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Seaweeds and Seagrasses of Southern California: Distributional Lists for Twenty-one Rocky Intertidal Sites

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Abstract.—A total of 213 macrophyte taxa was identified from 21 rocky intertidal sites in southern California, with 194 identified to the level of species, 14 to genus, and 5 to family. Eight southern California taxa were added to distributional records reported in the *Marine Algae of California.* The number of taxa ranged from 107 at Government Point, Santa Barbara County, to 51 at West Point, San Nicolas Island. No significant differences (Mann-Whitney two-sample test) in number of taxa were obtained between island and mainland or between sand-influenced and sand-free intertidal sites. Similarly, no significant difference (Kruskal-Wallis nonparametric ANOVA by ranks) was found in the numbers of taxa collected among sites exposed to warm, intermediate and cold water masses. It appears that site-specific combinations of environmental conditions determine species richness at southern California intertidal sites rather than large-scale patterns in abiotic environmental parameters.

Southern California coastal waters are characterized by a rich flora of benthic marine macroalgae and seagrasses. The relatively large coastal area, which includes a total of ca. 917 km of shoreline distributed over a latitudinal range of only ca. 212 km, exhibits much variation in exposure to wave action, ocean water masses, thermal regimes, and in substratum composition. This high degree of habitat heterogeneity is believed (Murray et al. 1980; see also Abbott and Hollenberg 1976) to contribute strongly to the high diversity of macrophytes known to occur in southern California waters.

Despite its taxonomic richness, knowledge of the southern California marine macrophyte flora is still best described as being in the early stages of exploration (see Murray 1974). Marine macroalgal floristics of southern California were advanced dramatically by Abbott and Hollenberg (1976) who provided taxonomic descriptions, distributional data and taxonomic keys for 669 species of California seaweeds. Unfortunately, little additional progress has been made in our taxonomic understanding of southern California seaweeds since Abbott and Hollenberg's (1976) classic work, and today floristic knowledge is poorly developed for most of the southern California region. This is particularly true for the seaweeds occurring on the relatively pristine and biogeographically important Southern California Islands where taxonomic contributions during the last 12 years have been limited to species lists provided with ecological (Littler 1979) and geographical (Apt et al. 1988) surveys. This situation contrasts greatly, for example, with

the considerable progress that has been made (e.g., Scagel et al. 1986; Gabrielson et al. 1987) in advancing our understanding of the systematics of the seaweeds of northern Washington, British Columbia and southeast Alaska.

This paper provides lists of marine macroalgae and seagrasses collected from 21 southern California intertidal sites during the 1975–1979 ecological sampling program sponsored by the U.S. Department of Interior, Bureau of Land Management (now referred to as Minerals Management Services). Previous versions of these records have been used for distributional analyses of macrophytes occurring in southern California waters (Murray et al. 1980; Murray and Littler 1981). However, the species lists generated for these sites are currently available only in unpublished governmental reports. These distributional data for intertidal seaweeds and seagrasses are of particular value considering the paucity of recent floristic information on southern California macrophytes.

Methods

Marine macroalgae and seagrasses were collected from 21 rocky intertidal sites located in southern California between Point Conception and the United States-Mexico border (Fig. 1; Table 1). Seven stations were located on the mainland and 14 were established on the eight Southern California Islands or Channel Islands which have been divided (Philbrick 1967) into Northern (San Miguel, Santa Rosa, Santa Cruz, and Anacapa) and Southern (San Nicolas, Santa Barbara, Santa Catalina, and San Clemente) groups. A minimum of one station was established on each island, with seven stations located on members of the Northern and seven on members of the Southern Channel Island groups.

Study sites encompassed the geographic extent of the southern California region and consisted of areas representative of protected or semi-protected rocky shoreline. Collections were not made at sites that received consistently heavy wave action, such as characterizes much of the central and northern California coast (see Ricketts et al. 1985) which receives direct exposure to ocean swells. Similarly, sites varied as to the composition and stability of the substratum, and exposure to ocean currents and seawater temperature regimes.

The study sites (Fig. 1; Table 1) were visited from one to several times between July 1975 and July 1979. Macrophyte collections at each site were made over a period of at least three days and included not only taxa found in ecological samples, but also specimens of conspicuous forms observed in the vicinity of the study areas. Details of the ecological sampling program including the visitation dates for each site are provided elsewhere (Littler 1977, 1978, 1979, 1980a, b; Littler and Littler 1985) and, hence, will not be described here.

Because only 12 of the 21 study sites were sampled throughout the year (summer, fall, winter, spring), seasonally-occurring macrophyte taxa were likely missed at the sites subjected to less intense seasonal sampling. Our observations at the 12 sites where seasonal sampling occurred suggest that relatively few intertidal macrophytes are completely absent from the southern California shoreline during any particular season. However, we did record significantly fewer numbers of taxa at the 9 sites subjected to incomplete seasonal sampling (Crook Harbor, San Miguel Island; Prisoner's Harbor, Santa Cruz Island; South Coast and North Coast, Anacapa Island; West Point, San Nicolas Island; Catalina Harbor, Santa Catalina Island; Northwest Coast, San Clemente Island; Paradise Cove, Los Angeles Coun-

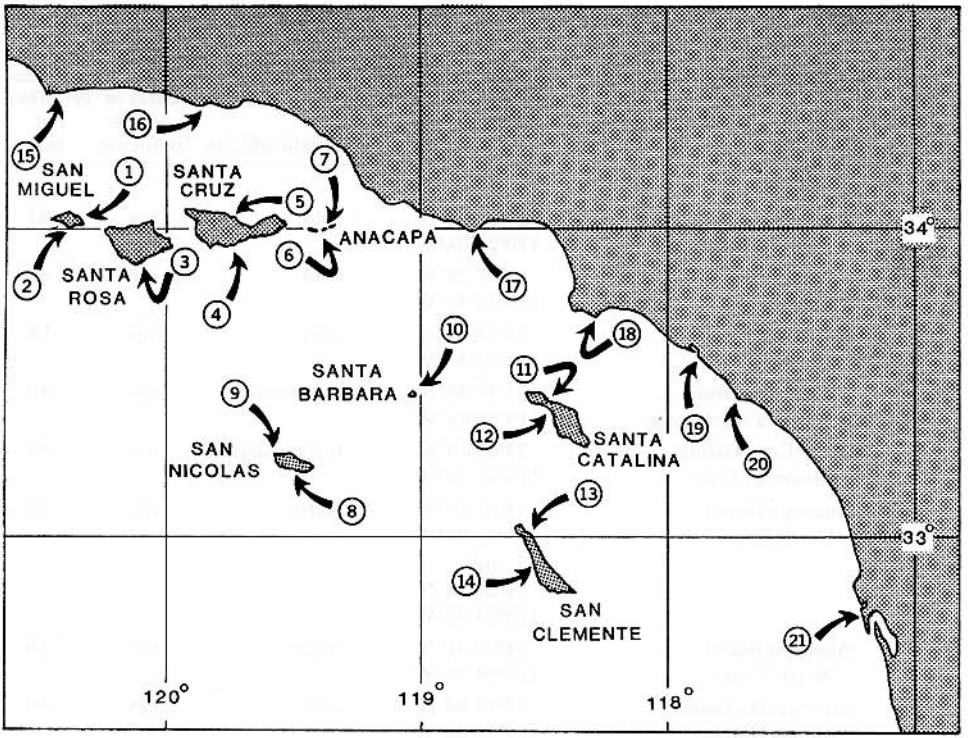

Fig. 1. Locations of the 21 rocky intertidal sites. Refer to Table 1 for numerical key to sites.

ty; and, Dana Point, Orange County) compared with the 12 sites where collections were made throughout the year (65.0 ± 9.4 vs. 84.8 ± 13.8 S.D.; Mann-Whitney two-sample test, $U = 94.0$, $n_1 = 12$, $n_2 = 9$, $P < .01$). Analyses of taxa numbers using only data from the 12 sites where seasonal sampling was performed produced statistical results identical to those where all 21 sites were considered. Consequently, the numbers of taxa reported herein and employed in statistical comparisons are the "raw" recorded values and have not been weighted to reflect sampling frequency.

Macrophyte collections generally were preserved in 3–5% Formalin-seawater as suggested by Abbott and Tsuda (1985) and returned to the laboratory for identification and processing. Specimens were identified by the authors; most identifications were confirmed by Dr. Isabella A. Abbott, currently of the University of Hawaii. For selected macrophytes such as crustose algae and members of taxonomically difficult genera (e.g., *Cladophora, Ceramium,* and *Polysiphonia*), identification to the species level usually was not performed due to time constraints. Instead these specimens have been categorized under higher taxonomic units, i.e., genus or family. Herbarium specimens of most taxa were prepared and deposited in the U.S. National Herbarium, National Museum of Natural History, Smithsonian Institution.

Results

A total of 213 taxa was identified from the 21 rocky intertidal sites, with 194 identified to the species level, 14 to the level of genus and 5 to the level of family. A list of the taxa and the sites at which they were collected is presented in Table 2.

Table 1. Names, locations, characteristics, and numbers of taxa for the 21 rocky intertidal sites. Floristic affinities are derived from Murray and Littler (1981).

Site number	Site location	Latitude and longitude	Floristic affinity	Sand or cobble influence	Number of taxa
Island sites					
1	San Miguel Island, Cuyler Harbor	34°02′55″N 120°20′08″W	cold	yes	85
2	San Miguel Island, Crook Point	34°01′28″N 120°22′43″W	cold	no	62
3	Santa Rosa Island, South Point	33°53′31″N 120°06′31″W	cold	yes	78
4	Santa Cruz Island, Willows Anchorage	33°57′43″N 119°45′16″W	intermediate	no	89
5	Santa Cruz Island, Prisoners Cove	34°01′14″N 119°41′14″W	intermediate	no	61
6	Anacapa Island, South Coast	34°00′19″N 119°25′05″W and 34°00′24″N 119°24′38″W	warm	no	77
7	Anacapa Island, North Coast	34°00′31″N 119°24′21″W	warm	no	58
8	San Nicolas Island, Dutch Harbor	33°12′54″N 119°28′22″W	cold	yes	98
9	San Nicolas Island, West Point	33°16′43″N 119°34′41″W	cold	no	51
10	Santa Barbara Island, Cave Canyon	33°28′43″N 119°01′36″W	intermediate	no	92
11	Santa Catalina Island, Fisherman Cove	33°26′47″N 118°29′04″W	warm	no	91
12	Santa Catalina Island, Catalina Harbor	33°25′42″N 118°30′42″W	warm	no	69
13	San Clemente Island, Wilson Cove	33°00′06″N 118°33′03″W	warm	no	79
14	San Clemente Island, Northwest Coast	33°58′06″N 118°34′18″W	warm	no	80
Mainland sites					
15	Government Point, Santa Barbara County	34°26′35″N 120°27′06″W	cold	yes	107
16	Coal Oil Point, Santa Barbara County	34°24′27″N 119°52′40″W	intermediate	yes	95
17	Paradise Cove (Malibu), Los Angeles County	34°00′42″N 118°47′30″W	intermediate	yes	68
18	Whites Point, Los Angeles County	33°43′11″N 118°19′39″W	warm	yes	58
19	Corona Del Mar, Orange County	33°35′14″N 117°51′54″W	warm	yes	65
20	Dana Point, Orange County	33°35′25″N 117°42′44″W	warm	yes	59
21	Ocean Beach, San Diego County	32°44′35″N 117°15′15″W	warm	no	80

Table 2. Lists of macroalgal and seagrass taxa for the 21 rocky intertidal stations. Nomenclature after Abbott and Hollenberg (1976) as modified by Scagel et al. (1986).

Taxon	Site number
Division Chlorophyta	
O. Ulotrichales	
f. Chaetophoraceae	
unidentified crust	9
f. Monostromataceae	
Monostroma zostericola Tild.	15
f. Ulvaceae	
Enteromorpha spp.	5, 7, 8, 9, 10, 11, 12, 13, 14, 16, 18, 19, 21
Enteromorpha clathrata var. clathrata (Roth) Grev.	10, 13, 15, 16
Enteromorpha compressa (L.) Grev.	5, 13
Enteromorpha flexuosa (Roth) J. Ag.	1, 2, 4, 8, 16, 21
Enteromorpha intestinalis (L.) Link	1, 3, 8, 17, 21
Enteromorpha linza (L.) J. Ag.	8, 21
Ulva angusta S. & G.	16
Ulva californica Wille	1, 2, 4, 5, 6, 7, 11, 12, 13, 17, 18, 19, 20, 21
Ulva lobata (Kütz.) S. & G.	1, 2, 3, 4, 5, 8, 9, 10, 14, 15, 16
Ulva taeniata (Setch.) S. & G.	8, 15, 16, 21
O. Cladophorales	
f. Cladophoraceae	
Chaetomorpha linum (Müll) Kütz.	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Chaetomorpha spiralis Okam.	4, 21
Cladophora spp.	1, 2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 18, 19, 21
Cladophora columbiana Coll.	1, 2, 3, 4, 6, 8, 9, 15, 17, 21
Cladophora sakaii Abb.	16
O. Siphonocladales	
f. Siphonocladaceae	
Cladophoropsis fasciculatus (Kjellm.) Okam.	1, 8, 11, 13

Table 2. Continued.

Taxon	Site number
O. Codiales	
f. Bryopsidaceae	
Bryopsis corticulans Setch.	1, 4, 6, 8, 9, 10, 11, 15, 16, 18, 19, 21
f. Derbesiaceae	
Derbesia marina (Lyngb.) Sol.	10
f. Codiaceae	
Codium cuneatum S. & G.	11, 12
Codium fragile (Sur.) Har.	1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 14, 15, 17, 19, 20
Codium hubbsii Daws.	10, 11, 14
Codium setchellii Gardn.	1, 2, 10, 11, 15
Division Phaeophyta	
O. Ectocarpales	
f. Ectocarpaceae	
unidentified filamentous species	3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
O. Chordariales	
f. Ralfsiaceae	
unidentified encrusting species	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Diplura simulans Hollenb.	10
Hapalospongidion gelatinosum Saund.	6, 12, 21
Hapterophycus canaliculatus S. & G.	4, 10, 11, 12
Pseudolithoderma nigra Hollenb.	2, 4, 6, 7, 10, 11, 12, 13, 14
f. Corynophlaeaceae	
Cylindrocarpus rugosus Okam.	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Leathesia nana S. & G.	8, 15
f. Chordariaceae	
Analipus japonicus (Harv.) Wynne	15
Haplogloia andersonii (Farl.) Levr.	15

Table 2. Continued.

Taxon	Site number
O. Dictyosiphonales	
f. Dictyosiphonaceae	
Coilodesme rigida S. & G.	13
f. Punctariaceae	
Soranthera ulvoidea Post. & Rupr.	15
O. Scytosiphonales	
f. Scytosiphonaceae	
Colpomenia peregrina (Sauv.) Ham. and Colpomenia sinuosa (Roth) Derb. & Sol.	3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Endarachne binghamiae J. Ag.	3, 4, 6, 10, 11, 12, 13, 14, 15, 17, 20, 21
Hydroclathrus clathratus (C. Ag.) Howe	11, 13
Petalonia fascia (Müll.) Kuntze	2, 4, 6, 10, 11, 15, 16, 17, 18
Scytosiphon dotyi Wynne	1, 3, 5, 6, 7, 10, 11, 13, 14, 15, 16, 17, 19, 21
Scytosiphon lomentaria (Lyngb.) J. Ag.	3, 4, 8, 9, 11, 12, 13, 15, 16, 17, 18, 19, 21
O. Dictyotales	
f. Dictyotaceae	
Dictyopteris johnstonei Gardn.	4, 6, 10
Dictyopteris undulata Holmes	4, 9, 10, 11, 13, 19, 21
Dictyota flabellata (Coll.) S. & G.	4, 7, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21
Pachydictyon coriaceum (Holmes) Okam.	4, 6, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21
Taonia lennebackeriae J. Ag.	3, 8, 16
Zonaria farlowii S. & G.	4, 6, 7, 11, 12, 13, 14, 16, 17, 20
O. Sphacelariales	
f. Sphacelariaceae	
Sphacelaria californica (Sauv.) S. & G.	7, 12, 13
Sphacelaria furcigera Kütz.	6, 7, 11

Table 2. Continued.

Taxon	Site number
O. Desmarestiales	
f. Desmarestiaceae	
Desmarestia ligulata var. ligulata (Lightf.) Lamour.	3, 4, 5, 8, 10, 14, 15
O. Laminariales	
f. Laminariaceae	
Laminaria sp.	8
Laminaria farlowii Setch.	5, 7
Laminaria setchellii Silva	1, 2, 9
Laminaria sinclairii (Harv.) Farl., Anders. & Eaton	15
f. Alariaceae	
Egregia menziesii (Turn.) Aresch.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Eisenia arborea Aresch.	4, 6, 7, 8, 9, 10, 11, 12, 13, 19, 20
f. Lessoniaceae	
Macrocystis pyrifera (L.) C. Ag.	3, 4, 5, 6, 8, 9, 10, 11, 13, 16, 17, 19
O. Fucales	
f. Fucaceae	
Fucus gardneri Silv.	15
Hesperophycus harveyanus (Decne.) S. & G.	1, 2, 3, 4, 6, 7, 8, 11, 12, 14, 15, 19
Pelvetia fastigiata f. fastigiata (J. Ag.) DeToni	15, 16, 17, 19, 20
Pelvetia fastigiata f. gracilis S. & G.	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14
f. Cystoseiraceae	
Cystoseira neglecta S. & G.	11, 20
Cystoseira osmundacea (Turn.) C. Ag.	4, 7, 16, 17, 18
Cystoseira setchellii Gardn.	7
Halidrys dioica Gardn.	2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20
f. Sargassaceae	
Sargassum agardhianum J. Ag.	10, 11, 12, 13, 14, 20
Sargassum muticum (Yendo) Fensh.	5, 7, 11, 12, 13, 14, 18, 19, 20

Table 2. Continued.

Taxon	Site number
Division Rhodophyta	
O. Bangiales	
f. Erythropeltidaceae	
Erythrotrichea carnea (Dillw.) J. Ag.	19
Smithora naiadum (Anders.) Hollenb.	1, 3, 5, 6, 8, 15, 16, 17, 21
f. Bangiaceae	
Bangia vermicularis Harv.	1, 4
Porphyra lanceolata (Setch. & Hus) Smith	1, 2
Porphyra perforata J. Ag.	1, 2, 3, 4, 5, 6, 8, 10, 14, 15, 16, 18, 19, 21
Porphyra thuretii Daws.	15
Porphyrella californica Hollenb.	11, 12, 13
O. Nemaliales	
f. Acrochaetiaceae	
Audouinella daviesii (Dillw.) Woelk.	11
f. Nemaliaceae	
Nemalion helminthoides (Vell.) Batt.	1, 2, 3, 4, 5, 6, 8, 10, 11, 12, 13, 14, 16, 17, 18, 21
f. Helminthocladiaceae	
Cumagloia andersonii (Farl.) S. & G.	4, 10, 17, 18, 21
f. Bonnemaisoniaceae	
Bonnemaisonia hamifera Har.	14
f. Gelidaceae	
Gelidium coulteri Harv. and Gelidium pusillum (Stackh.) LeJolis	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Gelidium nudifrons Gardn.	7, 13, 15
Gelidium purpurascens Gardn.	1, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 17, 19, 21
Gelidium robustum (Gardn.) Hollenb. & Abb.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Pterocladia capillacea (Gmel.) Born. & Thur.	1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21
Pterocladia media Daws.	6, 12, 14, 16

Table 2. Continued.

Taxon	Site number
O. Cryptonemiales	
f. Dumontiaceae	
Farlowia mollis (Harv. & Bail.) Farl. & Setch.	10
Pikea californica Harv.	14, 15
f. Peyssonelliaceae and Hildenbrandiaceae	
unidentified crusts	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
f. Corallinaceae	
Amphiroa zonata Yendo	4, 10, 11, 12, 19
Bossiella orbigniana ssp. dichotoma (Manza) Johansen	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Bossiella orbigniana ssp. orbigniana (Dec.) Silva	6, 7, 10, 11, 16, 18, 19, 20
Calliarthron cheilosporioides Manza	1, 2, 9, 17
Calliarthron tuberculosum (Post. & Rupr.) Daws.	1, 3, 4, 6, 8, 9, 10, 11, 15, 16, 19
Corallina officinalis var. chilensis (Dec.) Kütz.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Corallina vancouveriensis Yendo	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Haliptylon gracile (Lamour.) Johans.	1, 6, 7, 10, 11, 12, 13, 14, 19, 20, 21
Jania crassa Lamour.	6, 10, 14, 20, 21
Jania tenella (Kütz.) Grun.	11, 12, 13, 14
Lithothrix aspergillum Gray	3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Melobesia mediocris (Fosl.) Setch. et Mason	1, 2, 3, 4, 5, 6, 8, 13, 15, 16, 17, 20, 21
unidentified crustose species	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
f. Gloiosiphoniaceae	
Gloiosiphonia capillaris (Huds.) Berk.	3, 15
Schimmelmania plumosa (Setch.) Abb.	15
f. Endocladiaceae	
Endocladia muricata (Post. & Rupr.) J. Ag.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 15, 16, 17
Gloiopeltis furcata (Post. & Rupr.) J. Ag.	11, 12
f. Cryptonemiaceae	
Carpopeltis bushiae (Farl.) Kyl.	10
Carpopeltis divaricata Okam.	5, 6, 8, 11, 12, 13

Table 2. Continued.

Taxon	Site number
Grateloupia doryphora (Mont.) Howe	1, 2, 3, 4, 5, 8, 10, 14, 15, 16, 17, 21
Grateloupia sp.	4
Prionitis angusta (Harv.) Okam.	10, 12
Prionitis cornea (Okam.) Daws.	3, 20
Prionitis lanceolata (Harv.) Harv.	1, 3, 4, 5, 6, 7, 8, 9, 10, 15, 16, 17, 18
Prionitis linearis Kyl.	17
f. Kallymeniaceae	
Callophyllis flabellulata Harv.	19, 21
Callophyllis violacea J. Ag.	1, 2, 3, 8, 10, 15, 16
Callophyllis sp.	10, 15
O. Gigartinales	
f. Petrocelidaceae	
Petrocelis middendorfii (S. & G.) West	1, 2, 4, 9, 15, 18
f. Nemastomataceae	
Schizymenia pacifica (Kyl.) Kyl.	3, 5, 6, 10, 13, 15, 21
f. Solieriaceae	
Opuntiella californica (Farl.) Kyl.	18
Sarcodiotheca gaudichaudii (Mont.) Gabr.	1, 2, 4, 8, 10, 15, 16, 17
Sarcodiotheca furcata (S. & G.) Kyl.	8
f. Hypneaceae	
Hypnea johnstonii S. & G.	11
Hypnea valentiae var. valentiae (Turn.) Mont.	7, 11, 14, 20, 21
f. Plocamiaceae	
Plocamium cartilagineum (L.) Dix.	1, 2, 3, 6, 8, 10, 11, 12, 13, 14, 15, 16, 17, 20, 21
Plocamium violaceum Farl.	1, 2, 3, 4, 8, 10, 11, 15, 19, 21
f. Gracilariaceae	
Gracilaria lemaneiformis (Bory) Weber-van Bosse	15

Table 2. Continued.

Taxon	Site number
Gracilaria pacifica Abb.	1, 2, 8, 11, 16
Gracilaria papenfussii Abb.	4, 16
f. Phyllophoraceae	
Ahnfeltia gigartinoides J. Ag.	15
Ahnfeltia plicata (Huds.) Fries	1, 15
Besa papillaeformis Setch.	9
Gymnogongrus chiton (Howe) Silv. et DeCew	5, 8, 15
Gymnogongrus leptophyllus J. Ag.	1, 2, 8, 14, 15, 16, 17, 20
Stenogramme interrupta (C. Ag.) Mont.	1, 2, 8, 16
f. Gigartinaceae	
Gigartina canaliculata Harv.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Gigartina corymbifera (Kütz.) J. Ag.	1, 2, 8, 15
Gigartina exasperata Harv. & Bail.	8, 15
Gigartina harveyana (Kütz.) S. & G.	1, 2, 4, 7, 8, 15, 16
Gigartina leptorhynchos J. Ag.	3, 4, 5, 6, 7, 8, 9, 15, 16, 18
Gigartina spinosa (Kütz.) Harv.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21
Gigartina volans (C. Ag.) J. Ag.	2, 3, 8, 15, 16
Iridaea cordata var. cordata (Turn.) Bory	1, 2, 3, 4, 8, 9, 10, 15, 16
Iridaea heterocarpa Post. & Rupr.	1, 3, 8, 15
Iridaea lineare (S. & G.) Kyl.	15
Mastocarpus jardinii (J. Ag.) West	1, 8, 15
Mastocarpus papillatus (C. Ag.) Kütz.	1, 2, 3, 4, 5, 6, 7, 8, 9, 15, 16, 18
Rhodoglossum affine (Harv.) Kyl.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Rhodoglossum californicum (J. Ag.) Abb.	8
O. Rhodymeniales	
f. Rhodymeniaceae	
Botryocladia pseudodichotoma (Earl.) Kyl.	8
Rhodymenia californica var. californica Kyl.	3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21
Rhodymenia pacifica Kyl.	1, 4, 5, 6, 10, 15, 17

Table 2. Continued.

Taxon	Site number
f. Champiaceae	
Coeloseira compressa Hollenb.	3, 6, 7, 19
Gastroclonium subarticulatum (Turn.) Kütz.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21
O. Ceramiales	
f. Ceramiaceae	
Callithamnion pikeanum Harv.	1, 2, 3, 8, 15, 16
Callithamnion rupicolum Anders.	1, 2, 3, 4, 6, 8, 9, 11, 12, 13, 14, 15, 16, 18, 21
Callithamnion spp.	3, 6, 7, 8
Centroceras clavulatum (C. Ag.) Mont.	1, 2, 3, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Ceramium codicola J. Ag.	4, 10, 11, 19, 20
Ceramium eatonianum (Farl.) DeToni & Ceramium sinicola S. & G.	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Ceramium pacificum (Coll.) Kyl.	3, 8
Ceramium viscainoense Daws.	4, 10, 18, 21
Ceramium spp.	1, 3, 4, 5, 6, 8, 10, 11, 12, 13, 14, 18, 19, 20, 21
Microcladia borealis Rupr.	1, 2, 15
Microcladia californica Farl.	13, 15
Microcladia coulteri Harv.	1, 2, 3, 4, 5, 8, 10, 15, 16, 17
Platythamnion heteromorphum (J. Ag.) J. Ag.	15
Pleonosporium squarrulosum (Harv.) Abb.	1, 16, 17
Tiffaniella snyderiae (Farl.) Abb.	1, 5, 8, 11, 13, 14, 15, 16, 17, 18, 21
f. Delesseriaceae	
Acrosorium uncinatum (Turn.) Kyl.	5, 10, 11, 13, 14, 16, 18, 19, 20, 21
Anisocladella pacifica Kyl.	1, 8, 10, 11, 13, 15, 16, 17, 19, 21
Cryptopleura corallinara (Nott.) Gardn.	10, 11, 12, 13, 18, 20, 21
Cryptopleura crispa Kyl.	1, 3, 4, 5, 6, 7, 8, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21
Cryptopleura lobulifera (J. Ag.) Kyl.	2, 3, 4, 21
Cryptopleura ruprectiana (J. Ag.) Kyl.	1, 2, 15
Cryptopleura violacea (J. Ag.) Kyl.	1, 2, 8, 9, 10, 15, 16
Hymenena flabelligera (J. Ag.) Kyl.	8
Nienburgia andersoniana (J. Ag.) Kyl.	5, 6, 8, 14, 15, 16, 19, 21
Phycodrys setchellii Skottsb.	1, 3, 5, 15, 16, 17

Table 2. Continued.

Taxon	Site number
f. Dasyaceae	
Heterosiphonia erecta Gardn.	13, 14, 21
Pogonophorella californica (J. Ag.) Silv.	3, 8, 15, 16, 21
Dasya sp.	14
f. Rhodomelaceae	
Chondria arcuata Hollenb.	6
Chondria californica (Coll.) Kyl.	4, 5, 7, 11, 12, 14, 16, 18, 19, 20, 21
Chondria decipiens Kyl.	8, 14, 15, 16, 20
Chondria nidifica Harv.	1, 8, 15, 16, 17
Chondria sp.	3
Erythrocystis saccata (J. Ag.) Silv.	4, 5, 9, 10, 11, 16, 17, 19, 20
Herposiphonia littoralis Hollenb.	4, 6, 7, 11, 12, 13, 14, 18, 19, 20, 21
Herposiphonia plumula (J. Ag.) Hollenb.	1, 3, 4, 7, 8, 10, 11, 13, 14, 16, 17, 18, 19, 20
Herposiphonia verticillata (Harv.) Kyl.	1, 3, 4, 10, 12, 13, 14, 18, 21
Laurencia masonii S. & G.	4, 6, 12, 13, 18, 20
Laurencia pacifica Kyl.	4, 5, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21
Laurencia sinicola S. & G.	3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21
Laurencia snyderiae Daws.	11, 13, 14
Laurencia spectabilis Post. & Rupr.	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
Laurencia splendens Hollenb.	1, 2, 4, 8, 11, 15, 16
Laurencia subopposita (J. Ag.) Setch.	11, 14, 16, 17, 21
Laurencia sp.	3, 21
Neorhodomela larix (Turn.) Masuda	15
Ophidocladus simpliciusculus (Crouan & Crouan) Falk.	21
Polysiphonia acuminata Gardn.	4, 6, 8, 10, 11, 12, 14, 15, 16, 17, 19, 21
Polysiphonia hendryi var. hendryi Gardn.	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 20, 21
Polysiphonia johnstonii S. & G.	16
Polysiphonia pacifica Hollenb.	1, 16
Polysiphonia paniculata Mont.	1, 8, 15
Polysiphonia scopulorum var. villum (J. Ag.) Hollenb.	1, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 18
Polysiphonia spp.	2, 3, 4, 5, 6, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21

Table 2. Continued.

Taxon	Site number
Pterosiphonia baileyi (Harv.) Falk.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 19, 21
Pterosiphonia bipinnata (Post. & Rupr.) Falk.	8, 15
Pterosiphonia dendroidea (Mont.) Falk.	1,3, 4, 5, 6, 7, 8, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21
Pterosiphonia pennata (C. Ag.) Falk.	11, 12, 14, 15
Division Spermatophyta	
f. Zosteraceae	
Phyllospadix scouleri Hook	1, 3, 4, 5, 8, 9, 10, 14, 15
Phyllospadix torreyi Wats.	2, 3, 6, 7, 8, 11, 12, 13, 15, 16, 17, 19, 20, 21

The number of taxa identified for each station varied from 107 (Government Point, Santa Barbara County) to 51 (West Point, San Nicolas Island) and averaged 76.3 ± 15.5 S.D.; no particular relationship between the number of species collected and the main abiotic features of the sites were apparent. Statistically significant differences were not obtained either between island and mainland (76.4 ± 14.3 vs. 76.0 ± 18.9; Mann-Whitney two-sample test, $U = 51.0$, $n_1 = 14$, $n_2 = 7$, $P > .05$) or between sites characterized (see Murray et al. 1980; Murray and Littler 1981) as exposed to water masses of warm (71.6 ± 11.5), cold (80.2 ± 21.2) and intermediate (81.0 ± 15.4) seawater temperatures (Kruskal-Wallis nonparametric ANOVA by ranks, $H = 1.85$, $df = 2$, $P = 0.60$). Similarly, no significant difference in numbers of taxa was obtained (Mann-Whitney two-sample test, $U = 62.5$, $n_1 = 9$, $n_2 = 12$, $P > .05$) when comparisons were made between sites identified (Littler et al. 1989) as mostly receiving exposure to seasonal sand inundation or cobble movements (79.2 ± 18.0) and those essentially free of sand or cobble influence (74.1 ± 13.7).

Discussion

The results of this study significantly augment existing distributional records of southern California macrophytes by providing lists of intertidal floras for 14 island and 7 mainland sites. Although floral lists for numerous southern California mainland sites exist (e.g., Dawson 1959, 1965; Widdowson 1971; Nicholson and Cimberg 1971; Thom and Widdowson 1978; Thom 1980), prior to our study intertidal floras of island stations were known for only San Clemente (Sims 1974; Littler and Murray 1975; Murray and Littler 1977), Santa Cruz (Seapy and Littler 1982; Apt et al. 1988) and San Nicolas (Caplan and Boolootian 1967; Littler et al. 1983) Islands. Additionally, this study adds eight new taxa (specimens are on file at the National Herbarium) to the list of algae known to occur in southern California waters based on distributional data provided by Abbott and Hollenberg (1976). Two of these (*Ceramium viscainoense* and *Carpopeltis divaricata*) are not listed for the California flora by Abbott and Hollenberg (1976), but appear in a list of algae collected from Santa Cruz Island (Apt et al. 1988). They represent species that appear to have more southerly distributions. Each of the remaining six taxa (*Besa papillaeformis, Hymenena flabelligera, Mastocarpus jardinii, Microcladia borealis, Monostroma zostericola,* and *Porphyra lanceolata*) are species with more northerly, cold water distributional centers. These species appear in southern California waters at sites most proximal to the colder waters of the California Current, i.e., on San Miguel and San Nicolas Islands or at Government Point. With the exception of *Porphyra lanceolata,* which was found in southern California waters by Nicholson and Cimberg (1971), none of these taxa has appeared in recent species lists (e.g., Widdowson 1971; Thom and Widdowson 1978; Thom 1980; Apt et al. 1988) of southern California intertidal seaweeds.

Prior to our research, few studies of intertidal algae on the relatively isolated offshore islands had been performed (see Murray 1974). Consequently, we anticipated that our study, besides providing new, site-specific lists, would result in numerous additions to the southern California flora and perhaps, several new species. Although we generated new distributional records for individual islands, our sampling program produced only eight additions to Abbott and Hollenberg's (1976) list of species occurring in southern California waters. This suggests that

the list of intertidal macrophytes comprising the southern California flora likely will expand only after careful biosystematic study. However, it is probable that many species as yet unreported for southern California waters, particularly those with distributional centers north of Point Conception, eventually will be identified from subtidal habitats in southern California. Stewart (1984) has observed that several species common in the low intertidal zone along central California shores occur in deep subtidal sites in southern California, indicating that colder water seaweeds can survive at more southerly latitudes by occupying deeper water habitats. Her observations are supported by Lewbel et al. (1981) who found that the shallow subtidal (ca. 20 m) fauna and flora of Cortes and Tanner Banks, two seamounts located ca. 180 km west of San Diego, had close affinity with the cold water, central California biota.

In examining the distributions provided in Table 2, in conjuction with our own observations and information provided by Abbott and Hollenberg (1976) and Abbott and North (1972), it is possible to identify seaweeds that serve as potential indicators of cold or warm water intertidal habitats in southern California. Cold water sites, such as those at Government Point and on San Nicolas and San Miguel Islands, appear to support populations of seaweeds such as *Analipus japonica, Fucus gardneri, Laminaria setchellii, Callithamnion pikeanum, Iridaea cordata* var. *cordata, Neorhodomela larix,* and *Laurencia spectabilis.* In contrast, intertidal habitats of sites characterized by exposure to warm water masses, such as occur for much of Santa Catalina and San Clemente Island, are often uniquely characterized by populations of *Colpomenia sinuosa, Dictyopteris undulata, Eisenia arborea, Endarachne binghamiae, Halidrys dioica, Sargassum agardhianum, Zonaria farlowii, Chondria californica, Jania tenella, Laurencia snyderiae,* and *Pterocladia capillacea.*

The abiotic environmental features of greatest importance in determining the abundances of macrophyte populations and the structure of macrophyte communities in southern California intertidal habitats appear to be the frequency and extent of sand scouring and accumulation on the rocky substratum, and the thermal characteristics of the water masses to which a site is exposed (Littler, et al. 1989). However, our analyses indicate that there is no relationship between species richness and the thermal regime or the degree of sand influence for intertidal sites in southern California. Additionally, species richness does not vary significantly between island and mainland sites. These findings suggest that the richness of rocky intertidal macrophyte floras in southern California is controlled by site-specific factors and does not conform to patterns based on large-scale gradients of abiotic environmental features or insular geographical position.

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