OCS Study
MMS 96-0044

Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and Western Santa Barbara Channel

FINAL REPORT
Volume 3 of 14

The Cnidaria

MMS U.S. Department of the Interior
Minerals Management Service
Pacific OCS Region

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Volume 3 of 14

The Cnidaria

Edited by:

James A. Blake
Paul H. Scott

Submitted by:

Science Applications International Corporation
10260 Campus Point Drive
San Diego, California 92121

For:

U.S. Department of the Interior
Minerals Management Service
Pacific OCS Region
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Camarillo, California 93010

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This report is not deemed nor intended to be a valid publication for the naming of new taxa as stipulated in the International Code of Zoological Nomenclature, Article 8b.

Project Organization

Program Manager

Dr. Andrew L. Lissner
Science Applications International Corporation
10260 Campus Point Drive
San Diego, California 92121

Deputy Program Manager

Dr. James A. Blake
ENSR, 89 Water Street
Woods Hole, Massachusetts 02543

Project Technical Officer

Mr. Frank J. Manago
U.S. Department of the Interior
Minerals Management Service, Pacific OCS Region
770 Paseo Camarillo
Camarillo, California 93010

Contributing Authors

Dr. Daphne Fautin
Dr. F. G. Hochberg
Mr. John Ljubenkov

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AFFILIATION: Science Applications International Corporation.

ADDRESS: 10260 Campus Point Drive, San Diego, California 92121.

PRINCIPAL INVESTIGATORS': James A. Blake, Andrew L. Lissner.

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BACKGROUND: The Taxonomic Atlas of the Santa Maria Basin and western Santa Barbara Channel is an extension of the benthic reconnaissance (Phase I) and monitoring programs (Phase II) that were conducted by the MMS since 1983. The organisms that were collected as part of those programs provide the material on which the Atlas is developed. In order to fully document the fauna collected by those programs, a series of 14 volumes will be prepared that provide keys, descriptions, and illustrations of the benthic fauna of the hard and soft substrate environments. A team of 40 experts on the fauna has been assembled to carry out this work and their contributions are distributed among the 14 volumes.

OBJECTIVES: The objectives of Volume 3 are to describe the Cnidaria that occur in the Santa Maria Basin and Western Santa Barbara Channel. Three chapters covering the Hyrozoa, the Octocorallia (Anthozoa), and three order of anemones (Anthozoa).

DESCRIPTION: Volume 3 treats the species comprising the Phylum Cnidaria. This phylum includes the hydroids, octocorallians, and so-called sea anemones. The text is organized into 3 chapters chapters: Hydrozoa; Anthozoa, Subclass Octocorallina; and Anthozoa, the Orders Actinaria, Ceriantharia, and Zoanthinaria. These chapters are organized into sections that include the morphology, taxonomic history, biology, keys of species, and descriptions of genera and species. Each species is fully illustrated, often with relevant characteristics labeled and identified.

SIGNIFICANT CONCLUSIONS: The keys, detailed descriptions, and illustrations to the various hyrdoids, octocorals, and anemones presented here represent an important contribution to understanding the distribution of cnidarians in the offshore waters of California. Many poorly known species are newly defined with new illustrations.

STUDY RESULTS: The fauna of the Santa Maria Basin and western Santa Barbara Channel is evaluated from samples that were taken from depths of about 50 to 1,000 m. Organisms were collected from soft sediments using box cores and from rocks using manipulator arms of submersibles and remotely operated vehicles. The collections are organized into sets of vouchers from Phase I and II that have been made available to the team of investigators. Additional material from the bulk collections now archived with the Natural History Museum of Los Angeles County is also being examined. The total number of species treated in the entire Taxonomic Atlas (14 volumes) may exceed 1,000 species.

Volume 3, representing the Phylum Cnidaria includes the hydroids, octocorals, and 3 orders of anemonies: Actinaria, Ceriantharia, and Zoanhinaria. A total of 40 genera and 49 species are included. None are new to science, several of the anemones are likely new species, but are poorly represented in the collections. Numerous species are redescribed and illustrated.

Among the Hydrozoa, 24 species and 17 genera are treated. Each species is illustrated and keys are presented to all genera and species included. Where available, a discussion of relevant biology in included for each species. The 12 species of octocorals are newly illustrated and described, providing readers with a useful guide to assist in their identification. Most of the anemones belong to the Order Actinaria and include many of the common sea anemones found in offshore waters. In contrast, the available specimens of the Order Ceriantharia were mostly too small to be identified and the Order was not adequately treated. Only a single species of Zoanthinaria was found in the collections.

STUDY PRODUCT: Blake, J.A. and P.H. Scott (Editors). 1996. Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and Western Santa Barbara Channel. Volume 3. The Cnidaria. A final report prepared by Science Applications International Corporation, for the U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region, Camarillo, CA. OCS Study MMS 96-0044. Contract No. 14-35-0001-30484.

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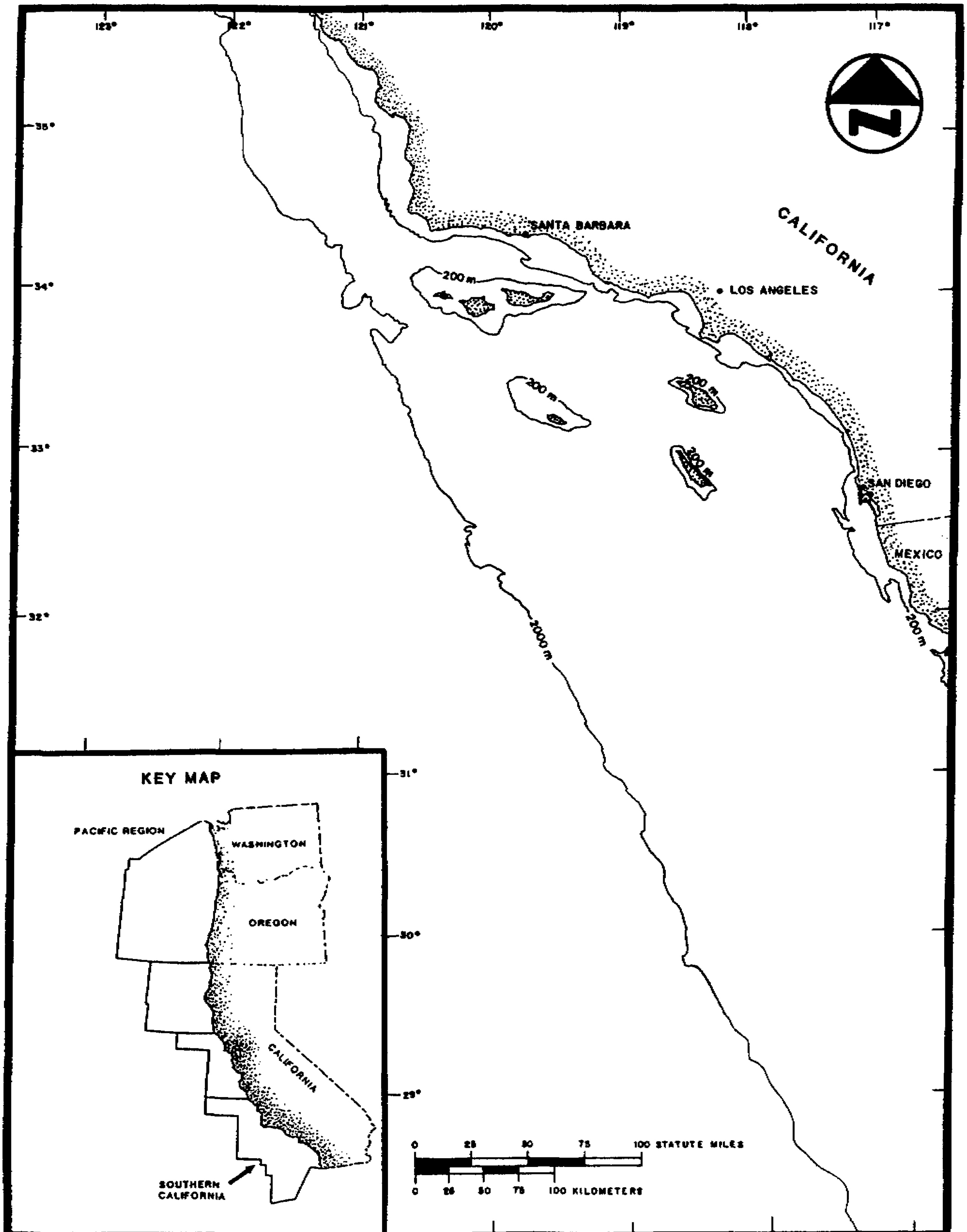
*P.I's affiliation may be different than that listed for Project Manager(s).



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Contributing authors: Dr. Daphne Fautin, Dr. F. G. Hochberg, Mr. John Ljubenkov.

16. Abstract (Limit: 200 words)

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Marine invertebrates, Cnidaria, Hydrozoa, Anthozoa, Octocorallia, Stolonifera, Pennatulacea, Actinaria, Ceriantharia, Zoanthinaria, taxonomy, California, Santa Maria Basin, Santa Barbara Channel, continental shelf.

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List of Acronyms

AHF	Allan Hancock Foundation, University of Southern California, Los Angeles, California.
BLM	Bureau of Land Management.
BRA	Refers to a station designation from the MMS Phase I Reconnaissance: Benthic Rocky, transect A/B.
BRC	Refers to a station designation from the MMS Phase I Reconnaissance: Benthic Rocky, transect C/D.
CAS	California Academy of Sciences, Department of Invertebrate Zoology, San Francisco, California, USA.
LACM	Natural History Museum of Los Angeles County, Los Angeles, California, USA.
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA.
MEC	Marine Ecological Consultants, Carlsbad, California.
MMS	Minerals Management Service.
MNHNT	Museum of Natural History Society, Newcastle-upon-Tyne, England.
MSUI	Museum of the State University, Iowa.
OCSD	Orange County Sanitation District, California.
RCBM	Royal British Columbia Museum, Victoria, British Columbia, Canada.
SCAMIT	Southern California Association of Marine Invertebrate Taxonomists.
SBMNH	Santa Barbara Museum of Natural History, Santa Barbara, California, USA.
SDNHM	San Diego Natural History Museum, San Diego, California, USA.
SMNH	Swedish Museum of Natural History, Stockholm, Sweden.
USNM	United States National Museum. A historical designation for the National Museum of Natural History (NMNH), Smithsonian Institution, Washington, D.C., USA.

1. Class Hydrozoa

by

F. G. Hochberg[1] and John Ljubenkov[2]

Introduction

The Class Hydrozoa contains a large number of species, the majority of which measure less than an few centimeters in height. Alteration of generations occurs in most genera. In classic life cycles this involves an asexual benthic polypoid stage alternating with a sexual planktonic medusoid stage. One or the other generation may be suppressed or lacking. The polyp stages treated here are typically the dominant stages in the life cycle. Hydroid polyps are usually colonial and often polymorphic. Over 2,500 species have been described, the majority of which are marine. The class is divided into seven suborders of which only two are treated here. Benthic siphonophores (e.g., *Dromalia*) and stylasterine hydrocorals (e.g., *Allopora*) occur in the depth range of the study area, but they have not been collected.

Hydroids occur at all depths, but are most common in the littoral or shallow subtidal zones. The deep-water fauna off California is less diverse and more poorly understood than adjacent shallow-water faunas.

Our knowledge of the systematics of hydroids of the eastern pacific is in need of revision. In many cases the two stages in the life cycle have been studied and described by separate authorities which has resulted in a morass of conflicting names for what are different life history morphs of the same species. Monographic reevaluations of hydroids in Europe by Cornelius, Vervoort and others; in the Western North Atlantic by Calder; and in the Western North Pacific by Naumov and others have resulted in a number of recent changes in the definition of families and genera, and clarification of species names. New collection and examination of live material is essential in such revisionary work.

The treatment in this Atlas is taken principally from the works of Fraser (see literature cited; see also Schmitt, 1948). Many of his names refer to European species which will eventually need to be reevaluated. A number of Fraser's species appear to be identical to those described by Nutting and need to be critically reevaluated by a study of types and other identified material in museum collections. Much of material studied or identified by Fraser does not appear to be extant. The specimens and types which document Fraser's 1948 paper were transferred from the Allan Hancock Foundation at the University of Southern California to the Santa Barbara Museum of Natural History and are now available for study.

[1] Department of Invertebrate Zoology, Santa Barbara Museum of Natural History, 2559 Puesta del Sol Road, Santa Barbara, CA 93105-2936 USA
[2] MEC Analytical Corp., 2433 Impala Drive, Carlsbad, CA 92009 USA

Glossary of Morphological Terms

Abcauline. Off, from or away from the stem; used in reference to the side of a hydrotheca.

Aboral. Pertaining to the region away from or most distant from the mouth.

Adcauline. Next to or toward the stem; used in reference to the side of a hydrotheca.

Adnate. Congenitally joined together; said of unlike parts (*e.g.*, one side of hydrotheca growing attached to stem).

Alternate. A branching pattern in which the branchlets of a hydroid colony come off the stem at alternate levels. Pattern of branching may be regular or irregular.

Anchor Filaments. Filaments at base of stem of solitary polyps (*e.g., Corymorpha*) which serve as a holdfast to anchor polyp in soft substrates (also termed frustules).

Annulated. Possessing a ringed appearance; usually refers to the series of rings on the pedicel at the base of the hydrotheca or adjacent to the attachment with the stem.

Athecate. Hydroids which lack a protective, chitinous covering or hydrotheca around the hydranth; also used to refer to internodes in some hydroids that lock hydrotheca (opposite of thecate).

Blastostyle. Modified zooid (gonozooid) from which medusoids are budded; axial portion of a gonangium; may be surrounded by a protecting theca (gonotheca or gonangium).

Calycine. Location in relation to the hydrotheca (*e.g.*, subcalycine, below the hydrotheca; supracalycine, above the hydrotheca).

Capitate. Knobbed at the tip, as in tentacle; distinct terminal knob studded with nematocysts.

Cauline. Having or growing on a stem (e.g., abcauline, adjacent to the stem; adcauline, away from the stem).

Cnidae. Intracellular "stinging capsules" that are used in offense and defense (also termed nematocysts).

Cnidome. The collective types of cnidae possessed by a cnidarian or a part thereof.

Coenosarc. The cellular and intercellular substance of a zooid or whole colony.

Colony. Genetically identical individuals formed by asexual reproduction that live as a group of individuals or zooids physically connected by a common stem or stolon.

Dactylozooid. A small mouthless zooid armed with nematocysts, specialized for protective functions; tentacles and gastrovascular cavity lacking.

Diaphragm. A transverse, perforated partition or thin shelf located at the base of the hydrotheca; forms a support for the hydranth.

Distal. Toward the oral region or tip of a branch, away from the base or stem.

Fascicled. A bundle or association of two or more stems; varying degrees of intimacy, either in loose contact or tightly associated, with few or many cross communication (also termed polysiphonic).

Filiform. Long, threadlike tentacle over which the nematocysts are evenly distributed; tapering gradually but slightly from base to tip.

Frustules. see anchor filaments.

Gastrozooid. Hydroid polyp specialized for feeding; hydranth.

Gonangium. Asexual reproductive polyp in certain hydrozoans; consists of an axial blastostyle and surrounding gonotheca.

Gonophore. The reproductive structures on a hydrozoan colony which 1) gives rise directly to the sexual products (gametes); or 2) gives rise to an attached or free medusa which in turn releases gametes; or 3) the sexual medusa itself.

Gonosome. All specialized generative zooids of a colony and associated perisarcal structures which which are directly involved with sexual reproduction (*i.e.*, produce medusae or gametes).

Gonotheca. The peridermal cup- or vaselike structure surrounding the reproductive polyp or blastostyle of thecate hydroids.

Gonozooid. Hydrozoan zooid specialized for sexual reproduction.

Hydranth. The feeding polyp consisting of the body, hypostome, mouth and tentacles, but not including the hydrotheca or pedicel.

Hydrocaulus. Branched, upright, axis connecting and supporting the polyps of an erect hydrozoan colony; or the single pedicel in solitary forms (also termed stem).

Hydrocladium. Lateral branch(es) growing from hydrocaulus.

Hydrorhiza. Branched, rootlike structure attaching colony to the substrate (also termed stolon).

Hydrotheca. The chitinous, peridermal, cuplike structure surrounding and protecting the feeding polyp of most thecate hydroids; hydranth may be completely drawn in when disturbed (also termed theca).

Hypostome. Conical raised area surrounding the oral region in some hydrozoans; bearing the tentacles (also termed manubrium, proboscis).

Internode. That portion of the stem or branch between noticeable joints or nodes; characteristic of the Plumulariidae.

Manubrium. A tubular structure bearing the mouth at its free end (see also hypostome).

Margin. Edge of hydrotheca aperature; also termed rim.

Medusoid. Medusa stage which is sessile or remains attached to the colony.

Mesial. In, near or toward the middle.

Monosiphonic. Simple, not fascicled or polysiphonic; in reference to the stem.

Nematocyst. A type of cnida.

Nematophore. The small, highly modified zooid containing nematocysts which are used for protective function; characteristic of the Family Plumulariidae.

Nematotheca. The chitinous, peridermal, cuplike structure surrounding the nematophores or nematocyst containing defensive polyps of thecate hydroids.

Nematozooid. Zooid specialized for defense; bears dense concentration of nematocysts (see dactylozooid).

Operculum. Chitinous flap or lid of one or more segments that closes the aperture of the hydrotheca or gonotheca when the polyp is retracted.

Opposite. In reference to a branching pattern in which the branchlets of a hydroid colony come off the stem at the same level (compare with alternate).

Oral. Adjacent to the mouth, as in tentacles.

Pedicle. A small stalk or stalklike support that bears the hydrotheca.

Peduncle. In hydromedusae, the cone of jelly which hangs down into the subumbrellar cavity and on which the manubrium and stomach are situated.

Pellicle. Thin, translucent covering the stalk of some athecate hydroids.

Periderm. see perisarc.

Perisarc. Thin, chitinous, noncellular, nonliving protective covering surrounding the stolons and upright branched portions of some hydrozoan colonies; secreted by ectodermal cells of the coenosarc.

Phylactogonium. Protective branch or leaf of hydroid colony surrounding the gonangia; containing nematophores.

Planula. Ciliated free-swimming larval stage with a solid, cylindrical body.

Polymorphism. Polyps modified to perform specific functions - for example, feeding gastrozooids, reproductive gonozooids, and defensive dactylozooids.

Polyp. see zooid.

Polysiphonic. see fascicled.

Proximal. Toward base or stem, away from oral region or tip of branch.

Pseudohydrotheca. False theca which partially surrounds hydranth in some athecate hydroids.

Radial canal. In medusae, the canals extending from the stomach to the ring canal.

Ring canal. In medusae, the canal extending around the margin of the bell.

Sessile. Hydrotheca or other structures attached directly to stem or branch of a colony; lacking a pedicel.

Solitary. Individual polyps not physically attached to others.

Sporosac. Reduced gonophore that does not develop into a free medusa, but remains attached and produces gametes.

Stem. see hydrocaulus.

Stolon. see hydrorhiza.

Subcalycine. Situated below a hydrotheca.

Supracalycine. Situated above a hydrotheca.

Tentacle. Long, unsegmented, cylindrical protruberance from the oral region of the polyp; used for food gathering (see modifiers: capitate, filiform, moniliform; aboral, oral; primary, secondary).

Theca. see hydrotheca.

Thecate. Hydroids with a chitinous (perisarcal) covering surrounding the hydranth. Opposite of athecate.

Trophosome. All specialized portions of a hydroid colony or zooid and associated perisarcal structures which are directly involved with feeding and defense; structures not directly involved with sexual reproduction (see gonosome).

Tubular. Sides parallel or nearly so; used to describe a hydrotheca.

Whorl. Tentacles arranged in a circle on the circumference of the hydranth.

Zooid. The individual member of a colonial organism; may be nutritive, generative, defensive, sensory or a combination of the above (also termed polyp).

Abbreviations Used in the Figures

ab, adaxial nematocyst bulb
ac, acrocyst
ad, axial canal
af, anchor filaments
ar, annular rings (annulation)
at, aboral tentacle
bp, bifurcate phylactogonium
bs, bivalve shell
c, chevron (=oblique internode)
da, dactylozooid
di, diaphragm
ec, endodermal canal
ga, gastrozooid
go, gonozooid
gp, gonophore
gt, gonotheca
hr, hydrorhiza
hs, hypostome
ht, hydrotheca (in, internode) (n,node)
hy, hydrocaulus
m, manubrium
np, nematophore
nt, nematotheca
op, operculum
ot, oral tentacle
pb, pedicel branch (first)
pd, pedicel
pr, perisarc
pt, primary tentacle
rc, radial canal
s, stolon
st, secondary tentacle
tb, terminal bulb
te, tentacle

List of Species

Order Hydroida

Suborder Anthomedusae [= Athecata, Gymnoblastea]

Family Bougainvilliidae Lutken, 1850
Rhizorhagium formosum (Fewkes, 1889)
Perigonimus repens (Wright, 1858)

Family Corymorphidae Altman, 1872
Corymorpha palma Torrey, 1902
Euphysa sp. A
Euphysora bigelowi Maas, 1905

Family Monobrachiidae Mereschkowsky, 1877
Monobrachium parasitum Mereschkowsky, 1877

Suborder Leptomedusae [= Thecata, Calyptoblastea]

Family Campanulariidae Johnston, 1836
Clytia denticulata (Clark, 1876)
Laomedea altitheca (Fraser, 1948)

Family Campanulinidae Hincks, 1868
Calycella syringa (Linnaeus, 1767)
Oplorhiza gracilis (Stechow, 1921)

Family Lafoeidae A. Agassiz, 1865
Acryptolaria pulchella (Allman, 1888)

Family Lovenellidae
Lovenella producta (G.O. Sars, 1873)

Family Aglaopheniidae
Cladocarpus gracilis Fraser, 1948
Cladocarpus vancouverensis Fraser, 1914

Family Plumulariidae L. Agassiz, 1862
Plumularia corrugata Nutting, 1900
Plumularia exilis Fraser, 1948

Family Sertulariidae Lamouroux, 1812
Abietinaria amphora Nutting, 1904
Abietinaria pacifica Stechow, 1923
Abietinaria traski (Torrey, 1902)
Abietinaria variabilis (Clark, 1876)
Dynamena pumila (Linneus, 1758)

Family Thyroscyphidae Stechow, 1920
Symplectoscyphus pedrensis (Torrey, 1904)
Symplectoscyphus tricuspidata (Alder, 1856)
Symplectoscyphus turgidus (Trask, 1857)

Key to Families of Attached Polypoid Stages

1A. Hydranths unprotected by hydrothecae or pseudotheca; gonophores unprotected by gonangia .... Suborder Anthomedusae 2

1B. Hydranths protected by hydrothecae; gonophores protected by gonangia or similar structures .... Suborder Leptomedusae 4

2A. Hydranths with a single filiform tentacle .... Monobrachiidae

2B. Hydranths with numerous filiform tentacles; typically in 1 or 2 whorls 3

3A. Hydranths with single basal (aboral) whorl of tentacles .... Bouganvilliidae

3B. Hydranths with 2 whorls (oral and aboral) of tentacles .... Corymorphidae

4A. Hydrotheca free from stem or branches (may be adnate in some Lafoeidae)................................ 5

4B. Hydrotheca sessile and more or less adnate to stem or branches 7

5A. Hydrotheca without operculum 6

5B. Hydrotheca with operculum and with diaphragm .... Campanulinidae

6A. Hydrotheca tubular, with or without diaphragm .... Lafoeidae

6B. Hydrotheca campanulate, with diaphragm .... Campanulariidae

7A. Nematophores present on stem or branches or both; hydrotheca without operculum 8

7B. Nematophore absent; hydrotheca with operculum 9

8A. Gonophores without protection .... Plumulariidae

8B. Gonophores protected by phylactogonia or corbulae .... Aglaopheniidae

9A. Hydrotheca margin entire (smooth), operculum with 1 or 2 valves; gonophores smooth or with longitudinal ridges .... Sertulariidae

9B. Hydrotheca margin with 3 teeth; operculum with more than 2 valves ....Thyroscyphidae

Description of Species

Family Bougainvilliidae Lutken, 1850

Diagnosis. Perisarc well developed; hydrants with single basal whorl of filiform tentacles and conical proboscis. Gonophores producing sporosacs or free medusae.

Key to Species of Bougainvilliidae

1A. Gonophores producing sporosacs; sporosacs not permanently surrounded by perisarc .... *Rhizorhagium formosum*

1B. Gonophores producing free medusae; medusae with tentacles arranged singly ..... *Perigonimus repens*

Genus *Rhizorhagium* Sars, 1874

Diagnosis. Colony branched or unbranched. Hydranths fusiform; perisarc extends up around hydranth as thin pseudohydrotheca. Gonophores fixed sporosacs; borne on distinct branch-like pedicels. Sporosacs initially enclosed in thin perisarc; bursts in later stages and then confined to pedicels.

Remarks. The hypstomes of bougainvilliid hydranths generally are conical with a single, regular (or irregular) circlet of tentacles. The polyps of *Rhizorhagium* are very similar to the polyps of *Perigonimus* but the latter have a more distinct pseudohydrothecal structure and the perisarc does not appear silty.

***Rhizorhagium formosum* (Fewkes, 1889)**

Figure 1.1

Perigonimus formosus Fewkes, 1889: 6.

Bimeria formosa: Torrey, 1902: 8.

Garveia formosa: Fraser, 1911: 23; 1937: 35, pl. 5(figs. 20a-d); 1948: 195.

Rhizorhagium formosum: Cairns *et al.*, 1991: 14

Material Examined. California: Santa Maria Basin, off Pt. Buchon, 35°05.8'N, 120°49.2'W, 91 m; coll. Battelle, M/V *Aloha*, cruise 1-1, Sta. R-1(rep 3), October 1986 (SBMNH).

Additional material examined:— OCSD 8609, Sta. CON (rep 4), 57 m, 21 Apr 1986.— OCSD 8503, Sta. 0 (rep 4), 57 m , 23 Oct 1985.

Description. Trophosome: Stolons grow in cracks and sutures of gastropod shells and other suitable hard substrates; occasional branching, but without obvious reticulated structure. Individual zooids arise separately on pedicels; height variable, up to 4 mm. Perisarc smooth or wrinkled; with texture produced by incorporation of very fine silty material; terminates above level of tentacles and basal to hypostome. Hydranth with 10-16 tentacles in single whorl.

Gonosome: Gonophores arise singly from stolon; borne on short pedicels. Perisarc thick in early stages.

Nematocysts: Not described.

Type Locality and Type Specimens. Not searched. Off the coast of California.

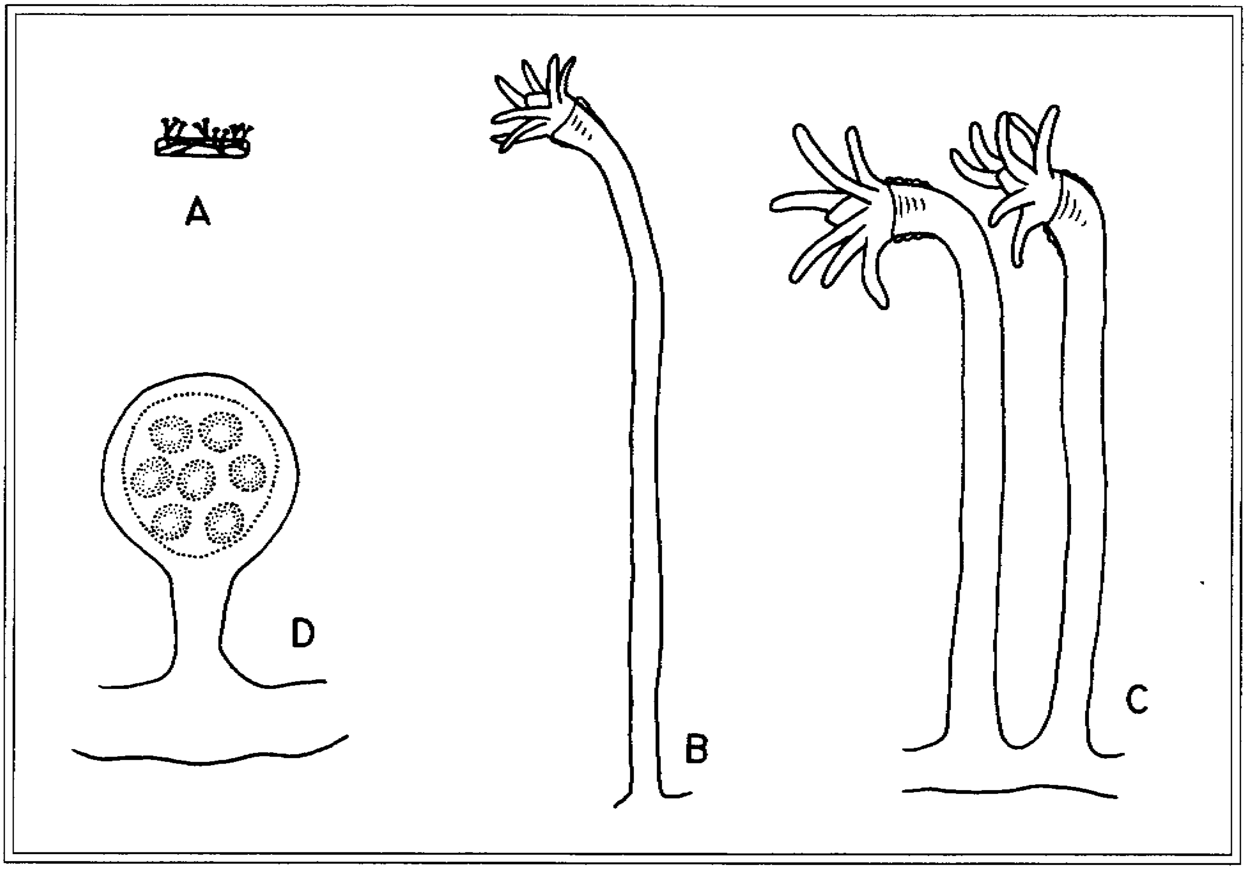

Figure 1.1. *Rhizorhagium formosum* (Fewkes, 1889): A. entire colony on gastropod shell, natural size; B-C. zooids; D. gonophore (after Fraser, 1937).

Distribution. Eastern North Pacific Ocean, recorded from San Francisco Bay, California to Natividad Island, Baja California, Mexico. Depth range, 10-550 m.

Biology. The biology of this species has not been elucidated.

Genus *Perigonimus* M. Sars, 1846

Diagnosis. Colonies stolonal on shells of bivalves; with monosiphonic or polysiphonic hydrocaulus. Perisarc soft, forming a pseudohydrotheca. Hydranth with single distal whorl of filiform tentacles; hypostome conical. Gonophores free medusae, arising singly or in clusters from hydrorhiza, hydrocaulus or hydrocladia. Medusae with short manubrium; oral tentacles 1 per radial canal, usually branched. Radial canals 4; ring canal present. Marginal tentacles all alike in structure, arising in clusters from 4 tentacle bulbs. Ocelli usually present. Gonads on manubrium. Medusa buds occasionally produced.

Remarks. There is considerable confusion with regards to the status of *Perigonimus*. The genus was reviewed by Rees (1956). The medusa stage needs to be recovered in order for the identification of the genus and species to be clarified.

Perigonimus repens (Wright, 1858)

Figure 1.2

Eudendrium pusillum Wright, 1857: 231; 1858: 448.

Atractylis repens Wright, 1858: 450.

Perigonimus repens: Allman, 1864: 365.—Calkins, 1899: 339.—Torrey, 1902: 29-30.—Fraser, 1911: 24; 1913: 150; 1914: 120; 1936: 123; 1937: 38, pl. 6(figs. a-d); 1938a: 17; 1938c: 131; 1948: 195.—McCormick, 1965: 141-144.—Lees, 1986: 105-106.

Material Examined. California: Santa Maria Basin, off Pt. Sal, Sta. BSS-40, colony on *Saxicavella pacifica*, (USNM); off Pt. Conception, colony on *Nuculana leonina*, Sta. BSS-78 (SBMNH); off Pt. Sal, colony on snail, 123 m; cruise 1-1, Sta. PJ-7, (rep 1), Box Corer, October 1986; (SBMNH).

Additional material examined: OCSD Voucher: colony on *Nassarius perpinguis*, Survey 8948, Sta. C-2 (rep 2), 55 m, 22 Jul 1989, MEC A106. CSA Voucher: colony on *Bittium* sp., panel 1, survey 2, Sta. 1-2 (rep B), 250 ft [76 m], 7 Dec 1986, MEC A69; colony on *Nassarius perpinguis*, OCSD Survey 8718, Sta. C-2 (rep 3), 56 m, 12 Jan 1987, OCSD Survey 8948, Sta. C-2 (rep 2), 55 m, 22 Jul 1989; OCSD Survey 8948, Sta. 5 (rep 2), 60 m, 22 Jul 1989.

Description. Trophosome: Colonies typically grow on shells of gastropods and ostracods. Individual polyps arise directly from reticulated stolon which grows in grooves and sutures of shell substrate. Polyps single, simple, occasionally branched to produce 2 polyps; with thin, clear pseudohydrotheca; maximum height from 1.5-2 mm. Perisarc typically with same diameter throughout but with occasional irregularities or constrictions; appears silty. Hydranths with about 10 tentacles; tentacle bases scattered, mainly falling in one cycle.

Gonosome: Gonophores stalked; shape roughly spherical; arise singly or in pairs, arise either directly from hydrorhiza or from lower parts of stem. Perisarc clear.

Medusae: Free; with two well developed and 2 rudimentary tentacles.

Nematocysts: Not described.

Type Locality and Type Specimens. Not searched; possibly not extant. Not traced.

Distribution. Eastern North Pacific Ocean, Admiralty Islands, Alaska to Santa Elena Bay, Ecuador and the Galapagos Islands. Depth range, 18-105 m. Also recorded from the Western North Atlantic Ocean, Great Britain.

Biology. Off southern California this species is the main hydrozoan epibiont on: 1) gastropod mollusks (*Bittium quadrifilatum, Colus halli, Nassa mendica, Nassarius fossatus, N. perpinguis, Turbonilla* spp.); 2) bivalve mollusks (*Acila casternsis, Nuculana leonina, Saxicavella pacifica*) and 3) ostracods. Colonies first appear near the apex of the shell and eventually grow to cover the entire shell. Medusae are ready for liberation in March.

In southern California the greatest densities are found at about 90 m on the shelf edge where *Nassarius perpinguis* is the prefered substrate. McCormick (1965) reported the presence of *Perignimus repens* on 74% of the shells of the bivalve, *Acila casternsis*, collected off Oregon.

Remarks. Fraser (1937) reported only two species in this genus *Perigonimus* on the west coast, namely *P. repens* and *P. serpens* both Allman, 1863. We suspect they should be synonymized in the future as the morphological differences are very slight. However, these species are both from the Eastern North Atlantic and perhaps more thought should be give to a critical redescription of the form from the Eastern North Pacific.

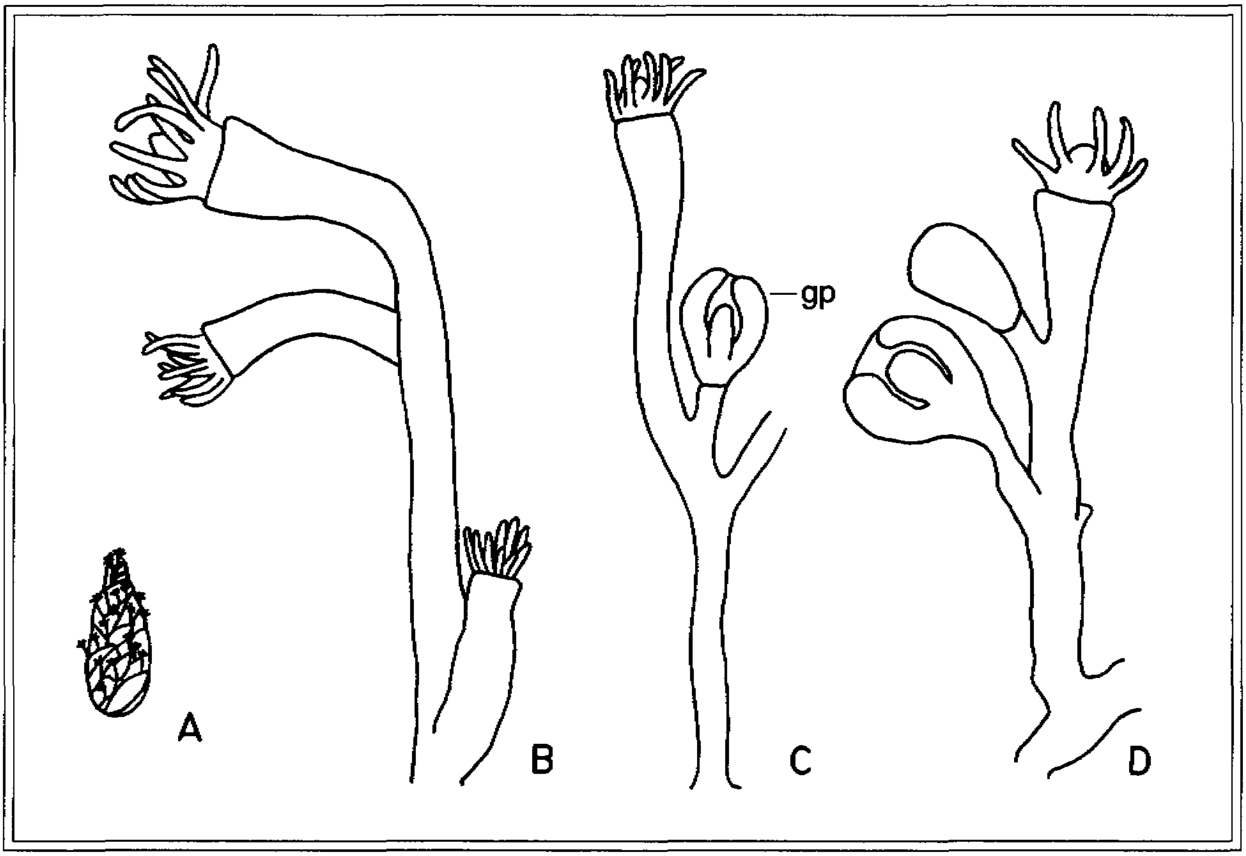

Figure 1.2. *Perigonimus repens* (Wright, 1858): A. entire colony on shell of snail, *Nassarius*, natural size; B. hydranths on terminal portion of stem; C-D. hydranths with gonophores (after Fraser, 1937).

At least two other species of *Perigonimus* occur in the region: *P. yoldia-arcticae* Birula, 1897 which lives exclusively on the shells of bivalve mollusks and an undescribed species, *P.* sp. A. which lives on the introvert of the sipunculid *Nephasoma diaphanes.* Both of these species have been collected in the Santa Maria Basin and western Santa Barbara Channel.

Family Corymorphidae Altman, 1872

Diagnosis. Zooids solitary, large. Hydrants with proximal (oral) and distal (aboral) rings of filiform tentacles. Gonophores producing free medusae with 4 radial canals; 3 of the 4 tentacles very much reduced.

Key to Species of Corymorphidae

1A. Oral tentacles few, capitate; polyp size minute .... *Euphysa* sp. A

1B. Oral tentacles many, filiform; polyp size medium to large 2

2A. Aboral tentacles numerous, 50-70 in number .... *Corymorpha palma*

2B. Aboral tentacles 15-20 in number .... *Euphysora bigelowi*

Genus *Corymorpha* M. Sars, 1835

Diagnosis. Pedicel with thin perisarc; tubular, fleshy processes (anchor filaments) arising from pedicel near the base. Hydranth abruptly distinct from pedicel; with 2 distinct sets of filiform tentacles; proximal tentacles longer than distal tentacles; distal set in several contiguous rows. Gonophores borne on branched pedicels between 2 whorls of tentacles; producing free medusae with 4 radial canals; 3 of 4 tentacles aborted or very much reduced.

Remarks. The polyp genus *Corymorpha* includes a heterogeneous mixture of several separte evolutionary lines (see Sassaman and Rees, 1978). One line is associated with the medusa genus *Euphysa* Forbes, 1848 (see comments for that genus) and the second with the medusa genus *Steenstrupia* Forbes, 1846. Despite differences of nomenclatural opinion, the separation of the family Corymorphidae into several distinct lines is generally accepted as elucidated by Rees (1957)

Corymorpha palma Torrey, 1902

Figure 1.3

Tubularia ? Hargitt, 1902.

Corymorpha palma Torrey, 1902: 37-43, pl. 2(fig. 21).—Torry, 1902: 987.—Torrey, 1904:9-10. Fraser, 1911: 27; 1937: 49, pl. 9(fig. 39a-b).—Lees, 1986: 105-114.

Material Examined. California—1 specimen; 34°56.9'N, 120°49.9'W, 142 m; coll. Battelle, M/V *Aloha*, cruise 1-1, Sta. PJ-8 (rep 2), Box Corer, October 1986 (SBMNH).

Additional material examined: Anaheim Bay Voucher: survey 0990, Sta. R (rep. 1); beam trawl; MEC A400.

Description. Trophosome: Polyps large, solitary; length up to 14 cm. Hypostome with 2 cycles of tentacles. Oral tentacles villiform; 18-30 in number, irregularily arranged in several whorls around mouth. Aboral tentacles villiform; numerous, 50-70. Perisarc with numerous anchoring filaments at base of polyp; filaments forming rootlike mass which attaches polyp to substrate.

Gonosome: Gonophores borne on peduncles attached to body of hydranth between proximal and distal tentacles.

Medusae: Attached medusoids, with 4 radial canals; manubrium, often several times longer than bell.

Nematocysts: Not described.

Type Locality and Type Specimens. Not traced. San Pedro, California.

Distribution. Eastern North Pacific Ocean: central California to northern Baja California and possibly the Gulf of California, Mexico (JL, pers. obs.). Depth range from low intertidal, 0-60 m.

Common Name. Fairypalm hydroid.

Biology. The species typically lives in bays and estuaries where the water is turbid from moderate current velocities or offshore in soft mud habitats where the sediment is likewise stirred up. Eggs are laid in May to June.

The large size and relative ease of collecting and maintaining *Corymorpha palma* in the laboratory has facilitated an extensive literature dealing with the biology of this species. The behavior of the species has been treated in papers by Torrey (1904a, 1905), Parker (1917), and more recently by Wyman (1965), Ball (1973) and Ball and Case (1973). Development, regeneration, budding, and fission have been extensively investigated by Torrey (1907, 1910a-c). Details of the aggregation of dissociated cells is discussed in Child

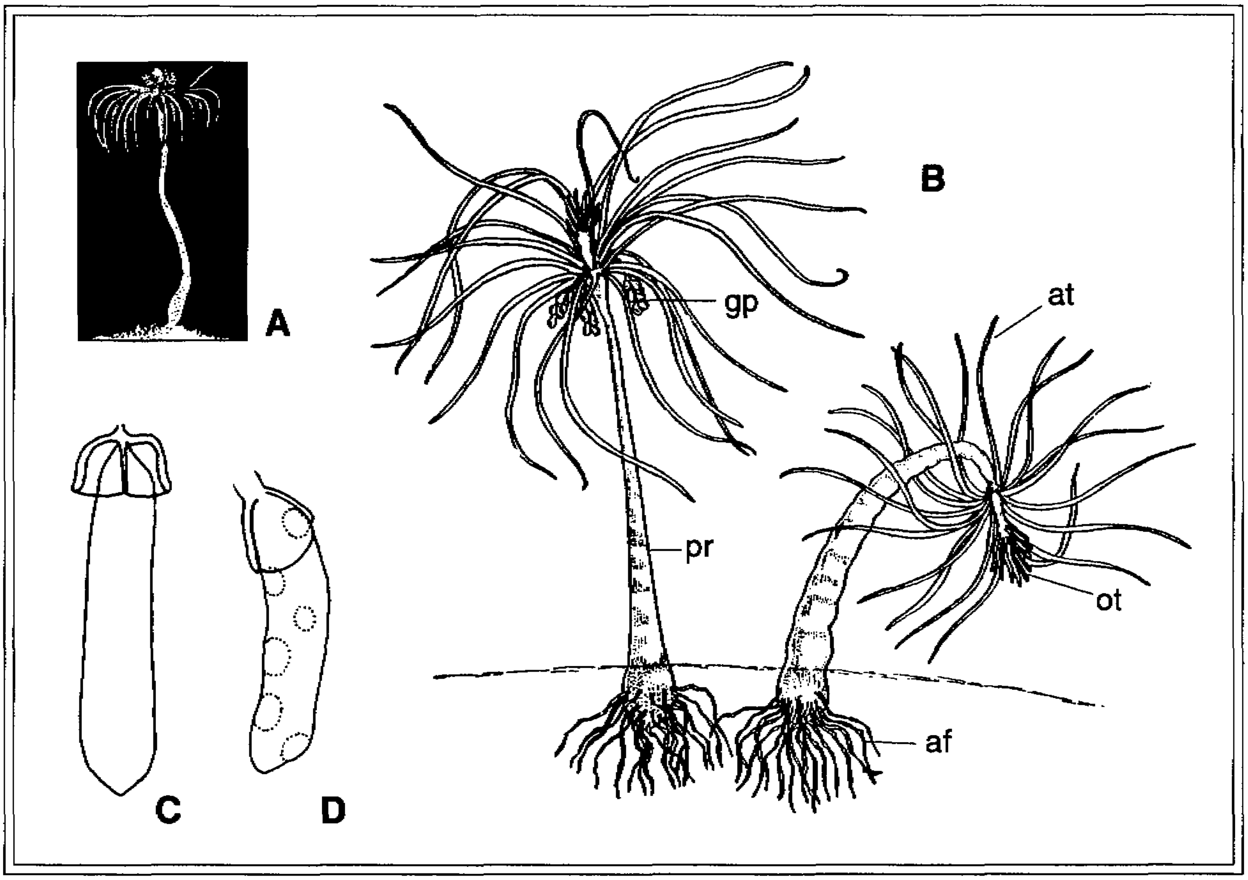

Figure 1.3. *Corymorpha palma* Torrey, 1902: A. entire polyp, natural size; B. enlarged zooids showing gonophores; C. male medusoid; D. female medusoid [Figure A. after Ricketts *et al.*, 1968; B. after MacGinitie and MacGinitie, 1968; C, D. after Torrey, 1907].

(1928). The movement of chemicals through the tissues is addressed in Chapman and Pardy (1972) and algae associated with *Corymorpha* studied by Pardy and Rahat (1972). Details of holdfast movement and of the statocyst were elucidated by Campbell (1968, 1969).

Remarks. Tubularine polyps and corymorphine polyps cannot be easily differentiated except for their method of attachment to the substrate (anchored to hard substrate vs. "rooted" in mud). Fraser (1937) placed this species in the family Corymorphidae, whereas Naumov (1969) considered *Corymorpha palma* to belong in the Family Tubulariidae. Following Sassaman and Rees (1978) we have left this species in the Corymorphidae.

Genus *Euphysa* Forbes, 1848

Diagnosis. Polyps solitary, small; stalk enveloped by thin perisarc. Hydranths with conical hypostome and 2 cycles of tentacles; oral or distal tentacles few in number, capitate; proximal tentacles numerous, moniliform. Gonophores borne on short stalks, arising from hypostome between tentacle cycles.

Medusae free; umbrella with or without apical projection; apex rounded, dome-like; with 4 radial canals, with 1-4 moniliform marginal tentacles often unequally developed; stomach not extending beyond umbrella margin. Without ocelli. Gonads completely surrounding stomach.

Remarks. The genera *Corymorpha* and *Euphysa* have been defined in a number of different ways. Naumov (1969) placed both *Euphysa* and *Steenstrupia* (a hydromedusa name) in *Corymorpha* M. Sars. In *Corymorpha* the tentacles are villiform or moniliform in both cycles. However, in *Euphysa* the aboral tentacles are moniliform whereas the oral tentacles are capitate. Most recent authors place *Euphysa* in a family distinct from *Corymorpha* on this basis.

Euphysa sp. A

Figure 1.4

Corymorpha aurata (**non** Forbes): Fauchald and Jones, 1976.

Euphysa sp. Lees, 1986: 106-114.

Material Examined. California: BLM-AHF specimens.—1 specimen; OCSD 8606, Sta. 5 (rep 3), 59 m, January 1986, 1 specimen; OCSD 8501, Sta. 21 (rep 1), 46 m, 21 Aug 1985, 1 specimen; OCSD, Sta. 5 (rep 3); OCSD Voucher; survey 9382, Sta. 37 (rep 1), 55 m; 20 Jan 1993.

Description. Trophosome: Polyps solitary, small. Hypostome with two whorls or cycles of tentacles. Aboral tentacles moniliform; about 10 in single whorl. Oral tentacles capitate; at least 4 in number. Growth buds present on underside of tentacular area; appear as swollen bulges directed downward. Perisarc thin, often with pattern of rings formed by small pits; continuing past end of body to form long thin tendrils or anchor filaments; tendril ends often wraping around sand grains.

Gonosome: Medusoid buds develop on small stalks on hypostome between oral and aboral rings of tentacles.

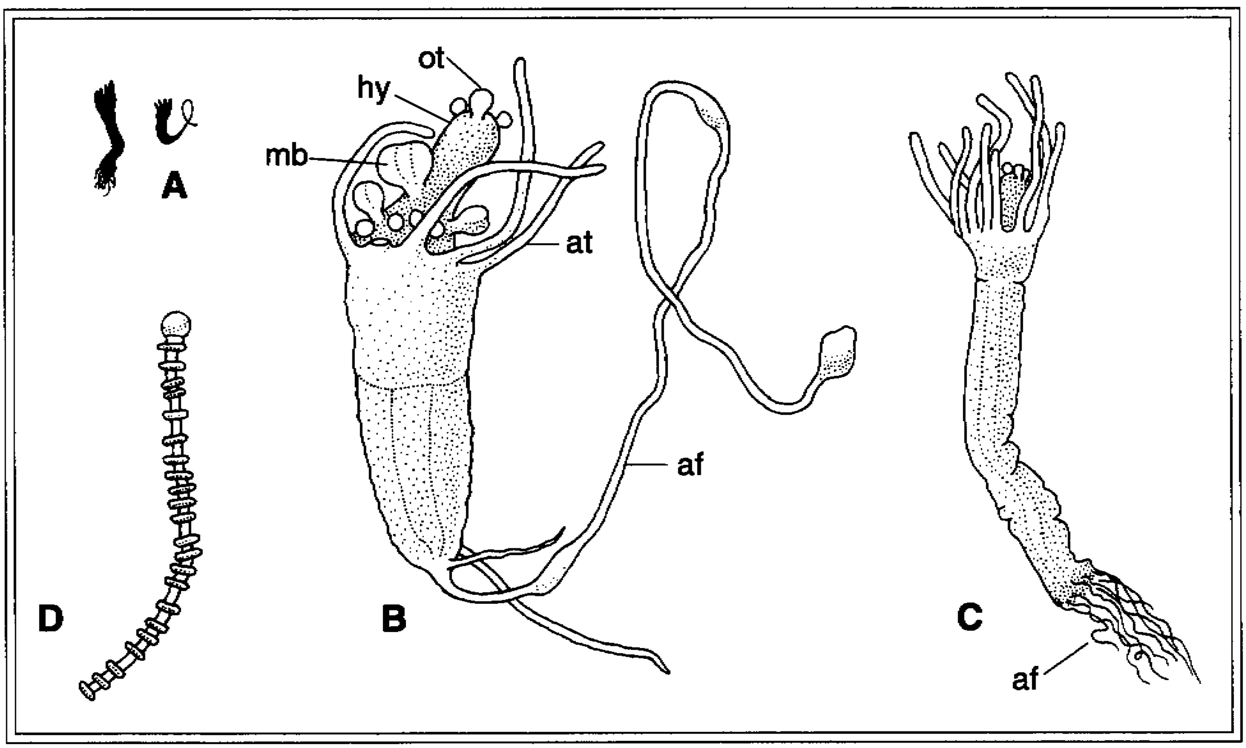

Figure 1.4. *Euphysa* sp. A: A. entire polyps, natural size; B. adult specimen with developing medusa buds; C. young specimen; D. details of a tentacle showing rings of nematocysts (original illustrations).

Medusae: Free medusae unknown.

Nematocysts: unknown.

Distribution. Eastern North Pacific Ocean, central and southern California. Depth range from 4-100 m. Recorded in both Los Angeles Harbor and Marina del Rey, and from about 400 m depth on the Santa Rosa Plateau adjacent to the Santa Cruz Basin.

Biology. Widely distributed on soft sediment bottoms off central and southern California. Presumed to feed on either suspended particulate matter or meiofauna.

Remarks. Ljubenkov (*in* Fauchald and Jones, 1976) previously identified this species as *Corymorpha aurata* because it appeared similiar to the European species. The species does not belong in the genus *Corymorpha* and as it lives in southern California, we are treating it as a distinct species until more information is available. Norenburg and Morse (1983) recently reviewed the genus *Euphyoa.*

Euphysora bigelowi Maas, 1905

Figure 1.5

Euphysora bigelowi Maas, 1905: 6-7; pl. 1(figs. 1-3).—Vanhoffen, 1911: 197; 1913: 7; pl. 1(fig. 3).—Browne, 1916: 173-174.—Kramp, 1928: 34-35, figs. 8-12; 1948: 20; 1953: 262; 1958: 340; 1961: 39.—Chiu, 1954: 51-52.—Chow and Huang, 1958: 174, 189; pl. 1(fig. 3).—Ganapati and Nagabhushanam, 1958: 92-94.—Cairns *et al.*,1991:20.

Corymorpha bigelowi: Hartlaub, 1907: 80.—Sassaman and Rees, 1978: 485- 495; figs. 1(a-d), 2(a-d), 3(a-e).

Steenstrupia bigelowi: Mayer, 1910: 36; fig. 9.—Lele and Gae, 1935: 91.—Bal and Pradhan, 1952: 76.

Euphysa bigelowi: Uchida, 1927: 188-189; text fig. 28, pl. 10 (fig.3).—Uchida, 1947: 300.—Yamazi, 1958: 135.

Material Examined. California: Santa Maria Basin, off Purisima Point, 2 specimens; 34°41.4'N, 120°57.9'W, 410 m; coll. Battelle, M/V *Aloha*, cruise 1-3, Sta. R-6 (rep 2), Box Corer, May 1987 (SBMNH).

Description. Trophosome: Solitary, erect, up to 13 mm high by 1 mm wide. Hypostome terminal, 3 mm high, flask-shaped, with 2 whorls of tentacles; distinctly demarcated from hydrocaulus by circular groove or diaphragm. Aboral tentacles up to 5 mm long, filiform, 15-20 in number in single whorl; oral tentacles much shorter, slightly thickened at tips, 30-35 in number in several irregular rows; in life tentacles not very contractile. Hydrocaulus thick and parenchymatous, more or less cylindrical; papillae absent. Perisarc thin, flexible, enclosing hydrocaulus from thickened annular or ectodermal ring just below diaphragm to base; often extending beyond base of hydranth in form of thin tube. Endodermal canals well developed and easily visable through hydrocaulus. Base slightly swollen, width 1.5 mm; anchoring rootlets or filaments present, arising from endodermal canals.

Gonosome: Gonophores produce free medusae. Pedicels (blastostyles) short, 1-2 mm long, inflated, not highly branched; arising just distal to aboral tentacles. Clusters of medusae buds present, a single bud at the terminus of each branch.

Medusae: Elongate, bell-shaped, up to 5 mm high. Nematocysts absent on exumbrellar surface. Apical projection conical with small papillae on surface. Apical canal well developed, variable in length, extending about 65% way to tip. Radial canals 4 in number. Manubrium tubular, extending to velar opening; mouth simple, circular, armed with nematocysts. Marginal tentacles 4 in number, all hollow. Single primary tentacle as long as bell, unbranched, with club-shaped terminal nematocyst bulb plus 8-9 subterminal, adaxial nematocyst bulbs. Secondary tentacles, short, simple, without nematocyst bulbs but covered with scattered

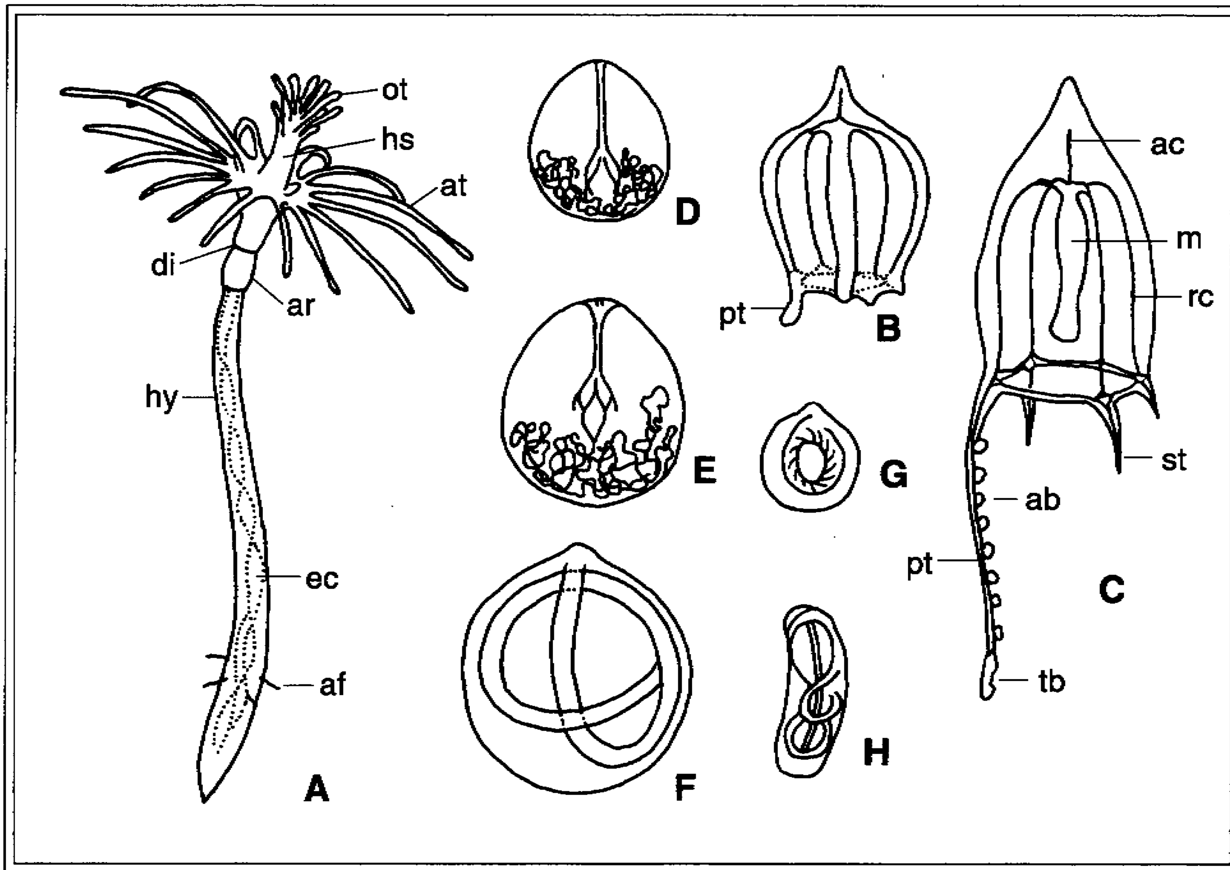

Figure 1.5. *Euphysora bigelowi* Maas, 1905: A. composite drawing of mature polyp; B. newly released medusa; C. adult medusa; D-H: cnidome, undischarged nematocysts, D. small stenotele (aboral tentacle, polyp); E. large stenotele (aboral tentacle); F. desmoneme (aboral tentacle); G. microbasic mastigophore (oral tentacle, polyp); H. anisorhiza (secondary tentacle, adult medusa) (after Sassaman and Rees, 1978).

nematocysts; tentacles lateral to primary tentacle twice as long as tentacle opposite to primary tentacle. Ocelli absent. Gonads surrounding manubrium. Medusae colorless except for pale yellow nematocyst bulbs on primary tentacle.

Nematocysts: *Hydroids*, Desmonemes 4-6 x 3.5-4.5 μm; microbasic mastigophores 7.5-8.5 x 3-4 μm; stenoteles (small) 7-8 x 4.5-5 μm; stenoteles (large) 13-16 x 8.5-10 μm.—*Medusae*, Desmonemes 6.5-9 x 3.5-5.5 μm; microbasic mastigophores 3-4.5 x 8-9.5 μm; stenoteles (small) 7-10 x 7-9 μm; stenoteles (large) 11-15 x 9-13 μm; ?anisorhizas 9-11 x 10-12 μm.

Type Locality and Type Specimens. Types not searched. Malay Archipelago.

Vouchers. Deposited by Sassaman and Rees (1978), polyps, USNM 56762 and medusae, USNM 56760 .

Distribution. Eastern North Pacific Ocean, California to Chile; precise distribution not known. Depth range not known. Also recorded from the Indian Ocean, India, Alphonse Island. Western Pacific Ocean, Australia; China; and Japan. Indo-West Pacific Ocean, Malay Archipelago; Hong Kong; Philippines; Nicobar Islands; and Palau Islands. (see Kramp, 1961 for review of distribution).

Biology. Asexual reproduction was observed by Sassaman and Rees (1978). Termed "frustulation" by Kramp (1948) the process is similar to transverse fission in which the terminal portion of the base of the polyp detaches from the hydrocaulus, develops tentacles and within a few days breaks free of the parental perisarc.

Gonosome development occurs about two weeks after larval metamorphosis and medusae are released about six weeks later (Sassaman and Rees, 1978). The asynchronous development of gonosomes results in a prolonged period of medusae liberation. One polyp observed by Sassaman and Rees (1978) produced 34 medusae over a period of three weeks. Newly released medusae lived for only a few days in the laboratory.

Family Olindiidae

Diagnosis. Zooids growing individually from a stolon. Hydranth with only 1 tentacle. Gonophores producing free medusae.

Remarks. This family variously has been designated as the Monobrachiidae or the Oliniadiidae. The latter is a variant spelling of the family name.

Monobrachium Mereschkowsky, 1877

Diagnosis. Colonies reptant; epibiotic on living bivalves and foraminiferans; polyps arising singly from reticulate stolon. Hydranth without perisarc; with conical hypostome and only 1 tentacle; constricted at base; stalks not pronounced. Gonophores arising from stolon; medusoids sessile, with 4 radial canals and up to 16 tentacles.

***Monobrachium parasitum* Mereschkowsky, 1877**

Figure 1.6

Monobrachium parasitum Mereschkowsky, 1877: 226-228; pl. 5(figs. 1-6).—Levinsen, 1893: 151.—Stafford, 1912: 73.—Broch, 1916: 42.—Fraser, 1918a: 337; 1918b: 131-138; 1921: 141; 1927: 326; 1937: 24-25; pl. 2 (fig. 7); 1927: 326; 1937: 24-25; pl. 2(fig. 7); 1927: 326; 1937: 24-25; pl. 2(fig. 7)..—Rylov, 1923: 156.—Vul'fius, 1937: 69.—Naumov, 1957:168-169; text figs. 1-2; 1960 [in 1969]: 547-549; text figs. 394-396—Hand, 1957: 84- 87; figs. 1-2.—Rees, 1967: 219..—Lees, 1986: 106-113, 117.

Monobrachium parasiticum [sic]: Vagner, 1889: 1-3; 1890: 273-307; pls. 8-9.—Bonnevie, 1899: 51.

Material Examined. California: off Point Arguello, 34°34.35'N, 120°45.18'W, 99 m; BSS-58, 5 Jan 1984, USNM; off Point Buchon, 35°05.8'N, 120°42.9'W, 91m; coll. Battelle, M/V *Aloha*, cruise 1-1, Sta. R-1 (rep 1), H-S Box Corer, Oct 1986 (SBMNH).

Description. Trophosome: Colonies stolonal with creeping reticular hydrorhiza bearing numerous (20 or more) sessile hydranths. Hydranths concentrated in posterior region of shell around hinge. Hydrorhiza filiform, smooth, extending over surface of shell to margin. In small bivalve species stolonial network plate-like covering entire shell. Hydrorhiza and part of hydrocaulus enclosed in thin, wrinkled perisarc; terminal portion of hydrorhiza which projects beyond margin of shell without perisarc. Gastrozooids small, 1-3mm high, elongate and fusiform. Pedicel reduced or absent. Hypostome 25-50% as long as hydranth; separated from hydranth by deep constriction. Mouth terminally located, surrounded by densely arranged

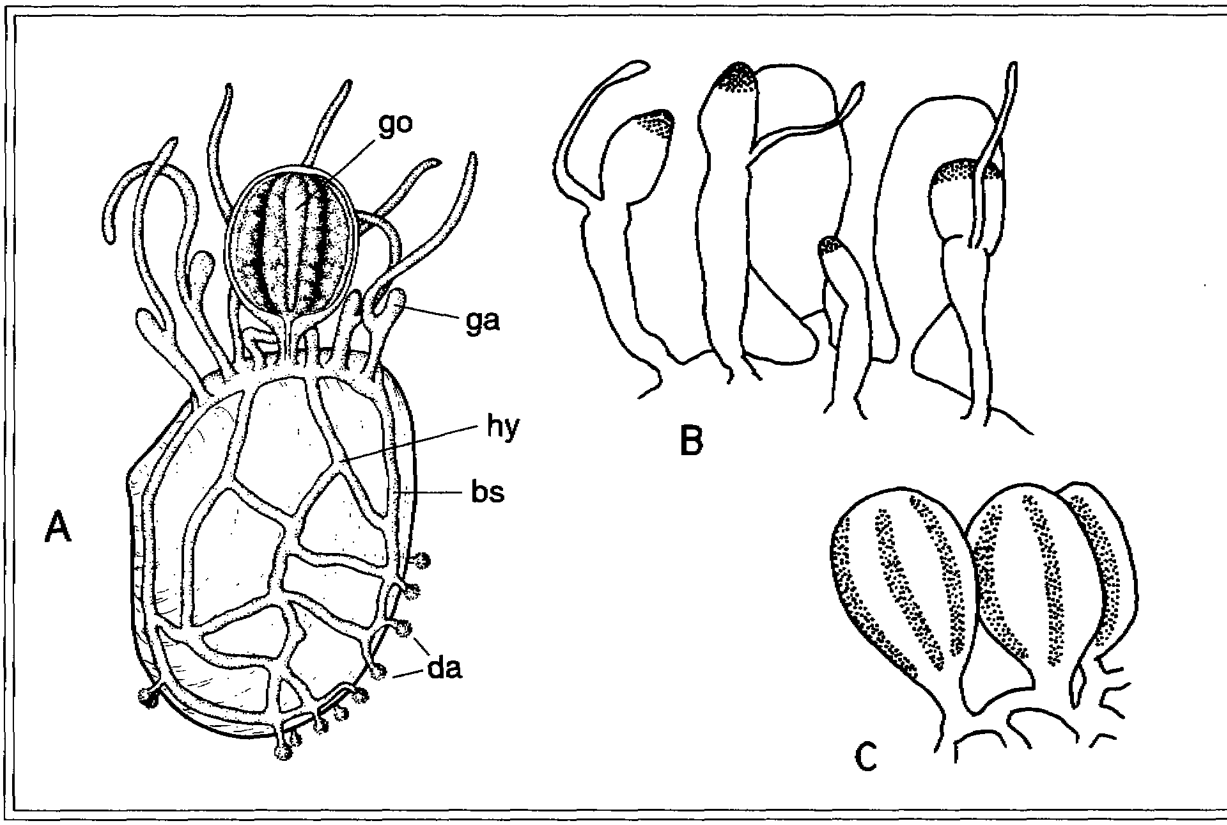

Figure 1.6. *Monobrachium parasitum* Mereschkowsky, 1877: A. colony on shell of bivalve mollusk, *Axinopsida serricata*, note presence of dactylozooids at the margin of the shell; B. enlarged section of colony showing cluster of feeding and reproductive zooids; C. gonozoids (Figure A. after Hand, 1957; B. after Naumov, 1969; C. after Fraser, 1937).

nematocysts. Single filiform tentacle present, projects at 90° to body; length when extended exceeding length of hydranth; entire surface covered with scattered nematocysts. Capitate dactylozooids present where hydrorhiza projects beyond margin of shell; appearing as globular concentrations of large nematocysts.

Gonosome: Gonophores arising singly from hydrorhiza on very short stalks; completely invested with perisarc. Number of gonophores limited, typically 2, but never more than 4 per colony. Only 1 sessile medusoid produced per gonophore; shape globular, 3 mm high by 1.5 mm wide; velum well developed; radial canals 4 in number; manubrium rudimentary, mouth absent; tentacles short, 16 in number, located between velum and ectodermal fold. Gonads extending as 2 longitudinal folds along sides of each radial canal.

Nematocysts: Not described.

Type Locality and Type Specimens. Unknown.

Distribution. Eastern North Pacific Ocean, Alaska to Baja California, Mexico. Depth range 30-200 m. Also recorded from the Western North Pacific Ocean; Japan, Okhotsk Sea; North Atlantic Ocean; Canada, and Greenland. Arctic Ocean; Spitsbergen, Barents Sea, Chuckchi Sea, Kara Sea, and the White Sea.

Biology. *Monobrachium* is an epibiont that is restricted in its occurrence to the shells of live, deep-water bivalve mollusks and arenaceous foraminiferans. In the Eastern North Pacific Ocean it has been found on the shells of the following bivalves: Thyasiridae, *Axinopsida serricata* (Carpenter) [=*A. viridus* (Dall)]; Lasaeidae, *Axinodon redondoensis* (Burch) [=*Tomburchus* or *Aligena redondoensis*]; Astartidae - *Astarte crenata* (Gray); Tellinidae, *Macoma baltica* (Linn.) [=*T. solidula* Pulteney], *M. calcarea* (Chemnitz) [=*T. lata* Gmelin], and *M. moesta* (Deshayes). It also has been reported to live on the test of the foraminiferan *Halophragmoides planissimum*. The above clam species are small and have short siphons. They live near the sediment surface in fine sand and soft silt. Although the hydroids have easy access to the shells of these surface-dwelling clams they are poorly protected from abrasion. In life the polyps are very mobile as are the tentacles. Given the location on the shell they can intercept food in the clams respiratory curents.

Rees (1967) postulated that *Monobrachium* may be similar to other commensal hydroids such as *Proboscidactyla*. When the host dies the hydrorhiza become activated and the club-like dactylozooids at the margin of the shell elongate and increase in number. In *Proboscidactyla* the free ends of the hydrorhiza are delicate and sticky and easily torn off even in weak currents of water. When broken off they are capable of attaching to a new host and thus may serve to propogate the species asexually.

On the Hueneme Shelf, *Monobrachium* has been observed in moderate densities in spring, winter and summer (Lees, 1986). Lees (1986) also noted in his study that although the clam *Axinopsida serricata* occurred in depths as shallow as 27 m, the hydroid only was found at depths greater than 50 m. He suggested that the upper limits of the hydroid distribution must be controlled by some factor other than substrate.

In BLM-OCS samples, populations of *Monobrachium parasitum* were concentrated at outer continental shelf stations between 31-491 m where the substrate is fairly coarse with sand, shell fragments and pebbles. The highest densities were at 150 m in depth. At stations close to the Patton Escarpment nearly 100% of *Axinodon redondoensis* were infected whereas at stations in the San Pedro Basin the host clam was present but no *Monobrachium* were observed. At deeper stations there was a tendency for the clams to become overgrown with a rusty coating which apparently inhibits growth of the hydroid. Although *Monobrachium* appears to be present at all times of the year adult colonies in a reproductive state were noted only in summer samples. In the first year of the BLM-OCS study of the bivalves collected 35 of 81 (43%) specimens of *A. redondoensis* and 22 of 173 (13%) *Axinopsida serricata* were infested with colonies of *M. parasitum*.

Family Campanulariidae Johnston, 1836

Diagnosis. Hydrotheca campanulate, never sessile, never adnate to or immersed in the stem or branches; diaphragm always present; hydranth with trumpet-shaped proboscis. Gonophores producing sporosacs or free medusae; when produced medusae usually have lithocysts; gonads located on radial canals.

Genus *Clytia* Lamouroux, 1812

Diagnosis. Colonies arising from an unbranched or irregularly branched stem. Gonophores producing free medusae, somewhat spherical, with 4 tentacles at time of liberation.

Clytia denticulata **(Clark, 1876)**

Figure 1.7

Campanularia denticulata Clark, 1876: 213, pl. 1(fig. 4).—Nutting, 1901: 189; 1915: 36.—Torrey, 1902a: 51, pl. 4 (fig. 34).—Fraser, 1911: 29-30; 1913: 150; 1914: 32; 1937: 60, pl. 12 (fig. 50); 1948: 203.—Stechow, 1913: 122.

Clytia denticulata: Cairns *et al.*, 1991:23.

Material Examined. California: Western Santa Barbara Channel, Sta. BRC-02 (USNM).

Description. Trophosome: Polyps small; arising singly from reptant stolon, occasionally branched. Pedicel of varying lengths; annulated at base and just below hydrotheca. Hydrotheca deep bodied, with about 15 sharp teeth.

Gonosome: Gonotheca arising directly from stolon; opening as wide as gonotheca; collar absent. Pedicles short, annulated.

Nematocysts: Not described.

Type Locality and Type Specimens. Presumed to be in the collections of YPM, not searched. Port Etches, Alaska, 10-18 fm [18-33 m].

Distribution. Eastern North Pacific Ocean, Alaska to Tenacatita Bay, Mexico. Depth range, 15-75 m.

Biology. Biology information not reported in the literature.

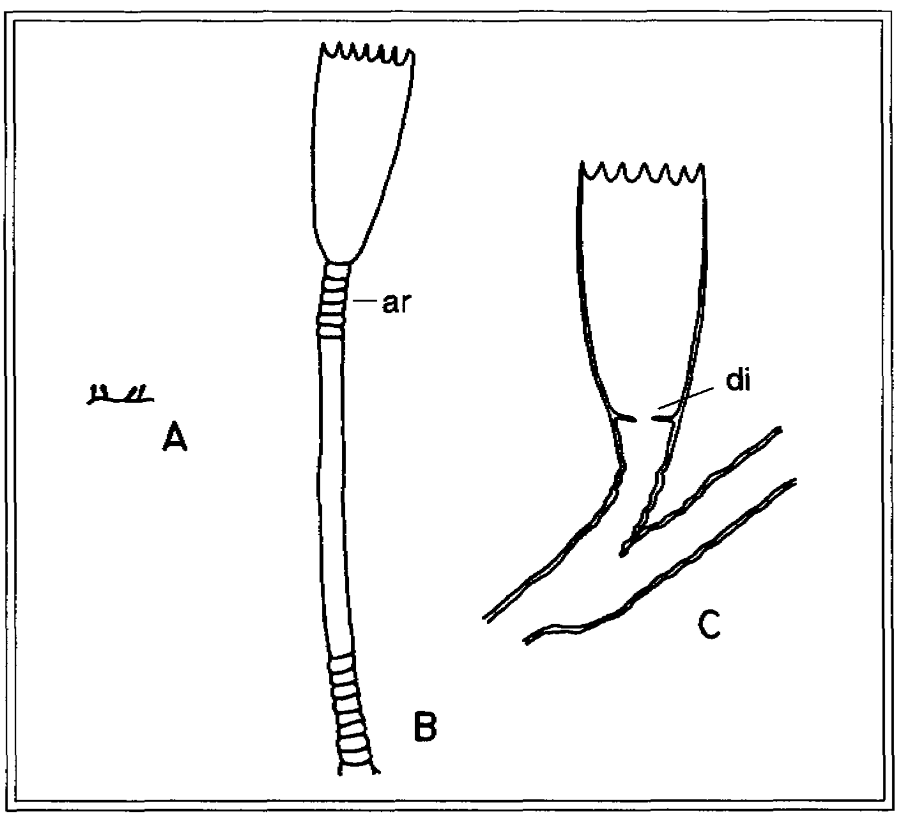

Figure 1.7. *Clytia denticulata* (Clark, 1876): A. entire colony, natural size; B. hydrotheca and pedicel showing characteristic annulations; C. detail of hydrotheca to show diaphragm (Figures A-B. after Fraser, 1937; C. after Torrey, 1902).

Genus *Laomedea* Lamouroux, 1812

Diagnosis. Colonies typically stolonal, seldom erect and branched; stolons of hydrorhiza not anastomosing. Hydrotheca campanulate, walls with unthickened perisarc, not abruptly everted distally; demarcated from pedicel by annular perisarc thickening; diaphragm absent. Gonophores fixed sporosacs.

Laomedea altitheca (Fraser, 1948)

Figure 1.8

Campanularia altitheca Fraser, 1948: 202, pl. 23(figs. a-d).
Laomedea altitheca: Cairns *et al.*, 1991:23.

Material Examined. California: holotype (SBMNH) (see below); California Sta. BRC-01 (USNM).

Description. Trophosome: Colonies small; height about 2 cm; stem fascicled, unbranched. Hydrothecae large; with 10 castellate teeth. Pedicels long arising from fascicled stem; 2-3 annulations below base of each hydrotheca.

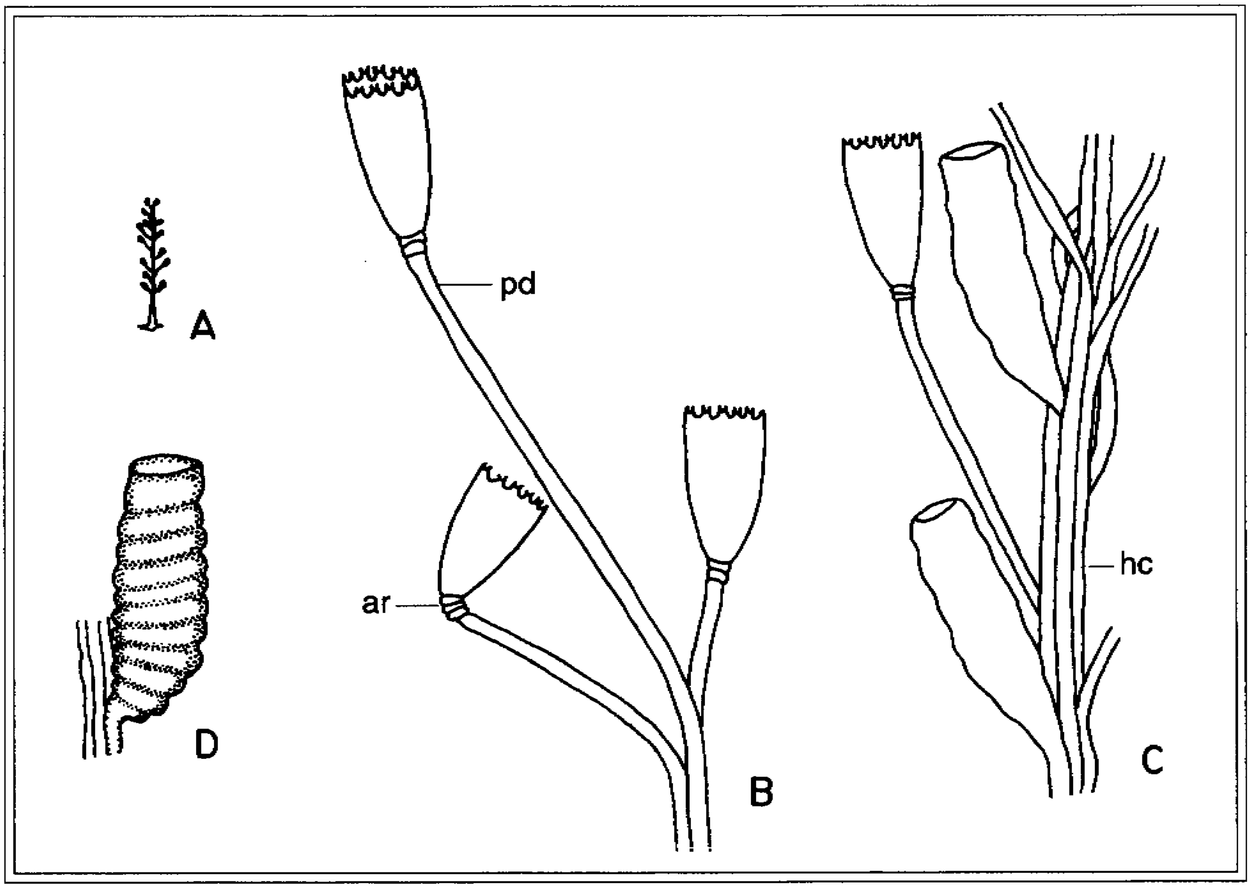

Figure 1.8. *Laomedea altitheca* (Fraser, 1948): A. entire colony, natural size; B. three hydrothecae with long pedicels; C. fascicled stem hydrocaulus with hydrotheca and gonangia; D. strongly corrugated gonangium (after Fraser, 1948).

Gonosome: Gonangia tubular, truncate at free end, tapering at base; arise directly from stem; walls vary from slightly wavy to strongly annulated.

Nematocysts: Not described.

Type Locality and Type Specimens. Holotype SBMNH [AHF 33]; San Clemente Island, California, south of Pyramid Cove, 55-69 fms [100-126 m], coll. R/V *Velero III*, Sta. 1012-39.

Paratypes not located.

Distribution. Eastern North Pacific Ocean, Santa Maria Basin, California to Cabo San Lucas, Baja California del Sur, Mexico. Depth range, 70-165 m.

Biology. Nothing is known about the biology of this species.

Remarks. This genus as well as the entire family are critically in need of revision.

Family Campanulinidae Hincks, 1868

Diagnosis. Colonies stolonal or erect, branched or unbranched. Hydrothecae pedicellate or sessile; always operculate; operculum formed of converging segments. Hydrants with conical proboscis.

Gonophores producing sporosacs or free medusae.

Key to Species Campanulinidae

1A. Nematophores absent; operculum with 8-9 segments .... *Calycella syringa*

1B. Nematophores present; operculum with 12 segments .... *Oplorhiza gracilis*

Calycella Hincks, 1864

Diagnosis. Colonies stolonal, not erect nor branching. Hydrotheca arising directly from stolon, walls of unthickened perisarc; margin distinct; separated from pedicel by thick, annulated perisarc. Gonophores fixed sporosacs; arising directly from stolon; extruded into acrocysts.

Remarks. In some treatments this genus is placed in its own family, the Calycellidae.

***Calycella syringa* (Linnaeus, 1767)**

Figure 1.9

Sertularia syringa Linnaeus, 1767: 1311.

Calycella syringa: Clark, 1876a: 217, pl. 6(fig. 25).—Calkins, 1899: 358, pl. 4(fig. 20A-C), 6(fig. 20D).—Nutting, 1889: 741; 1901: 194-195.—Torrey, 1904b: 20.—Fraser, 1911: 42, pl. 3(fig. 6); 1913: 152; 1914: 156; 1935: 144; 1936: 124; 1937: 91-92; 1940: 40; 1948: 216.—Broch, 1918: 32-34.—Cairns *et al.*,1991:21.

Calicella syringa: Stechow, 1923: 134.—Naumov, 1960 [in 1969]: 332, text fig. 198.—Vervoort, 1946: 216, text-figs. 92, 93; 1972: 36.

Material Examined. California: Western Santa Barbara Channel: Sta. BRC-01(USNM).

Description. Trophosome: Colony composed of solitary polyps, arising directly from creeping hydrorhiza; hydrorhiza smooth, not reticulated. Hydrotheca tubular; margin distinct, forming rim, reduplicated; operculum composed of 8-9 segments. Pedicels long or short, always annulated.

Gonosome: Gonophores oval or obovate; borne on stolon; pedicel with 2-3 annulations; sporosacs extruded into acrocyst.

Nematocysts: Not described.

Type Locality and Type Specimens. Unknown, probably not extant.

Distribution. Eastern North Pacific Ocean, Alaska to Cedros Island, Baja California, Mexico. Depth range, intertidal, 0-300 m. Also reported from the Western North Pacific Ocean, Northern Asia and Kara Sea. Eastern North Atlantic Ocean, Great Britain, Norway, Iceland, and Greenland. Western North Atlantic Ocean, Canada (Labrador).

Common Name. Creeping bell hydroid.

Biology. Reported to be an epibiont which typically grows attached to the stems of other hydroids (e.g., *Tubularia, Hydrallmania, Lafoea*), algae and other similar living substrates (Clark, 1876c; Calkins, 1899).

Remarks. A small species often confused with *Oplorhiza gracilis*. Cornelius (1978) reviewed the genus.

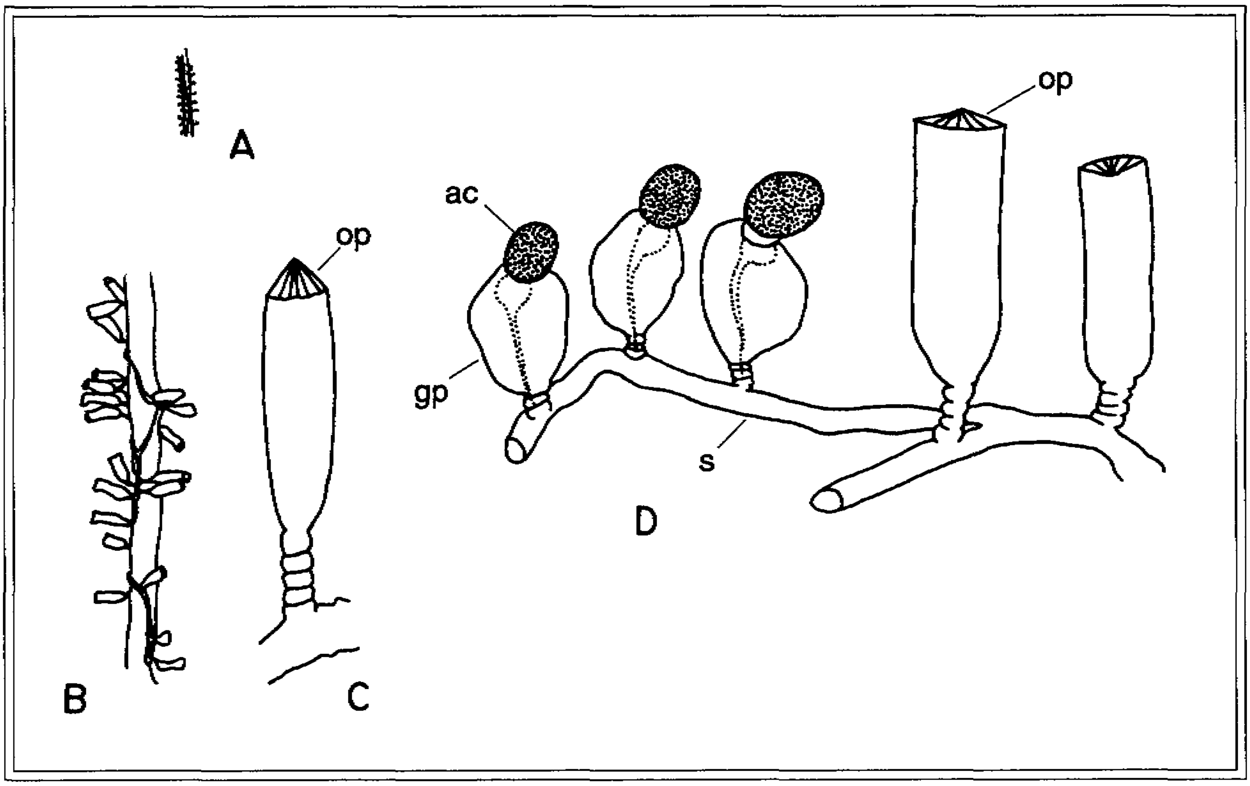

Figure 1.9. *Calycella syringa* (Linnaeus, 1767): A. entire colony, natural size; B. enlarged aspect of colony; C. single hydrotheca showing characteristic short, annulated pedicel; D. stolon with hydrothecae and gonophores (Figure A. after Fraser, 1937; B. after Calkin, 1899; C. after Fraser, 1911; D. after Naumov, 1960 [in 1969]).

Genus *Oplorhiza* Allman, 1877

Diagnosis. Colonies usually stolonal, occasionally erect and branched with polysiphonic stem. Hydrotheca pedicellate, radially symetrical, deeply campanulate, cone-shaped, widest at distal end; thin diaphragm present. Operculum cone-shaped, distinctly separated from hydrotheca. Nematophores solitary or aggregated, occuring on hydrorhiza or on both hydrorhiza and pedicels. Gonophores unknown.

Remarks. In the past this genus variously has been placed in the Family Lovenellidae or Campanulinidae because it could not be established whether species produce free medusae or have fixed gonophores. In Cairns *et al.* (1991) it has not been allocated to a family and its classification status is indicated as uncertain. The genus resembles *Egmundella* Stechow, 1921 but differs in having fusiform instead of cone-shaped hydrotheca.

Oplorhiza gracilis (Stechow, 1921)

Figure 1.10

Egmundella gracilis Stechow, 1921: 226; 1923: 124.—Fraser, 1935: 144; 1936: 124; 1937: 95; pl. 19 (fig. 101).—McCormick, 1965: 142.—Lees, 1986: 106.—Cairns *et al.*, 1991: 22.

Oplorhiza gracilis: Naumov, 1960 [in 1969]: 339.

Material Examined. California: Santa Maria Basin, off Purisima Pt., 34°41.4'N, 120°57.9'N, 410 m, coll. Battelle, M/V *Aloha*, cruise 1-3, Sta. R-6 (rep 2), Box Corer, May 1987 (SBMNH).

Description. Trophosome: Colonies small, zooids 1-2 mm high; arising from creeping, irregularly branched hydrorhiza. Pedicels unbranched or with 1-2 branches; annulated at base; passing almost imperceptibly into hydrotheca. Perisarc moderately thin with irregular wrinkles. Hydrothecae turbinate with sinuous margins; operculum with 12 segments. Nematophores spherical; present on pedicels and/or hydrorhiza; contracted at base to form short stalk.

Gonosome: Gonophores unknown.

Medusae: Unknown.

Nematocysts: Not described.

Type Locality and Type Specimens. Not searched. Not traced.

Distribution. Eastern North Pacific Ocean, Queen Charlotte Islands, British Columbia, Canada to Santa Maria Basin, California. Depth range 20-100 m.

Biology. Very rare in its occurence. The few reports of this species have noted its occurrence on shells of gastropod mollusks (*Neptunia lyrata*).

Remarks. Some investigators have placed this species in the genus *Egmundella* which it closely resembles. Except for the presence of nematophores the species also closely resembles *Lovenella producta*.

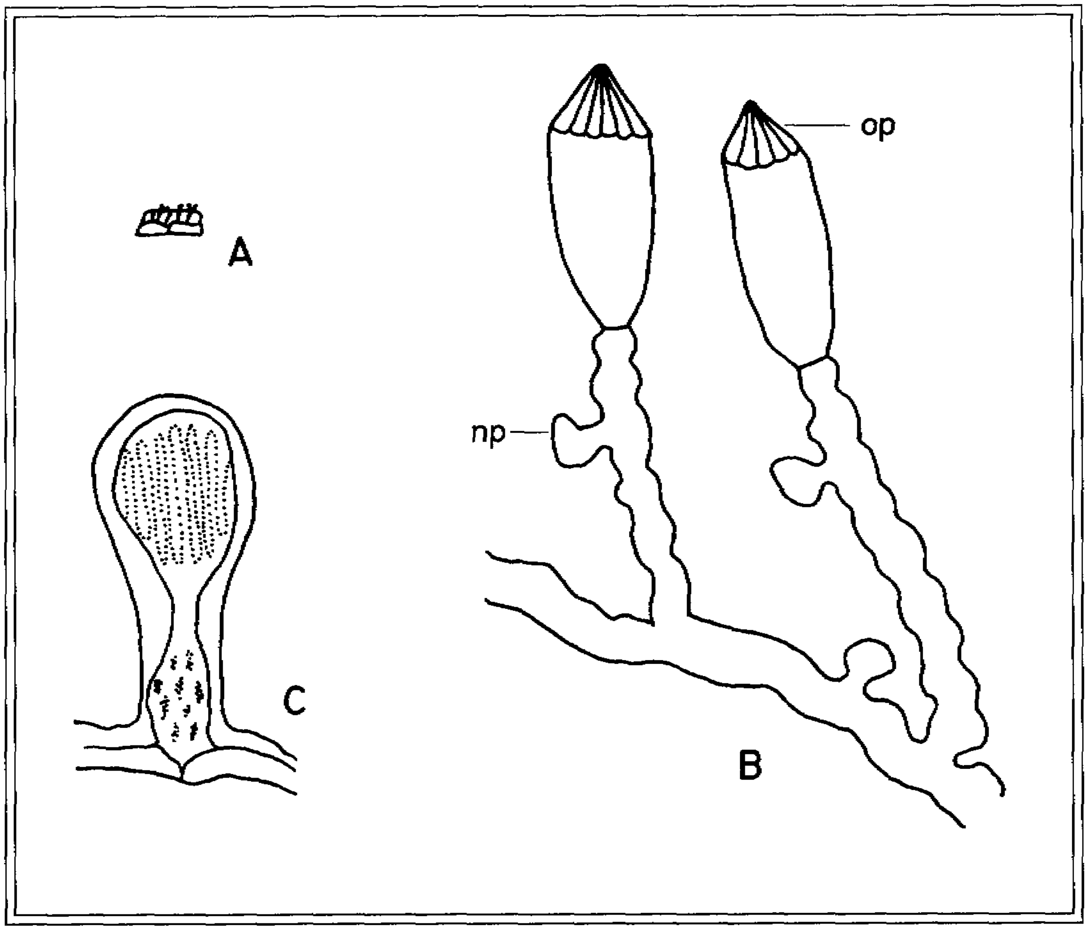

Figure 1.10. *Oplorhiza gracilis* (Stechow, 1921): A. entire colony, natural size; B. enlarged section of colony; C. nematophore (after Fraser, 1937).

Family Lafoeidae A. Agassiz, 1865

Diagnosis. Colony stolonal or erect and branching. Hydrothecae tubular, even rimmed; without operculum; with or without diaphragm; pedicellate or sessile, adnate in some species. Hydranth with conical hypostome. Gonothecae aggregated, as scapus or coppinia. Sexual generation a fixed sporosac.

Genus *Acryptolaria* Norman, 1875

Diagnosis. Colonies erect, more or less alternately branched; hydrocaulus and branches polysiphonic with 2 longitudinal rows of alternate hydrothecae. Hydrothecae sessile, tubular, adnate to axial tube or immersed in accessory tubes basally, curving outwards and becoming free distally; diaphragm absent; hydrothecal base indistinctly demarcated by ring of small desmocytes. Reduced hydtothecae occasionally present on accessory tubes. Nematotheca absent. Gonophores fixed sporosacs. Gonothecae aggregated; coppiniae with or without modified hydrothecal tubes.

Remarks. See recent discussion of the genus in Calder (1991).

Acryptolaria pulchella (Allman, 1888)

Figure 1.11

Cryptolaria pulchella Allman, 1888: 40.—Fraser, 1925: 172.

Acryptolaria pulchella: Nutting, 1927: 210.—Fraser, 1937: 116, pl. 24 (figs. 31a-c); 1938c: 134.

Material Examined. California: Sta. BRA-02 (USNM).

Description. Trophosome: Colony 5-6 cm tall; with stout, fascicled stem; bases of branches also fascicled; nodes absent; primary branches pinnate, irregularly arranged or loosely alternate; secondary branching regularly alternate. Hydrothecae curved outward, bases more or less adnate; same size throughout; alternate and regularly placed.

Gonosome: Unknown.

Nematocysts: Not described.

Type Locality and Type Specimens. Not searched. Pacific Ocean (Challenger Reports).

Distribution. Eastern North Pacific Ocean, San Francisco Bay, California to the Galapagos Islands, Ecuador. Depth range, 10-200 m.

Biology. Nothing has been reported in the literature about the biology of this species.

Remarks. Fraser (1944: 213, pl. 42(figs. 193a-c)) reported this species in the Western North Atlantic Ocean but the drawings do not match the description provided in his 1937 book.

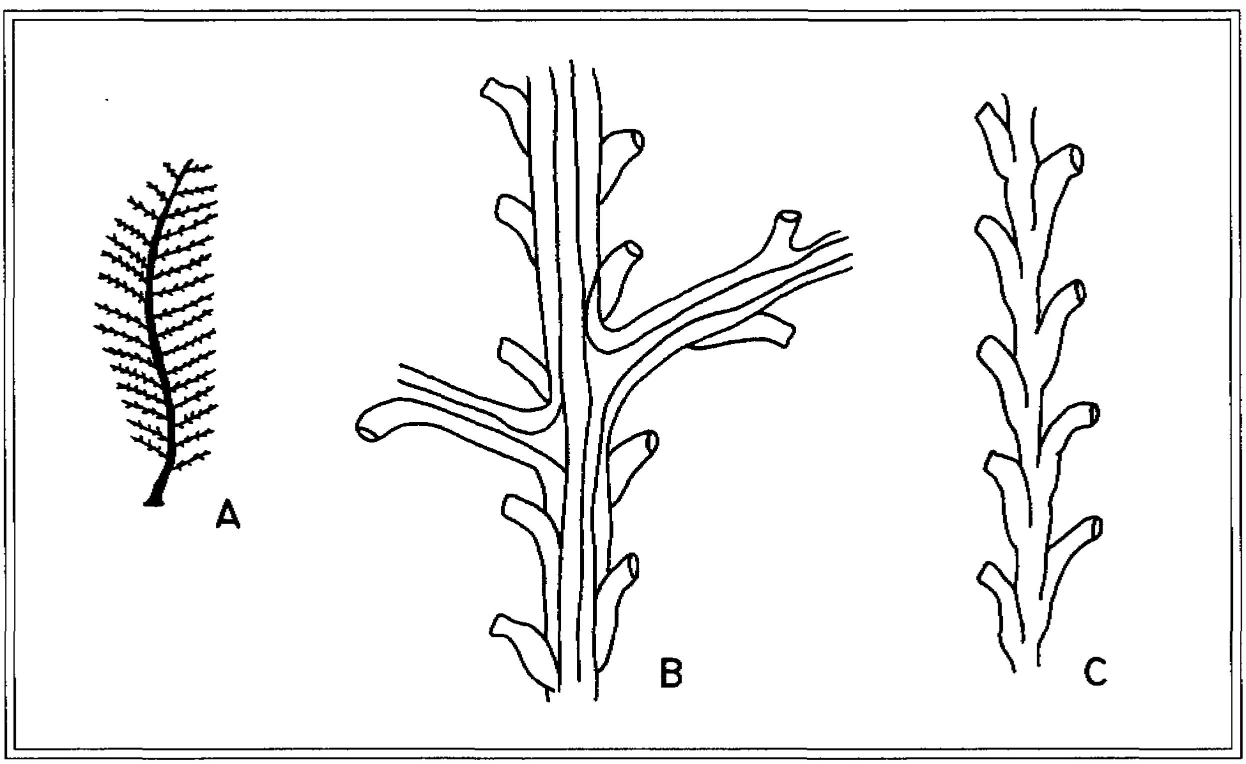

Figure 1.11. *Acryptolaria pulchella* (Allman, 1888): A. entire colony, natural size; B. portion of fascicled main stem; C. portion of simple stem or branch (after Fraser, 1937).

Family Lovinellidae Hincks, 1868

Genus *Lovenella* Hincks, 1868

Diagnosis. Colony branched or unbranched; hydrotheca turbinate; operculum sharply defined by sinuous margin on tube of hydrotheca; nematophores absent. Gonophores borne on stems, producing free, bell-shaped medusae with 8 tentacles in 2 sets and 4 lithocysts.

Lovenella producta (G.O. Sars, 1873)

Figure 1.12

Calycella producta G. O.Sars, 1873: 30.—Hincks, 1874: 134

Lovenella producta: Fraser, 1911: 44-45, pl. 3(figs. 7-10); 1913: 152; 1914: 159; 1937: 96, pl. 19 (figs. 102a-c); 1938a: 40; 1938b: 109; 1948: 219.

Material Examined. California: Santa Maria Basin, off Pt. Buchon, 1 colony, 35°05.5'N, 120°53.4'W, 161m; coll. Battelle, M/V *Aloha*, cruise 1-1, Sta. R-2 (rep 2), Box Corer, Oct 1986 (SBMNH).

Description. Trophosome: Zooids typically arising singly from hydrorhiza, occasionally one or more zooids branching off another pedicel. Hydrotheca turbinate; margin appears distinctly scalloped or sinuous due to curved bases of opercular segments. Operculum with 12 or more pie-shaped segments which interlock to form cone; often inverted. Pedicels long, length to 6 mm; always annulated at base. Demarcation between pedicel and hydrotheca gradual, not distinct; in region of transition hydrotheca often slightly turbinate or twisted. Nematophores absent.

Gonosome: Unknown.

Nematocysts: Not described.

Type Locality and Type Specimens. Not searched. Not traced.

Distribution. Eastern North Pacific Ocean - Vancouver Island, British Columbia, Canada to Anacapa Island, California. Depth range 90-700 m. Also reported from the Western North Atlantic Ocean - Maine, USA.

Biology. Fraser (1913) recorded this species growing on tubes of serpulid annelids.

Remarks. This species is nearly indistinguishable from *Oplorhiza gracilis* from which it differs in the complete absence of nematophores. Fraser (1937) feels that many of the reported instances of this species are actually *O. gracilis*, especially from the Vancouver Island region. *Lovenella nodosa*, reported by Lees (1986) from the Hueneme Shelf may actually be *L. producta*.

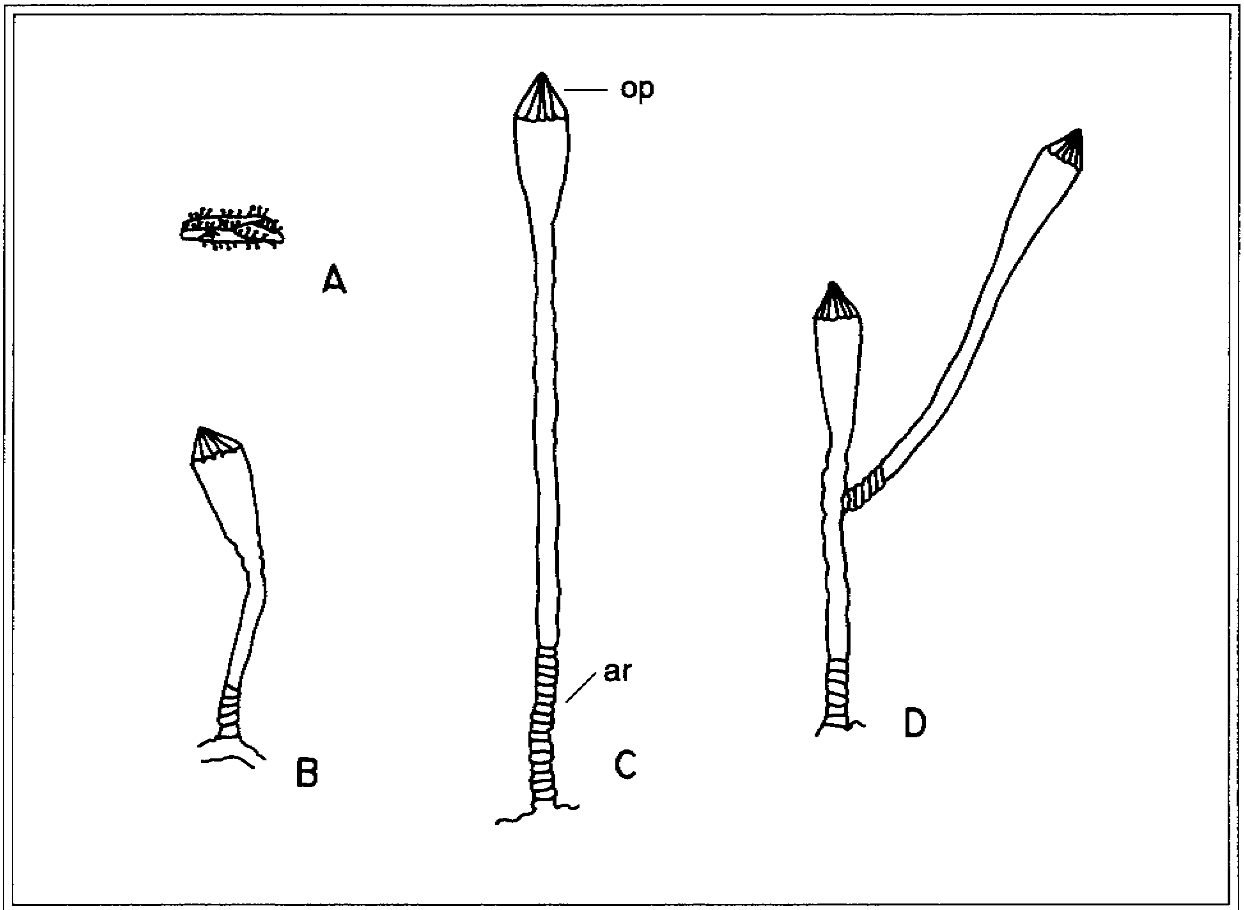

Figure 1.12. *Lovenella producta* (G.O. Sars, 1873): A. entire colony, natural size; B-D. single zooids to show variation in sizes, note characteristic annulations only at base of pedicels; D. branched colony [Figures A, C, D, after Fraser, 1937; B. after Fraser, 1911].

Family Aglaopheniidae

Key to Species of Aglaopheniidae

1A. Colony small, slender, height to 1 cm; hydrotheca present on stem .... *Cladocarpus gracilis*

1B. Colony large, plumose, height to 12 cm; hydrotheca absent on stem .... *Cladocarpus vancouverensis*

Genus *Cladocarpus* Allman, 1874

Diagnosis. Hydrothecae deep with smooth margin or crenulated with low, blunt teeth. Mesial nematophores short. Gonophores not situated within corbulae; associated with slender branches (phylactogonia) which arise from stem at base of hydrocladia. Phylactogonia bearing nematophores but lacking hydrothecae.

Cladocarpus gracilis Fraser, 1948

Figure 1.13

Cladocarpus gracilis Fraser, 1948: 269-270, pl. 36(figs. 39a-d).

Material Examined. California: holotype (SBMNH, see below). Additional material examined: BLM/OCS Baseline Survey—specimens from the following BLM station localities: 143, 145, 148, 152, 155, 164, 175, 220.

Description. Trophosome: Colony delicate, small, 10 mm high; simple, slender, arising directly from creeping stolon; holotype unbranched but other colonies examined alternate and pinnately branched. Distal half of hydrocaulus thecate. Nematophores in single wandering row on face of hydrocaulus; nematophores originating below insertion of first chevron-shaped segment. Hydrothecae long, slender, length more than twice width; diameter increasing from base to margin; prominent medial tooth on face of margin, remainder of margin irregularly waved or slightly toothed. Up to 9 hydrothecae present on face of stem between distal chevron and origin of branch pedicels; hydrothecae absent on stem face distal to origin of first branch pedicel. Supracalycine nematophores much smaller than length of hydrothecae; mesial nematophores not adherent to face of hydrothecae, but attached to internode below base of hydrotheca.

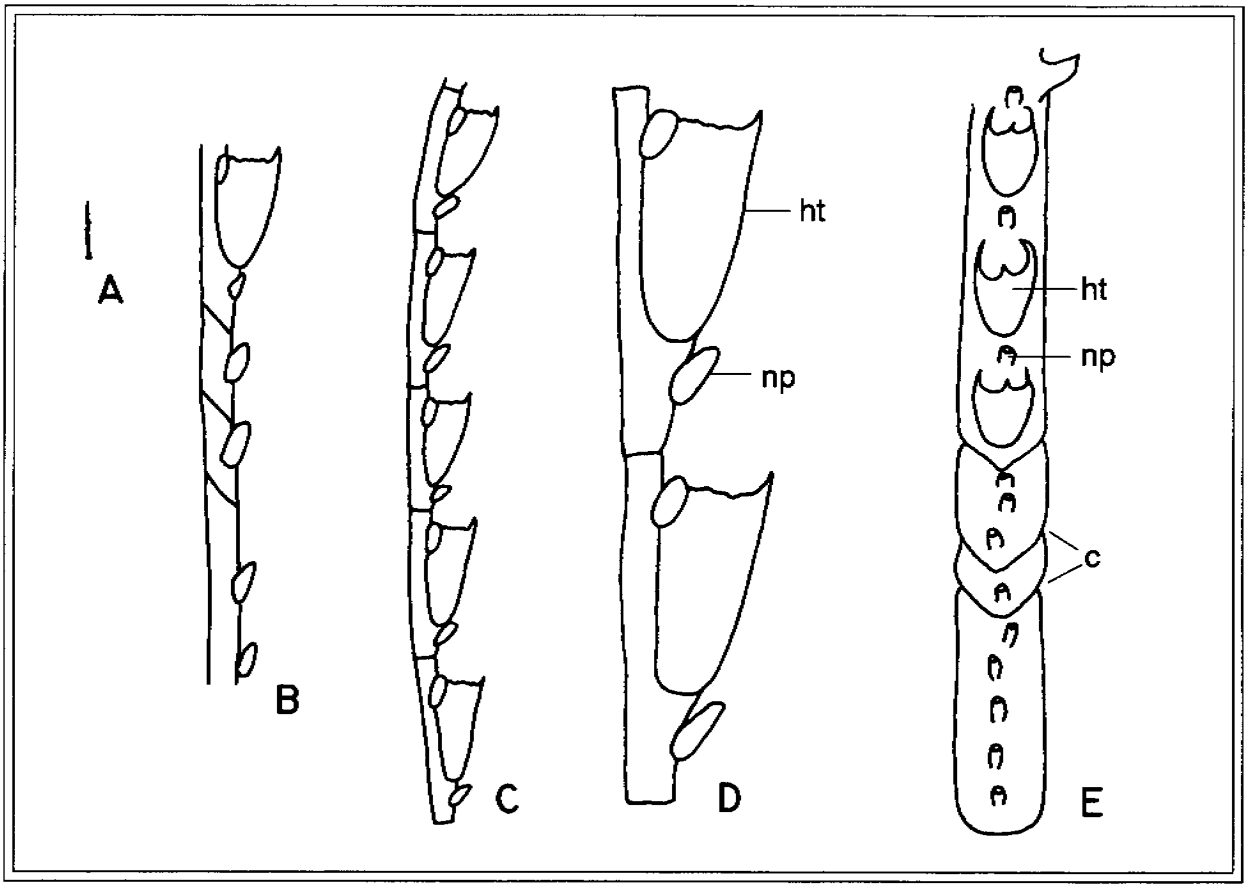

Figure 1.13. *Cladocarpus gracilis* Fraser, 1948: A. entire colony, natural size; B. first hydortheca and portion of proximal stem, lateral view; C. medium portion of stem, lateral view; D. two hydrothecae, lateral view; E. arrangement of hydrothecae and nematophores on lower stem, stylized, enface view (Figures A-D. after Fraser 1948; E. original).

Gonosome: Gonophores and phylactocarps located on distal parts of stem.

Nematocysts: Not described.

Type Locality and Type Specimens: California, holotype - SBMNH [AHF 131]. California, Santa Catalina Island, bearing 2.8 mi WNW of Long Point, 64-88 fm [117-161m]; coll. R/V *Velero III*, Sta. 1307-41.

Distribution. Eastern North Pacific Ocean: Santa Rosa Ridge and Santa Catalina Island shelf California. Depth range, 90-268 m.

Biology. Information on the biology of this species is not available in the literature.

Remarks. Fraser (1948) described this species from an incomplete single specimen which lacked the stem above the hydrothecae. He concluded that the species should perhaps be placed in the genus *Antenella*, in which the hydrocladia arise directly from a creeping stolon. In the material recently examined, enough specimens are available to see that a pinnate colony is formed similiar to other species in the genus *Cladocarpus*. *Cladocarpus gracilis* is the only species in the genus that has hydrothecae on the stem.

Cladocarpus vancouverensis Fraser, 1914

Figure 1.14

Cladocarpus vancouverensis Fraser, 1914: 204; 1937: 182-183, pl. 41(figs. 221a-d); 1946: 93, 408; 1948: 273.

Material Examined. California, off Morro Bay, Sta. BRA-027 (USNM).

Additional material examined: Several specimens from near San Miguel and Santa Rosa Islands; BLM/OCS Baseline Survey (1975-77), Stas. 28 (129 m), 38 (133 m), and 155 (163 m).

Description. Trophosome: Colony large, plumose, height to 12 cm; stem simple, unbranched. Hydrocladia regularly alternate, branches on 2 sides not in same plane; divided into regular internodes. Hydrothecae adnate throughout; deep-bodied, deeper than wide; distinct large medial tooth on face of margin, remainder of margin weakly crenulated with small, wavy teeth. Two supracalycine nematophores, much smaller than hydrotheca length; mesial nematophore projected outward, base adnate, distal portion free. Nematophores on front of stem changing from widely spaced pairs to very narrowly spaced pairs below origin of first chevron-shaped segment. Chevron-shaped segments present, 2-4 below origin of branch pedicels. Septal ridge present at base of supracalycine nematophore, at base of hydrotheca and 2 others regularly placed between these.

Gonosome: Gonophores borne on front of stem; ovoid with rounded distal end. Protected by 2-pronged phylactogonia, tips of each prong typically bifurcate.

Nematocysts: Not described.

Type Locality and Type Specimen. Presumed to be in collections of BCPM (Arai, 1977); not searched. [Canada. British Columbia], Vancouver Island region.

Distribution. Eastern North Pacific Ocean, Queen Charlotte Island, British Columbia, Canada to San Benito Islands, Baja California, Mexico. Depth range, 25-400 m.

Biology. Unknown.

Remarks. The colonies of *Cladocarpus vancouverensis* resemble those of the genus *Aglaophenia* but are smaller, more delicate and have fewer hydrothecae on the branches. Three other species of *Cladocarpus* are reported to occur in southern California: *C. pinguis* is shorter and stouter; *C. gracilis* (incompletely by Fraser from an incomplete specimen); and an undescribed species (sp. A *sensu* Ljubenkov) which has been collected so far only from the Encina Outfall.

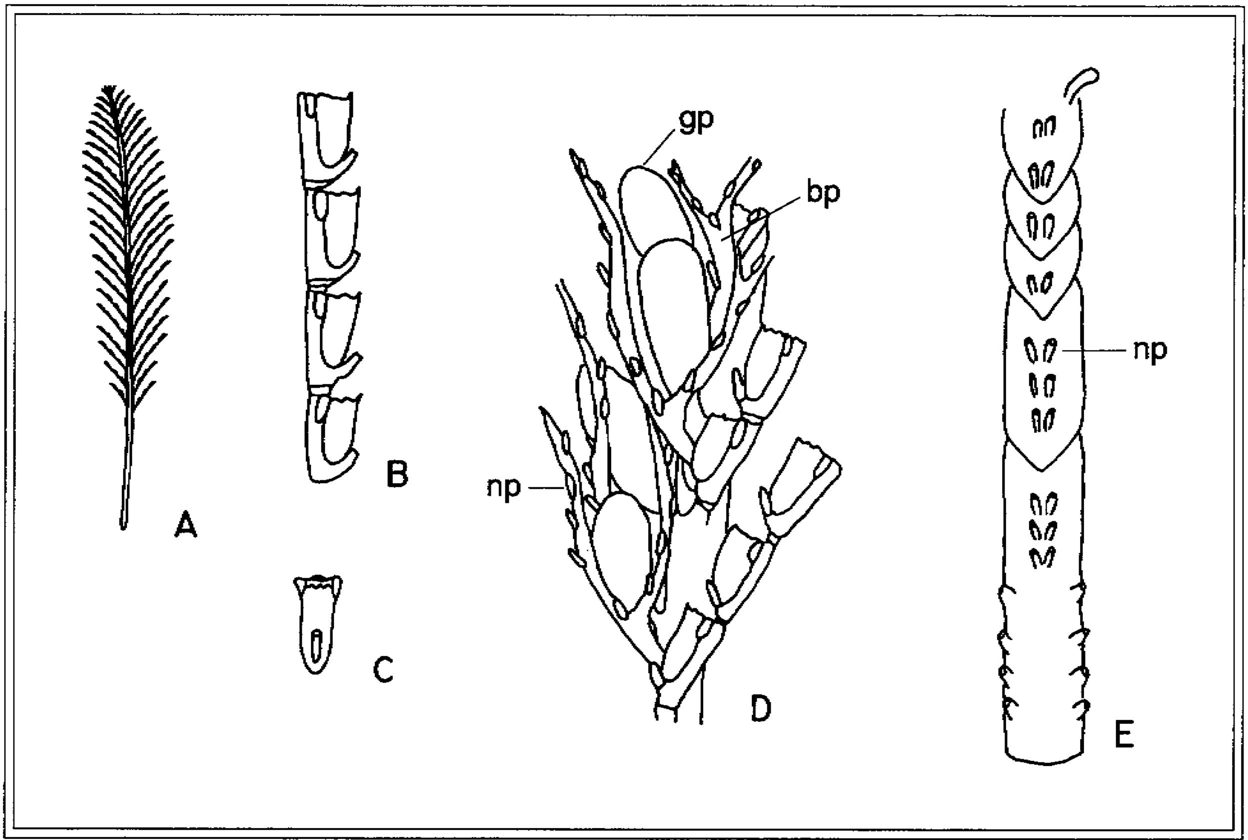

Figure 1.14. *Cladocarpus vancouverensis* Fraser, 1914: A. entire colony, natural size; B. portion of hydrocladium, lateral view; C. hydrotheca, enface view; D. gonophores and phylactogonia; E. arrangement of nematophores on lower stem, note absence of hyrotheca, stylized, enface view (Figures A-D. after Fraser, 1937; E. original).

Family Plumulariidae L. Agassiz, 1862

Diagnosis. Hydrothecae growing only on one side of the branches (hydrocladia); sessile, more or less adnate; operculum absent; nematophores always present. Gonophores producing fixed sporosacs; often protected by special modifications of the branches.

Key to Species of Plumulariidae

1A. One mesial nematophore on each thecate and athecate internode; internodes with conspicuous septal ridges .... *Plumularia corrugata*

1B. Two mesial nematophores on each thecate and athecate internode; internodes smooth, without sepatal ridges .... *Plumularia exilis*

Genus *Plumularia* Lamarck, 1815

Diagnosis. Colonies erect; hydrocaulus typically unbranched; hydrocladia unbranched, pinnately arranged; each branch with hydrothecae on only 1 side. Hydrothecae sessile, more or less adnate; margin entire. Nematophores present, movable. Gonophores fixed sporosacs; without protection.

Remarks. This is a large and confusing genus with well over 30 species described in the Eastern North Pacific. The genus is badly in need of revision because the extent of variability of characters such as the number of nematophores per internode is not known.

Plumularia corrugata Nutting 1900

Figure 1.15

Plumularia corrugata Nutting, 1900: 64, pl. 6(figs. 1-3).—Fraser, 1911: 82; 1914: 205; 1935: 145; 1937: 186-187, pl. 42 (figs. 225a-d; 1938a: 63; 1938b: 111; 1938c: 136; 1948: 276.

Material Examined. California: San Diego, OCSD 8503, Sta. 37 (rep 5), 61 m; 22 Oct 1985 [several colonies].—Oregon: USNM BLM-OCS Voucher, Tanner Bank; Sta. 816.

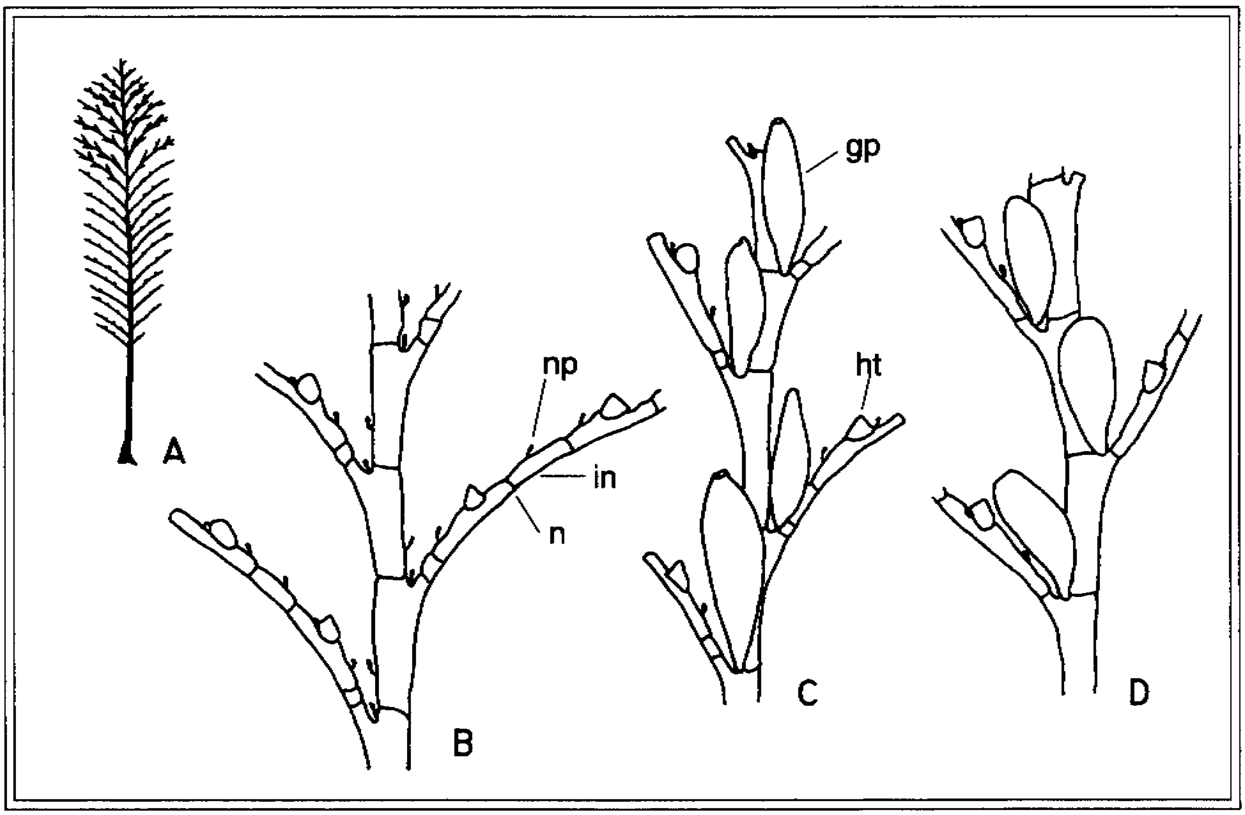

Figure 1.15. *Plumularia corrugata* Nutting, 1900: A. entire colony, natural size; B. portion of main stem and hydrocladia; C. male gonphores; D. female gonophores (after Fraser, 1937).

Description. Trophosome: Colonies medium size, height to 2 cm. Stem simple, arising directly from rootlike hydrorhiza; divided into regular internodes; branches arising from small process at distal end of each internode. Branches alternate, all in the same plane; with 5-10 polyps per branch. Cauline internodes marked by constriction; septum not obvious. Thecate and athecate internodes alternate on hydrocladia; first internode after branch arises very short and non-hydrothecate. Two supracalycine nematophores and one subcalycine mesial nematophore on each thecate internode; single mesial nematophore on all but first athecate internodes; single mesial nematophore on each cauline internode on side opposite branch pedicel; single nematophore in each branch axil.

Gonosome: Gonophores attached to branch pedicels. Female gonagium elongate, three times as long as broad; ovoid, distal end truncate. Male gonangium elongate; distal end often constricted in bottleneck shape.

Nematocysts: Not described.

Type Locality and Type Specimens. Syntypes - USNM 18609; USNM 18610; MSUI 11721; MSUI 11722. 10 mi east of Petros Island.

Distribution. Eastern North Pacific Ocean - San Juan Archipelago, Washington to the Galapagos Islands, Ecuador. Depth range 60-90 m.

Biology. Information on the biology of this species not reported in the literature.

Plumularia exilis Fraser, 1948

Figure 1.16

Plumularia exilis Fraser, 1948: 277-278, pl. 38(figs. 43a-c).

Material Examined. Mexico: holotype (SBMNH see below).— California: off Pt. Arguello, Sta. BRA-06.

Description. Trophosome: Colony medium size, clustered, height to 4 cm. Hydrocaulus thin, sinuous; internodes elongate with branch pedicel located at distal end. Branching pattern alternate. Proximal internode of each branch very short, lacks both a nematophore and a hydrotheca; thecate and athecate internodes alternate distal to first naked internode. Two nematophores present on branch face of each athecate hydrocladial internode; two supracalycine nematophores present on each thecate internode. Each hydrocauline internode with up to 4 nematophores on side opposite of hydrocladia; single nematophore in each branch axil.

Gonosome: Gonophores numerous, large, length to 1.25 mm; shape, elongate obovate, tapering at proximal end, truncate with small opening at distal end; attached to face of branches or in axil of branches.

Nematocysts: Not described.

Type Locality and Type Specimens. Holotype - SBMNH [AHF 140]; Mexico, Lower California [Baja California del Sur], off Cape San Lucas, San Jaime Bank, 75 fm [137 m]; coll. R/V *Velero III*, station 618-37.

Distribution. Eastern North Pacific Ocean, Santa Maria Basin, California to Cabo San Lucas, Baja California del Sur, Mexico and into the Gulf of California. Depth range, 10-275 m.

Biology. Information on the biology of this species has not been reported in the literature.

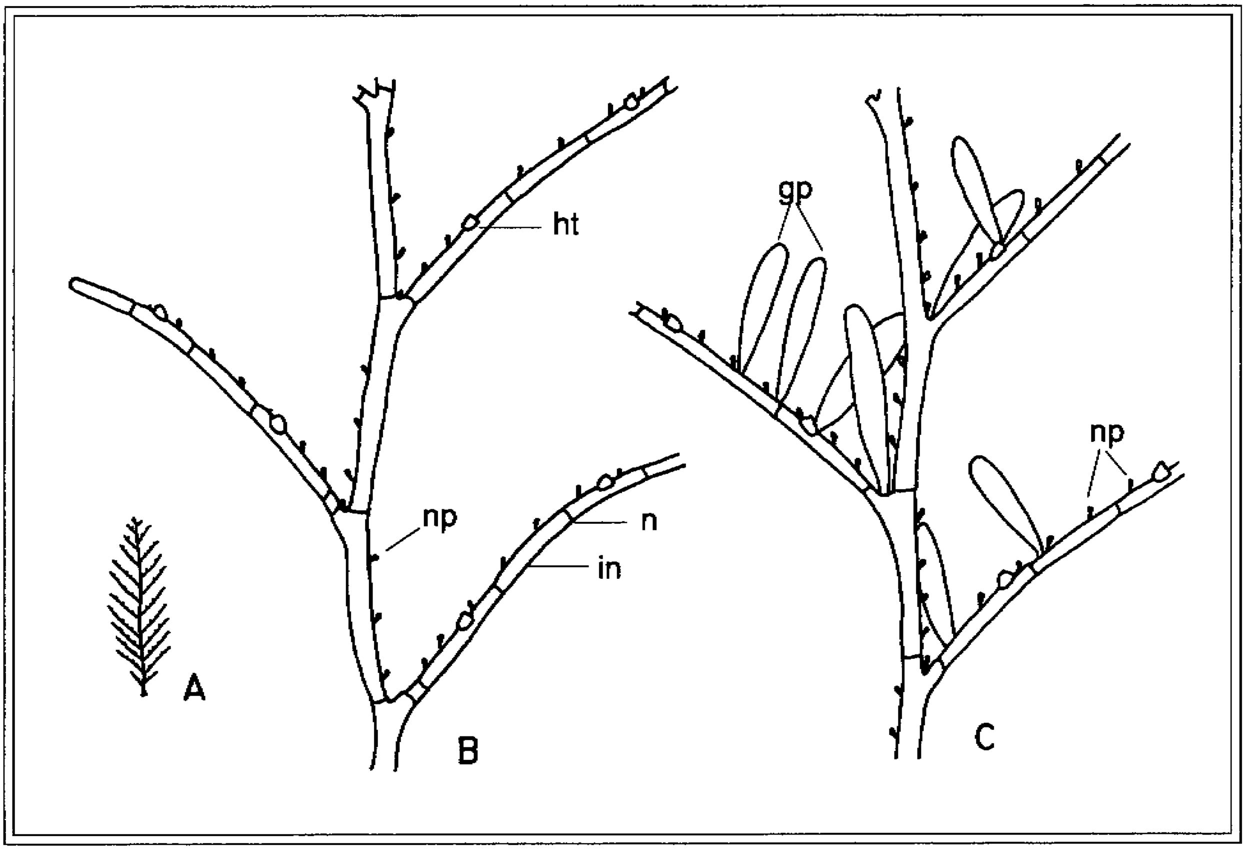

Figure 1.16. *Plumularia exilis* Fraser, 1948: A. entire colony, natural size; B. portion of colony showing branching pattern and distribution of hydrothecae and nematophores; C. gonophores (after Fraser, 1948).

Family Sertulariidae Lamouroux, 1812

Diagnosis. Hydrothecae sessile, usually arranged on both sides of stem and branches; either alternate or opposite; more or less adnate; operculum present. Nemotaphores absent. Gonophores producing fixed sporosacs.

Key to Species of Sertulariidae

1A. Hydrothecae opposite, margins tridentate; operculum with 2 valves .... *Dynamena pumila*

1B. Hydrothecae alternate, margins entire or smooth; operculum with single flap .... *Abietinaria* 2

2A. Stem relatively slender, hydrothecae short and thick .... *Abietinaria traski*

2B. Stem stout 3

3A. Cauline nodes rarely, if at all, with an annulus; hydrothecae elongate; gonangia smooth .... *Abietinaria pacifica*

3B. Cauline nodes with single annulus 4

4A. Gonangia with strong longitudinal crests or ridges .... *Abietinaria amphora*

4B. Gonangia smooth or transversly annulated .... *Abietinaria variabilis*

Genus *Abietinaria* Kirchenpauer, 1884

Diagnosis. Colony erect, branched or unbranched; hydrocaulus monosiphonic. Hydrocaulus and hydrocladia with hydrothecae in 2 longitudinal rows. Hydrothecae sessile, arranged in alternate or subopposite pairs; broad proximally, tapering toward aperature. Hydrotheca margin smooth. Operculum a single flap attached to adcauline side of hydrotheca aperature. Gonophores fixed sporosacs.

Abietinaria amphora Nutting, 1904

Figure 1.17

Abietinaria amphora Nutting, 1904: 119, pl. 34(figs. 2-4).—Fraser, 1911: 58; 1913: 153; 1914: 179; 1935: 144; 1936: 125; 1937: 127; 1948: 235.

Material Examined. California: off Pt. Conception, 2 reproductive colonies, Sta. BRS-073; San Onofre, Barn Kelp Bed, 40 ft; Apr 1973 (USNM).

Description. Colony large, height to about 4 cm. Hydrocaulus straight, with regularly alternate branching pattern; branches and hydrothecae absent on lower stem; 3 hydrothecae present on same side of stem between 2 succesive branch pedicels; secondary branching absent; branch nodes and septa very weak. Hydrothecae nearly opposite; base and about 50% adjacent side adnate.

Gonosome: Gonophores typically arranged in 2 longitudinal rows on face of stem or proximal portions of branches. Gontheca large, fusiform or amphora-shaped, with 4 or 5 longitudinal crests or ridges.

Nematocysts: Not described.

Type Locality and Type Specimens. Holotype - USNM 19821. Pacific Ocean, 54°18'N, 165°55'W, 56 fm [102 m]; coll. R/V *Albatross*, station 2866.

Paratypes - USNM 19900, MSUI 18745.

Distribution. Eastern North Pacific Ocean, Alaska to Tanner Bank, California. Depth range, intertidal to 275 m.

Biology. Information on the biology of this species not found in the literature.

Remarks. The species *Abietinaria costata* (Nutting, 1910) from Alaska closely resembles *A. amphora* and may be a junior synonym.

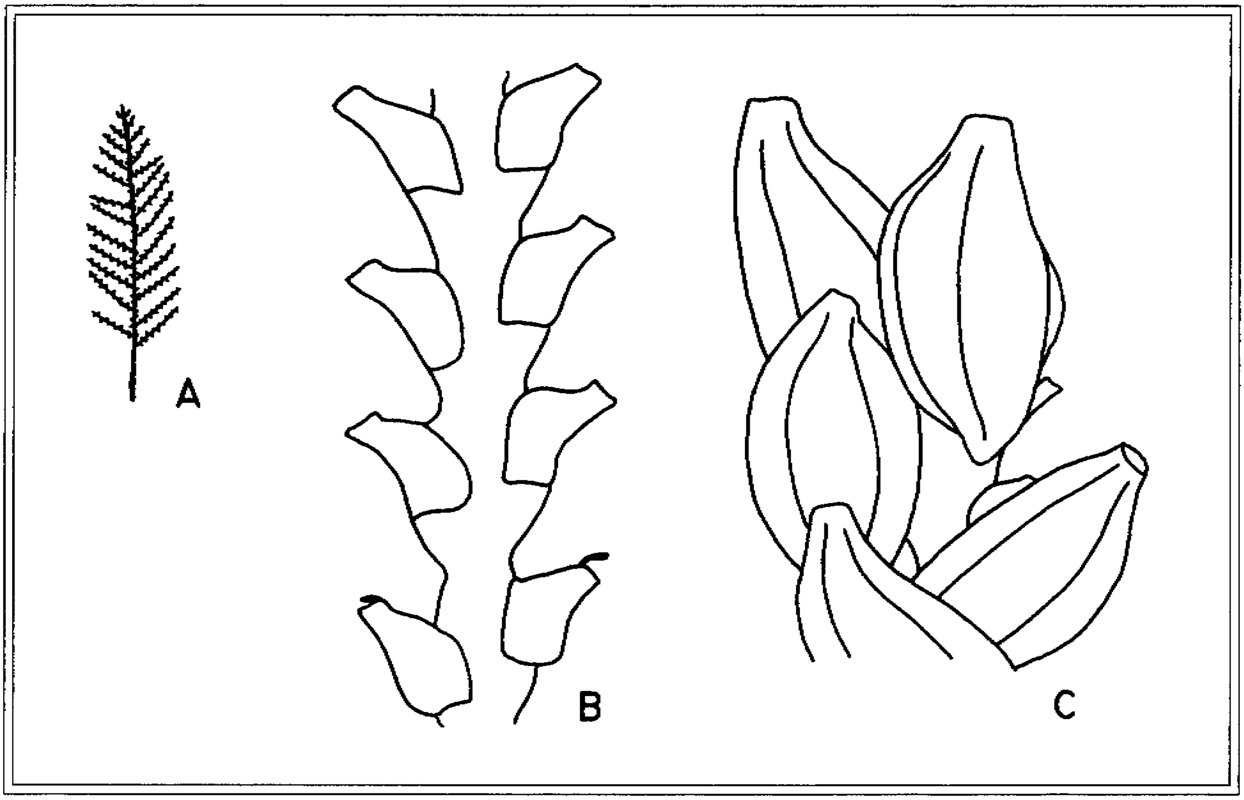

Figure 1.17. *Abietinaria amphora* Nutting, 1904: A. entire colony, natural size; B. portion of branch with hydrothecae, lateral view; C. gonophores (after Fraser, 1937).

Abietinaria pacifica Stechow, 1923

Figure 1.18

Abietinaria pacifica Stechow, 1923: 197. —Fraser, 1937: 134, pl. 29(fig. 154); 1948: 237, pl. 27(figs. 16a-c).

Material Examined. California: Western Santa Barbara Channel, Sta. BRC-01(USNM).

Additional material examined: MMS/MEC CARP; south of Point Arena, 1150 ft [350 m]; cruiseT-11, Sta. SB43 (rep A), 29 November 1987.

Description. Trophosome: Colonies large, height to 9-10 cm. Hydrocaulus simple (monosiphonic) with very weak nodes and septa. Branching pattern alternate; length of branches to 12 mm; 3 widely spaced hydrothecae present between 2 succesive branch pedicels on same side of colony; single hydrotheca present in branch axil; single joint present on each branch at junction of branch and branch pedicel. Hydrothecae regularly alternate, not closely packed; elongate shape; base and about 75-85% of adjacent side adnate, convex; free side slightly concave; neck absent; margin positioned at right angle to stem.

Gonosome: Gonotheca shape obovate, sharply truncated at distal end, collar absent, surface smooth.

Nematocysts: Not described.

Type Locality and Type Specimens. Not searched. Not traced.

Distribution. Eastern North Pacific Ocean - Point Arena, California to San Benito Islands, Baja California, Mexico. Depth range 50-350 m.

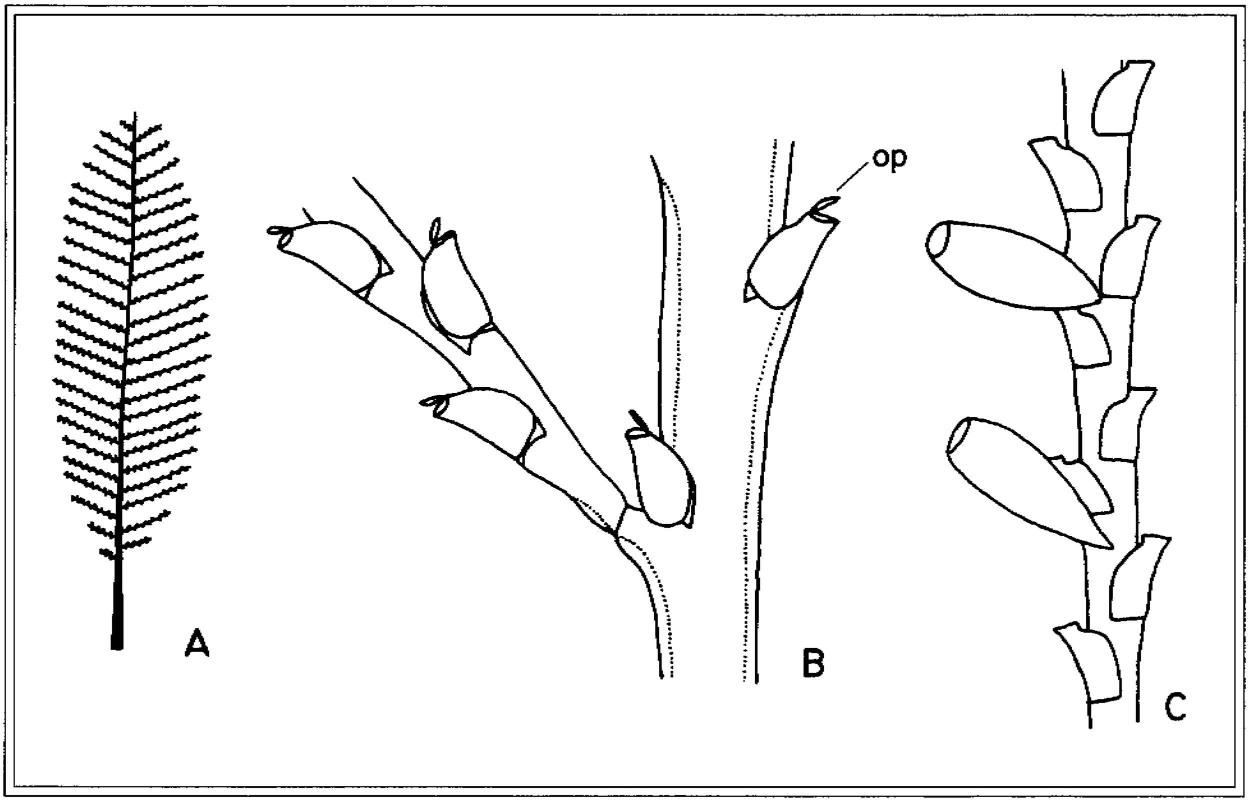

Figure 1.18. *Abietinaria pacifica* Stechow, 1923: A. entire colony, natural size; B. portion of stem showing origin of branch; C. portion of stem showing hydrothecae and gonphores (Figures A, C. after Fraser, 1948; B. after Fraser 1937 from original in Stechow, 1923).

Biology. The original fragment which Stechow (1923) described came from the back of a decorator crab.

Remarks. This species bears a great similarity to *Abietinaria traski* (Torrey, 1902) and is probably closely related if not the same. The principal differences are the shape of the hydrotheca, the distance between successive hydrothecae, and the distance to the first hydrotheca on the branch.

Abietinaria traski (Torrey, 1902)

Figure 1.19

Sertularia traski Torrey, 1902a: 69-70, pl. 9(fig. 83).

Abietinaria traski (Torrey).—Nutting, 1904: 118, pl. 33(figs. 6-11).—Fraser, 1911: 63; 1913: 153; 1914: 182; 1935: 145; 1937: 135-136, pl. 29(figs.156a-b); 1948: 238.—McCormick, 1965: 142-143.

Material Examined. California: off Morro Bay, BRA-27 (USNM).

Description. Stem long, straight, lower portion free of branches; simple (monosiphonic) with poorly developed nodes. Branching pattern alternate; nodes absent on branches. Hydrothecae alternately arranged, rather widely spaced; base and about 50% of hydrotheca adnate, convex; free side very slightly concave. Stem light horn color; branches white.

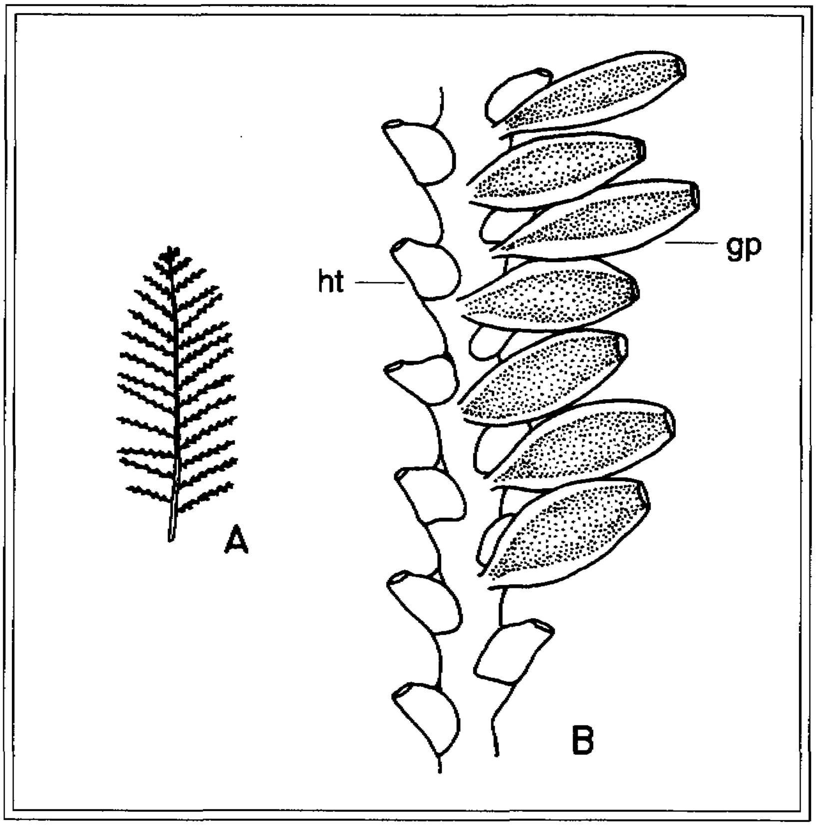

Figure 1.19. *Abietinaria traski* (Torey, 1902): A. Portion of colony, natural size; B. portion of branch with hydrothecae and gonophores, lateral view (after Fraser, 1937).

Gonosome: Gonophores arising in rows on faces of branches, inserted near bases of hydrothecae; gonotheca shape elongate-ovoid, without distinct neck or collar, smooth.

Nematocysts: Not described.

Type Locality and Type Specimens. Presumed to be in the collection of the University of California, not searched. USA, Californa, San Pedro.

Distribution. Eastern North Pacific Ocean, Berg Inlet Alaska to San Benito Islands, Baja California Mexico. Depth range, 10-400 m.

Biology. Information on the biology of this species not reported in the literature.

Remarks. See above remarks under *Abietinaria pacifica.*

Abietinaria variabilis (Clark, 1876)

Figure 1.20

Sertularia variabilis Clark, 1876a: 221-222, pl. 8(figs. 40-48), pl. 9(figs. 49-50).—Kirchenpauer,1884: 35-36, pl. 14(fig. 6).

Thuiaria variabilis: Nutting, 1901: 203.

Abietinaria variabilis: Nutting, 1904: 123.—Fraser, 1911: 63; 1914: 183; 1935: 145, 1936: 25, 1937: 137, pl. 30 (figs. a-c).—Kudelin, 1914: 406, 408, 428, 443, text figs. 140-141, 157-158, pl. 3 (fig. 10, pl. 4 (fig. 1).—Naumov, 1960 [in 1969]: 405-406, text fig. 265, pl. 3 (fig. 3).

Material Examined. SBMNH specimens from California.

Description. Trophosome: Hydrorhiza lamellar. Hydrocaulus straight or slightly sinuous. Branching alternate with branches held at roughly a 45° angle; all in one plane; base of branch constricted but without a clear branch pedicel; branches attached at proximal end of stem internode; sometimes second order branchlets present. Hydrothecae in two rows, alternate, base of one about the midpoint of the one opposite; hydrothecal margin tilted away from branch, sometimes to point of being turned downwards; adjacent side 50 to 90% immersed.

Gonosome: Gonophores typically attached adjacent to base of hydrotheca. Gonotheca shape ovoid, with small stalk, smooth to rugose; up to 10 denticles inside aperature.

Nematocysts: Unknown.

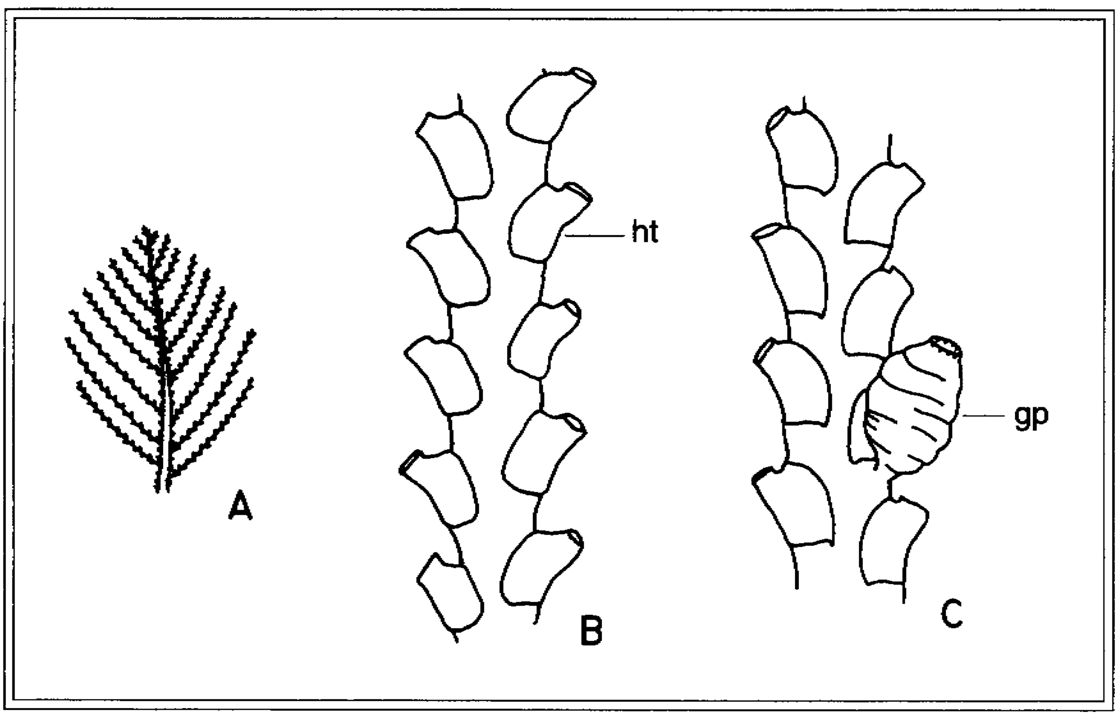

Figure 1.20. *Abietinaria variabilis* (Clark, 1876): A. Portion of colony, natural size; B. portion of branch with hydrothecae; C. branchlet with gonotheca (Figures A-B. after Fraser, 1937; C. after Naumov, 1960 [in 1969]).

Type Locality and Type Specimens. Presumed to be in the collections of YPM, not searched. Not indicated.

Distribution. Eastern North Pacific Ocean, Alaska to southern California. Depth range 25-4000 m, typically 25-100 m. Also reported from Western North Pacific Ocean, Sea of Okhotsk, Bering Sea.

Biology. Unknown.

Remarks. This species varies greatly in shape and proportion. Naumov (1969) immersed *Sertularia anguina* Trask, 1857, and *Abietinaria tilesii* and *A. cartilaginea* both Kirchenpauer, 1876 in this taxon. If this proves to be a valid decision than *A. anguina* (Trask) should be the senior synonym.

Genus *Dynamena* Lamouroux, 1812

Diagnosis. Colonies erect, branched or unbranched; hydrocaulus monosiphonic. Hydrocaulus, and hydrocladia when present, with hydrothecae in 2 longitudinal rows. Hydrothecae sessile, in opposite to subopposite pairs, occasionally in groups of 2 or more pairs per internode. Hydrothecal margin tridentate; median tooth smaller and less conspicuous than lateral teeth. Operculum with 2 valves – adcauline valve usually smaller than abcauline valve and divided into 2 parts by median line. Hydranth without an adcauline diverticulum. Gonophores fixed sporosacs.

Remarks. *Sertularia* differs from *Dynamena* in that the hydrothecae, which are also bicuspidate, are alternate rather than opposite. *Sertularella*, also with alternate hydrothecae, is then distinguishable from *Sertularia* because the hydrothecae are tri-or quadri-cuspidate. There are no true *Sertularia* species on the Pacific coast.

Dynamena pumila (Linnaeus, 1758)

Figure 1.21

Sertularia pumila Linnaeus, 1758: 807.—Pallas, 1766: 130.—Agassiz, 1862: 326, pl. 32; 1865: 141.—Nutting, 1904: 51-53, pl. 1(figs. 1-3).—Broch, 1910: 173, 219.—Fraser, 1911: 74; 1913: 175; 1921: 40.—Kudelin, 1914: 247.—Vervoort, 1946: 252.

Dynamena pumila (Linnaeus).—Naumov, 1960 [in 1969]: 53, text fig. 38; 356-357, text figs. 219A-C.—Cornelius, 1979: 271-273.

[for additional synonyms and references see Nutting, 1904]

Material Examined. California: BLM-OCS Baseline Study 1975-1976 specimens.

Description. Trophosome: Colonies erect; height typically less than 5 cm; arising from creeping hydrorhiza. Base of stem twisted; internodes on stem with 1-3 pairs of opposite hydrothecae; hydrocladia originate singly or in opposite pairs on internode below hydrotheca, branches of the second order may arise. Hydrothecae elongate, slender; sessile, base and about 75% of adcauline side adnate; remaining portion of adcauline side curved outward; margin bicuspidate, teeth sharp, subequal. Operculum with 2 valves.

Gonosome: Gonophores arise from internode below each hydrotheca. Gonotheca shape vase-like to ovoid; with truncated neck or collar, smooth; stem short.

Nematocysts: Not described.

Type Locality and Type Specimens. Not searched. Not traced.

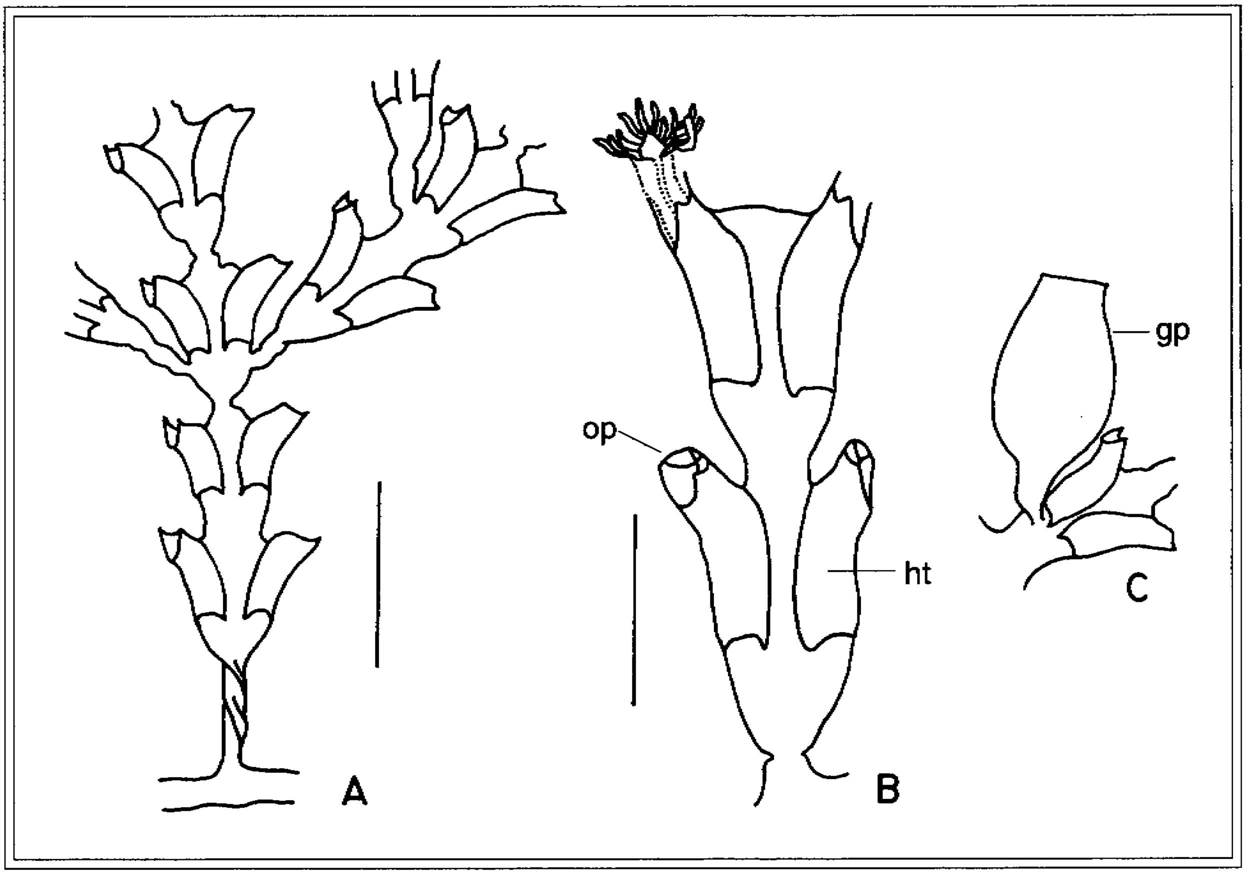

Figure 1.21. *Dynamena pumila* (Linneus, 1758): A. portion of colony near base showing arrangement of hydrothecae; B. two pairs of hydrothecae; C. gonotheca and pair of hydrothecae (after Naunov, 1969). Scales = 1 mm.

Distribution. Eastern North Pacific Ocean, California. Depth range to 250 m. Also reported from Western South Pacific Ocean, New Zealand. Eastern North Atlantic Ocean, Great Britain; Belgium; Italy; Denmark; Norway; Iceland; and Greenland. Western North Atlantic Ocean, Canada (Nova Scotia) and USA (New England).

Common Name. Sea Oak.

Biology. The life cycle is illustrated in Naumov (1960 [in 1969]: fig. 38). Free swimming medusae are absent and planulae are released directly from the gonophores.

Although typically an intertidal form which grows under stones, it has been found at depths to 250 m.

Remarks. Naumov (1969) doubts the reality of Clark's report of this species on the Pacific coast and he restricts its distribution to the north Atlantic and northern Europe. Fraser bases his inclusion of this species in the Californian fauna on Clark's citation. Both *Dynamena desmoides* and *D. cornicina* also occur in California where they have been collected at depths ranging from 2-1860 m (BLM-OCS Baseline study, 1975-76).

Family Thyroscyphidae Stechow, 1920

Diagnosis. Colonies stolonal or erect, arising from a creeping hydrorhiza; growth commonly monopodial with terminal growing points. Hydrothecae radially to bilaterally symmetrical; pedicellate, or both sessile and pedicellate in the same colony, or sessile but adnate only at diaphragm. Hydrothecal margin entire, or with 3-4 teeth; operculum of 1, 3 or 4 valves, and either persistent or shed early; annular diaphragm present. Hydrants with an annular fold basally, or with an abcauline diverticulum; hypostome conical, surrounded by a whorl of filiform tentacles. Gonophores fixed sporosacs.

Remarks. Members of this family were originally included in the family Sertulariidae. They were subsequently removed to the subfamily Thyroscyphinae by Stechow (1920) and the subfamily Parascyphinae by Splettstösser (1929). Most authorities currently place them in a separate family (see Calder, 1986, 1991).

Genus *Symplectoscyphus* Marktanner-Turneretsher, 1890

Diagnosis. Colonies and hydrotheca similar to *Sertularella* but hydrotheca margin with 3 teeth and operculum with 3 valves. Gonophores fixed sporosacs; gonotheca walls strongly ridged.

Remarks. This genus has been recognized by most recent authors as similar to but distinct from *Sertularella* on the basis of the number of teeth on the margin of the hydrotheca and the number of operculum valves.

Key to Species of Thyroscyphidae

1A. Hydrothecal wall annulated; gonotheca entirely covered with numerous upcurved spines .... *Symplectoscyphus pedrensis*

1B. Hydrothecal wall smooth 2

2A. Teeth unequal; stem erect, stout; gonotheca with few low relief spines distally around opening .... *Symplectoscyphus turgidus*

2B. Teeth equal; gonotheca annulated with distinct ridges .... *Symplectoscyphus tricuspidata*

Symplectoscyphus pedrensis (Torrey, 1904)

Figure 1.22

Sertularella conica **non** Allman, 1877.—Torrey, 1902a: 60-61, text figs. 19-21.

Sertularella pedrensis Torrey, 1904b: 27.—Fraser, 1911: 70; 1914: 191; 1937: 155; 1938: 110; 1948: 243-244.

Symplectoscyphus pedrensis: Cairns *et al.*, 1991: 27.

Material Examined. California, San Diego.— 1 colony; OCSD 8942, Sta. 12 (rep. 2), 60 m; 20 January 1989.— several colonies; OCSD 052, Sta. T-6(haul 4), 36 m.

Description. Trophosome: Colony erect; small, usually less than 2 cm; with one or more branches, arising directly from creeping stolon. Hydrocladia with 1 hydrotheca per internode, hydrothecae alternate. Internodes fairly short with hydrothecae at distal end; nodes weak but obvious. Hydrotheca with tricuspidate margin; walls smooth or with faint annulations, stronger distally.

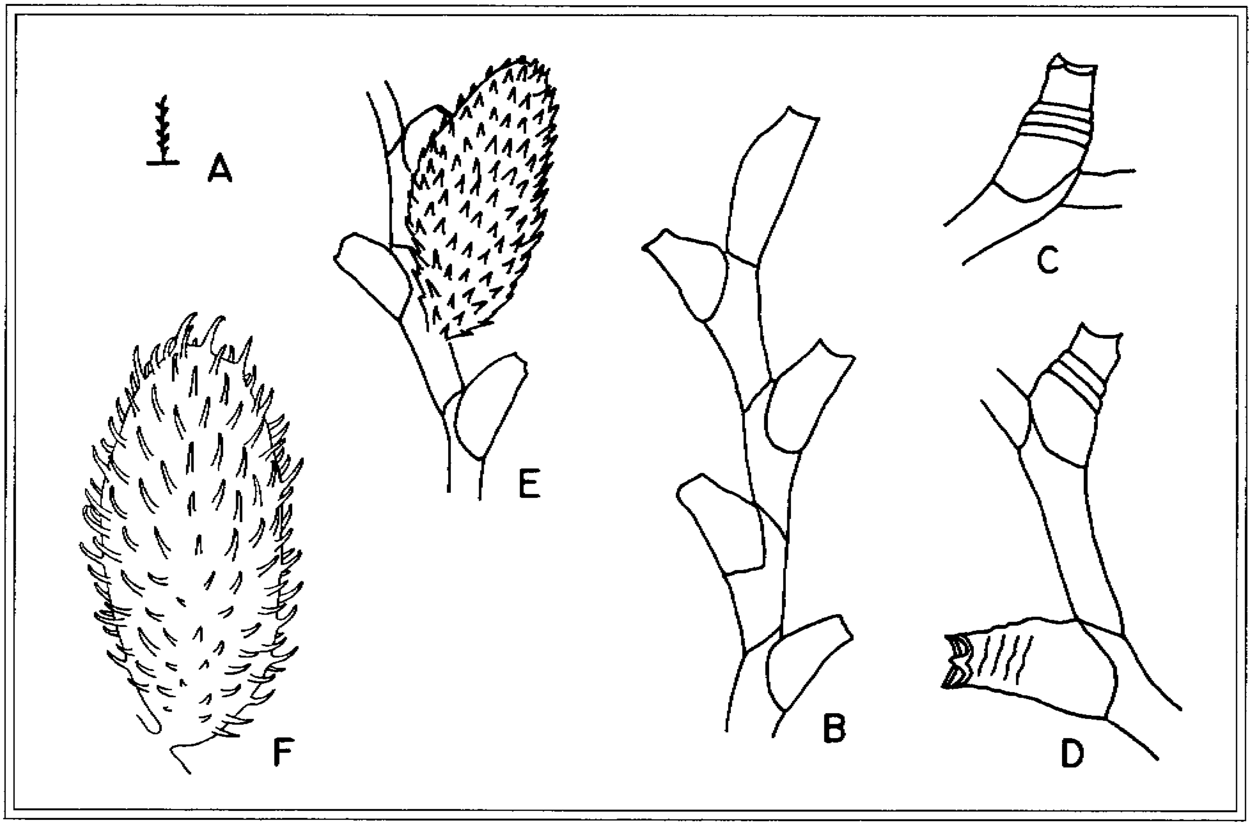

Figure 1.22. *Symplectoscyphus pedrensis* (Torrey, 1904): A. entire colony, natural size; B. portion of stem and smooth hydrothecae; C-D. details of sculptured hydrothecae; E. portion of stem with gonotheca; F. detail of spinouse texture of gonotheca (Figures A, B, E. after Fraser, 1937; C, D, F. after Torrey, 1905).

Gonosome: Gonophores large; shape spherical to elongate-ovoid structures; walls covered by short, upcurved spines.

Nematocysts: Not described.

Type Locality and Type Specimens. Types presumed to be in the collections of the University of California, not searched. USA, California, San Pedro.

Distribution. Eastern North Pacific Ocean, British Columbia, Canada to Costa Rica. Depth range, 16-96 m.

Biology. Colonies typically form tufts on algae and other living substrates. Naumov 1960 [in 1969] considered the species to have a type III life cycle in which a free medusa stage is suppressed and planulae are liberated from the gonangium. This type of reproductive behavior limits dispersal of larvae to the immediate vicinity of the parent colony.

Remarks. Fraser's illustrations (1937) of this species show the gonophores as more elongate than typically seen in specimens from southern California.

Symplectoscyphus tricuspidata (Alder, 1856)

Figure 1.23

Sertularia tricuspidata Alder, 1856: 356, pl. 13(figs. 1-2).

Cotulina tricuspidata: Agassiz, 1865: 146.

Sertularella tricuspidata: Clarke, 1876a: 224, pl. 6(figs. 26-27).—Nutting, 1899: 741; 1901: 201; 1904: 100-102, pl. 25(figs. 3-7).—Calkins, 1899: 360, pl. 4(figs. 2A-C).—Torrey, 1904b: 28.—Fraser, 1911: 71; 1913: 154; 1914: 193; 1933: 260; 1935: 145; 1936: 126' 1937: 159, pl. 36 (figs. 191a-c); 1948: 246.

Symplectoscyphus tricuspidatus (Alder).—Stechow, 1923: 173.—Vervoort, 1972: 166-168, text figs. 54a-b.—Cairns *et al.*, 1991: 27.

Sertularella hesperia Torrey, 1902: 63-64, pl. 7(figs. 57-58).

Type Locality and Type Specimens: Types presumed to be in collections of the University of California, not searched. California, mouth of San Diego Harbor, 1-9 fm [2-16 m].

For additional synonymy information see Nutting 1904.

Material Examined. California: 1 colony; OCSD 8721, Sta. C (rep. 1), 59 m; 25 April 1987.

Description. Trophosome: Colony erect, small; arising from creeping stolon; branched in alternate or dichotomous pattern. Stem slender, twisted at intervals; internodes regularly present above each hydrotheca; nodes marked by pronounced constriction of stem but without strong septum; hydrothecae at distal ends of internodes set on slight shoulder. Base and about 20-30% of adcauline side of hydrothecae adnate with stem. Hydrothecae large, maximum length 0.4 mm, maximum diameter 0.2 mm; cylindrical shape, tubular with straight or curved sides, often slightly expanded; walls smooth, without annulations; margin with 3 teeth; operculum with 3 valves. Hydrothecae sometimes prolonged with reduplications of margin.

Gonosome: Gonophores large, height to 1.6 mm; numerous on stem and branches. Gonotheca shape ovoid; distinct raised ridges or ribs present as continuous rings around gonotheca; with small tubular or funnel-shaped aperture.

Nematocysts: Unknown.

Type Locality and Type Specimens. Reported to be in England at MNHNT (Nutting, 1904); not searched. Not traced.

Distribution.: Eastern North Pacific Ocean, Alaska to Todos Santos Island, Baja California, Mexico. Depth range, 1-500 m.

Circumpolar, boreo-arctic species. Also reported from the Eastern North Atlantic Ocean, Great Britain, Denmark, Iceland, Greenland. Western North Atlantic Ocean, New England to Canada (Newfoundland).

Biology. Information on the biology of this species is not reported in the literature.

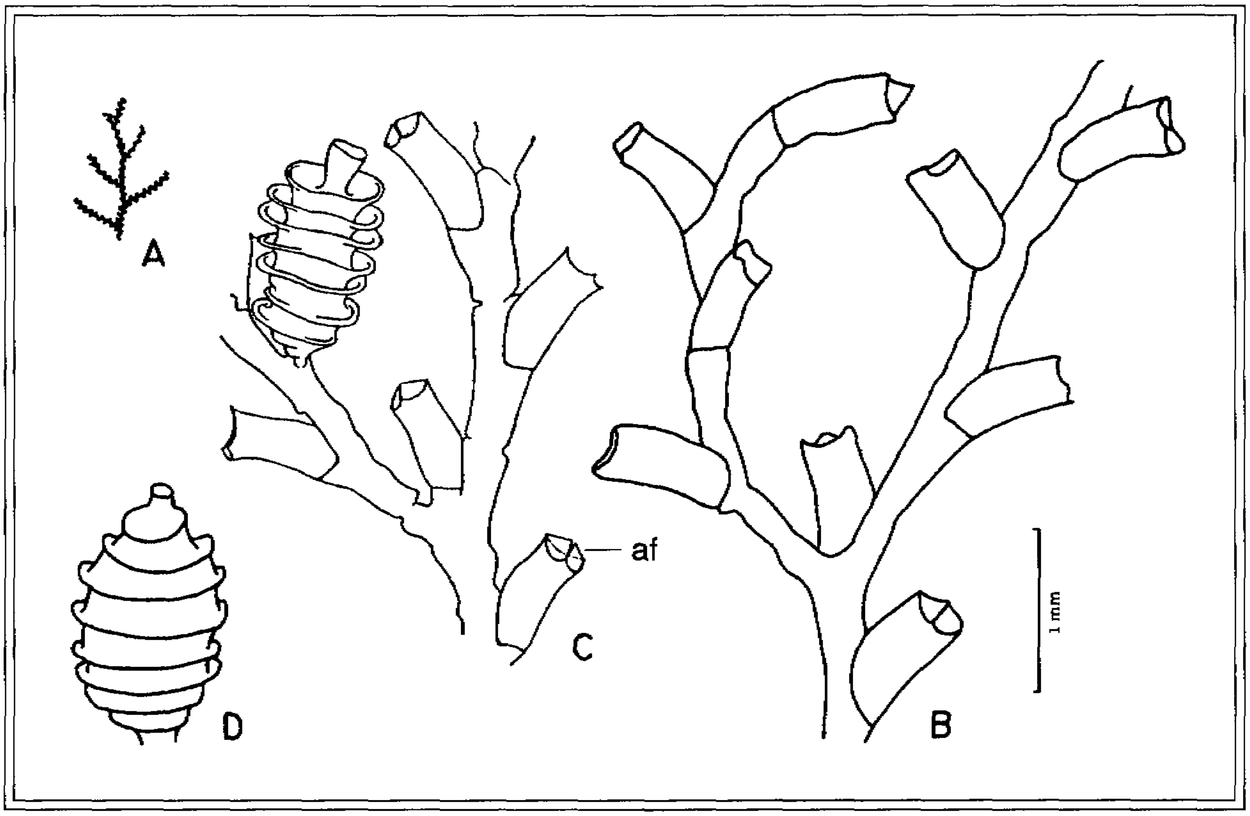

Figure 1.23. *Symplectoscyphus tricuspidata* (Alder, 1856): A. entire colony, natural size; B-C. portion of stem showing branching and hydrothecae; C. branch with attached gonotheca; D. gontheca (Figures A, B, D. after Fraser, 1937; C. after Naumov, 1960 [in 1969]).

Symplectoscyphus turgidus (Trask, 1857)

Figure 1.24

Sertularia turgida Trask, 1857: 113, pl. 4(fig. 1).

Sertularella turgida: Clark, 1876a: pl. 38(figs. 4-5).—Torrey, 1902a: 64, pl. 7(figs. 59-62), pl. 8(figs. 63-69); 1904b: 29, text figs. 22-23.—Nutting 1904: 85.—Fraser 1911: 71; 1913: 154; 1914: 193; 1935: 145; 1936: 126; 1937: 160; 1940: 41; 1948: 246.—McCormick, 1965: 141.—Lees, 1986: 106.

Symplectoscyphus turgidus (Trask).—Cairns *et al.*, 1991: 27.

Sertularella conica **non** Allman, 1877.—Calkins, 1899: 359, pl. 4(fig. 22).

Sertularella nodulosa Calkins, 1899: 360, pl. 5(figs. 29A-B).

Material Examined. California: off Pt. Conception, BRA-02 (USNM).

Description. Trophosome: Colony erect; small, up to 2 cm; irregularly branched, branches nearly same size as main stem. Hydrothecae arranged in alternate pattern on stem; shape tubular, with straight sides; margin tricuspidate; base and 25-50% of adcauline side of hydrotheca adnate with stem.

Gonosome: Gonophores in axils of hydrothecae. Gonotheca spindle-shaped; distal end with few, low-relief spines.

Nematocysts: Not described.

Type Locality and Type Specimens. Presumed to be in the collections of CAS; probably not extant; not searched. San Francisco Bay, California.

Distribution. Eastern North Pacific Ocean, Alaska to San Benito Islands and Santa Maria Bay, Baja California, Mexico. Depth range, low intertidal, 0-200 m.

Biology. Typically attached on rocky bottoms. McCormick (1965) recorded several epibionts on *Symplectoscyphus turgidus*, namely a foraminiferan (*Cibicides lobatulus*), demosponge, hydroid (*Lafoea adnata*) and mollusk (*Skeneopsis* sp.).

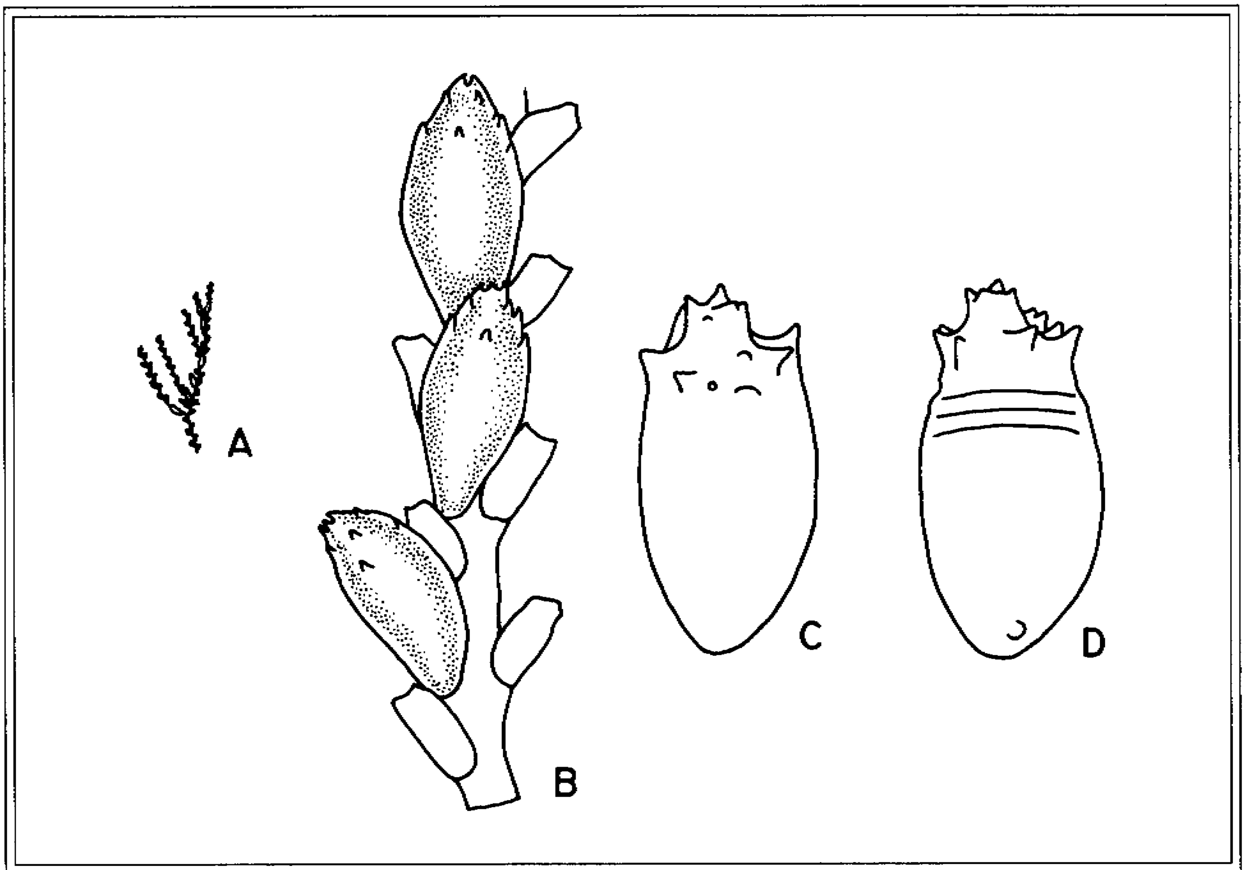

Figure 1.24. *Symplectoscyphus turgidus* (Trask, 1857): A. portion of colony, natural size; B. portion of branch showing hydrothecae and gonothecae; C-D. details of gonotheca sculpture (Figures A-B. after Fraser, 1937; C-D. after Torrey, 190).

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2. Class Anthozoa: Subclass Octocorallia
Orders Stolonifera and Pennatulacea

by

F. G. Hochberg[1] and John Ljubenkov[2]

Introduction

Octocorals are colonial anthozoans in which, as is typical of the class, the medusoid stage is completely absent. Unlike hydrozoan polyps the mouth leads into a tubular pharynx that extends more than half way into the gastrovascular cavity. The gastrovascular cavity in turn is divided by longitudinal septa into radiating compartments and the edges of the septa bear nematocysts. The gonads are gastrodermal in origin and the mesoglea is cellular.

The Subclass Octocorallia, also know as the Alcyonaria, is comprised of forms whose polyps have very uniform construction. Although sizes vary, the basic polyp plan consists of a cylindrical body and a single ring of tentacles that surrounds to flattened oral disk. Unlike other anthozoans, the symmetry of this group is invariably octomerous. All members have 8 complete or perfect septa and 8 tentacles. Each tentacle bears a series of fingerlike processes, termed pinnules, in a featherlike arrangement along both sides (Figure 2.1). There is a single siphonoglyph and muscle bands are always on the sucal side of the septa. Almost all species have an internal skeleton formed by separate of fused calcareous sclerites in the mesogloea. In colonial forms, such as sea pens and sea fans, a horny central axis may be present.

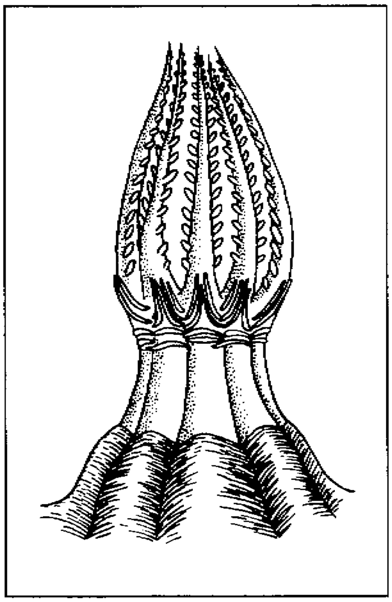


Figure 2.1 Generalized illustration of an octocoral.

The flagella in the siphonoglyph move water into the polyp. Strong flagella on the asulcal septa, the two septa opposite the siphonoglyph, force water out of the pharynx. The elongate mouth, flattened pharynx and single siphonoglyph confer a bilateral symmetry on otherwise radially symmetrical polyps. The siphonoglyph surface often is termed the ventral surface.

Polyps project from stolons, fleshy mats or vertical extensions of coenenchyme. Polymorphism in polyps typically occurs in some orders. Gastrozooids or autozooids are large bear tentacles and function mainly in feeding. Siphonozooids, although tiny and lacking tentacles, have powerful siphonoglyphs that help to ventilate large colonies. A third group of intermediate sized zooids, the mesozoids, may also be present.

[1] Department of Invertebrate Zoology, Santa Barbara Museum of Natural History, 2559 Puesta del Sol Road, Santa Barbara, CA 93105-2936 USA

[2] MEC Analytical Corp., 2433 Impala Drive, Carlsbad, CA 92009 USA

The common names given to the different octocoral groups are based on the different growth patterns observed. In sea pens the shape is similar to a fern frond when alive but resembles a narrow pen when contracted or preserved. In sea pansies the colony is leaf-shaped with polyps on the upper side of the rachis. In both groups the colony is anchored in soft sediment by a stalk or peduncle. The related sea fans grow in a lattice-like or branched pattern.

The systematics of west coast octocorals is in need of critical review. The confusion is due in part to the cosmopolitan distribution of a number of species which when first collected off California were described as new species. A second problem relates to the lack of types for may of the taxa described from the west coast. The excellent reviews by Williams (1965) and Bayer (1956,1981) have helped to resolve much of the generic confusion surrounding many species names that potentially represent synonyms that still need to be resolved (see also Dunn, 1982).

Collection and Preservation

The majority of the telestaceans and pennatulaceans examined in this study were collected by bottom trawl. Although small species or specimens can be collected intact and in good condition, most large species/ specimens are broken or otherwise damaged when the come up in large trawl hauls. Gorgonians which are attached to rocks or other hard substrates typically are collected by dredge or grab. Small specimens come up in good shape but again large specimens are often damaged in the process of collecting. For species that live in depths accessible to divers it is better to collect animals by hand to prevent damage. Sea pens should be individually dug out of soft sediments taking care to remove the entire animal including the peduncle. Gorgonians can be removed from the rocks to which they attach by using a know or chisel.

Prior to fixation and preservation specimens should be narcotized in order to allow the zooids to expand. A variety of techniques can be used to relax octocorals. Each species has to be individually tested to determine what method works best. Chilled sea water works well with shallow water forms, and allowing deep water specimens to warm up to room temperature is also effective. Chemical agents such as menthol, magnesium chloride, magnesium sulfate and MS 222 or other standard narcotizing agents also can be used.

Specimens to be stored in wet collections should be fixed in 5-10% buffered formalin for no more than 24 hours. Large trays or pans should be used for fixing specimens in order to keep them as straight as possible. Specimens should not be fixed in storage jars unless they are very small. Following fixation specimens should be rinsed in freshwater and then placed in 70% ethyl alcohol for long term preservation.

Large specimens of sea pens and sea fans are often so long or bulky that they are difficult to house. Several methods are used to store long pens. 1) In older collections sea pens are often stored in long glass tubes with cork or rubber stoppers at each end. Although the specimens are preserved straight with distortion they are difficult to study because the entire specimen (often several meters in length) has to be removed in order for any portion of the colony to be examined. In addition, long, thin glass containers are difficult to house unless special racks are built to prevent breakage. 2) Prior to placing in regular museum storage jars, long pens can be coiled and tied in several places with thin cordage while still soft and flexible. However with this method they are difficult to remove and handle for study. Following preservation the axis often becomes brittle and when such specimens are untied and uncoiled, they often break. 3) Specimens may be broken in several places prior to fixation and preservation in standard museum jars. The disadvantage with this method is that such specimens many be difficult to reassemble unless each piece is tagged to indicate its position in the colony. In this method it also is advisable to tie all the pieces of each specimen together especially if several specimens are placed in the same jar.

Gorgonians, especially large specimens, typically are sun dried following collection or fixation. Small specimens of gorgonians or sections of large specimens in which the polyps have been relaxed should be preserved in alcohol. Dried gorgonians are placed in boxes or plastic bags to provide protection in drawers. Tags for dried specimens should be tied to a branch or to the main stem and not left loose in the box or bag.

Whenever possible color photographs of live animals should be taken to document the form and color of living colonies.

Laboratory Study

The study of all octocorals requires an analysis of the calcareous sclerites that are present in different part of the colony. Temporary mounts are made by first removing small pieces of tissue from various parts of the body and placing each piece on a separate glass microslide (1 × 4 inch). Be sure to record from what part of the colony each tissue sample has been taken. The tissue on each microslide is then dissolved in several drops of sodium hypochlorite (liquid bleach). When the tissue is gone add several drops of water to rinse the preparation. With a fine pipette remove the excess liquid and add a small cover slip (22 × 22 mm) prior to examination under a compound microscope. Measurement and drawings should be made to determine the ranges in sizes and variations in shapes and textures of sclerites from different sections of the body. In older specimens that have been stored in unbuffered formalin or acidic alcohol, the sclerites may have dissolved and be completely absent. However, several sea pen taxa lack sclerites or have very small ones that easily are overlooked. It is best to examine fresh or recently collected specimens for sclerites.

In the case of pennatulaceans, measurements should be made of the colony's total length and then the relative lengths of the rachis and peduncle. The total number of pinna (polyp bearing leaves per colony) and the number of gasterozoids per pinna also are important characters. The number and location of siphonozoids associated with the rachis and pinna are other key characters to observe. Details of external morphology, such as the number and location of siphonozooids, especially small ones embedded in the rachis, often can be enhanced by applying a small amount of aqueous methylene blue to the region being examined.

Glossary

Anthocodia. Upper tentacular part of polyp which in most cases can be retracted within the rind or calyx.

Anthostele. Lower, thickened part of polyp body wall into which the anthocodia may be withdrawn; commonly stiffened with spicules (see also calyx).

Asulcal. Side of polyp opposite siphonoglyph.

Autozooid. Feeding polyp with 8 well-developed tentacles and septa; only kind of polyp in monomorphic species and major type in dimorphic species [= gastrozooid; see siphonozooid].

Axis. Central supporting structure of Gorgonacea and Pennatulacea; in the former, it may be spicular, consolidated or unconsolidated, or horny, with more or less nonspicular calcareous matter.

Axoblast. Individual scleroblast of the axis epithelium.

Bark. Rind of holaxonian Gorgonacea.

Calyx. Wart-like projecting anthostele.

Coenenchyme. Colonial spiculiferous mesogloea.

Collaret. Transverse, subtentacular ring of spicules.

Cortex. Outer coenenchymal layer of gorgonaceans, especially Scleraxonia; outer, horny layer of holoaxonian axis, as opposed to its medulla.

Crown and points. Transverse collaret with superposed opercular rays.

Filament. Thickened, convoluted edge of septum; in Octocorallia, filaments of 2 septa opposite siphonoglyph are very long and heavily flagellated, whereas those of remaining six are shorter and glandular.

Gastrovascular cavity. Interior space of polyp radially partitioned by septa.

Medulla. Central zone of scleraxonian stem; rarely, central chord of holaxonian axis.

Mesentary. Soft septum.

Mesogloea. Jelly-like substance separating the 2 cellular epithelial layers of cnidaria.

Operculum. Anthocodial spicular apparatus that more or less closes calyx or protects tentacles in contraction.

Oral disc. Distal integument of polyp surrounding mouth, enclosed by ring of tentacles; forms roof over gastrovascular cavity.

Peduncle. Sterile stalk found in sea pens, typically buried in soft sediments.

Pharynx. Tubular passageway between mouth and gastrovascular cavity.

Physa. Inflated tip of peduncle in sea pens.

Pinnule. Digitate lateral branch of tentacle of octocoral polyps.

Polyp. Individual of octocoral colony (= zooid).

Polyp leaf. United proximal part of adjacent polyps that produces a leaf-like expansion, from margin of which anthocodiae project.

Polypary. Colony as a whole.

Rhachis. The polyp bearing portion of a pennatulacean colony, often appears featherlike (see peduncle).

Rind. Outer, spiculiferous coenenchyme of Holaxonia gorgonians.

Sclerite. Calcareous skeletal element of mesogloea, irrespective of form (= spicule).

Scleroblasts. Ectodermal cells of mesogloea that produce calcareous sclerites.

Septum. Thin radial noncalcareous partition dividing gastrovascular cavity of polyp (see mesentery).

Siphonoglyph. Strongly ciliated groove extending down one side of pharynx.

Siphonozooid. Polyp with reduced tentacles or none, and commonly reduced septal filaments; usually much smaller than autozooids.

Solenium. Canal lined with gastrodermis penetrating coenenchyme and interconnecting gastric cavities of polyps.

Spicule. Properly, a long sharp sclerite (see sclerite).

Sulcal. Side of polyp nearest siphonoglyph.

Sulcus. See siphonoglyph.

Verruca. Calyx; tubercle of sclerite.

Zooid. Any individual of colony, irrespective of its morphological specializations (= polyp; in most German works; = siphonozooid).

List of Species

Subclass Octocorallia Haeckel, 1866
- Order Stolonifera Hickson, 1883
  - Family Telestidae Milne-Edwards and Haime, 1857
    - *Telesto californica* Kükenthal, 1913
    - *Telesto nuttingi* Kükenthal, 1913
    - *Telestula ambigua* (Nutting, 1909)
- Order Pennatulacea Verrill, 1865
  - Suborder Sessiliflorae Kükenthal, 1915
    - Family Stachyptilidae Kölliker, 1880
      - *Stachyptilum superbum* Studer, 1894
    - Family Ombellulidae Williams, 1995
      - *Ombellula magniflora* (Kölliker, 1880)
  - Suborder Subselliflorae Kükenthal, 1915
    - Family Halipteridae Williams, 1995
      - *Halipteris californica* (Moroff, 1902)
    - Family Pennatulidae Ehrenberg, 1834
      - *Pennatula californica* Kükenthal, 1913
      - *Ptilosarcus gurneyi* (Gray, 1860)
    - Family Virgulariidae Verrill, 1868
      - *Virgularia agassizii* Studer, 1894
      - *Acanthoptilum album* Nutting, 1909
      - *Acanthoptilum gracile* (Gabb, 1863)
      - *Stylatula elongata* (Gabb, 1862)

Description of Species

Subclass Octocorallia Haeckel, 1866
Order Stolonifera Hickson, 1883

Family Telestidae

***Telesto californica* Kükenthal, 1913**

Figure 2.2

Telesto rigida Nutting, 1909: 685. Not Wright and Studer, 1889.
Telesto californica Kükenthal, 1913:229-231, text figs A, B, pl.7 (figs. 1, 2).—Ljubenkov, 1980: 56

Material Examined. BLM-OCS collections.

Description. Colonial octocoral composed of an axial polyp with lateral, branching polyps whose size is equal to the axial polyp. Base of colony lamellar. The primary (axial) polyp may give rise to secondary and tertiary polyps. The polyps have eight longitudinal furrows which indicate mesenterial insertions; proximal part of polyp empty. The stiff walls of the polyps contain mainly warty spindles for spicules.

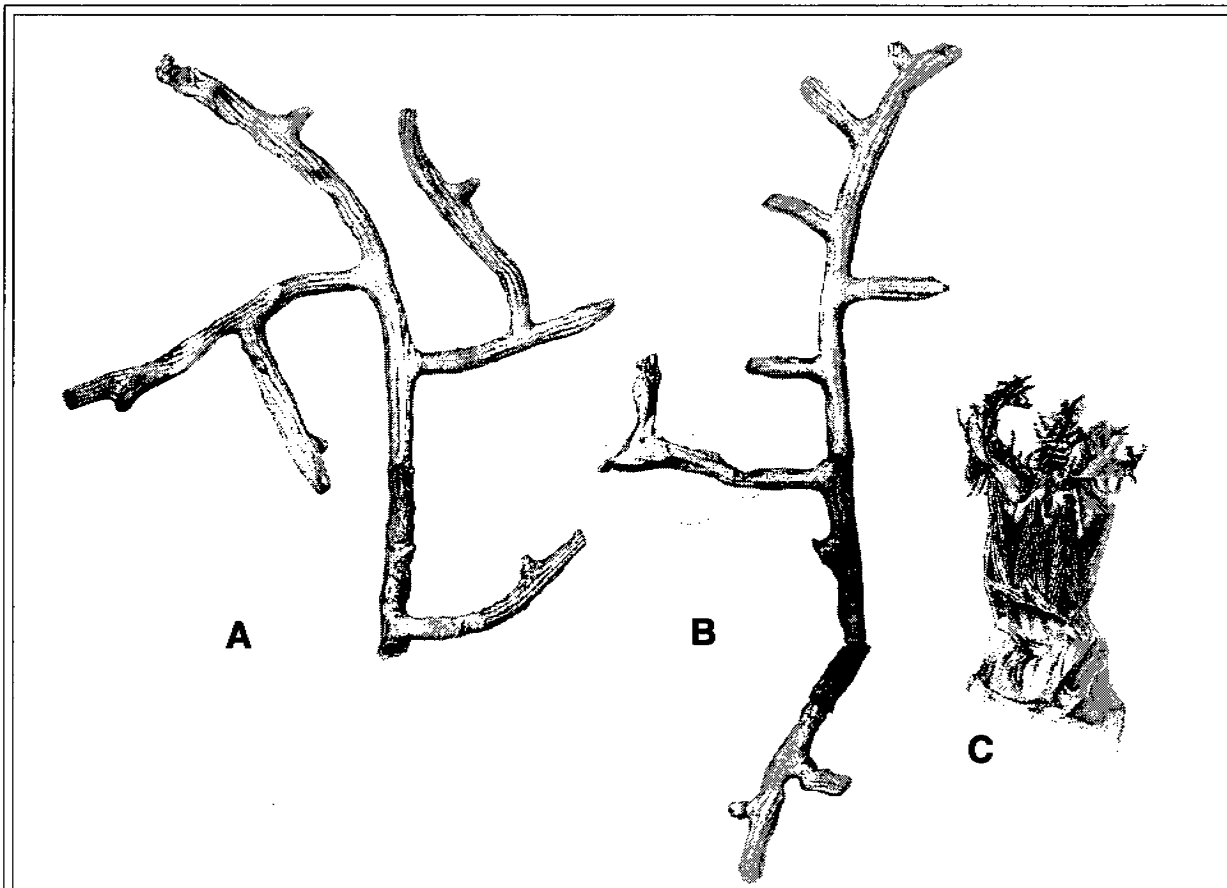


Figure 2.2 *Telesto californica*, views of colony: A, SBMMH 01-65-32; B, USC 1948-50; C, detail of polyp SBMNH 51530.

Type Locality and Type Specimens. Holotype, not designated in original description. California, bearing 8.6° W 2.5 mi off east point San Nicolas Island, 31 fm [57 m]; coll. USBCF *Albatross*, station 4422.

Distribution. Southern California and probably northern California.

Biology. While noted from 31 fms by Nutting, this is primarily a species from outer shelf and upper slope areas. BLM-OCS benthic photos often showed this species on the sill between basins.

Remarks. Nutting thought this was Wright and Studer's *T. rigida*, but Kükenthal recognized it as a new species.

Telesto nuttingi Kükenthal, 1913

Figure 2.3

Telesto nuttingi Kükenthal, 1913: 231-233, text figs C, D, pl.7 (fig. 3).

Material Examined. BLM-OCS collections; SBMNH

Description. Colony composed of an axial polyp with lateral polyps whose size is equal to or less than the axial polyp. Longitudinal furrows deep and narrow. Length of longest polyps 75 mm; proximal part of polyp empty. The axial polyp also has short lateral polyps except where the larger branches originate. Anthocodial spicules are flattened spindles (0.18 x 0.06 mm) thickly studded with warts. Color orange gold to bright gold.

Type Locality and Type Specimens. Holotype not designated; possibly still in the collections at SIO. Southern California, China Point, 48 fm [88 m].

Etymology. Named in honor of Nutting for his work on octocorals.

Distribution. Southern California.

Biology. Unknown.

Remarks. Kükenthal found this species in the collections at the "Biological Station in La Jolla" while reviewing Nutting's material.

Genus *Telestula* Madsen 1944

Diagnosis. Octocorals with small slender zooids in which mesenteries extend down to stolon only while zooids are young; lower part of coelenteric cavity in older zooids partially filled with mesogloeal tissue. Proximal part of zooid developed into stem-like structure which may constitute largest part of zooid; secondary zooids may arise from this area. Proximal part of secondary zooids developed in similar manner when colony reaches certain size. Secondary zooids of higher order may occur. Sclerites of body wall typically blunt, coarsely tuberculate oval plates; those of intrusion tissue much-branched irregular forms more or less fused together.

Type species. *Telestula septentrionalis* Madsen; by original designation.

Remarks. Colonies like *Telesto* but smaller and less profusely branched.

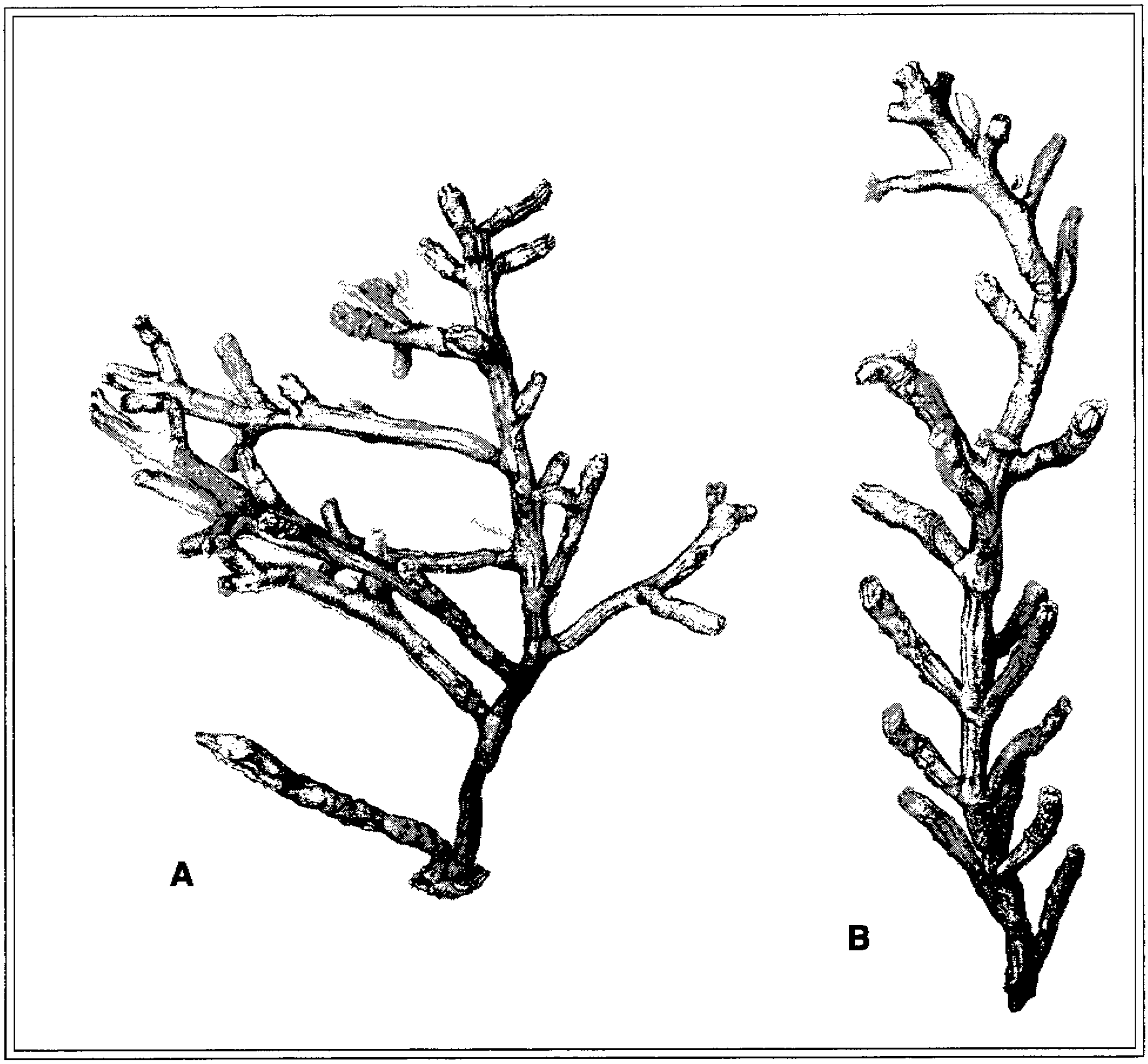


Figure 2.3 *Telesto nuttingi*, views of colony: A, SBMNH; B, SBMNH 1348-4.

Telestula ambigua (Nutting, 1909)

Figure 2.4

Telesto ambigua Nutting, 1909: 686, pl. 84(fig. 1, 2), pl. 90(fig. 1).
Telestula ambigua: Bayer, 1952: 131.

Material Examined. Holotype (see below).

Description. Colony with simple monopodial branching; base membranous. No regularity to secondary and tertiary branching. Height to 14 mm.

Spicules in polyp walls not fused; slender, thorny spindles in calyx walls.

Color in alcohol pale yellowish-brown, lighter distally; longitudinal furrows lighter than background, animal appears banded.

Type Locality and Type Specimens. Holotype - USNM 25421. Monterey Bay, California, bearing S 39° E 10.7 mi off Pt. Pinos lighthouse, 524 fm [958 m]; coll. USBCF *Albatross*, station 4514.

Distribution. California, currently known only from the type locality.

Biology. Unknown.

Remarks. Lack of fused spicules and growth mode separate this genus from *Telesto*.

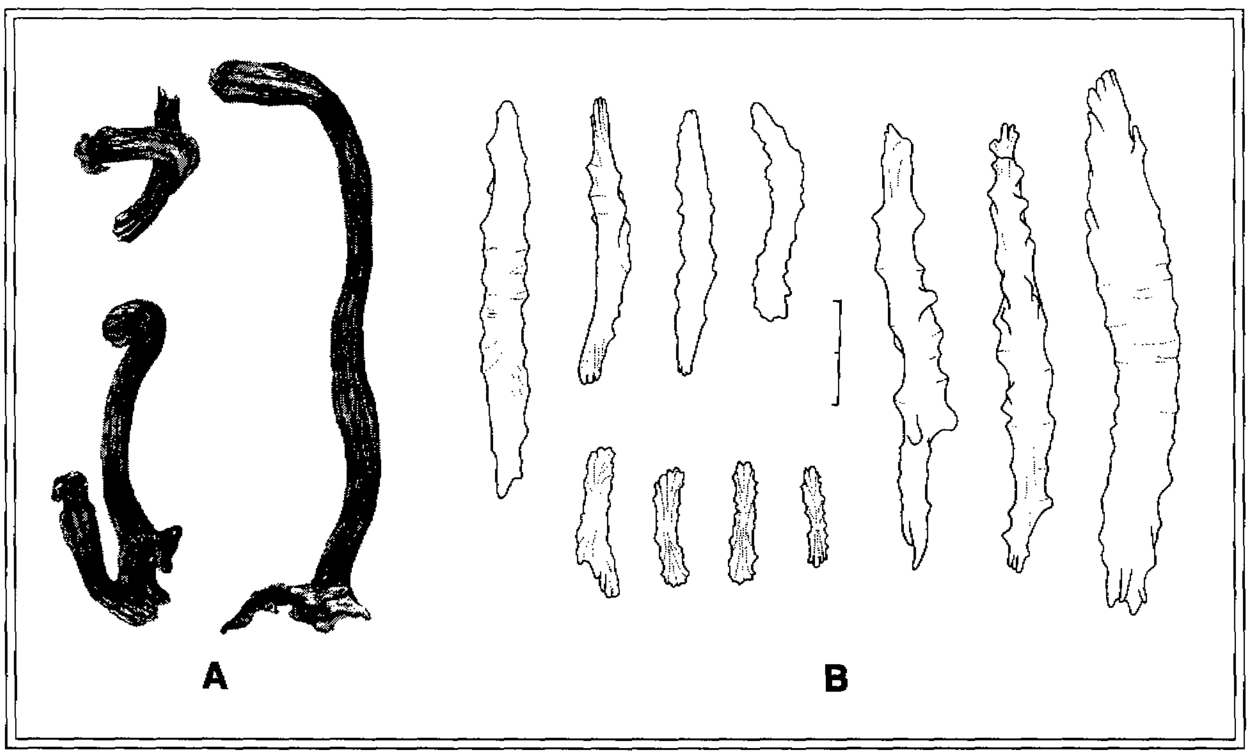


Figure 2.4. *Telesto ambigua*: A, views of 3 polyps from colony, Holotype, USNM 25421; B, sclerites from the body.

Order Pennatulacea Verrill, 1865

Key to Families of Pennatulaceans

(Modified from Hickson, 1916)

1A.	Rachis radially symmetrical; axis present, rudimentary or absent	Veretillidae
1B.	Rachis bilaterally symetrical	2
2A.	Axis absent	3
2B.	Axis present	4
3A.	Rachis flattened, leaf-shaped	Renillidae
3B.	Rachis cylindrical or club-shaped	Echinoptilidae
4A.	Autozooids irregularly distributed or arranged in longitudinal rows on the rachis	5
4B.	Autozooids arranged in whorls or bilateral pairs	7
4C.	Autozooids arranged in transverse or oblique rows or in primitive leaves	8
4D.	Autozooids arranged in well developed leaves supported by spicules	10
5A.	Autozooids without calices	Kophobelemnidae
5B.	Autozooids with calices	6
6A.	Autozooids of various stages of growth arranged in closely set oblique rows on the rachis	Funiculinidae
6B.	Autozooids arranged in longitudinal rows on the rachis	Protoptilidae
7A.	Arranged in single terminal whorl or tassle	Ombelullulidae
7B.	Arranged in several whorls or pairs	Chunellidae
8A.	With ventral radial canals; gonads developed in fully formed autozooids	Halipteridae
8B.	With dorsal radial canals	9
9A.	Gonads developed in fully formed autozooids	Anthoptilidae
9B.	Gonads developed in young autozooids	Virgulariidae
10A.	Siphonozooids on leaves absent	Pennatulidae
10B.	Siphonozooids on leaves present	Pteroeididae

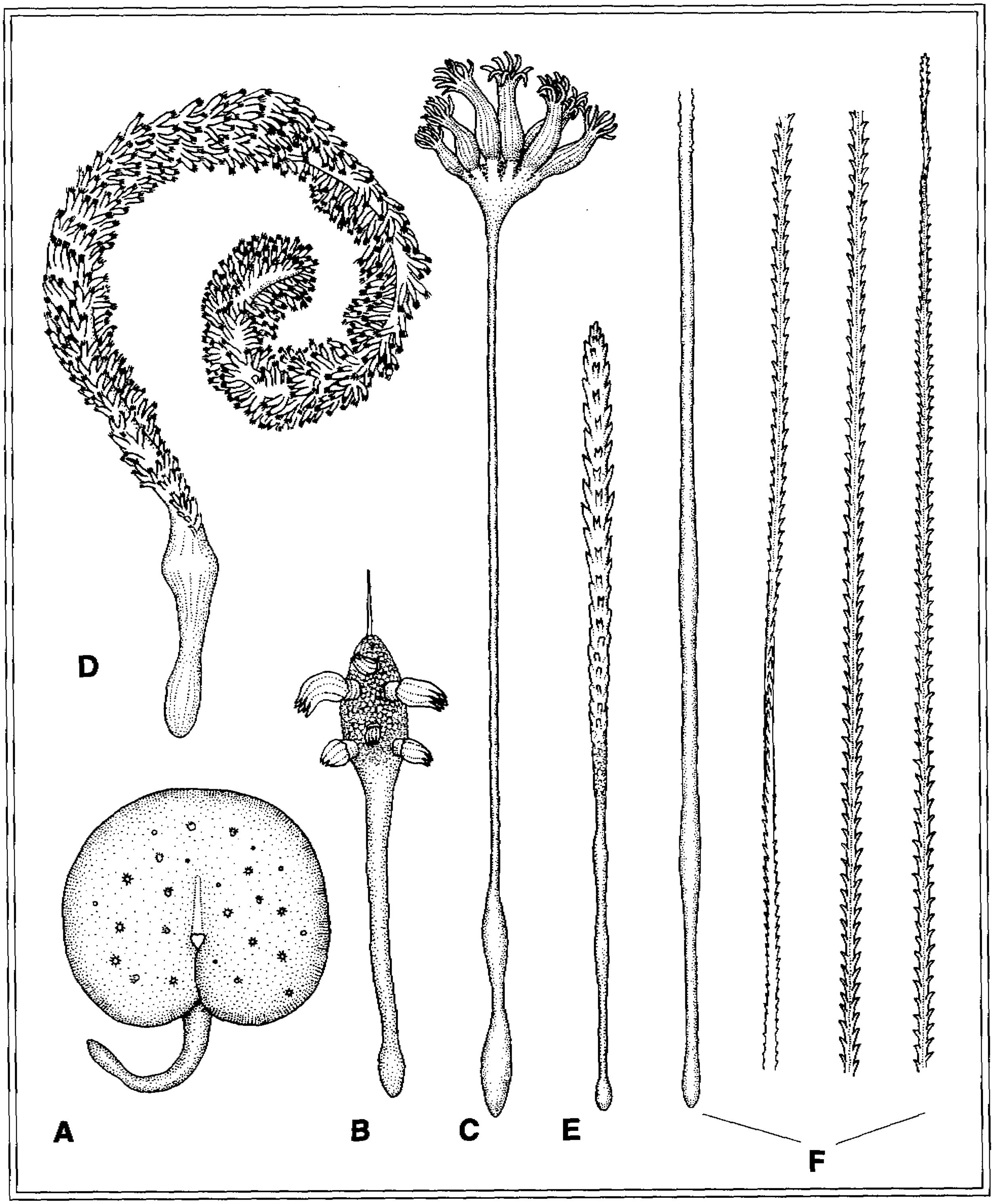


Figure 2.5. Genera of sessiliflorae pennatulaceans, entire colonies: A. *Renilla amethystina*: 10-25 m, Redondo Canyon, CA (SBMNH 51257), 60 mm RL; B. *Kophobelemnon affine*: 2430-2710 m, Monterey Bay, CA (SBMNH), 100 mm TL; C. *Ombellula lindhali*: 1005-1060 m, off Avila, Santa Lucia Banks, CA (SBMNH 49154), 350 mm TL; D. *Anthoptilum grandiflorum*: 457-512 m, off Avila, Santa Lucia Banks, CA (SBMNH 49152), 380 mm TL; E. *Stachyptilum superbum*: 181 m, off Avila, Santa Lucia Banks, CA (SBMNH 49156), 100 mm TL; F. *Distichoptilum gracile*: 1260-1277 m, off Avila, Santa Lucia Banks, CA (SBMNH 49155), 1100 mm TL.

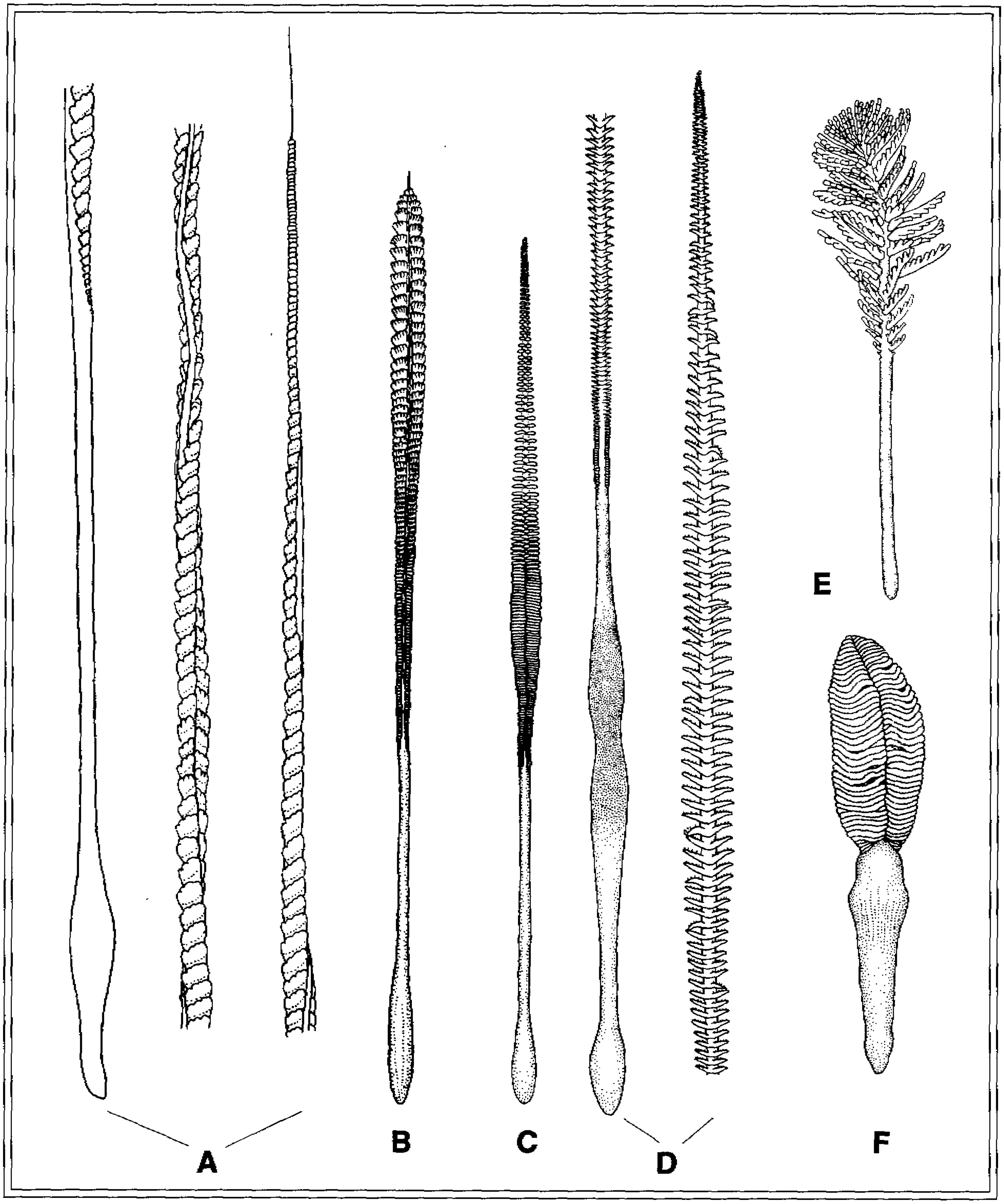


Figure 2.6. Genera of subselliflorae pennatulaceans, entire colonies: A, *Halipteris californica*: 475 m, Santa Barbara Channel, CA (SBMNH 45568), 950 mm TL; B, *Stylatula elongata*: (modified from MacGinitie & MacGinitie, 1968), 280 mm TL; C, *Virgularia agassizi*: 14 m, off Santa Barbara, CA (SBMNH 49487), 300 mm TL; D, *Acanthoptilum gracile*: 15-35 m, off Santa Catalina Island, CA (SBMNH 49691), 650 mm TL; E, *Ptilosarcus gurneyi*: 15-35 m, off Santa Catalina Island, CA (SBMNH 49688), 225 mm TL; F, *Pennatula californica*: 475 m, Santa Barbara Channel, CA (SBMNH 45509), 90 mm TL.

Suborder Sessiliflorae Kükenthal, 1915

Family Stachyptilidae Kölliker, 1880

Genus *Stachyptilum* Kölliker, 1880

Diagnosis. Colonies stout and clavate or slender, firm or spongy in texture. Symmetry of rachis bilateral throughout. Axis present throughout length of colony. Polyp leaves absent. Autozooids arranged in oblique rows in 2 longitudinal series along rachis. Each row disposed alternately to corresponding row on other side of rachis. Anthocodiae 3 to several per row, retractile into densely-spiculated calyces. Calyces indistinctly toothed or with 2-3 long terminal teeth. Siphonozooids mostly in oblique rows between rows of autozooids, often with calyces formed by fan-shaped arrays of sclerites. Sclerites of polyp calyces and rachis with 3-flanged needles and spindles; peduncle may have oval- or rod-shaped plates; tentacles may have rods (modified from Williams, 1995)

Type Species. *Stachyptilum macleari* Kölliker, 1880; by monotypy.

Stachyptilum superbum Studer, 1894

Figure 2.7

Stachyptilum superbum Studer 1894: 56.—Nutting, 1909: 708-709; pl. 37(figs. 5, 6).— Balss, 1910: 36.— Kükenthal and Brock, 1911: 261-265; text-figs. 84-91.—Kükenthal, 1913: 259-261; text-figs. C^1, D^1, pl. 8(fig. 9).

Material Examined. California, Santa Maria Basin, off Pt. Sal, CAMP 1-1, Sta. R7, rep. 3, 0.5, 0-10 cm.,(2).

Description. A short, stubby colony with completely adnate leaves that appear to fall into spirals. 4-7 polyps per "whorl". Polyps fully retractile into a heavily spicularized calyx, with at least 2-6 larger spicules protruding at top. On one side calyces absent from strip containing 2 rows of siphonozooids. Patches of siphonozooids also present below each calyx. Axis not running into physa. Balloonlike physa perforated with "cinclides". An empty chamber parallel to axis.

Type Locality and Type Specimens. See Studer, 1894. Panama, Gulf of Panama, 7°16'45"N, 79°56'30"W, 210 fm [384 m]; coll. USBCF *Albatross*, station 3389.

Distribution. Central and southern California.

Biology. Occurs on Slopes.

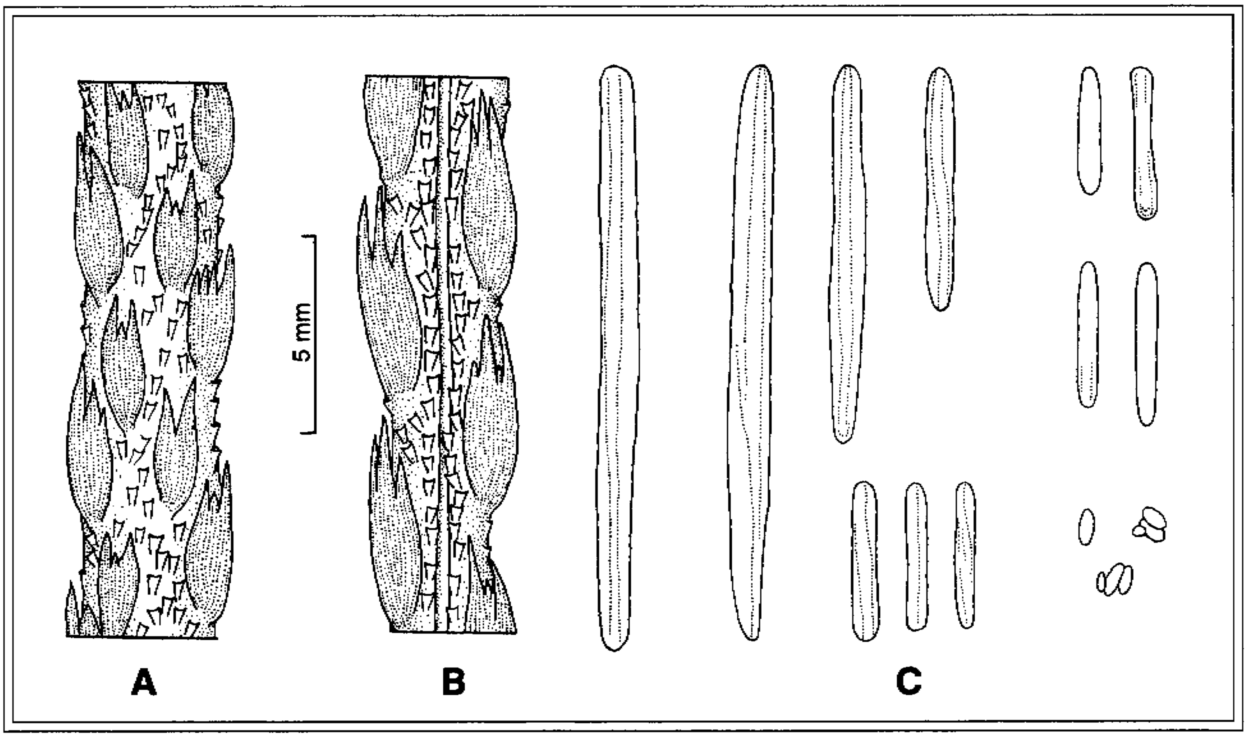


Figure 2.7. *Stachyptilum superbum*: A, B, views of colony; C, sclerites from the body. SBMNH 49156.

Family Ombellulidae Williams, 1995

Genus *Ombellula* Cuvier, 1798

Diagnosis. Colonies with long, slender stalk and terminal cluster of polyps. Symmetry of rachis bilateral. Conspicuous axis present throughout colony; round to quadrangular in cross-section. Polyp leaves absent. Autozooids restricted to terminal cluster containing 1-40 polyps. Anthocodiae non-retractile, calyces absent. Siphonozooids present on rachis at base of autozooids and below terminal cluster on upper part of stem. Sclerites present (in only 3 species) or totally absent (in all other species). When present sclerites spindles, rods, ovoid rods, or needles; three-flanged or round in cross-section; surfaces often rough with numerous low knobby tubercles. Sclerites often present in tentacles, walls of autozooids and peduncle (modified from Williams, 1995).

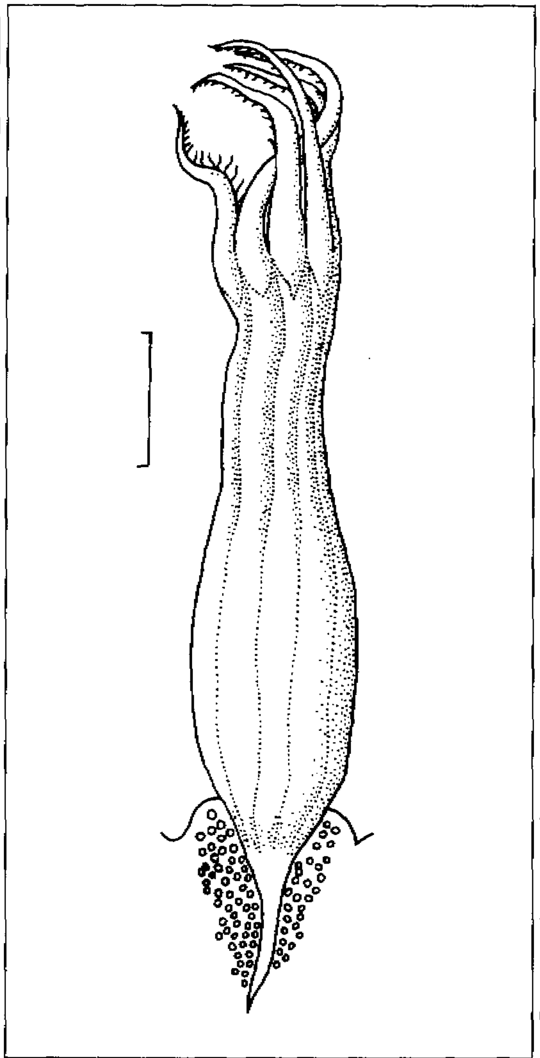
Type Species. *Isis encrinus* Linnaeus, 1758; by subsequent designation.

***Ombellula magniflora* Kölliker 1880**

Figure 2.8

Umbellula magniflora Kölliker, 1880: 240.—Nutting, 1912: 420.—Pasternak, 1962: 126.—Ljubenkov, 1980:58.
Umbellula loma Nutting, 1909: 712-713, pl. 87 (fig. 9).

Type Locality and Type Specimens. Types presumed to be at University of California, Scripps Institution of Oceanography; not extant. USA, California, off San Clemente Island, 330 fm [604 m].



Material Examined. California: BLM-OCS, SCCWRP collections. Pt. Piedras Blancas, 35°29.3'N, 121°35.8'W, 906 m; coll. R/V *Agassiz*, 25 ft otter trawl, 1 April 1974; SIO B174-12; N of Catalina Island, 33°33.5'N, 118°39'W, 534-585 m; SIO 76-95, 40 ft otter trawl, 9 March 1976; SIO CO-422; N end of Santa Catalina Island, 33°33.5'N, 118°38'W, 556-585 m; coll. SIO 76-96, 40 ft otter trawl, 9 March 1976; SIO CO-426.

Description. Distinctive long stem with tuft (or rachis) of rather large polyps at distal end. Rosette shaped rachis with only one ring of secondary autozooids at outer margin. Up to twelve zooids; axis square. Sclerites absent throughout colony.

Type Locality and Type Specimens. West of Kerquelen Island, 1600m. Types not extant.

Distribution. Southern California.

Biology. Occurs in deep basins usually below about 400 m.

Remarks. Many more species of *Umbellula* have been described since early specimens were taken from many places. However, Pasternak (1962) collapsed all forms which locked sclerites into 3 species, namely: *U. magniflora, U. lindahli,* and *U. thomsoni.*

Figure 2.8. *Ombellula magniflora*: view of single polyp (SBMNH 49154).

Suborder Subselliflorae Kükenthal, 1915

Family Halipteridae Williams, 1995

Genus *Halipteris* Köllier, 1869

Diagnosis. Colonies long, slender, whip-like. Rahcis bilaterally symmetrical throughout. Axis extends throughout colony length; round to quadrangular in cross section. Polyp leaves present in mature colonies as ridges. Autozooids disposed in many oblique rows along 2 longitudinal series. Adjacent autozooids often united at their bases forming raised ridges, which emerge from opposite sides of rachis. Anthocodiae retractile into calyces with 2 terminal teeth. Siphonozooids sparsely scattered on rachis between oblique rows of autozooids. Sclerites: calyces with 3-flanged spindles; peduncle with smooth rods; tentacles often with three-flanged rods.

Type Species. *Virgularia christii* Koren and Danielssen, 1847; by subsequent monotypy (see Kölliker, 1869).

***Halipterus californica* (Moroff, 1902)**

Figure 2.9

Pavonaria californica Moroff, 1902: 393-394.—Kükenthal, 1913: 249-250; table 8; pl. 8(figs. 6, 7), text-figs. V,W.

Balticina californica: Nutting, 1912: 40.

Balticina pacifica Nutting, 1909: 704-705; pl. 87(figs. 1,2); 1913; pl. 6(fig. 4).

Type Locality and Type Specimens: Holotype - USNM 25426. USA, California, bearing S 59°E 5.6 mi off Pt. La Jolla, Soledad Hill, 243-280 fm [444-512 m]; coll. USBCF *Albatross*, station 4326

Halipteris contorta Nutting, 1909: 707-708; pl. 86(figs. 3,4).

Type Locality and Type Specimens. Holotype - USNM 25427. USA, California, Santa Catalina Island, bearing SW 2.1 mi off SE Point, 52-88 fm [95-161 m]; coll. USBCF *Albatross*, station 4409.

Stachyptilum quadridentatum Nutting, 1909: 709; pl. 87(figs. 7,8).

Type Locality and Type Specimens. Holotype: USNM 25428. USA, California, bearing N 86°30' E 9.4 mi off Point Loma lighthouse, 92-108 fm [168-198 m]; coll. USBCF *Albatross*, station 4360.

Material Examined. SBMNH specimens from California.

Description. *Colony* large. Axis runs into physa. *Polyps* very large, non-retractile; arranged in 114+ rows, 2-5 per row; polyps surround and obscure stem. Calyces with thorny spines; decreasing in size from first to last to last polyp in each row. Siphonozooids,15 to 20 between each row of polyps; not surrounded by spicules. *Spicules* confined to polyps and calyces; tentacles spiculate. Spicules bar shaped.

Type Locality and Type Specimens. Types unknown. Presumed to be from the coast of California, details of locality not provided in original description.

Distribution. Off California, about 200 m and deeper.

Remarks. Moroff may not have macerated the polyps and therefore overlooked their spicules which led Nutting to place this in *Balticina*.

Biology. An Outer Shelf to Basin floor species. Benthic photographs of living *Balticina* show the polyps expanded to great size while the colony leans over so that the distal end nearly touches the substrate.

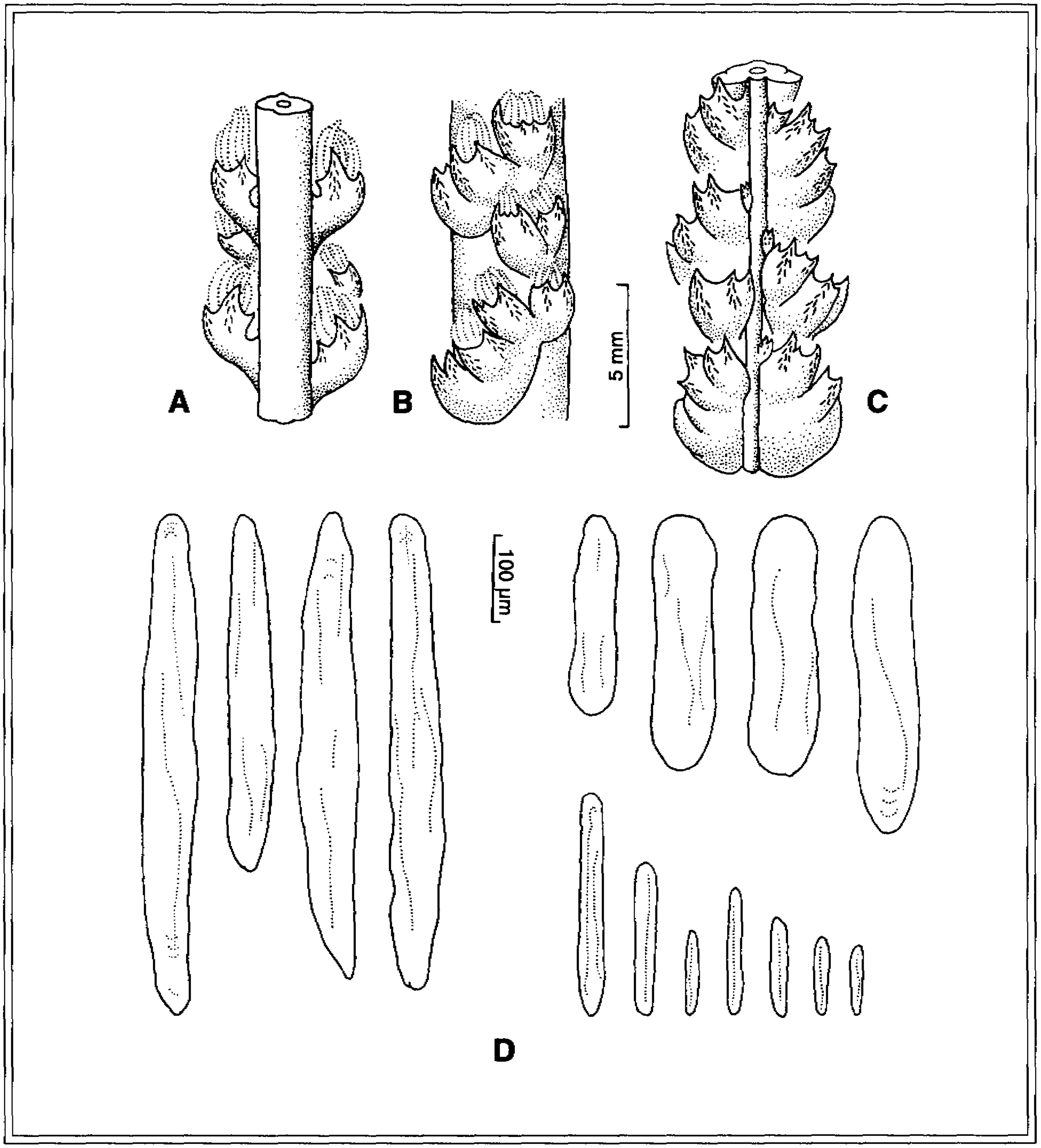


Figure 2.9. *Halipterus californica* : A, B, C views of colony; D, sclerites from the body. SBMNH 45568.

Family Pennatulidae Ehrenberg, 1834

Genus *Pennatula* Linnaeus, 1758

Diagnosis. Colonies feather-shaped in appearance. Symmetry of rachis bilateral throughout. Axis present throughout length of colony. Polyp leaves present, usually large and conspicuous, deltoid, sickle-shaped, or fan-shaped. Autozooids arranged in 1 or more rows along margins of polyp leaves. Anthocodiae retractile into spiculiferous calyces. Calyces tubular, most often with 8 terminal teeth. Siphonozooids confined to rachis, often extending between polyp leaves. Mesozooids also may be present on rachis or on margins of polyp leaves opposite the autozooids. Sclerites: calyces with 3-flanged needles; peduncle surface with 3-flanged rods; peduncle interior with tiny ovals.

Type Species. *Pennatula phosphorea* Linnaeus, 1758; by monotypy.

***Pennatula californica* Kükenthal, 1913**

Figure 2.10

Pennatula aculeata Nutting, 1909: 688-689.

Pennatula phosphorea var. *californica* Kükenthal 1913: 241-243.

Material Examined. BLM-OCS collections.

Description. A relatively small pennatulid with 20+ pairs of leaves (pinnae) with up to 10 autozooids per leaf; leaves stiff and heavily spicularized. Stem swollen below the rachis. Siphonozooids on ventral surface of stem in bands on either side of a bare median strip. Spicules are needles and bars of a bright carmine color which give color to the colony.

Type Locality and Type Specimens. Holotype not designated, but all specimens apparently come from Pt. Loma or the Channel Islands.

Distribution. Throughout California possibly the west coast.

Biology. Occurs at the base of slopes and basins generally below 400 m.

Remarks. Nutting (1909) insufficiently described his species *Pennatula aculeata*. Kükenthal (1913), who re-examined some of Nutting's specimens, states that a note in the jar in Nutting's handwriting identifies 10 specimens of *P. phosphorea* from *Albatross* "Station 4407". Nutting does not list this station but he does list an *Albatross* Station 4417 which is perhaps what Kükenthal meant.

Genus *Ptilosarcus* Verrill, 1865

Diagnosis. Colonies stout; feather-shaped. Rachis bilaterally symmetrical throughout. Axis extends length of colonly. Polyp leaves present; kidney-shaped, margins often sinuous. Autozooids crowded on distal margins of polyp leaves. Anthocodiae retractile into calyces. Calyces spiculiferous, usually with 1-2 indistinct to very conspicuous terminal teeth. Siphonozooids numerous; in 2 longitudinal tracts along rachis, clumped or continuous, not present on polyp leaves. Sclerites - calyces and polyp leaves with three-flanged needles and spindles or longitudinally grooved oval-shaped plates and rods; peduncle with smooth, relatively large ovals.

Type Species. *Sarcoptilus gurneyi* Gray, 1860; by subsequent monotypy.

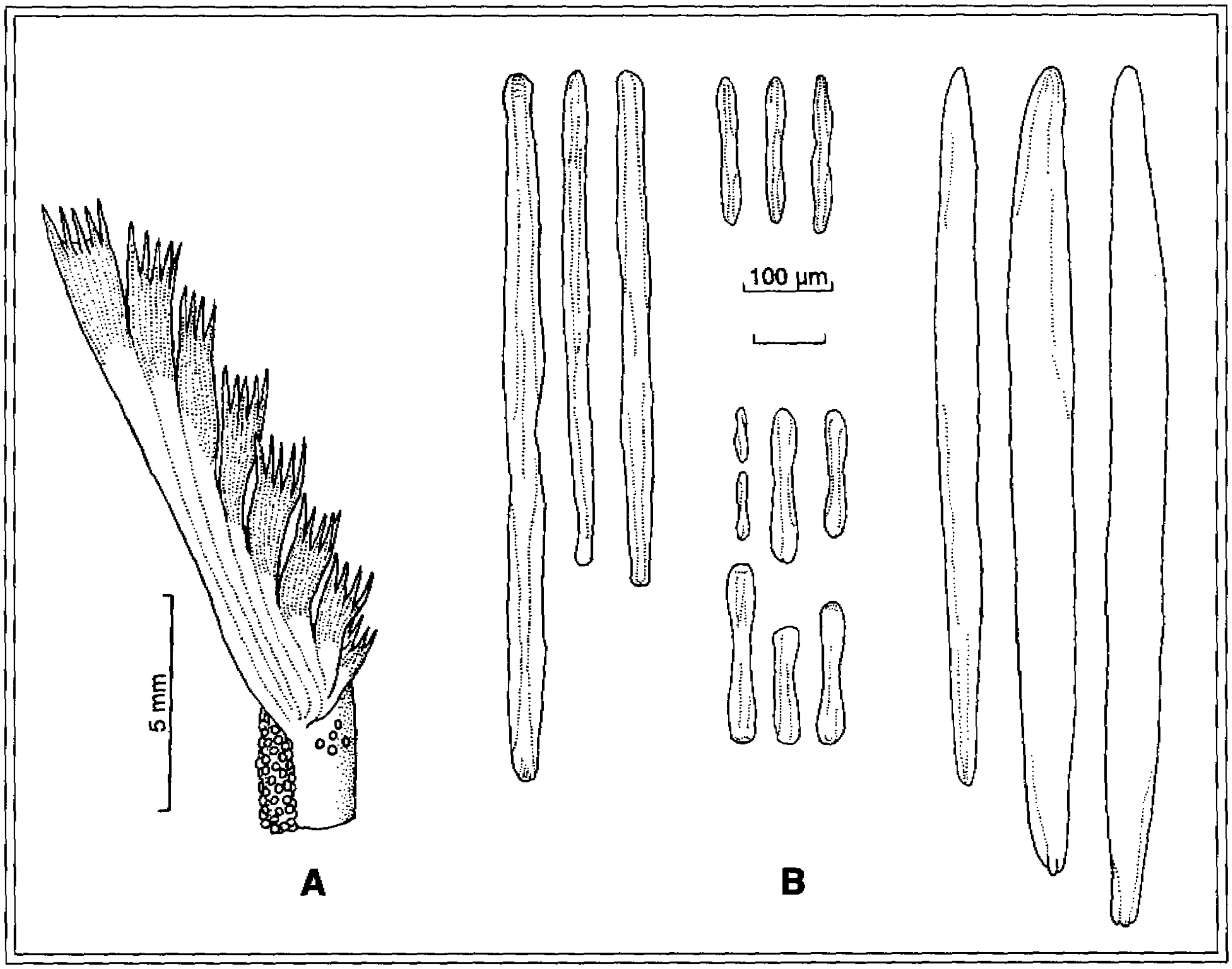


Figure 2.10. *Pennatula californica*: A, lateral view of pinna; B, sclerites from the body. SBMNH 45509.

Ptilosarcus gurneyi (Gray, 1860)

Figure 2.11

Material Examined. BLM-OCS, Orange County, and SBMNH collections.

Description. Colony shaped like a fleshy feather with a very fat stem; with 52+ leaves per side, and about 150 polyps per leaf in 3 rows. Two wide rows of siphonozooids present on ventral side of rachis with bare zone between them. Spicules include spindles and needles colored violet, red, orange, and purple. Stem square in cross section. Nutting (1909) contains a detailed anatomical description of an individual.

Type Locality and Type Specimens. Not searched. Not traced.

Distribution. Pacific coast from Alaska through Baja California.

Biology. A shelf species which occurs intertidally in colder waters. Often forms dense beds where they are preyed on by several sea stars.

Remarks. See Batie, 1972 for the extensive synonyms of this species including *Sarcoptilus*, *Leioptilum* and their anagrams.

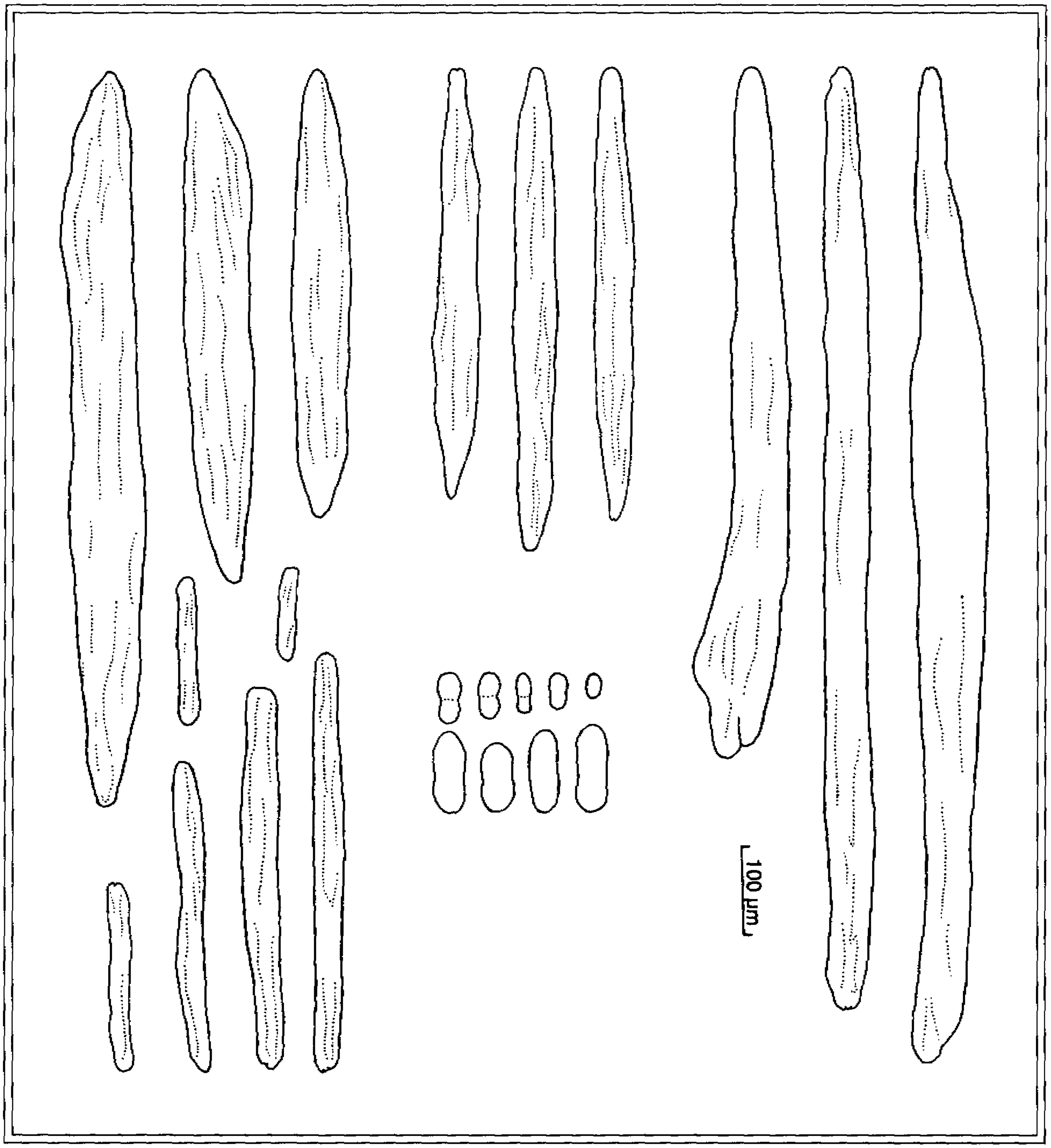


Figure 2.11. *Ptilosarcus gurneyi*: sclerites from the body. SBMNH 49688.

Family Virgulariidae Verrill, 1868

Genus *Virgularia* Lamarck, 1816

Diagnosis. Colonies long, slender and vermiform or more stout, robust and rigid. Rachis symmetry bilateral throughout. Axis extends throughout most of colony length; sometimes extending beyond apex of rachis; mostly round in cross section. Polyp leaves present; relatively short, often congested or sometimes with intervals of bare rachis between adjacent leaves. Autozooids tubular, fused for most of length to form relatively thin poly leaves; 3-100+ autozooids per polyp leaf. Anthocodiae retractile into bulbous flesh; proximal portions of polyps, forming fleshy calyces. Siphonozooids sparsely distributed on polyp leaves below free parts of autozooids or more commonly on rachis between polyp leaves. Sclerites absent except for minute oval bodies in peduncle interior.

Type Species. *Pennatula mirabilis* Linnaeus, 1758; by subsequent monotypy.

Virgularia agassizii Studer, 1894

Figure 2.12

Virgularia bromleyi Kölliker, 1880: ??—Kükenthal, 1913: 243.

Halisceptrum cystiferum Nutting, 1912: 698.

Material Examined. BLM-OCS and OCSD collections.

Description. Typical elongate sea pen with 32 or more pairs of short (in contraction) leaves, 4-5 polyps per leaf. Virgulariform polyps with 8 bumps or small projections revealing the octo-symmetry of the polyp. Entire colony with only a few small spicules or none (especially in long preserved specimens). Physa swollen with axis visible within. Stem with distinct groove.

Type Locality and Type Specimens. see Kölliker, 1880. *Challenger* Reports, Zoology, pt. 2.

Distribution. Throughout California.

Biology. A very common sea pen along the Pacific coast.

Remarks. Polyps of genus *Virgularia* are distinct in their poor spiculation and beautiful feathery form when expanded. Colonies can retract into the substrate.

Genus *Acanthoptilum* Kolliker, 1870

Diagnosis. Colonies long, slender, to somewhat feather-shaped. Rachis bilaterally symmetrical throughout. Axis present throughout length of colony. Polyp leaves present, often sickle-shaped, biseriate along rachis; numerous and mostly crowded with extent of naked rachis between leaves usually not exceeding length of single leaf. Autozooids 4-9 per polyp leaves, grading larger distally. Anthocodiae retractile into sparsely spiculated calyces which may have several indistinct rounded terminal teeth. Siphonozooids minute, in 1 or 2 longitudinal rows on rachis between polyp leaves. Sclerites: at base of each polyp leaf an irregular cluster of 3-flanged spindles; calyces, rachis and peduncle with 3-flanges spindles or small to minute ovals or rods (modified from Williams, 1995).

Type Species. *Acanthoptilum pourtalesii* Kolliker, 1870; by monotypy.

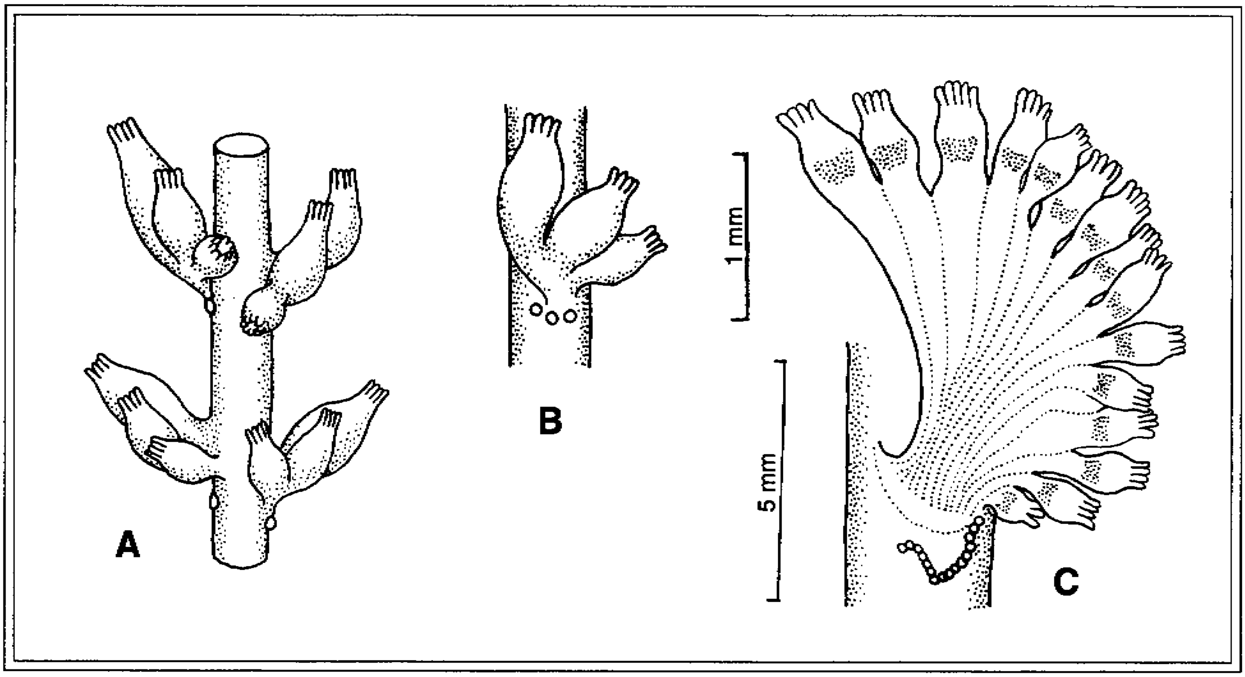


Figure 2.12. A, B. *Virgularia agassizii*: views of portion of rachio, SBMNH 51250. C. *Virgularia californica*: lateral view of portion of rachio showing single pinna. SBMNH 49487.

Acanthoptilum album Nutting, 1909

Figures 2.13

Acanthoptilum album Nutting, 1909: 701-702.—Kükenthal, 1913: 246-247.—Ljubenkov, 1980:58.

Material Examined. Orange County collections.

Description. Typical member of genus with characteristic spicularized leaves and calyces. 4-5 polyps per leaf, 3 siphonozooids between adjacent leaves. All spicules are clear which gives the colony a white appearance. The rachis occupies about 2/3 of the total length.

Type Locality and Type Specimens. Holotype - USNM 25424. California, bearing S 15° E 2.8 mi off Point Piños lighthouse, 59-65 fm [108-119 m]; coll. USBCF *Albatross* station 4473.

Distribution. Central and southern California.

Biology. Unknown.

Remarks. See remarks under *Acanthoptilum gracile*.

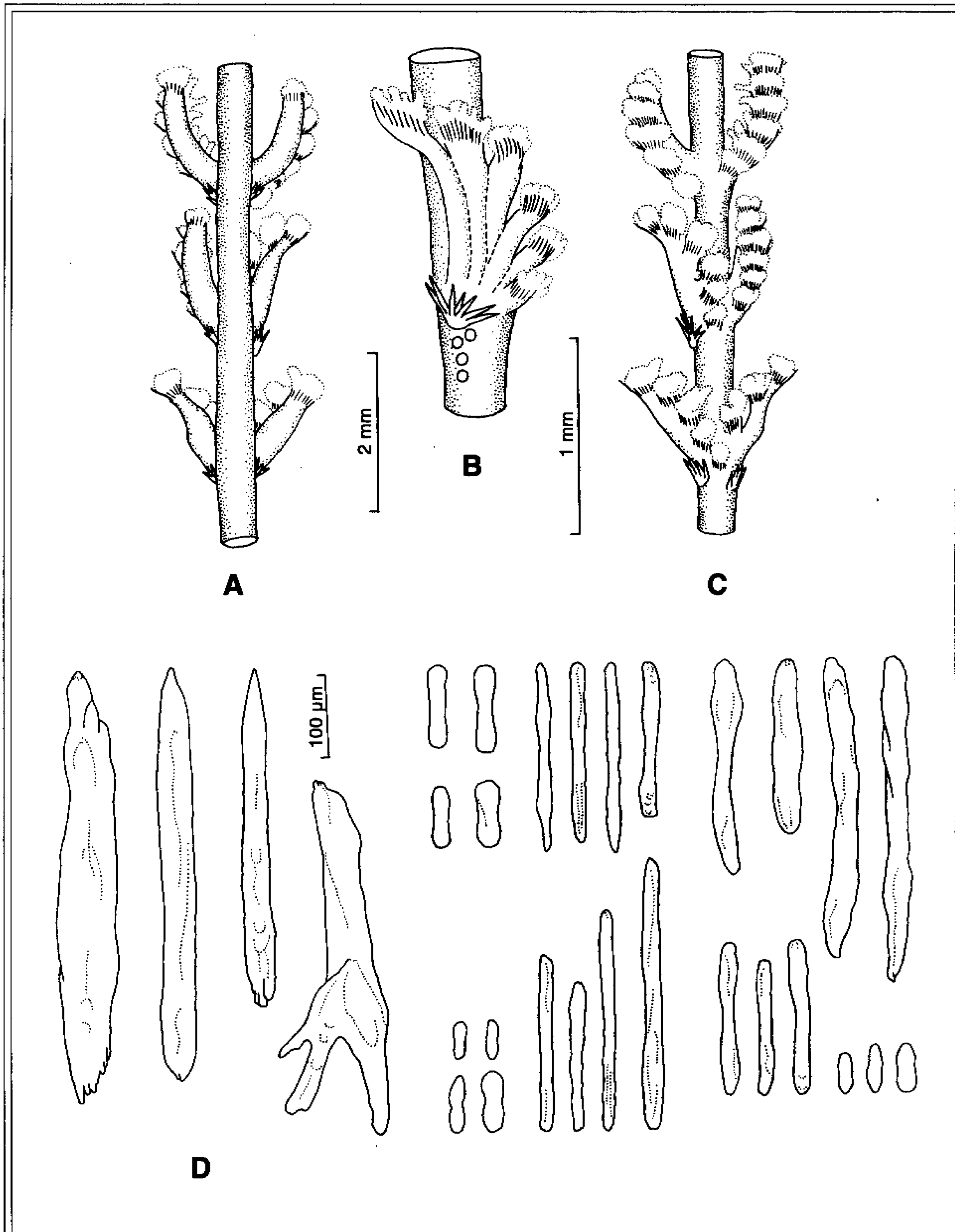


Figure 2.13. *Acanthoptilum album*: A, B, C views of colony; D, sclerites from the body. SBMNH 49268.

Acanthoptilum gracile (Gabb, 1863)

Figure 2.14

Virgularia gracilis Gabb, 1863: 120.—Verrill, 1868: 383-384.

?*Acanthoptilum gracile*: Nutting, 1909: 700-701, pl. 86(figs. 3, 4).—Kükenthal, 1913: 245-246.—Ljubenkov, 1980: 58.

Acanthoptilum gracile: Kukenthal, 1915: 65.—Ricketts, Calvin and Hedgepeth, 1968: 317, text-fig. 234.—Morin, 1976: 630, text-fig. 1b.—Williams, 1995: 123, text-figs. 5E, F, 9H.

Material Examined. BLM-OCS, Orange County collections.

Description. Long slender whiplike colony with basal physa and without a purple band. Color in alcohol light tan brown. Leaves with 8-9 autozooids; calyces and leaves heavily spicularized with needles; spray at base of leaves with large spicules; 6-12 prominent siphonozooids between adjacent leaves. Needle spicules with slight yellow tinge, not carmine.

Type Locality and Type Specimens. Not designated; presumed not extant (see Coan and Bogan, 1988). Monterey Bay, California, 20 fm [36 m].

Distribution. Monterey and southern California.

Biology. Unknown.

Remarks. *Acanthoptilum* spp. have whiplike colony shapes, leaves with a spray of spicules at their bases, calyces usually contain long needles. The leaves are attached by their base to the stem; they are heavily laden with spicules. The stem usually contains spicules lightly scattered and the purple band is thick with spicules. The genus needs a thorough revision.

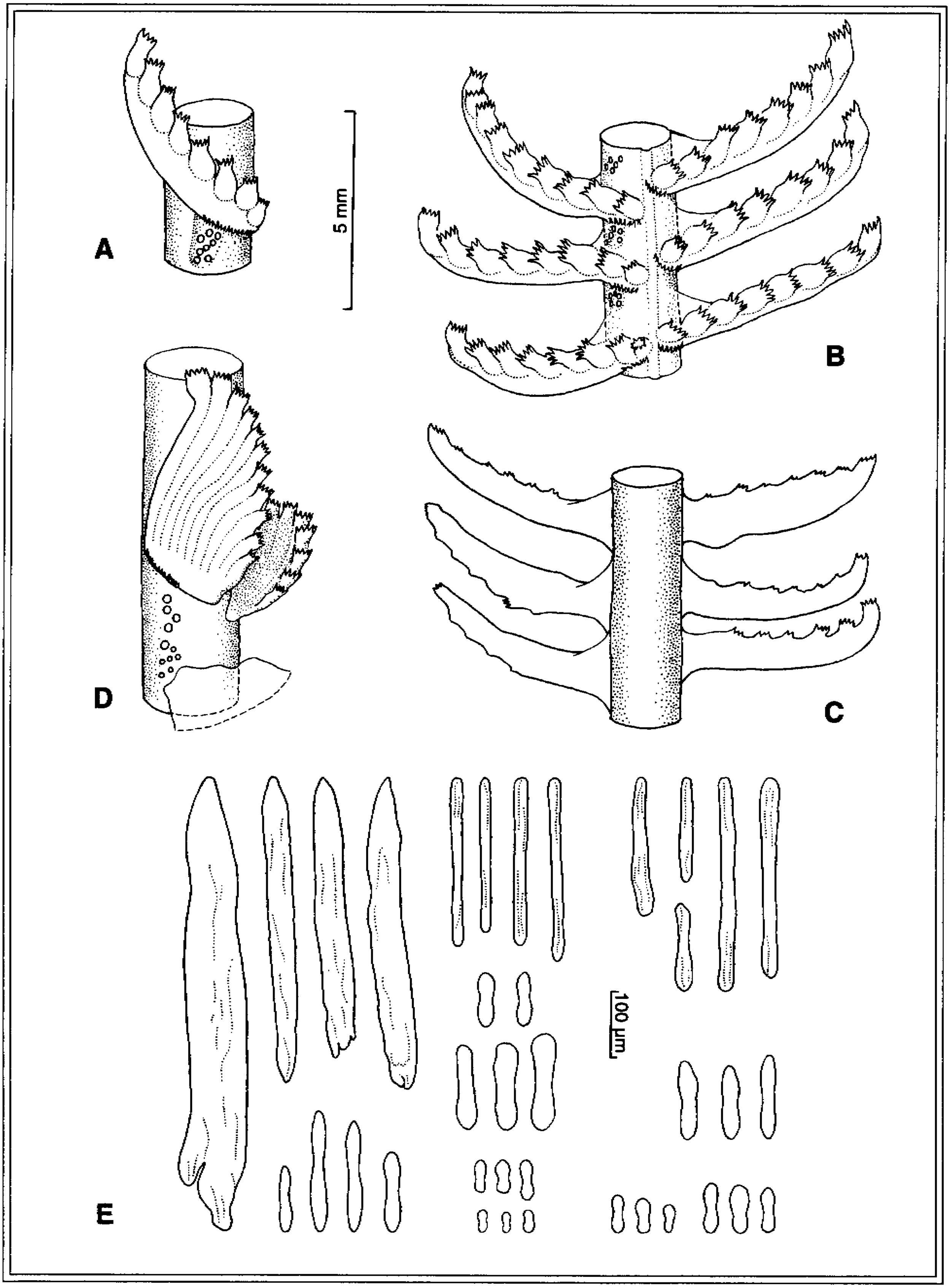


Figure 2.14. *Acanthoptilum gracile*: A, B, C, D views of colony; E, sclerites from the body (A-C, SBMNH 49693. D, SBMNH 49691).

Genus *Stylatula* Verrill, 1864

Diagnosis. Colonies long, slender, often vermiform. Rachis bilaterally symmetrical throughout. Axis present through entire colony; mostly round in cross section. Polyp leaves present, short, densely arranged on rachis. Each polyp leaf subtended by strong fan-like armature of long sclerites. Autozooids 5-30 per polyp leaf. Anthocodiae retractile into bulbous basal portions of polyps. Siphonozooids absent from polyp leaves, arranged on rachis between leaves. Sclerites: polyp leaf armature with elongate, partly or entirely 3-flanged, flattened needles, often broad and rounded at one end, tapering and pointed at opposite end; calyx-like proximal portions of polyps may contain spindles; peduncle interior often with minute oval bodies; absent from other parts of body.

Type Species. *Virgularia elongata* Gabb, 1862; by subsequent designation.

***Stylatula elongata* Gabb, 1863**

Figure 2.15

Virgularia elongata Gabb, 1863: 167.—Gray, 1870: 19.

Stylatula elongata: Verrill, 1864: 30;1868: 384; 1870: 560.—Nutting, 1909: 699-700, pl. 86(fig. 2).—Kukenthal and Broch, 1911: 317-319, text-figs. 114-116.—Kükenthal, 1913: 244-245; 1915: 68-69, text-fig. 70.—Morin, 1976—Ljubenkov, 1980: 59.—Williams, 1995: 122-123, figs. 5C, D, 9G.

Stylatula Ringei Pfeiffer, 1886: 59.

Type Locality and Type Specimens. Types not searched. "Unter-Californien, von Diego" [California, San Diego].

Stylatula columbiana Verrill, 1922: 11-12, pl. 3 (figs. 1-4a).

Type Locality and Type Specimens. Types not searched. [Canada, British Columbia], W coast of Vancouver Island, Ucluelet, 13 fm [24 m].

Material Examined. BLM-OCS and Orange County Collections.

Description. Colony shaped like test-tube brush; 20-24 polyps per leaf; leaves attached by inner margin to stem. Each leaf supported by spray of 12-16 large needle spicules, with leaves slightly overlapping on one side of stem; with about 10 pairs of leaves per inch, with numerous papilliform siphonozooids scattered about free portions of rachis. No spicules in polyps.

Color in life: colony grayish-brown; physa salmon. Color in alcohol: colony brownish-white.

Type Locality and Type Specimens. Types not designated; presumed not extant (see Coan and Bogan, 1988). California [further locality details not provided in orignial description].

Distribution. California.

Biology. Numerous benthic photographs show that many colonies have had their tips eaten by fishes. These nipped tips provide a substrate for some hydroids and Bryozoa.

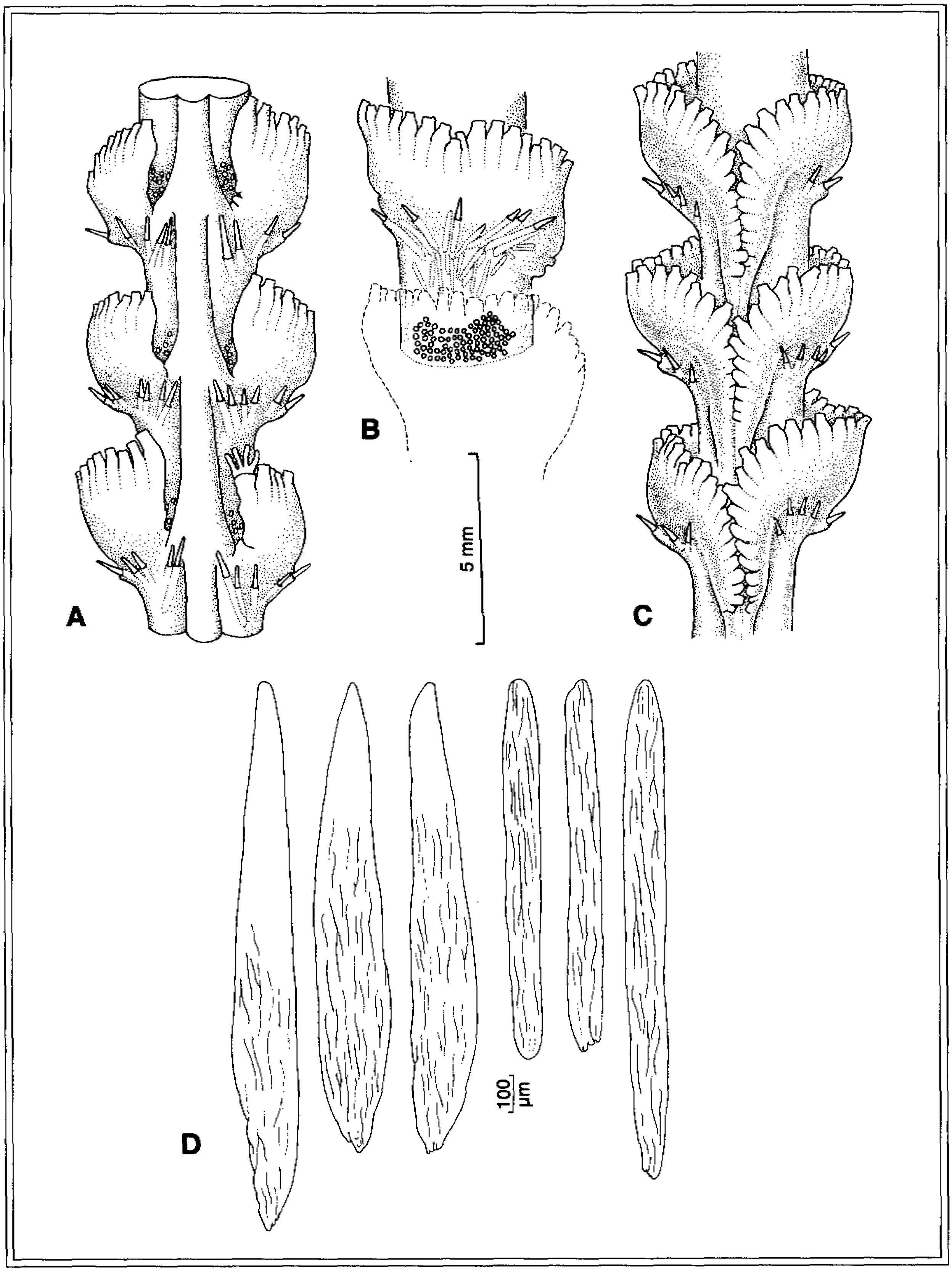


Figure 2.15. *Stylatula elongata*: A, B, C, views of colony; D, sclerites from the body (SBMNH 49704).

Acknowledgments

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3. Class Anthozoa

Orders Actiniaria, Ceriantharia, and Zoanthinaria

by

Daphne Gail Fautin[1]

Introduction

Members of the three orders covered in this section, which belong to anthozoan subclass Hexacorallia, resemble one another in lacking a skeleton. Corallimorpharia, a fourth order sharing those attributes, occurs in the northeast Pacific, but there were no specimens of it in this collection. The fifth non-skeleton-forming hexacoral order, Ptychodactiaria, consists of three monotypic genera confined to high latitudes. All of these animals may be referred to as sea anemones, but I prefer to reserve that term for actinians. The common name often used for ceriantids is "tube anemones," and I recognize none other than "zoanthids" for the third group.

Few hexacoral faunas are sufficiently well known that species identifications can be made exclusively, or even primarily, from living specimens. Descriptions of many species do not specify color, expanded posture, behavior, or other attributes absent in preserved specimens. This is because many species of especially deep-sea and tropical anthozoans were described by experts who did not see them alive, not having participated in the expeditions on which they were collected (Dunn, 1981). These anatomically simple animals possess few distinguishing features. Further, the size and form of askeletal anthozoans can change while the animals are alive and certainly during the processes of collection and preservation. Thus, variety, size, and distribution of cnidae, and histological features of the musculature may be critical in diagnosing species. Nature of the marginal sphincter muscle, if any, can be especially important. Although not included in this report, I used these characters in verifying identifications of the specimens in this collection from the Santa Maria Basin and Western Santa Barbara Channel. Because identification of these animals relies largely on features that persist in preserved specimens, it is likely that cryptic/sibling species are unrecognized (Knowlton, 1993).

No single external feature can unambiguously be used to assign these non-skeletalized anthozoan polyps to order. A key to the orders precedes the narrative concerning each order. That narrative includes information about external anatomy, which suffices for assignment to order, and internal anatomy, which is essential for most generic and species identifications. The narrative of Order Actiniaria is followed by a dichotomous key to the 12 actinian species (three identified only to genus). There is one species of Zoanthinaria in the collection and no specimen of Ceriantharia could be identified to species. A glossary contains terms necessary to understand the keys and taxonomic discussions.

The mid-water fauna of the vicinity where these specimens were collected has northern, southern, western, and endemic components (Ebeling *et al.*, 1970). The distribution of most deep water actinians is poorly documented. Members of genera *Edwardsia*, *Epizoanthus*, *Pachycerianthus*, and *Peachia* are widely distributed, if not cosmopolitan; those of *Actinostola* are typical of the deep seas at high latitudes; and those of *Hormathia* are worldwide in deep seas. Sea anemones of the genera *Edwardsia*, *Halcampa*, and

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[1] Department of Systematics and Ecology, and KU Natural History Museum, University of Kansas, Lawrence, KS 66045 USA

Anemonactis occur off Plymouth, England (Walton and Rees, 1913), and those of *Metridium* are common at least in shallow British waters (Fautin *et al.*, 1990). Thus, at the generic level, this fauna appears unremarkable for northern latitudes/deep seas. *Halcampoides purpurea* apparently occurs in all boreal waters, *Peachia quinquecapitata* occurs in both the eastern and western North Pacific, *Hormathia digitata* had previously been reported from boreal/North Atlantic waters, and *Actinostola carlgreni* was previously known from Sagami Bay. Thus, these species are widely distributed. In contrast, *Edwardsia californica*, *Epizoanthus induratum*, *Halcampa decemtentaculata*, *Metridium giganteum*, and *Pentactinia californica* may be endemic to the northeast Pacific. A great deal more research on both taxonomy and distribution is necessary to understand the biogeography of actinians, cerianthids, and zoanthids.

Biology

The animals in this collection are infaunal except for the zoanthid (members of this class probably are never infaunal) and three species of actinians. This habitat is correlated with inconspicuousness, and, in actinians, with small body size, which contribute to a dearth of information. Indeed, as mentioned in the remarks of some species, other than descriptions, there is no primary literature on them, and little or nothing is known of their biology.

Glossary of Morphological Terms

Acontia. Nematocyst-studded threads arising from mesenteries of some actinians. May be extruded through mouth or body wall. Their cnidom (qv.) may define actinian families. Some cerianthids possess comparable structures called acontioids.

Actinopharynx. Tube of tissue extending from mouth into coelenteron, continuous with oral disc. Unique to and present in all anthozoans.

***Actinostola* rule**. Members of pair of mesenteries unequal in size such that retractor muscle of the better-developed member faces a mesentery of the preceding cycle; characterizes some genera in actinian family Actinostolidae.

Capitulum. Division of column in zoanthids and some actinians distal to and thinner than scapus.

Cinclides. Plural of cinclis. Pores in the body wall, or thinnings that can be ruptured to form pores, through which coelenteric fluid can be expelled; in animals with acontia, acontia may be carried through cinclides by the fluid.

Clone. Collective term for genetically identical individuals formed by asexual reproduction that are not physically connected to one another.

Cnidae. Collective term for nematocysts, ptychocysts, and spirocysts. The *sine qua non* of cnidarians, these intracellular "stinging capsules" secreted by the Golgi apparatus are used mainly in offense and defense.

Cnidom. Types of cnidae possessed by a cnidarian or a part thereof.

Coelenteron. Central body space of a cnidarian (also called gastrovascular cavity).

Coenenchyme. Tissue connecting polyps of colonial anthozoans.

Colony. Collective term for genetically identical individuals formed by asexual reproduction that are physically connected.

Column. Tubular "body" of an anthozoan.

Complete. See mesentery.

Conchula. See siphonoglyph.

Couple. Two mesenteries (or 2 pairs of mesenteries) on opposite sides of column that arise simultaneously.

Distal. Toward oral disc, away from base.

Limbus. Where pedal disc meets column.

Macrocneme. Mesentery with strong retractor muscle and filaments; often gametogenic, commonly complete.

Margin. Where oral disc meets column.

Mesentery. Radial sheet of tissue extending from body wall. Those reaching actinopharynx are "complete" or "perfect"; those reaching only part way are "incomplete" or "imperfect." May be added singly (in cerianthids) or in pairs and couples (qv.) (in actinians and zoanthids).

Microcneme. Incomplete mesentery with weak retractor muscle; lacking filaments and gametes.

Nematocyst. A type of cnida; there are about 30 varieties.

Pair. Two adjacent mesenteries that arise simultaneously; equal in size (typical of actinians) or not (typical of zoanthids).

Perfect. See mesentery.

Physa. Basalmost portion of actinian in some of those actinians that have a divided column; used to dig or anchor in sediment.

Protocneme. One of 3 coupled mesenteries attached to cerianthid siphonoglyph and immediately flanking the radius bisecting the siphonoglyph (thus forming plane of symmetry of the polyp).

Proximal. Toward base, away from oral disc.

Ptychocyst. A type of cnida occurring only in cerianthids; used in tube formation.

Scapulus. Histologically differentiated division of column in some actinians that is distal to scapus and typically thick.

Scapus. Division of column in zoanthids and some actinians distal to base; commonly constitutes most of a polyp's length.

Siphonoglyph. Longitudinal channel in actinopharynx down which water can be driven due to longer cilia lining it. Oral end may be drawn out into lobed projection called conchula.

Solitary. Polyps not physically attached to others. Solitary polyps may not be genetically unique: see clone.

Spirocyst. A type of cnida made only by anthozoans; its tubule is sticky.

Key to the Orders of Non-Skeletalized Hexacorallia

1A.	Colonial	Zoanthinaria
1B.	Solitary	2
2A.	Polyp encased in felt-like tube	Ceriantharia
2B.	Polyp naked or with adherent detritus	3
3A.	Tentacles in two distinct cycles	Ceriantharia
3B.	Tentacles around the margin only, or not arrayed in cycles	4
4A.	Tentacles arising from oral disc (and perhaps from margin as well)	Actiniaria
4B.	Tentacles arising only at the margin	5
5A.	Aboral end rounded or pointed, unattached	Actiniaria
5B.	Aboral end flat, adherent or not	6
6A.	Column encrusted with sand or other debris	Zoanthinaria
6B.	Column smooth	Actiniaria

Order Actiniaria

Sea anemones are exclusively solitary, although some reproduce asexually to form clones. They are far more diverse ecologically and morphologically than are either cerianthids or zoanthids. Most of the taxa in this collection are infaunal, and therefore the animals are small, vermiform, and not attached to a hard substratum — attributes atypical of members of the order as a whole.

An external feature important to identification is number, arrangement, length, and form of tentacles. They may be cyclically or radially arrayed on the oral disc, be scattered, or exhibit a combination of those arrangements; commonly they are simple, tapered cylinders, but they may be branched, capitate, or swollen along their length. The other major external feature is nature of the column. It may be divided into regions. The form of the basalmost portion determines whether the animal can attach to firm substrata or burrow in sediment (abásilarian anemones, lacking basilar muscles, cannot adhere to substrata firmly so generally burrow; basilarian anemones have basilar muscles so can adhere firmly to substrata but may burrow). Some or part of the column may be encrusted with debris, have a cuticle, or be naked; it may have tubercles, adhesive warts, or other specializations.

Internal anatomy is also critical to accurate identification. For specimens in this collection, number and array of mesenteries, and features of the actinopharynx suffice.

Nearly 1,000 species of sea anemones are known (Carlgren, 1949). About 50 have been documented from the northeast Pacific, half primarily from the intertidal zone and the others primarily subtidal. However, the bathymetric and geographic distributions of most are poorly resolved. In this collection I identified 50 specimens in 12 species (but see the *caveat* concerning identification in the Introduction) belonging to seven families; I was able to identify three species only to genus. *Halcampoides purpurea* was not previously recorded from the Pacific; *Anemonactis mazeli*, *Hormathia digitata*, and *Actinostola carlgreni* were not previously recorded from the eastern Pacific, although, based on museum collections, the last two appear to be common in these waters.

The remaining specimens, which were too small and/or poorly preserved to be identified, seem to belong to the species other than those I identified to either genus or species. Four very elongate, vermiform specimens from Phase I (Sta. 21 [×1] and Sta. 27 [×3]) belong to one species of family Edwardsiidae, but cannot be identified further because their internal anatomy is indistinct. Their body form, absence of a strong cuticle, and lack of longitudinal grooves distinguish them from *Edwardsia californica*. Six others from Phase I (Sta. 1 [×4], Sta. 14 [×1], and Sta. 21 [×1]) belong to a single species, but the bases are torn from all of them and some are otherwise damaged also; they cannot be identified. Some of the remaining unidentified 11 specimens may belong to these species. Because these animals are not included in the key, it is important to verify with the species discussions identifications made by use of the key.

Key to the Species of Actiniaria

1A. Column lacking adherent base; commonly vermiform (long, narrow; basal end may be pointed) or globular 4

1B. Column with adherent base; not vermiform (may be as wide as long) 2

2A. Column smooth 3

2B. Column with cuticle and grooves (large specimens nodular) .... *Hormathia digitata*

3A. Column not divided into regions (commonly white, short relative to width; tentacles short but most marginal) .... *Actinostola* cf. *carlgreni*

3B. Column divided into long scapus, short capitulum (commonly yellowish, often very long relative to width; entire oral disc tentaculate) .... *Metridium giganteum*

4A. Tentacles capitate (usually 20, may be fewer) .... *Anemonactis mazeli*

4B. Tentacles not capitate 5

5A. Five pairs of complete mesenteries (other, smaller ones may be present) 6

5B. Other than five pairs of complete mesenteries 8

6A. One distinct siphonoglyph 7

6B. No distinct siphonoglyph; tentacles ten, stubby; five pairs each of macrocnemes and microcnemes .... *Halcampa decemtentaculata*

7A. Siphonoglyph drawn into conchula (column indistinctly divided; smooth but may be wrinkled, have sausage-like constrictions) .... *Peachia quinquecapitata*

7B. No conchula; mesenteries bilateral about siphonoglyph (column often sand-encrusted; 20 tentacles) .... *Pentactinia californica*

8A.	Eight complete mesenteries	9
8B.	Six pairs of complete mesenteries	10
9A.	Column cross-section resembles 8-pointed star	*Edwardsia californica*
9B.	Column globular; densenly covered with nemathybomes	*Scolanthus* sp.
10A.	All mesenteries complete	*Halcampoides purpurea*
10B.	Six pairs of macrocnemes; at least six pairs of microcnemes	10
11A.	Column with adherent debris	*Calamactinia* sp.
11B.	Column with dark cuticle; physa may be flattened	*Halcampella* sp.

Description of Species

Genus *Hormathia* Gosse, 1859

Diagnosis. Hormathiidae (Acontiaria) with column divided into scapus and scapulus; scapus with protrusions except sometimes in young individuals, and with a cuticle. Mesogleal sphincter strong. Maximum number of tentacles about 96. Mesenteries of first cycle complete, sterile.

Remarks. This genus (indeed, the entire family Hormathiidae) is well represented in the deep sea. Carlgren (1949) listed 15 species in the genus, two with uncertainty, inexplicably omitting one species he himself had described. The considerable taxonomic confusion is probably partly attributable to the variable development of protrusions on the scapus.

Hormathia digitata (Müller, 1776)

Figure 3.1

Actinia digitata Müller, 1776:231.

Hormathia digitata: Carlgren, 1942:44 (includes synonymy); 1949:93 (synonymy). — Grebel'nyi, 1980:12 (includes synonymy).

Material Examined. California: Santa Maria Basin, Phase I, Sta. 76 (×2); Phase II, Sta. R-6 (×1).

Description. Column faintly or strongly divided into longer scapus, with small, pointed to domed, scattered protuberances that may be arrayed in vague longitudinal columns; and short scapulus, with a coronal ring of protuberances just below the tentacles. Animals examined columnar, with pedal disc expanded or not, to about 10 mm column diameter and height; members of the species grow much larger. Commonly opaque white with golden-brown cuticle adherent in cracks and on tips of protuberances.

Pedal disc may adhere to gastropod shell (as that from station R-6). Oral disc usually retracted; with 48-72 short, often nipple-shaped tentacles in specimens examined; large individuals with up to 96.

Mesenteries regularly hexamerously arranged; those of 6 primary pairs complete and sterile, others fertile. Acontia prominent in specimens examined: coiled spring-like, protruding into actinopharynx and even out mouth.

Cnidom: Spirocysts, basitrichs, microbasic *p*-mastigophores (acontia contain only basitrichs).

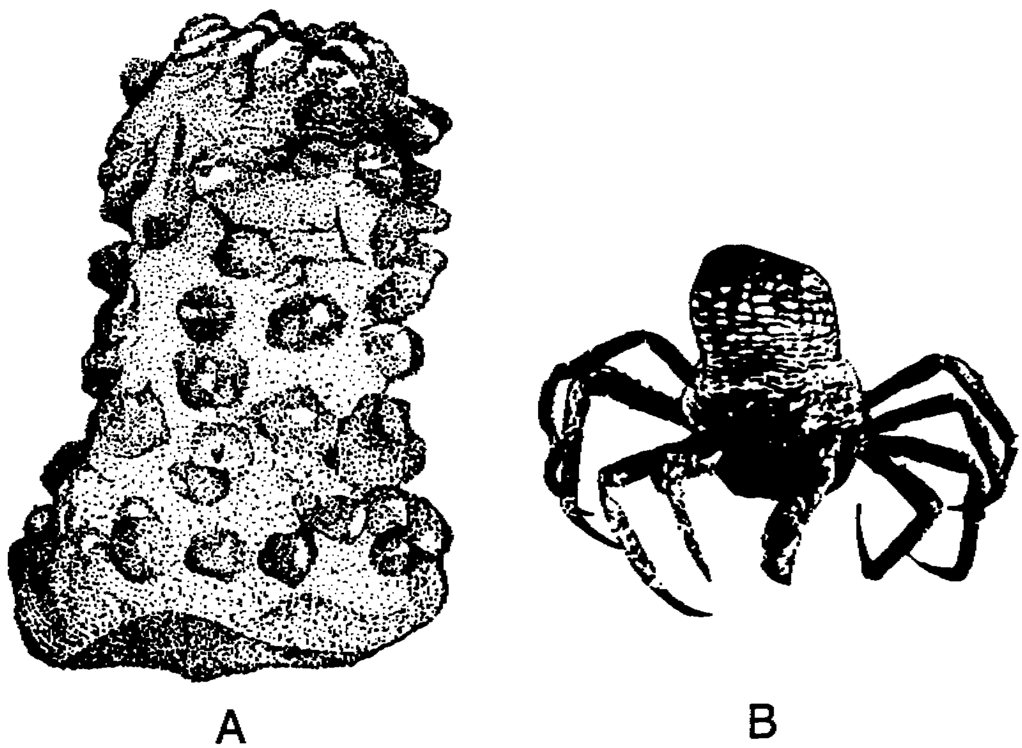

Figure 3.1. *Hormathia digitata*: A, specimen with pronounced protuberances (from Grebel'nyi, 1980); B, specimen with less prominent protuberances attached to crustacean *Hyas* (from Carlgren, 1942).

Biology. Actinians of this species are abundant at depth in the northeast Pacific. They apparently require a firm substratum but do not seem particular about it — they often occur on gastropod shells or other living animals (see Fig. 3.1B) and have even been collected attached to rubber gloves.

Remarks. The identity of this species has been uncertain. Grebel'nyi (1980) convincingly argued for the synonymization of *Hormathia nodosa, H. josephi, H. incubans*, and *H. marioni* with *H. digitata* (type species of the genus) in the North Atlantic, asserting that variability between individuals is responsible for the plethora of names. He suggested that a fifth species, *H. coronata*, belongs in hormathiid genus *Actinauge*. There are virtually no records of any species of this genus along the Pacific coast of North America, despite large numbers of specimens in museums, probably because of uncertainty in taxonomy resulting from variability among individuals.

Type Locality and Specimens. Species described from the waters of Norway or Denmark; no type specimen designated.

Distribution. Circumarctic; southern limits of distribution in North Pacific unknown. Depth range at least 10-1,000 m, based on Arctic and North Atlantic records.

Genus *Actinostola* Verrill, 1883

Diagnosis. Actinostolidae (Mesomyaria) with thick, firm column and comparatively weak sphincter. Inner tentacles longer than outer, bases sometimes thickened on the aboral side; outer ones with microbasic *b*-mastigophores distally. Longitudinal muscles of tentacles and radial muscles of oral disc mesogleal. Mesenteries of the first two cycles sterile; retractor muscles of those from the third or fourth cycle onward arrayed so that the one nearer the mesentery of the preceding cycle is better developed than its partner (the *Actinostola* rule).

Remarks. This genus (indeed, the entire family Actinostolidae) is well represented in the deep sea. Carlgren (1949) listed 12 species in the genus, one of which Riemann-Zürneck (1978) placed in its own genus. None is unequivocally known from the northeast Pacific.

Actinostola cf. *carlgreni* Wassilieff, 1908

Figure 3.2

Actinostola carlgreni Wassilieff, 1908:28. — Carlgren, 1949:78.

Catadiomene carlgreni: Stephenson, 1920:558.

Material Examined. California: Santa Maria Basin, Phase I, Sta. 17 (×1).

Description. Column nearly as long (42 mm) as wide (50 mm). Oral disc only slightly retracted so tentacles visible. Limbus extended beyond level of pedal disc but same diameter as column. Tan ectoderm remaining only in shallow circumferential wrinkles. Tentacles short, outer mostly shorter than inner, all lacking ectoderm. So entire animal white in color (from exposed mesoglea).

Short sphincter muscle mesogleal, weak; narrow, adjacent to endoderm of margin, less than 20% width of margin.

All mesenteries except those of highest order complete, sterile. Those of highest order fertile (questionable in individual examined), extend from base to oral disc; members of highest-order pairs slightly unequally developed (that is, they follow the *Actinostola* rule).

Cnidom: The genus is characterized by spirocysts, basitrichs, microbasic *p*-mastigophores, and microbasic *b*-mastigophores, but because of the erosion of ectoderm, this could not be ascertained in the specimen examined.

Biology. Unknown.

Remarks. Clearly a member of family Actinostolidae, this animal appears to belong to *Actinostola*. The only nominal species of the genus that has been documented in the eastern North Pacific, *A. spetsbergeneis*, was transferred by Riemann-Zürneck (1978) to the new genus *Glandulactis* based partly on the absence of mesenteries arrayed according to the *Actinostola* rule. This specimen agrees well with Wassilieff's brief description of *A. carlgreni*.

Type Locality and Specimens. Sagami Bay, 730 m. Holotype in the Zoologische Staatssammlung des Bayerischen Staates, Munich, Germany.

Distribution. *Actinostola carlgreni* is definitely known only from Sagami Bay. If this specimen really belongs to *A. carlgreni*, the species is at least circum- or trans-North Pacific. This specimen was from 654 m.

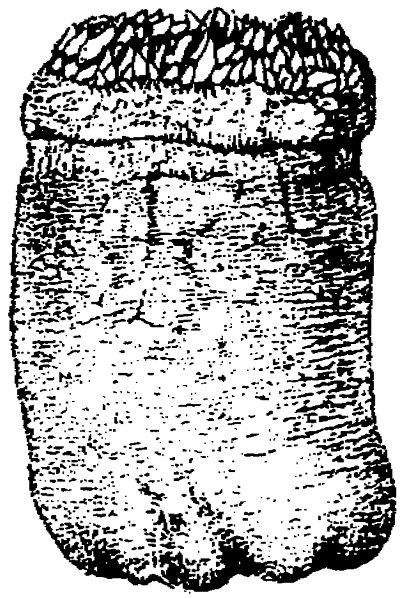

Figure 3.2. *Actinostola groenlandica* (from Carlgren, 1921; slightly larger than life): the numerous, short tentacles and wrinkled column are typical of preserved specimens of all species of the genus.

Genus *Metridium*

Diagnosis. Metridiidae (Acontiaria) with mesenteries not divisible into macrocnemes and microcnemes; acontia with basitrichs, microbasic *b*-mastigophores, and microbasic amastigophores.

Remarks. Authorship of this genus is in doubt, as summarized by Manuel (1981a). Oken is credited with it by Carlgren (1949), but his names have been declared nomenclaturally invalid. An appeal has been made to have de Blainville recognized as the author.

Metridium giganteum Fautin, Bucklin, and Hand, 1990

Figure 3.3

Metridium senile: see below under Remarks

Material Examined. California: Santa Maria Basin, Phase I, Sta. 4 (×2); Phase I, Sta. 27 (×2); Phase I, Sta. 28 (×1), in addition to all type specimens and many others.

Description. Column long (subtidal individuals may attain 1 m height), relatively narrow (column height/pedal disc diameter >2:1); tapered distally; prominent collar between long scapus and shorter capitulum (Fig. 3.3). Commonly opaque white, occasionally salmon orange or brown. Lacking cinclides.

Pedal disc adherent to firm substratum; diameter typically 125 mm, maximum 200 mm. Oral disc much broader than column; stiffly lobed (Fig. 3.3B); marginal portions densely covered with hundreds of

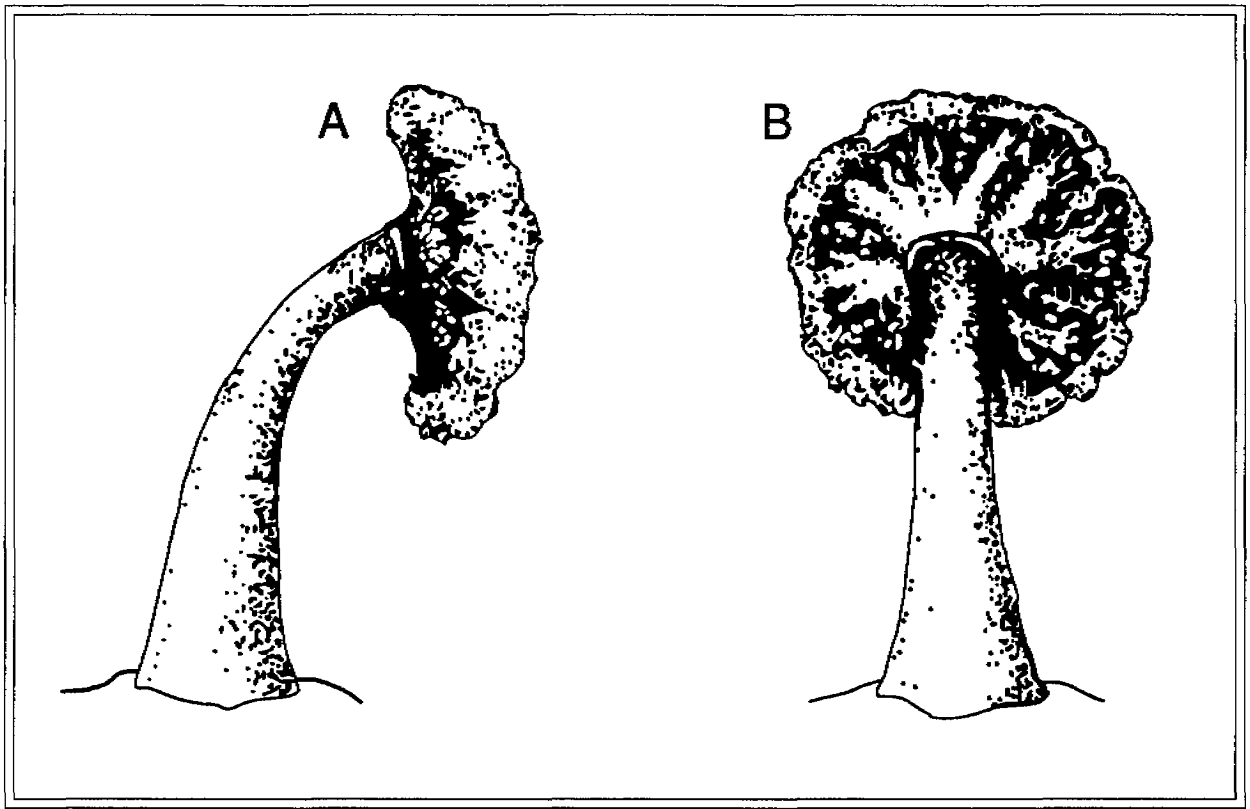

Figure 3.3. *Metridium giganteum* in strong current (from Koehl, 1976): A, side view; B, column and underside of oral disc. Note raised collar near oral end of column, and bracing of oral disc lobes.

short, pointed tentacles giving disc frilled or fluffy appearance (Fig. 3.3A); tentacles of central oral disc longer, sparser. Tentacles and oral disc same color as column. No catch tentacles.

Mesenteries regularly hexamerously arranged due to the virtual absence of asexual reproduction.

Three specimens examined are very small (3-10 mm long), resembling *Diadumene*. However, cnidae agree very closely with those of *Metridium* and differ from those of species of *Diadumene* and allied genera. Moreover, of actinians with acontia, thin walls, and columnar shape, only *Metridium* is known from depth in the northeast Pacific.

Cnidom: Spirocysts, basitrichs, microbasic *b*-mastigophores, microbasic *p*-mastigophores, microbasic amastigophores.

Biology. Actinians of this nearly exclusively subtidal species can achieve the greatest height and mass (but not breadth) of any sea anemone. They are common on pilings in shallow water, and occur deeper on firm objects such as shells. Populations consist of solitary individuals or groups of genetically distinct ones. Reproductive potential is almost exclusively sexual: individuals rarely fragment, and excised fragments regenerate infrequently and very slowly, in contrast to those of *M. senile*.

Remarks. Three species of *Metridium* occur along the west coast of North America: *M. exilis*, *M. senile*, and *M. giganteum* (see Fautin *et al.*, 1990). *Metridium exilis* is morphologically, biologically, and biochemically distinctive. The other two were previously considered to belong to one species, *M. senile*, a highly variable species first described from the northeastern Atlantic. Compared with *M. senile*, *M. giganteum* is less translucent, its column mesoglea is thicker and stiffer, it feels more slippery, and its height:width ratio is greater; its retractor muscles are larger, and its sphincter muscle is relatively much larger; permanent oral disc lobes are reinforced by mesogleal thickenings in larger individuals of *M.giganteum*, whereas the oral disc of *M. senile* is unlobed when small and lacks mesogleal thickenings when large; individual tentacles of *M. senile* are distinct, while the oral disc of *M. giganteum* appears fluffy. For biochemical differences, see Bucklin and Hedgecock (1982). Nematocysts do not differ consistently between the two, their size seemingly correlated more with size than species of the individual.

This interesting, ecologically important genus is the subject of a variety of research, including biomechanics (e.g. Koehl, 1976, 1977) and theoretical ecology (e.g. Sebens, 1981). From the literature, it is not always obvious which species was studied.

Type Locality and Specimens. Monterey County, California, 2.4 km SW of Point Piños Lighthouse, 80 m. Holotype CAS #003349 from *Albatross* station 4439; paratypes CAS #004370 from *Albatross* station 5787: San Mateo County, California, 13.3 km W of Point Montera Light, 75 m (x2); CAS #003508: north of Farallon Islands, off Cordell Bank, 182 m (x2); USNM #85789 from *Albatross* station 5789: San Francisco County, California, 6.3 km W of Farallon Light, 84 m (x1); SBMNH #45511: off Gaviota, Santa Barbara County, California (ca. 34°23'N 120°10'W), 256 m (x1); SBMNH #45512: off Gaviota, Santa Barbara County, California (ca. 34°23'N 120°10'W), 201 m (x1); RBCM #986-79-11: Hecate Strait, British Columbia (54°12'N 131°3.4'W, 99 m) (x3).

Distribution. From Alexander Archipelago, Alaska (56-58°N) (or further north) along Pacific coast of North America through California, in bays or open water. Typically subtidal; previously known range extended by specimens in this collection to 611 m.

Genus *Anemonactis* Andres, 1881

Diagnosis. Haloclavidae (Athenaria) with elongate, cylindrical column not divided into distinct regions, and lacking sphincter. Column with cinclides in uppermost part, and scattered solid papillae; rounded aboral end perforated by numerous apertures. Capitate tentacles 20, inner longer than outer.

Remarks. *Anemonactis mazeli*, the type species, is the best known of the three nominal species; the other two are from Australia, and may be synonymous (Carlgren, 1949).

Anemonactis mazeli (Jourdan, 1880)

Figure 3.4

Ilyanthus mazeli Jourdan, 1880:41.

Anemonactis magnifica Andres, 1881:329.

Eloactis mazeli: Andres, 1883:257. — Garstang, 1892:380. — Faurot, 1895:152. — Rees, 1913:70. — Walton and Rees, 1913:68. — Stephenson, 1935:91.

Halcampella minuta Wassilieff, 1908:7.

Eloactis mazelii: Carlgren, 1921:111. — Uchida, 1938:288.

Haloclava minuta: Carlgren, 1949:30 (synonymy).

Anemonactis mazelii: Carlgren, 1949:31 (synonymy).

Anemonactis mazeli: Manuel, 1981a:184 (includes synonymy).

Material Examined. California: Santa Maria Basin, Phase II, Sta. PJ-7 (x1).

Description. Cylindrical scapus 7 mm long, 4 mm broad; yellowish, with minute solid papillae; connected with physa by constriction. Physa flattened, diameter 4 mm, with adherent debris.

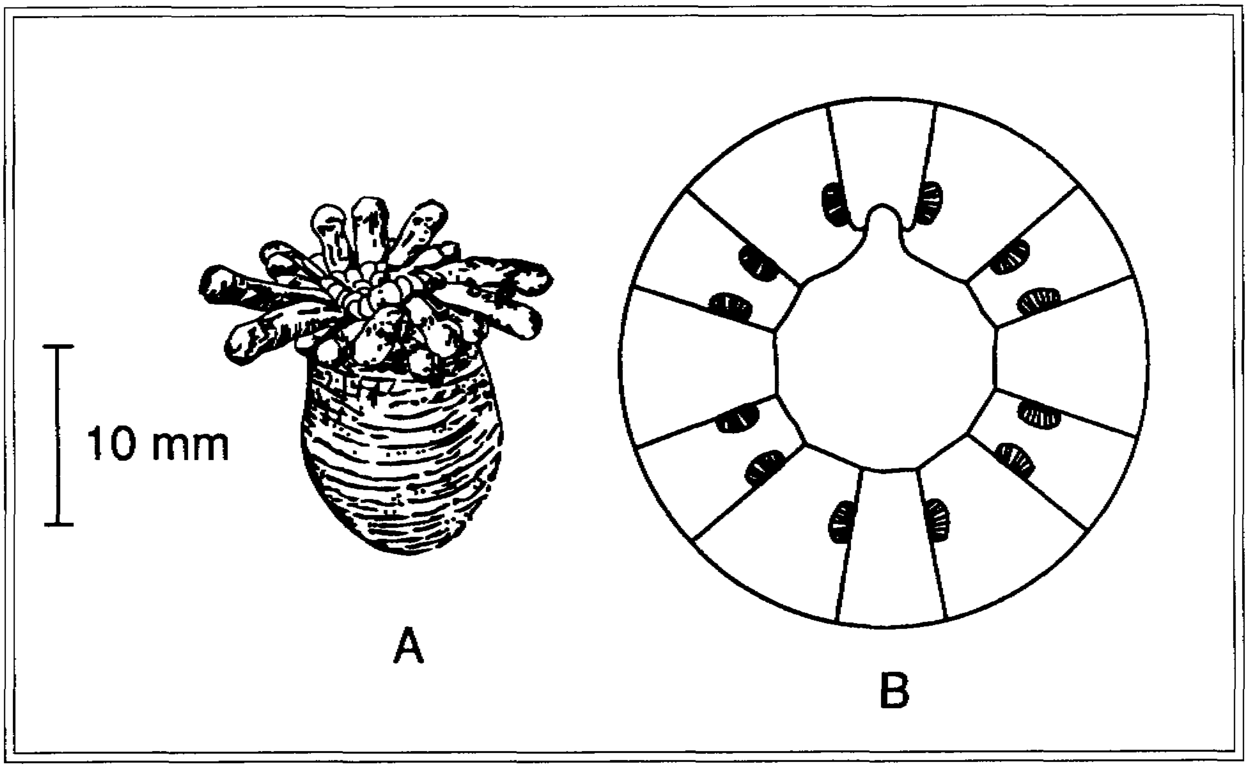

Figure 3.4. *Anemonactis mazeli* (from Uchida, 1938): A, whole specimen; B, cross-section.

Tentacles 10, relatively short; each with distinct, lighter-colored capitate end (Fig. 3.4) comprising dense, long (more than 100 mm), thin (3-4 mm) basitrichs, as well as sparse spirocysts.

Cnidom: Spirocysts (few seen in this specimen but reported by Carlgren [1921] to be absent), basitrichs, microbasic *p*-mastigophores.

Biology. Reported by Manuel (1981a:185) to burrow "in mud, sand or gravel, always offshore."

Remarks. Rees (1913) provided the most thorough description of the species, Stephenson (1935) summarized biology and external morphology, and Carlgren (1921) detailed internal anatomy and histology. Jourdan (1880:41) remarked "Comme chez tous les Actiniens, sa forme est très variable et dépend beaucoup de l'état d'extension ou de contraction dans lequel se trouve l'animal." This specimen conforms to those accounts except in having only 10 tentacles. However, it is also smaller than those studied, and Carlgren (1921) examined what he reported as a "young" specimen in which he found only 11 tentacles.

Wassilieff's (1908) description and figures of *Halcampella minuta* are clearly of this species. Carlgren's (1949) uncertainty about the generic placement of the species may be because of its possession of only 15 tentacles (which presumably was related to its small size — 10 mm long) and its Japanese locality. These attributes are now known to be consistent with *Anemonactis mazeli*.

Type Locality and Specimens.No type specimens recorded. Originally described from 60-80 m in the northeastern Gulf of Marseilles.

Distribution. Previously known from the Mediterranean, North Sea, Japan, from 20-650 m. This specimen is from 123 m.

Genus *Halcampa* Gosse, 1858

Diagnosis. Halcampidae (Athenaria) with elongate, cylindrical column usually divided into physa, scapus, and capitulum, and with a weak sphincter. Mesenteries divided into macrocnemes and microcnemes.

Remarks. Carlgren (1949) listed six species in the genus, including one with a query. Since then, three additional species, including *Halcampa decemtentaculata*, have been described.

Halcampa decemtentaculata Hand, 1955

Figure 3.5

Halcampa decemtentaculata Hand, 1955:360 (includes synonymy); 1957:413.

Halcampa duodecimcirrata: Carlgren, 1936:19; 1949:34 *pro parte*. — Cutress, 1949:12.

Material Examined. California: Santa Maria Basin, Phase I, Sta. 9 (x1); Phase I, Sta. 25 (x1); Phase I, Sta. 52 (x1); Phase I, Sta. 65 (x1); Phase I, Sta. 74 (x1); Phase I, Sta. 79 (x1); Phase II, Sta. PJ-10 (x1); Phase II, Sta. PJ-14 (x1).— Weatern Santa Barbara Channel, Phase I, Sta. 88 (x1).

Description. Column vermiform, divided into distinct regions; specimens examined yellowish to tan; 5 x 2 mm, 6 x 1.5 mm, 9 x 2 mm, 17 x 3 mm, 18 x 2.5 mm, 28 x 8 mm, 30 x 4 mm, 45 x 8 mm, 45 x 10 mm. Physa often bulbous, occasionally pulled in; scapus may have adherent debris; in expanded specimens capitulum slightly flared, thin so that at least macrocnemic insertions (10) visible through it. Several cinclides per endocoel reported (Hand, 1955); only that at tip of physa discerned in some specimens examined.

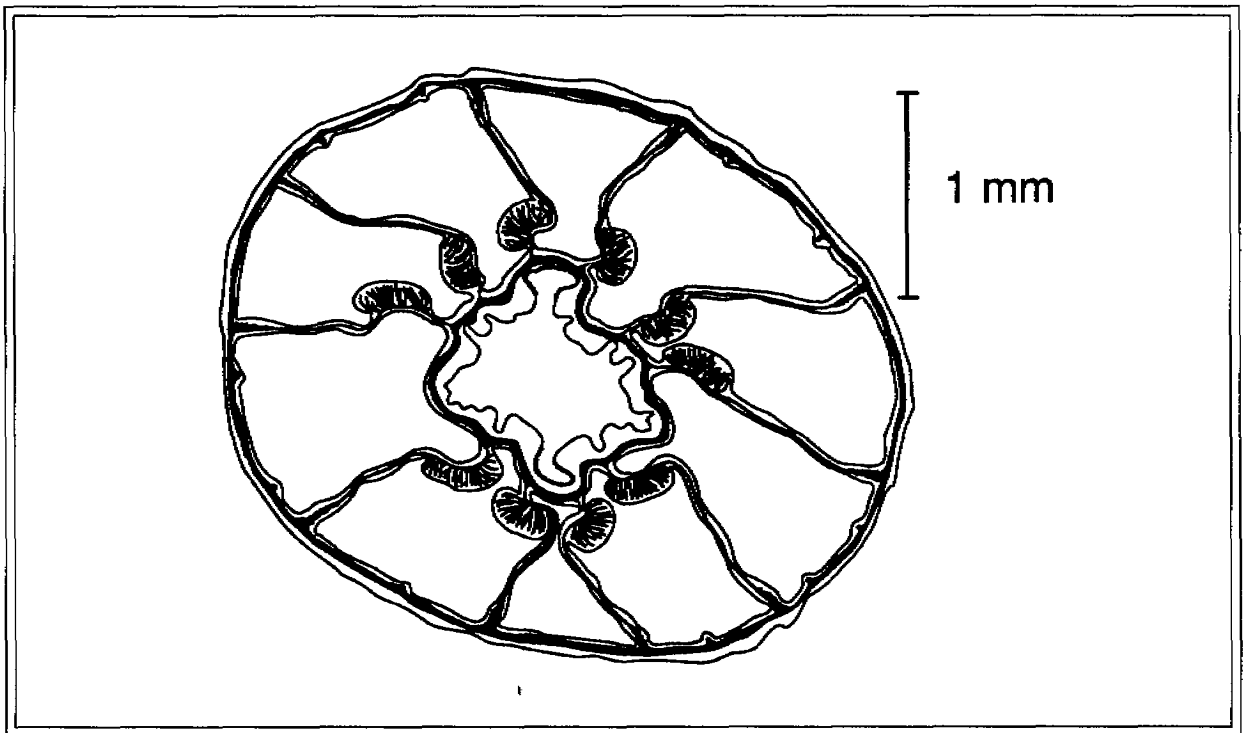

Figure 3.5. *Halcampa decemtentaculata*: cross-section from Hand (1955) illustrating distinctive arrangement of mesenteries.

Ten tentacles stubby, cylindrical in expansion (to 2 mm long), most nearly as wide as long (about 0.5 mm) in contraction. Darkly pigmented endoderm in specimens examined. Tentacles and mouth area darkly pigmented in two specimens; Cutress (1949) described variations in markings of oral disc. Mouth protuberant in one expanded specimen.

Ten macrocnemes and 10 microcnemes run entire length of column; arrayed in 4 pairs each plus 1 pair composed of macrocneme and microcneme. Two pairs of macrocnemes directives: 1 pair flanked by pair of microcnemes then pair of macrocnemes; other pair flanked by mixed pair then pair of microcnemes (Fig. 3.5). No or few microcnemes evident in smallest specimens examined. No acontia.

Cnidom: Spirocysts, basitrichs, microbasic *p*-mastigophores.

Biology. Anemones burrow in sand and gravel; Cutress (1949) reported they may expand and be visible intertidally on overcast days. He also stated that the larvae are parasitic on medusae.

Remarks. Hand (1955) provided detailed information about distinguishing *Halcampa decemtentaculata* from the similar species *H. duodecimcirrata*, with which it has been confused, and *H. arctica*.

Type Locality and Specimens. Havens Neck, Mendocino County, California. Lectotype USNM 50637 (Hand, 1957).

Distribution. At least from Washington to southern California. It was previously known only from the lower intertidal zone; specimens in this collection came from 98-398 m.

Genus *Peachia* Gosse, 1855

Diagnosis. Haloclavidae (Athenaria) with elongate, cylindrical column, and lacking sphincter. Tentacles normally 12, inner shorter than outer. Oral end of single very deep siphonoglyph drawn out into lobate conchula, occasionally siphonoglyph entirely separated from rest of actinopharynx so it forms a tube.

Remarks. Larvae of all 11 nominal species of this genus (and the one unnamed one) live parasitically on medusae.

Peachia quinquecapitata McMurrich, 1913b

Figure 3.6

Peachia quinquecapitata McMurrich, 1913b:963. — Carlgren, 1949:32 (synonymy).

Bicidium aequoreae McMurrich, 1913b:967.

Material Examined. California: Santa Maria Basin, Phase II, Sta. PJ-6 (×1); Phase II, Sta. R-1 (×2); Phase II, Sta. R-2 (×1).

Description. Column of larger individuals vermiform, not divided into distinct regions; smooth aside from circumferential wrinkles that are presumably due to contraction; may also be constricted at one or more points so animal appears like link sausages. Specimens examined retracted. Extended ones 30 mm long, one with uniform diameter of 13 mm, other 22 mm at broadest, 12 mm at constriction. Two smaller specimens globular, also with circumferential wrinkles but longitudinally grooved at mesenterial insertions as well; one 6 mm broad by 4 mm long (it resembled a pumpkin), the other 10 mm long by 8 mm diameter.

Aboral end may be abruptly narrowed, nipple-like; commonly indented to depth of several mm. Twelve tentacles either nipple-like, mostly 2 mm long by 3 mm greatest diameter at base (some slightly elongated radially), or digitiform and up to 4 mm long by 1.5 mm at base. Ectoderm of column and tentacles pinkish-brown or yellowish, column may have indistinct white reticulation, particularly in larger individuals.

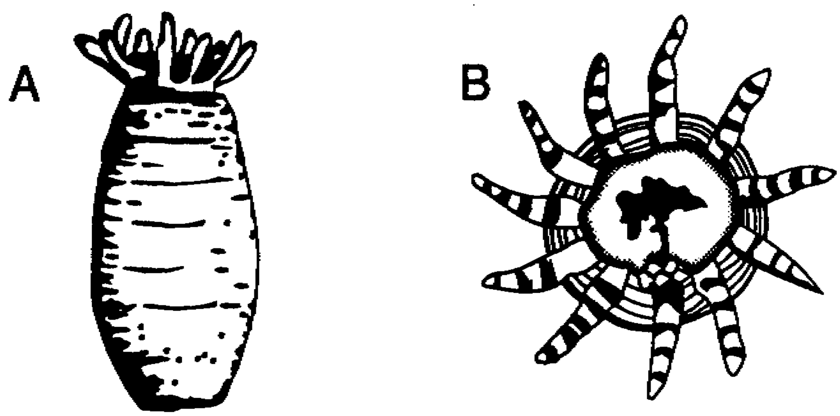

Figure 3.6. *Peachia quinquecapitata* (from McMurrich, 1913b): A, whole animal; B, oral disc and tentacles.

Cinclides not visible in specimens examined; reportedly discernible only in well-expanded specimens under proper illumination (Spaulding, 1972).

Mesenteries continuous entire length of column, distinctively arrayed in larger individuals: 6 pairs complete, including 2 pairs of directives, with diffuse retractor muscles; 4 pairs secondaries with very weak musculature lack filaments. Exocoels flanking 1 pair of directives lack secondaries; other pair of directives associated with deep siphonoglyph that is separated from actinopharynx, forming distinctive conchula at oral end. Smaller specimens had only 6 pairs of mesenteries, which extended entire length of animal. All specimens examined sterile. No acontia.

Cnidom: Spirocysts, basitrichs, microbasic *p*-mastigophores.

Biology. Larvae of this animal, as of all members of the genus, is parasitic on medusae (Spaulding, 1972).

Taxonomic Remarks. Some of the specimens examined conform precisely to the detailed original description (McMurrich, 1913b), including the depression in the center of the base, and the end of one being narrower than the rest of the column. Although its vermiform or globular shape is not unusual, its internal anatomy is very distinctive. Contrary to my experience, McMurrich (1913b) wrote that its column is "intense brownish red," a coloration that may be retained in preservation. *Bicidium aequoreae* was described from the parasitic larva. Although he thought it likely that *B. aequoreae* represented the larva of *P. quinquecapitata*, McMurrich (1913b) considered it prudent to describe them separately because an association between parasitic larvae and the adult form had not been definitely established.

Type Locality and Specimens. Nanoose Bay, Vancouver Island, 15-20 fathoms. Type specimens could not be located: they are not at CAS, RBCM, or USNM.

Distribution. From British Columbia south at least to the Santa Maria Basin. Known from low intertidal; the previously known range was extended to 161 m by these specimens.

Genus *Pentactinia* Carlgren, 1900

Diagnosis. Halcampoididae (Athenaria) with elongate cylindrical column and no sphincter. Four pairs and two single perfect mesenteries, the latter paired with microcnemes. One siphonoglyph, 20 tentacles.

Remarks. *Pentactinia* is a monospecific genus.

Pentactinia californica Carlgren, 1900

Figure 3.7

Pentactinia californica Carlgren, 1900:1166; 1931:33; 1949:29.

Material Examined. California: Santa Maria Basin, Phase I, Sta. 4 (×1); Phase I, Sta. 16 (×1); Phase II, Sta. PJ-7 (×1); Phase II, Sta. PJ-8 (×1); Phase II, Sta. PJ-22 (×1).

Description. Column vermiform, reportedly divided into regions but not obvious in specimens examined; ectoderm encrusted with fine sand. Aboral end (physa) of specimens examined indented; said to be distinct in extension (Fig. 1). Column of specimens examined 2-10 mm long × less than 1 to 3 mm broad. 20 tentacles small, short, outer nearly as broad as long, inner longer than outer; yellowish in extension or dark pink when retracted.

Mesenteries continuous entire length of column, but strong retractor muscles, filaments, and gonads (if any) of 10 macrocnemes confined to distal half. Single strong siphonoglyph connected with directive pair; five other macrocnemes arrayed on either side of each directive, imparting very pronounced bilaterality to internal anatomy (Fig. 3.7A). Retractors strong, reniform (Carlgren, 1931).

Data based mainly on 2 larger specimens; it was difficult to discern detail in the three smaller ones.

Cnidom: Spirocysts, basitrichs, microbasic *p*-mastigophores.

Biology. Nothing is known about this animal. Aside from Carlgren's original description and his redescription, this is the only published record of its occurrence.

Type Locality and Specimens. San Pedro, California; beach. Six specimens were said by Carlgren (1900) to be in SMNH. Two syntypes are SMNH 1162. The others were thought by Lennart Sandberg (personal communication), Curator at SMNH, to be in the Zoologiska Museet in Lund, Sweden, but they are not (personal communication from Lennart Cederholm, Curator, Zoologiska Museet).

Distribution. Southern California. Known from low intertidal to at least 591 m (specimens in this collection).

Genus *Edwardsia* de Quatrefages, 1842

Diagnosis. Edwardsiidae (Athenaria) with elongate, cylindrical column divided into physa, scapus, scapulus, and capitulum; lacking sphincter. Short physa without nemathybomes (spheroidal invaginations of the ectoderm into the mesoglea, laden with nematocysts), long scapus with nemathybomes. Eight macrocnemes and at least 4 microcnemes (very weak and confined to the distal portion of the body). Tentacles at least 12, the inner shorter than the outer.

Remarks. *Edwardsia* is the largest genus of athenarian actinians and one of the largest of all sea anemones, Carlgren (1949) having listed 56 species, one questionably. Williams (1981) recognized 40 species, and summarized the status of other nominal species.

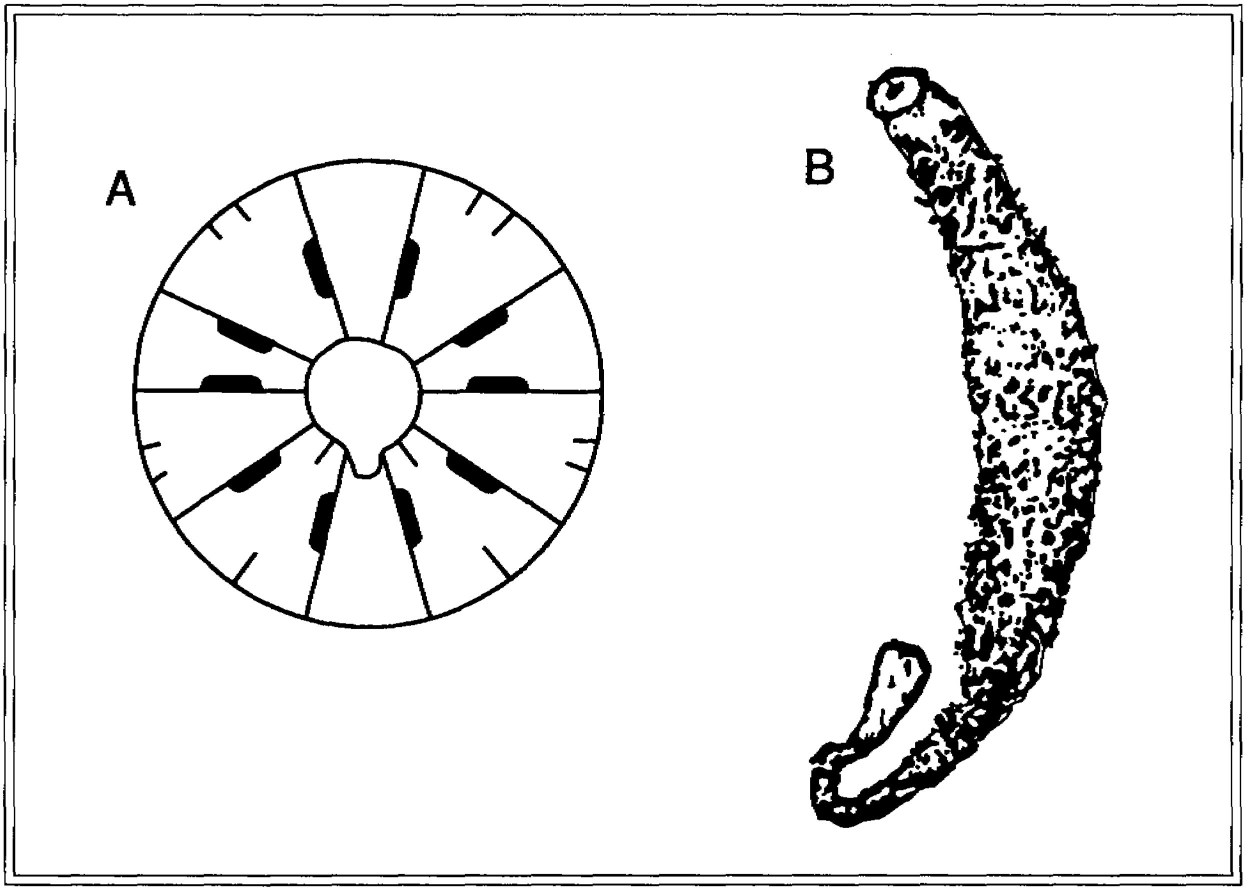

Figure 3.7. *Pentactinia californica*: A, cross-section, illustrating distinctive arrangement of mesenteries (from Carlgren, 1900); B, whole animal (from Carlgren, 1931).

Edwardsia californica (McMurrich, 1913a)

Figure 3.8

Edwardsiella californica McMurrich, 1913a:551.

Edwardsia californica: Carlgren, 1936:18; Carlgren, 1949:24. — Williams, 1981:346 (synonymy).

Material Examined. California: Santa Maria Basin, Phase I, Sta. 56 (×2); Phase I, Sta. 78 (×1); Phase II, Sta. R-7 (×1); Phase II, Sta. PJ-10 (×1).

Description. Vermiform; specimens examined to 30 mm long, 7 mm diameter. Scapus long, with brown cuticle, prominent nemathybomes; some circumferentially wrinkled; most specimens examined longitudinally grooved along macrocnemes so that column resembles 8-pointed star in cross-section; longitudinally striped, with ridges light colored, grooves dark (these stripes may be single or double). Physa short, well separated from scapus by constriction in most specimens, generally encrusted with fine sand. 12 yellowish tentacles in specimens examined.

Macrocnemes eight; microcnemes presumably present in distal portion of column but not prominent.

Cnidom: Spirocysts, basitrichs, microbasic *p*-mastigophores.

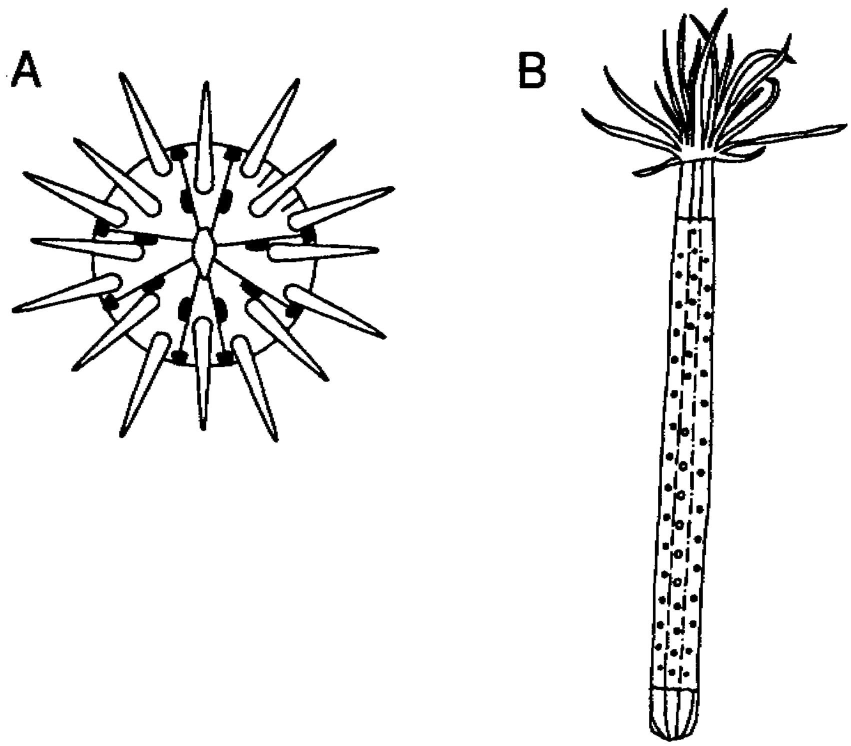

Figure 3.8. Diagrammatic sketch of *Edwardsia* (from Williams, 1981): A, oral disc and tentacles; B, expanded animal, illustrating basal physa, long scapus with nemathybomes, and distal scapus.

Biology. Nothing is known about this species.

Remarks. McMurrich's (1913a) description of whole animals and their histology conforms precisely to the specimens examined. Carlgren's (1936) brief treatment of the species provides data on cnidae, which differ slightly from what I found. However, the cnidae of one specimen differed slightly from those of the other three examined, and so cnidae may be variable in this species.

Carlgren (1936) transferred the species to the genus *Edwardsia*, a placement with which Williams (1981) agreed.

Type Locality and Specimens. "Anaheim Bay (Creek), California: Muddy shore, about one mile inland, at or below low water, one example; mud flats and shore at, or below, low tide, 'Stingaree Hole,' six examples" (McMurrich, 1913a:551). Type specimens USNM 30716.

Distribution. Southern California. Known intertidally to 900 m (this collection).

Genus *Scolanthus* Gosse, 1853

Diagnosis. Edwardsiidae (Athenaria) with column divided into scapus and scapulus; physa externally identical to scapus, with cuticle and tenaculi. No sphincter. Eight macrocnemes.

Remarks. Manuel (1981b) discussed his resuscitation of Gosse's (1853) genus *Scolanthus* and his opinion that Carlgren's (1921) *Isoedwardsia* is synonymous with it. However, he believed that not all six species Carlgren (1949) listed in that genus belong in *Scolanthus*.

Scolanthus sp.

Material Examined. California: Santa Maria Basin, Phase I, Sta. 21 (×1); Phase II, Sta. R-1 (×7).

Description. All specimens examined contracted, pear- to American football-shaped; maximum length 4 mm, maximum diameter about 1 mm. Column orangish brown due to rough cuticle, with numerous, easily visible nemathybomes. Eight mesenterial insertions visible entire length of column.

Ten tentacles counted in one individual. Blunt conical, slightly longer than broad.

Character, number, and arrangement of mesenteries obscure due to small size of animals.

Cnidom: Spirocysts, basitrichs, microbasic *p*-mastigophores found.

Biology. Unknown.

Remarks. These animals agree with Manuel's (1981b) diagnosis of *Scolanthus* except that two animals in which they were counted had 10 tentacles, as contrasted with 16 supposedly in *Scolanthus*. However, these specimens are very small and so might be expected to have fewer tentacles. No species of this genus or other similar edwardsiid is known from California. The specimens are so small as to preclude a more detailed diagnosis.

Genus *Halcampoides* Gosse, 1858

Diagnosis. Halcampoididae (Athenaria) with elongate, smooth, cylindrical column not divided into regions (although aboral end may resemble a physa), and no sphincter. Six pairs of perfect, fertile mesenteries; no microcnemes. Two indistinct siphonoglyphs, 12 cylindrical tentacles.

Remarks. Several species of the genus have been described, but Carlgren (1921) synonymized all as *Halcampoides purpurea*.

Halcampoides purpurea (Studer, 1879)

Figure 3.9

Halcampa purpurea Studer, 1879:545.

Halcampoides purpurea: Carlgren, 1921:82 (includes synonymy); 1949:27 (synonymy). — Manuel, 1981a:182 (synonymy).

Material Examined. California: Santa Maria Basin, Phase I, Sta. 13 (×1); Phase II, Sta. PJ-14 (×1).

Description. Column vermiform, not divided into distinct regions, although may be circumferentially contracted along its length so it somewhat resembles a chain of sausages; longitudinally furrowed along mesenterial insertions (12); smooth aside from circumferential wrinkles that are presumably due to contraction; aboral end expanded, reportedly with cinclides but not detectable in specimens examined. Ectoderm brown, scraped off particularly around base. Retracted specimens examined 48 mm long × 13 mm maximum column diameter, 15 mm aboral end diameter; 30 mm long × 10 mm maximum column diameter, 13 mm aboral end diameter.

Tentacles long, cylindrical, abruptly terminating in threadlike extension; retracted in specimens examined. Pale brown color.

Mesenteries distinctive: 6 pairs complete and fertile, including 2 pairs of directives, with very strong retractor muscles.

Cnidom: Spirocysts, basitrichs, microbasic *p*-mastigophores.

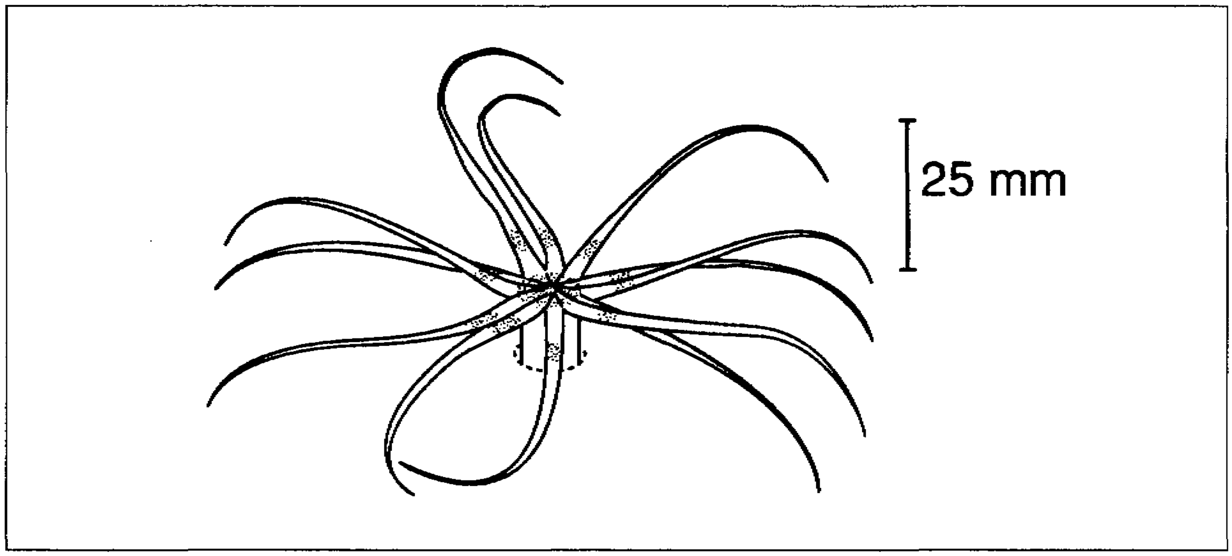

Figure 3.9. *Halcampoides purpurea* (from Manuel, 1981a): distal end of expanded animal *in situ*.

Biology. This animal is said to be capable of great extension when alive — Manuel (1981a) reported it is up to 100 mm long when not buried in sediment and can greatly exceed that when buried, with tentacles reaching 100 mm in length. It appears to be nocturnal in Galway Bay, to which Manuel (1981a) attributed the paucity of records.

Remarks. Carlgren (1921, 1949) and Manuel (1981a) considered there to be only one species of this genus in the world. It is very distinctive. This species was given several names in various parts of the world before its extraordinary range was recognized. Additional synonyms were given by Carlgren (1921); none was used for animals on this coast.

Carlgren (1921) summarized reports of some nematocysts and color in life: column is often suffused with pink or red, and oral disc may have reddish radial lines on oral disc, vivid green lips, and white spots near mouth. He also illustrated muscle variability.

Type Locality and Specimens. Kerguelen, South Central Indian Ocean, 6-100 fathoms; no type specimens located.

Distribution. Previously reported from both poles, around Britain, and the Mediterranean; thought by Carlgren (1949) to be cosmopolitan. This is the first record of the species along the west coast of North America. Known from 1-1,134 m.

Genus *Calamactinia* Carlgren, 1949

Diagnosis. Halcampoididae (Athenaria) with elongate column divided into scapus and scapulus. Sphincter absent. Six pairs of perfect, fertile macrocnemes, including 2 pairs of directives; microcnemes also present.

Remarks. This genus and its only species (*C. goughiensis*) are both listed as new in Carlgren's (1949) catalog. There is no other description of either, Carlgren apparently not having found time to elaborate on them before his death within a few years of his catalog's being published. The genus *Calamactinia* is listed in volume VI of *Nomenclator Zoologicus* (Edwards and Hopwood, 1966) with the 1949 Carlgren citation. Six lines of text in Carlgren's catalog are devoted to diagnosing the genus. In addition, there is a specific entry consisting of "*C. goughiensis* n. sp. SW of Gough Isl., 141-162 m." I interpret this presentation as equivalent to a combined description of new genus and new species, which is deemed in Article 13(c) of the *International Code of Zoological Nomenclature* "to confer availability on each name." This further implies to me that, there being only one species in the genus as Carlgren knew it, the generic description can be interpreted as applying to the species.

Calamactinia sp.

Material Examined. California: Santa Maria Basin, Phase I, Sta. 2 (×4).

Description. Column bulbous, varying from club-shaped to American football-shaped. All animals examined retracted; total length 5-15 mm, maximum width 2-5 mm. Sand, small bivalve shells, etc. adhere to scapus. No physa, short scapulus.

24 tentacles: inner longer than outer, but each about 1 mm long; narrow, tapering to pointed end.

No sphincter muscle or siphonoglyphs discernible; 6 pairs of fertile macrocnemes (including 2 pairs of directives) and 6 pairs of microcnemes extend entire length of column.

Cnidom: Spirocysts, basitrichs, microbasic *p*-mastigophores.

Remarks. Carlgren (1949) made no mention of the adherent debris, which is a conspicuous feature of this animal. His generic diagnosis included the phrase "scapus ... with a rather thick, easely [sic] deciduous cuticle." I omitted that feature from my diagnosis of the genus, choosing to interpret that feature as characteristic of *C. goughiensis*. The specimens from California have, instead, adherent debris, and so, I infer, belong to a second species of the genus. Before it can be described, type material of *C. goughiensis* must be examined. Additional material of the California species should also be studied.

Genus *Halcampella* Andres, 1883

Diagnosis. Halcampoididae (Athenaria) with elongate column divided into physa, scapus (which has tenaculi), and scapulus; no sphincter. Six pairs of perfect, fertile macrocnemes, including 2 pairs of directives; microcnemes also present. Two indistinct siphonoglyphs; tentacles short, stubby.

Remarks. Three species were listed in this genus by Carlgren (1949), including *H. robusta*. Presumably in Carlgren's (1931) description of *H. robusta* and discussions of *H. maxima* by Wassilieff (1908) and Carlgren (1931), references to a "capitulum" were actually to a scapus.

Halcampella sp.

Material Examined. California: Santa Maria Basin, Phase I, Sta. 52 (×2); Phase II, Sta. R-8 (×1).

Description. Column vermiform. Physa discoidal, mostly smooth but with remnants of cuticle, pulled in along mesenterial insertions, broader than most proximal part of scapus; crusty cuticle thicker on scapulus than scapus, perhaps due to scapulus being introverted in all specimens examined; scapus, which represents most of animal's length, with easily eroded cuticle, may be greatly narrowed proximally. Ectoderm light brown, visible where cuticle eroded, particularly proximally; no adherent material. Retracted specimens examined 23-25 mm long × 6-8 mm maximum column and basal diameter.

Tentacles short, stubby; 12 in specimens examined.

Six pairs of mesenteries complete and fertile, including 2 pairs of directives, with very strong retractor muscles. At least 1 cycle of microcnemes.

Cnidom: Spirocysts, basitrichs, microbasic *p*-mastigophores.

Remarks. The *gestalt* of these animals is virtually identical to that of *Halcampoides purpurea*. However, specimens of *H. purpurea* are smooth, have long tentacles, and lack microcnemes.

It is difficult to determine whether these three specimens belong to a known species. The description of the type species, *Halcampa endromitata* Andres, 1881, is so brief as not to be diagnostic. The figure in the more informative redescription, in which Andres (1883) transferred the species to his new genus *Halcampella*, resembles these specimens except that the physa of these is discoidal rather than rounded and *H. endromitata* has 24 tentacles rather than 12, but that may simply be a function of size. The Mediterranean and presumably shallow habitat of *H. endromitata* also makes it unlikely to be the same as those from California.

The specimens on which the other two species in the genus were based were large (to 150 mm long), which could account for some differences between them and the three California specimens (if both of the others actually do possess a capitulum and not a scapulus, they belong not only to a different species but to another genus). The physa was torn from the sole specimen of *H. robusta* Carlgren, 1931, which could easily occur with the specimens from California.

Order Ceriantharia

Tube anemones are exclusively infaunal, each animal forming a tube that is a feltwork composed mostly of ptychocysts (a type of cnida), mucus, and mud (Mariscal *et al.*, 1977). When disturbed, the sensitive cerianthid rapidly retracts into its tube, which typically extends above the surface of the sediment. The tube is unique to this group, but because it is often not collected, it cannot be relied upon to assign a specimen to order. Related to the possession of tubes, cerianthids are exclusively solitary. A cerianthid has a long column that tapers to an end that is either narrow and rounded, or is bulbous (Fig. 3.10). The most distinctive external attribute of a cerianthid, aside from its tube, is its simple tentacles arrayed in two cycles: a whorl of short ones immediately surrounds the mouth, and longer ones are arrayed at the margin (Fig. 3.10). Internally, a cerianthid has a single siphonoglyph and its mesenteries, which are all complete, arise singly. There is no marginal sphincter muscle.

Because of their subtidal, infaunal habitat, little is known about the natural history or live appearance of animals of most species, and the polyps may be difficult to collect intact. This dearth of knowledge contributes to taxonomic uncertainty: so few specimens of most species have been studied that range of intraspecific ontogenetic and geographic variability are unknown. Of about 50 species of cerianthids recognized worldwide, perhaps four or five occur in the waters of southern California.

The number of specimens in this collection is uncertain because some of the seven lots contain pieces (commonly the distal end). Cerianthids may grow to more than 300 mm in length (Arai, 1965), but the longest intact specimens in this collection were only 25 mm. Character and arrangement of mesenteries are essential to

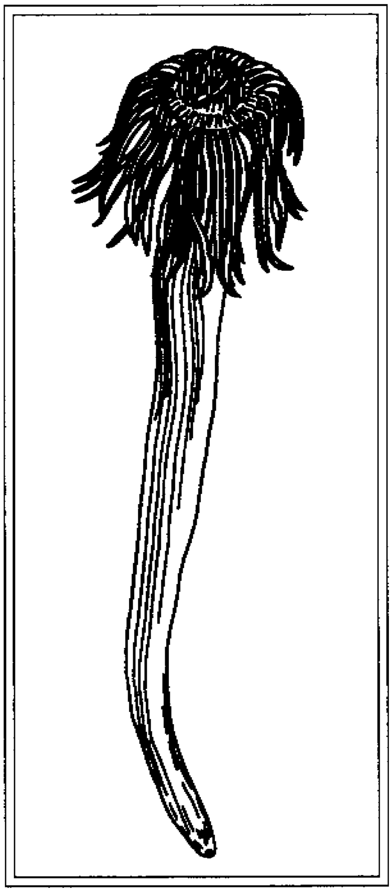

Figure 3.10. Ceriantharian (after Hyman, 1940).

family and genus placement; mesenteries of most of these specimens were insufficiently developed or well-preserved for such determinations. None of the specimens in this collection were identified to species, but, based on its short protocnemes, one from Sta. R-1 (Phase II; 91 m) was placed in the genus *Pachycerianthus*, a member of family Cerianthidae. All but one of the other specimens in the collection appear similar to that of *Pachycerianthus*; thus, all but that one may be at least congeneric, if not conspecific. Animals of the species *P. fimbriatus* are common and variable (Arai, 1971) along the west coast of North America, as well as elsewhere; the species was originally described from Indonesia (McMurrich, 1910).

Order Zoanthinaria

Zoanthids may be solitary, clonal, or colonial. Polyps are always(?) attached to firm substrata, although, of course, in species with a thick coenenchyme, they arise from the common tissue that is fixed to the substratum. Colonies of many deep-water taxa form symbioses with hermit crabs. Zoanthids typically incorporate sand, sponge spicules, tests of foraminiferans, or other small, hard objects into their body walls and coenenchyme, in some species so thickly as to form essentially an exoskeleton. Although some actinians attach debris to their columns, in zoanthids such material is incorporated into the living tissue, the difference being obvious to an experienced zoologist. A zoanthid's column is divided into a longer scapus and a shorter capitulum; debris is usually thicker in the former. The short, simple tentacles are arrayed in a single marginal cycle (Fig. 3.11).

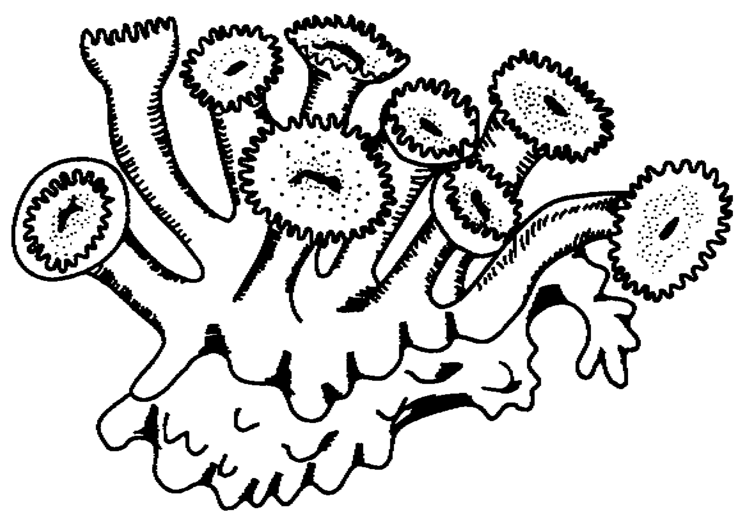

Figure 3.11. A colony of zoanthids (after Hyman, 1940).

The mesenteries of zoanthids are paired and coupled; the typical pair is composed of one complete and one incomplete mesentery. However, a pair of compete directive mesenteries is attached to the single siphonoglyph; the other pair of directives is incomplete. The marginal sphincter muscle is endodermal or mesogleal, and single or double.

Perhaps 250 species are valid, although more have been described. Because of the debris in the body wall, these animals are difficult to study. Nine species have been described from the northeast Pacific; only *Epizoanthus induratum* is in this collection. Its scapus is thickly encrusted by uniformly fine sand, and its coenenchyme is thin so that most of the length of each polyp is free of the common tissue.

Description of Species of Zoanthinaria

Genus *Epizoanthus* Gray, 1867

Diagnosis. Epizoanthidae with single mesogleal sphincter. Scapus and coenenchyme are encrusted with foreign material. The arrangement of mesenteries is macrocnemic. This means that, of the mesenteries flanking the incomplete directives, the member of the pair nearer the directives is complete whereas the other member of the pair is incomplete, and both members of the pair of mesenteries beside that flanking pair are complete. In the rest of the pairs, except for the directives attached to the siphonoglyph, the member of the pair on the side toward the siphonoglyph is complete.

Remarks. Nine species of this large genus are known from the eastern Pacific (Cutress and Pequegnat, 1960).

Epizoanthus induratum Cutress and Pequegnat, 1960

Epizoanthus induratum Cutress and Pequegnat, 1960:95.

Material Examined. California: Santa Maria Basin, Phase I, Sta. 4 (x28); Phase I, Sta. 20 (x40).

Description. Column pillar-like, from 1 - 9 mm length, 1.5 - 3.5 mm diameter; completely encrusted with fine sand grains of uniform size, including prominent ridges of scapulus. Aboral end of most specimens examined torn — presumably they had been embedded in a common coenenchyme. About 20 tentacles in specimens examined.

Macrocnemes about 20; microcnemes only in distal portion of column.

Cnidom: Spirocysts, microbasic *p*-mastigophores, microbasic *b*-mastigophores, holotrichs.

Biology. The only publication about this animal is the original description, which noted that large colonies occur "principally upon shale but may occasionally be found on the gorgonian *Muricea californica*" and that it "is bioluminescent and pale salmon in color" (page 96). These observations could not be verified in the material examined.

Remarks. Holotype: colony of about 60 polyps from Corona del Mar, California, 1 mi (1.6 km) SE of Newport Harbor entrance and 0.5 mi (0.8 km)off shore at 75 ft (23 m), encrusted on base and lower portion of *Muricea californica* that was attached to shale, USNM 51054. Paratypes: colony of about 20 polyps from type locality, encrusting a piece of shale, USNM 51055; about 100 polyps constituting fragments of a colony from 1.3 mi (2.1 km) SE of Corona del Mar, California, at 75 ft (23 m), encrusting a piece of shale, USNM 51058.

Distribution. Southern California. Known from 23-396 m (this collection).

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Appendix

Lists and Maps of Stations

Table A.1. Position of soft-substrate stations taken during the Phase I Reconnaissance.

Station	Latitude	Longitude	Depth (m)
1	35°27.86′N	121°05.33′W	98
2	35°27.70′N	121°06.52′W	200
3	35°27.07′N	121°10.20′W	291
4	35°26.56′N	121°14.93′W	393
5	35°25.77′N	121°21.69′W	585
6	35°20.88′N	120°59.62′W	109
7	35°20.65′N	121°02.57′W	197
8	35°20.00′N	121°06.58′W	308
9	35°19.48′N	121°10.06′W	398
10	35°18.28′N	121°18.65′W	591
11	35°17.80′N	121°22.13′W	690
12	35°15.03′N	120°57.31′W	98
13	35°14.54′N	120°59.77′W	197
14	35°14.15′N	121°02.04′W	299
15	35°13.98′N	121°04.54′W	393
16	35°12.23′N	121°16.29′W	591
17	35°11.61′N	121°22.55′W	654
18	35°09.08′N	120°56.55′W	197
19	35°08.93′N	120°59.66′W	296
20	35°15.72′N	121°04.68′W	396
21	35°06.11′N	120°44.82′W	49
22	35°05.85′N	120°50.23′W	99
23	35°05.60′N	120°55.18′W	195
25	35°05.07′N	121°00.75′W	390
26	35°04.38′N	121°15.99′W	590
27	35°04.30′N	121°19.27′W	611
28	35°04.22′N	121°19.65′W	603
30	34°54.19′N	120°47.07′W	98
31	34°53.76′N	120°52.96′W	200
32	34°53.56′N	120°56.81′W	297
33	34°53.43′N	120°59.66′W	396
34	34°53.15′N	121°04.40′W	492
35	34°52.96′N	121°10.30′W	548
36	34°52.77′N	121°15.37′W	492
38	34°49.81′N	120°52.66′W	197
39	34°49.53′N	120°56.85′W	294
40	34°49.24′N	121°00.81′W	392
41	34°48.35′N	121°19.14′W	495
42	34°48.04′N	120°47.50′W	100
43	34°46.59′N	120°52.92′W	197
45	34°44.91′N	120°59.59′W	395
46	34°41.22′N	121°13.56′W	597
47	34°41.99′N	121°10.81′W	378
48	34°45.11′N	120°52.85′W	196
49	34°45.03′N	120°56.31′W	290
50	34°37.80′N	121°01.66′W	591
52	34°39.56′N	120°47.64′W	98
53	34°37.69′N	120°50.38′W	196
54	34°36.57′N	120°52.02′W	396
55	34°33.66′N	120°56.31′W	590
56	34°30.32′N	121°01.02′W	900

Table A.1 (Continued)

Station	Latitude	Longitude	Depth (m)
58	34°34.35'N	120°45.18'W	99
59	34°33.65'N	120°47.18'W	216
60	34°33.25'N	120°48.34'W	275
61	34°33.01'N	120°48.89'W	345
62	34°30.46'N	120°52.13'W	582
63	34°26.29'N	120°58.08'W	930
64	34°33.15'N	120°40.90'W	59
65	34°31.27'N	120°43.27'W	107
66	34°30.46'N	120°44.55'W	201
67	34°30.29'N	120°45.50'W	282
68	34°29.24'N	120°45.99'W	390
69	34°22.88'N	120°54.20'W	927
70	34°29.67'N	120°43.70'W	200
71	34°29.04'N	120°44.01'W	306
72	34°28.41'N	120°44.76'W	401
73	34°28.21'N	120°36.80'W	98
74	34°26.84'N	120°38.61'W	201
75	34°26.08'N	120°39.65'W	293
76	34°25.59'N	120°40.98'W	387
77	34°22.62'N	120°44.02'W	578
78	34°18.78'N	120°49.30'W	762
79	34°24.12'N	120°28.32'W	98
80	34°22.86'N	120°28.34'W	196
81	34°21.26'N	120°28.83'W	294
82	34°18.71'N	120°29.55'W	394
83	34°17.20'N	120°30.20'W	444
84	34°13.54'N	120°31.19'W	394
85	34°25.88'N	120°16.31'W	113
86	34°24.45'N	120°17.02'W	197
87	34°21.60'N	120°17.11'W	299
88	34°17.89'N	120°16.86'W	393
89	34°13.79'N	120°16.56'W	471
90	34°09.44'N	120°16.30'W	375
91	34°11.73'N	120°07.43'W	540
92	34°08.70'N	120°07.50'W	444
93	34°07.63'N	120°07.51'W	357
96	34°22.91'N	120°05.42'W	296
94	34°24.54'N	120°05.47'W	96
95	34°23.70'N	120°05.47'W	198
97	34°22.28'N	120°05.49'W	393
98	34°12.87'N	120°05.59'W	561
99	34°11.22'N	120°05.86'W	540
100	34°08.67'N	120°05.50'W	443
101	34°07.51'N	120°05.65'W	357
102	34°59.71'N	120°48.22'W	99
103	34°59.63'N	120°53.56'W	197
104	34°59.45'N	120°56.49'W	294
105	34°59.23'N	120°59.60'W	392
106	34°58.95'N	121°04.42'W	492
107	34°58.65'N	121°15.08'W	573
108	34°58.21'N	121°17.88'W	492

Note: Sample labels from the Soft-substrate stations have several identification codes which include a station number, sample type, replicate number, and analysis type. These are as follows: 001 to 200 = the range of station numbers; BSS = Benthic Sediment Single (i.e., a non-replicated station); BSR = Benthic Sediment Replicate (three replicates taken at this station); BSV = Benthic Sediment Variance (subsamples); 01-09 = replicate numbers; TX = a taxonomy sample. Sample labels having the designation BRA, represents a sample from rocks taken as part of the hard bottom survey.

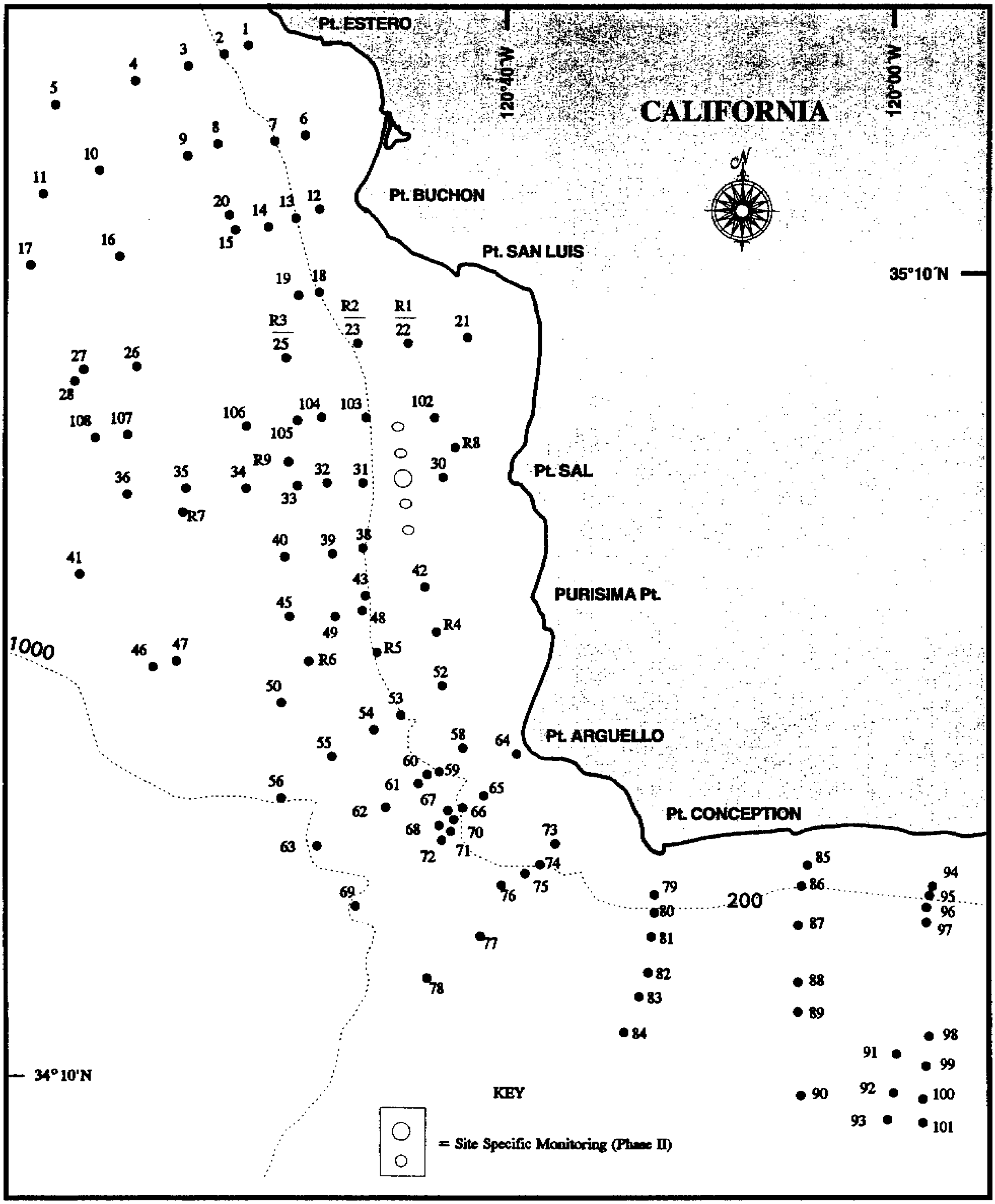

Figure A.1. Map showing location of soft-substrate stations from the Phase I Reconnaissance and Phase II Monitoring Programs.

Table A.2. Location of soft-substrate stations taken during the Phase II Monitoring Program.

Station	Latitude	Longitude	Depth (m)
R-1	35°05.83'N	120°49.16'W	91
R-2	35°05.50'N	120°53.40'W	161
R-3	35°05.30'N	121°00.90'W	409
R-4	34°43.01'N	120°47.39'W	92
R-5	34°42.69'N	120°50.83'W	154
R-6	34°41.40'N	120°57.90'W	410
R-7	34°52.90'N	121°10.30'W	565
R-8	34°55.30'N	120°45.87'W	90
R-9	34°53.68'N	120°59.12'W	410
PJ-1	34°55.79'N	120°49.91'W	145
PJ-2	34°55.32'N	120°49.59'W	142
PJ-3	34°56.26'N	120°49.58'W	138
PJ-4	34°56.26'N	120°50.24'W	150
PJ-5	34°55.32'N	120°50.24'W	152
PJ-6	34°54.71'N	120°49.91'W	148
PJ-7	34°55.79'N	120°48.60'W	123
PJ-8	34°56.87'N	120°49.91'W	142
PJ-9	34°55.79'N	120°51.23'W	169
PJ-10	34°53.63'N	120°49.91'W	147
PJ-11	34°57.95'N	120°49.91'W	136
PJ-12	34°55.58'N	120°49.91'W	145
PJ-13	34°56.01'N	120°49.91'W	144
PJ-14	34°55.79'N	120°49.26'W	134
PJ-15	34°55.79'N	120°50.57'W	155
PJ-16	34°55.03'N	120°48.99'W	130
PJ-17	34°56.56'N	120°48.98'W	126
PJ-18	34°56.56'N	120°50.84'W	158
PJ-19	34°55.03'N	120°50.84'W	167
PJ-20	34°50.38'N	120°49.91'W	148
PJ-21	35°01.23'N	120°51.15'W	143
PJ-22	34°55.25'N	120°49.93'W	143
PJ-23	34°56.33'N	120°49.90'W	143

Table A.3. Sampling dates of MMS Phase II Monitoring Program.

Cruise	Date
1-1	October 1986
1-2	January 1987
1-3	May 1987
2-1	July 1987
2-3	October 1987
2-4	January 1988
2-5	May 1988
3-1	October 1988
3-4	May 1989

Table A.4. MMS Phase I - Locations of hard-substrate transects.

Station	Beginning Latitude	Longitude	End Latitude	Longitude	Depth (m)
1 A/B	34°24.454'N	120°01.876'W	34°24.464'N	120°00.878'W	69-73.5
1 C/D	34°24.076'N	120°00.443'W	34°24.184'N	120°01.480'W	73.5-78
2 A/B	34°11.377'N	120°29.318'W	34°11.289'N	120°28.774'W	110-126
2 C/D	34°10.984'N	120°28.094'W	34°10.780'N	120°27.554'W	120-123
4 A/B	34°27.539'N	120°40.364'W	34°28.162'N	120°40.189'W	168-237
6 A/B	34°30.246'N	120°35.555'W	——.—	——.—	54-63
6 C/D	——.—	——.—	34°30.421'N	120°34.315'W	54-63
13 A/B	34°42.570'N	120°47.899'W	34°42.107'N	120°48.253'W	92-100
13 C/D	34°42.556'N	120°48.147'W	34°42.974'N	120°47.424'W	88.5-100.5
14 A/B	34°43.589'N	120°49.093'W	34°42.826'N	120°48.370'W	96-105
14 C/D	34°43.244'N	120°49.406'W	34°42.893'N	120°48.822'W	105-117
16 A/B	34°46.544'N	120°50.197'W	34°45.912'N	120°49.726'W	91.5-123
17 A/B	34°49.382'N	120°50.768'W	34°49.600'N	120°50.688'W	160.5-168
19 A/B	34°47.833'N	120°51.425'W	34°47.097'N	120°50.793'W	148.5-177
20 A/B	34°46.470'N	120°50.289'W	34°46.140'N	120°49.885'W	90-130.5
21 A/B	34°47.335'N	120°45.903'W	34°47.548'N	120°46.123'W	75-90
22 A/B	34°50.365'N	120°48.221'W	34°50.990'N	120°48.365'W	114-115.5
23 A/B	34°49.868'N	120°47.393'W	34°50.003'N	120°47.480'W	93-102
25 A/B	35°05.662'N	120°47.562'W	35°06.036'N	120°47.652'W	64.5-72
26 C/D	35°11.586'N	120°55.556'W	35°11.555'N	120°55.233'W	108-111
27 A/B	35°20.906'N	120°59.657'W	35°21.035'N	120°59.603'W	96-126
28 A/B	35°21.539'N	120°59.641'W	35°21.867'N	120°59.299'W	96-105
29 A/B	35°27.864'N	121°05.331'W	35°27.805'N	121°05.277'W	102-106.5

Table A.5. MMS Phase II - Locations of hard-substrate photosurvey stations.

Station	Latitude	Longitude	Depth (m)
PH-E	34°30.26'N	120°42.76'W	119
PH-F	34°30.81'N	120°42.36'W	105
PH-I	34°29.96'N	120°41.68'W	107
PH-J	34°29.82'N	120°41.82'W	117
PH-K	34°29.37'N	120°42.26'W	160
PH-N	34°29.21'N	120°42.05'W	166
PH-R	34°29.11'N	120°42.67'W	213
PH-U	34°31.48'N	120°43.51'W	113
PH-W	34°31.52'N	120°45.86'W	195

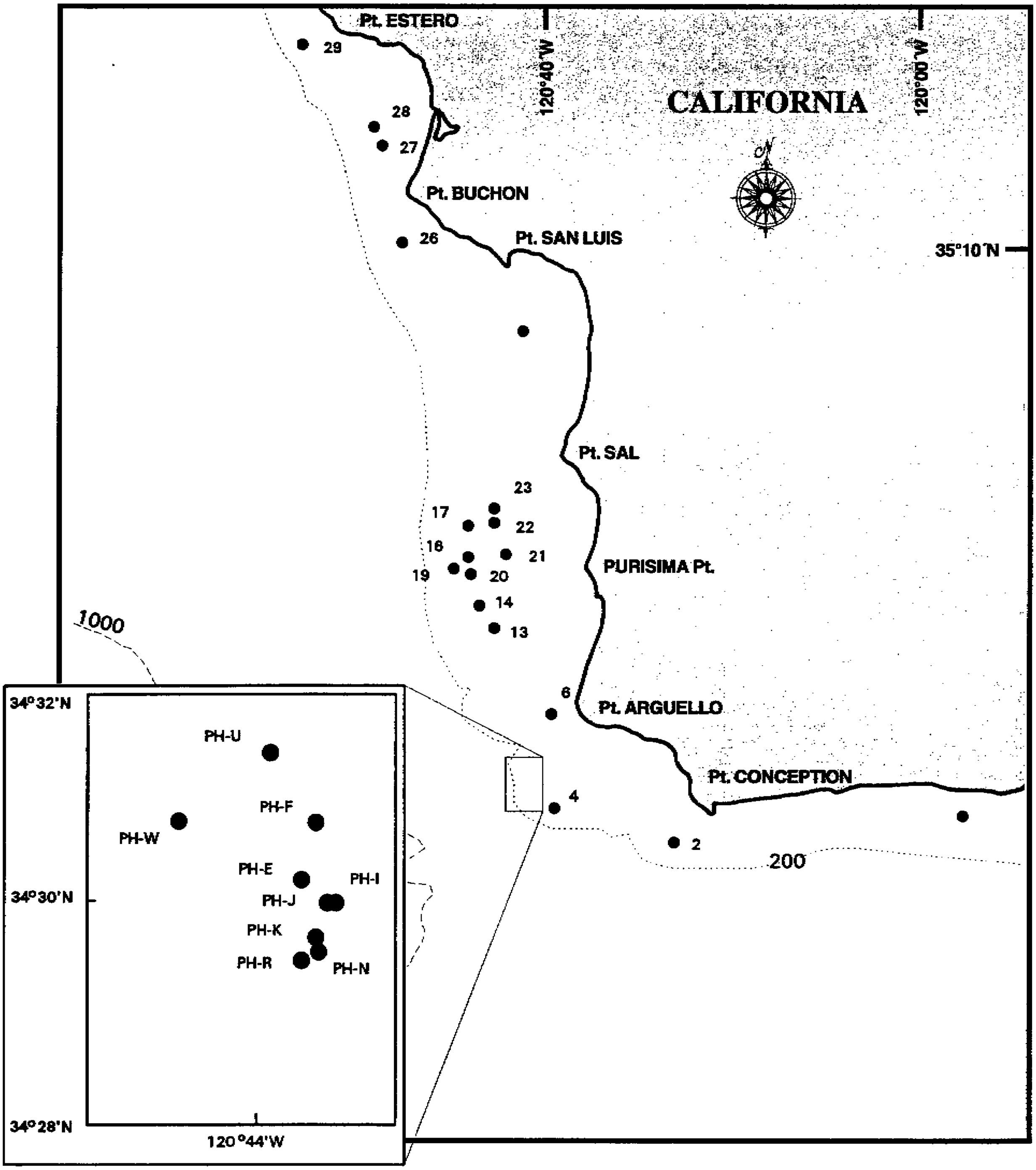

Figure A.2. Map showing location of hard-substrate stations from the Phase I Reconnaissance and Phase II Monitoring Programs. Phase II stations are indicated in the inset.

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.