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New records of the Chlorophyta from South Africa, with the emphasis on the marine benthic flora of KwaZulu-Natal

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Eleven species of marine Chlorophyta that have not previously been reported for South Africa have been found on the coast of Kwazulu-Natal: *Avrainvillea cf. riukiuensis* Yamada; *Boodleopsis pusilla* (Collins) W.R. Taylor, Joly & Bernatowicz; *Bornetella nitida* Sonder; *Caulerpa serrulata* (Forsskål) J. Agardh; *C. taxifolia* (Vahl) C. Agardh; *Chaetomorpha spiralis* Okamura; *Cladophoropsis sundanensis* Reinbold; *Halimeda gracilis* Harvey ex J. Agardh; *Neomeris annulata* Dickie; *Neomeris bilimbata* Koster; *Udotea indica* A. Gepp & E. Gepp. Three of the above genera (*Avrainvillea*, *Boodleopsis* and *Bornetella*) are new for South Africa. Descriptions and illustrations are provided for each species. Furthermore the species are compared with other similar species in the area and their ecology and biogeography are briefly discussed.

Introduction

The seaweed flora of South Africa has long been recognised as being rich in species when compared with other regions. Detailed data, especially for the south and east coast, are not readily available but a synthesis of available information gives a total of around 800 species, 150 of which are Chlorophyta (Bolton and Anderson 1997). The high species diversity in South Africa is a consequence of the extreme diversity of marine conditions. The different temperature regimes on the west, south and east coast (caused by the different ocean currents which sweep along the South African shores) result in more or less distinct seaweed floras (see Stephenson 1947, Bolton 1986, Bolton and Anderson 1990, Bolton and Anderson 1997).

The coast of Kwazulu-Natal stretches from Port Edward in the south to the Mozambiquan border in the north, on the east coast of South Africa. The coastline was designated as the 'subtropical East Coast', characterised by a distinct flora, by Stephenson (1947). More recently the existence of a distinct subtropical flora in Kwazulu-Natal was questioned, as the flora seems to be composed of an eastwardly decreasing number of Agulhas Province species, replaced largely by Indo-West Pacific species as the water temperature rises (Hommersand 1986, Bolton and Anderson 1997).

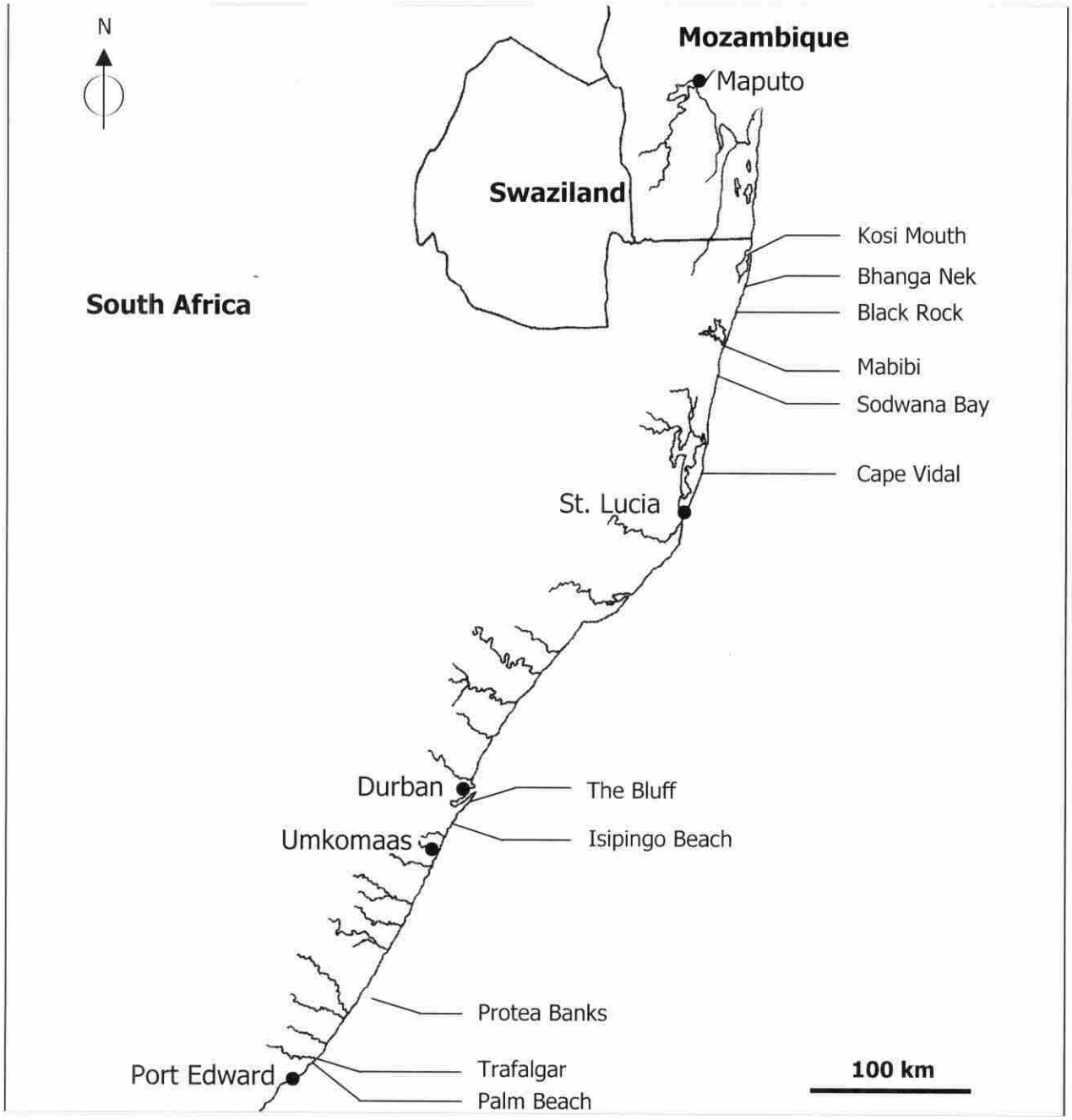
It should be pointed out that the knowledge of the seaweed flora of Kwazulu-Natal is scarce and that a detailed study of the flora is needed in order to make further biogeographic conclusions. In a joint research project between the University of Ghent (Belgium) and the University of Cape Town (South Africa) the biogeography of the seaweeds of Kwazulu-Natal are being studied. This study should give us a better understanding of the seaweed distribution in Kwazulu-Natal and the affinities with other seaweed floras.

Apart from a thorough treatment of the genus *Codium* by Silva (1959) and a number of other publications dealing with Chlorophyta (e.g. Papenfuss 1940, 1943, 1952, 1956, Papenfuss and Egerod 1957, Norris 1992), the benthic marine green algae of the east coast of South Africa, especially the coast of Kwazulu-Natal are understudied. 131 Chlorophyta taxa in 38 genera have been reported for the Indian Ocean coast of South Africa. The genera *Caulerpa* (23 taxa), *Cladophora* (20 taxa), *Codium* (19 taxa) and *Enteromorpha* (9 taxa) are responsible for more than half of the taxa. Other genera with relative high species numbers (5 or more) are *Bryopsis*, *Chaetomorpha*, *Rhizoclonium* and *Ulva*.

This paper gives a preliminary report on 11 Chlorophyta species which are reported for the first time for South Africa.

Material and Methods

Specimens examined were collected along the eastern coast of South Africa on several occasions between November 1995 and August 2000 in the framework of a bilateral scientific cooperation between the Flemish community (Belgium) and South Africa. The collecting sites were located beween Cape Morgan (southern Transkei) and Kosi Bay (northern Kwazulu-Natal) (Map 1). In total over 800 Chlorophyta specimens were collected. Specimens were processed as herbarium specimens in the field and part of each specimen was preserved in 5% formalin in seawater.



Map 1: Map of KwaZulu-Natal with position of the sampling stations

Voucher specimens are deposited in GENT and BOL. Herbarium abbreviations follow Holmgren *et al.* (1990).

Results

CLADOPHORALES
Cladophoraceae
***Chaetomorpha spiralis* Okamura**, 1903a: no. 94; 1903b: 131–132
Type locality: Nemoto, Chiba Prefecture, Japan (*leg.* Okamura, 'Algae Japonicae Exsiccatae', Imperial Fisheries Institute, Tokyo; isotype in UC *fide* Silva *et al.* 1996: 767; sets of the exsiccatae in various herbaria fide Stafleu and Cowan 1981).

Description: Thallus dark green, erect, composed of rigid, simple filaments, spirally coiled at the base, attached by branched rhizoids. Basal cell curved, length up to 4 000µm, diameter 300µm at the base, up to 750µm at the distal end. Cells above the basal cell subcylindrical, diameter 530–570µm, gradually increasing in diameter towards the apex and becoming barrel-shaped; distal cells up to 1 100µm

in diameter; l/w of cells in middle and distal part of thallus 1.5–2.0.

Ecology: epiphytic on *Amphiroa bowerbankii* Harvey in intertidal rockpools.

Specimens examined: KZN 814: Palm Beach (19/08/1999); KZN 943: Port O'Call, Trafalgar (20/08/1999).

Discussion: Along the East African coast this species has only been reported from Somalia (Sartoni 1992) and Kenya (Coppejans *et al.* 2000). The species resembles *C. crassa* (C. Agardh) Kützing, which has previously been reported from South Africa (Simons 1977, Farrell *et al.* 1993), but differs in its mode of attachment (*C. crassa* is a free floating species), the elongate basal cell and smaller diameter of the filaments (Sartoni 1992).

Cladophoropsis sundanensis Reinbold, 1905: 147
Figures 6–8
Syntype localities: various in Indonesia, including Solor and Semau fide Weber-van Bosse, (1913: 77) (*leg.* Weber-van Bosse, Siboga Expedition, 937 279 372, L).

Description: Thallus light green, forming compact cushions, up to 6cm across and 1.5cm thick, composed of strongly entangled, branched filaments. Basal branching pseudodichotomous, terminal branching unilateral with lateral branches arising under a cross wall and not displacing the main axes. Apical cells cylindrical with rounded tip, diameter 70–140µm, l/w ratio up to 80. Diameter of intermediate branches 90–140µm, l/w ratio of cells 4–50. Diameter of basal filaments 180-250µm. Short hapteroidal rhizoids present throughout the thallus.

Ecology: Epilithic in intertidal rockpools and infralittoral fringe.

Specimens examined: HEC 10944: Isipingo Beach (21/01/1995); KZN 395: Mabibi (09/08/1999); KZN 1693: Island Rock (14/08/2000); KZN 2148: Sodwana (11/02/2001).

Discussion: Our specimens correspond very well with the descriptions and illustrations of *C. sundanensis* by Weber-van Bosse (1913: 77–79, figure 18), Børgesen (1935: 10–11, figure 1), Egerod (1975: 46, figures 8–10) and Sartoni (1986: 365, figure 6B).
C. sundanensis has a pantropical distribution; in the south western Indian Ocean it has been recorded from Kenya, Tanzania, Mauritius and Réunion (Silva *et al.* 1996: 793–794).

The only *Cladophoropsis* species hitherto recorded for South Africa is *C. herpestica* (Montagne) Howe, which differs from *C. sundanensis* by its much coarser filaments (generally 240–340µm in diameter), abundant, long, descending rhizoids throughout, and lateral branches which tend to displace the main axis.

BRYOPSIDALES
Caulerpaceae
***Caulerpa serrulata* (Forsskål) J. Agardh**, 1837: 174
Figure 1
Fucus serrulatus Forsskål, 1775: 189
Type locality: Mokha, Yemen (*leg.* Forsskål, C).

Description: Thallus relatively stiff, consisting of a creeping, irregularly branched stolon, giving rise to erect fronds and downward growing rhizoid-bearing branches; erect fronds simple or dichotomously branched, flat, branched in a single plane, not spirally twisted, up to 15mm high and 2mm wide, with coarsely serrate margins.

Ecology: Growing on sand and sand-covered rocks, at a depth of 12–20m.

Specimens examined: KZN 338: 2-Mile Reef, Sodwana Bay (09/08/1999); KZN 632: Sexton Reef, Bhanga Neck (14/08/1999); KZN 1722: 2-Mile Reef, Sodwana Bay (15/08/2000).

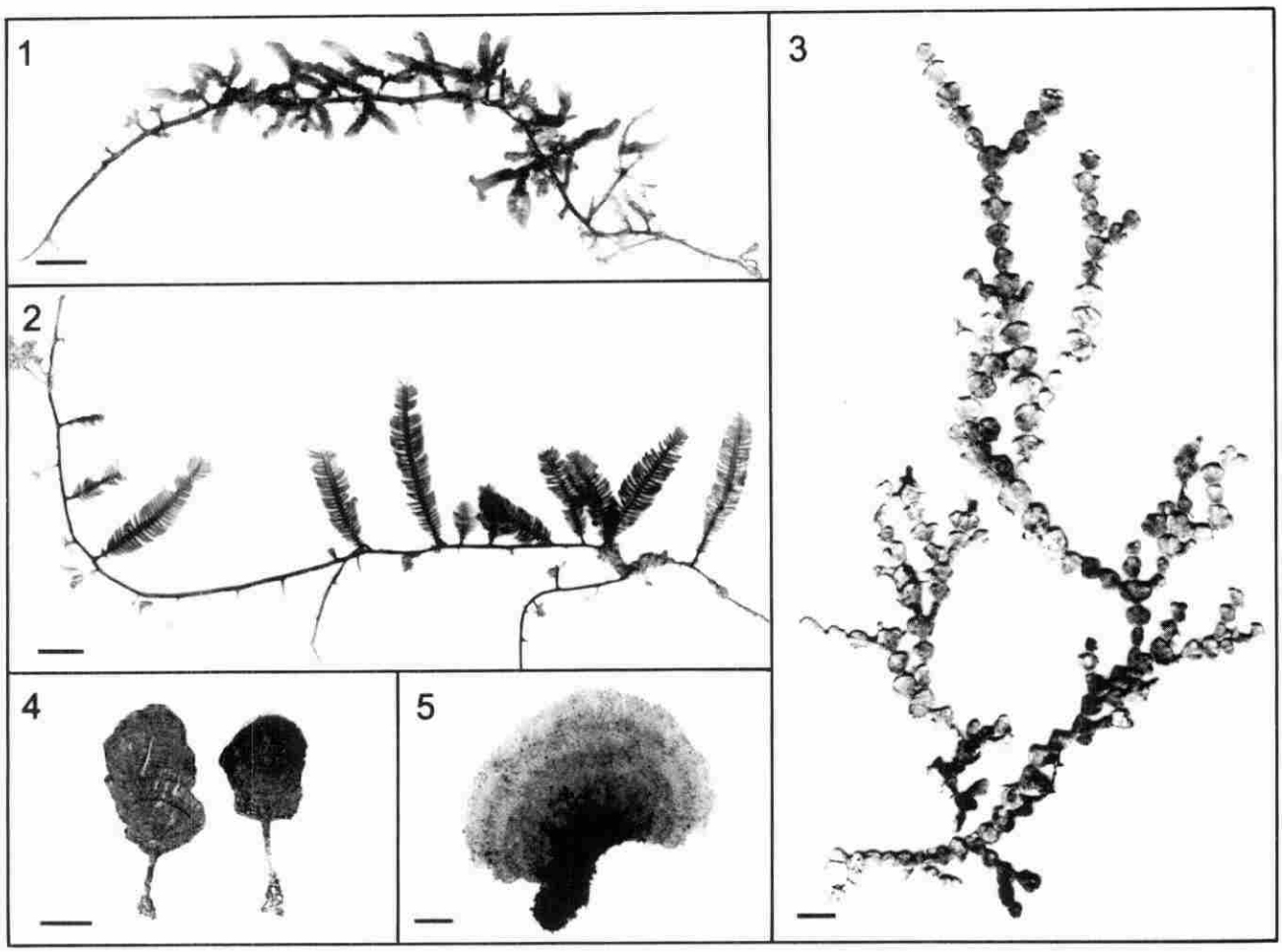
Discussion: The coarsely serrate, flattened, erect fronds distinguish *C. serrulata* from any *Caulerpa* reported from South Africa. The species resembles certain growth forms of *C. cupressoides* (Vahl) C. Agardh characterised by a wide rachis with marginally placed distichous branchlets or spines, which has also been reported for South Africa (Seagrief 1980: 21). However, the rachis of the latter is always terete to slightly compressed but never flattened as in *C. serrulata* (Coppejans and Prud'homme van Reine 1992: 673). *C. serrulata* is widely distributed in the Atlantic, Pacific and Indian Oceans, and is known from all countries along the East African coast (Silva *et al.* 1996).

***Caulerpa taxifolia* (Vahl) C. Agardh**, 1817: XXII
Figure 2
Fucus taxifolius Vahl 1802: 36.
Type locality: St. Croix, Virgin Islands (*leg.* H. West). M Vahl was professor in botany at the University of Copenhagen, so it would be logical that his specimens were accomodated in Copenhagen. According to Nielsen and Price (pers. comm.) the existence of any original material in C and several other herbaria could not be documented and therefore the selection of a neotype is needed.

Description: Branched stolons bearing pinnate erect fronds, 10–40mm high, 5–8mm wide; rachis 0.8–1mm in diameter, occasionally branched, naked at the base (1–3mm); branchlets on 2 opposite rows in a single plane, dorso-ventrally compressed, navicular, upwardly curved, slightly constricted at the base, with parallel sides and gradually tapering to the acuminate apex; ramuli densely set but not overlapping.

Ecology: epipsammic on coarse sand, growing at a depth of 20–43m.

Specimens examined: KZN 414: 7-Mile Reef, Sodwana Bay (09/08/1999); KZN 508: Tiger Reef, Bhanga Neck (13/08/1999); KZN 633: Sexton Reef, Bhanga Neck



Figures 1–5: General habit. **1.** *Caulerpa serrulata* (KZN 338); **2.** *C. taxifolia* (KZN 414); **3.** *Halimeda gracilis* (KZN 509); **4.** *Udotea indica* (KZN 363); **5.** *Avrainvillea* cf. *riukiuensis* (KZN 2119); scale-bars 1–5: 1cm; 5: 2mm

(14/08/1999); KZN 2122: Deep Sponge Reef, Sodwana Bay (11/02/2001).

Discussion: *C. taxifolia* resembles *C. mexicana* Sonder ex Kützing and the two species are not always easily distinguished. The branchlets of *C. taxifolia* have parallel sides in the middle part, whereas those of *C. mexicana* have a marked swollen part in the middle or subapical part, resulting in overlapping ramuli (Coppejans and Beeckman 1990, Coppejans and Prud'homme van Reine 1992). Small plants of *C. mexicana* have been reported from Kwazulu-Natal (The Bluff, Durban and Umhlanga Rocks) by Papenfuss (1956: 65–66) but might, in fact, belong to *C. taxifolia*. The species is widely distributed in the subtropical and tropical parts of the Atlantic, Indian and Pacific Oceans.

Halimedaceae

***Halimeda gracilis* Harvey ex J. Agardh**, 1887: 82

Figures 3, 9–10

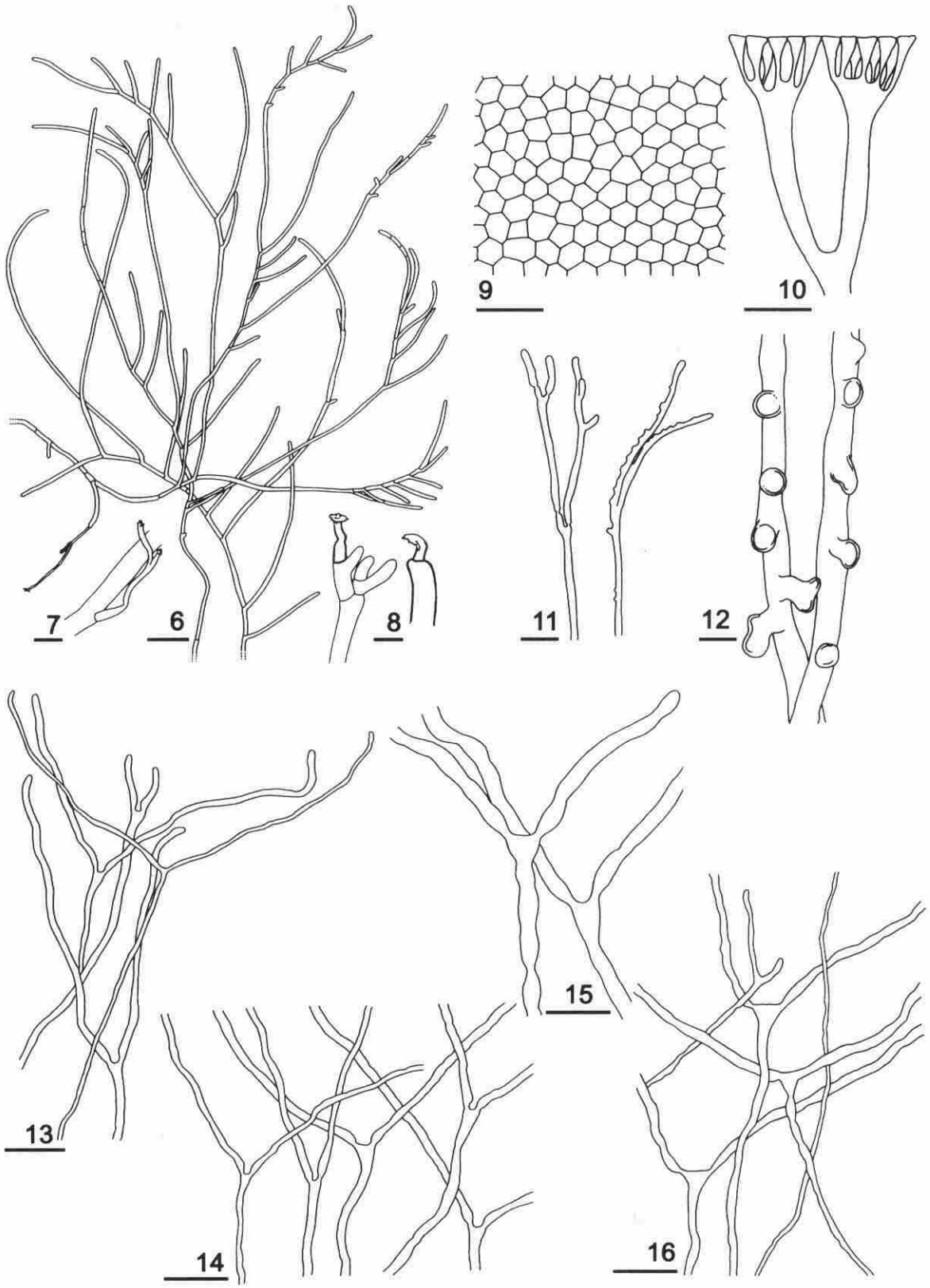
Type locality: Sri Lanka [Harvey's Ceylon Algae (1857a) n° 72, BM; sets of the exsiccatae at FH, FMC, L and NY *fide* Stafleu and Cowan (1981)].

Description: Thallus flaccid and decumbent, up to 25cm long. Branching di- or trichotomous, sparse basally, more frequent higher up, 1–8 segments between two consecutive branchings. Segments flattened and ribbed, heavily calcified, brittle, cuneate or trilobed, the upper margin entire, undulated or trilobed, up to to 8mm long and 10mm broad. Colour when dry whitish to light green. Cortex composed of two layers of utricles, primary utricles hexagonal in surface view, (30–) 35–50 (–55)µm in diameter, 40–80µm long in section, up to 7 supported by each secondary utricle; secondary utricles clavate, 25–50µm broad, up to 100µm long and generally extending to the medulla.

Ecology: Epilithic, 43m deep.

Specimen examined: KZN 509: Tiger Reef, Bhanga Neck (13/08/1999).

Discussion: *Halimeda gracilis* is a pantropical species, occurring in the Indian Ocean, western Pacific and the western Atlantic. Along the east African coast the species has only been recorded from Kenya (Coppejans and Verellen 1991: 16) and Tanzania (Coppejans *et al.* 2000: 72). *H. gracilis* can be recognised by its entangling and decumbent



Figures 6–16: 6–8. *Cladophoropsis sundanensis* (KZN 2148): **6.** general branching pattern; **7, 8.** hapteroidal rhizoids; **9, 10.** *Halimeda gracilis* (KZN 509): **9.** hexagonal utricles in surface view; **10.** cross section of the cortex with two layers of utricles; **11, 12.** *Udotea indica* (KZN 363): **11.** filaments of blade with uneven supra-dichotomial constrictions; **12.** filaments of the blade with peltate or truncate papillae; **13–16.** *Avrainvillea* cf. *riukiuensis* (KZN 2119): **13, 14.** blade siphons; **15.** medullary siphons of the stipe; **16.** cortical siphons of stipe. scale-bars. 6: 1 000µm; 7, 8–10, 13–16: 100µm; 11: 200µm; 12: 50µm

thallus and the whitish, brittle, cuneate or trilobed segments (Hillis-Colinvaux 1980: 144–147).

Udoteaceae

***Udotea indica* A. Gepp & E. Gepp**, 1911: 121–122, plate II: figures 13, 14; plate VI: figures 52, 53
Figures 4, 11–12
Type locality: Karachi, Pakistan (*leg.* J.A. Murray, BM).

Description: Thallus erect, 2–5cm long, slightly calcified and thus rather stiff, composed of a stipe and a blade, attached to the substratum by a small tuft of rhizoids. Stipe simple, 5–15mm long, about 1mm thick. Blade 15–40mm long, 15–35mm broad, elliptical, ovate or rotundo-flabellate, usually rounded at the base but sometimes cuneate or subcordate.

Filaments of the blade 40–50µm in diameter, radiating from the stipe to the margin, dichotomously branched, the supra-dichotomial constrictions being markedly uneven; filaments locally bearing numerous unilateral, short, unbranched, peltate or truncate papillae, borne only on the exposed surface of the filaments. Filaments of the stipe irregularly dichotomously branched, having lateral appendages with dichotomously divided apices forming an external cortex.

Ecology: Shallow intertidal pools.

Specimens examined: KZN 363: Mabibi (09/08/1999); KZN 1678: Mabibi (13/08/2000); KZN 1735: Sodwana Bay (15/08/2000); KZN 1820: Cape Vidal (18/08/2000); KZN 2187: Mabibi Reef (13/02/2001).

Discussion: The only *Udotea* species hitherto recorded for South Africa is *Udotea orientalis* A. Gepp & E. Gepp, which in habit is very similar to the above species. *U. orientalis* differs from *U. indica* in the blade filaments being devoid of lateral papillae (Gepp and Gepp 1911: 122).

***Avrainvillea* cf. *riukiuensis* Yamada**, 1932: 267–268, figure 1, plate III
Figures 5, 13–16
Type locality: Nawa, Ryukyu-retto, Japan (*leg.* T. Teramachi, 12768b, SAP).

Description: Thallus solitary, olive-green, 12mm tall. Blade thin, reniform, faintly zonate, 9mm tall, 13mm wide. Stipe unbranched, cylindrical, 3mm long, 1.5mm in diameter. Blade siphons cylindrical, 5–18µm in diameter (up to 25µm at dichotomies). Morphology of the blade siphon apices rounded to slightly inflated. Medullary siphons of stipe cylindrical to slightly moniliform, 17–38µm in diameter. Cortical siphons of stipe cylindrical to slightly moniliform, 7–30µm in diameter.

Ecology: Epilithic on horizontal substrate, subtidal (-30m).
Specimen examined: KZN 2119: Deep Sponge Reef, Sodwana (11/02/2001).

Discussion: Blade siphons of most *Avrainvillea* species are thicker than 20µm. Three taxa have been described with smaller blade siphon diameters: *A. hollenbergii* Trono from the Caroline Islands with blade siphons (3–) 6–12 (–14)µm in diameter, *A. riukiuensis* from Japan with blade siphons (9–) 19µm in diameter, and *A. levis* Howe f. *translucens* D. Littler & M. Littler from the Caribbean with thin blade siphons (5–10µm) intermixed with thick (20–30µm) siphons (Olsen-Stojkovich 1985: 44, Littler and Littler 1992: 394).

Only one small (juvenile?) specimen was found in our collections. The siphon morphology and dimensions correspond fairly well with the descriptions and illustrations of *A. riukiuensis* (Olsen-Stojkovich 1985: 44, figure 23, plate 9a) and the original description of *A. gracillima* Børgesen from Mauritius (Børgesen 1940: 52, figure 15, plate II, figure 2), a species that has been reduced to synonymy of *A. riukiuensis* by Olsen-Stojkovich (l.c.). Our plant differs however from *A. riukiuensis* in its overall smaller habitus.

This is the first record of the genus *Avrainvillea* in South Africa.

Boodleopsis pusilla (Collins) W.R. Taylor, Joly & Bernatowicz 1953: 105–106
Figures 17–21
Dichotomosiphon pusillus Collins, 1909: 431–432
Syntype localities: Jamaica and Bermuda (*leg.* Collins, NY).

Description: Thallus uncalcified, forming caespitose tufts, consisting of a main axis forming slender ramified rhizoidal filaments and upright intertwined siphonous branches. Main axis 80–210µm in diameter; rhizoidal filaments dichotomously branched, 8–30µm in diameter. Erect filaments 60–120µm in diameter near the base, 40–55µm in the middle and apical parts; branching dense, mainly di- or trichotomous, occasionally verticillate; filaments constricted just above the supporting filament.

Only one, immature gametangium observed.

Ecology: Intertidal, sometimes entangled with the stolons of *Caulerpa racemosa* (Forsskål) J. Agardh.

Specimens examined: KZN 653: Black Rock (14/08/1999); KZN 1908: Protea Banks, Southern Pinnacle (4/02/2001); KZN 1945: Protea Banks, Northern Pinnacle (5/02/2001);

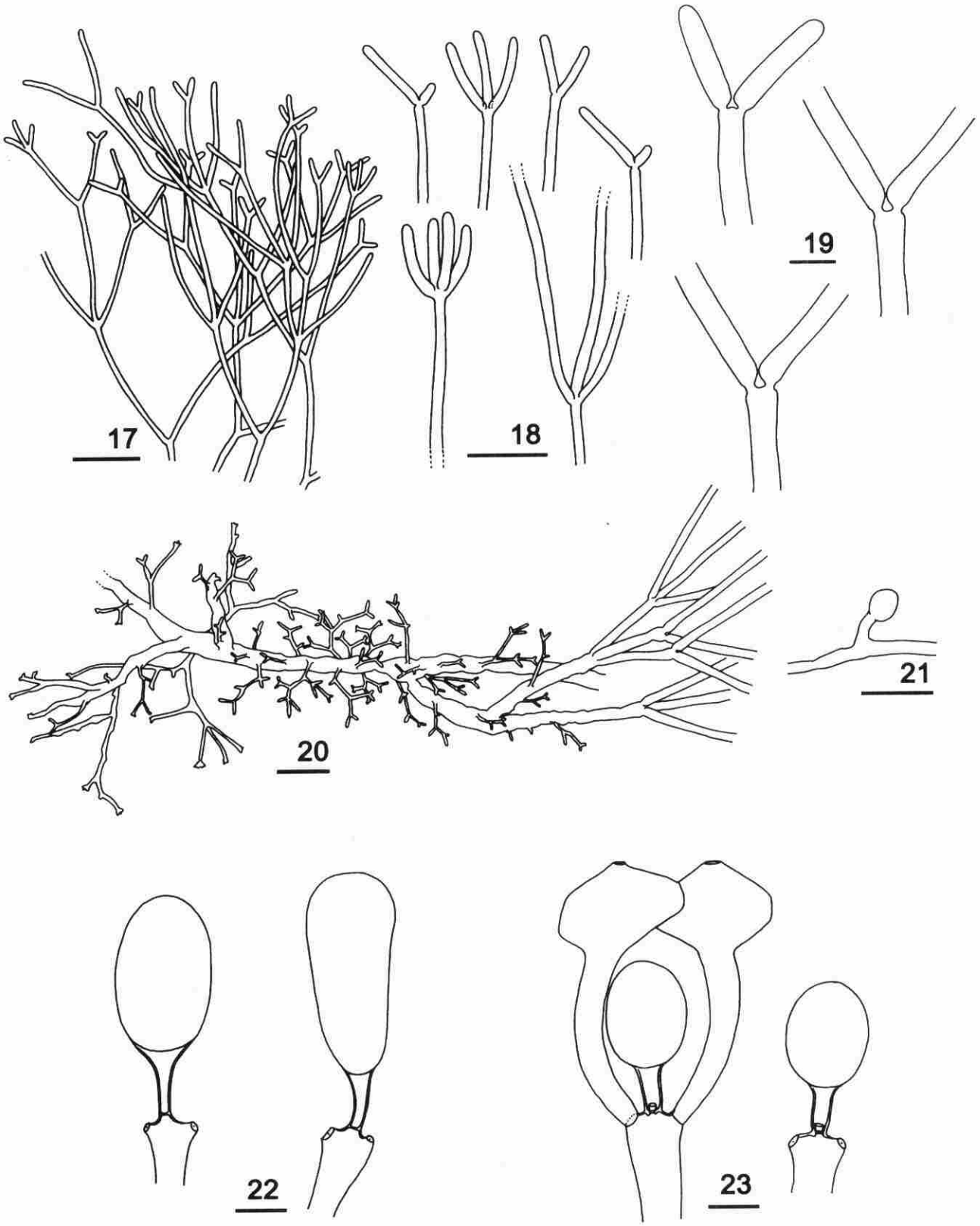
Discussion: *Boodleopsis pusilla* is a pantropical species. Along the east African coast it has been reported from Kenya (Coppejans *et al.* 1992: 63), Tanzania (Lawson 1980: 3) and Mozambique (Isaac and Chamberlain 1958: 124–127, figure 2, 3). This is the first record of the genus in South Africa.

Dasycladales

Dasycladaceae

***Bornetella nitida* Sonder**, 1880: 39
Type locality: Tonga [Harvey's Friendly Island Algae (1857b) n° 83, MEL; sets of the exsiccatae at FH, G, L and NY *fide* Stafleu and Cowan (1981)].

Description: Thallus clavate, sometimes curved, 2–2.5cm high, 6–7mm in diameter, dark green, consisting of a central



Figures 17–23: 17–21. *Boodleopsis pusilla* (KZN 653): **17.** upright intertwined siphonous branches; **18.** dichotomous, trichotomous and verticillate branching of the filaments; **19.** filaments constricted just above the supporting filament; **20.** rhizoidal filaments; **21.** immature gametangium; **22.** *Neomeris annulata*, gametangia (KZN 258b); **23.** *Neomeris bilimbata*, gametangia (KZN 258a). scale-bars: 17: 1 000µm; 18: 500µm; 19, 21: 100µm; 20: 300µm; 22, 23: 50µm

axis bearing whorls of lateral branches along its entire length. First order branches distally producing second order branches with inflated apices cohering laterally to form a monostromatic cortex. Cortex cells (measured in surface view between parallel sides of the lateral walls of the hexagons) 190–210µm; lateral walls of the cortex cells calcified. Gametangia spherical, borne laterally on the first order branches, 1–2 per branch, 200–210µm in diameter, each producing a large number (>20) of cysts.

Ecology: Subtidal (-20m), epilithic.

Specimen examined: KZN 615: Sexton Reef, Bhanga Neck (14/08/1999).

Discussion: *Bornetella nitida* is widely distributed in the tropical south-eastern Pacific and Indian Oceans; in the south-western Indian Ocean it has been recorded from Mauritius (Børgesen 1946), Réunion (Payri 1985) and the Comore Islands. This is the first record of the genus for South Africa. *Bornetella* comprises 4 species, two of which (*B. nitida* and *B. oligospora* Solms-Laubach) are characterised by clavate thalli, the others [*B. capitata* (Harvey ex E. Wright) J. Agardh and *B. sphaerica* (Zanardini) Solms-Laubach] by spherical thalli. *B. oligospora* differs from *B. nitida* by the large number of gametangia (>4) on the primary axes and the low number of cysts (<8) produced per gametangium (Valet 1969: 586). See Silva *et al.* (1996: 887) for nomenclature of this species.

Neomeris Lamouroux 1816: 241
Neomeris is a pantropical genus of 7 species, two of which (*N. dumetosa* Lamouroux and *N. van-bosseae* Howe) have been previously reported for South Africa; *N. annulata* and *N. bilimbata* are reported here for the first time for South Africa. *N. van-bosseae* is the most common *Neomeris* species in Kwazulu-Natal; *N. annulata* and *N. bilimbata* were each only found on one occasion. The occurrence of *N. dumetosa* (Critchley *et al.* 1994) remains uncertain since no description nor illustration was given. Table 1 gives the main characters to distinguish the four South African species.

Neomeris annulata Dickie, 1874: 198
Figure 22
Type locality: Mauritius (*leg.* Colonel Pike, BM).

Description: Thallus 10–14mm long and 2–2.5mm in diameter. Primary branches 250–320µm long, 14–20µm in diameter at the base and 50–65µm at the apex. Secondary branches with a flattened apex, strongly calcified except for the cortex surface, each branch bearing an unbranched hair at the apex (leaving a scar when shed). Gametangia strongly calcified and cohering in discontinuous transverse rows within a calcareous sheath, elongate elliptical to obovate, 150–190µm long, 65–90µm in diameter.

Ecology: Epilithic, subtidal (-10m), mixed with *Neomeris bilimbata*.

Specimen examined: KZN 258b: 2-Mile Reef, Sodwana Bay (08/08/1999).

Discussion: *Neomeris annulata* is widely distributed in the tropical Atlantic, Indian and Pacific Oceans. In the south-western Indian Ocean it has been recorded for the Comore Islands, Mauritius (type locality), Réunion, Tanzania and Kenya (Silva *et al.* 1996: 889, Coppejans *et al.* 2000: 77). *N. annulata* is unmistakable on account of the discontinuous transverse rows of calcification at the base of the thallus, visible with the naked eye.

Neomeris bilimbata Koster 1937: 221–223, plate XV: figures 1, 4, 5.
Figure 23
Type locality: Itu Aba, Tizard Bank, South China Sea (Expedition of the Oceanographic Institution of Nhatrang (Annam, Vietnam) to the Tizard Bank, Station 871, n° 4, L 936254130).

Description: Thallus 8–10mm long, 1.5–2mm in diameter. Primary branches 300–370µm long, 30–35µm in diameter at the base and 40–50µm at the apex; basal branches clavate, 400–500µm long, 60–100µm in diameter. Secondary branches strongly calcified, each branch bearing an unbranched hair at the apex (leaving a scar when shed). Gametangia strongly calcified but free from each other, ellipsoid, 100–115µm long, 75–80µm in diameter. Cellulosic plug as a cylinder in the pedicel of the gametangium.

Ecology: Epilithic, subtidal (-10m), sometimes mixed with *Neomeris annulata*.

Specimens examined: KZN 258a: 2-Mile Reef, Sodwana Bay (08/08/1999); KZN 2092: 2-Mile Reef, Sodwana Bay (10/02/2001).

Discussion: *Neomeris bilimbata* is known from the W- and

Table 1: Main distinctive characteristics of the 4 South African *Neomeris* species

	primary segments coherent by calcification	gametangia laterally coherent by calcification	shape of gametangia	cellulosic plug morphology
N. annulata	-	+	pyriform	cylinder in the pedicel of the gametangium combined with a cone in primary branch
N. bilimbata	-	-	ellipsoid	cylinder in the pedicel of the gametangium
N. vanbosseae	-	-	spherical	variable: absent, inconspicuous swelling or downward pointed spine
N. dumetosa	+	-	spherical	?

SW-Pacific; in the Indian Ocean the species has, up to now, only been reported from Singapore and the Seychelles. *N. bilimbata* resembles *N. van-bosseae* Howe and *N. mucosa* Howe, but differs in the morphology of the cellulosic plug and apical shape of the primary branches (Koster 1937: 221–223, Valet 1969: table on pg 599).

General discussion

Many of the newly reported species consist of relatively wide-spread tropical species: *Boodleopsis pusilla*, *Caulerpa taxifolia*, *Cladophoropsis sundanensis*, *Halimeda gracilis*, and *Neomeris annulata*. Most other species are widely distributed in the tropical and subtropical Indo-Pacific: *Caulerpa serrulata*, *Chaetomorpha spiralis*, *Udotea indica*, *Bornetella nitida* and *Neomeris bilimbata*. The presence of *Boodleopsis pusilla* and *Caulerpa serrulata* along the northern part of the Kwazulu-Natal coast is not suprising as these species have been reported from the Inhaca Peninsula near the southern border of Mozambique (Isaac and Chamberlain 1958, Pocock 1958), therefore only indicating a minor range extension. Most of the other species mentioned above have been previously recorded in the south-western Indian Ocean, yet one species, *Chaetomorpha spiralis*, constitutes a substantial range extension. *C. spiralis* is a Japanese species with a disjunct distribution in the Pacific Ocean (Philippines, Papua New Guinea, Australia and California), and the northern and eastern parts of the Indian Ocean [often as *Chaetomorpha torta* (Farlow ex Collins) Yendo; see Silva *et al.* 1996)]. In the western Indian Ocean *C. spiralis* has only been reported from Somalia (Sartoni 1992: 299) and Kenya (Coppejans *et al.* 2000: 62). *Avrainvillea riukiuensis* seems to have a very disjunct distribution. The species has been described from Japan and has also been recorded from Mauritius and Bahrain (as *Avrainvillea gracillima*).

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