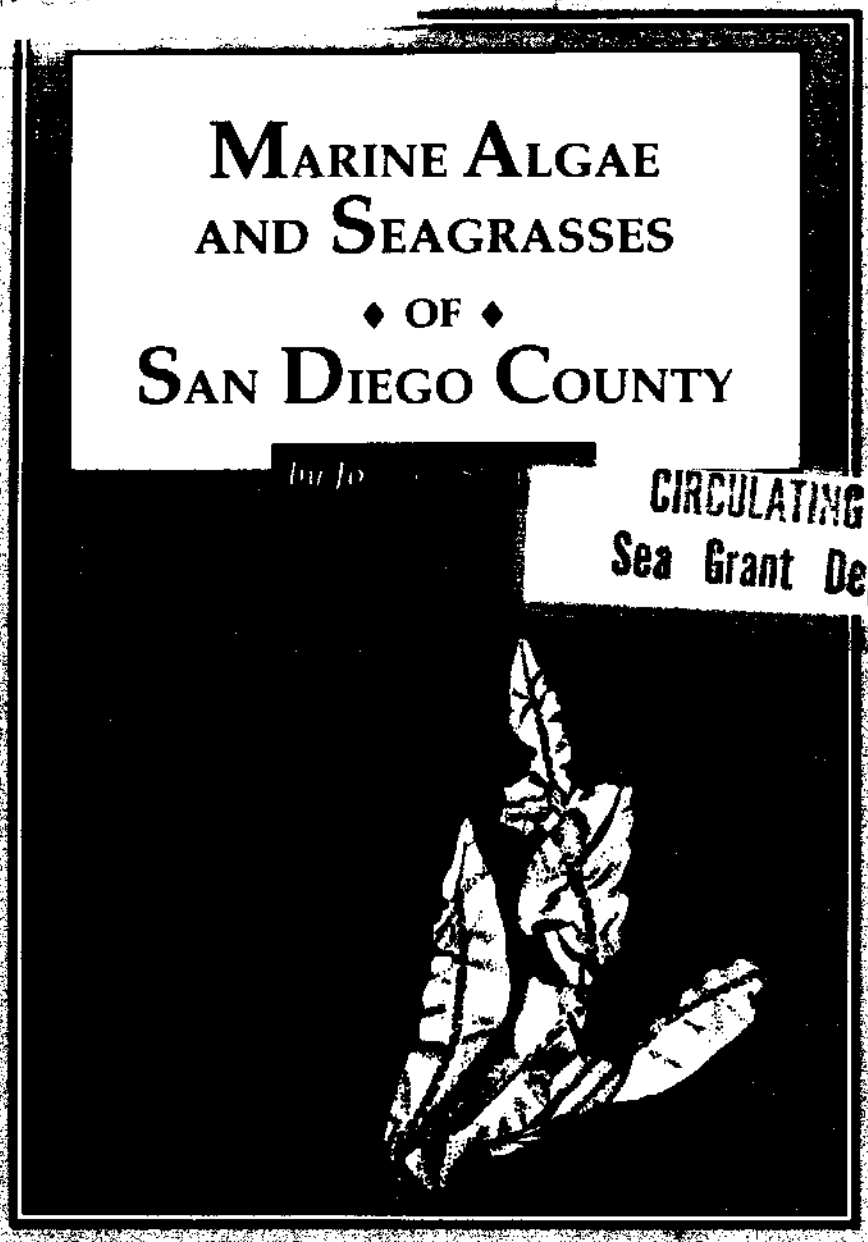
Marine Algae and Seagrasses ♦ of ♦ San Diego County



♦ A Publication of the California Sea Grant College ♦

ROSEMARY AMIDEI
COMMUNICATIONS COORDINATOR

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On the cover: *Berkeleya hyalina* and *Apoglossum (Phrix) gregarium* (not to scale: see pp. 23 and 140). Drawing by Nancy Hulbirt. Design by Victoria Cypherd.

Marine Algae and Seagrasses of San Diego County

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A Handbook of Benthic Marine Plants from Intertidal and Subtidal Sites Between the U.S.-Mexican Border and Orange County, California

◆

Joan G. Stewart
Associate Research Biologist
Scripps Institution of Oceanography
University of California, San Diego

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◆ A Publication of the California Sea Grant College ◆
Report No. T-CSGCP-020

DEDICATED

. . . . . to James R. Stewart,
Research Diving Safety Officer,
Scripps Institution of Oceanography,
University of California, San Diego,
whose interest in marine plants and subtidal collections
has added immeasurably to the completeness of this handbook.

CONTENTS

INTRODUCTION

During the early days of ship-based exploration along the coast of California, expeditions spent most of their time between Monterey and San Francisco. Menzies, however, with Vancouver's ships, spent nearly 2 weeks in San Diego late in 1793 before sailing south to El Rosario, thence to Hawaii. The few collections from this voyage were later described in scattered works. The only alga that possibly represented a San Diego collection was the species now known as *Egregia menziesii* (Papenfuss, in Abbott and Hollenberg 1976. **Marine Algae of California**, hereafter referred to as **MAC**).

Daniel Cleveland (1885) compiled information from his own field experiences and other scattered references to marine algae in the San Diego area into a checklist that provided the first published information for this part of the state. A few years later, just before and after 1900, Mary Snyder collected and identified algae from local beaches; many of her specimens were deposited in herbaria in California. Some were sent also to professional biologists on the east coast of the United States and cited in their publications, but her records were never assembled in any single place. Cleveland, a resident of San Diego County for 60 years until his death in 1929, and Palmer, also from San Diego, sent specimens to Farlow at Harvard to be identified and, if considered new to science, to be named by him. The two local collectors were recognized by the names of several algae that occur locally (e.g., *Sargassum palmerii; Ozophora*, *Platysiphonia*, and *Pterosiphonia clevelandii*).

Setchell and Gardner, working principally in Berkeley, compiled into two volumes (Setchell and Gardner, 1920, 1925) previously published and herbarium records of Chlorophyta and Phaeophyta along the entire Pacific coast of North America. The authors intended to describe the sources of their material in an introduction to the final part (Rhodophyta) which was never prepared. It is unclear, therefore, how many previously unreported collections are cited in their work. There is a great amount of detailed information about habitats, variation, and local distribution for the green and brown algae, and these volumes remain useful for San Diego County despite numerous nomenclatural changes since they were published.

Kylin, the Swedish specialist in algal taxonomy, visited La Jolla during the summer of 1922, but his interest was primarily in obtaining specimens of selected taxa for comparative anatomical study.

From Snyder's time until the arrival of E. Yale Dawson in La Jolla in 1942, San Diego lacked resident phycologists. Dawson's three years of inten-

sive work in San Diego County led to the publication (1945d) of his "annotated list" by the San Diego Natural History Museum. This combined his own collection data with earlier records for this area. He observed that taxa included on the basis of single or fragmentary collections, often picked up unattached on beaches, may have been carried here from other regions by longshore currents rather than being part of the local flora.

Because diving biologists can now directly observe submerged habitats, it is no longer necessary to depend on beach drift to describe the subtidal algal flora. In the present checklist, if a species has not been found growing attached along the coast of San Diego County, and if the only record of its occurrence in this region is based on single or rare washed-ashore plants, we consider it unlikely that it occurs in the local flora. Where such species are mentioned in the following list, the source of the original record is noted.

Collections from depths beneath about 13 m, or beneath the depth of warmer summer water temperatures, disclose an algal flora rather different from the intertidal flora. Many of the algae that in San Diego are uniquely deep-growing species, particularly those always restricted to habitats beneath the thermocline, are common intertidal zones to the north. Seasonal distributional patterns occur in subtidal as well as intertidal habitats; some species can be found, or are most common, only at certain times of the year. Distinct specific temporal and spatial distribution patterns are briefly described, for they provide information that can be useful in formulating studies about community dynamics and biological interactions.

The present checklist incorporates relevant information from Dawson's list (for species marked *) and other published data, but details are drawn primarily from the author's experience with San Diego County algae. Cited specimens not otherwise attributed are JS collected or filed with JS material, now deposited with the Los Angeles County Natural History Museum algal herbarium (LAM). Dawson's comments about individual species are from the appropriate section of **Marine Red Algae of Pacific México** (1953b-1962) if not cited directly; similarly, information referred to Abbott without citation is in **Marine Algae of California** (**MAC**). Taxa names used by earlier workers, including those in Dawson's studies, are not referred to here if specific synonymy is listed in **MAC**. Herbaria abbreviations include UC (University of California, Berkeley), CAS (California Academy of Sciences, San Francisco), AHFH (Allan Hancock Foundation Herbarium, Los Angeles), and LAM (Los Angeles County Museum of Natural History). Species lists for several selected sites, with representative common taxa as well as species with very restricted distributions, are compared in Appendix A.

Rocky intertidal beaches (marked in Figure 1 by short lines perpendicular to the shore) on the ocean-facing side of Pt. Loma consist of wave-cut benches, and species composition varies among the many different habitats available. Algal turf anchored by a few articulated coralline species, and comprising 40+ species that grow epiphytically, is a conspicuous vegetation form on these nearly flat platforms. Dense beds of *Phyllospadix* (surfgrass) grow seaward from about the 0.0' tide level and many of the algae that are easily recognized under the leaves are rare or lacking in algal turf or on boulders. These gently sloping beaches narrow toward Sunset Cliffs and end near the Ocean Beach Pier. Cabrillo National Monument Tidepools and a site near Ladera St., described extensively in Stewart studies (as Sites D and C respectively) are in this area.

Several miles of sandy beaches that are unsuitable for growth of attached algae lie between Ocean Beach and the beginning of the mostly rocky coastline from Pacific Beach to Torrey Pines State Reserve. False Point (also referred to as Gunnery Pt. or Pacific Beach Pt.), just north of Pacific Beach, the site of several studies by students at San Diego State University, resembles in many aspects the boulder-strewn portion of the Cabrillo Tidepool area. As one moves north to La Jolla, beaches tend to slope more steeply than do the Pt. Loma platforms, and the intertidal areas are generally narrower and exposed to stronger wave action. Some of the most common species of the Pt. Loma beaches are not found in the La Jolla area, while others that are occasionally abundant in La Jolla sites are lacking or rare in other parts of San Diego County. Sites A (South Casa) and B (just north of Wind and Sea Beach) were compared with the two Pt. Loma Sites (C and D) in earlier studies of algal vegetation (Stewart and Myers 1980, Stewart 1982).

North from Del Mar to the Orange County line, rocky points and short rock shelves are interspersed with long sand beaches, and algae are more sparse, both in number of species and amount of vegetation. Seasonal sand movement intermittently buries and abrades surfaces and is probably an important influence on plants and animals in these habitats. There are approximately 122 km (76 miles) of open ocean coast in San Diego County; brackish water sites are found in lagoons or estuaries. Approximately 28 km (17 miles) of the northern county coast is included within the U.S. Marine Corps Camp Pendleton Military Reservation and for this reason not accessible to the public.

Just as the plants one finds on intertidal beaches vary from site to site and from one time of year to another, the algal associations growing subtidally offshore differ in the same ways. The biota associated with *Macro-*

cystis in kelp beds has been most studied, but away from kelp on rock outcroppings or on more sandy or muddy surfaces (Fig. I) there are populations of other very distinctive algae that are lacking or very rare in kelp beds.

Despite the general year-to-year persistence of important physical characteristics of the various subtidal sites, major storms can change the nature of the bottom, and thus the attached algal assemblages. An example of such changes occurred after a storm in January 1988 that broke away large portions of clay-rock from portions of the head of the La Jolla submarine canyon, and scoured other exposed unbroken rocks. Eighteen months later populations of several species had reappeared.

An interesting area for algal taxa is the region extending southward offshore from the tip of Pt. Loma towards Imperial Beach. Here rocky ridges rise from the bottom at depths varying from 25 to 17 m. *Botryocladia neushulii, Pterochondria woodii, Phycodrys setchellii, Ozophora*, and large *Halymenia*-like blades have been found here. Imperial Beach subtidal consists of a cobble bottom that often supports dense algal growth. It was from drift on beaches between Coronado and Imperial Beach that several new species of large-bladed red algae were described (**MAC**). In our experience, the only collections of *Farlowia mollis, Erythroglossum californicum* and *Pikea robusta* have been unattached specimens washed ashore on the beach at Imperial Beach. It is on isolated rock outcroppings southwest of Pt. Loma that some of the species found intertidally or in shallower water in central or northern California occur at depths well beneath the summer thermocline. Oceanographic data indicate that there are strong current eddies off Pt. Loma, at least part of the year, a factor that may influence the composition of nearby subtidal algal associations.

Rocks or debris on the muddy bottom and submerged structures in San Diego Bay provide habitats for species not found on exposed coasts, including many small filamentous forms that are characteristic of quiet water. Beds of *Zostera* (eelgrass) occur in Mission Bay and San Diego Bay, although dredging and construction have destroyed most of the once abundant vegetation.

Subtidal algae collected by diving from boats near the Coronados Islands, 24 km (about 15 miles) southwest from San Diego and 11 km offshore in Mexican waters, often are included in studies of San Diego County algae. Several taxa that were first described from the Coronados Islands have been found in recent diving searches at sites other than the type locality; the algal vegetation from these islands (shallow water to about 30 m) closely resembles vegetation in comparable habitats between Pt. Loma and Pt. La Jolla.

Seaward from the intertidal beach on the west side of Pt. Loma a broad underwater slope with interspersed patches of sand and rock ledges gradually becomes predominantly rock with occasional sand channels and large rock outcroppings. *Macrocystis* interspersed with *Pterygophora* becomes dominant at about 8 m. This association grows on hard substrates out to about 23–27 m; the length and width of the kelp bed changes from year to year. The base of New Hope Rock is at a depth of about 18 m; at the top, diverse habitats are within 6–7 m of the surface. Several subtidal studies have focussed on this particular site, and it is cited as the source of several important algal collections. Populations of *Pelagophycus porra* overlap *Macrocystis* beds on their seaward margins and grow out to about 35 m. Approximately 1.5 km offshore, the bottom drops off abruptly seaward in a series of ridges and gullies which terminate at a depth of about 37 m in mud or sandy silt. This is the Loma Sea Cliff, an ancient submerged shoreline that parallels the present Point Loma. Very few plants grow beyond the outer edge of this submerged terrace, but the algal vegetation on the shoreward slope is dense and rich in species wherever patches of rock provide stable substrate for attachment. Habitats that are particularly interesting for smaller algae include surfaces of sponges, abalone and scallop shells, stipes of large brown algae, and axes of perennial red thalli that accumulate assortments of epiphytic species. *Gelidium robustum* and *Calliarthron* are examples of basiphytes that are excellent sources of smaller epiphytes. Nests of the garibaldi fish (*Hypsypops rubicunda*) are kept clear of most larger algal thalli, leaving a low-growing algal turf in which small species, otherwise difficult to find, can be collected.

Offshore and to the north of Mission Bay, patches of kelp again mark the presence of underwater rocky substrates, but there are also sites lacking *Macrocystis* where other algae are abundant beyond the 13–17 m contour. Shallower than this, water temperatures can rise to 23°C or slightly more in summer months, while below the thermocline temperatures rarely exceed 16°C at any time of the year.

There are several subtidal sites in La Jolla Bay, near the heads of the branches of the submarine canyon system, where the biota is unlike that found elsewhere in southern California. For example, a population of *Sarcodiotheca furcata* has persisted for at least 20 years in 17–27 m near the head of La Jolla Canyon; intermittently *Stenogramma, Sarcodiotheca gaudichaudii, Agarum, Acrosorium*, and *Desmarestia* occur, but little else grows here. This is the only source of *Sarcodiotheca furcata* we know of along the coast of San Diego County, perhaps in southern California. In the north branch of the Scripps Submarine Canyon below about 30 m, *Maripelta* grows. This alga is recognized by a blue iridescent sheen and is restricted to very deep habitats.

Canyon sites are referred to in the discussions of several other taxa in the checklist.

Quast Rock lies about 0.8 km (1/2 mile) west of Pt. La Jolla. The base lies at about 25 m, while the top of the outcropping is about 17 m beneath the water surface in La Jolla Bay. This is a frequently visited underwater site where numerous species of characteristically deep-growing plants and animals can be observed. There are several other submerged offshore rocks in the area with similar assemblages. None are within the Underwater Ecological Preserve, whereas the nearshore head of the La Jolla Submarine Canyon lies within a Reserve where collecting is not permitted.

North of Torrey Pines Beach, rocky subtidal outcroppings and ledges lie offshore from intertidal rocks at Del Mar, between Cardiff State Beach and Encinitas, and from Moonlight State Beach to the south end of Carlsbad State Beach (Figure 1). The occurrence of rocks in this northern part of the County both intertidally and subtidally is patchy, and the region has more sandy than hard bottom. Most common algae are annual, ephemeral species that can develop rapidly whenever a surface is free from sand but that do not persist to form diverse macroalgal associations.

The various algae throughout these areas and habitats of the San Diego County coastline include taxa that can be assigned to several different biogeographical categories: (1) intertidal species typical of intertidal floras that are found both to the north and south of San Diego; (2) subtidal taxa that are widespread in deep-water sites along the Pacific Coast of North America; (3) intertidal species that occur intertidally or in shallow water in warmer regions south of Bahía Vizcaíno in Baja California and in the Gulf of California; (4) deep subtidal taxa that grow intertidally or in very shallow water in central and northern California.

A group of species found in central and northern California and in northwestern Baja California is conspicuously absent from the coast of San Diego County. At least 15 of these taxa are large and could not be overlooked if they were present. Examples include such easily recognized species as *Leathesia nana*, *Laminaria setchellii*, large *Porphyra* thalli, and *Mastocarpus (Gigartina) papillatus*. These disjunct distributions are usually explained in terms of water temperatures. San Diego County beaches lie in the southern part of the southern California Bight, a broad embayment where water circulation patterns include wide and changeable eddies as well as north–south currents. Wind and wave directions along the coast differ between seasons and affect upwelling of cold deeper water. The particular localities on the Pacific coast of Baja California where populations of "northern" algae occur characteristically are sites strongly influenced by persistent patterns of

upwelling. Seasonal sand deposition on rock surfaces, and the nature and inclination of rocky substrates may also be important to help explain the marked contrasts between the algal vegetation of San Diego County and that to the north and south.

The present checklist is intended to provide both a means of recognizing and naming algae (approximately 360 taxa) found along the coast of San Diego County, and to suggest where and when individual taxa can be found. To make it useful generally to field biologists without specialized training in phycology, the descriptions depend mostly on features that can be observed in the field with little or no magnification. They are written to modify or supplement but not to duplicate the more complete information in **MAC** (Abbott and Hollenberg, 1976). Neither the complete taxonomic citations nor the keys of this manual are repeated.

Information about size, variation in morphology, and local habitats given for each taxon refers to San Diego County specimens when these are different from plants elsewhere in California. Illustrations show species or forms that are distinctive in San Diego habitats and that are not pictured in **MAC**. If local material conforms well to plants described in **MAC**, only a few of the more conspicuous features are mentioned to aid in recognizing the plant. Complete descriptions and a glossary can be found in **MAC**. Taxa are arranged by families, genera alphabetically under each family, and species are listed alphabetically within genera. The appropriate page in **MAC** is indicated for each entry. Selected references, mostly nomenclatural revisions published since 1976, are cited. New information noted in this checklist includes: range extensions both from the north and south into San Diego County, descriptions and illustrations of five species not found in **MAC** (*Berkeleya hyalina, Chloropelta caespitosa, Cutleria cylindrica, Apoglossum (Phrix) gregarium, Phycodrys cerratae*), notes concerning reproductive stages not previously known, and supplementary comments about rarity/abundance of taxa locally.

Special acknowledgement is due to James R. Stewart, Research Diving Safety Officer at Scripps Institution of Oceanography, UCSD, who provided many of the most important subtidal collections and to whom this publication is dedicated. Other diving biologists also contributed information and specimens. We particularly thank Ron McPeak of Kelco for sharing his local diving experience; Isabella Abbott of the University of Hawaii for advice concerning several uncommon or rare species of red algae; and individuals at Scripps, who offered comments about particular algae. UCSD's Academic Senate Committee on Research contributed funds for clerical assistance to catalog specimens. Original drawings are by Nancy Hulbirt.

LIST OF TAXA

Arranged by families, genera alphabetically under each family and species listed alphabetically within genera. Taxa excluded from San Diego at this time in [ ]. Taxa not treated in **MAC** with **.

COLONIAL DIATOMS

NAVICULACEAE
**Berkeleya hyalina*
**Berkeleya rutilans*

XANTHOPHYTA

VAUCHERIACEAE
Vaucheria sp.

CHLOROPHYTA

ULVELLACEAE
Entocladia cingens
Pilinella californica
Ulvella applanata
Ulvella setchellii

MONOSTROMATACEAE
[*Monostroma oxyspermum*]

ULVACEAE
Chloropelta caespitosa
Enteromorpha spp.
Ulva californica
Ulva dactylifera
Ulva expansa
Ulva rigida

CLADOPHORACEAE
Chaetomorpha californica
Chaetomorpha linum, C. aerea
Chaetomorpha spiralis
Cladophora albida
Cladophora columbiana
Cladophora graminea
Cladophora microcladioides
Cladophora sericea, C. stimpsonii
Lola lubrica
Rhizoclonium riparium

CODIOLACEAE
[*Urospora* sp.]

BRYOPSIDACEAE
Bryopsis corticulans
Bryopsis hypnoides
Bryopsis pennatula
Derbesia marina—Halicystis ovalis

CODIACEAE
Codium cuneatum
Codium fragile
Codium johnstonei
Codium setchellii, C. hubbsii

PHAEOPHYTA

ECTOCARPACEAE
Ectocarpus parvus
Feldmannia cylindrica
Feldmannia globifera
Feldmannia hemispherica
Feldmannia irregularis
Hincksia granulosa
Hincksia mitchelliae
Hincksia sandriana
Hincksia saundersii
Streblonema investiens

MYRIONEMATACEAE
**Chilionema ocellatum*

RALFSIACEAE
Diplura simulans
Endoplura aurea
Hapalospongidion gelatinosum
Hapterophycus canaliculatus
Pseudolithoderma nigra

Ralfsia confusa
Ralfsia hesperia
Ralfsia integra
Ralfsia pacifica

LEATHESIACEAE
Leathesia difformis
Petrospongium rugosum

CHORDARIACEAE
Haplogloia andersonii
Tinocladia crassa

CUTLERIACEAE
****Cutleria cylindrica***

COILODESMACEAE
Coilodesme californica
Coilodesme rigida

SCYTOSIPHONACEAE
Colpomenia peregrina
Colpomenia sinuosa
Colpomenia tuberculata
Endarachne binghamiae
Hydroclathrus clathratus
Petalonia fascia
Scytosiphon dotyi
Scytosiphon lomentaria

DICTYOTACEAE
Dictyopteris undulata
Dictyota binghamiae
Dictyota flabellata
Pachydictyon coriaceum
Taonia lennebackerae
Zonaria farlowii

SPHACELARIACEAE
Sphacelaria californica
Schacelaria didichotoma
Sphacelaria rigidula

DESMARESTIACEAE
Desmarestia ligulata var. *firma*
Desmarestia ligulata var. *ligulata*

LAMINARIACEAE
Agarum fimbriatum
Laminaria farlowii
[*Laminaria setchellii*]

ALARIACEAE
Egregia menziesii
Eisenia arborea
Pterygophora californica

LESSONIACEAE
Dictyoneuropsis reticulata
Macrocystis pyrifera
Pelagophycus porra

FUCACEAE
Hesperophycus californicus
Pelvetia fastigiata

CYSTOSEIRACEAE
Cystoseira osmundacea
Cystoseira setchellii
Halidrys dioica

SARGASSACEAE
Sargassum agardhianum
Sargassum muticum
Sargassum palmeri

RHODOPHYTA
PORPHYRIDIACEAE
Chroodactylon ornatum
Stylonema alsidii

ERYTHROTRICHIACEAE
Erythrocladia subintegra
Erythrotrichia spp.
Smithora naiadum

BANGIACEAE
Bangia vermicularis
Porphyra perforata
Porphyrella californica

ACROCHAETIACEAE
Audouinella complex
Rhodochorton purpureum

NEMALIACEAE
Nemalion helminthoides

HELMINTHOCLADIACEAE
Cumagloia andersonii
Helminthocladia australis
Helminthora stricta
Liagora californica

GALAXAURACEAE
Scinaia confusa
Scinaia johnstoniae
Scinaia snyderae

BONNEMAISONIACEAE
Asparagopsis taxiformis
Bonnemaisonia hamifera

GELIDIACEAE
Gelidium coulteri
Gelidium nudifrons
Gelidium purpurascens
Gelidium pusillum
Gelidium robustum
Pterocladia caloglossoides
Pterocladia capillacea
Pterocladia media

DUMONTIACEAE
Farlowia mollis
Leptocladia binghamiae
Pikea californica
Pikea robusta
Weeksia digitata

PEYSSONNELIACEAE
Cruoriopsis aestuarii
Peyssonnelia profunda
Peyssonnelia rubra var. *orientalis*
Pulvinia epiphytica
Rhodophysema elegans var. *polystromatica*
Rhodophysema minus

HILDENBRANDIACEAE
Hildenbrandia dawsonii
Hildenbrandia occidentalis
Hildenbrandia prototypus

CORALLINACEAE
(crustose taxa)
Choreonema thuretii
Fosliella paschalis
Heteroderma nicholsii
Hydrolithon decipiens
Lithophyllum (spp.)
Lithothamnion (spp.)
Melobesia marginata
Melobesia mediocris
Mesophyllum lamellatum
Neogoniolithon setchellii
Neopolyporolithon reclinatum
Pseudolithophyllum neofarlowii
Tenarea (spp.)

CORALLINACEAE
(articulated, erect taxa)
Amphiroa beauvoisii
Bossiella californica ssp. *californica*
Bossiella californica ssp. *schmittii*
Bossiella chiloensis
Bossiella orbigniana
Bossiella plumosa
Calliarthron cheilosporioides
Calliarthron tuberculosum
Corallina frondescens
Corallina officinalis var. *chilensis*
Corallina pinnatifolia
Corallina polysticha

Corallina vancouveriensis
Haliptilon gracile
Jania adhaerens, J. tenella
Jania crassa
Lithothrix aspergillum

ENDOCLADIACEAE
Endocladia muricata

HALYMENIACEAE
Carpopeltis bushiae
Cryptonemia angustata
Cryptonemia borealis
Cryptonemia obovata
Cryptonemia ovalifolia
Dermocorynus occidentalis
Grateloupia prolongata,
G. doryphora
Halymenia californica
Halymenia gardneri
Halymenia hollenbergii
"Lobocolax"
Prionitis angusta
Prionitis australis, P. cornea,
P. linearis
Prionitis lanceolata

KALLYMENIACEAE
Callocolax fungiformis
Callophyllis firma
Callophyllis flabellulata
Callophyllis thompsonii
Callophyllis violaceae
Kallymenia pacifica

CHOREOCOLACACEAE
Gelidiocolax microsphaerica
Leachiella pacifica

CRUORIACEAE
Cruoria profunda
Haematocelis rubens
Haematocelis zonalis

NEMASTOMATACEAE
Schizymenia dawsonii
Schizymenia epiphytica
Schizymenia pacifica

SOLIERIACEAE
Gardneriella tuberifera
Opuntiella californica
[*Reticulobotrys catalinae*]
Sarcodiotheca furcata
Sarcodiotheca gaudichaudii

HYPNEACEAE
Hypnea johnstonii
Hypnea valentiae var. *gardneri*
Hypnea valentiae var. *valentiae*
Hypnea variabilis

PLOCAMIACEAE
Plocamiocolax pulvinata
Plocamium cartilagineum
Plocamium violaceum

GRACILARIACEAE
Gracilaria lemaneiformis
Gracilaria pacifica
Gracilaria papenfussii
Gracilariophila gardneri

PHYLLOPHORACEAE
Ahnfeltia fastigiata
Ahnfeltia gigartinoides
Gymnogongrus chiton
Gymnogongrus leptophyllus
Ozophora clevelandii
Petroglossum parvum
Stenogramma interrupta

GIGARTINACEAE
Gigartina canaliculata
Gigartina exasperata
Gigartina harveyana
Gigartina leptorhynchos

Gigartina ornithorhynchos
Gigartina tepida
Gigartina volans
Rhodoglossum affine
Rhodoglossum californicum
Rhodoglossum roseum

PETROCELIDACEAE
[*Mastocarpus papillatus*]
[*Petrocelis franciscana* (stage in life history of *Mastocarpus papillatus*)]
Petrocelis haematis

RHODYMENIACEAE
Botryocladia neushulii
Botryocladia pseudodichotoma
Fauchea laciniata
[*Fryeella gardneri*]?
Maripelta rotata
Rhodymenia arborescens
Rhodymenia californica,
R. pacifica
Rhodymenia rhizoides
Rhodymeniocolax botryoides
Sciadophycus stellatus

CHAMPIACEAE
Binghamia forkii
[*Champia parvula*] ?
Gastroclonium compressum,
G. parvum
Gastroclonium subarticulatum

LOMENTARIACEAE
Lomentaria caseae
Lomentaria hakodatensis

CERAMIACEAE
Aglaothamnion cordatum
Aglaothamnion endovagum
Antithamnion defectum
Antithamnion hubbsii
Antithamnion kylinii
****Antithamnion tenuissimum***
Antithamnionella sp.
Antithamnionella elegans
[*Antithamnionella pacifica*]
Callithamnion biseriatum
Callithamnion catalinense
****Callithamnion ramosissimum***
Callithamnion rupicolum
Centroceras clavulatum
Ceramium californicum
Ceramium clarionense
Ceramium codicola
Ceramium eatonianum
Ceramium flaccidum
Ceramium pacificum
Ceramium sinicola
Ceramium sp. (*zacae?*)
Griffithsia furcellata
Griffithsia pacifica
Microcladia coulteri
Neoptilota densa
Platythamnion pectinatum
Platythamnion villosum
Pleonosporium squarrulosum
Pleonosporium vancouverianum
Ptilothamnionopsis lejolisea
Scagelia pylaisaei
Spyridia filamentosa
Tiffaniella synderae

DELESSERIACEAE
Acrosorium venulosum
Anisocladella pacifica
****Apoglossum gregarium***
Asterocolax gardneri
Branchioglossum undulatum
Branchioglossum woodii
Cryptopleura corallina,
C. crispa
Cryptopleura farlowiana
Cryptopleura rosacea
Cryptopleura violacea
Erythroglossum californicum

Gonimophyllum skottsbergii
Holmesia californica
[*Hymenena* species]
Membranoptera weeksiae
[*Myriogramme caespitosa*]
Nienburgia andersoniana
Nitophyllum hollenbergii
***Phycodrys cerratae*
Phycodrys profunda
Phycodrys setchellii
Platysiphonia clevelandii
Platysiphonia decumbens
Polyneura latissima
Sorella delicatula
Sorella pinnata

DASYACEAE
Colacodasya californica
Dasya sinicola var. *abyssicola*
Dasya sinicola var. *californica*
Heterosiphonia erecta
Heterosiphonia japonica
Pogonophorella californica
Rhodoptilum plumosum

RHODOMELACEAE
Amplisiphonia pacifica
Chondria arcuata
Chondria californica
Chondria dasyphylla
Chondria decipiens
Chondria nidifica
Chondria oppositiclada
Erythrocystis saccata
Herposiphonia littoralis
Herposiphonia plumula
Herposiphonia secunda f. *tenella*
Herposiphonia verticillata
Janczewskia gardneri
Janczewskia lappacea
[*Jantinella verrucaeformis*]
Laurencia lajolla
Laurencia pacifica
Laurencia sinicola
Laurencia snyderae
Laurencia spectabilis
Laurencia splendens
Laurencia subdisticha
Laurencia subopposita
Levringiella gardneri
Ophidocladus simpliciusculus
Polysiphonia acuminata
Polysiphonia bajacali
Polysiphonia brodiaei
Polysiphonia confusa
Polysiphonia decussata
Polysiphonia flaccidissima
Polysiphonia hendryi
Polysiphonia indigena
Polysiphonia johnstonii
Polysiphonia mollis
Polysiphonia nathanielii
Polysiphonia pacifica
Polysiphonic paniculata
Polysiphonia savatieri
Polysiphonia scopulorum var. *villum*
Polysiphonia simplex
Pterochondria woodii var. *pygmaea*
Pterosiphonia baileyi
Pterosiphonia dendroidea
Pterosiphonia farlowii
Pterosiphonia pennata
Veleroa subulata

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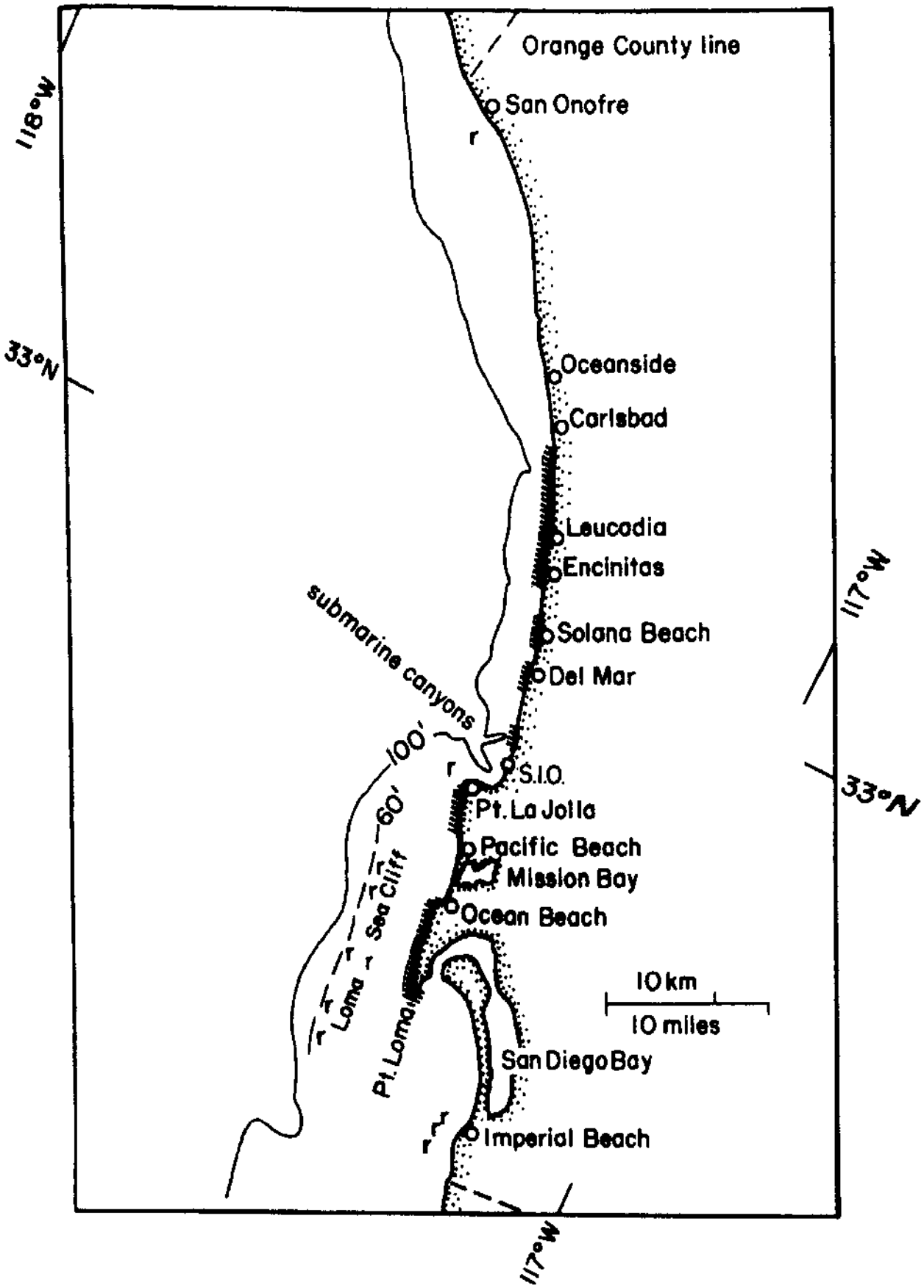

Figure 1. San Diego County. Rocky intertidal beaches [▨] and subtidal sites [r].

COLONIAL BENTHIC DIATOMS (Bacillariophyta in MAC)

NAVICULACEAE

Berkeleya hyalina (Round and Brooks) Cox

Chastain and Stewart 1985.

Identification and classification of diatoms traditionally depend on features of valve morphology that can be observed only after cells have been cleaned and examined with high magnification. The two colonial benthic species of *Berkeleya* included here secrete and live in tubes of mucilage that are aggregated into tufted thalli that attach to surfaces and resemble filamentous ectocarpoid algae.

B. hyalina has an easily recognizable morphology; for many years, prior to the studies that finally identified the species by frustule characteristics, I called it the "Palm" or "Broccoli" diatom, both terms descriptive of the macroscopic morphology. The species is presently known from Ensenada and Bahía de los Angeles in Baja California, southern California, and the type locality in Togo, West Africa. In San Diego County it is often abundant in mid-intertidal habitats, April-October, on rocks or mollusc shells. Thalli grow to 3 cm high, are dark olive-brown, branched as shown in Figure 2, soft and slippery to the touch.

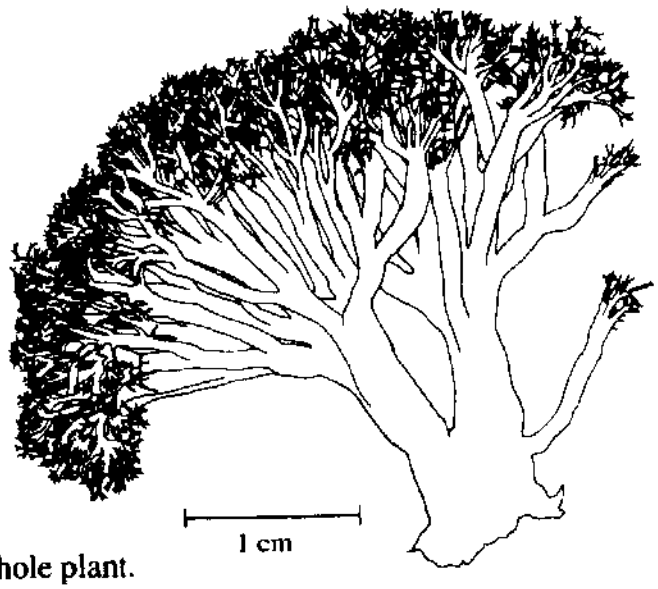

Figure 2. *Berkeleya hyalina.* Whole plant.

Berkeleya rutilans (Trent.) Grun.

(See comments above, for *B. hyalina*)

This species is cosmopolitan and on the Pacific coast has been recorded from

Baja California to the Aleutian Islands (Lobban 1985). Macroscopic colonies to 3 cm high are loosely, sparsely, and irregularly branched. In size, color, and habitat they are similar to ectocarpoid thalli, and microscopic examination may be necessary to confirm identification. The species occurs throughout the year here.

XANTHOPHYTA

VAUCHERIACEAE

Vaucheria sp.

50

Dark green filaments, 33–60 µm diameter, without constrictions and not divided into cells (lacking septa within the long thin tubes); often found in large felt-like mats, mostly unattached, on muddy surfaces of tidal flats, or near lagoons, estuaries, or marshy areas near salt water. The genus includes freshwater, brackish water, and marine species, which are identified by microscopic reproductive features. In San Diego County *Vaucheria* is most easily observed on mud flats in the Tijuana River Estuary, at the south end of San Diego Bay, the northeastern end of Mission Bay, or in the flood control channel of San Diego River. **MAC** treats specimens from similar habitats in central California as *V. longicaulis*.

CHLOROPHYTA

ULVELLACEAE

56–64

Marine taxa presently placed in this family have minute thalli formed of small green filaments that branch in irregular ways. Typically they are found as specks on, or in, other algae such as *Polysiphonia* and *Chondria* species, or *Pterocladia capillacea*. The filaments that compose the dark green spots can be dissected out under a microscope but field-collected epi- or endophytes are seldom identifiable. When grown in laboratory cultures, the filaments can be recognized as forms such as are attributed to this family (Chaetophoraceae in **MAC**).

In addition to the 4 species listed below with San Diego records, *Endophyton ramosum* Gard., *Acrochaete geniculata* (Gardn.) O'Kelly (1983) (as *Pseudodictyon geniculatum* in **MAC**), *Bulbocoleon piliferum*, and two additional species of *Entocladia* have been recorded from Los Angeles or Orange County.

**Entocladia cingens* Setch. and Gardn.

64

Endophytic in *Chaetomorpha californica* (type collection) and several other

algal species. Type locality, Ocean Beach in San Diego County. *Entocladia codicola* Setch. and Gardn. and *E. viridis* Reinke are known from Orange County.

Pilinella californica Hollenb.

58

Light green filaments, short, unbranched or branched near base, are interspersed with longer filaments that taper to long slender hair-like tips; epiphytic on *Eisenia* stipes near Scripps Pier, La Jolla (type locality). Aguilar and Aguilar (1986) report collections from Punta Morro, Baja California, on *Egregia* stipes.

Ulvella applanata (Setch. and Gardn.) South and Tittley

South and Tittley 1986

Pseudulvella applanata Setch. and Gardn., 61

Short filaments form smooth, bright green discs to several mm broad on shells of a periwinkle, *Littorina planaxis* Nutt. Setchell and Gardner (1920) remark that the host snail is very abundant between Alaska and San Diego; although the algal species has been found only in central California, **MAC** suggests that it is probably coextensive with the host.

Ulvella setchellii Dang.

59

This species forms small discs, up to 2 mm broad, on the surface or within the walls of other algae. The filaments radiate in laterally adjoined, dichotomously branched rows from a central region, and remain mostly in one layer. Once this species has been recognized, it will be easily distinguished with a dissecting microscope (see Fig. 9, **MAC**).

In San Diego found on *Amplisiphonia* from the Loma Sea Cliff, 15 m, February.

MONOSTROMATACEAE

[**Monostroma oxyspermum* (Kütz.) Doty

68

Traditionally, flat green blades that are only one layer of cells thick have been treated as species of *Monostroma*. *M. oxyspermum* is described as typically found in quiet brackish or fresh water "to southern California." I can find no records of specimens from San Diego County; occasionally very large specimens of *Ulva expansa* superficially resemble *Monostroma* from northern localities, but examination shows them to be two layers thick rather than one.

Dawson's Checklist includes this species (as *M. quaternarium*) on the basis of Setchell and Gardner's 1920 comment.]

A recent study of motile reproductive cells (O'Kelly *et al.*, 1984), supported the transfer of this species as the type of the genus *Gayralia* (Vinogradova 1969); other workers reduce the genus to a subgenus of *Monostroma*. See discussion in Scagel *et al.* (1986) p. 230.

ULVACEAE

Chloropelta caespitosa Tanner

Tanner 1980

Thalli oval or rounded, a few mm to 60+ mm in diameter, peltate or split to the base, margins smooth or ruffled; distromatic, with central attachment disk. The species is separated from other small green blades (*Ulva* species) by the pattern of early development. The initial uniseriate filament becomes multiseriate and develops into a monostromatic sac, thus far resembling other Ulvaceae. Each cell then divides once so as to form a distromatic saccate germling. Rupture of the apical end and continued growth result in a peltate distromatic alga resembling *Ulva*.

The description of the genus and species was based on laboratory cultures derived from collections in Los Angeles and Orange counties. Among specimens collected from La Jolla by Dawson and originally identified as *U. californica*, Tanner recognized *Chloropelta* thalli. In 1976 he collected specimens from high intertidal rocks at Tourmaline Surfer Park, Pacific Beach and since then has found specimens at La Jolla Cove and Casa beach, in La Jolla.

**Enteromorpha* spp.

73

Thalli pale green, sometimes yellowish, tubular, with tube walls one cell layer thick. The size and shape of the thallus varies, with more or less branching, and the thickness, shape, and proportions of the small cells that form the tube determine which of six named species can be recognized (*E. clathrata, E. compressa, E. flexuosa, E. intestinalis, E. linza, E. prolifera*).

Species of this genus grow from brackish water to marine habitats, are common in estuaries, tidal lagoons, sloughs, on docks and hulls of boats, or on intertidal rocks along open ocean coasts. With thorough study it perhaps would be possible to sort out distinct entities from the forms that can be collected locally, but at present, lacking adequate comparative information, I refer tubular distromatic (=two cell layers thick when the thallus is cross sectioned) green algae to *Enteromorpha* sp.

Zedler (1982) lists *E. clathrata* var. *crinita* (Roth) Hauck as one of two macroalgae associated with *Batis* mostly in winter–spring samples, in the Tijuana Estuary. Setchell and Gardner (1920) list *E. clathrata* (as *E. crinita*) from wood or floating in San Diego intertidal habitats. Dawson's Checklist cites the species with no collection data. Setchell and Gardner (1920) list "*E. torta*" in high intertidal rock pools, December, San Diego, and Dawson (1945d) repeats this information. *E. torta* is a name applied to specimens in Atlantic regions but is not recognized in recent studies of California collections. Setchell and Gardner (1920) include San Diego in the ranges of *E. compressa* and *E. intestinalis* ("common"). *E. linza*, treated by them as a species of *Ulva*, is also distributed from Alaska to Mexico. Dawson's Checklist repeats this information, and additionally includes *E. flexuosa* (as *E. tubulosa*) without citing collections for San Diego.

Ulva

Ulva thalli are bright green leafy blades, two cell layers thick, variously ruffled and clumped, and often conspicuous in intertidal habitats. There are three distinct forms in San Diego County that we treat here as *U. californica*, *U. expansa*, and *U. dactylifera*. The most common, at times extremely abundant over rocks on high to midtidal beaches, is a small intertidal species that we consider *U. californica*. *U. expansa* can grow to 2 m in length and nearly as broad, but usually the thalli are torn and unattached in very quiet water in San Diego Bay, Mission Bay, the San Diego River flood control channel, or intertidal creeks of the Tijuana Estuary. A third taxon grows in midsummer very low in the intertidal zone, with or near *Phyllospadix*. *U. rigida*, similar in form to *U. californica*, also has been identified at several locations.

**U. californica* Wille

78

Blades mostly less than 2 cm high, in dense clusters, oval to irregular; crisped, undulate margins; attached by slender stipe, or more broadly across the base of the blades; thin blade often appears somewhat thicker near the base. "Usually in dense, turflike stands atop rocks, occasionally epiphytic, midtidal to upper intertidal...formerly common in southern California" (**MAC**).

Forms that resemble this species are extremely common on all San Diego County beaches, particularly conspicuous in the late spring to early summer. Abbott currently questions the identification as *U. californica* of many recent collections from southern California (pers. comm.). The description of *U. californica* fits isolated subtidal thalli as well as dense clumps that cover intertidal rocks. Dawson's Checklist listed it as common May–July.

*_Ulva dactylifera_ Setch. and Gardn. [and see _U. costata_ (Howe) Hollenb., _U. taeniata_ (Setch.) Setch. and Gardn.]
80 [80, 87]

Blades mostly bright grass-green, simple or with several long narrow divisions from discoid base, or more commonly a short (1-2 cm), broad (3 cm) basal portion from which 1-7 cm long (to 20+ cm) narrow blades arise; blades densely ruffled with spirally twisted margins, usually more or less dentate below; blade area mostly twice as thick in the middle portion as in marginal strips.

After _U. californica_ has become less conspicuous following its springtime "bloom," blades I identify as _U. dactylifera_ begin to grow under other algae low on intertidal rocks. I have collected specimens up to 30 cm long late June–October, usually by searching under _Phyllospadix_ leaves where it is recognized by its bright color and twisted form. Occasional individual blades resemble thalli of _U. taeniata_, stated (**MAC**) to occur only as far south as Ventura in California, but when they develop from a broader undivided basal blade area, the thalli conform in this and other features to the description of _U. dactylifera_. Blades of _U. costata_, another similar species, differ primarily in having a thicker median "rib"; a distinct central region can be found in some of the San Diego thalli treated here as _U. dactylifera_.

Our variable collections appear to belong to a single taxon, and the lack of clear distinctions among the three names that have been associated with long twisted thalli in California points to a need for study of this group.

*_U. expansa_ (Setch.) Setch. and Gardn.
80

Blades medium to pale green, elongate or more round, sometimes expanded to more than 1 m long, 0.5 to nearly 1 m wide; deeply ruffled margins, but not lobed. On rocks, or epiphytic lower intertidal to subtidal; in sheltered water, usually free-floating.

Our specimens conform to the information given in **MAC**. See comment above ≈_Ulva_ species for localities.

*_Ulva rigida_ C. Ag.
87

Blades dark green, relatively stiff, less than 3 times as long as broad (or orbicular), deeply lobed, ruffled, with short solid stipe.

A widely distributed species with distribution records (**MAC**) that bracket San

Diego. Tanner has observed what he identifies as *U. rigida* at several localities in San Diego Co. "These plants are densely tufted like *U. californica* but differ in that they are larger (up to 8 cm or more), have irregularly lobed thalli instead of being cuneate, are much thicker, have several pyrenoids per cell and have dentate margins (when the margins are not eroded)" (pers. comm.).

MAC and Dawson's Checklist list *U. lactuca, U. lobata,* and *U. angusta* for localities both north and south of, but not within, San Diego County.

CLADOPHORACEAE

**Chaetomorpha californica* Coll.

101

Setchell and Gardner (1920) quote Collins as describing this as "the most slender erect marine species (of *Chaetomorpha*), not likely to be mistaken for any other...." Filaments are less than 40 µm in diameter, while *C. linum* is more than 40 µm in diameter, but the two are otherwise very similar.

The type specimens were collected from sandstone rocks in shallow pools in the upper intertidal zone in La Jolla. Pools such as these along the entire coast of San Diego County often are coated in spring or early summer with *Chaetomorpha* thalli. Whether these represent *C. californica, C. linum,* (or *C. aerea*) or both is often uncertain.

**Chaetomorpha linum* (Müll.) Kütz. [or *C. aerea* (Dill.) Kütz]

101

Unbranched green filaments, 40–100 µm diameter, locally mostly to 7 (25) cm long, attached at the base.

This species is seasonally abundant in the late spring to summer in shallow pools in the mid- to high intertidal zone. It also grows epiphytically as single strands in algal turf and in shallow subtidal habitats.

Plants identified as *C. linum* are found worldwide, often in habitats similar to those described in California, and in the past other names have been used in different parts of the range (see *C. californica*). Dawson's Checklist refers to *C. linum* (as *C. aerea*) without mention of San Diego localities. Blair (1983) and the Silva and Miller checklist cited in the discussion of *Rhizoclonium* consider that *Chaetomorpha aerea* and *C. linum* are separate species, with *C. aerea* generally attached and *C. linum* free-floating. If this opinion is correct, the plants from San Diego County represent *C. aerea*. **MAC** treats the two forms as stages of one species, *C. linum.*

*_Chaetomorpha spiralis_ Okam.

101

Unbranched filaments, with large cells to 1 mm diameter that individually are visible without magnification; filaments firm, almost stiff, and often coiled into clumps or spirally twisted.

In quiet water the strands are less coiled, looser, and when stretched out can be up to 60 cm long. The dark blue-green color and shiny appearance often catch one's eye where the thalli grow under other algae, in dark crevices, or under overhanging rocks in the low intertidal zone, less often subtidally to 10 m. Occasionally during fall months piles of the thalli occur on the mud flats at the north end of Mission Bay or floating and semi-attached to other large algae or *Zostera* in the Flood Control Channel. It has been described as resembling tangled green monofilament fish line.

*_Cladophora albida_ (Huds.) Kütz.

104

Small, green filamentous thalli; this species is a delicate one, much branched, with branchlets nearly the same width as the branch from which they grow.

San Diego specimens are small (to 5 mm) and found only as individual epiphytes or on rocks mixed with other algae, in mid- to low intertidal habitats on all the county beaches. Unless one deliberately looks for species of *Cladophora,* they probably will be overlooked, but the bright green color and the filamentous branched forms are conspicuous among the pale intertidal coralline forms or against the dark red-purple thalli in shaded ledges or crevices.

Specimens associated with this epithet elsewhere on both Pacific and Atlantic coasts grow in thick dense mats with a characteristic soft spongy consistency.

Dawson's Checklist (*C. albida* including *C. delicatula*) cites no San Diego County localities.

*_Cladophora columbiana_ Coll.

105

Small green branched filaments, with apical cells often 90–150 μm in diameter.

In the field, thalli appear similar to *C. albida* and occur in the same habitats. Both species are found epiphytically in algal turf as well as in more shaded habitats on sides of channels amongst other algal thalli. *C. columbiana* has

also been collected subtidally from the nest of a garibaldi fish on the Loma Sea Cliff.

MAC refers to tufts to 15 cm tall growing in dense mats on sandy horizontal rocks. Such forms are not found in San Diego County.

Dawson's Checklist (as *C. trichotoma*) cites no San Diego collections. Setchell and Gardner (1920, as *C. hemisphaerica*) mention the tufted habit associated with wave-swept rocks in central California (and lacking in San Diego habitats).

**Cladophora graminea* Coll.
105

Thalli with bright green filaments; apical cells 4–6 times as long as wide, to 150 µm diameter, similar in size to apices of *C. columbiana*; sparsely branched until close to the tips of the axes where branches can be more regularly alternate. Cells, particularly the basal cells of axes, very long (**MAC** reports the length as 20–30 times the breadth). San Diego specimens to 5–6 cm high.

Several collections from subtidal (10–20 m) San Diego sites document this species locally. It is never abundant nor common, and rare in habitats where it is typically found north of San Diego. As do other *Cladophora* species, this one grows in tufts. The long narrow cells distinguish the species.

Setchell and Gardner (1920) cite San Diego collections of this as "one of coarsest of west coast species...of *Cladophora*" with "dichotomous" branching where each arm is composed of a single segment (cell). **MAC** records the species only south to San Pedro and describes it from mid to low intertidal habitats. K.A. Miller has collected subtidal specimens from the Channel Islands.

**Cladophora microcladioides* Coll.
106

Setchell and Gardner (1920) cite as San Diego records specimens from the upper subtidal zone, or (as *f. stricta*) the lower intertidal zone. The regular recurved branches that characterize the species are lacking in *f. stricta* as recognized by Setchell and Gardner (1920).

**Cladophora sericea* (Huds.) Kütz./ *C. stimpsonii* Harv.
108

Cladophora sp. in our collections comprises forms tentatively attributed to one

or the other of these two species, but that conform well to neither. There are many variants or ecotypes of *Cladophora* species in this area that are encountered both in intertidal and subtidal work, and these frequently are not easily sorted with available published information.

Setchell and Gardner (1920) refer to *C. sericea* from San Diego (as *C. flexuosa)* and to *C. stimpsonii* from San Pedro. As *C. flexuosa,* P.B.-A. 2239 and possibly 729 are cited as the basis for extending the distribution to San Diego (Dawson 1945d). No other San Diego localities or collections are noted.

Lola lubrica (Setch. and Gardn.) Ham. and Ham.
92

Unbranched uniseriate green filaments, attached to substrate by simple unbranched rhizoids that develop from cells near the base of the thalli; cells 35–60 µm diameter, 65–180 µm long, with upper cells frequently elongate-oval and somewhat constricted.

The species has been infrequently recorded from northern Washington south to Costa Rica, typically entangled with other algae or on mud. A collection from a cable lying on the sand seaward of the Scripps Pier included some material that was identified by Hollenberg as this species. We include it here to call attention to the possibility that it may be found in overlooked habitats.

Setchell and Gardner (1920) compared this species, as *Rhizoclonium,* with other species of that genus, saying that *L. (R.) lubrica* shows fewer or no rhizoids, has thinner walls and longer cells, and in masses is slippery or "lubricous."

Rhizoclonium riparium (Roth) Harv.
92

Unbranched uniseriate, dark to light-green filaments, often twisted and forming entangled masses on mud, wood, or other algae, or free-floating unattached thalli; the length/width ratio of individual cells, used in early studies to characterize species, is probably unreliable; cells mostly cylindrical, 35–50 (70) µm in diameter, 1–3 (6) times longer. Occasional cells with rhizoidal branches.

In San Diego, identified only from mud in or near the tidal creeks in Tijuana Estuary, and only occasionally present there. Growth is perhaps affected by the wide fluctuations in salinity between seasons and years. During a year-long study in 1977, Zedler (1982) found *Rhizoclonium* at all times during the year, frequently in samples from the portions of the marsh dominated by *Batis*

maritima and *Monanthochloe littoralis*, two vascular plants associated with intermediate and higher levels of salt marshes. In lower zones it was absent or infrequently found.

Setchell and Gardner (1920) distinguished California *Rhizoclonium* species from *Chaetomorpha* species by the characteristically cylindrical cells that are not swollen, and a tendency to form horizontal skein-like clumps. The separation of *Chaetomorpha* from *Rhizoclonium* and the usefulness of retaining *Lola* as a third genus on the basis of life history and vegetative morphology has been reviewed by Blair (1983) and in an update of taxonomy for California marine algae (Silva and Miller) that is in preparation. The latter workers recognize only *Chaetomorpha* and *Rhizoclonium*, "admitting that the generic boundaries are tenuous."

CODIOLACEAE

Urospora

93

The genus includes species of cooler waters that are mostly unbranched filaments with distinctive rhizoids growing only from cells near the base of plant. These rhizoidal branchlets can grow downward within or outside the extracellular wall material. The filaments appear erect, being attached at one end, in comparison with *Rhizoclonium* which occurs in the form of entangled unattached threads.

Published ranges of *U. penicilliformis* and *U. wormskioldii* extend to southern California, but we know of no San Diego County collections of either species. Setchell and Gardner (1920) treat the genus as *Hormiscia*.

BRYOPSIDACEAE

**Bryopsis corticulans* Setch.

111

Erect main axes sparsely branched or mostly bare below, with abundant symmetrical pinnate branches above; main axes to 1 mm diameter, ultimate branches 150–300 µm diameter, constricted at base. Older branches can develop coarse descending rhizoidal branches from their bases. Distinguished from *B. pennatula* in part by the difference in the amount of branching along the lateral branches, and in part by height. *B. corticulans* can exceed 8 cm while *B. pennatula* is described as mostly less than 4 cm high.

Numerous thalli resembling this description of *B. corticulans* have been collected from the docks in south San Diego Bay in March, with large speci-

mens to 7 cm high. Shevlin has examined cultured and fresh collections, and conducted crossing experiments between numerous isolates of Pacific and Atlantic *Bryopsis* thalli. His tentative conclusion (pers. comm. 1989) is that *B. corticulans* is a widespread and variable species that can resemble *B. hypnoides*; he questions the presence of the latter species on the coast of California. He points out that distichous branching is seen at least distally in most *B. corticulans* specimens and that the cultured isolates I mention as *B. pennatula* may also represent *B. corticulans*.

**Bryopsis hypnoides* Lamour.
113
Thalli tufted, to 3 cm high, dull green and profusely radially branched.

On the open coast, specimens of *Bryopsis* species are not easily found because the typical habitat is usually inaccessible, very low in the intertidal on the vertical sides of channels, under or mixed with other algae. Many of the field-collected thalli are not clearly radially branched, and thus it is often difficult to separate the two common species in this habitat. *B. hypnoides* is described as occasional to locally abundant on sand-covered rocks British Columbia to Panama but previously has not been recorded south of Los Angeles County in California.

Distinct species as treated in MAC are often difficult to segregate from San Diego County material. Setchell and Gardner (1920) wrote that "species of *Bryopsis* present problems of determination of exceeding complexity and difficulty."

Bryopsis pennatula J. Ag. (and see *B. corticulans*)
113
Thalli tufted, to 3 cm high, with mostly simple erect axes with terminal branching distichous to partly radial.

This portion of the description in MAC of the species is appropriate for certain collections of San Diego plants. When such thalli were grown in culture, however, they became less tufted in the upper portions and more regularly pinnately branched as in *B. corticulans*. We find specimens intertidally and subtidally to 27 m between January and April. These collected thalli are distinctly distichous and seldom more than 3 cm high with mostly simple branchlets, and resemble *B. pennatula*, previously reported only as far south as Orange County.

Dawson's Checklist identified specimens from intertidal rocks in La Jolla as *B. corticulans*.

**Derbesia marina* (Lyngb.) Sol.

115

Thalli are formed from coenocytic tubular "filaments," 50–70 µm diameter, branched irregularly with no size differences between branches; no septation within the branches; under a microscope relatively large sporangia filled with multiflagellate zoospores can be seen in many collections.

In San Diego, thalli form large entangled clumps loosely attached to other algae or *Zostera* in the flood control channel (mouth of San Diego River), or on the jetty along the entrance channel to Mission Bay from late summer into November. In a very different habitat, *Derbesia*-like filaments form extensive low mats that bind sand on high intertidal rocks on Pt. Loma beaches at the same time of year. The thalli from these two very different habitats are similar.

"*Derbesia*" morphology occurs in algae that have been shown by laboratory studies to be alternate stages in life histories of very different gametangial morphologies (e.g., species of *Bryopsis* in other parts of the world, and *Halicystis* in California). It is quite possible that the various collections of *Derbesia* represent different taxa.

Dawson's Checklist recorded collections from near The Caves, La Jolla, on low intertidal rocks in June.

Halicystis ovalis (gametophytic stage of *Derbesia marina*)

115

Thallus a deep green coenocytic sphere, 2–10 mm in diameter, attached to coralline crusts on rocks, shallow subtidal to 25 m in or near kelp beds.

This alga, appearing as a tiny dark green globe close to the rock surface, is not often found. When it is recognized, it is very distinctive although collecting is difficult — the thallus floats away as soon as it is loosened from the substrate. Note that the habitats known for *Halicystis* and *Derbesia* in San Diego County are somewhat disparate.

CODIACEAE

Codium cuneatum Setch. and Gardn.

116

Thalli erect, to 35 cm high, regularly or irregularly dichotomo-flabellately branched, with more or less wedge-shaped (cuneate) flattened segments; branches 2–15 mm broad, mostly compressed throughout except for branch tips and near the base. Utricles not mucronate (i.e.,without tiny spine on tip).

In San Diego County, found only at intervals of several years, in no predictable cycle, usually in late summer to fall, in quiet water in Mission Bay or the flood control channel of San Diego River. It is an easily recognized form because of its large (30–40 cm high) thalli and the broad upper segments, but the local distribution is irregular in time and restricted to a few sites. Silva (1951) described a large range of forms for this species, including some from Mission Bay collected in 1929. The species was based on a collection from Bahía de los Angeles in the upper Gulf of California and later was found on rocks intertidally to subtidally at Santa Cruz Island off the coast of California. Silva suggests that taxonomic and ecologic study is needed for this and other *Codium* taxa.

The statement (Dawson *et al.* 1960) that this species is "common 30–60 ft." in kelp beds is not presently applicable for San Diego localities. The flattened specimens discussed (Dawson 1945b) as *C. simulans* and compared with Setchell and Gardner's *C. tomentosum* and with *C. cuneatum* from the Gulf of California probably represent *C. cuneatum*.

**Codium fragile* (Sur.) Har.

118

Thalli dark green, often appearing nearly black, to 40 cm high; one or many cylindrical branches arising from a broad basal holdfast, abundantly dichotomously branched above, clumps often appearing densely clustered. Utricles mucronate.

This is a common conspicuous larga alga on rocky beaches across the midintertidal region. New growth appears in the spring; as the thalli grow, they accumulate epiphytes. In the fall or early winter, they are often conspicuously spotted with patches of small red filaments, mostly *Ceramium* and *Polysiphonia* species in San Diego County. A blue-green alga grows just beneath the surface, entwining around the utricles that compose the *Codium* thallus. We have not verified the identification of the blue-green taxon associated with *C. fragile* here; species of *Anabaena, Phormidium*, and *Calothrix* have been isolated from *Codium* species elsewhere.

Silva (1951) placed most of the California specimens formerly referred to *C. tomentosum* in synonymy with *C. fragile*. The Setchell and Gardner compressed plants noted in Dawson's Checklist are not explicitly transferred by Silva; based on his opinion concerning variation in *C. fragile*, it is highly unlikely that they ("*C. tomentosum* from La Jolla") represent anything other than *C. fragile*.

Codium johnstonei Silva

118

Thalli dark green, erect, consisting of a single cylindrical or slightly compressed, irregularly shaped rod, without branches, lobing or lateral protuberances; to 10 cm high and to 2 cm diameter.

MAC lists only a few records, none for San Diego County, other than the type material from Santa Cruz Island that was first described by Silva in 1951. The species is rare and always subtidal; we have found it outside the Pt. Loma kelp beds to 30 m, and near the Coronados Islands. No other subtidal organism can be confused with this alga.

Aguilar *et al.* (1984) recorded collections from Isla Todos Santos (Ensenada), Baja California, at 10–17 m.

Codium setchellii Gardn./ *C. hubbsii* Daws.

118

These are two flattened, dark green (appearing nearly black underwater) species of *Codium*. Thalli of both are mostly 2–3 cm across, but occasionally to 4–5 cm, and irregular in outline. They are distinguished by examining the utricle walls with a microscope. *C. setchellii*, lacking the pits or small holes in apical portions that characterize *C. hubbsii*, is rather common in the low intertidal zone in central and northern California.

In southern California, prostrate *Codium* specimens are mostly subtidal and for this reason are often referred to *C. hubbsii* without the necessary microscopic observations. Most specimens I have examined from various subtidal habitats in San Diego County I identified as *C. setchellii*; for this reason, the question of the occurrence of *C. hubbsii* in San Diego is presently unresolved. K. A. Miller has verified specimens of *C. hubbsii* from subtidal sites in the Channel Islands. Silva (pers. comm.) writes that "*C. hubbsii* can be distinguished from *C. setchellii* (when the presence or absence of pitting is not obvious) by the abundance of hair scars on old utricles compared to their almost complete absence in the latter species."

Dawson *et al.* (1960) list both species from kelp beds, noting that *C. hubbsii* was common 10–25 m in northern Baja California and that the two species are macroscopically indistinguishable.

PHAEOPHYTA

ECTOCARPACEAE

(122–146)

Included here with San Diego records are species of *Hincksia* (*Giffordia* in MAC; see Nomenclatural Note in Silva *et al.*, 1987), *Feldmannia hemispherica*, and possibly *Ectocarpus parvus*, all representing the formerly all-inclusive genus of *Ectocarpus*. These are brown filamentous algae with mostly intercalary cell division, often closely branched and with neither a cushion-like amorphous basal stage nor holdfast tissue growing into a host plant. The sporangia of the three separated genera are terminal or lateral, and single rather than clustered. *Ectocarpus* is distinguished, in the narrow sense, by having a few band-shaped chloroplasts in each cell, a feature that is difficult to evaluate in many specimens. *Hincksia* and *Feldmannia* species have numerous discoid chloroplasts per cell, and *Feldmannia* thalli have distinctive zones of small dividing cells. Most collections of often very abundant filamentous brown algae have sessile lateral plurilocular sporangia and can be identified as one of several species of *Hincksia*. Occasionally thalli with 1- to 5-celled stalks below the sporangia have been found that may represent *H. saundersii*.

Populations of these various species are extremely abundant on the sides of tide pools in late summer to fall and over the sand and algae in turf mats intermittently during spring to summer months. *Feldmannia hemispherica* is mostly identified from *Pelvetia*, while several taxa grow on *Zostera* and algae in the quiet waters of the Mission Bay entrance and San Diego River flood control channels. Single specimens have been recorded from deep subtidal sites, including garibaldi nests. A colonial diatom, *Berkeleya rutilans*, forms tufted thalli that closely resemble ectocarpoid algae.

Setchell and Gardner (1925) treated 41 taxa as species or forms of *Ectocarpus* on the U.S. and Mexican Pacific coasts.

**Ectocarpus parvus* (Saund.) Hollenb. (126). This is a common epiphyte on larger brown algae along the entire Pacific coast, including southern California. Setchell and Gardner (1925) treat the taxon as *E. confervoides* var. *parvus*. The type locality cited in MAC was San Pedro, Los Angeles County, but Setchell and Gardner (1925) suggest that the "sand-covered rocks" of the original description were located in San Diego.

**Feldmannia cylindrica* (Saund.) Hollenberg and Abbott (132). MAC refers to San Diego in the distribution records. Setchell and Gardner (1925) cite a small (less than 2 mm high) form that they found on *Codium fragile* at La Jolla. (*Ectocarpus flocculiformis* of Setch. and Gardn. is now included in

F. cylindrica.) Dawson's Checklist citation of *E. cylindrica* is based on the Setchell and Gardner record.

**Feldmannia globifera* (Kütz.) Ham. (134). Also cited by Setchell and Gardner (1925) from *Codium* at La Jolla, and similarly, Dawson's Checklist repeats this record.

**Feldmannia hemispherica* (Saund.) Hollenb. (134). Epiphytic brown filaments, 2–10 mm high, with basal mass of creeping filaments on or in the host alga, sparsely branched. Recorded elsewhere from several algae, but in San Diego identified only from *Pelvetia fastigiata*.

Feldmannia irregularis* (Kütz.) Ham. (136). The record referred to in **MAC probably is based on material deposited in the herbarium at UC. [Early collections of filamentous brown algae in UC, some from southern California, are also labelled as *Giffordia irregularis* (Kütz.) Joly, and synonymy for this latter epithet includes *Ectocarpus mucronatus*, *E. coniferus*, *E. simplicuisculus* and *Giffordia conifera*.]

Hincksia granulosa* (J.E. Smith) Ham. (140), **H. mitchelliae* (Harv.) Ham. (143), and **H. sandriana* (Zan.) Ham. (145) (as *Giffordia* species in **MAC) have been identified in our collections with reasonable certainty. *H. saundersii* (Setch. and Gardn.) Hollenb. and Abb. (146), "known only from Monterey County" or forms resembling this species have also been found.

**Streblonema investiens* (Coll.) Setch. and Gardn.
152
This species, recorded by Dawson's Checklist on the basis of an early Collins description of specimens growing on *Helminthocladia* at La Jolla, is considered by **MAC** to be "of questionable status."

MYRIONEMATACEAE
157–163
Cultures that are initiated from collections of intertidal or subtidal algae often develop contaminating clumps of very small unbranched or sparsely branched golden brown filamentous algae. These thrive under laboratory conditions and probably are mostly species that are associated with the Myrionematacean genera. Reproduction is rare or absent in these cultures, and the nature of the attachment layers uncertain, and thus we hesitate to identify any of these apparently ubiquitous algae on the basis of features observed in laboratory-grown thalli. Field-collected material is inadequate for a comparative study at present. According to the distributional records cited in **MAC**, species of the

genus *Myrionema* are restricted to the colder water north of Monterey County. Three species of *Compsonema* are recorded only from central to northern California, and one of the two species of *Hecatonema* is similarly restricted. *H. streblonematoides* has been identified in collections from Baja California but in California is reported only from Marin County and Monterey County. Filaments, including reproductive cells, that resembled species of *Hecatonema* or *Compsonema* have been found in San Diego county habitats on subtidal sponges among sediment, debris, and other algal filaments.

Chilionema ocellatum (Kütz.) Sauv.

New, unpublished record. See citation in Parke and Dixon 1976.

George Russell, who has studied small brown filamentous algae in Europe, identified *Chilionema ocellatum* during a visit to La Jolla in May 1975, epiphytic on *Pelvetia* (voucher has been lost; basiphyte cannot be verified).

RALFSIACEAE

163–175

The following species have ranges that include localities both north and south of San Diego County:

Diplura simulans Hollenb.
Endoplura aurea Hollenb.
**Hapalospongidion gelatinosum* Saund.
**Hapterophycus canaliculatus* Setch. and Gardn.
Pseudolithoderma nigra Hollenb.
Ralfsia confusa Hollenb.
R. integra Hollenb.
R. hesperia Setch. and Gardn.
**R. pacifica* Hollenb. (includes *R. occidentalis*, collected and identified 1946 by Dawson, from La Jolla, at UC)

Thin brown-black crusts adhering closely to the substrate that typically are considered as *Ralfsia* species are common on intertidal rocks on San Diego County beaches. Thicker, convoluted, and more loosely attached thalli of *Hapterophycus canaliculatus* and *Petrospongium rugosum* (in *Leathesiaceae*) are abundant in some years in the same habitats. Certain of these brown crusts have been shown to represent stages or phases in the life histories of larger erect species of brown algae in other parts of the world.

LEATHESIACEAE

Leathesia difformis (L.) Aresch.

176

Thalli of the macroscopic phase hollow, globular, yellowish brown, to 12 cm in diameter to the north, smaller in San Diego County and less convoluted. When a piece of the thallus is pressed between one's fingers it separates or feels mucilaginous, in contrast with *Colpomenia* thalli that are similar externally.

This species is strictly seasonal, first appearing in early March, becoming abundant by April–May, and virtually absent by late May or early June. It is often much more abundant on some beaches, and in some years, than others. It attaches to bare rock, as well as to other algae, and is often epiphytic on coralline species. Internally, *Leathesia* consists of branched filaments, while in *Colpomenia* large colorless cells form a parenchyma-type medulla. This contrasting character verifies identifications.

**Petrospongium rugosum* (Okam.) Setch. and Gardn.

Cylindrocarpus rugosus Okam., 177

Macrothalli more or less prostrate, convoluted, rugose (wrinkled or ridged), and not tightly adherent to rock; golden to dark brown, often somewhat circular in outline, to 8 cm diameter. The internal anatomy, similar to *Leathesia*, easily distinguishes this crust from others.

Abundance and seasonality vary from year to year; thalli can be found in many habitats in and above the mid-intertidal zone.

CHORDARIACEAE

**Haplogloia andersonii* (Farl.) Levr.

182

Thallus erect, gelatinous, narrow, cylindrical; branching irregular but profuse; to 40–50 cm high; most branches 2–3 mm wide; older axes often hollow; somewhat soft to the touch; the presence of numerous colored hair cells that grow out from the outer layer of cells results in a fuzzy appearance in water.

Reported as occasional to locally abundant throughout California to San Diego County, but here very rare, in pools or channels in the intertidal zone.

Setchell and Gardner (1925) (as *Myriogloia*) refer to variation in the size of plants from different localities and to differences in the abundance of hairs along the branches. Since Dawson's collection (1945d) of thalli on rocks near the Scripps Pier in May, there have been no other published records. We found specimens in 1968 on rocks south of La Jolla Shores beach.

Tinocladia crassa (Suring.) Kyl.
184
Thalli erect, to 15 (25) cm high, irregularly branched throughout, and soft or gelatinous; branches cylindrical, 2–3 mm diameter, with hairs.

The "La Jolla" record in MAC, as far as we can determine, is based on plants Dawson collected and identified [as *Eudesme (Aegira) virescens*] from mid-intertidal pools near the Beach and Tennis Club in La Jolla. He reported finding it in "fair abundance" in June, 1944 (1945d), and noted that vegetative growth during cool winter and spring months and seasonal occurrence would be expected for this cold-water species. Collections from Santa Catalina Island provided material for a study which placed the species in *Tinocladia* as *T. crassa* (Mower and Widdowson 1969). A single distinctive specimen that probably represents *T. crassa* was collected at the same time that *Cutleria cylindrica* (see below) recently was found.

CUTLERIACEAE
Cutleria cylindrica Okam.
Hollenberg 1978
Axes to 23 cm high (San Diego specimens), erect from discoid holdfast; branches to 2 mm diameter, dichotomously branched with slender apices 120–200 µm in diameter; growth from meristematic activity at uniseriate base of numerous terminal, simple, colored filaments that are cylindrical, up to 1 mm long and 12–20 µm in diameter, and that quickly become multiseriate by longitudinal divisions of cells; deciduous assimilatory branchlets soon partially replaced by numerous protuberant soral tufts of unbranched fertile filaments (after Hollenberg 1978 and see for illustration of microscopic detail of thallus).

Thalli (Fig. 3C) that were conspicuously different from any previously collected species were found in Pt. Loma intertidal pools in the winters of 1984–85, 1985–86, and 1986–87, the first a year of unusually warm water and following a winter of unusually strong storms. They were absent the following winters (1987–89). Subsequent study concluded that the thalli were very similar to the alga collected at Santa Catalina Island in 1973 and identified as *Cutleria cylindrica* by Hollenberg (1978), a species described from Japan. He discussed the similarities of this "*Cutleria*" species to *Myriogloia* and other taxa in the family Chordariaceae (see above), and questioned its affinities with Cutleriaceae. Additional specimens were collected by Terry Klinger subtidally near San Clemente Island several times in 1986–87, and from shallow subtidal rocks off Bird Rock in La Jolla in 1986. It has not been found elsewhere in San Diego County.

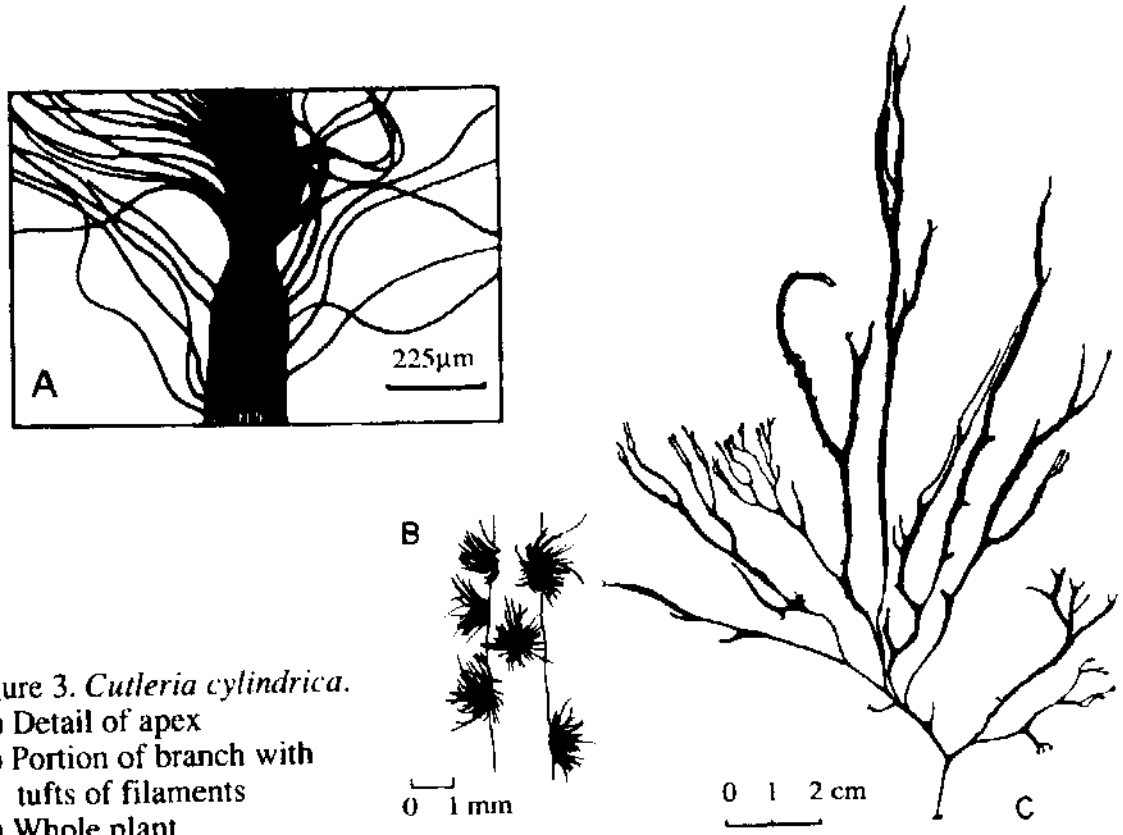

Figure 3. *Cutleria cylindrica.*
(A) Detail of apex
(B) Portion of branch with tufts of filaments
(C) Whole plant
A and B after Hollenberg 1978.

COILODESMACEAE

**Coilodesme californica* (Rupr.) Kjellm.

188

Thalli epiphytic, saccate, less compressed, and with walls thinner than *C. rigida*. Specimens as much as 1 m long to 12 cm broad have been found in northern California, but large specimens from San Diego are approximately 15 cm high. The color is a light olive tan that dries to almost green, an easily recognized characteristic.

The few collections from San Diego County occurred on *Cystoseira osmundacea*, a subtidal species.

Setchell and Gardner (1925) record it south only to San Pedro in Los Angeles County, indicating it was similarly infrequent in the southern part of the state early in the century.

**Coilodesma rigida* Setch. and Gardn.

191

Thalli are flattened brown sacs, with thick-to-thin walls, appearing as blades

attached only (?) on *Halidrys dioica*, and thereby restricted to the low intertidal or upper subtidal zones.

Reported as frequent at Santa Catalina Island, and in Orange and Los Angeles counties, it is not often found in San Diego. Another species is found on *Cystoseira*, and because of the difficulty of distinguishing young or basal vegetative parts of *Cystoseira* and *Halidrys*, the corresponding species of *Coilodesme* may also be confused.

Dawson (Checklist) noted it was common on *Halidrys* in La Jolla in June.

SCYTOSIPHONACEAE

Colpomenia peregrina (Sauv.) Ham.

204

Compared with *C. sinuosa* (below), thalli are thinner and smoother, but otherwise similar. Both species grow on rocks and on other algae; for San Diego County, *Halidrys* and *Sargassum muticum* are recorded as basiphytes for *C. peregrina*, which is probably a relatively rare alga here.

**Colpomenia sinuosa* (Roth) Derb. and Sol.

204

Thalli globular, hollow, golden to slightly darker brown, irregular in shape and size, with innumerable variations in appearance, becoming sometimes lobed or convoluted with age.

At times in the mid-intertidal region, mats of coralline algae, or rocks that have been recently rolled or broken and that therefore expose bare surfaces, will be covered with large patches of brownish blobs of algal growth that are identified as *C. sinuosa*. They are most abundant in late spring and early summer and can appear then disappear from large areas within several weeks. Thalli also grow in low intertidal or shallow subtidal habitats, on larger algae (e.g., *Sargassum muticum*) as well as on rock substrates.

Dawson's Checklist lists, as forms of *C. sinuosa*, several taxa now considered to be distinct species.

Colpomenia tuberculata Saund.

204

Thalli globular, irregularly shaped, with walls relatively thick, rigid, and eventually forming blunt-to-sharp projections that can give the surface a rough, "warty" appearance. This species is generally darker and heavier looking than *C. sinuosa*, although young small thalli of both species are similar. Thalli vary greatly in size and surface texture with habitat and age.

As thalli become older, some of the tubercles usually break away (or the walls are eaten from beneath by juvenile *Pachygrapsus* crabs?), leaving holes of various sizes and shapes. In some years, when these thalli are abundant and remain on the beaches until late in the summer-fall season, they become very perforate, superficially resembling illustrations of *Hydroclathrus*. *Colpomenia* thalli remain relatively discrete and the walls are thick and coarse while *Hydroclathrus* thalli tend to grow into large expanded mats, become "lacy" in appearance, with thinner walls, and without tubercles.

Recognition of thalli as *C. tuberculata*-with-holes depends in part on prior observation of the progression of forms, and in part on actual experience with populations of *Hydroclathrus*, a species from warm-water localities that is abundant elsewhere, but not in California. Setchell and Gardner (1925) observed that old *C. tuberculata* thalli come to resemble *Hydroclathrus*, substantiating our opinion.

**Endarachne binghamiae* J. Ag.

200

Blades golden to dark brown (fertile portions), without midribs, several arising from small single basal discs; to 20 cm high; many clearly and conspicuously curved at the tips, scimitar-like, in some cases a useful field characteristic. The species here most often grows on otherwise nearly bare rock surfaces in the upper intertidal zone or in lower areas, mostly on tops of rocks and associated with barnacles and sparse clumps of other algae.

When thalli of *Endarachne* are sectioned, one sees densely intertwined branched filaments in the medulla (enda = inner; rachne = as in a spider web). When thalli of *Petalonia fascia*, externally similar, are sectioned, the medulla is observed to be formed from large colorless cells. There has been considerable argument about the presence or absence of one or the other of these species in localities south of Santa Barbara. *Endarachne* is not recorded from the coast north of Santa Barbara, while *Petalonia* becomes increasingly less common to the south. A representative herbarium subsample of thalli externally resembling *Endarachne/Petalonia*, collected from San Diego County beaches at all times of the year over a 15-year period, was examined. No *Petalonia* thalli were found prior to the collections of 1984 referred to below.

In a not-easily obtained Russian series (Vinogradova 1973) *Endarachne binghamiae* was transferred as *Petalonia binghamiae* (J.Ag.) Vinogradova. Until this study can be evaluated by other workers, I maintain the taxonomy of **MAC**. The separation of the two species from California is unambiguous and the distinction in medullary anatomy seems appropriate for generic status.

**Hydroclathrus clathratus* (C. Ag.) Howe
206

Thalli irregularly globular when young, hollow and sessile; usually aggregated in patches; soon developing numerous perforations to 8 mm diameter; thalli later growing together to cover the rock surface; margins of perforations involute; widely distributed in tropical and subtropical seas.

In many years this alga is absent from San Diego County; the globose brown thalli with holes one sees are instead forms of *Colpomenia tuberculata* (see preceding). Dawson (Checklist) stated that *Hydroclathrus* had been found in the tide pools near the Beach and Tennis Club north of La Jolla Shores beach, and we found a few isolated thalli in the early 1960's, including a subtidal collection near the Coronados Islands. Although we have followed the development of *Colpomenia* thalli with this question in mind, we found no other *Hydroclathrus* until late fall 1984, when plants appeared south of Sunset Cliffs along the beaches of Pt. Loma. They were scattered in this area throughout winter 1984–85, following a year of warmer-than-normal water temperatures.

**Petalonia fascia* (Müll.) Kuntze
200

Erect olive-brown to golden-brown blades, one or more arising from small base; linear or broadly lanceolate; San Diego thalli to 15 cm high (to 35 cm in central and northern California) and mostly less than 4 cm wide, with tapering but not curved apex. Some thalli bear tufts of multicellular hairs; small surface cells enclose several layers of large colorless medullary cells.

Very rarely found in San Diego County, possibly only during or following years of "unusual" water conditions or related changes in nearshore current patterns. No known prior published records for the county or verified unpublished collections. Although Dawson collected intensively, and where it grows it is conspicuous, he cites no records specifically for San Diego County. Until 1984 every plant that was brought to us as an example of *Petalonia* proved to be *Endarachne*. For this reason we question records of *Petalonia* in San Diego localities that are based on field observation, without microscope confirmation. In 1984–87 we found dense and abundant populations scattered on rocks in shallow pools or channels in mid-intertidal regions during late fall to spring months. Until habitat and field appearance became familiar, we cut sections of blades collected from numerous patches for comparison with specimens of *Endarachne binghamiae* (see above). [Setchell and Gardner (1925) note that *Endarachne* resembles forms of *Ilea* (= *Petalonia*) *fascia* so closely in general appearance that it is necessary to examine sections to distinguish them with certainty.]

During the winter of 1984–85 we first found *Petalonia* in habitats where *Endarachne* would not be predictably found. *Petalonia* blades disappeared

from pools before *Endarachne* became common on raised rock surfaces. In the following two winters a few blades, scattered in the same area, could be found, but the species was far less conspicuous than during the first year, and it was absent from many of the pools where it grew in 1984–85. It was not found after 1987.

Scytosiphon dotyi Wynne
198

Thalli unbranched, erect hollow cylinders that usually are (slightly) flattened; to 12 cm high, 1 mm diameter, tapering to rather a narrow tip and also toward base; growing in tufts of several or many tubes, sometimes twisted, greenish to dark brown; hairs in dense tufts in small depressions on surface.

MAC states that this is mostly a winter annual, restricted to vertical faces of large boulders and seawalls in the upper intertidal region. On San Diego beaches an alga that matches this description is often abundant on high intertidal rocks in summer months as well as into the winter. Many of the larger thalli of *S. lomentaria* that occur throughout the intertidal are not constricted; lacking this distinction, it is possible that some of the small plants may represent small or juvenile forms of *S. lomentaria*.

Aguilar *et al.* (1984) record populations of *S. dotyi* in five contiguous localities near Punta Cabras, Baja California, most abundantly in winter.

**Scytosiphon lomentaria* (Lyngb.) Link.
198

Thalli unbranched, erect tube-like, cylindrical, and (ours only rarely) constricted at regular intervals; San Diego plants to 35 cm high, 3–10 mm diameter (elsewhere to 70 cm high); light to very dark brown in color. This is distinctly a late winter/early spring annual on our beaches where it can cover newly exposed rock surfaces in channels or low areas throughout the midtidal region. It also grows in quiet shallow water in Mission Bay, including the entrance channel, and in the flood control channel of San Diego River. Thalli grow rapidly, and on monitored surfaces plants can appear and grow to 16–20 cm within several weeks. Attachment to other than bare rock is very rare. In some years it is markedly more abundant than in others.

Dawson's Checklist refers to various forms, described earlier by Setchell and Gardner (1925), as occurring in La Jolla. These are differentiated primarily by width. Thalli we find are seldom constricted as shown, Figure 162, in **MAC**. *"Ralfsia pacifica"* (or another brown crust) has been shown to represent a phase in the life history of *S. lomentaria*, but the two forms need not alternate, each can repeat itself, and cylindrical and complanate erect forms both occur in some California localities (Littler and Littler 1983).

DICTYOTACEAE

**Dictyopteris undulata* Holmes

212

Thalli irregularly dichotomous, yellowish brown to olive, often with a very distinctive pale bluish iridescence when submerged; with prominent midribs, often slightly notched at the tips of blades; wavy or undulate margins.

The variability in specimens of this perennial species is extensive but probably represents changes with age and annual growth cycles in various habitats. Young, or small, plants have broad branches throughout. "Stipes" develop when lateral blade portions are lost from midribs of older thalli. Some specimens completely lack the blade areas to either side of the midrib and are so eroded as to appear to consist largely of long, to 30+ cm, dark or black cylindrical branches. Intermediates link extreme forms. The species is found in winter and spring in low intertidal pools, and to below 33 m in the La Jolla Canyon where this is one of the deepest growing species.

**Dictyota binghamiae* J. Ag.

207

Thalli light to medium brown, darker below; flat and dichotomously divided; to 35 cm high but mostly less; occasionally with pinnate branches; axes 1–1.5 (2) cm broad, with broadly rounded tips and axils, often with marginal teeth; mostly subtidal. Regular dichotomous branching and the presence of a single relatively large apical cell distinguish this and other *Dictyota* species.

On San Diego specimens the marginal teeth are consistently observed. Subtidal specimens are often very thin and perforate.

Note: Setchell and Gardner's (1925) discussion of '*D. binghamiae*' no longer is applicable due to subsequent taxonomic revisions of *Dictyota* species on the Pacific coast of North America.

**Dictyota flabellata* (Coll.) Setch. and Gardn.

207

Thalli medium brown; one to several flat axes from basal disc, branching evenly and distinctly dichotomous with blunt-rounded apices, smooth surface on all parts. In cross section mostly 3 cells thick (two single-cell layers of outer cortical cells with a single layer of large colorless medullary cells). *D. flabellata* is distinguished from *D. binghamiae* by not showing a tendency to pinnate branching and by lacking marginal teeth or irregularities.

On most San Diego beaches *Dictyota* thalli grow in midtidal pools or channels where they are unlikely to be exposed to air. These grow quickly, from small

germlings to narrow plants approximately 5 cm high within several weeks, and clumps or populations appear and disappear seasonally. These usually submerged intertidal thalli are mostly light golden brown, rather thin, and seldom bear epiphytes. Margins are completely smooth, and branching is strictly and strikingly dichotomous (not as *D. binghamiae*). This small common form is presently attributed to *D. flabellata*, but in several ways it differs from deeper water forms of the species.

Among larger intertidal and subtidal dichotomous forms that lack marginal dentation, there is considerable variability in color and thickness. Some specimens show occasional adventitious branching from the sides of branches away from the growing tip (as in *D. binghamiae*), and others are often very dark with a leathery texture, as described for *Pachydictyon coriaceum*. To clarify the distinction between *Dictyota* and this *Pachydictyon* species, cross sections were cut from several different portions of each of 20 specimens selected to represent an array of forms and habitats. Most sections, from most thalli, were 3 cells thick and on this basis the plants are identified as representing *Dictyota*. Among the few plants where margins were more than 3 cells thick, some resembled *D. binghamiae* in morphology. Considering the longevity suggested by size, appearance, and epiphyte cover of some *Dictyota* thalli, it seems likely that in older thalli medullary cells near the margins occasionally divide to form an additional row. If this is so, the status of *Pachydictyon coriaceum* as a separate taxon in San Diego would be dubious. Most subtidal specimens, by morphological criteria, can be attributed to one of the two presently recognized species of *Dictyota*. Thalli grow from shallow to deep subtidal rocks, and in both San Diego and Mission Bay, including the Channel entrance.

Pachydictyon coriaceum (Holmes) Okam.

209

Thallus divided into narrow dichotomous portions, with overall fan-shaped morphology; margins smooth, apices rounded; dark brown; to 30 (44) cm high, branches mostly 9–13 mm broad, often somewhat coarse or leathery appearing. Branches mostly 3 cells thick, but margins 4+ cells thick.

To distinguish thalli of this species from species of *Dictyota*, we examined cross-sections from numerous specimens of otherwise similar plants as described above. Development of additional (producing more than one layer) medullary cells near margins, considered to be diagnostic for *Pachydictyon coriaceum*, did not effectively separate our collections into two genera (see discussion for *Dictyota flabellata*). I list *P. coriaceum* as a separate species, but with a query. In San Diego County all the common subtidal dichotomously branched brown algae can probably be referred to either *D. binghamiae* or *D.*

flabellata, following the treatment for these two taxa in MAC. *D. flabellata*, confirmed by microscopic examinations of cross sections, includes some thalli with thick-appearing, dark-colored basal portions. Some of these specimens could be identified as *P. coriaceum* if sectioning located areas with two or more layers of medullary cells and if this character is considered in itself diagnostic for a separate genus.

**Taonia lennebackeriae* J. Ag.
213

Thalli erect, golden to darker brown, to 100 cm high, variable in width, to 4–5 cm in lower third; no midrib or apparent differentiation in the blades; these often long and uniform in width, or wider away from the base, with an elongate wedge shape; occasionally with indistinct bands of dark-colored reproductive cells in a partially concentric pattern across blades.

A distinctive aspect of *Taonia* blades in the field is the torn ragged-appearing blade tip that undulates back and forth in shallow water in sand-filled channels of intertidal beaches. We have also collected subtidal thalli to 20 m offshore, as well as in quiet water sites in Mission Bay. On individual beaches the appearance and disappearance of populations seems related to sand movement, as rocks are covered and uncovered from spring through December.

This species does not occur much farther north than Los Angeles County ("California" is cited as the type locality; MAC states "probably near Santa Barbara") and presumably is more characteristic of lower latitudes where water often is warmer. Because very large (to 100 cm high) specimens have been found in deep subtidal sites (beneath summer thermocline depth), and in winter and early spring months, we hesitate to relate its distribution directly to effects of warm water.

**Zonaria farlowii* Setch. and Gardn.
215

Profusely flabellate (fan-shaped), with frequent dichotomies in all parts of the thallus; tips of each flat branch often divided into several shallow divisions that are pale yellowish green in contrast to lower darker blade areas; no midrib or differentiation in blades; often with heavy stipe below where older blades have eroded laterally, leaving only thickened basal part; to 24 cm high; typically in aggregated clumps, attached to sand-covered rocks in the upper or midtidal region, occasionally into subtidal habitats (to 30 m).

Zonaria is often associated with the same habitats where *Taonia* occurs, both species being adapted to partial or complete burial by sand during part of each year. Basal thalli presumably remain viable and resume growth when

uncovered. Survival and the potential for regrowth under these conditions has been demonstrated for *Zonaria* near Santa Barbara (Dahl 1971), near the northern limit of distribution along the coast of California.

Discussed by Setchell and Gardner (1925).

SPHACELARIACEAE

**Sphacelaria californica* (Sauv.) Setch. and Gardn.

216

Thalli filamentous, uniseriate only near the apices, growing in isolated discrete dark brown erect tufts, relatively stiff; all axes and branches terete, with longitudinal divisions in cells near the tips producing several elongate cells in place of the original single cell in the filament apex; to 3 cm high, more branched above than below, in irregular arrangements; the microscopic vegetative reproductive structures, characteristic of all species in this genus, are short and unbranched in *S. californica*.

This is one of two common intertidal species; the short branchlets that commonly are the only form of reproduction are not often seen. Thalli can grow directly on rocks but are often epiphytic on other algae, including algal turf on flat intertidal platforms. We have identified the species additionally from high intertidal pools. Our records suggest it may be most often found November–March.

Sphacelaria didichotoma Saund.

218

Thalli densely tufted, filamentous; uniseriate near apices; all axes and branches terete with longitudinal divisions in cells near the tips producing several elongate cells in place of the original single cell of each filament; thalli to 4 mm high, with creeping basal axes usually epiphytic; rare. Propagula (vegetative branchlets serving reproductive function) are branched into at least two bifurcations.

This species has been recorded growing on subtidal algae along the Loma Sea Cliff and near the Coronados Islands to 17 m. When bleached formalin-preserved specimens are examined, the branching pattern and branch dimensions appear similar to *Cladophora* thalli that grow in the same sites. *Cladophora* is rarely, if ever, an epiphyte; with closer examination, the polysiphonous structure of *Sphacelaria* can be recognized.

Sphacelaria rigidula Kütz.

Prud'homme van Reine 1982

S. furcigera Kütz., 218

Thalli often densely tufted, filamentous, uniseriate near apices, all axes and branches terete; longitudinal divisions in cells near the tips producing several elongate cells in place of the original single cell in the filament; usually 5 mm to 1 cm (or more) high, branching often distant and sparse; the slender short branchlets that function as reproductive structures are rarely seen. They consist of a narrow straight "stalk," usually with 2 or 3 narrow straight arms of equal length. In European material, apical cells of the first-developed arms can occasionally produce new arms and the process can be repeated several times. This sequence could produce thalli resembling those described for *S. didichotoma* in California.

In San Diego, thalli at times are very abundant and easily found where the dark stiff tufts contrast with the pale coralline thalli on intertidal horizontal rock surfaces between Ocean Beach and the tip of Pt. Loma in winter and spring months. It is one of two common intertidal species. In other parts of the world this cosmopolitan species is widely distributed. Although MAC records it as "rare" in California, it apparently becomes rather less rare in this southern part of the state.

DESMARESTIACEAE

**Desmarestia ligulata* (Lightf.) Lamour.

222

All *Desmarestia* species are characterized by having large flat, dark to light brown thalli that are clearly divided into mostly round or slightly compressed axes and branches that bear broad leaf-like or more narrow blades in very symmetrical regular patterns. Tufts of hairs terminate blade apices. When blades are damaged (crushed, or exposed to air or rain) they turn greenish blue due to the release of H_2SO_4 from cells. *D. ligulata* is an extremely variable and widely distributed species. In San Diego, thalli are up to 2 cm wide, more narrow toward the apex of the thallus, usually branched more oppositely than alternately. Growth follows an annual cycle. Specimens up to 2–3 m high have been collected in fall months, while very small plants are found in spring through summer months. Locally it is abundant both on sand bottom sites in La Jolla Bay and on rocky areas off Pt. Loma; always subtidal, 13–27 m, or on rocks at the lowest, rarely exposed border of the intertidal zone. Most of the variants recognized in California collections can be found in San Diego. The species fluctuates greatly in abundance from year to year.

The two species listed in Dawson's Checklist for San Diego (*D. munda*, *D. herbacea*) were included in MAC as synonyms of *D. ligulata* var. *ligulata* on the basis of vegetative characters. Comparisons based on other features, and extended to European species, suggest that nomenclatural and taxonomic changes are likely in the future.

Desmarestia ligulata var. *firma* (C. Ag.) J. Ag.

225

Thallus differing from the preceding forms in lacking the division into distinct axes and blades, consisting more or less of a single mostly unbranched blade. These thalli can be large (to 34 cm high and 21 cm broad) with a clearly evident midrib the entire length of the blade.

The variety thus described was formerly treated as a separate species, *D. tabacoides*, referring to the tobacco leaf-shaped blades. Most specimens are much less distinctive than the "typical" specimen illustrated in Figure 186 of **MAC**. Nakahara (1984) showed that specimens of *D. tabacoides* and *D. ligulata* from Japan differ in several attributes, including chromosome number, and therefore represent two distinctive species. Specimens resembling var. *firma* infrequently are found in subtidal habitats to 25 m; variants of *D. ligulata* var. *ligulata* grow in the same habitats.

LAMINARIACEAE

Agarum fimbriatum Harv.

234

Thalli are single unbranched brown blades on short stipes attached by small inconspicuous haptera. A distinct broad midrib runs from the base toward the distal part of the blade, which is usually torn and ragged. The blade surface is bullate, meaning with bulging ridges and pockets, not smooth. The entire blade area is perforated by small holes that develop early in the growth of juvenile thalli.

Specimens in San Diego County sites, to 80+ cm high, can be collected during all months, 17–33 m deep on rocks in or near Pt. Loma and La Jolla kelp beds. Our records suggest that small young plants are found winter-spring and the largest thalli in August-January, perhaps representing an annual growth cycle.

The species occurs from Alaska south along the Pacific coast, and recently the range was extended from San Diego to Isla Todos Santos, Ensenada, Baja California where thalli to 90 cm high were found (Aguilar et al. 1984).

[*Costaria costata*, with an implied range into San Diego County (Dawson 1945d) has not been found here.]

**Laminaria farlowii* Setch.

231

Thalli consist of a single short (4–7 cm) stipe growing from a holdfast and bearing a large blade that lacks a midrib and that lies close to the substrate

rather than rising erect in the water column. The dark brown blade (to 5 m long) is covered with blister-like bulges and ridges ("bullae"), but many smaller specimens are nearly smooth.

This is one of the more conspicuous large brown subtidal plants referred to as kelps. It is common under the canopy or near the edges of *Macrocystis* beds as deep as 33 m.

[*Laminaria setchellii* Silva
Druehl 1979
Laminaria dentigera Kjellm., 229
California specimens previously identified as *L. setchellii* were combined with *L. dentigera*, a more northern species, in MAC; Druehl (1979) describes differences that justify retaining *L. setchellii* for digitate *Laminaria* thalli in southern California. Aguilar *et al.* (1984) has found specimens on several of the points south of Ensenada where cold water upwelling is associated with marine algae otherwise found far to the north. The species has not been found in San Diego County, nor is it to be expected on the basis of ecological conditions.]

ALARIACEAE

**Egregia menziesii* (Turn.) Aresch.
244
Thalli large, to 15 m long, consisting of several strap-shaped flattened branches densely covered along both edges with broad or narrow, usually somewhat linear, short blades; golden brown to dark, or almost olive brownish green; flat axes sometimes smooth to 3–4 cm wide, or covered partially or entirely with minute tubercles; lateral bladelets to 8 cm long, narrow at base, and highly variable in shape, from broad to filiform; oval pneumatocysts scattered among bladelets, and variable in size, number, and shape.

The extensive morphological variability observed in different parts of the same plant, among plants in the same area, and throughout the range of the species does not make identification difficult. No other alga has long strap-like fringed thalli; these are commonly washed up on beaches wherever there are rocks offshore for attachment. Dense beds of *Egregia* grow in the very shallow nearshore subtidal zone but specimens can be found as deep as 15 m.

**Eisenia arborea* Aresch.
242
Thalli are large, conspicuous, brown palm-like seaweeds that grow just up to the lower border of the intertidal zone on stable rock substrates and extend

subtidally to over 33 m. The heavy stipe is mostly somewhat flattened, very dark brown to nearly black, and in subtidal specimens can be more than a meter long; shallow-water thalli usually are considerably shorter; top of stipe divided into two short symmetrical portions, each of which bears a clump of long dark brown blades that hang down from the erect stipe apex. Blades strikingly dentate along margins and corrugated on surface; no pneumatocysts.

Small forms, such as grow in shallow water, superficially resemble *Postelsia* of central and northern California. At the deep limit of its subtidal range, plants may resemble *Pterygophora* when the stipe bifurcation is obscure in large thalli.

**Pterygophora californica* Rupr.

241

Thalli perennial, with a stout branched holdfast; long unbranched erect stipe, cylindrical in basal portion, flattened above, woody, with concentric rings in cross section; single terminal blade without midrib, smooth surface; lateral blades of approximately same size and shape as terminal blade, borne on both margins of flattened upper portion of stipe; each margin with row of 5–10 specialized blades (sporophylls) that produce reproductive sori; such blades are shed each year after spores are released, with new growth following; stipes to 1.5 m high, to 4 cm broad above, terminal blade to 80 cm, 10 cm wide, with entire thallus 2–3 m high.

Extensive patches of this alga grow in many offshore kelp beds, effectively cutting off most light from the underlying substrate. The dynamic interrelationships among this and other kelp bed species off Pt. Loma are described by Dayton *et al.* (1984).

LESSONIACEAE

Dictyoneuropsis reticulata (Saund.) Smith

248

Blades of perennial sporangial thalli to 95 cm tall, growing from short prostrate stipes that also bear marginal haptera; blades linear, with flattened midrib, mostly 15–25 cm broad (San Diego specimens to 10 cm), with coarse network of narrow ridges across blades lateral to midrib. Sori between reticulations, at times over midrib.

R. McPeak found a few specimens in November 1973 at 16 m depth west of La Jolla. He has also observed (pers. comm.) dense and extensive patches of the species off Pt. Fermin (at site referred to as "Horseshoe Kelp"), in Los Angeles County at a depth of about 25 m. In 1983, one specimen (of two observed) was

collected from near Todos Santos Island, Ensenada, Baja California (Aguilar and Pacheco, 1985). These several new records extend the distribution: in MAC, reported from British Columbia to northern Channel Islands in California.

**Macrocystis pyrifera* (L.) C. Ag.
257

Macroscopic thallus with a basal branched holdfast and long, erect, cylindrical stipes that are branched near the base several times and bear blades at regular intervals in an apparent spiral arrangement; terminal blade broad and curved; the entire plant can be over 33 m long; mature lateral blades are lanceolate with an uneven surface, to 80 cm long and 40 cm broad, usually with a pneumatocyst at the base near the attachment to the stipe.

This is the common kelp that is harvested off Pt. Loma and La Jolla from kelp beds where fishing and diving boats congregate, and that washes up on the beaches in huge piles after storms or (in small pieces) after kelp cutters go through the beds. The relationships among this large dominant plant, the understory algae, and the fish and invertebrates that share this habitat have been intensively studied both because so many of the species (lobster, abalone, fish, kelp) are commercially valuable, and because of intrinsic interest in this conspicuous cohesive plant community. *Macrocystis pyrifera* occurs on the coasts of Chile, Argentina, and several islands in the South Atlantic, as well as along the west coast of North America. Two other species occur on the Pacific coast north of San Diego County, as well as in the southern hemisphere.

**Pelagophycus porra* (Lem.) Setch.
251

Thalli consist of a holdfast with branched haptera, a long (to 27 m) unbranched stipe bearing a single large (to 20 cm diameter) pneumatocyst from which two opposite primary branches extend laterally; each of several secondary branches ends in a single large blade; these huge blades can be to 20 m long and 1 m wide, and are covered with coarse ridges and irregular "blisters"; blade margins usually with short spine-like protuberances.

Beds of this species are often referred to, and included with *Macrocystis*, as kelp. Off San Diego County the species grows in deeper water seaward from *Macrocystis* beds, to 27–30 m. The stipes and blades hang in midwater, seldom growing to the surface. This species, the only one in the genus, is limited to waters between central California and northern Baja California, and is one of the most spectacular of the west coast kelps. We have collected very small plants both in summer and winter.

FUCACEAE

**Hesperophycus californicus* Silva

Silva 1990

H. harveyanus (Decne.) Setch. and Gardn., 266

This is a large and easily identified alga, superficially resembling a small *Fucus*. Apparently it does not now grow in San Diego County. Setchell and Gardner (1925) note that it was found between Monterey and Ensenada, and a 1902 La Jolla collection by M.S. Snyder is filed at SIO. L. Aguilar (pers. comm.) has recently collected it farther south, at Punta Baja, a cold-water locality. Dawson (1945d) reported that thalli were fairly abundant near Bird Rock, 4.8 km south of La Jolla; this is a sheltered cove within a small bay where algae more frequently associated with warm water (*Spyridia, Jania*) are often abundant. Since then, collectors have searched in this same site, but the species has not been found again. We have located several specimens from Islas Coronados (1897-1949) at UC.

**Pelvetia fastigiata* (J. Ag.) DeToni

261

Thalli dichotomously branched above holdfast, all branches lying in one plane, compressed above, more terete below, tough, olive green, to 90 cm high; branching regularly dichotomous throughout, but the two branches from one dichotomy generally unequal in length; the apical portions of branches broader and rough textured when reproductive structures are developing in this part of the thallus.

The intertidal distribution in San Diego conforms to that described for the species throughout California—often abundant in patches on rocks somewhat protected from open surf, mostly on or near tops of rocks in the upper mid-tidal region or lower on rocks near the high intertidal. Small clumps of this species are frequently found growing on nearly vertical surfaces of seawalls associated with *Endocladia muricata* and *Nemalion*. Thalli are perennial, but new growth develops in the spring and summer, while older axes become covered with epiphytic brown filaments in the late summer and fall. Gunnill (1980) describes recruitment and mortality of this species in the Ecological Preserve just south of SIO between 1973–1977.

Setchell and Gardner (1925) write that the largest plants are found in southern California, the central portion of the range on this coast. The very distinctive form *gracilis* occurs on high exposed rocks in the inner bay at Ensenada, to the south of San Diego, as well as in Monterey County and the offshore California islands, but has not been found in San Diego County.

CYSTOSEIRACEAE

**Cystoseira osmundacea* (Turn.) C. Ag.

269

Large brown thalli, with a perennial holdfast; in San Diego, stipe and branches mostly produced in annual cycles; blades with midrib and symmetrical lateral portions; mature branches ending in a tapering series of bead-like vesicles on short side branches; beyond these, flat branches develop with fertile structures.

Basal portions of this species are similar to basal portions of *Halidrys*. In southern California *Cystoseira* grows from shallow to deeper subtidal (13–17 m) while *Halidrys* is most abundant from shallow subtidal into low intertidal habitats. When the small strings of spherical (*Cystoseira*) or flattened (*Halidrys*) vesicles are absent from the thalli, the species cannot be confidently identified; the ecological separation is useful when positive identification is not critical.

Dawson's (1945b) reference to *Cystoseira neglecta* cast ashore at La Jolla might have represented a drift piece of local *C. osmundacea* or *C. neglecta* carried from Catalina Island where K.A. Miller finds this latter species to be rather common. The specimen cited (Dawson, 1945b, as *Blossevillea brandegeei*) as representing *Stolonophora brandegeei* (Setch. and Gardn.) Nizamuddin, a species known primarily from Guadalupe Island, also was likely to have been drift *Cystoseira* (or *Halidrys*).

**Cystoseira setchellii* Gardn.

269

MAC cites "to San Diego" in the distribution record, and adds "no plants from the San Pedro region were found. . .during the years 1969-72. . .probable that this species no longer grows at the type locality." Gardner (1913) established the species for plants cast ashore at Redondo Beach and near San Pedro in Los Angeles County, citing no additional records. San Diego records include specimens dredged from the Coronados Islands in 1949 and collected from 17 m off La Jolla (by C. Limbaugh, probably about 1950) presently filed in the Herbarium at U.C. Berkeley (UC). The species is described as similar to a short form of *C. osmundacea*. Aguilar *et al.* (1984) reported finding an attached subtidal population of typical *C. setchellii* off Isla Todos Santos (Ensenada), Baja California.

**Halidrys dioica* Gardn.

272

Large brown thalli, often to 2+ m or more in length, differentiated into very different-appearing basal and apical portions; the lower stipe produces alternate branches that give rise to pinnately branched long branches; in upper

portions branches bear tapering branchlets formed of flat vesicles; above these, receptacles with reproductive structures develop later in the year on closely and intricately branched frond apices.

In San Diego County, as in other parts of southern California and Baja California where this species grows, *Halidrys* is abundant in intertidal channels and on shallow subtidal rocks on exposed beaches. It is generally higher on the shore than *Cystoseira* which is restricted mostly to subtidal rocks. As noted above for *C. osmundacea*, when the chains of vesicles are present, the two species are easily distinguished; when lacking, it is essentially impossible to separate specimens into two taxa by morphology.

SARGASSACEAE

**Sargassum agardhianum* J. Ag.

275

Thalli radially or apparently alternately branched, mostly less than 25 cm high; branching continuous and similar from base to apex, including branches that are leaf-like with midribs and toothed dentate margins; pneumatocysts solitary, spherical or slightly ellipsoid, terminal on branchlets, with a tiny spine on the side away from the short stalk; small woody holdfast with several axes usually in a single clump.

For periods of several years this species will be absent on beaches where it had been collected previously; during this time populations will be found on other beaches, so it is not clear if the growth of the species is related to large-scale environmental fluctuations. Occasionally it is found on rocks in sand or in sandy channels between platform rocks, but in other sites it can develop in the midst of algal turf; growth appears to begin in late spring to early summer. In midtidal habitats where *S. muticum* also grows, the two species can be distinguished by the presence (*S. agardhianum*) or absence (*S. muticum*) of a sharp point on the small pneumatocysts. *S. muticum* in these situations is branched similarly and the contrast between clustered vs. widely-spaced branchlets (as cited in **MAC**) may not prove useful for field identifications. Even large thalli of *S. agardhianum* (25–35 cm high) are smaller and more robust-appearing than most *S. muticum*. Setchell and Gardner (1925) state that form is considerably modifed by habitats, being "short and stocky" in the midtidal region, more elongated in deeper quieter water.

Type locality for *S. agardhianum* is San Diego.

Dawson *et al.* (1960) report finding it to 10 m in kelp, but this is not the typical habitat, and we have not collected it away from shallow subtidal near-shore habitats.

Sargassum muticum (Yendo) Fensh.
275

Thalli to 2 m, or more in subtidal or quiet-water situations, arising from a small thick holdfast with main branches developing close to the base of the initial stipe; repeatedly branched to form bushy thalli; leaves linear in basal portion, to 10 cm long, margins dentate; leaves in upper portions more narrow, margins toothed or almost smooth; pneumatocysts borne in clusters or single in leaf axils, smooth, without a spine from the surface; fertile branchlets also developing in leaf axils.

The introduction of this species, presumably directly or indirectly from Japan, is described in MAC. We collected it in the Flood Control Channel (mouth of San Diego River) in 1969, but it had been noticed as early as 1958–59 in Quivera Basin of Mission Bay. Seasonal reproduction and growth cycles of San Diego populations (Deysher and Norton 1982) produce fertile zygotes March–June, and juvenile plants attach on previously bare or cleared surfaces primarily during this same period.

S. muticum is conspicuous in shallow water in Mission and San Diego Bays where large plants grow near the docks and piers, and on rocks along the channel entrance to Misson Bay. On exposed beaches it grows both on intertidal and subtidal rocks.

At present its distribution extends south to Punta Abreojos in Baja California (Aguilar *et al.* 1984).

**Sargassum palmeri* Grun.
277

Thalli perennial, arising from solid, rough-surfaced holdfast; stipe terete, to 1.2 m long, bearing 2–5 terete or slightly angled alternate branches at apex, disintegrating following reproduction; primary branches producing sterile "leaves" that are alternately dissected into 15–25 slightly flattened divisions 2–3 cm long; older branches and occasionally branchlets more or less spiny; numerous lateral terete secondary branches arising in axils of "leaf"; leaves with indistinct midrib; pneumatocysts produced in blade axils, usually solitary, smooth, on ends of stalks as long or longer than the diameter of the pneumatocysts.

This species is recorded as being distributed on offshore islands south from Santa Catalina. We have found it in drift on beaches near Imperial Beach and from just north of Del Mar to Encinitas during winter and spring months. It is likely that it grows on rocks offshore on sandy beach slopes. We have not collected attached plants.

Dawson's Checklist refers to a specimen from San Diego Bay (drift?).

RHODOPHYTA

PORPHYRIDIACEAE

Chroodactylon ornatum (C.Ag.) Basson

Basson 1979

Asterocytis ramosa (Thwaites) Schmitz, 283

Microscopic filaments in gelatinous walls.

R.A. Lewin isolated and identified (as *A. ornata*, Lewin and Robertson 1971) the only known California collection from a seawall near an ocean-water discharge pipe. In culture the alga appeared blue-green, with sheaths 1–3 mm thick.

**Stylonema alsidii* (Zan.) Drew

Drew 1956

Goniotrichum alsidii (Zan.) Howe, 280

Thalli filamentous, to 5 mm high, often branched irregularly, with cells surrounded by colorless gelatinous sheath layer and partly appearing loose and irregularly arranged in some thalli.

Epiphytic on many different algae in various habitats. Locally we have found this species subtidally to 27 m, on *Gelidium nudifrons*, *Sarcodiotheca gaudichaudii*, *Polysiphonia*, unattached blades of *Zostera marina* var. *latifolia*, and other unspecified substrates. It will be recognized only when the larger thalli are examined under a microscope.

Dawson's San Diego Checklist lists this as *G. elegans;* in **PMR 1** (Dawson 1953b) *G. alsidii* includes *G. elegans* (Chauv.) Zan.

ERYTHROTRICHIACEAE

Erythrocladia subintegra Rosenv.

284

Thalli microscopic, epiphytic, monostromatic, with cells laterally adherent and in radiating rows from a central area. Cells at the margins often bifurcate.

A common epiphyte from low intertidal to subtidal habitats. A specimen found on *Janczewskia* (which was in turn growing on *Chondria nidifica)* establishes this species for San Diego County.

E. irregularis, differing in having the radiating filaments free near margins (not joined), is currently treated by most taxonomists as conspecific with *E. subintegra*.

Erythrotrichia spp.
284–289
Thalli microscopic, often epiphytic, filaments, mostly unbranched, bright pink on various substrates.

In the course of picking tiny thalli from tunicates, sponges, other algae, rocks, or shells such as abalone or scallops, *Erythrotrichia*-like filaments are frequently recognized. The basal portion is seldom intact when the thalli are collected in this way; individual filaments are less than 1 cm tall, occasionally with multiseriate portions. It is likely that all these rather numerous collections and observations refer to a single, somewhat common (although inconspicuous) alga, *E. carnea* (Dillw.) J. Ag., described as a common epiphyte with a wide geographic distribution. **MAC** notes that other species reported for California may represent forms of *E. carnea*.

Our records of specimens from non-algal substrates extend the known habitats. Prior to use of SCUBA to sample deeper sites, the diversity of growth on these various substrates had not been recognized.

Dawson's Checklist refers to *E. carnea* as cosmopolitan, without mention of San Diego collections, and to *E. tetraseriata* as a southern California alga.

**Smithora naiadum* (Anders.) Hollenb.
291
Thalli epiphytic on *Phyllospadix* and *Zostera*, with several to many monostromatic blades mostly less than 1 cm high, rising from a basal cushion on seagrass leaves; algal blades oval to irregularly round in shape, with the upper margins often torn, occasional large plants to 2 cm high. As noted (**MAC**) for forma *minor* in southern California, no conspicuous sori are observed in local material.

For many years *Smithora* was found, sometimes throughout the year, usually particularly abundant and common during winter and spring months. Between December 1982 and 1988 the species was absent or rare on beaches where formerly it had been easily collected. The first year of this interval was a period of higher average water temperatures, with seasonal warmer water occurring earlier in the year and extending later into fall months, suggesting that distribution of *Smithora* may involve a response to water temperature.

Dawson (1953b) recorded the species from "virtually all peninsular (Pacific Baja California) and (Mexican) island stations to as far south as Isla Magdalena, at all seasons."

BANGIACEAE

Bangia vermicularis Harv.

Sheath and Cole 1984

Bangia fusco-purpurea (Dillw.) Lyngb., 294

Thalli of the macroscopic stage unbranched filaments, dark red or nearly black, to 10 cm high, usually 1–3 cm in San Diego localities; these commonly aggregated in patches on rocks in the upper intertidal zone.

The species is ubiquitous, often common, throughout its range. Extensive mats of *Bangia* grow on rocks north from central California, but are less common on San Diego County beaches where it is usually a winter–early spring annual plant. It has been reported from a site north of Ensenada in Baja California (Pacheco and Aguilar 1984). Sheath and Cole (1984) concluded that the four species earlier described on the Pacific coast of North America are variants of a single taxon.

**Porphyra perforata* J. Ag.

299

Thalli of very thin, delicate, small blades, mostly about as broad as long, one layer of cells thick, sessile, blades deeply lobed and ruffled, greenish to purplish-brown, reproductive portions in marginal patches appear as pale borders when the cells have been discharged.

In northern California and in cold water sites of Baja California, thalli are 15–30 (110) cm high, but the largest we have found in San Diego are 11 cm, and commonly they are 1–2 cm high. The species is most abundant as a winter or early spring ephemeral, although in some years it can be found as late as November, persisting on particular rocks on La Jolla beaches through the summer.

Because the size of these southern plants differs so markedly from the large thalli familiar to workers elsewhere, many older collections were not identified as *P. perforata*. Data for numbers of spores in packets and chromosome counts (2 per nucleus) support the identification of these several populations as *P. perforata*.

Porphyrella californica Hollenb.

305

Thalli in clusters of small (1–2 cm) blades, pale pink to light reddish-brown, oval or broader (to 2.5 cm), on very short stipes, one layer of cells thick, and very thin and delicate appearing; reproductive cells in patches along margins that leave a pale or ragged border when shed.

The species was previously reported from Laguna Beach on the California coast. In San Diego County, very small *Porphyra*-like blades are found on mussels or gooseneck barnacles at the same sites where *Porphyra perforata* grows on rocks, and at the same season. Thalli are generally less than 1 cm high, and differ in color from *P. perforata.* The epizooic plants may represent *Porphyrella californica.* When *Porphyrella gardneri* (a species that grows on the margins of large members of the Laminariales and that is absent from San Diego) was transferred to the genus *Porphyra*, Hawkes (1977) suggested that study of *Porphyrella californica* might determine that this species also is more correctly placed in *Porphyra.*

ACROCHAETIACEAE

Audouinella complex (*Acrochaetium/ *Rhodochorton*)
308-323

Thalli microscopic, filamentous, branched; a few taxa grow on rocks, but most are on or in other algae or animals. Monosporangia common, other reproduction rarely found.

Such algae have been collected locally as subtidal epiphytes on *Pleonosporium vancouverianum, Gelidium robustum, Callithamnion* sp., *Tiffaniella snyderae, Sorella delicatula,* and on sponges and tunicates; intertidally, on *Pterocladia capillacea, Rhodymenia* sp., and *Phyllospadix scouleri. Rhodochorton purpureum* grows in caves in the La Jolla area, as reported by Dawson (1945d) and confirmed by recent collections.

Species belonging to this group are found in all parts of the world, but the small filamentous thalli are not easily identified either from natural habitats or from culture studies. Woelkerling (1983) writes: "The *Audouinella* complex contains a diverse but distinctive assemblage of marine and freshwater red algae. . . . Compared to most other Rhodophyta, acrochaetioid algae have a simple morphology, but their taxonomy is rather more complex. . . . Since 1970, at least fourteen different classification systems have been used for these algae. Moreover, species concepts and delineations generally continue to be vague and changeable; generic concepts remain unresolved."

We have not attempted to segregate our material into "species" other than recognizing *Rhodochorton purpureum* in its distinctive habitat. Dawson (1953b) listed 16 species from Pacific Mexico. MAC includes 15 species of *Acrochaetium*, several of which were cited in Dawson's Checklist as species of *Rhodochorton.*

*_Rhodochorton purpureum_ (Lightf.) Rosenv.

323

Thalli 1–1.5 cm high, filamentous, uniseriate, usually in tufts or mats, with prostrate creeping portions bearing erect sparsely branched filaments; the basal axes are intertwined in this species that grows in caves in the high intertidal or on shaded rocks. Although *Rhodochorton* species are included in the *Audouinella* complex, the specialized habitat that is apparently everywhere associated with this species singles it out as distinct. It can still be found on the upper surfaces of shallow caves against the cliffs at the south end of La Jolla Bay, as described (as *R. rothii*) in Dawson's Checklist.

NEMALIACEAE

*_Nemalion helminthoides_ (Vell.) Batt.

324

Thalli gelatinous, rubbery, cylindrical, 1–6 mm diameter, unbranched or with several branches often toward the tips; axes often gradually tapering to the tip; clumps of one to several thalli growing from small circular disks, with both base and axes a dark brownish-red color.

As reported for other California regions, San Diego thalli are restricted to sloping or vertical sides of rocks or concrete seawalls in the high intertidal zone, and are most abundant between April and November.

Northern specimens are reported to 135 cm long, mostly 20–45 cm, but San Diego County plants are commonly less than 10 cm, with 25 cm representing an extremely long plant.

HELMINTHOCLADIACEAE

*_Cumagloia andersonnii_ (Farl.) Setch. and Gardn.

329

Thalli clumped, with several soft, rubbery, dark reddish brown strands growing from small disks on rocks; these erect axes are cylindrical, with few or no branches, but covered with small spinelike branchlets with forked tips. San Diego thalli are mostly 6–10 cm high, occasionally to 20 or 30 cm, and 3–8 mm in diameter.

Throughout California, as well as in San Diego County, this is an annual species that is here found late March through July, with greatest abundance usually in May and June. It is particularly conspicuous on high intertidal sandstone rocks in the La Jolla area in some years; everywhere absent in other years.

Dawson described specimens from northern Baja California as being relatively small forms resembling southern California specimens, but we also find very large thalli, and populations usually include a wide range of sizes.

**Helminthocladia australis* Harv.
327

Thalli little to much branched, but only to 3–4 orders; axes cylindrical to 10 mm diameter in San Diego County, smaller to the north; thalli very slippery, rubbery; branching completely irregular, with no pattern or similarity among specimens. Pale brownish red, or tan or dull yellowish pink, and conspicuous among other algae because of size (to 10–20 cm high) and the sprawling thick strands that stand out against the background turf of small algae on intertidal rocks. On some specimens the shorter (younger?) branchlets are dark red, in contrast with the thick pale main axes.

Recorded north only to Santa Barbara, in San Diego it is more abundant in late summer, and during many years is not found at all. In recent years, with warmer water locally, it has been more often found, suggesting it is indeed associated with such conditions. Dawson did not find it on the Pacific coast of Baja California, possibly because most rocky sites where he collected were in areas of cold water upwelling. Another explanation is that the plants do not persist long in any given site and could be overlooked by sampling only at times when the species was absent. In San Diego, it has been found on intertidal rocks on various beaches.

**Helminthora stricta* Gardn.
327

Thalli dull straw-pink in color, lubricous, 1–2.5 cm high, to 1 mm diameter, irregularly branched; attached by small disc to *Phyllospadix* leaves, where plants are found in clusters.

The type collection came from a *Phyllospadix* specimen, La Jolla, in June, and is referred to in Dawson's Checklist. The second collection known for this alga consisted of plants on drift *Phyllospadix* in central California in 1949. Only a few additional specimens, none from southern California, have subsequently been identified with this species.

Liagora californica Zeh

329

Thalli bushy, compressed below, terete above, repeatedly dichotomously branched, 6–12 (16) cm high, with bright red apices, grayish-white below where heavily calcified.

In California, "infrequent, on rocks, lower intertidal to upper subtidal, Santa Catalina I., and Pt. Loma, San Diego Co." This **MAC** citation for San Diego County is based on a specimen collected in 1875 by Edward Palmer, and deposited in the herbarium at University of California, Berkeley, noted by Dawson (1945c). No other specimens from the mainland of southern California are known to us.

The color and texture of this species are striking, both when growing in shallow water habitats as well as after being collected; and if the alga were present in an area, it would easily be recognized as distinctive. If the single specimen reported for Pt. Loma was found in drift material, the source could have been outside the area, accounting for its absence from collections of locally attached algae.

GALAXAURACEAE

**Scinaia confusa* (Setch.) Huisman

Huisman 1985

Pseudogloiophloea confusa (Setch.) Levr., 335

Thalli axes terete, dark red or brownish in exposed intertidal habitats, 3–15 cm high, regularly dichotomously branched, often with proliferous clusters near bases of branches; apices tapering, otherwise nearly unifom diameter (1) 2–5 mm throughout.

Infrequent, over a wide range, British Columbia to Punta San Quintín, Baja California, on rocks mid- to low intertidal and subtidal.

Dawson (1945d) commented that a portion of a fertile plant was found in July on the beach near Scripps Pier, La Jolla. No recent San Diego County collections are known to us. As noted for *Scinaia johnstoniae*, it is necessary to compare the size and arrangement of cortical cells to distinguish these two species. *Scinaia johnstoniae* is found to the south of San Diego, and drift plants could presumably reach San Diego County beaches.

**Scinaia johnstoniae* Setch.

332

Thalli axes cylindrical, 6–13 cm tall, dichotomously branched, without constrictions, broader (3.5–5 cm) above, to 1–2 mm diameter below; upper branches appearing fan-shaped, with acute apices.

Very rare in southern California, more common south and into the Gulf of California. This species is virtually identical macroscopically with *S. (Pseudogloiophloea) confusa* and a cross section is necessary to distinguish the two. Several specimens in herbaria (UC, HAFH) were collected from dredge or drift material off the coast of San Diego County prior to 1946.

**Scinaia snyderae* (Setch.) Huisman

Huisman 1985

Pseudoscinaia snyderae Setch., 333

This species is included solely on the basis of Setchell's 1914 description of the San Diego County type collection ("at Pacific Beach," 1898), as cited in MAC. It has never been re-collected, and was not discussed by Dawson.

MAC notes that this species is externally very similar to *Scinaia (Pseudogloiophloea) confusa*. Since no collections other than the type are recognized, its status is doubtful.

BONNEMAISONIACEAE

Asparagopsis taxiformis (Del.) Trev.

340

Axes cylindrical, 1.5–2 mm diameter, to 10–20 cm tall; mostly bare in lower third, densely branched above, with soft feathery appearance.

In the San Diego area, known from subtidal collections 1986–89 at the Coronados Islands. Seen frequently at San Clemente Island, 100 km west of San Diego as well as more northern Channel Islands. Common in warm seas, worldwide, including Mexican eastern Pacific islands.

**Bonnemaisonia hamifera* Har.

338

See MAC for description and distribution information. Dawson (1945d) cites, as , an old specimen (P.B.-A. 490) from Pacific Beach as a "record" for San Diego County. No San Diego County collections are known to us.

GELIDIACEAE

**Gelidium coulteri* Harv.

344

Thalli mostly less than 10 cm high, in clumps and patches on rocks in the midintertidal region; major branches relatively few from main axes, but all branches are covered with evenly spaced short distichous branchlets that characteristically are approximately the same length along branches from base to apex of plant; fertile apices of irregular shapes, often broad, and giving the thallus a more bushy appearance.

Further north this species is common in high intertidal habitats, as well as lower, but in San Diego County it is found predominantly in positions somewhat protected from heat or desiccation, often under ledges on sides of rocks in higher zones, or on vertical surfaces that are wave-splashed even during low tides. It is not as common or abundant here as it is to the north. In late spring or early summer patches of algae that are often identified as *G. pusillum* are actually young, small *G. coulteri*, a species that grows in an annual cycle.

Gelidium thalli are highly variable in branch dimensions and branching patterns, yet these are the criteria for distinguishing species. *G. coulteri* is recognized in San Diego by the presence of evenly spaced, similar length lateral branchlets and by being restricted to a rather narrow region intertidally.

Dawson (1953b) wrote that the species is common in Pacific Baja California localities with lower water temperature; its southern limit apparently coincides with the southernmost area of upwelling, near Isla Magdalena.

**Gelidium nudifrons* Gardn.

345

Thallus to 35 cm high, clumped, sparsely and irregularly branched; axes compressed to flattened, of similar dimensions from base to apex, generally less than 0.6 mm broad. The illustration (Fig. 288) in **MAC** gives the plant a heavier, coarser appearance than is accurate; it appears thin, slender and wiry.

Strictly a subtidal species, it grows in isolated clumps or patches in kelp beds or on open rocks to 30 m. Along La Jolla beaches thalli are often found in piles of drift algae where they are recognized by their dark, nearly black color, as well as their morphology. Individual clumps can be large and in some offshore areas are dense and abundant, and therefore the species has been considered as a possible source of agar. Tests, however, show it to be much less useful than *G. robustum* and at this time it is not harvested commercially.

The type locality is Ensenada, 150 km south of San Diego.

**Gelidium purpurascens* Gardn.
345

Thalli mostly with rather regular distichous branching, sometimes in part polystichous, alternate, or opposite, with or without geniculate junctions between axes and branches; more or less compressed, branches sparse, or more dense, but on single thalli consistent, usually regularly spaced; ultimate branchlets mostly less than 1 mm broad, while those of *G. robustum* are often wider; intertidal to subtidal.

This brief description, based on the treatment in **MAC**, comprises the wide range of branching patterns observed in San Diego County populations. Previously there had been 6–8 distinct species described for the more conspicuous varieties, but when a large number of specimens is assembled, the gradation from one to another is continuous, and it seems more appropriate to consider them as a single entity. For practical purposes, if a large specimen from low intertidal or subtidal rocky substrate is neither sparsely branched (*G. nudifrons*) nor robust (*G. robustum*) it is probably *G. purpurascens*.

Dawson's Checklist included this species as *G. pulchrum*, formerly a name applied to the finest, most delicately branched variants.

Gelidium pusillum (Stackh.) Le Jol.
347

Thalli 1–2 (5) cm high; prostrate axes terete, producing terete erect axes and/or compressed erect branches; erect parts sometimes becoming secondarily attached to substrate, with additional prostrate axes forming near the attachment point; erect branching distichous, predominantly irregular; flattened branches to 1.5 mm broad; when tetrasporangial sori and cystocarps develop on apices, these branchlets often become conspicuously broad, or densely aggregated, giving the thalli various different appearances. This species is often very abundant in high intertidal zones, but is also common in scattered habitats throughout intertidal and subtidal regions. It is found in all the oceans of the world in warm temperate to tropical regions, always with a multitude of forms.

Many of the mid-high intertidal rocks that elsewhere would be covered or spotted with low mats containing *G. pusillum* are in San Diego County scoured or buried with sand during parts of the year, then at other times left bare when sand is carried farther offshore. Under such conditions the dark-red fuzzy red algal turf that develops is more often a mixture of species of *Polysiphonia* or other filamentous Ceramialean taxa. *G. pusillum* is most common in habitats less affected by sand movement and accumulation, such

as on some of the higher rocks that are above the level of sand accumulation or on exposed outcroppings where surf continually removes sand. Small patches have been found subtidally. Cystocarpic specimens are necessary to identify two small rare species of *Pterocladia* that can resemble forms of *G. pusillum*.

In Dawson's Checklist most of the plants referred to *G. crinale* and probably many collections of *G. coulteri* were included in *G. pusillum* as presently circumscribed.

**Gelidium robustum* (Gardn.) Hollenb. and Abb.
347

Thalli to 40 cm high (to 100 cm near offshore California and Mexican islands); branches mostly compressed but often nearly cylindrical below; branching characteristically regular, distichous, often with a bend close to the junction with main axes ("geniculate," meaning bent as in a knee joint) and frequently symmetrical and pinnate at least on upper portions of axes; lower portions of axes often unbranched as a result of having lost older branches from long-lived fronds. Nearshore, along the coast of San Diego County, there are dense populations on subtidal rocks or ledges; isolated clumps occur within kelp beds, usually on rocks that rise off the bottom. This is the largest and coarsest of California gelidiaceous algae and is easily recognized along channels in the low intertidal as well as in subtidal habitats.

Type locality is near Ensenada, 150 km south of San Diego. Dawson's Checklist listed this as *G. cartilagineum*. In **PMR 1** (1953b) he compared collections from northern Baja California and southern California and wrote that maximum development occurred in rocky coastal areas with cold upwelling water, where plants may be up to one meter high and consist of huge clumps with "hundreds of fronds."

This species has been the subject of many studies because of its economic value as the source of high quality agar. Field work has shown it to be perennial, to grow slowly, and to occur to 20 m depth primarily in areas where water currents or surge are strong, presumably continually providing nutrients. Large amounts are presently harvested.

**Pterocladia caloglossoides* (Howe) Daws.
349

Thalli mostly less than 1 (2) cm high, axes 45–570 µm wide (subtidal specimens mostly less than 200 µm, while intertidal thalli may grow to 750 µm wide) and all specimens 60–120 µm thick. Prostrate axes flattened and similar to erect axes, flattened against substrate by regularly arranged disk- or

peg-like structures with erect axes developed from the surface opposite the attachment point; erect branches pinnately branched or simple, and often secondarily attached to the substrate and thus appearing as prostrate axes; this growth pattern repeated to form a creeping system of connected erect and prostrate branches, with variable numbers of erect system branches (Figure 4). The presence of tetrasporangia in broad V-shaped rows on the tips of branches is often characteristic of this species, but the feature also is seen in other small related species of *Gelidium* and *Pterocladia*.

When MAC was prepared, few collections were available for study. Specimens of *P. parva* from the Gulf of California were compared with the few known specimens of *(Gelidium) caloglossoides* from central California. The type locality of *P. caloglossoides* was incorrectly given as San Felipe, which is the type locality of *P. parva*. More recently, these several taxa were reevaluated and *P. parva* is now included as a synonym of *P. caloglossoides* (Stewart and Norris 1981); the correct type locality of this latter species is "on shells, dredged in (5 m), Island of San Lorenze (Peru)."

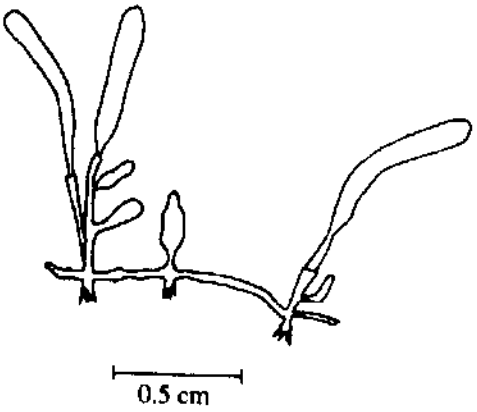

Figure 4. *Pterocladia caloglossoides.* Prostrate axes with attachment structures opposite erect axes.

**Pterocladia capillacea* (Gmel.) Born. and Thur.
350

Thalli to 30 cm high, branching distichous, often with very regular and pinnate appearance, sparse to dense, uniform within single thalli, or variable in some branches; axes and branches of various widths and lengths, with the result that many morphological forms occur, some correlated with rather distinct habitats or different seasons; all branches and axes are flattened to compressed, to 2 mm broad, 0.9 mm thick below; ultimate branchlets often nearly as broad as the lower portions; the branches may be constricted where they join the parent axis, but not bent; typically one or several percurrent axes arise from a cluster of pale, cylindrical prostrate axes; branches from these are longer toward the base of the axis, shorter toward tip, giving a pyramidal outline to the frond. This symmetrical variant is common in southern California. In San Diego County, it is one of the most abundant species on midtidal to subtidal rocks (to

20 m) with consistently moderate to heavy surf. On broader, more gently sloping beaches (such as Pt. Loma) it is found only in lower zones, often near or under beds of *Phyllospadix*. This is a cosmopolitan alga of warm temperate water, found south of Santa Barbara in California and at least to the outer coast of Bahía Magdalena in Baja California.

Dawson's Checklist lists the species as *Gelidium pyramidale*. *P. capillacea* is one of the economically important red algae that provides a source of high-quality agar and is harvested off the coast of southern and Baja California. Recent studies in Hawaii suggest that this alga, in certain localities where it is abundant there, may be an important component in the diet of sea turtles.

**Pterocladia media* Daws.

351

Thalli 3–5 (8) cm high, in small clumps, simple or sparsely branched, erect percurrent axes from system of stoloniferous prostrate axes attached to rocks by short peg-like rhizoids; branching irregularly distichous, all axes and branches uniformly thin, narrow, 150–300 µm broad, 100–200 µm thick, compressed.

Specimens are more slender, less regularly branched than *G. pusillum*, which can be similar in height and grows in similar habitats. *P. capillacea* is usually more regularly branched and wider, flatter-appearing in all parts of the thallus. Although thalli of *P. media* differ markedly from other gelidiaceous algae locally, the single distinct apical cell in actively growing tips, and the presence of internal rhizoidal filaments identify specimens as a member of the family.

This species is infrequently or rarely found on rocks on sandy beaches between San Francisco and San Diego in California. Locally, when rocks with small populations of the alga are buried for many months, the following year the plants are not found on them, and therefore it is only sporadically found.

Type locality is the rocky beach just north of Wind & Sea beach in La Jolla.

Some of the collections treated as *G. crinale* in Dawson's Checklist represent early records of the species later treated as *P. media*.

DUMONTIACEAE

**Farlowia mollis* (Harv. and Bail.) Farl. and Setch.

357

Thalli 10–20 cm tall, bright red to blackish red; main axis flattened, 1–3 mm wide, usually compressed; branches of higher orders frequently subcylindrical,

soft to touch and slippery, predominantly distichous, alternate; ultimate branches on rapidly growing thalli to 1 mm wide, becoming eroded on older thalli, sometimes appearing paddle-shaped with smooth margins; the obscure midrib and veins that are common in two other species usually are not seen in *F. mollis*.

This description is copied without modification from MAC, as in San Diego County we have found only a single drift specimen on Imperial Beach in May, and the alga is of questionable occurrence in the local marine flora. In central California it is frequent, usually found as isolated thalli on rocks in sandswept areas. It has not been collected south of San Diego as far as we can determine.

Dawson's Checklist lists *F. crassa* (=*F. mollis)* but this may be based on an earlier Cleveland record rather than on his own observations. [Aguilar *et al.* (1984) report finding *F. compressa* about 5 km south of Punta Santo Tomás, south of Ensenada in Baja California.] Lindstrom and Scagel (1987) treat *F. compressa* and *F. crassa* as synonyms of *F. mollis*.

**Leptocladia binghamiae* J. Ag.
363

Thalli uniaxial, with a dome-shaped apical cell that can be seen clearly with a compound microscope; main axes to 4–5 mm wide, to 40 cm high (larger specimens occur north of San Diego County); compressed, deep red, drying to blackish red, repeatedly branched dichotomously or irregularly, and margins of all branches with short teeth; final branchlets often also short and tooth-like.

This alga is infrequently found in very low intertidal sites in San Diego County; in subtidal habitats large thalli are occasionally abundant. Isolated single thalli have been collected to 33 m throughout the year.

Pikea californica Harv.
359

Thalli to 20 cm high, bushy, with several axes arising from single holdfast; branching pinnate but often very irregularly spaced; major branches 1–1.5 mm broad, ultimate branchlets pointed and spinelike; most branches compressed; deep red color, often drying to nearly black.

In some specimens the major axes appear percurrent and uniformly broad and distinct from base to apex; in others the larger major axes and branches are distinctly broader than the secondary or final branches or branchlets. *Leptocladia binghamiae* thalli are very similar to and easily confused with

species of *Pikea*. Branching in *Leptocladia binghamiae* is often rather clearly dichotomous without the tendency toward one or two primary axes. Branch margins are somewhat dentate in *Leptocladia* and the thalli tend to be more compressed and often broader.

We have collected confirmed specimens of *P. californica* from a rock outcropping 22–27 m in La Jolla Bay where *Leptocladia* also grows.

Punta Baja, about 360 km south of San Diego, is the southernmost record for this species. Dawson's Checklist reference (from "The Caves," La Jolla, June-September) probably represents *Leptocladia binghamiae*. See *Pikea robusta*, for suggested synonymy.

Pikea robusta Abb.
359

Thallis to 40 cm high, usually only one axis per holdfast; rust red with several major branches 1.5-4 mm wide, percurrent, flattened, arising from single short stipe; pinnate, distichous branching; branches irregular, or somewhat opposite; secondary branches as wide as primary; ultimate branchlets dense, fringing the axes.

The distribution of this subtidal species is stated (**MAC**) as extending south only to Santa Barbara County. Specimens have been found at Imperial Beach after winter storms and Dawson (1945b) recorded the species (as *P. pinnata*) from the beach at Coronado. Based on these few records, it is likely to be rare in deeper, below-thermocline sites in San Diego, unless the fact that all or most records are drift specimens indicates a northern origin. Lindstrom and Scagel (1987) place *P. robusta* in synonymy with *P. californica*; they suggest that the broader flatter thalli of *P. robusta* represent younger plants, and the less-branched, darker thalli ("*P. californica*") are older, perennating specimens.

Weeksia digitata Abb.
366

We list this species, with no description, only because San Diego is cited (**MAC**) as the southern end of the range of the species. We have not collected specimens nor located specimens from southern California in herbaria. Thalli are dissected or divided large red blades, resembling other taxa known to be common locally (i.e., *Cryptomenia obovata*). Only careful study can confirm the identification of a *Weeksia* specimen in collections of subtidal algae.

Specimens of another *Weeksia* species have been collected off Pacific Baja California, with a disjunct distribution that brackets San Diego County.

Noncalcified Crustose Genera [in MAC, PEYSSONNELIACEAE, HILDENBRANDIACEAE, HALYMENIACEAE, CRUORIACEAE, PETROCELIDACEAE]

These genera are much less common intertidally in San Diego County habitats than they are along beaches in central and northern California, but when rocks are not covered with sand, or in sites exposed to heavy surf, they can be found intertidally and subtidally. The following taxa are those reported in MAC to have Pacific coast ranges that include San Diego County or Orange County although for several taxa we have not been able to document collection records for San Diego. Two species were identified locally by Dawson. We cite none of our own or other unpublished collection information because identification requires comparative microscopic study of several specimens and taxa, and few workers anywhere have the necessary experience. Thalli of *Amplisiphonia pacifica* (RHODOMELACEAE), not allied in the families included in this section, are prostrate blades loosely attached to the substrate and easily recognized. Some of the crustose taxa listed here are now known to represent a stage in the life history of non-crustose species. (Number) refers to page in MAC.

Cruoria profunda Daws. (473)

Cruoriopsis aestuarii Hollenb. (376)

**Dermocorynus occidentalis* Hollenb. (441)

Haematocelis rubens J. Ag., *H. zonalis* Daws. and Neush. (474, 475)

Hildenbrandia dawsonii (Ardré) Hollenb., **H. occidentalis* Setch., *H. prototypus* Nardo. (377-378)

**Petrocelis franciscana* Setch. and Gardn., **P. haematis* Hollenb. (476)

Peyssonnelia profunda Hollenb. and Abb., *P. rubra* var. *orientalis* Web. v. Bosse (371)

Pulvinia epiphytica Hollenb. (374)

Rhodophysema elegans var. *polystromatica* (Batt.) Dix., *R. minus* Hollenb. and Abb. (372)

PEYSSONNELIACEAE

Cruoriopsis aestuarii Hollenb. (376). One record from Orange County; possibly part of the life history of *Gloiosiphonia capillaris*, a species not known from San Diego County.

Peyssonnelia profunda Hollenb. and Abb., *P. rubra* var. *orientalis* Web. v. Bosse (371). *P. profunda* thalli are up to 6 cm broad, slightly calcified, subtidal. Abbott (pers. comm.) writes that the species is "not like *P. rubra* var. *orientalis* or *P. meridionalis*." Dawson *et al.* (1960) describe *P. rubra* var. *orientalis* as a small bright red crust-like plant, found to 20 m in kelp beds, and the commonest of several similar species "that can be distinguished only by vertical sections through reproductive parts." Hollenberg and Abbott (1968) cite as *P. meridionalis* (in **MAC** stated to be a species that probably occurs south to southern California) certain material earlier treated as *P. pacifica*. The reference in Dawson's Checklist to *P. pacifica* therefore suggests a third species may occur in San Diego County "on intertidal rocks and shells."

Pulvinia epiphytica Hollenb. (374). One of the two known collections of this epiphytic species was from Del Mar.

Rhodophysema elegans var. *polystromatica* (Batt.) Dix., *R. minus* Hollenb. and Abb. (372). Both species recorded from Orange County.

HILDENBRANDIACEAE

Hildenbrandia dawsonii (Ardre) Hollenb., *H. occidentalis* Setch., *H. prototypus* Nardo (377-378). All three species recorded both from the coast of California north of San Diego and from Mexican Pacific islands off Baja California.

Calcified Custose Genera

CORALLINACEAE

These are usually pale lavender-pink, or a pale to bright rose-pink in color, and mostly consist of very thin crusts on rocks, other algae, invertebrates, or any hard stable substrate. After decalcification and microscopic examination, the anatomical arrangement of vegetative cells or the position and form of reproductive structures are compared for taxonomic purposes. Certain taxa can then be associated with field characters, within restricted areas. Even for many of the more common forms there is disagreement among specialists about identification or nomenclature and for this reason we have not attempted to proceed beyond listing the taxa recorded from San Diego sites either in **MAC**

or Dawson's papers. Numerous taxonomic combinations have been published since Dawson's work and most previous synonyms are listed in **MAC**. Subsequent studies for several groups have further rearranged species (e.g., Woelkerling *et al.* 1985). The ranges for the following taxa include localities north and south from San Diego. (Number) refers to page in **MAC**.

Choreonema thuretii (Born.) Schmitz (397)

Fosliella paschalis (Lem.) Setch. and Gardn. (399)

**Heteroderma nicholsii* Setch. and Mason (399). Dawson (1945d), as *Fosliella*, lists this as common at La Jolla on *Dictyota, Dictyopteris, Eisenia*, and *Cryptopleura* species.

**Hydrolithon decipiens* (Fosl.) Adey (399). Thalli described as macroscopically smooth crusts that in some areas are frequent or common on stones or (mollusc) shells. A small epiphytic coralline crust from San Diego was sent to a specialist in such taxa who identified the specimen as *H. decipiens*. The material represented a common epiphyte in midtidal zones, often seen on erect corallines (*Corallina* or *Lithothrix*). Dawson (1945d) lists the species for San Diego County as *Lithophyllum*. Steneck and Paine (1986) consider the stone- and mollusc-attaching alga to be *L. impressum* in the Washington to Alaska region. These workers transfer specimens from southern California to *Pseudolithophyllum* and describe them as thin, growing on small stones. It is unclear, therefore, how to identify epiphytic coralline crusts that are relatively common in San Diego habitats.

**Lithophyllum grumosum* (Fosl.) Fosl. (393)

**L. imitans* Fosl. (393). Type locality, Pacific Beach. Dawson (1945d) states it is common in San Diego County (presumably intertidal) and lists it from kelp beds (Dawson *et al.* 1960).

L. lichenare Mason (393). Combined as *Pseudolithophyllum muricatum* (Fosl.) Steneck and Paine 1986.

**L. proboscideum* (Fosl.) Fosl. (395)

Lithothamnion (381-387). Eight species, four of which have been recorded in San Diego County.

**L. aculeiferum* Mason (La Jolla)
L. australe (Fosl.) Fosl.

**L. californicum* (Fosl.) (see Steneck and Paine 1986)
**L. crassiusculum* (Fosl.) Mason
**L. giganteum* Mason. Type collection dredged off La Jolla; cited (Dawson *et al.* 1960) as occurring in kelp beds.
L. microsporum (Fosl.) Fosl.
L. pacificum (Fosl.) Fosl. Placed in synonymy with *L. phymatodeum* Fosl., Steneck and Paine 1986.
L. volcanum Daws.

Melobesia marginata* Setch. and Fosl. (388). Epiphyte on *Laurencia spectabilis* (Dawson 1945d). Similar spots of thin coralline crusts on *Gigartina canaliculata* under *Phyllospadix* leaves resemble *Melobesia mediocris*; if this latter is considered to be obligately confined to angiosperm species, crusts on *Gigartina* may indicate an additional basiphyte for *M. marginata*. **MAC lists species of *Gymnogongrus* as well as *Laurencia* as basiphytes.

**Melobesia mediocris* (Fosl.) Setch. and Mason (389). Thalli are epiphytic crusts, thin and irregular in shape to 2 mm diameter, but converging and overlapping on leaves of *Phyllospadix* and *Zostera* (seagrasses). This species has been invariably associated with one of these two genera and customarily is identified on this basis.

Mesophyllum lamellatum (Setch. and Fosl.) Adey (391). As a species of *Lithothamnion*, listed as occurring in (San Diego?) kelp beds (Dawson *et al.* 1960).

**Neogoniolithon setchellii* (Fosl.) Adey (400). As *Hydrolithon*, listed as common near La Jolla (Dawson, 1945d).

Neopolyporolithon reclinatum (Fosl.) Adey and Johans. (392). "Alaska to La Jolla."

Pseudolithophyllum neofarlowii (Setch. and Mason) Adey (397). This is a whitish lavender crust that grows over intertidal rocks, at times very abundantly. It is described as common in northern and central California and reported to be seasonally conspicuous on upper mid-tidal rocks in San Diego. Steneck and Paine (1986) write that "this is the only crustose coralline which survives in the upper reaches of the intertidal zone," but it "also occurs. . .in lower intertidal zones."

**Tenarea ascripticia* (Fosl.) Adey (395). Taxonomy and nomenclature of species included in the current treatment of this taxon are confusing. It has recently been suggested that many *Tenarea* species earlier assigned

to *Dermatolithon* need to be treated as species of *Titanoderma* (Woelkerling *et al.* 1985). As *Fosliella ascripticia* and *F. intermedia*, Dawson recognized specimens on species of *Corallina*, *Gelidium* and other red algae at La Jolla and beaches to the north.

T. canescens (Fosl.) Adey. Dawson **PMR 3** (1960) reported two collections of *Dermatolithon canescens* (Fosl.) Fosl. from southern California; **MAC** noted these, adding that further study is required before the species (as *Tenarea*) can be accepted for the California flora.

T. dispar (Fosl.) Adey (395). Recorded (as *Dermatolithon)* abundantly from *Gelidium* in kelp beds (Dawson *et al.* 1960), forming discs to 1 cm diameter.

Articulated Erect Coralline Taxa

**Amphiroa beauvoisii* Lamour.

Norris and Johansen 1981

A. zonata Yendo, 400

Articulated calcified axes in tufts, dichotomously branched, appearing terete in all axes; 3–6 (10) cm high, segments smooth, uniform dimensions in individual thalli; segments slender, to 1.2 mm diameter and about 10 times (or more) as long ; sori in whitish mounded conceptacles on the sides of the branches (as in *Lithothrix*).

A. beauvoisii is a variable species widely distributed in warmer areas of the Atlantic and Indian Oceans, as well as from southern California to Ecuador in the eastern Pacific.

On San Diego beaches the species is seldom abundant or common, but during May–November thalli can be found in pools or on rocky flat beach platforms intertidally and to 7 m or more in shallow subtidal habitats. It is not associated with any other alga or with any single habitat, apparently growing as scattered individual clumps during periods of warmer water. In 1983–84, when water temperatures were warmer than during several prior years, we found *Amphiroa* more commonly than before, confirming the belief that it is a species from semi-tropical waters that occurs in southern California under favorable conditions, but irregularly. Dawson described its distribution in Baja California as usually in warm intertidal areas or in high tide pools subject to heating; lacking from areas of upwelling influence.

Dawson's Checklist refers to three taxa as species of *Amphiroa*. *A. crassa* is a species known from the western Pacific; why the name was associated with

San Diego algae is unclear. (*Jania crassa* occurs in southern California.) *Calliarthron tuberculosa* from San Diego (M. Snyder specimens) was distributed in P.B.-A. as *Amphiroa tuberculosa*, accounting for this latter record. *A. nodulosa* was applied to collections of *Lithothrix aspergillum* distributed as P.B.-A. material.

Bossiella californica (Dec.) Silva spp. *californica*

410

Larger specimens of *B. orbigniana* could be interpreted as *B. californica*, but no southern California sites are recorded for *B. californica* spp. *californica*. *B. pachyclada*, collected from Baja California by Dawson, is now included in *B. californica*.

**Bossiella californica* spp. *schmittii* (Manza) Johans.

411

We have not collected this distinctive dorsi-ventral *Bossiella* form in San Diego. As *Calliarthron schmittii*, the taxon was described in 1937 for plants dredged in 1904 from 9.7 km NW of Pt. Loma Lighthouse.

Bossiella chiloensis (Dec.) Johans.

412

This species is primarily pinnately branched, with intergenicula in upper branches less than 2 mm long. The degree to which axes are branched and the length of lateral branches separate thalli from *B. plumosa*. **MAC** lists no California collections south of Monterey. Dawson (1958) identified a La Jolla collection as *B. insularis* (=*B. chiloensis*) suggesting that variants of other *Bossiella* species may resemble *B. chiloensis*, or that this latter species does indeed occur in southern California.

**Bossiella orbigniana* (Dec.) Silva

412

Branching mostly dichotomous; flat intergenicula with sharply pointed wings, broader (to 5 mm) than long (less than 2.5 mm); 1–5 conceptacles on each fertile intergeniculum; thalli commonly less than 10 cm high; outer margin of each wing curving convexly down to midrib and not distinguishable from lower margin; wings of successive intergenicula separated by gaps and branches appearing serrate, jagged in outline.

We find these thalli in mostly low intertidal sites, in shallow water along rocks in the channel entrance to Mission Bay, and commonly in kelp beds 10–17 m.

San Diego specimens of spp. *orbigniana* vary in width of the intergenicula (1–2+ mm) and in the degree to which marginal wings are developed. Dawson found it south to Punta Baja, and on offshore Mexican islands. For San Diego County, he listed (1945d) collections as *Bossea orbigniana* and *B. gardneri*. P.C. Silva notes (pers. comm.) that the correct spelling of the epithet should be *orbignyana*.

Bossiella plumosa (Manza) Silva
414

Branching pinnate; intergenicula broader (3 mm) than long (1–1.5 mm), prominently winged, the wings sharp-edged, upper part of wings lacking where branches arise; conceptacles usually 2 (3, 4) on face of fertile intergeniculum; most upper genicula branched, some branches with only 1 intergeniculum.

San Diego specimens occur on rocky beaches, low in the intertidal. The pinnate, frequent branching gives these thalli a dense and markedly different appearance compared with *B. orbigniana*. Lacking separation between successive wings, the axes are more compact in outline than other *Bossiella* species.

Johansen (in MAC) cautions about confusing this species with *Corallina frondescens*, a species (mostly?) from northern California. Branching is similar in both, but fertile *Bossiella* specimens clearly show conceptacles only on the faces of intergenicula.

**Calliarthron cheilosporioides* Manza
414

Branching pinnate or basally dichotomous; to 30 cm high; conceptacles on or near margins of flat intergenicula (occasionally on surface, not strictly marginal); lower intergenicular segments mostly 4–6 mm broad, 2–3 mm above, to 7 mm long; upper margins at 45° angle upward to long axis of branch.

On subtidal rocks, often a dominant understory component of the vegetation beneath and near kelp beds.

Dawson records plants from 18 m at Islas Los Coronados (1953b) and notes that intertidal occurrence in Baja California is limited to northern localities of maximum upwelling intensity. We have not found intertidal thalli in San Diego County.

Calliarthron tuberculosum (Post. and Rupr.) Daws.

416

San Diego County occurrence uncertain. Dawson listed it from Isla Gerónimo, México, and recorded specimens (Dawson *et al.* 1960, as *C. regenerans* Manza) from kelp beds, but it is not clear if this is intended to refer to a San Diego site.

Corallina

Three species are common and, with experience, easily recognized by habitat and morphological features in San Diego County. Each species is variable, thalli are often of similar size, and the distribution on individual beaches overlaps, and therefore single specimens often cannot be confidently identified. It is necessary to examine the range of variation within populations, and to compare thalli in several habitats to learn to distinguish the species. Conceptacles appear terminal on all species of *Corallina* ("axial in origin"). Populations are perennial, with seasonal growth cycles.

Most often, *C. officinalis* grows in the low intertidal region in shallow pools, often within the *Phyllospadix* zone, and into subtidal areas where it is seldom or never exposed to air. *C. pinnatifolia* is one of two common and abundant intertidal species, but also grows in shallow subtidal pools beside *C. officinalis*. The axes of *C. vancouveriensis* are clumped and when small, viewed vertically they appear like tiny rosettes, with the central axis often white-tipped, encircled by branch tips in one or more tight whorls. As the thalli grow, the apices retain this form, but it is less easily recognized when the axes become taller and no longer stand erect. Other species of *Corallina* whose ranges, according to records summarized in **MAC**, appear to include San Diego, either are undocumented by San Diego County specimens, or were listed on the basis of single or dubious collections.

Corallina frondescens Post. and Rupr.

403

Numerous synonymies are assembled by Johansen in **MAC** for this species, including *C. pinnatifolia* var. *digitata*. This suggests that some of the forms that we consider to be within the range of variation of *C. pinnatifolia* have been placed with *C. frondescens* by other workers. *C. pinnatifolia* in Mexican localities, as described by Dawson (**PMR I**, 1953b) includes varieties we find in San Diego. The southern specimens cited by Johansen as *C. frondescens* may instead represent *C. pinnatifolia*, a species that needs further study in this northern part of its range.

*_Corallina officinalis_ var. _chilensis_ (Dec.) Kütz.
405

Fronds whitish, pink, to pale lavender purple, to 15 cm tall, often regularly pinnately branched, with branches progressively shorter near the apex, and in one plane (distichous). Axial intergenicula flat, 1–2 mm long, 1.5 mm broad, not winged; lower portions of main axes often bare of branches with cylindrical intergenicula; coarser and less densely branched compared with *C. vancouveriensis* and *Haliptilon gracilis*. Our collection records conform to the habitats listed in MAC: low intertidal and subtidal rocks to 20 m depth and tidepools in the mid-to upper intertidal zone.

*_Corallina pinnatifolia_ (Manza) Daws.
405

Fronds to 7 cm high, in compact clumps, axial intergenicula to 1.5 mm long to 2 mm broad, mostly flattened, and lobed or extended in various shapes; pinnate plumose branching, branched on nearly every segment, often with lateral spur developed beneath some or all branchlets.

This is the most abundant anchor species of intertidal algal turf where the morphology is extremely variable. A useful way of separating this species from *C. vancouveriensis* is the appearance of the tips of clusters of young branches; in contrast with the more delicate rosette appearance often seen in *C. vancouveriensis*, *C. pinnatifolia* tips line up in short, approximately parallel series when observed from directly above (Figure 5). This species tends to be whitish, or yellowish to pink; over large areas of the intertidal zone it is exposed to long periods of exposure to sun and dry air. Factors regulating the distribution and relative abundance of *Corallina*-dominated turf above beds of *Phyllospadix torreyi* include both competition and tolerance of exposure to air temperature and desiccation (Stewart 1989a,b).

The species is found at most intertidal rocky shore localities in Baja California on the Pacific coast to Isla Magdalena, but north only to Santa Barbara County in southern California. It is also common and abundant in the Gulf of California.

Dawson included it in the Checklist as *Joculator pinnatifolius*.

*_Corallina polysticha_* Daws.
405

Because of the variable branching that can be observed in field studies of intertidal populations of *Corallina pinnatifolia*, we hesitate to identify any San

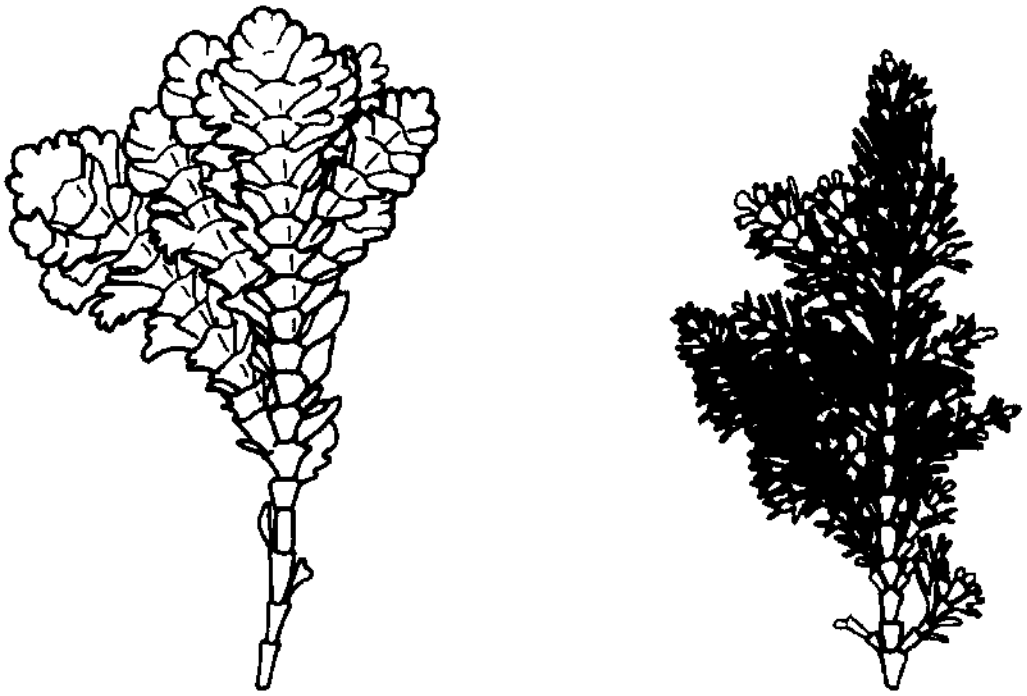

Figure 5. *Corallina pinnatifolia* (left) and *C. vancouveriensis* (right).

Diego County collections as *C. polysticha*. Specimens that correspond to the polystichous branching (more than 2 branchlets from single intergenicula) described for this species can be selected from populations of both *C. pinnatifolia* and *C. vancouverensis*.

**Corallina vancouveriensis* Yendo
405

Fronds various in shape and color, to 10 (+) cm high; often densely branched, with lateral branchlets all short and about the same length, frequently more than 2 per segment; some forms with very delicate narrow branches; intergenicula less than 1 mm long, and 1 mm broad.

Several forms are described by Dawson in his treatment of the species in Baja California, and these are similarly found in San Diego County. A distinctive variant with lateral branchlets much more slender than main branches is densely verticillate (2–5 branchlets per segment), with prominent percurrent axes. These thalli, to 14 cm long, and uniformly dark lavender in color, are often congested in limp tufts that hang down on sides of rocks in areas

exposed to relatively heavy surf. Other forms are abundant and dominant in algal mats (turf) that cover large areas of flat intertidal rock platforms. These are more or less densely branched, often less strikingly verticillate except near apices, with longer branchlets that are themselves branched, partly pinnately, with irregular shapes, and mostly less than 7 cm high. The species is uncommon or absent below the intertidal zone. Forms of *Corallina* sp. (*C. officinalis* var. *chilensis*?) that resemble forms of *C. vancouveriensis* can be found to 10 m in kelp beds.

Listed in Dawson's Checklist as *C. gracilis* f. *densa*.

**Haliptilon gracile* (Lamour.) Johans.
416 (as *Haliptylon*)
Thalli with conceptacles at the tips of branches, branching pinnate with intergenicula less than 0.5 mm broad, to 0.8 mm long; branchlets along main axes and branches with terete or subterete intergenicula; to 10 cm high.

Easily identified due to its fine, delicate, narrow branchlets that contrast with the broader thalli of *Corallina* species that grow with it in low intertidal regions where plants are shaded or protected from exposure to air. It often is conspicuous within and near the margins of *Phyllospadix* beds. Most of our records are between late fall and early spring.

Dawson recorded it for San Diego (1945d) as *Corallina gracilis*. Later he found it absent from areas of intense upwelling, confined to the warm spots south to Bahía Tortuga, Baja California. In kelp beds it is uncommon, except in shallow water.

Jania adhaerens Lamour./ *J. tenella* (Kütz.) Grun.
418
Jania species characteristically are strikingly regularly dichotomously branched with terete axes and branches throughout; conceptacles are at the tips of branches. The two taxa considered together here are found in small (1-2 cm high) dense soft clumps, with all axes very delicate, less than 0.2 mm in diameter, in contrast with the coarser axes of *Jania crassa*.

J. adhaerens is described as having the angle between branches mostly more than 45° while in *J. tenella* the angle is narrower, mostly less than 45°. The two species are otherwise similar. In San Diego such thalli are common in tufts or patches during warmer water months throughout the midtidal to lower tidepools, on rocks or growing epiphytically on other algae in turf mats. This

habitat information conforms to the published description of habitats for *J. tenella* in California, yet in a representative sampling of plants collected from several sites and at different times, of 80 measured branching angles, 48 were more than 45°, 20 were less, and 11 were essentially = 45°. In a single clump, angles on one thallus were predominantly (7:1) greater than 45°, while on another from the same clump, the proportion was reversed (1:7) with most angles less than 45°. Generally the thalli appear more like Figure 372 (*J. tenella*) than Figure 370 (*J. adhaerens*) in **MAC**; although this treatment considers *J. adhaerens* to be "common" and *J. tenella* "uncommon" in San Diego County. Most intergenicula were approximately 100 µm in diameter, with larger to 150 µm, smaller to 50 µm. J. N. Norris has suggested (pers. comm.) that in the Gulf of California the two taxa cannot be separated, but the taxonomic combination has not been formally published. Because both species are widely distributed in other parts of the world, the decision to combine them requires a more comprehensive study than Norris or I have attempted.

Dawson's Checklist reported two species of *Jania* present in San Diego; assuming one of these to be *J. crassa*, it appears likely that he recognized a single taxon for the forms we designate here, although these were not the specific names he mentioned.

Jania crassa Lamour.

418

Thalli dichotomously branched; conceptacles at the tips of branches (as for genus); individual clumps can be to 7 cm high, with intergenicula (150) 200–300 (400) µm diameter, of variable length, but always much longer than broad.

Distribution records for the eastern Pacific suggest that this is a warm-water species. We find it in winter as well as summer on most intertidal beaches, although our records indicate it is most abundant in late summer–fall months. It often is relatively common, and easily recognized by the bright pinkish-lavender color and white tips on regularly spaced dichotomies. Once the species has been compared directly with *Jania adhaerens/tenella*, the size difference is clear, and they cannot be confused. These are the only calcified taxa so distinctly and strictly dichotomously branched with axial conceptacles. Branching in *Amphiroa* resembles this pattern, but conceptacles are usually present and clearly lateral.

Dawson (1953b, as *J. natalensis*) noted that *J. crassa* is confined to the "warmest intertidal localities along the southern California and northwestern Baja California coasts."

**Lithothrix aspergillum* Gray
401

Thallus with a characteristic lavender-pink color; branches and axes mostly terete with branching irregular around the axes; 3–10 cm high, about 1 mm in diameter in most branches and axes; segments usually somewhat shorter than wide. Crustose base attached to thalli of *Corallina* species in algal turf or on rock surfaces; most abundant in the midtidal zone; less often found, but present, in other habitats. Small and large thalli can be found at all times of the year, although individual clumps probably do not persist more than several months (Stewart 1989b). In some respects the thallus size and shape resemble *Corallina vancouveriensis*, but the conceptacles are easily seen on the sides of the axes, appearing as small whitish mounds.

Dawson *et al.* (1960) record it to 13 m in kelp beds.

ENDOCLADIACEAE

**Endocladia muricata* (Post. and Rupr.) J. Ag.
422

Thalli densely bushy, 4–8 cm tall, dark red to nearly black, branches ±0.5 mm diameter, cylindrical throughout, covered with spines to 0.5 mm long, giving thallus a harsh, rough texture.

Where present, abundant on rocks very high in the intertidal, often above all other algae on seawalls or large rocks, associated with *Pelvetia*.

Locally, there are many beaches where it is not found (i.e., between Sunset Cliffs and Pt. Loma), but on the seaward wall of the Casa Breakwater in La Jolla, or along the vertical wall between residences and the rocky beach south of La Jolla Shores Beach, it is always present, usually abundant and conspicuous, seldom more than 4 cm high. It always is found in small discrete patches, seldom mixed with other algae (except *Pelvetia*).

The rough texture of this alga and the restriction to a particular habitat identifies the species.

Dawson collected specimens south only to Punta Santo Tomás, 30 km south of Ensenada, suggesting (1953b) that on the coast of Baja California it was limited to a few northern sites by increasing desiccation in its high intertidal habitat.

HALYMENIACEAE

**Carpopeltis bushiae* (Farl.) Kyl.

442

Thalli deep red to orange-red, to 10 cm high, with crowded dichotomous branching, giving a dense, bushy appearance to the specimen. Upper axes and branches flattened, 3–4 mm wide, narrower below, with the tips of all branches curled or undulate at the margins, with blunt tips. Reported (**MAC**) for the coast of southern California and offshore islands south to San Benitos Island, Baja California. Occasional, but easily recognized in very low intertidal to shallow subtidal habitats, to 13 m. Most collections have been in summer and fall months. In some sites, along walls of vertical channels, it is seasonally abundant with *Gelidium nudifrons, G. robustum, Pterocladia capillacea,* articulated corallines, and sparse *Phyllospadix.* Plants are occasionally heavily encrusted with a sponge (often *Hymeniacidon ungodon*).

Cryptonemia angustata (Setch. and Gardn.) Daws.

437

"Uncommon. . .subtidal. . .La Jolla," noted in **MAC**. Dawson's (1958) records include a citation of an early report of drift specimens at Mission Beach and a plant collected in a La Jolla kelp bed. When treating Mexican specimens (**PMR 2**, 1954) he described the blades as very thin, to 14 cm high, relatively narrow (2 cm; **MAC** states to 6 cm wide), membranous, rose red, simple or dichotomously divided, proliferating from torn edges, on short flattened slender stipes. Compared with the more common *C. obovata*, thinner, narrower, more delicate (Dawson *et al.* 1960).

Cryptonemia borealis Kyl.

438

Abbott identified as this species specimens collected by C. Limbaugh in 1954 and by W. J. North in 1961, from La Jolla Submarine Canyon. This is another of the irregularly divided, proliferous, deep-water red blades that must be sectioned and carefully compared with other species for even a tentative identification.

**Cryptonemia obovata* J. Ag.

438

Thallus a lobed, divided blade, reddish brown in color, often without a stipe, with one or several blades arising from minute disc. San Diego specimens are mostly 10–25 cm tall (largest is 30+ cm), seldom more than 15 cm wide; many

appear to have divided when small into two evenly developed blades, but larger blades are often torn and rebranched secondarily. A thickened rim is often seen, perhaps a consequence of growth in the central part of the blade exceeding marginal expansion. Young, entire blades and large lacerated blades often are part of the same clump, suggesting that these are perennial and that much of the variation (Figure 6) represents combinations of several growth cycles.

Figure 6. *Cryptonemia obovata*. Characteristic blade morphology.

In San Diego County this is a very common red blade, scattered under *Pterygophora* within kelp beds. We have collected it as deep as 50 m in canyons as well as 5–10 m deep off La Jolla beaches. Abbott, writing in **MAC**, notes that this species is comparatively easily identified by color, size, and thickness. Other blades with similar external morphology may represent *Kallymenia pacifica* or species of *Halymenia* and *Cryptonemia*. All of these, except for *C. obovata*, are rare in San Diego County collections. *C. obovata* is the only one of these externally similar species listed by Dawson in the Checklist.

Cryptonemia ovalifolia Kyl.

438

Blades are oval, simple, and rarely divided or lobed in any way; small, to 8 cm, some specimens with a bluish sheen to the otherwise clear pink color.

This species is described as occurring in often dense clusters in shaded overhanging habitats (presumably intertidal) in California north of Monterey County. We have found blades that we provisionally refer to the species in several very low intertidal and subtidal sites.

Dermocorynus occidentalis Hollenb.

441

This is a non-calcified crust (see preceding discussion of such crusts), 1–3 cm in diameter, with erect cylindrical to flattened branches to 2 mm tall on which reproductive structures develop. The type collection was from Laguna Beach, Orange County. A specimen from Punta Banda (Ensenada, Baja California) was later given to Hollenberg for study. No further records are known. If fertile specimens are found, they should be easily recognized. We list it here because the two known collection sites are approximately the same distance north and south of San Diego.

Grateloupia prolongata J. Ag., **G. doryphora* (Mont.) Howe

432, 435

The geographic ranges of two species of *Grateloupia* include sites north and south of San Diego County. Thalli of both taxa are bladelike, narrow, and longer than wide. *G. prolongata* is described as mostly 8–20 cm high, with slender proliferations scattered from all parts of the thallus, growing in low intertidal tidepools. *G. doryphora* specimens are to 2 m tall, with short spine-like proliferations on margins of blades, extremely variable in morphology and habitat.

Dawson's Checklist recognized 3 species (*G. californica, G. maxima, G. abreviata*) that later were combined with *G. doryphora*. One, *G. abreviata*, had been typified by a specimen from La Jolla. *G. doryphora* (widely distributed between Puget Sound and Peru) is distinguished from *G. prolongata* by having distichous rather than radially arranged proliferations. Dawson wrote about *G. doryphora* (as *G. schizophylla*, Dawson 1954) that this highly variable species was rare off the northern coast of Baja California, the southern part of its range, and there confined to regions of upwelling, suggesting it is a species more likely to occur in cool-water localities than in most parts of southern California. We have not found any intertidal *Grateloupia* specimens in San Diego County; several collections from subtidal sites resemble material from Punta Banda that Dawson referred to as *G. abreviata*. We believe that the taxon now known as *G. doryphora*, if presently occurring in San Diego, will be rarely found and only in deeper colder water.

Dawson's Checklist recorded *G. prolongata* from tidepools of La Jolla (see *Prionitis lanceolata*), and later (**PMR 1**, 1953b) listed it from Pacific and Gulf coasts of Baja California. His extensive collections indicated that the species was most abundant and common in subtidal waters in the Gulf of California.

Other species of *Grateloupia* are known from subtropical and tropical Mexican localities. The absence or rarity of San Diego County specimens suggests that local habitats are not favorable either to the warm-water species or to the cold-water northern taxa. We consider most of the high tidepool thalli that superficially resemble *Grateloupia prolongata* probably to be either *Prionitis lanceolata* or *Rhodoglossum affine*; further study is needed to resolve this question. Species of "*Grateloupia*" have been listed on survey reports for beaches throughout southern California in recent years, but we question this identification for local plants.

Halymenia californica Smith and Hollenb.
425

We have no records of recently collected, confirmed San Diego specimens, although the species may be represented in collections of large red blades that are not easily identified. MAC states it is a common subtidal species along the entire Pacific coast south of British Columbia and into the Gulf of California.

Halymenia gardneri (Kylin) Parkinson
(see Lindstrom 1986)
Halymenia coccinea (Harv.) Abb., 425

Thalli of large, single, usually undivided blades with ruffled margins, 15–40 cm wide and 30–45 (110) cm long, bright cherry red when fresh, with soft slippery texture, drying to a brownish red; subtidal.

We have identified as *H. coccinea* one collection of several blades to 20 cm high and 15 cm wide, from 37 m in the north branch of Scripps Submarine Canyon, December.

The distinctive texture of the blades is said to be diagnostic, but without considerable experience with freshly collected specimens of similar species that occur in the same habitats, the feature probably is of little assistance. Microscopic comparison of internal cell arrangements is necessary for identification.

Halymenia hollenbergii Abb.
429

Thalli of often large, entire to lobed blades, pink to rose-brown in color, longer than broad, with margins ruffled or lacerated in various ways; to 60–70 cm high, 16–18 cm broad.

Species of *Halymenia* characteristically have thin, smooth-feeling blades that must be sectioned and studied with the aid of a compound microscope for identification.

The type specimens were collected by divers 11–13 m off Imperial Beach. We have found similar thalli washed ashore on Imperial Beach after winter storms, and additional similar specimens have been collected subtidally nearby, although identification of many of these collections is tentative.

"*Lobocolax*"

see Smith 1944, p. 248, *L. deformans* Howe

For many years this name was applied to a small growth that was observed on species of *Prionitis* and thought to represent another of the parasitic-epiphytic red algae that are restricted to closely related host species. Dawson found these "peculiar" structures along northern Pacific Baja California and suggested (1953b) that they were not an independent organism, but a "malformation resulting from a. . .bacterial (?) infection." McBride *et al.* (1974) showed that *L. deformans* was indeed a gall, or outgrowth of cells from the host plant that contained intercellular rod-shaped bacteria, and for this reason it was omitted from **MAC**. These anomalous structures have been noted locally on *Prionitis australia/linearis/corneum* from Imperial Beach.

Prionitis angusta (Harv.) Okam.

444.

In one of our collections from a La Jolla low intertidal site, a plant with narrow, flat, mostly dichotomous branching has been identified tentatively by Abbott as *P. angusta*.

Prionitis australis (J. Ag.) J. Ag./ *P. cornea* (Okam.) Daws./ **P. linearis* Kyl.

445, 448

Thalli of these three species consist of flattened axes and branches, mostly more than 2.5 cm broad, regularly dichotomous branching in one plane, sparse or dense with the distance between successive branches and the angle between the forks of a dichotomy variable. As is true for species of *Prionitis*, all major branches are approximately the same breadth throughout any single thallus, but thalli from the same collection can vary in this dimension. The lateral margins of many branches develop short peg-like or nearly leafy proliferations in various numbers and arrangements; surfaces of all branches and axes are otherwise smooth; height is similar for the three taxa we are treating together here.

Illustrations in **MAC** (Figures 394, 395, 398) show rather distinctive thalli, but San Diego County specimens from low intertidal and shallow to 20 m subtidal rocky sites completely intergrade in every feature, and we cannot separate our material into one or another of these species. In order to evaluate these local collections, we examined large collections in the Herbarium at Allan Hancock Foundation, now LAM, (including Dawson material), and found similar overlap and variability in other southern California thalli. At present, we refer to local specimens as representing a complex that includes the three species as treated in **MAC**, pending a formal taxonomic resolution of the problem.

Dawson applied *P. cornea* to subtidal kelp-bed specimens (Dawson *et al.* 1960) and listed *P. linearis* (as *Zanardinula*) from low intertidal habitats in his Checklist. The type specimen of this latter taxon was collected in La Jolla.

Prionitis lanceolata (Harv.) Harv.
447

Stipes several to numerous, or single, arising from discoid holdfasts, thalli mostly less than 15 cm high (larger specimens elsewhere), branches mostly less than 5 mm, occasionally to 10 mm wide; 2–3 times irregularly dichotomously divided, the ultimate dichotomy usually forked near the tip of the branch; proliferations along the edges of the compressed branches pinnately arranged, often longer near the base or in middle portions; plants reddish to yellowish green, or pinkish tan.

This summary description, modified from **MAC**, is based on intertidal plants in our collections and differs in several respects from the information compared there for high and low intertidal forms. San Diego thalli are smaller, with mostly broader axes that taper to narrow, often long, unbranched tips. Dawson mentions irregular primary branching as a distinctive character (**PMR 2**, 1954). Abbott's comments point to the extensive variability found in central California habitats. The species is not common in San Diego, and specimens have been confused with *Grateloupia prolongata*, a less flattened alga where proliferous branches are not strictly pinnate. *Prionitis lanceolata* often grows in tidepools with *Rhodoglossum affine* and *Gigartina leptorhynchos*, which are greenish yellow or tan in this habitat. For each genus, the cross section is distinctive. In the low intertidal zone beneath *Phyllospadix*, thalli are deep red or purple.

Dawson *et al.* (1960) mention specimens to 0.7 m high, 13 m deep in kelp beds.

Dawson implies (1945d) that *P. lyallii* (as *Zanardinula andersoniana*) may be

found in San Diego, but no collections are cited. **MAC** refers to the variability of this species, which can include forms very similar to some specimens attributed to *P. lanceolata*.

KALLYMENIACEAE

**Callocolax fungiformis* Kyl.

469

This is one of the "parasitic" red algae that is apparently restricted to one or a few species of related larger red algae, in this case species of *Callophyllis*. Our recognition of *Callocolax* from San Diego County is based on thalli found on *C. flabellulata*, the most common host, that was attached to *Bossiella* in the Pt. Loma kelp beds.

Dawson's Checklist records one collection on *Callophyllis* sp., dredged off Pt. Loma. His specimen was described as *Callocolax globulosis*, later combined with *C. fungiformis*. Aguilar and Pacheco (1985) recently found specimens in Bahía del Rosario, extending the range into Baja California.

Callophyllis firma (Kyl.) R. Norris

460

The single specimen we attribute to this species is very small, peltate, deep rose in color, with a crisp texture, bluish sheen, and slippery feel; medullary cells are visible in surface view, as described for the species (**MAC**). On this basis we recognize the taxon for San Diego County, where it is well within the subtidal range (**MAC**: British Columbia to Baja California) given for the species on the Pacific coast.

Very small peltate subtidal thalli most frequently represent germlings or juvenile thalli of *Callophyllis flabellata* or species of Rhodymeniaceae (see note for *Kallymenia pacifica*, below).

**Callophyllis flabellulata* Harv.

461

Thalli to 15 cm high, with various branching patterns as illustrated in **MAC**, p. 462. In cross section, the small cells interspersed between large medullary cells are diagnostic. San Diego County records of *Callophyllis* include many small subtidal plants 1–2 cm high that are epiphytes on larger algae. This form is common and can also be collected from non-algal substrates. Thalli 10–15 cm high, less frequently found, occur on rocks.

Dawson's Checklist listed the species as *C. marginifructa*.

Callophyllis thompsonii Setch.
464

As are most species of *Callophyllis*, these thalli are much and variously divided blades, arising from discoid holdfasts, without midribs or veins, with margins of variable appearances. The medulla is formed of large uncolored cells, as seen in a cross section under a compound microscope. Cystocarps form within the blade and often are numerous, giving a speckled appearance to the thallus. *C. thompsonii* is distinguished by having main branches mostly less than 2 cm broad, with broadly rounded, unnotched tips.

Of the several specimens in our collections that resemble this species, one, found among drift algae on Imperial Beach, was confirmed by I. A. Abbott.

**Callophyllis violacea* J. Ag.
464

San Diego thalli are mostly less than 12 cm high, dark red to purplish black, one to several branch-blades from a small discoid holdfast, with a distinctive smooth firm texture; intertidal plants grow in tufts, and we find all the forms shown in Figure 412, MAC.

Specimens have been found at all times of the year, mostly in the low intertidal, infrequently in shallow subtidal habitats (Dawson *et al.* 1960, list a collection from 25 m in kelp beds). Thalli are scattered under other larger thalli on rocks; the dark color is a consistent field characteristic. Dawson's Checklist also notes the presence of *C. dissecta*, a synonym of *C. violaceae*.

Kallymenia pacifica Kyl.
454

Species of *Kallymenia* are large, thin blades, sometimes divided but seldom branched, distinguished from other foliose taxa (*Callophyllis, Cryptonemia, Halymenia*) by examining cross sections with the aid of a compound microscope. Thalli are more firm, relatively thicker and often slippery, almost "waxy" when dry; but these features are helpful only after one has had considerable experience with the several taxa, all rare and subtidal in San Diego County. Of the several collections that we tentatively identified as *Kallymenia pacifica*, Abbott confirmed two from kelp beds along the Loma Sea Cliff. These specimens were to 25 cm long.

Type material for this species was collected in the 1890's from "San Diego" (as *Meredithia californica*); Abbott (1968) stated that many peltate specimens attributed to this species represent *Callophyllis firma*.

CHOREOCOLACACEAE

Gelidiocolax microsphaerica Gardn.

342

Thallus a smooth, more or less hemispherical mound, 0.18–0.23 mm diameter, found epiphytically on species of *Gelidium* from subtidal (*G. robustum, G. purpurascens, G. nudifrons*) or intertidal (*G. coulteri*) collections.

Collections of both reproductive phases have been recognized on San Diego *Gelidium* thalli, but detecting these minute epiphytes (or hemiparasites?) generally requires a microscope.

A study of parasitic species found on Gelidiaceae (Fan and Papenfuss 1959) stated. . . "it appears more likely that *Gelidiocolax* belongs in the Choreocolaceae." This tentative assignment, not adopted in **MAC**, was recently supported by finding another species of the genus on a member of the Rhodomelaceae (Norris 1988).

Leachiella pacifica Kugrens

Kugrens 1982

Choreocolax polysiphoniae Reinsch, 470

Thalli on species of *Polysiphonia, Pterosiphonia*, or *Pterochondria*, forming small, pale-brownish, globose cushions 0.6–4 mm diameter.

In California the species has been recorded from Laguna Beach (Orange County). Dawson found cystocarpic thalli among collections of *Polysiphonia collinsii* (=*P. hendryi*) from Cabo Colnett in northern Baja California in March. Between these two localities, including the coast of San Diego County, specimens have not been found.

CRUORIACEAE

Cruoria profunda Daws.

473

A non-calcified crustose species (see prior discussion); the type specimen was dredged at Cortez Bank, southwest of San Diego, where the algal vegetation is similar to that in subtidal sites near the mainland coast here. "Probably the tetrasporic life history stage of *Opuntiella californica*" (Scagel *et al.* 1986). No other California records are known.

Haematocelis rubens J. Ag., *H. zonalis* Daws. and Neush.
474, 475

Both these non-calcified crustose species (see prior discussion) are recorded from "Southern California." San Diego specimens were recorded by Dawson (*H. rubens*) at the Caves, La Jolla, in January (**PMR I**, 1953b).

Petrocelis: See *Mastocarpus* (Petrocelidaceae)

NEMASTOMATACEAE

Schizymenia dawsonii Abb.
478

Thallus a blade, without veins, to 30 cm high, 25 cm broad, 250–300 µm thick, bluish rose, entire or deeply cleft 2 or 3 times, with mostly smooth margins; stipes 2–3 mm long; gland cells inconspicuous (compared with other species of the genus).

Punta Santo Tomás, south of Ensenada in Baja California, was the locality for the type collection of this species. Two collections from San Diego sites were treated in the original discussion of the species, one each from Bird Rock and Imperial Beach, subtidal or drift. We have found attached specimens that are very distinct and easily recognizable at 37 m in the north branch of the Scripps Submarine Canyon in winter months.

The species was described soon after the death of E. Y. Dawson in 1966 and named to commemorate his contribution to the study of marine algae of California and Mexico. This seems an appropriate place to insert a quotation from the introduction to **MAC**, initially planned with his participation: "with his untimely death. . .modern phycology was deprived of its most energetic and one of its most brilliant and productive taxonomists. . .Many more Pacific coast species would have borne his name but for the fact that it was he who had first discovered and described them." We are pleased to be able to report new records of *S. dawsonii*. Our material conforms to earlier descriptions; margins appear torn (grazed?), with a few very small adventitious proliferous blades.

Schizymenia epiphytica (Setch. and Laws.) Smith and Hollenb.
478

Thalli consist of entire, coarse, wrinkled blades without veins, somewhat broader in the lower portion, with crisped, rimlike marginal thickening in older plants; to 40 cm high, 150–300 µm thick; usually without stipe, developing directly from small fleshy holdfast; gland cells numerous, to 125 µm diam; blades bluish red when wet and fresh, darker when dry.

The surface texture of specimens from central California is quite distinctive

and we know of no collections from San Diego County that resemble these northern plants in this respect. During a period of winter storms, a specimen tentatively identified as *S. epiphytica* was found on the beach at Imperial Beach, a site where other "northern" species have been found in drift.

**Schizymenia pacifica* (Kyl.) Kyl.
481

Thalli consist of blades, often several in clumps, without veins, brownish red, slippery, with a characteristic rough surface; blades oval, wider or more narrow above a wide base, often deeply split or divided; without any apparent stipe in most cases, growing from small fleshy holdfast; 25–30 (70) cm high, 15–30 cm wide, 200–500 µm thick; gland cells small (compared with *S. epiphytica*) but often prominent in fresh material.

MAC states that this species is common on rocks in exposed locations in lower intertidal to subtidal habitats along the entire Pacific coast of North America. In contrast with the many species that are found in low intertidal habitats north of central California but only subtidally in southern California, we have collected this species in low intertidal and shallow-water habitats. The gland cells are often difficult to recognize. This is the only species of *Schizymenia* recorded by Dawson along the northern coast of Baja California. Aguilar *et al.* (1984) recently found it at several sites in Baja California throughout the year.

SOLIERIACEAE

Gardneriella tuberifera Kyl.
485

Whitish, or pink, hemispherical "parasite" (gall?) 2–6 mm diameter, on *Sarcodiotheca gaudichaudii*.

Reported from colder water localities both to the north and south but not from San Diego.

**Opuntiella californica* (Farl.) Kyl.
485

Thallus with single undivided primary blade arising from small base; secondary blades growing from the margin of primary blade, occasionally with additional branching; secondary blades 2–3 mm thick, commonly larger than primary blade; blades fan-shaped, broadest above the middle, dark red; thallus to 20 cm high, 30 cm broad; stipes 4–8 mm long.

The typical forms described above and illustrated (Figure 430) in **MAC** are rarely found in San Diego County. Several thalli from subtidal rocks that externally resemble less typical specimens of *O. californica* lack the large

distinctive gland cells that characterize this species. (These thalli alternatively may be identified as a smooth form of *Gigartina exasperata*.) Dawson's Checklist reports specimens from extreme lower intertidal habitats.

In 1984–85, M. Tegner found numerous thalli growing on the inner, shallow edge (8–10 m) of the Point Loma kelp bed in an area where the species had not previously been seen.

[*Reticulobotrys catalinae* Daws.
487
Nowhere in the submarine canyons or elsewhere subtidally off the coast of San Diego County, have we observed this easily recognized alga. Dawson and Neushul (1966) noted that a deep (32 m) collection resembling *Reticulobotrys* later "proved to be a deep-water *Botryocladia*." They do not specify the specimen, but we suggest it may well have been the La Jolla Canyon specimen referred to by **MAC**. If this is so, it invalidates the only record we know of for San Diego. We have collected the species from offshore Channel Islands where it is indeed conspicuous among other algae.]

Sarcodiotheca furcata (Setch. and Gardn.) Kyl.
488
San Diego thalli to 25 cm high, dull red, flat, dichotomously to irregularly branched in one plane, narrow below, arising from slender cylindrical stipes 1–2 cm long, with a very small discoid holdfast attached to shells or small rocks; primary blades to 3 cm broad, to 1 mm thick, margins entire or conspicuously proliferous; terminal divisions of blades sharply forked, but older eroded or damaged tips do not show this characteristic appearance; cystocarps distributed over blades, protuberant, present in most collections. Lateral branches are often large, with the proliferations developed into secondary blades from margins near the bases of the original primary blade. On other thalli the proliferations are regularly spaced and small, superficially appearing as *Prionitis* thalli.

We have found this species only near the edge of the head of La Jolla Canyon, where it is one of several large algae that form a unique assemblage of taxa. This particular site, visited regularly since the first SCUBA surveys of La Jolla Bay, is referred to locally as Sarcodiotheca Point. The population persisted, apparently unchanged in extent since first observed in 1958, until a storm in January 1988 left the area bare of vegetation. The area is between 18 and 23 m with sand, small cobbles, and scattered shells overlying the shale bedrock. *Stenogramma* and large *Sarcodiotheca* (*Neoagardhiella*) *gaudichaudii* thalli were usually associated with *S. furcata*, and seasonally *Desmarestia* was abundant.

Not recorded from the Pacific coast of Baja California. Distribution is apparently discontinuous between British Columbia and Costa Rica.

**Sarcodiotheca gaudichaudii* (Mont.) Gabrielson

Gabrielson 1982

Neoagardhiella baileyi (Kütz.) Wynne and Tayl., 483.

Thalli of clumps of cylindrical axes branched near the base, as well as in various irregular patterns along upper parts of the axes, to 4 mm in diameter; the dimensions of the axes vary in diameter and height; characteristically the tips are acute and often there is a noticeable constriction or narrow portion at the base of branches where they join the main axis; dark red in color, or purple, or nearly black. Individual thalli are occasionally found from low intertidal rocks to deep in the submarine canyons off La Jolla. Specimens vary so much as to appear completely dissimilar when extremes are compared. The identification can be confirmed by examining a cross section. A compound microscope shows a core of small filaments intertwined in the center, surrounded by large cells that grade into an outer layer of small pigmented cortical cells. No other local alga, with similar external form, shows this internal anatomy.

Small specimens, mostly less than 10 cm high, are associated with *Phyllospadix* beds. These often do not appear as strikingly cylindrical as do the subtidal larger thalli that can reach 50+ cm high and are comparatively sparsely branched. In La Jolla Bay they grow on shells and small rocks on a sandy bottom and have been confused with cylindrical *Gracilaria* species. These subtidal specimens are often basiphytes for *Ceramium californica* and species of *Polysiphonia* and *Antithamnion.*

This California species has been the subject of numerous taxonomic and nomenclatural studies. Earlier nomenclature included *Agardhiella tenera*, used by Dawson in several lists, and *A. coulteri* (in Smith 1944; Dawson 1945d). Abbott (1978) showed that *N. baileyi*, the name cited in **MAC**, was incorrectly applied to eastern Pacific plants which she combined with *N. gaudichaudii.* Silva (1979) proposed the retention of *Agardhiella* for the genus. Gabrielson (1982) transferred the species to *Sarcodiotheca* on the basis of reproductive structures and development. Vegetatively, however, the two *Sarcodiotheca* species in California are very different.

HYPNEACEAE

Hypnea johnstonii Setch. and Gardn.

489

This species, although recorded from "Orange County to Mexico" in warm-water localities, has not been found in San Diego County. It is described as forming coarse thick mats in intertidal habitats.

H. valentiae var. *gardneri* Hollenb.

490

Thalli virtually the same as those of var. *valentiae* (**MAC** notes smaller diameter) but showing strikingly different clusters of tetrasporangia that resemble "parasitic" red algal species. Indeed, the reproductive branchlets on older collections had been referred to *Hypneocolax stellaris* and thought to be a separate species of alga growing on *Hypnea*. Subsequent investigation convinced Hollenberg (1972) that California specimens were actually *Hypnea* branches with distinctive clumps of tetrasporangial stichidia. Such thalli in California are presently treated as a variety of *H. valentiae*. We have collected specimens from low intertidal habitats on La Jolla beaches October–December.

**Hypnea valentiae* (Turn.) Mont. var. *valentiae*

490

Thalli radially branched, typically cylindrical, with numerous short spiny branches; a single distinct apical cell is seen with a compound microscope, and this feature often proves useful to recognize this and other *Hypnea* species; zonate tetrasporangia occur on short terminal branchlets termed stichidia; the species is highly variable in morphology and color; branches tend to be twisted or entangled with one another or with other algae, larger in diameter toward the base, and distinctly tapering above.

Hypnea valentiae var. *valentiae* is found at all seasons of the year, in large and small clumps, but becomes very abundant in most midtidal or lower sites between June and October. It is characteristically yellowish tan to greenish in color when lying on top of algal turf or rocks exposed to bright light. Under other algae or *Phyllospadix* the color is darker, less yellow. Axes may creep among other thalli; because there is no clear branching pattern by which to distinguish the species in the field, it is useful to gather several plants for comparison and identification. Tetrasporangial stichidia are not common, but conspicuous when present.

Dawson's observations led him to believe that this is a warm-water species, occurring only in areas in Baja California where cold-water upwelling is reduced or absent. For San Diego, he recorded the species (1945d) as *H. californica* and *H. adunca*.

Hypnea variabilis Okam.

490

Axes and main branches slightly to strongly compressed, in contrast to other California species of the genus; thalli are large and bushy, to 10 cm high, 1.2–2 mm wide, 0.7–1 mm thick, with branching becoming cylindrical in ultimate

short (1.3 mm) branchlets. Apparently distributed from La Jolla south to Baja California, and in southern Japan (type locality). *Hypnea* species vary greatly in size and branching, and grow in a wide variety of habitats intertidally in southern California. Dawson (**PMR 4**, 1961) recognized as *H. variabilis* compressed forms in several localities north of Ensenada, Baja California. Earlier (1946) he recorded a few "imperfect specimens. . .(that could not be identified with any certainty) found in beach drift at La Jolla." This remains the only published record of this flattened species for San Diego County. I occasionally collect plants that can be tentatively referred to this species.

PLOCAMIACEAE

**Plocamiocolax pulvinata* Setch.

494

Thalli forming small, cushion-like mounds on *Plocamium cartilagineum*, perhaps living parasitically; to 5 mm diameter, white to light tan; the mounds consist of branched, radiating branches to 2.5 mm long, variously branched.

We have observed what appears to be this algal "parasite" on *Plocamium cartilagineum* from low intertidal collections (elsewhere it has also been found subtidally).

Dawson's mention (1945b) of this species on *Nienburgia andersonii*, in La Jolla, November, probably represents a finding of *Asterocolax gardneri*.

**Plocamium cartilagineum* (L.) Dix.

492

Thalli with erect axes growing from prostrate branches; erect axes and branches compressed to flattened; branching sympodial, alternately distichous, pectinate, with each of the pectinate branches bearing three to four branchlets; thalli to 25 cm high (subtidal specimens are often larger than intertidal), bright pink to deeper red; branches straight or curved out, or slightly inward; in each of the groups of pectinate branchlets the first, lowermost, is unbranched, while the others are successively pectinate.

Along the entire Pacific coast of North America this species is very common intertidally and subtidally to 40 m. The bright color and feathery branching pattern make it distinctive, and it is widely used in decorative crafts. Very finely branched, delicate-appearing forms grow in tide pools, where water temperature rises during summer months; this form is particularly conspicuous on the rocky beaches in the southern end of La Jolla Bay, and between La Jolla Cove and Pacific Beach. Germlings several mm high are often found

epiphytically on large brown and red seaweeds, although larger plants seldom occur as epiphytes.

**Plocamium violaceum* Farl.
494

Thalli mostly 4–5 cm high, reddish violet, often very dark, in densely branched small clumps; main axes 1–1.5 mm diameter, branches only slightly compressed; the alternately distichous pattern of *P. cartilagineum* is found in this species also, but here the unbranched lowermost branchlet of each group is distinctly longer (2–6 mm) than successive branchlets of the same group, and curved strongly toward the parent axis or branch.

This species is much less frequently found in San Diego County than to the north. In low intertidal habitats one or several clumps within a small area can be found September–June; the species is occasionally more abundant and reproductive December–March. In our experience it is restricted to low intertidal habitats and shallow subtidal zones. Where it occurs it is usually not abundant, suggesting that conditions in this southern part of the state are generally unfavorable for growth or maintenance of populations. Dawson recorded only tetrasporangia in Mexican collections.

GRACILARIACEAE

**Gracilaria lemaneiformis* (Bory) Weber-van Bosse
Abbott 1983
G. sjoestedtii Kyl., 498

Thalli cylindrical, often more than 30 cm high, branching variable, often but not necessarily on rocks partially buried in sand in mid- to low intertidal and subtidal habitats along the entire coast of Pacific North America.

Large beds of the species occur in the southern end of San Diego Bay and in Mission Bay on mud flats in shallow water. The thalli collected on cobbles or shells, subtidally on sandy beaches off Imperial Beach or in La Jolla Bay, probably represent *G. pacifica*, see ff.

Dawson's Checklist refers to plants in San Diego Bay as mostly *G. confervoides* (*G. verrucosa* in **MAC**; *G. pacifica* ff.) and to those on the open coast as *G. sjoestedtii*.

The genus *Gracilariopsis* was described (Dawson 1949b) to accommodate those cylindrical species of *Gracilaria* that lacked nutritive filaments in the cystocarps. The new genus was based on *G. sjoestedtii*; *G. robusta* and *G. andersonii* were also transferred to *Gracilariopsis* by Dawson. These three

taxa were retained in *Gracilaria* in MAC. Fredericq and Hommersand (1989) have compared reproductive processes in species of *Gracilaria* and believe it is necessary to resurrect the genus *Gracilariopsis*. Nomenclature of California species will need revision accordingly.

**Gracilaria pacifica* Abb.

Abbott 1985

G. verrucosa (Huds.) Papenf., 500

Thallus sparingly irregularly branched or unbranched, from percurrent axes 1–2.5 mm thick in sheltered bays, 1.5–3.5 mm thick in open coastal situations. Similar to *G. lemaneiformis* but commonly more robust.

We find tall specimens, to 1 meter and more, on sandy bottoms at 17 m near the submarine canyon heads where thalli are occasionally very abundant.

**Gracilaria papenfussii* Abb.

Abbott 1983.

G. andersonii (Grun.) Kyl., 495

Thalli mostly cylindrical throughout and less than 15 cm high; distinctly stiff and almost wiry; branching irregular in density and in length; color usually very dark red to black; apices often eroded and straw-colored near the tips.

Frequent on rocks that are embedded in sand on intertidal beaches. In San Diego this alga is restricted to a few beaches (or at least is easily found only in these several locations), where it is further limited to those months when the sand is moved away from the sides of rocks. Apparently, populations are maintained from year to year by basal parts that persist under sand and then produce erect thalli after the sand is moved away by heavy surf (in most years, late fall through spring). The appearance of the thalli varies, perhaps in part because of erosion by sand movement. Large patches, including fertile specimens, are found January–May. Several taxa of *Gracilaria* are known to produce dense coatings of colorless hairs (when nutrients become depleted?), and *G. papenfussii* has been found in June in this condition.

I can confirm no recent verified collections of other species of *Gracilaria*. *G. textori* var. *cunninghamii* and *G. turgida* occur both north and south of San Diego County. Dawson *et al.* (1960) refer to *G. cunninghamii* from kelp beds, and earlier (Dawson, 1945b) a La Jolla specimen was listed under this name [*G. (Tylotus) cunninghamii*]. Specimens of San Diego *Callophyllis violacea* could be misidentified as *G. textori* var. *cunninghamii*, and for this reason we

suggest that perhaps the occasional thalli that have been referred to this latter species should be re-evaluated. **MAC's** record for *G. veleroae* from La Jolla probably refers to specimens identified (Dawson 1946) on the basis of resembling the Gulf of California species. These were not discussed in his study of Northeast Pacific Gracillariaceae (1949b), nor were any Pacific Baja California or California localities cited in a later treatment of the family (1961), suggesting that his initial identification had not been supported by subsequent experience.

**Gracilariophila gardneri* Setch.
500; probably *G. oryzoides* Setch. and Wils., 502
A specimen attributed to this epiphytic/parasitic species was collected on *G. papenfussii* (as *Gracilaria andersonii*) at La Jolla in December (Dawson 1945b); no other records for San Diego County are known to us.

PHYLLOPHORACEAE
**Ahnfeltia gigartinoides* J. Ag.
503
Thalli of numerous, more-or-less cylindrical branches, repeatedly, often densely (10–15 times) dichotomously branched, rigid to wiry; deep red to nearly black, 10–30 cm high; branches 0.5–1.5 mm diameter, often short, tapering.

Rarely found throughout a wide north-south range that includes southern California. We have not collected the species nor does Dawson in **PMR 4** (1961) cite southern California or northwest Baja California specimens. Dawson's Checklist comment that the species is occasional in the San Diego region perhaps was based on a misidentification.

Ahnfeltia plicata (Huds.) Fries
503
Very similar to *A. gigartinoides*, but more wiry; smaller, to 14 cm high, and 0.25–0.5 mm in diameter, also stiff.

This species also has a wide north–south range that includes localities in Baja California (Bahía Colnett, Bahía San Quintín, to Bahía Vizcaino), but no San Diego records are known to us.

Maggs *et al.* (1989) attribute specimens previously referred to *A. plicata*, from central California and Baja California, to *A. fastigiata.* Numerous anatomical and reproductive differences between the two species are described; in particular, branching in *A. fastigiata* is more regularly dichotomous, and axis width is usually less than 0.5 mm compared with up to 1 mm in *A. plicata.* Another

study (Maggs and Pueschel 1989) of female and postfertilization reproductive development in *A. plicata* resulted in a proposal to establish a separate family and order based on this species.

Gymnogongrus chiton (Howe) Silva and DeCew
Silva 1979
Gymnogongrus platyphyllus Gardn., 508

Thalli stiff, compressed to flattened, dichotomous, with few erect branches in clump; to approximately 20 cm high, dull red to purplish; with "arching parallel fans of branches" forming a symmetrical and regular pattern of branching as a result of the upper wide dichotomies in each branch being similarly spaced; upper branches mostly 4–6 mm wide, less than 1 mm thick, with blunt, smooth apices; reproductive structures, when present, in prominent protruding mounds.

Our records for this species (mostly late spring–early fall) suggest that it is widespread in diverse habitats: Mission Bay and the Flood Control Channel, on Pt. Loma and La Jolla intertidal rocks, on subtidal rocks to 20 m. It is conspicuous occasionally in drift algae. Some thalli show tapered (not blunt) apices, and branch width is variable within a single thallus. Dawson (1945d) refers to drift specimens on the beach near the Scripps Pier.

Gymnogongrus leptophyllus J. Ag.
506

As are other *Gymnogongrus* species in California, thalli of this species are erect, attached to rock surfaces, with several main axes arising from small discs; easily recognized by the rigidity and strictly dichotomous branches mostly in one plane and compressed. *G. leptophyllus* is distinguished by the narrow (0.5–1 mm) upper branch width; most specimens are under 9 cm high, dull red-brown in color, with conspicuously forked apices.

In central California the plants are frequently abundant on sand-swept rocks; in San Diego County they are rare and not restricted to this habitat. *G. linearis* and *G. chiton*, larger plants with wider branches, are similarly uncommon and often it is difficult to identify single specimens from San Diego collections. Very narrow specimens, identified as *G. leptophyllus*, have been found on rocks near Coronado, in crevices south of Ocean Beach, and on rocks in 10 m deep water near the Loma Sea Cliff. Other specimens have been picked from drift algae washed onto La Jolla beaches. In these specimens the branching tends to be dense above, with shorter intervals between dichotomies. Subtidal specimens have been somewhat larger than the 9 cm height reported by **MAC**.

**Ozophora clevelandii* (Farl.) Abb. (? *O. latifolia* Abb.)
512

Thalli of erect, branched, flattened blades, to 30 cm high, dull red, with or without short cylindrical stipes less than 2 cm long; main axes to 3 cm broad, irregularly to regularly dichotomously branched in fan-shaped arrangement, ultimate bladelets rounded, some with proliferous branchlets, 7–10 cm long, 1–2 cm broad; reproductive structures on small leaf-like proliferations on the blade surfaces or along margins, or in blister-like spots on blade surfaces.

In San Luis Obispo County, in central California, Sparling (1977) described numerous *Ozophora* specimens that could not be separated into the two species described in **MAC** and suggested that these collections be identified as *O. clevelandii* (typified by a San Diego collection) until further study clarifies the limits of the species. In southern California thalli are rare, and found only in deep water. We have found thalli tentatively identified as *Ozophora* in several collections from 17–37 m, branches mostly but not always as broad as in *O. clevelandii* (to 2 cm) and to 20–25 cm high, often fertile, and often heavily encrusted or entirely encased in invertebrate (worm and bryozoan) cases, suggesting that thalli are several years old. Abbott (pers. comm.) requires fertile specimens for identification of species and doubts that *O. latifolia* occurs in southern California.

Dawson (**PMR 4**, 1961) remarked that *O. clevelandii*, "frequently observed by divers at La Jolla," was recognized by the distinctive broad, flattened branch tips. He also wrote (Dawson *et al.* 1960) that the species was found under the kelp canopy at depths of 17 m and on dimly lighted bottoms of 33 m or more.

Dawson's Checklist includes the species (as *Phyllophora clevelandii*) on the basis of large plants washed ashore at Pacific Beach.

Petroglossum parvum Hollenb.
511

Thalli with mostly single erect blades to 10 (15) mm high, arising from spreading prostrate axes on short stipes, once or twice dichotomous; blades narrow, to 2 (3) mm wide, often with adventitious new blades from torn or damaged edges; several cell layers in cross section, with large inner cells and smaller outer, cortical cells.

These small blades often occur under *Phyllospadix* with *Anisocladella pacifica* and *Nienburgia andersoniana*. *Petroglossum* and *Anisocladella* blades have the same shape and external morphology but *Petroglossum* blades lack mid-ribs and venation and are thicker than those of *Anisocladella*. In some years *Petroglossum* is more abundant than in others; it is seldom easily found, and

probably is more often present during winter and spring months than later in the year, although we have found it throughout the summer and fall in some years. We have collected tetrasporangial and gametangial specimens November–February both intertidally and subtidally.

P. pacificum Hollenb. (508) is a larger, more branched species which I have not found, although La Jolla is included in distribution records according to **MAC**. Dawson did not find it in Mexican collections; in the Checklist the plants he lists as *P. pacificum*, growing under *Phyllospadix*, probably represent the species recognized as *P. parvum*.

**Stenogramma interrupta* (C. Ag.) Mont.
514

Thalli with several erect branches arising from discoid holdfast; flattened, in one plane, dichotomously divided, light or deep red, to 20 cm high; branches 5–10 (18) mm broad, linear, with slightly broader apices; occasionally with proliferous terminal blades; on rocks in low intertidal to subtidal sites along the entire Pacific coast of U.S. and Mexico, and on the Atlantic shores of Europe. Cystocarpic development produces the appearance of an interrupted midrib, a feature unique to this species among California algae.

This summary description, based on **MAC**, needs modification or expansion to encompass the forms from submarine canyons in San Diego County that we attribute to the species. We have collected cystocarpic plants January–June among thalli of *Sarcodiotheca furcata* near the edge of the canyon in La Jolla Bay. Nonreproductive plants that resemble these cystocarpic thalli are so irregularly branched that they might, if collected separately, be treated as forms of *Ozophora*. The variability in this particular population may be partly related to the longevity of individual thalli. The site is within La Jolla Bay and beneath depths of heavy surge, possibly allowing thalli to persist and grow over several years. It is also a sandy area, removed from rock outcroppings inhabited by fish or large invertebrate grazers. We find very small thalli February–June, with pale clear pink blades. These "new" thalli grow to 10 cm high by the end of summer, with ultimate dichotomies 1 cm wide. Simultaneously we find (older) blades to 15 cm high, thicker, usually eroded or torn, darker colored, and often fertile. If these were found apart from the "new" thalli, they would initially be considered a different species. From many of these "old" thalli, thin new blades, with the bright color and regular dichotomous branching of the first-year growth, develop along old margins or apices.

This is the only site where this species has been found off San Diego County. Since a January storm in 1988 (see *Sarcodiatheca furcata*) disturbed substrates here, algal thalli of these larger species have not been found.

GIGARTINACEAE

**Gigartina canaliculata* Harv.

518

Thalli with cylindrical axes and branchlets, all of similar dimension (2–4 mm wide); papillae not apparent in nonreproductive plants that therefore, in this feature, do not resemble thalli of other common species of *Gigartina*; San Diego specimens mostly less than 15 cm high, often greenish yellow to dark green in shaded habitats; in clumps or dispersed over or among thalli of other turf algae; branching irregular, mostly sparse; fertile thalli are densely branched with short branchlets.

The most common midintertidal form of this species is often not at first recognized by workers familiar with the larger, discrete clumps found in central California and northward. The branch diameter varies in different habitats; more loosely branched, coarser (more than 2 mm diameter), and taller plants were formerly treated as *G. serrata.* Specimens growing under *Phyllospadix* and in similarly protected habitats are more purple, darker, and often larger and more erect, while the specimens that are common, although inconspicuous in mats of intertidal vegetation, are yellowish and generally mostly prostrate. Branches become secondarily attached to other algae, or thalli are entirely epiphytic. The smooth, narrow, tapering branches distinguish thalli from other species in the field. Fertile plants are misleadingly different due to the development of papillae and short dense branches along the upper axes. We find specimens in shallow subtidal habitats as well as intertidally.

**Gigartina exasperata* Harv. and Bail.

521

Thalli are large blades, little branched, mostly less than 30 cm high, but occasionally to 60 cm; papillae short (to 1 mm), hemispherical, and closely spaced when present (see below); 1 to several blades growing from single small discoid holdfast with short stipes; margins smooth, ruffled, or dentate; apices blunt to pointed; shape of blade from nearly circular to narrow, symmetrical or curved.

We include in this highly variable species various large *Gigartina* blades from subtidal sites, rather than attempting to divide single collections between *G. exasperata* and *G. corymbifera.* On none of these specimens have we seen papillae that correspond to those described for *G. corymbifera.* The two species are contrasted largely on the basis of collections from central California, and our San Diego County material is difficult to interpret by the criteria summarized in **MAC**. Thalli of *G. exasperata* have been found in most subtidal areas, including depths greater than 33 m in the La Jolla canyons.

Occasional thalli are nearly smooth, with few or undeveloped papillae. These blades resemble specimens referred to *Rhodoglossum roseum*; alternatively, if gland cells were present, some forms could be treated as *Opuntiella* thalli.

Dawson distinguished this taxon (as *G. californica*) from *G. corymbifera* as having more acute tips and by showing basal branching from and just above the stipe, but these features also vary when northern thalli are included in the comparison.

Dawson's Checklist lists *G. corymbifera* (as *G. binghamiae*) from San Diego, represented by thalli cast ashore in June–November. At that time *G. exasperata* was considered a more northern species that was otherwise difficult to distinguish from southern California thalli.

**Gigartina harveyana* (Kütz.) Setch. and Gardn.
521

Thalli formed of broad [1.5–3 (7) cm], divided, very long (30–40+ cm) blades, narrowing toward the pointed tips, with numerous soft papillae of various sizes and shapes along blade margins and over the surfaces.

The length/width proportion separates this *Gigartina* from other species, and such thalli have been recognized only rarely in shallow (to 7 m) subtidal habitats on rocks off La Jolla beaches or in drift material in several parts of San Diego County. According to Dawson's observations of plants in areas south of San Diego, the papillae on and near the margins can grow out to form narrow bladelets 3–6 cm long when they are grazed or otherwise damaged.

**Gigartina leptorhynchos* J. Ag.
523

Thalli dark brown to black or pale yellowish green in high intertidal pools; typically to 20 cm high, to 30 cm in Mission Bay Channel on jetties; axes narrow, much branched with variable widths throughout single thalli; small but dense and conspicuous papillae that are mostly 1–3 mm long, soft, not stiff, and almost rodlike in some specimens; the combination of numerous small branchlets and long dense papillae gives the soft, often limp thalli a characteristic "fuzzy" appearance.

Plants occasionally found in high intertidal pools may not be immediately recognized because of the pale yellowish color and sparsely branched main axes. Low intertidal specimens under or near *Phyllospadix* are dark to nearly black, but the typical morphology is easily recognized. Thalli are usually separate and scattered rather than aggregated into extensive patches or clumps as they often are in central California.

**Gigartina ornithorhynchos* J. Ag.
Silva 1979
Gigartina spinosa (Kütz.) Harv., 525
Thalli coarse, purplish to black; in isolated clumps to 30+ cm high, frequently divided near the base as well as above, or remaining as a simple undivided blade; occasionally with small marginal bladelets; numerous short (1–3 mm), wide, stiff papillae over all surfaces.

This species presently includes several taxa previously considered as separate species and varieties in southern California. Treated as a single entity (**MAC**), *G. (spinosa) ornithorhynchos* occurs in low intertidal areas exposed to surf south of Monterey, Calfornia. One-to-few specimens recognizable by the rough dark blades usually can be found in any short search in the appropriate habitat. Many San Diego specimens are wider (to 10 cm) than the 4–6 cm width noted for northern specimens, and occasional large thalli might be considered as *G. exasperata* if they were collected in deep subtidal habitats. *G. ornithorhynchos* grows only to approximately 10 m and is most often found in shallower water and low intertidal sites.

Dawson also concluded that this was the common blade-like intertidal *Gigartina* species of San Diego County. It is allied with warm-water associations, less common or lacking in areas to the south in Baja California with cold upwelled water.

Dawson's Checklist lists *G. echinata*, *G. eatoniana*, and *G. armata*, all species included with *G. spinosa* in **MAC**, and *G. farlowiana*, probably also a form of the same species (the epithet is omitted from **MAC**).

Gigartina tepida Hollenb.
527
Branches mostly less than 1 mm wide, evenly compressed to flattened, of similar width throughout; thalli 2–4 (10) cm high, purplish, loosely tufted, with clumped, often sparse branches arranged irregularly; some branchlets near upper portions sharply pointed; papillae usually few.

MAC describes the habitat as apparently restricted to sheltered water and lists only a few collections, none south of Newport Bay in Orange County. We have collected *G. tepida* in San Diego County from quiet water areas as well as beaches exposed to rather heavy surf. Cystocarpic plants have been found in Mission Bay Channel, and 10–13 m subtidally on the Loma Sea Cliff. G. J. Hollenberg, who described the species, confirmed an identification of a plant from Mission Bay. It is probably a rare alga, in addition to being inconspicuous.

Gigartina volans (C. Ag.) J. Ag.

527

Thick, narrow blades, to 40 cm high, branched, often with many small marginal blades, and few or no papillae; thalli in clumps with several blades from a common holdfast; dark purple to brown; blade shape and branching may vary with reproductive phase.

"Oregon to Baja California on sand-covered rocks." We have not collected the species in San Diego County. Dawson (1945d) refers to specimens in La Jolla, and (Dawson *et al.* 1960) mention specimens from kelp beds to 10 m. These records may represent thalli of other morphologically variable taxa rather than *G. volans*, which is distinctive to the north, and as presently circumscribed, easily recognized.

**Rhodoglossum affine* (Harv.) Kyl.

539

Thalli in bushy, erect clumps, mostly less than 5 cm high, greenish olive or reddish purple to blackish; blades usually smooth, concave/convex; thalli in the high midtidal zone often appearing quite different from those in low intertidal habitats; blades of some forms mostly less than 2 cm wide, repeatedly dichotomously branched, with final dichotomies close together and congested above; other thalli of similar height are mostly less than 1 cm wide and more sparsely branched, occasionally with a few lateral proliferations, darker in color.

These forms identified from San Diego County do not correspond to the descriptions provided for northern populations (**MAC**). In San Diego, thalli are found in two very different habitats; high intertidal plants often are on rocks or in tide pools with *Prionitis lanceolata*. In localities outside San Diego, forms of *Grateloupia doryphora* may resemble *P. lanceolata* or forms of *Rhodoglossum affine* that co-occur in the same habitat. *Rhodoglossum affine* has large tetrasporangial sori, while species of the other two genera have scattered tetrasporangia. Our records suggest that plants begin to grow in the early spring and are most often collected in the summer–fall. Low intertidal forms are widely scattered and easily overlooked in shaded crevices, under larger algae, or in *Phyllospadix* beds. These are very dark purple, but otherwise resemble high intertidal thalli. We have not found larger specimens such as are mentioned in **MAC**. Figure 7 illustrates the plant Dawson described from several localities as a narrow form with branches terminally curled or twisted—a form that is locally characteristic of high intertidal pools in summer.

Parkinson (1981) has proposed that the removal of this species to the genus *Gigartina* (Kim 1976) be accepted and states that the necessary new epithet is *G. montereiensis*. The Parkinson study is obscurely published and not generally available. If this species is indeed correctly referred to the genus *Gigartina*, the specific name change becomes necessary. Until other workers have evaluated the generic status of the California taxon, however, I prefer to retain *Rhodoglossum affine* for this common, widespread, and well-known species.

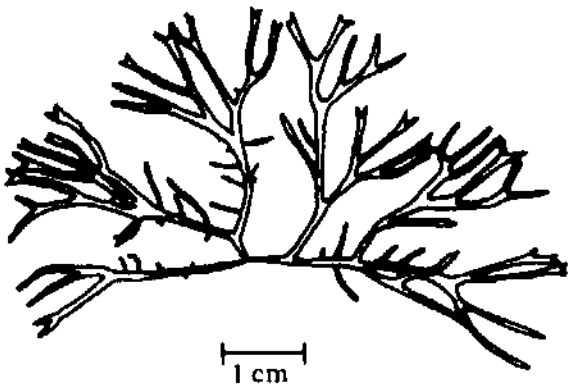

Figure 7. *Rhodoglossum affine*. Form commonly found in high tide pools in San Diego County.

**Rhodoglossum californicum* (J. Ag.) Abb.
539

Dawson's Checklist notes that this species (as *R. americanum*) is recorded for San Diego only on the basis of specimens collected in 1901 near Coronado (P.B.-A. #538). The species is known from cold-water sites in Baja California as well as in northern California, but probably is best excluded at this time from the San Diego algal flora.

The same study cited for *R. affine* (Parkinson 1981) supports the return of *R. californicum* to *Iridea*, following Kylin's 1941 opinion. At present it seems preferable to follow the nomenclature of **MAC** for the reasons given above (for *R. affine*).

Rhodoglossum roseum (Kyl.) Smith
541

Thalli with one or more erect blades arising from small discoid holdfasts, 8–15 cm high, oval or wider below; blades with rounded apices, occasionally with stipes 2–3 mm long; cystocarps large (more than 1 mm diameter) and conspicuous when present; blade surfaces otherwise smooth, not markedly thin or slippery.

The collections we have tentatively referred to this species include several thalli found on the beach at Imperial Beach and Mission Beach. Additional

material with cystocarpic plants and observations of attached plants are necessary to confirm the presence of the species in subtidal habitats.

Specimens initially referred to *Gigartina exasperata* as a form essentially lacking papillae, may prove to represent a *Rhodoglossum* species. Some are 20–45 cm high, which is considerably larger than noted for *R. roseum* from central California. Dawson recorded thalli to 30 cm, with ruffled margins, from northern Baja California.

PETROCELIDACEAE

[*Mastocarpus papillatus* (C. Ag.) Kütz.
Guiry *et al.* 1984
Gigartina papillata (C. Ag.) J. Ag., 523
This species does not occur in San Diego County and is listed here only because its presence/absence is frequently questioned. It is one of the most striking examples of the taxa that skip from central California to the localities of northern Baja California where cold water is brought to the shore by strong upwelling currents. In these southern areas and north of Santa Barbara, it is often an exceedingly abundant, dominant alga over high to mid-intertidal rocks.

West *et al.* 1978 established a crustose *Petrocelis* phase in the life history of *Gigartina agardhii,* which was placed in synonymy with *G. jardinii.* The species was later transferred to *Mastocarpus* (Guiry *et al.* 1984); the disjunct distribution is similar to that of *M. papillatus*. Although Dawson mentions the species as *Gigartina agardhii* in the Checklist, the record probably refers to forms of *G. spinosa.*]

[**Petrocelis franciscana* Setch. and Gardn., **P. haematis* Hollenb.
476
'*Petrocelis franciscana*' is found in areas of cold-water upwelling (e.g., Cabo Colnett) in Baja California but is absent from most of southern California and from San Diego County. The species (as *P. middendorffii*) was found to be the tetrasporangial phase of *Mastocarpus papillatus* (Polanshek and West 1977), an alga also absent from San Diego County.

Type locality and only record for P. *haematis* is Orange County.]

RHODYMENIACEAE

Botryocladia neushulii Daws.
551
Thalli 8–20 cm high, several axes growing from small basal attachment; branching irregular, often sparse, with small bulbs (sacs), filled with viscous

fluid, scattered along all axes and branches. We have found this very distinctive alga only on rocks at 17–20 m between the tip of Pt. Loma and Imperial Beach.

This rare species has been recorded from the California Channel Islands and south to Bahía San Quintín in Baja California. The type collection came from 16 m, in the La Jolla Cove kelp bed in 1956. Recently, one small specimen that resembles the species was found in drift on a beach near the Cove, suggesting that thalli may still grow in this locality. It is too conspicuous an alga to be overlooked by divers if present.

**Botryocladia pseudodichotoma* (Farl.) Kyl.
551

Thalli consist of divergently branched, solid cylindrical axes to 15 cm high, bearing numerous, large fluid-filled sacs up to 4, rarely 7, cm long, and 0.5–2 cm in diameter.

Thalli are infrequently collected subtidally 5–33 m along the entire coast of San Diego County, never abundantly, but throughout the year. It is one of the most easily identified algae, and in popular "guide to seaweed" booklets is sometimes given a common name of "seagrapes."

Beach drift specimens that Dawson referred to *Halosaccion* in the Checklist were probably individual sacs from this *Botryocladia* species. (See *Reticulobotrys*, SOLIERIACEAE.)

Fauchea laciniata J. Ag.
544

Thalli mostly less than 3 cm tall, single or several together, pale clear pink and often with bluish sheen; the blades appear sessile or with a short narrow portion that is either rolled or developed as a stalk bearing a nearly peltate blade portion; medulla of large cells that can be easily seen with low magnification within the small-celled cortex or by holding the thallus against a bright light. Cystocarps on the surface of the blades often show an encircling flared margin (= coronate).

The species, as treated in **MAC**, includes large forms in clusters to 12 cm high in central California, as well as collections previously distinguished as a "pygmy" form or species. In subtidal collections throughout the year, from most rocky bottoms 8–33+ m deep, the very small algae described here are easily found on various substrates with all reproductive phases frequently seen.

Larger specimens have been shown to us by other divers as perhaps represent-

ing *Fryeella* because of the blue color that is so striking underwater, but this character that has made *Fryeella* a well-known alga to the north is not restricted to that genus. *Fryeella* is rare or absent south of Morro Bay in San Luis Obispo County. I have not been able to locate the specimen from Papalote Bay, near Punta Banda, Baja California that was cited by **MAC**. Very small specimens develop a nearly peltate morphology, but this feature also develops in related genera.

The internal structure and the conspicuous form of the cystocarps characterize *Fauchea* species, while the cortical anatomy and position and shape of cystocarps separate *Fauchea* species from *Leptofauchea*. Some of the thalli in our *F. laciniata* (f. *pygmaea*) collections would perhaps be attributed to *Leptofauchea* if we did not have such a large series of thalli that all appear to represent a single entity. The blades tend to be irregularly branched and shaped and secondarily reattached to substrates. The type collection of f. *pygmaea* was from articulated corallines in Los Angeles County. Dawson (1950) recognized the taxon from 14–16 m near the Coronados Islands.

Fryeella gardneri (Setch.) Kyl.

549

Thalli are hollow, but not conspicuously so, as the median cavity is crossed by arched septa that are seen from the outside as curved bands. Underwater (this is strictly a subtidal species) the thalli appear as blades with generally dichotomous divisions. **MAC** records the size to 16 cm high, stating that the plants are often found lying flat on the surfaces of rocks rather than being erect in the water. Cystocarps are relatively large (1+ mm diameter) and prominent on the surfaces of blades. We have found no erect forms that resemble this species, and most of the small, fragmented, prostrate specimens with tetrasporangia that others have identified as *Fryeella,* we would treat as *Fauchea laciniata*. Dawson does not record *Fryeella* from Baja California and **MAC** records no collections south of Morro Bay in central California. R. McPeak has a single specimen collected from south of Pt. Loma, June 1982, at a depth of 23 m that resembles typical northern thalli of this species. (K. Miller has recently collected plants she identifies as *Fryeella* from the Coronados Islands.)

Maripelta rotata (Daws.) Daws.

548

Thallus bright rosy pink, peltate, with a vivid blue sheen when alive; thin, smooth, slippery-feeling circular blades develop singly on top of stipes, probably annually, and when shed leave small ridges or scars; stipes are to 4.5 cm high and blades of San Diego plants are mostly 3–7 cm broad.

The note in **MAC** referring to this species as frequent under kelp canopy is misleading for San Diego sites; the thalli commonly found in relatively shallow-water kelp beds are young, smooth-margined *Sciadophycus* specimens. *Maripelta* is everywhere a deep-water alga and off San Diego is found either very deep under *Pelagophycus* blades outside *Macrocystis* beds, or in the La Jolla submarine canyons below 28 m and at least as deep as 60 m. It has been observed at 82 m from submersibles near Anacapa Island. At these depths it shows little color but was recognized by the circular shape and bluish glow.

Rhodymenia arborescens Daws.

553

Blades with distinct branched stipe growing from a simple prominent cone-shaped or disc holdfast 5–10 mm wide; without stolons; blade segments 3–4 (6) mm broad, thalli 10–15 (24) cm high, 6–10 (16) cm broad.

Dawson *et al.* (1960) referred to the species as being common under kelp canopies between Los Angeles County and the southern tip of Baja California, with the woody, conical holdfast being distinctive. We have collected thalli that match descriptions of this alga, but the presence or absence of stolons and the morphology of the holdfast are not always easily interpreted.

**Rhodymenia californica* Kyl./ **R. pacifica* Kyl.

554, 557

Thalli dichotomously branched, flattened, growing from cylindrical axes that often are densely pigmented; erect blades often firm to very stiff; divisions of blade less than 3 mm broad and thalli to 7 cm high (*R. californica*) or 8–13 cm high, with branches 4–19 mm broad (*R. pacifica*); blades typically broadened and blunt at apices, in many forms more narrow and attenuate. With low magnification, large medullary cells can be seen between the outer cortex of very small cells; this characteristic is useful in recognizing this and related genera when the thalli are small and lack the branching pattern typical of older plants. Plants with narrow blades such as distinguish *R. californica* can be found in shaded low intertidal to subtidal rocky habitats where they often are abundant. Basal, prostrate axes (stolons) may be buried in sediment or covered by sessile invertebrates. Growing amongst these larger plants are small thalli of various shapes, including occasional very small peltate blades that presumably are juveniles of the same species. Very broad specimens, characteristic of *R. pacifica*, can occur in similar habitats. Intermediate forms are common, and by relying only on height and branch width, many collections cannot be clearly distinguished as one or the other species. Some very small thalli are broad, but as the divisions increase in number they become successively

narrow. Large typical *R. pacifica* are mostly found subtidally, but narrow *R. californica* forms can also be found in the same habitats.

**Rhodymenia rhizoides* Daws.

559

Type locality for this species was San Diego (Dawson 1941). He later (1963a) wrote, "one is led to wonder whether *R. rhizoides* might represent a variation of *R. pacifica* with prominently branched stipes and stolons."

**Rhodymeniocolax botryoides* Setch.

562

Thallus whitish, 3–4 mm in diameter, with many short, thick branches to 0.75 mm long. Occasional "parasite" on *Rhodymenia* species.

Dawson (1945d) reported finding abundant material on old specimens of *Rhodymenia* in beach drift at La Jolla throughout the winter and spring of 1944–45.

Sciadophycus stellatus Daws.

547

Thalli consist of bright rosy pink peltate blades, with a bluish color when wet and alive; single blades, to 4–6 cm diameter, grow on stipes to 0.5–1.5 cm high; young undamaged blades develop several to 12 points along the periphery, evenly spaced and of similar size and shape, giving the thallus a symmetrically stellate shape.

Blades grow first as simple circular discs, then, as growth proceeds, the star morphology develops as points grow out from the margin. These points can secondarily attach to the substrate and initiate new blades. Older plants develop various irregular shapes as the margin becomes damaged or reattached; short-stiped plants often appear to be prostrate. Entire blades with symmetrical radiating points, such as are shown in Figure 491 of **MAC**, are seldom found. Once one becomes familiar with these thalli they are recognized in most of the rocky subtidal areas of moderate water movement. We do not find them within La Jolla Bay or in the canyons, and believe that most of the peltate plants observed under the kelp canopy and nearby are *Sciadophycus*, with *Maripelta* restricted to deeper sites.

CHAMPIACEAE

Binghamia forkii (Daws.) Silva

564

Thalli strongly flattened, distichously branched; main axes at first solid but

becoming progressively more hollow, finally with central cavity essentially hollow, with regular septa dividing hollow parts into segments; to 2 mm wide at broader upper branches, pinnate branches 1–5 mm long, narrow at base. Branching is often strikingly opposite and regular above the primary dichotomies. Characteristic forms are shown in Figure 8.

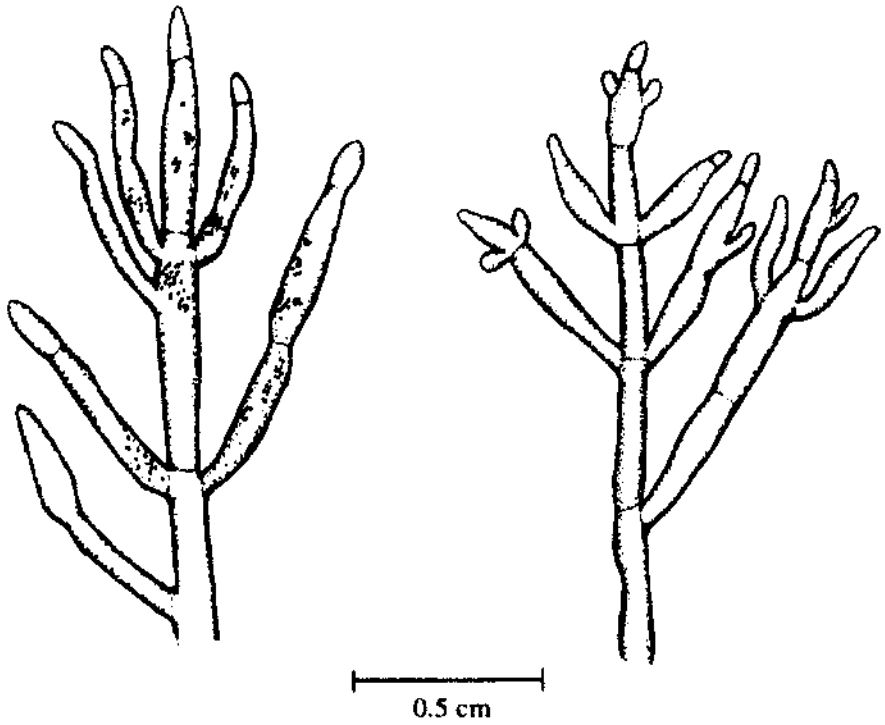

Figure 8. *Binghamia forkii*. Whole thalli.

This species is easily found May–November on the platform rock beaches between Ocean Beach and Pt. Loma, where thalli form a yellowish or greenish mat of repent epiphytic thalli over algal turf. It usually is less abundant but seasonally occurs on beaches north of Mission Bay. All reproductive phases are present wherever thalli are collected.

The species was typified by thalli epiphytic on *Pterocladia capillacea* and *Hypnea valentiae* in drift at La Jolla (Dawson 1945a) and has subsequently been recorded from the California Channel Islands, other sites in southern California, and south to Bahía San Hipólito in Baja California. Specimens were reported (Dawson *et al.* 1960) from 8–13 m in kelp beds.

Thalli from three localities in northwest Baja California that I believe to represent this very common (in San Diego County) species, have recently been studied (Lee *et al.* 1988) and removed to a new genus and species, *Binghamiopsis caespitosa*. Both *Binghamia* and *Binghamiopsis* are allied with *Lomentaria* in Lomentariaceae by these authors.

Champia parvula (C. Ag.) Harv.
565

Thalli 1–2 cm high, branched, cylindrical or occasionally somewhat compressed, often low and creeping and reattached to other algae in algal turf, branching irregular; segments mostly 0.7–1.2 mm diameter, hollow throughout, but with regular diaphragms partitioning the axes and branches into segments 0.5–1 mm long; segments slightly constricted at each septum.

This is an alga found worldwide in tropical to subtropical localities; I have never collected it in, or seen specimens from, San Diego County. Most, or all, of the occurrences recorded by Dawson were from localities in the Gulf of California rather than on the Pacific coast of Baja California. The La Jolla record mentioned in **MAC** refers to a specimen growing on *Codium fragile* at Bird Rock, La Jolla (Abbott, pers. comm.). '*Champia*' specimens from San Diego County that I have seen were misidentified *Binghamia* or *Coeloseira* thalli.

**Gastroclonium compressum* (Hollenb.) Chang and Xia, **G. parvum* (Hollenb.) Chang and Xia
Chang and Xia 1978
Coeloseira compressa Hollenb., *C. parva* Hollenb., 566

The two species are small septate intertidal epiphytes; they are separated by the number of cells in branch walls, and by whether thalli are erect or spreading. Polysporangia (in place of tetrasporangia) are a generic character. *G. compressum* axes are described as up to 3–7 cm high, more compressed, and secondarily attached to substrates from downward-curving apices. *G. parvum* is distinguished as being mostly erect and less than 3 cm high.

Several variants, including forms typical of both species, are common, scattered in algal turf where branches are entangled over and within *Corallina* or mixed with other epiphytes. These two small species are relatively conspicuous because of the tube-with-constriction morphology, frequently with an iridescent sheen. Most axes are 3 cm or less in height and creeping, with reattached branches that are similar to erect axes. We have tried unsuccessfully to consistently separate plants in the field into one or the other entity. Both were described originally from southern California (Redondo Beach and Corona del Mar) and subsequently found in Pacific Baja California. Dawson referred intertidal thalli and subtidal thalli to both species.

The Checklist notes that the two species often occur together.

*_Gastroclonium subarticulatum_ (Turner) Kütz.
Hawkes 1986
Gastroclonium coulteri (Harv.) Kyl., 567
Thalli often to 26+ cm high, with the ultimate branchlets hollow and septate; main axes solid, 1–2.5 mm in diameter, cylindrical; irregularly branched; with tetrasporangia or polysporangia; lower parts of the branches are often dark red to black, while above the color can be more greenish.

As it is along the entire California coast, in San Diego County the species is common, but here only in shaded low intertidal habitats or in shallow subtidal areas. Axes and branches frequently appear to have been bitten off several cm above the substrate, suggesting fish grazing.

It is found in similar habitats south to Punta Abreojos in Pacific Baja California.

LOMENTARIACEAE

Lomentaria caseae Daws.
567
This species is known from only two collections, one being type material attached to _Phyllospadix_ leaves cast up on the beach at Del Mar (Dawson 1946). The second, also identified by Dawson, consisted of specimens attached to _Zostera_ at Guadalupe Island.

Lomentaria hakodatensis Yendo
569
Thalli formed of narrow, hollow, somewhat compressed tubes without septa, mostly less than 1 mm wide; these are branched in an irregular pattern, and typically taper to curved (uncinate) apices. Cystocarps are described as "prominently rostrate"; I have found only tetrasporangial reproduction in the few San Diego collections I have seen.

This is a small inconspicuous alga that grows as an epiphyte mixed with other entangled algae from low intertidal habitats. One small specimen was found in a collection from 27 m.

The species is probably usually rare as well as being inconspicuous in San Diego. The irregular branching and uncinate apical growth are maintained under culture conditions and are useful diagnostic features. The hollow undivided morphology is easily seen under low magnification where edges appear as dark borders outside the paler central region.

A single Ensenada record represents Baja California material; Dawson and Neushul (1966) allude to an intertidal collection in La Jolla.

CERAMIACEAE

Aglaothamnium cordatum (Børg.) Feldm.-Maz.

616

Thalli with regular branching from every cell in alternate spiral arrangement; in thick masses or tufts to 4 cm high; branches becoming smaller in diameter toward tips; uninucleate, thus differentiated from California species of *Callithamnion* that are multinucleate.

This is a late-summer to fall alga that is found abundantly on the docks and mudflats in south San Diego Bay, rarely in open coast intertidal sites. We have not seen reproduction. Spencer *et al.* (1981) state that, because other characters do not now appear to be well correlated with the number of nuclei in species related to *Callithamnion*, "most authors still include uninucleate specimens as *Callithamnion* species."

**Aglaothamnium endovagum* (Setch. and Gardn.) Abb.

617

Thalli partly endophytic within blade-like red algae; creeping filaments irregularly to unbranched; erect filaments to 200 µm high irregularly or rarely branched.

Reported from La Jolla (Dawson, 1945d, as a *Callithamnion* species) as an endo- or epiphyte associated with *Grateloupia abreviata* (=*G. doryophora*) in June.

**Antithamnion defectum* Kyl.

573

Specimens from San Diego County are a few mm high (less than 10), with lateral (secondary) branchlets strictly opposite, and with third-order branching only from the upper side of the branchlets. This tiny feathery-appearing species is very common in offshore subtidal sites where thalli remain beneath the summer thermocline and thus are seldom exposed to summer surface-water temperatures. We have collected it on a variety of substrates: on *Tethya* and other sponges, scallop shells, larger (*Gelidium robustum*) or smaller (*Sorella*) algae, in all months of the year, and with all reproductive phases present. Specimens range from very delicate to coarse, branches respectively <10 to >34 µm wide.

Antithamnion hubbsii Daws.

573

The species was distinguished (Dawson 1962) as having pinnate branching, gland cells, pointed branch tips, mostly prostrate epiphytic axes, and solitary unbranched rhizoids from basal cells of branches. The type and one other collection were reported from Guadalupe Island off the coast of Pacific Mexico. **MAC** records an additional collection from a shallow subtidal site near Santa Catalina Island.

We collected thalli that may represent *A. hubbsii* in July from a 27 m site near La Jolla.

**Antithamnion kylinii* Gardn.

574

We have three collections, one October and two April, that resemble *A. kylinii,* all from subtidal (23–28 m) sponges (*Tethya*). The material included tetrasporangial and spermatangial thalli.

Dawson's Checklist lists the species (as *A. secundatum*) from San Diego Harbor in December. In 1962 (**PMR 7**) he reported several subtidal collections from Cabo Colnett to Isla Magdalena in Baja California.

**Antithamnion tenuissimum* (Gardner 1927a) was described from drift material found on a La Jolla beach. He wrote that its affinities were doubtful and the branching pattern unclear. Dawson, in the Checklist, stated that it is an "exceedingly fragile, silky species 3–6 cm long. . . in La Jolla, frequent in June."

Reference to *A. tenuissimum* is omitted from **MAC**, but no citation of a transfer or combination of the name has been located. It is included here as a separate record from San Diego.

Antithamnionella sp.

San Diego subtidal collections of very small filamentous red algae include thalli with branching that closely resembles *Gymnothamnion elegans*, as shown in Figure 571, **MAC**. Basal cells of branchlets and branches are more or less of the same size as adjacent cells, and tetrasporangia are sessile on branchlet cells as in *Antithamnionella* species. This latter genus includes species with 2–5 branchlets from each axial cell; our specimens are clearly

pinnate. These distichous thalli less than 1 cm high, many from the Loma Sea Cliff, are here referred to *Antithamnionella* sp. Gland cells, clearly seen on one specimen, conform to the description for *Antithamnionella elegans* (see below) but other characteristics do not. The symmetry of branching, position of tetrasporangia, absence of gland cells on some thalli, and dimensions of these San Diego collections closely resemble *Antithamnion scrippsiana*, described by Dawson (1949a) for plants found on a *Macrocystis* holdfast floating near Santa Rosa Island. This *Antithamnion* species was later combined with *Antithamnionella glandulifera* (**MAC**), a species with large thalli, which is reported to be a common epiphyte in the low intertidal zone along the entire Pacific coast.

Antithamnionella elegans (Berthold) Price and John
Cormaci and Furnari 1988; Price *et al.* 1986
A. breviramosa (Daws.) Wollaston in Wom. and Bail., 580

Specimens from San Diego County are less than 4 mm high, with prostrate and erect uniseriate axes that grow on various subtidal substrates at depths between 13–30 m. Symmetrically whorled branchlets are 1–4 per whorl, but distichously paired or three per whorl are most often seen. Most thalli in our numerous collections contain some branches with three branchlets, although variation in this feature occurs on individual thalli. Gland cells are frequent. The longest cells in axes are from 3 to 12 times as long as wide, and cell diameter of these larger cells varies between 10 and 50 µm. Erect axes may show only unbranched short branchlets, or a pattern of secondary branching from alternate sides of the axis, usually with an unbranched (but with whorl branchlets) cell in between cells bearing branches. Whorl branchlets may have up to 16 cells, but these characteristically are distinctly smaller than axial cells. All reproductive phases are present in our collections and found throughout the year.

MAC describes *A. breviramosa* as having branchlets, mostly 3 per whorl. Cormaci and Furnari (1988) discussed the reasons for combining *A. breviramosa* with *A. elegans* and described four varieties: "within *A. elegans* the number and arrangement of whorl branchlets in different collections appears to vary within well-defined ranges. . . ." Many of the San Diego plants fall into var. *elegans* [whorl branchlets usually in whorls of 3 (rarely 2 and then distichously arranged)] or var. *sublittoralis* [". . .usually in whorls of 2 (rarely 3). . .distichously arranged"]. The variability in San Diego material could result from a developmental sequence whereby branchlet initiation and elongation, and the growth of secondary branches, are correlated with the age of the thallus.

[*Antithamnionella pacifica* (Harv.) Woll.
582
Typically, the lower axes twine together, with cells 20+ times longer than broad, gland cells are absent or rare, and one form shows hooked, curved apices. The species is reported as common on *Nereocystis,* which is not found in southern California, or on other large algae and, according to **MAC**, has been reported from "Alaska to Baja California." No records are known for San Diego County, and Dawson did not report finding it on the Pacific Coast of Baja California.]

Callithamnion biseriatum Kyl.
610
Differing from *C. catalinense* (see ff) in having blunter terminal cells, spreading apices, smaller axial cells, but otherwise vegetatively very similar. Tetrasporangia occasional, in clusters of 2–3.

Callithamnion catalinense Daws.
612
Filamentous, small thalli, uncorticated, branching mostly in one plane and pinnate; less than 15 mm tall, branchlets simple and alternate, incurved, with sharp tips.

Thalli that we attribute to this species are all from deep (17–37 m) subtidal sites and are found on a variety of substrates: several sponge taxa, scallop shells, tunicate stalks, other algae, and mixed with small forms in nests of the garibaldi fish. All reproductive phases have been found, and specimens have been collected throughout the year. **MAC** cites only two collections of this species, one from near Santa Cruz Island and another from Santa Catalina Island. If the numerous collections from San Diego County are correctly identified with this species, the circumscription of the taxon and its range should be modified to include southern California material. These collections, however, alternatively may be interpreted as forms of *C. biseriatum.* The key to *Callithamnion* species in **MAC** contrasts acute vs. blunt tips of branchlet apices or terminal cells to separate the species. The distinction is not clear when our specimens are examined.

**Callithamnion ramosissimum*, described by Gardner (1927b) as growing on *Hypnea* at La Jolla, is listed in Dawson's Checklist as a species that was commonly overlooked because of diminutive size (8–12 mm). The species was

not treated under this name in **MAC**, and we have not located other references to the epithet.

**Callithamnion rupicolum* Anders.
613
Thalli less than 1 cm high, branching regularly alternate, but variably pinnate to bipinnate, or mixed; branchlet apices recurved or straight.

Such thalli have been found as intertidal epiphytes at all seasons, and all reproductive phases are represented in San Diego County material. They are often found on species of *Corallina* and on *Pterocladia capillacea*, but are not restricted to these particular taxa

Along the entire coast of California this species is common on other algae in the intertidal. Abbott refers to several variants that in **MAC** are treated as a single species. These include forms attributed to *C. breviramosum* and *C. rigidum* from Baja California. Dawson lists these, as well as *C. rupicolum*, as occurring south to Isla Magdalena.

**Centroceras clavulatum* (C. Ag.) Mont.
604
Filaments form dense dark-red clumps; individual axes are sparsely branched, often appearing mostly dichotomous; tips abruptly incurved, characteristically forcipate (pincer-like); minute spines protrude from each segment; thalli break easily at nodes.

Seasonally this alga grows epiphytically over large areas of the beach on the surface of algal turf, attached to larger thalli, or directly to rocks in tide pools. It is conspicuous by the contrast between its dark color and the usually paler basiphyte thalli and is most abundant in fall and winter months. Tetrasporangial and spermatangial plants have been collected locally.

This is a species known from most parts of the world with warm temperate to tropical waters. Thalli are easily recognized by the pincer-like tips of branches, the minute spines, and the manner in which they break when filaments are handled.

Ceramium species are recognized by the presence of comparatively large axial cells and by bands of much smaller corticating cells that encircle the filament at the base of each axial cell, obscuring the junctions between the larger cells. *C. californicum, C. clarionense, C. flaccidum,* and *C. zacae*? clearly show this

characteristic in all thalli, both apically and basally. Four other species, *C. codicola, C. eatonianum, C. pacificum,* and *C. sinicola* are more extensively corticated; usually filaments are entirely covered with a layer of very small cells, or the large axial cells are exposed only in younger portions. The unifying pattern, however, can be recognized because the layer of outer cells does not obliterate the outlines of the inner cells. Keys often distinguish species by the relative straightness vs. curvature of apices, but I have not found this useful for most local collections.

**Ceramium californicum* J. Ag.
594

Corticated only at nodes; thalli of San Diego specimens less than 1.5 cm high, lower axes to 130–200 µm diameter, sparsely branched; branch dichotomies relatively closely spaced above, and branches slender, 40–60 µm near the apices that are slightly curved inward (forcipate).

Most thalli I identify as this species grew on *Sarcodiotheca gaudichaudii* (*Neoagardhiella*) or scallop shells, 15–30 m on isolated rock outcroppings of La Jolla Bay or near the heads of the submarine canyons. Collections during late winter to early spring months have included all reproductive phases.

Intertidal *Ceramium* specimens on *Sarcodiotheca gaudichaudii* (*Neoagardhiella*) tend to resemble *C. gardneri,* which is similar to *C. californicum.* On the Pacific coast, *C. californicum* is reported (**MAC**) from low intertidal or subtidal habitats, between northern Washington and Baja California and *C. gardneri* from rocks in the low intertidal from British Columbia to the Channel Islands of California.

Dawson reported *C. californicum* from several localities as far south as Bahía Magdalena.

Ceramium clarionense Setch. and Gardn.
595

Thalli corticated only at nodes, relatively coarse, with straight apices; often three or more tetrasporangia per node protruding in whorls; the gland cells easily recognized in this species. San Diego specimens to 15 mm high.

This is apparently everywhere a small epiphytic species; we find isolated tufts on larger algae mostly between early summer and fall on intertidal beaches. Tetrasporangia are frequently found; gametangial thalli are rare.

Records cited in **MAC** indicate this is a warm-water species; the type locality

is Revillagigedo Islands, Mexico, and it occurs south to tropical waters near Oaxaca.

**Ceramium codicola* J. Ag.

600

Small, completely corticated *Ceramium* thalli that grow on *Codium fragile* are generally identified as this species; it is recognized microscopically as having inflated, pigmented basal rhizoids that grow into the soft *Codium* thallus. Older *Codium* thalli on intertidal beaches often are covered with patches of dark reddish-brown epiphytes, and *C. codicola* is common among these.

**Ceramium eatonianum* (Farl.) DeToni

600

This completely corticated species is relatively large among San Diego species of the genus, up to 4–5 cm high; gland cells at nodes are easily seen with a microscope, allowing certain identification.

This is one of two common, and often very abundant, intertidal *Ceramium* species. I have collected it throughout the year on numerous algae (often covering *Pterocladia capillacea*), and fertile plants are frequently found. Some of the specimens show conspicuous proliferous branching such as characterizes *C. pacificum*, but other features, including the difference in color ascribed to the two species, lead us to identify all the intertidal plants as *C. eatonianum*. This species extends south to Isla Magdalena, Baja California.

Ceramium flaccidum (Kütz.) Ardissone

Womersley 1978

C. gracillimum var. *byssoideum* (Harv.) Maz., 597, and *C. taylorii* Daws. 598

(After Womersley:) Thalli slender, variable in height, mostly 0.5–5 cm, usually growing as epiphytic tufts; prostrate basal filaments producing several to numerous erect axes; branching alternate or subdichotomous, occasionally with moderately short laterals near apices, becoming denuded in lower parts where the red-brown nodes contrast with the colorless, uncorticated, internodal region that consists of a single elongate cell; internodal space up to 8 times as long as node. Branch dimensions variable, partly correlated with the degree of water movement (100–250 µm wide below, 60–100 µm above). Each of the 6–7 cells in the first ring of nodal cells (periaxial cells) cuts off two cells above, but only a single, laterally elongate cell below; this may later divide into 2–4 cells, or may cut off one or two additional cells. Above the original periaxial cells, chains 3–4 cells long are produced. (In Australian specimens, a few outer cortical cells are formed occasionally, some becoming gland-like

and others producing slender hairs. I have not observed these features in California plants.) Tetrasporangia in whorls of 2, less often 4–7, with prominent involucre. Distribution is probably cosmopolitan in cold-temperate to tropical seas.

Thalli of this species, together with *C. eatonianum* and *Centroceras clavulatum*, are the most abundant and widespread small, red filamentous epiphytes in intertidal habitats in San Diego County. [MAC reports that *C. gracillimum* var. *byssoideum* is rare in California, while *C. taylorii* is "occasional" in southern California.] *C. flaccidum* is extremely fine and delicate, easily recognized by the elongated internodes contrasted with narrow nodal bands and the darker apical regions where central cells have not yet elongated (Figure 9). Womersley examined many eastern Pacific species from México and included *C. masonii* and *C. fimbriatum* from Mexican coasts, in addition to the two cited from California, in the synonymy of *C. flaccidum*.

We find all reproductive phases in fall months, peak abundance is in October, and thalli are more common on beaches of La Jolla than south of Ocean Beach. It has been reported (as *C. taylorii*) north only to Los Angeles County.

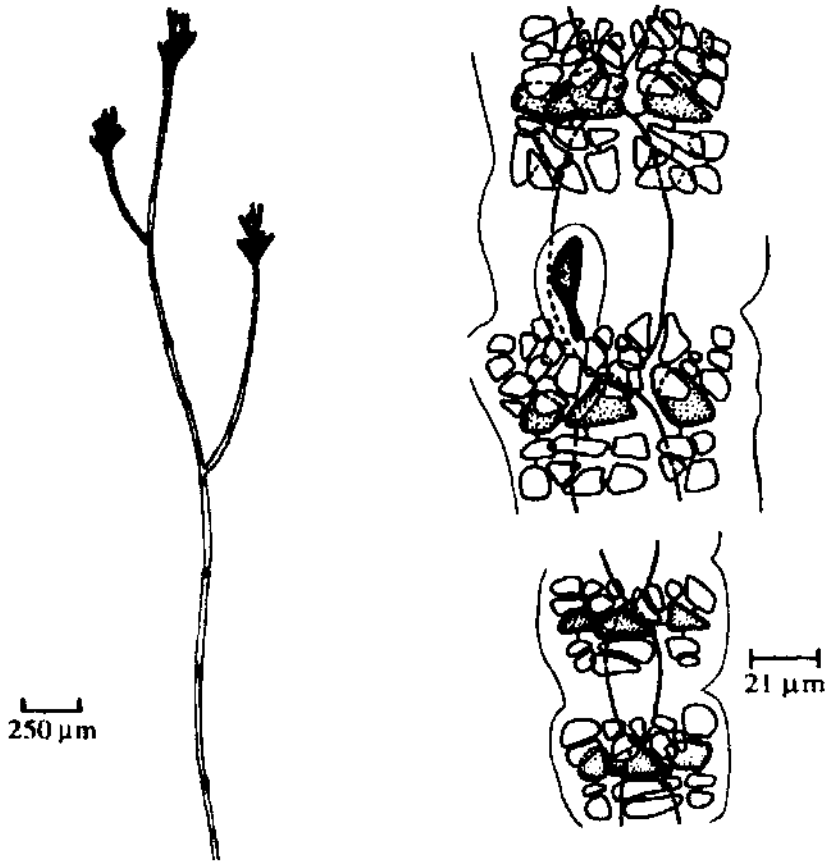

Figure 9. *Ceramium flaccidum*. Branch (left) and nodal cortication pattern (right, from Womersley 1978).

Ceramium pacificum (Coll.) Kyl.

600

Thalli completely corticated, clear pink-red in color, branches 200–300 μm in diameter with relatively long intervals between dichotomies; heavily proliferous with short radial branchlets, apices nodding or forcipate, corticating cells small, some more elongate in older basal nodes; tetrasporangia immersed in cortex on branches, irregularly distributed.

We find small, 1–2 cm high, thalli of this species on *Sarcodiotheca furcata* and *S. gaudichaudii* (*Neoagardhiella*) or on shells or small rocks on the sand in La Jolla Bay, 17–23 m. Small thalli often show only primary regular dichotomous branching, lacking the short branchlets that are described as diagnostic for the species.

MAC records it "to Baja California and the Gulf of California"; Dawson (1962) listed it in **PMR 7** on the basis of a drift collection from just south of Punta María, Baja California. It was considered by him (Dawson *et al.* 1960) to be associated with kelp beds in southern California.

Ceramium sinicola Setch. and Gardn.

602

Thalli completely corticated, except occasionally in younger filaments; epiphytic, usually less than 3 cm high; branches taper gradually from base to apex, with apices often straight on longer axes, forcipate on younger branches; tetrasporangia embedded in cortical bands.

This species is frequently found when basiphyte algae of intertidal algal turf are examined with low magnification, but thalli are not easily recognized in the field because clumps consist of only a few sparsely branched filaments in many cases and are inconspicuous. Nevertheless, it has been found in all intertidal turf study sites, somewhat more often in fall to spring months, and is easily collected from *Pterocladia capillacea* and *Corallina* with all reproductive phases present.

Distributed (**MAC**) south of Santa Barbara, indicating warm-water affinities. Type locality is Bahía Todos Santos, Baja California.

Ceramium sp. (*zacae*? Setch. and Gardn.)

598

C. zacae is distinguished in Abbott and Hollenberg's key to *Ceramium* (**MAC**) by being corticated only at nodes, with forcipate apices and

conspicuous tetrasporangia, 1 or 2 per node. These are characteristics seen in many of our subtidal collections of small *Ceramium* thalli (less than 1 cm high), which cannot be clearly attributed to any other species, yet which, in other respects, do not conform to the description of *C. zacae*. We have collected cystocarpic and spermatangial specimens, but the identification remains tentative.

C. zacae was described from Bahía San Bartolomé, near Bahía Tortugas, in central Baja California in 1937, and since then has been reported only a few times from low intertidal habitats over a wide geographical range. This is one of many species of *Ceramium* that was first described on the basis of single or few specimens; in this instance, the type material cannot be located (P. Silva, pers. comm. 1981) in the Herbarium of the California Academy of Sciences. An extensive study of eastern Pacific *Ceramium*, such as Womersley's for southern Australia, is definitely needed.

**Griffithsia furcellata* J. Ag.
621

Thalli with large cells, long and narrow compared with cells of *G. pacifica*; dark rose-red in color; subdichotomously branched, 120–270 µm in diameter, 4–5 times as long basally; tetrasporangia single at nonforking nodes, on pedicels of 1 or 2 cells without involucre or trichoblasts; spermatangia in small terminal oval heads.

This species is reported as rare and subtidal in California; the single locality listed (MAC) is Newport Bay, in Orange County. Dawson describes it as a species of quiet water, either sheltered bays or in deep, clear-water sites. We find it abundant in San Diego Bay in clumps to more than 7 cm high on piers or docks in the late summer (July–November). It has also been collected from the La Jolla Submarine Canyon. Fertile thalli are rare; cystocarpic plants have not been found here.

Dawson's Checklist, without giving a San Diego locality, describes it (as *G. multiramosa*) as finely branched, bright pink, very delicate, 5–10 cm high.

**Griffithsia pacifica* Kyl.
621

Filamentous thalli of large cells (1–2 mm diameter) visible to the unaided eye, conspicuously dichotomously branched; found mostly as small isolated tufts less than 3 cm high, with basal cells attached to substrates by rhizoids.

Single thalli occur on other algae, on rocks, shells, sponges, in garibaldi nests, probably indiscriminately on subtidal surfaces to 27 m; all reproductive phases have been found on San Diego thalli. The cells are very delicate and quickly begin to turn orange-pink when handled or damaged. When alive, in fresh collections, they are clear, bright pink and easily picked out from other algae or debris.

M. coulteri Harv. [**Microcladia californica* Farl.]
606

These two species are both completely corticated with regular alternate distichous branching, often symmetrical throughout the frond. Both are delicate-appearing epiphytes that are restricted to certain larger red or brown seaweeds. In MAC they are separated by the presence (*M. coulteri*) or absence (*M. californica*) of an involucre around the cystocarp; Abbott writes that the vegetative limits of the two species are confused.

Microcladia thalli are rare in San Diego County; I have found specimens in the low intertidal zone on *Gigartina canaliculata* and subtidally on *G. exasperata*.

Dawson (1945d) reported finding *M. coulteri* in central and northern Baja California and in San Diego. A recent study (Gonzalez and Goff 1989) has demonstrated other differences between the two species, while establishing that presence or absence of an involucre surrounding the cystocarp is not a reliable distinction. The authors note that they have "not seen specimens of *M. californica* from south of the Monterey Peninsula," indicating that San Diego collections are likely to be *M. coulteri*.

Neoptilota densa (C. Ag.) Kyl.
632

(*Ptilota* C. Ag. has been conserved requiring transfer of species presently assigned to *Neoptilota* Kylin.)

Thalli large, feathery, dark red, to 30 cm high; axes compressed, to 3 mm wide, with dense "fringe" of short branchlets; irregularly branched; branchlets curved, sickle-shaped, smooth on margin facing the axis, serrate on opposite margin, and each of these opposite a small branch rudiment that bears reproductive structures.

The branching arrangement that is diagnostic for this species and the variations that distinguish other species of *Neoptilota* cannot be seen clearly without magnification. We have collected the species once, on a rock ledge

about 1.6 km south of Pt. Loma, 17–20 m, in November. There it was associated with other algae that are typically found to the north, or in the pockets of colder water to the south; Dawson (1962) recorded *N. densa* from such sites on the coast of Baja California. He also listed (1945d) *N. californica* (as *Ptilota)* as an epiphyte on *Gelidium* at La Jolla. *Neoptilota* species are very rare in San Diego County.

Platythamnion pectinatum Kyl.
588

Thallus uniaxial, uniseriate, entirely uncorticated, 4 branchlets per whorl on lower axial cells, with two opposite long branchlets at right angles to two opposite short branchlets. Branching from these longer branches from the upper side only, regularly arranged and of similar length and these branchlets also pectinately branched. Thalli in central to northern California to 5 cm high; axial cells 2–3 times as long as wide, or much shorter.

The whorled branching from every axial cell and on older cells of major branches gives thalli a dense fuzzy appearance; a microscope is required to see the details of branch arrangement. This species has been collected several times from rocks in La Jolla Bay at 22–27 m, but the specimens are all less than 1 cm high and were found on other algae or pieces of sponge or rock that were collected and examined under low magnification.

Dawson did not find the species on Pacific Mexican coasts.

Platythamnion villosum Kyl.
590

Thalli similar in size and morphology to San Diego specimens of *P. pectinatum*; where *P. pectinatum* bears several short branchlets from the upper sides of cells of the longer branches, *P. villosum* bears 1 or 2 from the upper side of each of the branch cells, and one from below. Each of these is only a few cells long, and all are of similar length, giving the thallus a densely spiny appearance. **MAC** notes that this is a common species in low intertidal to subtidal sites between Alaska and Baja California.

In San Diego County the species is more frequently found than is *P. pectinatum*, but only below approximately 13 m subtidally. We have found it on tunicate stalks, shells, stipes of *Pterygophora*, sponges, and in algal turf in garibaldi nests. Thalli have been found throughout the year, reproductive between January and August.

Dawson (1962) recorded the species from Bahía Blanca and Punta María in central Baja California.

**Pleonosporium squarrulosum* (Harv.) Abb.
618

Thallus of uniseriate branched filaments, mostly less than 1–2 cm high, with branching regularly alternate from opposite sides of the main axes and branches; main axes strongly percurrent and distinctly larger than lateral branchlets; lower axes with at least light cortication over basal cells (in northern collections larger specimens are more extensively corticated). Polysporangia (a feature of the genus) with 32–64 spores, on short stalks and terminating alternate branchlets; the spermatangial branchlets also terminal on alternate branchlets.

The specimens we find in the same habitats, on the same basiphytes and invertebrate substrates with *P. vancouverianum*, are seldom conspicuously corticated, and usually we must examine the lower axes very carefully with a microscope in order to confirm the presence of even short corticating filaments; otherwise thalli of the two species are vegetatively similar. All San Diego collections are very small (*P. squarrulosum* is recorded as growing up to 20 cm high elsewhere) and grow intertidally as well as subtidally.

Dawson recorded this species from San Diego (1945d; Dawson and Neushul 1966) as *P. polycarpum* and *P. pygmaeum.*

Pleonosporium vancouverianum (J. Ag.) J. Ag.
620

Thallus of uniseriate uncorticated branched filaments, mostly less than 1–2 cm high, with branching regularly alternate from opposite sides of the main axes and branches; the distinguishing feature of the genus is the presence of polysporangia (in place of the tetrasporangia that occur in similarly branched *Callithamnion* species); spermatangia in this species develop on alternate sides of lateral branches. A compound microscope is necessary to evaluate these reproductive states in the two *Pleonosporium* species. Our mostly subtidal collections of *P. vancouverianum* are usually less than the 2.5 cm height recorded for northern specimens.

Several species of tiny uniseriate filamentous algae are found almost ubiquitously subtidally. *Antithamnion defectum* and *Antithamnionella elegans* have distinct branching patterns, *Tiffaniella* is irregularly branched, and the cells are relatively long and narrow, while species of *Ceramium* have characteristic internodal cortication. *Pleonosporium vancouverianum* is as common as any of these, and even without reproductive features can be tentatively identified by a process of elimination. Subtidally it occurs on

numerous substrates including other algae; we have collected it only rarely from (low) intertidal habitats. The species is found throughout the year, often reproductive.

Ptilothamnionopsis lejolisea (Farl.) Dix.
626
Thalli of minute filaments, monosiphonous, uncorticated, with colorless prostrate branched axes; erect axes pigmented, very sparsely branched, deep red, 1–2 mm high, forming tufts at the joints of articulated corallines (in San Diego, usually *Calliarthron*); the few branchlets tend to be from only one side of axes; all parts similar in diameter, little tapering toward blunt apices; cells nearly as long as wide.

The type locality for this species is San Diego, where it is very abundant and common on collections of subtidal *Calliarthron*. We have collected it throughout the year, with all reproductive phases easily found.

**Scagelia pylaisaei* (Mont.) Wynne
Wynne 1985c
Scagelia occidentale (Kyl.) Woll., 584
Thalli of uniseriate filaments, with branching in whorls of 3 (or 2,4) and branchlets of unequal length on each axial cell; gland cells often numerous on lower cells of branchlets; branching usually at intervals of 1–4 axial cells.

This species was described as a species of *Antithamnion*, then later transferred to a newly described genus. If the whorled branchlets were not uneven in length, the specimens from San Diego that we attribute to the species could be included among the variable forms we consider to represent *Antithamnionella elegans*. Our specimens show three branchlets per whorl and gland cells are lacking. Basal cells are slightly smaller than distal cells in branchlets, and branches are up to 60 µm in diameter. Intertidal on rocks, La Jolla, January.

Dawson does not record the species from Pacific Mexico; it is recorded in his Checklist as a species of *Antithamnion* from rocks near Scripps Pier, La Jolla in May.

**Spyridia filamentosa* (Wulf.) Harv.
608
Thalli terete, bushy, richly branched, cortication in bands on all axes and

branches, with short spine-like uncorticated branchlets giving a fuzzy appearance to the entire thallus; to 20 cm high, deep bright red in color.

In some years, this is very abundant in mid to late summer months. Thalli attach to other algae in such profusion as to cover all other vegetation in tide pools or shallow channels, or on low rocks in the upper intertidal zone, commonly on La Jolla beaches near the Beach and Tennis Club and in the area around Bird Rock. It is most abundant where there is less surf in summer and surface water temperatures become relatively warm during periods with little wave action to mix water layers. This observation about small scale local distribution is consistent with the geographic distribution in subtropical and tropical regions.

Dawson described it as an "abundant summer annual in the warm bays of Baja California, south of Bahía San Quintín"; its apparent absence in northern Baja is further evidence that the algal vegetation between Santa Barbara and central Baja consists of disjunct associations that are related to local patterns of water circulation rather than presenting a gradually changing north-south continuum.

**Tiffaniella snyderae* (Farl.) Abb.
624

Uniseriate, uncorticated filaments; branching in upper parts often from one side of the filament and irregular; with low magnification the narrow cells appear distinctly longer than cells of most other small filamentous algae; 2–3 cm high, occasionally to 4–5 cm in very low intertidal or shallow-water sites that are shaded; the plants can form dense clumps or mats appearing deep red, but individual thalli appear pale; basal axes often form a mesh in sand from which erect branches develop; all axes and branches of similar width and dimension.

The uniform height and width of axes and branches, combined with the often densely aggregated growth habit of the thalli, make them easily recognized where they appear as a dark red fuzz. In this form, thalli cover sandy ledges of the low intertidal region near the border of *Phyllospadix* beds, mostly on beaches with moderate to heavy surf. Here it is associated with *Anisocladella* and *Pogonophorella*, taxa that also grow where sand accumulates. It occurs in subtidal turf and often is a component of the filamentous mat in garibaldi nests. All reproductive phases are present in both intertidal and subtidal collections. In place of tetraspores, this species bears polyspores. Without observing this character, however, one can easily identify the species because no other of the small, filamentous taxa is so irregularly branched nor has cells so long in proportion to breadth (10–20X).

DELESSERIACEAE

**Acrosorium venulosum* (Zan.) Kyl.

Wynne 1989

Acrosorium uncinatum (Turn.) Kyl., 659

Small irregularly branched thin, pale, asymmetrical blades, tending to linear in shape; microscopic veins irregularly branched; usually epiphytic, low intertidal zone to 30 m in the offshore canyons; to 5 (10) mm wide, and 10 cm high, with narrow tips that often are curved or hooked (uncinate); tetrasporangia are found rarely, gametophytes not found locally.

Thalli are easily recognized when they grow in clumps or masses over other algae. Subtidal clumps of thalli can be conspicuous on rock or worm tubes, as well as growing epiphytically. They are collected from these deep sites at all seasons. McPeak has found it very abundant south of Pt. Loma at 12–15 m depth.

The microscopic veins of *Acrosorium* thalli probably can be recognized only with magnification; in intertidal habitats *Cryptopleura* blades may be similar, but the basally thickened region, the rounded or ruffled margins, and the duller color will usually identify them as *Cryptopleura*. Subtidally, other morphologically asymmetrical, veinless small blades (*Nitophyllum hollenbergii, Cryptopleura*) can grow on the same surfaces with *Acrosorium*, but the uniform thinness, linear shape, tapering or curved apices, and the color of *Acrosorium* set it apart.

A recent study (Wynne 1989) presents evidence that the alga with a worldwide distribution in cool to warm temperate waters that is currently known as *A. uncinatum* is typified by material now identified as *A. venulosum*, requiring the application of this name to California specimens.

Anisocladella pacifica Kyl.

653

Thalli are symmetrical, small, leaf-like blades, linear, never oval, with distinct midrib, lateral veins and dentate margins; erect blades mostly 2–4 cm high, to 0.5 cm wide; between veins and midrib the blade portion is one layer of cells thick, giving the plants a fragile appearance. Reproductive structures form between veins, away from midrib. Blades develop from prostrate axes that usually are buried in sand, or attached to rock, sediment or *Phyllospadix* rhizomes. (See Figure 10, and comment for *Phycodrys profunda.*)

Dawson *et al.* (1960) recorded this species to 13 m in kelp beds; we find it only in the low intertidal zone, typically restricted within or near *Phyllospadix* beds where it occurs mingled in sand with *Tiffaniella snyderae* and *Nienburgia*

andersoniana. All reproductive phases have been found here. This species was recently found in central Chile; otherwise, it is known only from the Pacific coast of North America.

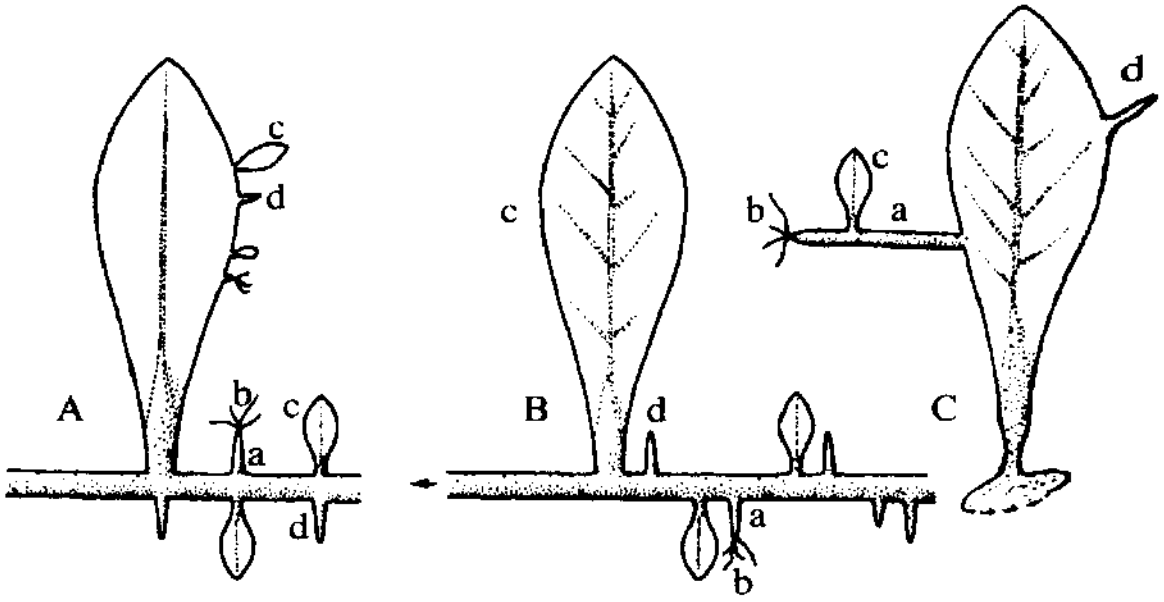

Figure 10. Thallus patterns for (A) *Nienburgia andersoniana*, (B) *Anisocladella pacifica*, (C) *Phycodrys profunda*. Arrow indicates direction of apex in (B). (a = hapteron, b = rhizoids, c = secondary blade, d = spine).

Apoglossum gregarium (Daws.) Wynne

Wynne 1985b

Phrix gregarium Stewart 1974

Unbranched blades on short branched stipes, less than 1 cm high, 1–2 mm wide; larger blade surfaces often rippled, undulate from the margin into the midline, younger blades more flat; distinct single apical cell and symmetrical lateral rows of cells; central line of extremely elongated cells; single or several blades from basal axes (Figure 11). This is a delicate, almost microscopic alga that is not rare, but difficult to recognize without magnification. It is collected from sponges, masses of bryozoans, algal turf in nests of garibaldi fish, or among other small blades and filaments in subtidal rocky habitats. Reproductive as well as vegetative thalli have been found at all times of the year, in sites beneath the summer thermocline between La Jolla Bay and the outer kelp beds off Pt. Loma (approximately 17–28 m). Elsewhere, specimens have been collected by R. Moe subtidally at the Galápagos Islands and off Palos Verdes in Los Angeles County, and by J. R. Stewart at San Benitos Islands, Mexico. The type specimens (few and damaged) were dredged from 8–16 m, growing on a hydroid, in the southern Gulf of California and identified by Dawson (1966) as a new species of *Hypoglossum*.

Our southern California specimens appear conspecific with Dawson's Gulf

collection. With additional San Diego material available for study, it was found that the species differed in several attributes from the presently accepted limits for *Hypoglossum*, and a new genus (*Phrix*, referring to the deep blade ruffling) was described (Stewart 1974) to accommodate the Dawson type material as well as the collections from southern California. Wynne (1985b) examined the type specimen of *Phrix* (*Hypoglossum*) *gregarium* and offered the opinion that characteristics shared with *Apoglossum* warrant the combination as *A. gregarium*.

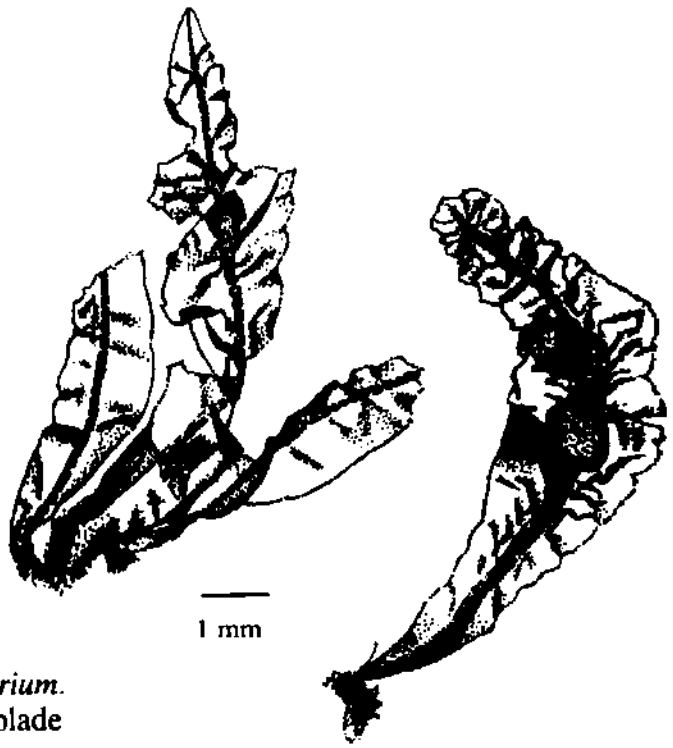

Figure 11. *Apoglossum* (*Phrix*) *gregarium*. Clump of blades (left) and blade with cystocarp (right).

Asterocolax gardneri (Setch.) Feldm. and Feldm.
658

This species appears as a cluster of pale, very narrow leaflets on blades of larger leaf-like red algae. The entire thallus is 2–3 mm diameter with leaflets 1–3 mm long, and thus is seen only by scanning other algae under low magnification. We have found specimens on *Anisocladella pacifica* in a low intertidal habitat, and on *Phycodrys profunda* from the Loma Sea Cliff.

Branchioglossum undulatum Daws.
636

Small delicate blades with distinct midribs; branching from near base of blade into 1–3 lobes or from stipe; small discoid holdfast; blades pink, with undulate, slightly ruffled margins, 1–2 cm high, 2–5 mm wide.

Dawson (1949a) stated in the description of the new species, that compared with *B. woodii*, the blades are shorter, broader, conspicuously undulate and

apices usually more obtuse. In both species blades may branch pinnately, and new blades develop from margins. *B. undulatum* is frequently found and easily recognized subtidally off San Diego, mostly 10–20 m, rarely as shallow as 5 m, occasionally reproductive.

Branchioglossum woodii (J. Ag.) Kyl.
637
Thalli of small linear blades, 1–3 mm broad, 1–2.5 (7) cm high, with a percurrent primary blade/axis that branches from margins.

Small specimens resemble less-branched thalli of *Branchioglossum undulatum*. I have not found larger, more complexly branched specimens from San Diego County sites that could be unquestionably identified as *B. woodii*, and many older references are dubious. The species is included here to point out an apparent extremely disjunct distribution. Dawson (1962) lists no records from southern California or the Pacific coast of Baja California north of Bahía Vizcaíno. The species is, however, well-known both from cold-water localities to the north (British Columbia to central California) and from southern Baja California and the Gulf of California.

**Cryptopleura corallinara* (Nott) Gardn./ **C. crispa* Kyl.
666
These two species are very similar. Both have thin broad blades with microscopic veins that can be seen by holding the blade up to the light; a heavier midrib develops in the basal part; blades often are broader toward the apex, with ruffled or undulate margins; tetrasporangia occur in sori along margins or in small marginal leaflets.

In San Diego County one finds numerous morphological forms of *Cryptopleura* thalli, some mostly adherent to the basiphytic alga, some with both adherent and erect free blades. These thalli are common on *Corallina* species, on *Pterocladia capillacea*, or *Gelidium* in the low intertidal and subtidal sites. Very similar non-epiphytic forms grow in the same habitats on rocks and *Phyllospadix* rhizomes. Abbott (**MAC**) suggests that in the northern part of California, broad small *Cryptopleura corallinara* plants are often difficult to separate from young *C. violacea*. I find that young *C. lobulifera* thalli resemble non-epiphytic *C. crispa* in central California. Size and position of sori are not necessarily useful criteria to separate species, and both *C. corallinara* and *C. crispa* grow on *Corallina* (**MAC**). Many of the small subtidal specimens from *Calliarthron* or *Gelidium robustum* are likewise difficult to segregate. *C. violacea* in San Diego County is retained for the more narrow, ribbon-like forms.

Type localities for both *C. crispa* and *C. corallinara* are in San Diego County.

**Cryptopleura farlowiana* (J. Ag.) Ver Steeg and Josselyn
Ver Steeg and Josselyn 1983
Botryoglossum farlowianum (J. Ag.) DeToni, 671
[Scagel *et al.* (1986, p. 244) comment that the combination proposed by Ver Steeg and Josselyn is invalid because they did not cite the basionym.]

Thalli deep rose to brownish red; erect axes 10–50 cm tall, blades to 4 cm wide, with broadly rounded to blunt apices, margins with ruffles and proliferations; larger than other similar *Cryptopleura* species and not epiphytic as are other *Cryptopleura* taxa.

This is one of several taxa that in San Diego are largely restricted to the rocky subtidal off Imperial Beach. The specimens resemble very closely those common in central and northern California, including the variability discussed in **MAC**. Ver Steeg and Josselyn (1983) found that the location and shape of tetrasporangial sori, in combination with margin morphology, were the most useful taxonomic characters for distinguishing the three *Cryptopleura* species of their study. They concluded that there is no evidence to support continued segregation of *Cryptopleura* and *Botryoglossum* on the central California coast; I concur in their judgement for San Diego County specimens.

Cryptopleura rosacea Abb.
668
Thalli growing in clumps on rocks, flabellately branched in ribbon-like lobes 5–10 cm high, branches 2–3 cm broad, ultimate divisions with blunt to spatulate apices.

We list this species here to note that *Cryptopleura* specimens similar to the forms described for *C. rosacea* are occasionally found; the collections we have seen probably represent dense clumps of *C. crispa*. Superficially they can be confused with *Carpopeltis*. Published records for *C. rosacea* refer only to drift specimens at Carmel in central California.

**Cryptopleura violacea* (J. Ag.) Kyl.
668
Thalli of slender, long, ribbon-like blades, to 25 cm high, deep rose to blackish, or greenish pink; tending to dichotomous divisions, sometimes broader and more flabellate near the tips; lower midribs often appear as stipes after the blade portion has been eroded away; margins undulate, or with proliferous leaflets. Monostromatic with veins as are all species of *Cryptopleura*.

In San Diego, this species is characteristically found under or near *Phyllospadix* in shaded low intertidal habitats, or subtidally on *Gastroclonium subarticulatum, Pterocladia capillacea*, and *Corallina* axes. To compound the confusion discussed for *C. corallinara/C. crispa* (above), Abbott has written that the forms included in *C. crispa* in southern California could easily be grouped with small young *C. violacea* in the north, suggesting that throughout the Pacific coast range of these several species, there are either 4 species that overlap in distribution and morphology, or 1–3 highly variable species.

Erythroglossum californicum (J. Ag.) J. Ag.
648

Thalli with long leaf-like blades, bright pink, with midrib and dentate margins. Larger specimens appear less leaf-like, with branches to 12 cm high, 2–5 mm wide, and lateral blade portions near the base so eroded that the midrib appears as a stipe with blade tissue present only along the upper portions of the thallus. Abbott (**MAC**) mentions misidentifications (as *Erythroglossum*) of *Anisocladella pacifica* and *Sorella delicatula* specimens. *Erythroglossum californicum* is a very rare alga, with probably only 2–4 verified records from California south of Santa Barbara (type locality). We have found two collections washed up on on the beach at Imperial Beach after winter storms, in different years.

A plant Dawson cites as the only record for Baja California was re-examined by Abbott and found to be a specimen of *Sorella delicatula.* A study in progress indicates that the name and taxonomic position of *E. californicum* is likely to be shifted in the near future.

Gonimophyllum skottsbergii Setch.
673

Thallus a rosette of simple or lobed blades; considered to be a "parasite" on blades of species in the family Delesseriaceae; clumps less than 1.5 cm diameter, pale pink, blades individually 1–3 mm high with ruffled margins.

Dawson (1945b) cited a single specimen on *Cryptopleura violacea*, 20 m deep off Pt. Loma in 1943, for the only known San Diego record.

**Holmesia californica* (Daws.) Daws.
640

Thalli with flat, dark red, broad (4–7 cm) blades, 8–15 (20) cm high; branched near base, with undulate margins; primary midrib present below, lacking above; young blades membranous, thicker and leathery when older and

reproductive; reproductive structures on papillae (small leaflets) that develop on the surface of upper parts of blades.

Type locality, Loma Sea Cliff, dredged in 25 m, March 1944. Since this species was first found in San Diego County, it has been collected to the north as far as British Columbia. **MAC** reports that there are several localities in northern California where it is frequently collected subtidally. A single collection is known from Baja California (Punta Santo Tomás); to our knowledge it has not been relocated in San Diego County.

[***Hymenena*** species
660–664
No specimens of any *Hymenena* species are reported south of San Luis Obispo; the occasional thalli from the Imperial Beach area that resemble species of *Hymenena* (*flabelligera?*) probably represent forms of *Cryptopleura* (*Botryoglossum*) *farlowiana*, an uncommon species in San Diego County and in several localities on the coast of Baja California.]

Membranoptera weeksiae Setch. and Gardn.
639
Thalli small ribbon-like thin blades, each with a distinct percurrent midrib from the base to near the tip; blade portions to either side one layer of cells thick, thus very delicate and thin, no apparent lateral veins; entire thallus usually less than 4 cm high (in San Diego), clear pink in color.

These are not common, but occasionally abundant on articulated corallines (*Calliarthron* or *Bossiella*) below 17 m, often 23–33 m. All fertile phases have been found in late summer collections, but an April collection contained both tetrasporangial and spermatangial thalli. They are often eroded, damaged, and not easily distinguished among other thin-bladed epiphytes (i.e., *Nitophyllum hollenbergii, Sorella* spp.) that occur on the same basiphytes.

No specimens have been recorded from localities south of San Diego, although it is unlikely that the range does not extend into Mexican waters.

Myriogramme caespitosa Daws.
654
Thalli form clumps of soft, thin, rose-pink blades, mostly less than 1 cm in widest dimension, prostrate, secondarily attached to rocks or other algae by numerous peg-like disks that grow from the surfaces of the blades

(*Cryptopleura* species also re-attach in this manner); blades overlap, margins are more or less ruffled, and venation is completely absent.

Most small blades that are one layer of cells in thickness and that lack any midrib or veins, such as are common on other subtidal algae, are probably best attributed to *Nitophyllum hollenbergii*, although vegetatively many of the specimens resemble forms described as *Myriogramme caespitosa*. This latter species is said to have chains of carpospores, however, and on the thalli we have examined all carpospores have been only terminal, as is characteristic for species of *Nitophyllum*. We list this small *Myriogramme* species only to call attention to the occurrence of small forms that often vegetatively resemble *M. caespitosa*; at present we know of no material that definitely documents this species or any other representative of the genus for San Diego County.

**Nienburgia andersoniana* (J. Ag.) Kyl.
653

Thalli with prostrate axes that branch to form either new prostrate axes or bear widened blades that branch to form new blade portions; blades are conspicuously dentate, with a thickened midrib in lower parts, but lack lateral nerves; blade portion polystromatic; rose-pink, bright or dull, often with a greenish iridescent sheen when wet. The erect branches (axes) vary in width, from 1 to more than 12 mm wide, and thalli are to 20 cm high.

In low intertidal habitats, often under *Phyllospadix*, the symmetrical leaf-like blades are easily recognized by the marginal teeth, the distinct midrib, and by the presence of creeping, narrow axes that broaden and merge into erect axes that bear lateral blades (Figure 10). Subtidally to 27 m, often in kelp beds, where thalli often are larger, less prostrate, occasionally epiphytic (on *Gelidium robustum, Corallina* species, *Bossiella*, or *Macrocystis* holdfasts). Both gametangial and tetrasporangial plants have been found intertidally and in the Mission Bay Channel during late fall to winter months.

Nitophyllum hollenbergii (Kyl.) Abb.
658

Thalli 1–2 cm high, blades on short stipes, branched or unbranched, narrow or broadly ovate, with rounded or divided apices; blades are one layer of cells thick throughout, without midribs or veins.

The small, broad blades of this species, variously shaped and with ruffled margins, are found frequently in nests of garibaldi fish, on *Calliarthron* and other large thalli, and among small algae on rock surfaces subtidally 8–37 m. Fertile specimens are found at all times of the year. At present we include with *N. hollenbergii* all small monostromatic blades lacking venation although

thalli often resemble the forms described for *Myriogramme caespitosa* (above). *Cryptopleura* species grow on the same algal basiphytes; these can form small blades that also are ruffled and monostromatic but with the aid of a microscope veins can be detected. The presence of a thickened basal midrib-stipe portion can also help distinguish *Cryptopleura* species from *Myriogramme/Nitophyllum* species.

Phycodrys cerratae Daws., Acleto and Foldv.
Dawson, Acleto, and Foldvik 1964
Stewart 1989c

From the same site at about 20 m in the La Jolla Submarine Canyon, we collected specimens in 1974 and again in 1981 of an alga we eventually identified as *P. cerratae* (Figure 12). The site is part of a study area visited regularly by divers, and the algal flora has been monitored carefully; thus, the absence of the species in intervening years is relatively assured. (Additional material will be gratefully received!) Blades are leaf-like, to 12 cm high and 3.5 cm wide, with a central rib but no, or only very faint, lateral venation. Numerous new blades develop from the margins of the primary blade and can become as long as 7 cm.

The San Diego County collections and an additional G.J. Hollenberg collection from Los Angeles County were compared with other *Phycodrys* species, particularly with the Peruvian type material of *P. cerratae* and with collections of *P. isabellae*, a smaller species with less marginal branching and secondary attaching rhizoids from blade margins. The southern California plants clearly represented a single species and were most similar to *P. cerratae* (Stewart 1989c). Dawson *et al.* (1964) list 29 other marine algal species from Peru that also occur in San Diego County, suggesting that there is indeed an affinity between these floras and supporting the assignment of these southern California collections to a species otherwise known only from drift plants collected near Lima, Peru.

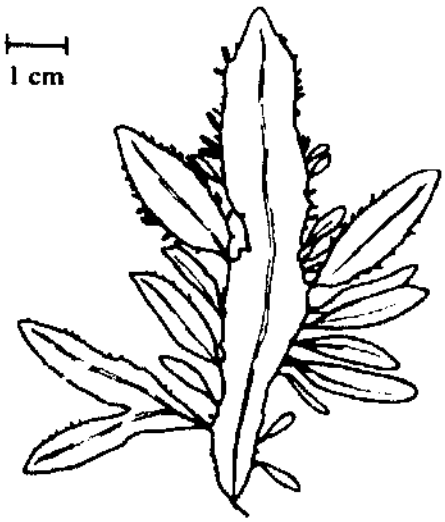

Figure 12. *Phycodrys cerratae*. Plant collected off La Jolla Shores beach.

Phycodrys profunda Daws.

647

Thalli of small pink leafy blades, 2–3 cm high, growing from prostrate axes or basal clumps of stipe-like tissue; each blade usually single on short stipe, with heavy, distinct midrib and lateral nerves or veins, more developed in some thalli, less so in others; margins of blades appearing dentate, or producing secondary blades or haptera that reattach the blade to other algal, animal, or rock surfaces.

Rarely a small blade develops from the side of a lateral hapteron that itself is growing from the margin of a larger blade, but otherwise blades do not grow directly from blade margins. When the blades are picked, the secondary attachment structures are torn and few collected thalli are undamaged. The irregularly spaced lateral "nerves" that produce the leaf-like morphology make this species rather easy to recognize despite the damaged condition of most thalli. It occurs in numerous subtidal sites on rock or scallop and abalone shells, rarely primarily epiphytic, and at all times of the year. *Phycodrys profunda* also grows in the lower intertidal zone on La Jolla beaches where *Anisocladella pacifica* and *Nienburgia andersoniana* also are common. The three can be distinguished by their distinctive regular developmental patterns (Figure 10; see also Stewart 1976). The species has not been recorded from Mexican localities.

**Phycodrys setchellii* Skottsb.

647

Leaf-like blades to 20 cm high, dark to bright pink, to 4 cm wide, often branched near the base, with conspicuous, relatively heavy midribs and lateral nerves; margins mostly smooth and lacking lateral proliferations (haptera, blades, or rhizoids).

The genus *Phycodrys* contains the most leaf-like of all red algae, with the blades symmetrically divided by a midrib, and with opposite or irregularly alternate lateral nerves or veins. Large thalli of this species are common in central and northern California in intertidal as well as subtidal habitats. In San Diego County *P. setchellii* is apparently associated with, and perhaps restricted to, habitats off Imperial Beach or beyond the southern end of Pt. Loma. Our specimens are small and generally less "typical" than those illustrated in **MAC**.

The specimens listed by Dawson from Baja California are from localities of cold-water upwelling, or from very deep offshore island sites.

**Platysiphonia clevelandii* (Farl.) Papenf.
642

A dissecting microscope will be necessary to recognize both this species and *P. decumbens*, and a compound microscope to distinguish between the two. Thalli of both consist of thin narrow blades and creeping flattened axes. Prostrate and erect portions are polysiphonous, with 4 pericentral cells and several cells laterally arranged in a precise and symmetrical order (see Figure13); blades grow from the midline of other blades, as illustrated in **MAC** Figures 854, 855.

MAC describes this species as up to 5–8 cm high, but we find only tiny thalli, prostrate on sponges, shells, in mats of algal turf, or on rocks in low intertidal and subtidal habitats. Tetrasporangia occur February–September, and occasionally spermatangia are found in spring months (see *P. decumbens*). In Pacific Mexico, Dawson recorded *P. clevelandii* south to Scammon's Lagoon, in shallow (4–6 m) water; specimens from the Gulf of California (Dawson 1966) have been re-examined and found to be *P. decumbens*.

Platysiphonia decumbens Wynne
644

See description of *P. clevelandii*. Without magnification, thalli of both of these species appear to be thin, delicate, narrow blades that lie close to the substrate. With a microscope it can be determined that *P. decumbens* blades and axes are 7 cells wide, and bladelets grow from only one surface, whereas *P. clevelandii* thalli are 5 cells wide and bladelets can develop on both surfaces (Figure 13).

Both species are widely distributed between here and Puget Sound and south into Mexican localities. Locally, *P. decumbens* has been found growing near *P. clevelandii*; only tetrasporangial reproduction has been observed.

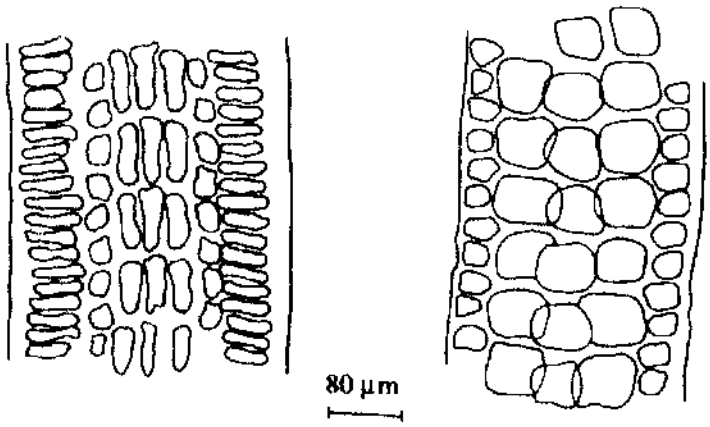

Figure 13. *Platysiphonia clevelandii* (right) and *Platysiphonia decumbens* (left). Magnified whole blade surface.

**Polyneura latissima* (Harv.) Kyl.

651

Thalli of erect blades, growing on very small discoid holdfasts or flattened prostrate axes; short stipes, young blades oval and entire and mostly monostromatic (one layer of cells thick), becoming lobed, divided, variously shaped, and polystromatic with increase in size and age; no midrib but with a very conspicuous network of interconnected nerves and veins throughout blade except in upper or very young portions; blades to 45 cm high, sometimes equally wide, deep pink to dull red in color.

This is a very conspicuous and often abundant species in shallow to deeper subtidal habitats along most of the coast of California north of San Diego at least to British Columbia, and is conspicuous by its absence in most sites off San Diego. Where it occurs, it is restricted to depths below about 17 m. Thalli are rare in the La Jolla Canyons, occasionally abundant along the Loma Sea Cliff, south of Pt. Loma, and off Imperial Beach.

Some very large thalli have been collected, as well as thalli with new blades growing from older eroded basal remnants, suggesting perennial growth. Small blades, recognizable by the presence of barely discernible nerves, grow on rocks or as epiphytes on the basal portions of larger algae.

Dawson's Baja California records are from cold-water sites, consistent with the San Diego deep-water distributional pattern. His previous (1945d) San Diego record is based on dredged specimens from the Coronados Islands, south of Pt. Loma.

**Sorella delicatula* (Gardn.) Hollenb.

648

Thalli of delicate, narrow blades, erect and regularly branched, mostly dichotomously, with a thin but distinct (with magnification) midrib; lateral nerves or veins are lacking; blades mostly 300–500 µm broad throughout and entire thalli mostly less than 2.5 cm high; on rocks or epiphytic on *Cryptopleura, Gelidium robustum, Callophyllis flabellulata, Calliarthron,* or on worm tubes, sponges, and with other small thalli in nests of garibaldi fish subtidally to 33 m; intertidally on rock ledges on sides of channels in shaded seldom-exposed habitats. All reproductive phases are found, at all times of the year. In culture, the complete life history is completed in 6–8 weeks, indicating this is a fast-growing species (Stewart 1977).

The uniform narrowness of the thalli and branching pattern (Figure 14) easily distinguish *Sorella* (both species) from other small epiphytic blades (*Nitophyllyum hollenbergii* and *Cryptopleura*) that are broader and typically unsymmetrical.

Branchioglossum undulatum, *Membranoptera weeksiae*, and *Phycodrys profunda* are symmetrical with mid-lines more or less thickened, but these occur mostly as single simple blades rather than branched thalli (see *S. pinnata*). Neither species of *Sorella* has been recorded from Mexican Pacific localities.

**Sorella pinnata* Hollenb.

650

Thalli are delicate blades with faint midribs, similar to *S. delicatula*, but broader (800–1200 µm wide) and often with a heavier, more developed midrib; typically specimens attributed to this species are more or less pinnately branched along a percurrent axis-blade; seldom more than 2 cm high (as are *S. delicatula)*, and found in the same sites and on similar substrates growing with *S. delicatula* (Stewart 1977).

The study of San Diego collections cited here was not available when **MAC** was prepared. Extensive sampling from a variety of subtidal and intertidal habitats showed that specimens with the characteristics earlier described for *S. pinnata* are uncommon. In single collections one finds narrow thalli (to 500 µm wide) that are dichotomously or flabellately branched with indistinct central lines (*S. delicatula*) mixed with forms that could be tentatively assigned to *S. pinnata*. Numerous thalli are intermediate in breadth (500–800 µm wide), and branched in atypical patterns (Figure 14). Mature reproductive structures are similar on all vegetative forms and cannot be used for species discrimination. The habitat and morphological intergradation between forms suggests that two distinct species should not continue to be recognized. The species have not been collected from the Pacific coast of Baja California.

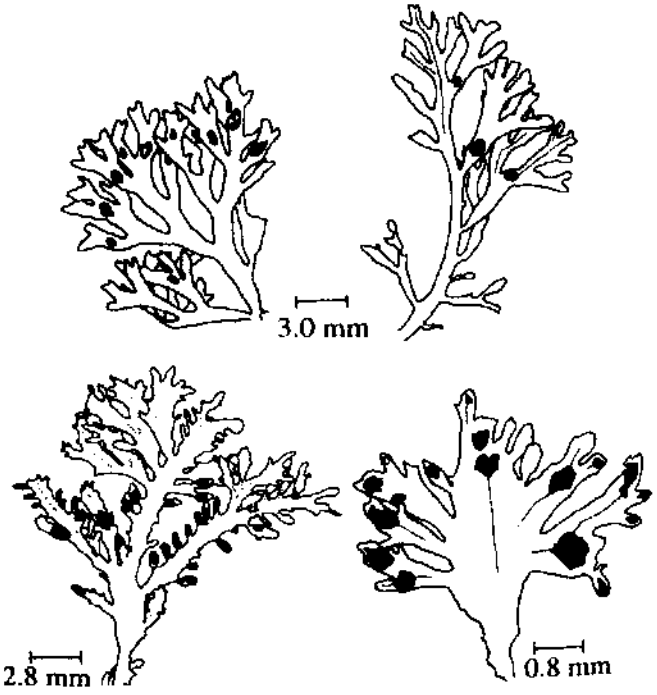

Figure 14. *Sorella* thalli with pinnate branching as described for *S. pinnata*, dichotomous branching as described for *S. delicatula*, and mixed branching.

DASYACEAE

Colacodasya californica Hollenb.

680

Thalli parasitic on *Heterosiphonia erecta*, forming light pink to pale cream-colored, densely tufted growths, 1–2 mm high; microscopic anatomy described in **MAC**.

Four collections, from intertidal *H. erecta* in November, over several years, have been tentatively identified as this species of *Colacodasya* although they initially were considered as the somewhat swollen congested tetrasporangial stichidia of the "host" species. Few collections are known of this "parasitic" taxon, previously recorded only from beween Pt. Vicente in Los Angeles County and Laguna Beach. If the San Diego specimens are in fact the species, the range is extended south to Pt. Loma.

Dasya sinicola var. *abyssicola* (Daws.) Daws.

676

Small, delicately branched, with branches appearing as nearly microscopic bottle brushes; deep red-pink; axes sometimes single or in clusters from a variety of substrates. The branchlets mostly are clustered near the tips of the axes and main branches and are formed from uniseriate filaments of cells (monosiphonous). This variety, *abyssicola*, is less than 2–3 cm high, with lateral branches (40–60 µm diam.) and main axes smaller in diameter than the other varieties of the species. Larger thalli are found in warmer southern waters.

In San Diego, this alga is often conspicuous by its color and shape on pieces of sponge, large algae, or other benthic substrates. We have found tetrasporangial and cystocarpic thalli in deep sites, and vegetative plants on piers or barges in San Diego Bay. It appears to have a rather wide distribution in respect to the several factors that differ in these two types of habitats, but it apparently does not grow on intertidal rocky beaches. Our records show no seasonality.

**Dasya sinicola* var. *californica* (Gardn.) Daws.

676

Thalli 3–10 cm high, determinate laterals 80–110 µm diameter near base and more persistent than in var. *sinicola*.

Dawson terms this a coarser variety. Reviewing the variability in habitat and morphology in our collections of *Dasya* specimens, we find plants that could be identified either as var. *californica* or var. *sinicola* but because they are

mostly less than 3 cm high, we have grouped them at present with var. *abyssicola*. Occasional larger thalli are found in San Diego Bay.

The type collection of *D. sinicola* var. *californica*, as *D. californica*, was from "La Jolla," in 1927. Dawson (1945d) recorded the taxon as *D. californica* from pools at the south end of La Jolla Shores beach in May.

**Heterosiphonia erecta* Gardn.
676

Thallus with polysiphonous major axes, 4 pericentral cells, monosiphonous pigmented ultimate branchlets; growth pattern sympodial; entirely uncorticated, with branching every 2 segments; to 5 cm high.

Thalli are very abundant during winter months as epiphytes in the low intertidal zone in turf, or in clumps near *Phyllospadix* beds, or mixed with other algae in more exposed positions. In habitats where plants are exposed to air and sun during winter midday low tides, thalli become pale, almost yellowish pink, but when more shaded they are bright pale pink. The close branching and tapered ultimate (monosiphonous) branchlets give it a fuzzy appearance. This species has not been found subtidally.

The type specimen was collected as an epiphyte from *Phyllospadix*, La Jolla.

Heterosiphonia japonica Yendo
678

Thallus with polysiphonous major branchlets, 5 pericentral cells, ultimate portions of branchlets pigmented and monosiphonous; branching distichous, in one plane; main axes cylindrical and corticated near base but noticeably compressed above; branching alternate, mostly with two segments between laterals.

MAC notes that the species is infrequently found, and only as far south in California as Orange County, and that gametophytes are rare in the eastern Pacific. In San Diego County it is not uncommon, but strictly subtidal at mid-depths 10–23 m, often attached to articulated corallines but also on sponges and other benthic surfaces. Cystocarpic thalli have been found in April collections.

**Pogonophorella californica* (J. Ag.) Silva
678

Thalli with polysiphonous major axes and monosiphonous pigmented ultimate laterals; sympodial growth (a feature of the family) not clearly observed in this

species; branching radial around cylindrical axes; all axes and branches bare of laterals in lower portions, short tufts of monosiphonous branchlets mostly near branch tips; except for these monosiphonous ultimate branchlets, the thallus is completely and heavily corticated, and the polysiphonous condition cannot be seen; thalli 3–10 cm high, in loose clumps, with prostrate axes often in sand.

The local distribution is restricted spatially as well as temporally. On the rocky beach north of Wind and Sea Beach in La Jolla it is common in *Phyllospadix* beds between November and May and less easily found the rest of the year. In similar habitats south of Ocean Beach it has not been found. Fertile plants are found in the La Jolla populations in winter. It is often associated with *Anisocladella, Tiffaniella, Nienburgia*, and *Petroglossum* in shallow sand on rocks in the low intertidal zone. It has been reported from kelp beds to 20 m, but we have not found it subtidally, despite searching.

Dawson (1945d) wrote that it was "easily distinguished by the slender smooth, branched axes below, ending in 'furry' tips."

Rhodoptilum plumosum (Harv. and Bail.) Kyl.

680

Thalli erect, irregularly distichously branched from percurrent flattened axes; to 4 mm wide, margins densely fringed with monosiphonous branched filaments to 1.5 mm long.

Although thalli from northern California reach 40 cm in height and usually are 10–20 cm high, the few specimens we have found on subtidal rocks are less than 3 cm high. Despite their small size, they are conspicuous by the dense fringe of filaments along soft flat axes. On our specimens the filaments are relatively evenly distributed, rather than tufted or irregularly separated, as described for young thalli.

The only other local specimens we know of were collected by the first scientific diver at Scripps Institution, Conrad Limbaugh, who recognized several thalli as an unusual species in the Scripps Submarine Canyon, probably 1958–59.

RHODOMELACEAE

**Amplisiphonia pacifica* Hollenb.

721

This species grows in the form of smooth, rounded blades that are completely flattened against rocks, attached by short unicellular rhizoids. The blades are often ruffled at the margins, and new growth overlaps and overgrows older

blades, forming patches several layers thick, and several cm across. Color in the field is dull, dark red, although individual blades separated from the rock are brighter, red-pink.

We have found thalli occasionally in low intertidal habitats, but more often subtidally to 27 m. Both gametangial and tetrasporangial plants have been collected from these sites. A microscope is not necessary to identify this very distinctive species that was first described from Corona del Mar (Orange County) in 1939. It is now recorded from British Columbia to Punta Eugenia in Baja California.

Dawson's Checklist refers to finding thalli on crustose corallines and holdfasts of *Eisenia* in the lower intertidal.

Chondria and ***Laurencia.*** Pairs of species of each of these two genera share critical vegetative characters, making it often difficult to identify individual thalli. All species of both genera are completely corticated over a primary polysiphonous structure. Size and branching pattern vary similarly in each genus. The flattened *Laurencia* species (*L. spectabilis*, in San Diego) have no local counterparts among *Chondria* species, so it is the terete, radially branched forms that will be most confusing. All *Laurencia* species have a prominent apical pit. Some *Chondria* taxa also show this feature, while others taper toward the branch tips. *Chondria* thalli, in theory, can be distinguished by having a cluster of trichoblasts (hair-like branched filaments formed of several colorless cells) growing from around the apical cell, whether this is within a pit or at the tip of the branch. But in practice, some thalli lack these—perhaps because they are easily broken off and therefore lost before the collection is examined, or because they are naturally deciduous and therefore absent in older material, or because they do not always develop on all thalli. On *Laurencia* thalli trichoblasts are rare, rudimentary or evanescent, but they do develop, thus further blurring this distinction.

Spermatangia develop on specialized flat, round "stichidia" on *Chondria* thalli, as opposed to short, cylindrical branches in *Laurencia*, but male plants are rarely found. Tetrasporangial and cystocarpic thalli are similar for both genera.

Throughout the world, and since algal taxonomy began, workers have studied and argued over these two genera; in San Diego County there are several species in each genus that are clearly recognized, but for others small samples or single thalli will be virtually impossible to identify without considerable experience with field variation and reproductive thalli.

Chondria arcuata Hollenb.

724

Thalli dull red when growing in shaded habitats, but pale or almost yellowish in the more common intertidal turf habitats where it grows in San Diego. Erect branches are cylindrical, often somewhat arched or curved as they grow horizontally over other vegetation, secondarily attached at frequent intervals; a tuft of trichoblasts from the apical pit may be conspicuous in freshly collected young (?) material, but in older plants or thalli that have been several hours in containers, this feature may be misleadingly absent. The species is one of the most common and abundant epiphytes growing on *Pterocladia capillacea* and *Corallina pinnatifolia* in algal turf on La Jolla beaches, less common elsewhere in the county. **MAC** records it as rare in southern California and gives only three known collections from Los Angeles and Orange counties. Dawson (1963b) did not find it in Mexican collections.

**Chondria californica* (Coll.) Kyl.

724

Thalli mostly 4–5 cm high, but often much larger when it occurs in large clumps of tangled branches; usually epiphytic, purplish, in the water conspicuously pale and iridescent; variously branched, attaching to other algae partly by means of tendril-like branch tips; branches thin, cylindrical, or somewhat compressed, tapering toward the tips, with trichoblasts near, and growing from, the tip.

The description of the habitat for specimens elsewhere in California is appropriate for San Diego County plants: common in various habitats in the low intertidal to shallow subtidal; in San Diego, particularly in pools where plants are seldom, if ever, exposed to air. Dawson (1963b) described forms variously erect or more prostrate, with entwining or more prostrate axes, with straight to hooked tips, and attached to rocks or other algae—"a widespread tropical plant with extensive occurrences in well insolated subtropical and temperate waters along the Pacific Coast." (This species in other localities is the "host" for *Jantinella*, an epiphyte/parasite not reported from San Diego County.)

Type locality, La Jolla.

Chondria dasyphylla (Woodw.) C. Ag.

726

Thalli with terminal pit and tuft of trichoblasts; irregularly alternately branched, to 5–15 cm high; differs from *C. oppositiclada* primarily in branching pattern.

This species is widely distributed on North Atlantic coasts, Japan, and the Pacific Coast of North America. MAC cites no San Diego County collections, but Dawson (1946, 1958) recorded specimens (as *C. telmoensis* and *C. pacifica*) from La Jolla. Our collections include thalli with branching patterns characteristic both of *C. dasyphylla* and *C. oppositiclada*, suggesting that either both species are present here or that locally a single variable taxon occurs.

**Chondria decipiens* Kyl.
726

This is a very robust species with coarse, densely branched main branches 12–20 cm high; otherwise similar in most features to *C. nidifica*.

Dawson (1945d) reported finding thalli cast up on La Jolla beaches in June, but we have not seen any specimens that resemble this species.

**Chondria nidifica* Harv.
726

Thalli 15–20 (40) cm high, dark red, with few to many cylindrical axes growing from basal holdfasts and haptera; erect axes 1–2 mm diameter, irregularly branched from all sides; branch tips often appearing as if bitten off by fish (?); fertile branches usually recognized in tufts or clumped, whereby reproductive thalli appear very different from vegetative.

This species is mostly restricted to very low intertidal rocks, often in or near beds of *Phyllospadix;* on several La Jolla beaches it becomes quite abundant and easily found winter to spring. Occasionally it occurs in the upper portions of subtidal regions, to 10 m in shallow-water kelp beds.

Erythrocladia sp. has been found on *Janczewskia lappacea,* which was in turn growing on *Chondria nidifica* in December.

Chondria oppositiclada Daws.
727

Thalli slightly to very bushy, with several to many axes arising from common base; branches cylindrical, irregularly and radially alternate, often with subopposite pairs or triplets; to 15 cm high; apical pit and terminal trichoblasts distinguish the species from forms of *Laurencia* that can be similar.

Epiphytic or on rocks, low intertidal to subtidal (18 m), locally often associated with *Phyllospadix* beds. The distribution is apparently limited to the coast between San Diego County and Scammon's Lagoon in Baja California.

Between Sunset Cliffs and the tip of Pt. Loma, this species has been collected with tetrasporangia and cystocarps. *C. dasyphylla* is a very similar species, distributed throughout the eastern Pacific, with predominantly alternate branching.

Type locality, La Jolla, on *Egregia* at 10 m.

**Erythrocystis saccata* (J. Ag.) Silva
738

Thalli epiphytic on species of *Laurencia*, where it grows out of the tip of the host plant and appears bright to brownish red; at first the form is a simple spherical sac, then larger thalli become rough, convoluted, or lobed.

In San Diego intertidal sites this alga is often quite abundant, both on terete (*L. pacifica*) and flattened (*L. spectabilis*) species. It is most often found in the low intertidal habitats where these *Laurencia* taxa are most common.

Herposiphonia littoralis Hollenb.
718

Thallus polysiphonous, 10–12 pericentral cells, uncorticated; branching from near one side of the axis, appearing somewhat secund, with no bare nodes between branches; all axes and branches prostrate, with 3 erect determinate branches between successive indeterminate branches; determinate branches simple, with indeterminate lateral branches mostly not, or little, developed.

This species was described for collections from Orange County and is recorded as being often common in thin patches 4–8 cm broad on rocks in the midtidal to upper intertidal levels. Rocky areas in the northern part of San Diego County, where habitats are similar to those described for adjacent Orange County beaches, have not been regularly sampled, but south of Del Mar the species is rare. G. J. Hollenberg confirmed a collection from the Flood Control Channel.

**Herposiphonia plumula* (J. Ag.) Hollenb.
718

Thallus polysiphonous, with mostly 8–12 pericentral cells, uncorticated; brownish red, branching strictly distichous, with 3 alternate determinate branches between successive alternate indeterminate branches; determinate branches ±1.2 mm long, broadest at base, tapering to acute apices, with 10–12 segments; indeterminate branches progressively longer from apex to base of main axes.

In San Diego, this species is found subtidally and, based on our records, is most abundant during late fall to early spring months, often growing on *Corallina officinalis* or *Calliarthron*, but not restricted to these substrates. It is recognized by the regular arrangement of branches, flattened against and attached to surfaces, with little or no erect growth.

Dawson 1945d, as *H. parva*, noted this species is "commonly epiphytic on corallines."

**Herposiphonia secunda* (C.Ag.) Ambronn f. *tenella* (C.Ag.) Wynne
Wynne 1985a
Herposiphonia tenella f. *secunda* (C. Ag.) Hollenb., 720
Thallus polysiphonous, 8–10 pericentral cells, uncorticated; brownish red; branching on one side only; axes attached and creeping over other algae or other substrates; indeterminate branches more or less developed, arranged from slightly alternate surfaces every third or fourth segment, with 1 or 2 bare and/or one determinate branch between successive indeterminate branches; determinate branches simple, erect, curved toward apex to some degree.

G.J. Hollenberg confirmed the identification of one of our collections from 17 m in a kelp bed near the Coronados Islands, growing on *Gelidium nudifrons*, for a recent San Diego County record. The secund branching pattern of these thalli is distinctive, but the species is rarely found.

Dawson lists it (as *H. secunda*) only from the Gulf of California and south of La Paz in Mexico (1963b).

**Herposiphonia verticillata* (Harv.) Kyl.
720
Thallus polysiphonous, with 14–16 pericentral cells; primarily prostrate and matted, with free, erect branches 1–2 cm long, dark reddish brown; determinate branches distichous, but curved and thus appearing to grow from all sides of the axis; 3 alternating determinate branches between successive indeterminate branches and no bare nodes; indeterminate branches mostly undeveloped, segments mostly shorter than broad; common epiphyte, low intertidal.

As it is elsewhere on the California and Mexico coasts, this is a common species in San Diego County on brown and red algae and several non-algal substrates, along the Loma Sea Cliff to 13 m.

Dawson (1945d) noted that the "tips of the branches (are) curved or tending to coil."

**Janczewskia gardneri* Setch. and Guerns.
739
Thalli small, pinkish, warty cushions to 1 cm diameter, growing on *Laurencia spectabilis* or *L. splendens*, free branches 2 mm long. Fertile specimens have been collected on *L. spectabilis* in November on La Jolla beaches. Frequently seen during winter to early spring months.

**Janczewskia lappacea* Setch.
739
Thalli resemble thalli of *J. gardneri* (small, 3–5 mm diameter, pinkish, with protruberances emerging from a central cushion). This species grows on *Chondria nidifica*, which in San Diego County is usually confined to shaded or protected habitats in the low intertidal zone.

[*Jantinella verrucaeformis* (Setch. and McFadd.) Kyl.
713
A whitish "parasite" on *Chondria californica*, to 1.5 mm diameter; central solid portion with short, free polysiphonous branches; 7–8 pericentral cells, transversely divided.

Although *Chondria californica* is often abundant in San Diego intertidal habitats, we have not observed the "parasite" nor have others, including Dawson, recorded it from San Diego County localities.]

Laurencia lajolla Daws.
731
Dark red, with erect branched cylindrical axes 2–3 cm high arising from tangled creeping branches attached by frequent irregular disks; erect axes branched more above than below, with short branches mostly 700–850 µm diam.; sexual plants unknown.

Described by Dawson (1958) as a turf-forming species, attached to coralline algae. He noted that the species had not been found during previous intensive surveys of the site (type locality) during the early 1940's. Recently we have found specimens that resemble *L. lajolla* in a Pt. Loma intertidal site where it had not been seen during several prior years, suggesting that presence or absence may be influenced by environmental factors that vary from year to year.

Type locality, north of Wind and Sea Beach, La Jolla.

*_Laurencia pacifica_ Kyl.

732

Thalli terete, cylindrical in all parts; variable in size, habitat, and color. The numerous radially arranged branches on axes to 30 cm high are often approximately 2 mm in diameter below; main axes clearly percurrent; branching somewhat even (not tufted or dense) above, sparse below.

For many years intertidal terete forms (see Dawson 1963b) of *Laurencia* that grow as discrete thalli rather than in somewhat prostrate mats on the Pacific coast of North America have been described as a group of similar species or a single species (*L. pacifica*) with many ecological and morphological variants, as in **MAC**. Dawson distinguished several forms in San Diego, but our collections cannot be easily sorted by published criteria. For this reason we refer to them simply as *L. pacifica*. The taxon includes some of the most common epiphytes in algal turf and on rock surfaces, but also forms that occur as individual larger thalli in other habitats. Color can vary from greenish yellow to dark red to purple. These assorted collections may also include specimens of *L. lajolla* and *L. masonii*. Dawson (1963b) wrote: "This (*L. pacifica*) is an exceedingly variable species that assumes many perplexing forms under different local conditions. It is now recognized as having a much wider range than heretofore supposed. In its more characteristic 'typical' form it ranges throughout the cool exposed coastal waters from central California to Isla Magdalena, Baja California. In warmer areas within this range, such as Catalina Island, Isla Guadalupe, Bahía Viscaino, Isla Magdalena, it occurs together with the morphologically similar *L. masonii* with which it may often be confused if only external form is taken into account."

L. papillosa is a species widely distributed in warm seas throughout the world, but not on the coast of California. It is likely that a densely branched specimen of *L. pacifica* accounted for the inclusion of *L. papillosa* in Dawson's Checklist for San Diego.

*_Laurencia sinicola_ Setch. and Gardn.

732

Thalli flattened as for *L. spectabilis*. Branching in *L. sinicola* is less regularly distichous, and main axes and branches are not of markedly different lengths; often small, to 9 cm high, and probably rare; found on other algae.

Occasionally we collect algae with congested, flat branches that externally resemble *L. sinicola*, epiphytic on other algae (e.g. *Gigartina canaliculata*) on beaches between La Jolla Cove and Pacific Beach. Without examining the critical anatomical features that separate this species from *L. spectabilis*, the plants can only be tentatively identified.

As *L. scrippsensis*, Dawson (1945d) reported finding the species (10–16 mm high, epiphytic on *Sargassum agardhianum* and other algae in the lower intertidal zone) from La Jolla, and in **PMR 8** (1963b) he recorded a Cardiff specimen.

Laurencia snyderae Daws.

734

Thalli are recognized as *Laurencia* species by the terminal pit on rounded apices; branches and axes are terete, but the main branches are densely covered throughout with short simple branchlets; thalli are dark red-purple to black, with one or few relatively long (12 cm) percurrent sparsely branched axes that lie limply over intertidal rocks.

On San Diego beaches this is strictly a late spring to mid-summer alga and is particularly easy to find on beaches near Bird Rock in La Jolla and on the broad platform beaches along the west side of Pt. Loma. It grows on tops or sides of rocks exposed to desiccation and light during low tides. We have most frequently found it in years of warm summer water temperatures. Once identified, it is distinct and resembles no other alga of that particular habitat.

Dawson (1953a) believed it to be an indicator species of "warm spots" along southern California and Baja California, regularly absent from stations with cold upwelling, and present where surface waters are warm.

Type locality, La Jolla.

**Laurencia spectabilis* Post. and Rupr.

734

Thalli flattened; branching distichous, pinnately alternate to nearly opposite; often with branches short above, symmetrically longer below, thus giving fronds a pyramidal outline; apices broad and rounded.

This species contains several variants that have been described for particular branch dimensions and arrangements. Dawson treated Baja California collections of the species as a complex of three named varieties, each with geographic and morphological forms, and related by intermediate forms. San Diego forms mostly represent the taxon he refers to as var. *diegoensis*. In San Diego County these compressed-to-flat specimens of *Laurencia* are seldom found away from the shading or protection of other algae, overhanging rock edges, or *Phyllospadix* leaves, and therefore are restricted to low intertidal habitats and shallow-water kelp beds. The "parasitic" (=pale pink) alga that grows on this species is *Janczewskia gardneri*.

Listed in the Checklist as *L. diegoensis*, based on a La Jolla type specimen.

*_Laurencia splendens_ Hollenb.

735

Very similar to *L. spectabilis*, more often epiphytic, with the main axis prominently percurrent.

Dawson's *L. maxineae* (in the Checklist), described for an epiphyte on *Corallina* from La Jolla, was removed to synonymy with *L. splendens* in **PMR 8** (1963b). **MAC**, for this latter species, lists no San Diego records, but based on the treatment of the type collection of *L. maxineae*, *L. splendens* is included in the San Diego County flora.

Laurencia subdisticha Daws., Neush. and Wild.

737

A small, flattened species that was collected once (type specimen) in 20 m, at Isla Coronado del Sur, and to our knowledge never re-collected.

**Laurencia subopposita* (J. Ag.) Setch.

738

Thalli deep rose red, branch apices appearing blunt; commonly epiphytic on *Phyllospadix* where it entwines around itself and the "grass" leaves as do tendrils on pea vines; large clumps of *Phyllospadix* + *L. subopposita* are often conspicuous in the low intertidal zone. We have also collected *L. subopposita* subtidally to 20 m. Small plants can attach directly to rocks both in the low intertidal and subtidal regions. There is no other alga with which this species can be confused.

Levringiella gardneri (Setch.) Kyl.

713

This "parasite" occurs on *Pterosiphonia baileyi* or *P. dendroidea*; thalli are small (600 μm tall), tufted, radially branched, appearing densely and irregularly branched.

Recorded once for San Diego County (as *Stromatocarpus*) from *P. baileyi*, La Jolla, December (Dawson 1945b).

Ophidocladus simpliciusculus
* (Crouan and Crouan) Falk.

704

Thalli of polysiphonous filaments, 16–18 pericentral cells; uncorticated, erect; branches often with twisted appearance; sparse branching, thalli mostly in dense "fuzzy" mats on rocks in areas of sand and often heavy surf; trichoblasts, seen with magnification, are unpigmented, branched, often not persistent; tetrasporangia are 2–3 per segment.

At least low-power magnification is necessary to confirm identification of this and other filamentous red algae that occur in mats on rocks in sandy habitats (*Polysiphonia* species, including *P. confusa* and *P. scopulorum; Tiffaniella; Pterosiphonia dendroidea*) *Ophidocladus simpliciusculus* commonly grows along San Diego County coasts mixed with other tiny epiphytic taxa in algal turf in the lower midtidal region or with mixed vegetation under *Phyllospadix*. Subtidally we have found large, almost unialgal patches on rocks in La Jolla Bay.

Polysiphonia. Of the 17 species of *Polysiphonia* treated in **MAC**, 15 are stated to be distributed both north and south of San Diego County and accordingly are listed below. Of these, 10 have been found in our San Diego collections. An additional species, *P. brodiaei*, previously recorded only south to Santa Monica, has been found near Bird Rock in La Jolla.

A compound microscope and a copy of either or both **MAC** or **Pacific Mexican Red Algae 5** (Hollenberg 1961) will be necessary to identify local taxa in this genus. The brief notes here indicate easily seen contrasting characteristics but do not provide complete descriptions of the species. Generally, species in the genus are polysiphonous. When thalli are uncorticated, tiers of cells are conspicuous even with low magnification. Thalli are mostly found as erect clumps of filamentous axes, or entangled epiphytically; branching is variable, mostly radial, sparse and irregular in some species. Trichoblasts (unpigmented, monosiphonous short branchlets) are branched or unbranched, usually present near branch apices, 1 per segment, but soon deciduous, leaving persistent scar cells at points of attachment. Pericentral cells are relatively constant in number for a given species, 4–12 (22–24 in one species); thalli typically are dark reddish brown to black, San Diego forms usually 3–6 cm high except for infrequently found large thalli of subtidal specimens. Several intertidal species form dense mats over rocks in the upper part of the beach. A few species are often abundant and common and can be distinguished in the field by habitat and growth form.

**Polysiphonia acuminata* Gardn.
684
No recent collections.

Polysiphonia bajacali Hollenb.
684
Four pericentral cells; trichoblasts and scar cells commonly present and mostly in regular spiral sequence on each unbranched segment; percurrent axes not

distinct; segments of main axes shorter than, or barely as long as, wide.

Most of the characteristics described for this species are difficult to evaluate; several collections from San Diego Bay and from subtidal rocks in La Jolla Bay are tentatively referred to *P. bajacali*. The morphology resembles *P. flaccidissima* thalli which have been collected in the same habitats.

Polysiphonia brodiaei (Dillw.) Spreng.
694

Six to seven pericentral cells, but these are seen only in very small new branches; the only fully corticated species in the California algal flora. Thalli show distinct percurrent axes, with numerous laterals spirally arranged. Thalli to the north can be 15–25 cm high, but a single collection from near Bird Rock, La Jolla, was 3–4 cm high. The new record for San Diego County and recent collections from northwest Baja California (Aguilar and Aguilar 1986) constitute southward extensions of the range of this species.

Polysiphonia confusa Hollenb.
696

Eight to ten pericentral cells, uncorticated, abundant trichoblasts; thalli less than 3 cm high; relatively few lateral branches.

Occasionally this species forms extensive mats on the low rocks on north San Diego County beaches.

**Polysiphonia decussata* Hollenb.
686

Four pericentral cells; trichoblasts and scar cells present, in regular spiral sequence but separated from preceding branch by 1 or 2 unbranched segments; thalli mostly 1–2 cm high; branches and trichoblasts occurring alternately with 2 or 3 segments between branch and next trichoblast in spiral.

This is an infrequently found species, typically growing mixed with other small algae among rocks midtidal to subtidal. We have identified material from tidepools on La Jolla beaches.

**Polysiphonia flaccidissima* Hollenb.
688

Four pericentral cells; trichoblasts and scar cells commonly present, mostly in regular spiral sequence and on each segment, with branches developing at base

of a trichoblast; thallus soft, flaccid, with creeping filaments attached to substrate by rhizoids growing from pericentral cells.

Subtidal specimens have been collected from worm tubes, *Phyllospadix*, rocks, and scallop shells. G. J. Hollenberg, who studied *Polysiphonia* species for many years, at first identified some of these as *P. mollis*, then later treated them as *P. flaccidissima*, indicative of how similar the taxa can be. Very fine narrow (30–60 µm) forms occasionally are abundant in patches on intertidal *Corallina vancouveriensis*.

**Polysiphonia hendryi* Gardn. var. *hendryi*
696, 698
Ten to twelve pericentral cells; trichoblasts present but lacking on numerous of the unbranched segments; thalli dull reddish brown, mostly less than 1.5 cm high, densely branched, epiphytic; main axes quite distinct.

This is frequently found in the algal turf of the midtidal zone on all beaches. In sites where *Pterocladia capillacea* grows intermingled with *Corallina*, *P. hendryi* grows on either of these larger species, as well as attached to and entangled with axes of *Ceramium eatonianum*. *P. hendryi* appears to be most abundant between late fall and early spring.

Dawson's Checklist listed (in addition to *P. hendryi*) *P. gardneri* and *P. collinsii*, both of which are now included in *P. hendryi*.

Polysiphonia indigena Hollenb.
698
MAC lists San Diego as source of one of only two collections of this alga.

Polysiphonia johnstonii Setch. and Gardn.
699
Five to six pericentral cells; every segment, except for occasional lower ones, bears a trichoblast, scar cell, or branch; relatively stiff thalli, dark brown-red to nearly black; main axes and branches alternately, irregularly, often closely branched at narrow angles; variety *concinna* is mostly less than 2 cm high, with 5 pericentral cells and narrower axes, segments each about one-half as long as wide, in some cases even stouter. Several of our subtidal collections can be treated as *P. johnstonii* var. *concinna*. Some of these appear to have as many as 8 pericentral cells and in other features tend to resemble *P. confusa*, but at present there is inadequate material for comparative study.

The type specimen of var. *concinna* was epiphytic near Scripps Institution of Oceanography. Dawson *et al.* (1960) state this is a common subtidal species.

**Polysiphonia mollis* Hook. and Harv.

688

Four pericentral cells; trichoblasts and scar cells commonly present, in regular spiral sequence on each segment not bearing a branch; segments of main axes commonly 2–3 times as long as wide; thalli to 12 cm high, with small discoid base or creeping branches of limited extent; densely branched often apparently dichotomously above. Widely distributed along the Pacific coast of North America and in the tropical and subtropical Pacific.

Several collections identified as *P. flaccidissima* resemble *P. mollis* in many features, and have been found on "rocks, wood, or shells...in sheltered water" as the typical habitat of *P. mollis* is described. Several subtidal thalli from rock outcroppings in La Jolla Bay also probably can be attributed to this species.

Dawson *et al.* (1960) state that this is the commonest of the 4-pericentral species in kelp beds. In the Checklist it was included as *P. snyderae.*

Polysiphonia nathanielii Hollenb.

699

The only recorded collection of this species, other than the type collection from Los Angeles County, is from Playa de Rosarito, just south of Tijuana, 1947.

**Polysiphonia pacifica* Hollenb.

689

Four pericentral cells; trichoblasts and scar cells absent or very rare; inconspicuous prostrate axes, erect branches to 15 cm high, branching primarily alternate, 2 (4–5) segments between successive branches, segments in main branches 2 (3–10) times as long as wide.

P. pacifica is a highly variable species, with several named varieties recognized in California. Thalli we refer to the species are not sorted to variety. Our specimens are mostly less than 3–5 cm high; this may reflect short-lived or juvenile plants, or forms considered as var. *delicatula* by Hollenberg.

**Polysiphonia paniculata* Mont.

701

Few Baja California records are cited in Dawson's work; as *P. californica,* the species is listed in the Checklist, but without citing San Diego specimens.

*_Polysiphonia savatieri_ Har.

692

Four pericentral cells; trichoblasts and scar cells commonly present mostly in regular spiral sequence on unbranched cells; epiphytic, mostly less than 1 cm high, attached by tuft of rhizoids; erect branches somewhat dichotomous, irregularly branched, giving a bushy appearance; segments mostly shorter than wide.

Among the numerous collections of *P. hendryi* and *P. simplex*, the two common intertidal epiphytic *Polysiphonia* taxa, we have found occasional tufted specimens with 4 pericentral cells (as *P. simplex*) that have certain characteristics of *P. savatieri*, a species widely distributed on central and tropical Pacific shores. There are only a few scattered records from the Pacific coast between Monterey and Guadalupe Island.

As *Polysiphonia minutissima* in Dawson's Checklist.

*_Polysiphonia scopulorum_ var. _villum_ (J. Ag.) Hollenb.

692

Four pericentral cells; trichoblasts and scar cells, if present, not in regular spiral sequences except sometimes very near branch apices; mostly less than 2 cm high, on rocks; the prostrate axes of this species are extensively developed, and erect branches are unbranched, or with few branches, and grow at irregular distances from the long-spreading prostrate axes that are fastened from the lower surfaces to grains of sand or debris on sandy rock surfaces.

The habitat description in **MAC**, and in greater detail in Dawson's study of Mexican algae (as *Lophosiphonia villum*, **PMR 8**, 1963b), applies with little modification to San Diego thalli. In addition to the intertidal turf or matted forms, we also find it subtidally on rocks covered with sediment.

Treated as *Lophosiphonia villum* in Dawson's studies, including the Checklist.

*_Polysiphonia simplex_ Hollenb.

694

Four pericentral cells; trichoblasts and scar cells commonly present, mostly in regular spiral sequence on unbranched cells; segments in main axes mostly as long as wide, branching various but not with distinct percurrent (single or few distinct major) axes; on intertidal algae or attached to rock surfaces; 2–3 cm high locally.

The collections we group as *P. simplex* represent forms of *Polysiphonia* that are common in algal turf in high and midtidal vegetation throughout the year and that often are components of the dark red "fuzzy" mats that cover rocks in the high intertidal region in summer and early autumn.

Pterochondria woodii var. *pygmaea* (Setch.) Daws.
711
Thalli of erect, thin, narrow branches; entirely corticated, polysiphonous, with 12–30 pericentral cells; branching more or less regularly alternate, distichous; vegetative branches without trichoblasts; thalli 1–2 cm high, branches narrowly divergent and segments mostly shorter than broad.

Although **MAC** notes that this variety occurs mostly on *Cystoseira osmundacea* in shallow subtidal (1–5 m) sites in San Diego County we have collected subtidal specimens on the stipes of several large brown algae, on *Gelidium robustum*, on rocks to 22 m, from barges in San Diego Bay, and intertidally on *Pterocladia capillacea*. Male plants are easily recognized by the flattened, oval disc-like spermatangial branchlets; non-reproductive plants are distinguished by the flattened polysiphonous morphology.

**Pterosiphonia baileyi* (Harv.) Falk.
705
Thalli most frequently erect from prostrate branches; percurrent main branches and erect axes with alternate distichous branches, secondary branches markedly shorter and all of similar length; axes cylindrical, completely corticated, to 25 cm high, very dark red to nearly black; ultimate branchlets uncorticated, with 12–14 pericentral cells.

Rare in San Diego County, restricted to a few sites, with few records; from very low intertidal habitats, mixed with other algae on rocks. I have found very small thalli attached near the base of *Corallina* axes, thus epiphytic.

Dawson *et al.* (1960) recorded thalli from kelp beds, but whether these were in San Diego is not clear.

**Pterosiphonia dendroidea* (Mont.) Falk.
708
The description for *P. farlowii* (as *P. clevelandii* in **MAC**) needs little modification to encompass specimens of *P. dendroidea*; the single drift thallus on which the former species was based could well have been a variant of the latter. Outside San Diego County, *P. dendroidea* includes large coarse forms with numerous erect branches arising from creeping prostrate branches. Thalli

are characterized as branching from the percurrent axes at intervals of mostly 3 segments; branches of all orders are fused with the parent axis for slightly more than 2 complete segments, with intervals of 2 segments between branch initiation; segments of main axes 200–500 µm broad, distinctly compressed, mostly broader than long.

Specimens in San Diego County, including all reproductive phases, occur subtidally (to 30 m) on a variety of substrates, and in the low intertidal zone are associated with *Nienburgia andersoniana, Anisocladella pacifica*, and *Tiffaniella snyderae* in sandy mats near *Phyllospadix* beds, or with *Polysiphonia* species in a low turf over sandy rocks. Thalli are conspicuous by their resemblance to tiny feathers amongst less regularly branched filamentous forms.

Pterosiphonia farlowii Hollenb.

Hollenberg 1976

Pterosiphonia clevelandii (Farl.) Hollenb., 708.

Small, 2–3 cm high, erect, feather-like, pinnately branched thalli, with compressed percurrent main axes, 300–350 µm broad; polysiphonous with 10–12 pericentral cells, segments twice as broad as long; entirely uncorticated lateral branches at intervals of 2 segments, ultimate branchlets strongly recurved.

According to MAC (p. 708), "known only from the type collection from drift, San Diego, California." Among numerous collections of small uncorticated *Pterosiphonia* thalli, few show "strongly recurved" ultimate branchlets, although a tendency to this condition can be found in many of *P. dendroidea* thalli (see above).

**Pterosiphonia pennata* (C. Ag.) Falk.

708

Thalli with erect main branches only slightly compressed, from prostrate axes at intervals of 3 segments; 1–2.5 cm high; once or partly bi-pinnate; branchlets cylindrical, mostly simple, slightly incurved, mostly 1–1.5 mm long, at intervals of 2 segments; fused with axis for about 1 segment, segments in main axes approximately 140 µm wide, pericentral cells 8–10.

This species is distinguished from *P. dendroidea* in localities north of San Diego by its smaller dimensions (height, width of segments, and less branched), as well as the tendency to show incurved ultimate branchlets. We have found no large specimens of *P. dendroidea* here, and all our collections of small uncorticated *Pterosiphonia* are similar. We have identified, with

confirmation from G. J. Hollenberg, several specimens from subtidal habitats as *P. pennata*. Some of these collections also contained thalli more like *P. dendroidea*, raising the question of whether one or two small species grow in these sites.

Veleroa subulata Daws.

702

Murrayellopsis dawsonii Post, 701

Dawson (1944) described the genus and species for filamentous polysiphonous thalli, to 15 mm high, that were found in a subtidal dredge collection from Bahía Tepoca, Sonora, Mexico. The genus was characterized as having monopodial, sparingly branched thalli, with large persistent pigmented monosiphonous branchlets (= ramuli, or trichoblasts), 1 per segment in spiral sequence; main axes with 4 uncorticated pericentral cells, and 1 tetrasporangium per segment, also in spiral sequence. The species was further described as having segments 1.5–2 times longer than wide; ramuli to 700 µm long, mostly simple or with "2–3 limbs" from near the base; tapering from base to tip.

Another new genus, *Murrayellopsis*, was later established (Post 1962) for a collection from a nest of the garibaldi fish on the Loma Sea Cliff in San Diego County. The generic characters were similar to those described for *Veleroa*, but the monosiphonous ramuli were stated to be branched, and tetrasporangia were 2 per segment.

We frequently find one or both of these species on rocks or various subtidal benthic surfaces. I maintained cultures under several different laboratory regimes of temperature and light for over two years to examine vegetative growth. The young polysiphonous axes branch regularly to produce monosiphonous branchlets of uniform size. Initially these are unbranched, and they remain unbranched under some conditions. As the plants become older, all the ramuli on some axes become branched while on other axes on the same thallus they may remain simple. Based on this experimental information and observations of long and short branches and unbranched trichoblasts (ramuli) in collections from natural habitats, I concluded that the degree of branching and the length of the monosiphonous trichoblasts depends on the age and/or environment of the plant and are not taxonomically useful criteria.

A second feature initially thought to separate *Veleroa* and *Murrayellopsis* was the number of tetrasporangia per segment. Most of the thalli we find, including specimens with and without branched trichoblasts, have a single

tetrasporangium per segment, but occasionally thalli are found with both one and two per segment on the same plant. Observations of one very large tetrad, and one very much smaller in a single segment, suggest that after the first series in an axis forms and is shed, a second can develop. We also find specimens with two tetrasporangia of the same size in the same segment as shown in Figure 653 (**MAC**) for *M. dawsonii.*

For these reasons subtidal collections from diverse sites in San Diego County cannot be sorted into two species. The two taxa were merged (Stewart 1989c) at both the generic and species level; for reasons of priority, *Murrayellopsis dawsonii* becomes a synonym of *Veleroa subulata,* which is typified by the few scraps now deposited in collections at AHFH (LAM). Material studied (Stewart 1989c) included cystocarpic plants, not previously described, from the type locality of *M. dawsonii* (garibaldi nests on New Hope Rock) at 13 m in January.

Two genera of monocots, "seagrasses," occur in San Diego County in salt water habitats. *Phyllospadix* (surfgrass) species are dioecious (staminate and pistillate flowers on separate plants); rhizomes attach by closely spaced short roots to rocks exposed to surf on the open coast. Several species are distributed in the Pacific from Japan to Baja California; two occur in southern California. *Zostera marina* (eelgrass) is monoecious; rhizome internodes are more elongate with roots and rhizomes buried under sand or mud, seldom on exposed rocks. This *Zostera* species was common and formerly abundant in quiet water on U.S. east and west coasts, as well as along the European Atlantic coast. When shallow-water bays, estuaries, and lagoons are developed as harbors, marinas, or for other aquatic recreational uses, much of the *Zostera* habitat is lost. In San Diego Bay, Mission Bay and in the Flood Control Channel at the mouth of the San Diego River, *Zostera marina* leaves are typically about 5 mm wide. A form with leaves about 1 cm wide, var. *latifolia*, grows in La Jolla Bay on a sandy bottom between 10 and 25 m. Clumps of leaves, conspicuously wide and bright green, are often washed ashore onto La Jolla Shores Beach after storms.

On many rocky San Diego beaches two species of *Phyllospadix* form conspicuous beds in the low intertidal and shallow (to about 10–15 m) subtidal zones. *P. torreyi* has narrow (1–2 mm), compressed, often almost wiry leaves that are frequently more than 1 m long when they grow in tide pools or in lower less-exposed habitats. On surfaces where the plants are more often exposed to air, leaves are shorter and brown-tipped during seasons of daytime extreme low tides. Flowering stems are long, with several (2–5) spadices. *P. scouleri* leaves are thinner and broader (2–4 mm) and seldom more than about 50 cm long. Flowering stems of this species are short and bear single, rarely 2, spadices close to the base of the shoot. The two species occur together on some La Jolla beaches. *P. torreyi* alone dominates between Ocean Beach and Pt. Loma. Male and female flowers on *P. torreyi* can be found during spring months in these sites, and seeds remain through the summer season. In several localities clumps with leaves intermediate in morphology occasionally are found, and when there are no flowers, identification is questionable.

The genus *Ruppia* is not usually treated as a seagrass by either marine ecologists or taxonomists because it predominantly occurs in sites that are not strictly marine. Within the genus, taxonomy of 1–7 species is subject to differences of opinion. Summer collections from the Flood Control Channel (the portion of the San Diego River subject to tidal water intrusion) can be tentatively identified as *Ruppia maritima*, a species worldwide in distribution in shallow brackish to saline habitats, often in river estuaries. The very narrow leaves and stems distinguish the plants from *Zostera*, which also grows in this brackish-water channel.

APPENDIX A

Site Descriptions and Representative Species

Intertidal

Detailed descriptions and species lists have been published for two sites along west Pt. Loma and two in La Jolla (Stewart and Myers 1980, Stewart 1982). Here, we briefly contrast some major differences between the two areas.

Generally the Pt. Loma beaches are wide, gently sloping, wave-cut platforms where midtidal areas are covered with *Corallina*-anchored algal turf, mostly less than about 7 cm high; beds of *Phyllospadix torreyi* extend from the low intertidal into shallow subtidal regions. The intertidal platform at Cabrillo Tide Pools is broken by channels, loose boulders or slabs, and algal assemblages appear more often dominated by weedy or seasonally abundant, short-lived species (e.g., *Ulva, Lithothrix*). Just to the north, below Ladera St., the platform is more unbroken, with extensive uniform cover of perennial *Corallina* species that provide substrate for large numbers of epiphytic taxa. Here, *Binghamia forkii* and *Heterosiphonia erecta* are abundant seasonally, while uncommon or absent on La Jolla beaches. Interactions between algae and the seagrass within the border region where *Corallina*-anchored turf meets *Phyllospadix* beds, and mechanisms by which *Corallina* establishes and maintains dominance on algal-covered rocks have been described (Stewart 1989a,b).

Pacific Beach Pt. (also referred to as False Pt. or Gunnery Pt.), north of Mission Bay but south of the La Jolla beaches, is an irregular, sloping rocky beach, mostly cobble-boulder substrate, with little or no sand beach at base of cliffs. Abundant *Pelvetia* grows on sides of rocks; coralline-anchored turf is less widespread. *Sargassum agardhianum and S. muticum* both occur here. Erect corallines other than *Corallina* species (*Lithothrix, Jania* spp., *Amphiroa*) are often conspicuous. Limited census data suggest that algal abundances and diversity are lower here than along ocean-facing beaches of Pt. Loma or on La Jolla beaches. Smaller epiphytic taxa include *Chondria arcuata*, common at La Jolla but mostly absent on Pt. Loma, and *Binghamia forkii*, more characteristic of Pt. Loma.

Compared with the Pt. Loma sites, the La Jolla beaches in studies cited above have proportionally less *Corallina* in the algal turf, with *Pterocladia capillacea* a second dominant alga and very conspicuous during winter and spring months. *Gelidium coulteri* and *G. pusillum* also are more common here than at Pt. Loma localities. Among the epiphytes, *Ceramium flaccidum* is very abundant (and rare or absent from Pt. Loma turf) during fall months, *Hypnea* is often conspicuous entangled with *Pterocladia* axes, *Lithothrix* is usually less abundant on La Jolla beaches, and *Chondria arcuata* is common seasonally while rare on Pt. Loma.

Subtidal

On rocky subtidal outcroppings at the southern end of the county offshore from Imperial Beach, *Botryocladia neushullii*, often very abundant *Polyneura*, *Cryptopleura* (*Botryoglossum*) *farlowiana*, large blades of *Kalymenia* or *Halymenia* species, and *Sargassum palmeri* are notably present and elsewhere rare or absent. The few collections we have seen of *Microcladia coulteri* (on *Gigartina exasperata*), *Pterochondria woodii* var. *pygmaea* (on *Pelagophycus*), and *Phycodrys setchellii* have been from this area.

Loma Sea Cliff algal collections are as rich in small taxa as any from other parts of the California coasts; probably more than 50 species can be recognized in any single day's sampling. *Desmarestia ligulata*, *Agarum*, *Pterygophora*, *Laminaria farlowii*, *Macrocystis*, *Pelagophycus*, two species of *Dictyota*, *Dictyopteris*, *Cystoseira osmundacea*, *Sciadophycus*, *Plocamium cartilagineum*, *Gelidium nudifrons*, *G. purpurascens* and *G. robustum*, *Gigartina exasperata*, *Cryptopleura violacea*, *Cryptonemia obovata*, *Calliarthron cheilosporioides*, *Corallina officinalis* var. *chilensis*, *Bossiella orbigniana*, *Prionitis* sp. (*australis/cornea/linearis*), and prostrate *Codium* are among the larger easily-recognized taxa on rocky substrates. Filaments or small blades of *Sorella* spp., *Nienburgia andersoniana*, *Nitophyllum hollenbergii*, *Phycodrys profunda*, *Branchioglossum undulatum*, *Griffithsia pacifica*, *Callithamnion catalinense (?)*, *Antithamnion defectum*, *Platythamnion villosum*, *Pleonosporium* spp., *Pterosiphonia dendroidea*, *Herposiphonia plumula*, and *Tiffaniella* are frequently found on tunicate stalks, sponges, scallop and abalone shells, and on larger specimens of *Gelidium* and *Calliarthron*. Nests of garibaldi fish additionally may include tiny thalli of *Bryopsis* sp., *Cladophora* spp., *Dasya sinicola* var. *abyssicola*, *Veleroa subulata*, *Pterocladia caloglossoides*, and germlings of what probably are *Fauchea laciniata* thalli. These taxa are not restricted to any single association, but are easily recognized among the low-growing turf that is maintained by the fish when eggs are being "incubated." *Ptilothamnionopsis* grows on *Calliarthron* stipes, and *Gelidium* axes often are conspicuously covered with encircling attached blades of *Cryoptopleura* and *Nitophyllum hollenbergii*.

Sarcodiotheca Pt. extends seaward into the shoreward head of the La Jolla Submarine Canyon in La Jolla Bay. This head of the canyon is a popular destination for scuba divers, a short swim from the beach, and 20–25 m deep. The narrow sloping terraces that drop into the canyon here are often densely covered with clumps of *Acrosorium* interspersed with *Stenogramma*, *Sarcodiotheca furcata* and *S. gaudichaudii*. Seasonally, *Dictyopteris*, *Agarum* and scattered *Desmarestia* of all sizes are common. Mats of filamentous diatoms often appear as a brown film over large areas of fine-grained mud. The red "fuzz" that one observes on worm tubes, pieces of broken shells, or larger

attached algae includes species of *Polysiphonia, Ceramium*, and *Antithamnion*. This is one of the few sites where large, to 1 m high, specimens of *Sarcodiotheca (Neoagardhiella) gaudichaudii* can be found. Juvenile, occasionally larger, plants of *Macrocystis* have been noted nearby, but are not consistently present; *Sargassum muticum* also is occasionally present, not abundant. Many of the species noted as characteristic of the Loma Sea Cliff (*Rhodymenia* and *Prionitis*, for example) are generally absent.

The head of the North Branch of the Scripps Canyon at about 30–40 m, just a short distance north of Scripps Institution of Oceanography and also within La Jolla Bay, differs markedly in its algal flora. Predictably *Maripelta* can be seen here; *Ozophora*, abundant *Rhodymenia*, several forms or species of *Callophyllis, Dictyopteris, Schizymenia dawsonii*, and large red blades that variously represent *Halymenia, Gigartina exasperata, Polyneura* or other species are conspicuous while typically absent or more rare in the La Jolla Canyon nearby, just to the south. The sponges, rock surfaces, and stalks of gorgonian are often bare of epiphytes. Characteristically, there is little *Acrosorium* (compared with the large clumps in La Jolla Canyon), and no *Sarcodiotheca furcata* or *Stenogramma*. (These two latter taxa are restricted to the head of the La Jolla Canyon in our experience.) In shallower water, about 20 m deep and north of the North Branch Canyon rim, a stable rocky bottom supports algal assemblages very similar to those on the Loma Sea Cliffs at the same depths.

APPENDIX B

Name Changes Relevant to San Diego County Marine Algae Since Publication of Marine Algae of California (MAC). (Several others are discussed in text but are not accepted at this time.) Numbers refer to pages in **MAC**. References are listed in Literature Cited.

CHLOROPHYTA

Pseudulvella applanata Setch. and Gardn. (61) to: *Ulvella applanata* (Setch. and Gardn.) South and Tittley, South and Tittley 1986

PHAEOPHYTA

Giffordia species (122-146) to: *Hincksia* species. Silva *et al.* 1987

Cylindrocarpus rugosus Okam. (177) to: *Petrospongium rugosum* (Okam.) Setch. and Gardn. [It is unclear why the older name of this alga was cited in Abbott and Hollenberg 1976]

Sphacelaria furcigera Kütz. (218) to: *S. rigidula* Kütz., Prud'homme van Reine 1982

Laminaria dentigera Kjellm. (229) to: *L. setchellii* Silva, Druehl 1979

RHODOPHYTA

Asterocytis ramosa (Thwaites) Schmitz (283) to: *Chroodactylon ornatum* (C. Ag.) Basson, Basson 1979

Goniotrichum alsidii (Zan.) Howe (280) to: *Stylonema alsidii* (Zan.) Drew, Drew 1956

Bangia fusco-purpurea (Dillw.) Lyngb. (294) to: *B. vermicularis* Harv., Sheath and Cole 1984

Pseudogloiophloea confusa (Setch.) Levr. (335) to: *Scinaia confusa* (Setch.) Huisman, Huisman 1985

Pseudoscinaia snyderae Setch. (333) to: *Scinaia snyderae* (Setch.) Huisman, Huisman 1985

Amphiroa zonata Yendo (400) to: *A. beauvoisii* Lamour., Norris and Johansen 1981

Halymenia coccinea (Harv.) Abb. (425) to: *H. gardneri* (Kylin) Parkinson, see Lindstrom 1986

Choreocolax polysiphoniae Reinsch (470) to: *Leachiella pacifica* Kugrens, Kugrens 1982

Neoagardhiella baileyi (Kütz.) Wynne and Taylor (483) to: *Sarcodiotheca gaudichaudii* (Mont.) Gabrielson, Gabrielson 1982

Gracilaria sjoestedtii Kyl. (498) to: *G. lemaneiformis* (Bory) Weber-van Bosse, Abbott 983

Gracilaria verrucosa (Huds.) Papenf. (500) to: *G. pacifica* Abb., Abbott 1985

Gracilaria andersonii (Grun.) Kyl. (495) to: *G. papenfussii* Abb., Abbott 1983

Gymnogongrus platyphyllus Gardn. (508) to: *G. chiton* (Howe) Silva and DeCew, Silva 1979

Gigartina spinosa (Kütz.) Harv. (525) to: *G. ornithorhynchos* J. Ag., Silva 1979

Gigartina papillata (C. Ag.) J. Ag. (523) to: *Mastocarpus papillatus* (C. Ag.) Kütz., Guiry *et al.* 1984

Petrocelis franciscana Setch. and Gardn. (476): see *Mastocarpus papillatus*

Coeloseira compressa Hollenb., *C. parva* Hollenb. (566) to: *Gastroclonium compressum* (Hollenb.) Chang and Xia, *G. parvum* (Hollenb.) Chang and Xia, Chang and Xia 1978

Gastroclonium coulteri (Harv.) Kyl. (567) to: *G. subarticulatum* (Turner) Kütz., Hawkes 1986

Antithamnionella breviramosa (Daws.) Wom. and Bail. (580) to: *A. elegans* (Berthold) Price and John, Price *et al.* 1986 (and see Cormaci and Furnari 1988)

Ceramium gracillimum var. *byssoideum* (Harv.) Maz. (597) to: *C. flaccidum* (Kütz.) Ardissone, Womersley 1978

Ceramium taylorii Daws. (598) to: *C. flaccidum* (Kütz.) Ardissone, Womersley 1978

Scagelia occidentale (Kyl.) Woll. (584) to: *S. pylaisaei* (Mont.) Wynne, Wynne 1985c

Acrosorium uncinatum (Turn.) Kyl. (659) to: *A. venulosum* (Zan.) Kyl., Wynne 1989

Botryoglossum farlowianum (J. Ag.) DeToni (671) to: *Cryptopleura farlowiana* (J. Ag.) Ver Steeg and Josselyn, Ver Steeg and Josslyn 1983

Herposiphonia tenella f. *secunda* (C. Ag.) Hollenb. (702) to: *H. secunda f. tenella* (C. Ag.) Wynne, Wynne 1985a

Pterosiphonia clevelandii (Farl.) Hollenb. (708) to: *P. farlowii* Hollenb., Hollenberg 1976

Murrayellopsis dawsonii Post (701) to: *Veleroa subulata* Daws., Stewart 1989

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Presently accepted binomials for species that are documented for the San Diego flora, or that are likely to be present, are marked • (•? if the record cannot be verified).