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A guide to the identification of marine plants and invertebrate animals of tidewater Virginia

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A GUIDE TO THE IDENTIFICATION OF MARINE PLANTS AND INVERTEBRATE ANIMALS OF TIDEWATER VIRGINIA

Educational Pamphlet No. 13

by

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and

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VIRGINIA INSTITUTE OF MARINE SCIENCE

GLOUCESTER POINT, VIRGINIA

A GUIDE TO THE IDENTIFICATION

OF THE MARINE PLANTS AND INVERTEBRATE ANIMALS

OF TIDEWATER VIRGINIA

by

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INTRODUCTION

Purpose

The rapidly growing interest in the sea as a potential source of much greater quantities of food and raw materials than it presently yields has pointed to the need for more literature dealing with its many kinds of resources. The importance of the sea to the Commonwealth of Virginia and the interest of the citizens of the Norfolk area in the sea need no comment. These facts have for some time indicated a need for a local or regional guide to the marine plants and animals of Tidewater Virginia, one that will be helpful to high school students who develop an interest in marine biology, following a general biology course, and one that will be useful to adults who wish to identify and to know more about some of the common marine plants and animals that are abundant in the Tidewater area.

Scope

This work is but a beginning. It is the hope of the writers that it will serve to stimulate the preparation of a series of more specialized and detailed guides which will be useful to students and adults who may have had no more formal training than a course in high school biology.

The opportunity to collect and study the materials essential to the preparation of the present work came in the summer of 1963 when the writers were teacher participants in a National Science Foundation Cooperative College-School Science program in marine biology held at Norview High School, Norfolk, and sponsored jointly by the Norfolk School Board and the Virginia Institute of Marine Science at Gloucester Point.

The basis for choice of plants and animals to be included in this work was their apparent abundance during

the summer of 1963[1]. It should be emphasized that some of those included may be rare or absent at times and others not included may occasionally be abundant. Variations in environmental conditions, especially those affecting water temperature, salinity, light penetration, and other physical factors, cause variations in plant and animal populations. Some of these variations are seasonal, others are local and temporary, such as those which may be caused by an extended drought or a prolonged rainy season. Some species are strictly seasonal, especially among the algae, and may be present only during the summer or only during winter and spring.

Only brief references to microorganisms have been given. Since the study of plankton requires the use of microscopes, it was felt that more benefit would result from emphasis on organisms requiring only gross examination. Vertebrates have been omitted. The fishes are sufficiently described and figured in several inexpensive and readily available texts. Thus, their omission here is not likely to discourage their study.

The illustrations are based on sources listed in the references and differ chiefly in size or simplification from the originals.

Acknowledgements

Special thanks are extended to a number of the student participants in the program who collected and identified specimens, in particular to Glen Johnson for his help with anemones; Patricia Hutchinson and Harry Verstynen, annelids; Linda Rice and Carl Barrett, animals of sand beaches; Stuart Katz, ecology of the Elizabeth River; George Kelly, III, ecology of a salt marsh; Dale Truman and Jebb Baum, algae.

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[1]Delay in publishing this manuscript has enabled participants in subsequent NSF-CCSS programs to add to the list of common animals and plants, but the list is not intended to cover the entire flora and fauna of the areas visited.

Grateful acknowledgement is made to Dr. Harold J. Humm of the University of South Florida, teacher of the course, for his encouragement and editing of the manuscript; and to Mr. Robert S. Bailey, director of the program for the Virginia Institute of Marine Science, for his efforts in arranging for publication.

PLANKTON

Plankton is the term applied to all the organisms that live in suspension in the water and tend to drift with water currents. It comes from the Greek word "wanderer" and sets such organisms apart from the animals capable of efficient, self-directed movement. These are called nekton.

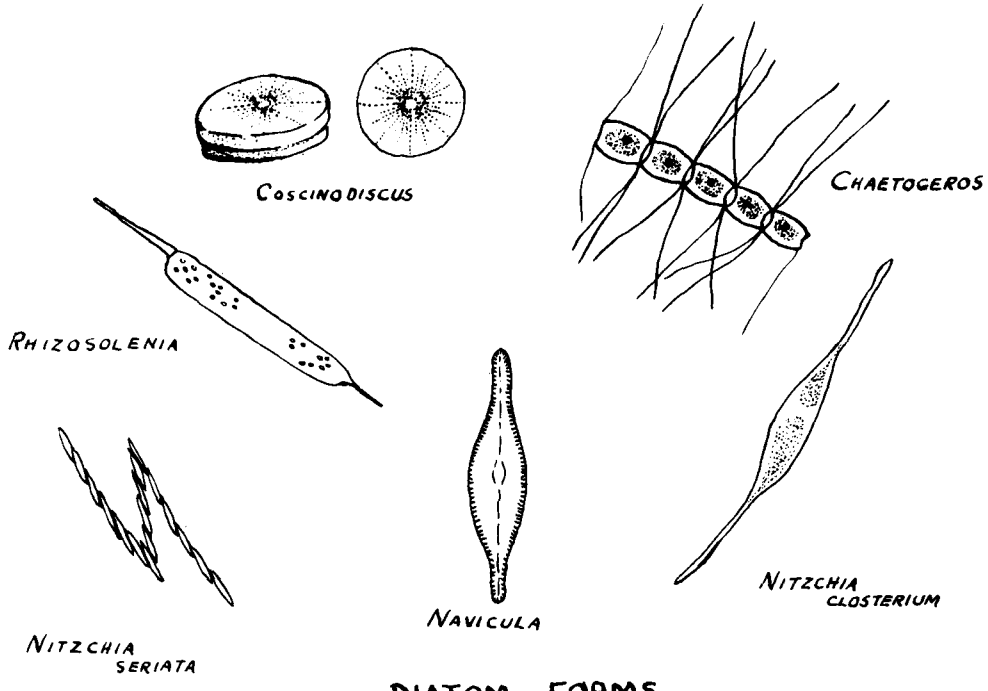
Plankton includes both plants and animals and therefore may be sub-divided into these two groups: phytoplankton, the plants; zooplankton, the animals. These organisms are usually microscopic or relatively small. They are not only the most numerous marine organisms, but also the most widely dispersed.

The phytoplankton, all the passively floating plants of the sea, are the basic producers that combine simple inorganic compounds in the water to form complex organic substances by photosynthesis. These then become the food of the smaller animals of the zooplankton which in turn form the food supply of larger animals. Therefore, the importance of the phytoplankton lies in its reproduction as the primary food supply of the sea. The chief plants of the phytoplankton are the diatoms and dinoflagellates (Plate 1).

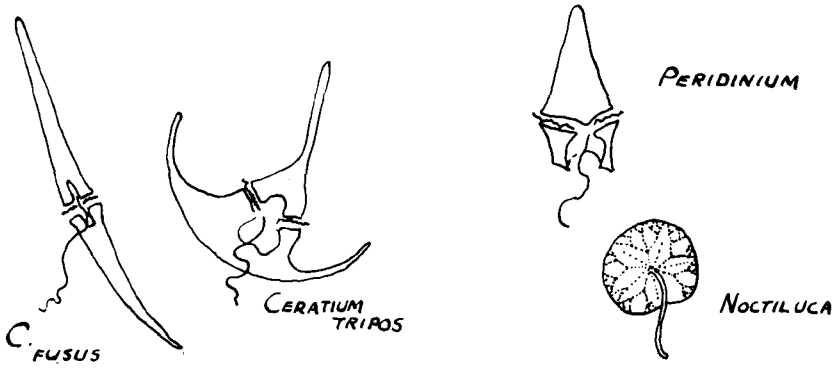
The zooplankton has considerably greater variety in its members. It is composed of two types of animals. First, those that spend all their lives as microscopic plankton drifting in the sea are called holoplankton. Along the Virginia coast this group is best represented by the protozoans called tintinnids, foraminifera, and radiolarians, and by crustaceans called copepods. Second, the early life stages (eggs and floating larvae) of microscopic animals that will develop later into free-swimming or bottom-dwelling types are called meroplankton. This includes mainly the developmental stages of invertebrates, but also the young of many fishes. Some of the most common meroplankton found in June and July were the larvae of crabs, snails, barnacles, annelids and oysters (Plate 2). Meroplankton are abundant during and shortly after the annual reproductive period of the adults, especially in spring and summer.

PLATE 1

PHYTOPLANKTON

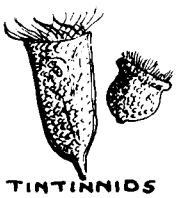


DIATOM FORMS

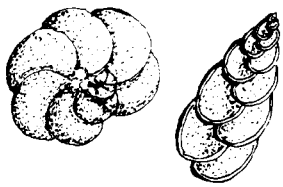


DINOFLAGELLATE FORMS

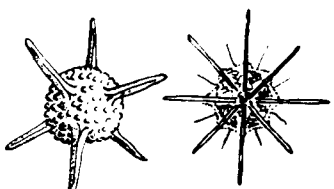
ZOOPLANKTON



TINTINNIDS



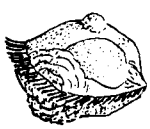
FORAMINIFERS



RADIOLARIANS

HOLOPLANKTON FORMS

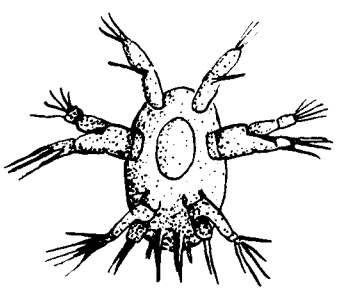
COELENTERATE
PLANULA LARVA



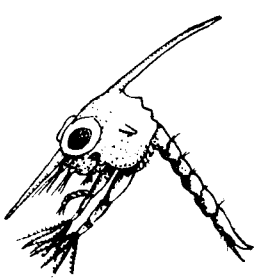
ANNELID
TROCHOPHORE LARVA

ECHINODERM
BIPINNARIA LARVA

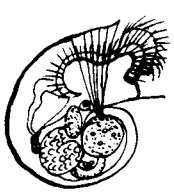
CRUSTACEAN
CYPRIS LARVA



CRUSTACEAN
NAUPLIUS LARVA



CRUSTACEAN
ZOEA LARVA



MOLLUSK
VELIGER LARVA

VERTEBRATE
LARVA WITH YOLK SAC

MEROPLANKTON FORMS

Collection Methods

Scientific institutions have elaborate equipment aboard oceanographic vessels for the collection of plankton. For amateurs, the basic device is a plankton net with apertures small enough to trap the minute organisms. Silk or nylon bolting cloth of the type used for sifting flour is the usual material. Its mesh size is numbered from 000 (coarsest) to 25 (finest). The net is an elongate cone with a frame to hold open the forward end, and with a detachable jar or vial at the small trailing end. A net of number 20 mesh, measuring about six inches in diameter at the opening by a yard long, is very useful. Sometimes a coarse screen is fitted across the frame to keep out larger, slow moving organisms such as comb jellies. The net may be dragged through waist deep water by a wading person or trailed from a boat. In deeper waters, a weight is added for collecting at greater depths.

Preservation

Plankton so collected may be washed from the net with sea water, down into the collecting jar where they can be removed for immediate examination. The addition of sufficient formalin to the jar to bring the concentration to 3% will kill and preserve the plankton and cause it to settle to the bottom from which it may be removed for examination at a later date. After the plankton has settled, the water at the top may be poured off carefully to concentrate the collection.

COLLECTING MARINE PLANTS

Seaweeds rarely grow unattached, but instead are attached firmly at their bases to some substratum (to the bottom or to each other) by some structure such as a holdfast or rhizoids. Since mud and sand are unstable bottoms, they are unfavorable substrata except in quiet bays and lagoons. On surf-beaten shores, the algae are usually confined to rocks.

Collecting

One of the most important considerations in collecting marine algae is the tide. Field trips should be planned so that the collector arrives an hour or two before low tide and will thus have about two hours of low water. It is almost impossible to make a thorough collection from an area when the tide is high, for the less common species are likely to be missed. Coastal newspapers usually give the time of low tide, but this alone is not the whole story. The very best collecting conditions occur when spring low tides prevail and these occur on or shortly after the day of the new and full moons. The predicted levels of the tide for each day are to be found in Tide Tables, Atlantic Coast of North America, published annually for an entire year by the U. S. Coast and Geodetic Survey and available from the Superintendent of Documents, Government Printing Office, Washington, D. C.[2], at $2.00 per copy. Each annual edition covers the calendar year.

During stormy weather, large quantities of marine algae are torn loose from their habitat. During or after the storm (sometimes several days later), these loose algae usually wash ashore in quantity. It is very difficult to predict when this loose material will be cast up on the beaches, but if the collector can manage to be present when this occurs, he can obtain excellent specimens of a large number of species, some of which grow

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[2]Look in "Yellow Pages" of your telephone directory under "Charts" for possible local sources of tide tables and navigation charts.

only in moderately deep water or only in an oceanic habitat when the salinity changes only slightly. Usually this material comes ashore upon a rising tide, so this is an exception to the general rule of collecting when the tide is low. Another phenomenon to be expected is the washing ashore of loose algae against the wind. If there are loose algae in the sea, then it is often profitable to look along a beach when the wind is blowing off the beach and out to sea. The reason is this: An offshore wind sets up a surface current that runs before it. Somewhere out at sea the surface current will sink and there will be a counter-current running against the wind direction along the bottom. This brings the algae (except those few that float) up the slope of the beach to the water's edge where they accumulate in a band where the bottom counter-current reaches the surface and becomes the wind-driven surface current. This effect is even more pronounced in a bay or enclosed body of water.

Marine algae grow in such a variety of habitats that the beginner will miss many species during his first collecting trips unless he is very careful and sharp-eyed. Some form a nondescript coating on intertidal rocks, that when wet is more slippery than ice, and one that has caused many broken bones and scraped skin from falls on rocks and barnacles at the sea coast. Intertidal rocks are even more slippery for rubber-soled shoes than for ordinary street shoes (which, however, are not recommended). When the collector has learned to recognize these intertidal algal coatings, he will avoid slipping and will also find some species which might otherwise be overlooked. These species are small, are usually blue-greens, and require a microscope for identification.

Equipment

The amateur collector will need the following equipment: heavy canvas shoes, vials and jars, plastic bags, tools for scraping and chipping, pails and, if possible, glass-bottom buckets. Equipment for the more advanced collector might include dredges, tongs, rakes, hooks, glass-bottom buckets, diving apparatus, snorkel and mask, and SCUBA gear.

PRESERVING MARINE PLANTS

It is most important while collecting to avoid overcrowding your specimens and to keep them in shaded, cool places. This prevents rapid decomposition and fading.

Live Specimens

To allow prolonged study and observation, specimens should be collected in individual containers. In the laboratory use petri dishes, finger bowls or jars with sea water for individual algae. Water should be watched and changed approximately 3 times a week. If it changes color or has a different odor, this would indicate a need for more frequent changes.

Make slides of portions of the whole specimen for microscopic study. Place a branch between sheets of heavy paper or cardboard and slice through with a razor blade to get cross-sections. A section is placed in a drop of water on a glass slide and covered with a cover slip for microscopic examination. A slide can be kept for several days in a cool place if the cover slip is ringed with glycerine before it is added. Semi-permanent slides can be made by mounting the specimen in "Karo" syrup instead of water. If the syrup is hardened in an oven, the mount may be stored in a dry place for several months.

Use salt water aquaria. There are two very good, and easily obtained, sources of information on this topic. One is in a booklet, Salt Water Aquaria, published by the Virginia Institute of Marine Science, Gloucester Point, Virginia. The other is contained within the Laboratory Manual for Survey Science (Teacher's Edition) published by Chesapeake Public Schools, Chesapeake, Virginia, 1963 (page 33).

Use of Formaldehyde Preservative

A 5% solution is made by adding 1 part of 40% formalin to 19 parts of sea water ("Commercial" or "U.S.P." formalin is considered as 100%). At the sea-shore toward the end of the field trip, the specimens may be sorted into plastic bags, vials, and jars, and

have 5% formaldehyde solution added to them. These individual containers of specimens may collectively be sealed in a can and kept in a cool, dark place. They may then be studied in natural color, form, and texture. Be sure to label properly with all pertinent information such as exact habitat, locality, date, collector's name, name of plant, and name of the person who identified it. The collector may wait to preserve his specimens until he returns to the laboratory but the results will not be as good or lasting.

Drying

Crustose specimens may be dried along with pieces of their substrate directly in the air and stored in suitable, labeled boxes. Calcareous algae which are too fragile or too thick to be pressed may be treated by being soaked for several weeks in a solution of 40% glycerine in 3% formalin, dried in air and stored in labeled boxes.

Herbarium Specimens

Preservation of marine algae in liquid is at best a temporary measure, with a few exceptions. Specimens preserved in liquid tend to fade very rapidly if left in the light (even an hour in the light will cause noticeable fading). If kept in the dark, formaldehyde-preserved specimens will keep their color for several months, especially if the solution is buffered, and these may then be made into herbarium specimens at any time. The sooner after preservation in liquid that herbarium mounts are made, the better is the color.

Once mounted on a sheet and dried, specimens of marine algae keep indefinitely and their color is preserved indefinitely if kept in the dark. If framed and used as a wall decoration, the color will fade in a few years. In direct sunlight, of course, the color fades rapidly even with herbarium specimens. There are many specimens well over 100 years old in the large herbaria that are as colorful as they were when first mounted.

For satisfactory and attractive herbarium specimens, the following procedure is recommended.

Type of Paper. Index cards of various sizes are satisfactory. The only disadvantage to this type of

paper is that it is of wood pulp in origin and it will tend to become yellow with age, especially if left in the light. If a stronger, whiter and more permanent paper is desired, it may be obtained at any print shop where one should ask for "rag content ledger" of a weight similar to that of index stock. The biological supply companies offer good grade herbarium paper, but it can probably be purchased at a lower cost at a print shop and in the quantity and sizes desired.

Mounting Procedure. Obtain a shallow pan (two to three inches deep) of sufficient dimensions to permit submerging the largest size sheet of mounting paper that you want to use. If the mounts are to be made on 3 X 5 or 4 X 6 index cards, then the problem of a suitable pan is easily solved. Pour clean sea water into the pan to provide a depth of about one inch. (NEVER put marine algae in fresh water, even after they have been preserved, for this tends to cause a bleeding of the pigments, bleaching, and a softening of the cell wall polysaccharides into a gummy mass.)

Soft delicate algae should be mounted by immersing the mounting paper in the water beneath the specimen and then lifting the paper, with specimen in proper position upon it, out of the water with great care. The position and shape of the specimen may be improved by judiciously dipping the corners or sides of the paper with specimen back into the water and removing it slowly. This will often cause the fine branches to spread out more evenly and will separate clumps of branchlets. The more care and time devoted to arranging the specimen on the paper, the more attractive and life-like will the dried specimen be.

In the case of fairly rigid and larger specimens, there may be no advantage to immersing the paper. In this case, lay the specimen on the paper, spread the branches with a dissecting needle, aided, if feasible, by drops of sea water from a medicine dropper. Once arranged, the specimen is ready for the press. There is an advantage in this case in not wetting the mounting paper, as drying will take place more rapidly.

The Covering Sheet. Once the mounting job is completed, the next step is to place some kind of sheet

over the specimen that will insure its sticking to the mounting paper rather than the press sheet above it. There are two kinds of sheets used for this purpose. By far the most satisfactory in most cases is waxed paper, especially for the more delicate specimens. Cut a piece of waxed paper a little larger than the specimen itself and carefully place the waxed paper over the specimen. After this is done, it is sometimes worthwhile to tap the waxed paper gently over the specimen as this may serve to spread fine branches more favorably.

The other kind of sheet used over specimens is cloth, such as muslin or gauze. Cloth is best for large, rigid plants such as Sargassum, Fucus, Ascophyllum and is suitable for Gracilaria, Chondria, and similar plants. The advantage is that it permits diffusion of water upwards in the press and it does not stick to large specimens. With small, delicate specimens, however, it may be quite unsatisfactory. In the case of sheet-like plants such as Ulva and Grinnellia, the pattern of the cloth may be impressed into the specimen. It is convenient to have handy pieces of an old bed sheet for the larger specimens, but it is safe to say that waxed paper will do for all kinds of algae. With the covering sheet in place, specimens are ready for the press.

The Press. A good plant press consists of three kinds of paper: plant press blotters, corrugated cardboard ventilators, and ordinary newspaper sheets folded once only. Plant press materials can be purchased from several biological supply houses, but one of the best sources is Cambosco, 37 Antwerp Street, Boston, Massachusetts. If you must make your own press, you can purchase desk blotter stock at a print shop and have it cut the desired size. This stock is much thinner than regulation plant press driers and should be used only as a second choice. Cutting your own corrugated cardboard is possible but not easy.

For maximum drying efficiency, the plant press is built up as follows: corrugated drier, blotter, one layer of newspaper (the other half of the newspaper folded out), the specimen with its cover, then the other half of the newspaper folded over the specimen, then another blotter and finally another corrugated drier. If the specimen is on a small sheet, several specimens

can be put into the same newspaper, each specimen covered by a separate sheet of waxed paper. Placing one sheet of waxed paper over two or more specimens causes a great inconvenience in changing the press.

The press may be built up in this manner until there are many specimens in it. However, it is advisable not to have the stack more than about one foot high because of the loss of even pressure with a higher stack. Start a second press on the floor beside the first one if there is more material to be pressed. On top place a piece of plywood or masonite cut about the size of the press material and on top of this board place two or three concrete blocks. If the press is less than about six inches high, one concrete block may provide adequate weight, but if coarse, rigid plants are included such as Sargassum, the weight of two blocks is not too much. On the other hand, a few plants, such as Dasya, make better specimens with less weight than this. Too much weight causes the main axes to be too flattened and spread out. It is better to place Dasya specimens in a separate press with little weight, such as two bricks.

It is customary when pressing land plant specimens to place the press itself in a heater-dryer of some sort, and many phycologists do this with algal material. However, much better specimens are obtained if the press is placed under weights as described and not placed in a heater-dryer nor used with straps. Artificial heat (from light bulbs, for example) causes algae to dry too fast and too thoroughly so that they tend to crack and the mounting paper tends to warp. Where straps are used instead of weight on top of the press, the pressure exerted is too little and warping results.

The ideal procedure is to have an extra batch of press material not in use. These are placed (in the exact order as used in the press) in a heater-dryer with two light bulbs. An overnight treatment renders this empty press bone dry and one or two changes of blotters and ventilators on successive days will usually result in ideally dried specimens in two or three days.

When the press is changed, it is advisable to change the newspapers also. Since the principal function of the newspapers is to take up any liquid sea water that may be

pressed from the specimens, the newspapers may be left out after the first change of the press. Use of newspaper initially, however, prevents the rapid accumulation of salt crystals in the blotters.

Care of Finished Specimens. No attempt should be made to lift the waxed paper off the specimens until they are thoroughly dry. At this time it will often fall off. If not, it is best to peel the waxed paper off from the base of the plant upward. If the plant begins to lift from the mounting paper when the waxed paper is pulled upward, hold the plant down next to the waxed paper and pull gently until the waxed paper comes off without lifting the specimen. The majority of specimens will stick to the mounting paper adequately by virtue of their own polysaccharide cell wall constituents, which act as adhesives. A few species, such as Sargassum and Fucus, will have to be fastened down later, however. Gummed cloth tape is best, but mucilage of some sort can be used. Non-water-soluble adhesives are not recommended for specimens that have taxonomic value, as this prevents the removal of a portion of the specimen later for soaking preparatory to microscopic study. When soaked in water, especially with a little detergent added, most pressed algae will swell to the original, normal condition and can then be studied in detail.

Finished specimens should be kept under mild pressure of some sort (such as a book) at least until they come into moisture equilibrium with the atmosphere, and should always be kept in the dark when not under observation, unless they are to be framed for wall hanging.

KEY TO THE GENERA OF THE COMMON MARINE ALGAE OF TIDEWATER VIRGINIA

HAROLD J. HUMM

Key to the Phyla

1 Individual plants microscopic, although plant masses are usually visible to the unaided eye; color green, bluegreen or blackish-green. . . .Cyanophyta

1 Individual plants macroscopic and visible to the unaided eye, although some are very tiny 2

2 Plants usually some shade of red in color, but some are yellow-brown, olive-green, purplish-green, or purple. . . . . .Rhodophyta

2 Plants brown of green. 3

3 Plants some shade of brown. . . . . .Phaeophyta

3 Plants green. . . . . .Chlorophyta

Cyanophyta

1 Plants single-celled and solitary, or in colonies of various form; not filamentous, the cells coccoid (except in that part of Entophysalis that penetrates shells or limestone where filaments are produced because of the habitat) 2

1 Plants producing filaments, the cells not coccoid 3

2 Cells spherical (except where adjacent cells have flattened sides), single, or embedded in groups within a common gelatinous sheath. . . . . .Anacystis

2 Cells somewhat elongate or pear-shaped, often in strata or cushions, the cells in one mass variable in size. . . . . .Entophysalis

3 Filaments without an obvious gelatinous sheath 4

3 Filaments with a sheath 5

4 Filaments forming a regular spiral, very small . . . . . .Spirulina

4 Filaments not in the form of a spiral. 5

5 Filaments 3-5 microns in diameter, apex of filament with a short taper and tending to be bent slightly . . . . . .Oscillatoria

5 Filaments 6 microns or more in diameter . . . . . .Lyngbya

Rhodophyta

1 Plants in the form of a flat sheet 2

1 Plants not in the form of a flat sheet. 3

2 Plants rose red, with a conspicuous midrib in the center of the blade. . . . . .Grinnellia

2 Plants purple to brownish-red, very thin, strictly intertidal, especially on oysters, without a midrib. . . . . .Porphyra

3 Plants delicately filamentous, the main axes of no greater diameter than an ordinary pin 4

3 Plants not delicately filamentous, coarser, at least in the main axes. 6

4 Plants monosiphonous, uncorticated . . . . . .Callithamnion

4 Plants corticated or polysiphonous. 5

5 Plants polysiphonous but not corticated. . . . . .Polysiphonia

5 Plants monosiphonous and corticated. . . . . .Ceramium

6 Branches of the plant bearing an abundance of fine, red filaments. . . . . .Dasya

6 Branches of the plant without fine, red filaments. 7

7 Tips of all branches with a tiny tuft of colorless filaments . . . . . .Chondria

7 Tips of branches without filaments 8

8 Plants consisting of a series of hollow, barrel-shaped segments. . . . . .Champia

8 Plants not consisting of barrel-shaped segments 9

9 The ultimate branchlets monosiphonous with corticating cells at the nodes only, the main axes completely corticated . . . .Spyridia

9 Both ultimate branches and other axes many cells thick 10

10 Plants red to yellowish-red in color; the branches with a hollow center having fine filaments in the hollow. . . .Agardhiella

10 Plants with cells in the center, not hollow, usually a purplish-green in color 11

11 Branches not flattened and bearing many small, spine-like branchlets; the main branches often ending in a hooked tip. . . . . .Hypnea

11 Branches sometimes flattened, the ultimate branches not fine or spine-like. . . . . .Gracilaria

Phaeophyta

1 Plants delicately filamentous, but often large. . . . . .Ectocarpus

1 Plants not filamentous. 2

2 Plants consisting of a flat, lanceolate blade . . . . . .Petalonia

2 Plants not consisting of a flat blade 3

3 Plants terete, hollow, and unbranched. 4

3 Plants branched and not hollow (except for air bladders) 5

4 Plants with constrictions, gametangia in large patches or covering the surface. . . . . .Scytosiphon

4 Plants without constrictions, gametangia in spots or small patches. . . . . .Asperococcus

5 Plants very soft, gelatinous, slippery, the main axes 3-5 mm in diameter; usually on eel grass . . . . . .Eudesme

5 Plants rigid, larger, and with some type of air bladder. 6

6 Main axes and branches flattened, air bladder intercalary. 7

6 Air bladders spherical, terminal on short stalks; plants with leaf-like appendages . . . . . .Sargassum

7 Branches strap-shaped and with a prominent midrib. . . . . .Fucus

7 Branches only a little flattened and not divided into a midrib and blade . . . . . .Ascophyllum

Chlorophyta

1 Plants in the form of a flat sheet. 2

1 Plants flattened and very elongated, or not flattened 3

2 Sheet two cells in thickness . . . .Ulva

2 Sheet onw cell in thickness. . . . .Monostroma

3 Plants consisting of a hollow tube, the wall one cell thick; the tube either collapsed or inflated. . . . . .Enteromorpha

3 Plants filamentous. 4

4 Filaments much-branched. 6

4 Unbranched single row of cells. 5

5 Individual filaments microscopic, forming patches on pilings and rocks in the intertidal zone. . . . . .*Ulothrix*

5 Filaments macroscopic, coarse . . . . .*Chaetomorpha*

6 Plants with cross-walls in the filaments and thus divided into cells; ultimate branches tending to be in dense clusters . . . . . .*Cladophora*

6 Plants without cross-walls, hence coenocytic . . . . . .*Bryopsis*

CLASSIFICATION AND DESCRIPTIONS OF PLANT GENERA

PHYLUM CHLOROPHYTA (Plate 3)

Plants microscopic or macroscopic, one-celled or many-celled, green in color because of the predominance of chlorophyll; branched or unbranched, the conspicuous marine species either filamentous, forming a flat sheet one or two cells thick, or forming a hollow tube in which the walls are one cell thick.

Class Chlorophyceae

Order Ulotrichales

Filamentous to foliaceous, unbranched or branched, usually a single parietal chromatophore, one nucleus, one or more pyrenoids.

Family Ulotrichaeceae

Genus Ulothrix. Filaments with cells containing a single bracelet-shaped chloroplast; quite similar to fresh water forms; growing as soft, silky mass on rocks or woodwork in the intertidal zone.

Family Ulvaceae

Genus Monostroma. A thin, flat sheet similar to Ulva but only one cell thick.

Genus Ulva. Two layers of cells in thickness, and forming broad, flattened blades; holdfasts small; blades sometimes extremely large, varying from an inch to two feet in diameter; margins lobed and undulate; frequently observed riddled with holes resulting from reproduction; commonly called "Sea Lettuce."

Genus Enteromorpha. Adult plants mostly tubular; size varying from fine hair-like to broad flat blades; branching evident to non-existent; very common seaweed; mostly attached to some hard substratum. Some very common species are:

a. linza: easily confused with Ulva; blade short to long with tapering apex and base; the two layers

of cells fused in the blade except at the margin where they separate and form a hollow. Not branched; some varieties undulate.

b. intestinalis: at first attached (to rock, shell, eel grass), often becoming a free-floater; long, tubular and generally inflated; easily identified by its blistered or puckered appearance.

c. prolifera: tubular; straight margins; abundantly branched.

d. compressa: similar to prolifera but fewer branches, with the main axes usually flattened.

Order Cladophorales

Filamentous, uniseriate, usually with a basal holdfast, branched or unbranched; cells multi-nucleate with a large central vacuole, numerous disc-shaped chloroplasts or the chloroplasts united to form a network, one to many pyrenoids, the cell walls often much thickened in the main axis.

Family Cladophoraceae

Genus Chaetomorpha. Plants unbranched, attached by the basal cell or in the form of tangled free filaments.

Genus Cladophora. Filamentous, branched uniseriate; usually attached by a holdfast; cells multi-nucleate; appearing as very find "grass"; vivid green; during reproductive period many zoospores or gametes may be active within the upper cells.

Order Siphonales

Plants coenocytic; filamentous, branched or unbranched, with small chromatophores, and with or without pyrenoids.

Family Bryopsidaceae

Genus Bryopsis. Plant erect; pale green in color; several main branches arising from the base,

of cells fused in the blade except at the margin where they separate and form a hollow. Not branched; some varieties undulate.

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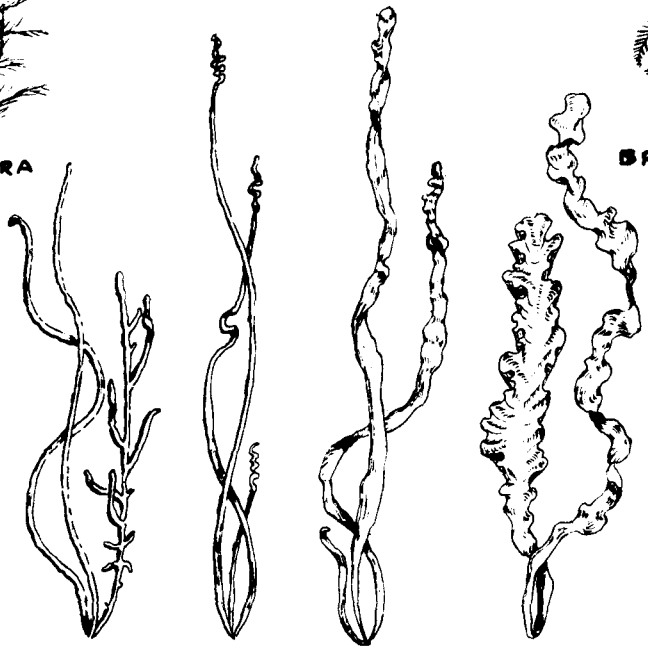
CHLOROPHYTA - THE GREEN ALGAE

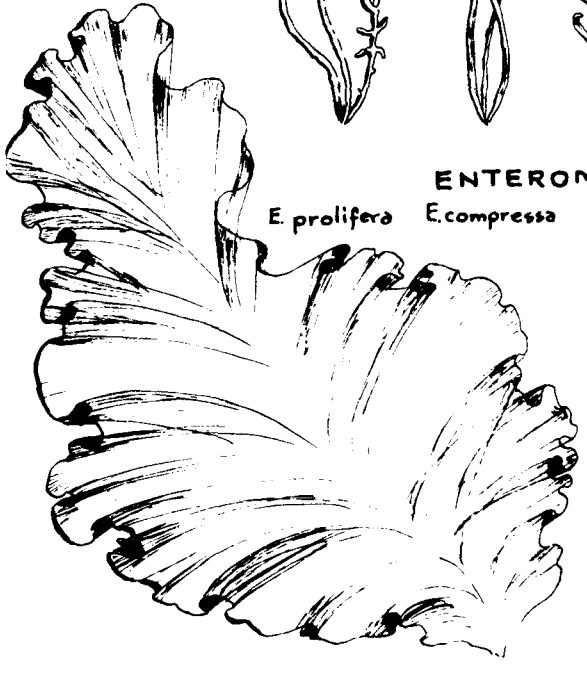
CLADOPHORA

BRYOPSIS

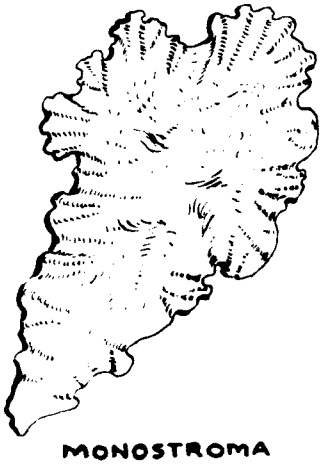


ENTEROMORPHA

E. prolifera E. compressa E. intestinalis E. linza



ULVA



MONOSTROMA

these branching to form a few main lateral branches of indefinite growth on which are tufts of ramelli nearly separated from the parent axis by constriction. No cross-walls, so that the plant is a coenocyte. It is most abundant during late winter and spring.

PHYLUM PHAEOPHYTA (Plate 4)

Algae brown colored; plants varying extremely in size and form; cells mostly containing only one nucleus; among the largest of the seaweeds; usually leathery; the "rockweeds" Fucus and Ascophyllum are sometimes used for packing shellfish and lobsters.

Class Phaeophyceae

Order Ectocarpales

Generally filamentous, branched and uniseriate.

Family Ectocarpaceae

Genus Ectocarpus. Freely branched from a rhizoidal or penetrating base; growth in upright filaments intercalary and apical in horizontal filaments; monosiphonous; gametangia resemble little ears of corn.

Order Chordariales

Although these plants are internally composed of filaments, many of them do not appear to be filamentous when viewed without magnification.

Family Chordariaceae

Genus Eudesme. Plants branched, the branches cylindrical, extremely gelatinous and slippery, usually found only on eel grass (Zostera), and present in Virginia only during winter and spring.

Order Punctariales

Members of this order prefer cool or cold water, and have an internal structure that is more parenchymatous than filamentous. The Virginia representatives either form elongate, flat blades or an unbranched, hollow tube.

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Zoospores are formed in one-celled (unilocular) sporangia; gametes are produced in multi-cellular (plurilocular) gametangia.

Family Punctariaceae

Genus Petalonia. Plants consisting of an elongate, flat blade tapered at each end but especially at the base which ends in a short, terete stalk and holdfast. Most plants are 3 to 12 inches tall, one-half to 3 inches wide. They are found in Tidewater Virginia only from November to April.

Genus Scytosiphon. Plants in the form of a slender, unbranched, terete tube, attached to rocks or woodwork and sometimes with a few constrictions. Found in Virginia only during winter and spring. Usually 6-12 inches tall.

Genus Asperococcus. Plants in groups, unbranched, dark brown, of a hollow tube that may be somewhat flattened, mostly 3-6 inches tall, about one-eighth inch in diameter, growing on stones and woodwork but present only in winter and spring along the Virginia coast.

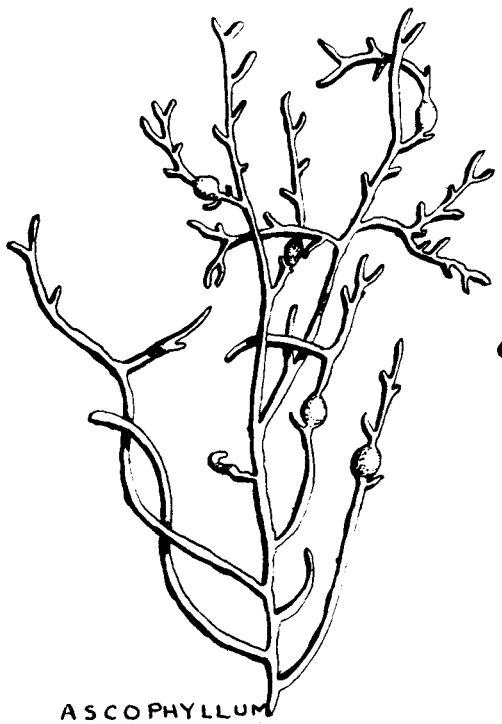
Order Fucales

Large brown algae that are 8 inches to a foot or more tall when mature and which possess some kind of air bladder so that the plants float when they are torn loose from the substratum to which they were originally attached. The growth is apical and the cell structure is parenchymatous.

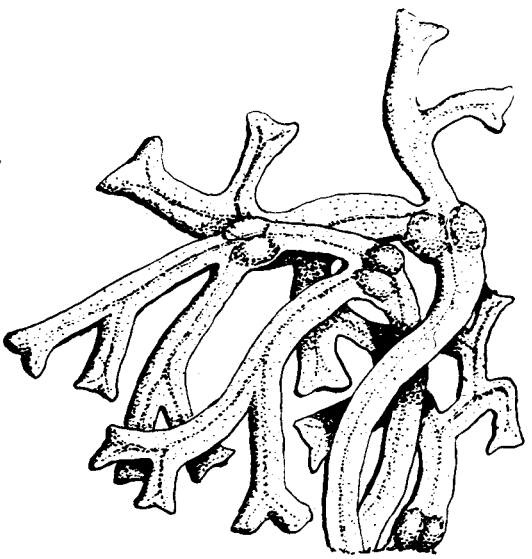
Family Fucaceae

Genus Fucus. These (along with Ascophyllum) are the "rockweeds." They grow almost entirely in the intertidal zone and can stand hours of exposure to air, sun, and rain. They are mostly 6-12 inches tall, much-branched, the branches flattened and strap-shaped and bearing air bladders. There is a fairly conspicuous midrib. When they reproduce (fall and winter only), the ends of the branches swell to form receptacles in which the gametes are produced.

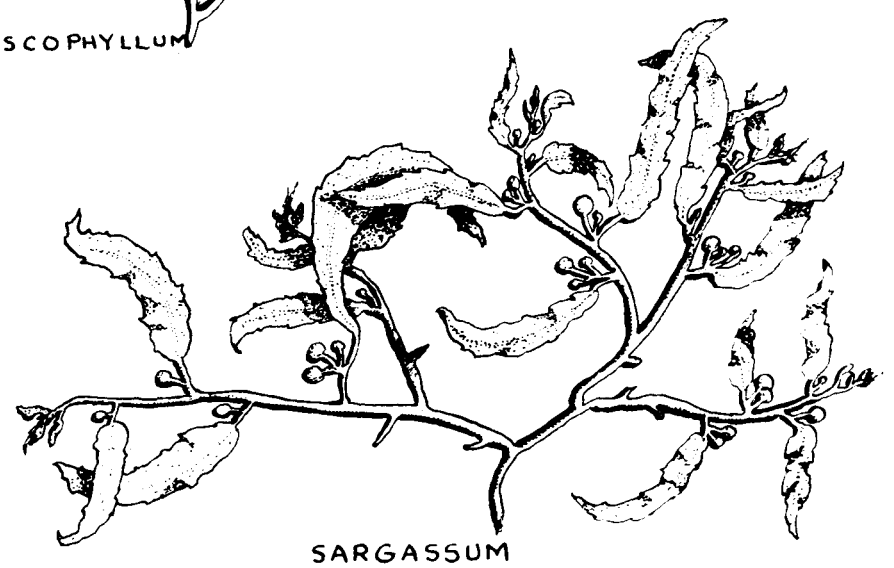
PHAEOPHYTA - THE BROWN ALGAE



ASCOPHYLLUM



FUCUS



SARGASSUM

Genus Ascophyllum. These plants are usually 12-18 inches tall, pinnately branched and with intercalary air bladders. They are rare along the Virginia coast, although they grow at Chincoteague and other places along the Eastern Shore. Drifting plants are often washed up on the beaches.

Family Sargassaceae

Genus Sargassum. This genus is characterized by terete stems that bear three kinds of appendages: leaves, air bladders, and (when reproducing) receptacles that arise in the axils of leaves and consist of little antler-like branches within which are hollow places called conceptacles in which gametes are produced periodically. The two species of Sargassum that occur in the Sargasso Sea are never attached and never reproduce (except by continued vegetative growth and fragmentation). All other species of Sargassum grow attached to rocks below low tide. The family to which this genus belongs is mainly tropical, only one species of Sargassum growing north of Florida along the Atlantic coast of the United States. This species (S. filipendula) and the two species of pelagic Sargassum from the Sargasso Sea are frequently found on Virginia beaches. Occasionally, tropical species from Florida or the West Indies drift north in the Gulf Stream and are blown ashore.

PHYLUM RHODOPHYTA (Plate 5)

The red algae may be almost any color when growing because of the variety of pigments they contain in addition to the red pigment (phycoerythrin) and the green pigment (chlorophyll). The color of the plants depends upon the proportion of the pigments and this is often determined by light intensity and other environmental conditions. Regardless of the color of a red alga, it always contains some of the red pigment whether it appears to or not. Fortunately for collectors, most red algae are some shade of red, but quite a few are greenish to purple. They are multicellular and range from microscopic species to large plants two or three feet long. One tiny species is only found boring into limestone (such as oyster shells) and the limestone

must be decalcified by treatment with a weak acid before the alga can be seen.

Class Rhodophyceae

Subclass Bangiophycidae

The Bangiophycidae are the simpler, more primitive red algae. They grow either as filaments or flat sheets and the cells do not have the fairly conspicuous intercellular protoplasmic connections that are characteristic of the Subclass Florideophycidae.

Order Bangiales

Family Bangiaceae

Genus Porphyra. Plant a flat, thin blade one or two cells thick, purplish-red in color, without a midrib, and growing only in the intertidal zone, especially on oyster shells. It is abundant in Virginia during winter and spring but rare or absent during the summer. Conchocoelis, which is found only within limestone as a tiny filament (see the description of Rhodophyta above), is now known to be an alternate phase of Porphyra. The Conchocoelis stage may be found the year around.

Subclass Florideophycidae

The Florideophycidae include the vast majority of the red algae and range from small, filamentous species to large, complex plants. They have a fairly conspicuous protoplasmic connection between cells derived from the same previous cell by cell division. Most of them exhibit an alternation of identical gametophyte and sporophyte generations. Since the sexes are usually separate, a plant may be male, female, or "tetrasporic." Which it is can be determined only by its reproductive structures. Tetrasporic plants produce only tetraspores, in the formation of which reduction division (meiosis) occurs. Tetrasporic plants are 2N (each cell has two sets of chromosomes). Of a group of four tetraspores, two are believed to give rise to male plants and two to female plants. When an egg cell is fertilized on a female plant by a spermatium produced on a male plant,

the zygote undergoes a complex development to produce a cystocarp which produces carpospores. These are 2N and germinate into tetrasporic plants.

Order Gelidiales

Typically wiry, dark purple to black, with slender branches, firmly attached to shells or stones (in Virginia).

Family Gelidiaceae

Genus Gelidium. Plants mostly one-half to two inches tall, firmly attached to shells or rocks, the branches slender, terete or somewhat flattened. This genus is the principal source of agar in Japan and California, but the Virginia plants are too small. Some plants of another genus, Pterocladia, closely resemble Gelidium, and the reader should refer to more technical books if he is interested in determining how the two differ.

Order Rhodymeniales

The Virginia representatives of this order are mostly bushy-branched plants 2-8 inches in height when mature. The basic characteristics of the orders of the red algae are too technical for delineation in this field guide.

Family Champiaceae

Genus Champia. Small plants 1-3 inches tall characterized by the barrel-shaped segments of which the branches are composed. The branches are thus hollow, the walls one cell in thickness.

Order Gigartinales

Members of this order are the largest red algae of the Virginia coast and are mostly bushy-branched in form and often very abundant. Tetraspores are usually found scattered on the branches just beneath the epidermal cells. In Hypnea, however, the tetraspores are found only in groups in the small side branches.

Family Solieriaceae

Genus Agardhiella. A large, much-branched, rose colored plant with smooth branches and 6-10 inches tall when mature. It can be distinguished from Hypnea and Gracilaria by examination of a thin cross-section under the microscope. Agardhiella is hollow in the center with the hollow containing colorless filaments arising from the inner walls. Hypnea and Gracilaria are filled with large cells in the center.

Family Hypneaceae

Genus Hypnea. Green to purple-green plants 4-12 inches tall when mature, much branched and bearing many short, slender branchlets. The main branches sometimes have hooked tips. Not common in the Norfolk area but usually abundant in the York River along the high bluff above the bridge at Yorktown on the Yorktown side on stones and shells (below the Fusiliers' Redoubt).

Family Gracilariaceae

Genus Gracilaria. Two species of Gracilaria occur in Virginia. One is olive green to purple-green, the branches sometimes flattened a little; the other is rose red and the branches always terete and slender. The plants grow to a height of 8-14 inches, are much branched, not hollow. An agar-like, gel-forming polysaccharide can be made from these plants (Humm, 1962). The greenish Gracilaria is G. foliifera (Forsskal) Børgesen and it is usually dichotomously branched; the red species is G. verrucosa (formerly G. confervoides) and is not dichotomously branched.

Order Ceramiales

Slenderly filamentous and branched, may be coarse, strap-shaped, or membranous; corticated or uncorticated.

Family Ceramiaceae

Genus Ceramium. Filamentous, all axes corticated at nodes; the internodes, if corticated, are covered by outgrowths from the nodes; branching usually dichotomous, tips of branches forcipate. Differentiation

of two very common species: a. strictum: rings of cortical cells at nodes only. b. rubrum: complete cortication, but thicker at nodes.

Genus Callithamnion. Very fine monosiphonous branching filaments; very like Cladophora; branching alternate; rounded soft tuft; bright rose-pink; grows well on Zostera or many other firm surfaces.

Genus Spyridia. Axes completely corticated while branchlets have corticated bands only at the nodes (like Ceramium); a delicately bushy little plant; branchlets give essentially a tropical species which inhabits protected, warm bays and pools.

Family Delessariaceae

Genus Grinnellia. A large, flat pink blade usually with distinct midrib from base to apex; one layer of cells thick except for midrib; if in reproductive phase, it will appear speckled; undulate (ruffled) edges. Common in the spring.

Family Dasyaceae

Genus Dasya. Bright red; main branches stout but soft, with filiform branchlets (like pine needles); branchlets crowded on axes; holdfasts disc-like; mature plants 8-20 inches tall. Most common in spring.

Family Rhodomelaceae

Genus Chondria. Plants bushy, alternately branched; branches cylindrical and spindle-shaped (constricted at bases); branchlets with terminal tuft of filaments; central filaments of elongated cells surrounded by four filaments of like cells (central and pericentral siphons) which in turn are surrounded by cortical cells (seen in cross-section).

Genus Polysiphonia. Filaments are usually dichotomously branched, coarse to very fine; stem cylindrical, uncorticated; at first encounter very easily confused with Ceramium; bright pink to blackish; species vary from an inch to 8 inches in height.

PHYLUM CYANOPHYTA

The bluegreen algae are individually microscopic, but they form layers, groups and cushions on various substrata and can then be seen without magnification. They make intertidal rocks extremely slippery as the cells or filaments are coated with a gelatinous agar-like polysaccharide which serves to protect the cells from extreme drying when intertidal forms are exposed at low tide. These plants have chlorophyll distributed throughout the outer portion of the cytoplasm in a colloidal form and lack chloroplasts. They have no organized nucleus; the nucleoproteins and DNA are distributed throughout a central portion of the cell and there is no membrane around this portion. Sexual reproduction and flagellated cells are lacking. These are the world's most primitive plants, even more so than the bacteria. They are sometimes placed in the same phylum as the bacteria since there are some blue-green algae that lack chlorophyll and cannot be distinguished from bacteria. Because of their similarity, they are all placed in one class, which is divided, by most authorities, into two orders.

Class Cyanophyceae (Myxophyceae)

Order Coccogonales

These are the non-filamentous or coccoid bluegreens that occur as single cells or in colonies of various form, held together by the gelatinous sheath.

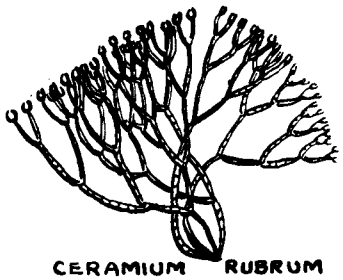
Family Chroococcaceae

Genus Anacystis. Cells single or in colonies, spherical or elongate. The cells of a colony are all of essentially the same size as cell division results in two equal daughter cells. Sometimes in the plankton but also mixed with other algae, on stones, shells, woodwork, and in the surface sand of intertidal beaches where protected from strong waves.

Family Chamaesiphonaceae

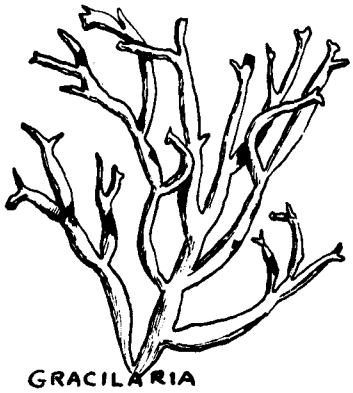
Genus Entophysalis. Cells single or in colonies forming cushions or a layer. These cells are usually

RHODOPHYTA - THE RED ALGAE



CERAMIUM RUBRUM

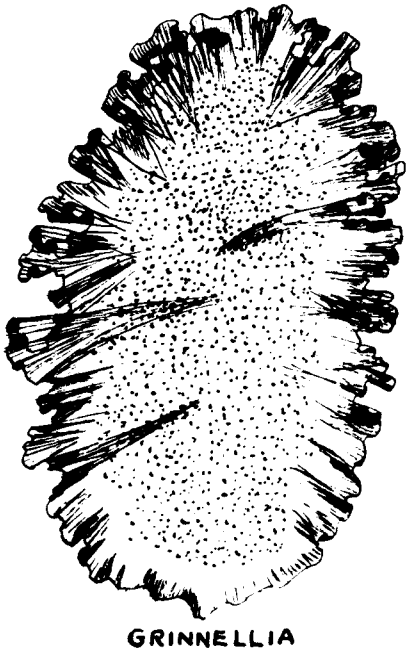
CERAMIUM STRICTUM



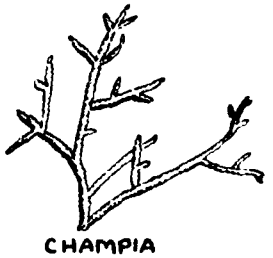
GRACILARIA

AGARDHIELLA

POLYSIPHONIA



GRINNELLIA



CHAMPIA

attached to a substratum and cell division results in two daughter cells of unequal size. Cells in a colony are variable in size. There are two common species in the Virginia area. One grows upon other algae or sometimes upon invertebrate animals (E. conferta Drouet and Daily) while the other is found upon stones, shells and wood, boring into limestone (E. deusta Drouet and Daily).

Order Oscillatoriales

These are the filamentous bluegreens. Some produce a gelatinous sheath, others lack it. True branching is rare among marine species, but some exhibit false branching. The number of trichomes within a sheath varies from the usual one to many. Some species produce heterocysts.

Family Oscillatoriaceae

Genus Spirulina. Filaments very slender (1-2 microns), spirally coiled and without cross walls, motile.

Genus Oscillatoria. Filaments without a sheath, straight or bent but not spiral, the cells often wider than long.

Genus Lyngbya. Filaments with a sheath but only one trichome per sheath, unbranched.

PHYLUM TRACHEOPHYTA (Plate 6)

Seed plants; the embryo remains connected with parent until partly developed; young plant with its food supply is a seed.

Class Angiospermae

Subclass Monocotyledonae

Order Najadales (Pond Weeds)

Family Najadaceae

Genus Zostera. Eel grass; stems horizontal, embedded in the bottom; leaves linear, up to several

feet long, one-fourth to one-half inch wide; staminate and pistillate flowers about equally numerous; fruit oblong-ovoid; seed strongly ribbed; found in shallow water in sheltered bays and coves where the salinity is 15 ‰ to 30 ‰; often washed ashore; flowers hidden from view within the leaf sheaths.

Genus Ruppia. Ditch grass; stem simple or branched, up to 2 feet long; leaves 1-3 inches long, about one-eighth inch wide; peduncle variable; much elongate, usually spiral toward the base; fruit ovoid, often unsymmetrical; found in brackish waters, and rarely in fresh water inland. Leaves much narrower than those of Zostera, grows in water of lower salinity.

Order Liliales

Family Juncaceae (The Rushes)

Genus Juncus. A rush; stems rigid, erect from long horizontal rhizomes, 1.5-3.0 feet tall; basal sheaths mostly leafless, the inner ones bearing rigid, erect, terete blades about as long as the stem and ending in a sharp tip; involucral leaf erect, appearing like a continuation of the stem; inflorescence apparently lateral, 2-6 inches long, with numerous, repeatedly forking, spreading branches, each branchlet terminated by 2-4 sessile glomerules which are subtended by short ovate bracts and composed of 2-6 flowers; perianth segments lanceolate, brown; salt or brackish marshes.

Order Graminales

Family Graminae (Grasses)

Genus Distichlis. Salt grass; culms 8-16 inches tall, with numerous rigid involute leaf blades mostly 2-4 inches long; panicle ovoid, 1-2 inches long; pistillate spikelets number 4-9; staminate spikelets 8-12; in salt marshes.

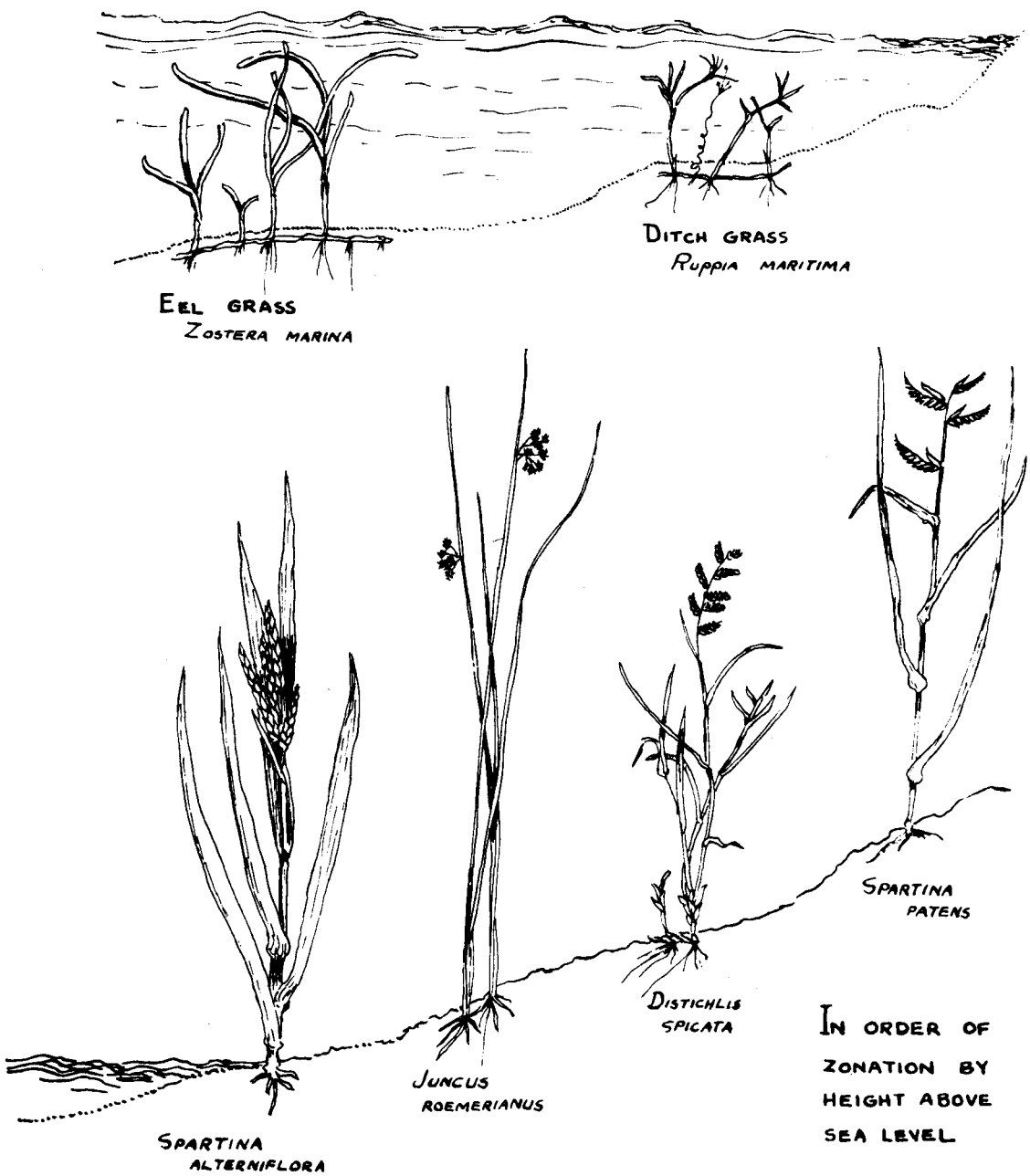
Genus Spartina (Two Common Species)

a. Spartina alterniflora: Cord grass. Culms stout, up to 8 feet tall, or as low as 12 inches; leaf blades elongate, 0.2-0.6 inches wide, glabrous or nearly

so; panicle narrow, 4-12 inches long; spikes slender, appressed to the axis, 2-4 inches long; spikelets scarcely imbricate, erect; rachis prolonged beyond the uppermost spikelet and usually conspicuously exceeding it; found in salt marshes partly submerged during high tides.

b. Spartina patens: Culms slender and stiff, usually gregarious from long rhizomes, 1-3 feet tall; leaf blades 0.04-0.12 inches wide, involute or flat at bases; spikes usually number 3-6 and 0.8-2.0 inches long; spikelets densely imbricate, found in salt marshes and on sheltered shores.

SPERMATOPHYTE MARSH PLANTS



COLLECTING MARINE ANIMALS

Again, as in plants, the habitats for marine fauna are quite varied. Many forms will be observed from any area of sand beaches, tidal flats, and salt marshes. Below are some specific habitats and collection ideas.

The Habitats

Mud Flats. A variety of mollusks and crustaceans may be located by the holes they make in the sand and mud. Large holes in high intertidal areas are usually occupied by fiddler crabs; two small holes, spaced in low tidal and subtidal zones, often indicate the presence of a clam. Clams can be dug with a shovel by piercing the bottom deeply. Sifting mud and sand will disclose worms and small clams. The ribbed mussel is attached by a byssus in mud among cord grasses and may be gathered by hand. The same is true of small barnacles and snails living on the grasses.

Sand Flats. Many crabs can be captured with nets or by hand but some will have to be collected by digging and sifting. Digging and sifting of sand at various levels above and below tide lines will reward the collector with various worms, mollusks, echinoderms, and crustaceans.

Beach Drifts and Intertidal Zone. Hydroids, tunicates, and bryozoans are frequently washed in with the tides and are easily collected. Many mollusks are obtained from the intertidal zone; some may be collected by hand while others are obtained by the digging and sifting method.

Sea Walls and Pilings. A variety of tube-secreting worms, sponges, hydroids and sea anemones may be gathered. Scraping frequently is needed to free the specimens. If specimens from many of these sources are left in small amounts of fresh water, the worms will crawl out of the tubes. Barnacles, mussels, oysters, and other sessile animals may be present in large numbers.

Equipment

Diving with a face mask is an excellent method for gathering sponges, corals, many arthropods and mollusks.

Glass-bottomed pails are valuable in locating and collecting animals as well as plants in shallow water when the surface has riffles or small waves. Seines are quite valuable along sandy beaches. Refer also to Collecting Marine Plants.

PRESERVING MARINE ANIMALS

While collecting, animals should be kept in shaded cool places and not be overcrowded if they are to be kept alive for study. In the laboratory a habitat as similar as possible to nature is desirable. Size and activity of specimens should be considered in determining the number to be placed in a petri dish, finger bowl, or similar container if overcrowding is to be avoided. If specimens are crowded, sea water should be changed frequently. It is advisable to pour the water through filter paper if it is turbid.

For long-range preservation, the same basic procedures are used as for plants except that zoologists ordinarily use 10% instead of 5% formalin for large specimens; 5% formalin is adequate for small animals. Never use a solution stronger than 10% and be sure to consider full-strength formalin as 100% and not as 35-40% (which it actually is). Always use sea water to make up the preservative. A pinch of borax is useful in maintaining a favorable pH or a piece of oyster or clam shell will serve the same purpose and will not produce white deposits on the specimen. An acid solution will dissolve calcareous material. Some collectors use a formaldehyde solution for initial preservation and after the specimens have been in it for a day or so they are transferred to a clean, clear formalin solution prepared from filtered sea water. Before the specimens are placed in this permanent solution, they may be rinsed thoroughly but briefly in tap water to remove sand or mud and any stained original solution clinging to them. In the permanent solution they can be clearly observed and will present a neat, professional appearance. Preserving jars with plastic caps should always be used as metal caps invariably corrode within a few months. Labels can be placed inside with the animal if they do not interfere with its observation. The best label paper is the

"pat-a-par" paper often used in meat markets to wrap boiled ham slices. This paper is very hard, will take India ink perfectly (no other ink should be used) and it remains firm in a liquid indefinitely.

Crustaceans may be preserved initially in sea water formaldehyde but authorities on this group strongly recommend that for permanent preservation they should be transferred to 70% ethyl alcohol or to denatured or isopropyl alcohol of lower concentration. Add 1% glycerine to prevent drying. A disadvantage of alcohol is its propensity for escaping slowly even through tightly-sealed caps, so that it is necessary to examine the jars at least once a year and add alcohol as needed to prevent drying. It is useless to attempt to preserve the natural colors of marine animals for these colors are pigments that are chemically complex and tend to decompose quickly in the absence of living cells. If the animal is a solid color, it can be stained with some permanent dye to imitate the natural color, but if the specimen exhibits a mixture of colors when alive, the problem of fading may be insoluble. In general, color will be retained longer in buffered formalin than in alcohol.

CLASSIFICATION AND GENERIC DESCRIPTIONS OF COMMON MARINE ANIMALS IN TIDEWATER VIRGINIA

PHYLUM PORIFERA (Plate 7)

Single animal or colony of animals; always sessile; form varies from globose or diffusely branched and anastomosed to an encrustation; colors vary but tend to be drab, except in Microciona; external form is modified by the environment. An individual is typically tube-shaped, with numerous incurrent pores and a single excurrent opening, the osculum. The skeleton is formed of calcareous or siliceous spicules, or it consists of tough protein (spongin) fibers.

Class Noncalcarea (or Demospongiae)

Most widely spread and dominant group; spongin and siliceous spicules in varying proportions.

Order Hadromerina

Family Clionidae

(See Hopkins, S. H. 1962. Distribution of species of Cliona (boring sponge) on the Eastern Shore of Virginia in relation to salinity. Chesapeake Science 3:121-127.)

Genus Cliona. Called "boring sponge." Common on shells of clams and oysters where salinity is above 15 ‰. Resembles warts; bright yellow to dirty brown. Much of sponge body is concealed within the shell. Cliona truitti tolerates salinities as low as 3 ‰.

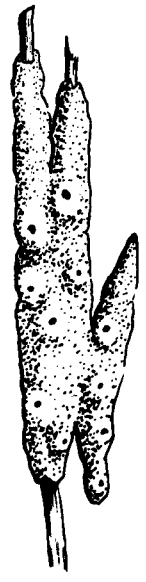
Order Halichondrina

Usually lacking a crust or cortex; skeleton reticulate; microscleres monaxon; megascleres oxeas or tylostyles; body of loose texture, with considerable spongin.

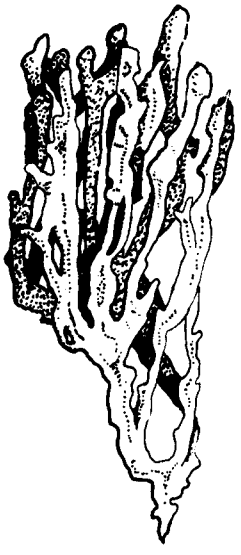
Family Poecilosclerina

Genus Microciona. Common all year; bright orange-red; large cluster of close-set finger-like

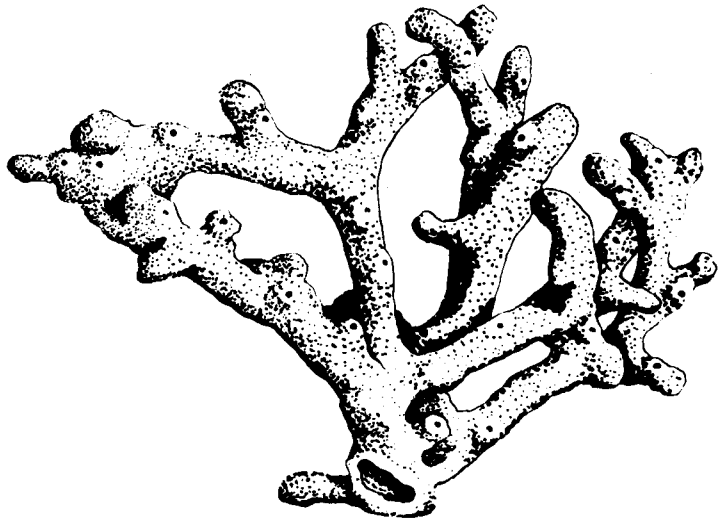
SPONGES



HALICLONA PALMATA



RED FINGER SPONGE
MICROCIONA PROLIFERA



HALICLONA VIRIDIS

lobes; called "red-finger sponge"; found attached in low intertidal zone to rocks, pilings, algae shells, alcyonarians, etc.; tips of "fingers" are sometimes swollen and often compressed; tough, spongy consistency; fingers may be 6 inches long; oscula scattered over the surface, with pores extremely numerous between them.

Family Haliclonidae

Genus Haliclona. Forms vary in adult stage from encrustation to erect branching colonies; brownish-grey in color; many prominent oscula in encrustations; branching colonies found frequently mixed with Microciona or attached alone, while encrustations occur on Zostera, mollusk shells, seaweeds, and old stems of soft corals.

Family Haploscleridae

Genus Halichondria. Form variable, often massive; spicules irregularly scattered; color grey, usually yellow but sometimes orange; fouling sponge; soft and easily torn; perforated by widely spaced pores.

PHYLUM COELENTERATA (Plate 8)

Tube-shaped, with single anterior opening; body wall of two layers with mesoglea between; solitary or colonial; nematocysts; division of labor; may or may not exhibit alternation of generations; radial symmetry.

Class Hydrozoa

Hydroid polyps and medusae, usually with alternation of generations. The hydroid stage, which is called the trophosome, is sessile, usually colonial and reproduces by budding the medusa stage, which is called the gonosome. The individual hydroids are small (a few mm in length). The colonies are often plant-like in appearance. Usually there is a secreted cuticle (perisarc) for rigidity and protection.

Order Thecata (Leptomedusae)

Polyps protected by transparent enclosure; distinct feeding and reproductive polyps bud separately from stem; medusae (when fully formed) detach themselves and leave by tiny opening in the gonotheca.

Family Sertulariidae

Genus Sertularia. Hydrothecae in two opposing rows, directly attached to stem; hydrothecal margin with 2 or 3 teeth. S. argentea is largest hydroid occurring in Chesapeake Bay.

Family Campanularidae

Genus Obelia. The numerous species belonging to this genus have a branched stem which may be simple or fascicled, with flower-like hydrothecae and with gonothecae arising from the axils of the branches; clear, greyish-black, or yellowish in color; many branches with annulated bases; may reach 8 inches in length; medusa with eight or more marginal tentacles but no oral tentacles.

Genus Gonothyraea. Similar in morphology to Obelia, but with teeth along the hydrothecal margin which are truncate. Gonophores produce fixed sporosacs rather than free medusae, colonies may reach 2 inches. An abundant winter form.

Order Athecata (Anthomedusae)

Polyps naked; gonads of ectodermal origin.

Family Eudendridae

Genus Eudendrium. Trophosome colony branched; perisarc distinct, annulations distinct to absent; hydranth with hypostome trumpet-shaped; single whorl of tentacles; attached to hard substrata.

Family Pennariidae

Genus Pennaria. Trophosome colony regularly branched; hydranth with basal whorl and a number of short, knobbed tentacles on the hypostome; attached to piles, rock, seaweeds; medusoid buds evident on side of hydranth; white to rose color.

Order Siphonophora

Mostly colonial and marine; float near surface of sea with individuals suspended from a float or swimming polyp; individual polyps exhibit division of labor.

Family Rhizophysaliidae

Genus Physalia. "Portugese man-of-war"; colony floats on surface of water; often carried by current and wind for long distances; can sink for protection when water becomes agitated; dome pear-shaped, with iridescent colors; tentacles long (sometimes reaching 11-16 yards); powerful stinging organs. NOTE: The stinging organs may still be active even if on the sand.

Class Anthozoa

Corals, sea anemones; only polyp form present; body usually cylindrical and attached permanently or temporarily at one end (foot); oral disc at opposite end with mouth central, surrounded by hollow tentacles (from several to over a hundred).

Order Actiniaria

Sea anemones with body consisting of a basal disc, oral disc and a column; tentacles may be few or many arranged in two to many rings on the oral disc; tentacles hollow and tapering to a point or knob containing nematocysts; mouth usually slit-like; mesenteries arranged in definite radiating pattern.

Family Aiptasiomorphidae

Genus Aiptasiomorpha. Green-brown sea anemone striped with yellow or orange and having numerous tentacles; found on pilings, in old barnacle shells, and on rocks in intertidal zone.

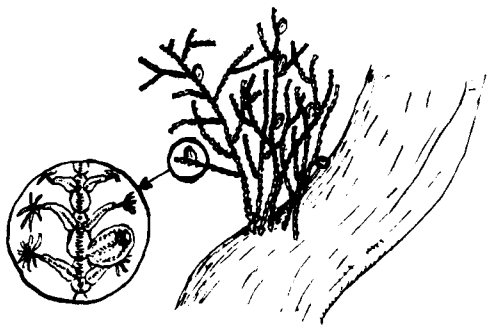
Family Diadumenidae

Genus Diadumene. Sea anemone; green-brown in shallows, pinkish in deeper water; without stripes; tentacles long; found on pilings and shells.

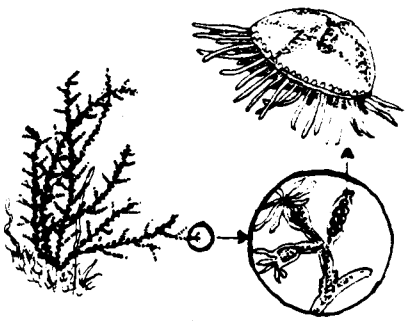
Family Actinostolidae

Genus Paranthus. Commonly called "sea onion"; white; tentacles short. Buried in sand.

COELENTERATES

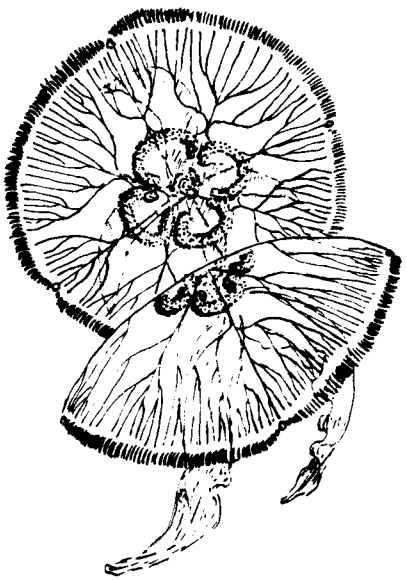


SERTULARIA

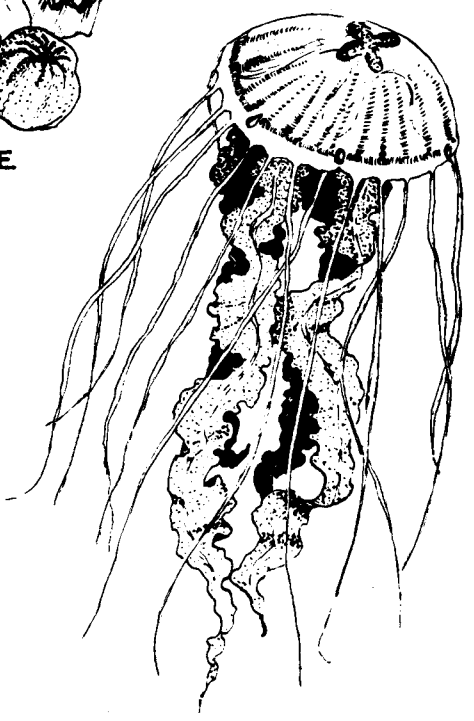


OBELIA

DIADUMENE



AURELIA



DACTYLOMETRA

Order Gorgonacea

Family Gorgoniidae

Genus Leptogorgia. Purple, "soft coral"; attached to shells and pilings; polyps extending from all sides; also referred to as a "whip coral"; up to approximately 12 inches in height. Farther south this species may be orange, yellow or purple. (Specimens collected in deep water of Chesapeake Bay exhibit these colors.)

Class Scyphozoa

Usually undergoing alternation of generations (few may have only one stage); medusae play most conspicuous part and are often large animals; true jellyfishes.

Order Semaeostomeae

No coronal furrow or pedalia; mouth opening central, with 4 gelatinous lips; tentacles hollow and rhopalia marginal; gonads in sac-like folds in endoderm.

Family Pelagiidae

Genus Chrysaora. Large medusa commonly known as a "stinging nettle"; may or may not have blood-red organs in dome; disc hemispherical in shape; with very long oral lobes and marginal tentacles; color of organs denotes white or red phase.

Family Ulmaridae

Genus Aurelia. Marginal tentacles minute; body flat and disc-like with four large white, horseshoe-shaped gonads in dome; color clear, white, pink, or bluish; abundant in summer; often called "white sea jellies"; 6-10 inches in diameter.

PHYLUM CTENOPHORA (Plate 9A)

Very soft and delicate "jellyfishes" living mostly in surface waters of the sea. The outer surface lacks hard structures and bears 8 longitudinal bands of cilia,

the characteristic "combs". All are remarkably luminescent when disturbed at night.

Class Tentaculata

With tentacles.

Order Lobata

Spheroidal body with two oral lobes and four auricles; two tentacles without sheaths.

Family Mnemiidae

Genus Mnemiopsis. Body ovate; lobes large, each bounded by deep side furrows; commonly called "comb jellies"; easily obtained by a plankton net or just by scooping with a container; easily damaged by handling; about 4 inches in length; both sides of the long, slit-like mouth are edged with a row of short tentacles; easily seen (gives off a luminescent glow) on dark nights when water is churned by hand, oars or motor.

PHYLUM PLATYHELMINTHES (Plate 9B)

Flatworms with soft bodies lacking segmentation, distinct head and paired appendages. Primitive third layer present; outer surface may or may not be ciliated; mouth ventral; parasitic or free living.

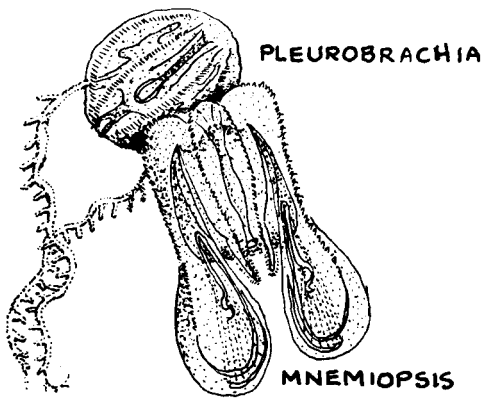
Class Turbellaria

Free-living flatworms; externally covered with cilia; form of gastrovascular cavity provides a basis for division into orders.

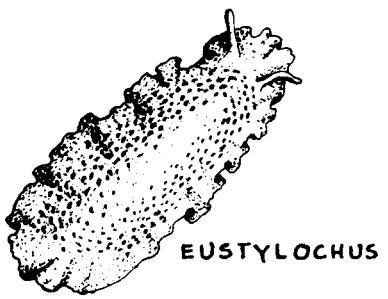
Order Polycladida

Exclusively marine; digestive tract profusely branched; body thin, leaf-like; numerous eyes in head region; pair of tentacles may be present, as may a sucker.

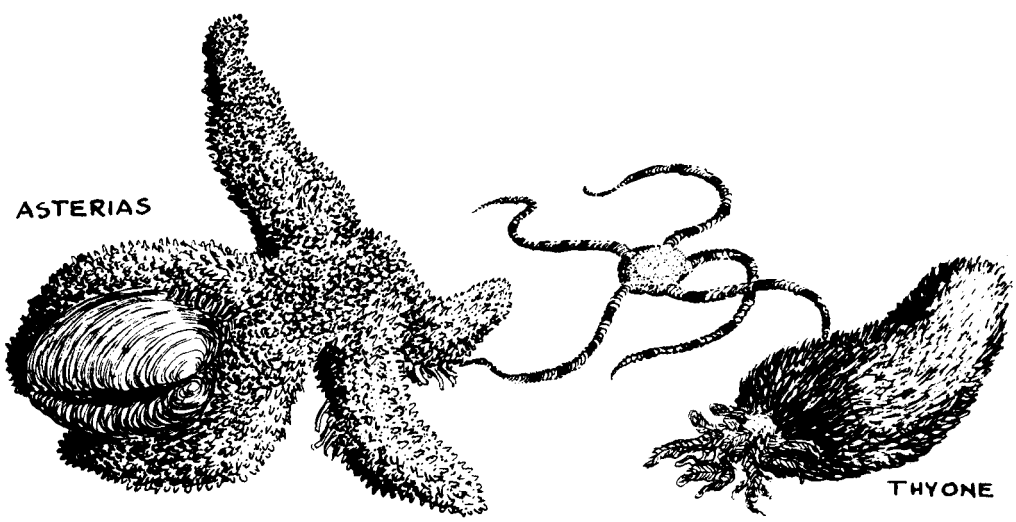
CTENOPHORES, ECHINODERMS, AND PLATYHELMINTHS



A. CTENOPHORES: COMB JELLIES



B. PLATYHELMINTH:
A POLYCLAD FLATWORM



C. ECHINODERMS:
STARFISH, BRITTLE STAR, SEA CUCUMBER

Family Planoceridae

Genus Stylochus. Body oval or elliptical and flat; color a pale yellow-brown varying to mottled green with a whitish network; tentacles short and white, each with a cluster of ocelli; margins undulating; common on seaweed and in old oyster shells. Intestine with numerous branches to all parts of body; mouth central and ventral.

PHYLUM RHYNCHOCOELA (Nemertea)

Soft, flattened, very contractile worms, often brightly colored in tropics; most are nonparasitic and marine, many burrow; unsegmented but often give appearance of being so due to regularly repeated subdivisions of internal organs; mouth on ventral surface near anterior; anus at posterior.

Order Heteronemertini

Three muscle layers, with the brain and lateral nerve cords above the circular layer and beneath the outer longitudinal layer; proboscis lacking stylet; mouth behind brain.

Family Lineidae

Genus Cerebratulus. Body long, flat, and broad, with a small pointed head and thin edges well adapted for swimming. Eyes usually absent; mouth a long slit; rose to light purplish in color; near low water mark, burrowing in shallow, sandy bottoms, but free-swimming during breeding season.

PHYLUM ANNELIDA (Plate 10)

True or segmented worms with elongated bodies and with anterior segments specialized and modified to form a distinct head.

Class Polychaeta

Each segment usually with paired parapodia of two main parts (both have setae and cirri); distinct head

with sense organs; protrusible proboscis frequently present. Mostly marine; many species iridescent; usually burrowing in substrate or living in tubes (calcareous or membranous). Divided for convenience into two groups, Errantia and Sedentaria, but Orders have not been established.

Family Onuphidae (Eunicidae)

Head triangular, with lobe-like palps; eyes 2, 4, or none; iridescent; numerous narrow segments ending in 2 or 4 anal cirri.

Genus Diopatra. Commonly called "tube worm" or "plume worm"; may be more than a foot in length and ½ inch in width; body iridescent, armored, constructs a tube of tough, parchment-like material, which reaches to a depth of 3 feet or more; portion of tube extending 2-3 inches above surface of a sand or mud flat is made of bits of debris to which seaweeds may attach. Body flat, greenish, with paired, bright red, plumed gills anteriorly.

Family Terebellidae

Upper lip of prostomium somewhat reduced and semi-circular; head with numerous grooved and ciliated tentacles; tubes membranous, may be coated with mud, sand or shell fragments.

Genus Enoplobranchus. Worm distinctly red; tentacles on anterior end may stretch to 4 inches; very fragile; may grow to length of 14 inches; readily found at low water mark in sandy-mud by digging and sifting.

Family Glyceridae

Pointed, ringed cone forms head having four small tentacles at the tip; proboscis may be rapidly forced out by strong muscles, exposing 4 hooked teeth at its club-shaped extremity.

Genus Glycera. "Blood worm"; prostomium elongate-conical with 4 minute tentacles; proboscis frequently 6-8 inches long; when free-swimming, these worms coil themselves in a loose spiral and rapidly

rotate on the axis; body light purplish-pink; burrows in sand of intertidal zone.

Family Nereidae

Usually free swimmers; distinct head and eyes with prostomial tentacles; chitinous buccal membrane; proboscis armed with pair of horny jaws and usually with a series of horny teeth.

Genus Nereis (Neanthes). Prostomium with pair of minute tentacles and 2 palps; peristomium with 4 eyes and 2 antennae; notopodia enlarged; found in sand.

Genus Platynereis. Morphology basically same as in Nereis escept that one of the four peristomial tentacles is very long, extending sometimes to the 10th segment or farther; lacks enlarged notopodium of Nereis; approximately 1 inch long.

Family Orbiniidae

Genus Scoloplos. Some parapodia with capillary setae; anterior and posterior ends pointed or rounded; anterior end not concealed; found in sand.

Family Arenicolidae

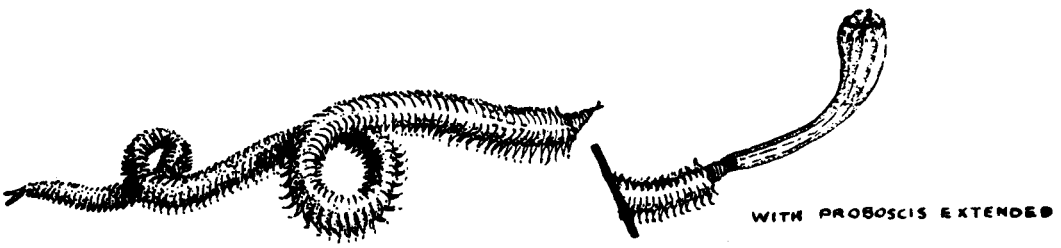
Head only moderately developed; no appendages; bounded posteriorly by nuchal grooves; no palps or tentacles; body divided into three regions.

Genus Arenicola. "Lug worm"; large (4-6 inches), greenish-black worm with short spines (setae) protruding from each segment; head only moderately developed; lacking appendages, palps, or tentacles; only indistinct eyes present; can burrow rapidly and deeply into the sand just below the low water mark; may be found between sea squirts.

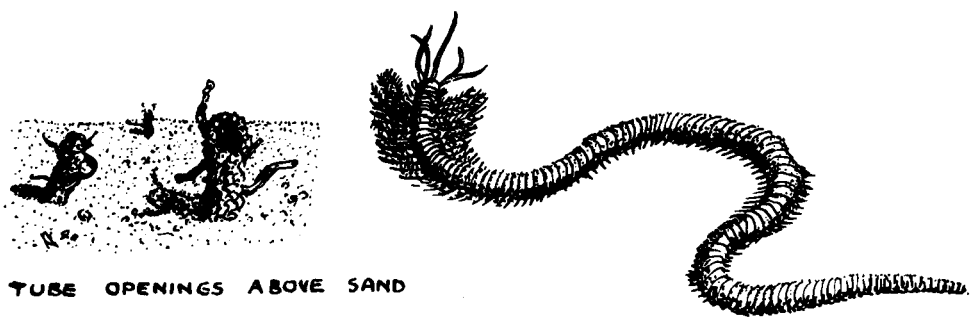
Family Sabellidae

Body somewhat rounded or slightly flattened; thorax of 5-12 bristled segments; abdomen of numerous segments with bristles and hooks; first segment partly enveloped

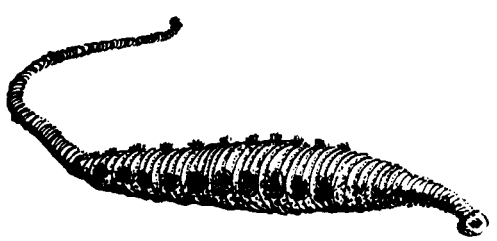
ANNELIDS

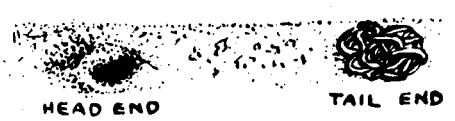


BLOOD WORM: GLYCERA



PLUME WORM: DIOPATRA





INDICATION OF BURROW IN SAND

LUG WORM: ARENICOLA

by a collar covering the branchiae; builds cylindrical mucoid tube of leathery or membranous consistency.

Genus Sabella. "Plume worm"*; greenish-brown worm with anterior end concealed by distinct tentacles resembling feathers; builds a cylindrical tube of mucous of a leathery or membranous consistency to which mud, sand, and other substances may stick; may be found between sea squirts. Plumes held outside of tube normally, but withdrawn instantly when the animal is disturbed.

PHYLUM ARTHROPODA (Plates 11 and 12)

Body with external segmentation and jointed appendages; segments differ in size, shape, and specialization; exoskeleton chitinous.

Class Crustacea

Breathe by gills (branchiae); two pairs antennae.

Order Amphipoda (Plate 11A)

Body elongated, usually laterally compressed; first thoracic segment fused with the head (also second segment in caprellids). Paired thoracic appendages 7, second and third pairs usually equipped for grasping and called gnathopods. Abdominal appendages 6 pairs, last 3 usually modified for jumping; eggs carried on ventral side of thorax in a "brood pouch" formed by flattened projections from thoracic legs; gills on periopods; easily obtained among seaweeds; very common. An example is Caprella, which is abundant on seaweeds, especially Gracilaria. It is excellent as food for other animals in the laboratory. It moves in a manner suggesting a measuring worm.

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*The serpulids make up another group of "plume worms." These worms build calcareous tubes. Their classification at the moment is in dispute.

Order Isopoda (Plate 11C)

Body usually flattened from top to bottom (dorso-ventrally); first segment of thorax fused with head, the remaining 7 being free and distinct; 6 abdominal segments; thoracic legs typically alike except for first 2 pairs of periopods which may be subchelate; abdomen less prominent than in amphipods, with appendages for swimming or breathing; thorax longer; carry eggs in "brood pouch" under thorax; an example is Ligia exotica, the "sea roach" which lives out of water most of the time on sea walls, pilings, and rock breakwaters.

Order Cirripedia (Barnacles) (Plate 11B)

Shrimp-like animals encased in a calcareous shell; 6 pairs of legs divided at the ends into curling, many-jointed branches which are ejected through openings in shell to gather food (appear feathery); body upside down in shell, attached by back of head to base of shell with its legs being uppermost.

Family Chthamalidae

Genus Chthamalus. Barnacle with plates of shell wall non-porous, usually 6 in number; very small and fragile; somewhat flattened, greyish white; attached to Spartina; abundant in high intertidal area on pilings, occurs singly or in small groups; base not calcareous.

Family Balanidae

Genus Balanus. Common barnacle on pilings, shells, rocks, and ship bottoms; base of each shell calcareous; plates porous, overlapping.

Order Decapoda (Plates 11D and 12)

Shrimp, lobsters, crayfish, and crabs; carapace covers entire thorax; cephalothorax cylindrical or compressed; abdomen small and bent under cephalothorax in crabs; first pair of periopods chelate, also others often slightly chelate; eggs usually carried on pleopods (swimmerets); gills situated in gill chamber on each side of thorax.

Family Paguridae

Genus Pagurus. General form crayfish-like; carapace not fused with epistome; antennae inserted lateral to eyes; uropods present (may be modified); soft abdomen swollen, membranous and asymmetrical; commonly called "hermit crabs"; found in intertidal zone; first pair of periopods chelate, last pair modified to hold body in shell; abdominal appendages rudimentary or absent. Found in shells of Littorina, Polynices, and other snails.

Family Hippidae

Genus Emerita. Similar to Pagurus except abdomen is reduced, bent under thorax; calcareous and symmetrical; second to fourth legs with last joint curved and flattened for digging; tail a telson and uropods not adapted for swimming but for digging; burrows in loose sand at edge of water where there is good wave action. Commonly called "mole crab."

Family Majidae

Genus Libinia. "Spider crab"; spider-like in form; carapace fused with epistome, at least at sides; antennae inserted between retractile eyes; uropods absent; appendages long, slender; median spines on carapace 6-9 in number; free-living; often camouflages carapace with debris; dense growth of chitinous hairs gives it furry appearance; chelipeds slender.

Family Portunidae

The swimming crabs. In all species the last pair of legs has flattened paddles.

Genus Ovalipes. Commonly called "lady crab" or "calico carb"; crab-like carapace fused with epistome; antennae between eyes; uropods absent; body of medium width; rostrum reduced; carapace not broad but short and rounded anteriorly; color purplish spots on a light-colored background.

Genus Callinectes. Carapace about twice as broad as long, anterior margin serrated and terminated posterolaterally by a long sharp spine. As in Ovalipes,

the last pair of periopods is broad and flattened to form paddles for swimming; commonly called "blue crab," "hard-shell crab" or "soft-shell crab" (during molting period).

Family Xanthidae

Genus Eurypanopeus. E. depressus is common on oyster bars.

Genus Panopeus. P. herbsti is common in lower Chesapeake Bay and York River.

NOTE: A key to identify local crabs has been prepared at VIMS.

Genus Neopanope. Tiny crab; color dark and dull; carapace more or less hexagonal; found among rocks or shells; chelae very large and powerful for the size of the crab.

Family Pinnotheridae

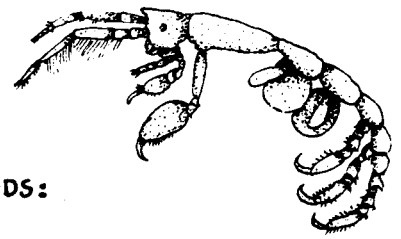
Genus Pinnotheres. P. ostreum, commonly called "pea crab" or "oyster crab," is present in a large number of oysters from particular regions of Chesapeake Bay.

Family Ocypodidae

Genus Ocypode. Commonly called "ghost crab"; eyestalks stout and often very long; chelipeds of male nearly equal; carapace of moderate width, nearly square, and with smooth edges; sandy white in color; antennae between eyes; runs swiftly sideways on tips of appendages over sand and makes burrows high up on beach.

Genus Uca. Common "mud or sand fiddlers"; eyestalks slender; chelipeds of male very unequal, the larger being carried across front of the body; shape otherwise basically same as in Ocypode; hard carapace brown or mottled; live in burrows in salt marshes and mud or sand flats.

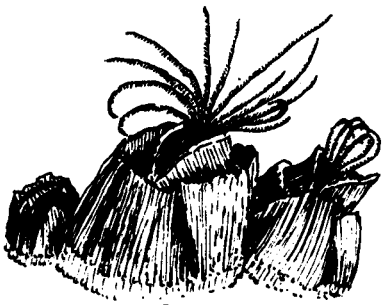
ARTHROPODS - REPRESENTATIVE CRUSTACEANS



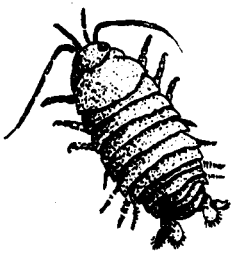
A. AMPHIPODS:

SAND FLEA

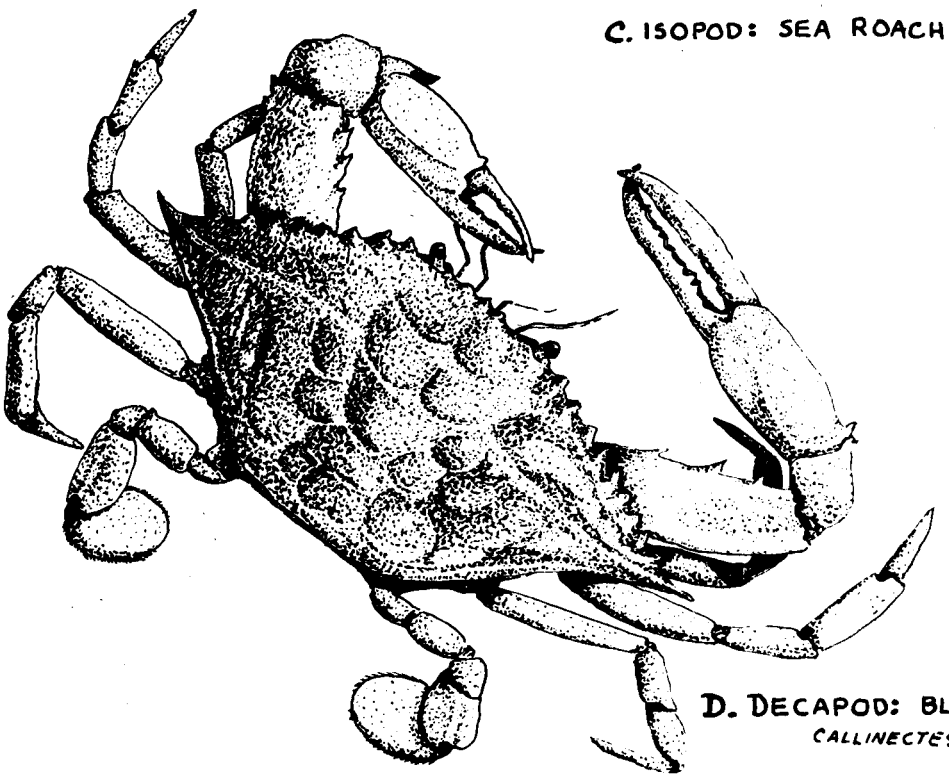
CAPRELLID



B. CIRRIPED: ACORN BARNACLE



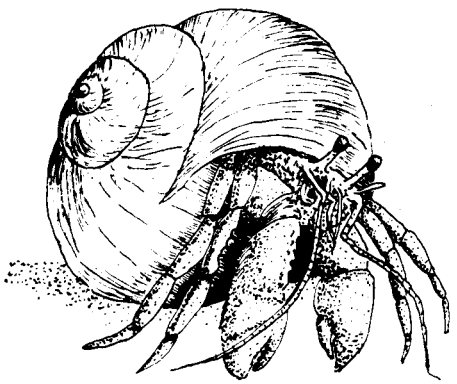
C. ISOPOD: SEA ROACH



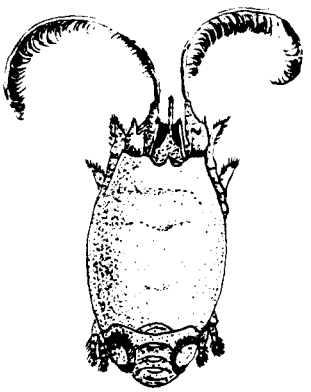
D. DECAPOD: BLUE CRAB

CALLINECTES SAPIDUS

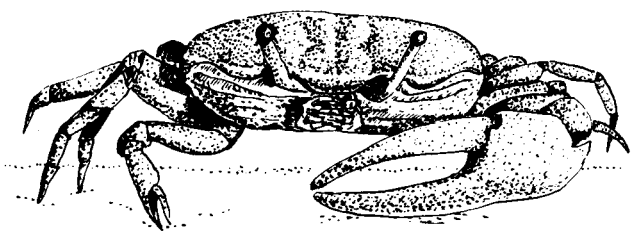
ARTHROPODS - ADDITIONAL DECAPODS



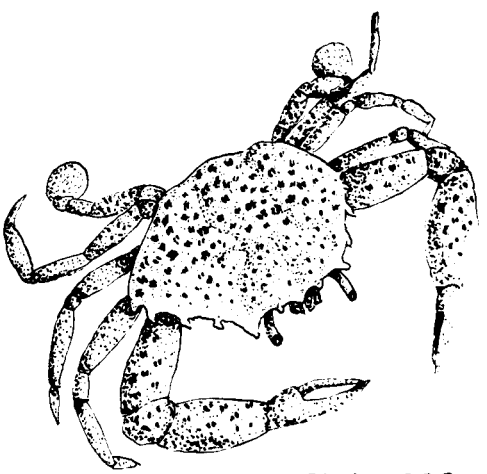
HERMIT CRAB: PAGURUS



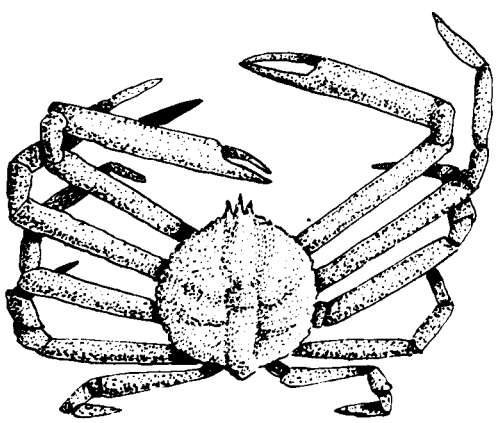
MOLE CRAB: EMERITA



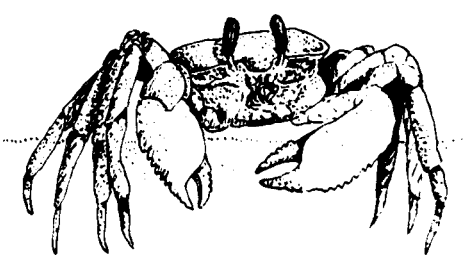
FIDDLER CRAB: UCA



LADY CRAB: OVALIPES



SPIDER CRAB: LIBINIA



GHOST CRAB: OCYPODE

PHYLUM MOLLUSCA (Plates 13 and 14)

Soft-bodied animals generally protected by an exoskeleton secreted by the mantle; one or two sections (valves) to the shell.

Class Pelecypoda (Plate 13)

Bivalves shell and mantle; no head; symmetrical.

Order Filibranchia (Prionodesmacea)

Bilobed mantle open at ventral and posterior edges; siphons lacking or poorly developed; shells iridescent; gills not reticulated.

Family Ostreidae (The Oysters)

Genus Crassostrea (Ostrea). Shell halves not equal; resting on and attached by the left valve; irregular and variable in shape; very thick, often folded, layers of shell, foot absent.

Family Anomiidae (The Jingle Shells)

Genus Anomia. Commonly called "jingle shell" or "Venus' toe nail"; shells thin and unequal; right shell smaller and with deep notch or hole through which the byssus projects to attach the animal to a rock or shell; shell circular to oval; outer surface scaly and dark in some areas, clear and pearly-like in others. Shell dark, when found on the beach, often has the scaly surface worn off, exposing the glistening greenish or golden Mother-of-Pearl.

Family Mytilidae (The Mussels)

Genus Mytilus. Edible mussel; shell wedge-shaped, being pointed in front and round behind; color black or dark brown outside with pearly interior fringed in violet; attached by byssus to rocks or each other; between tide lines and in shallow water; umbo anterior.

Genus Modiolus. One species, M. modiolus, is commonly called "horse mussel"; coarse shell wedge-shaped and thicker in front; umbo not quite at anterior

end; outside dark brown in color with inside pearly; has byssus; 4-6 inches in length; in Virginia found only off coast in deep water.

Genus Volsella. V. demissa is commonly called "ribbed mussel"; shell has numerous radiating ribs, coarser posteriorly and much finer anteriorly; shell brittle and delicately scalloped around thin edge; color greenish-yellow to dark brown, iridescent inside; 2-3 inches in length; found on mud flats and sand spits among roots of Spartina. Often exposed at low tide; umbo slightly to one side of apex.

Genus Brachidontes. B. recurvus is euryhaline and frequently abundant on oyster rocks. Smaller than ribbed mussels with a strongly "hooked" shell.

Order Eulamellibranchia (Teleodesmacea)

Gills reticulated; edge of mantle lobes mostly connected on ventral and posterior edges.

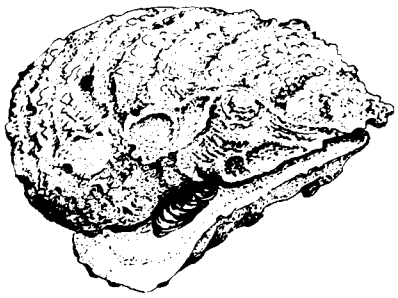
Family Veneridae (The Venus Clams)

Genus Mercenaria. Common clam used frequently for dissection as well as for food; called "hard-shell clam," "little-neck clam," or "quahogs"; thick shell ovate or heart-shaped; anterior end short with the posterior end rounded; ligament prominent, umbo directed forward; surface dirty white, with prominent concentric ridges; inner surface smooth, white with purplish margin; located on sand or muddy bottoms in shallow water; common "cherrystone clams" are immature clams of the same species; "chowders" may be 3 inches or more in length.

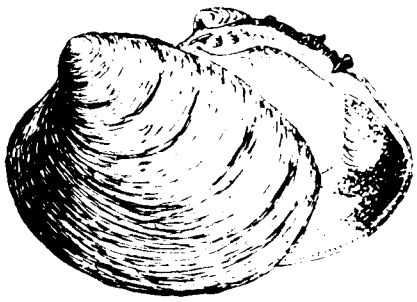
Family Sanguinolariidae

Genus Tagelus. Shell elongated with dorsal and ventral margins nearly parallel; umbo central, ligament posterior; shell may be thick or thin, depending on species (T. plebeius is the common large species in Virginia) and rounded at ends; color mostly white with brown; burrows in sand or mud to a depth of 3 feet; called "short razor clam"; shell about 4 inches long, 1 inch high.

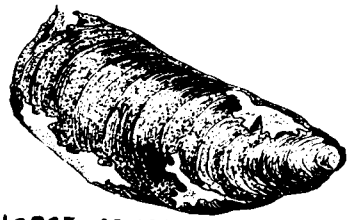
MOLLUSKS – PELECYPODS



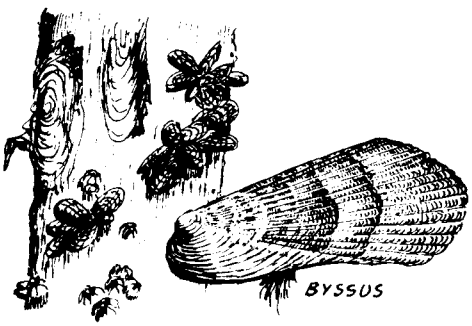
OYSTER : CRASSOSTREA



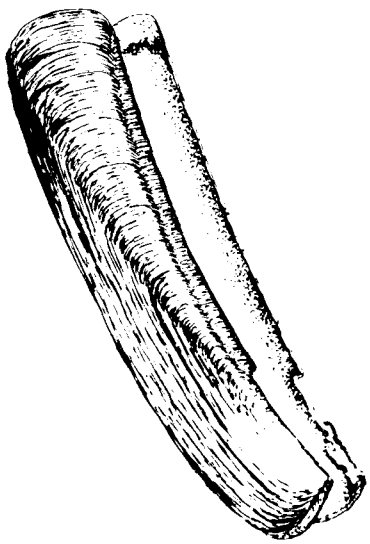
HARDSHELL CLAM : VENUS
(QUAHOG)



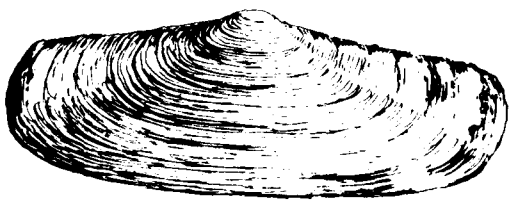
HORSE MUSSEL : MODIOLUS MODIOLUS



RIBBED MUSSEL : MODIOLUS DEMISSUS



RAZOR CLAM : ENSIS



SHORT RAZOR CLAM : TAGELUS

Family Solenidae

Genus Ensis. Common "razor clam" or "sword-razor clam"; shell very long and narrow; dorsally concave; umbo near anterior end; found in sand of shallow water; color yellowish or greenish; may reach 6-7 inches in length.

Family Myacidae

Genus Mya. Called "soft-shell clam" or "long-neck clam"; shell ovate to oblong, white; umbo near anterior end; found between tide lines, in mud flats and under stones; siphons bound together (form long "tongue"), only partly retractile; important as food although not as highly valued as Mercenaria.

Class Gastropoda (Plate 14)

Asymmetrical; shell usually spirally coiled; head distinct; foot broad, flat.

Order Mesogastropoda

Shell typically coiled; organs single rather than paired.

Family Naticidae (Moon Shells or Sand Collar Snails)

Genus Polinices. "Moon snail"; shell solid, globose, whorls 5, flattened above; color ashy-grey, tending to brown on the upper side, chestnut within; aperture round or lunar; foot very large and capable of being swollen and reflected over the shell to cover it, or nearly so; tentacles small, wide apart; found in tide pools. To find snail, locate path in sand and scoop under the mound at the end.

Family Littorinidae

Genus Littorina. "Periwinkles"; shell conical, thick, and solid, with 4 to 6 whorls; found on salt marsh grass (Spartina); foot longitudinally divided; color light, with reddish brown dots.

Order Neogastropoda

Shell well developed, usually with a siphonal canal; proboscis retractile; carnivorous species have a proboscis with a radula containing two or three large teeth in each row; nearly all have an operculum; all are marine.

Family Muricidae (The Rock Shells)

Genus Urosalpinx. "Oyster drill"; shell fusiform; surface with about 12 longitudinal, rounded ridges; brown or grey in color; aperture with short canal and sharp outer lip; about 6 convex whorls. Drills through shell of oysters and other clams and feeds on soft parts. An important oyster enemy in Virginia.

Genus Eupleura. "Oyster drill"; much like Urosalpinx but with much thicker outer lip and narrower canal; surface generally much rougher.

Family Nassariidae (Nassidae) (Dog Whelks or Mud Snails)

Genus Nassarius. "Mud snail"; foot square in front, generally bifurcate behind; shell conical, with 6 whorls, surface marked by numerous longitudinal and revolving creases; color brown or black; siphons prominent. Occurs in large colonies on mud flats in the intertidal zone.

In Chesapeake Bay, N. vibex, the mud snail, and N. obsoletus, the black mud snail, are often found in intertidal flats and Zostera beds. N. obsoletus shells have heavily eroded longitudinal furrows and epiphytic growth.

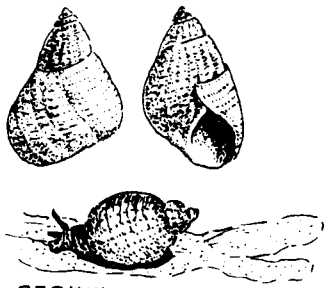
PHYLUM ECHINODERMATA (Plate 9C)

Skin spiny, resulting from skeleton of calcareous plates and spines; water vascular system for propulsion.

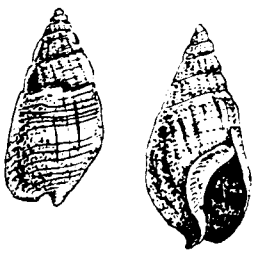
Class Asteroidea

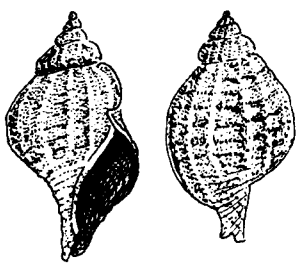
"Sea stars" or "starfish"; radii more or less elongated; oral surface ventral; some spines on surface

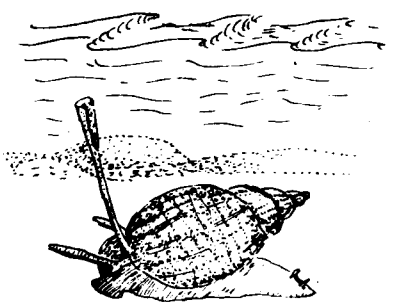
MOLLUSKS- GASTROPODS



MARSH PERIWINKLE:
LITTORINA

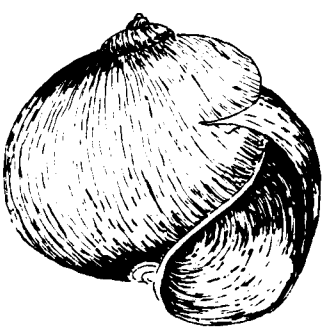




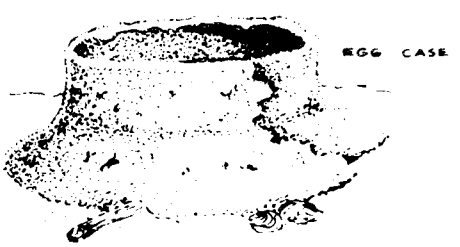


MUD SNAIL: NASSARIUS

OYSTER DRILL:
UROSALPINX



MOON SNAIL: POLINICES



movable (along edge of ambulacral groove); a red eyespot at tip of each arm; main axis (mouth to anux) is short.

Order Forcipulata

Family Asteriidae

Genus Asterias. "Starfish" or "sea star"; usually a small disc (dome) and 5 arms; aboral plates with reticulate arrangement and bearing spines; almost always 4 rows of tube feet per arm; found on bottom in shallow waters (particularly around clam and oyster beds), but mostly in deep water in Virginia, especially abundant at mouth of Bay.

Class Holothuroidea

Sea Cucumbers. Body elongated, usually cylindrical; oral surface not directed to ground but with main axis parallel to ground; calcareous plates minute, wall thus lacks rigidity; ambulacral appendages appear in variety of forms; oral tentacles present.

Order Apoda

Transparent (usually), elongated sea cucumbers without tubefeet; with 10 to 25 branched tentacles.

Family Synaptidae

Genus Leptosynapta. Holothurians without ambulacral feet; 10-25 feathered tentacles at anterior end; body long, worm-like, semi-transparent (internal organs visible); length 4-6 inches; common burrower in sandy bottoms.

Order Dendrochirota

Anterior end of body and arborescent tentacles can be drawn into body cavity.

Family Cucumariidae

Genus Thyone. Body ovate or elongate; tentacles 10; tubefeet scattered thickly over body; length to 5 inches; found in shallow water crawling on bottom; dull brown or olive to black.

Class Ophiuroidea

Body disc comparatively small, usually not more than 3/4 inch in diameter, while arms may be 3 inches long. Arms many jointed and only able to move sidewise.

Order Ophiurae

Family Amphiuridae

Disc furnished with clearly distinct scales or plates, and frequently with spines.

Genus Amphiodia. A. atra is the most common brittle star in the Chesapeake Bay area.

PHYLUM ECTOPROCTA (BRYOZOA)

Minute animals living mostly in large colonies on rocks, water plants and shells; form erect-branching or encrusting; composition calcareous, fleshy, or membranous; commonly referred to as "moss animals"; U-shaped digestive system consists of esophagus, stomach and intestine; mouth ring with ciliated tentacles (lophophore); anal opening located outside of lophophore.

Order Ctenostomata

Lacking calcification; outer wall chitinous or soft; may be encrusting or branched and plant-like.

Family Alcyonidiidae

Genus Alcyonidium. Fleshy, grey, gelatinous mass forming expanded, or erect and cylindrical, colony; irregularly branched; one species very abundant (A. verrilli) in this area; grows to height of 10-12 inches; surface smooth and glassy. Sometimes greenish or reddish because of algal epiphytes.

Family Vesiculariidae

Genus Amathia. Colony, about 2 inches in height; composed of erect, slender stems, repeatedly forking in different planes; color translucent-white.

Just below each fork there is a dark brown area on which is mounted a group of zooecia which are nearly cylindrical and somewhat curved; usually common on wharf-pilings and rocks in shallow water.

PHYLUM HEMICHORDATA (Plate 15)

Notochord consists of dorsal projections of anterior portions of digestive tract; body worm-like; unsegmented and soft in texture; composed of 3 portions: proboscis, collar, and trunk.

Class Enteropneusta

Family Harrimaniidae

Genus Saccoglossus. "Acorn worms"; elongated, worm-like hemichordates common on sand in shallow water. They leave a coiled mass of sand held together by mucus, which indicates the presence of a burrow; emits a disagreeable odor (somewhat like iodiform).

Sub-Phylum Urochordata (Tunicata)

Body of adult more or less cylindrical or globular and encased in a characteristic cuticular covering called the tunic.

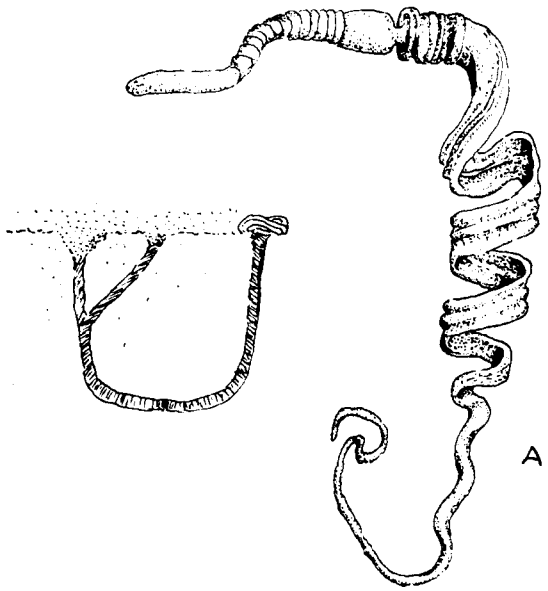
Class Ascidiacea

Order Solidobranchia

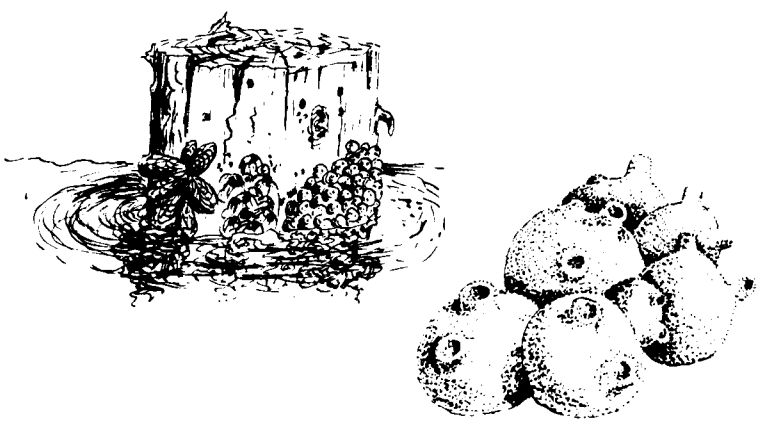
Family Molgulidae

Genus Molgula. "Sea squirts"; body globose or ovoid, in contraction laterally compressed; dull grey in color; may or may not be attached on pilings, eel grass, stones, etc.; often in large clusters; siphons retractile.

PRE - CHORDATES



A HEMICHORDATE: ACORN "WORM"
BALANOGLOSSUS



A TUNICATE: SEA SQUIRT
MOLGULA

AREAS WHERE COLLECTIONS WERE MADE

Locations

NORFOLK:	Lynnhaven Bay	Lh
	Chesapeake Beach	CB
	Fort Wool	FW
	Harrison's Pier (Ocean View)	HP
	Willoughby Spit	WS
	Lafayette River	LR
	Little Creek Jetty*	LCJ
CHURCHLAND:	Elizabeth River (Western Branch)	ER
	Respass Beach	RB
NANSEMOND COUNTY:	Nansemond River	NR
	Bennett's Creek	BC
GLOUCESTER COUNTY:	Virginia Institute of Marine Science, Gloucester Point	VIMS
EASTERN SHORE*:	Cedar Island	CI
CHESAPEAKE BAY TUNNEL*:	South Island	SI
VIRGINIA BEACH*:	Rudee Inlet	RI
YORK COUNTY:	King's Creek on York River	KC
	Yorktown	YT

Above listed locations were the only ones sampled. There are many other good collecting areas along Tidewater shores.

Types of Habitats

Below is a brief description of the major types of marine habitats found in the Tidewater area.

---

*1965. Brittingham and Cahoon.

1. SANDY BEACH: Open ocean beaches with areas of shifting sand caused by tidal currents and pounding surf. Protected beaches along bays and rivers. Extends from high water mark out as far as sand is moved by tidal and wave action. This distance may extend from a few feet to a mile or more. The following specific locations contain examples: Lh, CB, WS, VIMS, HP, KC.

2. MUD FLATS: Muddy shores along inner bays and estuaries. Animals not exposed to surf. Tidal currents often bring in much seaweed. Consistency of the mud may progress from thin and slimy through heavy sticky mud and sandy-mud up to a sandy beach. Animal life is most diverse in the sandy mud. The following are specific locations: Lh, LR, NR, BC, ER, RB, KC.

3. SALT MARSH: Located along flat tidal shores and are often flooded by high tides. Examples of this habitat may be found at Lh, BC, NR, RB, ER.

4. ARTIFICIAL SUBSTRATES: There are no natural rocky outcroppings along the Virginia coast, but such structures as artificial islands, breakwaters, and pilings supply a similar habitat which enables certain flora and fauna requiring a fixed substrate to establish themselves and flourish. Examples of this specific habitat occur at SI, FW, LCJ.

FIELD COLLECTIONS

Location	Phylum	Genus
Lynnhaven Bay salt marsh	Tracheophyta	Spartina (2 species)
		Juncus
		Ruppia
		Distichlis
	Arthropoda	Chthamalus
		Uca
		Ocypode
		Callinectes
		Pagurus
	Mollusca Gastropoda	Polynices
		Littorina
		Nassarius
	Pelecypoda	Mya
		Ensis
		Tagelus
		Crassostrea
		Modiolus
Lynnhaven Bay aquatic	Chlorophyta	Ulva
		Enteromorpha
		Cladophora
	Rhodophyta	Ceramium (2 species)
		Chondria
		Polysiphonia
		Gracilaria
		Agardhiella
		Dasya
	Coelenterata Hydroids	Sertularia
		Obelia
	Jellyfish	Aurelia
		Dactylometra

Location	Phylum	Genus
Lynnhaven Bay aquatic (cont.)	Coelenterata	
	Anemones	Aiptasiomorpha
		Diadumene
		Paranthus
	Ctenophora	Mnemiopsis
	Arthropoda	Balanus
		Callinectes
		Uca
		Pagurus
		Emerita
		Neopanope
	Mollusca	
	Gastropoda	Polynices
		Littorina
		Nassarius
	Pelecypoda	Venus
		Anomia
		Ensis
		Crassostrea
		Tagelus
		Mya
	Annelida	Glycera
		Diopatra
		Arenicola
	Chordata	
	Tunicata	Molgula
	Hemichordata	Saccoglossus
Chesapeake Beach*	Chlorophyta	Ulva
		Enteromorpha
		Cladophora
	Rhodophyta	Gelidium
		Agardhiella

*1965. Brittingham and Cahoon.

Location	Phylum	Genus
Chesapeake Beach (cont.)	Rhodophyta	Gracilaria Champia Polysiphonia Ceramium
	Phaeophyta	Fucus
Fort Wool	Chlorophyta	Enteromorpha Ulva Cladophora Monostroma Bryopsis
	Rhodophyta	Polysiphonia Ceramium (2 species) Callithamnion Grinnellia Agardhiella Gracilaria
Harrison's Pier	Chlorophyta	Enteromorpha Ulva Cladophora
	Phaeophyta	Fucus Ascophyllum
	Rhodophyta	Agardhiella Gracilaria Ceramium Callithamnion Gelidium
	Cyanophyta	Lyngbya Oscillatoria
	Tracheophyta	Zostera
	Ectoprocta	Alcyonidium Amathia
	Porifera	Haliclona Microciona

Location	Phylum	Genus
Harrison's Pier (cont.)	Ctenophora	Mnemiopsis
	Mollusca	
	Gastropoda	Polynices
	Pelecypoda	Venus
		Crassostrea
		Anomia
		Ensis
		Tagelus
		Mytilus
	Arthropoda	Balanus
		Ovalipes
		Callinectes
		Emerita
		Ocypode
	Coelenterata	
	Hydroids	Sertularia
		Obelia
		Pennaria
		Physalia
	Jellyfish	Aurelia
		Chrysaora
	Annelida	Glycera
		Nereis
	Hemichordata	Saccoglossus
	Chordata	
	Tunicata	Molgula
Willoughby Spit	Chlorophyta	Ulva
		Enteromorpha
		Cladophora
	Rhodophyta	Ceramium
		Porphora
		Grinnellia
		Gracilaria
		Agardhiella
		Hypnea

Location	Phylum	Genus
Willoughby Spit (cont.)	Cyanophyta	Oscillatoria Lyngbya
	Phaeophyta	Ascophyllum
	Porifera	Microciona Haliclona Halichondria
	Coelenterata Hydroid	Obelia
	Jellyfish	Physalia Aurelia Dactylometra
	Anemone	Diadumene
	Ctenophora	Mnemiopsis
	Annelida	Sabella Platynereis
	Arthropoda	Balanus Callinectes Neopanope Emerita Ocypode
	Mollusca Pelecypoda	Mercenaria Crassostrea Ensis Tagelus Anomia Mytilus
	Ectoprocta	Alcyonidium Amathia
	Chordata Tunicata	Molgula
Lafayette River salt marsh	Tracheophyta	Spartina Juncus Distichlis

Location	Phylum	Genus
Lafayette River salt marsh (cont.)	Cyanophyta	Spirulina Oscillatoria Lyngbya
	Chlorophyta	Enteromorpha
	Mollusca Pelecypoda	Crassostrea Modiolus
	Arthropoda	Uca Callinectes Balanus
Little Creek Jetty*	Chlorophyta	Enteromorpha Ulva Cladophora Bryopsis
	Rhodophyta	Agardhiella Gracilaria Ceramium Callithamnion Polysiphonia Champia Gelidium
	Phaeophyta	Fucus (floating)
Elizabeth River	Chlorophyta	Enteromorpha
	Cyanophyta	Oscillatoria
	Annelida	Scoloplos Nereis
	Mollusca Gastropoda	Littorina
	Pelecypoda	Mytilus

*1965. Brittingham and Cahoon.

Location	Phylum	Genus
Elizabeth River (cont.)	Mollusca Pelecypoda	Modiolus Crassostrea Mercenaria
	Coelenterata	Obelia
	Ctenophora	Mnemiopsis
	Arthropoda	Uca Callinectes
Respass Beach	Tracheophyta	Distichlis Juncus Spartina (2 species)
	Chlorophyta	Ulva Enteromorpha
	Coelenterata Jellyfish	Aurelia Chrysaora
	Arthropoda	Uca Balanus Callinectes
	Mollusca Gastropoda	Urosalpinx Littorina Polynices
	Pelecypoda	Modiolus Crassostrea Tagelus
Nansemond River and Bennett's Creek	Chlorophyta	Enteromorpha
	Cyanophyta	Oscillatoria
	Tracheophyta	Juncus Spartina Distichlis

Location	Phylum	Genus
Nansemond River and Bennett's Creek (cont.)	Coelenterata Hydroids	Obelia Pennaria
	Jellyfish	Aurelia Chrysaora
	Ctenophora	Mnemiopsis
	Arthropoda	Uca Balanus Callinectes
	Mollusca Gastropoda	Littorina Nassarius Urosalpinx
	Pelecypoda	Crassostrea Venus Modiolus
Gloucester Point (Virginia Institute of Marine Science)	Chlorophyta	Ulva Enteromorpha Cladophora
	Rhodophyta	Ceramium (2 species) Chondria Gracilaria Agardhiella Grinnellia Hypnea Gelidium Spyridia Polysiphonia
	Cyanophyta	Lyngbya Oscillatoria
	Coelenterata Hydroids	Sertularia Obelia Pennaria Diadumene

Location	Phylum	Genus
Gloucester Point (Virginia Institute of Marine Science) (cont.)	Coelenterata Jellyfish	Chrysaora Aurelia
	Anemone	Diadumene
	Coral	Leptogorgia
	Ctenophora	Mnemiopsis
	Porifera	Microciona Halichondria Haliclona
	Annelida	Enoplobranchus Scoloplos Glycera
	Arthropoda	Callinectes Balanus Libinia
	Mollusca Gastropoda	Urosalpinx
	Pelecypoda	Crassostrea Mercenaria Ensis Tagelus
	Chordata Tunicata	Molgula
	Ectoprocta	Alcyonidium Amathia
Cedar Island*	Tracheophyta	Spartina
	Chlorophyta	Ulva Cladophora Enteromorpha

*1965. Brittingham and Cahoon.

Location	Phylum	Genus
Cedar Island (cont.)	Rhodophyta	Grinnellia Hypnea Gracilaria Agardhiella Ceramium Callithamnion Champia Polysiphonia Lomentaria
	Phaeophyta	Fucus Dictyota
Chesapeake Bay Tunnel South Island*	Chlorophyta	Ulva Enteromorpha
	Rhodophyta	Polysiphonia Ceramium Callithamnion Agardhiella Gracilaria Champia
Rudee Inlet*	Chlorophyta	Ulva Enteromorpha
	Rhodophyta	Agardhiella Gracilaria Ceramium Callithamnion Polysiphonia

*1965. Brittingham and Cahoon.

GLOSSARY

A

aboral (ă bō'răl)	Top surface.
agar (ä gär)	The gel-forming ingredient in culture media obtained only from red algae.
ambulacral (ăm'bū lā krăl) groove	One of the radial grooves on the ventral surface of many echinoderms.
anastomose (ä năs'tō mōz)	To connect parts of any branching system with another.
annulated (ăn'ū lāt id)	Furnished with, or composed of, rings; ringed.
appressed (ă prĕst')	Pressed close to, or lying flat against something.
apex (ā peks)	The tip, point, or summit.
apical (āp'i kăl)	Near the tip.
arborescent (är'bō rĕs'ĕnt)	Resembling a tree.
auxiliary (ôg zil'ya ri) cells	Joint structure constituting the procarp.
axis (ăk'sis)	Any lengthwise central line, real or imaginary, around which parts of a body are symmetrically arranged.
axil (ăk'sil)	The angle between a branch or leaf and the axis from which it arises.

B

base	The bottom of anything.
beach drift	Collection of matter (living in this use) accumulating along tide lines.
bifurcate (bi'fer kāt)	Divided into two branches; forked.
bipectinate (bī'pĕk'ti nāt)	Double branched.

bladder	A membranous sac serving as a receptacle containing fluid or air.
blade	A leaf.
brackish water	A mixture of sea and fresh water.
bract (brăkt)	A leaf from the axil of which a flower or floral axis arises.
branchia (brăngkĭa)	A gill; gill-like organ.
buccal (bŭk'ăl)	Pertaining to the mouth.
byssus (bis'ŭs)	A tuft of filaments by which certain bivalves, as Anomia and mussels, fasten to rocks.

C

calcareous (kăl kâr ē' ŭs)	Consisting of or containing calcium carbonate.
carapace (kăr' ă pās)	A bony or horny case or shield covering the back of certain animals (turtles, lobsters, crabs, etc.)
cephalothorax (sĕf'ă lō thō'răks)	Head and thorax fused into one.
chelate (kē'lāt)	Pincer-like organ or claw-like appendage borne by certain crustaceans. (chela, cheliped)
chitin (kī'tĭn)	Horny substance forming the harder part of the outer integument of insects and crustaceans.
chloroplast (klō'rō' plăst)	Mass of green pigment in plant cells exposed to light for the production of chlorophyll.
chromatophore (krō'mă tō' fōr)	A plastid, containing pigment.
cirrus (sir us)	Slender appendage.
coalescent (kō'ă lĕs' ĕnt) branching	Many from one source.
coccoid (kŏk'soid)	Globe-like, grain-like.

coenocyte (sē'nŏ̄ sīt) — Organism composed of a number of united protoplasts forming a single large cell.

constriction (kŏn strĭk'shon) — Drawn together (less thick).

cormidium — Group of individuals of various forms budded from a common stalk.

coronal (kŏ̄ rō̄'năl) — Pertaining to a crown.

cortex (kôr'tĕks) — Outer layer of tissue.

corticated (kŏr'tĭ kāt ĕd) — Having outer layer of cortex cells (loose, thin walled, irregularly shaped cells).

cruciate (kroō-shĭăt) — Three intersecting walls with spores lying parallel.

crustose (krŭs'tōs) — Hard, solid (more or less) shell or crust.

culm (kŭlm) — Joint on the stem of grasses.

cyme (sīm) — Any form of inflorescence in which the main and secondary axes always terminate in a single flower.

cystocarp (sŷs'tŏ̄ kärp) — A sporocarp; a body which produces asexual spores.

D

dichotomous (dī kŏt'ŏ̄ mŭs) — Branching into two divisions; forked.

disciform (dĭs'ĭ fôrm) — Disk-shaped.

distromatic (dī'stro măt'ĭk) — Two layers of cells.

E

encrust (ĕn krŭst') — To surround; grow over one; encrustation.

enteron (ĕn'tĕr ŏn) — An inner canal or tube.

epiphyte (ĕp'y fīt) — A plant which grows on other plants but is not parasitic.

epistome (ĕp'ĭ stōm) — A projection above the mouth, as in some bryozoans.

ephithelium (ĕp'i thē'li ŭm) Membrane-like tissue covering a free surface.

F

fascicle (făs'i kl) A small bundle.
fauna (fâ'nă) Animals living within a given habitat.
fertile (fûr'tĭl) Capable of producing fruit.
filament (fĭl'ă mĕnt) Use in this paper--thread-like series of cells.
filiform (fĭl'i fôrm) Having the shape of a thread or filament.
flora (flō ră) Plants living within a given habitat.
foliaceous (fō li ā'shŭs) Leaf-like.
forcipate (fôr'si pāt) Pincer-like.
fusiform (fū'zi fôrm) Spindle-shaped; tapering at each end.

G

gametangium (găm'ē tăn'jĭŭm) Cell or organ in which gametes are produced.
glabrous (glā'brŭs) Smooth; having a surface without hairs or projections.
globous (glō'bŭs) Globular, spherical.
glomerule (glŏm ĕr ōōl) An inflorescence consisting of a compacted, or sessile, cyme.
gonad (gŏn'ăd) Reproductive organ.
gonotheca (gŏn'o thē'kă) A reproductive zooid of a hydroid colony.
gregarious (grē gâr i ŭs) Habitually living in a crowd or community; growing in clusters or colonies.

H

habitat (hăb'i tăt) The natural abode of a plant or an animal; particular location.

heterocyst (hĕt'ĕr ŏ sĭst') — One of the large transparent cells at intervals along the filament.

holdfast — Root-like outgrowth from base of organism for attachment.

hydranth (hī'drănth) — One of the nutritive zooids of a hydroid colony (hydrotheca).

hydroid (hī'droid) — Of or pertaining to a hydrozoan; resembling the hydra; polyp-like as distinguished from the medusa.

hypha (hī'fá) — Thread-like structure for attachment.

hypostome (hī'pŏ stōm) — A projection at the free end of the body of a hydroid polyp in which the mouth opens.

I

imbricate (ĭm'brĭ kāt) — Lying lapped over each other in regular order.

inequivalve (ĭn ē'kwĭ vălv') — Valves (shells) not equal in size.

inflorescence (ĭn'flŏ rĕs'ĕns) — General arrangement and disposition of the flowers on an axis; a flowering.

intercalary (ĭn tûr'ká lĕr'ĭ) — Situated some place between the apex and base.

internode (ĭn'tĕr nōd) — Space between nodes (joints).

intertidal — Area between high tide level and low tide level.

involute (ĭn'vo lūt) — Bot.-rolled inward at the margin or edges.
Zoo.-having the whorls closely coiled.

iridescent (ĭr'ĭ dĕs'ĕnt) — Exhibiting a rainbow play of colors.

L

lamellose (lá mĕl'ōs) — Thin gill plates joined into a common structure.

lanceolate (lăn'sē ō lāt)	Lance-shaped.
ligament (lĭg'ă mĕnt)	A tough band of tissue serving to connect two shells together.
lobed (lōbd)	Rounded projection.
lophophore (lō'fō fōr)	An organ (usually circular or horseshoe-shaped) surrounding the mouth and bearing tentacles.
luminescent (lū'mĭ nĕs ĕnt)	Exhibiting an emission of light.

M

mantle (măn t'l)	Fold or lobe of the body wall which contains shell secreting cells.
margin	Border; edge.
medullary (mĕd'ŭ lĕr'ĭ) cell	Centrally located cells.
medusa (ae) (mēdū'să)	Jellyfish.
megascleres (meg'a sklĕr)	Large spicules in sponge.
mesenchyme (mĕs'ĕng kim)	A mesoblastic tissue.
mesentery (mĕs'ĕn tĕri'i)	Membrane that envelopes internal viscera for anchorage to dorsal wall.
mesoglea (mĕs'ō glē'ă)	Layer of jelly-like material between outer and inner layer of cells in coelenterates.
midrib	Central vein of a leaf or thallus.
microscleres (mī krō sklēr)	Minute spicules in tissues of sponge.
monaxon (mŏn ăk'son)	Single axis; needle-like; developing inflorescence directly on the primary axis.
monosiphonous (mŏn'ō sī'fō nŏs)	Single filament of cells.
monostromatic (mŏn'ō strō măt'ĭk)	One layer of cells.
motile (mō tĭl)	Exhibiting motion.
mucin (mū'sĭn)	A substance originating from mucus membranes.
multinucleate (mŭl'tĭnū'klē āt)	Containing more than one nucleus per cell.

N

nematocysts (nĕm'ă tō sĭst)	Part of thread cells consisting of a bladder within which a long hollow thread lies coiled, through which poison may be injected into prey upon release.
node (nōd)	Joint in a stem or filament.
notochord (nō'tō kôrd)	A longitudinal elastic rod of cells which in lower vertebrates forms the supporting axis of the body.
notopodium (nō'tō pō'dĭ ŭm)	Dorsal portion of the parapodium of annelid worms.
nuchal (nū'kăl)	Pertaining to the back of the neck.

O

obtuse (ŏbtūs)	Blunt.
ocellus (i) (ō sĕl'ŭs)	Little eyes; simple; found in many invertebrates.
osculum (a) (ŏs'kū lŭm)	One of the excurrent orifices of a sponge.
ovate (ō'vāt)	Oval.
oxea (ŏk'sēă)	A needle-shaped sponge spicule sharp at both ends.

P

palp (pălp)	Segmented process attached to a mouth part, usually having a tactile or food-getting function.
panicle (păn'ĭ kl)	A compound racemose inflorescence; any pyramidal loosely branched flower cluster.
parapodium (păr'ă pō'dĭ ŭm)	A lobed appendage formed as a protuberance of the lateral body wall in some annelid worms.

parenchyma (pa reng'ki ma) Thin walled cells.

parietal (pa ri'etal) Situated toward the wall, away from the center.

pedalia (pe da'lia) Gelatinous basal expansions on the sub-umbrellar surface of some medusae, to which tentacles are attached.

peduncle (pe dung'k'l) A flower stalk.

pereiopod (pe ri'opod) Thoracic appendage of crustaceans, behind those associated with the mouth.

perisarc (per'i sark) Outer, usually horny, integument of a hydroid.

peristomial (per'i stomi al) Modified segment behind the mouth in some annelids, bearing tentacles and other sensory organs.

pinnate (pin'at) Feather-like arrangement of parts.

pistillate (pis'ti lat) Furnished with a pistil.

plankton (plangk'ton) Passively floating or weakly swimming animal and plant life of a body of water.

plastid (plas'tid) Small bodies of specialized protoplasm lying in the cytoplasm of some cells.

pleopod (ple'o pod) Appendage on the more anterior abdominal segments; swimmeret.

polyp (pol'i p) A hydra-like coelenterate.

proboscis (pro bos'is) Any of various tubular processes on the head of animals.

procarp (pro'karp) Complex female organ consisting of the carpogonium, one or more auxiliary cells, and other accessory cells.

proliferous (pro lif'er us) Cluster of branches; numerous.

prostomium (pro sto'mi um) Portion of the head situated in front of the mouth.

protoplast (pro to plast) The nucleus and cytoplasm exclusive of the cell wall.

pulvinate (pŭl vĭ nāt)	Cushion-shaped.
pyrenoid (pī rē'noid)	Small, colorless body occurring in a chloroplast, center of starch accumulation.

R

raceme (rā sēm)	A type of simple inflorescence in which the elongated axis bears flowers on short stems in succession toward the apex, as in the lily of the valley.
rachis (rā'kĭs)	Elongated axis of an inflorescence.
radius (i) (rā'dĭ ŭs)	Arm of an echinoderm; of a starfish.
ramellus (i) (răm ĕ'lŭs)	Minute or little branch.
receptacle (rē sĕp tă k'l)	That which serves for receiving something.
reticulate (rē tĭk'ū lāt)	Having veins or fibers crossing like a network.
rhizoidal (rī zoid'l)	Root-like structure, usually one-celled, occurring in lower forms of plant life.
rhizome (rī'zom)	An underground stem which usually produces roots below and sends up shoots progressively from the upper surface.
rhopalium (ro pā'lĭ ŭm)	A tentaculocyst; one of the marginal sensory bodies on the margin of the umbrella of many jellyfish.
rostrum (rŏs'trŭm)	An anterior beak-like projection of the cephalothorax in some crustaceans.

S

saline (sā'līn)	Consisting of or containing salt.

seaweed (sē'wēd) — Plant growing in the sea belonging to one of the phyla of macroscopic algae.

seriate (sēr'i at) — In series.

serrated (sĕr'āt ĕd) — Notched or toothed on the edge, like a saw.

sessile (sĕs'il) — Stationary; attached, not free-swimming.

seta (e) (sē'tá) — Slender bristly-like structure; a stiff hair, bristle appendage for some annelids.

sheath (shēth) — Secreted, gelatinous covering for blue-greens; the base of the leaf when sheathing a stem, as in grasses.

siphon (sī'fŏn) — Bot.-A filament of cells in "stem" of many algae, central siphon is a filament of cells in the center of the stem, while pericentral siphons are filaments of cells around the central siphon.
Zoo.-A pipe or tubular organ for drawing in or ejecting fluids.

spicule (spĭk'ul) — Minute, pointed body; calcareous or siliceous body which supports the tissues of sponges.

spikelet (spīk'lĕt) — A small spike; one of the small, few-flowered bracted spikes that make up the compound inflorescence of grasses and sedges.

spongin (spŭn'jin) — The horny substance which forms the supporting skeleton of bath sponges.

sporocarp (spō'ro kärp) — A body which produces asexual spores.

staminate (stăm'i nat) — Having or producing stamens.

sterile (stĕr'il) — Not fertile; incapable of reproduction.

stroma (strō'mȧ) — Layer of cells supporting the reproductive organs of certain algae and fungus.

stylet (stī'lĕt) — Bristle-like organ or appendage.

substrate (sŭb'strāt) — The substance or base on which an organism grows.

subtend (sŭb'tĕnd) — To enclose or embrace in its axil.

T

tentacle (tĕn'tȧ k'l) — Long, flexible process, usually tactile or prehensile, common to the coelenterates.

terete (tĕ rēt') — Cylindrical and tapering with circular cross-sections.

terminal (tûr mĭ năl) — Extreme end.

tetraspore (tĕt rȧ spōr) — One of the asexual non-motile spores commonly produced in groups of four.

thallus (thăl'ŭs) — Leaf-like structure in algae.

triangular (trī ăng'gū lĕr) — Simultaneous wall formation as 4 pyramidal spores meet in the center.

trichome (trī'kōm) — Filament of blue-green algae.

trophosome (trŏf'ō sōm) — The nutritive zooids of a hydroid.

tylostyles (tī'lō stīl) — A uniradiate pointed sponge spicule with a knob at the blunt end.

U

ultimate (ŭl'tĭ mĭt) — Farthest; extreme.

umbo (ŭm'bō) — The beak (raised part) of a bivalve shell above the hinge.

undulate (ŭn'dū lāt) — Having a wavy surface; ruffled.

uniseriate (ūnĭ'sēr'ĭ āt) — Single series.

uropod (ū'rō pŏd) — An abdominal limb of an arthropod, on either side of the telson, as in lobsters and shrimp.

W

whorled (hwûrld) — Zoo.-One of the volutions, or turns, on a univalve shell.
Bot.-A circle of similar parts about the same point on the axis.

Z

zonate (zōn'āt) — Arranged in a single row, as certain tetraspores.

zooecia (zō ē'shĭ ă) — Cells or tubes which inclose the feeding zooids of bryozoa.

zooid (zō'oid) — A more or less independent animal produced by fission, proliferation, or the like, and not by direct sexual methods.

zoospore (zō'ō spōr) — An asexual spore which is motile by flagella.

REFERENCES

Abbott, R. T. 1953. American seashells. D. Van Nostrand Co., Inc., New York. 541 pp.

Abbott, R. T. 1962. Sea shells of the world. Golden Press, New York. 160 pp.

Barnes, R. D. 1963. Invertebrate zoology. W. B. Saunders, Co., Philadelphia. 632 pp.

Berrill, N. J. 1956. The living tide. Fawcell Publ., Inc., New York. 238 pp.

Berrill, N. J. and J. Berrill. 1957. 1001 questions answered about the seashore. Dodd, Mead, New York. 305 pp.

Buchsbaum, R. and L. J. Milne. 1960. The lower animals; living invertebrates of the world. Doubleday, New York. 303 pp.

Carson, R. 1951. The sea around us. Oxford University Press, New York. 230 pp.

Carson, R. 1955. The edge of the sea. Houghton Mifflin Co., New York. 276 pp.

Coker, R. E. 1962. This great and wide sea: An introduction to oceanography and marine biology. Harper & Row, New York. 325 pp.

Dawson, E. Yale. 1956. How to know the seaweeds. W. C. Brown Co., Dubuque, Iowa. 198 pp.

Dawson, E. Yale. 1966. Marine botany: An introduction. Holt, Rinehart and Winston, New York. 371 pp.

Gleason, H. A. The new Britton and Brown illustrated flora of the Northeastern United States and adjacent Canada. The New York Botanical Gardens, 1952. 3 vol.

Griffith, R. E. 1961. Phytoplankton of Chesapeake Bay. Hood College Mon. 1, Contr. 172, Chesapeake Biol. Lab., Solomons, Md. 79 pp.

Guberlet, M. L. 1956. Seaweeds at ebb tide. University of Washington Press, Seattle, Washington. 182 pp.

Hardy, A. C. 1965. The open sea, its natural history. Houghton Mifflin Co., Boston. 335 + 322 pp.

Hillson, C. J. 1967. The preservation of marine algae for classroom use. Turtox News 45:16-18.

Hoyt, W. D. 1921. Marine algae of Beaufort, N. C. and adjacent regions. Bull. U. S. Bur. Fish. (1920) 36:367-556.

Humm, H. J. 1962. Key to the genera of marine blue-green algae of southeastern North America. Va. Inst. Mar. Sci., Spec. Sci. Rept. 28.

MacGinitie, C. E. and N. MacGinitie. 1949. Natural history of marine animals. McGraw-Hill, New York. 473 pp.

Miner, R. W. 1950. Field book of seashore life. G. P. Putnam's Sons, New York. 888 pp.

Morris, P. A. 1950. A field guide to the shells of the Atlantic and Gulf coasts. Houghton Mifflin Co., Boston. 236 pp.

Pratt, H. S. 1935. A manual of common invertebrate animals. The Blakiston Co., Philadelphia. 416 pp.

Ricketts, E. F. 1962. Between Pacific tides. Stanford University Press, Stanford, California. 516 pp.

Rogers, J. E. 1936. The shell book. C. T. Branford Co., Boston. 503 pp.

Russell, H. D. 1963. Notes on methods for the narcotization, killing, fixation, and preservation of marine organisms. Mar. Biol. Lab., Woods Hole, Massachusetts. 70 pp.

Smith, G. M. 1955. Cryptogamic botany. I. McGraw-Hill, New York. 546 pp.

Smith, R. I. 1964. Keys to marine invertebrates of the Woods Hole region. Mar. Biol. Lab., Woods Hole, Massachusetts. 208 pp.

Sverdrup, H. U., M. W. Johnson, and R. H. Flemming. 1942. The oceans, their physics, chemistry and general biology. Prentice-Hall, New York. 1087 pp.

Taylor, W. R. 1957. Marine algae of the northeastern coast of North America. Univ. Mich. Stud., Sci. Ser. 13:1-509.

Taylor, W. R. 1960. Marine algae of the eastern tropical and subtropical coasts of the Americas. Univ. Mich. Stud., Sci. Ser. 21:1-870.

Wass, M. L. 1965. Check list of the marine invertebrates of Virginia. Va. Inst. Mar. Sci., Spec. Sci. Rept. 24. 58 pp.

Yonge, C. M. 1963. The sea shore. Atheneum, New York. 350 pp.

Zaneveld, J. S. 1966. The marine algae of the American coast between Cape May, N. J., and Cape Hatteras, N. C. I. The Cyanophyta. Bot. Mar. 9:101-128.

Zaneveld, J. S. and W. D. Barnes. 1965. Reproductive periodicities of some benthic algae in lower Chesapeake Bay. Ches. Sci. 6:17-32.

Zim, H. S. and L. Ingle. 1955. Seashores. Golden Press, New York. 160 pp.