

The specific identity of *Neurymenia* (Rhodophyceae, Rhodomelaceae) in southeastern Africa

Richard E. NORRIS

National Botanic Gardens, Kirstenbosch, Private Bag X7, Claremont 7700, Republic of South Africa

NORRIS, R.E. 1988. The specific identity of *Neurymenia* (Rhodomelaceae, Rhodophyceae) in southeastern Africa. Jpn. J. Phycol. 36: 271-276.

Reinvestigation of specimens of *Neurymenia* collected in Natal by M.A. POCKOCK and G.F. PAPPENFUSS and designated by PAPPENFUSS as *Neurymenia fraxinifolia* has revealed that the species should be identified as *N. nigricans* TANAKA et ITONO, a species previously known only in southern Japan. *Neurymenia nigricans* has been found in more recent collections of this genus from northern Natal and *N. fraxinifolia* has been extended across the Mozambique border into South Africa. Male gametophytes are described for *N. nigricans* for the first time and young female and tetrasporophyte plants from Natal are also discussed.

Key Index Words: Amansieae—*Neurymenia*—*N. fraxinifolia*—*N. nigricans*—*Rhodomelaceae*—*Rhodophyceae*—taxonomy.

Neurymenia J. AGARDH (1863) is a member of the tribe Amansieae of the Rhodomelaceae, a group in which branched blade-like thalli are commonly produced. *Neurymenia* has an involute apical region on the blade, typical for the Amansieae, and is further characterised by its veined blades, often having a conspicuous midrib, the veins terminating at the margins of the blades in short branching spine-like branchlets, and similar adventitiously formed short cylindrical branchlets occurring on veins and midribs on both surfaces of the thallus. Marginal branchlets, and many of the surface borne branchlets, usually are sterile and bear only a dorsal row of trichoblasts or scar cells. Reproductive structures, when present, are produced instead of trichoblasts on dorsal sides of the surface-borne branchlets, but rarely on marginal branchlets. Branching of the thallus in *Neurymenia* occurs from the midrib or from the apex of the lateral vein.

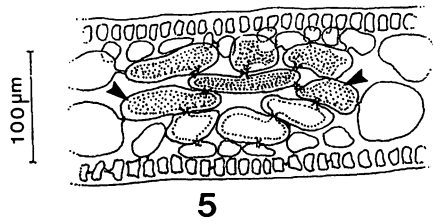
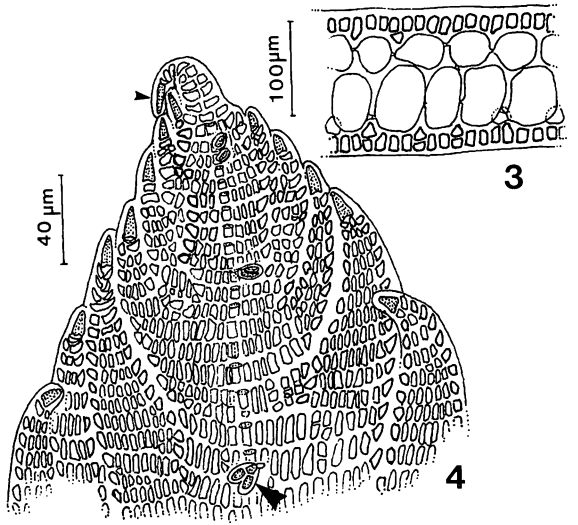
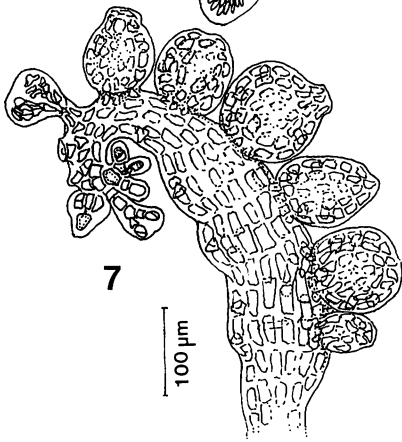
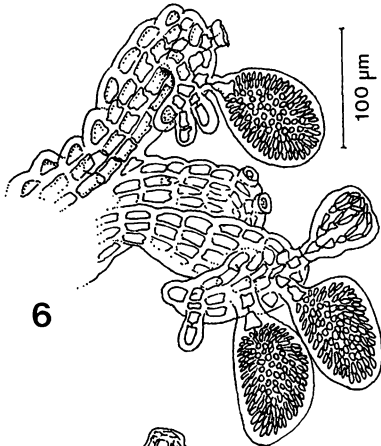
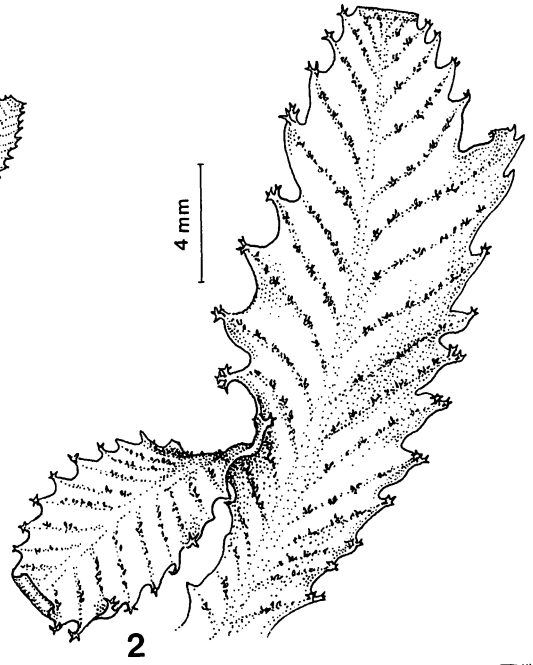
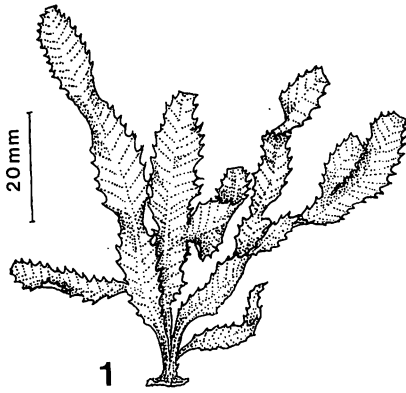
OKAMURA (1901) illustrated considerable variation of structure within *Neurymenia fraxinifolia*, at that time the type and only

species of the genus, the figures suggesting that the genus may contain more than a single taxon, a possibility proposed by BØRGESSEN (1933). TANAKA and ITONO (1969) critically examined *Neurymenia fraxinifolia* and provided details on its structure as well as on the female and tetrasporangiate reproductive structures. Their study of this genus in southern Japan also uncovered a second species in the genus, which they described as *N. nigricans* TANAKA et ITONO.

With the discovery of additional specimens of *Neurymenia* in Natal, comparison of their characters with the specimens from Japan is particularly important. This research has revealed particularly interesting results showing that two species, *N. fraxinifolia* and *N. nigricans*, are present in tropical and subtropical southeastern Africa.

Materials and Methods

Details of the *Neurymenia* specimens used in this study are as follows: *N. fraxinifolia*: I.I.O.E. (U.S. Program in Biol.) no. XIX-



O. ANDERSON.

12 (UC), Xai-Xai, Mozambique, 2-3-XI-1962; I.I.O.E. (U.S. Program in Biol.) no. XX-7 (UC), Zavora Reef, Mozambique, 4-XI-1962; I.I.O.E. (U.S. Program in Biol.) no. XXIV-37 (UC), Ponta Abril, Inhaca Is., Mozambique, 11-XI-1962; Natal Benthic Algae Program no. 5456, Lala Nek, 1-XII-1985 (*legit* J. Phelan); Natal Benthic Algae Program no. 5157, 9-mile Reef, N. of Sodwana Bay, Natal, 15-V-1986 (*legit* P. Prinsloo & E. Strydom). *N. nigricans*: M.A. Pocock no. 2127 (GRA), Perrier's Rocks, St. Lucia, Natal, 22-VII-1938; G.F. Papenfuss no. 1127, Perrier's Rocks, St. Lucia, Natal, 22-VII-1938; Natal Benthic Algal collection no. 610, intertidal on rock platforms south of the entrance to Kosi Bay, northern Natal; Natal Benthic Algal collection no. 4537 (NU 10010), intertidal at Cape Vidal, Natal, 26-IX-1984; Natal Benthic Algal Collection no. 5217, intertidal, Botelier Pt., Sodwana, Natal, April, 1977 (E. Olivieri); Natal Benthic Algal Collection no. 5457, intertidal, Lala Nek, 1-XII-1985 (*legit* J. Phelan). The male plant is from Kosi Bay and is in liquid preservative; slides of hand sections were made from it by directly mounting them in aniline blue stain in 50% corn syrup mounting medium. Microscopic studies on dried herbarium specimens were made from bits of material soaked in water and mounted on slides in corn syrup containing aniline blue.

Results and Discussion

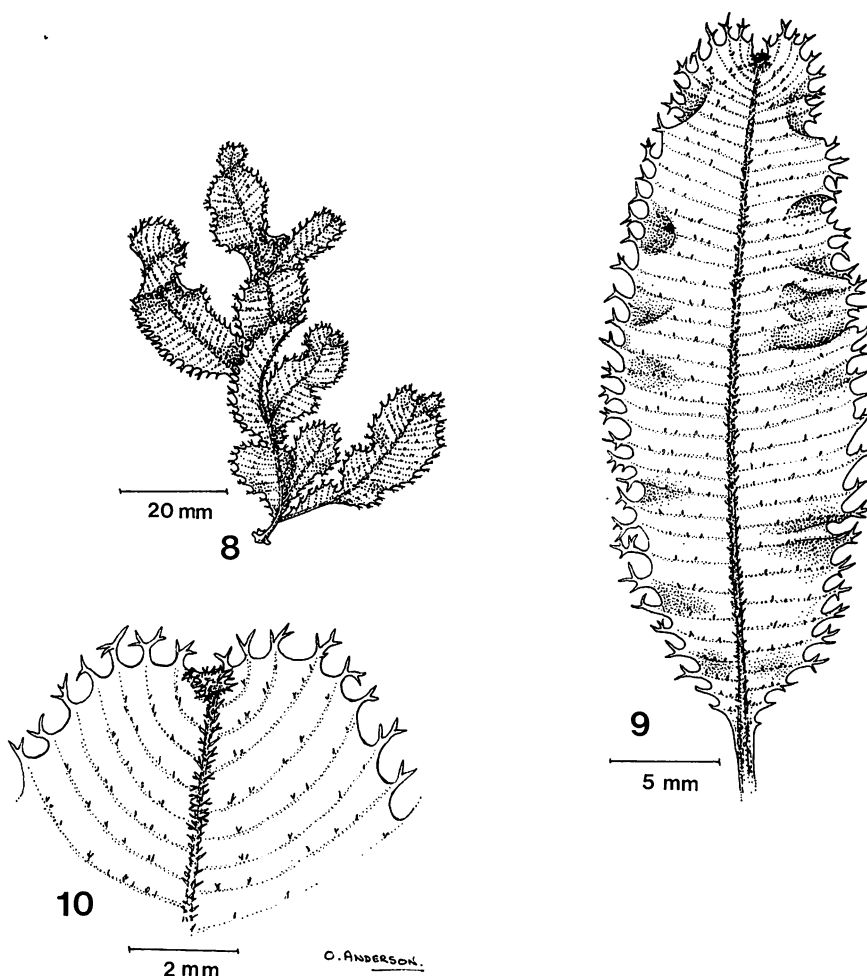
The southern African specimens are clearly separable into two groups: 1) those with long thalli and broad blades that are less

opaque, and with distinct midribs and lateral veins in most thalli (Fig. 8); 2) more opaque thalli having shorter and narrower blades in which the midrib is often indistinct, and in which lateral veins are invisible or only accentuated when adventitious branchlets are formed on them (Fig. 1). Adventitious branchlets develop on both the midrib and lateral veins in the first group (Figs 8-10) whereas these branchlets develop only on the lateral veins in the second group (Figs 1, 2). The marginal proliferous branchlets are longer in the first group (Fig. 9) than in the second (Fig. 2), and thallus branching occurs from the midrib in the first group (Fig. 8) whereas it occurs mostly from the apex of the lateral vein (marginally) in the second group (Figs 1, 2). The thalli that have more transparent blades are from tropical southeastern Africa, occurring in Natal only near the Mozambique border, whereas the smaller, marginally branching thalli are known only in northern Natal.

It is clear that two species are represented in these collections and the Mozambique specimens conform to the type species of *Neurymenia*, *N. fraxinifolia* (Figs 8-10), whereas the specimens from Natal (Figs 1-7) are similar to the only other species described in the genus, *N. nigricans* TANAKA et ITONO (1969) from southern Japan, and the discovery of this species in Natal extends its range to Africa and the Southern Hemisphere.

Characters used to separate the two species are clearly defined by TANAKA & ITONO (1969) and include the following: 1) *N. fraxinifolia* thalli are larger (up to 30 cm. tall) whereas *N. nigricans* has thalli that

Figs. 1-7. *Neurymenia nigricans*. 1. Habit of thallus. 2. More highly magnified branch showing involute tips, marginal branching, lateral veins forming an almost 45° angle with the midrib and adventitiously formed branchlets present only on the lateral veins. 3. Section through thallus blade showing thin cortication and unequal size of medullary cells, the smaller ones on the ventral side. 4. Unrolled branch apex showing apical cell (small arrow-head), free branch ends which produce serrations of the alae, and three small trichoblasts (large arrow-head on one). 5. Section through thallus midrib showing five pericentral cells (stippled, as is the axial cell) and the cortical cell rows emanating from the two dorsal pericentral cells (arrow-heads on first cell of each). 6. Three adventitious branchlets, two bearing male reproductive organs. Note the trichoblast in the same position on the dorsal side of the lower branchlet, and the scar cells on the upper two branchlets. 7. Female branchlet having six young pericarps. Trichoblasts are formed on the dorsal side in distal positions.



Figs. 8-10. *Neurymenia fraxinifolia*. 8. Habit of a small thallus. 9. A single blade showing folded margin, large proliferous marginal teeth, and adventitious branchlets formed on both the midrib and lateral veins. Note the almost perpendicular orientation of the lateral veins with the midrib. 10. A blade tip, ventral side, showing the narrowly involute apex and adventitiously formed branchlets present on both the midrib and lateral veins.

reach only one-half that length; 2) branching of thalli in *N. fraxinifolia* is only from the midrib whereas branching of *N. nigricans* occurs from the margin of the blade (older regions of thalli in the latter species that have lost the alae appear to branch from the midrib); 3) the large cells in the medulla, as seen in cross-section, are unequal in size in *N. nigricans* (Fig. 3) whereas the medullary cells of *N. fraxinifolia* usually are of equal size. I have examined the lectotype specimen of *N. nigricans* (Fig. A of Plate II in TANAKA & ITONO, 1969) to verify these

characters and, in addition, I consider the following characters useful in identifying the two species; 4) the blade margins in *N. fraxinifolia* usually are ruffled (Figs 8, 9) whereas the margins of *N. nigricans* are straight (Figs 1, 2); 5) the branch apices of *N. fraxinifolia* are deeply incised, the involute apex being very narrow and not including much tissue proximal to the apex (Fig. 10); apices of *N. nigricans* are not incised but, instead, gradually taper distally (Fig. 4), are involute far behind the apical cell, the involution forming a broad straight

line at the branch tip (Fig. 2); 6) the blades of *N. fraxinifolia*, as mentioned above, usually appear to be thinner than those of *N. nigricans* and, as a result, the midrib and lateral veins, and the adventitiously formed branchlets on them, are much more easily observed; 7) lateral veins diverge at almost 45° from the midrib in mature regions of blades in *N. nigricans*, whereas in similar regions of *N. fraxinifolia* blades they diverge at almost 90°; 8) adventitiously formed branchlets, sterile or fertile, occur on both the midrib and lateral veins in *N. fraxinifolia* (Figs 8, 9), whereas they occur mostly on the lateral veins in *N. nigricans* (Fig. 2). This latter character does not conform with the description of *N. nigricans* by TANAKA & ITONO (1969) who said that these branchlets occur on both the midrib and lateral veins in that species. Some specimens of *N. fraxinifolia* have midribs with very few adventitious branchlets so this character must be used with caution.

TANAKA & ITONO considered other characters important in separating the two species, particularly characters of reproduction which I cannot compare because few fertile specimens are available in our collections. A conspicuous difference in female specimens that they noted, however, was the number of procarps on the fertile adventitiously formed branchlets, 1–6 in *N. fraxinifolia* and up to 80 in *N. nigricans*. The southern African specimens never have as many procarps as described from the Japanese specimens, our specimens having numbers similar to those they described for *N. fraxinifolia* (Fig. 7). This difference in our specimens, along with the presence of adventitiously formed branchlets on the midrib in Japanese *N. nigricans* and their absence in our specimens, may indicate that a third species is present in the complex but many more specimens must be studied before such a conclusion can be drawn. The possibility exists that hybridization is occurring between *N. fraxinifolia* and *N. nigricans* and may be producing intermediate forms that are sometimes illustrated

(OKAMURA 1901, pl. 13, fig. 2, PHAM-HOANG HỒ 1969, fig. 2.205). Because the populations of the two species seem to be sparse and isolated from one another, however, it seems more probable that hybridization is not regularly occurring and that positions of major branches on the midrib or on the margin of blades can be a somewhat flexible character, as is the presence or absence of adventitiously formed branchlets on the midrib. The alae forming branches (primary exogenously formed branches) have free ends visible at an early stage of development in both species (Fig. 4) and trichoblasts have been found on the midrib, usually widely spaced and often rudimentary (Fig. 4). Trichoblasts also occur on sterile or fertile adventitious branchlets (Figs 6, 7) on most every more distal segment.

Illustrated records of East African *Neurymenia* have been provided by JAASUND (1976), FARGHALY (1980) and SEAGRIEF (1980). JAASUND's and FARGHALY's illustrations, from Tanzania and Madagascar, respectively, show plants typical for *N. fraxinifolia*. Seagrief's drawing, on the other hand, probably drawn from a Pocock specimen and representing a plant from Maputaland (N. Natal), is most likely to be *N. nigricans*. The distribution of the two species in eastern Africa seems to clearly indicate that *N. fraxinifolia* occurs only in tropical regions, whereas *N. nigricans* is found only in the sub-tropical southern region. Their range overlaps in the region of the Mozambique border with Natal where only small plants (up to 6 cm. long, and blades 1 cm. broad) of *N. fraxinifolia* have been rarely found. Only small specimens (up to 5 cm. long, and blades 0.7 mm. broad) of *Neurymenia nigricans* have been found in Natal.

The specimens collected by our team of collectors in Natal are the first male plants of *N. nigricans* that have been found. Indeed, the only male specimen of the genus was described by BØRGESEN (1933) for *N. fraxinifolia* and his illustration shows a male

branchlet lateral to a primary cylindrical marginal branch. The spermatangial stichidium shown by Borgesen is globose and without obvious dorsiventrality, whereas the stichidia found on the Natal male plants often are more ellipsoidal in outline and with a distinct dorsiventral orientation (Fig. 6), the internal branches of the fertile segment ('stichidium') being longer on the dorsal than on the ventral side. These may also be significant differences between the two species.

As has been shown by BØRGESEN (1933) for *N. fraxinifolia* and by NORRIS (1987) for *Lenormandiopsis nozawae*, a relative of *Neurymenia* in the Amansieae, the male branchlets replace trichoblasts on the cylindrical male branchlets produced on the thalli. Male branchlets of *N. fraxinifolia* and those found for *N. nigricans* are derived in the same manner and occupy similar positions along the dorsal side of the branchlets.

Acknowledgements

This research is supported by the CSIR, Pretoria. Professor R.N. PIENAAR, Univ. of the Witwatersrand, Johannesburg, is thanked for his encouragement and support for these studies. The loan of specimens from the U.S. Program in Biology, International Indian Ocean Expedition, was provided through the University of California Herbarium, Berkeley, and the assistance of Dr. P.C. SILVA is gratefully acknowledged. Specimens from Japan studied by TANAKA & ITONO were kindly sent

on loan from Kagoshima University by Dr. K. NOZAWA. Dr. T. NORO of Kagoshima University is also thanked for his assistance in locating these specimens. Mrs. Olive ANDERSON has provided the drawings and technical assistance was given by Mrs. B. WHITE and Miss L. RUSHWORTH.

References

- AGARDH, J.G. 1863. Species genera et ordines Floridearum, ...2(3), pp. 787-1291. C.W.K. Gleerup, Lund.
- BØRGESEN, F. 1933. Some Indian Rhodophyceae especially from the shores of the Presidency of Bombay. III. Bull. Misc. Information, No. 3. Roy. Bot. Gard., Kew pp. 113-142.
- FARGHALY, M. EL-S. 1980. Algues benthiques de la Mer Rouge et du bassin occidental de l'Océan Indien. These, Univ. Sci. Tech. Languedoc. Acad. de Montpellier. 299 pp.
- JAASUND, E. 1976. Intertidal Seaweeds of Tanzania. 160+3 pp. Univ. Tromsø.
- NORRIS, R.E. 1987. Structure and reproduction in *Lenormandiopsis nozawae* (Rhodomelaceae, Rhodophyta). Cryptogamie, Algologie 8: 211-221.
- OKAMURA, K. 1900-1901. Illustrations of the marine algae of Japan. Vol. I, ii+93+5 pp, XXX pls. Tokyo.
- PHAM-HOÀNG HỒ 1969. Rong Biển Vietnam, 555 p., Trung-Tâm Hoc-Liêu Xuất-Bán.
- SEAGRIEF, S.C. 1980. Seaweeds of Maputaland. pp. 18-41. In Bruton, M.N, & K.H. Cooper (eds) Studies on the ecology of Maputaland. Rhodes Univ., Grahamstown & Natal Branch, Wildlife Soc. of S.A., Durban.
- TANAKA, T. & ITONO, H. 1969. Studies on the genus *Neurymenia* (Rhodomelaceae) from southern Japan and vicinities. Mem. Fac. Fish. Kagoshima Univ. 18: 7-27.

Richard, E. NORRIS: アフリカ東南部産のイソバシヨウ属 *Neurymenia* (紅藻, フジマツモ科) について

M.A. Pocock 及び G.F. Papenfuss により Natal から採集され, Papenfuss によって *Neurymenia fraxinifolia* イソバシヨウ とされた *Neurymenia* イソバシヨウ属 の標本について再検討し, この種 (藻体) は, 従来日本南部にのみその生育が知られてきた *N. nigricans* Tanaka et Itono クロイソバシヨウ であることを解明した. *Neurymenia nigricans* は Natal 北部からのこの属の最近の採集において見い出され, *N. fraxinifolia* は Mozambique を越え South Africa に広がっている. *N. nigricans* の雄性配偶体が今回初めて記載され, Natal 産の若い雌性配偶体と四分孢子体が論議された. (National Botanic Gardens, Kirstenbosch, Private Bag X7, Claremont 7700, Republic of South Africa)