# Gelidium omanense sp. nov. (Gelidiaceae, Rhodophyta) from the Sultanate of Oman

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# Abstract

A new species of the red algal genus *Gelidium, G. omanense* M.J. Wynne, is described from the Sultanate of Oman, northern Arabian Sea. This species is a very commonly occurring eulittoral seaweed on the Omani coast, essentially one of the dominant species during the summertime southwest monsoon on exposed rocky shores. Its distribution is from Dhofar (southern Oman) in the west to Masirah Island, Sharqia, in the east. It has been mis-identified as *Suhria vittata* (L.) J. Agardh [now *Gelidium vittatum* (L.) Kütz.; cf. Tronchin et al. (2002)]. Recent studies of morphology and *rbcL* gene sequences, however, have demonstrated that this alga differs from other known species in *Gelidium* and should be recognized as a new species.

**Keywords:** Arabian Sea; *Gelidium*; *Gelidium omanense* sp. nov; Rhodophyta; Oman.

# Introduction

In some of the first accounts on the benthic marine algae of the Sultanate of Oman (Barratt et al. 1984, 1986, Kuwait 1988), Suhria vittata [Gelidium vittatum according to Tronchin et al. (2002)] was reported to occur in southern Oman, and those records were repeated by Silva et al. (1996). Although the type locality of Fucus vittatus was not specified (Linnaeus 1767), almost all records of this species are from southern Africa, and Stegenga et al. (1997) regarded it as a southern African endemic. That range includes Namibia (Wynne 1986, Rull Lluch 2002). The early rare reports of specimens turning up at Cádiz, Spain (Cremades Ugarte 1995) and Ghana (the Hornemann record cited by Lawson and John 1982) were most likely based on drift material (Cremades Ugarte, pers. comm. via e-mail, 4.v.2003). Suhria vittata forma lacerata was described by Grunow (1867) from St. Paul Island in the southern Indian Ocean; its status is at best uncertain. The status of plants referred to S. vittata forma vittata from the Sultanate of Oman is the focus of the present contribution, and evidence will be presented to show that this entity actually represents an undescribed species of Gelidium.

# Materials and methods

Most of the collections cited here were made at the end of the seasonal monsoon, namely, in September of 1999, 2000, and 2001 in Dhofar, Oman, as part of the Algal Biodiversity Project of Oman (1999-2002) funded by the British Government's Darwin Initiative grant for the 'Survival of Species'. 'TMRU' refers to unnamed personnel of the Tropical Marine Research Unit, University of York, U.K. Most of the specimens were attached when they were collected. In addition to the new species, the following additional two collections of an unidentified Gelidium ('Gelidium sp.') from Oman were analyzed and their rbcL sequences incorporated into the sequence analyses: Atery Cove (16.96094° N, 54.75627° E), east of Jizirat Hino, east of Mirbat, Dhofar: 13.ix.2000, leg. M. Wynne 13092000-06-38, attached to rope in littoral (MICH). Raaha (=Alto) Bay (16.95116° N, 54.81650° E), east of Wadi Zeid and east of Mirbat, Dhofar: 11.ix.2000, leg. G. Minton 11092000-04-33 (MICH).

Plants were usually pressed soon after collecting. Some portions were air-dried in silica-gel desiccant for later DNA extraction; other portions were preserved in 5% formalin/seawater. Wet-preserved material and rehydrated portions of pressed specimens were mounted on glass slides for observation with a Zeiss research microscope. These parts were hand-sectioned using a singleedged razor blade. Line-drawings were made with a *camera lucida*. Micrographs were taken with a Spot RT digital camera mounted on an Olympus BH2 microscope. Images were captured with a Nikon D1 digital camera mounted on a photo-stand. The digital images were then assembled into plates using Adobe Photoshop version 7.0.

Geographical co-ordinates were obtained in the field by using several GPS devices, primarily a model made by Garmin eTrex Summit (Garmin International Inc., Olathe, KS 66062, USA). Herbarium abbreviations are according to Holmgren et al. (1990). Names of authors of algal taxa are given according to Brummitt and Powell (1992).

Specimens used for DNA sequence analyses were quick-dried in silica gel dessicant after collection. Total genomic DNA was extracted following the protocol of Hughey et al. (2001) and sequences of chloroplastencoded *rbcL* generated following the amplification and sequencing protocols described in Thomas and Freshwater (2001) and Tronchin et al. (2003). The sequences of primers used in this study are listed in Freshwater and Rueness (1994). Sequence data were compiled and edited using Sequencher (Gene Codes Corp., Ann Arbor, MI, USA). The new *rbcL* sequences were combined with sequences available from GenBank to generate an alignment of 32 taxa. GenBank accession numbers and the collection locations for the taxa from which they were generated are listed in Table 1.

Characteristics of the aligned sequence data and models of molecular evolution were determined, and phylogenetic analyses were performed using MacClade (v. 4.0, Maddison and Maddison 2002), Modeltest (v. 3.06, Posada and Crandall 1998), and PAUP (v. 4.0, Swofford 2002).

Phylogenetic trees were generated using maximum likelihood and maximum parsimony methods. The maximum likelihood analysis consisted of 50 separate cycles of random addition of sequences, tree bisection reconnection (TBR) branch-swapping and MULTREES using the GTR+I+G model of evolution (model specifics available from the second author). Maximum likelihood bootstrap values were calculated from 100 replications of random addition of sequences, MULTREES, and TBR branch swapping. Parsimony trees were generated with a heuristic search scheme of 10,000 random sequence additions, MULTREES and TBR branch swapping. Parsimony bootstrap values were calculated from 1000 replications of 100 random sequence additions, MULTREES and TBR branch swapping. Parsimony bootstrap values were calculated from 1000 replications of 100 random sequence additions, MULTREES, and TBR branch swapping.

#### Gelidium omanense M.J. Wynne sp. nov

(Figures 1–18)

**Diagnosis:** Thalli robusti, dense ramosi, caespite bene evoluto axium ramosorum ligulatorum basifixi; caespes basalis conspicuus, 1.5–2.4 cm in diametro; axes erecti plerumque 5–17 cm alt., sed subinde ad 30 cm alt. Ramificatio ad 4 or 5 ordinibus, omnis ramificatio marginalis et complanata; primarii et saepe secundarii rami costati (saltem in partibus proximis); axes primarii et secundarii 3.5–6.0 (–7.0) mm in lat.; latitudo ramorum ordinis altioris 1.5–3.0 mm; laterales ordinis primarii as 18 cm in longitudine; thalli typice fimbriati moderate vel dense foliis parvis; haec foliola saepe ita congesta ut imbricata possint. Margines omnium ordinum axiorum subtiliter dentati; textura thalli tenaxiter cartilaginea. Frequenter, thalli aspectu arcuato, axibus primariis et secundariis arcuatis.

In sectione transverse filamentis rhizoidalibus ad corticem interiorem et medullam exteriorem abundanter locatis. In thallis asexualibus foliolae ordinis ultimae tetrasporangia in foliolis ordinis ultimae producientes, sorum in regionem centralem foliolae formata, sporangia irregulariter dispositis; sporangia in cortice immersa et cruciate divisa; sporangia 20–24×24–30 µm; foliolae tetrasporangiales saepe reflexae ubi maturae. Thalli masculi soris superficialibus spermatangialibus foliolas ordinis ultimae extense tegentibus. Thallus femineus cystocarpias in foliolis ordinis ultimae ferens, fimbriam densam marginalem formatis; cystocarpia sunt biloculata. Carposporangia lacriformia,  $4-8\times16-20$  µm, singulatim producta.

**Holotype:** Sultanate of Oman. Raaha (=Alto) Bay (16.95116° N, 54.81650° E), east of Wadi Zeid and east of Mirbat, Dhofar: 6.ix.2001, *leg. M. Wynne 06092001-01-15*, attached to mid-littoral exposed rocky shore; specimen deposited in MICH; (Figure 1).

Isotypes: Deposited in BM and ON.

**Etymology:** The specific epithet refers to the Sultanate of Oman, the provenance of the new species.

## Additional collections, all from Oman

- Type locality: Raaha (=Alto) Bay (16.95116° N, 54.81650° E), east of Wadi Zeid and east of Mirbat, Dhofar: 26.ix.1999, *leg. E. Doddsworth 26091999-01-03* (MICH, ON). *26091999-01-04* (BM, MICH, ON), 10 m. depth; 11.ix.2000, *leg. M. Wynne 11092000-04-52* (BM, MICH, ON, WNC); 12.ix.2001, *leg. M. Wynne 12092001-07-37* (BM, MICH, ON).
- Hatom Cove (16.96091° N, 54.82795° E), east of Mirbat, Dhofar: 16.ix.2000, *leg. M. Wynne* 16092000-09-36 (BM, MICH, ON); 8.ix.2001, *leg. M. Wynne* 08092001-03-13 (MICH, ON).
- Western side of Wadi Zeid (=Hoon's Bay) (16.94497° N, 54.80402°E), east of Mirbat, Dhofar: 10.ix.2000, *leg. M. Wynne 10092000-03-29* (BM, GENT, MEL, MICH, ON, PC, SAP, US, WNC); 17.ix.2001, *leg. M. Wynne 17092001-12-09* (BM, MICH, ON); 9.ix.2001, *leg. G. Richards 09092001-04-11* (BM, MICH, ON).
- Atery Cove (16.96094° N, 54.75627° E), east of Jazirat Hino, east of Mirbat, Dhofar: 13.ix.2000, *leg. M. Wynne 13092000-06-41*, male, tetrasporangiate (BM, MICH, ON, PC).
- 5. Taqah, Dhofar (17.03722° N, 54.40361°E), Dhofar: 23.ix.1983, *leg. TMRU*, tetrasporangiate (MICH).
- Sadh (17.04366° N, 55.08050° E), Dhofar: 1.xii.1996, *leg. J. Stirn*, 1 m. depth, tetrasporangiate (MICH, ON).
- Al Ashkarah (21.83333° N, 59.57500° E), south of Suwayh, Al Sharqia: 6.x.1992, *leg. B. Jupp* (MICH).
- Barr al Hickman (20.4666° N, 58.3550° E), east coast, Masirah Channel, Al Sharqia: 4.xii.1985, *leg. Rod Salm (=Jupp 114, 124)*, cystocarpic (MICH); (Figure 2).
- Jazirat Shinzi (20.57500° N, 58.93333° E), Masirah Island, Al Sharqia: 27.x.1995, *leg. J. Bryan & B. Jupp 125, 126, 127, 128, 130, 131* (tetrasporic, male) on wave-swept rocks (BM, GALW, MICH, ON, WNC).
- Jazirat Thukayr (20.55555° N, 58 93333° E) Masirah Island, Al Sharqia: 7.ii.1997, *leg. M. Wynne 10922* eroded down to 2–4 cm-tall main axes and holdfasts (MICH).

## **Results and observations**

#### Vegetative organization

Thalli are robust, perennial, densely branched, dark purplish-red in color, attached by a well-developed tuft of branching ligulate axes (Figures 1 and 2). This attachment tuft may be relatively conspicuous and massive, 1.5–2.4 cm in diameter. A cluster of erect primary axes arises from the attachment tuft. Erect axes are usually 5– 17 cm tall, but occasionally to 30 cm. These erect thalli are branched to 4 or 5 orders, all branching being marginal. All orders of branches are flattened. The median line of primary and secondary axes is thickened (at least in the proximal parts), resulting in a conspicuous midrib.

## Table 1 Collection location and GenBank accession numbers for taxa included in *rbcL* sequence analyses.

Таха	Collection location	GenBank accession no.
Acanthopeltis japonica Okamura	Shimoda, Shizuoka Pref., Japan (Shimada et al. 1999)	AB017673
Capreolia implexa Guiry et Womersley	Port Philip Bay, Victoria, Australia1	L22456
Gelidium canariense (Grunow) Prud'homme van Reine et al.	Puerto de la Cruz, Tenerife, Canary Islands <sup>2</sup>	L22460
G. capense (S.G. Gmel.) P.C. Silva	False Bay, Cape Peninsula, South Africa <sup>3</sup>	L22461
G. caulacantheum J. Agardh	Porirua Harbor, North Island, New Zealand 4	U00103
G. chilense (Mont.) Santel. et Montalva	Tongoy Bay, Coquimbo, Chile⁵	AF305800
G. coulteri Harv.	Balboa Peninsula, Orange Co., CA, USA6	U00105
G. crinale (Turner) Gaillon	Masonboro Inlet, New Hanover Co., NC, USA <sup>6</sup>	U00981
G. crinale	Awhai Is., Hyogo Pref., Japan (Shimada et al. 1999)	AB017679
G. floridanum W.R. Taylor	Sebastian Inlet, Indian River Co., FL, USA6	U00107
G. japonicum (Harv.) Okamura	Keelung, Taiwan <sup>7</sup>	AF501287
G. latifolium (Grev.) Bornet et Thuret	Plouguerneau, Brittany, France <sup>8</sup>	U00112
G. microdonticum W.R. Taylor	Cahuita, Limón, Costa Rica <sup>6</sup>	AF305799
G. micropterum Kütz.	Kommetjie, Cape Peninsula, South Africa <sup>3</sup>	U00446
*G. omanense M.J. Wynne	Hatom Cove, E. of Mirbat, Dhofar, Oman <sup>9</sup>	AY346460
*G. omanense	Wadi Zeid, E. of Mirbat, Dhofar, Oman <sup>9</sup>	AY346461
G. pacificum Okamura	Amatsukominato, Chiba Pref., Japan <sup>10</sup>	U16832
G. pluma Loomis	Hawai'i, Hawaiian Islands11	AF501288
G. pristoides (Turner) Kütz.	False Bay, Western Cape Prov., South Africa12	U01044
G. pusillum (Stackh.) LeJolis	Cancale, Brittany, France13	U01000
G. pusillum	Fedje, Hordaland, Norway <sup>13</sup>	U00999
G. rex Santel. et I.A. Abbott	Tongoy Bay, Coquimbo, Chile⁵	AF305801
G. serrulatum J. Agardh	Mochimo, Sucre, Venezuela6	U01042
G. sesquipedale (Clemente) Thuret	Aramar, Asturias, Spain <sup>2</sup>	L22071
G. sp.	Piha, North Island, New Zealand⁴	U01043
*G. sp.	Atery Cove, E. of Jazirat Hino, E. of Mirbat, Dhofar,	
	Oman <sup>9</sup>	AY346462
*G. sp.	Raaha Cove, E. of Mirbat, Dhofar, Oman <sup>9</sup>	AY346463
<i>G. vagum</i> Okamura	Jodogahama, Iwate Pref., Japan (Shimada et al. 1999)	AB017680
G. vittatum (L.) Kütz.	Kommetjie, Western Cape Prov., South Africa <sup>12</sup>	U00112
Ptilophora diversifolia (Suhr) Papenf.	Protea Banks, KwaZulu-Natal, South Africa14	AF305803
P. scalaramosa (Kraft) R.E. Norris	Bulusan, Sorsogon Province, Luzon, Philippines <sup>15</sup>	AF305804
P. subcostata (Okamura) R.E. Norris	Fujisawa, Kanagawa, Japan <sup>10</sup>	U16835

Newly published sequences are indicated by an \*. Samples for DNA extraction provided by: <sup>1</sup> M.D. Guiry, <sup>2</sup> J. Rico, <sup>3</sup> J.J. Bolton, <sup>4</sup> G. Knight and W. Nelson, <sup>5</sup> M.E. Edding, <sup>6</sup> D.W. Freshwater, <sup>7</sup> S.M. Lin, <sup>8</sup> J. Cabioc'h and M.H. Hommersand, <sup>9</sup> M.J. Wynne, <sup>10</sup> M. Yoshizaki, <sup>11</sup> K.J. McDermid, <sup>12</sup> M.H. Hommersand, <sup>13</sup> culture of J. Rueness and S. Fredriksen, <sup>14</sup> O. DeClerck, <sup>15</sup> L. Liao.

The primary axes and first-order laterals are 3.5–6.0 (–7.0) mm in width; higher-order branches 1.5–3.0 mm in width. The length of first-order laterals may reach 18 cm. Thalli are typically moderately fringed, at times very densely fringed with small final-order branches, or bladelets (Figure 2). These bladelets are often so congested that they overlap one another. The margins of all orders of axes are finely dentate. The thallus texture is cartilaginous, not easily torn apart. Some thalli are arcuate, with primary and secondary axes arching, all to one side (Figure 1).

Cross-sections of axes show rhizines to be concentrated in the inner cortex and the outer medulla (Figure 3). 'Rhizines' (Hine 1976), or 'hyphae' (Akatsuka 1986), are slender, thick-walled filamentous cells present in the medulla and/or the cortex and characteristic of *Gelidium*, *Pterocladia*, and *Pterocladiella* (Santelices and Hommersand 1997). The rhizines are intermixed with larger medullary cells (Figure 4).

Thalli are epilithic; they occur on wave-exposed rocky shores, from the littoral into the shallow sublittoral. They are most abundant during the summer monsoon and immediately after it. This species appears to be an endemic to Oman, occurring from Masirah Island, Al Sharqia, in the east to many sites in Dhofar, to the southwest.

#### **Reproductive structures**

One cystocarpic, several spermatangial, and many tetrasporangial reproductive stages were observed. Tetrasporangia are produced in short final-order branchlets, or bladelets (Figure 5), forming a sorus in the central region of the lateral (Figure 9) with sporangia irregularly arranged (not arranged in a "V") (Figure 6). The sporangia are immersed in the cortex and are cruciately divided (Figure 7). They are 20–24 $\times$ 24–30  $\mu$ m at maturity. The tetrasporangial bladelets often become reflexed when fully mature (Figures 10-16). Male thalli have superficial spermatangial sori extensively covering small finalorder branches. The female thallus bore cystocarps on final-order bladelets (Figure 8) that formed a dense marginal fringe (Figure 2). In transverse section the cystocarps were seen to be biloculate (Figure 17). Carposporangia are tear-drop shaped, measuring 4- $8 \times 16-20 \ \mu$ m, and are produced terminally from the gonimoblast filaments (Figure 18).

## rbcL analyses

A data set of 32 *rbcL* sequences was analyzed in this study. The last 1400 base pairs were analyzed because many included taxa were missing data at the 5' end of



Figures 1–2 Gelidium omanense. (1) Holotype (in MICH). (2) Cystocarpic specimen (in MICH).

the 1467 base pair gene. This data set included 454 variable (32.4%) and 358 parsimony informative (25.6%) sites. Multiple maximum likelihood analyses always resulted in the same tree of LnLi=-7938.72735 (Figure 19). Maximum parsimony searches resulted in 3 minimal trees of L=1191 (all sites), CI=0.434, RI=0.661. Differences between the maximum likelihood and parsimony trees were minimal, and the relationships of G. omanense to other taxa are the same in both types of trees (Figure 19). Sequences of rbcL generated from specimens of G. omanense collected at two separate locations varied at only one site in the gene sequence. Gelidium omanense is resolved within a well-supported clade that also includes G. pluma from the Hawaiian Islands and a second, as yet unidentified, Gelidium species from Oman. The rbcL sequence divergence between G. omanense and these two species is 6.8% and 5.5%, respectively.

# Discussion

The justification for the discrimination of *Gelidium oma*nense as a new species of *Gelidium*, a genus now recognized as containing about 106 species (Santelices 1991, Guiry and Nic Dhonncha 2003), is based upon both molecular and morphological evidence. The phylogenetic analyses indicate that *Gelidium omanense* is very distinct from *G. vittatum* (formerly *Suhria vittata*) and from species of *Ptilophora*. Basically, the *rbcL* gene sequence data place this taxon in a discrete position in the hypothesized *rbcL* gene tree (Figure 19). Similarly, as will be discussed below, the morphological characteristics of *G. omanense* separate it from other species in this large genus.

Analyses of *rbcL* sequences resolve *Gelidium omanense* within a clade that also includes *G. pluma* Loomis (Loomis 1960) from the Hawaiian Islands and an uniden-



# Figures 3–8 Gelidium omanense.

(3) Transverse section near apical tip showing a concentration of rhizines in the inner cortex and outer medulla. Medullary cells have thick walls and relatively small lumens. Scale= $50 \mu$ m. (4) Transverse section of older portion of a blade showing rhizines concentrated in the inner cortex and outer medulla. Medullary cells in this part of the blade have relatively large lumens. Scale= $50 \mu$ m. (5) Tetrasporangial bladelets. Scale= $500 \mu$ m. (6) Surface view of tetrasporangial sorus showing irregular arrangement of tetrasporangia. Scale= $100 \mu$ m. (7) Transverse section of tetrasporangial bladelet. Scale= $500 \mu$ m.

tified *Gelidium* species from Oman (Figure 19). The *rbcL* sequence divergence observed between multiple populations of a single species of *Gelidium* has been <2% (Freshwater and Rueness 1994). The *rbcL* sequence divergences between *G. omanense* and the other two species in its clade are >5% indicating that it is a distinct

species. The *G. omanense*-containing clade is associated with other clades containing Indo-Pacific species of *Gelidium* and *Acanthopeltis* Okamura. *Gelidium vittatum* (formerly *Suhria vittata*) is resolved in a clade of predominantly South African species that is not closely related to the clade containing *G. omanense*. There is similarly



Figures 9–16 Gelidium omanense. Tetrasporangial leaflets.

(9) Young stage. (10–16) Mature leaflets. Scale=1000 μm. [Figures 9–10: *leg. Wynne 2000-06-41*. Figures 11–13: *leg. Stirn, Sadh.* 14–16: *leg. Jupp 128*].

no close relationship between the *G. omanense*-containing clade and the clade of *Ptilophora* species (Tronchin et al. 2003).

With the merger of *Suhria*, *Onikusa*, and *Gelidium* (Tronchin et al. 2002), *Gelidium* is now represented by about 21 species in the broad region of the Indo-Pacific (Silva et al. 1996). One additional species, *G. chilense* (Mont.) Santelices *et* Montalva, was reported from Qeshm Island in the juncture of the Persian Gulf and the Makran coast of Iran (Sohrabipour and Rabii 1999). This species resembles *G. omanense* in its primary axes being broadly flattened and being highly dentate on the mar-

gins. Both species bear dentate tetrasporangial bladelets along the margins and have a central tetrasporangial sorus (Montagne 1839, Acleto 1973, both as *Acropeltis chilensis*). Rhizines are very abundant in the inner cortex and the outer part of the medulla (Santelices and Montalva 1983). Biloculate cystocarpic bladelets are present in both species (Santelices and Montalva 1983). Thalli of *G. chilense*, however, reach only 4 to 6 cm in height (Santelices and Stewart 1985, Santelices 1989, Hoffmann and Santelices 1997), compared with the 5–17 (–30) cm height of *G. omanense*. Thalli in *G. chilense* are not nearly as densely branched along the margins, nor is a midrib



Figures 17–18 Gelidium omanense.

(17) Transverse section of a mature cystocarp showing two locules. Scale=100 μm. (18) Transverse section of mature cystocarp showing carpospores developing singly and a pericarp of 8–9 cells. Scale=50 μm.





Bootstrap support values for maximum likelihood (M) and parsimony (P) analyses are given for branches when greater than 50%. Branches that are either not present in all minimal parsimony trees or that were different in the maximum likelihood and parsimony trees are indicated by an \*.

present in the lower axes as in *G. omanense*. Furthermore, analyses of sequence data place *G. chilense* and *G. omanense* in different clades (Figure 19). An examination of Sohrabipour and Rabii's (1999) Figure 5e shows a relatively small-statured gelidioid with broad axes, but it is distinct from *G. omanense* because of the sparse lateral branching and entire margins.

Gelidium pristoides (Turner) Kütz., a South African endemic, bears some resemblance to *G. omanense* in having foliaceous axes, 2–3 (–5) mm wide, with a midrib, and with dentate margins (Simons 1976, Norris 1992, as *Onikusa pristoides*, Stegenga et al. 1997). That species also has a bushy habit and is epilithic. But axes in *G. pristoides* are regularly proliferous from the midrib. Such a development of branches from the midrib surface does not occur in *G. omanense*. Furthermore, these two taxa fall out separately in the *rbcL* tree (Figure 19).

The seasonal southwesterly monsoon, which has such a significant impact on the benthic algal flora of southern Oman, also affects the algal floras of southern Yemen, Pakistan, and western India. Species of Gelidium have not been reported from southern Yemen (Ormond and Banaimoon 1994). The two taxa of Gelidium reported from Pakistan, namely, G. usmanghanii Afaq-Husain et Shameel (1996) and G. pusillum (Stackh.) LeJolis f. pakistanicum Afaq-Husain et Shameel (1999), are both smaller than G. omanense, neither reaching more than 7 cm in height. Because of its flattened axes, G. usmanghanii deserves some comparison. The erect thalli are 1.0-2.5(-3.0) mm wide and show spiral coiling along the long axis (Afaq-Husain and Shameel 1996). The primary axes of G. omanense are twice the width, and although they are often arching, they cannot be said to be coiling. The thalli of G. usmanghanii were described as being undulated along the margins but not finely dentate as in *G. omanense*. Thus, *G. omanense* can be easily distinguished from *G. usmanghanii*.

Only a few species of *Gelidium* have been reported from India (Sreenivasa Rao 1971, Desikachary et al. 1990). Only in *G. micropterum* Kütz. do thalli reach up to 5 cm, and the axes are flattened. This species is based on a type from the Cape of Good Hope, South Africa (Kützing 1868), and according to Stegenga et al. (1997) it has a soft and fleshy texture, with flattened axes up to 1.2 mm wide and with bisporangial sori in ultimate and penultimate bladelets. Blades of *G. micropterum* lack the highly dentate margins that are so characteristic of *G. omanense*.

The attribution of the Omani alga now called *Gelidium omanense* to *Gelidium* [*Suhria*] *vittata* is reasonable when one compares the general form of these two taxa. Thalli of *G. vittatum* are tall (often 40–50 cm tall, but even up to 80 cm, based on specimens in MICH) with broad axes (to 1 cm) with a prominent midrib and bear numerous marginal proliferations (Simons 1976, Stegenga et al. 1997, both as *Suhria vittata*). Reproductive organs are borne on these marginal proliferations to the different positions in the *rbcL* tree discussed above, *G. vittatum* is distinguishable because its bladelets are not finely dentate, it bears bisporangia rather than tetrasporangia, and it usually has an epiphytic habit.

The benthic marine algal flora of the Sultanate of Oman continues to reveal a rich assortment of undescribed taxa. Examples of other newly described taxa from Oman include several new species and some new genera (Nizamuddin and Campbell 1995, Wynne 1998, 1999a,b, 2001, 2002a,b, 2003a,b,c, Wynne and de Jong 2002, Schils and Coppejans 2002). *Gelidium omanense* can be added to the tally.

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