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Marine algae from Islas San Félix y San Ambrosio (Chilean Oceanic Islands)

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Abstract – A collection of marine algae made by R. W. Schmieder, organizer of the Cordell Expedition to Isla San Félix in March 2002, and observations made by Sylvia A. Earle during Cruise 12 of the R/V *Anton Bruun* in December 1965 have demonstrated the presence of eight species not previously reported from this remote and desolate volcanic island. The number of named species recorded from Isla San Félix is thereby increased to 19 compared to 28 for neighboring Isla San Ambrosio. The eight newly recorded species represent Rhodophycota (*Chondracanthus intermedius*, *Jania tenella*, and *Rhodymenia californica*), Phaeophycota (*Colpomenia sinuosa*, *Glossophora kunthii*, and *Hydroclathrus clathratus*), and Chlorophycota (*Chaetomorpha antennina* and *Codium cerebriforme*). Considering the two islands as a group, ten species have been recorded only from Isla San Félix, 19 have been recorded only from Isla San Ambrosio, and nine have been recorded from both islands, giving a total of 38 species. The marine algal flora of these islands has a strong affinity with that of Islas Juan Fernández, sharing 30 species (79%), of which 15 are insular endemics. Only 11 species (29%) also occur on the Pacific coast of South America, of which seven are widespread while four are endemic to South America. Only one species, *Padina tristromatica*, is endemic to Islas San Félix y San Ambrosio.

Chilean oceanic islands / Easter Island / Isla de Pascua / Isla San Ambrosio / Isla San Félix / Islas Juan Fernández / marine algae / Rapa Nui

Résumé – **Algues marines des îles San Félix et San Ambrosio (Îles océaniques du Chili).** Sur la base d'une collection d'algues marines faites par R. W. Schmieder, organisateur de la Cordell Expedition à l'Île San Félix en Mars 2002, et des observations faites par Sylvia A. Earle durant le Cruise 12 du R/V *Anton Bruun* en décembre 1965, huit espèces sont raportées pour la première fois de l'Ile de San Félix, île volcanique lointaine et désolée. On connaît maintenant 19 espèces pour cette île, chiffre qu'on peut comparer aux 28 de l'île voisine San Ambrosio. Les huit espèces appartiennent aux Rhodophycota (*Chondracanthus intermedius*, *Jania tenella*, et *Rhodymenia californica*), aux Phaeophycota (*Colpomenia sinuosa*, *Glossophora kunthii*, et *Hydroclathrus clathratus*), et aux Chlorophycota (*Chaetomorpha antennina* et *Codium cerebriforme*). Si l'on considère les deux îles comme un même groupe, 10 espèces ont été rapportées seulement de San Félix, 19 de la seule San Ambrosio, et neuf pour les deux îles à la fois, soit un total de 38 espèces. La flore phycologique marine de ces îles montre une forte affinité avec celle des îles Juan Fernández, partageant 30 espèces (79 %), dont 15 sont des endémiques insulaires. Seules 11 espèces (29 %) sont présentes sur la côte Pacifique d'Amérique du Sud, dont sept sont largement répandues tandis que quatre sont endémiques d'Amérique du Sud. Une seule espèce, *Padina tristromatica*, est endémique des ïles San Félix et San Ambrosio.

Algues marines / Îles océaniques du Chili / Easter Island / Île de Pâques / Île San Ambrosio / Île San Félix / Îles Juan Fernández / Rapa Nui

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Dedicated to Isabella Aiona Abbott, tireless researcher, beloved teacher, and pre-eminent facilitator between East and West, on the occasion of her 85th birthday.

INTRODUCTION

Physiography of Islas San Félix y San Ambrosio

Isla San Félix and its neighbor Isla San Ambrosio (Figs 1, 2) belong to Chile and are considered a geographical unit, formerly called Islas Desventuradas (or Islas de los Desventurados as given in *The Times Atlas of the World*, 1957 edition, pl. 118). They lie only 9.7 nautical miles (18 km) from one another, but about 500 nautical miles (926 km) west of Chañaral, Antofagasta Province, northern Chile, and an equally long distance almost due north of Islas Juan Fernández, a much larger chain of volcanic islands. Far to the west (about 1725 nautical miles or 3200 km) lies the outermost Chilean oceanic island, Rapa Nui (Isla de Pascua or Easter Island), an eastern outlier of Polynesia. The approximate coordinates of Islas San Félix y Ambrosio are 26º S, 80º W.

Because of physical and political impediments, very few biologists have visited these remote islands. Accounts of their geological evolution, geography, and biology have been assembled in a book edited by Castilla (1987). The following background information is based on these accounts unless otherwise indicated.

Both Isla San Félix and Isla San Ambrosio are very small, with a total area of 10.3 km^2. Isla San Félix is flanked by two even smaller extrusions, Islote González to the southeast and Roca Catedral de Peterborough to the northwest. These four volcanic masses, in addition to a few rocks adjacent to Isla San Ambrosio, constitute a discrete archipelago, the origin of which lay in the extrusion of magma through fracture zones in the Nazca Plate beginning approximately 3 million years ago. The archipelago, in turn, is part of an east-west chain of submerged and emergent volcanoes that have arisen along the Isla de Pascua "hot line". Islas San Félix y San Ambrosio rise about 4,000 m above the ocean floor.

Both Isla San Félix and Isla San Ambrosio are heavily eroded fragments of major volcanic structures. The western end of Isla San Félix is occupied by Cerro Amarillo (193 m). This hill of yellowish tufa is the remnant of one side of a crater, the other side being Islote González (166 m) off the southeastern end of the island, connected by a reef that is partially exposed in heavy seas. A platform 60 to 70 m high extends eastward and southward from Cerro Amarillo. Volcanic activity (emission of sulfurous gases) was observed on Isla San Félix as recently as 1922.

Isla San Ambrosio, by contrast, does not have a vestigial crater, erosion having left only a massif ranging in height from 330 to 478 m, arising abruptly from the sea. Recent volcanic activity has not been observed on this island.

Roca Catedral de Peterborough represents the plug of an eroded parasitic cone on the submarine flanks of Isla San Félix. It soars to a height of 50 m.

While Isla San Félix and Isla San Ambrosio are in close proximity, they originated many millenia apart and have undergone different patterns of volcanic activity. The resulting difference in topography is clearly reflected in the terrestrial flora.

Both islands front the ocean with daunting cliffs, those of Isla San Félix ranging in height from 15-20 m on the north side to 50-70 m on the south side. Those of Isla San Ambrosio are much more impressive, reaching 450 m in height. There is very litle sand along the shores of either island with the notable exception of the north shore of Isla San Félix just west of Punta Leander, where a swath of dark medium-grain sand about 50 m wide extends for about 500 m, flanked at each end by rocky cliffs (Schmieder, 2003: 164). The layers of lava (olivine basalt)

Fig. 1. Map showing position of Islas San Félix y San Ambrosio in relation to South America (courtesy of Cordell Expeditions).

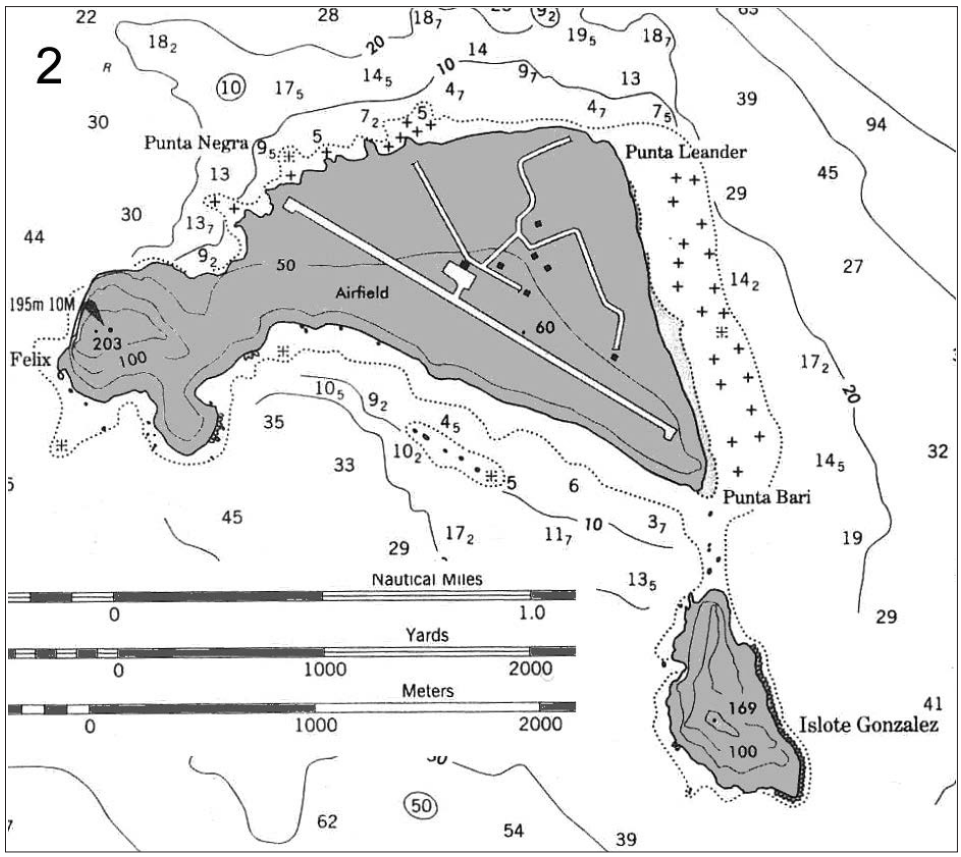


Fig. 2. Map of Isla San Félix (courtesy of Cordell Expeditions).

on Isla San Félix are scarcely eroded. There are pockets of volcanic ash and a small amount of guano. The general aspect is one of extreme barrenness. Only eight species of vascular plants have been recorded. Isla San Ambrosio, by contrast, with an elevation sufficient to capture significant amounts of moisture in the form of fog-drip or infrequent rain, supports a conspicuous vegetation comprising 19 species of vascular plants. Two species that were found on Isla San Félix have not been found on Isla San Ambrosio. The number of species of vascular plants for the archipelago is thus 21, of which 15 (71%) are endemic (Skottsberg, 1963; Hoffmann & Marticorena, 1987).

Previous botanical exploration of Islas San Félix y San Ambrosio

The first floristic account of Islas Desventuradas was that by R.A. Philippi (1870), who studied collections made in 1869 by Enrique M. Simpson, Commandant of the Chilean corvette "*Chacabuco*". Philippi recorded seven species of vascular plants from Isla San Ambrosio and one from Isla San Félix, five of which had not been described previously. The first mention of algae was

made by Ramón Vidal, Commandant of the schooner "*Covadonga*", which was sent to survey the islands for the Chilean Hydrographic Office in 1874. Vidal (1875: 749) noted that the marine algae on Isla San Félix were very scarce and mentioned only two: "*Ulvaica*", a misspelling of Ulvaceas (although no green foliaceous alga is known for the island) and "*Coralina*", probably referring to *Haliptilon roseum*. He made no mention of algae from Isla San Ambrosio. Vidal's collections of vascular plants were identified by Frederico Philippi (1875). The first significant collection of algae in the islands was made in October 1896 by Friedrich Johow (1859-1933), a German-born botanist at the Instituto Pedagógico in Santiago. Johow had completed a substantial portion of a manuscript on his collections of vascular plants at the time that Carl Skottsberg visited him in Santiago (August 1917). Skottsberg promised to help Johow with the manuscript and to arrange for its publication in Sweden at no cost to Johow. The first World War intervened and Skottsberg was unable to re-establish contact with Johow during the latter's lifetime. Following Johow's death in 1933, the collections and manuscript were sent to Skottberg through the efforts and generosity of Johow's widow, his academic successor Victor Baeza, and another botanist in Santiago, Gualterio Looser. Skottsberg reworked the manuscript, but retained quotations from Johow's manuscript. The account was published in 1937.

Skottsberg (1937: 82) mentioned that among Johow's collections were an unknown siphonous alga and a *Padina* with the structure of *P. pavonia*. He also mentioned that W.A. Setchell (University of California, Berkeley) had shown him collections made on Isla San Félix by the Templeton Crocker Pacific Expedition of 1935 sponsored by the California Academy of Sciences. These collections included *Sphacelaria* sp., *Splachnidium rugosum* (L.) Grev. ("dieselbe dünne Form wie bei Juan Fernandez"), *Padina* sp., and *Eisenia cokeri* Howe, originally described from Peru. Unfortunately, these collections have not been located.

Levring (1941), in his treatment of the marine algae of Islas Juan Fernández, incidentally cited two species as occurring also at Isla San Félix (*Codiolum kuckuckii* Skottsberg *et* Levring and *Splachnidium rugosum*) and one species as occurring also at Isla San Ambrosio (*Chaetomorpha firma* Levring). Later, Levring (1942) gave collecting information for these three species and added a new species, *Padina tristromatica*, from both islands, and a new record, *Myrionema strangulans* Greville, an epiphyte on the Isla San Félix specimen of *Padina*. The San Félix collections had been made on February 18, 1935, by James Paul Chapin, a curator of ornithology at the American Museum of Natural History in New York, during the Crocker Expedition, whereas the San Ambrosio collection had been made in October 1896 by Johow.

Because the treatment of Johow's collections was not published until 1937, two of his manuscript species were pre-empted by species described by Johnston (1935) on the basis of collections made by Bailey Willis (a geologist at Stanford University) in May 1923 and by Chapin (Crocker Expedition) in February 1935. The present-day inventory of vascular plants of Islas San Félix y San Ambrosio was completed by 1963 (Skottsberg 1963). An update by Hoffmann & Marticorena (1987) involved two name changes, but included no additional species.

In a compilation of marine algae from the Chilean oceanic islands, Etcheverry (1960) added seven more species to the known flora of Isla San Ambrosio based on collections made by Juan González in June 1950. The first publication devoted exclusively to the marine algae of Isla San Félix was that of Meneses & Hoffmann (1994). Isabel Meneses and Alicia Hoffmann were both on the faculty of Pontificia Universidad Católica de Chile at the time of writing.

Hoffmann had made a small collection of drift material from the only existing beach at the time of her visit to Isla San Félix. Formalin-preserved material collected at Isla San Félix by L. Di Salvo in 1983 and by Mario Edding in 1986 was also incorporated in their study. Unfortunately, in their compilation of species (their Table 1), Isla San Félix is lumped together with Isla San Ambrosio so that it is not possible to determine whether the eight species previously reported solely from Isla San Ambrosio had also been collected on Isla San Félix. Meneses & Hoffmann added six species to the floristic list for Isla San Félix, giving a total of ten species. In addition, they cited four genera without designating species.

Later in 1994, María Eliana Ramírez and her associates at the National Museum of Natural History in Santiago published a list of species of marine algae collected by Alex Wilder, the captain of a lobster fishing boat, on the north shore of Isla San Ambrosio (Ramírez *et al*., 1994). They were able to add 19 species to the previously reported 9 species, a total of 28 species for that island. In addition, they cited five genera without designating species and mentioned two unnamed parasitic species.

Against this backdrop of a poorly known flora, any new collections of marine algae from these islands are of great interest. The present paper reports previously unpublished results of two expeditions to Isla San Félix.

MATERIALS AND METHODS

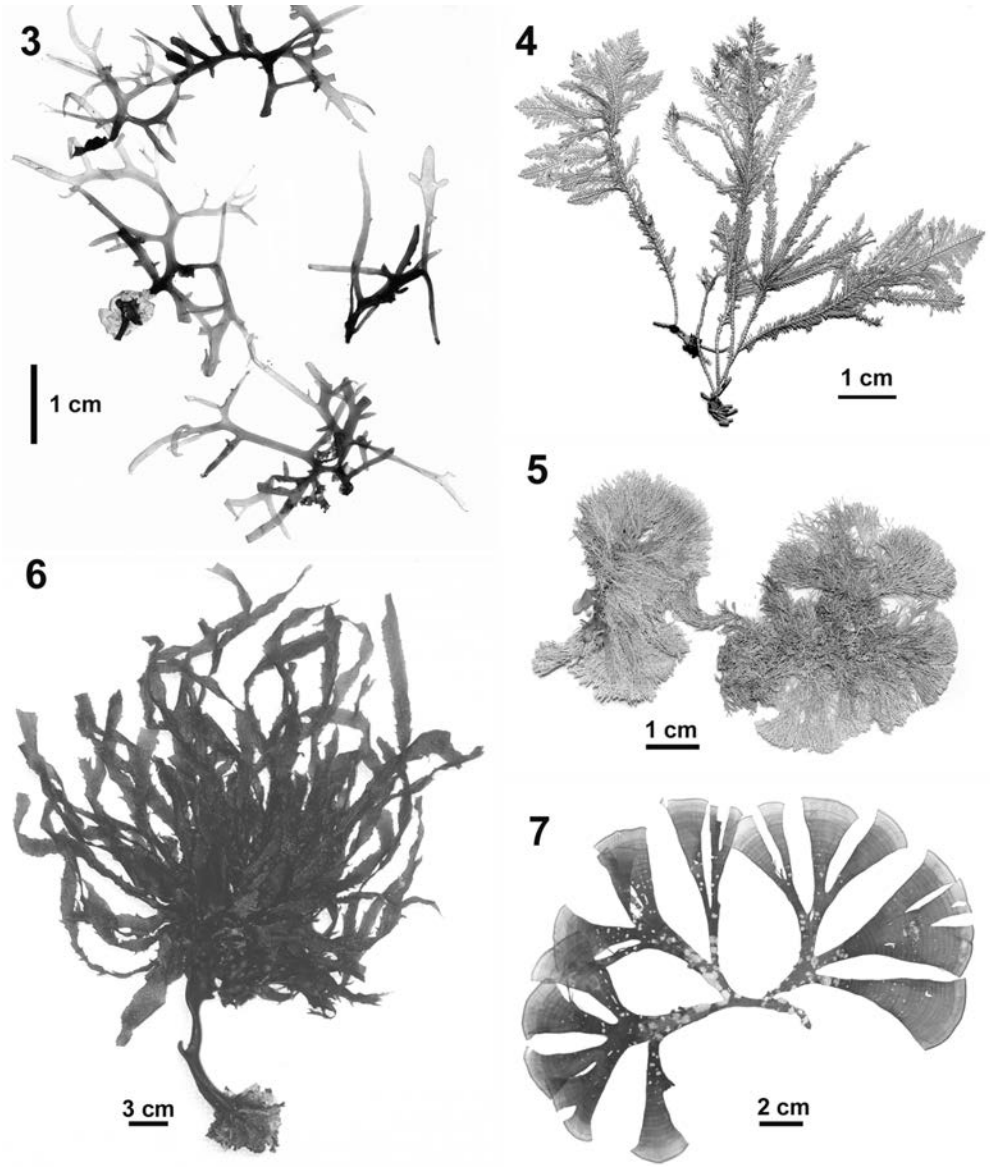
During Cruise 12 of the R/V *Anton Bruun*, Sylvia A. Earle observed and collected the biota of the shallow subtidal zone of Isla San Félix by scuba and free-diving at several sites in the period January 5-7, 1965. Dr. Earle deposited her notes in the Herbarium of the University of California, Berkeley (UC). With the cooperation of the Chilean navy, which maintains a small base on Isla San Félix, and with the support of numerous radio hobbyists and commercial firms, Cordell Expeditions (Walnut Creek, California) mounted an expedition organized by Robert W. Schmieder in March 2002. While the main purpose of the expedition was to establish radio transmission on a remote island for the benefit of radio hobbyists around the world who eagerly await the transmitted signal, Dr. Schmieder made a small collection of seaweeds by snorkeling in a cove adjacent to the landing on the northwest shore of Isla San Félix. A well-illustrated account of this expedition was published by Schmieder (2003). Identifications were made by comparing San Félix material with specimens from the Eastern Pacific housed at UC.

Comments on selected species

Rhodophycota (red algae)

***Chondracanthus intermedius* (Suringar) Hommersand** (*i*n Hommersand *et al*., *Hydrobiologia* 260/261: 115. 1993). *Gigartina intermedia* Suringar (*Ann. Mus. Bot. Lugduno-Batavi* 3: 259. 1867) (Fig. 3).

This species was originally described from Japan and has been widely reported in the western Pacific. It was first reported from the eastern Pacific by Dawson (1959: 26), who stated that "These plants [from the Gulf of California] are so remarkably like Suringar's species that this identification seems almost unques-



Figs 3-7. **3**. *Chondracanthus intermedius* (Isla San Félix, leg. R.W. Schmieder, UC). Scale bar = 5 mm. **4**. *Haliptilon roseum* (Isla San Félix, leg. R.W. Schmieder, UC). Scale bar = 1 cm. **5**. *Jania tenella* (Isla San Félix, leg. R.W. Schmieder, UC). Scale bar = 1 cm. **6**. *Eisenia cokeri* (Isla San Félix, leg. R.W. Schmieder, UC). Scale bar = 2 cm. **7**. *Padina tristromatica* (Isla San Félix, leg. R.W. Schmieder, UC). Scale bar = 2 cm.

tionably correct..". It was reported from Islas Juan Fernández and Isla San Ambrosio by Ramírez *et al.* (1994). It is represented in the present collection from Isla San Félix.

***Haliptilon roseum* (Lamarck) D.J. Garbary *et* H.W. Johansen** (*J. Phycol.* 18: 218. 1982). *Corallina rosea* Lamarck (*Mém. Mus. Hist. Nat. [Paris]* 2: 235. 1815) (Fig. 4).

This species was originally described on the basis of a collection made by F. Péron and C.A. Lesueur on board the *Géographe* during an expedition to Australia, 1801-1802. According to Johansen & Womersley (1986), this collection was probably made either in southwestern Australia or in southwestern Tasmania. After studying the type specimens of 12 species of *Corallina* and *Jania* that had originally been described from southern Australia, those authors concluded that they were all morphological variants of a single species, whose correct name is *H. roseum*. One of the synonyms is *Corallina cuvieri* Lamouroux (*Hist. Polyp. Corall. Flex*.: 287, pl. IX: fig. 8. 1816), which had been transferred to *Haliptilon* by Johansen & Silva (1978: 417). *Corallina cuvieri* or *Haliptilon cuvieri* are the names most frequently applied to southern Australian collections of this species. The first record of *H. roseum* from the southeastern Pacific was that by Levring (1943), who reported it (as *Corallina cuvieri*) from Islas Juan Fernández. Another species referred to *H. roseum* by Johansen & Womersley is *Corallina gracilis* Lamouroux (*Hist. Polyp. Corall. Flex*.: 288, pl. X: fig. 1. 1816), originally described from "Australasie". Specimens from La Jolla, California, determined as *C. gracilis* were distributed as no. 399 in the Phycotheca Boreali-Americana, issued in 1897. Subsequently, *C. gracilis* has been regarded as a common species in southern California and northern Baja California. Variability in *H. roseum* is related to light intensity and wave action.

***Jania tenella* (Kützing) Grunow** (*J. Mus. Godeffroy [Hamburg]* 3: 42. 1874). *Corallina tenella* Kützing (*Tab. Phycol.* 8: 41, pl. 85: fig. II. 1858) (Fig. 5).

This species was originally described on the basis of material from the Gulf of Naples and from an unspecified site on the coast of Mexico. After examining fragments of the type specimen, Dawson (1953) applied this name to numerous collections from southern California, Baja California, and Costa Rica. We sent a specimen from Isla San Félix to H. William Johansen (Clark University, Worcester, Massachusetts), an international authority on articulated coralline algae. While admitting that the taxonomy of janioid corallines was very difficult, he determined the specimen as *Jania rubens* var. *corniculata* (Linnaeus) Yendo (*J. Coll. Sci. Imp. Univ. Tokyo* 20, Art. 12: 38. 1905) (*Corallina corniculata* Linnaeus, *Syst. Nat.* ed. 10: 806. 1758). This taxon, like *Jania tenella*, was based on European material, but unlike that species, it has never been reported from the Pacific.

***Liagora brachyclada* Decaisne** (*Ann. Sci. Nat. Bot*., ser. 2, 18: 118. 1842).

This species was based on a specimen in the herbarium of Alcide Dessalines d'Orbigny (1802-1857), a French paleontologist who traveled in South America during the period 1826-1834. Decaisne gave as the provenance "Chili". This citation is puzzling because *Liagora* is not known from mainland Chile. According to Bruno de Reviers (pers. comm.), specimens from the d'Orbigny herbarium are supposed to have been deposited in Herb. Montagne (PC), but the type of *L. brachyclada* is missing. A specimen of *Liagora* that had been collected in Islas Juan Fernández by Carlo Giuseppe Bertero (1789-1831), a naval physician who settled in Chile in 1827, was initially identified as *L. pulverulenta* Lamouroux by Montagne (1835), a cryptogamic botanist who, like Decaisne, lived in Paris. After *L. brachyclada* was published, Montagne (1852: 269) referred Bertero's collection to that species and significantly amplified the original description. There is no indication that Montagne saw the type specimen. Because this specimen is missing, we herein designate the Bertero specimen in Herb. Montagne (PC) as

neotype in accordance with Art. 9.6 of the International Code of Botanical Nomenclature (St. Louis Code).

In his account of the marine algae of Islas Juan Fernández, Levring (1941) provided a detailed and illustrated description of this species based on specimens collected by Skottsberg. It is one of several species of *Liagora* in which the carposporophyte produces tetrads of carposporangia (carpotetrasporangia). Ramírez & Santelices (1991), in their catalogue of Chilean marine algae, state that *L. brachyclada* is endemic to Islas Juan Fernández. Subsequently, this species was reported from Isla San Félix by Meneses & Hoffmann (1994). The present collection comprises a single large and densely branched thallus.

***Rhodymenia californica* Kylin** (*Lunds Univ. Årsskr., N.F., Avd. 2*, 27{11}: 21, pl. 9: fig. 22. 1931).

This species was originally described on the basis of material collected at Pacific Grove on the Monterey Peninsula, California. It is presently regarded as a common species along the Pacific coast of North America from southern Alaska to Nayarit, Mexico, occurring in the lowest intertidal and in the subtidal to about 20 m. Taylor (1945: 250) identified two collections from the Galapagos Islands as this species, from depths of 27 and 55 m. The Isla San Félix specimens seem indistinguishable from California specimens referable to the form of this polymorphic species in which the apices are attenuate. This form was described as a distinct species, *Rhodymenia attenuata*, by Dawson (1941), who later (Dawson 1963) reduced the species to the rank of variety under *R. californica*. At that time, he commented that deep water forms of *R. californica* are more likely to develop the habit of var. *attenuata* than are those from shallow water. The Isla San Félix collection, however, was made in shallow water.

Phaeophycota (brown algae)

***Colpomenia sinuosa* (Mertens *ex* Roth) Derbès *et* Solier** (*in* Castagne, *Suppl. Cat. Pl. Marseille*: 95. 1851). *Ulva sinuosa* Mertens *ex* Roth (*Catalecta Bot.* 3: 327, pl. XII. 1806).

This species was originally described from Cádiz, in Atlantic Spain. Subsequently it has proved to be widespread in warm waters in all oceans. It was recorded from Islas Juan Fernández by Levring (1941) and from Isla San Ambrosio by Ramírez *et al*. (1994). It often grows alongside *Hydroclathrus*. It was not represented in the present collection, but Dr. Earle observed it in the shallow subtidal zone (to 10 m depth) at three sites on Isla San Félix (SE 65218, SE 65229, SE 65223). At each of these sites it was associated with *Hydroclathrus*.

***Eisenia cokeri* Howe** (*Mem. Torrey Bot. Club* 15: 55, pl. 14, fig. A; pls. 15, 16; pl. 18: fig. A. 1914). (Fig. 6).

This species of kelp was based on collections made on the mainland of Peru and on adjacent coastal islands by Robert E. Coker of the U.S. Bureau of Fisheries while serving as consultant to the Peruvian government in 1907. Howe noted the close relationship with *E. arborea* Areschoug from the Pacific coast of North America and with *E. bicyclis* (Kjellman) Setchell from Japan but pointed out several admittedly minor differences. According to Howe, the sporophylls are coarsely dentate, with the larger teeth bifid or bearing one or two smaller teeth. In California collections of *E. arborea*, most mature plants have sporophylls with both simple and compound teeth of varying prominence.

The distribution of this genus is remarkable. On the Pacific coast of North America isolated populations of *E. arborea* occur in the Queen Charlotte Islands

and on Vancouver Island in British Columbia, at Point Lobos just south of the Monterey Peninsula in California, and from Los Angeles County southward to Isla Magdalena in Baja California, including the Channel Islands and coastal Mexican islands. Two fragments of a kelp came up with the anchor on Isla Guadalupe, Mexico, during a California Academy of Sciences expedition to the Revillagigedo Archipelago in 1925. Setchell & Gardner (1930) described them as *Eisenia* (?) *masonii* and *E.* (?) *desmarestioides*. Complete specimens collected by one of us (PCS) at Isla Guadalupe in 1950 confirmed that the generic placement of these two species is correct, even though the compound sporophylls are unique in the genus. The presence of fronds that are intermediate in form between the two species strongly suggests that the type specimens are morphological variants of the same species, for which the name *E. desmarestioides* may be retained.

Taylor (1945) described *Eisenia galapagensis* on the basis of several specimens dredged from depths as great as 55 m. This species is similar to *E. cokeri*. Finally, Dawson *et al*. (1964) described a population growing at depths of 28-37 m in Bahía San Juan, Peru, as *E. gracilis*. The taxonomic distinctness of this species remains to be confirmed.

Eisenia cokeri was first recorded from the Chilean oceanic islands by Skottsberg (1937: 82), who mentioned that Setchell had shown him a collection from Isla San Félix made by the Templeton Crocker Pacific Expedition of 1935. Etcheverry (1960) identified a sublittoral collection from Isla San Ambrosio as that species. A collection from Isla San Félix was described and illustrated by Meneses & Hoffmann (1994), but only blade material was available. A similar incomplete specimen (in UC) had been collected earlier on Isla San Félix by Joseph R. Jehl of the San Diego Natural History Museum. A complete mature specimen was obtained by the Cordell Expedition.

Dr. Earle found that *Eisenia cokeri* was abundant at most sites on Isla San Félix. At one site (SE 65220) on the northwest side of the island, where the near-shore bottom comprised sloping lava boulders and reeflike rock areas interspersed with sand at a depth down to 10 m, *Eisenia* formed a dense canopy on the reeflike formations in a swift current at a temperature of 17 ºC. The thalli were up to a meter high. At a nearby intertidal site (SE 65222), where a narrow shelf with tide pools was backed by a cliff and dropped off abruptly into 10-15 m of water, *Eisenia* in the subtidal fringe was uncovered momentarily by surges. Along the sides of Roca Catedral de Peterborough, a cluster of basaltic columns about 2 km northwest of Isla San Félix, *Eisenia* grew at least as deep as 34 m (SE 65226). One clump was about 2.5 m in diameter.

***Glossophora kunthii* (C. Agardh) J. Agardh** (*Alg. Syst.* 2: 110. 1882). *Zonaria kunthii* C. Agardh (*Icon. Alg. Ined.* 2: pl. XV. 1821).

This species was originally described from Peru on the basis of a specimen collected by Alexander von Humboldt. Collections from Islas Juan Fernández were described and illustrated in detail by Levring (1941). It was first reported from Isla San Ambrosio by Etcheverry (1960) and from Isla San Félix by Meneses & Hoffmann (1994). Although it was not present in the collection at hand, it was observed by Dr. Earle in the shallow subtidal (to 10 m) at three sites on Isla San Félix (SE 65218, SE 65220, SE 65223) and at Roca Catedral de Peterborough.

***Hydroclathrus clathratus* (C. Agardh) Howe** (*in* Britton and Millspaugh, *Bahama Flora*: 590. 1920). *Encoelium clathratum* C. Agardh (*Sp. Alg.* 1: 412. 1823).

This common pantropical alga was not represented in the present collection, but it was reported from Isla San Ambrosio by Etcheverry (1960) and was

observed growing in the shallow subtidal zone by Dr. Earle at four sites on Isla San Félix in 1965 (SE 65218, SE 65220, SE 65223, SE 65225).

Padina tristromatica **Levring** (*Bot. Not.* 1942: 60, Figs 1, 2. 1942) (Fig. 7).

This species was described on the basis of two collections, one from Isla San Félix by Chapin, the other from Isla San Ambrosio by Johow. Levring did not specify which collection was the holotype, but according to Gaillard (1968, p. 24), who borrowed specimens from Levring, it was the Chapin collection from Isla San Félix. This beautiful alga is represented in the present collection and was observed by Dr. Earle at two sites on Isla San Félix growing subtidally as deep as 15 m. After comparing the type specimens of *Padina tristromatica* and *P. fraseri* (Grev.) Grev., Gaillard (1968) merged the two species. Womersley (1987, p. 219), however, although considering the two species to be closely related, separated them on the basis of the size of the central cells compared to the surface cells, smaller in *P. tristromatica* (Levring, 1942, fig. 2; Meneses & Hoffmann, 1994, fig. 7), larger in *P. fraseri* (Womersley, 1987, fig. 75G). Nonetheless, the cross-section of *P. tristromatica* published by Gaillard (pl. 5, upper) resembles Womersley's figure, so that the status of the two species remains unresolved.

Papenfussiella moseleyi **Levring** (*in* Skottsberg, *Nat. Hist. Juan Fernandez* 2: 624, fig. 8. 1941).

This species, which previously has been reported only from Islas Juan Fernández, was observed by Dr. Earle growing at depths of up to 15 m at four sites (SE 65218, SE 65220, SE 65223, SE 65225).

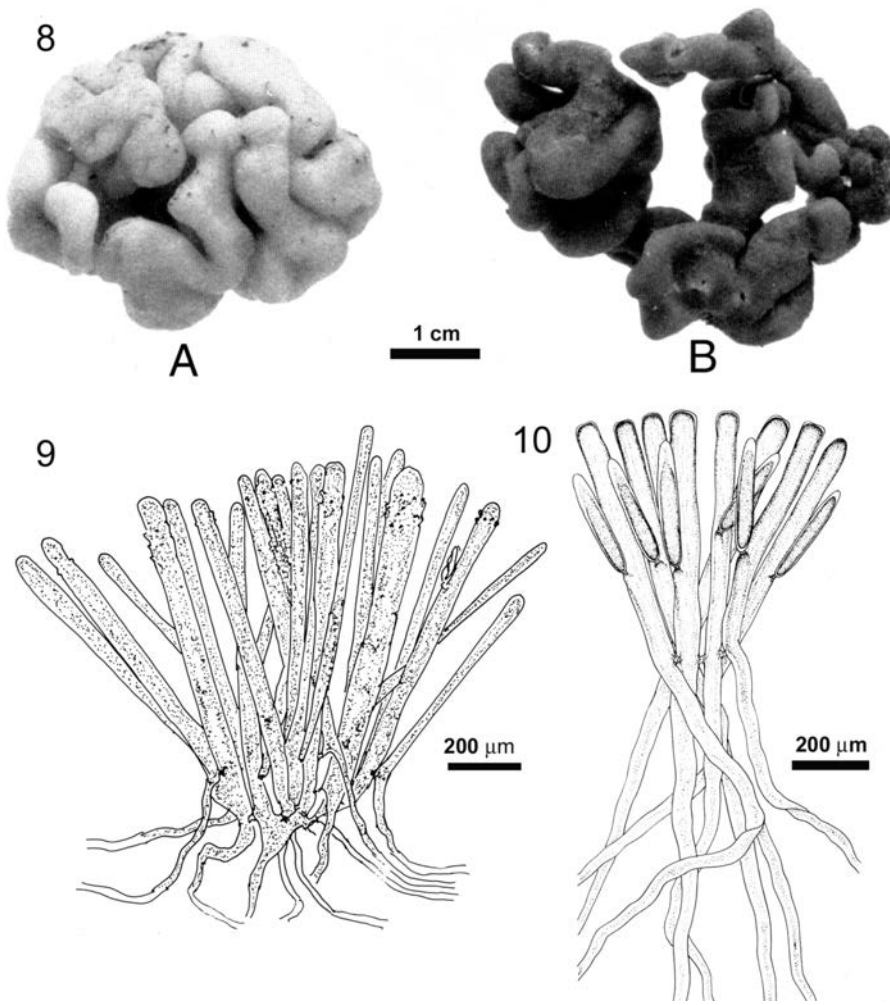
Chlorophycota (green algae)

Chaetomorpha antennina **(Bory) Kützing** (*Bot. Zeitung* 5: 166. 1847). *Conferva antennina* Bory (*Voy. Mers Afrique* 1: 381; 2: 161 footnote, 1804).

The presence of this species in the collection at hand confirms its pantropical distribution. Its habit, a stiff tuft of bright green unbranched filaments, is distinctive as is its habitat, intertidal volcanic rocks exposed to heavy wave action. This species was originally described from Réunion in the Indian Ocean. It was reported for Islas Juan Fernández by Levring (1942) and for Isla San Ambrosio by Etcheverry (1960). Dr. Earle observed it growing in the splash zone at the intertidal site on Isla San Félix (SE 65222) mentioned above under *Eisenia cokeri*.

Codium cerebriforme **Setchell** (*in* Skottsberg, *Nat. Hist. Juan Fernandez* 2: 588, pl. 34: Figs 1-3; pl. 39: Figs 1-5. 1937) (Figs 8, 9).

This species was described on the basis of collections made by Carl Skottsberg on Más a Tierra in Islas Juan Fernández in 1917. The collections were made both in the intertidal zone and in the subtidal to depths of 25 m. Setchell was impressed by the brainlike appearance of this applanate species, but its anatomy provides characters that are of much greater diagnostic value. In comparing *C. cerebriforme* with *C. dimorphum* Svedelius (Fig. 10), the common applanate species from mainland Chile, Setchell correctly pointed out several differences in their utricles. First, those in *C. cerebriforme* are very long and narrow ("macrostenophyse", a term coined by Setchell, l.c.) whereas in *C. dimorphum* they are moderately long and relatively stout ("mesophyse", a term also coined by Setchell, l.c.). Second, in *C. cerebriforme* the apical wall is thin whereas in *C. dimorphum* it is often thickened so that the apex is truncate or depressed. Third, older utricles in *C. cerebriforme* bear numerous hairs (or hair scars)



Figs 8-10. **8**. *Codium cerebriforme.* A, type before being dried, Más a Tierra, Islas Juan Fernández, leg. Skottsberg, UC. B, paratype before being dried, Más a Tierra, Islas Juan Fernández, leg. Skottsberg, UC. **9**. *Codium cerebriforme* (Isla San Félix, leg. R.W. Schmieder, UC). Cluster of utricles showing abrupt transition from utricle to rhizoidal filament. Note lateral growth of rhizoidal filaments (orig.). Scale bar = 200 µm. **10**. *Codium dimorphum* (type: Melinca, Islas Guatecas, Chile, leg. P. Dusén, fragment in UC). Cluster of utricles showing broad emergence and gradual tapering of rhizoidal filaments, which grow downward (orig.). Scale bar = 500 µm.

whereas hairs are absent in *C. dimorphum*. (The term "psilophyse"+ was coined by Setchell to apply to hairless utricles.)

A character of greater diagnostic value (and one that Setchell failed to recognize) involves the development of rhizoidal filaments. In *C. cerebriforme* they emerge from the base of the utricles as a narrow outgrowth and remain sharply more slender than parent utricles as they bend abruptly and grow laterally through the medulla. By contrast, in *C. dimorphum* the medullary filaments orig-

inate as broad outgrowths and taper gradually as they grow downward deep into the medulla.

The present collection is the first to be recorded from any site outside of Más a Tierra. It was observed by Dr. Earle growing on rocks in tidepools, especially in the splash zone, at the intertidal site on Isla San Félix (SE 65222) mentioned above under *Eisenia cokeri*.

***Codium skottsbergianum* (Setchell) P.C. Silva**.

This species, which was neither collected by the Cordell Expedition nor observed by Dr. Earle, was reported by Meneses & Hoffmann (1994) under its original name, *C. unilaterale* f. *skottsbergianum* Setchell (in Skottsberg, *Nat. Hist. Juan Fernandez* 2: 596, pl. 38: fig. 16. 1937). When describing this taxon, Setchell wondered about the antipodal distance between Islas Juan Fernández and the Gulf of California, the type locality of *C. unilaterale* Setchell *et* Gardner (*Publ. Calif. Acad. Sci*., ser. 4, 12: 710, pl. 15: Figs 30, 31; pl. 36. 1924). Silva (1951: 101), after examining the holotypes of *C. unilaterale* and *C. unilaterale* f. *skottsbergianum*, concluded that the latter represented a distinct species. Dawson (1944: 216) placed *Codium unilaterale* in the synonymy of *C. simulans* Setchell *et* Gardner (*Publ. Calif. Acad. Sci*., ser. 4, 12: 706, pl. 14: Figs 21, 22; pl. 31. 1924). Paucity of material of *C. skottsbergianum* precludes any meaningful discussion of possible related species.

DISCUSSION AND CONCLUSION

The collections made by R. W. Schmieder on the Cordell Expedition to Isla San Félix, March 20-22, 2002, and the notes made by Sylvia Earle on Cruise 12 of the R/V *Anton Bruun*, December 5-7, 1965, have enabled us to add eight species of marine algae to the known flora of that island, giving a total of 19 species. The eight newly recorded species represent Rhodophycota (*Chondracanthus intermedius*, *Jania tenella*, and *Rhodymenia californica*), Phaeophycota (*Colpomenia sinuosa*, *Glossophora kunthii*, and *Hydroclathrus clathratus*), and Chlorophycota (*Chaetomorpha antennina* and *Codium cerebriforme*). Considering the two islands as a group, ten species have been recorded only from Isla San Félix, 19 have been recorded only from Isla San Ambrosio, and nine have been recorded from both islands, giving a total of 38 species for the archipelago. While the obvious topographic differences between the two islands is sharply reflected in their vascular floras, there are no apparent differences in the marine habitat between the two islands. Therefore, with further sampling the composition of their marine algal floras will likely prove to be very similar if not identical.

The marine algal flora of these islands (Table 1) has a strong affinity with that of Islas Juan Fernández, sharing 30 species (79%), of which 15 are insular endemics. Only 11 species (29%) also occur on the Pacific coast of South America, of which seven are widespread while four are endemic to South America. Nine species (24%) also occur on Rapa Nui (Isla de Pascua or Easter Island) (Santelices & Abbott, 1988; Silva & Moe, 1996), but these are all widespread warm-water algae with the notable exceptions of *Distromium skottsbergii* Levring and *Cladophora perpusilla* Skottsberg *et* Levring, both of which are insular

Table 1. Species of marine algae reported from Islas San Félix y San Ambrosio and their distribution among other Chilean oceanic islands and on the Pacific coast of South America. SF= San Félix, SA= San Ambrosio, JF= Juan Fernández, RN= Rapa Nui, & PC= Pacific coast.

	SF	*SA*	*JF*	*RN*	*PC*
Rhodophycota					
Ahnfeltiopsis furcellata (C. Agardh) P.C. Silva *et* T.C. DeCew		•	•		•
Asparagopsis armata Harvey		•			•
Ceramium flaccidum (Kützing) Ardissone	•	•	•	•	
Chondracanthus intermedius (Suringar) M.H. Hommersand	•	•	•		
Cryptonemia sp.		•	•		•
Dasya spp.	•	•		•	
Dipterosiphonia heteroclada (J. Agardh) Falkenberg		•			
Dipterosiphonia parva (Dickie) Skottsberg *et* Levring		•	•		
Eupogodon pilosus (Weber-van Bosse) P.C. Silva		•		•	
Fernandosiphonia unilateralis Levring		•	•		
Grateloupia subsimplex Levring		•	•		
Haliptilon roseum (Lamarck) D.J. Garbary *et* H.W. Johansen	•		•		
Hymenena decumbenrs Levring		•	•		
Hypoglossum parvulum Levring		•	•		
Jania tenella (Kützing) Grunow	•			•	
Jania sp.		•		•	•
Laurencia sp.		•	•		•
Liagora brachyclada Decaisne	•		•		
Peyssonnelia sp.		•		•	•
Polysiphonia australiensis H.B.S. Womersley		•			
Polysiphonia spp.	•	•	•	•	•
Pterosiphonia pusilla Levring			•	•	
Rhodymenia californica Kylin	•				
Phaeophycota					
Colpomenia sinuosa (Mertens ex Roth) Derbès *et* Solier	•	•	•	•	•
Dictyota phlyctaenodes Montagne	•	•	•		
Distromium skottsbergii Levring		•	•	•	
Eisenia cokeri Howe	•	•	•		•
Glossophora kunthii (C. Agardh) J. Agardh	•	•	•		•
Hincksia intermedia (Rosenvinge) P.C. Silva		•			
Hincksia mitchelliae (Harvey) P.C. Silva		•	•	•	•
Hydroclathrus clathratus (C. Agardh) Howe	•	•	•	•	
Myrionema strangulans Greville	•		•		•
Padina fernandeziana Skottsberg et Levring		•	•		
Padina tristromatica Levring	•	•			
Papenfussiella moseleyi Levring	•		•		
Sargassum sp.	•				•
Sphacelaria cirrosa (Roth) C. Agardh		•	•		•
Splachnidium rugosum (Linnaeus) Greville	•		•		
Chlorophycota					
Chaetomorpha antennina (Bory) Kützing	•	•	•	•	•
Chaetomorpha firma Levring		•	•	•	•
Cladophora perpusilla Skottsberg *et* Levring		•	•	•	
Codiolum kuckuckii Skottsberg *et* Levring	•		•		
Codium cerebriforme Setchell	•		•		
Codium skottsbergianum (Setchell) P.C. Silva	•		•		
Ulva lactuca var. *rigida* (C. Agardh) Le Jolis		•	•		•

endemics. Only one species, *Padina tristromatica*, is endemic to Islas San Félix y San Ambrosio.

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