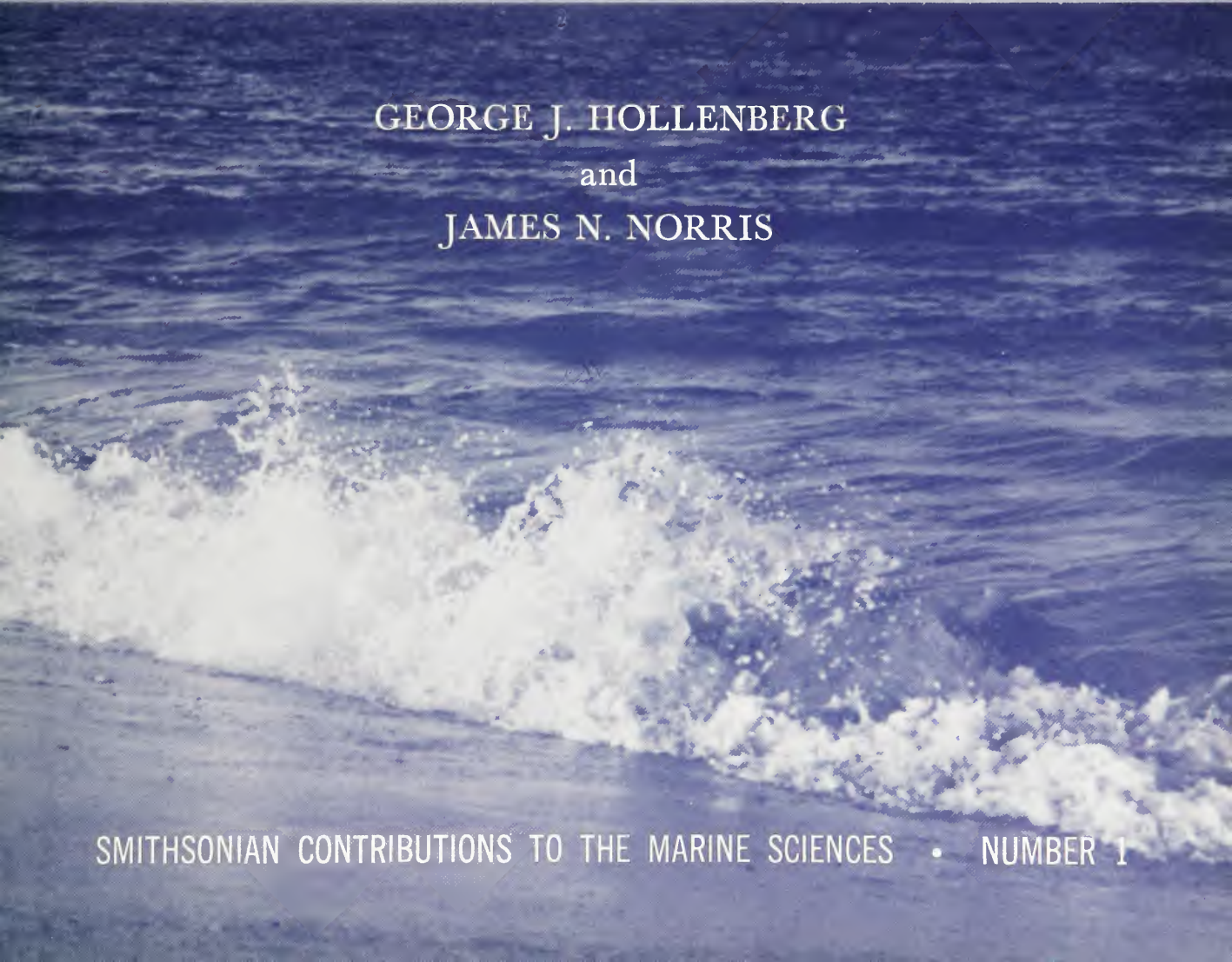


The Red Alga *Polysiphonia*
(Rhodomelaceae) in the
Northern Gulf of California



GEORGE J. HOLLENBERG
and
JAMES N. NORRIS

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ABSTRACT

Hollenberg, George J., and James N. Norris. The Red Alga *Polysiphonia* (Rhodomelaceae) in the Northern Gulf of California. *Smithsonian Contributions to the Marine Sciences*, number 1, 21 pages, 10 figures, 1977.—Taxonomic studies of *Polysiphonia* show 14 species to be present in the northern Gulf of California, Mexico. One of these, *P. sphaerocarpa* var. *cheloniae* is described herein as a new variety, and is found growing exclusively on the green sea turtle, *Chelonia mydas* L. This and three other species are recorded for the first time in the Gulf of California. The distribution of six other species is extended.

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The Red Alga *Polysiphonia* (Rhodomelaceae) in the Northern Gulf of California

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and *James N. Norris*

Introduction

The earliest records of *Polysiphonia* Greville (1824:308) in the Gulf of California were provided by Setchell and Gardner (1924), who described three new species. Later, Dawson (1944), in his investigations on marine algae of the Gulf of California, recorded seven species, including a new one. A detailed study of the taxa of *Polysiphonia* from the Gulf of California and Pacific coast of Baja California was first presented by Hollenberg (1961). These three papers constitute the basis for our knowledge of *Polysiphonia* in the Gulf of California.

Members of the genus *Polysiphonia* (Rhodomelaceae, Ceramiales) are distinguished by several important taxonomic characters: the number of pericentral cells; presence or absence of cortication; the manner of origin of rhizoids; the manner of origin of branches; the nature and position of trichoblasts; and the nature of spermatangial branchlets. These features have been pointed out in previous investigations by Hollenberg (1942a; 1942b; 1944; 1961; 1968a).

Herein we present our studies of recent intertidal and subtidal collections of *Polysiphonia* from the

northern Gulf of California. These collections were obtained by the junior author during field expeditions in 1972–1974 on the Gulf coasts of Baja California and Sonora. In addition, the following collections were utilized during the course of this study: those of the senior author from Puerto Peñasco, Sonora, in 1967; some additional material of the late Dr. E. Yale Dawson; and those of the junior author and Katina Bucher from the cruise of the R/V *Dolphin* to Las Islas de la Cintura (Midriff Islands) (Norris and Bucher, 1976).

Collectors are designated as follows: JN for J. N. Norris; H for G. J. Hollenberg; D for E. Y. Dawson; and KB for Katina E. Bucher. The numbers cited correspond to the collector's field notebooks. Specimens are being deposited in the following herbaria: first set, U.S. National Herbarium, Smithsonian Institution (US); duplicate material to University of California, Berkeley (UC); Phycology Herbarium, University of Arizona (ARIZ); Universidad Nacional Autonoma de México (MEXU). Herbaria housing the holotypes are abbreviated in accordance with Holmgren and Keuken (1974). Geographical locales under "Specimens Studied" are listed from north to south.

ACKNOWLEDGMENTS.—The Latin diagnosis was kindly provided by Dr. Hannah T. Croasdale (Dartmouth College). Field studies for collections were made possible through the support of the Na-

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tional Science Foundation (research grant GB-28623) to Dr. M. Neushul and J. Norris (Marine Science Institute, University of California, Santa Barbara). The junior author also wishes to thank again the University of Arizona for use of their Laboratorio de Biología Marina, Puerto Peñasco, Sonora, while he served as resident Marine Biologist/Station Director of the facility. Collections by Norris and Bucher from Las Islas de la Cintura were made possible only through the generosity of Dr. William Fenical (Scripps Institution of Oceanography), Chief Scientist on the R/V *Dolphin* cruise of April 1974.

Collections from the sea turtles were obtained by Dr. Richard S. Felger (Arizona-Sonora Desert Museum, Tucson, Arizona) and Edward W. Moser (Summer Institute of Linguistics, University of North Dakota). Further collections were given to Norris by Dr. Felger, Professor Richard Evans Schultes (Director, Botanical Museum of Harvard University), and Dr. Andrew T. Weil (Botanical Museum of Harvard University). Finally, we wish to thank Drs. Isabella A. Abbott, Robert W. Hoshaw, and Katina Bucher for reading the manuscript and offering suggestions for its improvement.

Key to the Species of *Polysiphonia*

THE SPECIES ARE ARRANGED ALPHABETICALLY IN THE TEXT

1. Pericentral cells 4 (Section Oligosiphonia) 2
Pericentral cells more than 4 (Section Polysiphonia) 11
2. Trichoblasts or scar-cells in general, regularly 1 per segment 3
Trichoblasts or scar-cells lacking or not regularly 1 per segment 9
3. Branching dichotomous throughout *P. masonii*
Branching lateral, not strictly dichotomous 4
4. Growing on sea turtles *P. sphaerocarpa* var. *cheloniae*, new variety
Not growing on sea turtles 5
5. Branches arising from a primary branch of a trichoblast (axillary to a trichoblast)
..... *P. flaccidissima*
Branches arising from an entire trichoblast primordium 6
6. Epiphytic, mostly less than 2 cm high *P. savatieri*
Usually not epiphytic 7
7. Segments in main branches mostly shorter than their diameter or sometimes as long
..... *P. simplex*
Segments in main branches mostly 1.5 times as long as their diameter or longer 8
8. Trichoblasts usually well developed; spermatangial stichidia arising as a primary branch of
a trichoblast *P. mollis*
Trichoblasts very rudimentary; spermatangial stichidia arising from an entire trichoblast
primordium *Polysiphonia* species
9. Thalli delicate, mostly intertidal, commonly forming mats or furry patches
..... *P. scopulorum* var. *villum*
Thalli not as delicate, mostly subtidal, not forming mats or patches 10
10. Thalli mostly less than 2 cm high; trichoblasts infrequent to rare *P. pacifica* var. *delicatula*
Thalli up to 4 cm high, of a terracotta color; trichoblasts numerous, arising at irregular
intervals *P. sonorensis*
11. Pericentral cells 5-6 12
Pericentral cells 8 or more 13
12. Thalli occasionally epiphytic, mostly 5 cm or more high *P. johnstonii* var. *johnstonii*
Thalli usually epiphytic, mostly less than 5 cm high *P. johnstonii* var. *concinna*
13. Thalli mostly less than 2 cm high *P. confusa*
Thalli mostly much larger, to 20 cm high *P. paniculata*

Polysiphonia confusa Hollenberg

FIGURE 1

Polysiphonia confusa Hollenberg, 1961:350, pl. 1; fig. 5.—
Dawson, Acelto, and Foldvik, 1964:87, pl. 33b.—Abbott and
Hollenberg, 1976:696, fig. 643.

Polysiphonia inconspicua sensu Hollenberg, 1944:479 [not
Polysiphonia inconspicua Reinsch, 1888:146].

DESCRIPTION.—Thalli 0.8–1.5(–3.0) cm high, with
erect axes mostly assurgent from prostrate branches
100–175 μ m in diameter, composed of segments

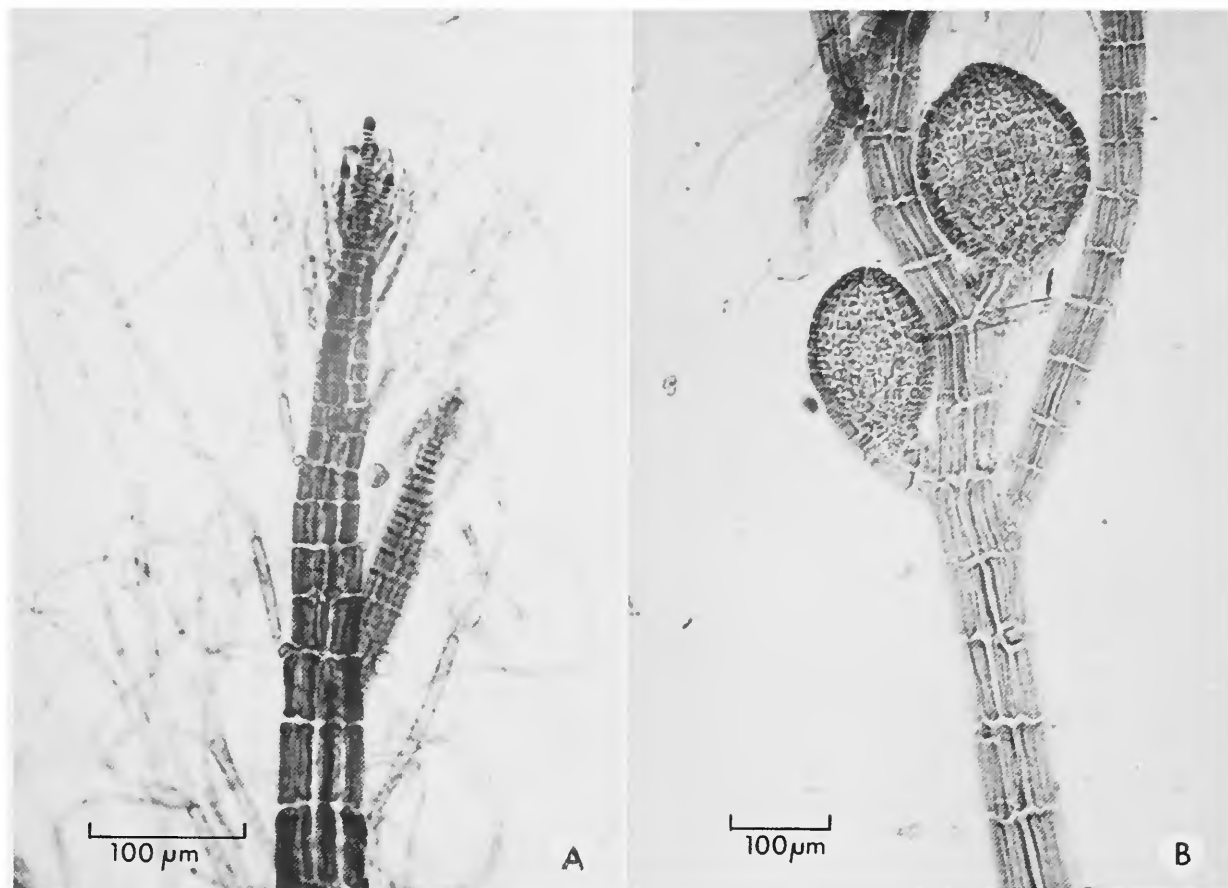


FIGURE 1.—*Polysiphonia confusa*: A, upper portion of thallus (JN-5577); B, cystocarpic plant (JN-3835).

about as long as the diameter or somewhat longer, attached by numerous unicellular rhizoids, arising 1 to several per segment as cells cut off from the proximal ends of the pericentral cells, and frequently having digitate apices; erect branches 60–150 μm in diameter, the segments 1.0–2.5 times as long; lateral branches arising exogenously in connection with trichoblasts at irregular intervals; pericentral cells 8–10, without cortication; trichoblasts to 1 mm long, with 1 or 2 dichotomies, arising 1 per segment in spiral sequence with $\frac{1}{4}$ divergence, soon deciduous, leaving persistent scar-cells.

Tetrasporangia, 60–80 μm in diameter, in long spiral series in slightly swollen segments of ultimate and subultimate branches; cystocarps globular, to 225 μm in diameter; spermatangial plants unknown.

TYPE-LOCALITY.—Mid-intertidal rocks, Corona del Mar, Orange County, California.

HOLOTYPE.—H-3285, 24 October 1942, in herbarium of G. J. Hollenberg (now at US).

GULF OF CALIFORNIA DISTRIBUTION.—Mid-intertidal regions; epizoic on sand dollars, epiphytic on *Codium* and growing on hard substrate of buoy; Puerto Peñasco to Desemboque de San Ignacio.

PACIFIC COAST DISTRIBUTION.—U.S.A.: southern California. Mexico: northern Baja California.

SPECIMENS STUDIED.—SONORA: JN-5577, sterile, growing on a sand dollar, *Encope grandis*, Bahía Cholla near Punta Pelicano, legit J. N. and K. B., 25 March 1974; JN-3835, cystocarpic, on NASA buoy, anchored off Laboratorio de Biología Marina, Playa Estación, Puerto Peñasco, legit J. N., 22 March 1973; JN-5158, growing on *Codium* sp., Desemboque de San Ignacio, legit R. E. Schultes, R. S. Felger, and A. T. Weil, 3 April 1974.

REMARKS.—Previously known on the Pacific coast from southern California and northern Baja Cali-

fornia (Hollenberg, 1961:351), this taxon is now recorded in the Gulf of California. It is apparently rare in the northern Gulf; only three collections have come to our attention. Although none of these specimens is from the habitat described as characteristic of *P. confusa* Hollenberg, size and structural features leave little room for doubt as to the identity as given.

Polysiphonia flaccidissima Hollenberg

FIGURE 2E

Polysiphonia flaccidissima Hollenberg, 1942b:783, figs. 8, 19; 1961:351, pl. 2: fig. 2; 1968a:63, figs. 2A, 11.—Dawson, Acelto, and Foldvik, 1964:88, pl. 78B.—Abbott and Hollenberg, 1976:688, fig. 634.

DESCRIPTION.—Epiphytic or saxicolous algae 10–25 mm high, erect from creeping basal branches attached by numerous unicellular rhizoids, which are cut off as separate cells from the pericentral cells; main erect axes 70–80 μm in diameter, with segments mostly 1–2 times as long as the diameter; branches of several to many orders, arising exogenously from a primary branch of a trichoblast, mostly at intervals of 6 segments or less, narrowed gradually below and above, at first usually strict and curving toward the parent branch; pericentral cells 4, totally ecorticate, with thin hyaline walls; trichoblasts simple or mostly with a single dichotomy, tapering to slender apices, arising 1 per segment in spiral sequence, with $\frac{1}{4}$ divergence, soon deciduous, leaving persistent scar-cells.

Tetrasporangia 50–70 μm in diameter, in spiral series in smaller branches, somewhat distending the segments; cystocarps globular; spermatangial stichidia arising as a primary branch of a trichoblast, with 1–2 celled sterile apices.

TYPE-LOCALITY.—On a coralline alga, rocky point, Laguna Beach, Orange County, California.

HOLOTYPE.—H-2269, 1 January 1938, in herbarium of G. J. Hollenberg (now at US).

GULF OF CALIFORNIA DISTRIBUTION.—Intertidal to subtidal, on rocks or occasionally epiphytic; Guaymas to Isla Espiritu Santo.

PACIFIC COAST DISTRIBUTION.—U.S.A.: southern California; Hawaiian Islands. Mexico: northern Baja California; Revilla Gigedo Archipelago; Guerrero. Costa Rica. Panama. Peru.

SPECIMENS STUDIED.—SONORA: JN-4267, tetrasporangial, and JN-4270, on *Padina*, from 1.5–6.1 m depth, Nueva Guaymas, legit Dale Evensen, 13 Oct 1973.

REMARKS.—In the northern Gulf this species is apparently rare, restricted in distribution to Guaymas and vicinity, Sonora. Across the Gulf it has been recorded from Santa Rosalía, and in the southern Gulf from Puerto Escondido and Isla Espiritu Santo (Hollenberg, 1961:352).

Polysiphonia johnstonii Setchell & Gardner var. *johnstonii*

FIGURES 2B, 3

Polysiphonia johnstonii Setchell & Gardner, 1924:767.—Hollenberg, 1944:475; 1961:357, pl. 2: figs. 4, 5.—Dawson, 1944:329; 1949:237; 1951:53, 57; 1954b:160; 1959:32; 1966:29.—Dawson, Neushul, and Wildman, 1960a:72; 1960b:26.—Norris, 1972:16.—Abbott and Hollenberg, 1976:699, fig. 649.

Polysiphonia marchantae Setchell & Gardner, 1924:768, pl. 49a.

Polysiphonia sinicola Setchell & Gardner, 1924:769.

Polysiphonia acuminata sensu Dawson, 1950:68; 1954b:159 [non *Polysiphonia acuminata* Gardner, 1927:100].

Polysiphonia richardsoni sensu Segi, 1951:253.—Dawson, 1954b:160 [in part, with reference to Gulf of California specimens cited by Setchell and Gardner, 1924:768 as *P. marchantae* only; non *Polysiphonia richardsoni* W. J. Hooker ex Harvey in W. J. Hooker, 1833:333].

DESCRIPTION.—Thalli relatively rigid, 5–12 cm high, dull red in color, nearly black on drying, attached by numerous unicellular rhizoids, which are cut off as separate cells from the pericentral cells of a limited prostrate base; primary erect branches several, relatively distinct, to 1 mm in diameter, repeatedly branched, the branches spirally arranged, arising at a narrow angle, which widens as the branch matures; ultimate branches usually relatively close and dense; segments in main branches 1.5 times as long as the diameter or shorter, with 5–6 pericentral cells, totally ecorticate; trichoblasts once or twice forked, arising 1 per segment in spiral sequence, with $\frac{1}{5}$ or $\frac{1}{6}$ divergence, soon deciduous, leaving persistent scar-cells; branches replacing trichoblasts in origin at irregular intervals.

Tetrasporangia 1(–2) per segment, 70–90 μm in diameter; cytocarps globular, 450–500 μm in diam-

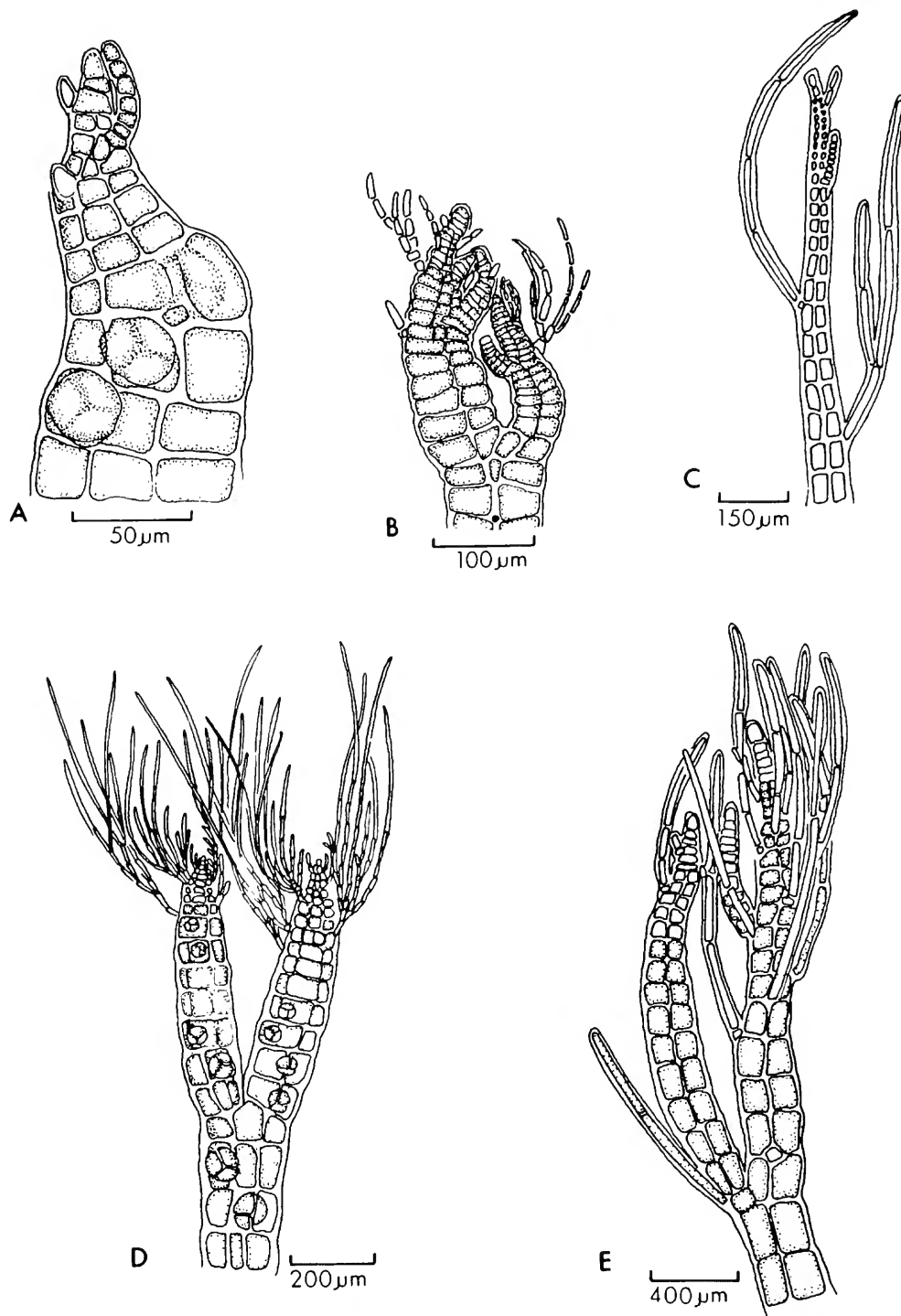


FIGURE 2.—A, *Polysiphonia johnstonii* var. *concinna*, branch tip of a tetrasporic plant (after Hollenberg, 1944); B, *P. johnstonii* var. *johnstonii*, apical portion of an axis showing trichoblasts and characteristically incurved tips (after Hollenberg, 1961); C, *P. sonorensis*, branch tip of the holotype (after Hollenberg, 1961); D, *P. masonii*, upper portion of a tetrasporic plant (after Hollenberg, 1961); E, *P. flaccidissima*, branch tip (after Hollenberg, 1942b).

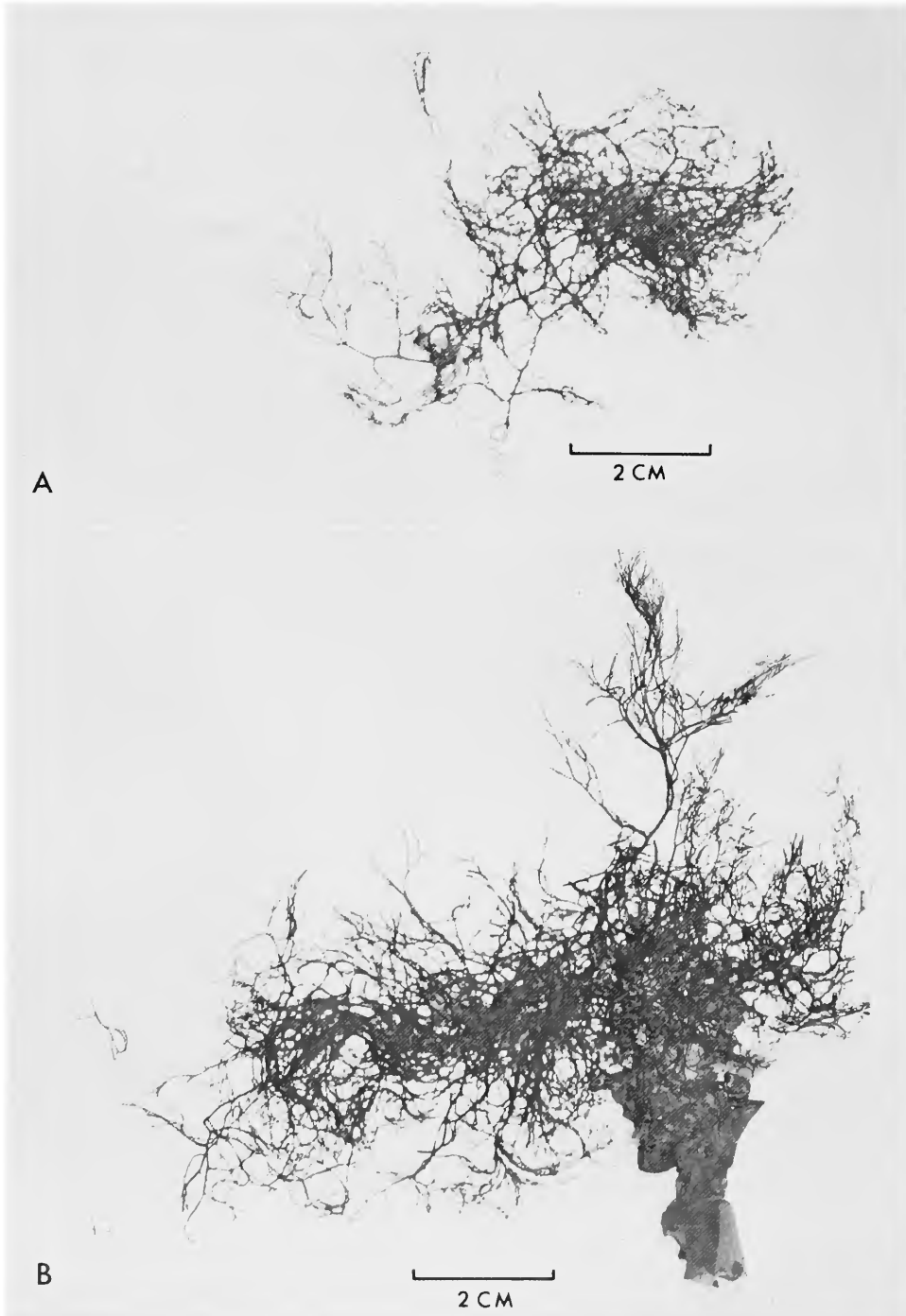


FIGURE 3.—*Polysiphonia johnstonii* var. *johnstonii*: A, B, habits of two specimens showing the divergent manner of branching (JN-3201).

eter, nearly sessile; spermatangial stichidia arising as a primary branch of a trichoblast, 100–140 by 30–40 μm in length and diameter, respectively.

TYPE-LOCALITY.—On *Gracilaria* sp., Isla San Esteban, Gulf of California, Mexico.

HOLOTYPE.—Ivan M. Johnston 110, April 1921 (CAS 1361, now at UC).

GULF OF CALIFORNIA DISTRIBUTION.—Intertidal and subtidal, on rocks or epiphytic; Puerto Peñasco to La Paz.

PACIFIC COAST DISTRIBUTION.—Santa Catalina Island, California; northern Baja California; Sinaloa.

SPECIMENS STUDIED.—SONORA: JN-3102, rocky intertidal, Punta Pelicano, 30 Jun 1972; JN-3260, on *Sargassum* sp. on rock platform with sand areas, Playa Hermosa, Puerto Peñasco, legit J. N. and K. B., 26 Jul 1972; JN-4040, spermatangial, intertidal rock platform, Playa Hermosa, Puerto Peñasco, legit J. N. and K. B., 3 May 1973; JN-5150, beach drift after strong winds, Desemboque de San Ignacio, legit R. E. Schultes, R. S. Felger, and A. T. Weil, 3 Apr 1974. BAJA CALIFORNIA DEL NORTE: JN-5462, 1–7 m depth, Punta la Gringa, Bahía de Los Angeles, legit J. N. and K. B., 28 Apr 1974; JN-3029, 5 m depth, Punta la Gringa, Bahía de los Angeles, 22 May 1972; JN-3201, and JN-3209 (a slender form), estuary, Bahía de las Animas, legit J. N. and G. Boehlert, 23 May 1972. LAS ISLAS DE LA CINTURA: JN-5280, tetrasporangial and cystocarpic, 10 m depth, W side of Roca Blanca, Puerto Refugio, Isla Ángel de la Guarda, legit J. N., J. Paul, and K. Robertson, 21 Apr 1974; JN-5314, intertidal to 10 m depth, Puerto Refugio, Isla Ángel de la Guarda, legit J. N. and K. B., 21 Apr 1974; JN-5369, 5–12 m depth off small islet, Puerto Refugio, Isla Ángel de la Guarda, 21 Apr 1974; JN-5762, intertidal, rocky shore NE side of Puerto Refugio, Isla Ángel de la Guarda, 23 Apr 1974; JN-5483, 3–10 m depth, S end of Isla Estanque, legit J. N. and K. B., 27 Apr 1974; JN-5508 and JN-5616A, 3–12 m depth, S end of Isla Estanque, legit J. N. and K. B., 27 Apr 1974; JN-5561, tetrasporangial, 3–8 m depth, rocky shore SE end of Isla San Esteban, 25 Apr 1974; JN-5528, cystocarpic, 3–5 m depth, off SE end of Isla San Esteban, 26 Apr 1974; JN-5707, epiphytic on *Laurencia sinicola*, and JN-5709, 3–8 m depth, SE end of Isla San Esteban, 25 Apr 1974; JN-5518, 1–5 m depth, SE end of Isla San Esteban, legit K. B., 26 Apr 1974.

REMARKS.—One of the most frequently encountered species of *Polysiphonia* in the northern Gulf, its distribution is now extended northward to Puerto Peñasco from Puerto Libertad (Hollenberg, 1961:358). In the northern Gulf, specimens are usually epiphytic and commonly sterile.

Polysiphonia johnstonii var. *concinna*
(Hollenberg) Hollenberg

FIGURES 2A, 4D

Polysiphonia concinna Hollenberg, 1944:474, fig. 10.—Dawson, 1951:53, 56; 1954b:159; 1959:32.

Polysiphonia johnstonii var. *concinna* (Hollenberg) Hollenberg, 1961:358, pl. 3: fig. 4.—Abbott and Hollenberg, 1976: 699, fig. 650.

DESCRIPTION.—This variety is similar to *P. johnstonii* var. *johnstonii* in detailed features, but smaller and shorter in dimensions throughout.

TYPE-LOCALITY.—Epiphytic on other algae, near Scripps Institution of Oceanography, La Jolla, San Diego County, California.

HOLOTYPE.—H-2015, December 1936, in herbarium of G. J. Hollenberg (now at US).

GULF OF CALIFORNIA DISTRIBUTION.—Mid-intertidal to subtidal, epiphytic on various algae, occasionally on rocks; Puerto Peñasco to Bahía Agua Verde.

PACIFIC COAST DISTRIBUTION.—Southern California; northern Baja California; Sinaloa.

SPECIMENS STUDIED.—SONORA: H 67–64, spermatangial, cystocarpic, on *Sargassum* sp. in drift, Playa Tucson, Punta Pelicano, near Puerto Peñasco, 8 Apr 1967; H 67–70, on *Sargassum* sp. in drift, Playa Estación, Puerto Peñasco, 8 Apr 1967. BAJA CALIFORNIA DEL NORTE: JN-4667, and JN-4668 spermatangial, and JN-4669 cystocarpic, the latter two on *Eucheuma uncinatum*, and JN-4670, cystocarpic, on *Codium* sp., 3–5 m depth N side of Puerto Calamajue, legit J. N. and K. B., 28 Mar 1973; JN-3011, cystocarpic, Islas de los Gemelos, Bahía de los Angeles, 21 May 1972; JN-4752, on *Padina*, Isla de los Gemelos, Bahía de los Angeles, 22 Dec 1972; JN-3238, spermatangial, on *Codium* sp., Bahía San Francisquito, 24 May 1972. LAS ISLAS DE LA CINTURA: JN-5804, cystocarpic, 3–6 m depth, off W side of Roca Blanca, Puerto Refugio, Isla Ángel de la Guarda, 22 Apr 1974; JN-5616B, 1–10 m depth off S end of Isla Estanque at the S end of Isla Ángel de la Guarda, legit J. N. and K. B., 27 Apr 1974; JN-5520b, on *Codium* sp., 1–5 m depth, SE end, off Isla San Esteban, legit K. B., 26 Apr 1974.

REMARKS.—Previously encountered off Isla San Jorge in the upper Gulf (Hollenberg, 1961:358), it was not surprising to find *P. johnstonii* var. *concinna* in Puerto Peñasco and vicinity. Number JN-3011, cited above, is placed in this variety with some hesitation, since the branches frequently arise in pairs one segment apart. Also the procarpial branches are numerous and present an unusual appearance. They seemingly arise from relatively

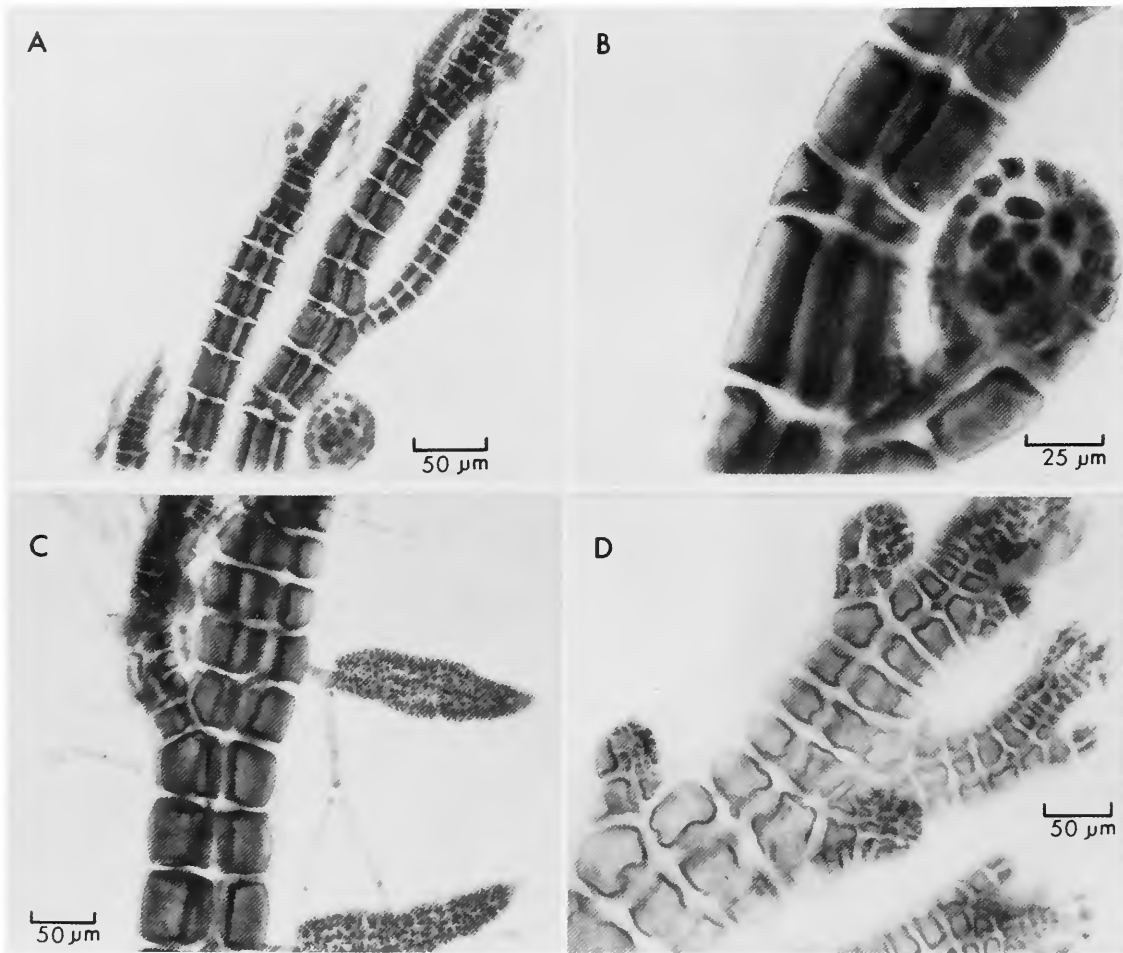


FIGURE 4.—A-C, *Polysiphonia sphaerocarpa* var. *cheloniae* (JN-4765): A, the upper branching and a young cystocarp; B, a nearly mature cystocarp; C, two spermatangial stichidia and the related trichoblast of one. D, *P. johnstonii* var. *concinna*, several young cystocarps with seemingly arrested development (JN-3011).

large trichoblast primordia (scar-cells) and remain prominent and undeveloped, at least for the most part.

Polysiphonia masonii Setchell & Gardner

FIGURE 2D

Polysiphonia masonii Setchell & Gardner, 1930:160.—Hollenberg, 1942b:783; 1961:358, pl. 6: figs. 2, 3.—Dawson, 1954b:160.

DESCRIPTION.—Reddish brown epiphytes 2–3 cm high, flaccid, attached by a bundle of short unicellular rhizoids with digitate apices, arising from

the lower segments of the erect primary axis; main axis 350–400 μm in diameter below, repeatedly and regularly branched dichotomously, composed of segments mostly as long as the diameter; branches nearly as large as the main axis at the point of insertion, arising from an entire trichoblast primordium; pericentral cells 4, ecorticate; trichoblasts to 480 μm long, with 2 or 3 dichotomies, tapering to very slender apices, arising 1 per segment in spiral sequence with $\frac{1}{4}$ divergence, soon deciduous, leaving persistent scar-cells.

Tetrasporangia in spiral series in the ultimate branches, 85–95 μm in diameter, not much distending the segments; cystocarps subspherical nearly

sessile, 300–325 μm in diameter; spermatangial stichidia arising from a primary branch of a trichoblast, broadly fusiform.

TYPE-LOCALITY.—Epiphytic on *Zostera*, Isla Guadalupe, off the Pacific Coast of Baja California.

HOLOTYPE.—H. L. Mason 86, April 1925 (CAS 173618, now at UC).

GULF OF CALIFORNIA DISTRIBUTION.—Intertidal, Puerto Peñasco.

PACIFIC COAST DISTRIBUTION.—Isla Guadalupe.

SPECIMEN STUDIED.—SONORA: H 67–60, tetrasporangial, intertidal, Playa Estación, Puerto Peñasco, 8 Apr 1967.

REMARKS.—Now reported for the first time in the Gulf of California, this seems to be the only record of the species other than those recorded from Isla Guadalupe (Hollenberg, 1961:359). Rarely encountered, it is known only from the present Gulf collection; three others, including the type specimen, from Isla Guadalupe.

Polysiphonia mollis J. D. Hooker & Harvey
in Harvey

FIGURE 5B

Polysiphonia mollis J. D. Hooker & Harvey in Harvey, 1847:43.—Dawson, 1957:8; 1966:29.—Dawson, Neushul, and Wildman, 1960a:72.—Hollenberg, 1961:359, pl. 4: fig. 2.—Abbott and Hollenberg, 1976:688, fig. 636.

Polysiphonia eastwoodae Setchell & Gardner, 1930:161.—Hollenberg, 1948:160.—Dawson, 1954b:160.

Polysiphonia tongatensis var.? sensu Setchell & Gardner, 1930:160 [non *Polysiphonia tongatensis* Harvey in Kuetzing, 1864:14].

Polysiphonia snyderae Kylin, 1941:35, pl. 12: fig. 34.—Hollenberg, 1942a:784, fig. 9.—Dawson, 1944:330; 1951:56; 1954b:160.

Polysiphonia snyderae var. *heteromorpha* Hollenberg, 1942b:784.

Polysiphonia snyderae var. *intricata* Hollenberg, 1942b:785.—Dawson, 1954b:161.

Polysiphonia tongatensis sensu Segi, 1951:207 [in part, with reference to Revilla Gigedo Islands' material of Setchell and Gardner, 1930:160 only; non *Polysiphonia tongatensis* Harvey in Kuetzing, 1864:14].

DESCRIPTION.—Thalli dull reddish brown, mostly 5–12 cm high from a discoid base or mostly assurgent from prostrate branches of limited extent, attached by unicellular rhizoids with frequently digitate apices, arising 1–2(–5) per segment from the proximal ends of the pericentral cells, from

which they are cut off as separate cells by a curving wall; erect branches 300–400 μm in diameter below, commonly 60–180 μm in diameter in upper parts; segments in main branches mostly 1–2 times as long as the diameter, but sometimes considerably longer; main erect branches richly branched pseudodichotomously above, mostly naked below; pericentral cell 4, ecorticate; trichoblasts 1 per segment in spiral sequence, with $\frac{1}{4}$ divergence, soon deciduous, leaving persistent scar-cells; branches arising at irregular intervals, commonly 6–10 segments apart, a branch replacing a trichoblast in the spiral sequence.

Tetrasporangia 60–70 μm in diameter, in spiral series in the ultimate and subultimate branches; cystocarps abundant, ovoid to nearly globular, 300–350 μm in diameter; spermatangial stichidia comprising a primary branch of a trichoblast.

TYPE-LOCALITY.—Epiphytic on other algae, Tasmania.

HOLOTYPE.—Collection of R. Gunn labeled "original sp. . . parasitical on large algae" in Harvey Herbarium (TCD).

GULF OF CALIFORNIA DISTRIBUTION.—Usually intertidal, epiphytic, or growing on rock, wood, shells, etc.; El Tornillal to Bahía San Lucas.

PACIFIC COAST DISTRIBUTION.—Southern British Columbia to northern Baja California; Sinaloa.

SPECIMENS STUDIED.—SONORA: JN-3326, adrift, inlet, El Tornillal, legit D. L. Lindquist; H 67–1.5, legit T. Scalione, Playa Estación, Puerto Peñasco, 28 Jan 1967; D27210 (US), rocky reef, Playa Tucson, N side of Punta Pelicano, vicinity of Puerto Peñasco, legit E. Y. Dawson, 6 Apr 1966. BAJA CALIFORNIA DEL NORTE: JN-2998a, spermatangial, from 7.6 m depth, Isla la Ventana, Bahía de los Angeles, 21 May 1972; JN-3265a, growing on "pen shell," *Pinna rugosa*, 3–4.5 m depth, Bahía San Francisquito, 24 May 1972; JN-3226, a slender form, growing on shells, Bahía San Francisquito, 24 May 1972.

REMARKS.—The recent collection from El Tornillal represents a slight northward extension from Puerto Peñasco, Sonora (Dawson, 1966:29). This species is widely distributed in temperate and subtropical regions. It is most frequently encountered in sheltered waters.

In collection JN-3265a the segments in the main axes are shorter than the typical length for the species. A more unusual feature in JN-2998a is the fact that the spermatangial stichidia arise from the entire trichoblast primordium. In both JN-2998a

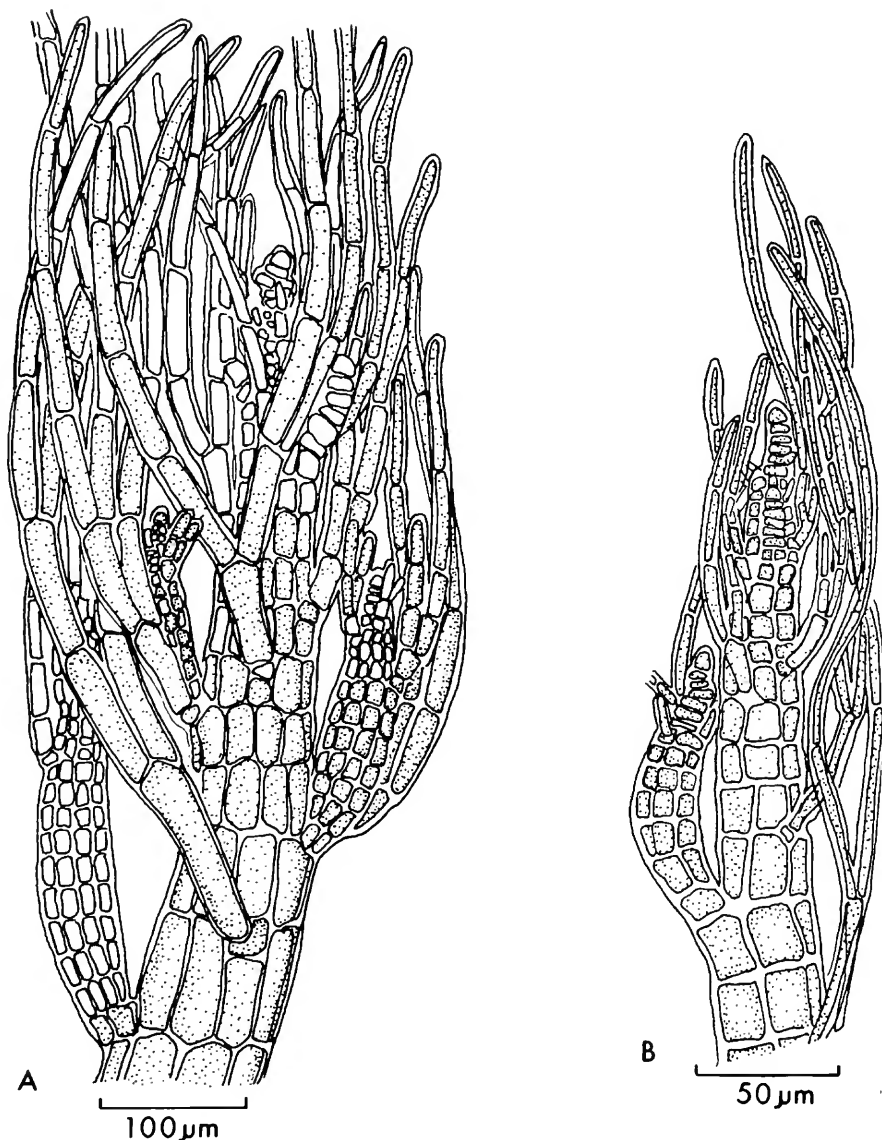


FIGURE 5.—A, *Polysiphonia paniculata*, branch tip (after Hollenberg, 1961); B, *Polysiphonia mollis*, branch tip (after Hollenberg, 1961).

and JN-3265a the trichoblasts are very rudimentary or are represented by scar-cells only. Furthermore, rhizoids in JN-3265a are cut off as separate cells from the pericentral cells. The latter feature does not normally occur in species such as *P. pacifica* in which spermatangial stichidia arise from the entire trichoblast primordium. More material representing these two entities is needed for confident identification.

Polysiphonia pacifica var. *delicatula* Hollenberg

FIGURE 6B

Polysiphonia pacifica var. *delicatula* Hollenberg, 1942b:778, 1961:362.—Smith, 1944:360.—Abbott and Hollenberg, 1976: 690.

DESCRIPTION.—Usually medium red, 0.5–2.0 cm high from prostrate branches 50–110 μm in diameter, arising endogenously from prostrate branches,

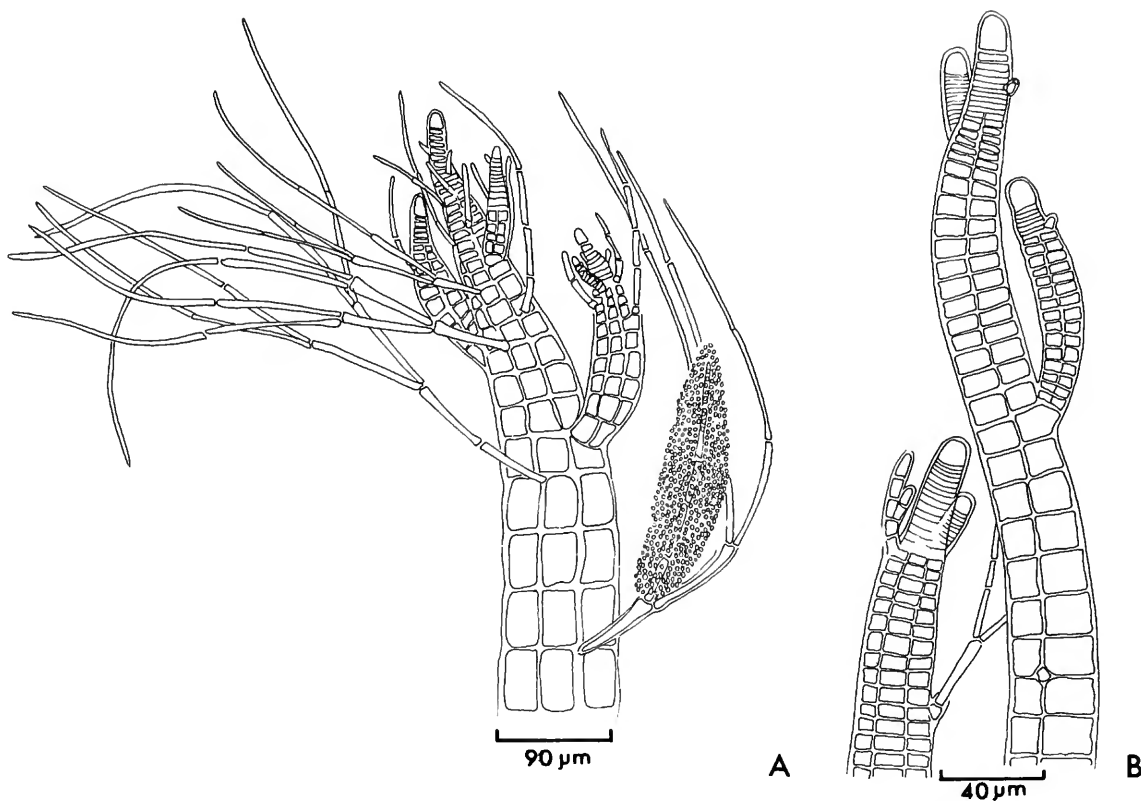


FIGURE 6.—A, *Polysiphonia sphaerocarpa* var. *cheloniae*, branch apices of a spermatangial plant (JN-4765); B, *P. pacifica* var. *delicatula*, branch apices (JN-4848).

and composed of segments 1.0–2.0 (–3.0) times as long; branches short and mostly with blunt apices; pericentral cells 4, ecorticate; trichoblasts lacking or exceedingly rare.

Tetrasporangia 50–60 μm in diameter, in straight series; cystocarps slightly urceolate; spermatangial stichidia slender, 140–200 μm in length by 30–40 μm in diameter, on very short pedicels, leaving persistent scar-cells when shed.

TYPE-LOCALITY.—On wharf piling, low tide level, Municipal Wharf, Monterey, Monterey County, California.

HOLOTYPE.—H 2888, 20 July 1939, in herbarium of G. J. Hollenberg (now at US).

GULF OF CALIFORNIA DISTRIBUTION.—Epiphytic on various algae or growing on rocks, low intertidal to subtidal; Puerto Peñasco to Guaymas; Bahía San Lucas.

PACIFIC COAST DISTRIBUTION.—Central California; Chiapas; Galápagos Archipelago.

SPECIMENS STUDIED.—SONORA: H 67–53, on coralline algae, Playa Estación, Puerto Peñasco, 25 Mar 1967; JN-4848a, epiphytic on *Gelidium johnstonii* (JN-4827), 3.3 m depth, on rock reef, Cabo Lobos, vicinity of Puerto Libertad, legit J. N. and K. B., 17 Nov 1973.

REMARKS.—Seemingly rare in the Gulf of California, its distribution is now extended northward to Puerto Peñasco from Bahía Guaymas (Hollenberg, 1961: 362). This species is generally found on rocks, wood, or epiphytic in deep or quiet waters.

Polysiphonia paniculata Montagne

FIGURES 4A, 5A, 7

Polysiphonia paniculata Montagne, 1842:254.—Kuetzing, 1863: 15, pl. 45c-e.—Howe, 1914:142.—Hollenberg, 1944:480, fig. 7; 1961:362, pl. 7: fig. 1.—Dawson, Neushul, and Wildman, 1960b:26.—Dawson, Aceldo and Foldvik, 1964:89, pls. 78A, 79.—Dawson, 1954b:160; 1966:29.—Smith, 1969:115 [725].—Abbott and Hollenberg, 1976:701, fig. 652.

Polysiphonia californica Harvey, 1853:48.—Kylin, 1941:36.—Dawson, 1944:332.—Smith, 1944:362, pl. 93: fig. 1.

DESCRIPTION.—Thalli densely tufted, soft, dark brownish red, mostly saxicolous, 10–25 cm high, arising from densely matted prostrate branches, attached by numerous unicellular rhizoids, with usually digitate apices, arising 2 or 3 per segment from the proximal end of the pericentral cells, from which they are cut off as separate cells; erect branches arising endogenously from the prostrate branches at close intervals, loosely branched to relatively naked below, densely clothed with branches above; branches of all orders exogenous, the ultimate branches commonly densely plumose, narrowed at the base; pericentral cells mostly 10–12, but sometimes as many as 14 in older parts or as few as 8 in younger parts, totally ecorticate; main axes 300–430 μm in diameter and composed of segments 2.0–2.5(–4.0) times as long; trichoblasts to 800 μm long, simple or mostly with 1 or 2 dichotomies, arising 1 per segment in spiral sequence with $\frac{1}{4}$ divergence, tardily deciduous, leaving relatively



FIGURE 7.—*Polysiphonia paniculata*, tetrasporic specimen (JN-4552) from the mud/sand flats of Bahía Cholla (vicinity of Puerto Peñasco), Sonora.

large scar-cells; branches arising in association with trichoblasts.

Tetrasporangia 80–100 μm in diameter, more or less spiraling in the ultimate and subultimate branches; cystocarps globular-ovoid, somewhat truncate, 350–400 μm in diameter; spermatangial stichidia 130–250 μm by 50–70 μm without sterile apex at maturity; thalli adhering to paper when dried.

TYPE-LOCALITY.—Peru.

HOLOTYPE.—Collection by Gaudichaud labeled “in fronde Ulvae nematoideae, ad littora Peruviana” in Montagne Herbarium (PC).

GULF OF CALIFORNIA DISTRIBUTION.—Mid-intertidal to subtidal, usually in protected bays and estuaries, Puerto Peñasco to Guaymas.

PACIFIC COAST DISTRIBUTION.—British Columbia to northern Baja California, Peru.

SPECIMENS STUDIED.—SONORA: D 27254, slender form, mud flats, Bahía Cholla, 6 Apr 1966; JN-4551, cystocarpic, sand flats, 1 m depth, Bahía Cholla, 8 Dec 1973; JN-4552, tetrasporic, growing on living sand dollar (*Encope grandis*), sand flats, Bahía Cholla, legit J. N. and J. Kudenov, 8 Dec 1973; JN-4993, sand flats, Bahía Cholla, legit J. N. and K. B., 9 Mar 1974; JN-3697, and JN-3713, both tetrasporangial, intertidal rock platform, W of Playa Hermosa, Puerto Peñasco, 2 Feb 1973; JN-4718, tetrasporangial, attached to sea shells, midway between Isla Tiburón and W of Campo Viboras, Sonora, legit G. L. Kooyman and E. Senate, 19 Dec 1973; JN-4773.5, spermatangial, collected along with *P. sphaerocarpa* var. *chelonina* (JN-4773), in the Infiernillo Channel between Campo Ona and Viboras, Sonora, legit R. S. Felger and E. Moser from a green sea turtle (*♀ Chelonia mydas*) that was harpooned by Guadalupe Lopez, a Seri Indian, 21 Jan 1974.

REMARKS.—This species apparently occurs only in the northern Gulf. Here it has been found mostly in calm waters of estuaries, mud flats, protected bays, and coastal areas. It is also one of the marine algae known to be epizotic on the green sea turtle, *Chelonia mydas* L. in the Gulf (see Felger, Clifton, and Regal, 1976; Norris, unpublished data).

Polysiphonia savatieri Hariot

FIGURE 8A

Polysiphonia savatieri Hariot, 1891:226.—Segi, 1951:202, fig. 10a-n, pl. 3: fig. 8.—Dawson, 1954b:160.—Hollenberg, 1961:363, pl. 7: fig. 4; 1968a:77, figs. 37, 38.—Abbott and Hollenberg, 1976:692, fig. 639.

Polysiphonia minutissima Hollenberg, 1942b:781, fig. 21.



FIGURE 8.—A, *Polysiphonia savatieri*, upper portion of a tetrasporic thallus (JN-4195); B, *P. scopulorum* var. *villum*, entire thallus (JN-5098A); note the dichotomous branched trichoblast.

DESCRIPTION.—Thalli epiphytic, dull reddish brown, mostly 3–10 mm high from a tuft or cushion of rhizoids, usually penetrating the host; rhizoids up to 1 mm long, cut off by a curving wall from the proximal end of the pericentral cells; main axes indistinct, commonly assurgent from the basal attachment, up to 148 μm in diameter; branches of several orders, exogenous, not associated with trichoblasts in origin, arising at variable intervals; pericentral cells 4, ecorticate; trichoblasts relatively short, 1 per segment in spiral sequence, with $\frac{1}{4}$ divergence, soon deciduous, leaving persistent scar cells.

Tetrasporangia in short spiral series, up to 80 μm in diameter, somewhat distending the segments; cystocarps slightly urceolate or mostly globular at maturity, 225–290 μm in diameter; spermatangial stichidia about 135 μm long and 40 μm in diameter,

comprising one primary branch of a trichoblast, without sterile apex.

TYPE-LOCALITY.—Epiphytic on large algae, Yokosuka, Japan.

HOLOTYPE.—A collection by Dr. Savatier, about 1885 (PC).

GULF OF CALIFORNIA DISTRIBUTION.—Mid-intertidal to shallow subtidal, epiphytic on various algae, growing on rocks or in tide pools; Puerto Peñasco to Bahía de Las Animas.

PACIFIC COAST DISTRIBUTION.—Central California to northern Baja California; Isla Guadalupe. Japan. Western tropical Pacific.

SPECIMENS STUDIED.—SONORA: JN-5030, on *Neogardhiella baileyi*, Punta Pelicano, legit J. N., K. B., and D. Moore, 17 Mar 1974; JN-3182, tetrasporangial, on intertidal rocks, W of Casa Garcia, Playa Estación, Puerto Peñasco, legit J. N. and K. B., 11 Jul 1972; JN-3545, cystocarpic, Cumpleaños tide

pool, Playa Estación, Puerto Peñasco, legit J. N. and K. B., 8 Sep 1972; JN-4537, tetrasporangial, Cumpleaños tide pool, Playa Estación, Puerto Peñasco, legit J. N. and K. B., 9 Nov 1973; JN-4195, tetrasporangial, and JN-4197, cystocarpic, on intertidal platform and tide pools, Playa Estación, Puerto Peñasco, 1 Jun 1973; H 67-14, low intertidal, Playa Estación, Puerto Peñasco, 25 Feb 1967; JN-3878, spermatangial, on *Codium* sp. in front of Laboratorio de Biología Marina, Playa Estación, Puerto Peñasco, 14 Apr 1973; JN-4266, cystocarpic, 6 m depth, Neuva Guaymas, legit D. Evanson, 13 Oct 1973. BAJA CALIFORNIA DEL NORTE: JN-3126, epiphytic on *Sargassum*, 9 m depth, Rocas Consag, legit D. L. Lindquist, 2 Jun 1972; JN-3281, spermatangial, on *Codium* sp., Puertecitos, legit J. N. and G. Boehlert, 17 May 1972; JN-4448, Isla la Ventana, Bahía de Los Angeles, 27 Jul 1973; JN-4442, on *Dictyota* sp., rocky intertidal, Isla la Ventana, Bahía de Los Angeles, 27 Jul 1973; JN-3216b, tetrasporangial, on *Gracilaria* sp., Bahía de Las Animas, legit J. N. and G. Boehlert, 23 May 1972.

REMARKS.—This species is infrequently encountered throughout its Pacific coast distribution (Hollenberg, 1961:364). It may now be added to the northern Gulf of California marine flora, where it was rather frequent among the recent collections.

Polysiphonia scopulorum var. *villum*
(J. G. Agardh) Hollenberg

FIGURE 8B

Polysiphonia scopulorum var. *villum* (J. G. Agardh) Hollenberg, 1968a:81, fig. 7A.—Abbott and Hollenberg, 1976:692, figs. 640, 641.

Polysiphonia villum J. G. Agardh, 1863:941.

Lophosiphonia villum (J. G. Agardh) Setchell & Gardner, 1903:329.—Hollenberg, 1942a:535.—Dawson, 1944:332, pl. 48: figs. 1-6; 1951:53; 1954b:161; 1963:421, pl. 169: figs. 1-3.—Taylor, 1945:304.

Lophosiphonia scopulorum sensu Dawson, 1959:36 [non *Lophosiphonia scopulorum* (Harvey) Womersley, 1950:188].

DESCRIPTION.—Brownish red thalli mostly 5–10 mm high from prostrate branches attached by unicellular rhizoids arising from the center of the pericentral cells, from which they are not cut off by cross walls; erect branches unbranched or mostly very sparingly branched, mostly 40–60 μm in diameter, composed of segments 1.0–1.5 times as long as the diameter, arising at irregular intervals in a strictly endogenous manner; lateral branches exogenous or endogenous, independent of trichoblasts, which they replace; pericentral cells 4, ecorticate; trichoblasts mostly infrequent to wanting, with 1 or 2 dichotomies, 250–480 μm long, soon deciduous.

Tetrasporangia 50–60 μm in diameter, in straight series, somewhat distending the segments; cystocarps ovoid, 150–190 μm in diameter; spermatangial stichidia cylindrical, without sterile apices, arising from an entire trichoblast primordium.

TYPE-LOCALITY.—“*Ad littus americanae tropicae*,” probably on the Pacific coast of Mexico.

HOLOTYPE.—A collection by Liebmann in the Agardh Herbarium (LD).

GULF OF CALIFORNIA DISTRIBUTION.—Intertidal rocks, Puerto Peñasco; Isla Angel de la Guarda; Isla Partida; Isla Turner; Isla Estanque.

PACIFIC COAST DISTRIBUTION.—British Columbia, Canada, to Costa Rica. Widely distributed in the northern Pacific and western Atlantic oceans.

SPECIMEN STUDIED.—SONORA: JN-5098a, collected with *P. simplex* (JN-5098b), midtidal rocks, Playa Estación, Puerto Peñasco, 24 Mar 1974.

REMARKS.—This species is found growing alone or with other algae, often forming a continuous turf on intertidal rocks. Dawson (1944:332; 1954b:161) reported this taxon from three islands of Las Islas de la Cintura under the name of *Lophosiphonia villum* (J. G. Agardh) Setchell & Gardner. Our new collection, moves the known distribution northward to Puerto Peñasco from Puerto Refugio, Isla Angel de la Guarda (Dawson, 1944:333, 1963:422).

The reasons for placing this species in *Polysiphonia* rather than in *Lophosiphonia* are given by Hollenberg (1968a:56). In this connection, the criteria listed by Hollenberg indicate that *Lophosiphonia mexicana* described by Dawson (1944:333) cannot be properly assigned to that genus. Further collections of “*L. mexicana*” are needed before a definitive disposition of the taxon can be made.

Polysiphonia simplex Hollenberg

FIGURE 9

Polysiphonia simplex Hollenberg, 1942b:782, fig. 18; 1961:364, pl. 5: fig. 1.—Dawson, 1944:331; 1951:53; 1954a:6; 1954b:160; 1966:29.—Abbott and Hollenberg, 1976:694, fig. 641.

Polysiphonia ferulacea sensu Segi, 1951:209 [in part, with reference to Pacific North American specimens cited by Hollenberg, 1942b:782 only; not *Polysiphonia ferulacea* Suhr in J. G. Agardh, 1863:980].

DESCRIPTION.—Thalli medium to dark brownish red, drying nearly black; usually saxicolous, commonly forming dense mats often of considerable extent, alone or mixed with other algae, or occa-

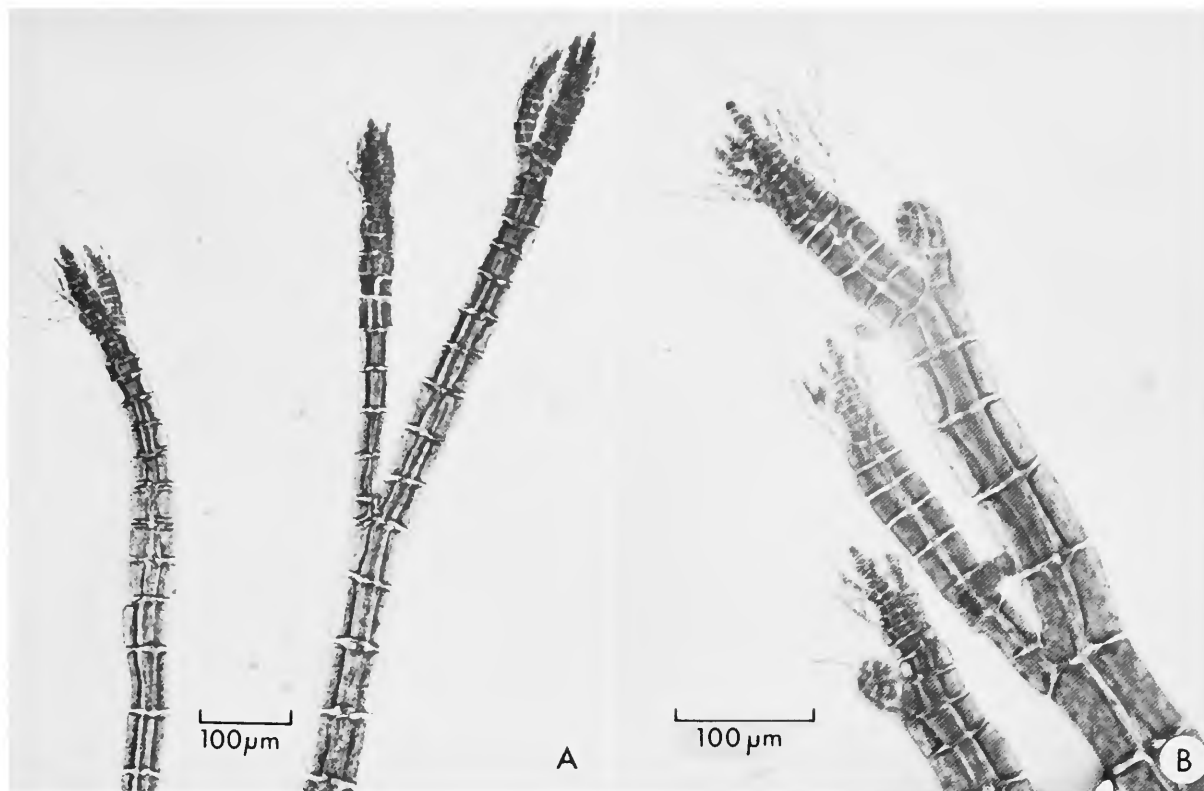


FIGURE 9.—*Polysiphonia simplex*: A, upper portion of the thallus showing the delicate trichoblasts (JN-5098B); B, upper portion of a cystocarpic thallus (JN-5038).

sionally epiphytic; with creeping basal branches 250–360 μm in diameter, composed of short segments, and attached by numerous unicellular rhizoids, which often have digitate apieces and are always cut off as separate cells from the proximal end of the pericentral cells; erect branches 1–3(–7) cm high and 160–250 μm in diameter near the base, arising in an exogenous assurgent manner; main axes usually distinct but not prominent, sparingly branched; branches exogenous, radially directed, of several orders; trichoblasts delicate, to 730 μm long with 1 or 2 dichotomies, 1 per segment in spiral sequence with $\frac{1}{4}$ divergence, soon deciduous, leaving persistent scar-cells; branches replacing trichoblasts in the spiral (arising from an entire trichoblast primordium).

Tetrasporangia up to 70 μm in diameter, in spiral series in the ultimate branches, more or less distending the segments; cystocarps ovoid-globular, 300–

350 μm in diameter, spermatangial stichidia 100–170 μm long, 35–40 μm in diameter, comprising one primary branch of a trichoblast; without sterile apex.

TYPE-LOCALITY.—On rocks, Laguna Beach, Orange County, California.

HOLOTYPE.—H 2115, 14 May 1937, in herbarium of G. J. Hollenberg (now at US; isotype at GMS).

GULF OF CALIFORNIA DISTRIBUTION.—Intertidal, growing alone or with other turf algae forming mats; Puerto Peñasco to Cabeza Ballena.

PACIFIC COAST DISTRIBUTION.—Southern California to southern Mexico. Costa Rica.

SPECIMENS STUDIED.—SONORA: D 27173, Bahía Cholla, mud-flat, 5 Apr 1966; H 67-64, tetrasporangial, cystocarpic, Playa Tucson, Punta Pelicano, 9 Apr 1967; JN-5038, cystocarpic, low intertidal, Punta Pelicano, 17 Mar 1974; JN-5098b, mid-intertidal rock platform, Playa Estación, Puerto Peñasco, legit J. N. and K. B., 24 Mar 1974.

REMARKS.—This species is reported by Dawson (1944:331) and Hollenberg (1961:364) from a number of Gulf localities. With the recent collections from Puerto Peñasco, we now know *P. simplex* to be widely distributed throughout the Gulf.

Polysiphonia sonorensis Hollenberg

FIGURE 2C

Polysiphonia sonorensis Hollenberg, 1942b:779, figs. 5, 20.—Dawson, 1944:330; 1954b:161.—Hollenberg, 1961:365, pl. 5: fig. 2.

DESCRIPTION.—Densely tufted algae of a terracotta color, not strongly adhering to paper on drying. 4–5 cm high from prostrate creeping branches 120–175 μm in diameter attached by unicellular rhizoids, which arise as outgrowths of the center of the pericentral cells, from which they are not cut off as separate cells; erect branches arising mostly endogenously or sometimes exogenously from the prostrate branches, 70–100 μm in diameter, composed of segments mostly 1.5–2.0 times as long as the diameter; branching dense, the branches arising exogenously at irregular intervals of mostly 1–20 segments and mostly at an acute angle with the parent branch; main axes indistinct; branches replacing trichoblasts; trichoblasts numerous, delicate, to 1 mm long, arising at irregular intervals, with 1 or 2 dichotomies, soon deciduous, leaving inconspicuous scar-cells.

Reproductive material has not been found.

TYPE-LOCALITY.—Afloat along the southeastern shore of Bahía Empalme, Sonora, Gulf of California.

HOLOTYPE.—Francis Drouet and Donald Richards 3426a (F); isotype: herbarium of G. J. Hollenberg (now at GMS).

GULF OF CALIFORNIA DISTRIBUTION.—Intertidal; Bahía Empalme to Guaymas.

SPECIMENS STUDIED.—SONORA: in addition to the type, there is one other collection (Frances Drouet and Donald Richards-3144) from rocks between tide marks on NW shore of harbor at Guaymas.

REMARKS.—Known only from two specimens, this species is apparently endemic to the Gulf. It was not found in the recent collections.

Polysiphonia sphaerocarpa var. *cheloniae*,
new variety

FIGURES 4A–C, 6A

DESCRIPTION.—Plantae ad 3.5 cm altae, a crista basali rhizoideorum per rhizoidea e ramis assurgentibus suppletorum, ortae; rhizoidea per muros curvatos a finibus proximalibus cellulorum pericentralium ut cellulae discretae abscissa; cellulae pericentrales 4; ramificatio pseudodichotoma; rami principales ad 300 μm crassi, e segmentis 1.0–2.5 (–3.0) plo longioribus quam lata compositi; segmentis in ramis iunioribus turgidulis; trichoblastae ad 400 μm longae, una in unoquoque segmento, 1–3 dichotomias habentes, ad apices delicatos attenuatae; rami e primordio integro trichoblastae intervalis fere 5–12 segmentorum enascentes, basim versus angusti.

Tetrasporangia ignota; cystocarpi globosi, ad 370 μm diametro; stichidia spermatangialia 160–175 μm longa, 40–48 μm diametro, cylindrica aut fusiformia, fere sine cacumine sterili, ut furca primaria trichoblastae enascentia.

Thalli to 3.5 cm high, from a basal tuft of rhizoids supplemented by rhizoids from assurgent branches; rhizoids cut off as separate cells from the proximal end of the pericentral cells; pericentral cells 4, ecorticate; branching pseudodichotomous; main branches to 300 μm in diameter, composed of segments 1.0–2.5 (–3.0) times as long as the diameter; branches arising from an entire trichoblast primordium in intervals of mostly 5–12 segments, narrowed toward the base; segments in younger branches turgid; trichoblasts one per segment to 400 μm long, with 1–3 dichotomies, tapering to delicate apices.

Tetrasporangia unknown; cystocarps globular, to 370 μm in diameter; spermatangial stichidia 160–175 μm long, 40–48 μm in diameter, cylindrical to fusiform, mostly without sterile apices at maturity, arising as a primary fork of a trichoblast.

TYPE-LOCALITY.—On green sea turtle, *Chelonia mydas* L., in Canal de Infiernillo between Campo Ona and Campo Viboras, Sonora, opposite the east coast of Isla Tiburón. Gulf of California.

HOLOTYPE.—J. Norris-4801, cystocarpic (US).

GULF OF CALIFORNIA DISTRIBUTION.—Canal de Infiernillo, between Sonora and Isla Tiburón.

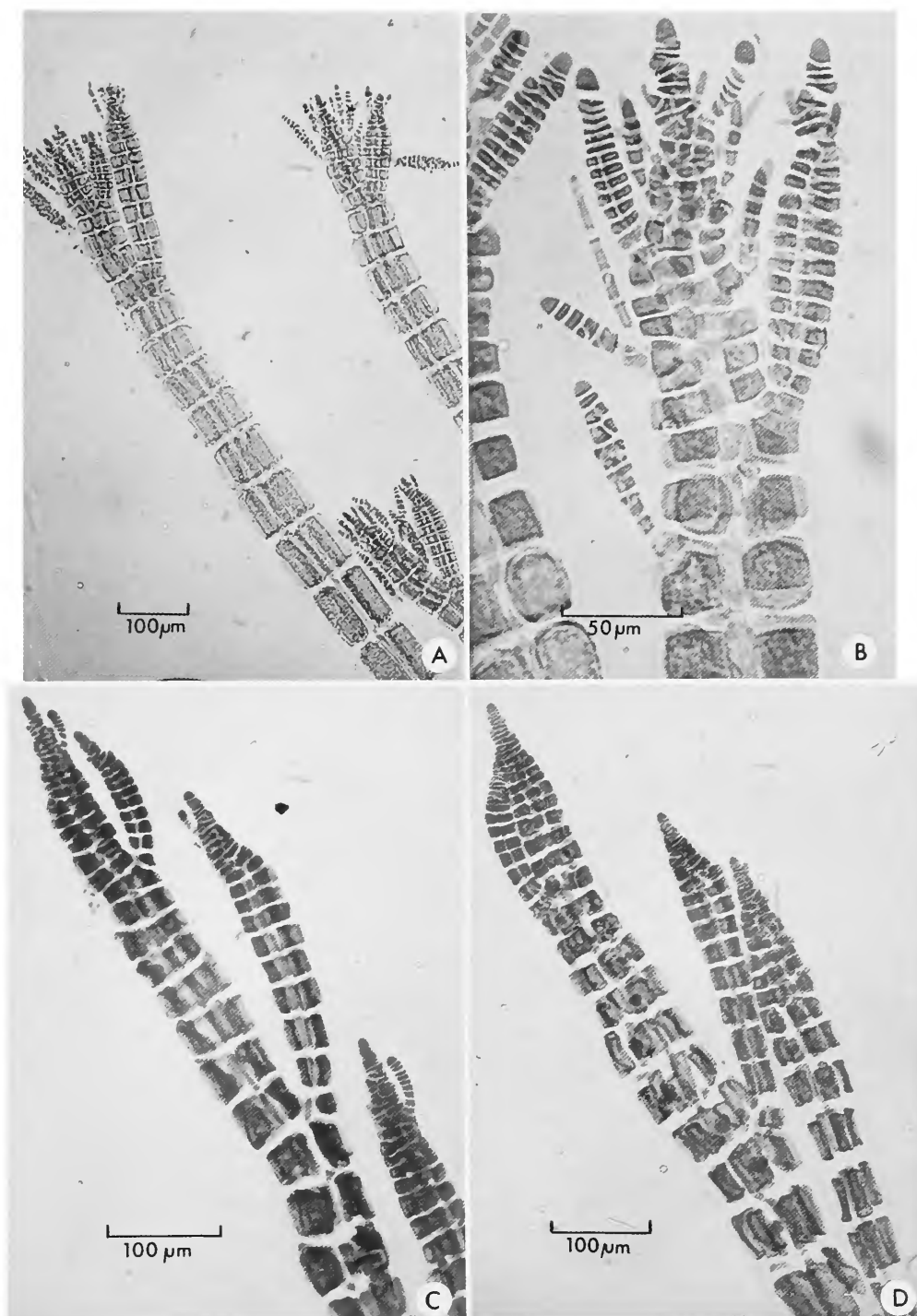


FIGURE 10.—*Polysiphonia* species: A, upper portion of a spermatangial thallus (JN-2998); B, branch tip, showing the spermatangial stichidia, which originates from an entire trichoblast primordium (JN-2998); C, upper portion, showing the usual absence of trichoblasts (JN-3265); D, upper portion of a tetrasporangial thallus, showing the developing tetrasporangia initials in the characteristic spiral sequence (JN-3265).

SPECIMENS STUDIED.—SONORA: all collections of this alga were made 21 Jan 1974 in the Infiernillo Channel between Campo Ona and Campo Viboras, Sonora (opposite the east coast of Isla Tiburón). They were collected by R. S. Felger and E. W. Moser from medium size to young adult green sea turtles (*Chelonia mydas*), which were harpooned by Guadalupe Lopez, a Seri Indian. Five collections were made: JN-4801, cystocarpic, holotype (US) was taken from the carapace of female turtle number 4, harpooned at approximately 9 m depth; JN-4765, partly spermatangial, was from the dorsal surface of the head and flippers of another female turtle number 2, harpooned at approximately 7.6 m depth; JN-4773, sterile, was collected from the carapace of female turtle number 1, taken from approximately 9 m depth; JN-4777, immature cystocarpic, was from the carapace of turtle number 1; and JN-4794, sterile, was from the dorsal surface of the head and front flippers of female turtle number 1.

REMARKS.—This alga seems very close in its general features to *P. sphaerocarpa* Boergesen (1918: 271) and especially to var. *sphaerocarpa* as described by Hollenberg (1968a:90) from the central and western Pacific Ocean. It differs from that variety in the substratum (i.e., the green sea turtle), and the consequent habitat. It is also somewhat taller than previously described specimens of that taxon.

At least two other species of *Polysiphonia* have been described as growing on sea turtles. *Polysiphonia tsudana*, collected from a species of sea turtle (*Chelonia*) taken near Laysan Island, Hawaii, was described by Hollenberg (1968b:205). It is smaller than the Gulf of California taxon, with branches much smaller in diameter and having shorter segments. Furthermore, the Laysan specimens of *P. tsudana* had a variable number of pericentral cells and the spermatangial stichidia arise from the entire trichoblast primordium, rather than from a primary branch as in *P. sphaerocarpa* var. *cheloniae* from the northern Gulf. *Polysiphonia caretia*, also described by Hollenberg (1971:15), was found growing on the carapace of a Loggerhead sea turtle (*Caretta caretta* L.), taken at the west end of Santa Catalina Island, off the coast of southern California. This alga is likewise smaller than the northern Gulf of California specimens. It differs, furthermore, in that the branches of the

California *P. caretia* are all or mostly all cicatrigenous in origin, arising from the scar-cells. Finally the rhizoids are cut off as separate cells in the Gulf of California specimens, but remain in open connection with the pericentral cells in the case of the California species.

Polysiphonia species

FIGURE 10

DESCRIPTION.—Thalli to 3 cm high, repeatedly pseudodichotomously branched at irregular intervals of mostly 8–10 segments; main axes to 320 μ m in diameter below, composed of segments 1.0–1.5 times as long as the diameter; pericentral cells 4, ecorticate; rhizoids not observed; trichoblasts very rudimentary or absent, scar-cells 1 per segment in spiral sequence.

Tetrasporangia in spiral series in the smaller branches; cystocarps not seen; spermatangial stichidia arising from an entire trichoblast primordium.

SPECIMENS STUDIED.—BAJA CALIFORNIA DEL NORTE: two collections are assigned to this entity: JN-2998b, spermatangial, from 7.6 m depth, Isla la Ventana, Bahía de Los Angeles, 21 May 1972; and JN-3265b, tetrasporangial, growing on the "pen shell" (*Pinna rugosa*), 3–5 m depth, Bahía San Francisco, 24 May 1972.

REMARKS.—The manner of origin of spermatangial stichidia is very much like that in *P. pacifica* and *P. scopulorum*, but the presence of a scar-cell or a trichoblast on each segment is not a feature normally associated with the origin of spermatangial stichidia from an entire trichoblast primordium as in the last named species. Also there are differences in the arrangement of the tetrasporangia. In *P. pacifica* and *P. scopulorum* they are in a straight series, whereas in our Gulf of California collections they are arranged in a spiral series (Figure 10D). It seems probable that these specimens represent an undescribed species. Further collections are needed to determine their taxonomic status.

Literature Cited

- Abbott, I. A., and G. J. Hollenberg
1976. *Marine Algae of California*. xii + [2] + 827 pages. Stanford: Stanford University Press.
- Agardh, J. G.
1863. *Species, genera et ordines Algarum, seu descriptiones succinctae specierum generum et ordinum, quibus algarum regnum constituitur*. Volume 2, part 3, pages 701–1291. Lund: G. W. K. Gleerup.
- Boergesen, F.
1918. The Marine Algae of the Danish West Indies, III: Rhodophyceae. *Danske Botanisk Arkiv*, 3:241–304.
- Dawson, E. Y.
1944. The Marine Algae of the Gulf of California. *Allan Hancock Pacific Expeditions*, 3(10):189–454.
1949. Resultados preliminares de un reconocimiento de las algas marinas de la costa Pacífica de México. *Revista de la Sociedad Mexicana de Historia Natural*, 9(3/4): 215–254.
1950. A Note on the Vegetation of a New Coastal Upwelling Area of Baja California. *Journal of Marine Research*, 9(2):66–68.
1951. A Further Study of Upwelling and Associated Vegetation along Pacific Baja California, Mexico. *Journal of Marine Research*, 10:39–58.
1954a. The Marine Flora of Isla San Benedicto Following the Volcanic Eruption of 1952–1953. *Allan Hancock Foundation Publications Occasional Paper*, 16:1–13.
1954b. Resumen de las investigaciones recientes sobre algas marinas de la costa Pacífica de México, con una sinopsis de la literatura, sinonimia y distribución de las especies descritas. *Revista de la Sociedad Mexicana de Historia Natural*, 13:97–197 + i-x [reprint of 1953 with corrections, index, pagination, and addenda].
1957. Notes on Eastern Pacific Insular Marine Algae. *Los Angeles County Museum Contributions in Science*, 8:1–8.
1959. Marine Algae from the 1958 Cruise of the *Stella Polaris* in the Gulf of California. *Los Angeles County Museum Contributions in Science*, 27:1–39.
1963. Marine Red Algae of Pacific Mexico, Part 8, Ceramiales: Dasyaceae, Rhodomelaceae. *Nova Hedwigia*, 6:401–481.
1966. Marine Algae in the Vicinity of Puerto Peñasco, Sonora, Mexico. *Gulf of California Field Guide Series*, 1:iii + 57. Tucson: University of Arizona.
- Dawson, E. Y., C. Acleto O., and N. Foldvik
1964. The Seaweeds of Peru. *Beihefte zur Nova Hedwigia*, 13: [5] + 111 pages.
- Dawson, E. Y., M. Neushul, and R. D. Wildman
1960a. Seaweeds Associated with Kelp Beds along Southern California and Northwestern Mexico. *Pacific Naturalist*, 1(14):1–81.
1960b. New Records of Sublittoral Marine Plants from Pacific Baja California. *Pacific Naturalist*, 1(19):1–30.
- Felger, R. S., K. Clifton, and P. J. Regal
1976. Winter Dormancy in Sea Turtles: Independent Discovery and Exploitation in the Gulf of California by Two Local Cultures. *Science*, 191:283–285.
- Gardner, N. L.
1927. New Rhodophyceae from the Pacific Coast of North America, VI. *University of California Publications, Botany*, 14:99–138.
- Greville, R. K.
1824. *Flora Edinensis*. lxxxii + 478 pages. Edinburgh: W. Blackwood.
- Hariot, P.
1891. Liste des algues marines reportées de Yokusuka (Japon) par M. le Dr. Savatier. *Memoires de la Société des Sciences Naturelles et Mathématiques de Cherbourg*, 27:211–230.
- Harvey, W. H.
1847. *Nereis Australis, or Algae of the Southern Ocean*. [2] + viii + 124 pages. London: Reeve Brothers.
1853. *Nereis Boreali-Americana; or, Contributions towards a History of the Marine Algae of the Atlantic and Pacific Coasts of North America, Part II: Rhodosperrmeae*. 258 pages. Washington, D. C.: Smithsonian Institution.
- Hollenberg, G. J.
1942a. Phycological Notes, I. *Bulletin of the Torrey Botanical Club*, 69:528–538.
1942b. An Account of the Species of *Polysiphonia* on the Pacific Coast of North America, I: Oligosiphonia. *American Journal of Botany*, 29:772–785.
1944. An Account of the Species of *Polysiphonia* on the Pacific Coast of North America, II: Polysiphonia. *American Journal of Botany*, 31:474–483.
1948. Notes on Pacific Coast Marine Algae. *Madroño*, 1948:155–162.
1961. Marine Red Algae of Pacific Mexico, Part 5: The Genus *Polysiphonia*. *Pacific Naturalist*, 2(6):345–375.
1968a. An Account of the Species of *Polysiphonia* of the Central and Western Tropical Pacific Ocean, I: Oligosiphonia. *Pacific Science*, 22(1):56–98.
1968b. An Account of the Species of the Red Alga *Polysiphonia* of the Central and Western Tropical Pacific Ocean, II: Polysiphonia. *Pacific Science*, 22(2):198–207.
1971. Phycological Notes, V: New Species of Marine Algae from California. *Phycologia*, 10(1):11–16.

Holmgren, P. K., and W. Keuken

1974. *Index Herbariorum, Part I: The Herbaria of the World*. Sixth edition, vii + 397 pages. Utrecht, Netherlands: Oosthoek, Scheltema & Holkema.

Hooker, W. J.

1833. Mosses, Hepatiae, Lichens, Characeae and Algae. Part I of volume 5 (*Class XXIV, Cryptogamia*) in *The English Flora of Sir James Edward Smith*. x + 4 + 432 pages. London: Longman, Rees, Orme, Brown, Green & Longman. [Listed under "J. E. Smith" in most libraries.]

Howe, M. A.

1914. The Marine Algae of Peru. *Memoirs of the Torrey Botanical Club*, 15:1-185.

Kuetzing, F. T.

1863. *Tabulae Phycologicae*. Volume 13, [i] + 31 pages. Nordhausen.
1864. *Tabulae Phycologicae*. Volume 14, [i] + 35 pages. Nordhausen.

Kylin, H.

1941. Californische Rhodophyceen. *Lunds Universitets Arsskrift, N. F. Avd. 2*, 37(2):1-51; and *Kunglig Fysiografiska Sällskapet Handlingar*, new series, 52(2):1-51.

Montagne, C.

1842. Troisième centurie de plantes cellulaires exotiques nouvelle, part 2. *Annales des Sciences Naturelles, Botanique*, series 2, 18:241-282.

Norris, J. N.

1972. Marine Algae from the 1969 Cruise of "Makrele" to the Northern Part of the Gulf of California. *Boletín de la Sociedad Botánica de México*, 32:1-30.

Norris, J. N., and K. E. Bucher

1976. New Records of Marine Algae from the 1974 R/V *Dolphin* Cruise to the Gulf of California. *Smithsonian Contributions to Botany*, 34:1-22.

Reinsch, P. F.

1888. Species et genera nova Algarum ex insula Georgia Australi. *Berichte der Deutschen Botanischen Gesellschaft*, 6:144-156.

Segi, T.

1951. Systematic Study of the Genus *Polysiphonia* from Japan and Its Vicinity. *Journal of the Faculty of Fisheries, Prefectural University of Mie*, 1(2):169-272.

Setchell, W. A., and N. L. Gardner

1903. Algae of Northwestern America. *University of California Publications, Botany*, 1:165-418.
1924. The Marine Algae: Expedition of the California Academy of Sciences to the Gulf of California in 1921. *Proceedings of the California Academy of Sciences*, fourth series, 12:695-949.
1930. Marine Algae of the Revillagigedo Islands Expedition in 1925. *Proceedings of the California Academy of Sciences*, fourth series, 19:109-215.

Smith, G. M.

1944. *Marine Algae of the Monterey Peninsula, California*. ix + 622 pages. Stanford: Stanford University Press.
1969. *Marine Algae of the Monterey Peninsula, California*. Second edition (incorporating the 1966 *Supplement* by G. J. Hollenberg and I. A. Abbott), x + 752 pages. Stanford: Stanford University Press.

Taylor, W. R.

1945. Pacific Marine Algae of the Allan Hancock Expeditions to the Galápagos Islands. *Allan Hancock Pacific Expeditions*, 12: iv + 528 pages.

Womersley, H. B. S.

1950. The Marine Algae of Kangaroo Island, III: List of Species, I. *Transactions of the Royal Society of Southern Australia*, 73(2):137-197.

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