Introduction

The South African coastline displays a unique floral diversity, with biota ranging from kelp beds on the west coast to coral reefs near the Mozambican border. The correlation between surface seawater temperatures and shore community compositions has been investigated by several researchers, who have firmly established that the main defining influences are the warm Agulhas current flowing down the east coast from Mozambique to the region where it meets the cold Benguela current (e.g. Stephenson 1948, Bolton 1986, Bolton and Anderson 1990). Stephenson (1948) divided the South African coastline into three marine provinces: the cold-temperate west coast, warm-temperate south coast, and sub-tropical east coast. More recently, seaweed biogeographers, although also recognising three floral provinces, have described them differently. The seaweed flora of the west coast is regarded as warm-temperate by Bolton (1986) and Lüning (1990) or cool-temperate by Emanuel et al. (1992) and Bolton and Anderson (1997), rather than cold-temperate. The presence of a distinct sub-tropical flora on the east coast (Kwazulu-Natal) is not accepted by either Lüning (1990) or Bolton and Anderson (1997). These authors consider the seaweeds of the east coast of South Africa to be the westernmost extension of the large Indo-West Pacific tropical region, and cast doubt on the existence of a distinct sub-tropical flora in Kwazulu-Natal.

The transition zone between the west and south coast marine provinces has been well studied and characterised by a clearly defined overlap zone (Bolton and Stegenga 1990, Jackelman et al. 1991), in contrast to the eastern border of the Agulhas (south coast) marine province which is less clear. Seawater temperature, the main defining ecological parameter in the distribution of seaweeds, gradually rises from around East London to northern Kwazulu-Natal (Bolton 1986). At present, it is believed that a distinct sub-tropical marine province in Kwazulu-Natal is unlikely, as the flora seems to comprise an eastwardly declining number of Agulhas-province species, these being replaced largely by Indo-West pacific species with the increase in water temperature (Bolton and Anderson 1997). It should be noted, however, that our knowledge of the marine flora of Kwazulu-Natal is limited. Apart from a limited number of taxa, studied in detail by students of G.F. Papenfuss in Berkeley (California) and a field guide on the seaweeds of Maputaland by Seagrief (1980), no detailed studies were available relating to Natal algae prior to 1985. In the eighties and early nineties R.E. Norris and co-authors published a series of papers on the algae of Kwazulu-Natal that gave some evidence that there is indeed a distinct flora in the region. In total they (see Norris 1992 and Silva et al. 1996 for a complete reference list) reported 63 species as new records for South Africa and described 23 new species, many of which are currently only known from Kwazulu-Natal. It has also been noted that elements of the Kwazulu-Natal marine algal flora have a link with southwestern Australia (Norris and Aken 1985, Twenty Marine Benthic Algae New to South Africa, with Emphasis on the Flora of Kwazulu-Natal

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A total of 20 new records of benthic marine algae has been added to the flora of South Africa, consisting of 6 taxa of Phaeophyta and 14 Rhodophyta. Most species have a pantropical or Indo-Pacific distribution and are generally known from several localities in the Indian Ocean (e.g. Asteronema breviarticulatum, Ceramium cingulatum, Dictyota cervicornis, D. ciliolata, Euptilota fergusonii, Galaxaura rugosa, Halymeria durvillei, Phacelocarpus tristichus). Others are only known from a limited number of reports scattered within the Indo-Pacific region (Balliella crouanoides, Gibsmithe hawaiensis, Predaea weldii, Hypoglossum minimum), possibly due to their subtidal habitat or small size. Apart from those algae with a large distribution range, some species show a distinctive southern Australian – South African distribution pattern (Carpopeltis phyllophora, Plocamium mertensii). Only Digeneopsis subopaca, originally described from Mozambique, appears to represent a local endemic species.
In a joint research project conducted by the Botany Departments of the Ghent University (Belgium) and the University of Cape Town (South Africa), the seaweeds of Kwazulu-Natal are being studied from a biogeographical perspective. Several sites along the coast from Port Edward in the south to Kosi Bay near the Mozambican border were sampled mainly between July 1998 and February 2001. The collections are now being identified and will eventually serve to provide a better understanding of the distribution and floristic affinities of the algae along the Kwazulu-Natal coast. This paper reports 20 species which are newly recorded for South Africa. Records on Chlorophyta have recently been published separately by Leliaert et al. (2001).

Material and Methods

Approximately 2400 specimens were collected over a period of two years (July 1998; August 1999; December 1999; July–August 2000; February 2001), as a result of a Bilateral Scientific and Technological Cooperation Project between the Flemish community (Belgium) and South Africa. Specimens were collected at various sites distributed along the entire Kwazulu-Natal coast (see Fig. 1) and were immediately processed as herbarium specimens, as well as being partly preserved in 4% formaldehyde/seawater. The specimens, bearing serial numbers prefixed by ‘KZN’

Fig. 1. The coast of Kwazulu-Natal, South Africa showing the sample sites.
have been deposited in GENT and BOL. Slide material was stained in a mixture of 1 g aniline blue powder, 50 mL Karo®, 45 mL distilled water, 5 mL acetic acid. Collection other than our own, those of R.E. Norris and co-workers (bearing serial numbers prefixed by ‘NAT’) deposited in UN and various other collectors in BOL were also examined. Herbarium abbreviations follow Holmgren et al. (1990). Digital images were taken, using an Olympus DP50 digital camera (Melville, USA) mounted on a Leitz Diaplan or Wild M10 microscope (Wetzlar, Germany).

**Results**

**Phaeophyta**

**Dictyotaceae**

**Dictyota cervicornis** Kützing, 1859; 11, pl. 24, fig. 2. *Figs 2–4*

Type locality: Key West, Florida.

Description: Thalli form low, dense mats (Fig. 2). The individual specimens are to 5 cm tall and composed of coarse, 2–3 mm wide, subdichotomous straps (Fig. 4). The margins are smooth, but the surface is beset with acute proliferations (Fig. 3). The apices are obtuse. Sporangia are scattered on both surfaces, but absent in the apical dichotomies. Sporangia, 120–135 µm in diameter, are placed mostly solitary and are borne on a single stalk cell, surrounded by a conspicuous involucrum. Gametangia were not observed. *In situ* the colour is brown with a blue-greyish iridescence.

Ecology: Specimens occur in the sublittoral fringe, generally on wave-exposed shores.


Discussion: *Dictyota cervicornis* is perhaps the most common *Dictyota* species in the Indian Ocean, characterised by surface proliferations and sporangia that are surrounded by an involucrum. It appears to be closely related to *D. crispata* Lamouroux and *D. magneana* De Clerck et Coppejans (De Clerck and Coppejans 1997, Coppejans et al. 2001), but differs mainly in the placement of sporangia, these being absent or present in the apical dichotomies respectively. Other characters which distinguish *D. crispata* from *D. cervicornis* include the morphology of the apices and the abundance and placement of surface proliferations. Detailed comparisons between the three species are made by Coppejans et al. (2001). *Dictyota cervicornis* exhibits a broad range of morphological growth forms, which can often be related to its habitat. Specimens growing in the shallow subtidal are often characterised by long slender straps in the distal parts of the thallus and recurved branchlets; specimens from exposed habitats generally form low, dense mats and lack slender straps. The South African specimens represent the typical growth form from exposed habitats. A major difference to previous observations is the occurrence of iridescence. Despite the examination of over 200 specimens by De Clerck (1999), mainly from the East African coast (Tanzania), iridescence was never observed. The taxonomic value and intraspecific variability of iridescence however, remains poorly understood (Gaillard 1972).

**Dictyota ciliolata** Sonder ex Kützing, 1859; 12, pl. 27, fig. 1. *Figs 5, 6*

Type locality: La Guaira, Venezuela.

Description: Thalli are erect, to 8 cm tall, attached by means of a single stupose holdfast (Fig. 6). Stolonoidal fibres are absent. Straps, 2–3 mm wide, are slender and dichotomously branched (Fig. 5). The margins are dentate, rarely smooth, while the surface is always smooth. The apices are rounded. The medulla and cortex are uniformly one-layered. Sporangia are single, scattered on both surfaces, but absent in the apical dichotomies. Sporangia, 95–110 µm in diameter, are borne on a single stalk cell and are not surrounded by a conspicuous involucrum. Gametangia were not observed.

Ecology: Specimens were collected in intertidal pools of the sublittoral fringe down to –12 m.


Discussion: *Dictyota ciliolata* is characterised by its supruse holdfast, dentate margins and the absence of stolonoidal fibres, although the margins of some specimens can be nearly smooth (Hörnig et al. 1992a,b). Several other dentate species of *Dictyota* occur in the Indo-Pacific and the Caribbean regions, as detailed by De Clerck and Coppejans (1999). Along the South African coast *D. ciliolata* is most similar to *D. liturata* J. Agardh and *D. subrhit* G. Murray. The latter species, however, has a multilayered medulla near the margins, whereas the medulla of *D. ciliolata* is uniformly one-layered. *Dictyota ciliolata* differs from *D. liturata* in the placement of the sporangia, which are arranged singly or distributed in longitudinal lines, respectively.

**Dictyota hamifera** Setchell, 1926; 92, pl. 14, figs. 1–6. *Fig. 7*

Type locality: between Papenu and Huau, Tahiti.

Description: The thallus is repent, up to 3 cm, attached to hosts at various points by patches of rhizoids. The straps, 1–2 mm wide, are dichotomously branched. The margins are smooth except for the falcate branchlets (Fig. 7), which may resemble teeth. The surface is smooth. The apices are rounded to tridentate. The medulla and cortex are uniformly one-
layered. Sporangia or gametangia were not observed.

Ecology: Specimens were collected at a depth of 18 to 25 m epiphytic on Plocamium sp.


Discussion: Dictyota hamifera was for a long time only known from the Pacific Ocean. Hörnig et al. (1992a) reported the species for the first time from the Atlantic Ocean, while De Clerck (1999) and Coppejans et al. (2000) recorded the species from the East African coast (Kenya and Tanzania). Dictyota hamifera is easily recognised by its falcate, swollen branchlets.


Type locality: Kunduchi, Dar es Salaam, Tanzania.

Description: Thalli are up to 6 cm high, attached by a small stupose holdfast. The dichotomously branched straps are narrow (0.8–1.2 mm) and of uniform width throughout the thallus (Figs 8, 10). The margins and surface are smooth. The medulla and cortex are uniformly one-layered. Sporangia form a well-defined line in the median part of the straps, but are not present along the margins (Fig. 9). Sporangia, 80–95 µm in diameter, are not surrounded by an involucrum and are borne on a single stalk cell. Gametangia were not observed.

Ecology: Specimens were collected in pools of the sublittoral fringe.


Discussion: Dictyota rigida was recently described from Tanzania (De Clerck and Coppejans 1999) and subsequently reported from Kenya (Coppejans et al. 2000). Characters defining D. rigida include the erect growth form, the stiff texture and the single stupose holdfast (De Clerck and Coppejans 1999). Dictyota rigida is most similar to the South African D. suhrii G. Murray and the Australian D. fastigiata Sonder. The latter two species, however, are characterised by a multilayered medulla, at least in the basal parts of the thallus.

Padina gymnospora (Kützing) Sonder, 1871: 47.

Type locality: St. Thomas, Virgin Islands.

Description: Thalli, attached by a small stupose rhizoidal base, are to 6.5 cm high, flabellate and composed of several lobes with inrolled margins (Fig. 11). The superior surface (the side toward which the margin is inrolled) is slightly to moderately calcified. Thalli are olive-brown in colour. In transverse section the thallus is composed of 4–6 layers of cells in the mid-regions and up to 8–9 layers near the base. Hair rows are present on both sides of the thallus, but more conspicuous on the inferior side of the thallus. Tetrasporangia are arranged in concentric lines, above each hair row, mainly (but not exclusively) developed on the superior surface. An evanescent indusium is present but is usually only clearly visible in very young sori (Fig. 12). Tetrasporangia are ovoid, up to 100 µm long and 70 µm wide. Gametophytes were not observed.

Ecology: Specimens are collected in shallow pools in the sublittoral fringe.


Discussion: Padina species are distinguished primarily on the number of cell layers, the distribution of hair bands, position of the sporangial sori (on the superior versus inferior surface) and the type of alternations of hair and sporangial bands. Padina gymnospora is characterised by the thick thallus (up to 8 cell layers), the distribution of sporangia primarily on
the superior surface of the thallus and the evanescent indusium (Allender and Kraft 1983, Womersley 1987). The species is most similar to *P. crassa* Yamada, the latter supposedly having sporangia only on the lower side of the thallus. Only *P. boryana* Thivy and *P. plumbea* (Areschoug) Levring have previously been reported from South Africa (Levrin 1940, Gaillard 1975). Both species are characterised by a 2-layered thallus and hence are easily distinguished from *P. gymnospora*. Due to confusion with *P. boergeresii* Allender et Kraft in the past, the distribution of *P. gymnospora* is difficult to assess in the Indian Ocean (Silva et al. 1996). The latter, however, has been reported with certainty from Australia and Oman (Womersley 1987, Wynne and Jupp 1998).

Incetae sedis *Asteronema breviarticulatum* (J. Agardh)


Figs 13–15

Type locality: San Agustín, Oaxaca, Mexico.

Description: Thalli, approximately 2.5 cm tall, form tufts of interwoven filaments, which have the appearance of a frayed rope at its tips (Fig. 13). Filaments are uniseriate and irregularly branched with numerous short hooked branches arising at an angle of 80°–90° (Fig. 14). Growth takes place by intercalary cell divisions. Cells are 25–33 µm wide, 60–80 µm long. L:B: 1–1.3. Plurilocular sporangia, placed on a 1–2-celled stalk, are spherical to ovoid and measure 30–38 µm wide. Gametophytes were not observed.

Ecology: growing in the intertidal, often attached to barnacles in wave-exposed localities.


Discussion: *Asteronema breviarticulatum* is a widespread warm-temperate to tropical species characterised by the shape of the plurilocular sporangia and the presence of short hooked branches. Ouriques and Bouzon (2000) transferred this species, which was commonly known as *Hincksia breviarticulata* (J. Agardh) Silva, to *Asteronema* on the basis of the stellate chloroplasts. Recent molecular studies by Draisma et al. (2001) and Rousseau et al. (2001) reveal, however, that *Asteronema* is polyphyletic and not related to the Ectocarpales *sensu lato*. Unfortunately *Asteronema breviarticulatum* itself was not included in the analysis. Pending further studies, *A. breviarticulatum* is listed as incertae sedis rather than under the Ectocarpales.

**Rhodophyta**

**Ceramiales**

**Ceramiaceae**


Figs 16–19

Type locality: Mage Island, Japan.

Description: Thalli form woolly tufts composed of uniseriate filaments to 40 mm high (Fig. 16). Filaments are opposite-distichously branched with indeterminate branches being formed every (1–) 2 (–5) segments. The apical parts of the axes show a distinctive sinusoidal curving (Fig. 17). Corticating rhizoids arise from the lower cells of the laterals and form a loose rag-like cortex (Fig. 19). The periaxial cells are 100–115 µm in diameter and bear spherical vesicular cells, 8–15 µm in diameter on their abaxial side (Fig. 18). Decussately divided tetrasporangia develop on the adaxial side of the periaxial cells of the laterals. Tetrasporangia are ovoid, 30–55 µm long and 30–38 µm wide. Gametophytes were not observed.

Ecology: *Balliella crouanioides* is a common component of the sublittoral zone (~20 to ~35 m), where it forms distinctive orangy-iridescent tufts on a variety of substrates (coral debris, various algae, sponges, etc.).


Discussion: *Balliella* species are recognisable by the presence of spherical vesicular cells (‘gland cells’), which occur adaxially or abaxially on the pericentral cells. Species are separated on the basis of their habit, branching pattern, position and size of vesicular cells and tetrasporangia. Wollaston (1984) reported *B. subcorticata* (Itono) Itono et Tanaka from Mozambique, but Huysman (1988) expressed the opinion that the specimen depicted was more similar to *B. crouanioides*, based on the overall branching pattern, arrangement of the tetrasporangia and size of the vesicular cells. Comparison of our material with the specimen studied by Wollaston (UC 1470004) reveals that they are identical and supports Huysman’s proposition. Athanasiadis (1996) provisionally assigned a collection of specimens from Kenya to *B. crouanioides*. Re-examination of the type collection proved to be necessary as some controversies exist on the branching pattern and placement of the gland cells in this species. The South African specimens match previous accounts of *B. crouanioides* very well (Itono and Tanaka 1973, Itono 1977, Huysman and Kraft 1984), although variation was observed in both the size (8–15 µm in diameter) and placement of the gland cells (abaxial but occasionally adaxial). As these characters are regarded to be of prime importance in delineating *Balliella* species, further research is needed on intraspecific variation.


Figs 20–22
Fig. 16. Habit of herbarium specimen (scale = 1 cm). Fig. 17. Detail of the sinusoidal apex and opposite-distichous branching (scale = 100 µm). Fig. 18. Cruciate divided adaxial tetrasporangia and abaxial gland cells (arrowheads) on the periaxial cells (scale = 25 µm). Fig. 19. Loose cortication at the nodes of the axes in the lower part of the thallus (scale = 100 µm).

Fig. 20. Habit of the typically clavate axis (scale = 500 µm). Fig. 21. Whorled tetrasporangia (scale = 100 µm). Fig. 22. Detail of the nodal structure in a proximal axis showing two anterior (arrowheads) and two posterior (arrows) cortical filaments (scale = 100 µm).

Fig. 23. Habit of herbarium specimen (scale = 1 cm). Fig. 24. Apical portion with alternate-distichous branching (scale = 100 µm). Fig. 25. Ultimate branchlet bearing lateral and terminal tetrasporangia (scale = 100 µm). Fig. 26. Detail of an ultimate branchlet with tetrasporangia (scale = 50 µm).

Fig. 27. Habit of herbarium specimen (scale = 1 cm). Fig. 28. Young lateral axes with curved, abaxial branchlets (scale = 500 µm). Fig. 29. Detail of a tetrasporangial branchlet (scale = 100 µm).
Type locality: Sape Strait, south of Sangeang Island, Indonesia.

Description: Thalli to 2 mm high consisting of unbranched erect axes, that arise mainly from a single point or from a creeping filament. Axes are somewhat clavate, measuring 90–100 µm wide near the base, 140–170 µm in the middle part of the thallus, ending abruptly in an attenuate apex (Fig. 20). Axial cells are lenticular, usually wider than long except near the base. A total of 8 periaxial cells are present per segment, each producing 2 anterior and 2 posterior or cortical initials of cortical filaments. Anterior initials cut off 1–2 acropetal filaments, which are up to 2 cells long (Fig. 22). Posterior initials either remain undivided or produce a single basipetal filament (Fig. 22). Cortication remains incomplete, but adjacent cortical bands may be nearly confluent. Tetrasporangia form in distinctive whorls, are slightly protruding and measure 28–35 µm in diameter (Fig. 21). Gametangia were not observed.

Ecology: Epiphytic on Plocamium telfairiae at –18 to 25 m.


Discussion: The South African specimens agree very well with the original description by Weber-van Bosse (1923) and a subsequent account of the species by Cormaci and Furnari (1991), who compared C. cingulatum with the Mediterranean C. giaccone Cor-maci et Furnari. The only difference we observed was the mode of attachment. Typically, C. cingulatum has erect axes in the terminal parts or produces erect branches. South African plants were usually strictly erect, but the presence of rhizoids in the lower part of the thallus indicates the possibility of a creeping growth form. Strictly erect versus ascending growth forms are not considered to be major taxonomic differences in Ceramium (Dixon 1960, Womersley 1978). Ceramium cingulatum is unique among South African representatives of the genus in its unbranched erect axes. The species has been reported in the Indian Ocean from Somalia, Tanzania and the Seychelles (Jaasund 1970, Sartoni 1975, Wynne 1995).

Euptilota articulata (J. Agardh) Schmitz, 1896: 7. Figs 23–26

Type locality: Australia.

Description: Thalli are erect, to 25 cm high and pinnately branched up to 5 orders (Fig. 23). A percurrent main axis is lacking. The holdfast is densely rhizoidal. Axes are corticated from close to the apices, with corticating filaments arising from the periaxial cells 5 to 10 cells proximal to the apex. Near the base the axes attain a width of 1.5 mm. Each axial cell bears a single lateral in a distichous-alternate pattern (Fig. 24). Determinate branchlets are ecoricate, straight, 12–17 cells long and pinnately branched (Fig. 25). Spine-like cells are absent. Indeterminate branchlets are formed irregularly and repeat the branching pattern of the main axes. Tetrahedrally divided tetrasporangia (40–52 µm in diameter) are borne laterally or terminally on the ultimate branchlets (Fig. 26). Gametophytic plants were not observed.

Ecology: Euptilota articulata has only been collected once in situ, at a depth of 35 m in southern Natal. The specimen in the Norris Herbarium (UN) was collected from the drift.


Discussion: The genus Euptilota contains at present four species, all of which are characterised by an alternately-distichously branched thallus, in which axial cells each bear a single lateral (Millar 1990, Womersley 1998). Euptilota articulata differs from E. pappeana Kützing, the only species reported from South Africa (Stiegenga et al. 1997), in the pinnate branching of the determinate laterals as opposed to laterals, which are either unbranched or once to twice dichotomously branched in the latter species. Euptilota articulata has previously been reported for Australia (Millar 1990, Womersley 1998), Japan (Itono 1977) and India (Umamaheswara Rao 1974).

Euptilota fergusonii Cotton, 1907: 262–264. Figs 27–29

Type locality: ‘Pantura’, Sri Lanka.

Description: Thalli are erect, to 15 cm high, pinnately branched up to 5 orders and lack a percurrent main axis (Fig. 27). The holdfast is densely rhizoidal. Axes are corticated from close to the apices with corticating filaments arising from the periaxial cells, approximately 12–14 cells proximal to the apex. Proximal axial cells are 450–500 µm wide and 240–270 µm long. Each axial cell bears a single lateral in a distichous-alternate pattern (Fig. 28). Determinate branchlets are ecoricate, curved upwards and up to 12 cells long. The basal 3 cells of a determinate lateral bear each a short adaxial side branch and the remaining cells remain unbranched, except for the ultimate and penultimate cells, which bear 1–2 (±4) spine-like cells (Fig. 29). Indeterminate branchlets are formed irregularly and repeat the branching pattern of the main axes. Tetrahedrally divided tetrasporangia (60 µm long, 40–50 µm wide) are borne laterally on cells of the ultimate branchlets. Gametophytes were not observed.

Ecology: Collected at two occasions only, at a depth of 15–25 m in northern Kwazulu-Natal (Sodwana area).


Discussion: Euptilota fergusonii is distinguished
from other *Eupitilota* species in having spine-like cells at the tips of the determinate laterals, the latter additionally being secundly, as opposed to alternately or subdichotomously, branched. *Eupitilota fergusonii* was originally described from Sri Lanka (Cotton 1907) and has previously been reported from Tanzania and Mozambique (Jaasund 1976, Wollaston 1984).

Delesseriaceae

*Hypoglossum minimum* Yamada, 1936: 138–140, fig. 2. **Figs 30–33**

Type locality: Naha, Okinawa-jima, Ryukyu-retto, Japan.

Description: Thalli consist of unbranched, lanceolate blades (7–12 mm high and 0.8–2.3 mm broad), attached by means of a small discoid holdfast (Fig. 30). Growth takes place from a single apical cell, with a typical type-one apical organisation (i.e. all second order row cells produce third order rows). The midrib remains uncorticated throughout. Tetrasporangial sori form discrete, paired ovate sori close to the midrib (Fig. 31), 900–1700 µm long and 400–600 µm wide. Tetrasporangial formation involves the lateral pericentral cells but not the transverse ones. Tetrasporangia, 62–80 µm in diameter, are cut off from second- and third order cell rows as well as from cortical cells, resulting in sporangia that lie in more than one plane of the blade. Spermatangial sori form discrete, somewhat oblique patches scattered over the wings (Fig. 32). Female plants produce a single cystocarp on the midrib in the distal region of the blades (Fig. 33).

Ecology: Collected on a single occasion, epiphytic on *Carpomitra longicarpa* Simons at –43 m.


Discussion: *Hypoglossum minimum* is a small species, which can easily be confused with *H. similans* Wynne, Price et Ballantine and *H. barbatum* Okamura, of which the latter has also been recorded from Kwazulu-Natal (Wynne and Norris 1991). *Hypoglossum minimum* is distinguished from the two other species by its erect rather than creeping habit (being attached by a single discoid holdfast), unbranched blades, a type-one apical organisation and tetrasporangia that are cut off from lateral pericentral cells. Although some of these features are also present in both *H. similans* or *H. barbatum*, this complete combination of characters is unique to *H. minimum* (Wynne et al. 1989, Wynne and De Clerck 2000). The only other Indian Ocean record comes from the Maldives (Hackett 1977). Recently Stegenga et al. (2001) described *H. imperfectum* from the South African south coast. The latter, however, differs from *H. minimum* in its prostrate habit and by fertile blades within which the proximal third-order cell rows fail to reach the thallus margin.

Rhodomelaceae

*Digeneopsis subopaca* Simons, 1970: 10, 11. **Fig. 34**

Type locality: Santa Maria, Inhaca, Mozambique

Description: Thalli are erect, very stiff and blackish in colour, to 11 cm tall (Fig. 33). Indeterminate axes are pinnately branched, compressed near the apices, but become rounded in the lower parts of the thallus. Indeterminate branchlets are stiff and incurved, 4–10 mm long and to 500 µm in diameter, bi- or trifurcately branched in up to 2 or 3 orders. The thallus is polysiphonous, consisting of an axial cell surrounded by 5 pericentral cells, which are obscured by a well-developed cortex from close to the apices. Tetrasporangia are formed in clustered stichidia near the bases of determinate laterals. The stichidia are 100–190 µm thick, with each segment bearing 2 tetrasporangia. Tetrasporangia are up to 115 µm in diameter and tetrahedrally divided. Gametophytes were not observed.

Ecology: Collected in intertidal rock pools and the shallow sublittoral from Mapelane (just south of St. Lucia) to Mozambique.


Discussion: *Digeneopsis subopaca*, originally described from southern Mozambique (Simons 1970), remains a poorly known representative of the Rhodomelaceae. In the absence of gametophytic material the taxonomic affinities of this monotypic genus are unclear. The morphology of the tetrasporangial stichidia and the compressed, bilateral nature of the plants, however, seem to indicate a close relationship to the Amansieae. The South African record of *Halopithys incurva* (Hudson) Batters in Seagrief [1984, as *H. pinastroides* (S.G. Gmelin) Kützing], seems to be based on a misidentification of a Pocock and Papenfuss collection (nr. 1024) which is referable to *D. subopaca*. The relationship of *Digeneopsis subopaca* to *Halopithys* and the other Amansieae is being studied by L. Phillips and G.T. Kraft (pers. com.).

Gigartinales

Dumontiaceae

*Gibsmithia hawaiensis* Doty, 1963: 458–465, figs. 1–17. **Fig. 35**

Type locality: Honolulu, Oahu, Hawaiian Archipelago.

Description: Thalli are to 4 cm high, pinkish-red in colour and composed of 4–5 gelatinous lobes, which are attached to a conspicuously cartilaginous, annulate stalk. The stalk is usually simple but may branch
twice in well-developed specimens. The lobes are un-divided and are broadly rounded, measuring approximately 1 cm in diameter and 3 cm in length. The thallus is multi-axial, composed of a filamentous medulla and cortex embedded in a gelatinous matrix. The distal ends of the cortical filaments produce the gelatinous matrix. Specimens were completely sterile.

Ecology: Growing epilithically at a depth of 20 m in northern Kwazulu-Natal.


Discussion: Gibsmithia hawaiiensis was originally described from the Hawaiian Archipelago and appears to be a common component of the deeper sub-tidal in the central, western and southern Pacific Ocean (Kraft 1986, Abbott 1999). Its presence in the Indian Ocean was until recently restricted to reports from Australia (Huisman 1992) and the Seychelles.
(Kalugina-Gutnik et al. 1992). However, a report from the East African coast (Coppejans et al. 2000) and the present collection indicates that G. hawaiiensis is the most widely distributed species of the genus.

Nemastomataceae


Type locality: Kaneohe Bay, Oahu Island, Hawaii.

Description: The gelatinous thallus is about 3.5 cm high, irregularly branched with numerous short, blunttapering branchlets (Fig. 36). The colour is pale pinkish *in situ*. The thallus is multiaxial, composed of a filamentous medulla and cortex embedded in a gelatinous matrix. The cortical filaments are dichotomously branched, with rectilinear cells, 4–5 µm wide by 8–13 µm long (Fig. 37). Gland cells are absent. Carpogonial branches are 3-celled (Fig. 39). Auxiliary cells are placed intercalary in cortical filaments and uteriform in shape with a prominent apical bulge. Nutritive cells, grouped per 3–6 in chains 1–3 cells long, are present on the cortical cells immediately below and on the 2 cells distal to the auxiliary cell (Fig. 38). The gonimoblast arises apically from the auxiliary cell and not laterally in conjunction with the connecting filament. Male gametophytes were not observed.

Ecology: Collected only once, attached to coral rubble at a depth of 18 to 25 m in northern KwaZulu-Natal.


Discussion: The genus *Predaea* is distinguished from all other red algae by the clusters of nutritive cells (Kraft 1984). From the Indian Ocean only *P. feldmannii* Børgesen var. *indica* Balakrishnan et Chawla (1984) and *P. huismanii* Kraft (1984) have been hitherto reported. *Predaea weldii* is characterised by its rectilinear-shaped cortical cells, the lack of gland cells, the relatively sparse and large nutritive cells and the gonimoblasts, which arise apically from the auxiliary cells. This is the first record of this species for the Indian Ocean.

Phacelocarpaceae

*Phacelocarpus tristichus* J. Agardh, 1885: 57–58. **Figs 40, 41**

Type locality: Mauritius.

Description: Thalli are erect, 7–10 cm high, sparsely branched and attached by a small discoid holdfast from which a short (up to 1 cm) terete stipe arises (Fig. 41). Axes are of uniform width, terete, 1.5 mm in diameter (including teeth). Triangular teeth are formed in 3 ranks along the axes (Fig. 40) except near the base, where there are 2 ranks. Teeth are slightly upwardly directed. 500 µm long and 270 µm wide near the base. Reproductive structures were not observed.

Ecology: Growing epilithically in large intertidal pools (Island Rock) and in the sublittoral to a depth of 43 m.


Discussion: The genus *Phacelocarpus* contains 9 species primarily distributed in the Southern Hemisphere (Indian Ocean, Australia and New Zealand), with the exception of *P. japonicus* Okamura from southern Japan (Womersley 1994). *Phacelocarpus tristichus* is predominantly distinguished from the other species by the placement of teeth in 3 ranks along the axes (although the number of ranks may vary from 2 to 4; Searles 1968), the majority of species having teeth in only 2 ranks. From South
Africa two species are known: *P. oligocanthus* Kützing and *P. tortuosus* Endlicher et Diceing, both occurring along the South African south coast and extending into KwaZulu-Natal (Searles 1968, Seagrief 1988). *Phacelocarpus oligocanthus* is a robust species characterised by teeth, which become submerged in the cortex of the main axes. *Phacelocarpus tortuosus* is closer to *P. tristichus* in size and habit but differs in the bilateral placement of the teeth and flattened axes to 2.5 mm wide (Searles 1968). *Phacelocarpus tristichus*, originally described from Mauritius, appears to be widely spread throughout the western Indian Ocean (Silva et al. 1996).

Halymeniales

**Halymeniaceae**

*Halymenia durvillei* Bory de Saint-Vincent, 1828: 180–181, pl. 15.  
**Figs 42–44**

Type locality: Port Praslin, New Ireland, Papua New Guinea.

Description: Thalli are erect, to 21 cm high and composed of irregularly branched, lubricous straps (Fig. 42). The base consists of a small discoid holdfast. Axes are branched up to 5 orders, taper from the base to the apices and measure 4–20 mm in width. Apices are acute and the surface is covered with acute proliferations (Figs 43, 44), which may develop into new axes. On transverse section the thallus is approximately 600 µm thick at mid-frond, composed of a pseudoparenchymatous cortex and a filamentous medulla. The cortex is 60–80 µm thick, composed of 6–8 cells forming anticlinal rows. Medullary filaments are mainly anticlinally arranged, 8–12 µm in diameter, with relatively abundant inner-cortical refractive ganglionic cells. The latter are irregularly shaped, with branched arms. Decussately divided tetrasporangia (14–20 µm long, 12–15 µm wide) are scattered over the thallus and are cut off from sub-surface cells. Gametophytes were not observed.

Ecology: Growing in deep intertidal rock pools or the shallow subtidal (–3 m).


Discussion: *Halymenia durvillei* is a widespread and easily recognisable species. The branching habit is very distinctive and separates it from most other species of *Halymenia*, with foliose blades. From South Africa, only *H. dilatata* Zanardini (Norris and Aken 1985) has been previously reported. This species has leafy blades with mottled surfaces, which rule out possible confusion with *H. durvillei*, which has been reported under various synonyms (*e.g.* *H. ceylanica* Harvey ex Kützing, *H. formosa* Harvey ex Kützing and *H. venusta* Børgeresen) within the tropical Indian Ocean (De Smedt et al. 2001).

*Carpopeltis phyllophora* (J. Hooker et Harvey) Schmitz in Schmitz et Hauptfleisch, 1897: 514.  
**Fig. 45**

Type locality: Port Arthur, Tasmania.

Description: Thalli are erect, to 13 cm high, planate and composed of dichotomously to irregularly branched axes, 2–7 mm in width. The base consists of a small discoid holdfast, which extends into a conspicuous midrib in the lower parts of the thallus. The apices are broadly rounded to obtuse, but proliferate with mechanical damage. On transverse section the thallus is 150–200 µm thick at mid-frond, composed of a pseudoparenchymatous cortex and a filamentous medulla. The cortex is 50–70 µm and 4–5 cells thick, composed of cells gradually decreasing in size towards the periphery, which are not arranged in antical rows. The medulla comprises about 1/3 third of the thallus thickness at maximum and is composed of compactly arranged filaments. Refractive ganglionic cells are absent. Tetrasporangia are restricted to the apical parts of the branches, are decussately to cruciately divided and ovoid (20 µm long, 12 µm wide). Gametophytes were not observed.

Ecology: Growing in lower intertidal pools and the sublittoral fringe.


Discussion: The genus *Carpopeltis*, comprising about 11 species, is mainly confined to the warmer waters of the Indo-Pacific Ocean. *Carpopeltis mai-lardii* (Montagne et Millardet) Chiang and *C. beckeri* Schmitz are known from South Africa. The latter represents an invalidly published manuscript name, the specimens on which it is based not belonging to *Carpopeltis* according to Papenfuss (see Silva et al. 1996). *Carpopeltis phyllophora* bears little resemblance to *C. mailardii*; the former being a rather large and supple species, the latter a small, cartilaginous species that branches profusely near the apices [Okamura 1909, as *C. rigida* (Harvey) Schmitz; Børgeresen 1943, as *C. rigida*; Chiang 1970]. Comparison of the South African specimens with the type specimen (BM, s.n.), collected by Dr Jeannerett at Port Arthur, Tasmania, reveals them to be morphologically very similar. It should be noted, however, that the South African specimens are rather variable with respect to thallus width, with some being as narrow as 1–2 mm, whereas others are 5–7 mm wide.

Plocamiales

**Plocamiaceae**

*Plocamium cl. mertensii* (Greville) Harvey, 1849 (1847–1849): 122.  
**Figs 46–49**

Type locality: Australia.

Description: Thalli are 9 (–17) cm tall, red in colour and alternately pinnately branched (Fig. 46). Individual axes, 2–3 mm wide, have a plumose aspect, con-
secutive branchlets being of the same length. Laterals have a tendency to produce narrow pinnules, giving the fronds a distinctive fimbriate aspect (Fig. 47). Ramuli form an alternate-distichous series of one simple and one compound branch, cut off at an angle of 45° (–60°) (Fig. 48). Simple ramuli are acerose, mostly straight, 2.5–3 (–4) mm long and 0.5–0.7 mm wide. Margins of the ramuli are smooth. The central axial filament is fairly visible after staining. Apices are slightly to strongly incurved. Clusters of tetrasporangial stichidia occur as adventitious axes in the axils of the ramuli or replace compound ramuli (Fig. 49). Individual stichidia are oblong and curved, up to 500 µm long and 80–20 µm wide, very occasionally branched at their apices. No sexual thalli were found.


Specimens: KZN 327: Sodwana Bay, intertidal (9.viii.1999); KZN 374: Mabibi (9.viii.1999); KZN

Figs 46–49. Plocamium mertensii.
Fig. 46. Habit of herbarium specimen (scale = 2 cm). Fig. 47. Detail of the apical portion of a distinctively fimbriate axis (scale = 1 cm). Fig. 48. Detail of an apex (scale = 1 cm). Fig. 49. Detail of tetrasporangial stichidia (scale = 250 µm). Fig. 52.

Figs 50–53. Plocamium telfairiae.
Fig. 50. Habit of type-one thallus (scale = 1 cm). Fig. 51. Habit of type-two thallus (scale = 1 cm). Fig. 52. Habit of type-three thallus (scale = 1 cm). Fig. 53. Detail of dendroid tetrasporangial stichidia (scale = 250 µm).

Fig. 54. Galaxaura rugosa. Habit of herbarium specimen (scale = 1 cm).
Discussion: This species has hitherto only been recorded from southern Australia. The distinctive morphology of the tetrasporangial stichidia and the fimbriate aspect of the axes of the South African specimens agree closely with the description of this species as set out in Womersley (1994). On the other hand, no serrations on the abaxial edge of the simple ramuli were observed. This character, however, does not appear to be fixed in the species. Also, the tendency of the proximal branchlets in an alternating series to become divided to a greater or lesser extent was not observed as typical of the Australian plants (G.T. Kraft, pers. comm.). This species is distinctly different from other South African species that have an alternating-distichous series of two, having relatively broad axes and relatively long, slender, clustered stichidia.

**Plocamium telfairiae** (W. Hooker et Harvey) Harvey ex Kützing, 1849: 885.

*Figs 50–53*

**Type locality:** Mauritius.

**Description:** Thalli are more or less pyramidal in outline, rose-red in colour, to 9 cm high. The main axes, 1 (−2) mm wide, are alternate-distichously branched at an angle of 25–70°. Ramuli form an alternate-distichous series of one simple and one compound branch. The latter are strongly incurved near the apices. Stellate or dendroid tetrasporangial stichidia are formed in the axes of the ramuli or replace a compound ramulus.

Ecology: Growing in intertidal rock pools and the sublittoral fringe to a depth of 15 m in northern KwaZulu-Natal.


Discussion: Three forms could be discerned for *P. telfairiae*, distinguished on the branching angle and differences in size of the axes. The density of branching is similar in type-one (Fig. 50) and type-two (Fig. 51), but the angle of branching is more acute in type-one (25–30°) as opposed to (30–) 40–55° (−70). This, combined with a narrower distance between consecutive branches, results in a greater degree of overlapping ramuli in type-one thalli. Simple ramuli are subulate to triangular, mostly straight to slightly incurved (rarely recurved). Simple ramuli in type-one are generally longer (1.5–2.5 mm) and broader (0.3–0.5 mm) than those of type-two (1–1.5 and 0.3 mm respectively). Compound ramuli are strongly incurved at the apex, with moderate overlapping in type-one and none in type-two. Type-three (Fig. 52) has a similar outline and structure, but is generally smaller (to 4.5 cm) and wider (1.5–2 mm). The ramuli of the latter are sub-pinnate, with a compound ramulus subopposite a simple one. The angle of branching lies between that of type-one and type-two (40–50°). Similarly, the simple ramuli sizes lie between type-one and type-two, although they have a wider base (0.5–1 mm). The central axial filament is not visible in type-one and type-two (or only near the apex), whilst it is in type-three. The tetrasporangial stichidia were found in type-one and type-three, whereas only female material was collected for type-two. The former occur in the axis of ramuli or replacing compound ramuli and having a stellate/tree-shape (Fig. 53).

The specimens examined agree with descriptions and herbarium specimens of this species (including an isotype specimen in BM). This is the first record of this species in South Africa, although Seagriff (1984) and Cormaci *et al.* (1991) credited this species to South Africa based on supposed records of Simons (1964). The latter, however, reported the species only from Mozambique and not from South Africa. This species has a wide distribution within the Indian and Pacific Oceans. There is also an Atlantic record from Ghana by Lawson and John (1987).

**Nemalionales**

**Galaxauraceae**

**Galaxaura rugosa** (Ellis et Solander) Lamouroux, 1816: 263.

*Fig. 54*

**Type locality:** Jamaica.

**Description:** Thalli are erect, to 8 cm high, hirsute and calcified. The axes are terete, dichotomously branched, 2 mm in diameter and densely covered by assimilatory filaments. The medulla consists of entangled filaments (12–16 µm in diameter). The cortex is filamentous with both short and long assimilatory filaments, which arise from inflated proximal cortex cells (33–42 µm in diameter). The cruciately divided tetraropangia are borne apically on short assimilatory filaments. They are ovoid, 25–30 µm long and 20 µm wide. Gametophytes were not observed.

Ecology: Epilithic in the lower intertidal zone.

**Specimens:** KZN 326: Sodwana Bay, intertidal (9.viii.1999); KZN 466: Mabibi (11.viii.1999); KZN 1685: Island Rock (14.viii.2000).

Discussion: Despite taxonomic confusion in the past (see Huisman and Borowitzka 1990), tetraropangians of *G. rugosa* are easily recognisable by their hirsute habit. Several species of *Galaxaura* and the morphologically similar genus *Tricleocarpa* are known from South Africa. *Galaxaura diesingiana* Zarnadini, *G. magna* Kjellman and *G. marginata* (Ellis et Solander) Lamouroux are all complanate. *Galaxaura obtusata* (Ellis et Solander) Lamouroux and *Tricleocarpa fragilis* (Linnaeus) Huisman *et* Townsend
are both terete, but are never hirsute and always lack the inflated proximal cells of assimilatory filaments. *Galaxaura rugosa* is widespread in the tropical Indian Ocean.

**Discussion**

Distribution patterns of tropical seaweeds are incomplete for many taxa. Several regions have received very little attention and remain seriously un(der)explored. There are not only limited data on small islands and archipelagos but also for several continental coastal regions such as Oman, Iran and Madagascar. This makes biogeographical assessments difficult, but a number of clear trends are indicated (Table I).

The majority of the Phaeophyta and Rhodophyta reported in this paper consist of widespread tropical species. *Asteronema breviarticulatum, Dictyota cervicornis, D. ciliolata* and *Galaxaura rugosa* are mainly pantropical species, occurring in the Atlantic (Caribbean Sea) and Indian Oceans as well as the Pacific Ocean. Some are present along the Western Australian coast. Next to the pantropical taxa, several species have a defined Indo-Pacific or Indian Ocean distribution: *Ceramium cingulatum, Euptilota fergusonii, Halymenia durvillei* and *Phacelocarpus tristichus*. The presence of pantropical and Indo-Pacific species along the northern part of the Kwazulu-Natal coast is not surprising, as several of these species have been reported from Inhaca in southern Mozambique. Their presence in the northern part of the Kwazulu-Natal coastline, therefore, only indicates a minor range extension. In contrast, the distribution range of *Digeneopsis subopaca* remains restricted to northern Kwazulu-Natal and the Inhaca Peninsula in Mozambique. Together with *Dasycladus ramosus* Chamberlain (1958), these species are probably endemic to the northern part of the overlap region between warm-temperate South African waters and the tropical Indian Ocean.

*Balliella crouanioides, Gibsmithia hawaiiensis, Predaea weldii* and *Hypoglossum minimum* are characterised by disjunct tropical Indo-Pacific distribution patterns. All three were originally described from the central or western Pacific Ocean and have been reported from a few scattered localities within the Indian Ocean. Their small size and subtidal habitat probably contribute to the scarcity of reports. *Balliella crouanioides* and *Gibsmithia hawaiiensis* have recently been reported for the East African coast (Coppejans et al. 2000). Their presence along the South African coast may indicate a wide distribution within the Indo-Pacific region.

*Carpopeltis phyllophora* and *Plocamium mertensii* are both Australian species. Norris and Aken (1985) and Hommersand (1986) regard this South African flora as having affinities with the western- and southern Australian algal floras, although there has been some debate on what may have caused these floristic similarities. According to Hommersand (1986), the

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General references: Womersley (1987; 1994; 1998); Millar and Kraft (1993); Silva et al. (1996); Phillips (1997); Wynne (1998); Yoshida (1998); Abbott (1999); Coppejans and Millar (2000); Coppejans et al. (2000); Huisman (2000).
genus *Carpopeltis* and to a certain extent *Plocamium* represent examples of species clusters that originated along the west and south coasts of Australia and migrated to South Africa during mid-to-late Miocene periods (16–6Mya) marked by a general decrease in temperature in the tropics. *Eupitilotica articulata* may also represent an example of the South African-Australian connection, although the species has also been reported from India and the North-West Pacific.

The distribution of *Padina gymnospora* is difficult to interpret due to taxonomic confusion in the past. Studies on the genus *Padina* along the East African coast (Somalia to South Africa) have revealed that *P. gymnospora* is absent along the tropical coasts of Kenya, Tanzania and the various tropical archipelagos (Muylle 2000). The species is, however, present in Kenya, Tanzania and the various tropical archipelagos (Muylle 2000). The distribution pattern is interesting as both geographically isolated populations are in habitats characterised by slightly cooler water temperatures than occur in the tropical Indian Ocean. Similar examples of disjunct distribution patterns between the northern Arabian Sea and the South African east coast are offered by: *Dictyopteris macrocarpa* (Areschoug) Schmidt, *Ecklonia radiata* (C. Agardh) J. Agardh and *Pseudocodium de-vriesii* Weber-van Bosse (Barratt *et al.* 1984, Barratt *et al.* 1986, Wynne 1999).

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**References**


