

***Parviphycus*, a new genus in the Gelidiellaceae (Gelidiales, Rhodophyta)¹**

Bernabé SANTELICES*

Departamento de Ecología,
Facultad de Ciencias Biológicas,
Pontificia Universidad, Católica de Chile, Casilla 193,
Correo 22, Santiago, Chile

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Abstract — A new genus of marine red algae, *Parviphycus* (Gelidiales), is proposed to accommodate those species previously assigned to *Gelidiella* that have the following features: distichous patterns of apical division in erect and prostrate axes, axial and periaxial cells in distinctive transverse rows, especially in upper and middle parts of the plants, and stichidia with few and regularly arranged rows of sporangia produced by periaxial cells. The type species is *Parviphycus adnatus* (Dawson) comb. nov. (basionym: *Gelidiella adnata* Dawson). Three other nomenclatural combinations are proposed: *P. antipai* (basionym: *Gelidiella antipai* Celan), *P. tenuissimus* (basionym: *Gelidiella tenuissima* Feldmann et Hamel) and *P. womersleyanus* (basionym: *Gelidiella womersleyana* Kraft et Abbott).

Algae / Gelidiales / Gelidiellaceae / pannosa-type stichidia / *Parviphycus* / Rhodophyta

Résumé — *Parviphycus*, un nouveau genre de Gelidiellaceae (Gelidiales, Rhodophyta). Un nouveau genre d'algue rouge, *Parviphycus* (Gelidiales), est proposé pour regrouper les espèces attribuées jusqu'à maintenant au genre *Gelidiella*, qui possèdent les caractéristiques suivantes : division distique des cellules apicales ; cellules axiales et périaxiales organisées dans des colonnes transversales distinctes, en particulier dans les parties supérieures et moyennes des plantes ; stichidies avec peu de sporocystes arrangés en colonnes et produits par les cellules périaxiales. L'espèce type est *Parviphycus adnatus* (basionyme : *Gelidiella adnata* Dawson). Trois autres combinaisons sont proposées : *P. antipai* (basionyme : *Gelidiella antipai* Celan), *P. tenuissimus* (basionyme : *Gelidiella tenuissima* Feldmann et Hamel) et *P. womersleyanus* (basionyme : *Gelidiella womersleyana* Kraft et Abbott).

Algues / Gelidiales / Gelidiellaceae / *Parviphycus* / Rhodophyta / stichidie de type *pannosa*

1. It is a pleasure to dedicate this work to my dear friend Izzie Abbott, on her 85th birthday.

* Correspondence and reprints: bsanteli@bio.puc.cl
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Table 1. Specimens examined in this study.

Specimens	Locality & Date	Determined by	Collection N ^o	Remarks
1. <i>Gelidiella acerosa</i> (Forsskål) Feldmann et Hamel	– Jeremie, Haiti May 6, 1941 – South of Dome Marie, Haiti May 11, 1941 – North coast of Haiti, June 23, 1941	H.H. Bartlet H.H. Bartlet H.H. Bartlet	B.P. Bishop Museum 530838 B.P. Bishop Museum 530839 B.P. Bishop Museum 530837	Fertile male plant Fertile male plant Fertile male plant
2. <i>G. adnata</i> Dawson	– Nha Trang, Viet Nam February 13, 1953	E.Y. Dawson	Smithsonian 56446	Holotype
3. <i>G. antipai</i> Celan (as <i>G. stichidiospora</i> Dawson)	– Isla Cedros, Baja California, Mexico	E.Y. Dawson	Los Angeles County Museum	Fragment of type
4. <i>G. tenuissima</i> Feldmann et Hamel	– Uliga Isls., Marshall Isls. October 10, 1953 – Santa Cruz Isls., Galapagos February 21, 1962 – Acajutla, El Salvador September 4, 1960	E.Y. Dawson E.Y. & M. Dawson E.Y. Dawson	Univ. of California 099560 Smithsonian 4855 Smithsonian 007272	Sterile Tetrasporic Sterile
5. <i>G. womersleyana</i> Kraft et Abbott	– Kawe Point, Hawaii Isl., Hawaiian Isls., USA	G.T. Kraft & I.A. Abbott	I.A. Abbott private collection	Isotype

RESULTS

Historical review

The genus *Gelidiella* was established by Feldmann & Hamel (1934) to replace *Echinocaulon* Kützinger (1843), a name already used for a genus in the Polygonaceae (Angiosperm). Since *Echinocaulon* Kützinger was a later homonym, *Gelidiella* Feldmann et Hamel was proposed as its replacement. The species in *Echinocaulon* Kützinger were characterized by the presence of an apical cell and the lack of thick-walled, delicate fibers (rhizines) in the cortex or medulla, a character that Feldmann & Hamel maintained as distinctive of the genus *Gelidiella*. Later, Fan (1961) suggested the lack of a known sexual generation as an additional characteristic of this genus.

Intragenetic heterogeneity was suspected since Feldmann's early characterization of *Gelidiella* (= *Echinocaulon*; Feldmann, 1931a, 1931b, 1931c). While he recognized species such as *Echinocaulon rigidiusculum* (Grunow) Feldmann, *E. setaceum* Feldmann and *E. nigrescens* Feldmann as congeneric, he also thought that *Gelidium bornetii* Weber-van Bosse (= *Gelidiella bornetii* (Weber-van Bosse) Feldmann) and *Gelidium pannosum* Bornet non Grunow (= *Gelidiella tenuissima* Feldmann et Hamel) may not belong to the same genus. Even though Feldmann & Hamel (1934) included all the above taxa in the genus *Gelidiella*, they recog-

INTRODUCTION

Taxonomic confusion at the specific and generic levels characterize the present circumscription of the genus *Gelidiella*. Between 20 and 25 generally small-sized, turfy species are included in this genus (Ganzon-Fortes, 1994), but about half of them are known only from one or two geographic localities. Single collections often provide limited insights into morphological variation, and thereby may have led to an artificially high number of described *Gelidiella* species. In fact, authors working with this genus (e.g. Dawson, 1956; Egerod, 1971; Santelices, 1977, 2002; Hatta & Prud'homme van Reine, 1991; Norris, 1992; Kraft & Abbott, 1998) have often remarked on the difficulties encountered when distinguishing species.

While reviewing the type materials of *Gelidiella adnata* Dawson, Santelices (2002) recognized that the pattern of apical division, the internal structure of the thallus and the structure of the stichidium of this species were conspicuously different from the respective patterns exhibited by the type species, *G. acerosa*. Therefore he recognized the need for a new genus in the Gelidiellaceae to accommodate the smallest-sized species similar to *G. adnata*. Later, additional morphological and molecular evidence were added that supported the proposal of heterogeneity within *Gelidiella* (Rico *et al.*, 2002). However, the examination of additional species seemed advisable before proposing a new genus. The study of another three, small species of *Gelidiella* (*G. antipai* Celan, *G. tenuissima* Feldmann *et* Hamel and *G. womersleyana* Kraft *et* Abbott) has now been completed and corroborates their close morphological similarity with *G. adnata*, their dissimilarity with *G. acerosa* and thereby the need to include these species in a different genus. This study first summarizes the historical evidence supporting the recognition of a new genus, and reports on the morphological studies with the three additional small-sized species of *Gelidiella*. Then the new taxon is described and new nomenclatural combinations are proposed.

MATERIALS AND METHODS

General procedures followed those described in previous morphological studies (e.g. Santelices, 1991a, 1991b, 2002; Santelices & Hommersand, 1997). The herbarium specimens of the species examined are listed in Table 1. All specimens were first examined under a stereomicroscope. Representative thalli were gradually rehydrated avoiding tissue damage, and fixed in a 10% formaldehyde solution in seawater. Axes and branches were cut 20–30 µm thick to avoid tissue destruction, using a Leitz freezing microtome. Sections were stained with 1% aniline blue and mounted in 50% Karo[®] corn syrup. Photomicrographs were taken with a Nikon Biophot Microscope. Slides with transections are deposited in the algal collection of the Sala de Sistemática, Pontificia Universidad Católica de Chile (SS/UC).

Table 1. Specimens examined

Specimens	
1. <i>Gelidiella acerosa</i> (Forsskål) Feldmann <i>et</i> Hamel	– Jeren May – South May – North June
2. <i>G. adnata</i> Dawson	– Nha Febr
3. <i>G. antipai</i> Celan (as <i>G. stichidiospora</i> Dawson)	– Isla C Mexi
4. <i>G. tenuissima</i> Feldmann <i>et</i> Hamel	– Uliga Mars Octo – Santa Febr – Acaj Sept
5. <i>G. womersleyana</i> Kraft <i>et</i> Abbott	– Kaw Haw Haw

The genus *G.* replace *Echinocaulon* Polygonaceae (Angios *Gelidiella* Feldmann *et* *Echinocaulon* Kützing lack of thick-walled, d ter that Feldmann & Later, Fan (1961) sugg characteristic of this g

Intrageneric l terization of *Gelidiella* recognized species su *E. setaceum* Feldmann that *Gelidium bornetii* Feldmann) and *Gelidi* Feldmann *et* Hamel) & Hamel (1934) inclu

nized morphological differences between groups of species, especially related to spore arrangement in the stichidia. Some species had conical stichidia, containing compactly arranged, unordered tetraspores (which they called the "acerosa-type" stichidia), while another exhibited elongated, cylindrical stichidia with tetrasporangia arranged in transverse rows (the so called "pannosa-type" stichidia). Later studies (e.g. Dawson, 1953, 1954a, 1956; Fan, 1961; Santelices, 1977; Hatta & Prud'homme van Reine, 1991; Guiry & Womersley, 1992; Norris, 1992; Ganzon-Fortes, 1994; Kraft & Abbott, 1998; Shimada & Masuda, 1999, 2000) confirmed the above distinctions among species groups. Thus, *Gelidiella bornetii* (Weber van Bosse) Feldmann *et* Hamel, *G. hancockii* Dawson, *G. indica* Sreenivasa Rao, *G. ligulata* Dawson and *G. taylorii* Joly are described as exhibiting "acerosa-type" stichidia while *G. adnata* Dawson, *G. antipai* Celan, *G. feldmanii* Baardseth, *G. lubrica* (Kützinger) Feldmann *et* Hamel, *G. myrioclada* (Børgesen) Feldmann *et* Hamel, *G. ramellosa* (Kützinger) Feldmann *et* Hamel, *G. sanctarum* Feldmann *et* Hamel, *G. tinereensis* Seoane-Camba and *G. trinitatis* Taylor have "pannosa-type" stichidia (see Ganzon-Fortes, 1994 for review). These studies, however, did not find additional morphological differences that could further characterize and help to separate these two groups of species.

Comparing the largest and one of the smallest species of *Gelidiella* (*G. acerosa* (Forsk.) Feldmann *et* Hamel and *G. adnata* Dawson, respectively), Santelices (2002) found 80-100-fold differences in axis length and 10-15-fold differences in axis diameter between both species. More importantly, these species differed in their respective patterns of apical division, external and internal structure of the axis, stichidial construction and tetrasporangial formation. Later, Rico *et al.* (2002) also found that the spermatangial morphology of *G. acerosa* differed from that of the small-sized species, *G. tenuissima*. Authors in the two above mentioned studies suggested that the described morphological differences may be interpreted as generic differences, but that examination of an additional number of species seemed necessary before suggesting taxonomic changes.

Together with their spermatangial studies, Rico *et al.* (2002) also performed molecular analysis (LSU and *rbcL*) to assess the relationship of *Gelidiella tenuissima* with *G. acerosa*. They found that both species represented different lineages within the genus, a result also found by Shimada & Masuda (2000) using small subunit ribosomal DNA sequences. Thus, current molecular data suggests that there may be two lineages in the genus, but more molecular studies are needed to better support the idea.

Examination of species with "pannosa-type" stichidia

As indicated earlier, "pannosa-type" stichidia have been described for 10 species of *Gelidiella* (Ganzon-Fortes, 1994). Four of these were examined in this study, including *G. adnata*, already examined by Santelices (2002); *G. antipai* Celan, extensively described by Boudouresque (1972) and considered to include *G. stichidiospora* Dawson; *G. tenuissima*, recently reviewed and cultivated by Rico *et al.* (2002) and *G. womersleyana*, described by Kraft & Abbott (1998).

A morphological comparison of the above 4 species with individuals of *Gelidiella acerosa* verified the differences already described between *G. acerosa* and *G. adnata* (Santelices, 2002) and simultaneously emphasizes the similarities between *G. adnata* and the other three studied small-sized species. Thus, while the thallus length of *G. acerosa* can easily reach 6-10 cm, axis length in the other species infrequently reaches beyond 6 mm (Figs 1-5).



Figs 1-5. External habit of *Gelidiella* species. Fig. 2. *Gelidiella adnata*, scale = 400 μ m.

especially related to stichidia, containing the "acerosa-type" stichidia with tetrasporangiate stichidia). Later (Hatta & Hata, 1977; Hata & Morris, 1992; Ganzon, 2000) confirmed the *bornetii* (Weber van Beuningen & Sreenivasa Rao, 1977) as "acerosa-type" stichidia. *Feldmannii* (Baardseth, 1977) and *Feldmannii* (Feldmann & Feldmann, 1977) have "pannosa-type" stichidia, however, did not characterize and

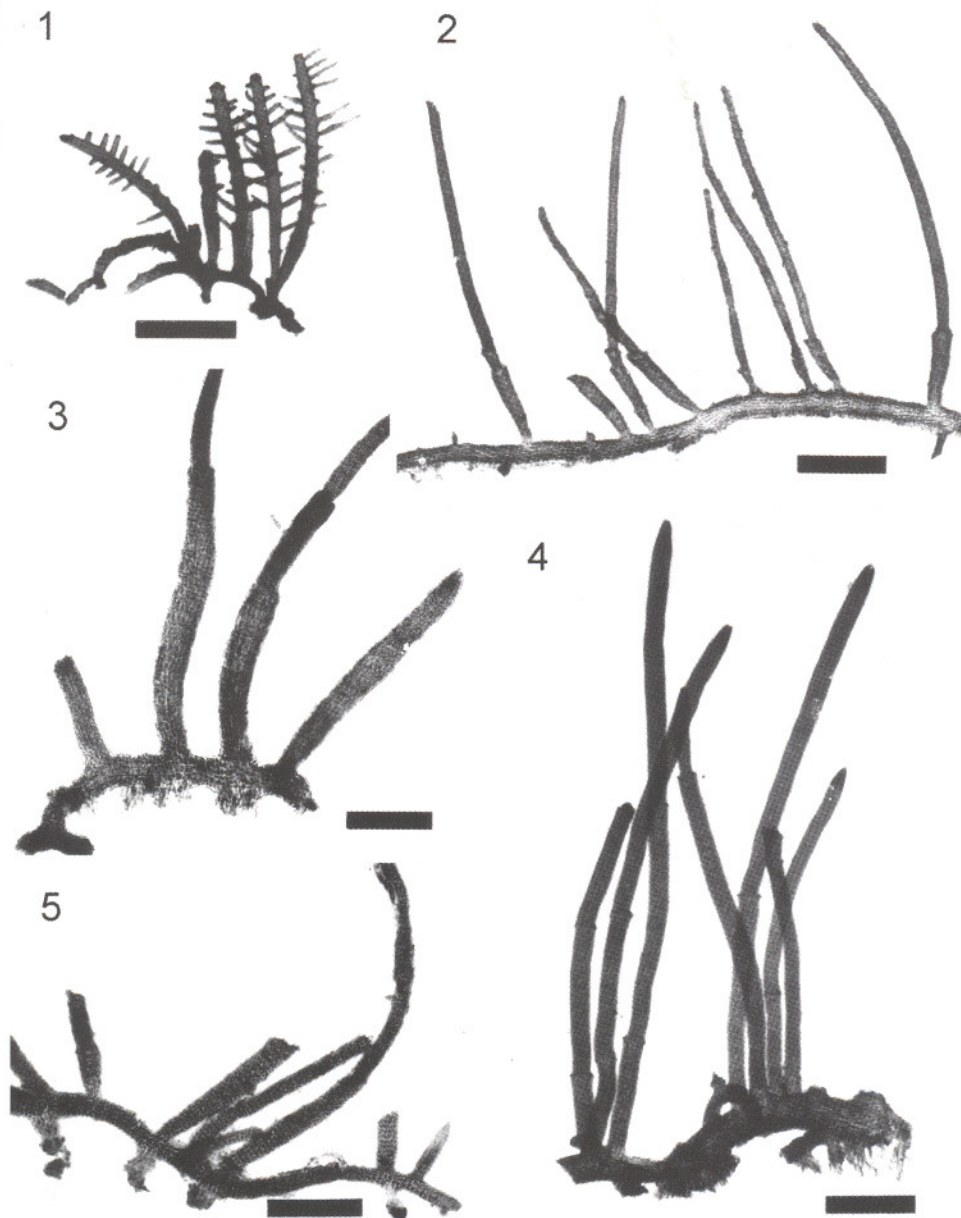
species of *Gelidiella* (Lawson, respectively), and 10-15-fold different, these species have different internal structure. Later, Rico (2002) *G. acerosa* differed from the two above mentioned species. Differences may be in additional number of stichidia.

Rico (2002) also presented the relationship of *Gelidiella* species. Masuda (2000) using molecular data suggests that molecular studies are

Stichidia

have been described for *G. acerosa* and *G. antipai* (Rico, 2002); *G. antipai* is considered to include *G. acerosa* cultivated by Rico (1998).

With individuals of *G. acerosa* between *G. acerosa* and *G. antipai* sizes the similarities of stichidia. Thus, while the length in the other



Figs 1-5. External habit of 5 species of *Gelidiella*. Fig. 1. *Gelidiella acerosa*, scale = 4 mm. Fig. 2. *Gelidiella adnata*, scale = 300 μ m. Fig. 3. *Gelidiella antipai*, scale = 130 μ m. Fig. 4. *Gelidiella tenuissima*, scale = 400 μ m. Fig. 5. *Gelidiella womersleyana*, scale = 150 μ m.

All the species of *Gelidiella* studied here grow by the activity of an apical cell that divides transversely (Figs 6-11). In the case of *G. acerosa*, cell divisions of the subapical and subsequent cells in the axial filament occur at right angles to each other in a short alternating series forming a clearly decussate pattern (Figs 6, 7). As a consequence, the central axial filament is visible only a short distance below the apex and axes and branches are cylindrical in outline. In the case of the other 4 species (Figs 6-11), the subapical cells have longitudinal divisions in 2 directions in the same plane, cutting off 2 periaxial cells and 2 lateral cells, which cut off further cells. This pattern of division is much closer to a distichous pattern than to a decussate pattern and the resulting erect and prostrate axes and branches are slightly compressed, especially close to the tips.

Internal thallus structure (Figs 12-17) also differed between *Gelidiella acerosa* and the 4 small-sized species of *Gelidiella* studied. A transection through the middle part of a young erect axis of *G. acerosa* shows several layers of pigmented cortical cells that grade into a medulla of globose cells (Fig. 12). Axial cells and periaxial derivatives can not be identified in cross section (Fig. 13). Transections through the erect axes of the other 4 species of *Gelidiella* (Figs 14-17) show a few (1-3) layers of cortical cells and 1-3 layers of medullary cells. In these species, axial and periaxial cells are produced in a distinctive transverse row of thick-walled cells that remain evident in most plant parts. These differences in internal structure between *G. acerosa* and the small-sized species studied here is apparent even when the transverse sections are made the same distance back from the apical cell.

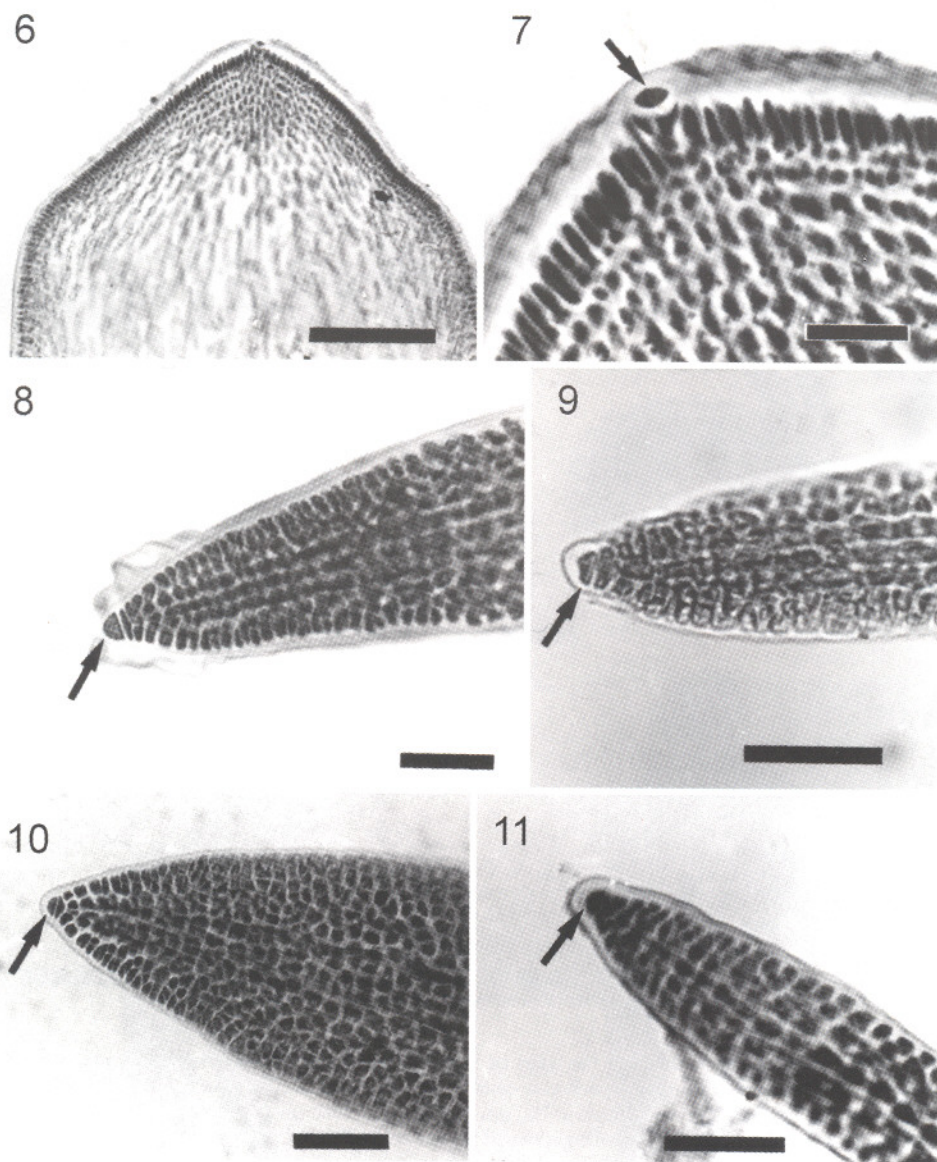
Differences in sporangia arrangement between *G. acerosa* and the other 4 species of *Gelidiella* (Figs 18-22) constitute an additional taxonomic difference. As already noted by Feldmann & Hamel (1934), the sporangia are abundant, compact and irregularly disposed in *Gelidiella acerosa*, without forming transverse rows, although they may exhibit a clear acropetal development. The other 4 species, on the contrary, exhibit stichidia with few, regularly arranged rows of sporangia formed from the apex. Longitudinal and cross sections through the sporangia of these species (Figs 23-26) indicate that in *G. acerosa* the sporangia frequently originate from internal cortical cells and less often from medullary cells. The position of the cells generating the sporangia is not fixed because internal cortical and external medullary cells are abundant in any branch, all seemingly have the capacity to differentiate sporangia and their original position can change by thallus growth (Fig. 23). In the cases of *G. adnata*, *G. antipai* and *G. tenuissima* (Figs 24-26) the sporangia originate from the periaxial cells flanking the axial cells on each side. In these species, therefore, spore production is restricted to cells with a fixed position in the plant and the number of spores produced in each mature transverse row of the stichidia is a function of the number of periaxial cells on each side of the thallus.

All the above morphological differences suggest the need for a new genus for those species previously assigned to *Gelidiella* that possess distichous patterns of apical division, axial and periaxial cells of upper and middle parts of the plant in distinctive transverse rows, and stichidia with few and regularly arranged rows of sporangia produced by periaxial cells. None of the existing genera of either the Gelidiaceae or the Gelidiellaceae seems able to accommodate the above species. The name *Parviphycus* is proposed for this new genus, a name that emphasizes the small size of the species included therein.

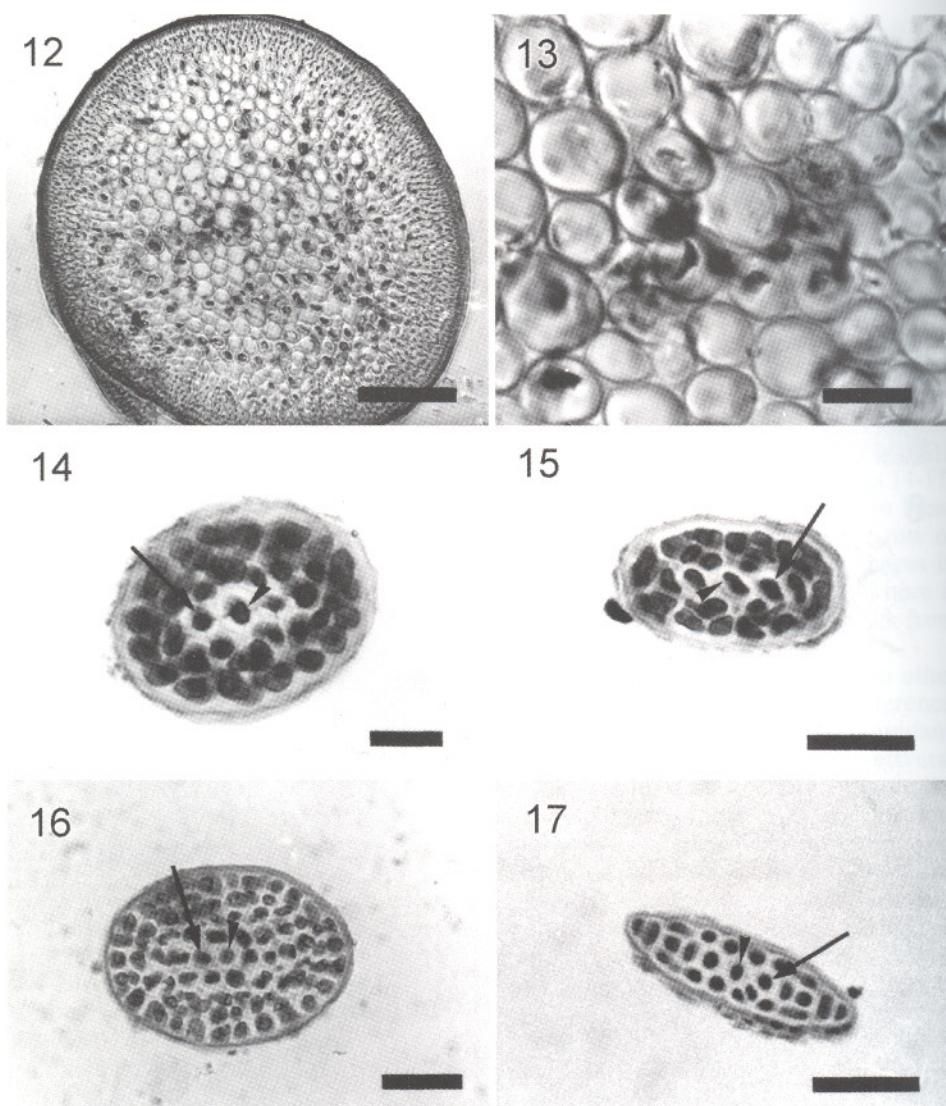


Figs 6-11. Tip of erect axes of *Gelidiella acerosa* (Fig. 6), *G. adnata* (Fig. 7), *G. antipai* (Fig. 8), *G. tenuissima* (Fig. 9), *G. tenuissima* (Fig. 10), and *G. tenuissima* (Fig. 11). Arrows point to apical (arrows) and subapical cells. Scale 30 μ m.

the need for a new genus to possess distichous and middle parts of few and regularly of the existing genus to accommodate new genus, a name



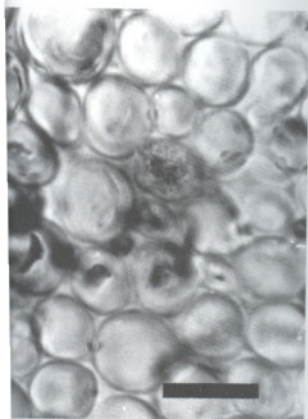
Figs 6-11. Tip of erect axes of 5 species of *Gelidiella* showing the pattern of division of the apical (arrows) and subapical cells. Figs 6, 7. *Gelidiella acerosa*, scales 100 μm in Fig. 6 and 20 μm in Fig. 7. Fig. 8. *Gelidiella adnata*, scale 30 μm . Fig. 9. *Gelidiella antipai*, scale 20 μm . Fig. 10. *Gelidiella tenuissima*, scale 30 μm and Fig. 11. *Gelidiella womersleyana*, scale 20 μm .



Figs 12-17. Cross section through the axes of 5 species of *Gelidiella*. Arrow heads indicate axial cells while long arrows indicate periaxial cells. Figs. 12, 13. *Gelidiella acerosa*. Fig. 12 shows the internal structure of erect axes, scale = 100 μ m. Fig. 13 is a close up of a central medullary region, scale = 10 μ m, with no evidence of axial or periaxial cells. Figs. 14, 15, 16 and 17 show respective transections through erect axes of *G. adnata* (scale = 20 μ m), *G. antipai* (scale = 20 μ m), *G. tenuissima* (scale = 25 μ m) and *G. womersleyana* (scale = 20 μ m).

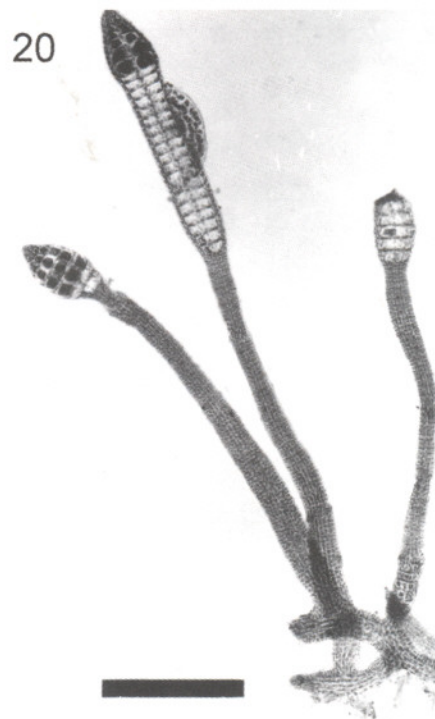
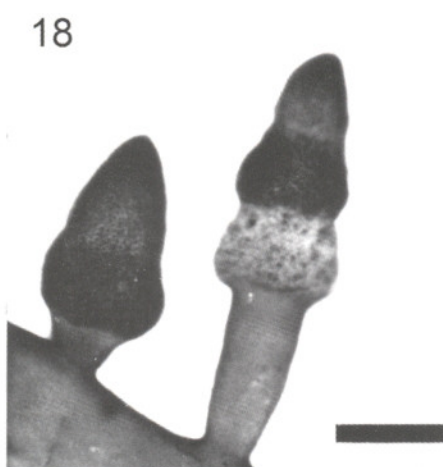
Figs 18-22. Surface view of tetrasporangial stichidia in 5 species of *Gelidiella*. Fig. 18. *Gelidiella acerosa*, scale = 500 μ m. Fig. 19. *Gelidiella adnata*, scale = 200 μ m. Fig. 20. *Gelidiella antipai*, scale = 200 μ m. Fig. 21. *Gelidiella tenuissima*, scale = 150 μ m and Fig. 22. *Gelidiella womersleyana*, scale = 100 μ m.

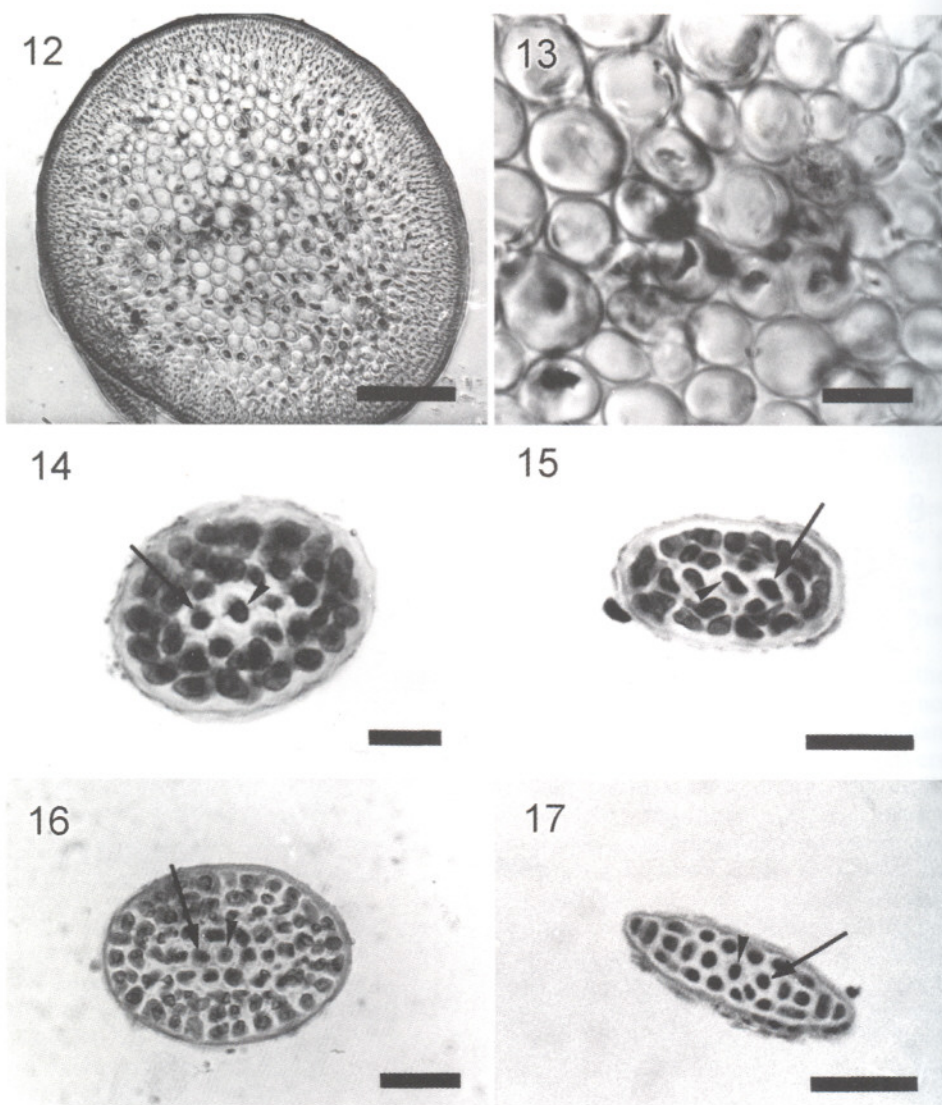




Arrow heads indicate axial
a *acerosa*. Fig. 12 shows the
of a central medullary region,
5, 16 and 17 show respective
ai (scale = 20 μ m), *G. tenuis-*

Gelidiella. Fig. 18. *Gelidiella*
Fig. 20. *Gelidiella antipai*,
22. *Gelidiella womersleyana*,

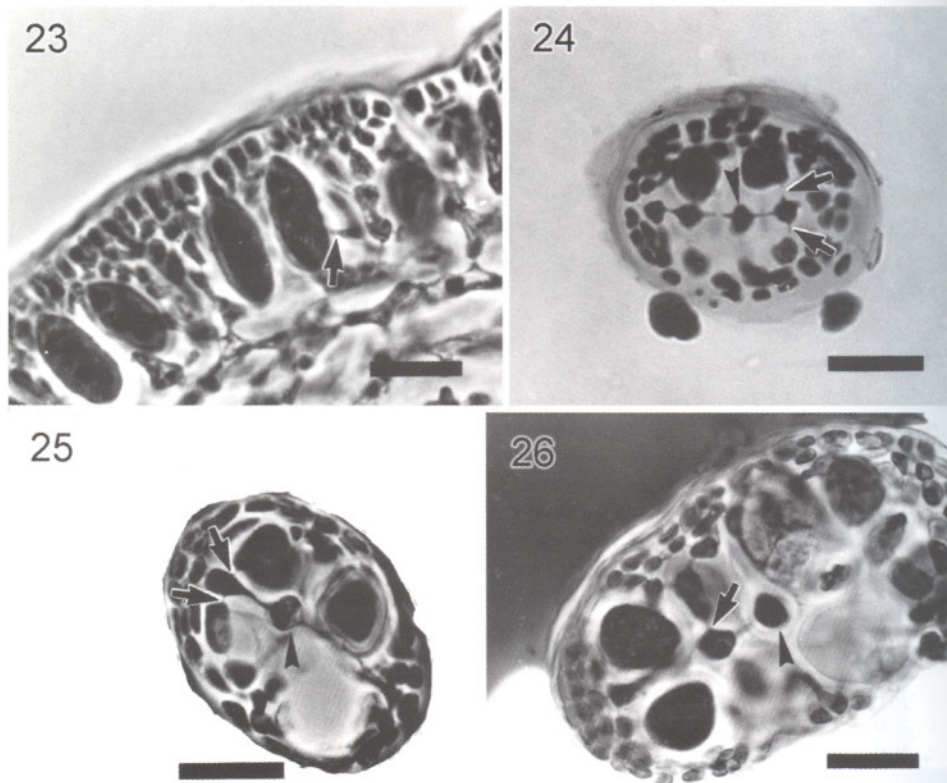




Figs 12-17. Cross section through the axes of 5 species of *Gelidiella*. Arrow heads indicate axial cells while long arrows indicate periaxial cells. Figs. 12, 13. *Gelidiella acerosa*. Fig. 12 shows the internal structure of erect axes, scale = 100 μ m. Fig. 13 is a close up of a central medullary region, scale = 10 μ m, with no evidence of axial or periaxial cells. Figs. 14, 15, 16 and 17 show respective transections through erect axes of *G. adnata* (scale = 20 μ m), *G. antipai* (scale = 20 μ m), *G. tenuissima* (scale = 25 μ m) and *G. womersleyana* (scale = 20 μ m).

Figs 18-22. Surface view of tetrasporangial stichidia in 5 species of *Gelidiella*. Fig. 18. *Gelidiella acerosa*, scale = 500 μ m. Fig. 19. *Gelidiella adnata*, scale = 200 μ m. Fig. 20. *Gelidiella antipai*, scale = 200 μ m. Fig. 21. *Gelidiella tenuissima*, scale = 150 μ m and Fig. 22. *Gelidiella womersleyana*, scale = 100 μ m.





Figs 23-26. Transection through mature stichidia of 4 species of *Gelidiella*. Note the sporangia produced by cortical cells in *G. acerosa* (Fig. 23) while in the other three species the sporangia are produced by the periaxial (medullary) cells (Fig. 24 = *G. adnata*, Fig. 25 = *G. antipai*, Fig. 26 = *G. tenuissima*). Arrow heads in Figs 24, 25 and 26 indicate axial cell. In all figures the arrows indicate the pit connection between the sporangia and the cells originating them. (Scale in all figures = 20 μ m.)

Taxonomic propositions

Parviphycus Santelices, gen. nov.

Plantae saepe teretes formant usque ad 2 cm alti. Thalli ex uno vel variis ramis erectis formantur qui ex superficie dorsali levantur ramorum postratorum. Axes postrati incrementum habent vagum, cum una cellula apicali quae in sensu transversali dividitur. Cellula subapicalis divisiones longitudinales monstrat in duas directiones, 2-4 cellulas periaxiales originantes, quae posterius cellulas laterales generant. Hic modus divisionis subdicotomicus est et axes demissi rotundi sunt aut debiliter compressi, usque ad 180 μ m diametri, subtracto adhaesi per rizoidis unicellularibus aut paucis cellulis, quod unum per cellulan efficitur ex tegumento magis extremo vel ex duobus tegumentis magis externis cellularum corticales. Rizoides mensuram habent usque ad 10 μ m diametri atque 300 μ m longitudinis, interclusi uni ex aliis, rizoidium velum formantes contiguum vel rizoidium lineas

*formantes interclusor
transversaliter ordina
6 cursibus transversali*

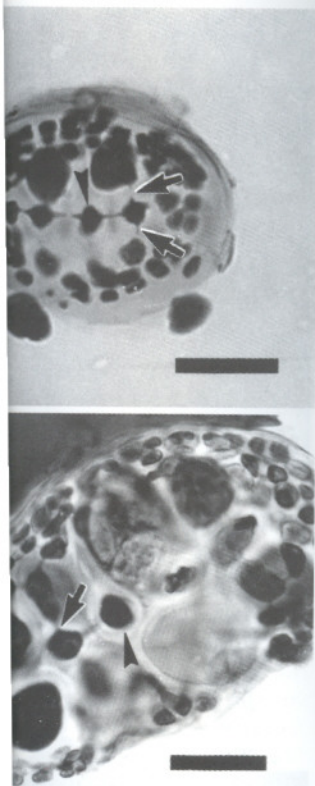
*Axes stolonif
constrictionibus debili
in forma irregulari, c
cum fissura et eviden
maliter oppositi illi q
postea in axes stol
obventitiae etiam nov*

*Axes erecti
bus divisionis apicali
lulis corticalibus bre
sectione transversali,
ium atque 1-5 cursib
salibus. Hae sunt cel
verias cellulas peraxi
horizontali modo cu
sis, cylindricis vel ex
terminalium; sempe
sequentia regulari fo
lulis periaxialibus fo
cumdata uno vel d
interrumpitur in me
subsphaericae sunt, in
Cognoscitur tantum
(*P. tenuissimus*). Sor
minalibus, vel termi
principalem. Cellul
Spermacia forma su*

Plants ofte
one to many uprig
Prostrate axis with
transversally. The s
ting off 2-4 periaxi
sion subdistichous
180 μ m diameter, a
zoids that originate
layers of cortical c
ing separately one
isolated rhizoids. C
sally on branches.

Stolonifer
linear axes, usuall
hairs in their api
renewed blade gro
opposing the fring
erous axes, develo
axes.

Erect ax
apical division ar
smaller cortical ce



Gelidiella. Note the sporangia in other three species the sporangia. Fig. 25 = *G. antipai*. Note axial cell. In all figures the cells originating them. (Scale

ti. Thalli ex uno vel variis
ar ramorum postratorum.
ula apicali quae in sensu
udinales monstrat in duas
rius cellulas laterales gen-
demissi rotundi sunt aut
cto adhaesi per rizoidis
an efficitur ex tegumento
nis cellularum corticales.
que 300 mm longitudinis,
orum vel rizoidium lineas

formantes intercluserum. Cellulae corticales in ramis iuvenibus cum axe maiore transversaliter ordinato in directionem rami principalis. Medulla cum 4 ad 6 cursibus transversalibus cellularum cylindricarum.

Axes stoloniferi axes lineales efficiunt sine constrictionibus vel tantum cum constrictionibus debilibus in base, generaliter simplicibus sed interdum derivatibus in forma irregulari, cum aut sine pilis in earum portionibus apicabilibus et saepe cum fissura et evidenti incrementi rami. Rami erecti ex superficie surgunt normaliter oppositi illi qui rizoides producit. Aliqui horum axium erectorum possunt postea in axes estoloniferi transformari, adhaesiones rizoidales producentes et obventitiae etiam novos axes producentes.

Axes erecti usque 20 mm longitudinis atque 180 mm diametri, cum basibus divisionis apicalis et constructio thali similis axibus raptantibus, sed cum cellulis corticalibus brevioribus, longitudinaliter ordinatis aut in forma irregulari. In sectione transversali, axes erecti formati videntur 1-3 cursibus cellularum corticalium atque 1-5 cursibus cellularum medullarium in cursibus dispositarum transversalibus. Hae sunt cellulae axiales (vel filamentum axiale centrale) collocatae inter varias cellulas peraxiales ad unumquodque latus cellulae axialis et quae ordinantur horizontali modo cum hac. Tetrasporangia in stichidiis lanceolatis originata, globosis, cylindricis vel extensis super brevibus pedicellibus positae vel in apice ramorum terminalium; semper stichidium per pedicellum vel ramum. Tetrasporangia in sequentia regulari formata ex apice (exempli gratia: 6, 8, 12, per segmentum), cellulis peraxialibus formata quae sunt ad laterem filamentum axialis. Tetrasporangia circumdata uno vel duobus tegumentis cellularum corticalium quarum continuitas interrumpitur in mensura in qua sporangia crescit atque maturat. Tetrasporangiae subsphaericae sunt, in forma crucifera divisae vel tetraedrica, usque 40 mm diametri. Cognoscitur tantum structuram reproductivam marium et tantum pro una specie (*P. tenuissimus*). Sori spermatangiales apparent utpote splenia incoloria in ramis terminalibus, vel terminent axem erectum vel se disponant lateraliter respectu ad axem principalem. Cellulae quae spermata producunt cellulis corticalibus formantur. Spermata forma sunt pyramidalia, 3-4 mm alti.

Plants often forming a low-stature turf, up to 2 cm. tall. **Thalli** formed by one to many upright branches arising from the dorsal side of prostrate branches. Prostrate axis with indeterminate growth, with a single apical cell that divides transversally. The sub-apical cell with longitudinal divisions in two directions, cutting off 2-4 periaxial cell which later cut off further cells laterally. **Pattern of division** subdistichous and creeping axes rounded or slightly compressed, up to 180 μ m diameter, attached to the undersurface by unicellular or few-celled rhizoids that originate one per cell from the most external or the two most external layers of cortical cells. **Rhizoids** are up to 10 μ m diam. and 300 μ m long, developing separately one from the other, forming a fringe of contiguous or bundles of isolated rhizoids. Cortical cells in young regions with long axis arranged transversally on branches. Medulla with elongated cylindrical cells in 4-6 transverse rows.

Stoloniferous axes give rise to basally unconstricted or slightly constricted linear axes, usually simple but sometimes irregularly branched, with or without hairs in their apical portions and often truncated with apparent evidence of renewed blade growth. Upright branches normally arise from the face of the axis opposing the fringe of rhizoids. Some of these uprights may later become stoloniferous axes, developing rhizoidal attachments and, eventually, also originating new axes.

Erect axes are up to 20 mm long and 180 μ m diameter, with patterns of apical division and thallus construction similar to the creeping axes, but with smaller cortical cells aligned longitudinally or irregularly. In cross section, the erect

axes are formed by 1 to 3 layers of cortical cells and 1 to 5 layers of medullary cells arranged in transverse rows. These are the axial cells (or the central axial filament) flanked by one or several horizontally aligned periaxial cells on each side of the axial cell.

Tetrasporangia borne on lanceolate, globose, cylindrical or terete stichidia located on short pedicels or in the apices of terminal branches; always one stichidium per pedicel or branch. Tetrasporangia formed in regular sequence from the apex (e.g. 6, 8, 12 per segment) by periaxial cells flanking the axial filament. Tetrasporangia surrounded by one or two layers of cortical cells in which the continuity is disrupted as the sporangia grow and mature. Tetrasporangia subspherical, cruciately to tetrahedrally divided, up to 40 μm diam. Only male reproductive structures known and only for one species (*P. tenuissimus*). **Spermatangial sori** appear as colorless patches in ultimate unbranched branchlets, either terminally in erect axes or laterally from the main axes. Spermatangial initials are formed from cortical cells. Spermatangia pyramidal in outline, 3–4 μm high.

Type species: *Parviphycus adnatus* (Dawson) Santelices

New combinations

Parviphycus adnatus (Dawson) Santelices, comb. nov.

Basionym: *Gelidiella adnata* Dawson [Marine plants in the vicinity of the Institut Océanographique de Nha Trang, Viet Nam. *Pacific Science* 8: 422, fig. 33 f (1954)].

Type locality: Nha Trang, Viet Nam.

Known geographic distribution: Viet Nam, Isla San Benedicto, Revillagigedo Archipelago, Arno Atoll in the Marshall Islands and Hawaii. The species has been confused with *G. antipai* and may occur in areas where *G. antipai* has been described.

References: Dawson, 1954a, 1954b, 1956; Santelices, 1977, 2002; Norris, 1992; Womersley & Guiry, 1994.

Parviphycus antipai (Celan) Santelices, comb. nov.

Basionym: *Gelidiella antipai* Celan [Note sur la flore algologique du littoral roumain de la mer Noire IV. *Bull. Sect. Scientifique de l'Académie Roumaine* 19: 3 (1938)].

Synonym: *Gelidiella stichidiospora* Dawson (1953).

Type locality: Cape Kaliakra on the Bulgarian coast of the Black Sea.

Known geographic distribution: the Mediterranean, Baja California, Natal (South Africa) and southern Australia.

References: Celan, 1938; Boudouresque, 1972; Norris, 1992; Womersley & Guiry, 1994.

Parviphycus tenuissimus (Feldmann et Hamel) Santelices comb. nov.

Basionym: *Gelidiella tenuissima* Feldmann et Hamel [Floridées de France. VII. Gélidiales. *Revue Algologique* 9: 102 (1936)].

Synonyms: *Gelidium pannosum* Grunow (Bornet, 1892); *Gelidium pannosum* Bornet, non Grunow (Weber van Bosse, 1921); *Echinocaulon pannosum* Feldmann (1931a); *Gelidiella pannosa* (Feldmann) Feldmann et Hamel (Fan, 1961); *Gelidiella tenuissima* (Thuret) Feldmann et Hamel (Boudouresque, 1969).

Type locality: Biarritz, France.

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, 1892); *Gelidium*
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ann et Hamel (Fan,
douresque, 1969).

Known geographic distribution: Great Barrier Reef, Australia, Thailand, Viet Nam, Indonesia, the Yeayama Islands in Japan, the Marshall Islands, Puerto Rico, the Canary Islands, Portugal, Morocco, Atlantic France, the Mediterranean, Senegal, Mauritania, Aldabra, Bangladesh, India, Kenya and the Seychelles.

References: Weber-van Bosse, 1921, 1928; Feldmann & Hamel, 1934, 1936; Dawson, 1954a; Fan, 1961; Boudouresque, 1969; Hatta & Prud'homme van Reine, 1991; Silva *et al.*, 1996; Shimada & Masuda, 2000; Rico *et al.*, 2002; Santelices & Rico, 2002.

***Parviphycus womersleyanus* (Kraft et Abbott) Santelices comb. nov.**

Basionym: *Gelidiella womersleyana* Kraft et Abbott [*Gelidiella womersleyana* (Gelidiales, Rhodophyta), a diminutive new species from the Hawaiian Islands. *Botanica Marina* 41: 56 (1998)].

Type locality: Kaiwi Point, ca 1 Km north of the harbor at Kailua-Kona, Hawaii Island, at 7-9 m deep.

Geographical distribution: known only from the type locality.

Reference: Kraft & Abbott, 1998.

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