Jpn. J. Phycol. (Sôrui) 38: 35–42, March 10, 1990

A critique on the taxonomy of an important agarophyte, *Gelidium amansii**

Richard E. Norris

National Botanic Institute, Kirstenbosch, Private Bag X7, Claremont, Cape Town, South Africa 7735

Norris, R. E. 1990. A critique on the taxonomy of an important agarophyte, *Gelidium amansii*. Jpn. J. Phycol. **38**: 35–42.

Originally described by Lamouroux from specimens collected in Madagascar and Mauritius, *Gelidium amansii* is also found in South Africa and on the eastern Asian coast. Not having been found again in Mauritius, a well collected area, the designation of Mauritius as its type locality may be an error. Recent collections in Madagascar also have not uncovered additional specimens of this species, and there may be an error in the entire original designation of the type locality by Lamouroux. The type specimen of *G. amansii* is a sterile plant having size and structural differences from the South African plants. The type specimen is also different from Japanese specimens identified as *G. amansii*. It is recomended that three different species are represented in this study, *G. amansii* possibly from Madagascar, *G. elegans* from eastern Asia and a new species, *G. abbottiorum*, from South Africa.

Key Index Words: agarophytes—eastern Africa—economically important seaweeds—Gelidiales—Gelidium—*Japan—Rhodophyceae.*

Fucus amansii was described by Lamouroux (1805) from specimens collected 'in insulae Franciae et Madagascar oris'. Lamouroux (1813) transferred this species to *Gelidium*. Two varieties were illustrated by Lamouroux (1805), one having many pseudodichotomous to pinnate branches (Fig. 1) and the other, a thallus fragment, with a more sparse but similar branching pattern. The branches in Lamouroux's figures appear to be flexuous, sub-terete in sectional view, and branch tips are gradually tapered to a sharp point. The axis is compressed, according to Lamouroux's description, at least in proximal regions. Lamouroux's original specimens were examined, described and photographed by Segi (1959) who found no reproductive branches on them, contrary to Lamouroux's figures. This discrepancy cannot be explained at this time. Plants similar to *G. amansii* were not collected in Mauritius in the thorough study made on that flora by Børgesen (1943), and it is possible, therefore, that the type specimen of this species is from Madagascar. Marine algal collections from Madagascar, however, are sparse and I have found no specimens similar to Lamouroux's in a few collections from there that were available for me to examine. The possibility exists, therefore, that a mistake was made in designating the locality of the original specimens used and illustrated by Lamouroux.

Plants identified as *G. amansii* also are recorded on the east coast of South Africa (Day 1969, Seagrief 1984), and in Japan (Kützing 1868, Okamura 1913–1915), China (Tseng 1983, Santelices 1988), and the Philippines (Silva *et al.* 1987). Using plants collected mostly in Japan, Santelices and Stewart (1985) and Santelices (1988) described *G. amansii* and compared it with other Pacific species of *Gelidium* without mentioning the fact that it also occurs on the South African coast. Santelices (1988) compared the type illustrations of *G. amansii* with plants from eastern Asia and reviewed similar

* The contents of this manuscript were presented as an oral paper at the XIIIth International Seaweed Symposium, Vancouver, in August 1989.

studies made by SEGI and AKATSUKA. Plants known as *G. amansii* in Natal have been compared with two other large *Gelidium* species from the southeastern African coast by NORRIS *et al.* (1987).

In my present investigation on the marine benthic algal flora of Natal, I have made a study of this species in southeastern Africa and compared it with the type specimen of *G. amansii* as well as with specimens assigned that name from Japan.

Materials and Methods

The following dried herbarium specimens were used in this study and are deposited in the designated herbaria: International Indian Ocean Expedition collections made in Natal by G. F. PAPENFUSS and R. F. SCAGEL (UC & UBC): PR-XXIX-53, Mission Rocks, north of St. Lucia (22-IX-1962); PR-XXX-32, Richards Bay (24-XI-1962); PR-XXXI-49, St. Lucia Lighthouse (24-XI-1962); PR-XXXIII-9, Chakas Rock (26-XI-1962); PR-XXXIV-33, Reunion Rocks (27-XI-1962); PR-XXXV-14, St. Michaels-on-the-Sea (28-XI-1962); PR-XXXVI-53, Shelley Beach, north of Uvongo (29-XI-1962); recent collections made in the 1980's by various collectors at several localities in Natal from Cape Vidal, northern Natal to Palm Beach, near the Transkei border, SAM 100323-100341 (liquid preserved pieces of thalli, in the SAM collections, were examined for many of these specimens). The Japanese specimens studied were all collected by Dr. I AKATSUKA in 1981 and are from Emi, Tiba-ken (SAM 100367-100376), Dôgasima, Izu Peninsula (SAM 100362-100366), Hamazima, Mie-ken (SAM 100356-100361), Takahama, Noto Peninsula (SAM 100349-100355), Kônami, Noto Peninsula (SAM 100346-100348), and Senkaku Bay, Sado Is., Niigata-ken (SAM 100342-100345).

Only photographs of the entire holotype specimen of *Gelidium amansii*, which is in the Lamouroux herbarium (CN), were examined, but fragments of the type specimen were found in UC and these were used for observing details of the structure of that species.

For investigations with the microscope, pieces of herbarium specimens were sectioned while the thallus was dry and the sections then soaked in freshwater and mounted in corn syrup medium containing aqueous aniline blue stain.

Observations

Thalli from Natal (Figs. 2, 3, 7) and Japan (Figs. 4, 6), when compared with the type specimen of *Gelidium amansii* (Figs. 1, 5), have

Table 1. Characters distinguishing *G. amansii* from three localities.

Character	Madagascar	Natal	Japan
Mature axes	Cylindrical to compressed	Compressed	Compressed to flattened
Branching pattern	Subdichotomous, mostly secondary	Pinnate, mostly tertiary	Pinnate, tertiary and quaternary
Branching near base	Common	Rare	Common
Angle of branching with axis	Acute	Mostly perpendicular	Acute
Branch tips	Gradually attenuate	Abruptly attenuate	Some gradually & others abruptly attenuate
Secondary branches	Straight	Often reflexed	Straight
Distance between secondary branchlets	1–3 mm	1–3 mm	1 mm
Tetrasporangial branches	Apiculate, up to 1 mm broad, short stalks, not geniculate	Spatulate, up to 1 mm broad, with long stalks, sometimes geniculate	Spatulate, up to 800 μm broad, long stalks, usually geniculate

few characters in common (Table 1). The thalli from Natal and Japan are pinnately branched whereas the type specimen of *G. amansii* has subdichotomous branching with a few pinnate branches. Ultimate branches of the type specimen of *G. amansii* are narrower than those in the Natal collections and they attenuate to a much finer tip than in most of the Japanese or Natalian plants. Sections of the axis of Madagascaran *G. amansii* reveal that it is only slightly compressed (up to approx. 1 mm thick), whereas the axis and some branches of the Japanese plants are slightly to strongly flattened and expanded (up to 2 mm broad and 350 μm thick). Axes in the Natal plants are up to 1 mm broad, cylindrical to distinctly compressed (up to 600 μm thick), but never as flat nor expanded as they are in the older parts of Japanese thalli.

Branching of the Madagascar plant as well as those from Japan occur near the base of the thalli, but the Natal plants often produce a long unbranched axis before the first lateral branch is formed, and, as a result, the mature thalli of the Natal plants have no or few pinnae in the proximal quarter to one-third of the axis. This area is well branched in both the Madagascar and Japanese forms.

The Natal thalli have many long branches directed at right angles from the axis, the long sterile branches often having few to no branchlets of the second order (Fig. 3). Third and fourth order branching in the Natal plants occurs but is relatively uncommon in many plants and usually develops only when thalli become reproductive (Figs. 2, 3, 7). Third order branching in the Madagascar plants (Figs. 1, 5) is rare, but it, as well as fourth order branching, is common in the Japanese plants (Figs. 4, 6). Branches in the Japanese plants are much closer together (approximately 1 mm apart) than in either the Madagascaran or Natalian plants (approximately 1–3 mm apart) (Figs. 5–7). Ultimate branches

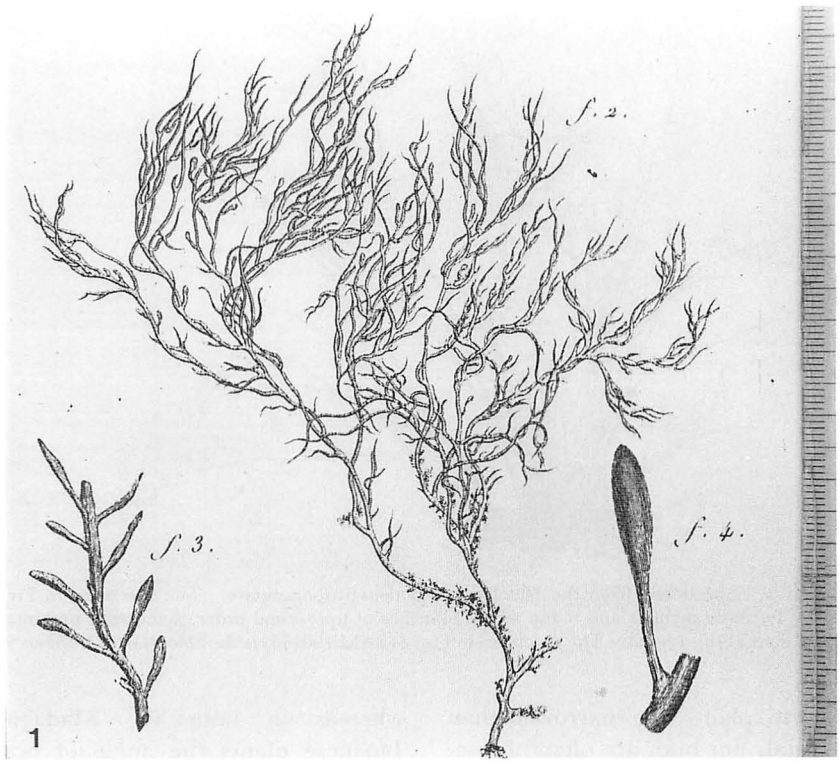
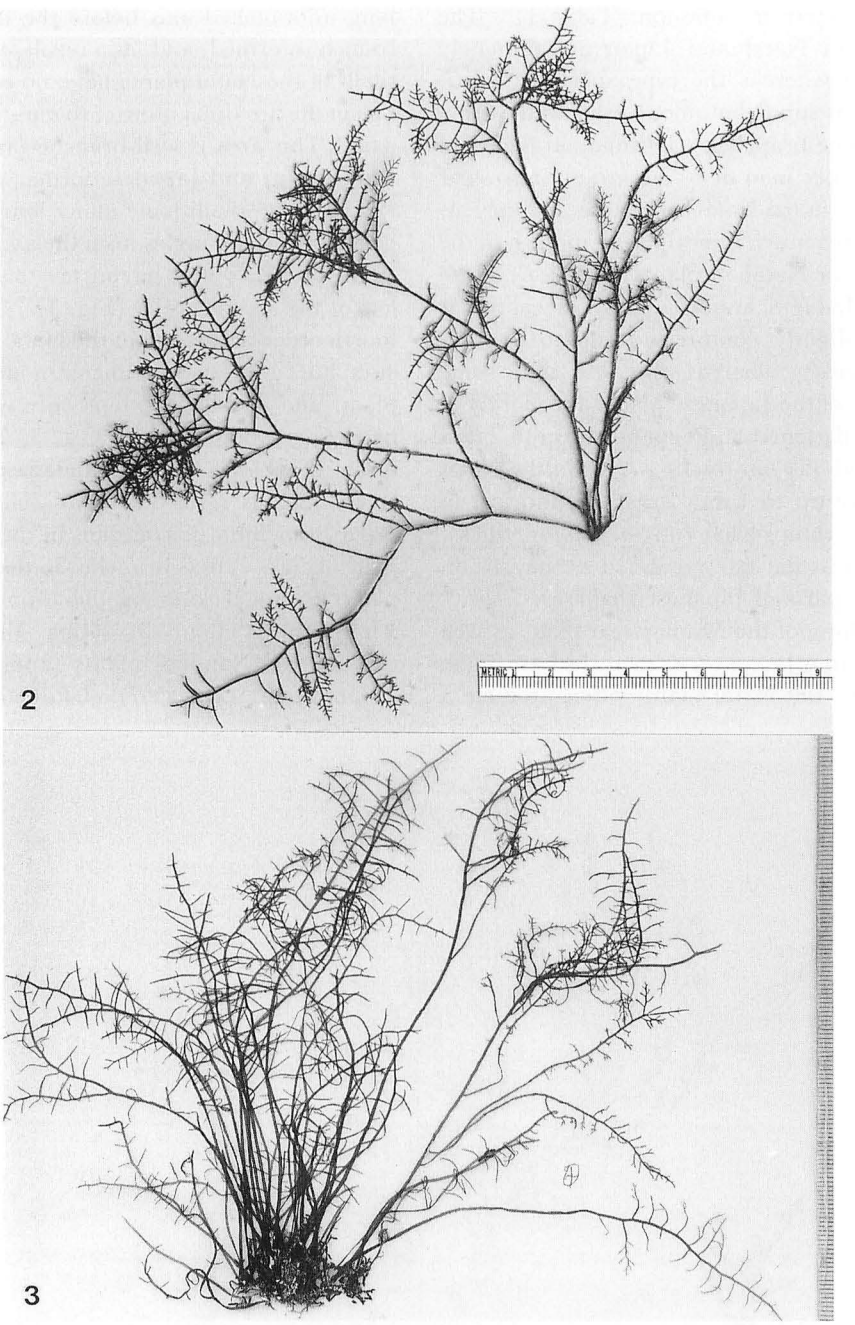


Fig. 1. Drawing of the type specimen of *Gelidium amansii* as published by LAMOUROUX (1805), Pl. 26 (the specimen in LAMOUROUX's Fig. 2 was estimated to be approximately 15 cm tall).



Figs. 2 and 3. Specimens from the Natal coast, both tetrasporangiate. The specimen in Fig. 3 (SAM 100323) has few fertile branchlets and many sterile branches of the second order, some with proximal reflexing typical for specimens of this region. The specimen in Fig. 2 (SAM 100135) is the holotype for *Gelidium abbottiorum*.

of the Japanese plants are narrower than those from Natal, but both are often obtuse. The angle of primary branches to the axis is often close to 90° in the Natal specimens, whereas in both the Madagascar and Japanese plants the angle of branching is always more acute (Figs. 5, 6). Secondary sterile branch tips on the Natal thalli are often

directed proximally, the lax branches being a unique and distinctive character for plants from this region (Figs. 2, 3).

Tetrasporangia-bearing parts of branchlets in the Natalian and Japanese specimens often have long stalks (up to 4 mm long) (Figs. 8, 9), whereas these regions on Madagascaran specimens are on shorter stalks (f.3 & f.4 within Fig. 1). The breadth of fertile parts of tetrasporangial branchlets is distinctly narrower in the Japanese plants (up to approximately 800 μm broad) than in plants from the other two regions (up to approximately 1 mm broad). Natalian tetrasporangial branchlets have broadly obtuse apices whereas the branchlet tips in the specimens from the other regions often are acute. Fertile branchlets of Japanese plants usually are geniculate and sometimes such branchlets are also geniculate in Natalian specimens. Fertile branchlets are not geniculate in the type specimen of *G. amansii* (f.3 & f.4 in Fig. 1).

The position of rhizines in branches is sometimes used to distinguish species of *Gelidium*, and rhizine in third order branches was a character used to separate *G. capense* from *G. amansii* and *G. pteridifolium* in southern Africa according to Norris *et al.* (1987). The rhizines of second and third order branches in the Natalian, Japanese and Madagascar specimens assigned to *G. aman-*

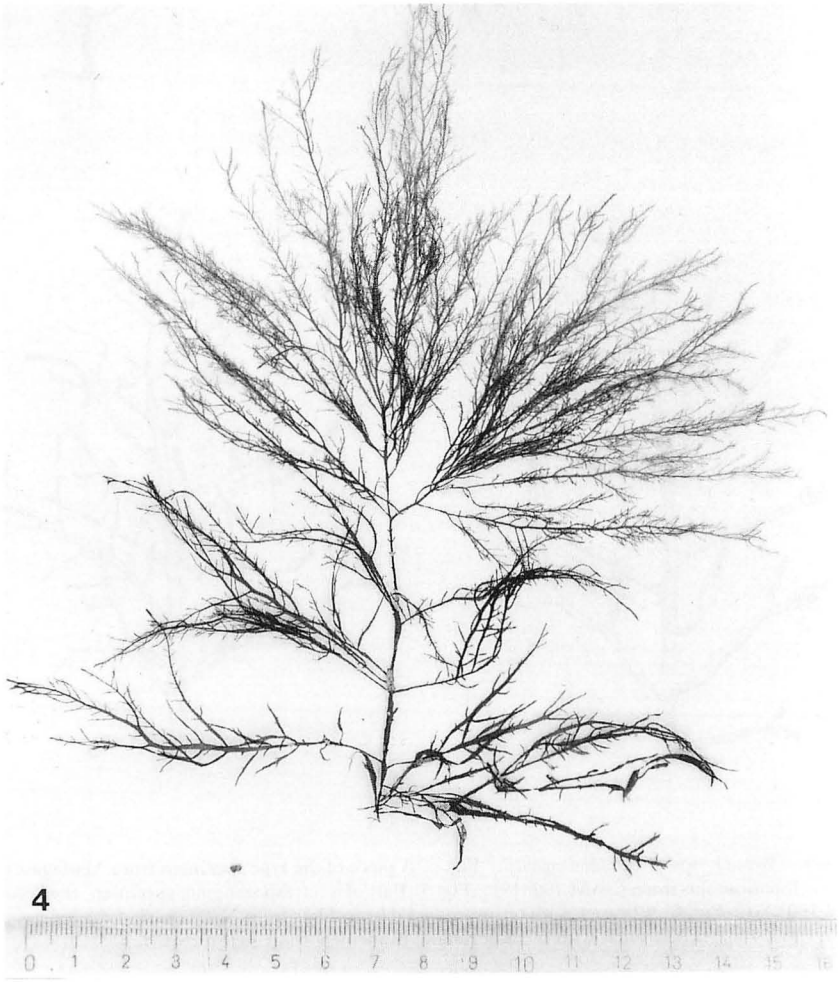
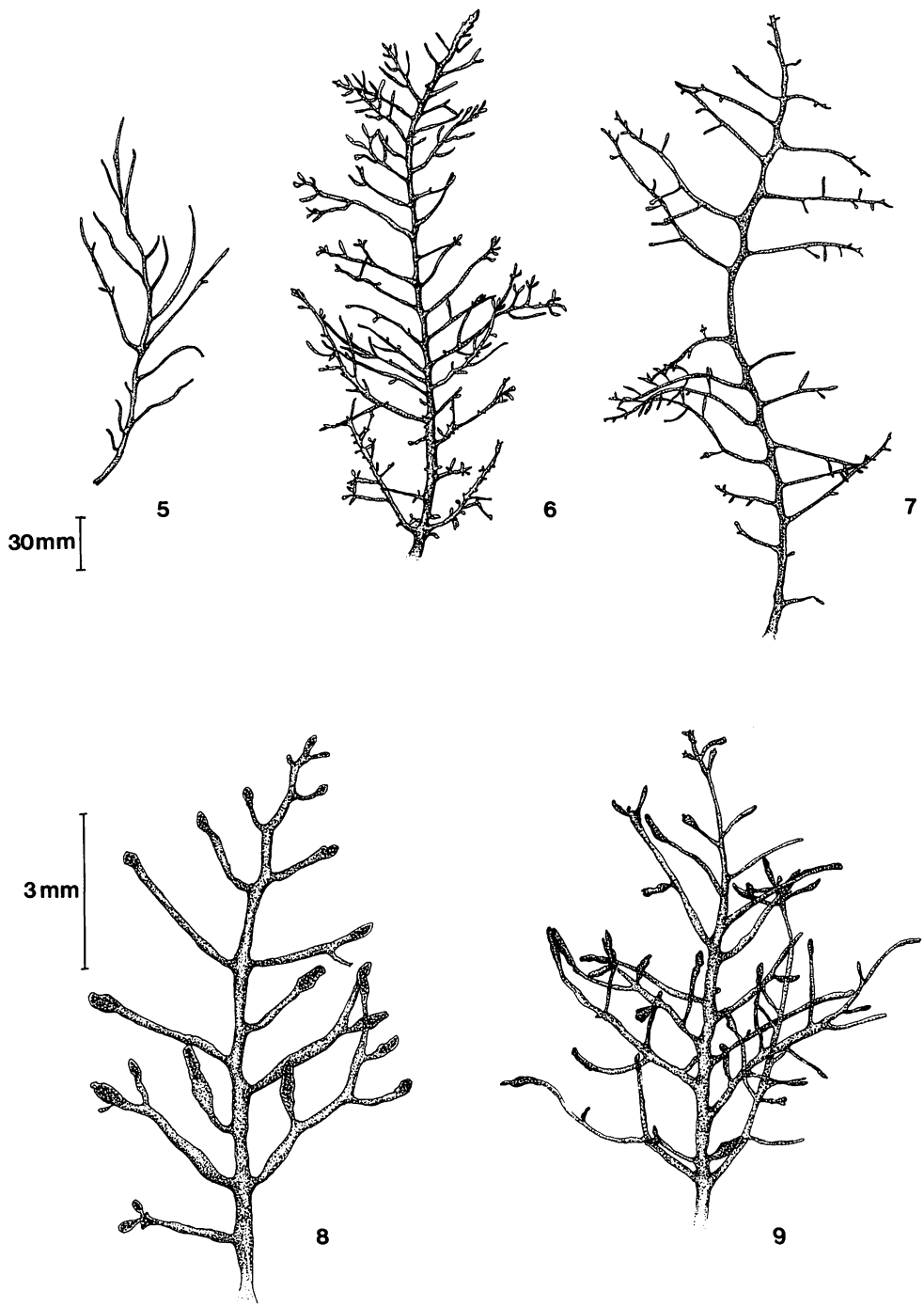


Fig. 4. A specimen from Takahama, Noto Peninsula, Japan legit I. Akatsuka (SAM 100349).



Figs. 5–9. Branch tips of *Gelidium amansii*. Fig. 5. A piece of the type specimen from Madagascar. Fig. 6. Branch from a Japanese specimen (SAM 100349). Fig. 7. Part of a tetrasporangiate specimen, the holotype, from Natal (SAM 100135). Fig. 8. A branch with tetrasporangial branchlets from Natal (part of the holotype specimen of *G. abbottiorum*). Fig. 9. A branch with tetrasporangial branchlets from Japan (SAM 100349).

sii, however, are all located mostly in the inner cortex. This character must be used with caution and recognized as generally unreliable in separating species of *Gelidium* (SANTELICES and STEWART 1985).

Conclusions

The characters exhibited by plants known as *Gelidium amansii* from the three areas, Madagascar, Natal and Japan, are consistently distinct from one another and it is recommended that three different species be recognized for these specimens. The Madagascar entity, being the type specimen of *G. amansii*, retains that epithet. *Gelidium amansii* as known in Japan is closely related to *G. pacificum* OKAMURA (1913–15) in habit as well as occurring in nearby habitats. SUTO (1954) considered *G. pacificum* to be much the same as Japanese *G. amansii* and AKATSUKA (1982) as well as SANTELICES (1988) came to a similar conclusion, pointing out the existence of many intermediate forms. I recommend that the epithet, *G. amansii,* be abandoned for the Japanese plants, as well as those from China and the Philippines, and the plants from that region be known as *G. elegans* KÜTZING (1868), a name assigned to synonymy of *G. amansii* (LAMOUROUX) LAMOUROUX by OKAMURA (1934), as a form of *G. amansii*, and that *G. pacificum* OKAMURA be designated a synonym of *G. elegans*.

The Natal *G. amansii* has a form different from the Madagascar type specimen of *G. amansii* as well as *G. amansii* of Japan. It is hereby proposed, therefore, that the southeast African plants previously known as *G. amansii* be given a new name, *G. abbottiorum* sp. nov. The new species epithet honours a unique couple who, both together and separately, have made many significant contributions to the advancement of marine phycology: Professor Isabella Abbott of the University of Hawaii, Honolulu, and her late husband, Dr. Donald P. Abbott, Emeritus Professor at the Hopkins Marine Station of Stanford University. ***Gelidium abbottiorum*** R. E. NORRIS sp. nov.

Rami erecti usque ad 300 mm longi, toti; axis usque ad 1 mm latus, 600 μm crassus; ramificantes plerumque in dimidio distali usque ad trientem distalem axis, ramosi usque ad quater pinnatim ubi fecundi; rami secondarii plerumque perpendiculares ad axem et saepe recurvati proximaliter et 1–3 mm distantes. Ramuli tetrasporangiferi varie formati, sed saepe elongati spathulati; ramuli fecundi aliquando geniculati. Holotypus speciminis (Tab. 3): SAM 100135, tetrasporophytum lectum e littore interaestuali Widenham, Natal, a Dr. A. CRITCHLEY (9-III-1986) (Nat 3768).

Erect branches up to 300 mm long, entire; axis up to 1 mm broad, 600 μm thick; branching mostly in the distal one-half to one-third of the axis, up to four times pinnately branched when fertile; secondary branches usually at a right angle to the axis and often proximally recurved and from 1–3 mm apart. Tetrasporangiate branchlets of variable shapes, but often elongate spathulate; fertile branchlets sometimes geniculate. Holotype specimen (Fig. 2): SAM 100135, a tetrasporophyte collected intertidally at Widenham, Natal, by Dr. A. CRITCHLEY (9-III-1986) (Nat 3768).

Acknowledgements

Support for my studies on the Natal benthic algae is provided by the CSIR, Pretoria. Collectors of specimens used in this study are especially thanked, particularly Dr. Alan CRITCHLEY and Dr. Isamu AKATSUKA. The staff of the Universitetets Botaniska Museum, Lund, Sweden, is thanked for allowing me to examine pertinent specimens and to photocopy the Lamouroux publications concerned. The fragment of the type specimen of *Gelidium amansii* was borrowed from the University of California, Berkeley, Herbarium where it was filed without a number. I thank Dr. Paul C. SILVA for permission to borrow this specimen as well as the cited specimens collected by Papenfuss and Scagel on the International Indian Ocean Expedition, 1962. I am also grateful to Dr. SILVA and Dr. Isabella ABBOTT for kindly providing

copies of pertinent references.

References

AKATSUKA, I. 1982. Preliminary observations and literature analysis of morphological variability in some Japanese species of *Gelidium* (Gelidiaceae, Rhodophyta) and an evaluation of criteria used in their discrimination. Nova Hedwigia **36**: 759–774.

BØRGESEN, F. 1943. Some marine algae from Mauritius, III: Rhodophyceae, Part 2: Gelidiales, Cryptonemiales, Gigartinales. Kongel. Danske Vidensk. Selsk., Biol. Meddel. **19**(1): 1–85.

DAY, J. H. 1969. A guide to marine life on South African shores. iii+300 pp. Balkema, Cape Town.

KÜTZING, F. T. 1868. Tabulae phycologicae. Volume XVIII, [iv]+35 pp. 100 pls. Nordhausen.

LAMOUROUX, J. V. F. 1805. Dissertations sur plusieurs espèces de Fucus. xxiv+83 pp. Agen.

LAMOUROUX, J. V. F. 1813. Essai sur les genres de la famille des thalassiophytes non articulées. Ann. Mus. Nation. d'Hist. Natur. [Paris], **20**: 21–47, 115–139, 267–293.

NORRIS, R. E., HOMMERSAND, M. H. and FREDERICQ, S. 1987. *Gelidium pteridifolium* (Rhodophyceae), a new species from Natal and the eastern Cape. S. Afr. J. Bot. **53**: 375–380.

OKAMURA, K. 1913–1915. Icones of Japanese Algae. Vol. III, 218 pp., pls CI-CL. Tokyo.

OKAMURA, K. 1934. On *Gelidium* and *Pterocladia* of Japan. J. Fish. Inst. (Tokyo Fish. Univ.) **29**: 47–67.

SANTELICES, B. 1988. Descriptions of Chinese and Taiwanese species of Gelidiales. p. 93–108. *In* I. A. ABBOTT [ed.], Taxonomy of Economic Seaweeds with reference to some Pacific and Caribbean species. Vol. II. Calif. Sea Grant College Program, La Jolla.

SANTELICES, B. and STEWART, J. G. 1985. Pacific species of *Gelidium* LAMOUROUX and other Gelidiales (Rhodophyta), with keys and descriptions to the common or economically important species. p. 17–32. *In* I. A. ABBOTT and J. N. NORRIS [eds.], Taxonomy of Economic Seaweeds with reference to some Pacific and Caribbean species. Calif. Sea Grant College Program, La Jolla.

SEAGRIEF, S. C. 1984. A catalogue of South African green, brown and red marine algae. Mem. Bot. Surv. S. Africa no. 47: vi+72.

SEGI, T. 1959. On the type specimens of *Porphyra tenera* KJELLMAN and *Gelidium amansii* LAMOUROUX. Rep. Fac. Fisheries, Prefectural Univ. Mie **3**: 251–255.

SILVA, P. C., MEÑEZ, E. G. and MOE, R. L. 1987. Catalog of the benthic marine algae of the Philippines. Smithsonian Contrib. Mar. Sci. no. 27: iv+179 pp.

SUTO, S. 1954. Tengusa no zôshoku. Suisan Zôshoku Sôsho No. 8: 53+4 pp. of corrections. Tokyo. (The agar seaweed, "Tengusa"—harvesting and propagating its resources.) (Not seen, cited from AKATSUKA 1982).

TSENG, C. K. (ed.) 1983. Common seaweeds of China. x+316 pp. Science Press, Beijing.

R. E. NORRIS：重要寒天原藻マクサの分類に関する論評

紅藻マクサ *Gelidium amansii* は，もともとマダガスカルとモーリシャスで採集された標本について LAMOUROUX によって記載されたものであるが，南アフリカおよび東アジア沿岸にも見られる。海藻採集がよく行われている地域であるモーリシャスではその後再び採集されていないので，モーリシャスをマクサの基準産地とするのは誤りであろう。また，マダガスカルにおける近年のいくつかの採集でもマクサの標本は得られていないので，LAMOUROUX による基準産地の原記載全体に誤りがあると思われる。マクサの基準標本は不稔個体で，南アフリカ産の藻体とは大きさと形態が異っており，マクサと同定されている日本産の標本とも異る。本研究で示される3つの異る種，すなわち，恐らくマダガスカル産とされるマクサ *G. amansii*, 東アジア産の *G. elegans*, および南アフリカ産の *G. abbottiorum*（新種），の区別を提唱する。(National Botanic Institute, Kirstenbosch, Private Bag X7, Claremont, Cape Town, South Africa 7735)