Estuarine and Coastal Sciences Association
Marine Mollusc Workshop 21-25 March 1994
Tutors: Ian Killeen and Jan Light

Monday	Tuesday	Wednesday	Thursday	Friday
Introduction	Rissoacea	Introduction to bivalve taxonomy	Mactracea	Review of course
Scope of course	Neogastropoda	Taxodonts	Solenacea	Examination of unseen samples
Literature		Mytilacea	Tellinacea	
Biogeography		Anomiacea & Ostreacea	Borers	
The phylum Mollusca		Pectinacea		
Littoral and sub-littoral assemblages				
Chitons				
LUNCH 12.30 - 13.30				
Caudofoveates & Solenogastres	Pyramidellacea	Lucinacea	Arcticacea	
Introduction to gastropod taxonomy	Other gastropod superfamilies	Galeommatacea	Veneracea	
Limpets	Opistobranchs	Astartacea	Myacea	
Trochacea	Cephalopods	Cardiacea	Hiatellacea	
Littorinacea			Thraciacea	
			Pandoracea	
16:00 to c.17:00 Review of day, further examination of material				

LITERATURE ON BRITISH MARINE MOLLUSCA

There have been a number of changes in nomenclature for the British species in the last few years. The Conchological Society has formally adopted that employed by Smith & Heppell (1991):

Smith, S. M., & Heppell, D., 1991. *Checklist of British marine Mollusca.* National Museums of Scotland information series no. 11. Edinburgh. (Available from Royal Scottish Museum, Chambers Street, Edinburgh EH1 1JF, price C. £9.50)

An awareness of the biogeography of the molluscan fauna is desirable when identifying unknowns. This can save much time and also reduce the possibility of misidentifications. For the most up-to-date information on the distribution of the British fauna, workers should obtain a copy of the revision of the 1982 Sea Area Atlas:

Seaward, D. R., 1990. *Distribution of the marine molluscs of north-west Europe.* Nature Conservancy Council, Peterborough.

This work contains a wealth of valuable distributional data although the different symbols used to classify date classes etc take some getting used to. The list of references is particularly useful. A list of additions, corrections and revisions to this work was published in 1993.

For identification of the British Prosobranchs, Opisthobranchs, chitons and scaphopods, the three recent Linnean Society Synopses are recommended. They are the only comprehensive, up-to-date works available:

Graham, A., 1988. Molluscs: Prosobranch and pyramidellid gastropods. *Synopses of the British fauna (NS) No.2 (2nd edition).* E.J. Brill, Leiden.

Jones, A. M. & Baxter, J. M., 1987. Mollusca: Caudofoveata, Solenogastres, Polyplacophora and Scaphopoda. *Synopses of the British fauna (NS) No.37.* Academic Press, London.

Thompson, T. E., 1988. Molluscs: benthic Opisthobranchs (Mollusca: Gastropoda). *Synopses of the British fauna (NS) No.8 (2nd edition).* E.J. Brill, Leiden.

All of these are available from the Linnean Society, Burlington House, Piccadilly, London WC1

For bivalves, the only reasonably comprehensive guide is Tebble's *British Bivalve Seashells*, BMNH 1966. Although a new Linnean Society Synopsis is in preparation, it will be some years before it is available. This work has a number of shortcomings, mainly the lack of good line drawings for every species and also there is no mention of the problems with juveniles.

The recently published *Marine fauna of the British Isles and NW Europe* by P. J. Hayward & J. S. Ryland, Clarendon Press, 1990, contains much useful ecological and descriptive material. It is incomplete, however, the molluscs section is a very

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useful adjunct to the above works. The drawings are accurate and for bivalves in particular it is a useful supplement to Tebble.

Another general work that is useful is *A student's guide to the seashore* by J. D. & S. Fish, Unwin Hyman, 1989.

The Conchological Society's *Papers for students* No.16 (Cockles), No.17 (Scaphopods), and No.19 (Cephalopods) contain helpful information and are still available from Adrian Norris at Leeds City Museum, Municipal Buildings, Leeds LS1 3AA Tel: 0532 438311.

Still extremely good for identification of prosobranchs and pyramidellids are the Supplements to the Journal of Molluscan Studies by Fretter & Graham on the *Prosobranch molluscs of Britain & Denmark.* These contain considerably more information than the new Synopsis. Most are out of print, but well worth picking up if you see them.

For nudibranchs, the Linnean Society Synopsis can be difficult to use on its own. As colour is often an important feature in accurately determining the species it is helpful to see colour photographs or illustrations. The 2 Ray Society monographs on the *Biology of Opisthobranch Molluscs* By Thompson (1976) and Thompson & Brown (1984) are excellent but rather too detailed merely for identification purposes. The Marine Conservation Society's *Nudibranchs of the British Isles* (Brown & Picton, 1979) has reasonably good colour photographs of most of the species likely to be encountered in general recording work.

The *Journal of Conchology* published by the Conchological Society of GB & Ireland, and the *Journal of Molluscan Studies* published by the Malacological Society of London contain many important papers on the biology, ecology and distribution of the British marine fauna.

THE MOLLUSC FAUNA ASSOCIATED WITH PARTICULAR SUBSTRATES

Whilst there is a great deal of overlap, each type of substrate tends to have its own suite of species. Although there will be geographical variations the following lists give typical assemblages that might be expected from different types of substrate. They are by no means exhaustive.

A) Estuarine mud - Tidal rivers where there is significant freshwater influence.

Lepidochitona cinereus

Littorina littorea
Littorina saxatilis
Littorina obtusata
Hydrobia ulvae
Crepidula fornicata
Retusa obtusa

Aeolidiella alderi

Ostrea edulis
other oyster spp.
Mytilus edulis
Cerastoderma edule
Abra tenuis
Macoma balthica
Scrobicularia plana
Tapes decussatus
Mya arenaria

B) Mud - fully marine environments often in depths >100m. Typically a low diversity fauna but often containing unusual or rare species (*) in low numbers.

Nucula nitidosa
Mysella bidentata
Phaxas pellucidus
Thyasira flexuosa
Abra alba
Abra nitida
Corbula gibba

Cylichna cylindracea
*Hyala vitrea**
*Tragula fenestrata**
*Jupiteria minuta**
*Saxicavella jeffreysi**

C) Muddy gravel. (W) = associated with weeds such as *Griffithsia*.

Acanthochitona fascicularis
other (unusual) chitons
Tectura virginea
Gibbula cineraria
Tricolia pullus (W)
Lacuna crassior
Rissoa interrupta (W)
Rissoa parva (W)
Alvania beanii
Pusillina inconspicua (W)
Crepidula fornicata (south)

Buccinum undatum
Hinia reticulata

Nucula nitidosa
Nucula nucleus
Ostrea edulis
Myrtea spinifera
Parvicardium exiguum
Abra alba
Abra nitida
Venerupis senegalensis
Mya truncata

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D) Gravel/Cobble often with dead shell. A rich habitat for molluscs. As many as 40 species of molluscs may be present.

Leptochiton asellus
Acanthochitona crinitus
Tectura virginea
Gibbula tumida
Gibbula cineraria
Calliostoma zizyphinum
Tricolia pullus (W)
Lacuna parva (W)
Rissoa interrupta (W)
Rissoa parva (W)
Crepidula fornicata (south)
Trivia spp
Ocenebra erinacea
Buccinum undatum
Hinia reticulata
Hinia incrassata
Nucula nucleus
Ostrea edulis
Chlamys varia
Aequipecten opercularis
Abra alba
Venerupis senegalensis
Mya truncata
Hiatella arctica
Spisula elliptica

E) Fine, slightly muddy, silty sand - often found off the end of chalk platforms & shallow water offshore.

Polinices polianus
Buccinum undatum
Hinia reticulata
Hinia pygmaea
Mangelia nebula
Philine aperta
Nucula nitidosa
Mysella bidentata
Acanthocardia echinata
Mactra stultorum
Spisula subtruncata
Phaxas pellucidus
Abra alba
Venerupis senegalensis
Mya truncata
Corbula gibba

F) Sand - Fauna may contain several elements from list E.

Polinices catenus
Polinices polianus
Hinia reticulata
Mangelia nebula
Epitonium clathrus
Acteon tornatilis
Mactra stultorum
Spisula solida
Lutraria lutraria
Razor species
Angulus tenuis
Fabulina fabula
Donax vittatus
Abra alba
Chamelea gallina

LITTORAL HABITATS

ROCKY SHORES

1. Very exposed - open shores with a vertical or strongly sloping profile, subject to considerable wave action. Wide splash zone, many crevices, low algal diversity:

Patella vulgata
Patella ulyssiponensis (S&W)
Patella depressa (S&W)
Melarhaphe neritoides upper shore, splash zone
Littorina saxatilis } not separable on shell
Littorina arcana (?W) }
Littorina nigrolineata (SW&W)
Nucella lapillus
Mytilus edulis
Musculus discors
Lasaea adansoni (= L. rubra) upper shore.

2. Semi-exposed - less open than above with a shallower slope and greater diversity of algae. Still subject to wave action. Often with large rocks.

All of the above species plus the following:

Tectura testudinalis northern
Tectura virginea
Helcion pellucidum
Monodonta lineata (SW&W)
Gibbula umbilicalis (S&W) – upper/middle shore
Gibbula cineraria
Tricolia pullus
Littorina littorea
Littorina obtusata
Littorina mariae
Lacuna pallidula
Rissoa parva
Rissoa interrupta
Hiatella arctica
Heteranomia squamula

3. Sheltered - often extensive ledge systems with low wave action. Many pools, crevices, overhangs. High diversity of weeds and other animals.

Fauna includes many of the species from Section 2 but fewer from Section 1. The additional fauna is almost endless depending on the degree of shelter and overall species richness of the site, however the following are typical:

Chiton species
Calliostoma zizyphinum
Lacuna vincta
Lacuna parva
rissoids
Trivia arctica
Trivia monacha
Lamellaria latens
Lamellaria perspicua
Buccinum undatum
Ocenebra erinacea
Hinia incrassata
nudibranchs
Modiolus barbatus (SW&W)
Chlamys varia
Venerupis senegalensis (= V. pullastra)

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4. Mixed shores - have many of the elements of a very sheltered rocky shore but have a variety of substrate types, particularly gravel and mud. They have many of the species from Sections 2 & 3, and the sandy shore list, but also a number of infaunal molluscs, especially bivalves:

Hinia reticulata
Philine aperta
Antalis spp
Anomia ephippium
Parvicardium exiguum
Cerastoderma edule
Loripes lucinalis (S&SW)
Lucinoma borealis
Tridonta spp. (W&N)

Spisula subtruncata
Mya truncata
Tapes decussatus
Tapes aureus
Venerupis senegalensis
Venus verrucosa
Crepidula fornicata (S to E)

5. MOLLUSCS OF A SANDY SHORE

The fauna of a sandy shore will to some extent depend on the degree of exposure and the size of the sand grains, and therefore, the stability of the sand. In an ideal sheltered sandy environment such as at Oxwich Bay, S. Wales or Camber Sands in Sussex, the mollusc fauna is relatively rich, although the diversity is much lower than on a sheltered rocky shore. In less favourable conditions such as the long stretches of sand on the Lincolnshire coast, the diversity is lower. Most of the molluscan species are infaunal and of which the majority are bivalves. The gastropods are usually species that are predatory on the bivalves and other infaunal animals. Generally there is less biogeographical variation in sandy shore faunas. Most of the species listed may be recorded by digging and sieving at LWST and below:

BIVALVES

Angulus tenuis
Fabulina fabula
Mactra stultorum
Donax vittatus
Ensis siliqua
Ensis arcuatus
Ensis ensis
Solen marginatus
Abra alba
Pharus legumen (S&W)
Chamelea gallina
Spisula solida
Lutraria lutraria

GASTROPODS

Polinices polianus
Polinices catenus
Hinia reticulata
Epitonium spp.
turrid spp.
Actaeon tornatilis (S&W)

Where there is a silty element, species such as *Cerastoderma edule* and *Macoma balthica* will occur.

SALTMARSH, LAGOONAL & BRACKISH WATER MOLLUSCS

Shingle Banks

There are frequently shingle banks associated with saltmarsh, estuarine rivers and lagoons. Digging into the shingle (down to 6") around the high tide level, particularly where a flora with sea purslane and shrubby sea blite has developed may yield the following species:

Paludinella litorina (S&SW)-RDB3
Truncatella subcylindrica (S)-RDB3
Ovatella myosotis
Leucophytia bidentata

pulmonates

Saltmarsh

Area of mud and small pools associated with rivers and estuaries and colonised with many species of plants and green algae. Species that may be found include:

Assiminea grayana (SE&E)
Hydrobia ulvae
Littorina saxatilis
Ovatella myosotis
Limapontia depressa 1mm jelly blobs
Alderia modesta

Lagoons

Bodies of water with a salinity range 5-35 parts per thousand of chloride. They may be land-locked with just a percolation of sea water, fed by a sea water spring or have direct contact with the sea through a narrow entrance. The species found are determined by the actual salinity level, however, they are usually drawn from the following:

Hydrobia ulvae
Hydrobia neglecta
Hydrobia ventrosa
best separated by tentacle pigment in live animals
Littorina saxatilis
Onoba aculeus – only recognised in last 10yrs as lagoonal
Lepidochitona cinereus
Akera bullata
Haminoea navicula
Cerastoderma glaucum
Abra tenuis – never sublitt.

Muddy shores - estuaries & tidal rivers

The fauna of these habitats will depend upon tidal flow, salinity, substrate etc.

Lepidochitona cinereus
Littorina littorea
Littorina saxatilis
Littorina obtusata
Crepidula fornicata (S to E)
Retusa obtusa
Aeolidiella alderi (S&W)
Tapes decussatus
Ostrea edulis
other oyster spp
Mytilus edulis
Cerastoderma edule
Abra tenuis
Macoma balthica
Scrobicularia plana
Mya arenaria

On muddy substrates that receive less brackish water influence the fauna will change to contain elements from the shore and gravel/mud shores in addition to many of the above.

CLASS: POLYPLACOPHORA - THE CHITONS

Ref: Jones A.M. & Baxter J.M. 1987. Molluscs: Caudofoveata, Solenogastres Polyplacophora and Scaphopoda. *Synopses of the British fauna* (NS) No. 37 Academic Press, London.

These notes are intended to highlight diagnostic features. The recommended text gives a key and thorough description of each species. The main features for separation are the presence or absence of spines, sculpture of the shell valves and girdle characteristics. Colour is also very helpful but this feature is lost in specimens stained with rose bengal.

Lepidochitona cinereus
By far the commonest intertidal and shallow water species. Can be difficult to identify. The animals have a dorsal keel with the valves covered in very fine granules. The girdle is moderately broad and covered in densely packed rounded granules.

Leptochiton asellus
The commonest sub-littoral species especially on gravel/cobble. Appears superficially similar to *L. cinereus* but has a proportionately narrow girdle which is covered by densely packed, elongate, bluntly pointed scales. Colour is usually cream but they are frequently covered in black Fe/Mn deposits.

L. cancellatus.
Smaller than *L. asellus* and with a rounded not keeled dorsum. Finely granular valves; girdle with squarish scales.

L. scabridus
Small, <8mm and with bright red foot. Rare.

Tonicella rubra
Typically valves are pink and brick red with patches and/or streaks of cream and light brown. Valves appear almost smooth; the girdle is granular.

Tonicella marmorea
The largest chiton in British waters (to 45mm) found mainly off northern and western coasts. Valves appear smooth but are actually covered in minute granules. The girdle is also covered in minute granules giving a leathery appearance. Usually has marbled green or red/brown appearance.

Ischnochiton albus
Similar in size and shape to *L. cinereus* and *L. asellus*. Recognisable by the distinctive girdle covered in very large oval scales. Scarce, mainly found off northern and western coasts.

Callochiton septemvalvis
Colour very similar to *T. rubra* but the spines on the girdle form a diamond pattern which gives a snakeskin appearance and this is diagnostic of the species. Common along western and northern coasts.

Hanleya hanleyi
More elongate shape than other chitons. The valves are coarsely sculptured with a pattern of small and large papillae. The girdle is narrow and densely covered by small spicules and numerous larger spines. A relatively rare, sub-littoral species occurring off western coasts.

Acanthochitona crinitus
Valve surfaces are coarsely granular with pear shaped papillae. Girdle has 18 tufts of bristles of which 4 arranged around head valve and remainder distributed at intersection of the valves. Frequent especially on rocky substrates.

A. fascicularis
Valve surface is finely granular with small round papillae densely distributed. Girdle as in *A. crinitus.* Much less common than *A. crinitus*, often in sheltered places on muddy gravel.

Girdles of selected species;

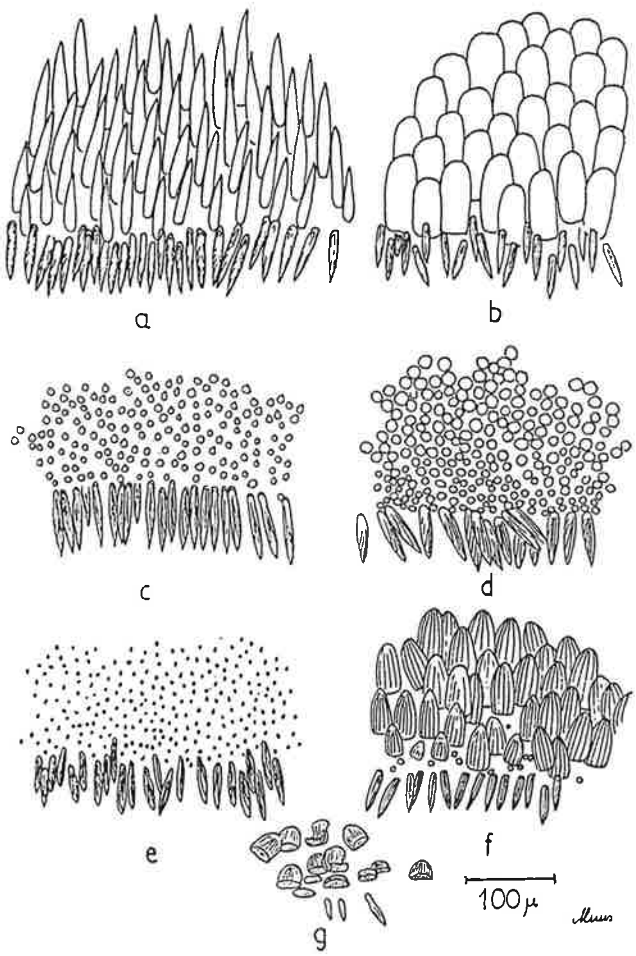
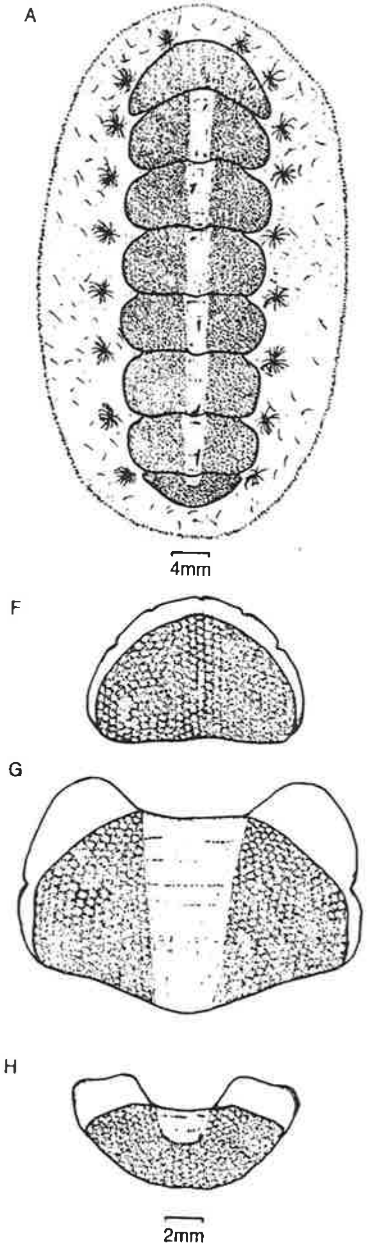
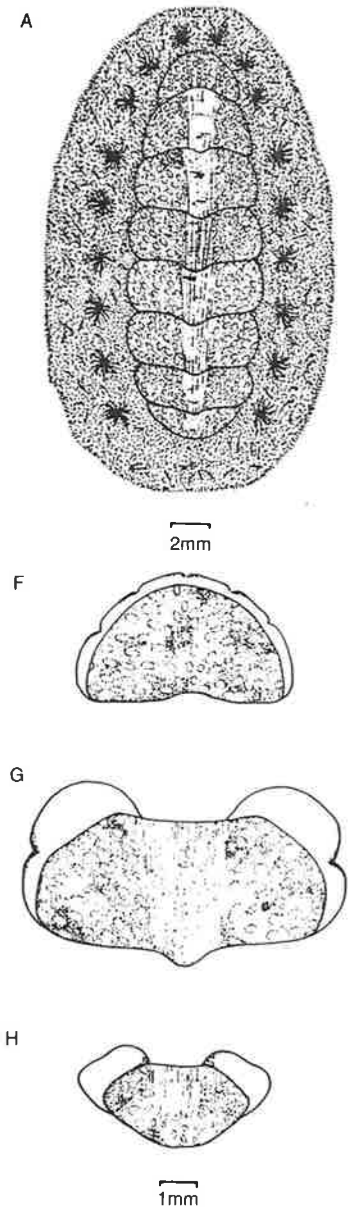


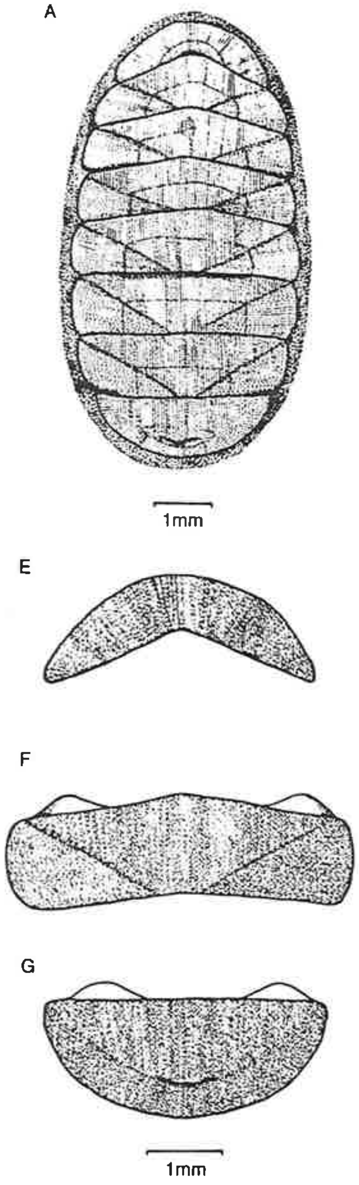
Fig. 19. Perinotums rand hos: a Callochiton laevis, b Ischnochiton albus, c Lepidochiton cinereus, d Tonicella rubra, e T. marmorea, f Lepidopleurus asellus, g L. cancellatus. Orig.



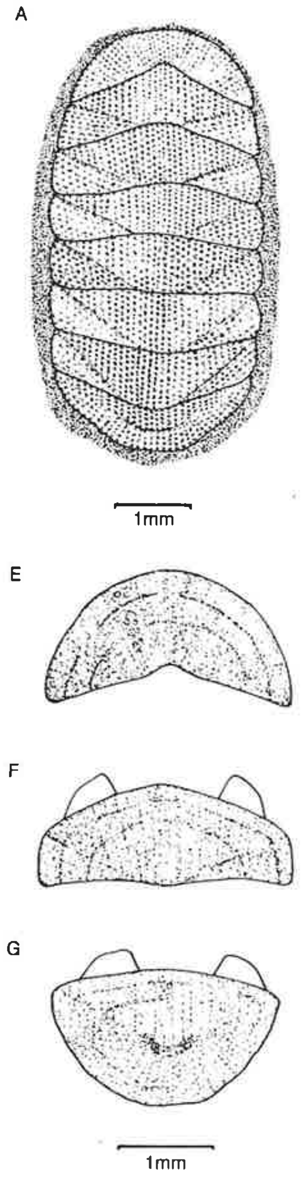
Acanthochitona fascicularis.



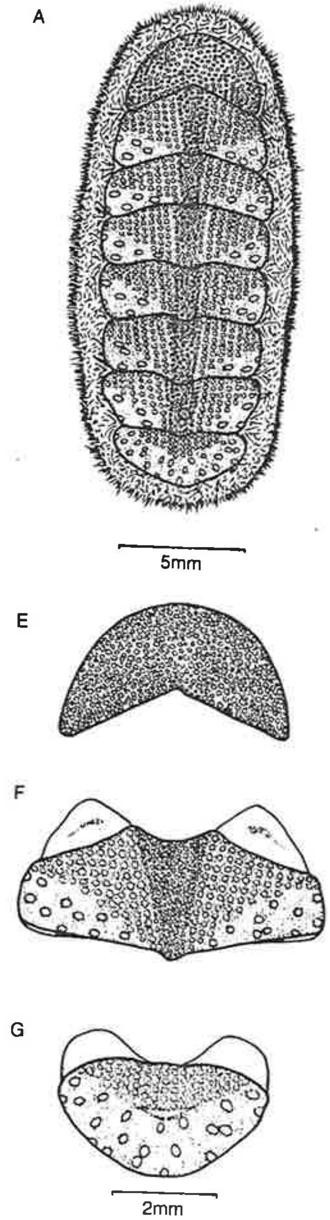
Acanthochitona crinitus.



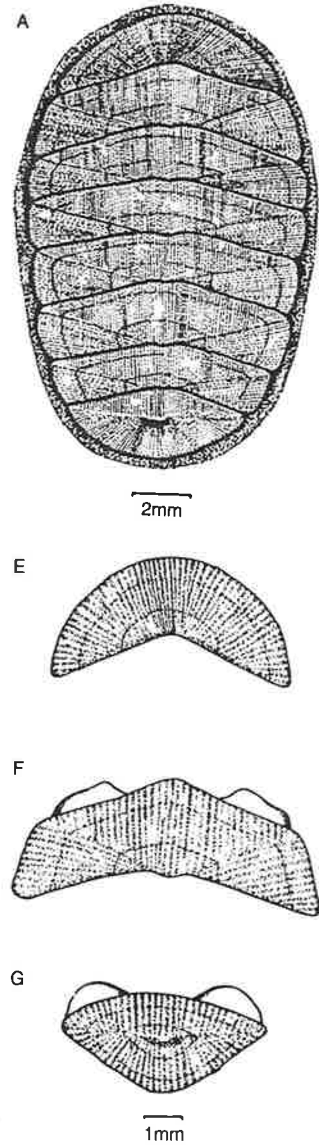
Leptochiton cancellatus.



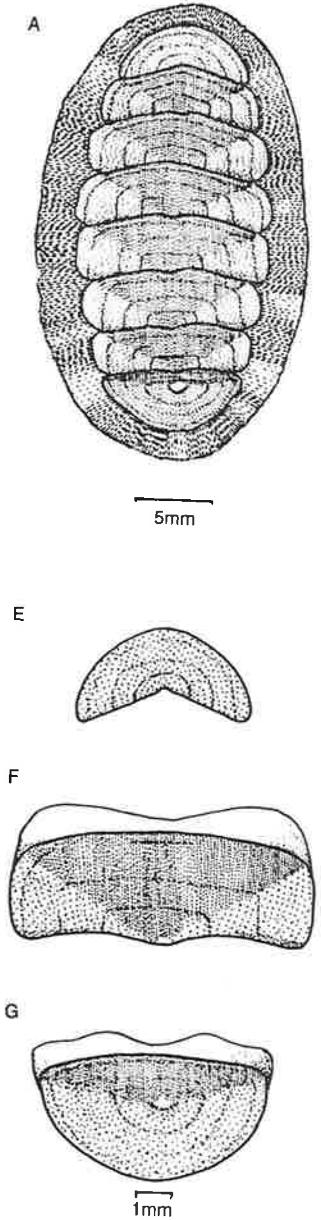
Leptochiton scabridus.



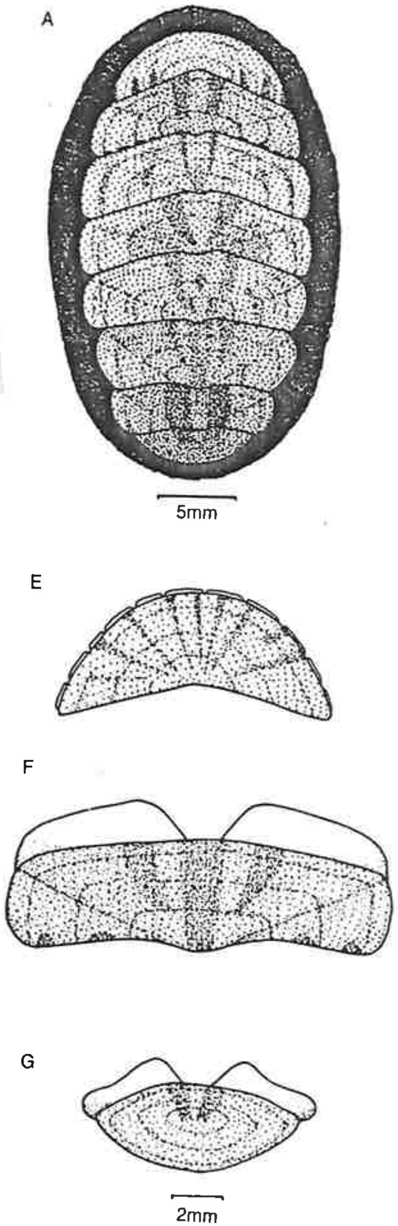
Hanleya hanleyi.



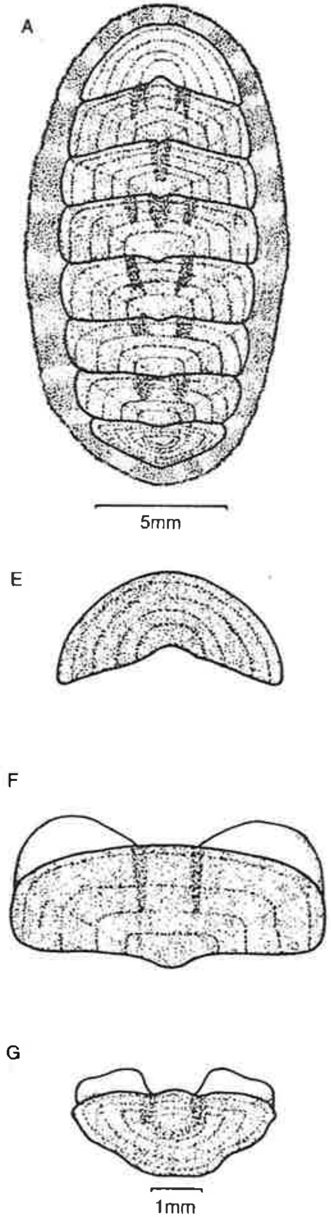
Leptochiton asellus.



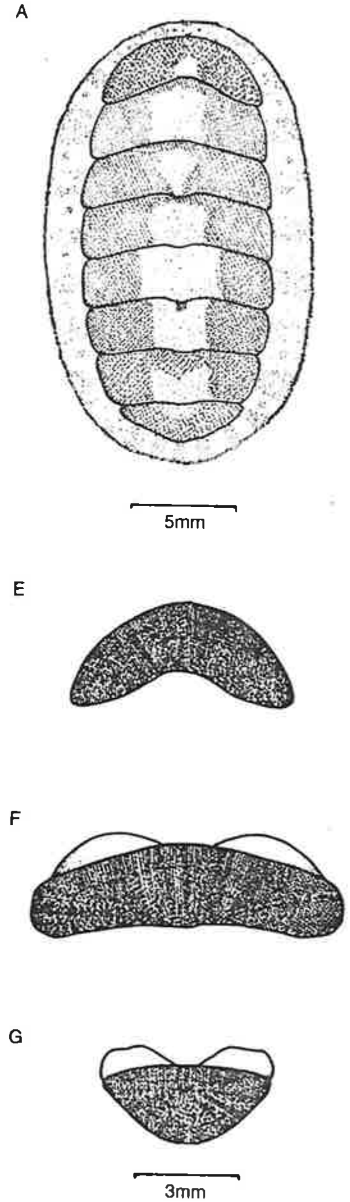
Callochiton achatinus.



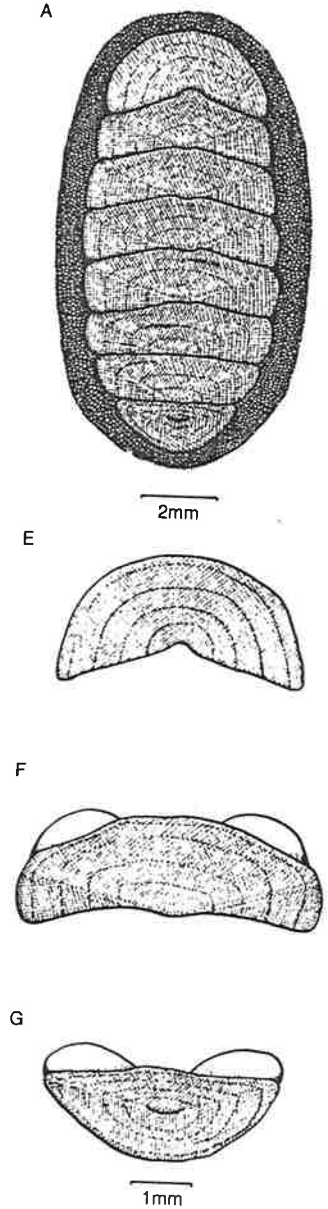
Tonicella marmorea.



Tonicella rubra



Lepidochitona cinereus.



Ischnochiton albus.

LIMPETS

The limpets, particularly the *Patella* species are amongst the commonest littoral animals on rocky shores.

Patella vulgata	*Helcion pellucidum*
Patella ulyssiponensis	*Tectura testudinalis*
Patella depressa	*Tectura virginea*

Patella

With experience, the *Patella* species are generally easy to separate providing factors such as habitat, exposure and geography are considered. They cannot be reliably identified on external shell characteristics alone and therefore it is always wise to 'flip' a few over to examine the animal:

P. vulgata - ubiquitous around the British Isles on any rocky substrate. Indifferent to exposure/shelter and lower salinity. Lives from very high on the shore to low water.

Considerable variation in shell size and shape. Grows to c. 60mm and may be high or low spired depending on exposure. Small flat specimens are easily mistaken for *P. depressa* from above! Inside of edge of shell is dullish and coloured olive, greyish blue etc, often with coloured radiating stripes. Foot of animal is a olivaceous 'sludge' colour and with no pigmentation to the marginal tentacles on the mantle.

P. ulyssiponensis (syn. *P. aspera*) - Does not occur between the eastern tip of the Isle of Wight and the Humber. Prefers exposed, fully marine environments. Lives from lower-middle shore downwards.

Length up to c. 60mm. Relatively low spired with distinct radiating ribs characteristically alternating 1 coarse, 2 fine. Often covered in weed. Inside of shell is polished, bluish-white with 'porcellanous' appearance, and with a pinky head scar. Foot of animal is bright apricot (greyer in juveniles), marginal tentacles have some white pigmentation.

P. depressa - A southwestern species occurring between the Isle of Wight and north Wales. There is much conjecture over its presence/absence in Ireland. Lives in exposed, fully marine environments from the middle shore downwards.

Length up to 30mm. Low spired with radiating ribs, often alternating 1 coarse 3-5 fine. Often occurs in low numbers and can therefore be difficult to spot. Inside of shell is polished with characteristic radiating brown rays, head scar usually orange. Foot of animal dark grey to black, marginal tentacles have distinct white tips. Animal must be examined for positive identification.

Individuals are frequently found with animals intermediate in character. These are probably best ignored and the search continued until 'true' specimens are found.

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Limpets (continued)

The remaining three species are unlikely to be confused with the *Patella* species but are superficially similar to species in the bottom list. They all have smooth shells and different ecological requirements to *Patella*.

Blue - Rayed Limpet.

Helcion pellucidum - Occurs all around the British Isles although it is local in the eastern Channel and southern North Sea. Typically lives on *Laminaria* spp although juveniles are often found on *Fucus serratus*. Occurs sub-littorally to c.20m.

Grows to c.15mm in length. Occurs as 2 shell morphs: a large, thicker shelled form that lives in the kelp holdfasts and a smaller, thinner shelled form that lives on the stipes and fronds. The species is characterised by its smooth brown shell and the presence of bluey green rays. These rays may be almost indetectable on old large specimens.

Tectura testudinalis - A northern species extending to Yorkshire on the east and Anglesey on the west coast. Occurs on rocks from the lower shore to c.50m. Does not live in very exposed environments.

Large specimens grow to 25mm in length. Dark reddish brown rays are present on the shell though they are often obscured by algae or erosion. Inside of shell polished bluey white with brown head scar. The ends of the brown rays are clearly visible around the inside margin of the shell.

Tectura virginea - Occurs all around our coasts from LWST down to c.100m. Lives on small pebbles and rocks, characteristically on those encrusted with *Lithothamnium* spp. and upon which they can be very difficult to spot.

Much smaller than the preceding species, growing to 10mm. Outer surface of shell is greyish with usually pink or brown rays. Inside polished with purple tinge and ends of pink rays visible at margin. (on inside)

OTHER SPECIES WITH LIMPET-LIKE SHELLS

Emarginula fissura - Slit in anterior margin, occurs on gravel and rocks from LWST to >100m. Common in west & north. Also *E.crassa* (large, northern) and *E.rosea* (small, southern)

Diodora graeca - Has keyhole at apex, occurs on rocks and gravel from LWST to >100m.

Puncturella noachina - Keyhole just anterior of apex, could be confused with juvenile *Diodora*. Northern, sulittoral.

(= Lepeta fulva)

Iothia fulva - No slits, has radial and concentric sculpture. Orange shell. Northern, sublittoral on stones to >100m.

= P. ancyloide

Propilidium exiguum - No slits, has radial and concentric sculpture. Sublittoral to >100m, mainly northern & western.

SUPERFAMILY - TROCHACEA

Monodonta lineata - Geographically restricted to south and west. Lives on mid and upper shore. Adults are distinctive but juveniles may be confused with *Gibbula umbilicalis*.

Gibbula cineraria - extremely common on rocky shores from mid-tide level and sulittorally on gravel & rocks to c.100m. When typical not difficult to identify, but its shell morphology is variable and specimens with depressed spires and uncharacteristic colour patterning can be confused with *G. umbilicalis.* Juveniles may also be confused with *G. tumida*

Gibbula umbilicalis - Geographically restricted to south & west. Occurs in a relatively narrow band on the upper shore. Typical specimens with purplish red, wider banded patterning are not difficult and juveniles are often easier than adults.

Gibbula magus - a distinctive trochid with a patchy distributuion. Not generally found with rocky shores trochids but prefers flatter stony, gravelly substrates, usually sublittorally. Juveniles might be confused with *G. tumida.*

Gibbula tumida - Not an easy species to identify. It may resemble the young of *G. cineraria* or *G. magus*. The shell profile is slightly more stepped and tumid than *G. cineraria* and it has a characteristic colour pattern. It is the smallest species of *Gibbula* when adult living on gravelly substrates from ELWST to >1000m.

reticulate, granular protoconch

Calliostoma zizyphinum - a very familiar species occurring on rocky substrates from LWST to >200m. Juveniles may be recognised by the granular protoconch. The deeper water *C. granulatum* is similar but has a distinct tuberculate shell.

Jujubinus miliaris - Medium sized with a granular shell and a conspicuous spiral ridge above each suture. Mainly northern and western on gravel from 10 to >500m. Juveniles can be tricky to spot when mixed with juvenile *Calliostoma* spp.

Jujubinus montagui - More elongate spire than *J. miliaris* and with narrow spiral ridges. Shell spotted along the ridges. On gravel and dead shell from10 -200m. Widespread, but rare in east Channel and North Sea.

Margarites helicinus - A small trochid (5mm) with a smooth glossy shell showing pink and green refringence, easy to separate when adult. Lower shore and shallow water on weeds. Essentially northern and northwestern. maerl beds

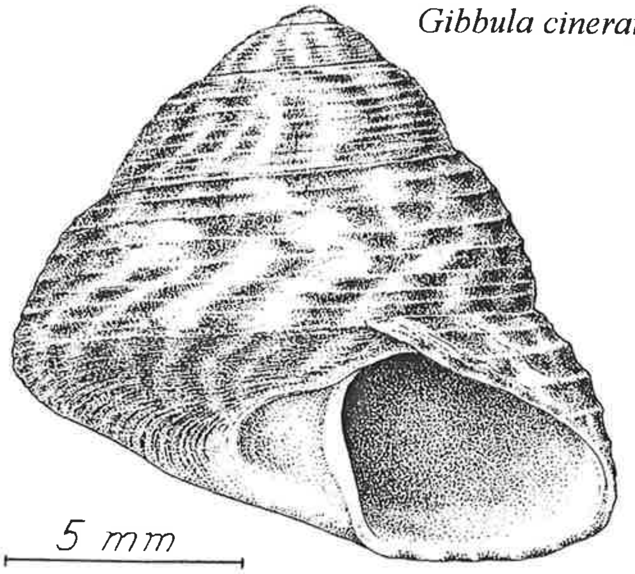
spiral sculpture on base.

Dikoleps nitens and *Skenea serpuloides* - Very small white shells (<2mm) living in gravel/dead shell from ELWST to >100m. *D. nitens* is smooth shelled, *S. serpuloides* has spiral sculpture.

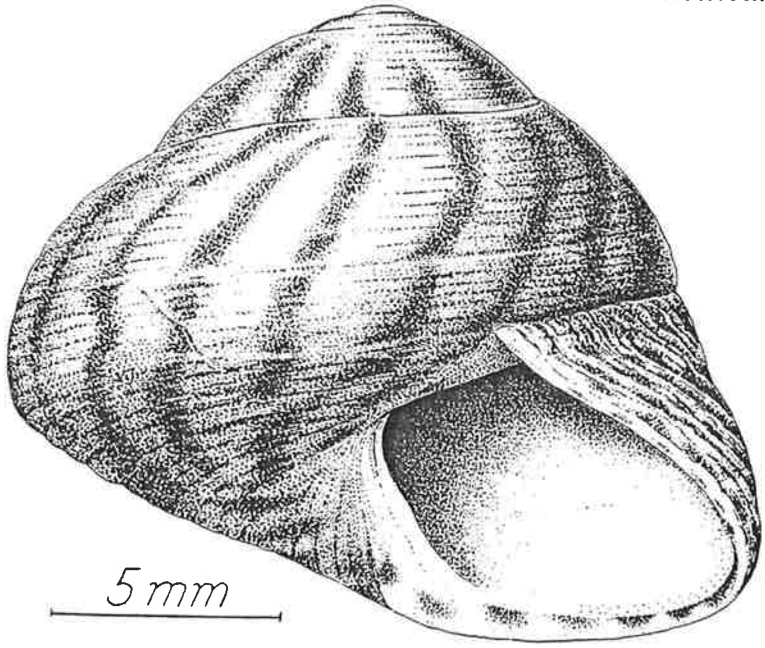
only British species with calc. operculum

Tricolia pullus - Distinctive, colourful species with red striped shell and white calcareous operculum. Lives on mainly red weeds from mid-shore to >50m depth.

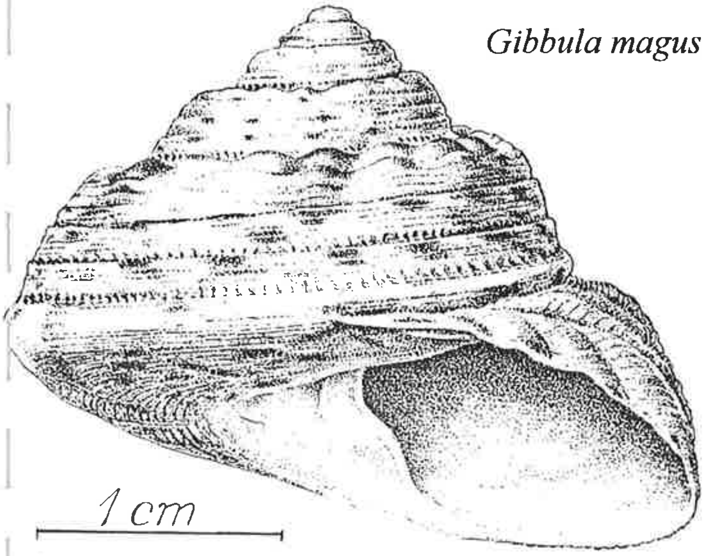
TROCHACEA



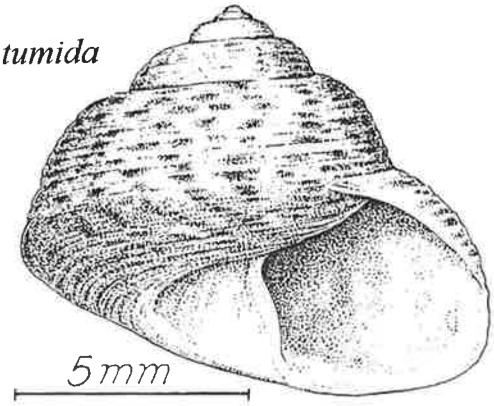
Gibbula cineraria



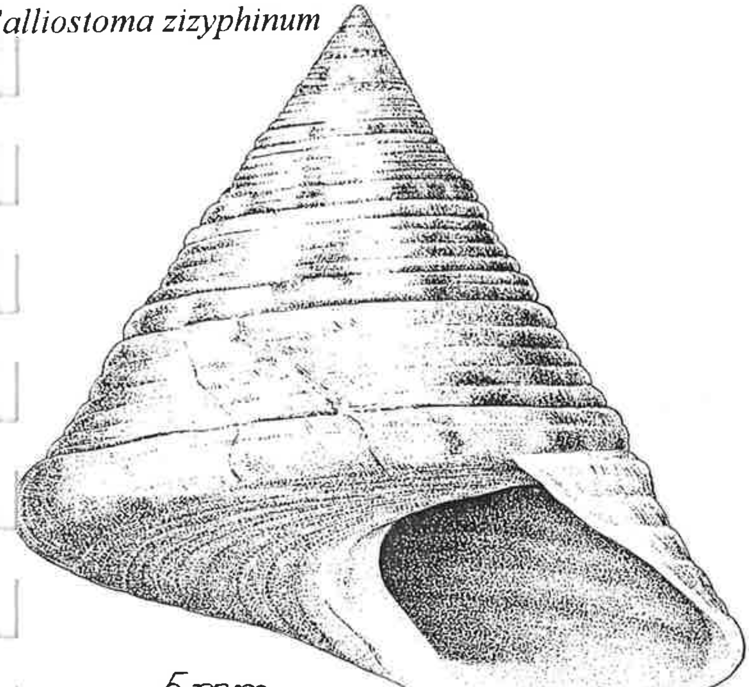
Gibbula umbilicalis



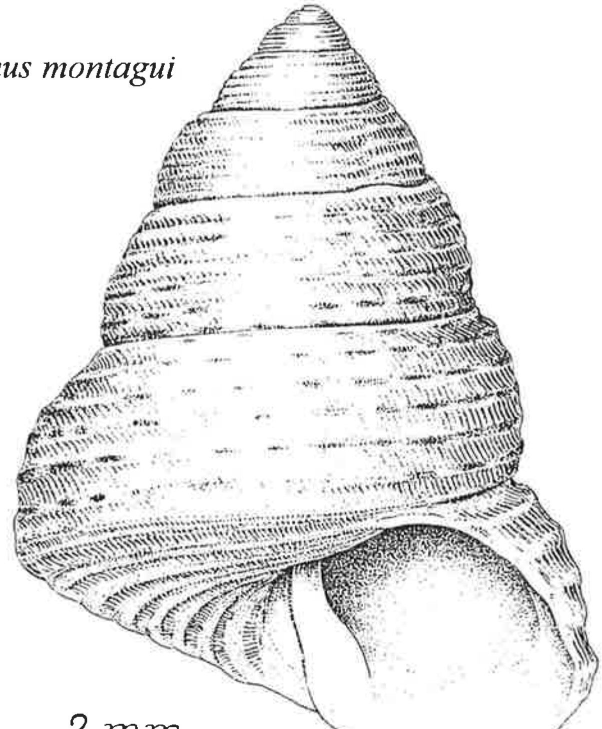
Gibbula magus



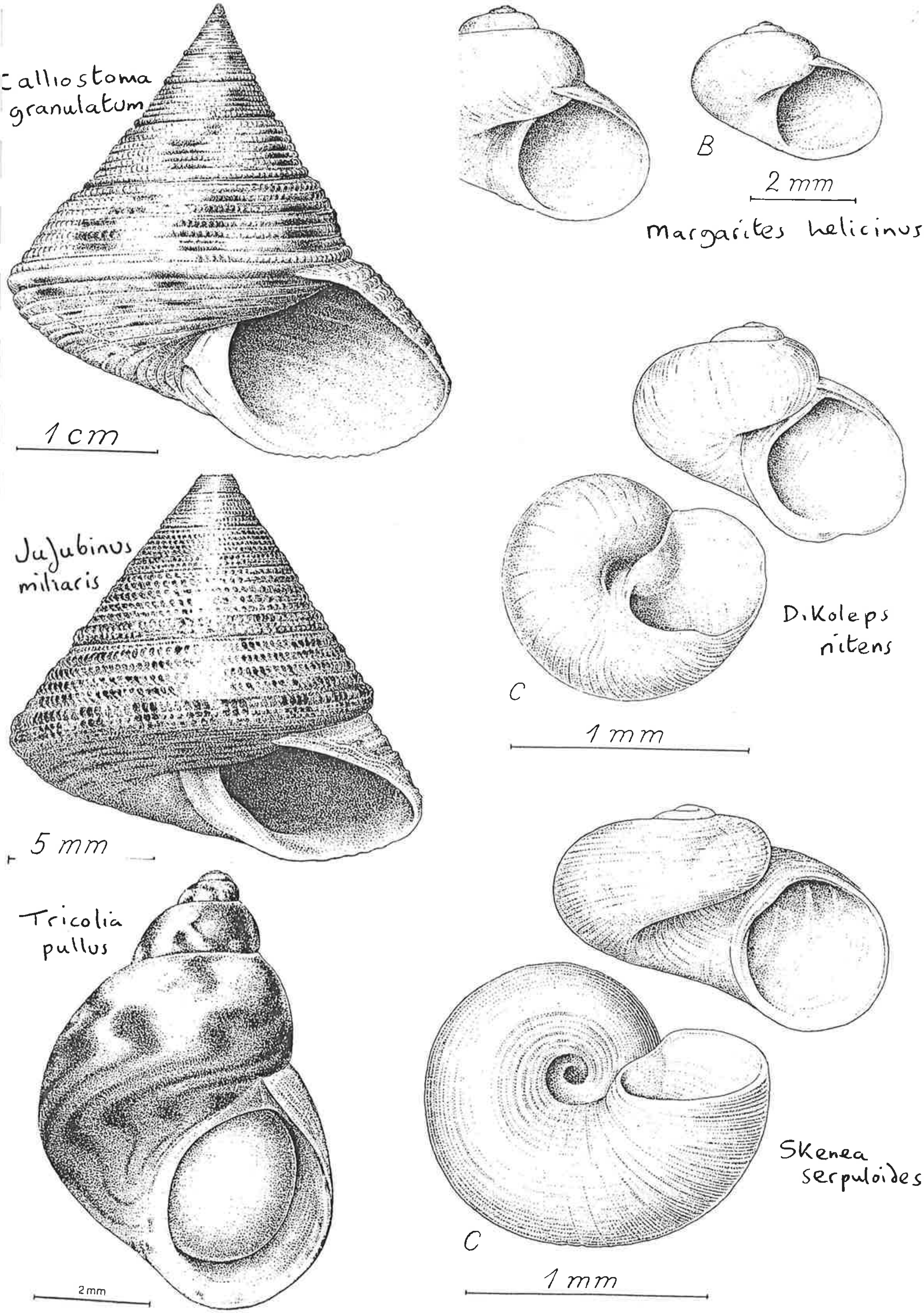
Gibbula tumida



Calliostoma zizyphinum



Jujubinus montagui



Calliostoma granulatum
1 cm
B
2 mm
Margarites helicinus
Jujubinus miliaris
Dikoleps nitens
C
1 mm
5 mm
Tricolia pullus
Skenea serpuloides
C
1 mm
2mm

WINKLES Littorinacea

The littorinids are amongst the most successful and frequently the most abundant group of molluscs on the shore. Amongst malacologists and general marine biologists alike, some have a reputation for being difficult to separate which to some extent is justified. It is not possible to separate some of the aggregates in the field, although this means that specimens have to be collected and preserved, it does increase the likelyhood of a positive identification.

Several species and countless forms are 'recognised' of which we will deal with the following:

Melarhaphe neritoides
Littorina obtusata
Littorina littorea
Littorina mariae

the *saxatilis* 'complex':

Littorina saxatilis
Littorina arcana
Littorina nigrolineata
[*Littorina neglecta*]
[*Littorina tenebrosa*]

periostracum flap over lip.

Melarhaphe neritoides - Relatively easy. Occurs very high on exposed shores (splash zone) in crevices, empty barnacles etc. Absent from the southern North Sea and the extreme east of the Channel.

Small (up to 10mm) smooth, pointed shell, usually bluey black/brown in colour with characteristic flap of periostracum projecting beyond the margin of the lip of the shell. Often occurs in low numbers and therefore can be difficult to locate (especially among *saxatilis* populations).

Littorina littorea - Relatively easy. Found on most shore types from moderately exposed to sheltered estuaries with reduced salinity. Widely distributed all around Britain.

Largest member of the genus (up to 30mm in height). Generally smooth shell with faint spiral lines. Many colour morphs but is usually dark grey or black often with alternate pale and dark spiral bands. Juveniles have spiral ridges and may be confused with *L. saxatilis* agg, but can usually be separated by the relatively large body whorl and the presence of pale & dark bands inside the outer lip.

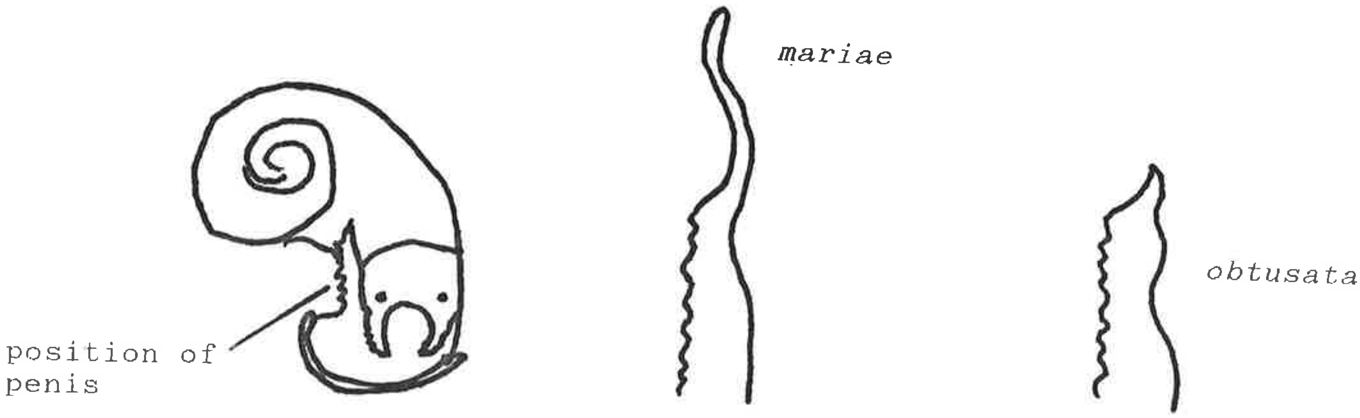
best examine anatomically
not figured:- Synopsis

Littorina obtusata and ***Littorina mariae*** - shell morphology unreliable, but very easy anatomically. They occur on a variety of shores from semi-exposed to very sheltered where they are always associated with fucoids. Generally *L. obtusata* lives slightly higher on the shore than *L. mariae* and it will also tolerate more estuarine conditions. Both occur all around the British Isles.

ctd.....

In size, shape and colour the 2 species are highly variable and similar to each other. Although not reliable for positive identification *L. obtusata* (>15mm) grows larger than *mariae* (>10mm) and is usually higher than it is broad. In *obtusata* the aperture is to the bottom right whereas on *mariae* it is more on the right hand side. *L. obtusata* has more appearance of a spire and often has spiral lines. Very variable in colour from yellow, orange, brown etc, though in sheltered conditions *obtusata* is usually olivaceous with a bright purple inside lip and a yellow edge.

For a positive identification it does require anatomical examination although dissection is unnecessary. Firstly you should endeavour to collect males, these are usually the smaller of the adult specimens (i.e. those with the thickened lip). Preserve specimens in alcohol or formalin and remove the animal when fixed. Hold or pin the animal down and peel back the mantle to expose the penis which is located at the back of the head on the right hand side. If you get a female continue to remove animals until you get a male. The two species are very easily separated on the basis of penis characteristics. *L. mariae* has a long filament, *L. obtusata* does not:



The *saxatilis* group

Littorina nigrolineata - tricky! A western species occurring from southwest England around the west and north coast of Scotland down to Northumberland. It lives on the middle and upper shore on fairly exposed rocky shores, frequently occurring in small weedy pools. They are egg laying.

Grows to c.20mm in height. The species is characterised by the distinct, wide, regular ribs separated by narrow grooves. These ridges are usually flattened and often referred to as straplike. Some populations are distinctly coloured with deep yellow shells and brown grooves, however, a plain greyish yellow shell is more usual. There is frequently no pigmentation of the grooves. Likely to be confused with *saxatilis*.

Live-bearer lays eggs

Littorina saxatilis and ***Littorina arcana*** - difficult. *L. saxatilis* occurs on the upper shore all around the British Isles in a wide variety of exposed and sheltered rocky habitats, groynes etc. It will also live on saltmarshes and in lagoons with low salinity levels. The ecology and distribution of *L. arcana* is incompletely known. Its distribution is generally similar to *L. nigrolineata*, absent from the Channel and southern North Sea. It lives with *saxatilis* but is said to prefer more exposed shores and live a little lower down.

The shell grows to c.15mm in height and have irregular raised spiral ridges. The colour shows a wide range from grey, yellow, orange, brown etc. The two species are indistinguishable on shell morhology and specimens must be collected and preserved to attempt separation.

The penis of the males is situated behind the right tentacle (as with *obtusata/mariae*) although not a totally reliable method of separation. The penis of *saxatilis* has a 'mucronate' tip whereas *arcana* is tapering with more glands:

saxatilis

arcana

There are major differences in the females as *arcana* is oviparous (egg laying) and therefore has a glandular oviduct, whereas *saxatilis* is oviviparous and gives birth to live young. Females collected in spring or summer will contain juveniles if they are *saxatilis* and if they do not, they are more likely to be *arcana*. Consult Hannaford-Ellis (1979) for further information.

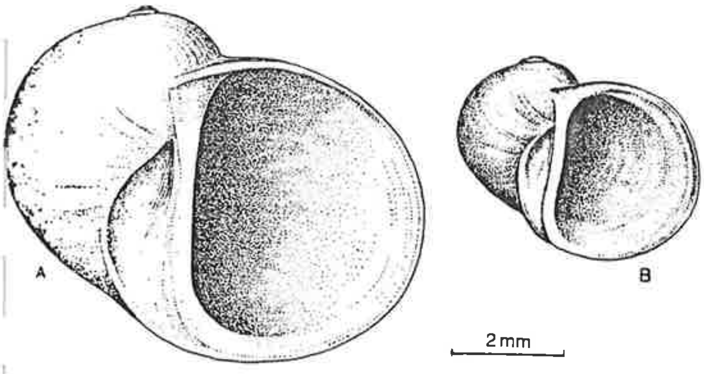
[*Littorina neglecta*] - Small tessellated specimens inhabiting barnacle shells have been traditionally referred to as *L. neglecta*. Recent work (Reid, 1993) has shown that specimens of this form from loci in southwest Britain and Ireland are a mixture of *saxatilis*, *arcana* and *nigrolineata*. Until the taxonomic position of *neglecta* is fully resolved, there is little virtue in recording this form unless material is retained in spirit.

[*Littorina tenebrosa*] - This is now regarded as thinner, smoother shelled form of *saxatilis* living in brackish water.

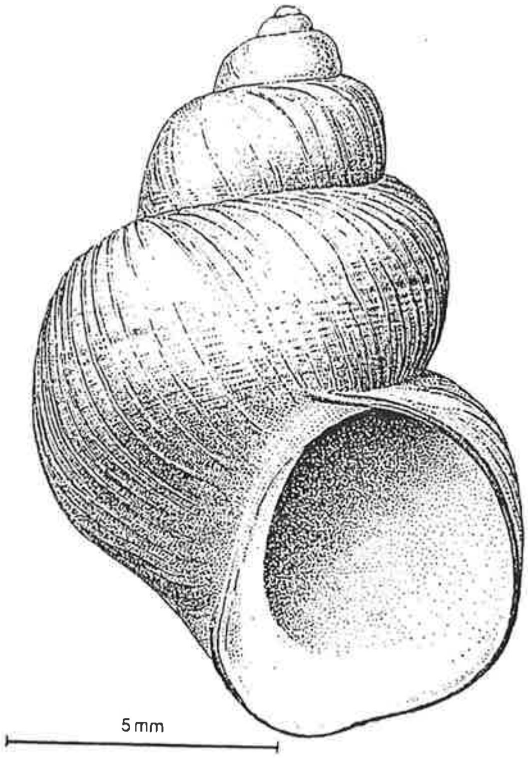
References:

Hannaford-Ellis, C.J., 1979. *J. Conch. Lond.*, **30**: 43-56
Reid, D.G., 1993. *J. moll. Stud.*, **59**: 51-62.

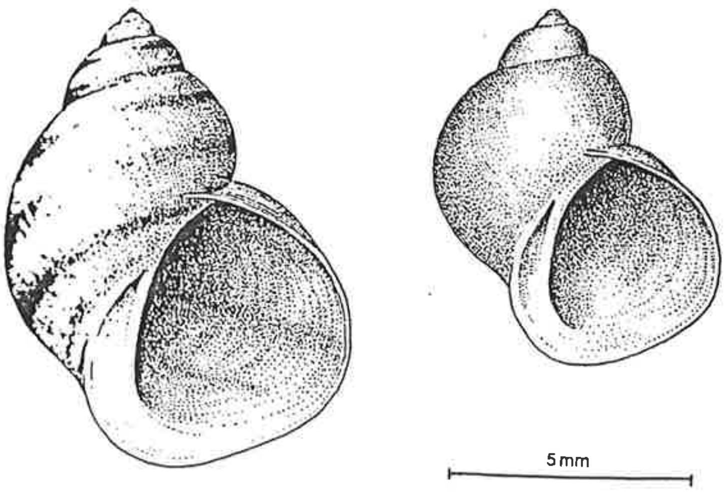
Genus *Lacuna* 'Chink shells'
green doughnut shaped eggs on kelp.



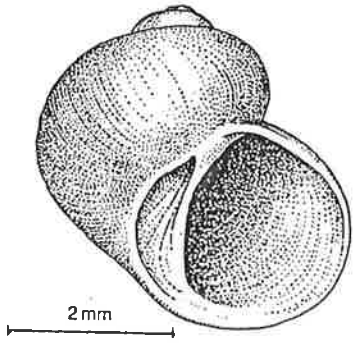
Lacuna pallidula. A, female; B, male.



Lacuna crassior.



Lacuna vincta.



Lacuna parva.

Lacuna species are similar in outline to *Littorina* spp. They have very large body whorls and (usually) distinct umbilical chinks which distinguishes them from juvenile *Littorina obtusata* agg. with which they may be confused.

Lacuna craasior - the largest species (to 15mm). Has thick, pinky brown periostracum. in life Shell usually lacks the umbilical chink. Almost always sublittoral to >50m often associated with *Alcyonidium* on muddy gravel.

Lacuna pallidula - Olive green shell. Littoral, most commonly found on *Fucus serratus*, *Chondrus* & *Mastocarpus*.

Lacuna vincta - usually has spiral brown bands, often on a pale green background. Associated with several weeds suchs as kelps and *Zostera*. Lower shore to c.10m depth.

Lacuna parva - varies in colour from brown to bright purple, never green. sometimes banded. Lives on red weeds especially *Mastocarpus* & *Chondrus* from LWST to c.10m depth.

RISSOACEA and 'allied' groups

The Rissoacea is a large superfamily comprising some 40 species. All of these gastropods are small, generally less than 5mm and many have ornate or strongly sculptured shells. For convenience we have included other superfamilies with similar sized and shped shells:

Rissoellacea
Omalogyracea
Cingulopsacea
plus *Skeneopsis planorbis* which is a littorinacean

They are unlikely to be confused with any other gastropod superfamily (apart from Epitonacea: Aclididae) when examined closely. The following features serve to separate them from other gastropods with small shells:

They lack the siphonal canal possessed by all neogastropods.
Eulimacea have tall pointed, highly glossy shells with very shallow sutures.
Pyramidellacea have a small apertural tooth and/or a protoconch lying across the apex or tucked into it.

Unlike many other gastropods, members of this group are frequently found in large numbers. Samples taken from the lower shore and shallow water weeds may yield several hundred individuals of as many as 15 species.

In addition to the species illustrated several others may occur on the lower shore and sub-littorally to c. 100m.

Rissoa membranacea - Largest of the rissoids, lives in sheltered, often euryhaline conditions. Frequently associated with *Zostera*.

Manzonia crassa - shallow water sediments, mainly southern.

Alvania beanii - sand & shell gravel, mainly north & west.

Hyala vitrea - smooth-shelled, sub-littoral mud with species such as *Abra nitida* and *Nucula nitidosa*.

Obtusella alderi - Minute shell with fine spiral and axial sculpture. Sub-littoral sand & shell gravel.

Hydrobia ulvae - Saltmarshes, estuaries etc, almost always in reduced salinity. Often occurs in enormous numbers.

PLANORBIFORM SPECIES

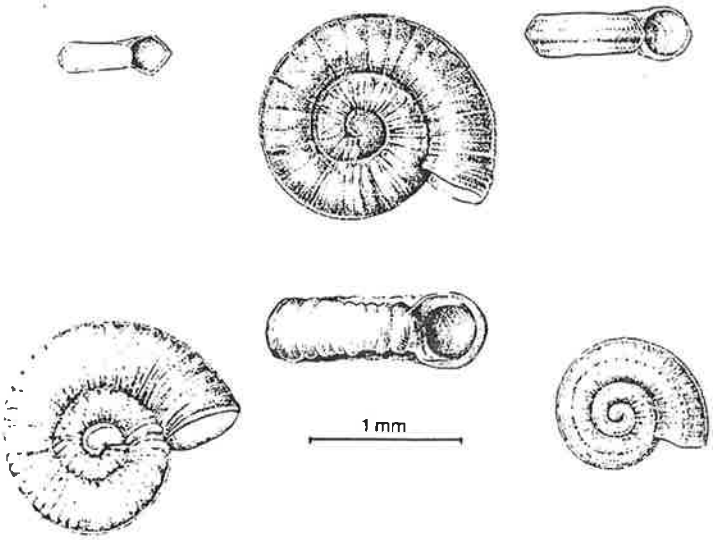


Fig. 111. *Ammonicera rota*.

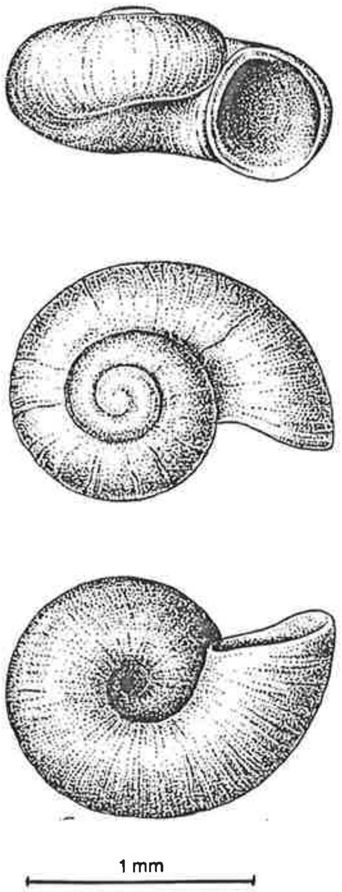


Fig. 112. *Skeneopsis planorbis*.

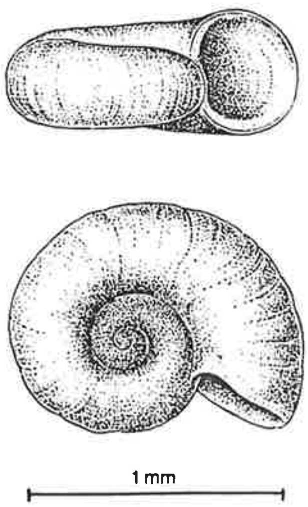


Fig. 110. *Omalogyra atomus*.

Skeneopsis planorbis - smooth, brown shell, low spire, wide, deep umbilicus. Lower shore on a variety of small weeds, particularly *Cladophora*. Seems to like exposed shores.

Omalogyra atomus - nearly smooth glossy, brown shell. Minute. Lower shore on fine weeds. Sometimes in very slightly brackish /lagoonal conditions.

Ammonicerina rota - minute shell with ornament of costae, tubercules and sometimes a peripheral keel. This sculpture is much easier to see when the shell is dry. Often has a peripheral brown band. Lower shore on fine weeds. Frequently associated with the preceding species.

THE *RISSOA* GROUP

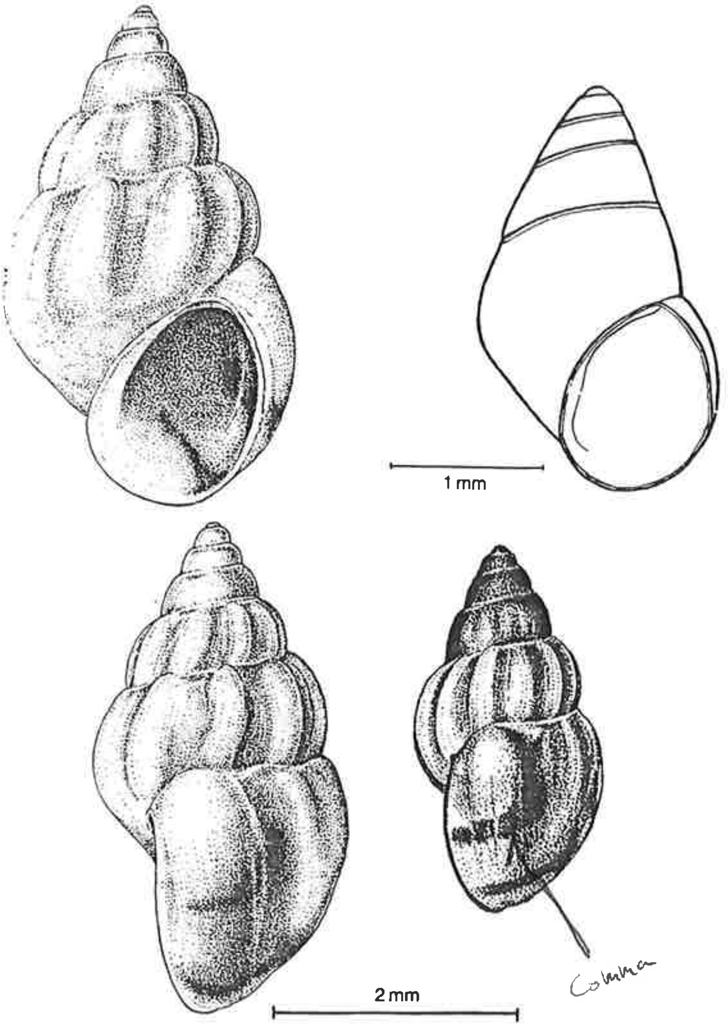


Fig. 80. *Rissoa parva*. Top right, a shell of the variety *interrupta*, sometimes regarded as a separate species.

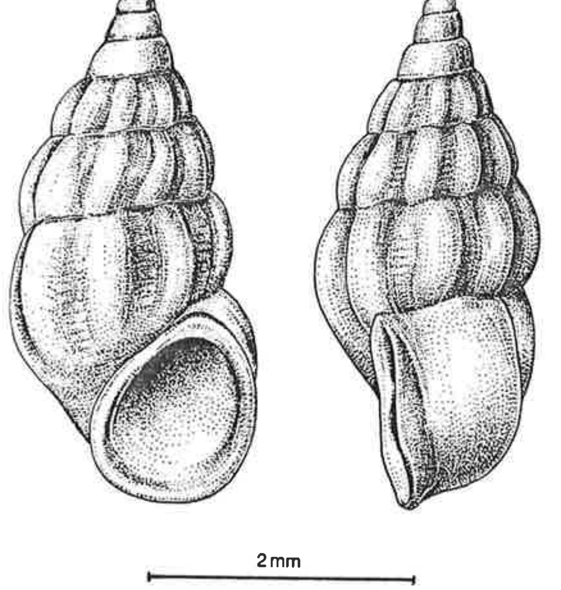


Fig. 81. *Rissoa guerini*.

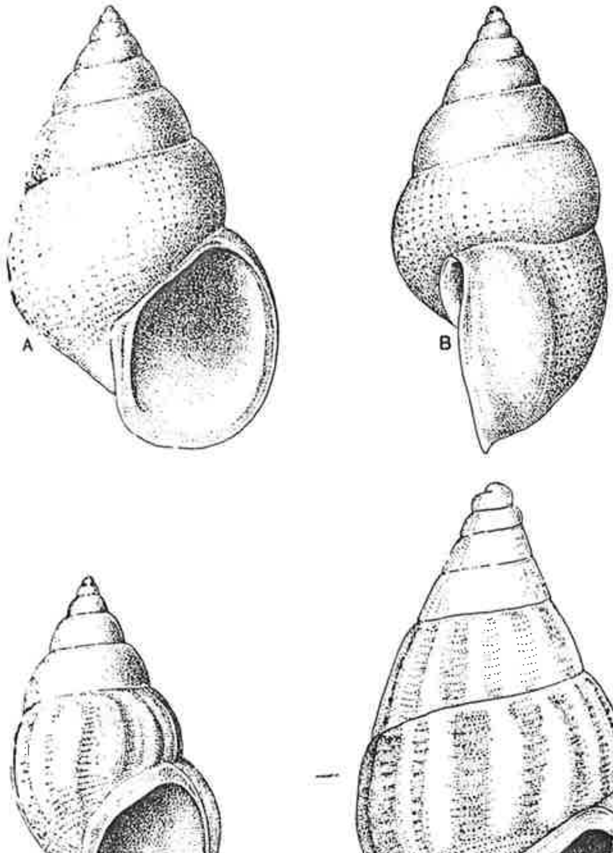


Fig. 82. A, B, *Rissoa porifera*; C, *R. rufilabrum*; D, *R. lilacina*.

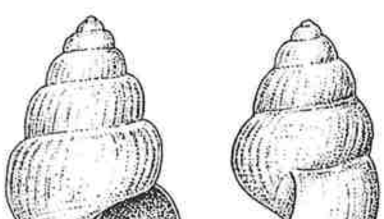


Fig. 84. *Pusillina inconspicua*.

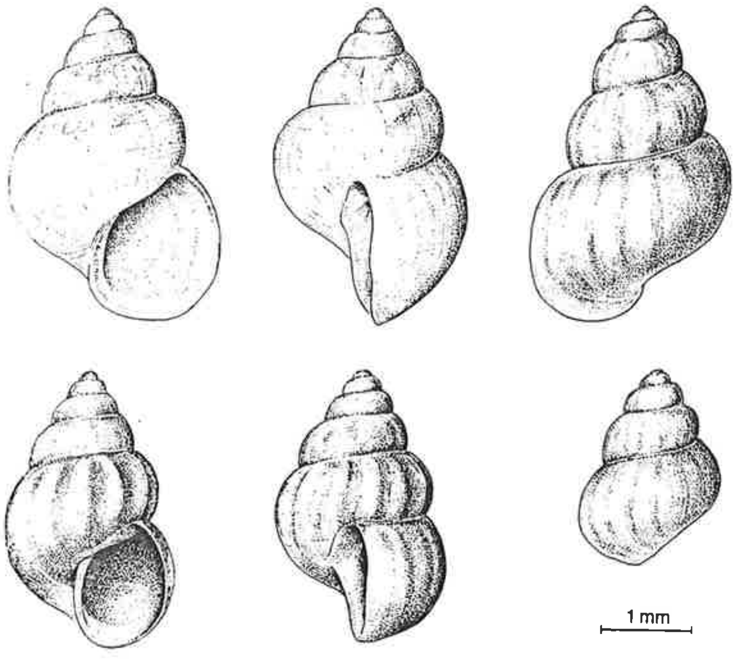


Fig. 85. *Pusillina sarsi*. Upper row, forma *sarsi*; lower row, forma *albella*.

Rissoa lilacina (including *R. rufilabrum* and *R. porifera* which are now regarded as forms of *R. lilacina*) - A very variable aggregate showing a range of sculptural features. They may usually be separated on the basis of their larger size and relatively thick shell. The shell has some colour from just a lilac lip to being completely lilac or brownish/purple. Low shore weeds.

Rissoa guerini - generally smaller and more slender than *lilacina.* Most whorls have thick costae. There is a thick labial varix (a ridge around the lip). The lip is often coloured brown/purple. Low shore weeds particularly *Codium.*

Rissoa parva and *R. interrupta* - usually the dominant molluscs in weed samples, variable and often difficult to separate from each other and other species. Adult *parva* have thick costae, a labial varix and a brown comma-shaped mark over the varix. Adult *interrupta* are flat-sided with smooth shells and a brown comma near the aperture. The comma is absent in juveniles of both species leading to confusion with *Pusillina.* Both species are variable in colour from brown to purple, often with purple apices, frequently spotted brown. There are usually intermediates in most samples. Weeds on middle & lower shore

Pusillina inconspicua - similar to *parva* group but smaller, more delicate shell. Has finer costae and usually has a purple spot on the apex, but no brown comma. Very low shore red weeds, particularly *Griffithsia* and frequently occurs at low density. Can be difficult to see amongst several hundred (especially juvenile) *R. parva.*

Pusillina sarsi - a seemingly uncommon species but included for comparison. Similar to *P. inconspicua* but with deeper sutures and more swollen whorls. There is a smooth and a costate form.

GASTROPODS WITH SPIRAL SCULPTURE

Fig. 100. *Onoba semicostata.*

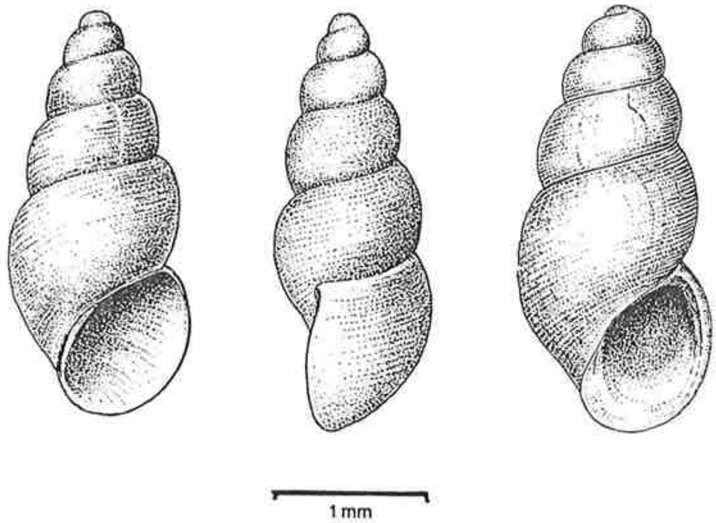


Fig. 101. *Onoba aculeus.*

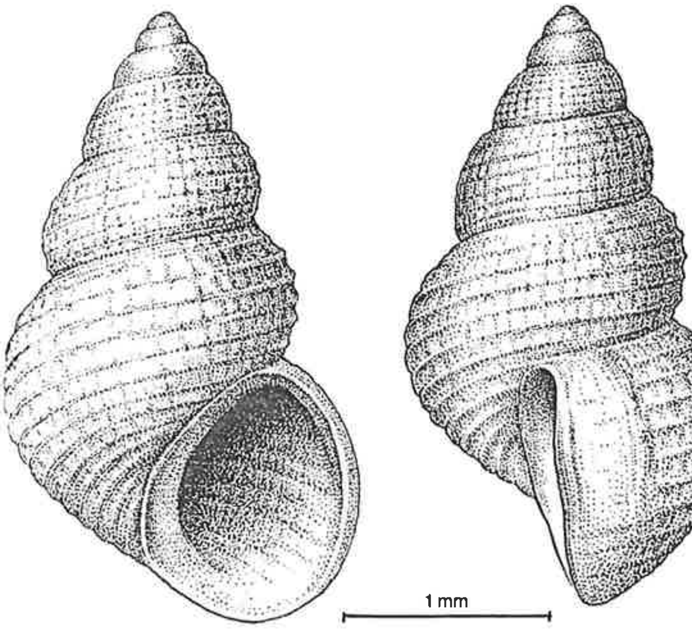


Fig. 94. *Alvania punctura.*

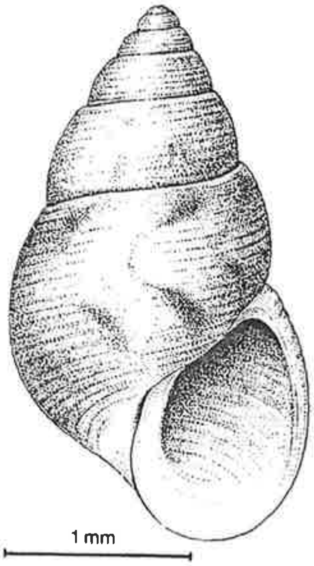


Fig. 90. *Alvania semistriata.*

Onoba semicostata and *O. aculeus* - lower shore, often together but aculeus seems to favour weeds whereas *semicostata* prefers more sediment. Difficult to separate but *aculeus* usually only has the costae on the apical whorls, *semicostata* often has an orangey/brown band on the body whorl. *O. aculeus* is commoner then the textbooks suggest.

Alvania semistriata - lower shore in weeds, sediment and sponge. Pointed spire, sculpture of spiral ridges and shell often has red/brown spots on the body whorl.

Alvania punctura - very low shore in weeds and sediment. Pointed shell with deep sutures and pattern of shallow square reticulations. Often has orange spots on the shell.

OTHER SMOOTH-SHELLED SPECIES

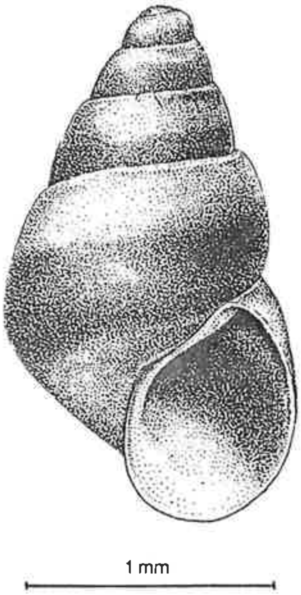


Fig. 103. *Barleeia unifasciata*.

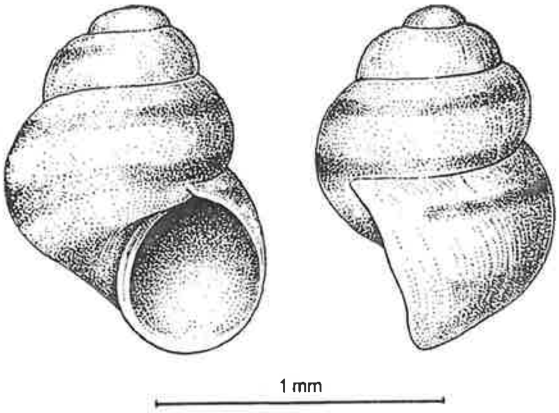


Fig. 106. *Cingulopsis fulgida*.

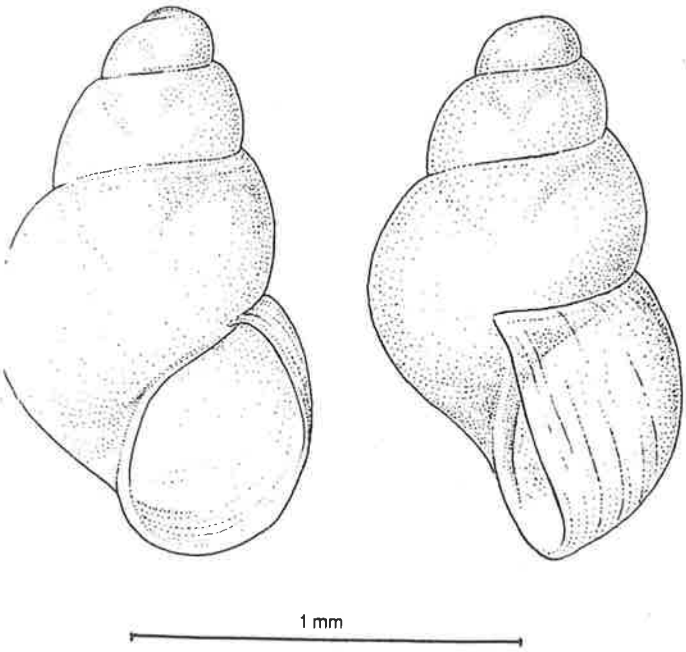


Fig. 107. *Rissoella diaphana*.

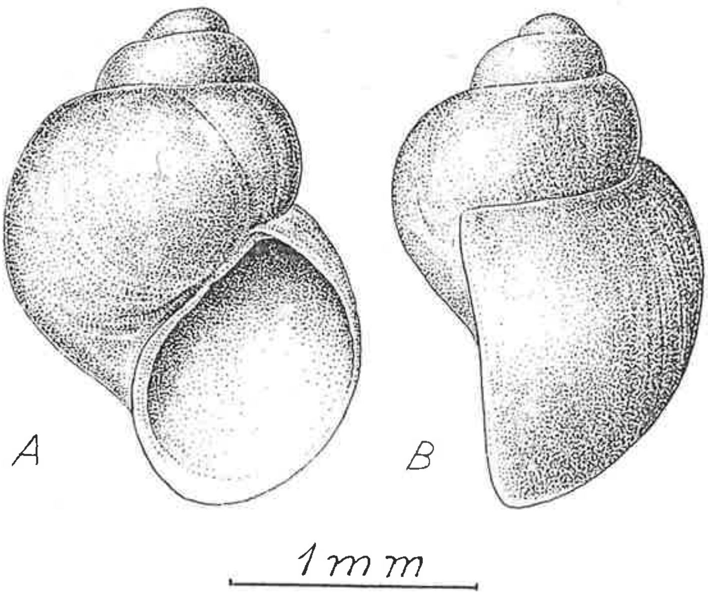


Fig. 183. *Rissoella opalina* (Jeffreys). Whalsey, Shetland. CMZ.

Barleeia unifasciata - low shore on fine, mainly red weeds. Smooth, flat sided, usually a reddish brown colour, often banded.

Eatonina fulgida - minute shell with swollen whorls and usually with 2 spiral brown bands. Lower shore pools etc on fine weeds.

Rissoella diaphana - minute, glossy, semi-transparent shell with swollen whorls. The animal has a conspicuous dark oval mark which is visible through the body whorl of the shell. Lower shore pools etc on fine weeds.

Rissoella opalina - Small glossy, brownish shell, taller & broader than *R. diaphana* and with a very large body whorl. Dark gut patch also visible through shell. Lower shore weeds, mainly northern and western.

Hydrobia Species

Aquatic snails of the genus Hydrobia are one of the major components of the biomass of estuaries and lagoons. Three species are represented, all with varying salinity requirements / tolerance :

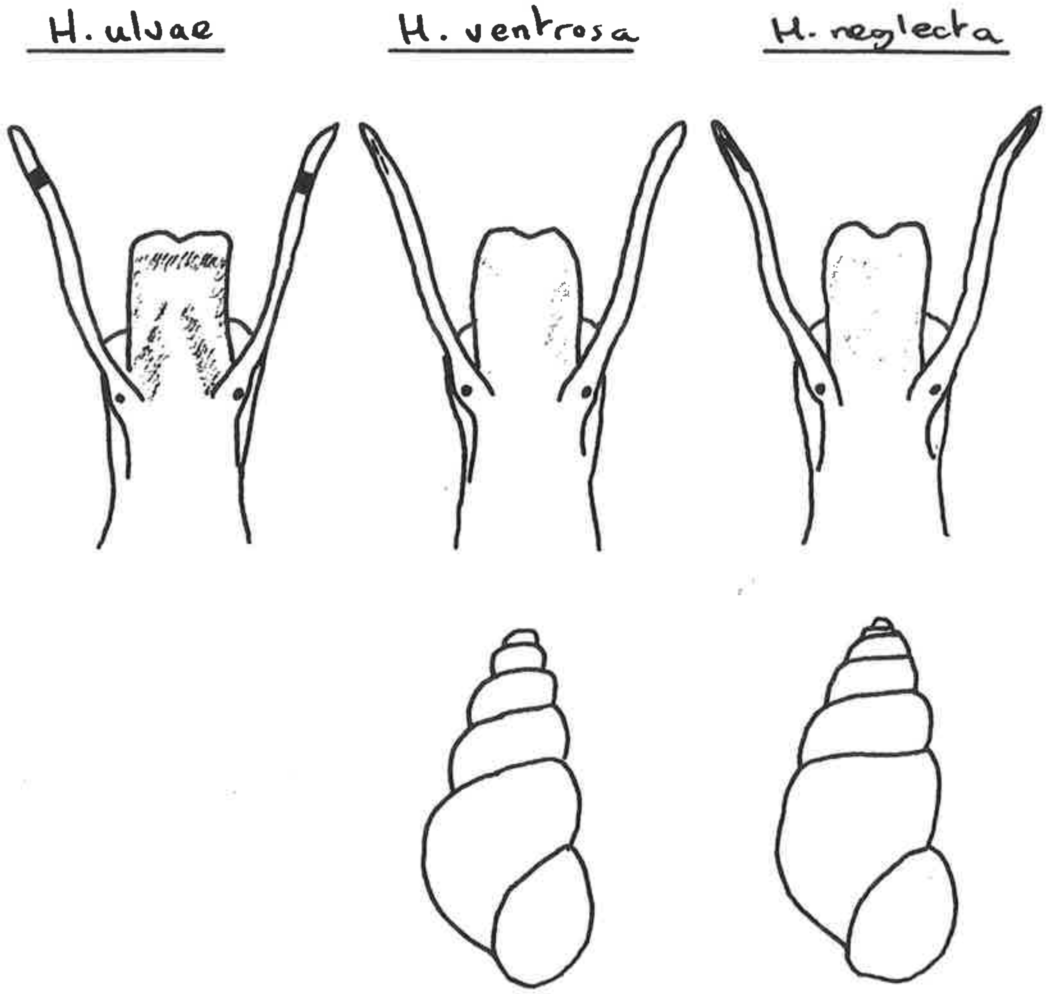
Hydrobia ulvae (Pennant) lives in countless millions on saltmarsh, mudflats and lagoons. Tolerant of higher salinity than the following two species.

Hydrobia ventrosa (Montagu) and H. neglecta Muus are inhabitants of brackish water lagoons and ditches.

In lagoonal habitats of favourable salinity all three species may co-exist.

H. ulvae is readily separated on the shell characteristics, being larger, flat sided with a straight outer lip. Examination of crawling animals reveals that the tentacles of H. ulvae have a short length of black pigment near the tip.

H. ventrosa and H. neglecta have swollen whorls dipping to sutures and a curved outer lip. They are not reliably separated from each other on shells alone. They may, however, be separated on tentacular pigmentation. H. neglecta has a cone of black pigment almost at the end of the tentacle. H. ventrosa lacks this feature although there is often a thin black streak.



Examination of the pigmentation of the snout may also offer a guide (not always reliable) to identity.

Once ventrosa and neglecta are split into heaps based on tentacles it is easier to notice the subtle differences in shell characteristics. H. neglecta tends to be less loosely coiled and is often larger and glossier.

NEOGASTROPODA - *HINIA* SPECIES

Snails of the genus *Hinia* are frequently encountered in benthic samples, often in significant numbers, yet they can be very difficult to recognise and separate. Detailed descriptions are given in:

Fretter, V., & Graham, A., (1985). The prosobranch molluscs of Britain & Denmark, Part 8 - Neogastropoda. *J. molluscan Studies* Supplement 15: 435-556.

Hinia reticulata - The largest species, up to 30mm and the easiest to identify. Relatively straight sided with the costae and spiral ridges interacting to give a series of raised blocks, more or less square in outline. The shell is usually covered in brown periostracum. When adult the lip is thickened and often has teeth. Juveniles are instantly separated from adult *incrassata* and *pygmaea* by the unthickened lip and from juveniles of those species by the proportionally larger last whorl. The animal inhabits soft substrates of muddy silt and sand, sometimes muddy gravel from LWST to c.25m.

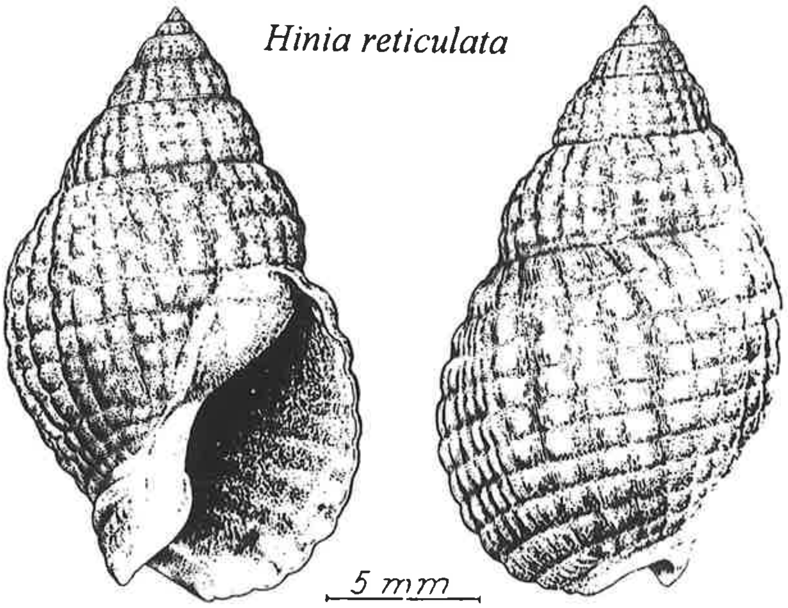
Hinia incrassata and *Hinia pygmaea*

The following list of characters are based on a mixed sample from the Eastern Channel:

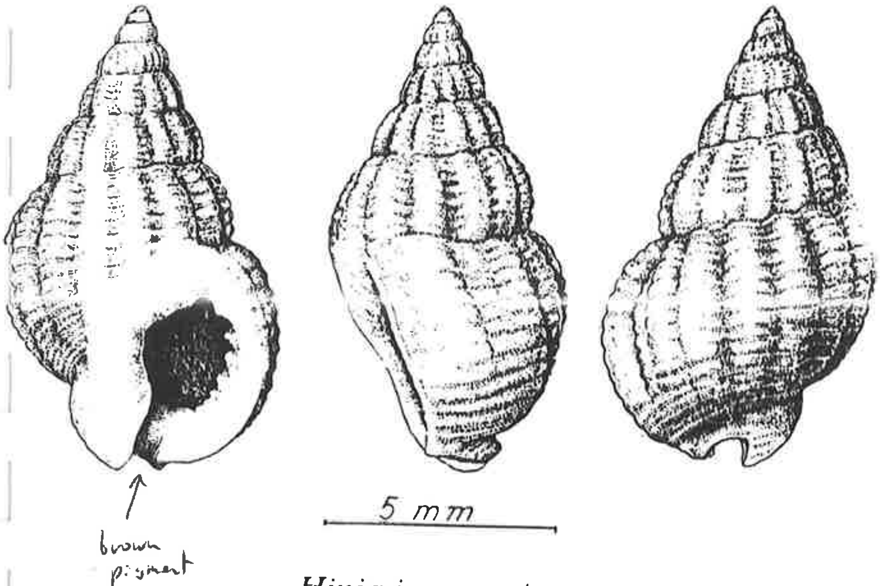
Character	*H. incrassata*	*H. pygmaea*
Apical angle	48°	42°
Height	14.9	11.5
Width at aperture	8.8	6.4
Ribs on last whorl	15.7	17.7
Spiral ridges on last whorl	13.8	11.1
Width of last varix	2 - 2.5	1.5 - 2
Spire varices	usually none	usually 1 - 3
Groove around siph. canal	Deep, bounded by a prominent spiral ridge.	No groove
Siphonal canal	Dark brown spot on and in the canal.	No dark spot
Colour	Pale brown with 3 darker, intermittent spiral bands prominent on white varices	Dark brown with brown or purple inner lip & siph. canal.

In *incrassata* the costae and spiral ridges cross to give oblong tubercles. In *pygmaea* the interaction is both more localised and more intense so that where they cross there is a smaller, squarer and rather more upstanding tubercle than in *incrassata*.

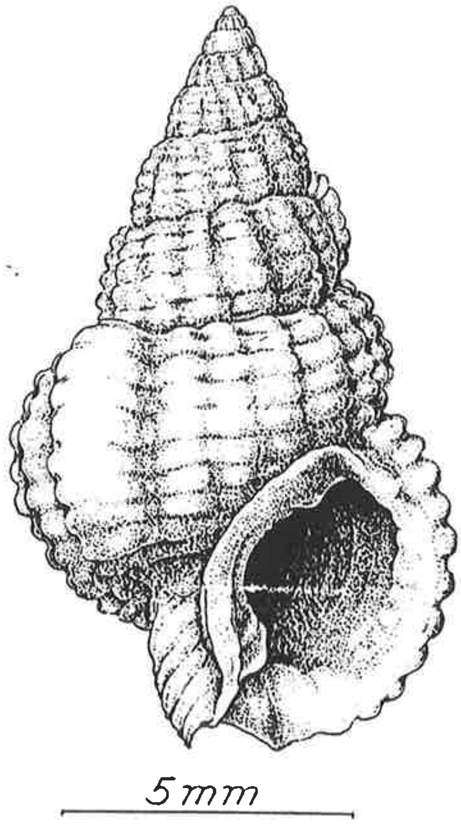
H. incrassata is generally found on hard substrates such as shell gravel, gravel, cobble and bedrock from lower shore rocks and sub-littorally to >100m. *H. pygmaea* is much less common than the other 2. It prefers soft sediments such as silt and sand, often with a muddy element. It is said to occur to >100m but most records are from <40m.



Hinia reticulata



Hinia incrassata



Hinia pygmaea

CONACEA: TURRIDAE

The Turridae, together with the Conidae and Terebridae form the Conacea. Of the three families only the Turridae are found in temperate waters and they are amongst the most advanced prosobranchs.

A general obscurity surrounds the British members of the Turridae. About 20 species are listed but most of these are said to be scarce or rare. The majority are dredged and only isolated specimens are found. The food is generally not known for most species; they are highly specialised carnivores. But it is assumed that some may feed on small polychaete worms and annelids. Most turrids are found on soft ground, mud or sand with perhaps some gravel. However some, such as the _Raphitoma_ species, favour stony bottoms.

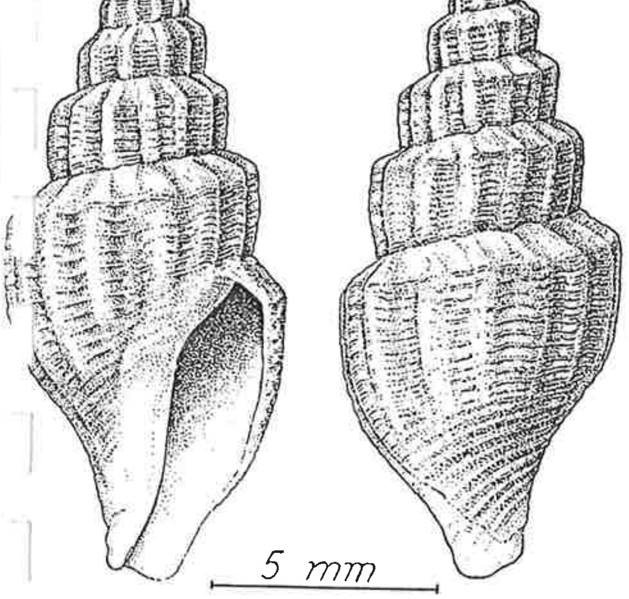
Turrid shells are small, often rather elongate and slender and usually with both spiral and axial ornament. The aperture is long and narrow with a siphonnal canal and nearly always with a conspicuous anal sinus. The long spindle-shaped shell is particularly well designed for the burrowing habit that turrids have adopted in search of their prey.

For this Workshop, we will look at some of the species that are more likely to be encountered in British waters:-

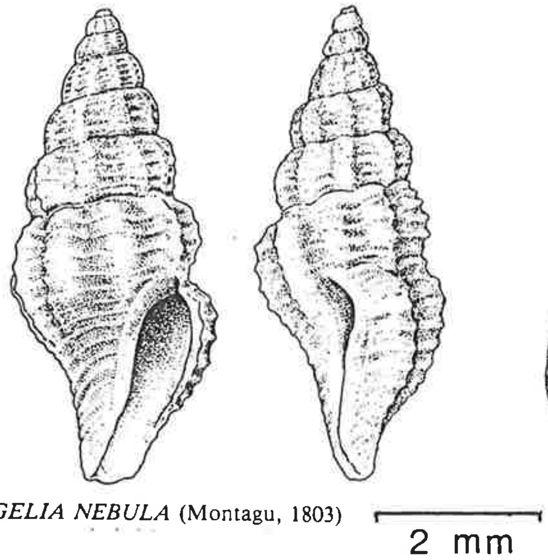
Haedropleura septangularis (Montagu, 1803)
Oenopota turricula (Montagu, 1803)
Oenopota trevelliana (Turtoo, 1834)
Oenopota rufa (Montagu,1803)
Mangelia nebula (Montagu, 1803)
Mangelia brachystoma (Philippi, 1844)
Mangelia attenuata (Montagu, 1803)
Cytharella smithi (Forbes, 1844)
Cytharella coarctata (Forbes, 1840)
Comarmondia gracilis (Montagu, 1803)
Raphitoma linearis (Montagu, 1803)
Raphitoma purpurea (Montagu, 1803)
Teretia teres (Reeve, 1844)

(Nomenclature follows Graham, 1988, _Molluscs: Prosobranch and Pyramidellid Gastropods_, Synopses of the British Fauna (New Sereis), No. 2 (2nd Edition) pub. by E J Brill.)

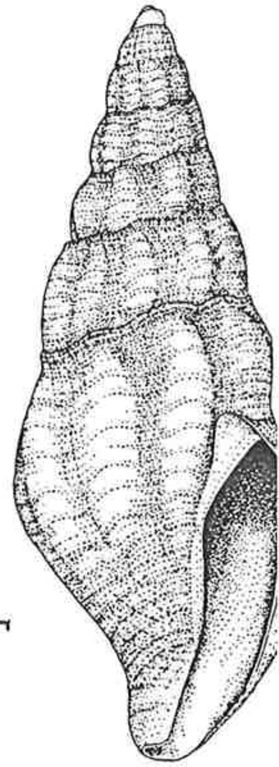
Various factors make these shells difficult to identify. Live-collected material is seldom available and the worn shells which one usually has to work with often lack the sculptural details which are a key identification characteristic. In addition, because of their solitary nature, determination often has to take place with a single specimen and one is not therefore afforded the advantages of basing an identification on the comparison of a series of specimens. A sheet bearing figures of the 13 species listed above is attached. A recently revised key to the British turrid genera and species is given in Graham, 1988 (see above). Notes on diagnostic shell characters are contained in this Synopsis. More detailed information on biology, morphology and distribution is provided in _The Prosobranch Molluscs of Britain and Denmark_, Part 8 - Neogastropoda by Fretter & Graham (Supplement 15 to _The Journal of Molluscan Studies_).

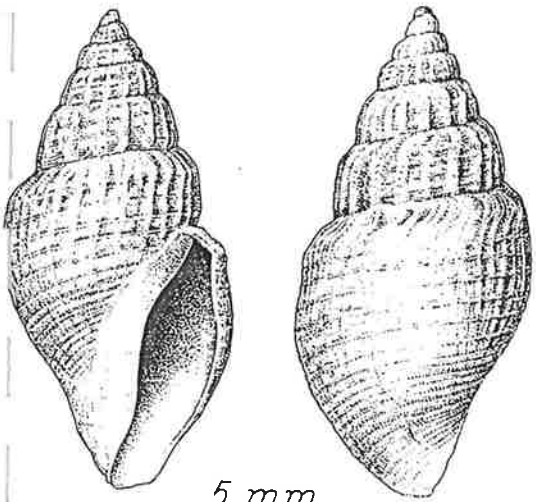


OENOPOTA TURRICULA (Montagu, 1803)

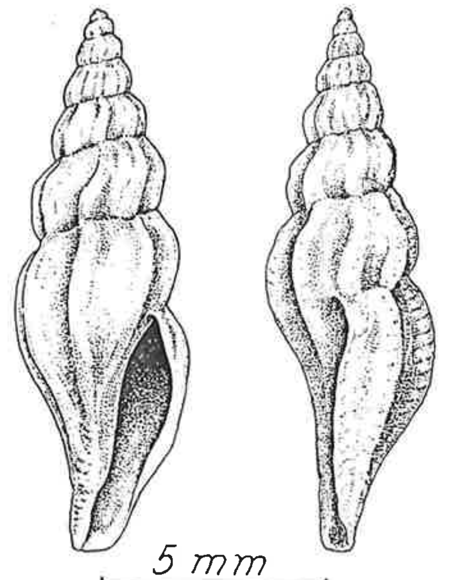


MANGELIA NEBULA (Montagu, 1803)

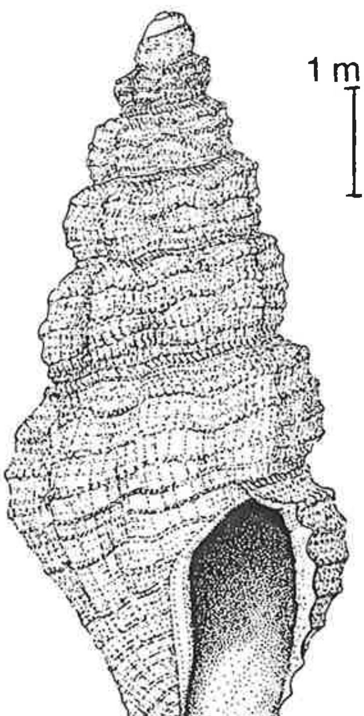




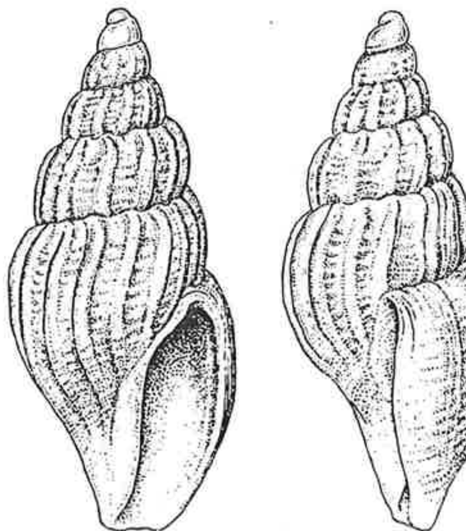
OENOPOTA TREVELLIANA



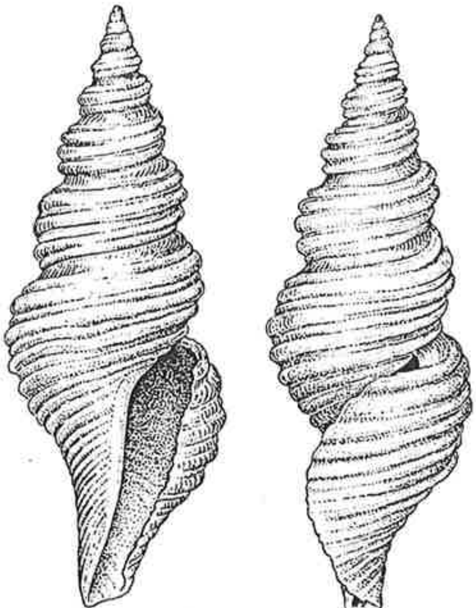
MANGELIA ATTENUATA



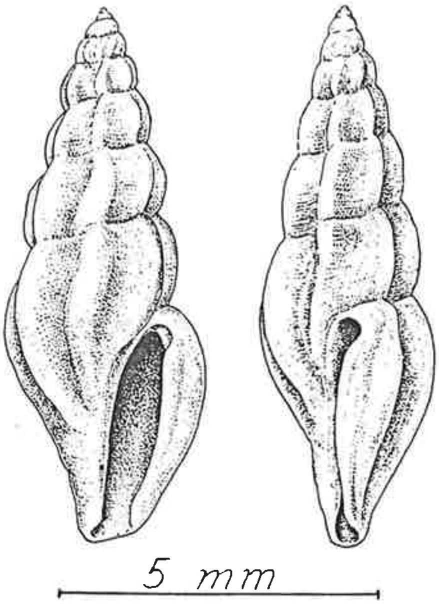
MANGELIA BRACHYSTOMA



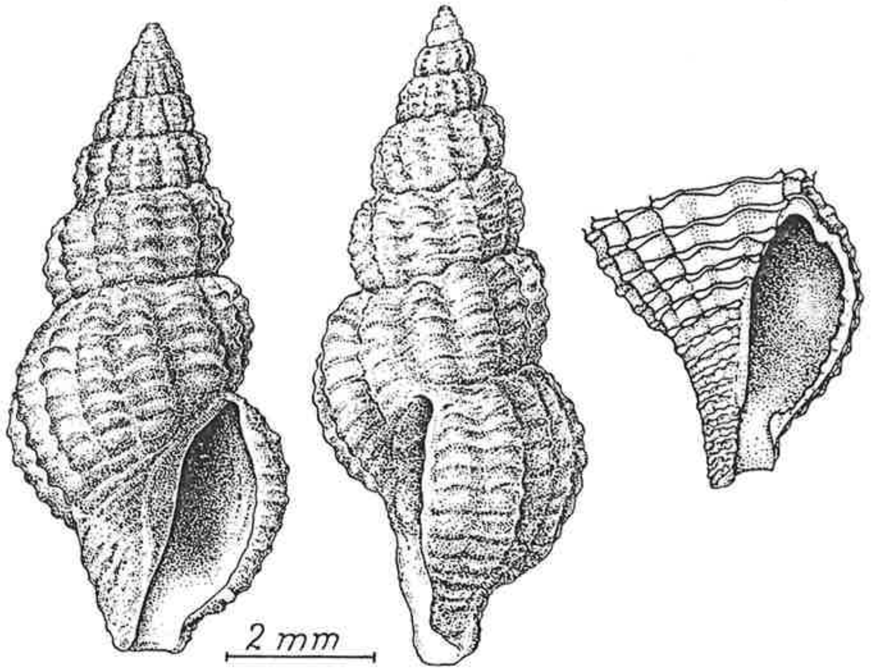
OENOPOTA RUFA (Montagu, 1803)



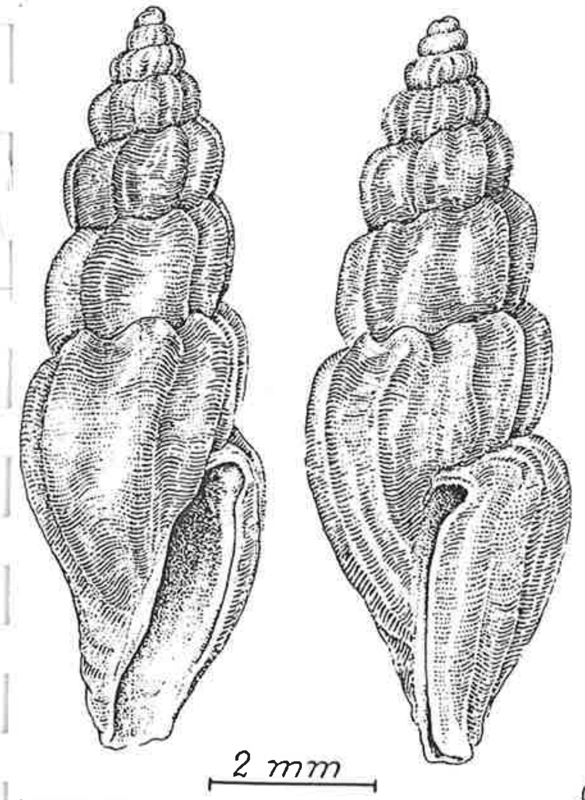
TERETIA TERES (Reeve, 1844)



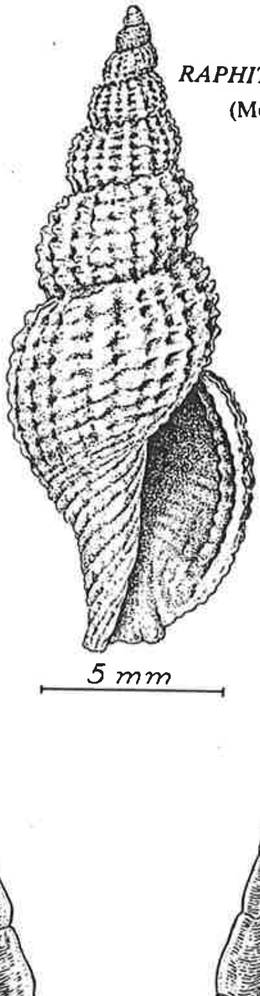
CYTHARELLA COARCTATA (Forbes, 1840)



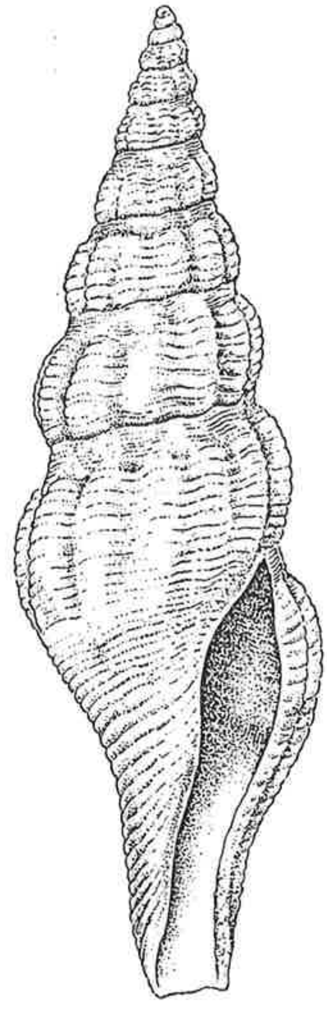
RAPHITOMA LINEARIS (Montagu, 1803)



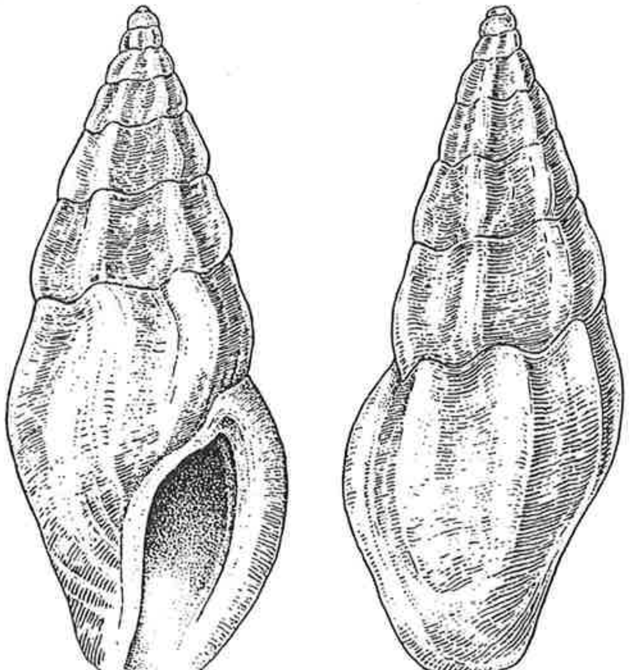
CYTHARELLA SMITHI (Forbes, 1840)



RAPHITOMA PURPUREA (Montagu, 1803)



COMARMONDIA GRACILIS (Montagu, 1803)



5 mm

HAEDROPLEURA SEPTANGULARIS (Montagu, 1803)

PYRAMIDELLACEA

The Pyramidellacea is a large group of generally white gastropods. All are predators or ectoparasites of other marine animals particularly polychaetes and other molluscs.

The shells all have heterostrophic apices: the whorls of the protoconch appear sinistral whereas the rest of the shell is dextral. The heterostrophy takes 2 forms: a) where the protoconch is submerged within the apex or b) where the protoconch lies on the apex at right angles to the axis of the main shell. Another feature of Pyramidellaceans is the presence of a more or less well defined fold or tooth on the columella.

Separation into genera is relatively straightforward but identification to species level is frequently difficult. The following notes are copied from:

Fretter, V., Graham, A., & Andrews, E.B., 1986. The Prosobranch Molluscs of Britain & Denmark, Part 9 - Pyramidellacea. *J. molluscan Studies Supplement* 16: 557-649.

Identification of pyramidellids. This is in some ways easy and in other respects difficult. To assign a given shell to a genus is relatively straightforward; to be sure to which species of that genus it belongs to is more difficult and, in more variable species, it may be hard to be certain of identification unless a range of shells is available for comparison. For this reason many of the aids given by Marshall, which nearly all depend on such comparisons, are not particularly helpful to the collector without such resources. For that reason we have prepared a set of scanning electron micrographs (Figs 419, 431) of shells in the most difficult areas of identification.

To assign a given shell to a genus three important features must be studied: (1) the arrangement of the protoconch, whether coaxial with the teleoconch and inverted, or transverse to the teleoconch; (2) the form of the ornament, and whether it is easily visible or microscopic; and (3) the growth lines, whether prosocline or opisthocline. At first sight a coaxial inverted protoconch may not suggest to an inexperienced eye that the shell is heterostrophic, but careful examination (see Figs 391, 396) shows that the protoconch whorls are *rising* from the concealed apex and would therefore appear sinistral if the surrounding teleoconch were broken away and the shell viewed conventionally. The genera with this type of protoconch are *Chrysallida, Partulida, Ividella, Tragula, Evalea, Liostomia, Jordaniella* and *Brachystomia;* those in which the protoconch lies exposed across the summit of the teleoconch are *Noemiamea, Odostomia, Eulimella, Ebala* and *Turbonilla.* The major features allowing recognition of the genus to which a shell belongs are given below; thereafter, for points aiding identification of the species see the notes at the end of each relevant genus.

Protoconch submerged.

Chrysallida: costae well developed; spiral ridges present, usually confined to basal part of each whorl and to the intercostal spaces; whorls smoothly convex in profile; tooth slight. (See p.575.)

Partulida: as *Chrysallida* but spiral ridges visible only on base of last whorl. (See p.575.)

Ividella: as *Chrysallida* but shell markedly turreted; whorls with prominent coarse ornament, the spiral ridges not confined to their basal half. (See p.575.)

Tragula: costae well developed; spiral ridges on basal part of each whorl crossing costae and producing nodosities there; whorls flat in profile in their adapical half; tooth absent. (See p.578.)

Jordaniella: some thickened growth lines may suggest slight costae; some low, strap-shaped spiral ridges present, usually more prominent in basal parts of whorls; last whorl not especially large; tooth moderately prominent. (See p.597.)

Evalea: no costae; usually low, strap-shaped spiral ridges present on basal parts of each whorl but sometimes absent; last whorl enlarged; growth lines opisthocline; tooth usually slight. (See p.592.)

Liostomia: no costae; spiral lines microscopic; last whorl not enlarged; growth lines opisthocline; tooth slight. (See p.592.)

Brachystomia: no costae; spiral lines microscopic; last whorl enlarged; growth lines prosocline; tooth usually prominent. (See p.606.)

Protoconch transverse to the teleoconch.

Noemiamea: shell globular; no costae; spiral ridges numerous, covering each whorl, strap-like; growth lines prosocline; tooth prominent. (See p.622.)

Odostomia: shell a moderately short cone; no costae; spiral ornament microscopic; growth lines prosocline; tooth usually prominent. (See p.620.)

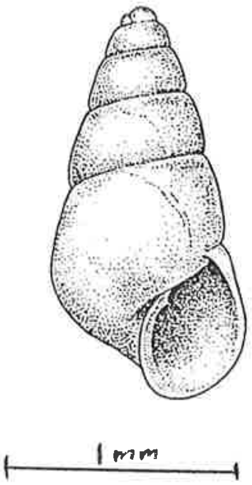
Eulimella: shell a tall cone; no costae, spiral ornament microscopic; whorls nearly flat-sided in profile; tooth present, not prominent. (See p.630.)

Ebala: shell a tall and slender cone; no costae; inconspicuous spiral ridges on basal half of whorls; whorls markedly tumid; no tooth. (See p.630.)

Turbonilla: shell a tall cone; costae prominent; spiral ornament confined to intercostal spaces; tooth slight. (See p.644.)

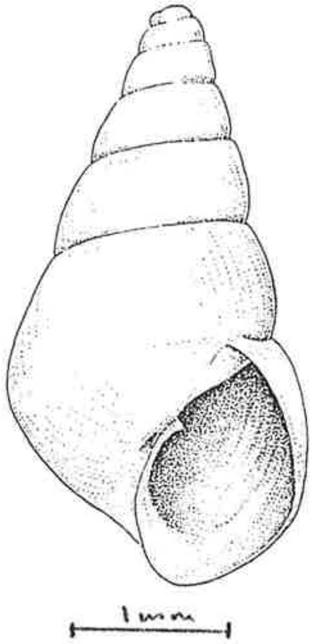
ODOSTOMIA AND *BRACHYSTOMIA*

The most common genera represented on the lower shore and in sub-littoral samples. They are also the most difficult.

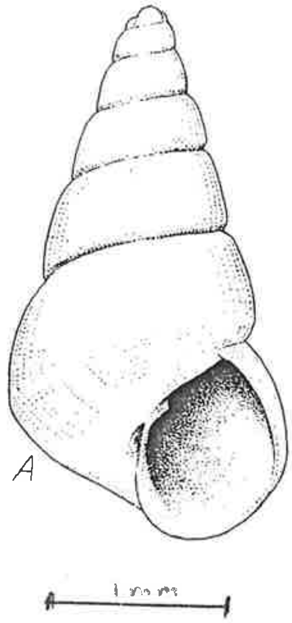


Odostomia plicata

O. turrita



O. unidentata

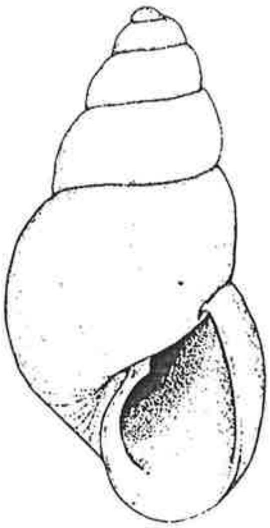


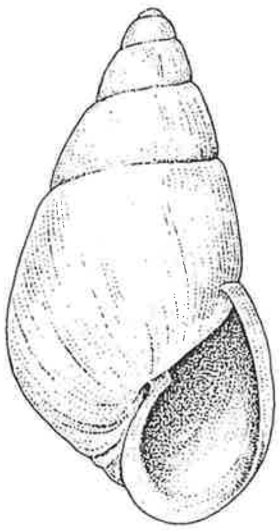
O. acuta

Odostomia plicata, turrita and *unidentata* are all common and widespread. All are associated with polychaetes particularly the tube building species *Pomatoceras* and *Sabellaria*. There is a gradual increase in size and the definition of the keel from *plicata* through *turrita* to *unidentata*. *O.acuta* is scarce, usually found on muddy substrates and is the only species with a distinct umbilicus.

Brachystomia scalaris

1mm



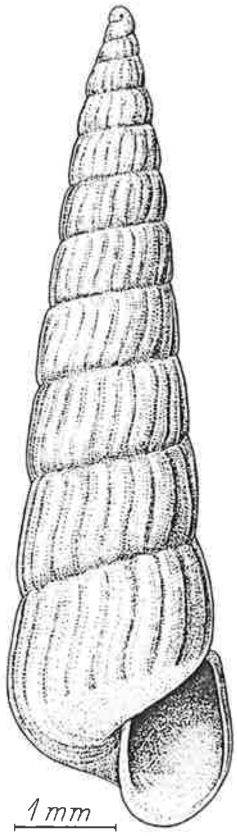


Brachystomia eulimoides

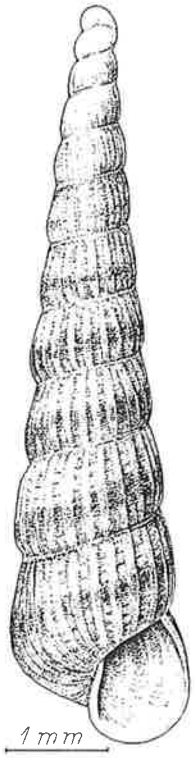
1mm

Both of these *Brachystomia* species are associated with other molluscs *B. scalaris* with *Mytilus edulis* and *B. eulimoides* on other bivalves particularly scallops. Both can be variable in size and shape but *eulimoides* has a taller body whorl and has much shallower sutures.

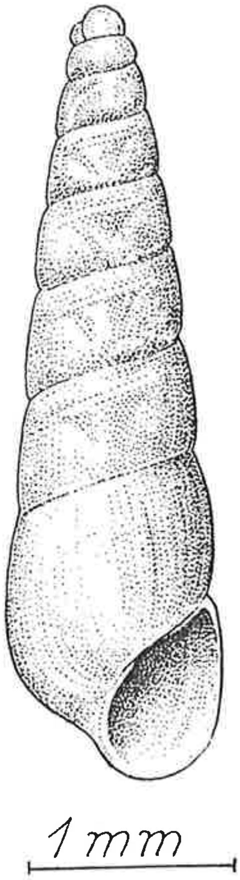
EXAMPLES OF OTHER PYRAMIDELLID SPECIES



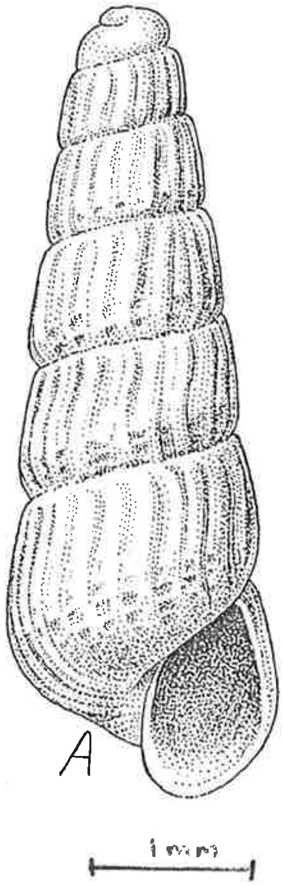
Turbonilla lactea



Turbonilla crenata

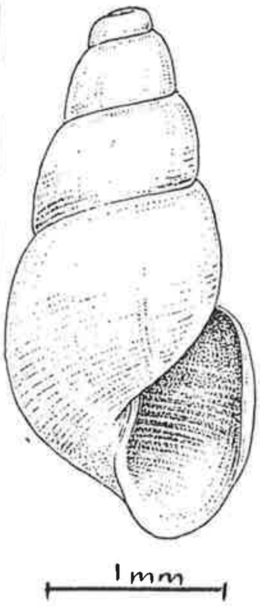


Eulimella laevis

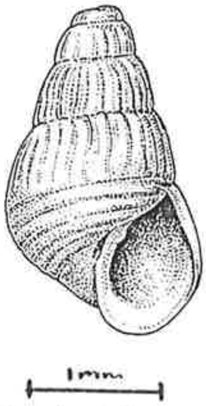


Chrysallida indistincta

The hosts of most of these species are not known. Turbonilla lactea is found on weeds, sand and gravel, sometimes intertidally whereas T. crenata is found in fine sediments usually with a muddy element. Eulimella laevis is poorly known and also difficult to separate from E. ventricosa. Chrysallida indistincta is found on a variety of substrates; mud, sand, shell gravel etc, C. obtusa is very similar.



Ondina divisa



Partulida spiralis

Ondina divisa is relatively rare and is usually found on substrates of sand & gravel often to depths > 100m.

Partulida spiralis is common and widespread and one of the easier species to identify. It is commonly associated with tube building polychaetes, particulary *Sabellaria*.

CLASS: OPISTHOBRANCHIA - THE SEA SLUGS

Ref: Thompson, T. E., 1988. Molluscs: Benthic Opistobranchs (Mollusca: Gastropoda). *Synopses of the British fauna (NS) No.8 (2nd edition).* E.J. Brill, Leiden.

The opisthobranchs can be divided into 2 groups: 1. Those completely shell-less: the nudibranchs and 2. Those with an internal or external shell.

1) NUDIBRANCHS - this is probably the most difficult group of marine organisms to identify when they are preserved and stained. In the majority of cases it is only possible to separate to generic or family level. If possible nudibranchs should be removed from the dredge or grab samples prior to preservation and identified while still alive.

Generally most of the species found will be associated with hard, rocky substrates, particularly those with hydroid and algal faunae. Nudibranchs are rarely found in samples of soft sediment such as mud or sand. The following are a selection of those most likely to turn up in benthic samples:

Doto spp. - All live on hydroids. *D. fragilis* can be identified preserved by its large unpigmented cerata, the others almost impossible unless dissected and radula examined!

Archidoris pseudoargus - 'the Sea Lemon' (yellow specimens look like lemons). A common large species (100mm) recognisable by the rough tubercles on the mantle. Feeds on sponges.

Aeolidia papillosa - Another large species (100mm) with very dense rows of long cerata and a white crescent mark on the head. Feeds on sea-anenomes.

Acanthodoris pilosa - a smaller dorid (40mm) with the mantle covered in tall conical tubercules. Very common in shallow water all around the country. Feeds on polyzoans, *Alcyonidium* etc.

Onchidoris spp. - dorids less than 25mm with the mantle covered in short tubercules. Difficult to separate when preserved; *O. bilamellata* is the commonest. Do not confuse with the prosobranch gastropods *Lamellaria* spp. which have an internal shell and an anterior siphon.

Eubranchus tricolor - Relatively easy when unstained. The cerata (coloured in live animals) are inflated and packed closely together. Lives on a variety of hydroids and is common on gravel and cobble especially along the west coast.

Biologists involved in surveying rocky shores and the sub-littoral fringe are likely to encounter many species too numerous to discuss in this handout. The above Synopsis or the MCS Nudibranch Guide shopuld be consulted.

OPISTHOBRANCHIA

2) SHELLED SPECIES. The species typically found in intertidal and benthic samples are represented by the following families:

a) Shell external - Acteonidae Diaphanidae Retusidae Scaphandridae

b) Shell internal - Philinidae

Acteon tornatilis - Solid, up to 20mm, light pink shell with white bands. Has an apertural tooth and an operculum, the only opisthobranch with these features. Lives in sand from LWST to >200m.

Diaphana minuta - Fragile, smooth, white shell up to 5mm, tapering towards apex. Flattened spire and upper margin of lip below top of body whorl. Lives in sandy sediments fro LWST to >200m. Sometimes found amongst lower shore weeds.

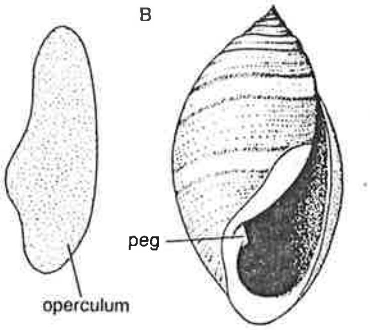
Retusa obtusa - Smooth, white shell with relatively straight sides. Spire is usually raised. Size depends on habitat, but specimens living in sandy estuaries may reach 10mm whereas more open shore specimens may only reach 3mm. *R.obtusa* lives in mud and fine sand usually in estuarine or euryhaline conditions where it feeds upon *Hydrobia ulvae*. Also found on muddy shores and amongst *Zostera*.

Retusa truncatula - Smooth, white shell, up to 5mm, straight sided and tapering towards apex. Spire flattened and slightly sunken. Aperture is the same length or slightly longer than the spire. Lives on sand and amongst weeds in more open marine conditions than *R. obtusa* from LWST to c.50m.

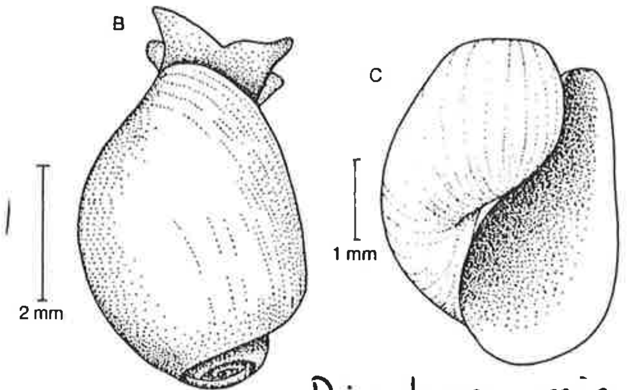
Cylichna cylindracea - Elongate shell, larger than *Retusa* spp, up to 15mm. Smooth, glossy white with orangey/brown periostracum. Straight sided with little taper towards (sunken) apex, aperture same length or slightly longer than spire. Lives in sub-littoral mud or muddy sand, often with *Abra nitida* and *Nucula nitidosa* to great depth.

Scaphander lignarius - Recognisable by its large size, up to 50mm. White, brown or orange shell with conspicuous fine spiral striae. The latter feature serves to separate juveniles of this species from other opisthobranchs. Lives in sand and shell gravel to great depth.

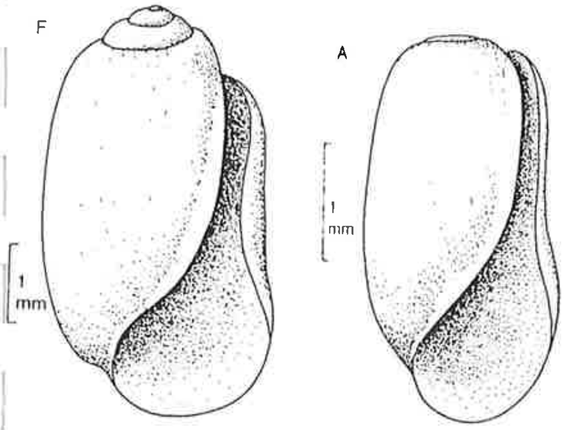
Philine spp. - This is a distinct genus of molluscs with an internal shell. The largest and commonest species *Philine aperta* is common on silt and sand from LWST to >100m. It may be recognised by its size, up to 50 mm and its smooth shell. There are 5 smaller *Philine* species which may be separated on shell characters, although they can be very difficult.



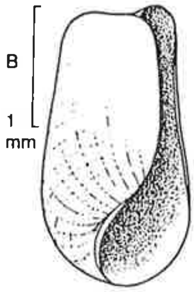
Acteon tornatilis



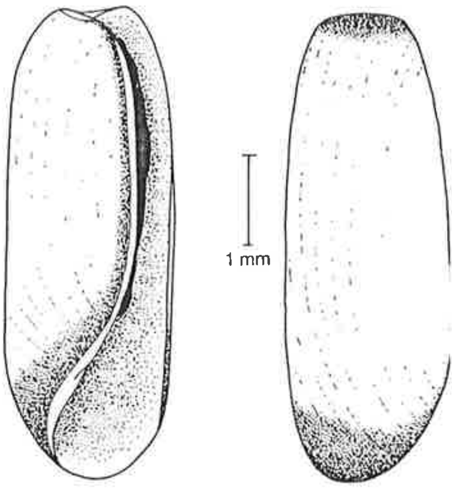
Diaphana minuta



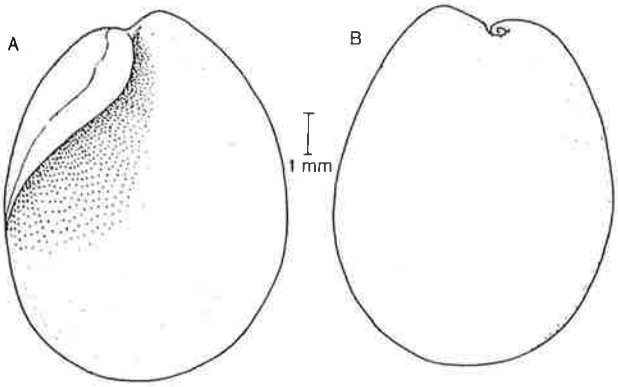
Retusa obtusa

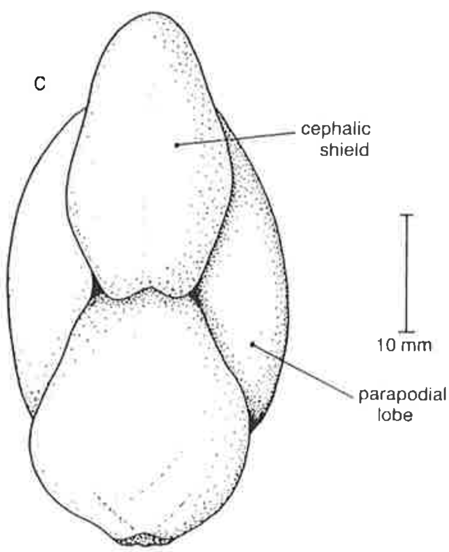


Retusa truncatula

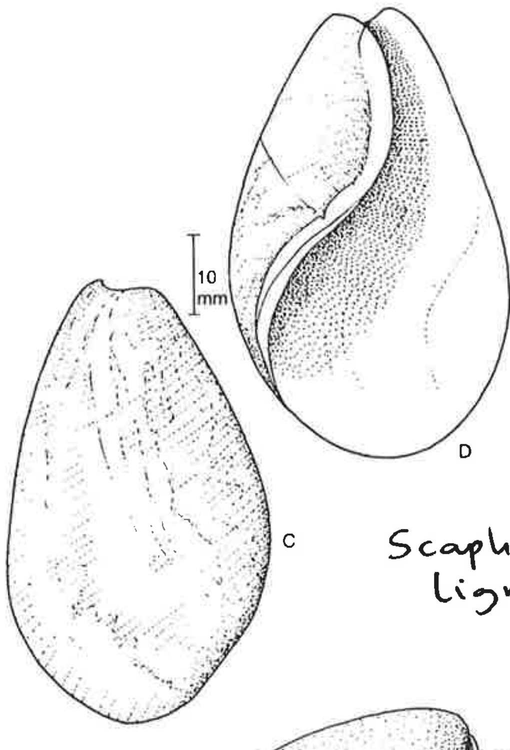


Cylichna cylindrace

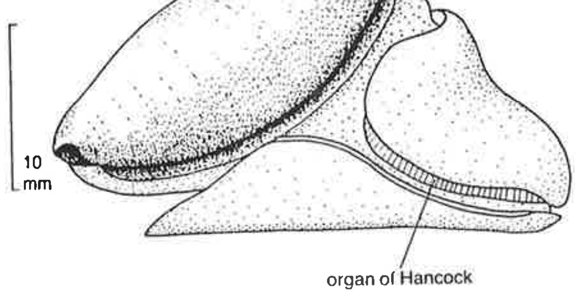




Philine aperta

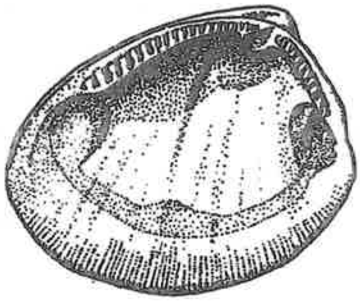


Scaphander lignarius

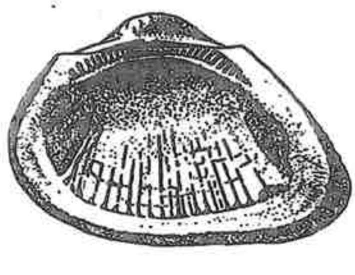


TAXODONTS

This group of bivalves comprising numerous families and genera are distinguished from all other bivalves by the hinge plate which is divided into two rows of projecting, interlocking teeth (the taxodont condition).



Nucula



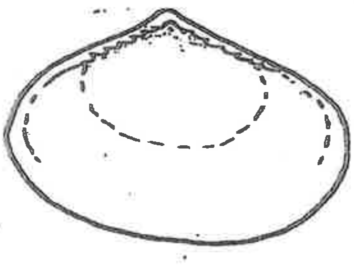
Striarca

Glycymeris

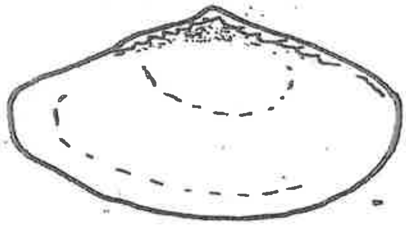
The majority of species are northern in distribution or occur in deep water (200->2500m), and only a few will be found on the shelf in lower latitudes: Nuculidae, Nuculanidae, Arcidae and Glycymeridae.

Nuculidae - see table of comparative characters.

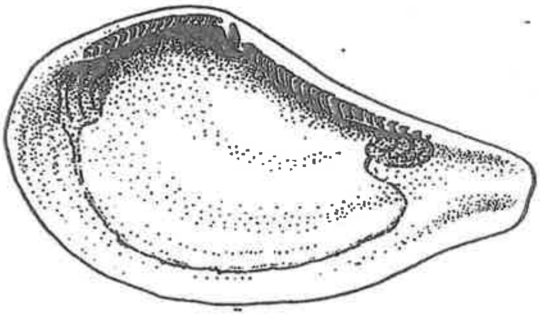
Nuculanidae: *Jupiteria minuta* - sub-adult to adult easily recognised by the drawn-out, short, truncated spout (rostrum) at the posterior end, the sculpture of concentric ridges, and the longitudinal ridges running from the umbone to the posterior end. Juveniles (<3mm) are more equilateral and have a more pronounced (pointed) umbone, the concentric sculpture is indistinct, although the fine radial sculpture is more visible.



<2mm



2-3mm



10mm

Arcidae: Robust shells which live by byssal attachment on shell gravels, coarse substrates, and in crevices of larger rocks. Only 2 species likely to occur: *Striarca lactea* (mainly southern and western), and *Arca tetragona* (widely distributed but uncommon).

Glycymeris glycymeris **- Shells >10mm very easy to identify - characteristic almost circular shape, concentric and radial sculpture, zigzag colouration, and brown, furry periostracum (especially around the margins. Juveniles (<5mm) are conspicuously rhomboidal in shape and have no brown periostracum. Smaller individuals have no radial sculpture.**

FEATURES OF NUCULACEA

Species / Feature	*Nuculoma tenuis*	*Nucula sulcata*	*Nucula nitidosa*	*Nucula nucleus*	*Nucula hanleyi*
Margin	Smooth	Crenulate	Crenulate	Crenulate	Crenulate
Periostracum	Silky to Glossy	Matt to Silky	Highly polished	Matt	Silky to Matt
Colour	Greenish/ yellow to brown	Olive to brown/ black	Grey/green, often with purple/ grey rays	Yellow/ green to greenish brown	Olive green, often with orange rays
Usual size (mm)	<10	<17	<8	<10	<12
Sculpture	Fine radiating ribs & concentric lines	Conspicuous fine radiating ribs & concentric lines	Very fine radiating ribs & few concentric lines	Very fine radiating ribs & few concentric lines	Very fine radiating ribs & some concentric lines
Anterior slope	Long & shallow	Medium length & slope	Short & steep	Short & steep	Long & shallow
Others					much flatter across the 2 valves than *N. nucleus*
Substrate	Fine, muddy silty sand	Fine mud & silt	Mud, muddy, silty sand	Coarse, muddy gravel, sand	Clean, sand, shell gravel
Depth (typical)	20 to >100m	20 to >100m	LWST to >100m	LWST to >100m	5 - 30m
Main Distribution	Northern & western	Northern & western	Throughout	Throughout	Irish Sea, south & southwest

MYTILIDAE

Mussels are frequent elements in most benthic samples, although some will only be present as spat.

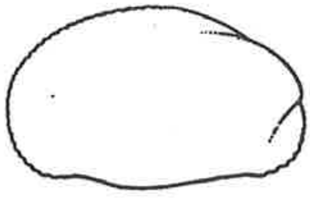
Mytilus edulis - Essentially an intertidal and shallow sub-littoral animal but spat is present in benthic samples often to depths of c. 100m. Umbone located at apex of anterior end. Small row of crenulations present on anterior end seen by folding back the periostracum. Spat < 2mm are separable from other mytilids by the straight dorsal margin, the umbo is not prominent and is located just forward of the anterior end, and the presence of hairs which are NOT thickened at the base.

Mytilus galloprovincialis - Common in the south-west. Differs from *M. edulis* by the more curved dorsal margin, the slightly concave ventral margin, and the prominent, almost hooked umbonal area.

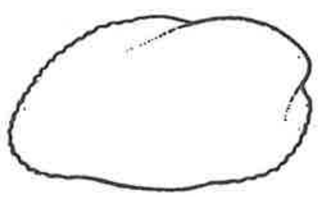
Modiolus modiolus - Anterior margin usually slightly concave. Umbonal area well developed, prominent and rounded, Shell has a projecting, rounded anterior end. Juveniles and spat have these features although the ventral margin tends to be convex, and the dorsal margin distinctly convex. Juveniles have spines, particularly on the posterior end which are often covered with sediment or detritus. The spines on spat are short and rather triangular in shape.

Modiolula phaseolina - A common species in shell gravels on south-western and western coasts. Similar in shape to young *Modiolus modiolus*, rarely grows above 10-15mm. Umbones prominent, rounded and projecting over the anterior end of the shell. Often purplish in colour (inside and outside). Prominent, long periostracal spines, thickened at the base. Hinge plate near umbones with small area of crenulations.

Musculus discors and ***Modiolarca tumida*** - Small mussels rarely more than 15mm long, usually much smaller. *M. discors* lives in algal turf and holdfasts whereas *M. tumida* is also associated with (and sometimes embedded in) ascidians such as *Ascidiella aspersa* and *Ascidia mentula*. Both have ribs radiating out from the umbones to the anterior and posterior ends: *M. discors* with 8-12a and 30-50p, *M. tumida* with 15-18a and 20-35p. However, they are very difficult to count, particularly in young individuals. *M. tumida* has very prominent umbones which are level with, or project beyond the anterior end of the shell, giving a concave appearance to the end of the shell. *M. discors* has a more sloping dorsal margin, less prominent umbones which are just in forward of the rounded anterior end. The shell of *M. discors* is couloured pale brown, gold or greenish, whereas *M. tumida* is whitish with a red-brown marbled pattern.



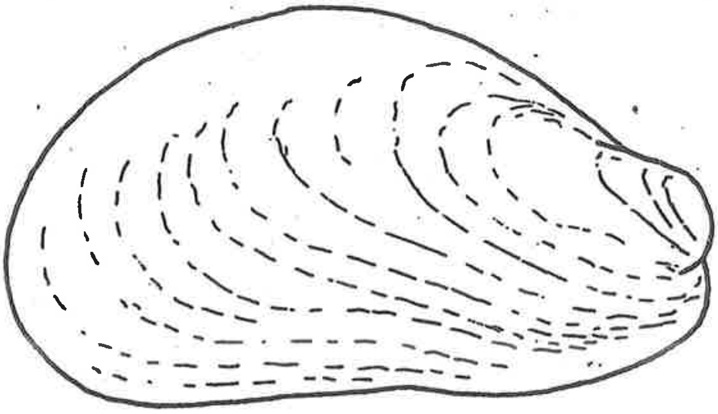
Musculus discors



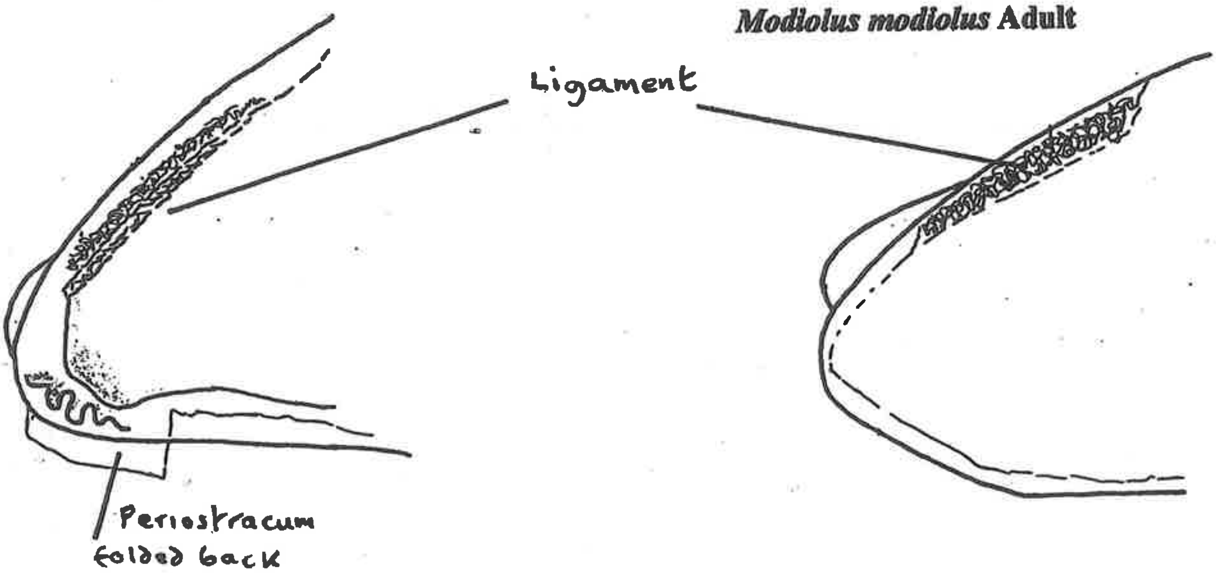
Modiolarca tumida

Features of *Mytilus edulis, Modiolus modiolus* & *Modiolula phaseolina*

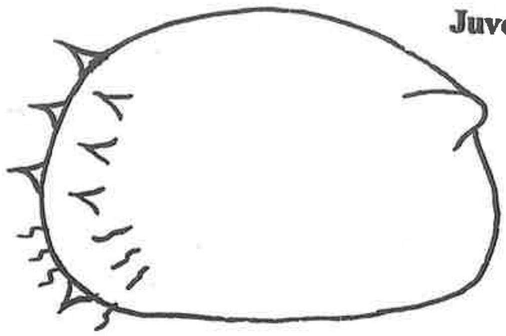
***Mytilus edulis* adult**



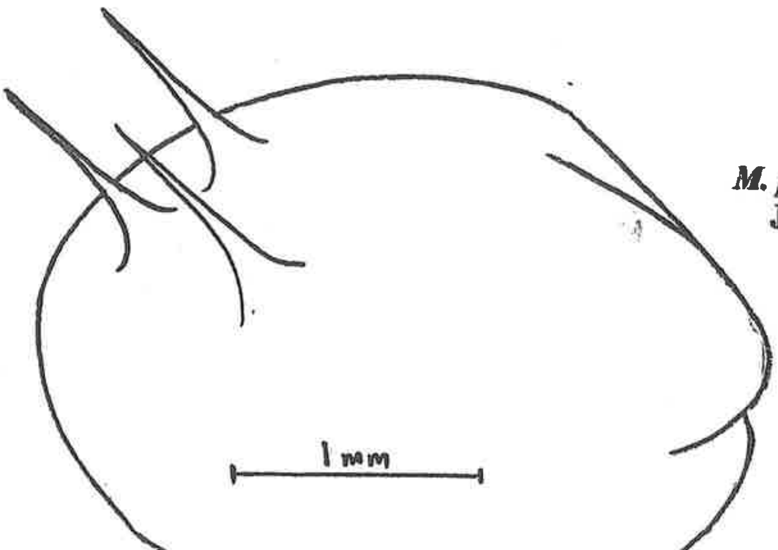
***Modiolus modiolus* Adult**



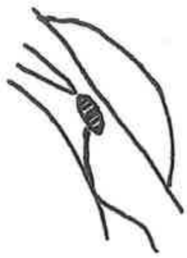
***M. edulis* Juvenile**



***M. modiolus* Juvenile**



***M. phaseolina* Juvenile**



***M. phaseolina* hinge plate**

ANOMIACEA

Anomiids are sessile, monomyarian,,filter-feeding pterioid bivalves, classified next to the Pectinacea. In both the anomiids and the pectinids the left valve (LV) is the upper valve, and the right valve (RV) the lowest. In both, the byssus modifies the RV, a notch in scallops, a slot and hole in anomiids. The single adductor muscle is, in both, the posterior adductor. Thus, anomiids might be viewed as modified scallops with a calcified byssus.

The lowermost muscle in anomiids is the posterior adductor (PA), leaving a single muscle scar in the RV and the lowest (ventral) scar in the LV. Its function is to pull the lower RV up against the LV. The uppermost (dorsal) muscle connects the LV with the calcified byssal plug which is cemented to the substrate: when it contracts it pulls the LV down hard against the substrate. In <u>Anomia ephippium</u> a third muscle lies between, the posterior protractor, but is absent in the other three species. The muscle attachment scars are radially furrowed in <u>Monia</u>, but smooth in <u>Anomia</u> and <u>Heteranomia</u>. Figure 1 shows the position and function of the byssal muscle (BM) and the posterior adductor (PA)

The gills are filibranch, like the mussels and the scallops, with descending and ascending filaments in <u>Monia</u> and <u>Anomia</u>, the latter has an additional membranous flap; but, in <u>Heteranomia</u>, there are only descending filaments.

1. Left upper valve with three muscle scars - <u>Anomia ephippium</u>
   Left valve with two muscle scars - 2.
2. Left valve muscle scars small, distinct, not furrowed - <u>Heteranomia squamula</u>
   Left valve muscle scars furrowed - 3.
3. Adductor and byssal scars separate and distinct - <u>Monia patelliformis</u>
   Adductor and byssal scars form one continuous scar - <u>Monia squama</u>

Eales 1939, p.150 uses both muscle scar and gill characters.

1. Upper valve (left) with thre muscle scars. Gill W-shaped with a short mem membranous flap, or fifth lamella, on the outer lamella - <u>Anomia ephippium</u>
   Two muscle scars on the left valve 2.
   One muscle scar on left valve, obviously formed by the union of two scars - <u>Monia squama</u>
2. Two scars separated on shell. Gill W-shaped but without the fifth lamella - <u>Monia patelliformis</u>
   Two scars adjacent. Gill Λ-shaped, no ascending filaments - <u>Heteranomia squamula</u>

KEY USING EXTERNAL MORHOLOGY ONLY

note if a pecten may develop rib-like ripples

1. Shell without radial sculpture (except xenomorphic), posterior lobe well developed in left valve making it asymmetric
   Anomia ephippium

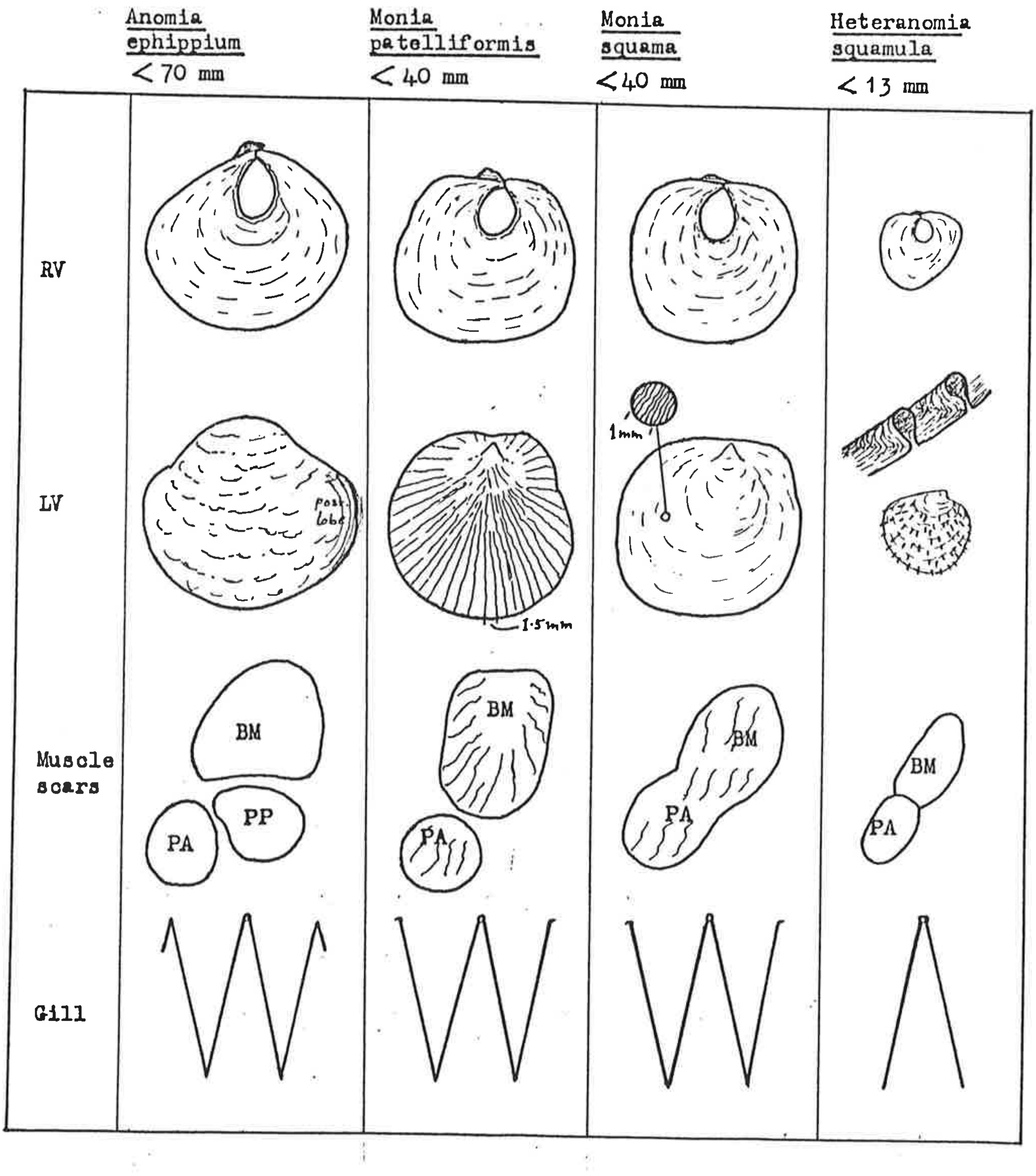
   Shell with radial sculpture 2.

2. Left valve with 30-40 ribs about 1-1.5 mm apart, often greenish
   Monia patelliformis

   Left valve with microscopic striations, hardly visible and crowded together 5-6 per mm
   Monia squama

   Left valve with hoolow, subcylindrical spines
   Heteranomia squamula

In general, a large specimen up to 70 mm is likely to be Anomia ephippium; specimens up to 40 mm with radial ornament will be Monia, and rib-density will separate them; while small specimens up to 13 mm may be juveniles of the above three or, if they have spines, Heteranomia squamula. Winckworth, p.32 offers the following remarks "All the species are very variable in shape, thickness and sculpture: and theyoung of all four are discouragingly similar in appearances, while the muscular scars are often very faint in small examples". On p.34 he says of H. squamula "There is no distinction between the smooth and aculeate (spiney) forms: I have taken wholly smooth, wholly aculeate and intermediate forms on the same Chlamys opercularis". It is true that the smooth forms of H. squamula are hardly distinguishable from the equivalent growth stage of Anomia ephippium. However, if you have 'wholly aculeate', 'wholly smooth' and the intermediate forms as well, it is highly probable that you have H. squamula in all its varieties: and you can falsify the hypothesis by dissecting the gill and finding that it has ascending filaments.



Juvenile pectinids

Fig. 2: Pecten maximus (Linne 1758)

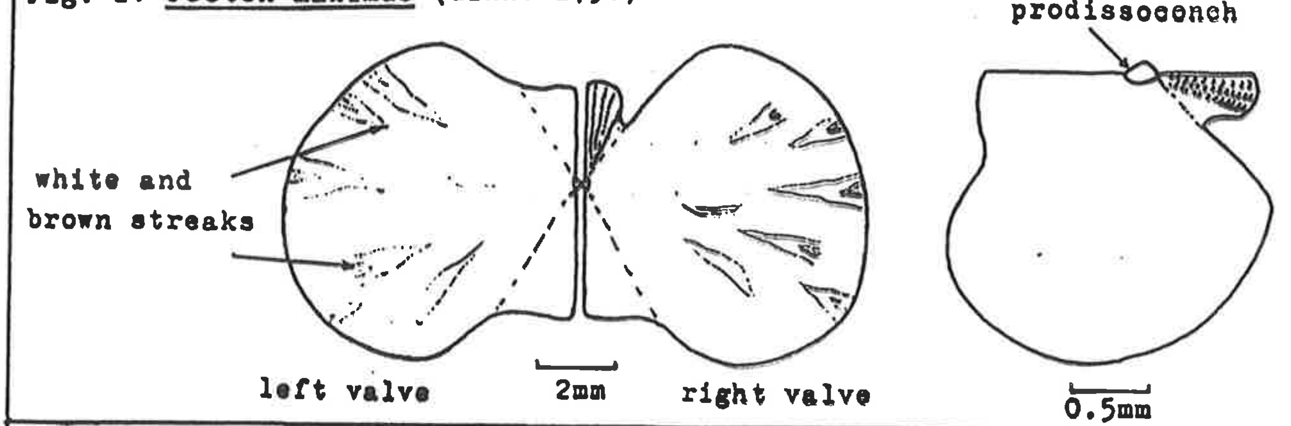


Fig. 3: Chlamys varia (Linne 1758)

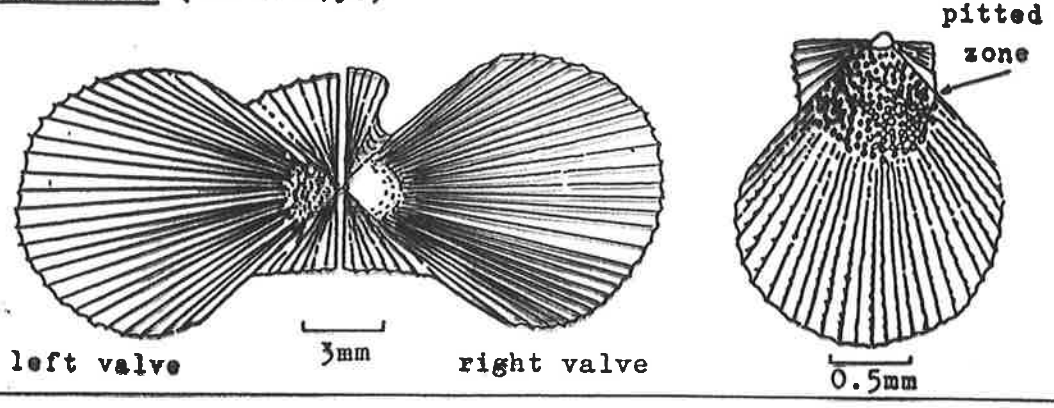


Fig. 4: Aequipecten opercularis (Linne 1758)

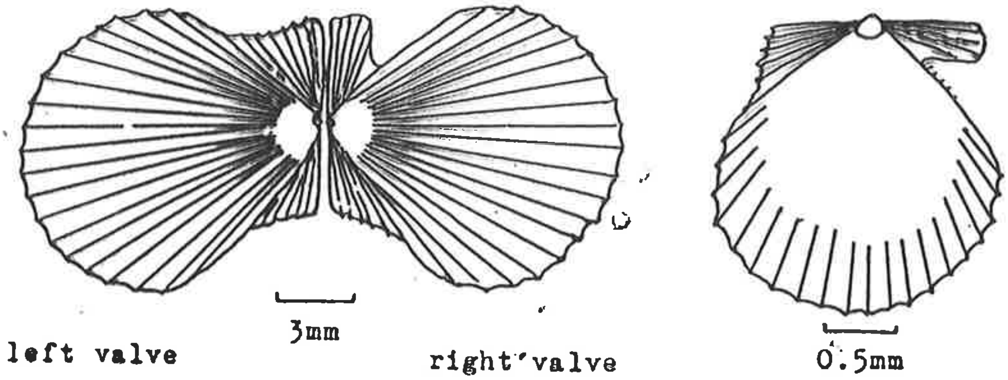
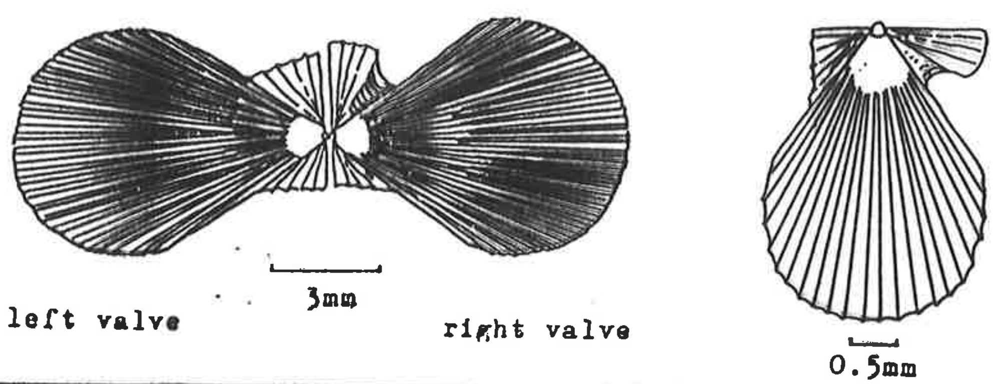
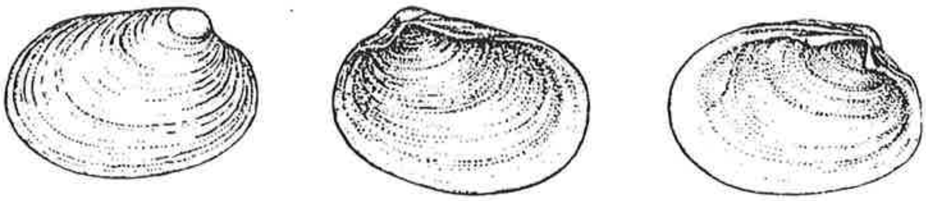


Fig. 5: Hinnites distorta (da Costa 1778)

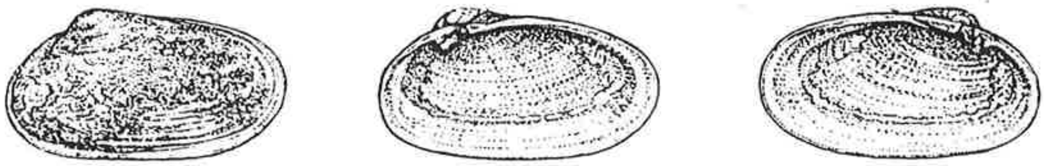


from Conc. Newsletter

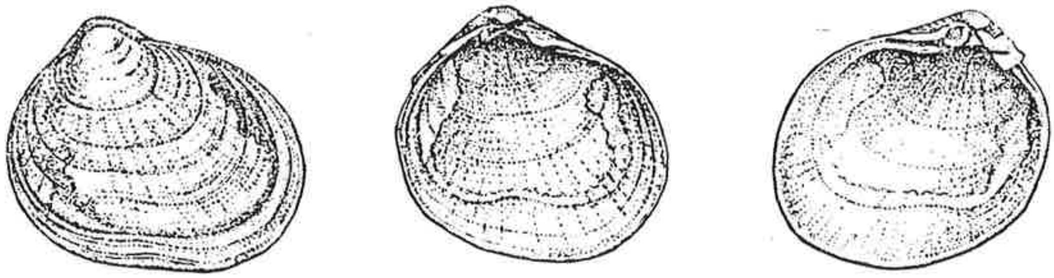
ERYCINACEA (GALEOMMATACEA)



Mysella bidentata



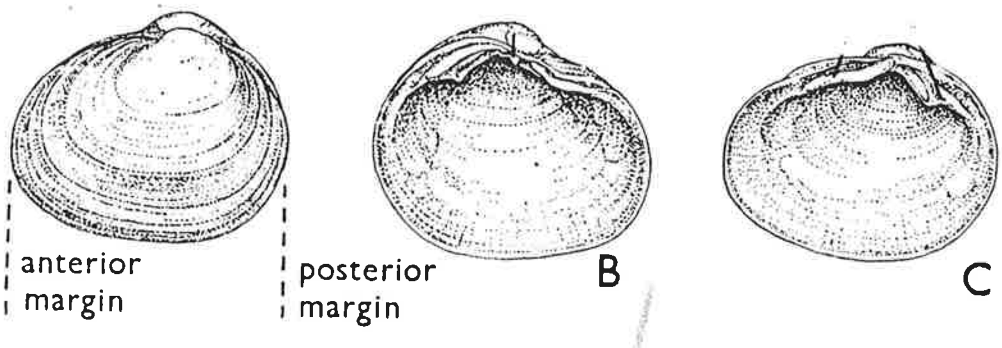
Tellimya ferruginosa



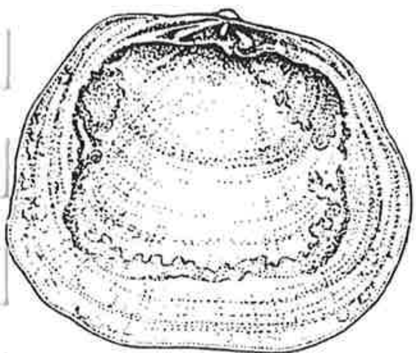
Montacuta substriata

Epilepton clarkiae

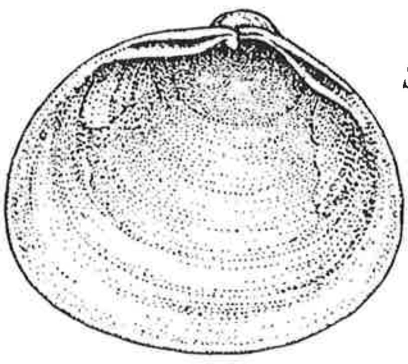
Kellia suborbicularis



Lasaea adansoni



Lepton squamosum



Semierycina nitida

LUCINACEA: THYASIRIDAE

This is an extremely difficult group of bivalves. In the northern North Sea and in water >100 metres depth, several species may occur. Workers likely to be dealing with this group should consult:

PAYNE, C.M., & ALLEN, J.A., 1991. The morphology of deep sea Thyasiridae (Mollusca: Bivalvia) from the Atlantic Ocean. *Phil. Trans. R. Soc. Lond.* **B 334**: 481-562.

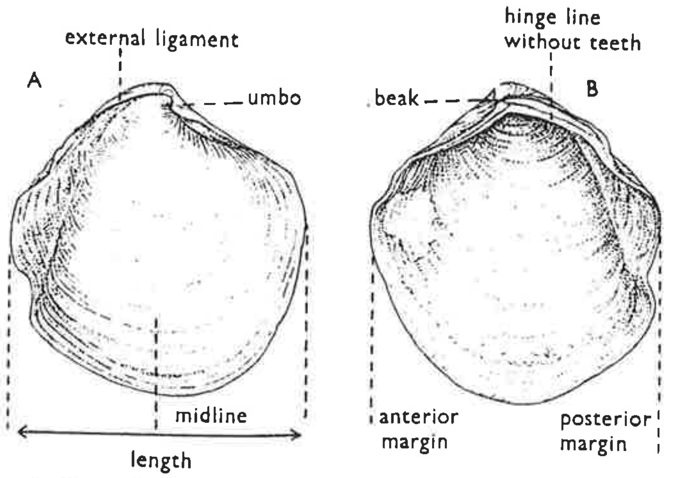
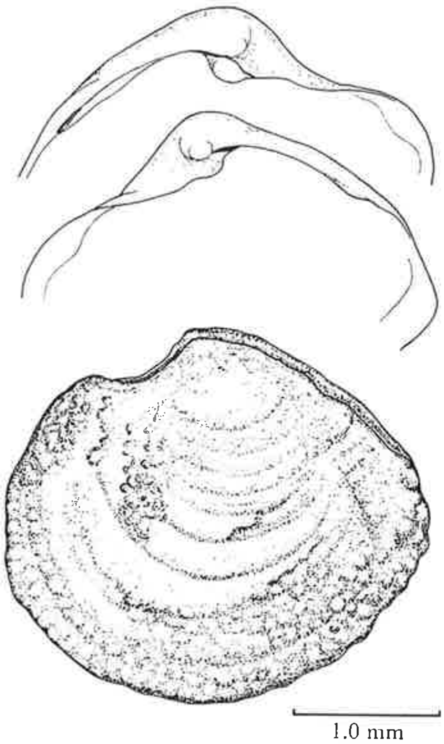
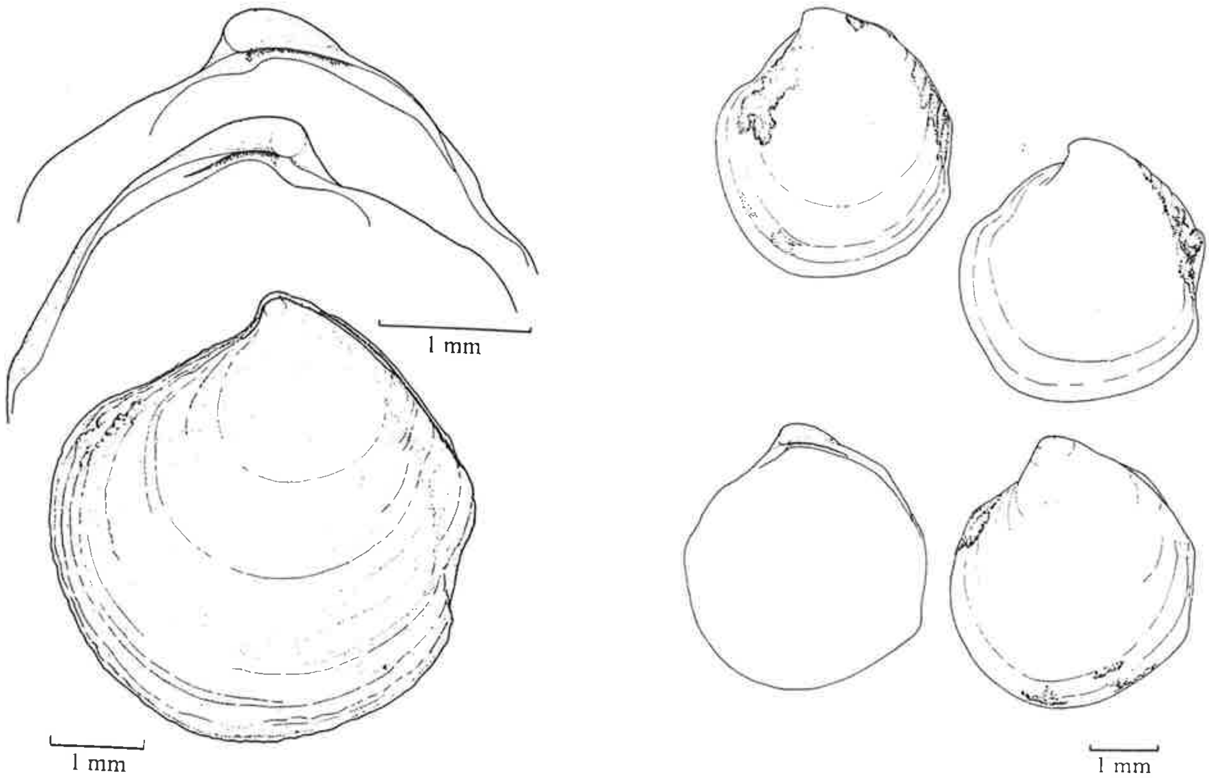


FIG. 5. Example of the Family Thyasiridae, Superfamily Lucinacea; *Thyasira flexuosa*, (a) view of the outside of the right valve and umbonal region of the left, (b) view of the inside of the right valve,

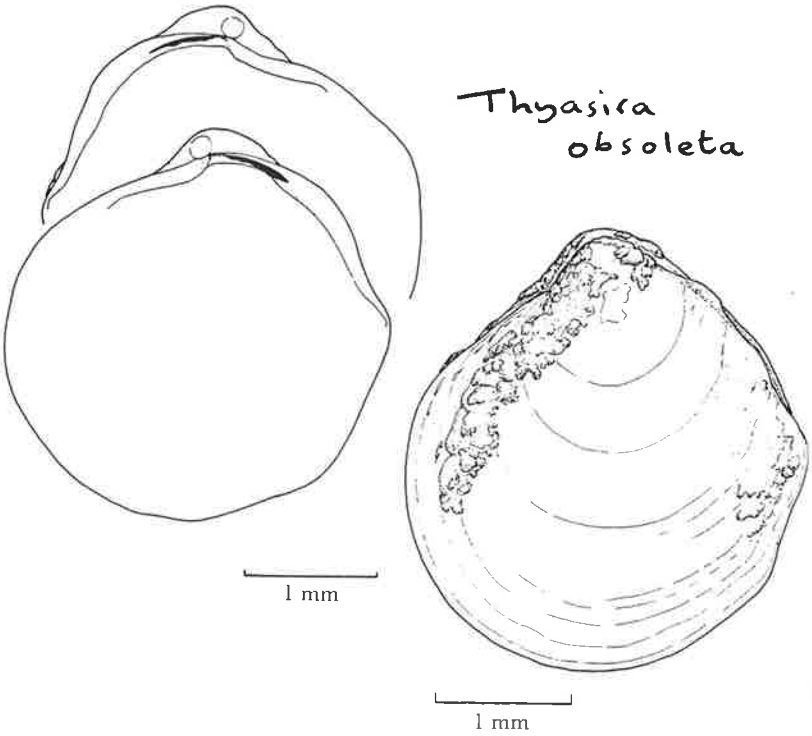


Thyasira ferruginea

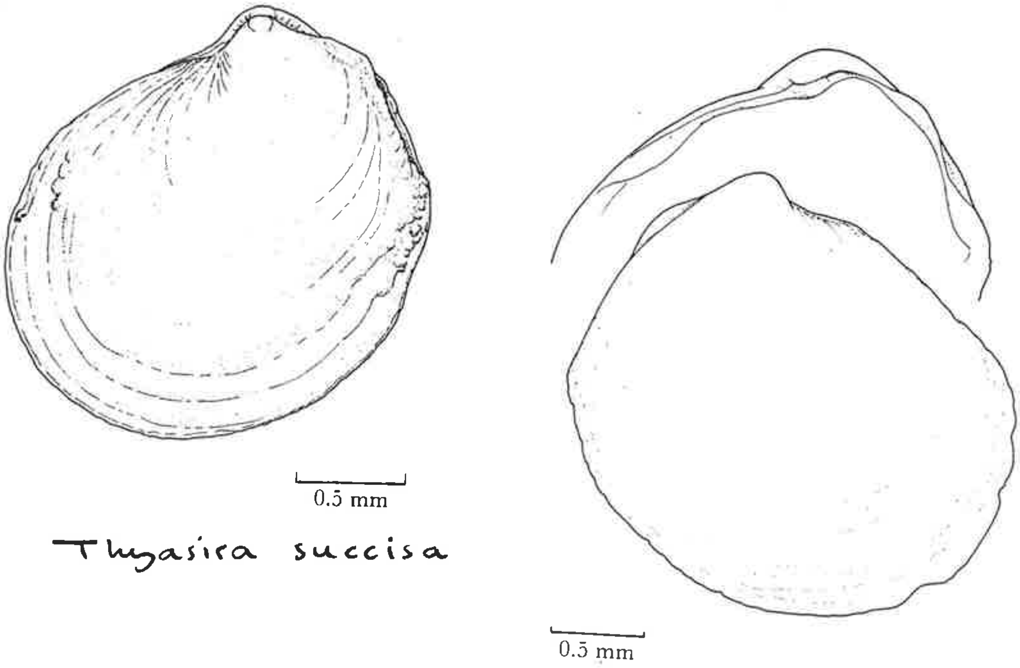


Thyasira equalis

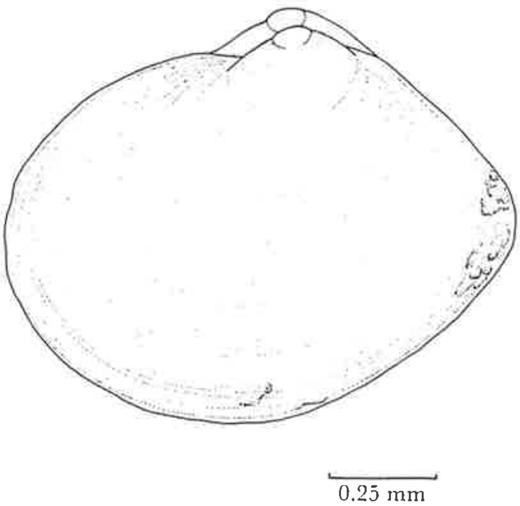
Thyasira croulinensis



Thyasira obsoleta



Thyasira succisa



Thyasira pygmaea

Thyasira eumyaria

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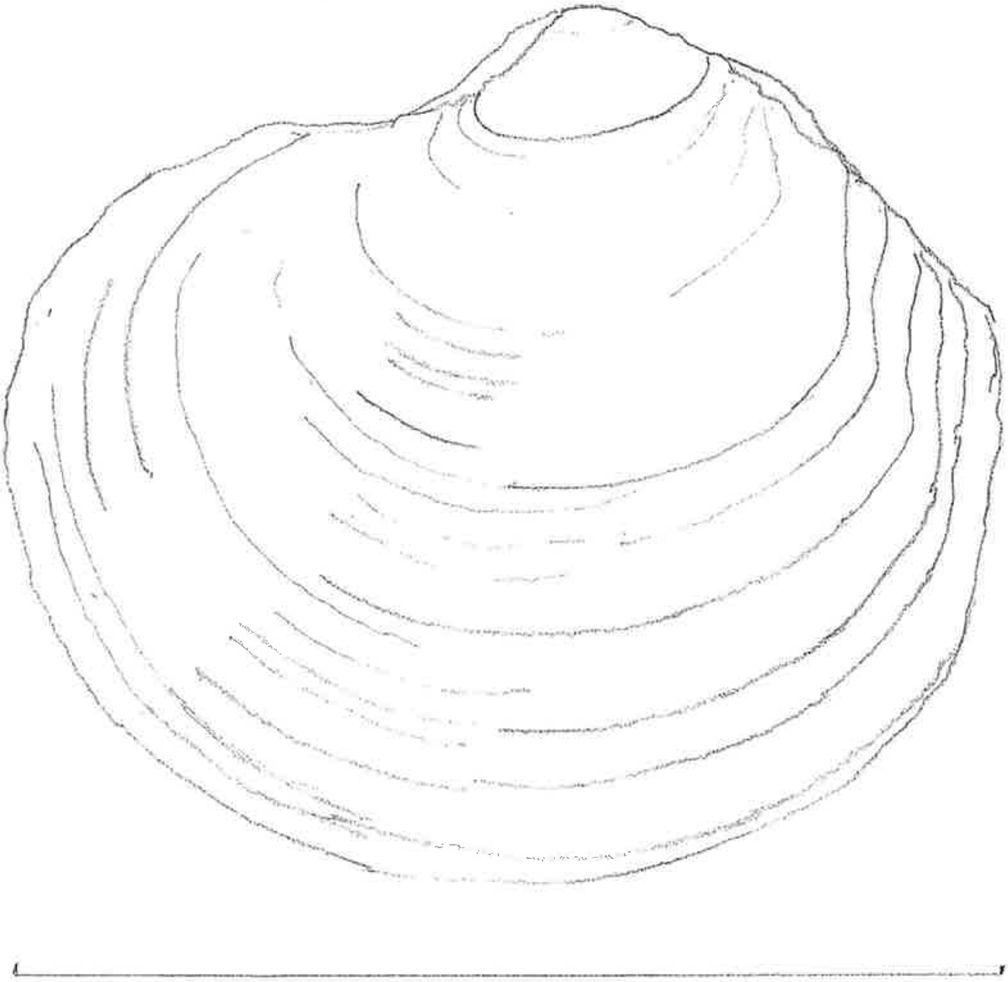
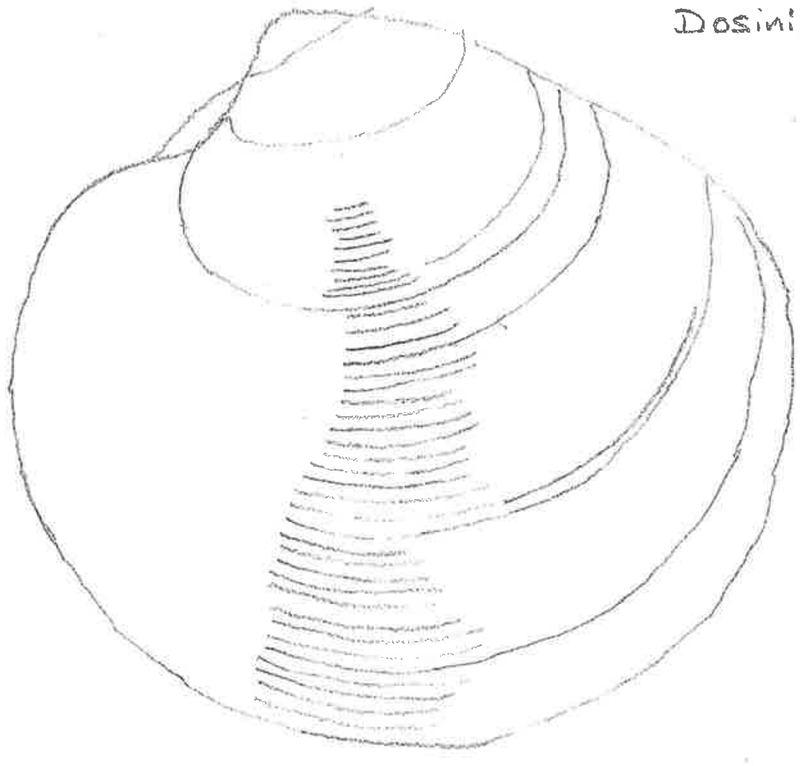
Lucinoma borealis



6 mm

Dosinia lupinus



KEY TO SOLENACEA

1. Hinge ligament in central part of shell. *Pharus legumen* (not a razor)
growth increments concentric.

   Hinge ligament at anterior end of shell 2

2. Shell with virtually straight, parallel sides 3

   Shell not like this 4

3. Shell with deep external groove close to anterior end .... *Solen marginatus*

   Shell without grooves near anterior end ....*Ensis siliqua*

4. Shell with both sides conspicuously curved and tapering towards posterior end... *Ensis ensis*

   Shell with slightly curved upper (hinge) side and distinctly curved lower side (ventral margin) 5

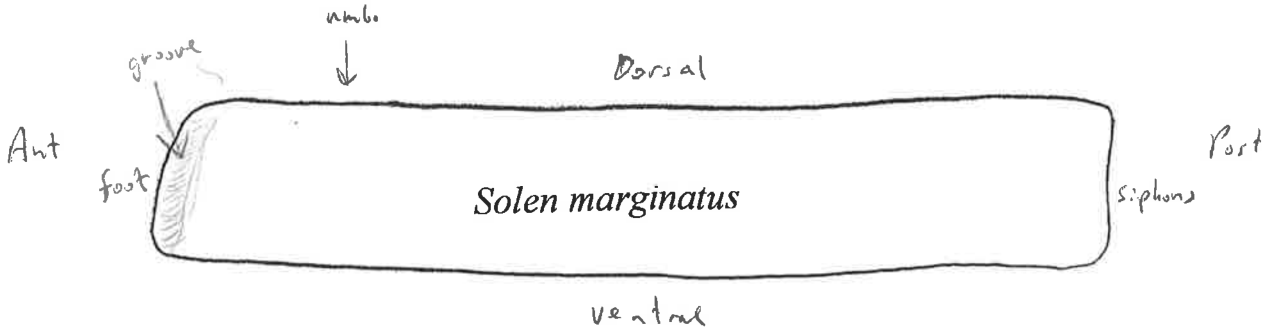
5. Shell < 5cm, tapering towards rounded anterior and posterior ends .... *Phaxas pellucidus*

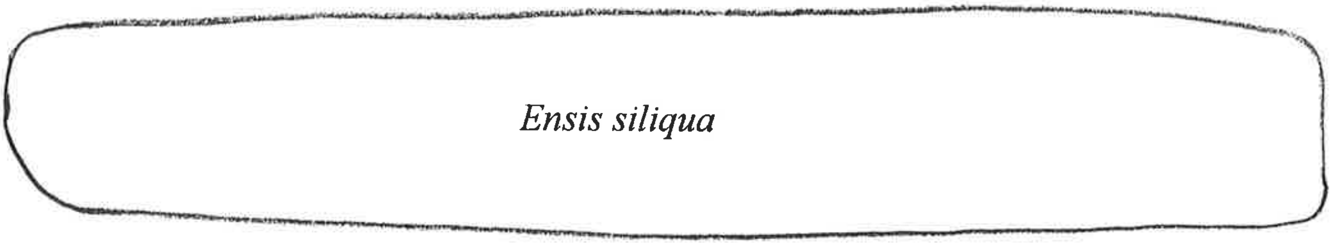
   Shell > 5 cm, no tapering towards anterior end 6

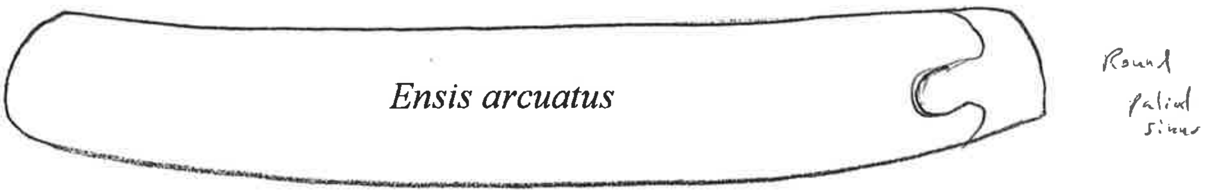
6. Length/height ratio 5 - 6 : 1, anterior adductor scar as long as, or only slightly longer than the ligament.............................. *Ensis americanus*

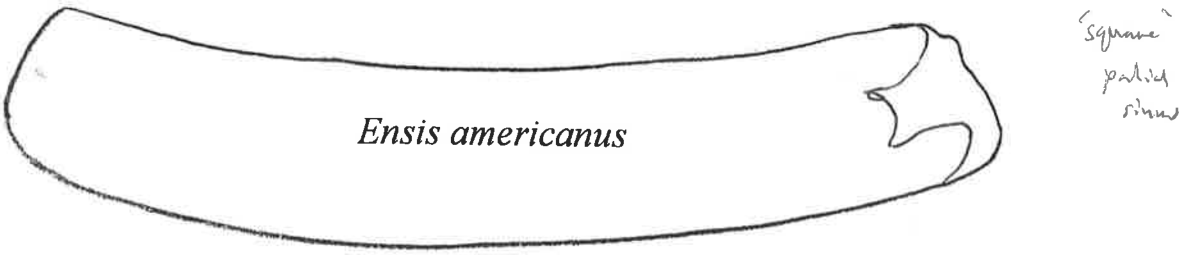
   Length/height 6.5 - 7.5 : 1, anterior adductor scar around 1.5 times longer than the ligament... *Ensis arcuatus*

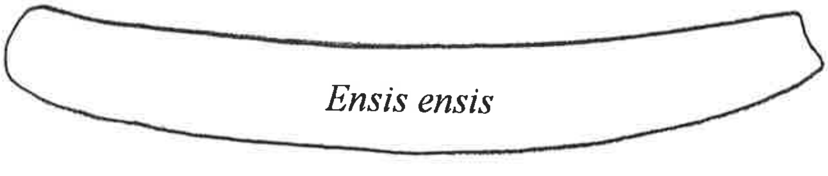
NOTES:
a) Juveniles often have greater curvature, even *E. siliqua*.
b) *Solen marginatus* is southern in distribution, has a horn coloured shell and even very small juveniles are straight sides.
c) *E. siliqua* and *E. americanus* live in shallow water (usually < 20m), the other species live at greater depths.
d) *E. americanus* is currently known from the Humber to Rye, but is spreading rapidly.
e) *E. americanus* and *E. arcuatus* are separable on other characters eg. the shape of pallial sinus, colour.



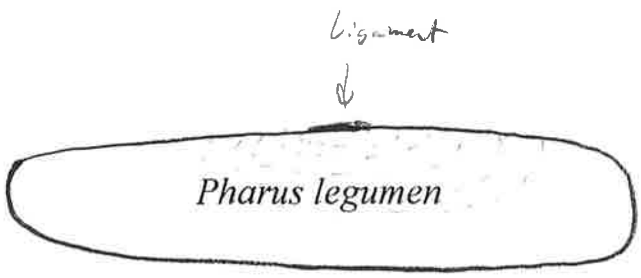








Phaxas pellucidus



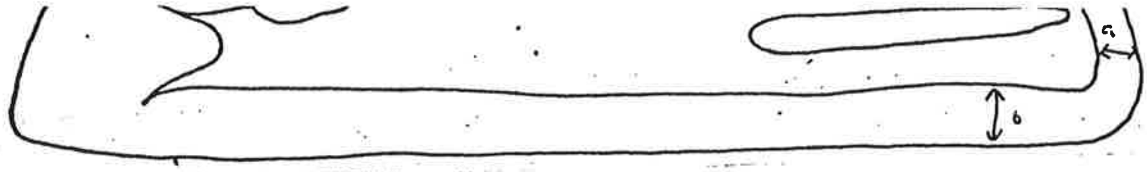


Fig. 4 *Ensis siliqua*

Elongate shell up to 215 mm in length. Straight dorsally and ventrally. Anterior pallial scar nearer to the anterior edge than ventral pallial scar is to the ventral edge (b:a 0.8 to 1.3) in the anterior region of the shell. Anterior adductor scar broadens posteriorly, Posterior gape oval..

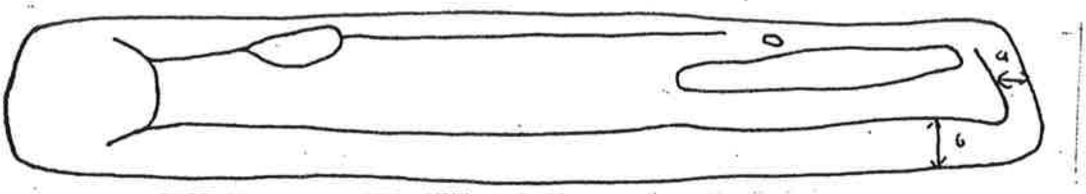


Fig. 5 *Ensis minor*

Elongate shell up to 170 mm in length. Straight dorsally and ventrally. Anterior pallial scar parallel to and much closer to anterior edge than ventral pallial scar is to ventral edge (b:a 1.5 to 2) in the anterior region of the shell. Posterior gape compressed. Anterior adductor scar not much broadened posteriorly.

		Ensis siliqua	*Ensis minor*
1. Anterior pallial scar	a)	diverging from anterior end	parallel to anterior end
	b)	close to anterior end b:a 0.8 to 1.3	close to anterior end b:a 1.5 to 2
2. Anterior adductor scar		broadened posteriorly	not much broadened posteriorly
3. Posterior adductor scar		at less than its own length from pallial sinus	at own length or more from pallial sinus
4. Posterior gape		oval	compressed

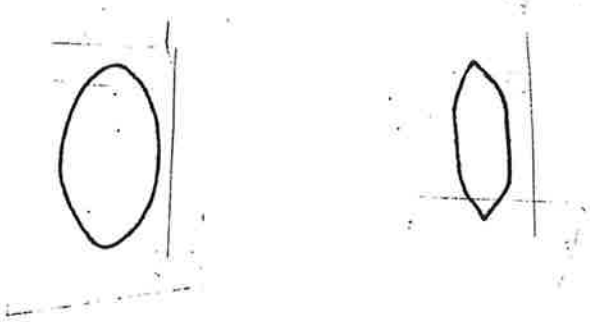


Fig. 6 *Ensis arcuatus*

Straight or slightly curved dorsal edge, curved ventral edge. Truncated anterior and posterior edges. Anterior adductor scar one and one third times length of ligament. Length to breadth ratio 8:1. Foot retractor scar posterior to ligament insertion. Posterior adductor scar at about its own length from pallial sinus. Pallial sinus U-shaped, not pointing to posterior adductor scar. Colour fleshy pink with brown periostracum.

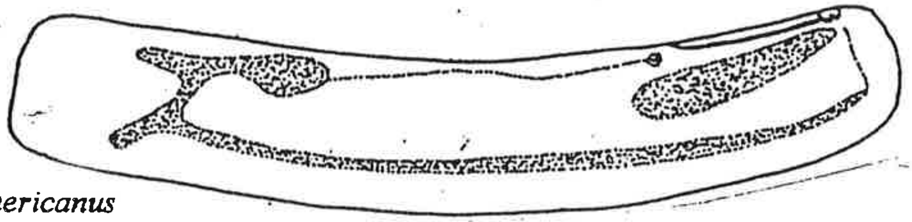


Fig. 7 *Ensis americanus*

Length to breadth ratio 6:1. Curved ventral edge, slightly curved dorsal edge. Truncated anterior and posterior edges. Anterior adductor scar as long as ligament or only slightly longer. Foot retractor scar opposite to ligament insertion. Posterior adductor scar very close to the pallial sinus, nearly bordering it. Pallial sinus reversed S shape, pointing to posterior adductor scar. Colour greyish violet with olive green periostracum.

	Ensis arcuatus	*Ensis americanus*
1. Length: breadth ratio	8:1	6:1
2. Anterior adductor scar	one and one third ligament length	1.1 times length of ligament
3. Foot retractor scar	posterior to ligament insertion	opposite ligament insertion
4. Posterior adductor scar	at its own length or more from pallial sinus	very close or joined to pallial sinus
5. Pallial sinus	U-shaped	reversed S shaped pointing to posterior adductor scar

CARDIIDAE

The cockles maybe recognised by:

- Equivalve shell
- Prominent umbones
- External, prominent ligament
- Sculpture of bold radiating ribs, often with conspicuous spines, tubercles or scales
- Two peg-like cardinal teeth in each valve
- Pallial line with no sinus

[Note: the venerid *Timoclea ovata* may appear similar to cockles but it has the heart-shaped lunule, a pallial sinus, and 3 prominent cardinal teeth in each valve]

Four genera are present: *Laevicardium*, *Acanthocardia*, *Cerastoderma* and *Parvicardium*

Laevicardium crassum - Adults easily recognised. Shell appears smooth but has a sculpture of 40-50 radiating ribs (with a shallow relief). Covered with a brownish periostracum particularly around the margins. Juveniles are smooth and glossy and the radiating ribs are very faint, or absent on very small (<5mm) individuals. Widely distributed in a variety of substrates.

The large prickly cockles, ***Acanthocardia*** species are very difficult to separate. However, only *A. echinata* is widespread and is the species most likely to be present in general benthic samples. *A. aculeata* is probably now confined to a small area around Torbay and *A. tuberculata* is known only from a few locations in southern England and South Wales. The differences between the three can be quite subtle, are difficult to describe and subjective to interpret.

Juvenile *Acanthocardia echinata* maybe separated from *Parvicardium* spp by the following:

- Interstices much broader than the ribs
- Interstices with well defined concentric lamellae
- Narrow ribs with a prominent, sharp keel capped by a row of pointed or tuberculate spines

Cerastoderma edule

- Ribs broader than the interstices
- Interstices generally smooth or with faint concentric sculpture
- About 24 radiating ribs with regularly spaced, flattened, scale-like spines (not cusped)
- External sculpture visible on inside as grooves extending from the ventral margin to just beyond the pallial line
- Compared with *Parvicardium* spp. Juveniles (<3mm) are almost rectangular in shape with prominent umbones and a sharp angle between the dorsal margin and posterior. The sculpture is unlike any *Parvicardium*.

Cerastoderma glaucum is essentially a lagoonal species although it does occur in estuaries in East Anglia and Southampton Water for example. It has a much thinner shell and the external sculpture is visible on the inside as grooves extending from the ventral margin to the umbones.

Parvicardium species characters

P. exiguum

- Shell generally robust and distinctly inequilateral
- Shell markedly truncated posteriorly, with ridge from top to lower posterior margin
- 20-22 ribs
- Ribs and interstices about equally broad
- Ribs with rounded tubercles, mainly on anterior end
- Interstices with fine concentric sculpture
- Generally found in inshore sheltered locations to c. 20m, in mixed muddy/sandy/gravel

P. minimum

- Shell nearly round, rather convex, thin & fragile, white
- Intercostal spaces narrow, but with fine conspicuous lamellae
- 28-32 ribs, shining through at the inside
- Ribs with one (sometimes 2) rows of sharply angled V-shaped cusps
- Mainly a northern species living in fine silt and mud from 20->200m

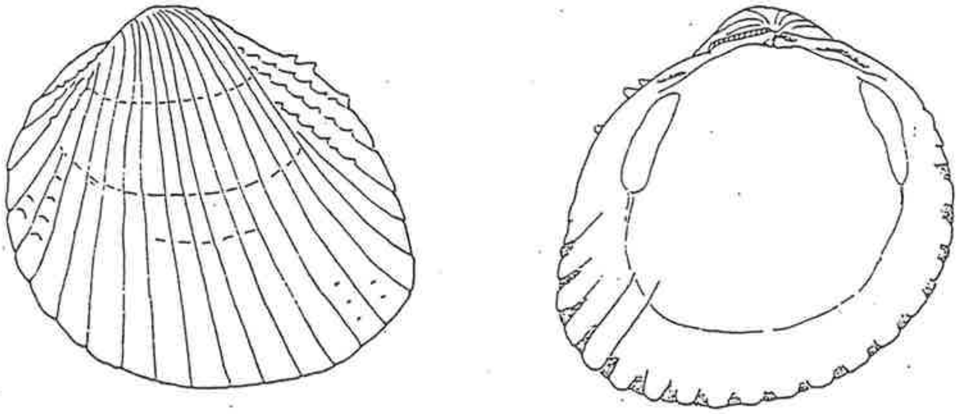
P. ovale = P. pinnatulum

- Shell roundish and rather thin, slightly inequilateral (the umbo is anterior of midpoint)
- Shell slightly truncated posteriorly
- Shell with 24-26 ribs which on the inside are prominent as grooves running from the ventral margin to the top
- Weak hingeline
- Ribs low and broad, interstices very narrow
- Ribs in the middle part of the shell are smooth
- The ribs at the anterior end have blunt scales
- The ribs at the posterior end have small spines
- Widely distributed, living in muddy sand, gravel and shell gravel

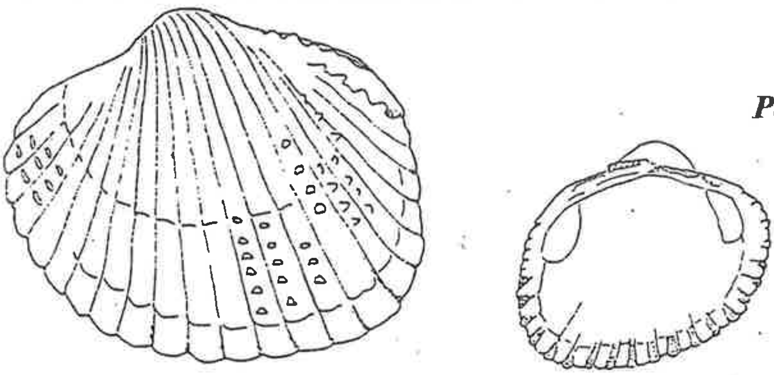
P. scabrum

- Shell roundish, solid, more-or-less equilateral (umbo centrally located)
- Shell truncated posteriorly
- 26-28 radiating ribs which on the inside are ONLY visible at the margin
- Robust hingeline
- Ribs much broader than the interstices
- ALL ribs have cusp-like spines
- Mostly south and west in muddy sand, gravel and shell gravel

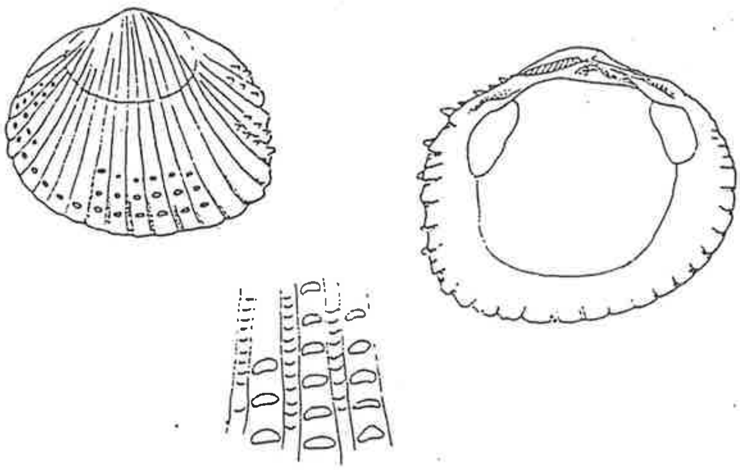
Parvicardium **shells**



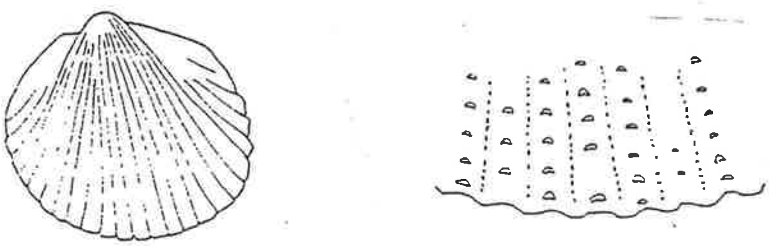
Parvicardium ovale



Parvicardium exiguum



Parvicardium scabrum



Parvicardium minimum

MACTRACEA

Two families are represented: the Mactridae and Lutrariidae. They are characterised by rather solid, more-or-less equilateral shells. They possess both an external and an internal ligament. The internal ligament lies within a small chondrophore recessed within the hinge line. Hinge with 2 or 3 cardinal teeth in each valve, the left with to cardinals fused to form an ∧ - shaped projection. Pallial line always indented with a pallial sinus. In the Lutariidae, the valves gape anteriorly and posteriorly.

Mactra stultorum - thin, brittle shell, pale brown colour often with radiating rays. Inside of shell often purple. Lateral teeth smooth not serrated. Juveniles are glossy and maybe separated from *Spisula* by the more prominent umbones and the dorsal margin with a conspicuously 'pinched' appearance. Lives inshore (<30m) in sand or silt.

Spisula - Three species are recognised: *S. subtruncata, S. solida* and *S. elliptica* although the taxonomic status of the latter 2 is unclear. All have solid, rather smooth, usually white shells with serrated lateral teeth.

Spisula subtruncata

- Large specimens reach 25mm
- Rather triangular in outline but asymmetrical
- Posterior hingeline slopes more sharply than anterior
- Lunule and escutcheon broad and elongate
- Escutcheon bounded by low ridges extending from umbones
- Left valve with 3 cardinal teeth, 2 of which are fused to form an ∧ - shaped projection which reaches almost to the lower line of the hinge plate
- Juveniles are markedly angular, particularly at the posterior end
- Lives in sand usually with a silty or muddy element, rarely to depths >30m

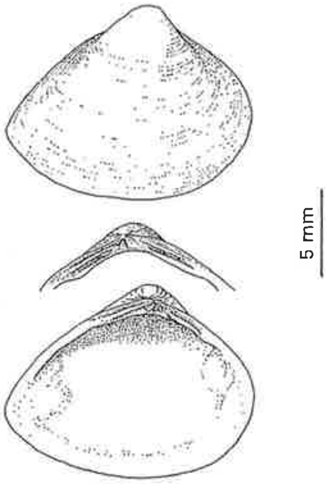
Spisula solida and *S. elliptica* differ mainly in the size and extent of the forked cardinal teeth in the left valve. There appears to be habitat partitioning suggesting that they may be no more than ecophenotypes. On the continent, the name *Spisula ovalis* is also used.

	solida	*ellipica*
Size	45mm	30mm
Habitat	Sand, inshore to c. 25m	Offshore, in scoured sands and gravels to c. 200m
Shape		More elliptical with less prominent umbones
Cardinal teeth - lv	extends half way down hinge plate	extends more than half way down hinge plate

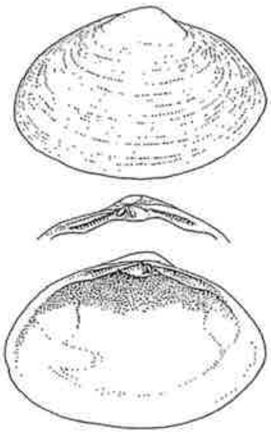
Juvenile *elliptica/solida* are virtually impossible to separate from each other, but differ from *S. subtruncata* by a less angular shell and the stepped appearance of the dorsal margin (the posterior dorsal margin is higher than the anterior).

Lutraiidae - 3 species of *Lutraria* are known from British waters: *L. lutraria, L. angustior and L. magna*. The latter species may now only live in the Channel Islands but is easily recognised by the distinctively concave dorsal margin and umbones offset anteriorly. *L. angustior* is a mainly western species and its taxonomic status is unclear - it differs from *L. lutraria* by its straighter, rather than curving, dorsal margin, and the palial line which is fused with the lower edge of the pallial sinus.

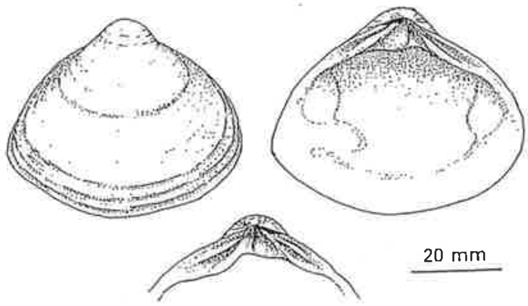
Lutraria lutraria is the species most likely to occur in benthic samples from the CEFAS area. It is recognised by its large (up to 130mm), solid shell which gapes anteriorly and posteriorly. The umbones lie just anterior of mid-line and the dorsal margin is gently convex. Adults are unmistakable but juveniles may be unrecognisable! Juveniles have sloping dorsal margins, a conspicuous smooth, bead like umbone and when below 4-5mm, no gape.



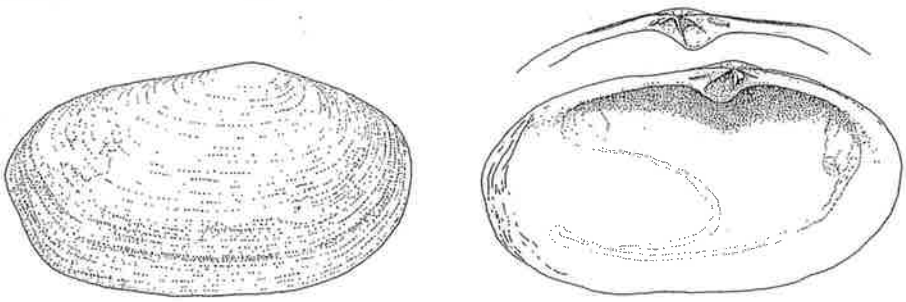
Spisula subtruncata



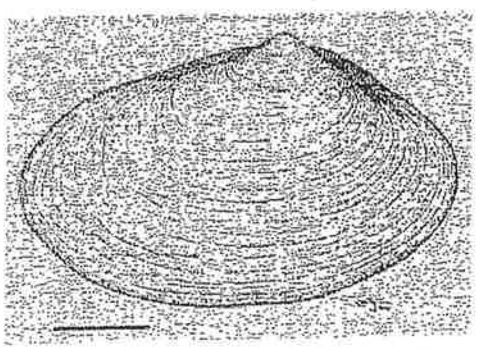
Spisula elliptica



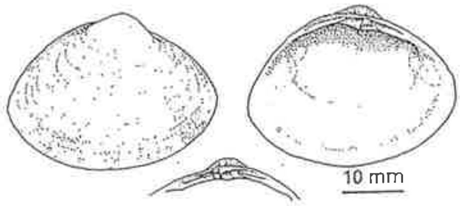
Spisula solida



Lutraria lutraria



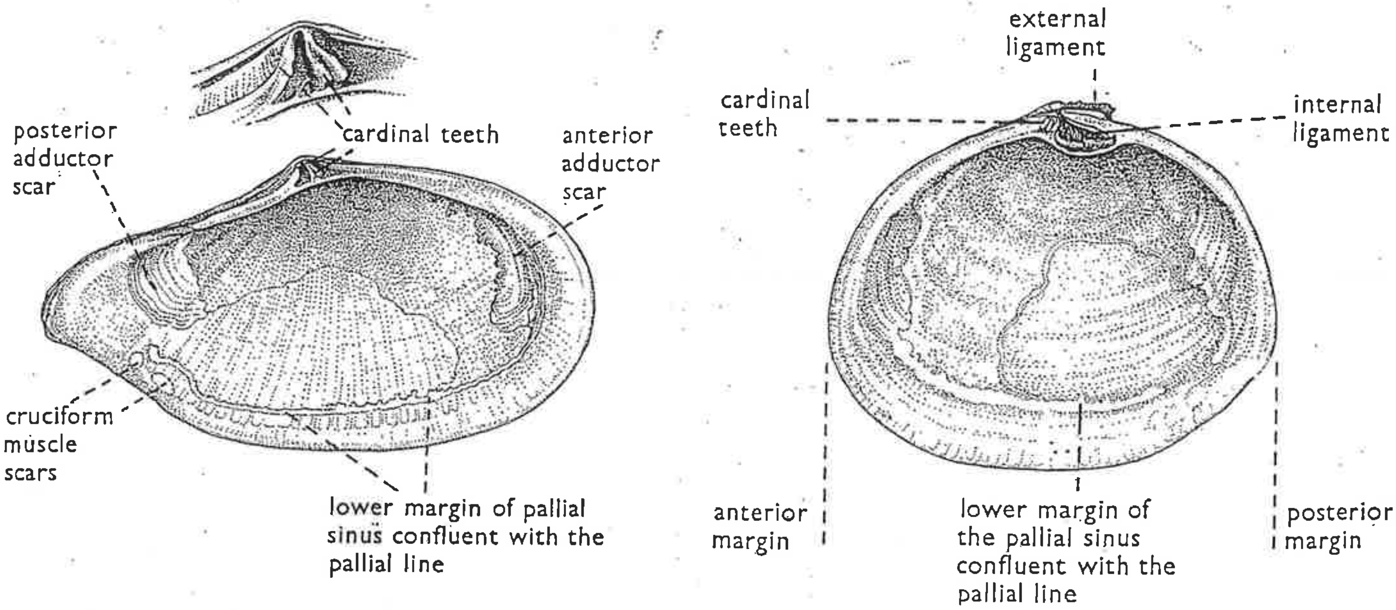
Lutraria lutraria Juvenile
(Scale Bar 1mm)



Mactra stultorum

TELLINACEA

- Shells mostly thin, somewhat flattened, and often very colourful
- Ligament external, often projecting, except in the Scrobicularidae in which it is mainly internal and attached to a chondrophore
- Deep pallial sinus, the lower limb of which (in most species) runs confluent with it

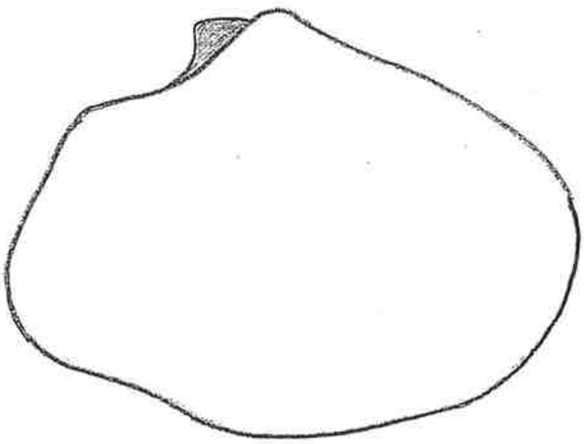


Tellinidae

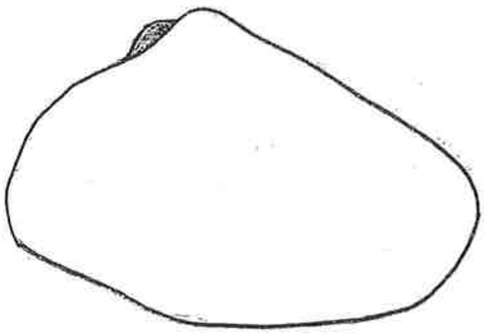
Generally thin, flattened shells with (in most) sharp angulations at the posterior end. Prominent external ligament (sometimes raised and triangular).

Species	Features
Macoma balthica	See page of illustrations
Angulus tenuis	See page of illustrations
Fabulina fabula	See page of illustrations
Angulus squalidus	A rare species, known only from a few south-western locations. Solid (to 45mm). Sloping (slightly concave) posterior dorsal margin, pointed at end. Two prominent grooves running posteriorly from the umbones. Shell usually orange or pink coloured. In sand/silt from LWST to c.10m.
Moerella donacina	Shell thin & brittle (to 25mm). Umbones clearly posterior of mid-line. Posterior dorsal margin steeply sloping. Cream colored shell with radiating pink or red bands. In silty sand and shell gravels from LWST to c. 50m. Mostly southern and western.
Moerella pygmaea	Smaller (10mm) and more oval than above. Posterior margin more rounded. Shell often pink or orange. Distinctive fine concentric sculpture. In shell gravels and sand from 5-c. 200m.
Arcopagia crassa	Shell solid, thick (to 60mm) with sculpture of fine but prominent concentric ridges. Umbones prominent. Pallial sinus NOT confluent with the pallial line. In shell gravels from 5-200m Mostly SW & W.

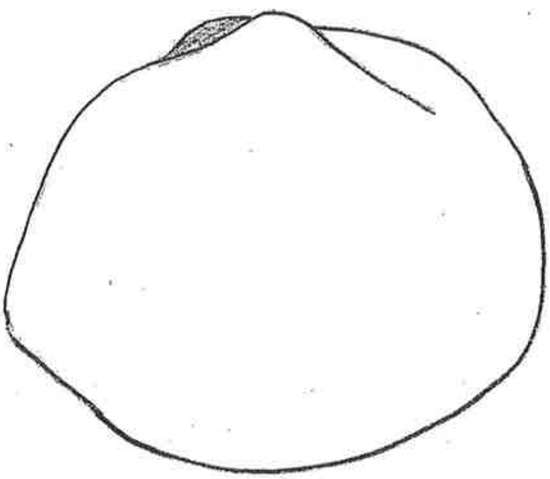
TELLINACEA - JUVENILES



Angulus tenuis - The species is usually only found in sand, intertidally and in the sub-littoral fringe. Juveniles are roughly oval with a L/H of <1.35. Umbo close to the mid point. Anterior end is angular & truncated. The ligament is conspicuous and slightly hooked.



Fabulina fabula - The species lives on sand from LWST to c.25m. Juveniles (<c.4mm) do NOT have any diagonal sculpture on the right valve. Elongate oval shell, L/H of 1.45. Umbo well anterior of mid point. Anterior end angular & truncated. Ligament conspicuous but not hooked as in *A. tenuis*.



Macoma balthica - Inhabits mud, sand & muddy gravel in estuaries and on sheltered shores from MLWM to shallow sub-littoral. Juveniles distinctly rounded, L/H <1.2. Umbo close to mid point and slightly bulbous. Anterior end angular & truncated. Ligament conspicuous, but longer and less pronounced than 2 spp. above. Anterior end usually covered with brown periostracum.

Scrobicularia plana (not illustrated) - Lives in estuarine mud and silt. Outline shape of juveniles very similar to *Macoma*, but umbo is less bulbous and the external ligament is much less pronounced. Easily separated by breaking open hinge to reveal an almost spherical, brown internal ligament. Shell usually covered with a thick brown periostracum.

Donacidae

Donax vittatus — Wedge-shaped shell with sculpture of fine radiating lines. Margin crenulate. Periostracum glossy. Lives in sand to c.15-20m depth.

Scrobiculariidae

Thin white shells with a small external ligament & an internal ligament in a chondrophore.

Species	Features
Scrobicularia plana	Thin, oval, brittle shell (to 60mm). Umbones prominent, almost pointed, and centrally located. External ligament indistinct. Internal ligament large, brown and almost spherical. Shell (especially in juveniles) often covered with a brown periostracum. Lives deeply buried in mud in tidal creeks, rivers and estuaries only.
Abra tenuis	Small (12mm) almost triangular, dull white shell. Umbones pointed and more-or-less centrally located. Lives in lagoons and estuaries only.
Abra nitida	See page of illustrations
Abra alba	See page of illustrations
Abra prismatica	See page of illustrations

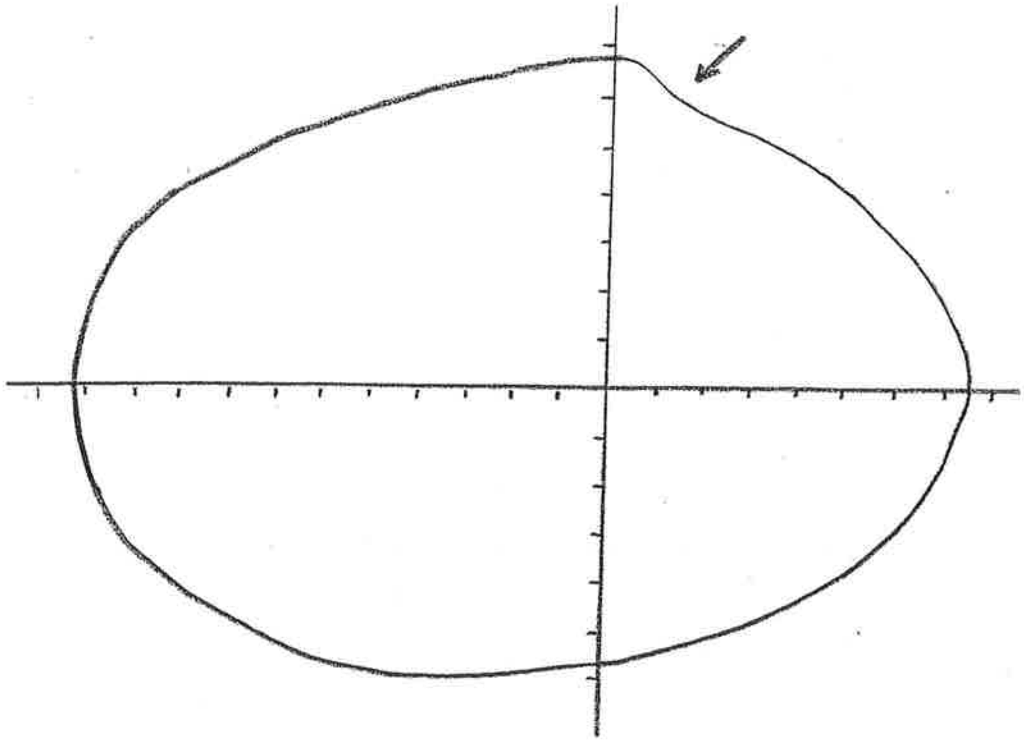
Psammobiidae

Species	Features
Gari fervensis	Elongate shell (to 50mm). Posterior margin with a sharply angled truncation, with a prominent keel from the umbones. Sculpture of fine concentric lines (and radiating ribs between the keel and dorsal margin- distinct on juveniles). White shell with pink rays and brown periostracum. In silty sand from LWST to c. 50m.
Gari tellinella	Small thin shell (25mm), oval, elongate with rounded ends. Highly coloured. In shell gravel from LWST to c. 200m. Mainly SW and W.
Gari costulata	Similar to *tellinella* but with ribs radiating from the umbones to the posterior end (cf young *fervensis*). Shell gravel to 150m, SW and W.
Gari depressa	The largest species (to 60mm). Umbones just anterior of mid point. Posterior end truncate and valves gape. Creamy shell with pink rays and a brown periostracum. Mainly western in shell gravel to c. 20m.

Solecurtidae

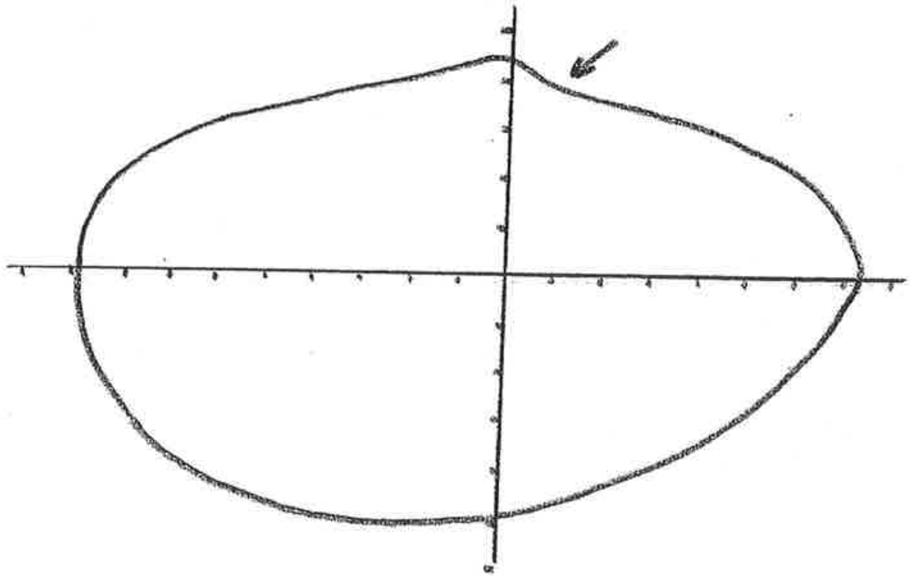
Species	Features
Pharus legumen	Shaped like a razor shell! Gaping at both ends. Anterior end tapered. Umbones located c. one third of length from anterior end. Ligament external and centrally placed. Lives in sand/silty sand. Mainly S &W.
Solecurtus scopula	Elongate shell (up to 60mm) gaping at either end. Umbones close to mid-point. Sculpture of concentric lines & radiating ridges. White shell with brown periostracum. Uncommon, mostly SW & W, in shell gravel.
Azorinus chamasolen	Elongate shell (up to 60mm) gaping at either end. Umbones just anterior of mid-point. Sculpture of concentric lines only. White shell with dark brown periostracum. Uncommon, mostly SW and W, in mud or mixed substrates with a muddy component.

ABRA SPECIES



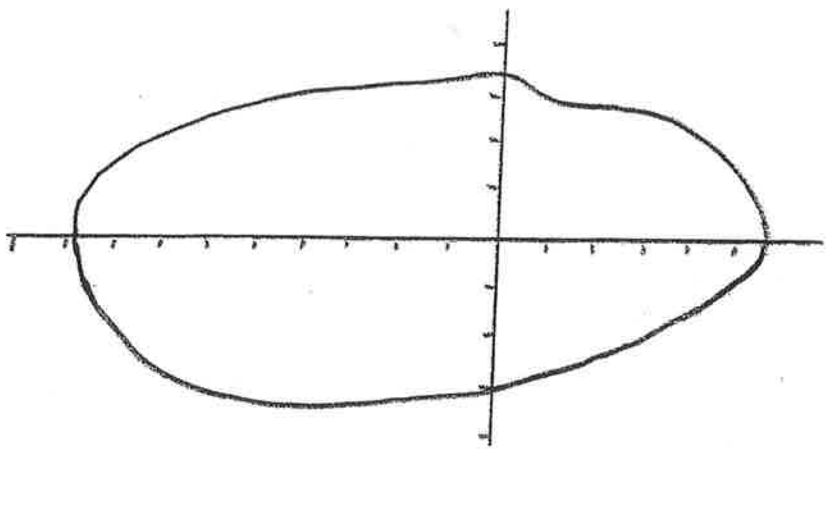
Abra alba

Generally oval in outline
Umbo just posterior to midline
Shell glossy, translucent grey to white
No shelf posterior to umbo
Generally lives in muddy, silty sand



Abra nitida

Elongate oval shell
Umbo just posterior of midline
Shell highly polished, translucent grey
Shelf posterior to the umbo
Generally lives in mud/muddy silt



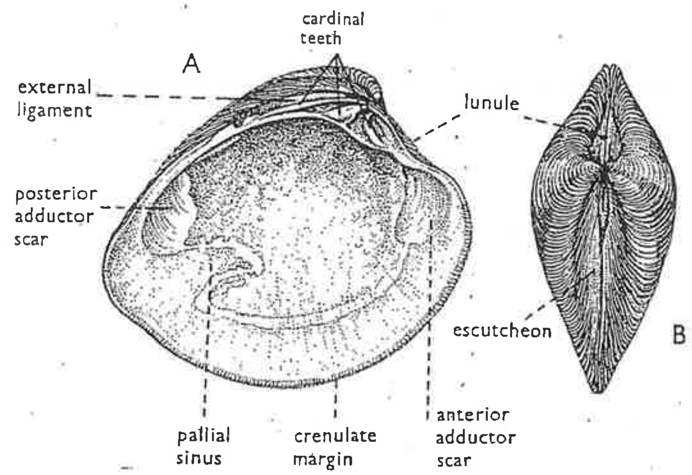
Abra prismatica

Elongate oval shell
Umbo in posterior half
Shell glossy, translucent grey
Shelf posterior to umbo
Generally lives in clean sand

VENERACEA

Veneridae

Solid equivalve shell
Umbones prominent and anterior of mid-line
Sculpture mainly of concentric grooves
Lunule distinct and heart-shaped
Hinge with 3 cardinal teeth in each valve, occasionally with anterior lateral teeth
Ligament external
Pallial line always indented with a pallial sinus



Species	Features
Circomphalus casina	Large (to 50mm), solid rounded shell with sculpture of deeply incised concentric ridges. Distinct, deeply set lunule with radiating lines. In shell gravels from LWST to c. 200m.
Venus verrucosa	Similar to above but sculpture of deep, concentric ridges and radiating lines giving a warty appearance. Southern, sheltered shell gravel habitats from LWST to c. 20m
Gouldia minima	Small (15mm max) rounded shell, with prominent (almost pointed) umbones located at mid-point. Sculpture of fine, smooth concentric ridges. In shell gravels from 5-200m.
Chamelea gallina	Broadly triangular shell (to 40mm). Sculpture of fine concentric ridges. Lunule deeply impressed, heart-shaped. Often with radiating reddish brown bands. In sand and silt, LWST to c. 30m.
Clausinella fasciata	Rounded - sub-triangular shell (c. 20mm), with sculpture of broead (slightly flattened) concentric ridges. Umbone prominent, slightly pointed. Very colourful. In shell gravels LWST to c. 200m.
Timoclea ovata Heart shaped can be identified by larval stage	Small shell (20mm max), sub-triangular. Sculpture of radiating AND concentric ridges (equally prominent). Lunule indistinct. May be confused with *Parvicardium*! Juveniles are circular in outline and have only very faint radial sculpture. Range of substrates from 5 - >200m.

Veneridae (continued)

Species	Features
Tapes aureus	Oval to sub-triangular shell (to 40mm). Hinge line sloping away from umbones on both sides. Sculpture of very fine concentric lines giving a silky appearance. Inside of shell deep yellow colour. Sheltered, shallow water environments with mixed sand, silts and gravels. Mostly south and west.
Tapes decussatus	Rather quadrate, robust shell (to 75mm). Umbones towards anterior. Sculpture of fine concentric AND radiating lines giving decussate appearance. Inside of shell often deep yellow, sometimes with purple around muscle scars. Sheltered muddy, gravel shores often in lower reaches of estuaries. Mostly south and west.
Tapes rhomboides	Oval, elongate shell (to 60mm). Hinge line sloping anteriorly, almost straight posteriorly. Posterior end rounded. Sculpture of fine concentric lines (appears silky). Inside and outside of shell often pink. In shell gravels from 5-200m. + maerl.
Venerupis senegalensis	Elongate to quadrate shell (to 50mm). Sculpture of fine concentric lines and faint radial lines. Dull whitish grey shell often with colored zigzag markings, inside often coloured purple around muscle scars. Extremely variable, young maybe confused with *Mysella bidentata*. In sand, silt and gravels LWST to c. 20m. Also in rock crevices.
Dosinia lupinus exoleta	Almost circular shell (to 60mm). Dorsal margin convex posteriorly and deeply concave immediately anterior of umbones, with a highly arched junction with anterior margin. Sculpture of fine concentric ridges. In shell gravel LWST to c. 50m.
Dosinia exoleta lupinus	Similar to above but smaller (to 40mm). Dorsal margin less concave anterior of umbones and NOT highly arched beyond it. Sculpture of very fine lines giving a smooth-silky feel. Often with pinky brown periostracum. In sand, silt and gravels with a muddy element. More widespread than *exoleta* and from LWST to 200m.

Petricolidae

Species	Features
Petricola pholadiformis	Elongate, chalky white shell (to 60mm). Sculpure of fine concentric ridges, very prominent at anterior end where they appear corrugate. Maybe confused with pholads but separable by absence of gape, presence of external ligament & cardinal teeth. Bores into mud and clay on lower shore. Humber to Dorset.
Mysia undata	Quite unlike above. Thin circular shell (to 35mm). Very fine concentric sculpture. Very distinctive pallial sinus which runs from the pallial line almost to the umbones. In sand, silt and gravels with a muddy element, 10-c.50m.

MYACEA

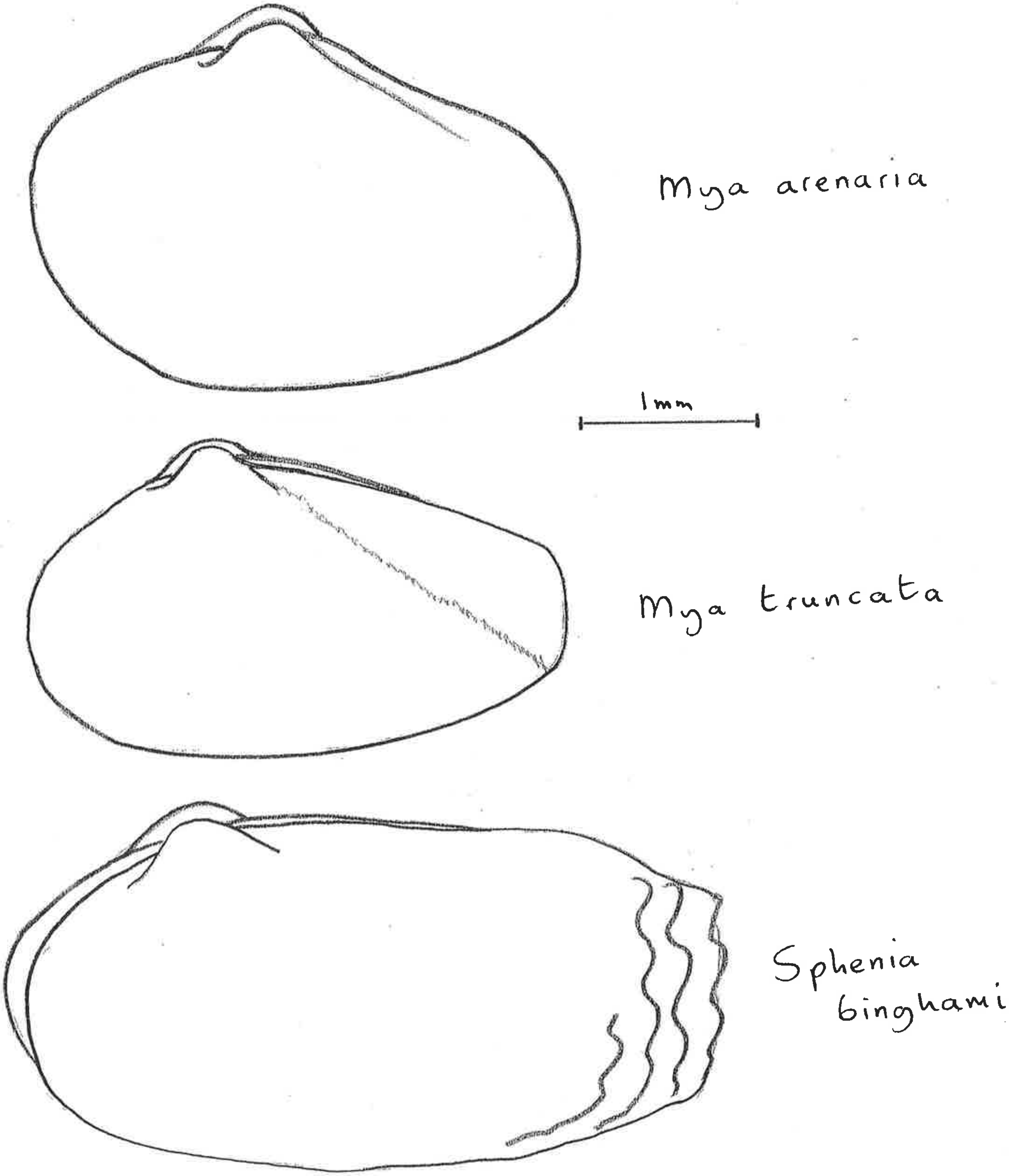
- White, inequivalve shells - the right valve is larger
- Hinge teeth absent
- Ligament mainly internal, attached to a chondrophore (usually projecting and prominent in the left valve)
- Pallial sinus present

Mya arenaria (estuarys)
- Large, solid white shell to c. 150mm
- Anterior end rounded, posterior end slightly truncated
- Large spoon-shaped chondrophore projecting out from left valve
- Posterior end gaping
- Pallial sinus deep and not confluent with the pallial line
- Periostracum brown and covering siphons at posterior end
- Lives in mud or muddy sand in sheltered or estuarine environments to c. 20m

Mya truncata (deeper waters)
- Solid white shell to c. 70mm
- Anterior end rounded, posterior end sharply truncate
- Large spoon-shaped chondrophore projecting out from left valve
- Posterior end gaping
- Pallial sinus deep with lower margin irregularly confluent with the pallial line
- Periostracum brown forming a thick rippled sheath which cover the siphons at posterior end
- Lives in a range of substrates from LWST to c. 100m
- Juveniles quite different from adult, may be confused with *Hiatella arctica* (but this species has a conspicuous external ligament (see also *Sphenia* below)

Sphenia binghami
- Shell small and thin (to 20m)
- A nestling species and therefore very variable in shape - usually oval to quadrate with posterior end truncated
- Small chondrophore projecting out from left valve
- Posterior end gaping
- Periostracum brown, mostly present at posterior end
- Lives attached by byssal threads inside holes and crevices from LWST to c. 100m
- May be confused with *Hiatella arctica* (but this species has a conspicuous external ligament

Corbula gibba
- Small solid oval to sub-triangular shell (12mm)
- Right valve very much larger than the left
- Chondrophore not projecting prominently in the left valve
- Sculpture of strong concentric ridges
- Periostracum brown or black
- Lives in a range of substrates, usually with a muddy element from LWST to c. 200m
- Juveniles more quadrate in outline and there is often a row of spines on the right valve



MYACEA: Juvenile *Mya arenaria*, *Mya truncata* and *Sphenia binghami*

HIATELLACEA

Hiatella arctica

- Solid white shell, up to 40mm long but usually no more than 20mm
- Shell more-or-less quadrate and truncated at either end, but as the species nestles in crevices it can often be very distorted
- Ligament external and conspicuous
- Umbones close to anterior end
- Sculpture of irregular concentric lines with two ridges running from the umbones to the anterior ventral margin. The ridges often have spines
- Hinge line with a projecting cardinal tooth in the right valve
- Lives attached by a byssus in holes and crevices and in weed holdfasts from the lower shore to >200m depth

Saxicavella jeffreysi

- Thin, fragile white shell to c.10mm
- Shell sub-triangular to wedge-shaped
- Umbones anterior to mid-line
- Dorsal margin slopes steeply to anterior
- Hinge line with small projecting cardinal tooth in the right valve
- Uncommon, lives mainly in mud or muddy gravel in depths of c. 5-30m, known from off Dungeness, the Solent and Cardigan Bay

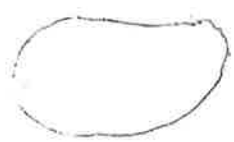
PANDORACEA

A group of brittle white bivalves which are either easy to identify from their shape, or difficult because of the microscopic size of different characteristics.

- Shell generally inequivalve, the right slightly larger or more convex than the left
- No hinge plate and no true teeth
- Ligament internal, external or both: when internal it lies in a chondrophore (or resilifer) and may be strengthened by a calcareous plate (or lithodesma)
- All except *Pandora* spp. have granular sculpture

Pandora pinna

- White (nacreous inside) shell to 20mm
- Shell with flat right valve and strongly convex left valve
- Umbones anterior of mid point
- Posterior dorsal margin straight
- Lives in sand, silt and gravel from 20-200m, mostly S and W



Pandora inaequivalvis As above except:

- Shell to 35mm
- Posterior dorsal margin strongly concave
- Lives in muddy sand (especially *Zostera* beds), silt and gravel from LWST to c. 20m depth. A rare species known mainly from a few localities in southern England (Solent, Swanage bay, Weymouth bay, Portland Harbour)

Pandoracea continued

Lyonsia norwegica

- Shell almost equivalve, roughly oval in outline with a straight dorsal posterior line and the posterior margin abruptly truncated and gaping. Grows to c. 40mm
- Shell surface with coarse granulations gathered into radiating lines which may be prominent as radiating ribs.
- Often covers parts of the shell with sand grains
- Lives in sand, silt and gravel from 20-200m

Cochlodesma praetenue

- Thin, dull white shell to c. 35mm. Dorsal anterior line curved, dorsal posterior line straight.
- Anterior end rounded, posterior end truncated and slightly gaping
- Umbones just posterior of mid point, prominent, almost pointed
- Shell surface with a crack in its upper layer on the posterior side of the umbones
- Shell surface granular, more so at posterior end
- Resilifer (chondrophore) projecting from right valve
- Lives in sand, silt and gravel to >100m depth

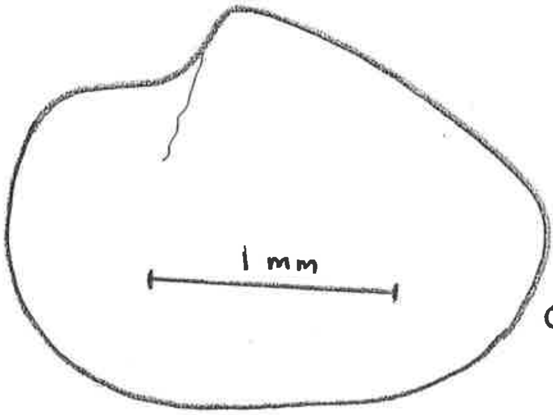
***Thracia* spp.**

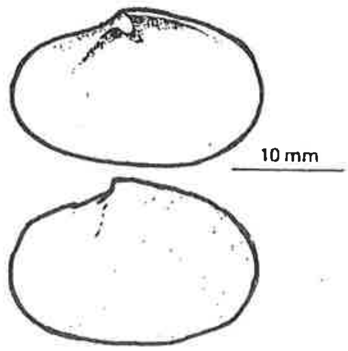
sand gravel/coarse sedime

See page of illustrations. Five species occur, but only two, ***T. phaseolina*** and ***T. villosiuscula*** are at all common. Both have dull white shells to c. 35mm with a larger, more convex right valve than the left. The umbones in both are more-or-less central, both have sloping dorsal margins and slightly truncated posterior ends. They are subtly different in shape but may be separated by the size of the granular sculpture. *T. phaseolina* is VERY finely granular (appearing smooth at x10 magnification), whereas the granules of *T. villosiuscula* are coarse and easily seen at x10. It is important to examine the granules in the central part of the shell as it is coarse in both species on the posterior ends. Juneniles of the two may be recognised by the sharply truncated and angular posterior end but the two are difficult to separate from each other. *T. phaseolina* lives in fine sand to muddy silt, whereas *T. villosiuscula* generally lives in coarser sands and gravels. Both occur from LWST to >100m.

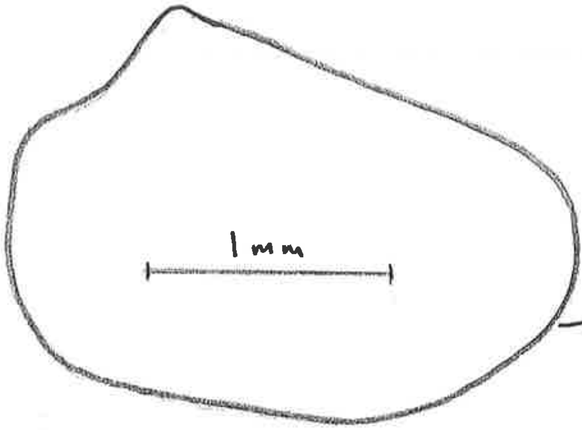
Thracia distorta is a smaller (20mm max) species, more triangular or quadrate in outline with a coarsely granular shell. It is nestler in holes and crevices and therefore variable in shape. It is generally uncommon with most records from southern and south-west England.

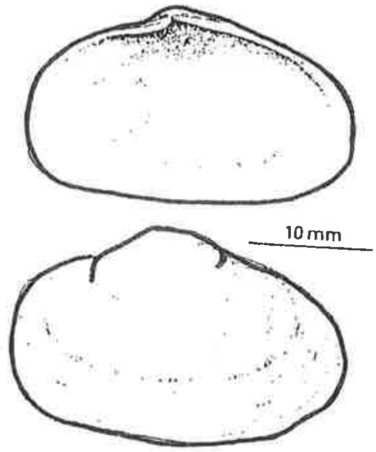
Thracia convexa is a large species (c. 60mm) which lives deeply buried in mud, and is usually only seen as juveniles which are recognisable by the almost diamond shape and granular surface sculpture. A mainly western species occurring from 20-200m. The fifth species *T. pubescens* is very large (90mm) rare and a deep burier in mud.



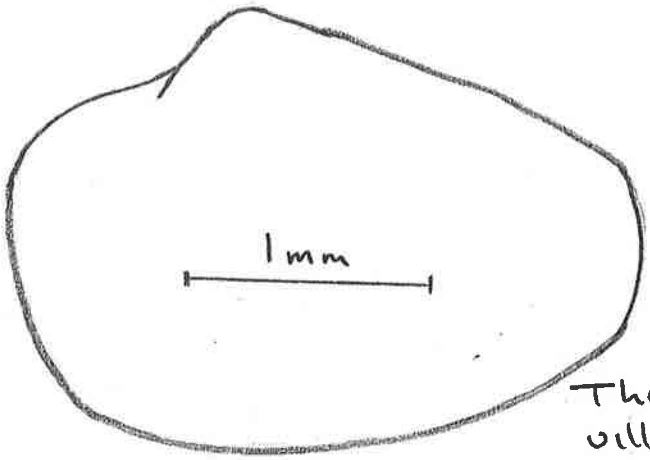


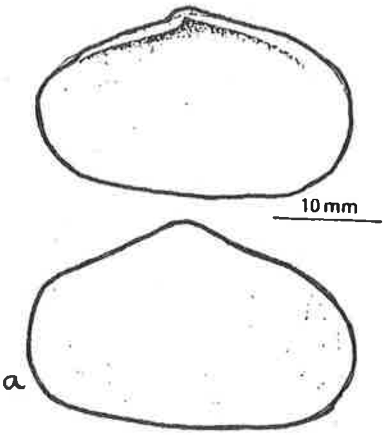
Cochlodesma praetenue



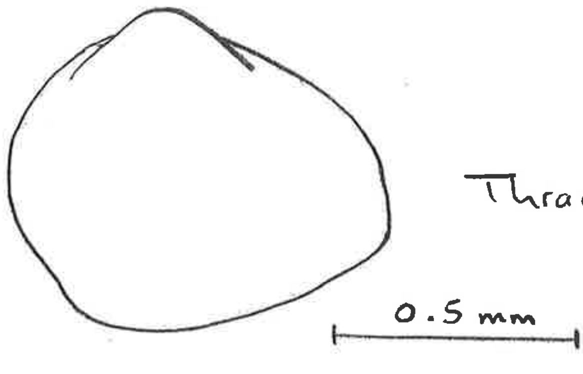


Thracia phaseolina





Thracia villosiuscula



Thracia convexa