent apertures. Test is transparent with small (<2 mm) zooids. Zooids are easily removed from the test by hand, and this species is easily removed from the substratum as a slimy film.

Encrusts a variety of submerged surfaces including shellfish, algae and barnacles.

**It could also be .....**
*Botrylliodes leachii*


Cosmopolitan

Brewin, B.I. (1946) Ascidians in the vicinity of the Portobello Marine Biological Station, Otago Harbour. *Transactions and Proceedings of the Royal Society of New Zealand*, 76 (2): 87–131.

Kott, P. (2001) The Australian ascidiacea Part 4: Aplousobranchia (3), Didemnidae. *Memoirs of the Queensland Museum*, 47 (1): 1–410.

Millar, R.H. (1982) The marine fauna of New Zealand: Ascidiacea. *New Zealand Oceanographic Institute Memoir*, 85: 1–117.

# *Lissoclinum notti* Brewin, 1958

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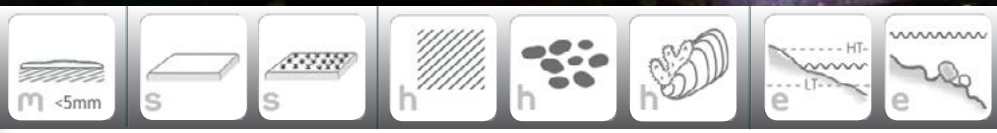



Colonies characteristically very thin, encrusting, <2 mm thick, easily torn and fragile. Zooids are not in marked systems, but there are relatively large, common exhalent apertures evenly distributed throughout the colony or on the apex of lobes formed on encrusted organisms. Spicules are found in 2 layers; at the surface and at the base of the colony, and have distinctive burr-shaped ends. Test is papery and easily torn. Colour in life is opaque cream, brown or violet.

Common on shallow subtidal reefs, wharf piles and aquaculture structures.


**It could also be .....**
*Didemnum* species complex
*Didemnum vexillum*

Western South Pacific

Brewin B.I. (1958) Ascidians of New Zealand. Part 12. Ascidians of the Hauraki Gulf. Part 3. *Transactions and Proceedings of the Royal Society of New Zealand*, 85 (3): 455–458.

# *Hypsistozoa fasmeriana* (Michaelsen, 1924)

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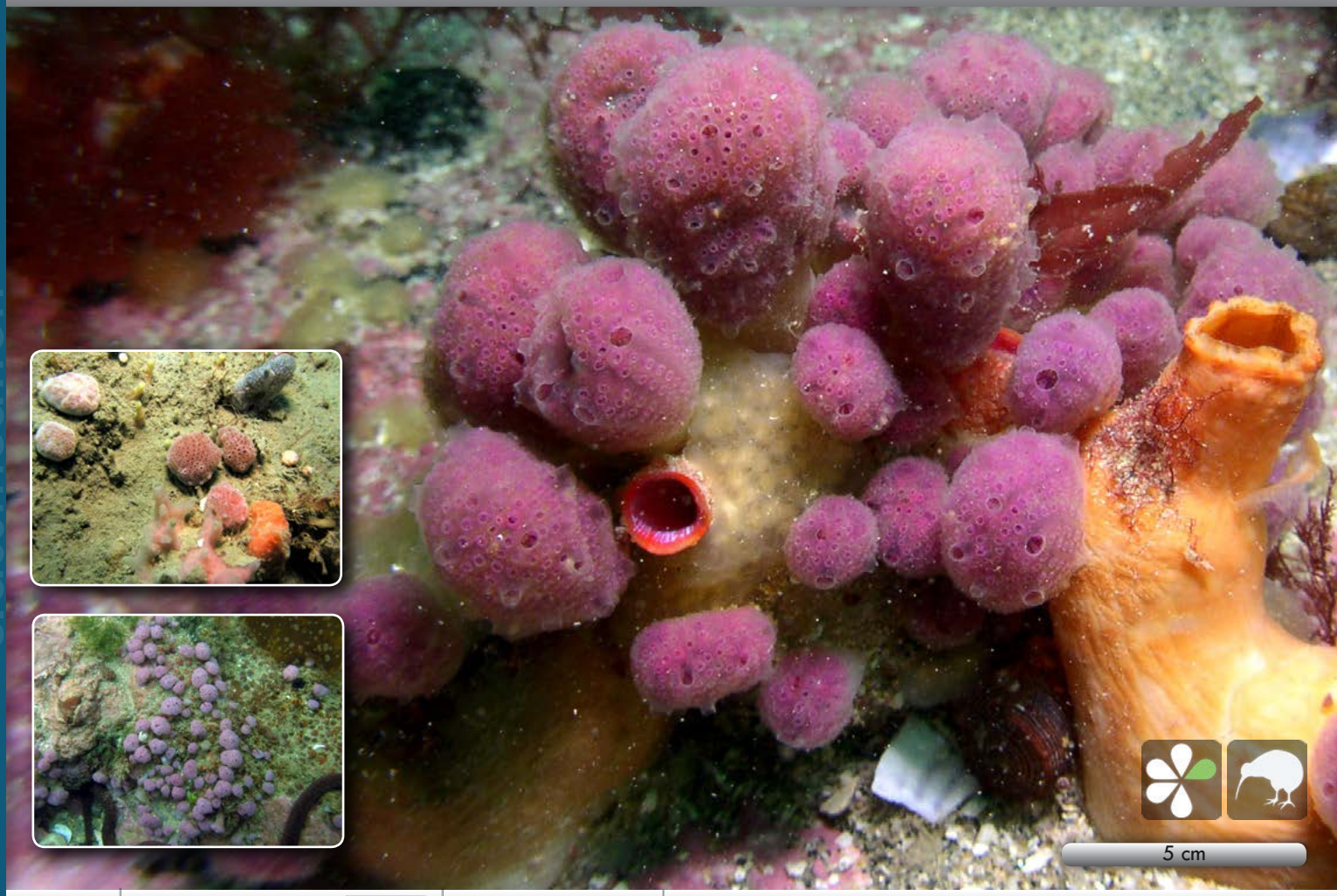
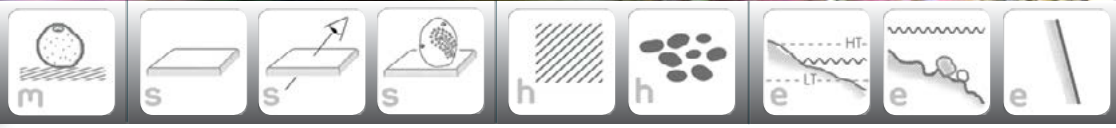




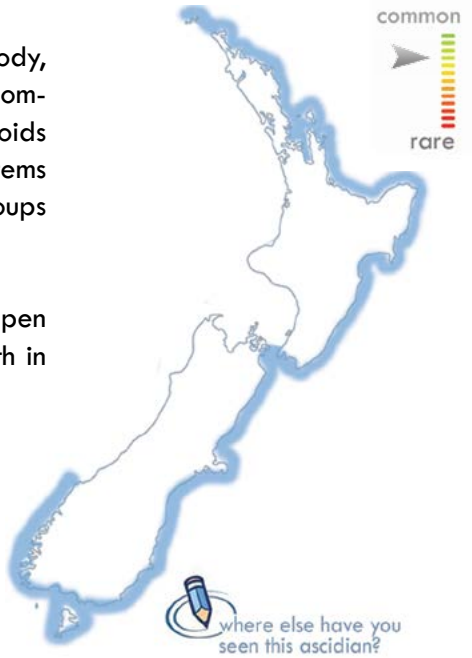




Colony consists of a short fleshy stalk topped with a much larger ovoid body, attached individually to the substrate. Body is often button or mushroom-shaped. Stalks are often not visible. Soft and gelatinous to the touch. Zooids are in parallel systems around numerous large exhalent apertures, systems linear and scattered over the body. Colonies can often occur in patchy groups 20 – 30 cm in diameter. Colour in life is usually fuchsia pink to violet.

Most common in shallow coastal reefs and on artificial structures in open harbours with high tidal flow. Colonies can be found down to 20 m depth in areas of moderate exposure.




**It could also be .....**
*Aplidium benhami*

Brewin, B.I. (1946) Ascidians in the vicinity of the Portobello Marine Biological Station, Otago Harbour. *Transactions and Proceedings of the Royal Society of New Zealand*, 76 (2): 87–131.

Millar, R.H. (1982) The marine fauna of New Zealand: Ascidiacea. *New Zealand Oceanographic Institute Memoir*, 85: 1–117.

# *Eudistoma elongatum* (Herdman, 1886)

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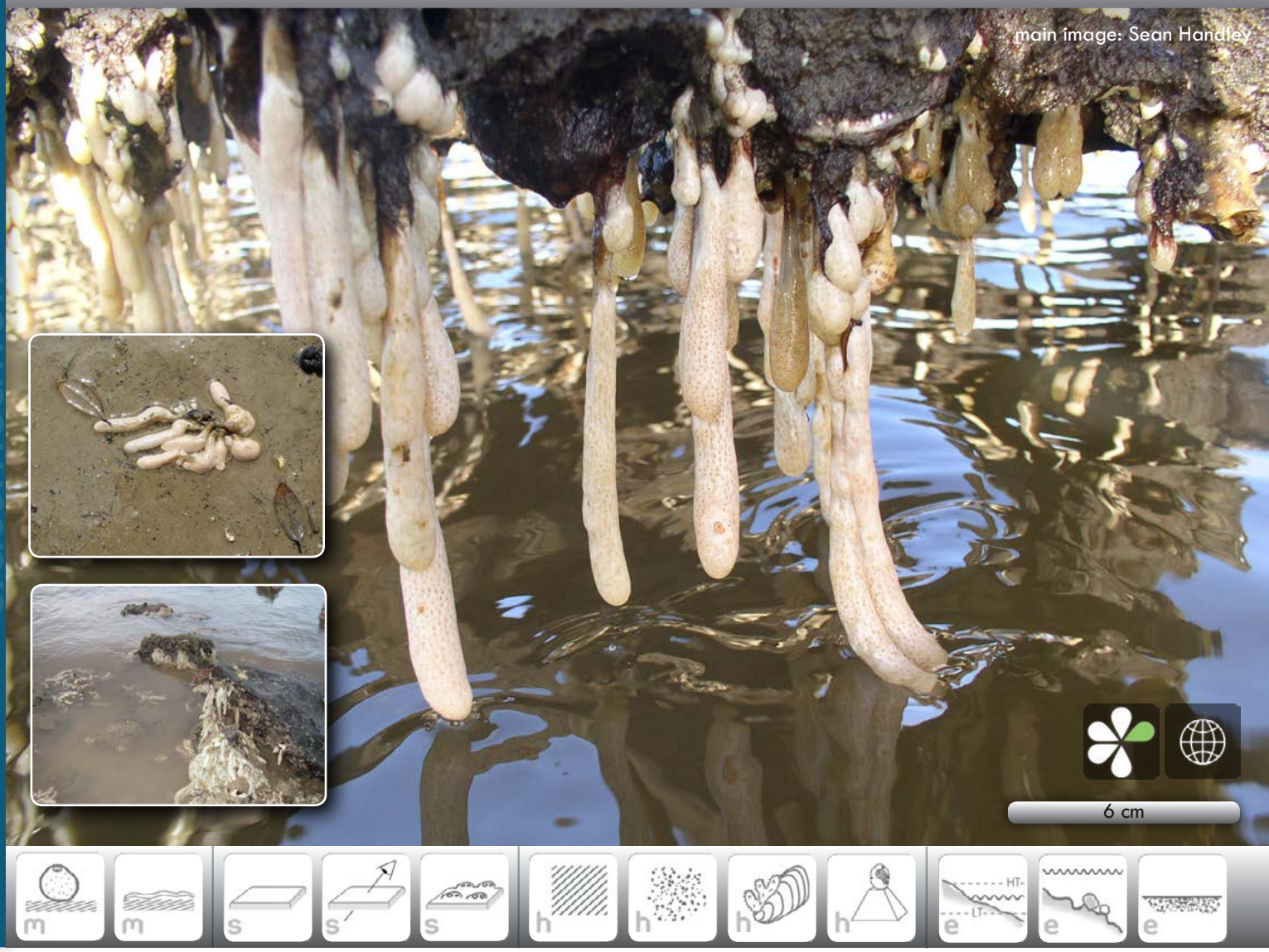
main image: Sean Handley





Long cylindrical pendulous colonies tapering to a smooth stalk, sometimes with short wart-like side processes. Test is smooth and gelatinous to touch, firm overall. Zooids appear as light brown specks, each with two tiny apertures opening separately to the outside. When reproductive, the zooids become orange with developing embryos. Colonies regress and over-winter as small (c. 10 mm) cream buds, re-growing the following spring to larger colonies.

Species occur locally in high abundance in sheltered bays, growing on oyster racks, mangrove roots, rocky shoreline and on shells embedded in mud. Restricted at present to the far north of the North Island.


Australia

Kott, P. (1990) The Australian Ascidiacea, Part 2, Aplousobranhia (1). *Memoirs of the Queensland Museum*, 29 (1): 1–226.

# *Aplidium phortax* (Michaelson, 1924)

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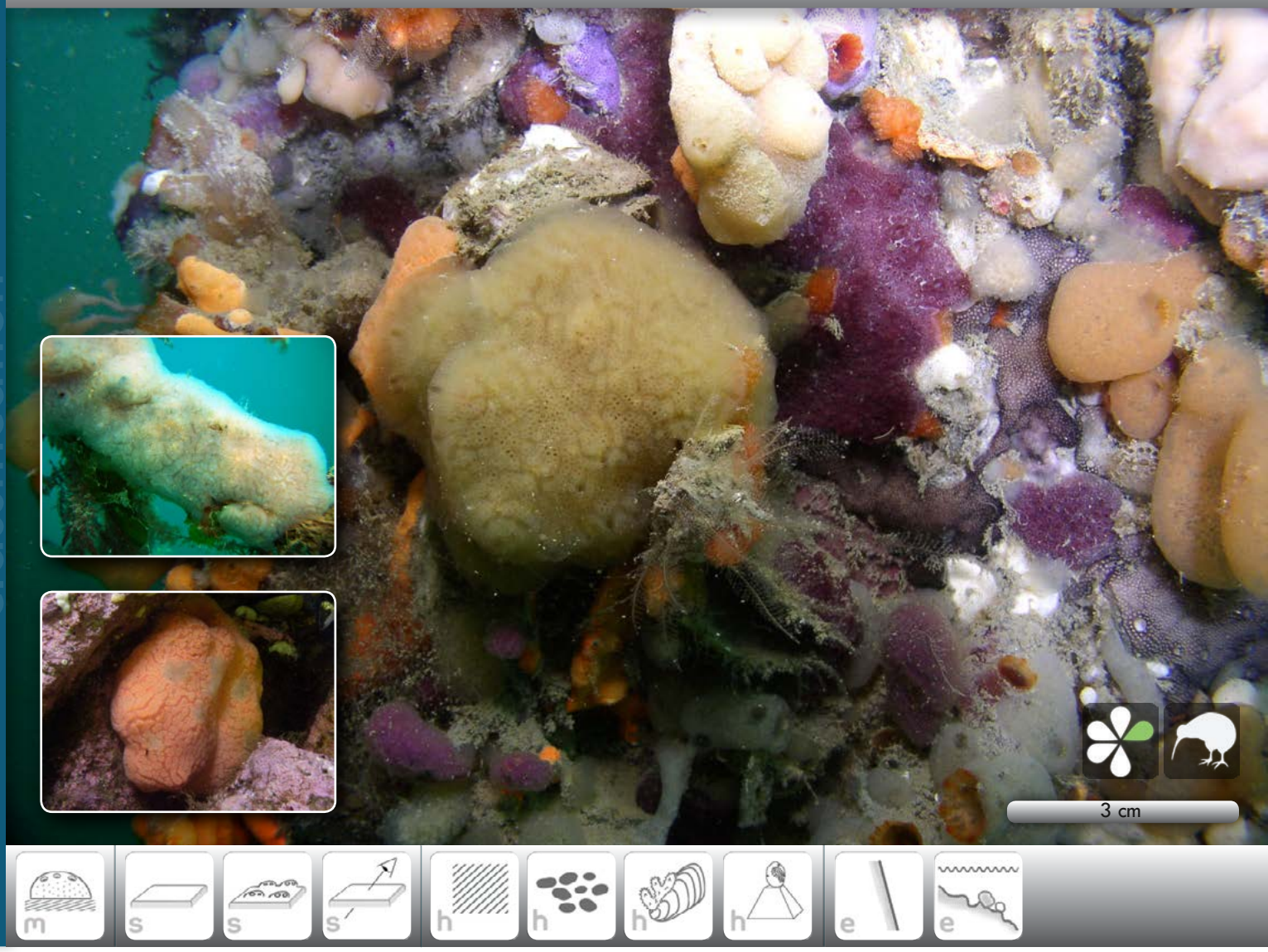




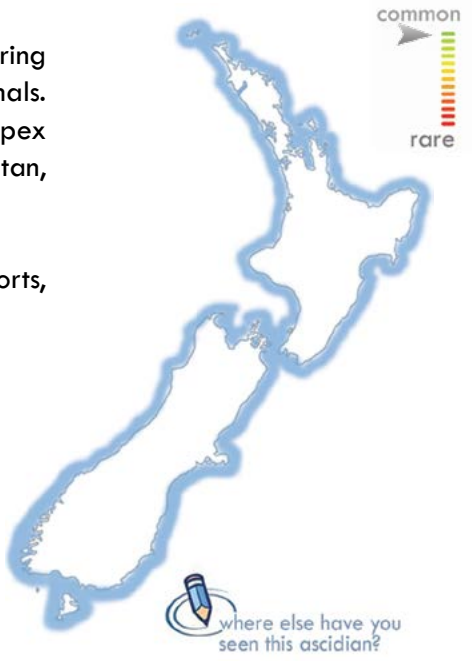







Large spherical, fleshy, firm, gelatinous colonies. Zooids form meandering double-rowed, at times branching systems, along obvious subsurface canals. Common exhalent apertures are indistinct, but are often situated on the apex of lobes on the colony. Colour in life varies from translucent cream, to light tan, to pink.

Very common species fouling wharf piles and aquaculture structures in ports, bays, and harbours.




**It could also be .....**
*Aplidium powelli*

Brewin, B.I. (1946) Ascidians in the vicinity of the Portobello Marine Biological Station, Otago Harbour. *Transactions and Proceedings of the Royal Society of New Zealand*, 76 (2): 87–131.

Millar R.H. (1982) The marine fauna of New Zealand: Ascidiacea. *New Zealand Oceanographic Institute Memoir*, 85: 1–117.

# *Ascidiella aspersa* (Müller, 1776)

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Class Ascidiacea Order Phlebobranchia Family Ascidiidae

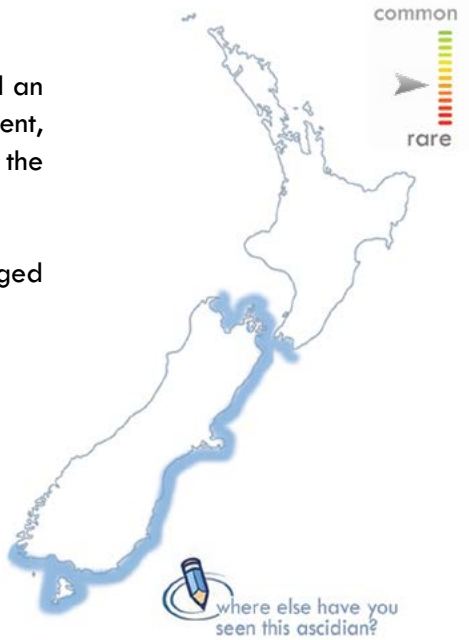
main image: Dennis Gordon
inset image: Arjan Gittenberger

2 cm



Sack-like ovoid body with an inhalant siphon at the top of the animal, and an exhalent siphon one third to halfway down one side. Test is thin, translucent, and covered in small bumps. The gill slits are elongate, and not folded, the tentacles are smooth.

This species is found on shallow subtidal rock, wharf piles and submerged structures, in both marine and estuarine environments of the South Island.




**It could also be .....**
*Corella eumyota*

Cosmopolitan

Brewin, B.I. (1946) Ascidians in the vicinity of the Portobello Marine Biological Station, Otago Harbour. *Transactions and Proceedings of the Royal Society of New Zealand*, 76 (2): 87–131.

Kott, P. (1985) The Australian Ascidiacea 1. Phlebobranchia and Stolidobranchia. *Memoirs of the Queensland Museum*, 23: 440.

Millar R.H. (1982) The marine fauna of New Zealand: Ascidiacea. *New Zealand Oceanographic Institute Memoir*, 85: 1–117.

# *Ciona intestinalis* (Linnaeus, 1767)

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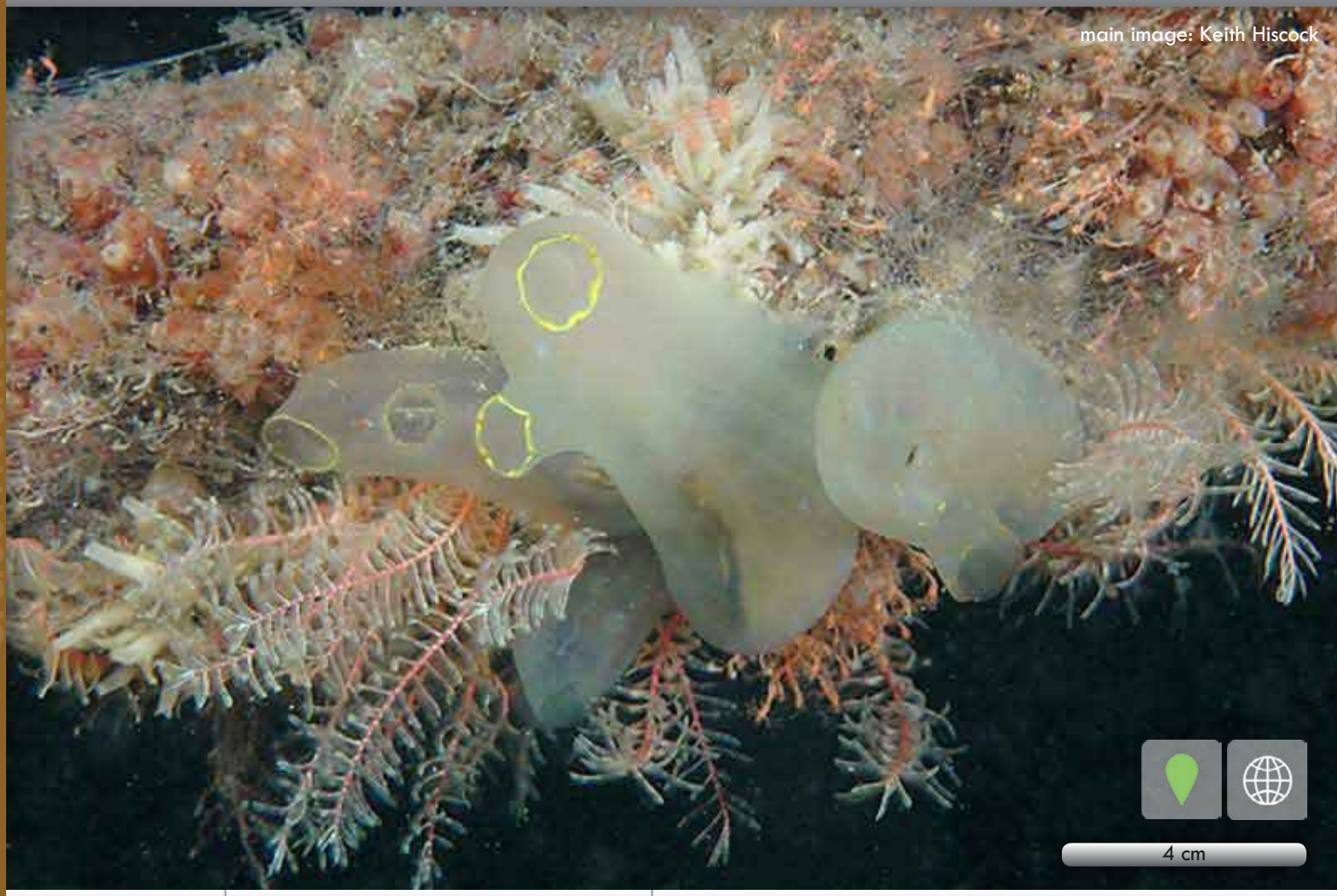


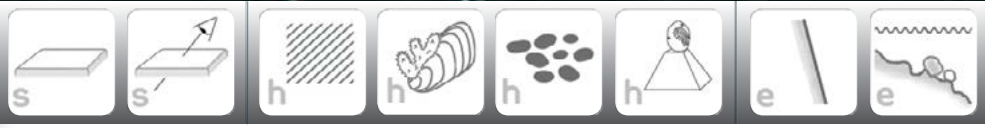



Two species of *Ciona* are known to co-occur in New Zealand ports and harbours. *Ciona intestinalis* has lemon yellow pigment spots on the siphon rim while *Ciona savigny* has orange pigment spots on the siphon rim.

Body elongate, tapering towards two closely spaced siphons. Test is soft, flexible, gelatinous, transparent, with light green pigment at the anterior end, and lemon yellow pigment spots on siphon rim. Gill slits are elongate, not folded, and tentacles are smooth. Six broad longitudinal muscle bands are found on each side of the body wall.

Often found in high abundance on aquaculture structures, wharf piles and pontoons around New Zealand.


**It could also be .....**
*Ciona savigny*

Cosmopolitan

Brewin B.I. (1950) Ascidians of New Zealand. Part IV. Ascidians in the vicinity of Christchurch. *Transactions and Proceedings of the Royal Society of New Zealand*, 78 (2-3): 344–353.

# *Ciona savigny* Herdman, 1882

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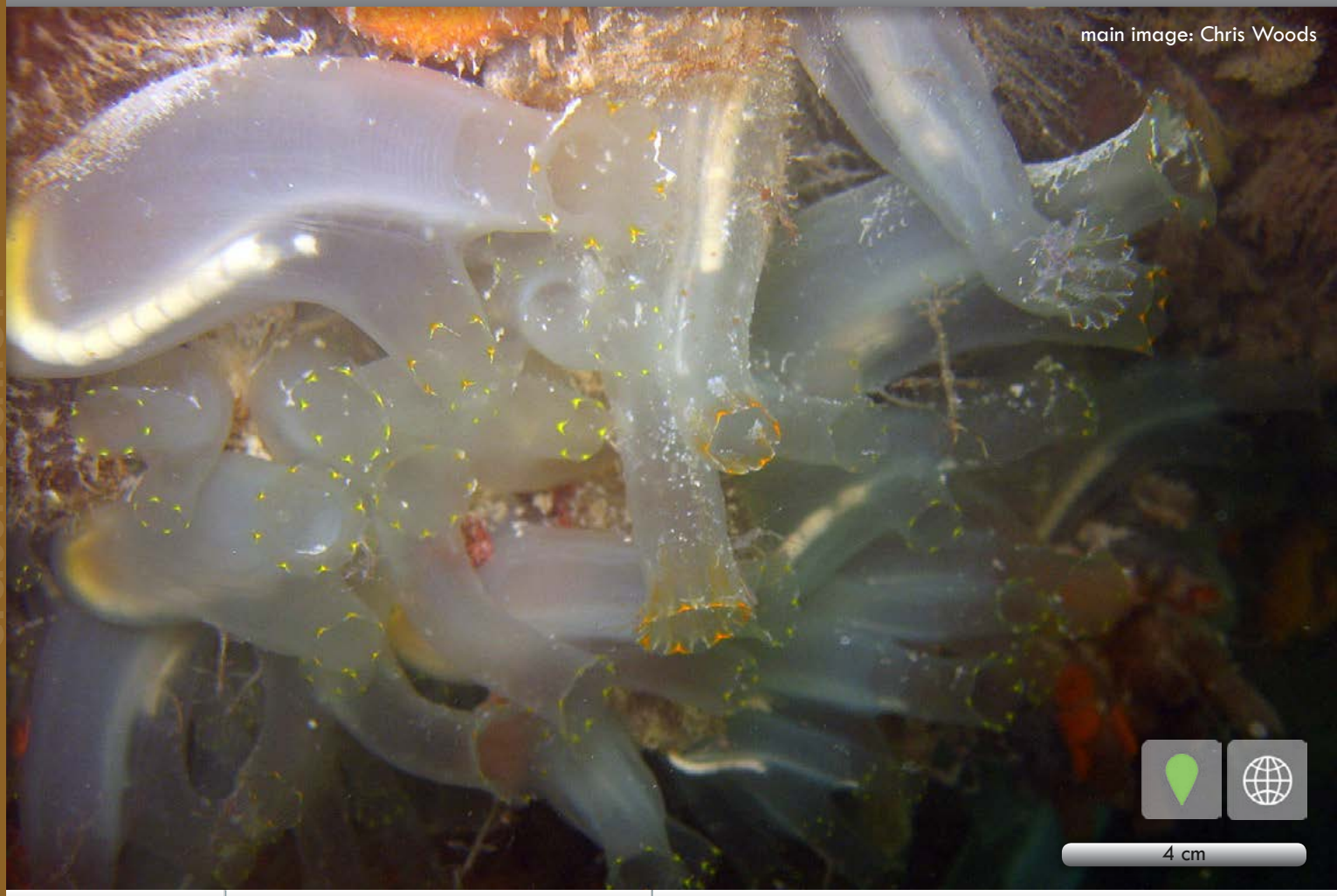


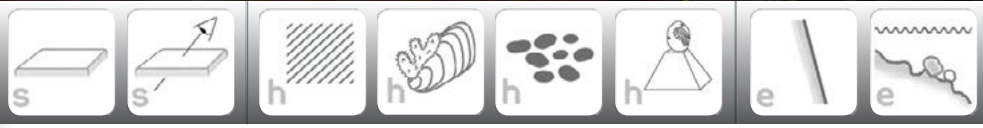



Two species of *Ciona* are known to co-occur in New Zealand ports and harbours. *Ciona intestinalis* has lemon yellow pigment spots on the siphon rim while *Ciona savigny* has orange pigment spots on the siphon rim.

Body elongate, tapering towards two closely spaced siphons. Test is soft, flexible, gelatinous, transparent, with light green pigment at the anterior end, and orange pigment spots on siphon rim, and yellow or white pigment flecks on the body wall. Gill slits are elongate, not folded, and tentacles are smooth. Six broad longitudinal muscle bands are found on each side of the body wall.

Often found in high abundance on aquaculture structures, wharf piles and pontoons around New Zealand.

**It could also be .....**
*Ciona intestinalis*


North Pacific

Brewin B.I. (1950) Ascidians of New Zealand. Part IV. Ascidians in the vicinity of Christchurch. *Transactions and Proceedings of the Royal Society of New Zealand*, 78 (2-3): 344–353.

Herdman, W.A. (1882) Report on the Tunicata collected during the voyage of H.M.S. Challenger during the years 1873–1876, Part 1, Ascidiae simplices. *Zoology of the Challenger Expedition*, 6 (17): 1–296.

# *Corella eumyota* Traustedt, 1882

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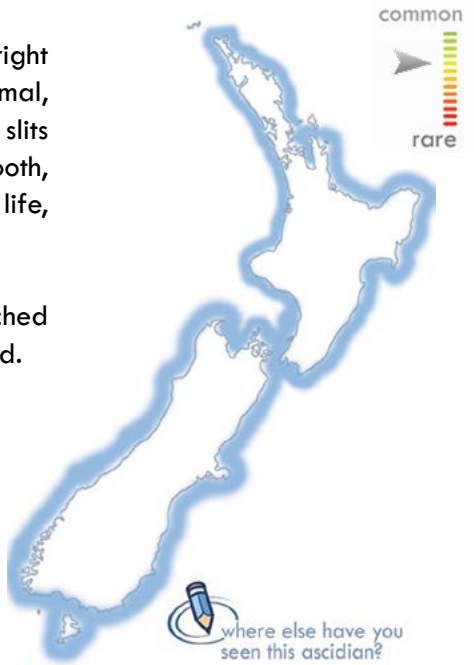
main image: Judith Oakley
inset image: Natural History Museum, UK






Body oval to elongate, laterally compressed, attached to the substrate on right side, individuals are often found in groups. Inhalant siphon at top of animal, smaller exhalent siphon ⅓ of the way down the side of the body. Gill slits spiral, gills not folded, and oral tentacles smooth. Test transparent, smooth, cartilaginous. Gut and gonads often visible through the test. Colourless in life, but some have bright peach inhalant siphons.

Prefers calm protected waters, found in shallow subtidal environments attached to wharf piles, ropes and other submerged structures around New Zealand.




**It could also be .....**
*Ascidiella aspersa*
*Molgula spp.*

Cosmopolitan

Millar, R.H. (1962) Further descriptions of South African ascidians.
*Annals of the South African Museum*, 46 (7): 113–221.

# *Botrylloides leachii* (Savigny, 1816)

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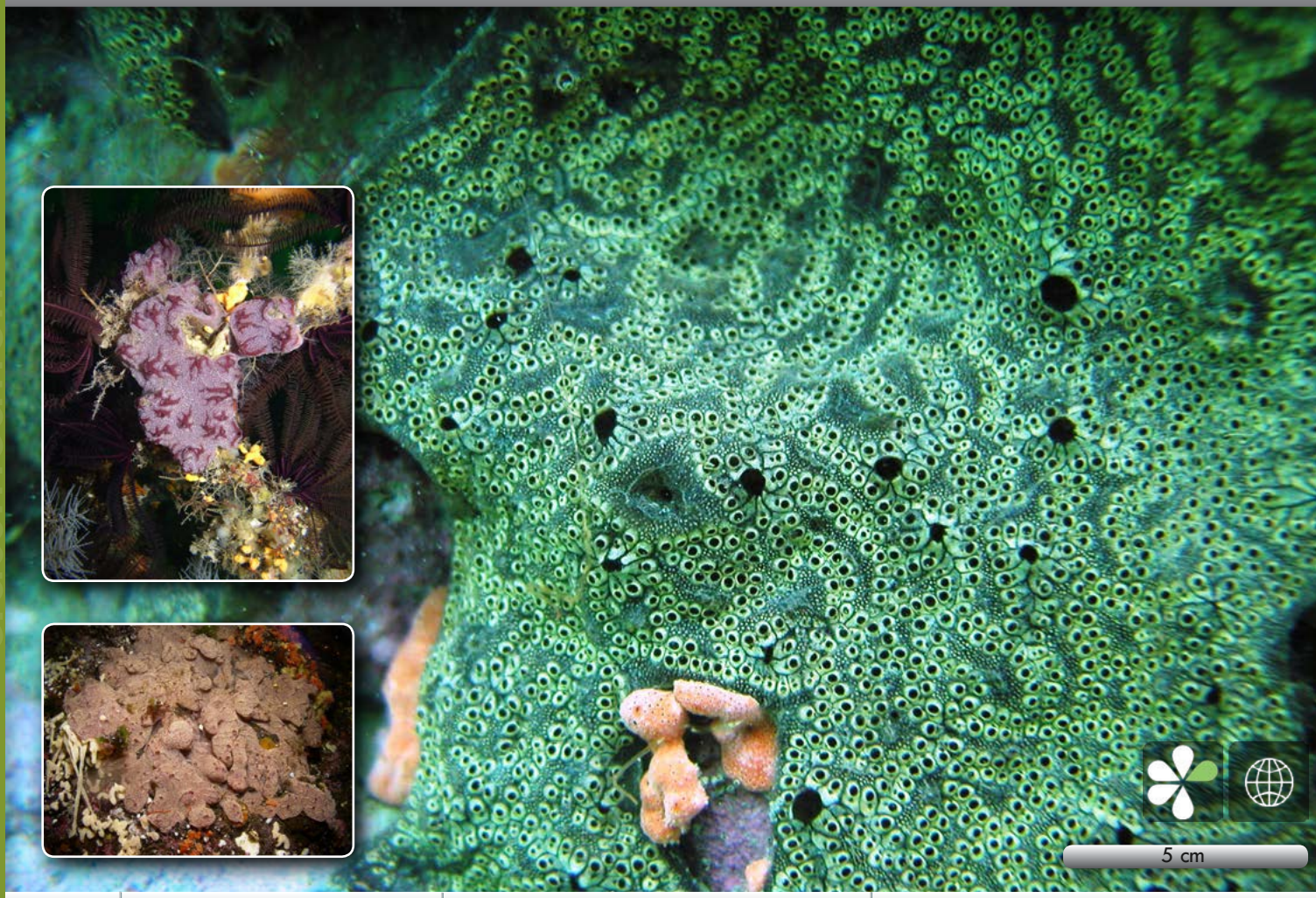
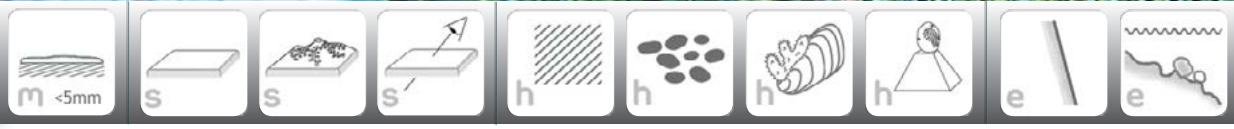
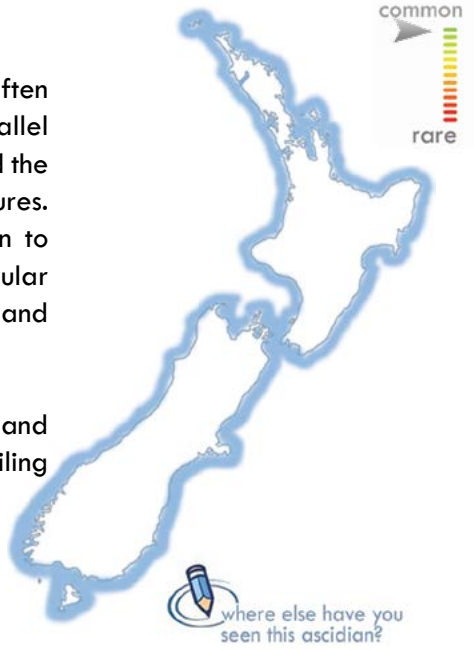




Colonies are encrusting, about 3-5 mm thick and up to 20 cm diameter, often overgrowing other species, giving colonies a lobate appearance. Parallel systems of zooids are usually obvious because of light pigmentation around the inhalant apertures. Systems connect to numerous common exhalent apertures. Colour in life is highly variable, ranging from typically purple to green to orange and cream. The test is transparent, soft and gelatinous. Small granular bodies are visible near the surface of the test between the zooid systems and the border of the colony.

Encrusts moorings, jetties and wharf piles, and is very common in ports and harbours throughout New Zealand. May have been introduced by early sailing ships.




**It could also be .....**
*Botryllus schlosseri*

North Atlantic Ocean and Seas

Brewin B.I. (1946) Ascidians in the vicinity of the Portobello Marine Biological Station, Otago Harbour. *Transactions and Proceedings of the Royal Society of New Zealand*, 76 (2): 87–131.

Kott P. (1985) The Australian Ascidiacea 1. Phlebobranchia and Stolidobranchia. *Memoirs of the Queensland Museum*, 23: 440.

Millar R.H. (1982) The marine fauna of New Zealand: Ascidiacea. *New Zealand Oceanographic Institute Memoir*, 85: 1–117.

# *Botryllus schlosseri* (Pallas, 1766)

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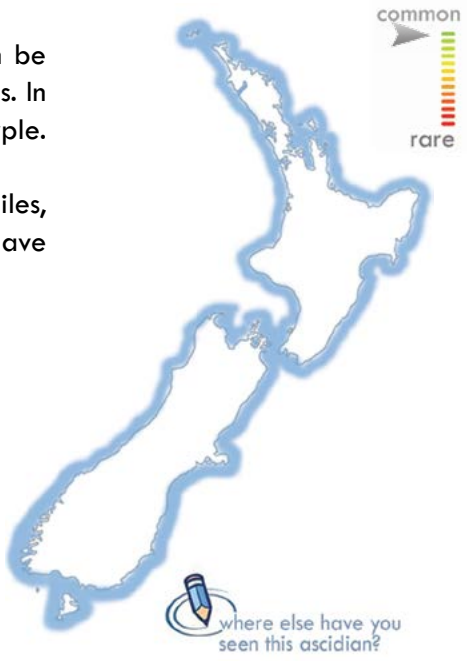
main image: Chris Woods






Colonies 3 mm thick, often co-occurring with *Botrylloides leachii*, but can be distinguished by circular zooid systems around common exhalent apertures. In life, colonies can vary widely in colour, but are usually orange, green or purple.

Encrusts moorings, jetties, undersides of mooring pontoons, and wharf piles, and is very common in ports and harbours throughout New Zealand. May have been introduced by early sailing ships.




**It could also be .....**
*Botrylloides leachii*

Cosmopolitan

Kott P. (1985) The Australian Ascidiacea 1. Phlebobranchia and Stolidobranchia. *Memoirs of the Queensland Museum*, 23: 440.

# *Botryllus tuberatus* Ritter & Forsyth, 1917

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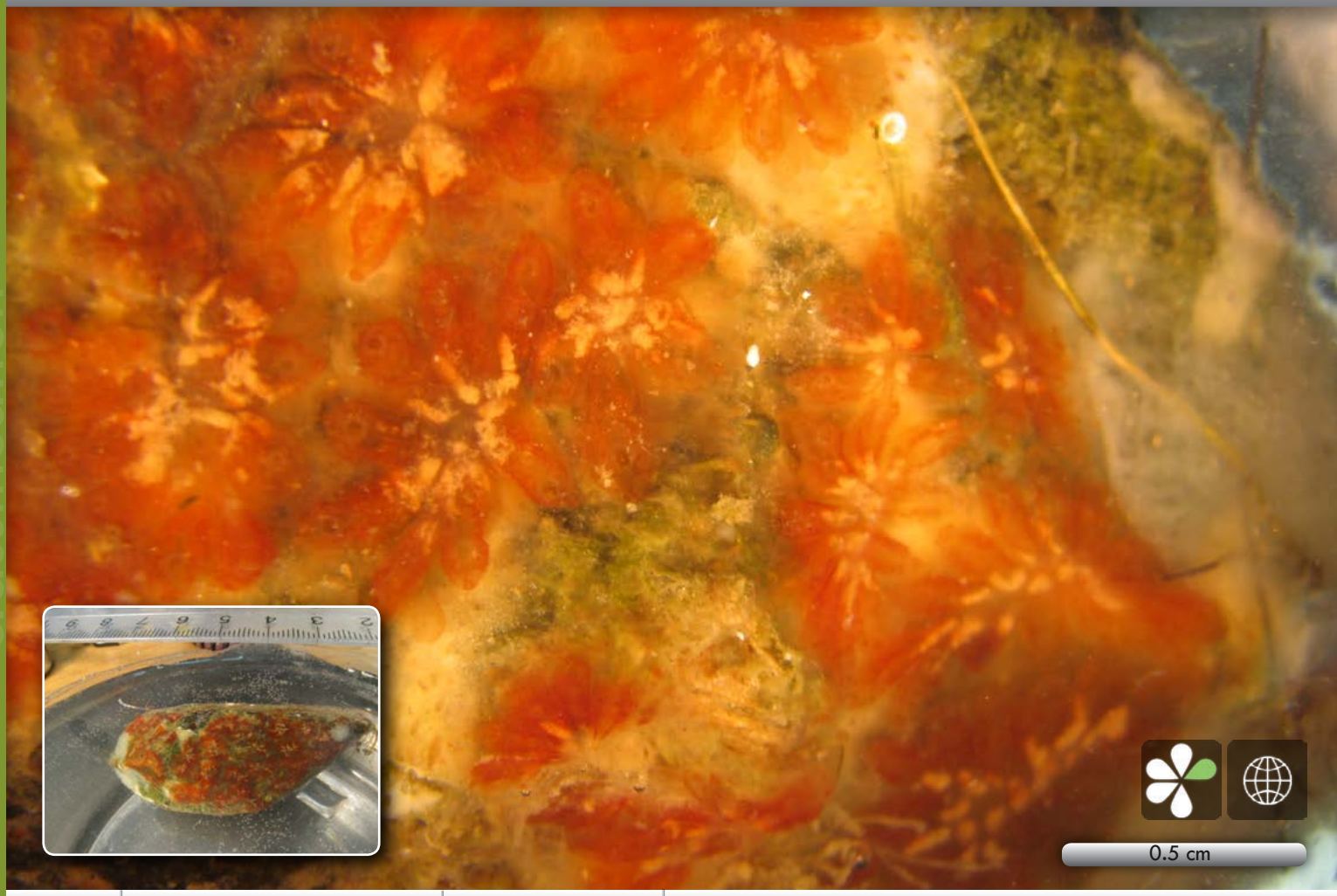






Colonies are small, delicate, very thin and transparent. Bright orange zooids are arranged in widely spaced circular systems, giving the colony a flower-shaped appearance. Colour in life brilliant orange and cream in a transparent test.

This species typically encrusts other organisms such as mussels and oysters in intertidal and shallow subtidal environments around Wellington south coast and Nelson harbour.


**It could also be .....**
*Botryllus schlosseri*

Circum equitorial

Kott P. (1985) The Australian Ascidiacea 1. Phlebobranchia and Stolidobranchia. *Memoirs of the Queensland Museum*, 23: 440.

# *Molgula manhattensis* (De Kay, 1843)

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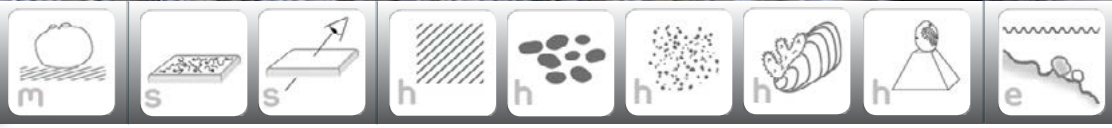
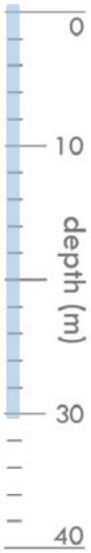
main image: Keith Hiscock
inset image: Misjel Declee

4 cm




Body small, spherical to oval, inhalant and exhalent siphons relatively long and close together on the upper surface. Test semi-translucent and relatively tough, looks like cellophane. Gill slits spiral, gills folded, and oral tentacles branched. Sediment adheres to short hairs on the surface of the test; hairs are usually longer at the base, forming root-like processes. Colour in life translucent to cream.

Tolerant of high sediment and low salinity. May occur in large aggregations on the seafloor. Presently restricted to the Manukau Harbour.


**It could also be .....**
*Molgula mortenseni*

Cosmopolitan

Kott, P. (1985) The Australian Ascidiacea I. Phlebobranchia and Stolidobranchia. *Memoirs of the Queensland Museum*, 23: 440.

# *Molgula mortenseni* (Michaelsen, 1922)

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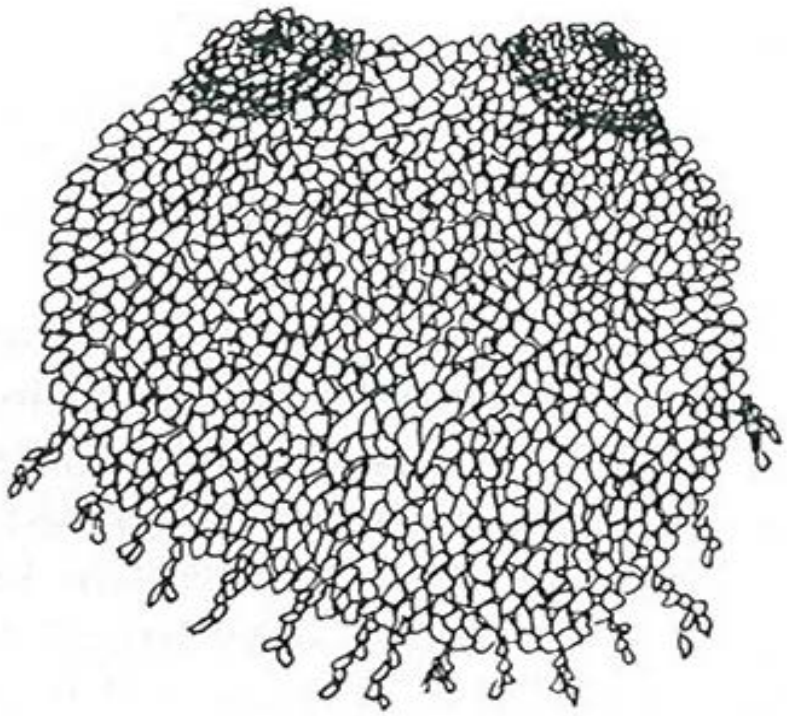
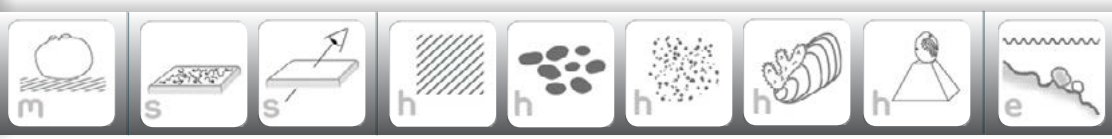
illustration sources from: Brewin (1951)



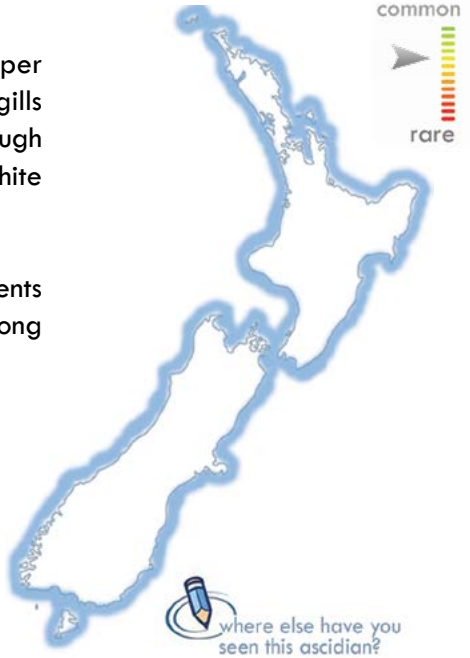
0.5 cm





Body ovoid to globular, 1–2 cm diameter, apertures close together on upper surface, test thin, flexible, coated with fine sand grains. Gill slits spiral, gills folded, and tentacles branched. A kidney can often be seen clearly through the body wall. Colour in life that of adherent sand, otherwise translucent white to cream.

Can be found in aggregations of individuals in high sediment environments such as harbour seabeds around New Zealand. Often epizoic, living among shells and other large solitary ascidians.




**It could also be .....**
*Molgula manhattensis*

South West Pacific Ocean

Brewin, B.I. (1951) Ascidians of New Zealand. Part 6. Ascidians of the Hauraki Gulf. Part 2. *Transactions and Proceedings of the Royal Society of New Zealand*, 79 (1): 104–113.

Kott, P. (1985) The Australian Ascidiacea I. Phlebobranchia and Stolidobranchia. *Memoirs of the Queensland Museum*, 23: 440.

# *Microcosmus squamiger* Michaelsen, 1927

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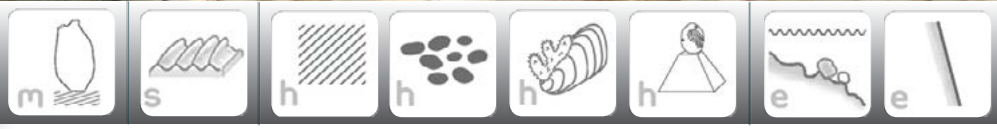
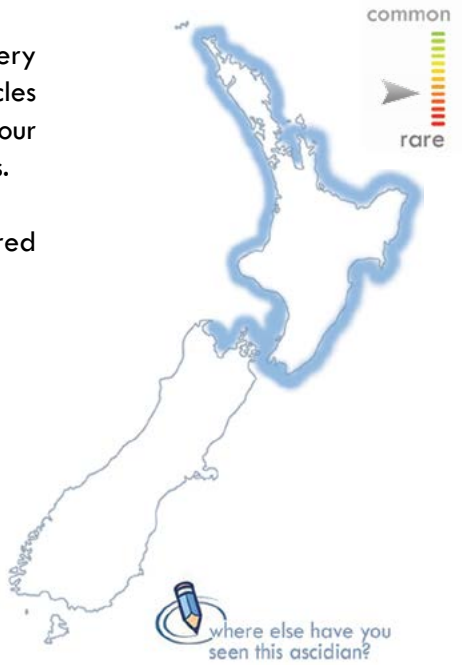
main image: Charles Griffiths



Body elongate to oval, apertures on short wart-like siphons. Test leathery and tough, at times hard and occasionally brittle. Gill slits simple, tentacles branched, left gonad crosses over the descending limb of the gut loop. Colour in life orange with maroon on wrinkles, orange and maroon-striped siphons.

Usually occurs in large aggregates on rock, concrete and cave walls in sheltered and exposed locations, predominantly around northern New Zealand.




**It could also be .....**
*Pyura* species complex
juvenile *Cnemidocarpa nisiotus*

Cosmopolitan

Kott, P. (1985) The Australian Ascidiacea I. Phlebobranchia and Stolidobranchia.
*Memoirs of the Queensland Museum*, 23: 440.

# *Pyura pachydermatina* (Herdman, 1881)

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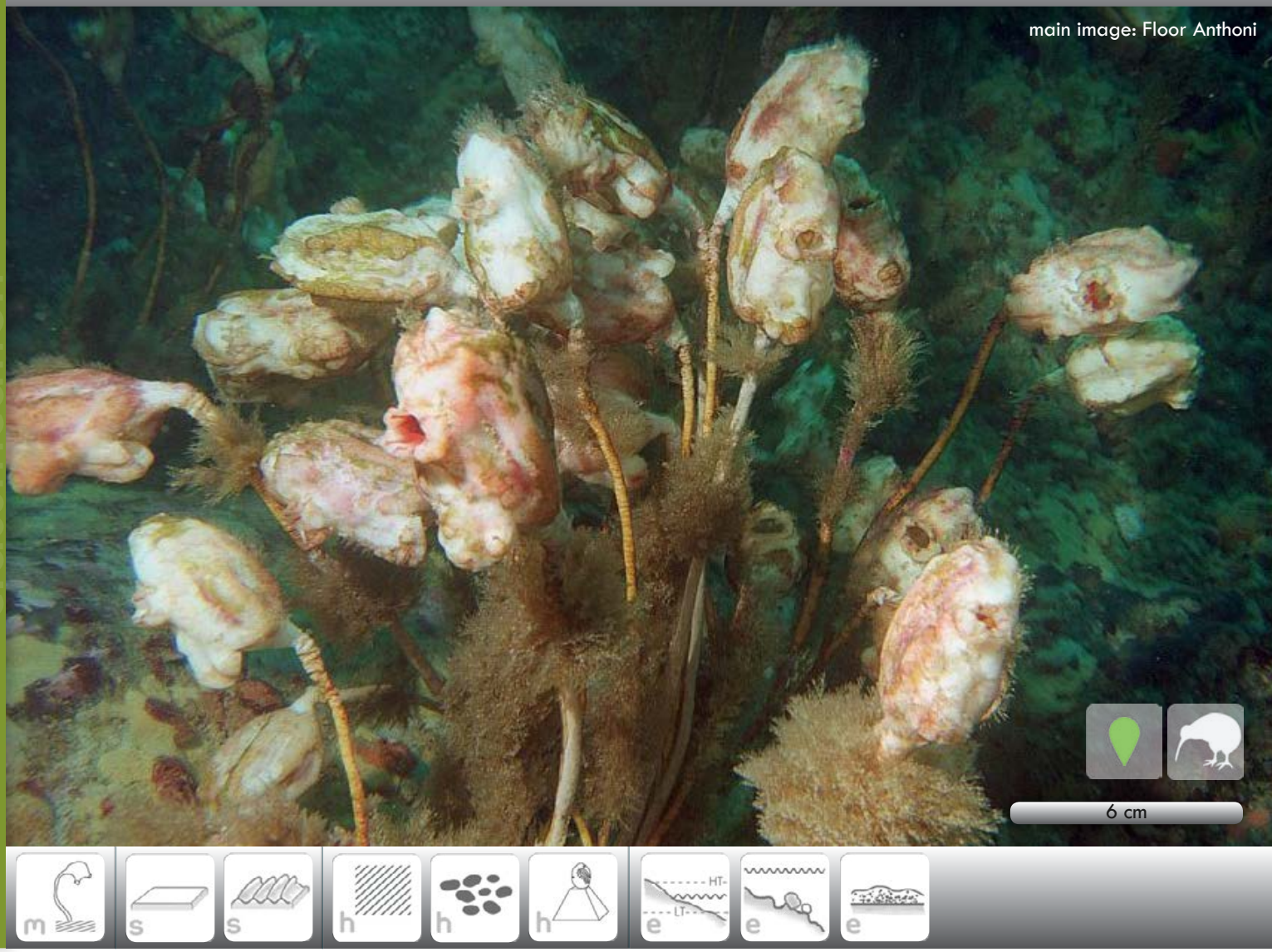
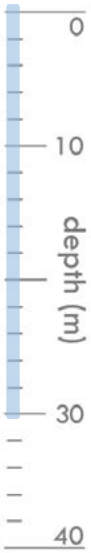
main image: Floor Anthoni










The 'sea tulip' is easily distinguished by its long leathery stalk and bulbous head. Stalks generally smooth or horizontally wrinkled, never longitudinally wrinkled. Large inhalant and exhalent siphons are obvious at the top of head. Surface of the head smooth, thrown into thick undulating longitudinal ridges that are more pronounced in smaller individuals. Gill slits elongate, gills folded, tentacles branched, gonads in paired blocks on each side of the body. Colour in life cream, tinged with maroon along longitudinal ridges and in siphons.

Sea tulips grow in high energy environments in southern New Zealand on the open coast, and in harbours with high tidal flow. In optimal conditions they can form dense forests on the sea floor from the intertidal down to greater than 30 m.

**It could also be .....**
*Styela clava*


Brewin, B.I. (1946) Ascidians in the vicinity of the Portobello Marine Biological Station, Otago Harbour. *Transactions and Proceedings of the Royal Society of New Zealand*, 76 (2): 87–131.

Millar, R.H. (1982) The marine fauna of New Zealand: Ascidiacea. *New Zealand Oceanographic Institute Memoir*, 85: 1–117.

# *Pyura doppelgangera* Rius & Teske, 2013

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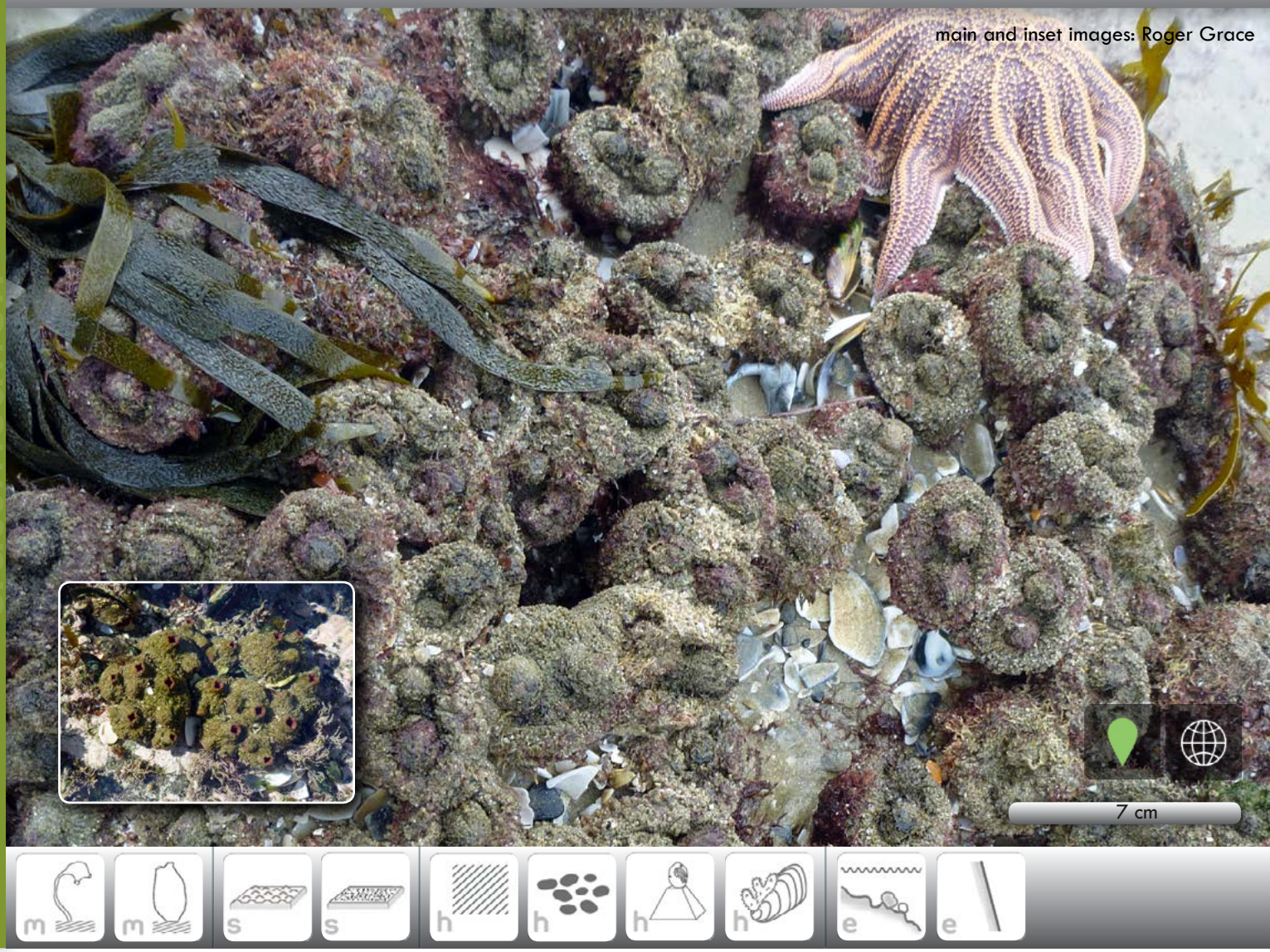
main and inset images: Roger Grace








Large, solitary, stumpy, chalice-shaped ascidian with two large mounds representing siphons set in the depressed upper surface of the body. Test tough, thick, cartilaginous, coated with sand and algal filaments. When inflated, cruciform or cross-shaped siphons are visible by the bright reddish orange body wall visible from exterior. Gill slits elongate, gills folded, tentacles branched. Colour in life is that of the sandy, encrusted test, may be quite green, siphons are bright reddish orange.

Individuals can be very large and often form dense aggregates on intertidal platforms, sometimes occupying 100% cover. May be found subtidally down to 12 m. Restricted at present to the Far North.


**It could also be .....**
*Pyura praeputialis*

Australasia

Rius, M., Teske, P.R. (2013) Cryptic diversity in coastal Australasia: a morphological and mitonuclear genetic analysis of habitat-forming sibling species. *Zoological Journal of the Linnean Society*, 168: 597-611.

# *Pyura* species complex

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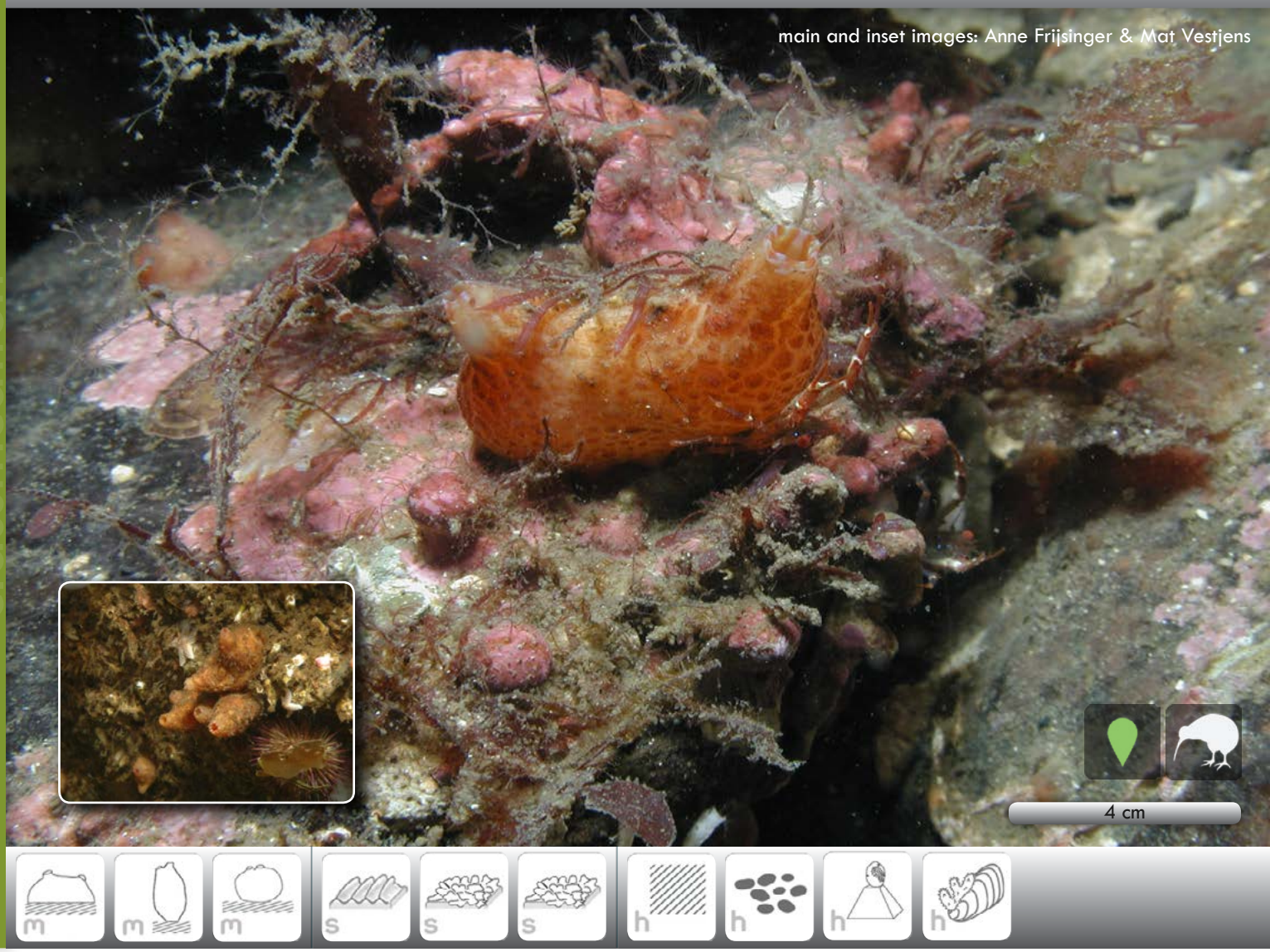





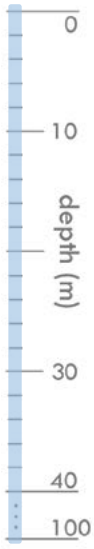


A 'species complex' is a group of closely related species that cannot be easily distinguished in the field due to their physical similarity. They often vary by only the smallest details. Species in the complex include *P. rugata* Brewin, 1948, *P. subuculata* (Sluiter, 1900) and *P. cancellata* Brewin, 1946.

Body elongate, oval to banana-shaped with long muscular siphons set reasonably close together or at either end of the body. Test tough, leathery, deeply furrowed, warty, finely wrinkled. Gill slits elongate, gills folded, tentacles branched. A long gonad on each side of the body wall may be arranged in paired blocks. Colour in life pale peach with darker burnt orange on raised sections of test. Siphons are often pigmented with deep purple, and siphon rim striped white or peach.

Found growing on the seabed attached to shell debris and fouling wharf piles around New Zealand.


**It could also be……**
*Cnemidocarpa nisiotus*
*Microcosmus squamiger*

Brewin, B.I. (1946) Ascidians in the vicinity of the Portobello Marine Biological Station, Otago Harbour. *Transactions and Proceedings of the Royal Society of New Zealand*, 76 (2): 87–131.

Millar, R.H. (1982) The marine fauna of New Zealand: Ascidiacea. *New Zealand Oceanographic Institute Memoir*, 85: 1–117.

# *Asterocarpa humilis* (Heller, 1878)

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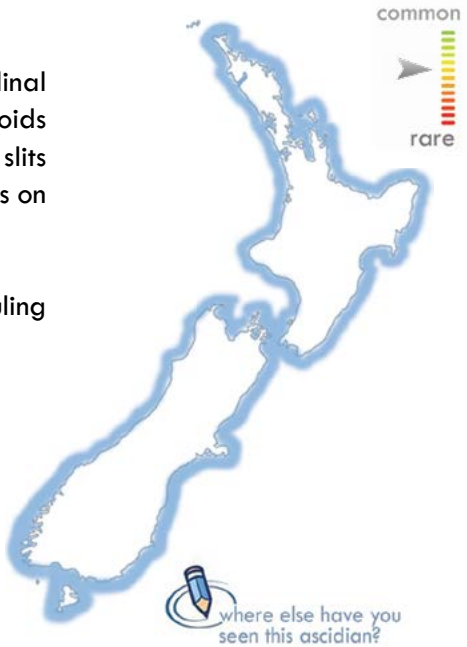
main image: Dirk Schories






Body globular with maroon siphons which have eight white internal longitudinal bands. The test is smooth and flexible, at times encrusted with sponges, hydroids and algae, and is translucent and usually grey to buff-coloured. The gill slits are elongate, tentacles smooth, and gonads appear in star-shaped clusters on either side of the body wall.

The species occurs in the subtidal under boulders, on wharf piles and fouling bivalves around New Zealand.




Tasmania / Indo-Pacific

Brewin B.I. (1946) Ascidians in the vicinity of the Portobello Marine Biological Station, Otago Harbour. *Transactions and Proceedings of the Royal Society of New Zealand*, 76 (2): 87–131.

Kott P. (1992) The Australian ascidiacea 3. Aplousobranchia (2). *Memoirs of the Queensland Museum*, 32 (2): 375–620.

Millar R.H. (1982) The marine fauna of New Zealand: Ascidiacea. *New Zealand Oceanographic Institute Memoir*, 85: 1–117.

# *Cnemidocarpa bicornuta* (Sluiter, 1900)

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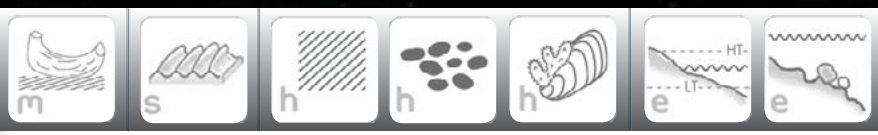
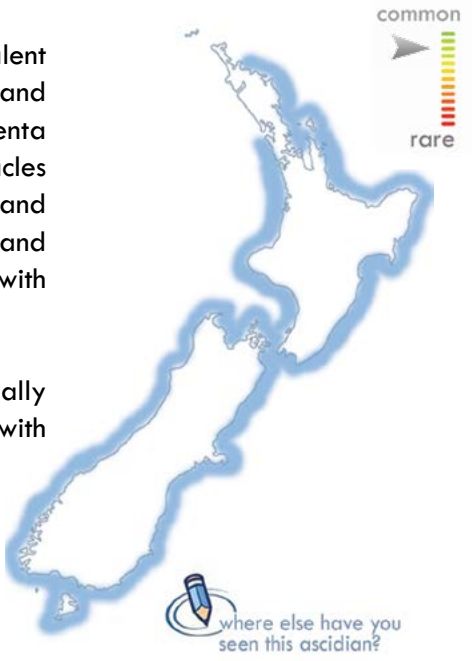




Banana-shaped with the inhalant siphon usually at the top, and the exhalent siphon nearer to the base. Siphons are separated by a distinctive saddle, and are covered in warty processes. Characterised by four bands of magenta pigment on the orange siphon lining. Gill slits are elongate, folded, tentacles are smooth. Gonads attached to the body wall under the gill sac are long and tubular, sometimes bent backwards at their terminal end. Test leathery and longitudinally wrinkled. Colour in life light orange to cream. Often fouled with hydrozoans, bryozoans and filamentous algae.

Very common in ports, harbours, and coastal environments. May be locally abundant on shallow reefs and wharf piles. Generally co-occurs with *Cnemidocarpa nisiotus*.




**It could also be .....**
*Cnemidocarpa nisiotus*

Brewin B.I. (1946) Ascidians in the vicinity of the Portobello Marine Biological Station, Otago Harbour. *Transactions and Proceedings of the Royal Society of New Zealand*, 76(2): 87–131.

Millar, R.H. (1982) The marine fauna of New Zealand: Ascidiacea. *New Zealand Oceanographic Institute Memoir*, 85: 1–117.

# *Cnemidocarpa nisiotus* (Sluiter, 1900)

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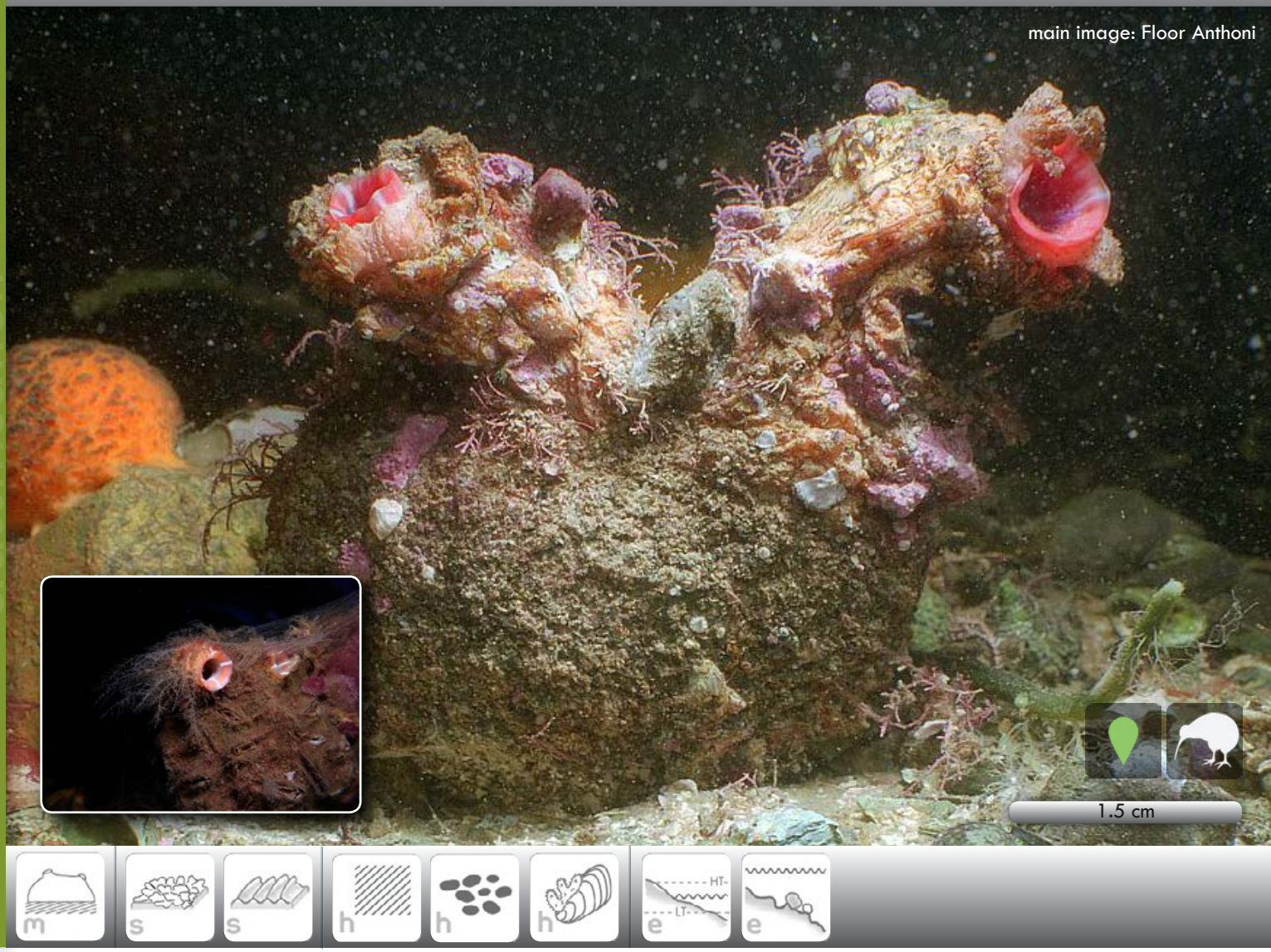
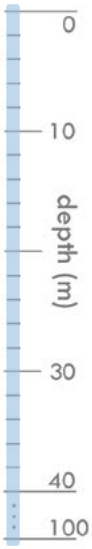
main image: Floor Anthoni



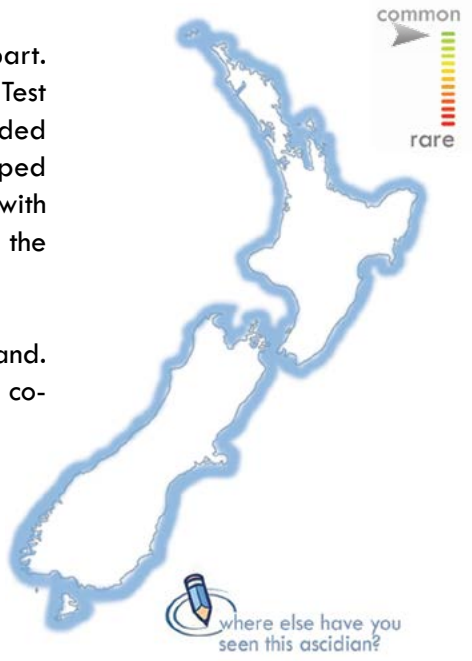







Oval shaped body with two siphons approximately half a body length apart. Body wrinkled, large irregular warty processes occur around the siphons. Test leathery, usually fouled with hydroids, bryozoans and algae. Gills are folded with elongate slits, tentacles are smooth, and there are three flask-shaped gonads on each side of the body wall. Colour in life dark brown to silty, with maroon siphon linings and four pale yellow to white longitudinal bands in the siphons.

Very common in ports, harbours and coastal environments around New Zealand. Can be locally abundant on shallow reefs and wharf piles. Generally co-occurs with *Cnemidocarpa bicornuta*.




**It could also be .....**
*Cnemidocarpa bicornuta*

Brewin B.I. (1946) Ascidians in the vicinity of the Portobello Marine Biological Station, Otago Harbour. *Transactions and Proceedings of the Royal Society of New Zealand*, 76(2): 87–131.

Millar, R.H. (1982) The marine fauna of New Zealand: Ascidiacea. *New Zealand Oceanographic Institute Memoir*, 85: 1–117.

# *Styela canopus* (Savigny, 1816)

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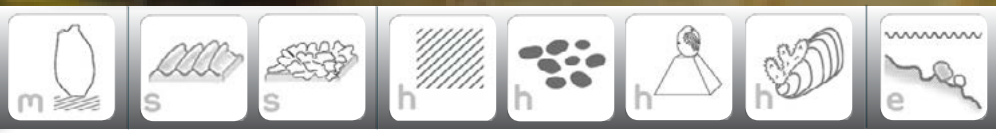
main and inset images: Rosana Rocha

1 cm





Body small, erect, oblong, with no stalk and two short closely spaced siphons on the top of the body, one slightly larger than the other. Test tough with warty tubercles occurring around the siphons and longitudinal wrinkles, becoming less distinct on the back of the body. Fine stripes run down the external surface of the siphons and upper body; these may be obscured by wrinkles in the tough leathery test. Gill slits elongate, gills folded, tentacles smooth, testis follicles outside ovary. Colour in life cream to tan, stripes white, or burnt orange brown with purplish tinges.

Occurs subtidally on wharf piles in low abundance, present known distribution, Nelson Harbour.

**It could also be .....**
*Pyura* species complex


Cosmopolitan

Kott, P. (1985) The Australian Ascidiacea I. Phlebobranchia and Stolidobranchia. *Memoirs of the Queensland Museum*, 23: 440.

# *Styela clava* Herdman, 1881

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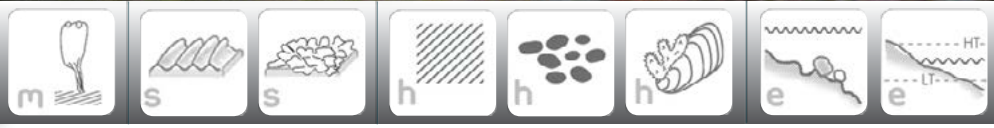
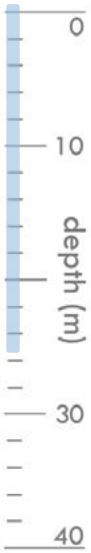
main and inset images: Rosana Rocha


Individuals usually with a short stalk, generally no longer than the cylindrical body, anchored to substratum by root-like processes. Short siphons are close together at the top of the body. Test leathery and conical, with warty swellings at the top around the siphons. Posterior half of test creased longitudinally and down the stalk. Gills folded, gill slits elongate, and tentacles smooth. Testis follicles outside ovary. Colour in life cream to tan, often covered with epiphytes and sediment.

Settles on artificial structures such as marina pontoons and marine farms, and the seabed. Can be locally abundant.

**It could also be .....**
*Pyura pachydermatina*


Cosmopolitan

Kott, P. (1985) The Australian Ascidiacea I. Phlebobranchia and Stolidobranchia. *Memoirs of the Queensland Museum*, 23: 440.

# *Styela plicata* (Lesueur, 1823)

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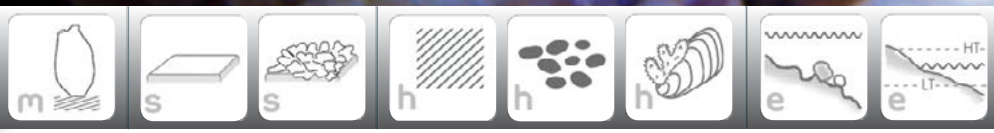
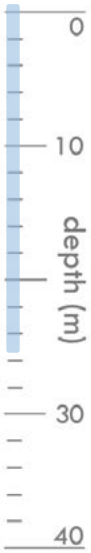
inset images: John Borom

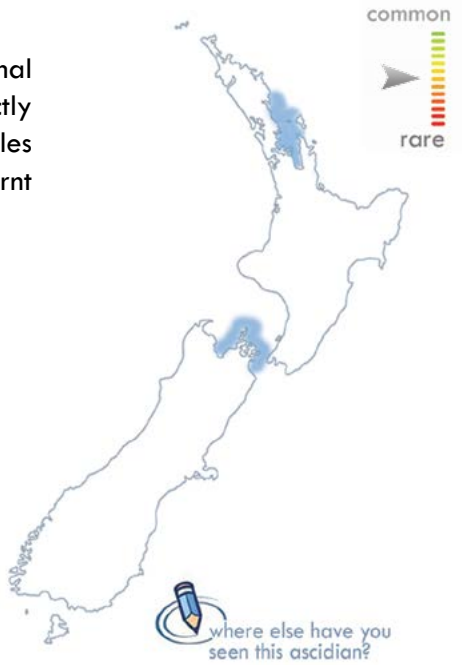
2 cm




Body ovoid with a firm, thick cartilaginous test. Test divided into longitudinal ridges which are further subdivided by horizontal creases, giving it a distinctly knobbed, pleated appearance. Gill slits elongate, gills folded, tentacles smooth, and testis follicles outside ovary. Colour in life dull white with burnt orange tinges.

Often occurs in dense clusters and is rarely fouled with other organisms.




Cosmopolitan

Kott, P. (1985) The Australian Ascidiacea I. Phlebobranchia and Stolidobranchia. *Memoirs of the Queensland Museum,* 23: 440.

Millar, R.H. (1982) The marine fauna of New Zealand: Ascidiacea. *New Zealand Oceanographic Institute Memoir,* 85: 1–117.

# icons morphology

| | | |
|---|---|---|
|  | ball | spherical, globular |
|  | loaf | rounded elongate, hemispherical |
|  | amorphous | without definable shape, often with lobed surface, potato or tuber-shaped, massive |
|   | thick encrusting | spreading over substratum, more than about 20 mm thick |
|   | thin encrusting | spreading over substratum, less than about 5 mm thick |
|  | fingers | finger-like, often arising from an encrusting or restricted base, digitate |
|  | meandering | wandering along and above substratum attached at intervals, repent |
|  | stalked grouped | stalked with club-shaped bodies attached to a common basal mat |
|  | stalked simple | single stalked bodies |
|  | grapes | bunched vase-shaped individuals joined basally |

| | | |
|---|---|---|
|  | brain | hemispherical with brain-like corrugations |
|  | sausage | long tubular sausage-shaped colonies |
|  | lobed cluster | closely packed flat topped lobes joined by basal mat |
|  | medusa | many single bodies on long stalks arising from a narrow basal mat |
|  | solitary saddle | widely-spaced siphons with low saddle in between |
|  | solitary stalked vase | elongated body with a short narrow stem, siphons closely spaced at anterior end |
|  | solitary stalked | oval bulbous body with 2 siphons on a long narrow stem |
|  | solitary mound | low, laterally elongate, oval shaped, with 2 siphons, separated by about ½ a body length |
|  | solitary rounded | rounded body, siphons often close together at the anterior end |
|  | solitary oblong | vertically elongated body with 2 siphons at the anterior end |

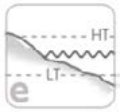
# icons surface

| | | | | | |
|---|---|---|---|---|---|
|  | smooth | even, hairless, silky, can be slightly undulating |  | warty | bearing small flattened bumps or tubercles, verrucose |
|  | radial systems | zooid apertures line subdermal canals radiating and branching away from common cloacal apertures |  | hairy | hairs projecting from the body of solitary ascidians, often holding sand grains, hirsute |
|  | circular systems | zooid apertures form rings around common cloacal apertures |  | raised lobes | common cloacal apertures raised at the terminal end of lobes |
|  | spiny | prickly bundles of very long spicules projecting from the test of solitary ascidians |  | transparent | gelatinous and see-through, translucent |
|  | rough | irregularly pitted and ridged surface, often tough, rugose |  | wrinkled siphons | siphons raised above the body wall, wrinkled and often warty |
|  | sand in test | sandy sediment incorporated into test of colonial ascidians, feels granular |  | spicules | star-shaped carbonate granules visible in and on the test |
|  | deeply wrinkled | bearing irregularly parallel ribs and grooves along the body wall |  | parallel systems | zooid oral apertures in parallel lines along subdermal canals |
|  | honeycomb | test surface with ridges in a honeycomb pattern |  | no systems | zooids open separately forming paired openings on low humps in the test |

# icons habitat

| | | | | | |
|---|---|---|---|---|---|
|  | rock | hard substrate such as mudstone, sandstone, basalt, compressed carbonates |  | mud | very fine muddy and silty sediments derived from terrigenous rocks, soils and clays |
|  | rubble | shell, stone, and pebble rubble |  | epizoic | living or growing on the external surface of an animal |
|  | sand | small coarse grains of worn silica, rock, and shell |  | artificial substratum | anything man-made such as mooring blocks, mussel lines, wharf piles |

# icons environment

| | | |
|---|---|---|
|  | intertidal | exposed shoreline zone between high and low tides, including rock flats, pools, overhangs, crevices, organisms exposed to wave action, temperature extremes, full illumination, and desiccation |
|  | subtidal | zone below the low tide, including rock flats, slopes, walls, crevices, overhangs, boulder fields, organisms exposed to wave surge and currents, and subdued illumination |
|  | wall | underwater cliffs and slopes, organisms exposed to wave surge and currents, and subdued illumination |
|  | indents | underwater caves, shelves and overhangs, organisms may experience wave surge, subdued illumination, or near darkness |

| | | |
|---|---|---|
|  | covered rock | sand and rubble spread over underlying hard substrate, organisms attached to basement rock susceptible to inundation and scouring from wave surge and currents, and subdued illumination |
|  | seabed | composed of a variety of sedimentary substrates including coarse gravels, shell hash and sands to finer sand, mud, and silts, organisms susceptible to inundation and scouring from wave surge and currents, and subdued illumination |
|  | bank | seabed raised into a bank of compacted rubbles and other carbonate materials including shell, kina and sealace hash, organisms exposed to wave surge and currents, and subdued illumination |

# icons life history

| | | |
|---|---|---|
|  | solitary | one animal bound by a single test |
|  | colonial | multiple animals bound by a single test |

| | | |
|---|---|---|
|  | native | species first described from and only found New Zealand waters, endemic |
|  | introduced | species first described from outside of New Zealand waters and is found in New Zealand and other locations, invasive |
|  | range extention | since first described in NZ, this species has been recorded elsewhere |

# glossary

| | |
|---|---|
| **amorphous** | without definable shape, often with lobed surface, potato or tuber-shaped, massive |
| **ampullae** | blind terminal expansion of the epidermal vessels, often flask-shaped in the Botryllidae |
| **anterior** | front |
| **apertures** | openings of the body to the exterior for exchange of water, inhalant 'mouth' (branchial) aperture, exhalent (atrial) aperture |
| **artificial substratum** | anything man-made such as mooring blocks, mussel lines, wharf piles |
| **ball** | spherical, globular |
| **bank** | seabed raised into a bank of compacted rubbles and other carbonate materials including shell, kina and sealace hash, organisms exposed to wave surge and currents, and subdued illumination |
| **brain** | hemispherical with brain-like corrugations |
| **cartilaginous** | having the texture of cartilage, firm and tough yet flexible |
| **circular systems** | zooid apertures form rings around common cloacal apertures |
| **covered rock** | sand and rubble spread over underlying hard substrate, organisms attached to basement rock susceptible to inundation and scouring from wave surge and currents, and subdued illumination |
| **deeply wrinkled** | bearing irregularly parallel ribs and grooves along the body wall |
| **environment** | physical, chemical, ecological, behavioural, and other conditions experienced by an organism |
| **epizoic** | living or growing on the external surface of an animal |
| **fingers** | finger-like, often arising from an encrusting or restricted base, digitate |
| **firm** | requires some pressure to compress, firm |
| **fleshy** | feels like skin or edam cheese, dense, slightly stretchy, cellular material more abundant than fibrous material |
| **gelatinous** | jelly-like, slippery |
| **gill sac** | organ used for both the exchange of gasses (breathing) and collection of food |
| **gonad** | reproductive structure |
| **granular** | sand papery texture due to presence of calcareous spicules in the test |
| **grapes** | bunched vase-shaped individuals joined basally |
| **habitat** | environment and local situation an organism lives in |
| **hairy** | hairs projecting from the body of solitary ascidians, often holding sand grains, hirsute |
| **honeycomb** | test surface with ridges in a honeycomb pattern |
| **indents** | indentations in the substrate such as underwater caves, shelves and overhangs, organisms may experience wave surge, subdued illumination, or near darkness |
| **intertidal** | exposed shoreline zone between high and low tides, including rock flats, pools, overhangs, crevices, organisms exposed to wave action, temperature extremes, full illumination, and desiccation |
| **loaf** | rounded elongate, hemispherical |
| **lobed cluster** | closely packed flat-topped lobes joined by basal mat |
| **meandering** | wandering along and above substratum attached at intervals, repent |
| **medusa** | many single bodies on long stalks arising from a narrow basal mat |
| **morphology** | shape |
| **mud** | very fine muddy and silty sediments derived from terrigenous rocks, soils and clays |
| **no systems** | zooids open separately forming paired openings on low humps in the test |
| **opaque** | impenetrable by light |
| **parallel systems** | zooid oral apertures in parallel lines along subdermal canals |
| **posterior** | back |
| **radial systems** | zooid apertures line subdermal canals radiating and branching away from common cloacal apertures |
| **raised lobes** | common cloacal apertures raised at the terminal end of lobes |
| **rock** | hard substrate such as mudstone, sandstone, basalt, compressed carbonates |
| **rough** | irregularly pitted and ridged surface, often tough, rugose |
| **rubble** | shell, stone, and pebble rubble |
| **sand in test** | sandy sediment incorporated into test of colonial ascidians, feels granular |
| **sand** | small coarse grains of worn silica, rock, and shell |
| **sausage** | long tubular sausage-shaped colonies |
| **seabed** | composed of a variety of sedimentary substrates including coarse gravels, shell hash and sands to finer sand, mud, and silts, organisms susceptible to inundation and scouring from wave surge and currents, and subdued illumination |
| **smooth** | even, hairless, silky, can be slightly undulating |
| **solitary mound** | low, laterally elongate, oval shaped, with 2 siphons, separated by about ½ a body length |
| **solitary oblong** | vertically elongated body with 2 siphons at the anterior end |
| **solitary rounded** | rounded body, siphons often close together at the anterior end |
| **solitary saddle** | widely-spaced siphons with low saddle in between |
| **solitary stalked vase** | elongated body with a short narrow stem, siphons closely spaced at anterior end |
| **solitary stalked** | oval bulbous body with 2 siphons on a long narrow stem |
| **spicules** | star-shaped carbonate granules visible in and on the test |

| | |
|---|---|
| **spiny** | prickly bundles of very long spicules projecting from the test of solitary ascidians |
| **stalked grouped** | stalked with club-shaped heads attached to a common basal mat |
| **stalked simple** | single stalked bodies |
| **subdermal canal** | a canal that connects zooids together around a common cloacal aperture (exhalent) |
| **subtidal** | zone below the low tide, including rock flats, slopes, walls, crevices, overhangs, boulder fields, organisms exposed to wave surge and currents, and subdued illumination |
| **surface** | patterning or ornamentation on the surface of the body of an animal |
| **tentacle** | tentacles surround the inhalant (branchial) aperture; they can be simple or branched and are important characters at the genus level |
| **test** | a protein coating surrounding the body, it can be tough and leathery in some solitary species, or a gelatinous matrix surrounding zooids in colonial species |
| **testis follicle** | sacs that contain sperm; these are usually cream-coloured and the ovary is orange, containing eggs |
| **thick encrusting** | spreading over substratum, more than about 20 mm thick |
| **thin encrusting** | spreading over substratum, less than about 5 mm thick |
| **translucent** | lets light through the test, but not enough to perceive distinct details through it. |
| **transparent** | test of both colonial and solitary ascidians can be gelatinous, apearing see-through, translucent |
| **wall** | underwater cliffs and slopes, organisms exposed to wave surge and currents, and subdued illumination |
| **warty** | bearing small flattened bumps or tubercles, verrucose |
| **wrinkled siphons** | siphons raised above the body wall, wrinkled and often warty |
| **zooids** | small individual sea squirts of the same species living communally in a common test, often forming systems to pump water, or opening individually to the exterior |

# acknowledgements

This guide is dedicated to the late Patricia Mather (nee Kott) in acknowledgement of her lifetime contribution to the taxonomy of Southern Hemisphere ascidians. Our knowledge of the New Zealand ascidian fauna is richer for the early works of Sluiter, Michaelsen and more recently, those of Brewin and Millar. Many of the images presented here were taken during NIWA's Marine Biotechnology Programme collection voyages; many thanks to Vicky Webb for having the foresight to support our research in this area. This work was funded by the New Zealand Foundation of Reaserch and Technology Contract CO1X0219 (Biodiversity and Biosecurity) to NIWA.

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# further reading

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