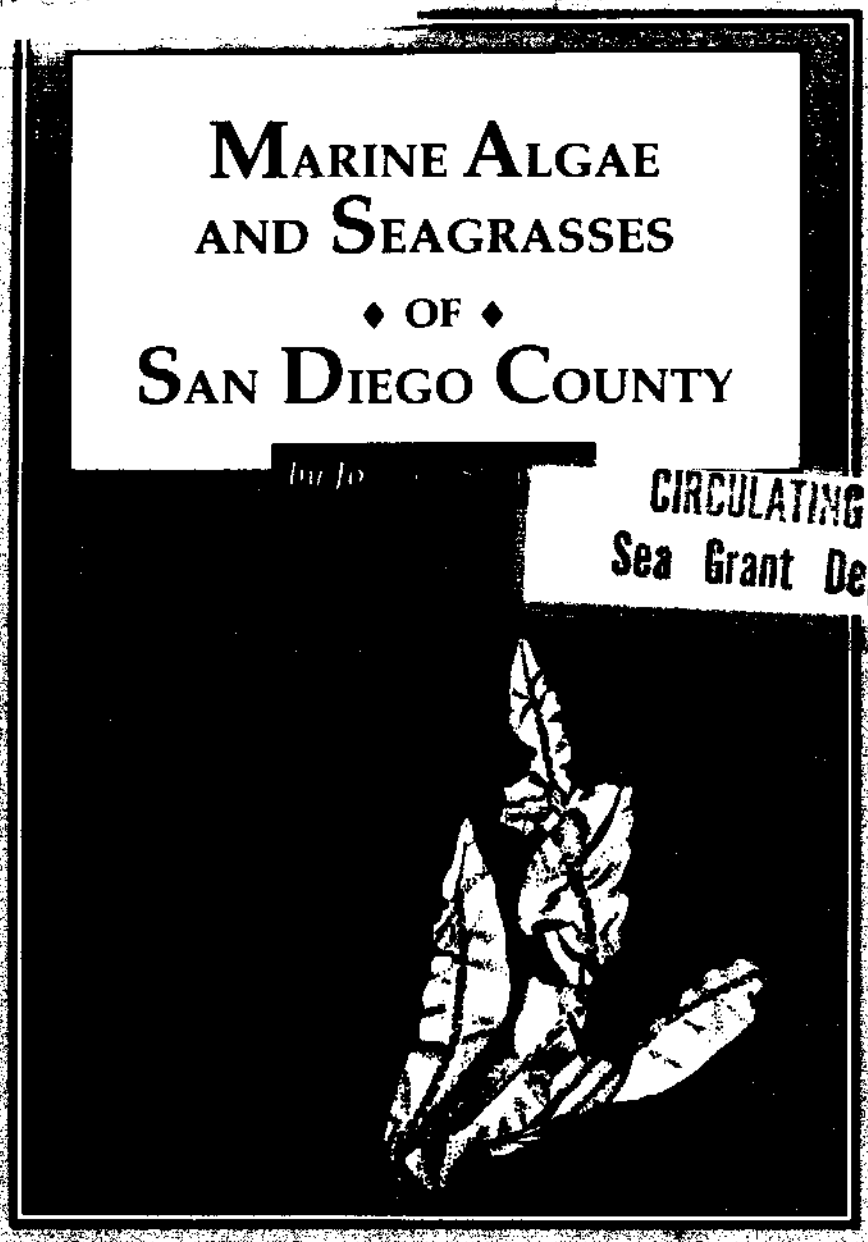
Marine Algae and Seagrasses ♦ of ♦ San Diego County



♦ 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

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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.

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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.

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