Spotted Whelk

Family: Buccinidae

Common Names: Spotted Whelk / Kawari

Latin Name: *Cominella maculosa*

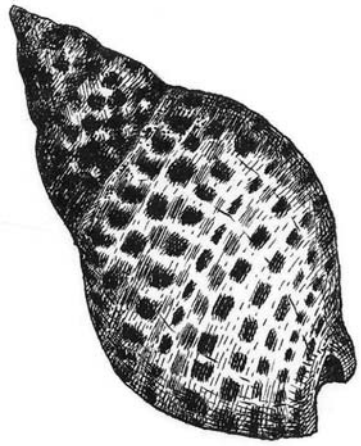
Height: 21-24 mm, Length: 38-47 mm

Description: Exterior greenish-yellow (sometimes orange) spirally patterned with small dark square-ish spots. Interior dark brown, lip dull orange to brown.

Habitat: Found on rocks, sand and in areas of eel grass (Zostera sp). Able to live on more exposed shores than the mudflat whelk.

Remarks: Less common than the Mudflat whelk.

Cultural uses: A traditional food of the Māori.



Mudflat Topshell

Family: Trochidae

Common Names: Mudflat Topshell / Whātiko

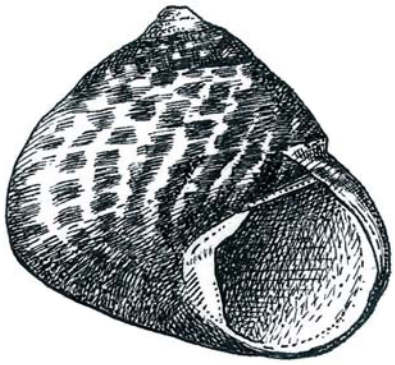
Latin Name: *Diloma subrostrata*

Height: 15–32 mm, Width: 17–29 mm

Description: Exterior greyish-brown to yellow with fine, closely spaced dark purplish-brown irregular zig-zag patterns. Young shells are sculpted with sharply raised narrow spiral ridges, which are smooth in older shells. Eroded shells are a dull leaden purple and show little ridging. All, including very eroded and overgrown older shells, have a bright yellow band inside which runs along the outer edge of the opening. There may also be an inner dark band either continuous or broken up into a few irregular blotches.

Habitat: On surfaces ranging from fine silts to boulders in the intertidal zone.

Remarks: Topshells are herbivores and feed by scraping algae from the substratum using their radular. They are easily dislodged on account of their comparatively small foot size. The shell opening is closed off by an operculum, protecting the soft parts of the animal from drying out, mechanical damage and to some degree, predation. This species is able to withstand turbid water and low levels of salinity.



Ridged Topshell

Family: Trochidae

Common name: Ridged Topshell

Latin name: *Diloma zelandica*

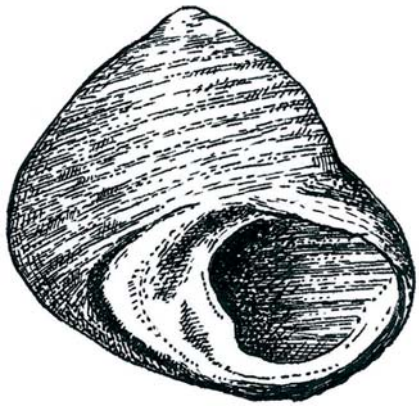
Height: 14-26 mm, Length: 18-30 mm

Description: Exterior irregularly flecked with small yellowish dots with more spotting on the lower parts. Spirally ridged shell, black with a greenish under-layer that shows in an outer-lip margining band. These ridges are always visible as lines on the shell interior. Dark rim on inner edge of shell (sometimes flecked with a lighter colour) and a green tinge before the opalesence inside.

Habitat: Similar to the Mudflat Topshell.

Remarks: It can be difficult to tell the Mudflat Topshell and the Ridged Topshell apart as surface patterning is highly variable within each species. Young specimens are also very similar while older shells often have their distinguishing characteristics eroded away.

May be confused with: Spotted topshell/ Māihi (*Melagraphia aethiop*)
Height: 21-28mm, Width: 21-31mm
Spotted Topshells have a solid, globe-shaped shell with a pointed tip. This is wider at the base and generally larger than both the Mudflat and Ridged Topshells. The exterior is covered with a thick, dull olive, finely ridged periostracum (outer coating). Weathered shells are dark bluish or purplish brown with spiral series of white vertical dashes, while their largest spiral band has distinctive fine cross-hatch patterns.



Topshell

Family: Trochidae

Common Names: Topshell / Matamatangongo

Latin Name: *Micrelenchus tenebrosus*

Height: 9-12 mm, Width: 8-10 mm

Description: Exterior dark bluish to dark greenish-grey with darker spiral ridges. Interior of opening iridescent greenish or bluish. All Micrelenchus species are less than 1cm wide.

Habitat: Generally associated with seaweeds (e.g. *Ulva gracillaria*) and seagrass in the sheltered waters of tidal mudflats.

Remarks: Previously divided into two species (*M. huttoni* and *M. tenebrosus*) between them occupying a range of habitats from open water situations to more sheltered situations. The former *M. huttoni* is now recognised as an 'ecotype' (a subset of individuals within a species with a characteristic appearance) or variant of *M. tenebrosus*.

Spire shells

Family: Batillariidae

Common Names: Spire Shell, Horn Shell / Koeti, Huamutu

Latin Names: *Zeacumantus lutulentus*

Height: to 30 mm

Descriptions: Exterior grey filmed. Close-up has two shallow divisions or ridges on the lower part of the shell.

Habitat: The Spire shell lives chiefly on organic mud.

Remarks: Spire shells are also known as horn shells. In mudflats, the Spire Shell and Small Spire Shell may be eroded and difficult to tell apart without close examination.

Mudflat Snails

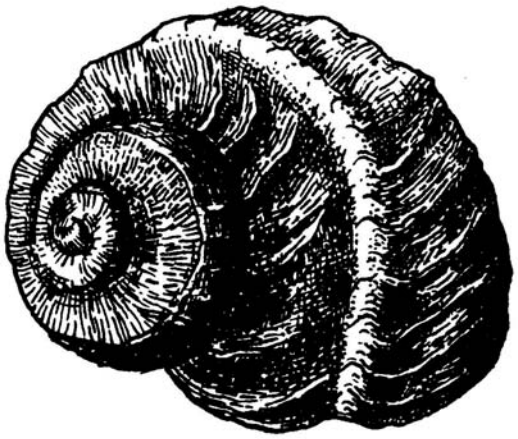
Family: Amphibolidae

Common Names: Mudflat Snail / Tātiko

Latin Name: *Amphibola crenata*

Height: 22- 31 mm, **Length:** 23–30 mm

Description: Grey to yellowish brown exterior, purple interior with a white lip. Thick, roughly sculptured shell. Similar in size and shape to the garden snail.



Habitat: Abundant on high tidal sandy-mud and muddy flats. Larger snails may live down to the low water line. Smaller snails are commonly concentrated on finer sediments and have a more restricted distribution than adults.

Remarks: Endemic to New Zealand estuaries. They are useful as an indicator species being sensitive to heavy metal pollution. The mudflat snail breathes air and survives underwater between tides by taking in a bubble of air before closing its operculum. They are most active when the tide is out. At high tide the snails lie buried and motionless in the sediments to avoid being eaten by fish. Mudflat snails reach maturity at 2 years and can live for 12 or more years. These snails are effective "gardeners", sifting and ploughing twice their own body weight of sediment hourly (approx 58kg annually per snail!). A characteristic long, thin meandering faecal string is left behind once the nutrients have been extracted from the organic matter in the mud.

Cultural uses: Large quantities of Mudflat Snails were eaten by early Māori.

Each breeding adult produces a nidus (a tyre-like rim containing 7,000 – 10,000 eggs) every 5 days throughout the November to March breeding season.
Photo: Monica Peters

Estuarine Limpet

Family: Acmeidae

Common names: Estuarine limpet

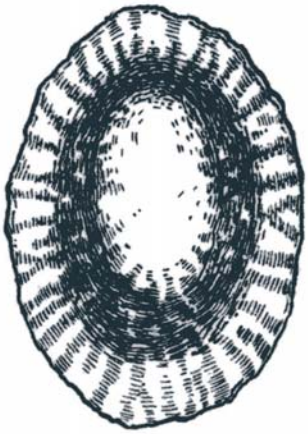
Latin Name: *Notoacmea helmsi*

Length: 8-12 mm

Description: Fragile shell variably coloured though usually light brown, black or greyish green with 30-40 radiating dark lines.

Habitat: Limpets are always found clinging to rocks and other hard surfaces including the shells of mudflat snails, cockles and mussels. They are found in the intertidal zone where they graze primarily on epiphytes and/or the microscopic stages of macro-algae.

Remarks: The ability to clamp down firmly on to hard surfaces when disturbed is a useful adaptation. This reduces the risk of being dislodged by waves and water currents and helps seal moisture inside the shell when out of the water. Being difficult to remove also provides protection from predators. Once under water, limpets raise their shells to allow a respiratory current to enter and grazing on small algae begins soon after.



Other Estuarine Organisms

Polychaetes

Length: Approximately 40mm.

Description: Finely segmented bodies with fine bristly hairs projecting from each. Commonly around 4cm long.

Remarks: Related to earthworms. Filter or deposit feeders. Polychaete worms are extremely common with over 5,300 different species described worldwide. Some are free moving while others are sedentary burying themselves into the estuary sediments leaving a pinprick hole on the surface. The distribution of the different species depends on the texture of the sediment, salinity, exposure to air and level of pollution.

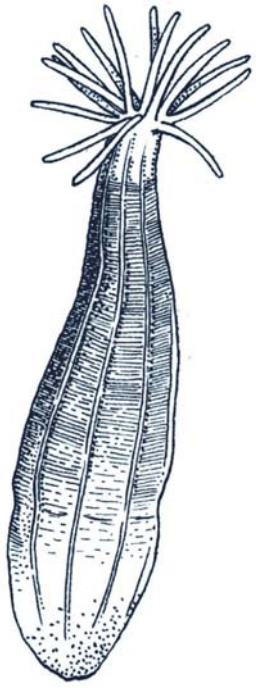
Burrowing Anemone

Latin Name: *Edwardsia tricolor*

Length: Up to 50mm

Description: Clay coloured and finely wrinkled. Usually less than 5cm long.

Remarks: One of the simplest of all anemones, the Burrowing Anemone digs into the sand by widening the base of its cylindrical body and thrusting its muscles in a down-wards motion. When the animal is buried, only the oral disk circled by 16 tentacles can be seen. Anemones are carnivorous, feeding on various invertebrates and fish, which are immobilised by special stinging cells on the tentacles (nematocysts). Prey is passed into the mouth by the tentacles.



Mudflat Anemone

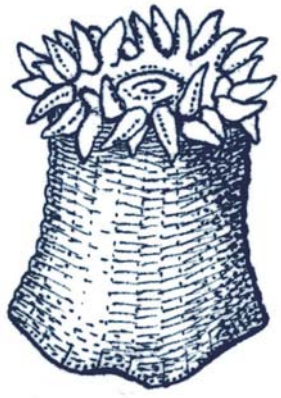
Latin Name: *Anthopleura aureoradiata*

Width: 8mm

Description: Brown or grey coloured. Disc 8mm across.

Remarks: This small anemone is typically found attached to cockle shells, though may also be found in areas where water forms a permanent pool. It may also burrow into the harbour flats attaching itself to small stones 3 or more cm below the surface. Where they are withdrawn at low tide, these anemones leave a characteristic circular depression on the surface of the sand.

Their colouration results from algae. It is common for anemones to contain algae which are protected and sheltered by the animal. Algae use up the anemones' waste products as nutrients and in return provide the anemone with some food in the form of carbohydrates they manufacture by photosynthesis.



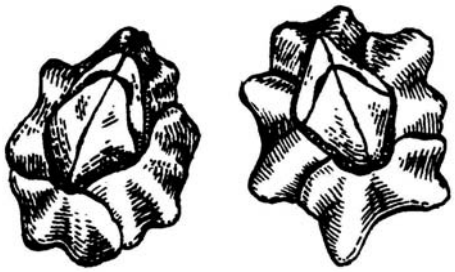
Estuarine Barnacle

Common Names: Modest Barnacle, Estuarine Barnacle

Latin Name: *Austrominius modestus*
Previously: *Elminius modestus*

Description: 1.5mm across, outline of the shell wavy at the base. Made up of 4 overlapping outer plates though these may be difficult to see because of the barnacle's small size. Distinctive kite-shaped feeding aperture. Barnacles growing in crowded colonies have thinner shells and a more columnar shape.

Remarks: Also known as the Modest Barnacle, this is the dominant barnacle of all harbour waters. The name has recently changed to *Austrominius modestus*. Barnacles reach high densities in estuaries through tolerance to low salinity, still water and high turbidity. They are attached to a variety of hard surfaces such as rocks, gravel, wharf piles, the pneumatophores (breathing roots) of Mangroves as well as cockle shells. Fine appendages attached to the barnacles filter plankton from the water. Predators include whelks, cushion stars and flatworms.



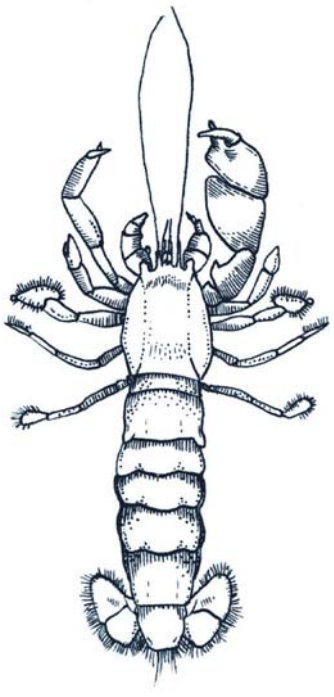
Ghost Shrimp

Latin name: *Callianassa filholi*

Length: Up to 50mm

Description: Pale milk-white tinged with coral pink, up to 5cm long.

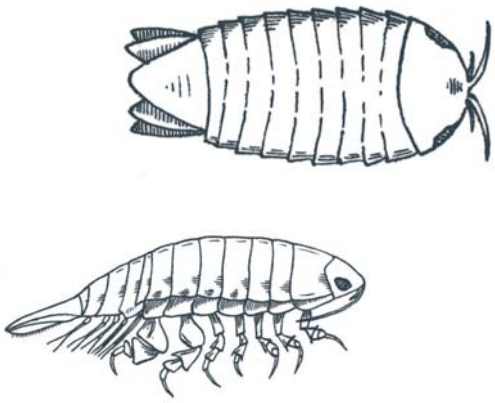
Remarks: The Ghost Shrimp makes long semi-permanent burrows up to 60cm deep in the muddy sand between mid- and low-tide levels. Burrows have several openings each and are occupied by one male and two females. Ghost shrimps prevent their burrow from collapsing by secreting mucus, which they adhere to the walls of the structure. Ghost shrimps are filter feeders, drawing surface sediments into the burrow through waving their pleopods (appendages on the abdominal segments). This produces a small crater at the inhalant opening of the burrow. The material rejected from the feeding process creates a characteristic volcano shape at the exit point of the burrow.



Amphipoda and Isopoda

Description: Both are only several millimetres long. Amphipoda have bodies that appear to be flattened from the sides (e.g. sand hoppers). Isopoda by contrast are flattened from above and are the marine relatives of the common garden slater (whose shape they resemble).

Remarks: Some of the names given to these crustaceans include sand hoppers, sand fleas, sea lice. Amphipoda have legs which are often long and they can move by jumping. Many Isopoda make a rapid scurrying movement out of the water and others can swim using abdominal appendages adapted for swimming called pleopods. The majority of these crustaceans are scavengers and feed on dead plant and animal matter.



Generic drawings of an isopod from the side and from above.

Stalk-eyed Mud Crab

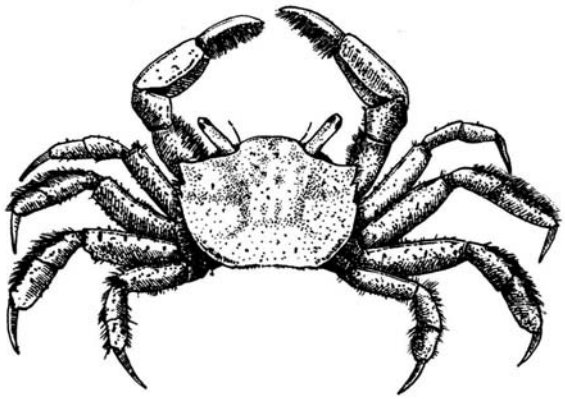
Latin Name: *Macropthalmus hirtipes*

Size: Generally do not grow larger than 20mm across the carapace, though older crabs may grow up to 30mm across.

Description: A low-tidal mud-flat crab. Deep-green carapace with scattered dense brown spots. Its legs are yellow-green and the nippers are red when viewed from below. Male and female have hairy legs while the only the male has hairy, symmetrical, spade-like nippers. The carapace is almost rectangular with 3 spines either side.

Remarks: Constructs temporary burrows in waterlogged sediments below mid-tide level, the main purpose of which is to protect the crab against predation. More nomadic and not so dependent on its burrow as *Helice crassa*.

Stalk-eyed Mud Crabs cannot survive more than 8 hours out of the water and are mainly active at night. A major part of the diet is made up of organic matter sifted from the surface mud, although fragments of algae growing on the shells of Mudflat snails are also eaten. Predators include: cod, eel, rays, snapper and sea birds such as herons and kingfishers.

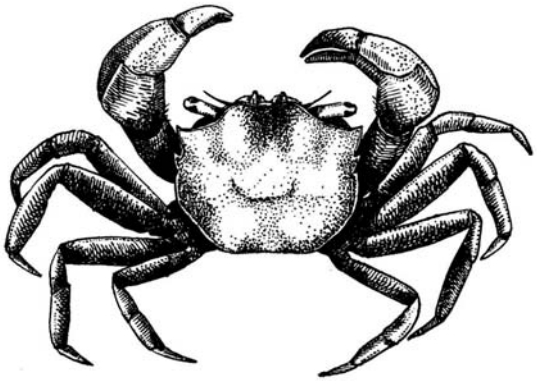


Tunelling Mud Crab

Latin Name: *Helice crassa*

Description: Grey to olive brown above, grey-ish-white underneath. Legs are without hairs and the carapace is almost square.

Remarks: The crabs construct permanent downward-slanting burrows 10-15mm across in well-drained compacted sediments up to 60cm long. Some are un-branched while others form a complex labyrinth of intersecting tunnels. The surface is littered with piles of excavations. Crabs never move far from their burrows, returning quickly to them in times of danger and stress. They are active on the surface as soon as the ebbing tide has exposed the mud flats and feed mostly on fine particulate organic matter though also occasionally on bleached and decomposing sea lettuce which is torn into small strips. The crabs are extraordinarily perceptive to moving objects and can react to a person more than 40m away.



Seaweeds

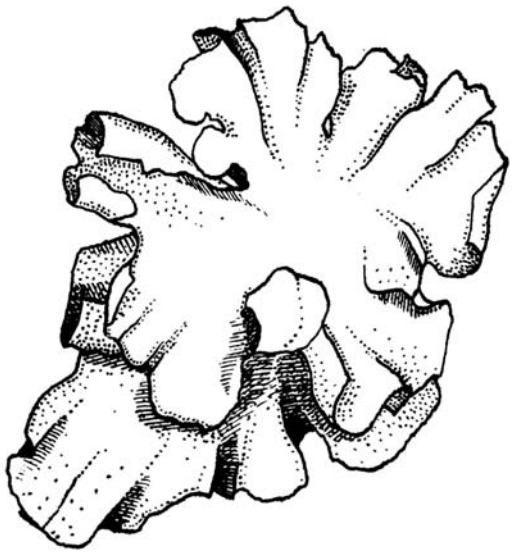
Sea Lettuce

Common Name: Ulva, Sea Lettuce

Latin Name: *Ulva lactuca*

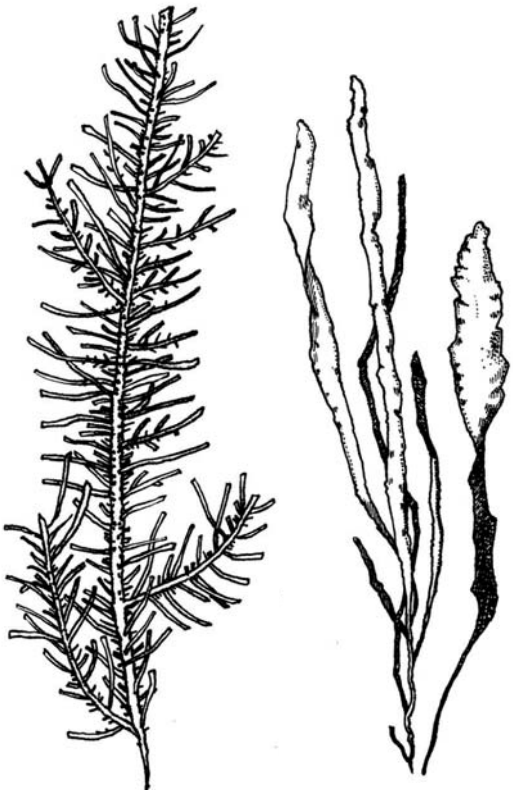
Description: Ulva, aptly named "sea lettuce" is bright green.

Remarks: Seaweeds are classified as algae and are only remotely related to terrestrial plants. In spring, longer days, warmer temperatures and higher nutrients levels in the water stimulate a flush of growth from Enteromorpha, Ulva and Gracilaria after their winter dormancy. Ulva and Enteromorpha flourish in green patches. When these seaweeds begin to rot, hydrogen sulphide - which smells like rotten eggs, is released.



Enteromorpha

Two growth forms of Enteromorpha shown



Description: Their bright green colour is reasonably unique. Growth forms are varied and range from short green turf on rocks to large tangled mats. Most likely forms found in estuaries include:

1. Short tufts on cobbles and rocks,
2. Narrow tangled strings in a mat form
3. In ponds as floating tangled mats
4. As tangled windrows on beaches

Remarks: Enteromorpha are always associated with some freshwater input. All Enteromorpha have hollow stems and the thicker stemmed variant tends to be only in permanent water.
They can be distinguished from filamentous green algae or slime by the way they lie on the ground.

Gracilaria

Latin Name: *Gracilaria chilensis*

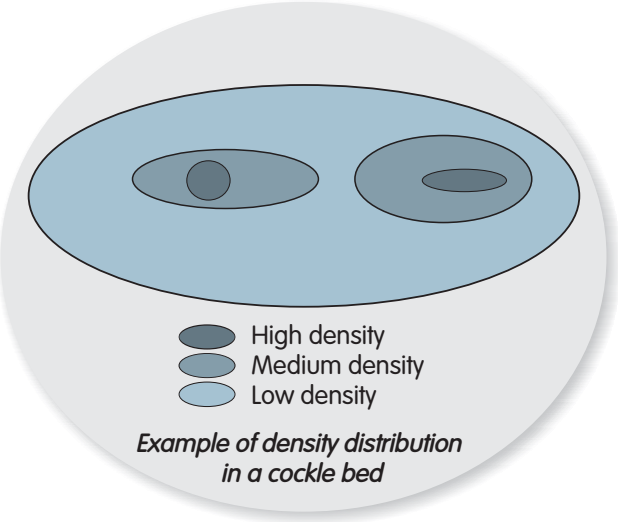
Description: Gracilaria is a red seaweed.

Remarks: Gracilaria can turn parts of the estuary deep brown during bloom conditions.

Appendix 2: Cockle Monitoring Methodology

Equipment required: Spade or trowel, 30cm ruler, large sieve, bucket, 2 ice cream containers, paper, pen, 4 stakes, GPS unit.

Prior to getting underway, it is important to know that cockles form patchy distributions throughout the estuary. Keep this in mind when mapping their density and follow the steps below.



Example of density distribution in a cockle bed

Step 1: Gather up all your equipment and go to a known cockle bed or an area you are interested in investigating.

Step 2: Try to locate the approximate boundaries of the cockle bed by digging around it's edges and trying to locate cockles. Where there are very low densities of cockles mark the boundaries with a stake. Place a stake at the low shore boundary and another at the high shore boundary. Place the other two stakes at the cross shore boundaries.

Step 3: Write down the positions of your boundary markers after checking their locations with a GPS unit if possible. You may be able to borrow a GPS unit from a local boat owner or Regional Council, District Council, Department of Conservation, or Fish and Game office. If a GPS unit is not available consider whether driving permanent markers (e.g. warratahs) deeply into the sediment will create a safety hazard. It is important to know the location of your monitoring sites if you plan to come back and monitor abundance over time.

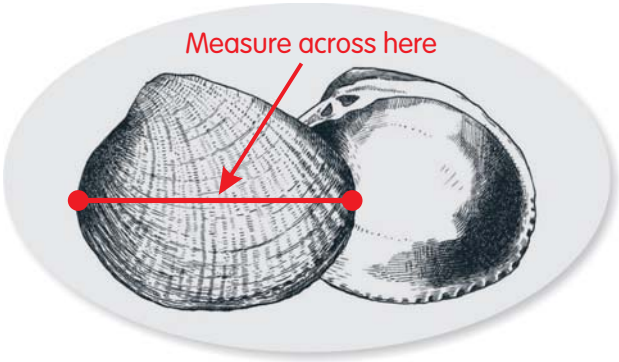
Step 4: After placing the boundary stakes, pace out the distance between the upper and lower shore pegs. Write this down. Then pace out the distance between the cross shore pegs. Write this down. Divide the number of paces by 10 for each distance (e.g. 40paces ÷ 10 = 4)

Step 5: You will be taking 10 samples up the shore and 10 samples across the shore (a total of 20 samples). The numbers you calculated above correspond to the number of paces between each sampling point across and up the shore.
Begin at the low shore marker and pace out the number of paces calculated in step 4 for the lower to upper shore markers. This is site one.
Write on your recording sheet 'Lower to Upper' as a heading and underneath write site one.

Step 6: Use your ruler to mark an area 316x316mm. The reason for this size is that it is exactly one tenth of a square meter (when you multiply the result by 10 you will estimate the density of cockles in $1m^2$). Dig out the 316mm x 316mm area down to 7cm depth or slightly more (cockles will live to a maximum of 7cm depth) and put the sediment and cockles into the ice cream container.

Step 7: Fill your bucket with water. Put the sieve over this and empty some of your sediment and cockles into the sieve. Swoosh the sieve in the water (but do not immerse it) to separate the cockles from the sediment. Put the cockles into your empty icecream container ready for counting. Continue until you have sieved all the sediment/cockles.

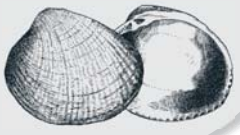
Step 8: Count the number of cockles that were present in the sample. Record this number on your sheet. If you want to keep a track of changes in cockle size overtime you may wish to measure the width of each cockle too. This is not compulsory.



Step 9: repeat steps 5-8 nine more times (so that you have taken 10 samples up the shore)

Cockle Density Classification:

High › 500/m2
Moderate 10-500/m2
Low ‹ 30/m2



Lower Shore – Upper Shore Cockle Data

Site	Individual cockle measurements (optional)	Average size (if measurements taken)	Total no. of cockles in sample	Total cockle no. multiplied by 10 = no./m^2
Site 1				
Site 2				
Site 3				
Site 4				
Site 5				
Site 6				
Site 7				
Site 8				
Site 9				
Site 10				

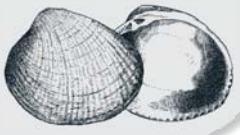
Step 10: repeat steps 5-9 for the 'cross shore' markers (i.e. sample 10 sites across the shore)

Across Shore Data

Stake 3: First stake across the shore GPS Coordinates
.....
Stake 4: Second stake across the shore GPS Coordinates
.....
Number of paces across shore between stakes
.....
Paces divided by 10 (distance between sites) .....

Cockle Density Classification:

High › 500/m2
Moderate 10-500/m2
Low ‹ 30/m2



Lower Shore – Upper Shore Cockle Data

Site	Individual cockle measurements (optional)	Average size (if measurements taken)	Total no. of cockles in sample	Total cockle no. multiplied by 10 = no./m^2
Site 1				
Site 2				
Site 3				
Site 4				
Site 5				
Site 6				
Site 7				
Site 8				
Site 9				
Site 10				