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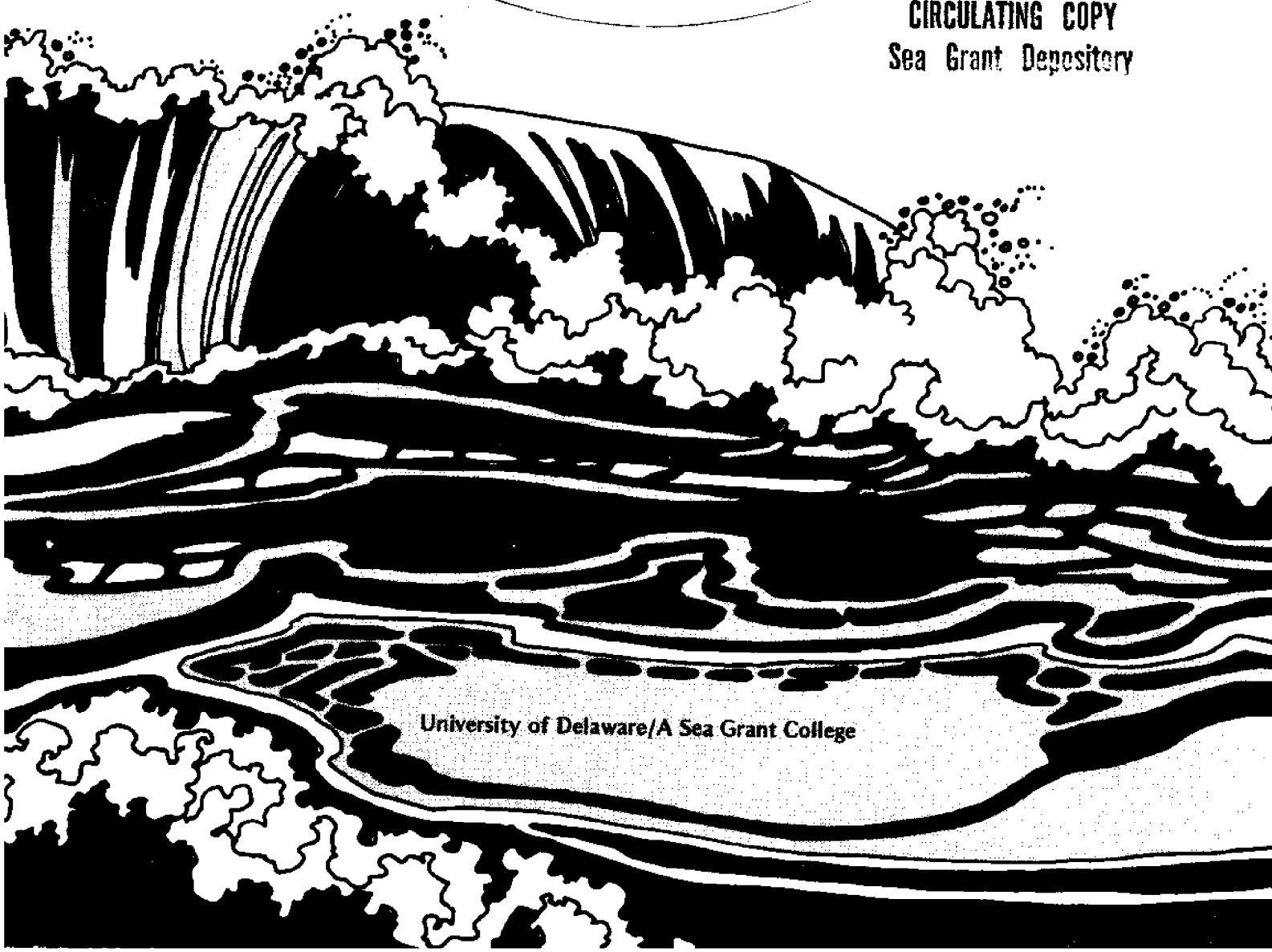

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PHYLUM MOLLUSCA:
A GUIDE TO THE MOLLUSCA OF THE DELAWARE BAY REGION

by

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Preface

In the spring of 1973, a Guide to the Macroscopic Estuarine and Marine Invertebrates of the Delaware Bay Region was published by the College of Marine Studies, University of Delaware, as Volume 5 of the Delaware Bay Report Series. The purpose of the guide was to facilitate the study of macroscopic estuarine and marine invertebrates of the Delaware Bay region with particular emphasis on benthic organisms. It contained a section on the Phylum Mollusca. Since the guide was published, our ecological studies have considerably increased the collecting areas of the former guide. As a result, we considered this a good opportunity to refine and amend the original version of the Mollusca while including species recently added to our collection.

At this time we would like to thank our associates, Mr. Peter Kinner and Dr. Les Watling, for their continuous and enthusiastic support of this work. We also wish to acknowledge the help of Drs. Mel Carriker, Tucker Abbott, and Ruth Turner who provided numerous suggestions and improvements for the preparation of this manuscript. In particular we are grateful to Dr. Turner and her associate, W. Baranowski, for permitting us to cite directly or modify portions of their forthcoming guide to be published in the series of guides on the marine flora and fauna of the Northeastern United States: Mollusca: Shelled Benthic Gastropoda, R.D. Turner and W. Baranowski.

INTRODUCTION

PHYLUM MOLLUSCA

The Mollusca are the second largest phylum of invertebrates. There is no standard molluscan shape, as they are evolutionarily plastic in their major anatomical features, such as the foot, shell, mouth parts, and respiratory organs. The phylum is divided into seven classes: the Monoplacophora, Aplacophora, Polyplacophora, Gastropoda, Scaphopoda, Bivalvia, and Cephalopoda. The classes represent widely differing degrees of evolution and specialization, and all are represented in the oceans. Generally, however, most molluscs have no internal skeleton, no segments, or joints. The one thing all Mollusca have in common is the presence of a mantle. A synopsis of the organ systems follows.

SYNOPSIS OF THE ORGAN SYSTEMS OF THE MOLLUSCA

The molluscan body is soft and unsegmented and consists typically of an anterior head, a ventral foot, a dorsal visceral mass containing the digestive and reproductive organs, a mantle, and commonly an external protective shell. Molluscs may be characterized more specifically as follows:

Bilateral symmetry, except in Gastropoda and some Cephalopoda whose viscera and shell are coiled; 3 germ layers; one-layered mostly ciliated epithelium with mucous glands;

Body usually short and enclosed in a thin dorsal mantle (or pallium) that commonly secretes a calcerous shell with an organic matrix of 1, 2, or 8 parts (exceptions: shell internal, reduced, or absent); head region is developed with tentacles and eyes (except in Scaphopoda and

Bivalvia); and a ventral muscular foot is differently modified for crawling, burrowing, or swimming, or may be absent (as in oysters);

Digestive tract is complete, often U-shaped or coiled as in the Gastropoda; mouth encloses a radula and jaws (except in the Bivalvia where they are absent); anus generally opens into mantle cavity; a large digestive diverticulum (liver, digestive gland, hepatopancreas), and frequently salivary glands, are present;

Circulatory system includes a dorsal heart with 1 or 2 auricles and 1 ventricle usually in a pericardial cavity; there is an anterior aorta and other arteries opening into hemocoels (only the Cephalopoda possess capillaries); blood may be colorless or contain hemocyanin;

Gaseous exchange occurs in 1 to many ctenidia, mantle (pallial) cavity, and/or epidermis;

Excretion is carried out by 1, or 1 or 2 pairs of nephridia (kidneys), mesodermal tubes opening from the pericardium into the mantle cavity; except in the Monoplacophora the coelom is reduced to small cavities of the nephridia, gonads, and pericardium;

Nervous system consists typically of 3 pairs of ganglia (cerebral above the mouth, pedal in the foot, visceral in the body) joined by longitudinal and cross nerves; many molluscs have organs for touch, smell, or taste, eyespots, complex eyes, and statocysts;

Sexes are usually separate (some are hermaphroditic, a few are protandric); gonads 1 or 2 with ducts; fertilization is external or internal; are mostly oviparous; development is by way of a trochophora larva followed by a veliger larva, or glochidial larva (in freshwater bivalves), or may be direct as in Pulmonata and Cephalopoda; there is no asexual reproduction.

CLASS POLYPLACOPHORA

(GK. polys, many; plax, plate; pherein, bear). The chitons superficially resemble flattened limpets; however, they lack tentacles and cephalic eyes. The shell is divided into eight transverse plates on the dorsal side which are embedded into the mantle or scale, fleshy girdle. They are bilaterally symmetrical with a terminal mouth (containing radula) and posterior anus. The gills are not paired, but lie on either side of the large central foot. Chitons are nocturnal, usually found intertidally, and most of them are herbivorous.

Family Chaetopleuridae

Chaetopleura apiculata (Say, 1830)

CLASS GASTROPODA

(GK. gaster, belly; podos, foot). The largest and most varied group of molluscs. Most univalves have spiral coiling and all gastropods at some time in ontogeny undergo a process called torsion. This process brings the mantle cavity to the front of the body while the visceral and pallial organs are twisted 180° in relation to the head and foot. They generally have a well developed head which contains a mouth with radula and well developed tentacles and a pair of eyes. The foot is primitively broad and flattened, usually with an operculum. The sexes are usually separate, although some orders are hermaphroditic. Most are herbivorous, but some are carnivorous.

Subclass Prosobranchia: This group consists mainly of aquatic gastropods whose shell structure appears to have some adaptive significance. There are three orders: the Archaeogastropoda, Mesogastropoda, and Neogastropoda. The gills are in the mantle cavity. The visceral mass retains pronounced torsion and the visceral loop forms a figure eight.

Order Archaeogastropoda: The oldest and least specialized of the Prosobranchia. They are all marine except some of the Neritacea and a few land-dwelling families. The general architecture is the top-shaped spire or turban shell. The sides of the foot bear fleshy filaments used as sense organs. Most are herbivorous or deposit scrapers having numerous radular teeth of the rhipidoglossate type. Sexes are separate.

Family Trochidae

Solariella obscura (Couthouy, 1838)
Margarites groenlandicus (Gmelin, 1971)

Order Mesogastropoda: The largest order of Mollusca and most diverse in mode of life. The fusiform or spindle-shaped spire is generally characteristic. The spout-like anterior canal in many is traversed by a pallial siphon drawing water into the pallial cavity, which enables the osphradium to chemically sample the environment in search of food. Most are mobile and often either carnivorous or herbivorous.

Family Littorinidae

Littorina littorea (Linne, 1758)
Littorina obtusata (Linne, 1758)
Littorina saxatilis (Olivi, 1792)
Littorina irrorata (Say, 1822)

Family Cerithiidae

Cerithiopsis greeni (C.B. Adams, 1838)
Seila adamsi (H.C. Lea, 1845)

Family Triphoridae

Triphora nigrocincta (C.B. Adams, 1839)

Family Epitoniidae

Epitonium humphreysi (Kiener, 1838)
Epitonium rupicola (Kurtz, 1860)

Family Skeneopsidae

Skeneopsis planorbis (Fabricius, 1780)

Family Hydrobiidae

Hydrobia totteni Morrison, 1954

Family Crepidulidae

Calyptraea centralis (Conrad, 1841)
Crepidula fornicata (Linne, 1758)
Crepidula convexa Say, 1822
Crepidula plana Say, 1822

Family Ovulidae

Simnia uniplicata (Sowerby, 1848)

Family Naticidae

Polinices immaculatus (Totten, 1835)
Polinices duplicatus (Say, 1822)
Lunatia heros (Say, 1822)
Lunatia triseriata (Say, 1826)
Natica clausa Broderip and Sowerby, 1829

Order Neogastropoda: All are carnivores or scavengers with fusiform shells, a strong anterior canal, and a well developed osphradium. They are the most advanced of the Prosobranchia with a highly concentrated nervous system and eversible proboscis. The embryos are generally intracapsular.

Family Muricidae

Urosalpinx cinerea (Say, 1822)
Eupleura caudata (Say, 1822)

Family Columbellidae

Anachis avara (Say, 1822)
Anachis lafresnayi (Fisher and Bernardi, 1856)
Mitrella lunata (Say, 1826)

Family Buccinidae

Colus pygmaea (Gould, 1841)
Colus stimpsoni (Morch, 1867)

Family Melongenidae

Busycon carica (Gmelin, 1791)
Busycon contrarium (Conrad, 1840)
Busycon canaliculatum (Linne, 1758)

Family Nassariidae

Nassarius vibex (Say, 1822)
Nassarius trivittatus (Say, 1822)
Ilyanassa obsoleta (Say, 1822)

Family Turridae

Pyrgocythara plicosa (C.B. Adams, 1850)
Kurtziella cerina (Kurtz and Stimpson, 1851)

Family Marginellidae

Marginella roscida Redfield, 1860

Subclass Opisthobranchia: There are three broadly different types of opisthobranchs: those that burrow in the substratum and possess thin external shells (Cephalaspidea); those that are flattened, naked, and slug-like (Nudibranchia); and those that swim are generally planktonic (Pteropoda). Evolutionarily the opisthobranchs rank highest among the gastropods; they have a vast adaptive morphology with nearly every family having some distinctive pattern. Generally in the Opisthobranchia the shell is reduced or lost as is the ctenidial gill. There is a loss

of torsion and eventually of the mantle cavity. There is a return to bilateral external symmetry. These are the most typically marine gastropods with only a few being high tidal representatives.

Order Cephalaspidea: External shell is present. Most are carnivorous, but some may be ectoparasitic, the food is crushed by strong limy plates lining the gizzard. The gills are present within a mantle cavity which is either on the right side or dorsally located. They are all hermaphroditic.

Family Pyramidellidae

Odostomia seminuda (C.B. Adams, 1837)
Odostomia impressa (Say, 1821)
Sayella fusca (C.B. Adams, 1839)
Turbonilla stricta Verrill, 1873
Turbonilla interrupta (Totten, 1835)

Family Acteonidae

Acteon punctostriatus (C.B. Adams, 1840)

Family Acteocinidae

Acteocina canaliculata (Say, 1822)

Family Haminoeidae

Haminoea solitaria (Say, 1822)

Family Retusidae

Retusa obtusa (Montagu, 1807)

Order Nudibranchia: This is the largest group of opisthobranchs. Detorsion is complete; the shell (except for the larval stage), gill, and mantle cavity are wholly lost, and rhinophores replace the head tentacles and osphradium. All species are hermaphroditic, and some are capable of self-fertilization.

Family Corambidae

Doridella obscura Verrill, 1870

Family Tergipedidae

Tergipes tergipes (Forskal, 1775)

Family Onchidoridídae

Acanthodoris pilosa (Muller, 1776)

Family Dotodae

Tenellia ventilabrum (Dalyell, 1853)

Family Favorinidae

Cratena pilata (Gould in Binney, 1870)

Subclass Pulmonata: These are hermaphroditic gastropods with no ctenidium. The mantle cavity is vascularized and functions as a "lung." Complex shelly teeth and ridges commonly occur which help guard the aperture against predators.

Order Basommatophora: These air breathers are dependent on moisture and live in salt marshes. They bear eyes at the tentacular bases as do the prosobranchs. Outer lip of the shell is toothed or grooved inside. They dwell primarily in salt marshes and on estuarine mud flats.

Family Melampidae

Melampus bidentatus Say, 1822
Detracia floridana (Pfeiffer, 1856)

GLOSSARY OF GASTROPOD TERMS

Aperture . . . . The opening from which the head and foot protrude

Apex . . . . . First formed part of the gastropod shell located at the narrow end and may be of several whorls

Base . . . . . The anterior, siphonal end, below the periphery of the body whorl

Callus . . . . . A calcareous deposit or thickening usually around the aperture on the columellar side

Siphonal Canal . An extension channel of the aperture for the enclosure of the siphons

Anal Canal . . . A small canal formed at the upper or posterior end of the aperture

Columella . . . . The solid pillar at the axis of the shell around which the whorls are formed

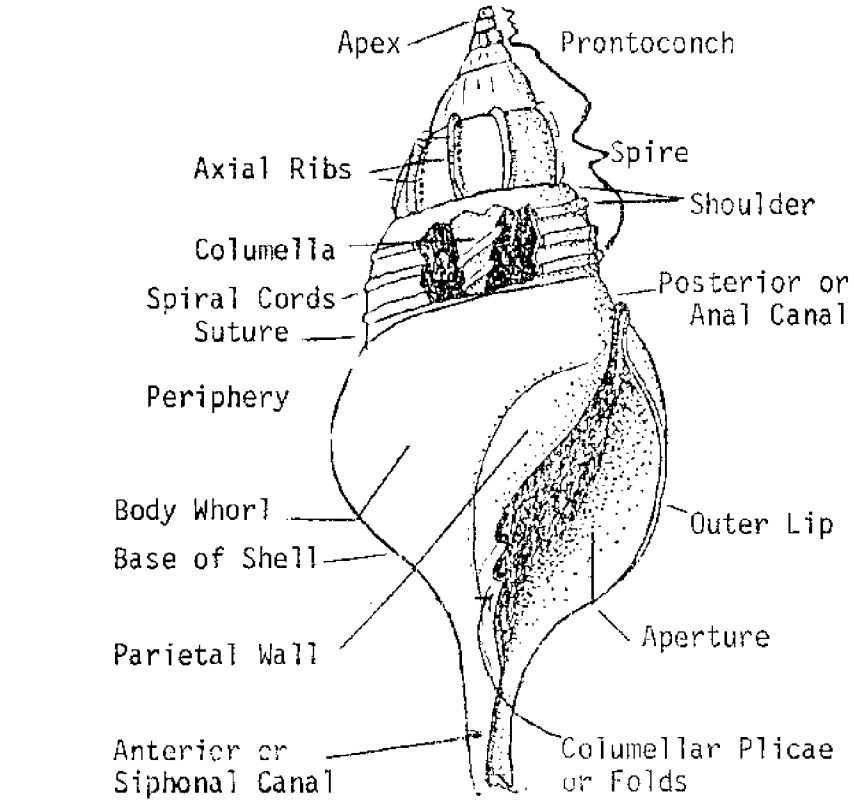
Length . . . . . Greatest vertical dimension parallel to the axis of coiling

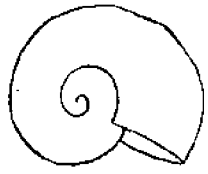
Protoconch . . . The initial whorls

Operculum . . . . A corneous or calcareous attachment on the foot serving as a partial or complete closure of the aperture

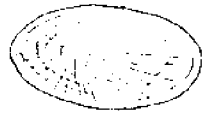
Suture . . . . . The continuous spiral line that marks the junction of each whorl

Umbilicus . . . . The open axis of coiling; a central cavity at the base of the shell





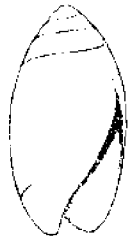
Involute



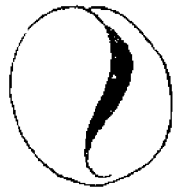
Patelliform
(Limpet-shaped)

Globose

Lenticular



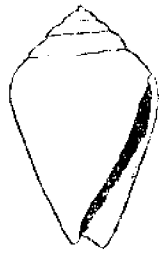
Obovate



Bulloid

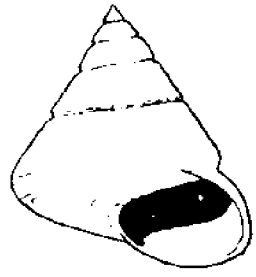
Turbinate

Cylindrical



Obconic

Turritiform



Trochoid

Plate 1. Parts of the gastropoda shell (Keen, 1963; Abbott, 1954).

KEY TO THE GASTROPODA OF THE DELAWARE BAY REGION

(Portions modified from Keen, 1965; R. Turner, unpublished)
For terminology, see Plate 1 and glossary p. 10.

1 Shell not present . . . . NUDIBRANCHIA. 2

Shell present 5

2 (1) With branchial plumes doubly pinnate arranged in a circle about the anus; with a single pair of tentacles; dorsal surface thickly covered with numerous soft, slender conical papillae of uniform size; mantle distinct from foot; size 30 mm . . . Acanthodoris pilosa

Without circlet of branchial plumes; other dorsal processes (pallial outgrowth) present or absent; with one or two pairs of tentacles 3

3 (2) Cerata absent, with a pair of small ctenidia between mantle and foot at posterior end of body in the midline; mantle covers entire body; size 5 mm . . . . . Doridella obscura

Cerata present. 4

4 (3) Single pair of tentacles arising directly from head (without basal sheaths); cerata simple without tubercles; . . . . . size 7 mm . . . . . .Tenellia ventilabrum

Two pair of tentacles, dorsal tentacles smooth, anterior lateral corners of foot extended and acutely angled; body pale gray with white margins, and three longitudinal reddish interrupted stripes on head and anterior part of body; size 30 mm. . . . . .Cratena pilata

5 (1) Shell patellate, not obviously spirally coiled, with internal shelf, deck or a cup . . . CREPIDULIDAE. 6

Shell obviously spirally coiled 9

6 (5) Shell with internal cup which arises near the center of the shell and flares out to the edge; size 12 mm . . . . . Calyptraea centralis

Shell with internal shelf or deck 7

7 (6) Shell flattened, apex rarely turned to one side; size 30 mm . . . . . Crepidula plana

Shell convex, high backed, interior polished, mottled purple, brown mixed with white. 8

8 (7) Small muscle scar anterior doral to right edge of shelf, shelf smooth, margin nearly straight; size 20 mm . . . . . Crepidula convexa

Muscle scar lacking; shelf marked with wavy growth lines, margin usually sinuous, size 50 mm . Crepidula fornicata

9 (5) Aperture entire, with no anterior canal or notch 10

Aperture with an anterior notch or canal 36

10 (9) Shell bulloid, spire concealed, aperture as long as shell, surface smooth, size 15 mm . . . . . .Haminoea solitaria

Shell not bulloid 11

11 (10) Shell cylindrical 12

Shell not cylindrical 13

12 (11) Columella with a basal fold, spire only slightly elevated, of 3-5 whorls, aperture not full length of shell; size 6 mm . . . . . Acteocina canaliculata

Columella without a basal fold, spire flat or with 1 whorl raised, size 3 mm . . . . . Retusa obtusa

13 (11) Outline obconic, outer lip strongly lirate within 14

Outline not obconic, outer lip smooth within. 15

14 (13) Columella with a moderately large tooth not upturned; size 8 mm . . . . . .Detracia floridana

Columella with two moderately large folds usually upturned; size 15 mm. . . . . Melampus bidentatus

15 (13) Shell trochoid, usually umbilicate; Interior pearly or nacreous 16

Shell variously shaped; interior porcelaneous 17

16 (15) Umbilicus set off by a beaded rib or by a change in rib pattern, margined by a strong cord; size 6 mm . . . . . .Solariella obscura

Ribbing of umbilical area not differentiated, not margined by a strong cord; axial sculpture lacking; size 41 mm . . . . . .Margarites groenlandicus

17 (15) Diameter greater than height; small to minute shells, base of shell umbilicate, with no callus covering, surface smooth, umbilicus narrow and deep; spire only very slightly elevated; size 10 mm . . . . . .Skeneopsis planorbis

Diameter equal to or less than height 18

18 (17) Columella with one or more folds, or inner lip with a strong spiral ridge entering aperture 19

Columella and inner lip smooth. 24

19 (18) Columella with a single thickened oblique fold at base. . . .20

Columella with three or more folds near anterior end of columella. . . . . GENUS PYRAMIDELLA

20 (19) Spire sculpture punctate or pitted, spire of 3-5 whorls; size 8 mm . . . . . Acteon punctostriatus

Spire sculpture without interspaces (punctate or pitted) between spiral ribs 21

21 (20) Shell sculpture above base beaded, composed of axial ribs and 4 spiral cords; base with spiral cords only; protoconch elevated; whorls 6-8; size 5 mm. . . . . Odostomia seminuda

Shell sculpture not beaded 22

22 (21) Spiral sculpture weak or absent. 23

Spiral sculpture strong, with 4 or 5 heavy cords above the periphery and numerous weak cords on the base; whorls 7, size 8 mm . . . . . Odostomia impressa

23 (22) Shell length greater than twice the width, whorls 6; shell smooth, columella thickened, twisting into aperture often with two fine ridges; aperature elliptical; size 6 mm . . . . . Sayella fusca

Shell length less than twice the width; apex blunt; whorls 4-5, convex, smooth; size 4 mm . . . . Odostomia gibbosa

24 (18) Outline globose to turbinate; length of aperture one-half or more of total length of shell. 28

Outline slender-ovate, turbinate to turritiform; length of aperture always less than one-half total length of shell . .25

25 (24) Shell smooth, umbilicus slit-like; whorls 4-5 1/2, usually eroded; size 4 mm . . . . . Hydrobia totteni

Shell sculptured, whorls generally 6 or more. 26

26 (24) Axial sculpture of rounded ribs, not extending on to base of shell, whorls flat-sided, sutures slightly impressed; axial ribs 20-24; size 7 mm . . . . . Turbonilla interrupta

Axial sculpture of strong, often blade-like ribs extending over base of shell. 27

27 (26) Basal ridge present; axial ribs white, 12-18 on body whorl; yellowish white to brown, with 2 darker brown spiral bands near the suture; 11 whorls; size 20 mm. . . . . .Epitonium rupicola

Basal ridge absent, axial ribs 8-9, blade-like to rounded; whorls 9-10; china white; size 19 mm . . . . . .Epitonium humphreysi

28 (24) Columella area and anterior (basal) portion of inner aperture broad, flattened and rounding into outer lip. . . . 29

Columella and anterior portion of inner aperture not broadened 32

29 (28) Shell globular; spire depressed, smooth or with microscopic spiral lines; bright yellow, greenish brown to nearly black, often spirally banded; whorls 5-6, size 13 mm. . . . . .Littorina obtusata

Shell trochoid, spire slightly elevated; sculpture of spiral threads or cords, may be obscure on spire of adults 30

30 (29) Outer lip sloping smoothly into body whorl; whorls flat sided 31

Outer lip meeting body whorl at an angle; whorls convex, sutures impressed; grayish-greenish to brownish-white, sometimes spirally banded with white; aperture reddish brown; columella white, tan to dark purple; whorls 6-8; size 18 mm . . . . . Littorina saxatilis

31 (30) Outer lip crenulate within; whorls 8-10; parietal lip orange to reddish brown posteriorly; shell grayish white; spiral cords with dark spots or streaks; size 30 mm . . . . . Littorina irrorata

Whorls 5-7, parietal lip white; shell gray to dark brown or black, spiral cord distinct on young; size 42 mm . . . . . Littorina littorea

32 (28) Umbilicus covered by thick pad or callus, operculum thick, with a calcareous outer layer, outer lip meeting body whorl at an angle, 4 whorls, size 32 mm. . . . . .Natica clausa

Umbilicus open to completely covered by a callus, operculum thin, horny, not calcareous 33

33 (32) Umbilical callus thick; chestnut brown, nearly covering large deep umbilicus; whorls 5; light purple-gray to tan; size 72 mm. . . . . .Polinices duplicatus

Umbilicus open, deep, conspicuous, not nearly occluded by the callus 34

34 (33) Parietal callus thick, truncated at umbilicus; whorls 5 smoothly sloping into preceding whorl; china white with a thin greenish-yellow periostracum; size 8 mm . Polinices immaculatus

Parietal callus not thickened or truncated; whorls not sloping smoothly into preceding whorl 35

35 (34) Parietal callus uniformly thin; whorls 5-6, convex, outer lip meeting body whorl at sharp angle; grayish white to brown; interior of aperture brown; size 120 mm. . Lunatia heros

Parietal callus thickened posteriorly at junction of outer lip with body whorl; whorls 5, outer lip meeting body whorl at moderate angle; cream to light brown; usually with solid or interrupted spiral bands of bluish or reddish-brown; size 35 mm . . . . . .Lunatia triseriata

36 (9) Length of aperture longest dimension of shell; aperture fairly wide, outer lip not denticulate; smooth inner lip twisted at posterior end; spindle-shaped; size 20 mm. . . . . Simnia uniplicata

Length of aperture less than total length of shell 37

37 (36) Aperture with anal canal (notch or slit) at or near suture. 53

Aperture without a posterior anal notch 38

38 (37) Aperture relatively long, three-fourths the length of the shell; spire evident; outer lip smooth; columella with 4 folds, shell shiny, smooth, with 3 faint spiral bands of pale orange, usually with 3 or 4 darker orange spots on margin of outer lip; size 14 mm . . . . . .Marginella roscida

Aperture less than three-fourths length of shell 39

39 (38) Turriform, spire with numerous whorls 40

Not turriform, whorls not especially numerous 42

40 (39) Shell dextral 41

Shell sinstral; aperture produced anteriorly into a nearly closed tubular siphonal canal; sculpture of beaded spiral cords; whorls 12; size 10 mm . . . . . .Trifora nigrocincta

41 (40) Sculpture of axial ribs and spiral cords crossing each other to give a beaded appearance; 2 or 3 strong smooth cords on base, siphonal canal very short; whorls 12; brown to black; size 6 mm . . . . . .Cerithiopsis greenii

Sculpture of axial ribs or spiral cords; base smooth; anal canal absent; whorls 10; yellowish-brown to dark brown; size 10 mm. . . . . .Seila adamsii

42 (39) Siphonal canal set off from body whorl by a constriction or furrow (fossa) 43

Siphonal canal not set off by a fossa 45

43 (42) Outer lip thin; 8-9 whorls with 4 or 5 rows of distinct uniform beads, formed by the crossing of axial and spiral ribs; shoulder pronounced, suture distinct; size 25 mm . . . . . Nassarius trivittatus

Outer lip not thin and sharp. 44

44 (43) Shell not eroded, outer lip and parietal callus greatly thickened in adult; whorls 6; axial sculpture of about 12 ribs crossed by spiral cords giving coarsely beaded appearance; shoulder sloping; suture indistinct; size 13 mm. . . . . Nassarius vibex

Shell heavily eroded, forming axial ridges in older specimens; parietal callus thick in adults; apex often eroded, outer lip with 5 or 6 small teeth extending back into aperture; whorls 5, shell dark reddish-brown to black; common on mud flats and tidal creeks; size 25 mm . .Ilyanassa obsoleta

45 (42) Siphonal canal short to nearly obsolete, outer lip rounding smoothly to anterior end of shell. 46

Siphonal canal moderate to long, outer lip sinuous. 48

46 (45) Shell with axial ribs or plications 47

Shell without axial ribs or plications, smooth; marked with fine, axial, zig-zag stripes; size 10 mm . . . Mitrella lunata

47 (46) Shell with about 12 axial ribs on upper half of whorl; spiral incised lines weak; size 15 mm . . . . . Anachis avara

Shell with about 15 axial ribs on entire whorl; spiral lines strong; size 15 mm. . . . . .Anachis lafresnayi

48 (45) Outer lip dentate or lirate within. 49

Outer lip smooth or merely reflecting surface sculpture . . .50

49 (48) Axial sculpture of rounded ribs; siphonal canal short, more or less open for its entire length; outer lip relatively thin, 9-13 axial ribs per whorl; size 38 mm . . . . . .*Urosalpinx cinerea*

Axial sculpture of thin, blade-like lamellae (12-14); siphonal canal nearly closed, tubular; aperture small rounded, outer lip heavy; ten strong spiral cords; size 31 mm . . . . . .*Eupleura caudata*

50 (48) Spire reduced; aperture length three-fourths shell length; siphonal canal long, constricted anteriorly 51

Spire moderately to greatly extended; aperture length less than two-thirds shell length; siphonal canal variable 52

51 (50) Suture channeled; spiral sculpture of many fine threads, cords at shoulder and edge of channel usually beaded; whorls 6; size 190 mm . . . . . *Busycon canaliculatum*

Suture not channeled; sculpture of fine spiral threads on young; absent in adult; shoulder knobbed; lip thickened in adults; whorls 6-8; size 290 mm . . . . . .*Busycon carica*

52 (50) Whorls flat-sided, sutures not impressed; sculpture of fine spiral incised lines; about 20 between lip and suture; whorls 8; size 125 mm . . . . . *Colus stimpsoni*

Whorls convex, sutures impressed; spiral sculpture of fine cords; about 12 between lip and suture; whorls 7-8; size 25 mm . . . . . *Colus pygmaea*

53 (37) Axial ribs 10-12, strong, rounded and crossed by prominent rounded to flattened spiral cords, producing beaded appearance; outer lip thickened in adult, whorls 6-7; size 8 mm . . . . . .*Pyrgocythara plicosa*

Axial ribs 8-10, broad rounded, angled and pronounced at shoulder; spiral sculpture of numerous uniform, fine threads; outer lip not greatly thickened; whorls 7-8; size 8 mm . . . . . *Kurtziella cerina*

Additional species which may be found in Delaware waters:

Caecum cooperi S. Smith, 1860
Diastoma alternatum (Say, 1822)
Cerithiopsis emersoni (C.B. Adams, 1838)
Epitonium angulatum (Say, 1830)
Crucibulum striatum Say, 1824
Natica pusilla Say, 1822

Additional species which may be found in Delaware waters: (continued)

Colus pubescens (Verrill, 1882)
Busycon contrarium (Conrad, 1840)
Terebra dislocata (Say, 1822)
Mangelia dalli (Verrill, 1882)
Odostomia dux Dall and Bartsch, 1906
Odostomia trifida (Totten, 1834)
Odostomia bisuturalis (Say, 1821)
Turbonilla stricta Verrill, 1873
Ovatella myosotis (Craparnaud, 1801)
Aeolidia pilillosa (Linne, 1761)
Doto cornuta (McMillan, 1791)
Cuthona concinna (Adler and Hancock, 1843)

CLASS SCAPHOPODA

(GK. skaphe, trough; podos, foot). These molluscs produce a tubular calcareous shell open at both ends. The long conical foot, genital openings, mouth, and feeding appendages (captacula) function through the larger opening. A radula is present, but there are no eyes, tentacles, or gills. Respiration takes place through the lining (epithelium) of the mantle. There is no heart or pericardium as blood circulates through contracting sinuses. The sexes are separate.

Family Dentaliidae

Dentalium occidentale Stimpson, 1851

Family Siphonodentaliidae

Cadulus agassizii Dall, 1881

CLASS BIVALVIA

(L. bis, twice; valvae, folding doors). The lamellibranchs are the second largest group of Mollusca; most are marine, but some live in fresh water. There is no head, no buccal mass, and no radula. The soft parts are enclosed within two hinged valves (bivalve). The valves

open by use of a ligament (external or internal) and are closed by the adductor muscle (one to three). The gills (ctenidia) are contained in the mantle cavity and are bipectinate. Most bivalves feed by ciliary and mucous movement on the gills and palps. The posterior part of the mantle is modified into siphons or apertures. Sexes are generally separate, although some may be hermaphroditic. Larvae are either veligers or glochidia. In classifying the Bivalvia, we have adopted the work of Vokes (1967) and Moore (1969). Abbott (1974) was also used in characterizing some of the orders.

Subclass Palaeotaxodonta: The nuculoids have taxodont dentition with either nacreous or crossed lamellar shell structure and are equivalved.

Order Nuculoida: Gills are in primitive posterior position; their filaments are triangular in two divergent rows (protobranch) on opposite sides of axis; modified labial palps used to collect food; foot is grooved usually without a byssus, marine.

Family Nuculidae

Nucula proxima Say, 1822

Family Nuculanidae

Yoldia limatula Say, 1831

Subclass Cryptodonta: Primitive, elongate, thin shelled, equivalve clams without hinge teeth. The mineral portion of the shell is made of aragonite.

Order Solemyoida: Periostracum thick and extending beyond the edge of the thin shell which gaps at both ends; gills protobranchiate. This is a primitive group with no near relatives.

Family Solemyacidae

Solemya velum Say, 1822

Subclass Pteriomorphia: Sedentary bivalves with free mantle margins, usually with a byssus or other means of fixation. Having a filibranchiate gill structure. The foot and anterior adductor usually becoming reduced or lost.

Order Arcoida: Represented by the ark shells with two equal size adductor muscles. Cardinal areas flat on the dorsal margin.

Family Arcidae

Anadara ovalis (Bruguiere, 1789)
Anadara transversa (Say, 1822)
Noetia ponderosa (Say, 1822)

Order Mytiloida: Represented by the true mussels and *Pinna* shells. Shells are inequilateral, but equivalve; usually having a strong byssus. Shell structure is prismato-nacreous. Without well developed siphons.

Family Mytilidae

Mytilus edulis Linne, 1758
Crenella glandula (Totten, 1834)
Modiolus modiolus (Linne, 1758)
Geukensia demissa (Dillwyn, 1817)

Order Pterioida: Represented by oysters, scallops. Generally inequivalve and inequilateral; ligament composed of uncalcified conchiolin is divided into one or more parts. Pallial sinus absent, shell pearly or porcelaneous, prismato-nacreous.

Family Pectinidae

Argopecten irradians (Lamarck, 1819)
Placopecten magellanicus (Gmelin, 1791)

Family Anomiidae

Anomia simplex Orbigny, 1842

Family Ostereidae

Crassostrea virginica (Gmelin, 1791)

Subclass Heterodonta: Represented by two living orders, the Veneroida and Myoida. These probably contain over half of the known marine species and genera. Siphons usually developed with mantle lobes more or less joined. Usually possessing distinct cardinal and lateral teeth. Ligament located posteriorly. Shell material never nacreous. Gills are eulamellibranchiate. Generally nestle or burrow in diverse substrata.

Order Veneroida: Commonly equivalve with equal-size muscle scars. Hinge usually with cardinals and laterals rarely with only cardinals or no teeth.

Family Lucinidae

Lucinoma filosa (Stimpson, 1851)
Divaricella quadrisulcata (Orbigny, 1842)

Family Cyrenoididae

Cyrenoida floridana (Dall, 1896)

Family Lasaeidae

Aligena elevata (Stimpson, 1851)

Family Leptonidae

Mysella planulata (Stimpson, 1857)

Family Carditidae

Cyclocardia borealis (Conrad, 1831)

Family Astartidae

Astarte undata Gould, 1841
Astarte castanea (Say, 1822)
Astarte borealis (Schumacher, 1817)

Family Cardiidae

Cerastoderma pinnulatum (Conrad, 1831)

Family Mactridae

Spisula solidissima (Dillwyn, 1817)
Mulinia lateralis (Say, 1822)
Rangia cuneata (Sowerby, 1831)

Family Solenidae

Siliqua costata Say, 1822
Ensis directus Conrad, 1843
Solen viridis Say, 1821

Family Tellinidae

Tellina agilis Stimpson, 1857
Macoma balthica (Linné, 1758)
Macoma tenta (Say, 1834)

Family Donacidae

Donax variabilis Say, 1822

Family Semelidae

Abra lioica (Dall, 1881)

Family Solecurtidae

Tagelus plebeius (Lightfoot, 1786)
Tagelus divisus (Spengler, 1794)

Family Arcticidae

Arctica islandica (Linné, 1767)

Family Veneridae

Mercenaria mercenaria (Linné, 1758)
Pitar morrhuana (Linsley, 1848)
Gemma gemma (Totten, 1834)

Family Petricolidae

Petricola pholadiformis (Lamarck, 1818)

Order Myoida: Thin-shelled burrowing bivalves with well developed siphons. Hinge with one cardinal tooth in each valve or teeth lacking (edentulous). Lunule and escutcheon poorly developed or lacking. Shell material not nacreous.

Family Myidae

Mya arenaria Linné, 1758
Paramya subovata (Conrad, 1845)

Family Corbulidae

Corbula contracta Say, 1822

Family Pholadidae

Barnea truncata (Say, 1822)
Cyrtopleura costata (Linné, 1758)

Family Teredinidae

Bankia gouldi Bartsch, 1908

Subclass Anomalodesmata: Group of great antiquity with many recent and fossil specimens dating back to early Paleozoic. Generally have poorly developed cardinals without laterals, mantle margin fused.

Order Pholadomyoida: Represented by the Pandoras, cuspidarians. Burrowing or nestling species which are equivalve to subequivalve with a primitive hinge. Eulamellibranchs constitute the living forms, while most fossil forms were septibranchs.

Family Lyonsiidae

Lyonsia hyalina Conrad, 1831

Family Pandoridae

Pandora gouldiana Dall, 1886
Pandora trilineata Say, 1822

Family Periplomatidae

Periploma leanum (Conrad, 1831)

GLOSSARY OF BIVALVE TERMS

Adductor muscle scars . Striated scars on the interior of the shell left from the attachment of the muscles that control the closing of the valves

Anterior end . . . . . End from which the foot usually protrudes, opposite the end where the siphons protrude, also the end where the lunule is located opposite the position of the ligament in majority of the bivalves

Apophysis . . . . . In the Pholad clams especially a thin shelly fingerlike projection found in the interior of each valve extending out from under the beak (umbo)

Umbo (Beak) . . . . . Located on the dorsal margin of the shell, the small tip of the shell usually located above the hinge. The first formed part of the valve

Byssus. . . . . A bundle of tough conchiolin threads spun by the foot and used in attachment to the substrate as in the Mytilidae

Chondrophore. . . . . Spoon-shaped resilifer or shelf in the hinge, holds the resilium or cartilage

Dimyarian . . . . . Adductor muscle scars of the same shape and size

Equilateral . . . . . Posterior and anterior halves of the valve are the same shape and size, umbones being in the center

Equivalve . . . . . Both valves of equal shape and size

Escutcheon. . . . . The smooth, long surface on the dorsal margin behind the ligament, located opposite the lunule

Heteromyarian . . . . . Adductor muscle scars of dissimilar shape and size, one much larger than other

Inequilateral . . . . . Posterior and anterior halves of the valve are unequal in shape and size

Inequivalve . . . . . Valves are dissimilar in shape and size, one being larger than other

Length. . . . . The greatest dimension of the shell measured by a line bisecting the adductor muscle scars, running posterior to anterior

Ligament. . . . . A band of tough elastic fibers generally posterior to the beaks located internally or externally

Lunule. . . . . Usually a heart-shaped impression on the dorsal margin of the valves anterior to the beaks opposite the escutcheon

Monomyarian . . . . . A single adductor muscle located approximately in the center of the valves

Nymph . . . . . On the hinge margin a projection to support the external ligament

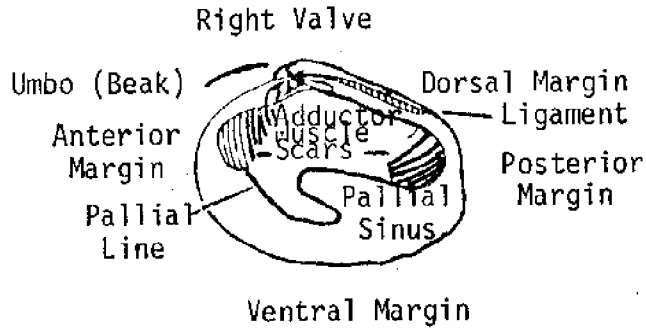
Pallial line . . . . . A scar line on the interior of the valves connecting the adductor muscles, line caused by the mantle muscle attachment

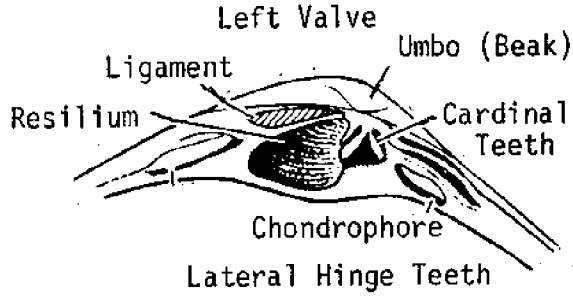
Pallial sinus . . . . . A curvature or embayment in the pallial line indicating the position of attachment of the siphon-retracting muscles

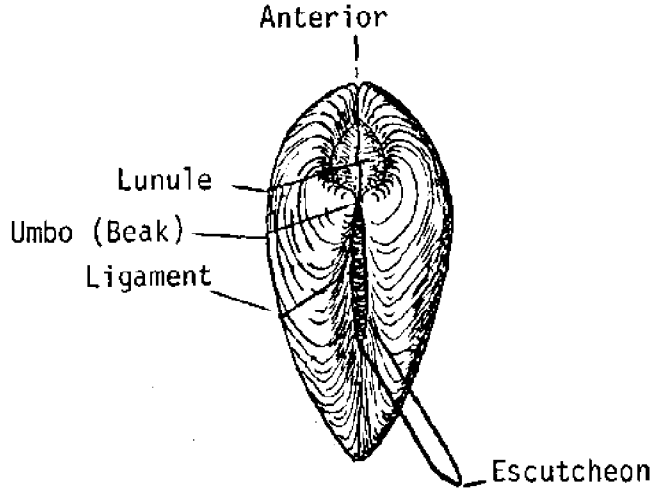
Periostracum. . . . . The outermost layer of the shell; a protective chitinous sheath

Resilium. . . . . Located on the chondrophore, it is the ligamental portion of the hinge

Taxodont. . . . . Dentition of the hinge teeth, alternating series of teeth and sockets







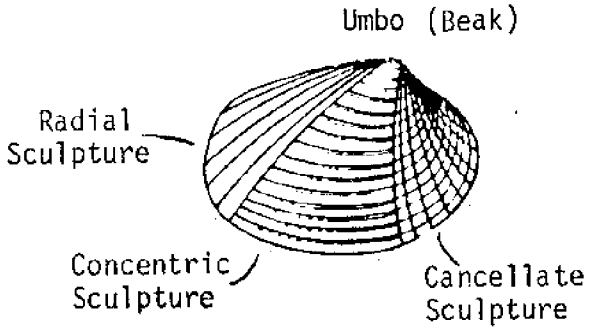


Plate 2. Parts of the bivalve shell (Keen, 1963).

KEY TO THE BIVALVE MOLLUSCA OF THE DELAWARE BAY REGION

(Portions modified from Keen, 1965; Turgeen, 1968)
For terminology, see Plate 2 and glossary pp. 25-26.

1 Shell with an apophysis or myophore in both valves 2

No apophysis or myophore present 5

2 (1) Anterior end indented by an angular notch; shipworms, wood burrowers 3

Anterior end arcuate or evenly curved 4

3 (2) Posterior end of animal bearing paddle shaped pallets. . Teredo

Pallets elongate or cone-in-cone type. Only wood burrower occurring in our region; maximum size 3.2 cm. . . . . .Bankia gouldi

4 (2) Shell rectangulate, anterior pointed, posterior truncate; gaping at both ends, protooplax lacking, radial ribs; maximum size 7.0 cm. . . . . .Barnea truncata

Shell oval, rounded at both ends tapering posteriorly with only a slight gap, protoplax present, bead radial ribs; maximum size 17.0 cm . . . . . .Cyrtopleura costata

5 (1) Taxodont dentition 6

Dentition other than taxodont. 10

6 (5) Ligament internal and confined to a central pit Hinge line curved. . . . . NUCULACEA 7

Ligament external not confined to a central pit Hinge line straight. . . . . .ARCACEA. 8

7 (6) Interior of valves nacreous, shell symmetrical, obliquely ovate, closing tightly; pallial sinus lacking; maximum size 1.5 cm. . . . . Nucula proxima

Interior not nacreous, shell asymmetrical, elongate, gaping widely; pallial sinus deep; maximum size 6.5 cm. . . . . .Yoldia limatula

8 (6) Left valve extending beyond right; beaks point toward anterior or center of shell; adductors impressed 9

Valves of same size, beaks point posteriorly; adductors elevated, posterior muscle scar raised to form a weak flange; maximum size 6.5 cm. . . . . Noetia ponderosa

9 (8) Beaks directed centrally; ribs on left valve usually beaded; external ligament long, wide, very distinct; maximum size 4.0 cm. . . . . Anadara transversa

Beaks directed anteriorly; ribs on left valve square, external ligament not as long or wide; maximum size 6.0 cm. . . . . Anadara ovalis

10 (5) Valves with one adductor muscle scar, monomyarian. 11

Valves with two adductor muscle scars. 14

11 (10) Dorsal margin produced anteriorly and posteriorly into triangular ears 12

Dorsal margin not eared. 13

12 (6) Both valves with strong radial sculpture; maximum size 7.5 cm. . . . . Argopecten irradians

Valves without radial sculpture; maximum size 20.0 cm . . . . . Placopecten magellanicus

13 (11) Adductor scar complex, central area showing superimposed secondary scars; right valve with prominent hole from calcified byssus attachment to substrate, shells thin, somewhat translucent, smooth; maximum size 5.0 cm. . . . . Anomia simplex

Adductor scar simple, valves thick, opaque, rough; maximum size 15.0 cm . . . . . .Crassostrea virginica

14 (10) Adductor muscle scars very unequal, heteromyarian; pallial sinus lacking. 15

Adductor muscle scars about the same size dimyarian (not necessarily the same shape), pallial sinus may be present 17

15 (14) Beaks terminal, shell smooth, blue-black with shiny periostracum, hinge with 3-12 crenulations; maximum size 7.5 cm. . . . . Mytilus edulis

Beaks near anterior end but not terminal 16

16 (15) Radial ribs strong, rough, bifurcating, no teeth at umbo; Black-brown; maximum size 10.0 cm. . . . . .Geukensia demissa

Radial ribs fine, may be slightly beaded and often crossed with finer concentric threads, olive brown; common offshore, cold-water species; maximum size 1.2 cm. . . . . .Crenella glandula

17 (14) Dorsal margin with cardinal and/or lateral teeth 21

Dorsal margin lacking teeth; irregular denticles may be present. 20

18 (17) Periostracum prolonged as a fringe beyond margins of shell; fragile shell, elongated and gaping at both ends, delicate, shiny brown periostracum, light radial bands of yellowish-brown coloration may be present; maximum size 2.5 cm. . . . . .Solemya velum

Periostracum if present not prolonged beyond margins 19

19 (18) Nearly equivalve, moderately convex; sinus very slight indistinct; with numerous radial lines; contains agglutinated sand grains; shell thin, fragile; maximum size 2.5 cm. . . . . .Lyonsia hyalina

Inequivalve, flattened or compressed without periostracum. Sinus represented by a series of separate small muscle scars. . . . . PANDORACEA. 20

20 (19) Height slightly more than 1/2 the length; posterior rostrum on the hinge line very short, stubby; maximum size 3.5 cm. . . . . .Pandora gouldiana

Height less than 1/2 length; posterior rostrum extended, more elongate; maximum size 2.4 cm . . . . . Pandora trilineata

21 (17) Valves elongate, razor shaped. 22

Valves otherwise 26

22 (21) Beaks at or near anterior end. . . . . SOLENACEA 23

Beaks sub-central. . . . . SOLECURTIDAE. . . . 25

23 (22) Beak in anterior fourth of shell; shell ovate - elongate; internal raised rib for support; right valve with bifid lateral; periostracum smooth, glossy; maximum size 6.3 cm. . . . . .Siliqua costata

Beak at far anterior end; shell elongate - rectangulate; raised rib lacking 24

24 (23) Two cardinals and one lateral in left valve, one cardinal and one lateral in right valve; dorsal and ventral margin curving slightly dorsally; maximum size 25 cm. . Ensis directus

One cardinal in each valve, laterals lacking; dorsal and ventral margins straight; maximum size 5.0 cm. . . . . Solen viridis

25 (22) Pallial sinus equal in size extending to midline, shell oblongate with anterior truncate, with large bulbous callus behind the two small cardinal teeth; maximum size 10.0 cm . . . . . .Tagelus plebius

As above except the valves are reinforced internally by a very weak, radial rib running across the center of the valve just anterior to the two small cardinal teeth. maximum size 4.0 cm. . . . . .Tagelus divisus

26 (21) Valves with well developed radial ribs 27

Radial ribs, if present, weak or faint 29

27 (26) Cardinal teeth fewer than three in either valve; lateral teeth present, two cardinals and two laterals in each valve; ligament external; 22-28 wide, flat ribs with arched scales may be missing on the central portion of valve; maximum size 1.2 cm . . . . . Cerastoderma pinnulatum

Cardinal teeth three in one valve, two in other. 28

28 (27) Two cardinal teeth in left valve and three in right valve; 18-20 rounded moderately rough or beaded radial ribs; inner ventral margin crenulated; laterals absent; maximum size 2.5 cm. . . . . Cyclocardia borealis

Two cardinal teeth in right valve and three in left valve; 40 or more prominent radial ribs with fine concentric lines. The anterior 10 or so are larger and bear prominent scales; maximum size 6.4 cm. . . . . Petricola pholadiformis

29 (27) Hinge with a chondrophore or a large, mostly horizontal projecting tooth in one valve, a socket or gap in the other . . 30

Hinge with similar tooth structures in either valve. 31

30 (29) Equivalve, roundly ovate; large spoon-shaped projecting chondrophore in left valve; anterior adductor elongate; suboval, pallial sinus somewhat V-shaped; maximum size 15.5 cm . . . . . Mya arenaria

In equivalve, oblong; single slender cardinal tooth; posterior end rostrate, ventral margin contracted near center of shell; left valve has a V-shaped notch in hinge just anterior to beak; has many weak concentric raised lines; maximum size 12.0 cm . . . . . .Corbula contracta

31 (29) With a well developed pallial sinus. 32

Pallial sinus lacking, pallial line entire or obscure. . . . 42

32 (31) Chondrophore present 33

Chondrophore lacking 35

33 (32) Ligament external and internal; chondrophore large, broad spoon-shaped; lateral teeth bear serrated or saw-teeth ridges; maximum size 17.5 cm . . . . . .*Spisula solidissima*

Ligament internal; chondrophore small, triangular; laterals lacking serrations. 34

34 (33) Shell triangulate with posterior radial ridge; left valve with two laterals, right with four; moderately inflated, beaks near center of shell; maximum size 2.5 cm. . . . . .*Mulinia lateralis*

Shell obliquely ovate, strong radial ridge lacking, left valve with two laterals, right with three; beaks near anterior end, high and inrolled anterior - ventrally; low salinity organism; maximum size 6.5 cm. . . . . *Rangia cuneata*

35 (32) One valve with at least three cardinal teeth 36

Each valve with a maximum of two cardinal teeth 38

36 (35) Hinge with laterals lacking or with obsolescent knob in anterior of left valve; periostracum distinct. 37

Hinge with two distinct laterals; periostracum inconspicuous; color whitish to tan with purplish overtones around beak, pallial sinus points dorsally; maximum size 0.7 cm. . . . . .*Gemma gemma*

37 (36) Laterals lacking; margins crenulate; pallial sinus shallow, left central cardinal tooth split; shell thick solid, moderately inflated; maximum size 13.0 cm . . . . . .*Mercenaria mercenaria*

Anterior lateral in left valve knoblike; margins smooth; pallial sinus deep; maximum size 5.0 cm. . . . . .*Pitar morrhuana*

38 (35) Shells light or fragile; each valve with two cardinals, one lateral or none; margins smooth. 39

Shells moderately heavy, firm; left valve with two cardinals and two laterals, right valve with one cardinal and two laterals; margins crenulate; maximum size 1.2 cm. . . . . *Donax variabilis*

39 (38) Right valve with distinct anterior lateral; ligament external and prominent, curved ventral margin; maximum size 2.0 cm. . . . . *Tellina agilis*

Right valve with anterior laterals obsolescent or lacking 40

40 (39) Shell smooth, orbicular, fragile, moderately inflated, equivalve; beaks nearer anterior end; two cardinals in each valve may be rudimentary in left valve. Pallial sinus deep; same size in both valves; maximum size 0.8 cm. . . . . .Abra lioica

Shell ovate; laterals lacking in right valve; pallial sinus extending further in one valve than other. 41

41 (40) Shell broadly ovate, not gaping; sinus extending further toward anterior adductor in right valve; maximum size 3.8 cm. . . . . .Macoma balthica

Shell oval - elongate, posterior truncate and gaping moderately; sinus extending further toward anterior adductor in left valve; maximum size 2.0 cm . . . . . Macoma tenta

42 (31) Anterior adductor scar narrower and longer than posterior, its lower end detached and bent inward 43

Adductor scars approximately equal in shape. 44

43 (42) Sculpture of sharp, raised, thin, concentric ridges, shell compressed; inner margin smooth; laterals obsolete, cardinal teeth bifid; maximum size 7.6 cm. . . . . .Lucinoma filosa

Sculpture of fine, criss-cross or divaricate, impressed lines; inner margin denticulate, shell moderately inflated; lateral hinge teeth well-developed; maximum size 2.0 cm. . . . . .Divaricella quadrisulcata

44 (42) Ligament sunken to completely internal 45

Ligament external, seated on a nymph 46

45 (44) Shell smooth, not concentrically ribbed, inequilateral cardinals wanting in one valve, two laterals in each valve; maximum size 0.5 cm . . . . . .Mysella planulata

Sculpture of fine concentric growth lines, two cardinals in each valve, laterals lacking; maximum size 0.5 cm. . . . . .Aligena elevata

46 (44) Valves thin shelled, pallial line indistinct; orbicular shaped brackish-water clams, hinge with two cardinals, the right valve having its anterior one bifid. maximum size 1.5 cm. . . . . .Cyrenoida floridana

Valves thickened, strong; pallial line distinct; stenohaline marine 47

47 (46) Shells with no sculpture apart from irregular growth rings . 48

Shells with concentric sculpture 49

48 (47) Shells circular in outline, equivalve, periostracum thick and black-brown, no lunule or escutcheon; maximum size 12.7 cm . . . . . .Arctica islandica

Shell triangular in shape, compressed, large shallow lunule, smooth except for weak, low concentric lines; inner margin of valves finely crenulate; maximum size 2.5 cm. . . . . Astarte castanea

49 (47) Concentric ridges strong near the beaks, but disappearing near the margins of the valves; inner margin of valves smooth; maximum size 5.0 cm . . . . . Astarte borealis

Concentric ridges strong throughout and evenly spaced; inner margin of valves may be crenulate; maximum size 3.2 cm. . . . . Astarte undata

Additional species which may be found in Delaware waters:

Amygdalum papyrium (Conrad, 1846)
Brachidontes recurvus (Rafinesque, 1820)
Cardiomya gemma (Verrill and Bush, 1898)
Congeria leucopheata (Conrad, 1831)
Corbula swiftiana (C.B. Adams, 1852)
Cumingia tellinoides (Conrad, 1831)
Cyclinella tenuis (Récluz, 1852)
Diplodonta (timothynus) verrilli Dall, 1900
Diplothyra smithii (Tryon, 1862)
Donsinia discus (Reeve, 1850)
Hiatella arctica (Linné, 1767)
Labiosa (labiosa) plicatella Lamarck, 1818
Laevicardium mortoni (Conrad, 1830)
Macoma phenax Dall, 1881
Mesodesma arctatum (Conrad, 1830)
Modiolus modiolus (Linné, 1758)
Musculus niger (Gray, 1824)
Nuculana acuta (Conrad, 1831)
Nuculana annulata Hampson, 1970
Pandora glacialis Leach, 1819
Pandora inflata Boss and Merrill, 1965
Paramya subovata (Conrad, 1845)
Parastarte triquetra (Conrad, 1831)
Periploma leanum (Conrad, 1831)
Thyasira gouldi (Philippi, 1845)
Thyasira trisinuata (Orbigny, 1842)
Yoldia sapotilla (Gould, 1841)

CLASS CEPHALOPODA

(GK. Cephale, head; podos, foot). Cehaplopods are the most highly developed of all molluscs. The shell is generally internal, some may be external (i.e. Nautilus) or lacking. The head is large with complex eyes, and the mouth with jaws and radula is surrounded by 8 or 10 arms or many tentacles. They have a "brain" enclosed in a cartilage-like case. Modification of the foot and mantle have made them most fast moving carnivores.

Order Teuthoidea: They possess two long tentacular arms which are retractable, and a circlet of 8 short arms. The tentacles have clusters of suckers at the tip while the short arms generally bear them in several rows along the under surface. Each sucker has a horny ring.

Family Loliginidae

Loligo pealeii Lesueur, 1821
Lolliguncula brevis (Blainville, 1823)

Family Ommastrephidae

Illex illecebrosus (Lesueur, 1821)

Order Vampyromorpha: These possess 8 arms, all of which are long and tentacular; the suckers run all along the ventral surface and have no horny rings.

Family Octopodidae

Octupus vulgaris Cuvier, 1797

KEY TO THE CEPHALOPODA OF THE DELAWARE BAY REGION

1 Body globose, usually without fins; eight arms with one to three rows of sessile suckers . . . . Order Octopoda. . . . . .Octopus vulgaris

Body more or less elongate, with fins; eight short arms and a pair of longer, tentacular, retractile arms, suckers pedunculate with horny rings. 2

2 Body elongate torpedo-shaped, fin pattern rhomboid in adults. . . . . Loligo pealei

Body shortened, stub-like; mantle length three to four times smaller than L. pealei; fin pattern ellipsoidal . . . . . Lolliguncula brevis

Additional species which may be found in Delaware waters:

Illex illecebrosus (Lesueur, 1821)
Illex oxygonius Ropes, Li and Mangold, 1969
Granelodone verrucosa Verrill, 1881

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