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A Revision of the Crustaceous Species of *Codium* from the Canary Islands at the BOERGESEN's Herbarium

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The genus *Codium* STACKHOUSE is distributed pantropically, being an important protagonist of the intertidal communities in the Canary Islands.

SILVA (1960) reviewed the species with erect thallus, specially those collected by BOERGESEN from the Canary Islands, and he found incorrect determinations.

CHACANA et al. (1991) verified the presence of 3 species of *Codium* with prostrate thallus and manifested a high degree of anatomical-morphological and habit variability that has made the taxonomy of the genus difficult.

The present study was designed to examine the species with prostrate thallus in BOERGESEN's Herbarium, collected in the Canary Islands.

Material and methods

The specimens collected by BOERGESEN and deposited in the Copenhagen Botanical Museum and Herbarium (C) were examined macro and microscopically (Fig. 1, 2). The dried material was soaked in a 1% solution of detergent (Teepol) for 24-72 h. or required a combination of slow boiling in 1 M NaOH or KOH for 1 h., followed by soaking in 1% Teepol for at least 48 h., at the same time, intertidal and sublitoral specimens deposited and dried material of La Laguna University Herbarium (TFC Phyc.), as well as liquid-preserved material stored in 4% formalin-seawater were compared.

The following abreviations were used to design the local distribution: T (Tenerife), P (La Palma), H (Hierro), C (Gran Canaria), F (Fuerteventura), and L (Lanzarote).

Taxonomic results

After a careful study of the mentioned material, we have been able to confirm the presence of the following taxa in the Canary Archipelago:

Codium adhaerens (CABRERA) C. AGARDH, Sp. Alg., 1: 457 (1823).

NEWTON 1931: 104; HAMEL 1931: 85; DELEPINE 1959: 7; CHAMBERLAIN 1965: 197; GAYRAL 1966: 211; LAWSON & PRICE 1969: 307; ARDRE 1970: 504; AFONSO-CARRILLO 1977: 84; LOPEZ-HERNANDEZ 1980: 62; VIERA-RODRÍGUEZ 1985: 191; GONZALEZ 1986: 213; SIK et al. 1987: 62.

Thallus aplanate, soft, light green, 3 mm thick, forming an indefinitely expanded layer of irregular shape with flattened surface or developing crest, closely adherent to the substratum. Utricles cilindrical 40-90 (-180) µm in diameter (400-) 500-700 µm long, utricles apex rounded and occasionally thickened 7-9 µm (Fig. 3, 4), utricular wall 1.8 µm, hair or hair-scar present usually at 90-110 µm below the utricle apex, medullary filaments 20-60 µm in diameter. Gametangia narrowly ellipsoidal to cilindrical, 60-80 µm in diameter, 255-330 µm long, 1-2 per utricle, borne on a pedicel about 7 µm long at 350-380 µm below apex of utricle.

Distribution in the Canary Islands: T, P, H, C, L, F.

Collections examined: HIERRO: M. CHACANA 6-4-1989 (TFC Phyc. 5645). LA PALMA: M. CHACANA 10/1988 (TFC Phyc. 5644). TENERIFE: San Andres, M.C. GIL-RODGRÍGUEZ & J. AFONSO-CARRILLO 13-7-1979 (TFC Phyc. 2213); Mta. Rosa, R. HAROUN 27-11-1982 (TFC Phyc. 290). GRAN CANARIA: Santa Catalina, F. BOERGESEN 3936, 1921 (C); Las Canteras, F. BOERGESEN 3593, 10-3-1921 (C). FUERTEVENTURA: Corralejo, M.C. GIL-RODRÍGUEZ & J. AFONSO-CARRILLO 3-5-1980 (TFC Phyc. 2367); Cueva de la Negra, M.C. GIL-RODRÍGUEZ & J. AFONSO-CARRILLO 30-4-1980 (TFC Phyc. 2473). LA GRACIOSA: R. HAROUN & A. VIERA-RODRÍGUEZ 17-4-1984 (TFC Phyc. 5062).

Habitat: Species abundant in rocky areas with flat surfaces of the intertidal shore. The expanded layers are sometimes intermixed with *C. intertextum* COLLINS & HERVEY.

Remarks: BOERGESEN (1925: 92, Fig. 38) gives a description and presents an iconography of specimens collected in the Canary Islands, they seem to refer to *C. difforme* KÜTZING. The herbarium material reviewed (C: 3936, 3593), and the microscopic preparations or slides taken by this author corresponding to the Canary material of this taxon are compared with characters given by SILVA (1951) and JONES & KRAFT (1984), we now consider that *C. difforme* was mistakenly determined. One of the characters, among others, that has helped us to clear up BOERGESEN's confusion, are the dimensions of utricles, which has led us to identify this material as *C. adhaerens*.

Codium effusum (RAFINESQUE) DELLE CHIAJE, Hydrophytologie Regni Neopolitani: 14 (1829).

ARDRE 1970: 505; LOPEZ-HERNANDEZ 1980: 62; COPPEJANS 1983: pl. 10; VIERA-RODRÍUEZ 1985: 193; GONZALEZ 1986: 214.

Syn.: *Codium difforme* KÜTZING, Phyc. Gener.: 309 (1856); HAMEL 1931: 87; DELEPINE 1959: 5; SEOANE-CAMBA 1965: 64; GAYRAL 1966: 211; LAWSON & PRICE 1969: 309.

Thallus aplanate, soft, light green, 2-3 mm thick, forming an expanded layer with undulated margins, slightly adherent to the substratum. Utricles cilindrical 60-200 (-400) µm in diameter, (700-) 1000-1500 (-2000) µm long, utricles apices rounded, slightly thickened 2-6 µm (Fig. 5), utricular wall 1.5 µm, hair or hair-scar common 90-150 (-180) µm below the utricle apex, medullary filaments 20-50 µm in diameter. Gametangia ellipsoidal-ovoid, 60-90 µm in diameter, 270-340 µm long, one per utricle, borne on a pedicel about 10 µm long at 400-450 µm below apex of utricle.

Distribution in the Canary Islands: T, C, L, F.

Collections examined: GRAN CANARIA: Las Canteras, N. GONZALEZ 5-6-1985 (TFC Phyc. 5426). FUERTEVENTURA: Gran Tarajal, M.C. GIL-RODRÍGUEZ & J. AFONSO-CARRILLO 2-5-1980 (TFC Phyc. 2468, 2411, 2445); Cotillo, M. VILLENA 19-10-1982 (TFC Phyc. 380). LANZAROTE: Mta. Clara, A. VIERA-RODRÍGUEZ 31-3-1983 (TFC Phyc. 5742); Playa Madera, L. ARRAEZ 14-7-1987 (TFC Phyc. 5146); Playa del Cochino, L. ARRAEZ 10-8-1987 (TFC Phyc. 5189).

Habitat: This species is very abundant, especially in flat rocky areas of the intertidal and sometimes appears until few meters depth.

Remarks: We didn't determine any of the BOERGESEN's specimens named as *C. difforme* as belonging to this taxon. This material is referred under *C. adhaerens* (see remarks *C. adhaerens*).

Codium intertextum COLLINS & HERVEY, The Algae of Bermuda: 54 (1917).

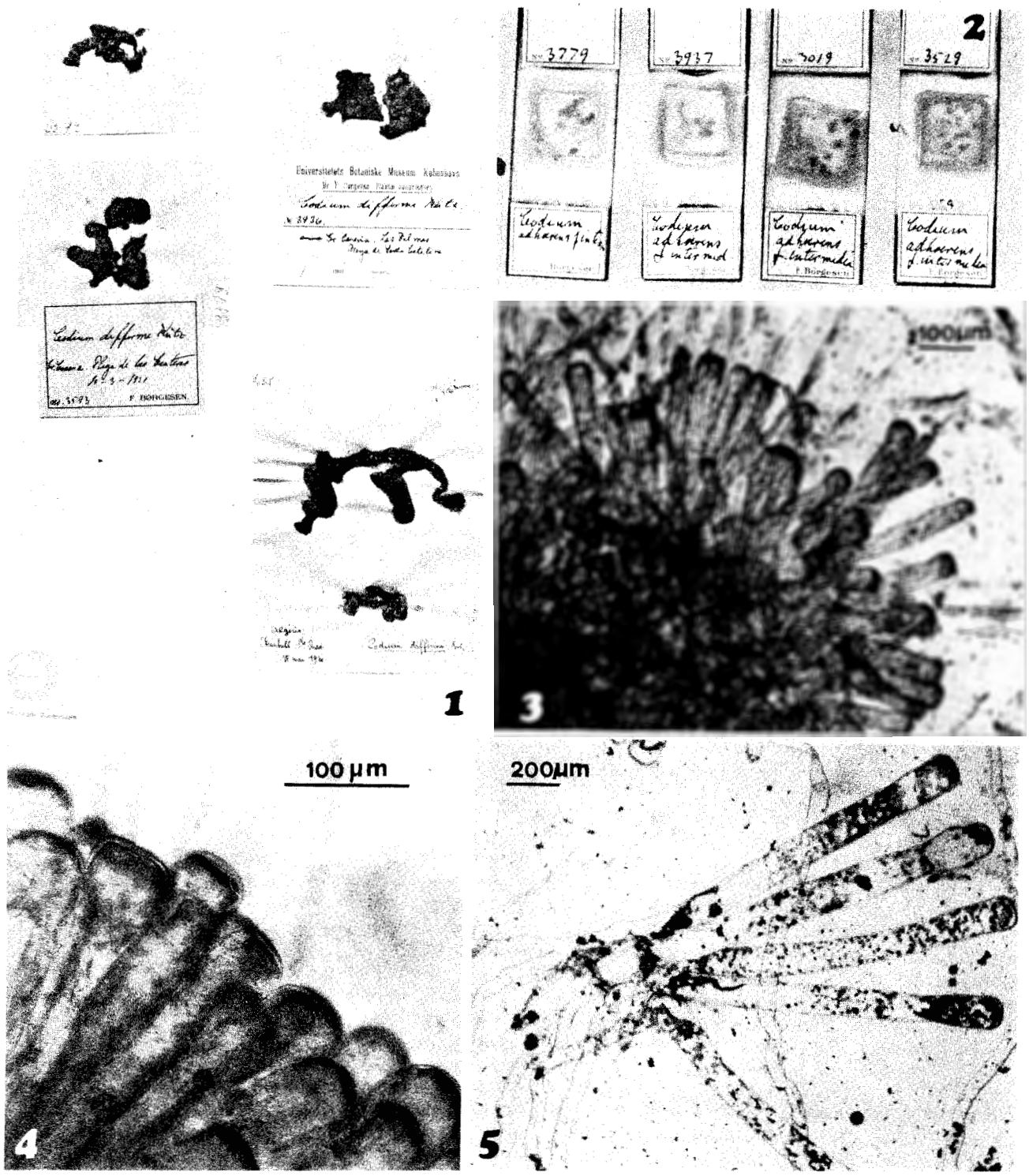
TAYLOR 1957: 185; SILVA 1960: 500; CHAPMAN 1961: 110; ABBOTT & HOLLENBERG 1976: 79; SCHNETTER 1978: 105.

Type: (L: 8451, IS0!).

Thallus applanate, firm, dark green, cerebriform like, 3-6 mm thick, developing orbicular excrecences, tightly adherent to the substratum but with free margins. Utricles cilindrical or clavate in large clusters 40-120 (-215) µm in diameter, (450-) 520-750 (-900) µm long, utricle apex rounded or truncate, slightly thickened 3-12 (-20) µm, introrsely umbonate, lamellate or deeply cribose (Fig. 6, 7), utricular wall thin 1.5 µm, hair or hair-scar common, borne in band extending 80-130 µm below the utricle apex, medullary filaments mostly 15-40 µm in diameter. Gametangia ellipsoidal or ovoid, 60-13 µm in diameter, 270-315 µm long, 1-2 per utricle, borne on a distinct pedicel, 8 µm long, at 345-380 µm below apex of utricle.

Distribution in Canary Islands: T, L, F, C.

Collections examined: BERMUDA: Tucker's Town, Hamilton Island, COLLINS 8451, 25-IV-1912 (L). GRAN CANARIA: Christoballo, F. BOERGESEN 3779, 23-3-1921 (C); Playa Sta. Catalina, F. BOERGESEN 3937, 27-3-1921 (C); Playa de las Canteras, F. BOERGESEN 3529, 10-3-1921 (C); Las Canteras, M.C. GIL-RODRÍGUEZ 12/1972 (TFC Phyc. 1288). TENERIFE: Pto. Orotava, F. BOERGESEN 3094, 9-1-1921 (C); Los Cristianos, M.C. GIL-RODRÍGUEZ 4/1971 (TFC Phyc. 1285); Güimar, M.C. GIL-RODRÍGUEZ 12/1970 (TFC Phyc. 1386), M.C. GIL-RODRÍGUEZ 1/1973 (TFC Phyc. 1286, 1384), M. LOPEZ-HERNANDEZ 27-12-1978 (TFC Phyc. 2063), M. LOPEZ-HERNANDEZ 12-7-1979 (TFC Phyc. 2050, 2073), M. LOPEZ-HER-

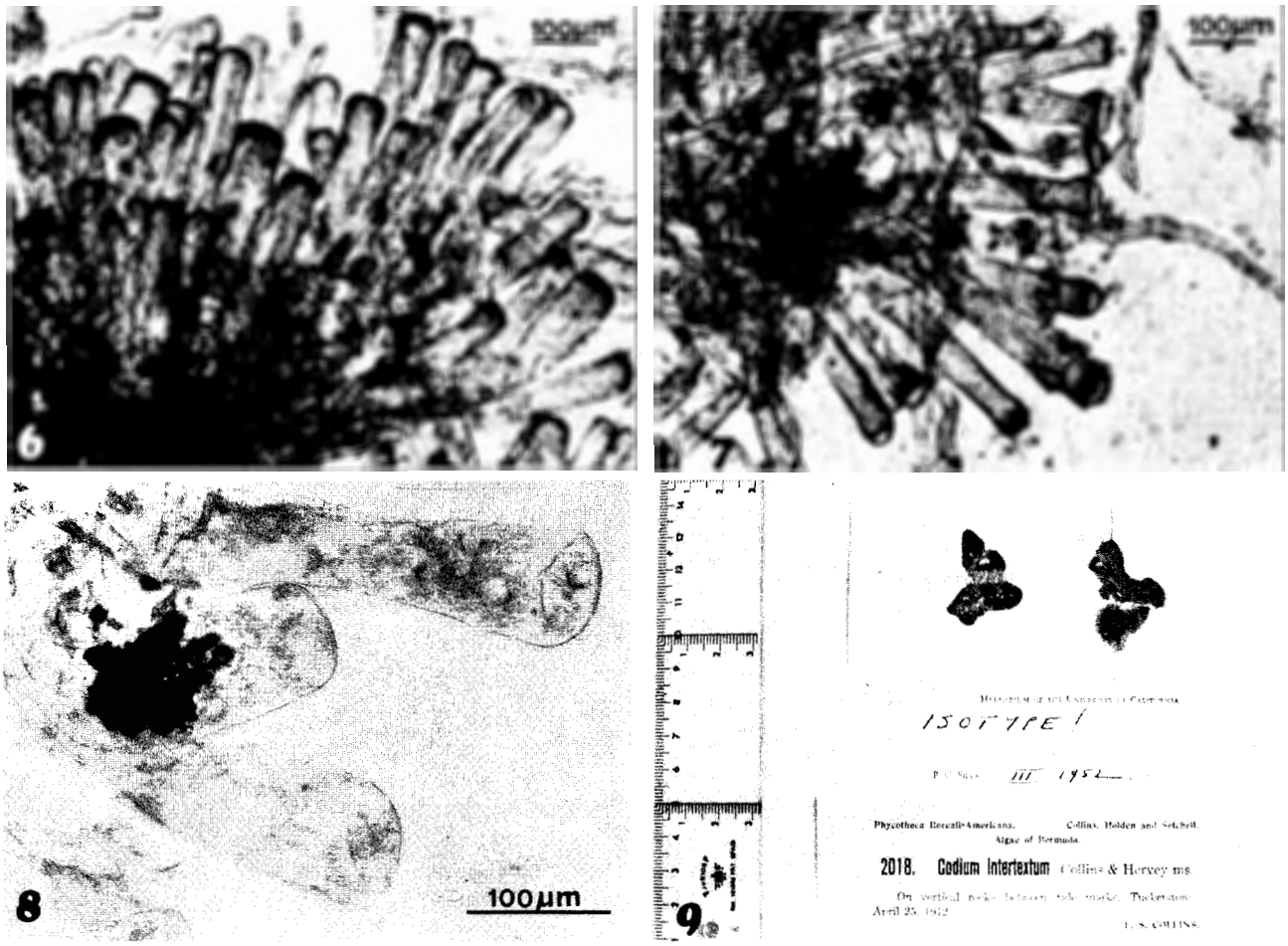


Figs. 1-5. The specimens collected by F. BOERGESEN. - 1: exsiccata; 2: microscopic slide; 3-4: *Codium adhaerens* (CABRERA) C. AGARDH, utricle morphology; 5: *C. effusum* (RAFINESQUE) DELLE CHIAJE, utricle morphology.

NANDEZ 22-10-1979 (TFC Phyc. 2074), R. HAROUN 20-8-1982 (TFC Phyc. 801), M. CAMPOS 20-5-1984 (TFC Phyc. 2652); La Tejita: M.C. GIL-RODRÍGUEZ 11/1974 (TFC Phyc. 1393), M. VILLENA 18-2-1983 (TFC Phyc. 229); Pto. Rico, M. DIAZ-PIFFERRER 3-5-1977 (TFC Phyc. 2045); Agache, W. WILDPRET & O. RODRÍGUEZ 12-3-1981 (TFC Phyc. 2727); Hergues, O. RODRÍGUEZ 2-4-1981 (TFC Phyc. 2712); Poris de Abona, L. ULE GONZALEZ 8-7-1982 (TFC Phyc. 637). LANZAROTE: Las Caletas, M.C. GIL-RODRÍGUEZ & J. AFONSO-CARRILLO 8-3-1980 (TFC Phyc. 2306); Playa del Paso, L. ARRAEZ 13-7-1987 (TFC Phyc. 5108).

from just above the lowest tide level to, occasionally 5 m depth. It is particularly common encrusting rocks.

Remarks: According to BOERGESEN's exsiccata and microscopic slides (C: 3779, 3937, 3094, 3529), the apparent specimens of *C. adhaerens* showed some special anatomical characteristics (dimensions of utricles and gametangia). On this basis, he proposed the name *C. adhaerens* forma *intermedia* BOERGESEN. He also suggested that the forma *intermedia* may have resulted from hybridization between *C. adhaerens* and *C. difforme*. However, according to the diagnostic characters for segregation of species proposed by SU-



Figs. 6-9. *Codium intertextum* COLLINS & HERVEY. - 6-7: utricle morphology; 8-9: ISOTYPUS (L.!): 845 (8: utricle morphology; 9: Typus).

cles morphology and dimensions and shape apex thickened; the specimens of BOERGESEN's Herbarium don't show the specific characters of *C. adhaerens*. The presence of an apex moderately thickened to deeply cribose, truncate and the utricles dimensions, are characters proposed by SILVA (1960) for *C. intertextum* and are closely related with characteristics of the type specimens (Fig. 8, 9).

Discussion

CHACANA et al. (1991) report *C. intertextum*, *C. adhaerens* and *C. effusum* in the Canary Islands. These species are characterized and separated taxonomically and are easily identified, although it is more difficult to distinguish *C. adhaerens* from *C. effusum*.

Codium intertextum has a flat thallus with abundant, prominent orbicular excrecences, which gives it a cerebriform characteristic. This, together with its dark green color, helps us to differentiate macroscopically the taxon from either *C. adhaerens* and *C. effusum*. Those taxa are characterized by their scarce if any low crests, and light green color. The main taxonomic features which permit the separation of *C. adhaerens* and *C. effusum*, in our judgement, are seen at microscopic level and are defined by the dimension of utricles and presence/absence of lamellate

Using criterias proposed by SILVA (1960) and JONES & KRAFT (1984), we verify the presence of these 3 species of aplanate thallus in the Canary Islands.

On careful study of these taxonomic characters, the material collected by BOERGESEN -1921- and deposited in Copenhagen (C), we have found incorrect determinations. The material has been referred by us to some of the mentionated taxa (*C. intertextum* and *C. adhaerens* which do not correspond with BOERGESEN's determinations. The reference he gives of *C. adhaerens* applies to *C. intertextum* and that of *C. difforme* to *C. adhaerens*.

Summary

The taxonomic problems of the genus *Codium* STACKHOUSE from the Canary Islands have led us to review the specimens collected and reported by BOERGESEN (1925).

Misidentifications of the erect species of *Codium* by BOERGESEN were already reported by SILVA (1960). The crustaceous species are not yet mentioned.

After studying those specimens of the BOERGESEN's Herbarium (C), the correct determinations for the crustose species are reported according to new criteria in the genus taxonomy. The following species occur in the Canary Islands: *C. adhaerens* (CABRERA) C. AGRADH, *C. intertextum* COLLINS & HERVEY, *C.*

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