Ulva Linnaeus, 1753

ULVALES, ULVACEAE

Mature thallus a flattened distromatic blade in which the two cell layers are developmentally independent but closely adherent. Blades can be broadly expanded, irregularly lobed, cuneate, linear, lanceolate, oblanceolate, or deeply divided into linear lacinae. Some species show regular perforations such as *U*. *reticulata*, or marginal dentations such as *U*. *rigida*. Growth of blade by diffuse cell divisions primarily along the margins. Usually attached to substrate by rhizoidal cells in a basal holdfast and/or rhizoidal extensions of cells in the lower portion of the blade or occasionally extending along part or the entire longitudinal axis of the blade. Vegetative reproduction by fragmentation or by growth of new upright thalli from basal cells and/or persistent holdfasts. Life history typically an alternation of isomorphic, unisexual haploid gametophytes and diploid sporophyte. A cosmopolitan genus with species in all oceans and estuaries of the world. Species of *Ulva* have traditionally been based on morphological, anatomical and cytological characteristics such as shape, size, presence or absence of dentation, thickness, cell dimensions and number of pyrenoids. Many studies have shown that these characteristics can be highly variable within species, varying with age, reproductive state, wave exposure, tidal factors, temperature, salinity, light and biological factors such as grazing.

- M.D. Guiry in Guiry, M.D. & Guiry, G.M. 29 August 2011. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. https://www.algaebase.org; searched on 26 October 2022

Ulva* and *Enteromorpha: *Ulva* L. and *Enteromorpha* Link were considered separate genera for many years, the former consisting of distromatic, foliaceous thalli and the latter monostromatic, tubular forms. Haydon et al, 2003 showed that culture and genetic analysis revealed that the two genera were synonymous. *Enteromorpha* was synonymised with *Ulva*.

Species described from Sri Lanka

Enteromorpha

bulbosa (Suhr) Montagne forma *Africana* (Kütz.) J. Ag., 1883 [GM 1887]
= *Ulva bulbosa* Pasilot de Beauvois, 1805.
compressa (Linnaeus) Nees, 1820. [GM 1887; Dur 1961a:18-19, pl. I fig. 7]
= *Ulva compressa* Linnaeus, 1753
i*ntestinalis* (Linnaeus) Nees, 1820. [GM 1887; Dur 1961a:18, pl. I fig. 4-6]
= *Ulva intestinalis* Linnaeus, 1753
muscoides (Clemente y Rubio) Cremades, 1990.
= *Ulva clathrata* (Roth) C. Agardh, 1811
prolifera (O. F. Muller) J. Agardh, 1883. [Dur 1961a:18, pl. I fig. 8]
= *Ulva prolifera* O. F. Müller, 1778

Ulva

fasciata Delile, 1813-1826. [GM 1887; Dur 1961a: 18, pl. I fig.1] = *U. lactuca* Linnaeus, 1753
fenestrata Postels & Ruprecht, 1840. [GM 1887; Dur 1961a: 17, pl. I fig.2,pl. XXI fig.1]
lactuca Linnaeus, 1753. [Dur 1961a: 17, pl. I fig.1]
reticulata Forsskal, 1775. [GM 1887; Dur 1961a: 17]
rigida C. Agardh, 1823. [Dur 1961a: 18]

- Silva et al, 1996

Species described from Sri Lanka (contd.)

Ulva compressa Linnaeus, 1753	*Ulva pertusa* Kjellman, 1897 = *U. australis* Areschoug, 1854
Ulva fasciata Delile, 1813	*Ulva prolifera* O.F. Müller, 1778
Ulva intestinalis Linnaeus, 1753	*Ulva reticulata* Forsskål,1775
Ulva lactuca Linnaeus, 1753	*Ulva rigida* C. Agardh, 1823
	- Coppejans et al, 2009
Ulva fasciata	*Ulva reticulata*
Ulva intestinalis (as *Enteromorpha*)	*Ulva rigida*
Ulva lactuca	*Ulva* sp.
	- Mallikarachchi, 2004
Ulva fenestrata	*Ulva prolifera*
Ulva intestinalis	*Ulva rigida*
	- Mallikarachchi, 2013a
Ulva compressa, Linnaeus, 1753	*Ulva prolifera* O. F. Müller, 1778
Ulva intestinalis Linnaeus, 1753	*Ulva reticulata* Forsskål, 1775
Ulva lactuca Linnaeus, 1753	*Ulva rigida C.* Agardh, 1823
	- Fernando, 2022 this publication

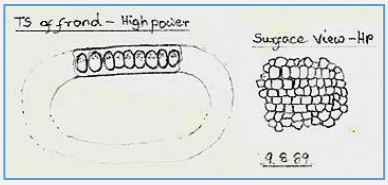
Description of species

Ulva compressa Linnaeus, 1753

Synonym: *Enteromorpha compressa* (Linnaeus) Nees, 1820

Morphology Epilithic thalli consisting of supple, hair-like fronds branching at the base, varying in width; intertidal, air exposed, or submerged, in shallow rock pools or near shore. Forms bright green pendulous tufts up to 30 cm high on vertical rock faces; or aligned with water flow on sloping substrates. In sheltered locations forms wide, tubular fronds.

Anatomy Thalli monostromatic, tubular, growing in tufts 4-15 cm high arising from small discs c. 450 µm wide. Each thallus branched from the base into a number of erect fronds of varying diameter: 70-150 µm initially widening upwards to 150-800 µm, or 70-100 µm throughout. The thallus width variable throughout its length, upper portions generally narrower than the middle; the apex rounded, club shaped or misshapen. Thalli on habitats exposed to surf generally with narrow fronds, those growing in calmer water with wider fronds. Cells in surface view isodiametric to rectangular with rounded corners 15-20 x 12.5-20 µm arranged in longitudinal and transverse rows.

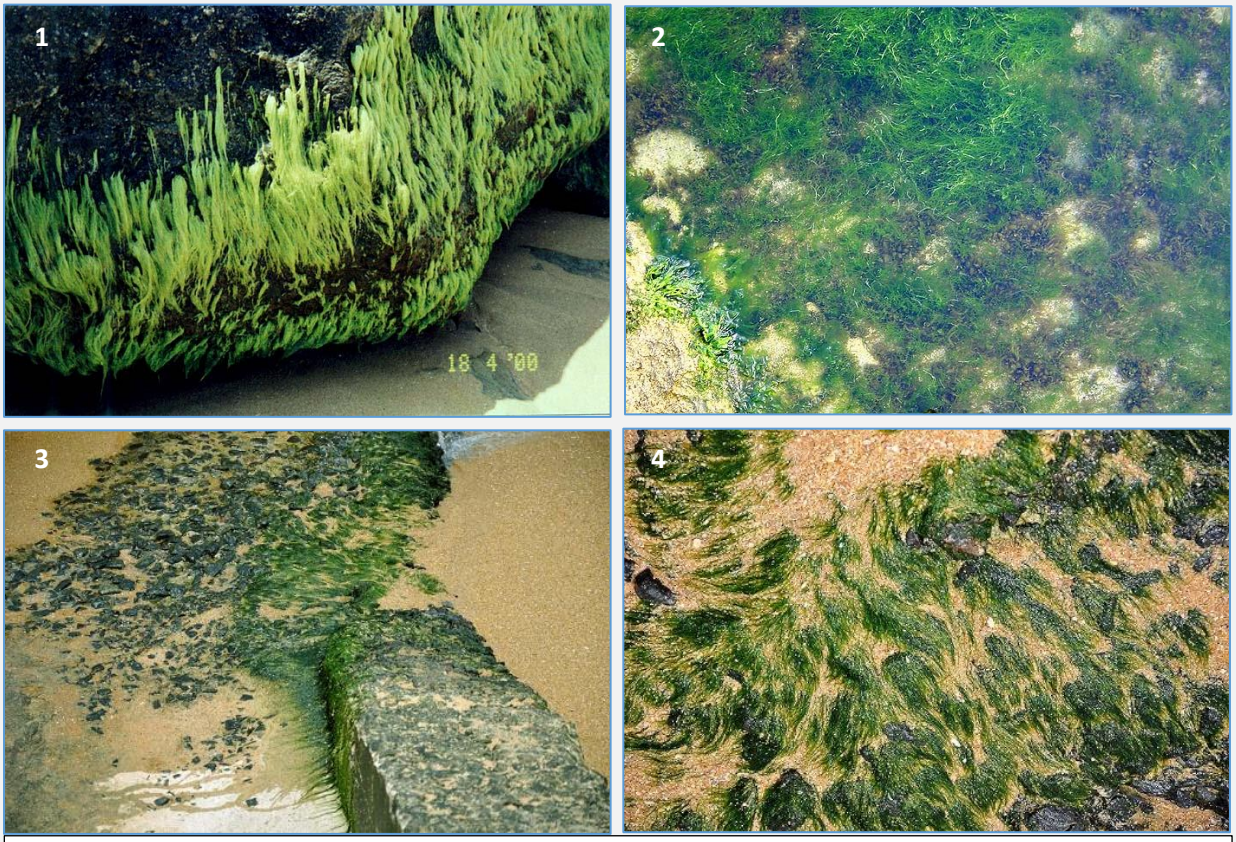


Single layered, tubular fronds, cells isodiametric or rectangular.

Ecology Usually attached to intertidal sloping to vertical rock faces or man-made structures along rocky shores, air exposed during low tides, but wave washed; or submerged in shallow tide pools, rocks, or trash in deeper water. Long (150-200 mm) and dense growths in hollows and fissures of rocks where water is more persistent, and shorter and sparse (20-40 mm) at higher levels (Dig Gala, 23.4.1989). Common on the Wellawatte to Mount Lavinia rocky shore; Beruwela; Kirinda Palatupana lewaya on trash. This species not recorded by Mallikarachchi, but his illustration and description of *E. intestinalis* from Hikkaduwa (2004) resembles *compressa* more than *intestinalis*. Durairatnam (1961) records the species from Jaffna – the lagoon and Mandaitivu.

Discussion The classical collection at PDA contains two folders (10.5.2000): *E. africana* and *E. compressa*. *E. africana* is a synonym of *Ulva hookeriana* (Kützing) H.S.Hayden, Blomster, Maggs, P.C.Silva,

Stanhope & Waaland, 2003 from the western Atlantic and the southern ocean (AlgaeBase, 2022). The folder *E. compressa* contains six specimens, including those from Mount Lavinia and Jaffna identified by various authorities under a variety of names. The species determined according to Durairatnam (1961).



***Ulva compressa* In-situ** ① Intertidal, upper beach, Wellawatte. ② Intertidal rock pool, Talpe. ③ Intertidal wave-washed rock structure at beach level, Wellawatte. ④ Detail showing algal tufts lying in the direction of water flow.

Material examined

HMF 006, 24.9.1995, Mount Lavinia - Lover's rocks, intertidal rocky shore, bright green pendulous tufts forming mats on the rock. Exposed to gentle wave action.

MBIOD 087, 15.4.1997, Mount Lavinia, Dig gala, intertidal rocky shore, on exposed rock and pools with water flow. Clumps of filiform and wide thalli, few branches basally.

HMF 216, 19.4.2000, Wellawatte, Fernando road, intertidal rocky shore, upper beach, epilithic, light green, pendulous tufts drying out at low tide, wave washed at other times.

HMF 217, 19.4.2000, Wellawatte, Fernando road, intertidal beach rock slope, lower beach, grass green, tufts on sloping rock regularly wetted by swells at low tide.

HMF 222, 21.10.1990, Wellawatte, Kinross lagoon, subtidal 2m, on rubber tyre near shore, tufts of short, inflated fronds, a few thread-like.

HMF 223, 6.9.1992, Beruwela, harbour shore, intertidal, rocks, coconut roots, polythene debris on upper beach, green tufted fronds forming sheets. Longest 30cm (estimated). Hair-like to 3mm wide, occasionally wider. Finer fronds show distal branching.

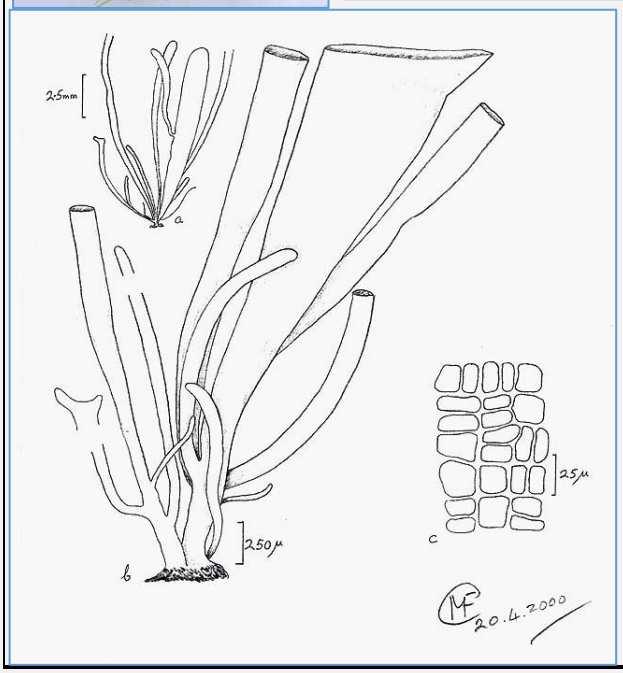
HMF 224, 22.8.1992, Mount Lavinia rocky shore, intertidal rocky shore on sheltered aspects, lower beach; epilithic green tufts forming mats on top and sheltered side of rock at edge; *Chaetomorpha antennina* on the exposed side of the same rock.

HMF 320, 21.10.2001, 10 cm, Kirinda, Palatupana, Kotuwemodera, Lewaya edge, on fibres and stones, on exposed debris lying on or buried in mud.

HMF 500, 24.7.2005, Wellawatte, Fernando Road, upper beach, near high water mark, epilithic on rock, bright green dependent tufts up to 10 cm high, consisting of supple, hair-like fronds branching at the base, varying in width.

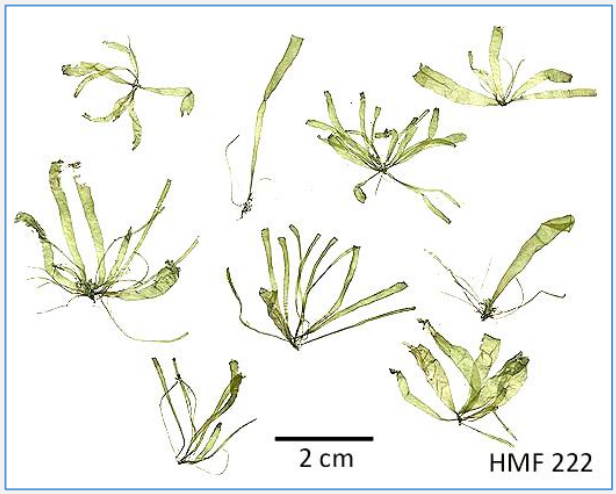
Ulva compressa

Ulva compressa
Linnaeus, 1753
Ex-situ images of freshly collected material photographed in water.



Ulva compressa Linnaeus, 1753
Drawing at left:
a) Entire tuft, a mix of filiform and wide fronds, long fronds cut.
b) Enlarged view showing branching.
c) Surface view of cells.
Microscope view of cells in surface view, above.

Ulva compressa



Herbarium scans of *Ulva compressa*

HMF 500: Filiform fronds; intertidal, pendulous, air exposed at low tide.

MBIOD 087: Filiform and wide thalli, few branches basally; intertidal rocky shore, on exposed rock pools and runnels of flowing water.

HMF 222: Inflated fronds, a few filiform; subtidal 2m, on rubber tyre near shore.

References

Coppejans et al, 2009:76. Fig. 52.

Durairatnam, 1961:18-19, pl. I Fig. 7 (as *Enteromorpha*)

Hayden, H.S., Blomster, J., Maggs, C.A., Silva, P.C., Stanhope, M.J. and Waaland, J.R., 2003. Linnaeus was right all along: Ulva and Enteromorpha are not distinct genera, *Eur. J. Phycol*. (August 2003), 38: 277 – 294.

Mallikarachchi, 2004:33, 140, photo (1) (*E. intestinalis*) – "Epilithic on coral rubble, stones and shells in upper and mid intertidal zone."

Mallikarachchi, 2013:16, 35, Fig. 1:B (*U. intestinalis*) - "Epilithic on rock surface in upper intertidal zone, exposed to wave action."

Ulva intestinalis Linnaeus, 1753

Synonym: *Enteromorpha intestinalis* (Linnaeus) Nees, 1820

Material examined & Discussion

This species was observed in the Rekawa lagoon. It was inadvertently collected together with a mass of the seagrass *Ruppia maritima*; its significance was not recognised at the time and no material was examined in detail nor preserved. The substrate was mud.

Coppejans et al (2009) describes this species as being best developed in sheltered lagoons where it grows in huge quantities, seemingly loose lying, as we found it in Rekawa. It is reported to grow up to 30 cm long, the lumen inflated with air bubbles, making the upper parts float on the surface of the water. The bases are thin and cylindrical, becoming irregularly inflated and constricted in the upper parts. The plants are unbranched.

There were no identified specimens in the Classical Collection of the National Herbarium, Peradeniya.

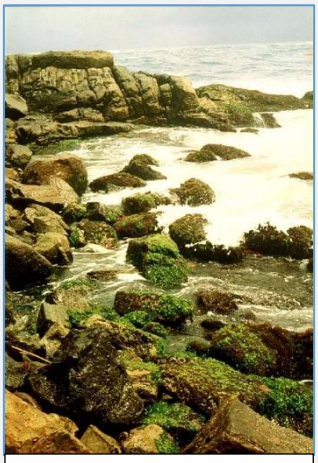
Ulva intestinalis - reproduced from Durairatnam (1961) p. 119, pl. I no. 6

References

Coppejans et al, 2009: 78, Fig. 53.
Durairatnam, 1961: 18, pl. I Fig. 4-6 (as *Enteromorpha*)

Ulva lactuca Linnaeus, 1753

Ulva fasciata Delile, 1813-1826 was synonymised with *U. lactuca L.*



Air exposed intertidal rocks at Mount Lavinia covered with a heavy growth of ribbons of *Ulva lactuca. Chaetomorpha antennina* also adds to the greening.

Preamble *Ulva lactuca* L. occurs in two forms—in exposed, intertidal habitats it exists as pendulous ribbons, particularly where it is air exposed at low tides, hanging down when growing on vertical surfaces or lying in the direction of water flow on sloping surfaces. Previously named *Ulva fasciata* Delile, it was synonymised with *Ulva lactuca* L in 2003 by Haydon et al. In shallow subtidal habitats where it is not subjected to strong currents, it exists as wide, foliar expanses. The microscopic appearances of both forms are similar.

Morphology Fronds irregular, thin and membranaceous, with few perforations 1-2 mm; broader than high, ovate, or elongate sub-rectangular, 15 x 14 cm to 23 x 15 cm, attached by a small disc; margins slightly to much ruffled, irregularly toothed. From intertidal habitats, air exposed at low tides and subject to surf, the fronds form dissected thalli, strap shaped up to 40 cm long, and 1-1.5-3 cm wide; at times shorter and narrower or wider, forming clusters (previously *U. fasciata* or *U. lactuca* forma *fasciata*).

Anatomy Membrane thickness 40-57.5-75-80 µm; 2 layers of cells; in surface view cells squarish, rectangular, or polygonal, with rounded corners, 15 x 10 µm, 25 x 12.5 µm, 15 x 15 µm, 17.5 x 10 µm; in cross-section cells taller than wide 12.5-17.5 x 25-35 µm (width x ht); margin with multicellular teeth.

One collection (HMF 319) examined had triangular marginal teeth 25-140 µm high and 37 µm wide at the base, the small and large ones at irregular intervals; amongst these at intervals of c. 75 µm or more were 25 µm wide strap shaped linear prolongations from the apices of marginal teeth, these up to 275 µm long, some showing constrictions that suggest that the distal portion is to be shed (as a propagule?).

Ecology Thalli forming a bright green fringe along the edge of the Palatupana Lewaya, 10-15 cm deep. Anchored by one edge of expanded frond buried in the mud, attached to a hard object, the larger portion free and entangled with others.

Bright to dark green fronds, epilithic on stones and other hard objects lying on the sand of the Beruwela, Barberyn Reef lagoon, at a depth of <0.5 m. These were adjacent to the shore, away from the reef where *U. rigida* was found.

Bright green fronds in the form of long ribbons, epilithic on beach rocks, air exposed at low tide but wave-washed, often trailing along the sand. Also on exposed vertical surfaces of rocks where the fronds are dependent when air exposed.

Discussion The collections were identified with reference to Durairatnam (1961) and Coppejans et al (2009) many years after collection, based on the—sometimes inadequate—contemporary descriptions and microscopic examinations and the herbarium specimens. Coppejans et al describes *U. pertusa* Kjellman, said to be similar to *U. lactuca*. These two, and *rigida*, possess different numbers of pyrenoids within the nuclei—an important observation that would be necessary for differentiation of the

species. Another important feature that should be recorded is the occurrence of rhizoidal filaments between the two cell layers basally, in the case of *U. lactuca*.

Material examined

MBIOD 004, 13.8.1995, Mount Lavinia rocky shore – Dig Gala, epilithic near high tide line, pendulous bright green ribbons on summit and sides of rock exposed to wave action.

HMF 046, 13.10.1996, Mount Lavinia rocky shore, Ora Gala, epilithic, bright green, fronds with short lobes.

HMF 225, 22.8.1993, Mount Lavinia rocky shore, epilithic, exposed and sheltered lower beach, bright green tufts growing on Dig Gala and Keti Ketiya. On Keti Ketiya growing on exposed side, fronds short and compact. On Dig Gala, growing on the flanks where it is frequently wave washed but not exposed to the full force of them, forming long ribbon-like, ruffled and twisted fronds up to 350 mm long and 20 mm wide.

HMF 319, 20.10.2001, Kirinda, Palatupana, Kotuwemodera, submerged 10-15 cm, lewaya (lagoon) edge, gregarious, bright green ruffled fronds, entangled with each other anchored in mud.

HMF 507, 28.8.2005, Beruwela, Barberyn Reef lagoon, submerged <0.5 m, epilithic on stones and other solid objects, large sub-rectangular expanses with few 1-2 mm diameter perforations.

Ulva lactuca Linnaeus, 1753

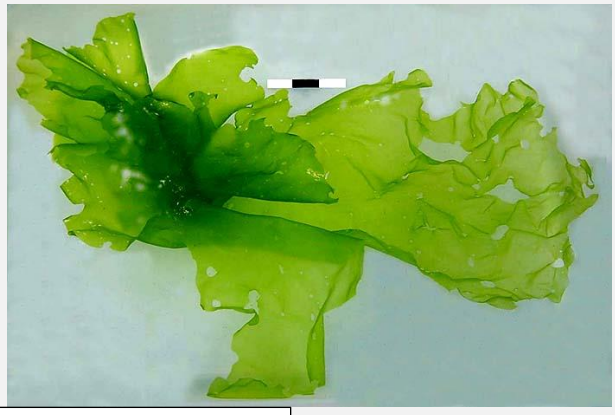
Ribbon form: intertidal, wave washed at low tide. Mt. Lav

Ribbon form: intertidal, exposed vertical habitat, Mt. Lavinia.

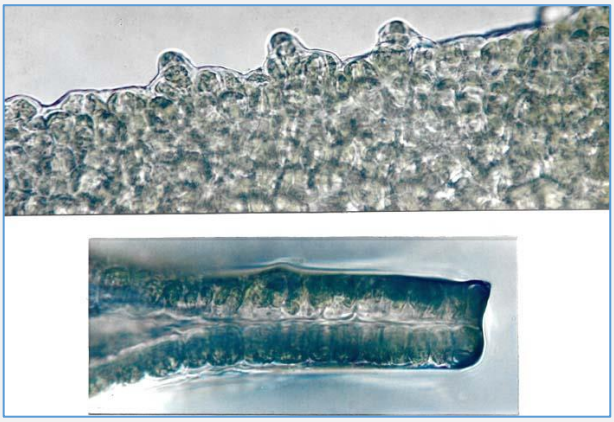
Foliar form: submerged in calm water. Beruwela.

Ulva lactuca

<u>*Ulva lactuca*: Foliar forms freshly collected, photographed ex situ in water</u>



HMF 507, Barberyn Reef lagoon, Beruwela, 28.8.2005



<u>Microscope images:
'*Ulva fasciata*' FNo. 150899/2</u>

Edge of thallus showing multicellular marginal teeth.

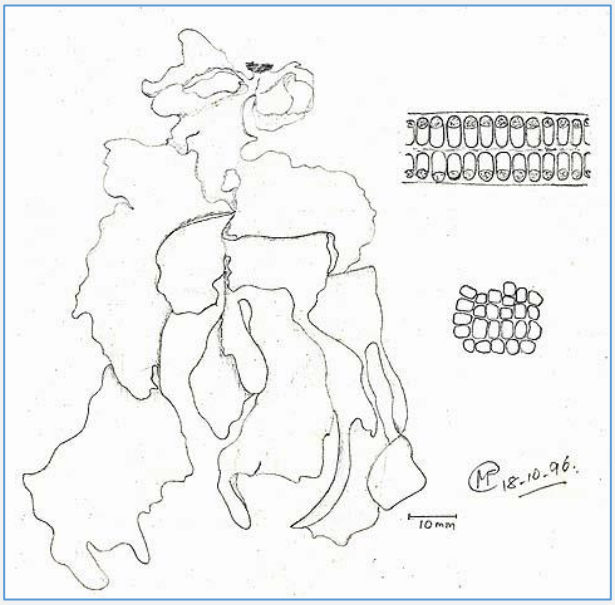
Transverse section showing di-stromatic construction.

References

Durairatnam, 1961: 18, pl. I Fig.1 – as *Ulva fasciata* Delile, 1813-1826
Durairatnam, 1961: 17, pl. I Fig.1– as *Ulva lactuca* Linnaeus, 1753
Coppejans et al, 2009:76, Fig. 52 – *Ulva fasciata*: 78, Fig. 54 – *U. lactuca*
Mallikarachchi, 2004: 33, 140 photo 2 – *Ulva fasciata*; 34 – *Ulva lactuca*
Haydon et al, 2003

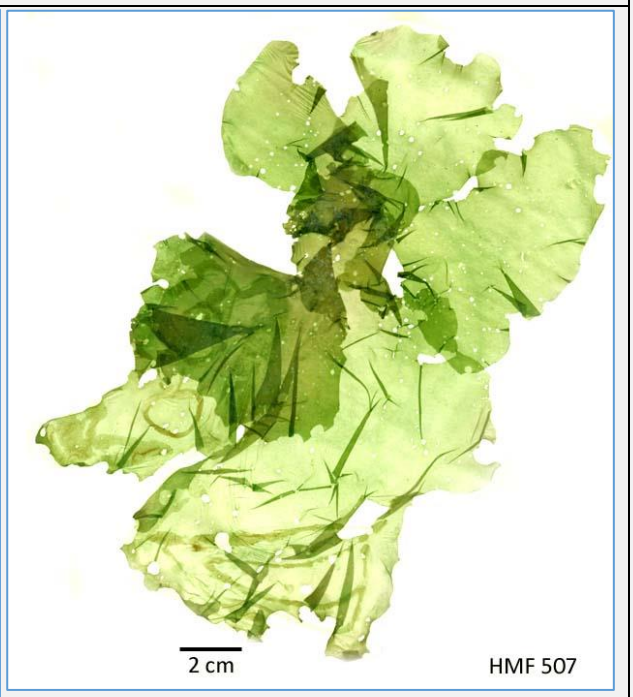
Continued next page

Ulva lactuca



Ulva lactuca drawings

Left: MBIOD 004, Mount Lavinia rocky shore. The intertidal form ('fasciata'), with cells in surface view and in transverse section.
Right: HMF 507, Beruwela lagoon. The foliar submerged form, spread out, showing marginal lobes and scattered perforations.



Herbarium scans

MBIOD 004, intertidal, Mount Lavinia rocky shore.
HMF 507, submerged, Barberyn reef lagoon, Beruwela.

Ulva prolifera O. F. Müller, 1778

Synonym *Enteromorpha prolifera* (O. F. Muller) J. Agardh, 1883.

Morphology Epilithic growth on the floor of a shallow tide pool, forming a bright green carpet. Tufted, branched filaments up to 30 mm long. Supple, collapsing out of water. Two or three orders of branches.

Anatomy Main filaments tubular, parallel-sided. In surface view the cells rectangular, arranged in 4-5 longitudinal rows side-by-side. Laterals also tubular but with fewer rows of cells, being narrower; the ultimate branches solid—fine, tapering, short, with single cells in a longitudinal row.

Ecology A single collection at Mount Lavinia in an intertidal pool, at the inshore end of Dig Gala, never seen after 1995. They are found in sheltered lagoons, as well as in the lower intertidal zone where they may be exposed to wave action.

Discussion Durairatnam, Mallikarachchi and Coppejans et al have described *Ulva prolifera*.

Durairatnam's collection was growing on rocks in sheltered areas, at Kankesanthurai, with cells arranged in longitudinal rows "in lower portions at least, and in the branches". The membrane 15-18 µm thick. Coppejans et al describe this species growing on shell fragments on the sandy-silty bottom at the margin of a sheltered lagoon. The thalli were 1 mm or less in diameter, "richly, radially branched, the side branchlets not branched again". Mallikarachchi's collection from Panama were epilithic on a rock surface in the lower intertidal area, exposed to wave action.

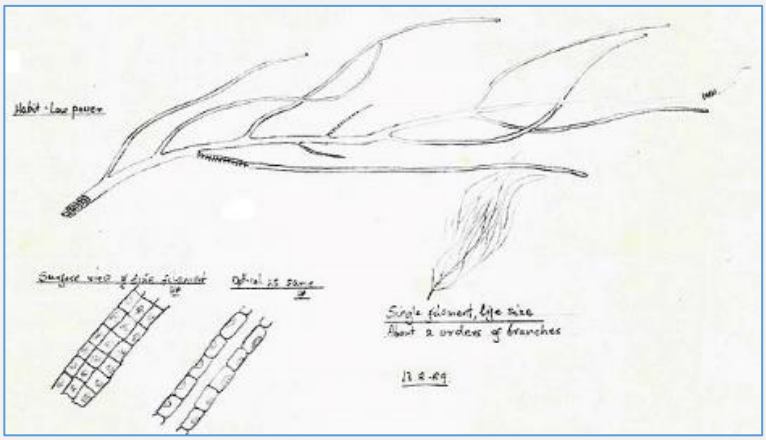
Material examined

HMF 565, 13.8.1995, Mount Lavinia rocky shore. Seen once.

References

Coppejans et al, 2009:80, Fig. 56
Durairatnam, 1961:18-19, Pl. I Fig. 8
Mallikarachchi, 2013a:16, 35, Fig. 1-C

Ulva prolifera O. F. Müller, 1778

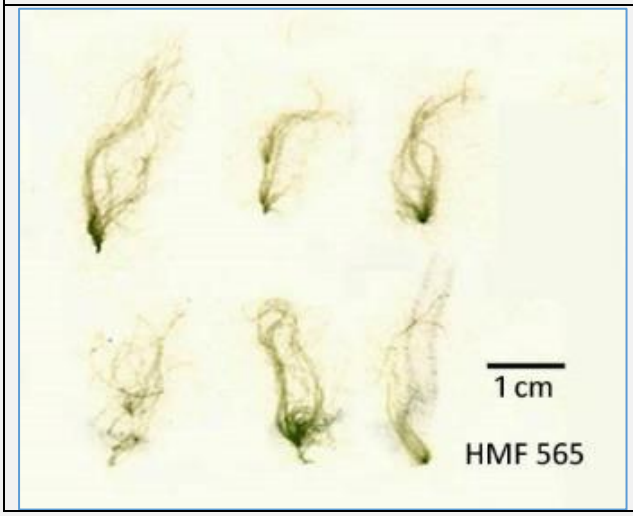


Drawing:

A single filament enlarged showing narrow lateral branches, progressively shorter and narrower.

Below left:

Cells in surface view and in optical section.



Herbarium scan of HMF 565.

Ulva reticulata Forsskål, 1775

Morphology Grass-green, erect, rope-like tuft that unravelled after collection into limp, tangled, perforated ribbons. Perforations large and medium, few small, margins wavy. Fronds ruffled.

The thallus elongated, irregularly shaped, approx. 8 cm long, 3 – 4 cm wide, much perforated with scattered large (3-4 cm) and more numerous small perforations (0.5-1 cm); much smaller ones are found around the margins.

Anatomy Frond 50 µm thick, lacinae margins devoid of teeth. Cells in surface view rectangular or squarish with rounded corners, or rounded (75 x 12.5 µm, 7.5 x 10 µm, 12.5 x 12.5 µm). In transverse section the cells arrayed in two rows, each rectangular with rounded ends (22.5 x 12.5 µm).

Ecology On hard substrates, often tangled with other algae. Coppejans et al (2009) observes that there is no demonstrable holdfast. At Uchchimuni specimens were found tangled on other algae on a shallow sand bottom. They appeared to have been torn off larger fronds. Upali Mallikarachchi (pers. comm.) reports that this species is common on the reef fronting the Coral Gardens Hotel—the former Rest House—at Hikkaduwa.

Discussion *Ulva beytensis* Thivy & Sharma, 1966, described from Beyt Island, Port Okha in Gujarat, India (Silva et al, 1996), is an accepted species in AlgaeBase (2021), distinguished from *U. reticulata* by the absence of teeth on the lacinae margins (Teo & Wee, 1983). This distinction is not accepted by some authorities (Silva et al, 1996 quoting Dixit, 1970: 104).

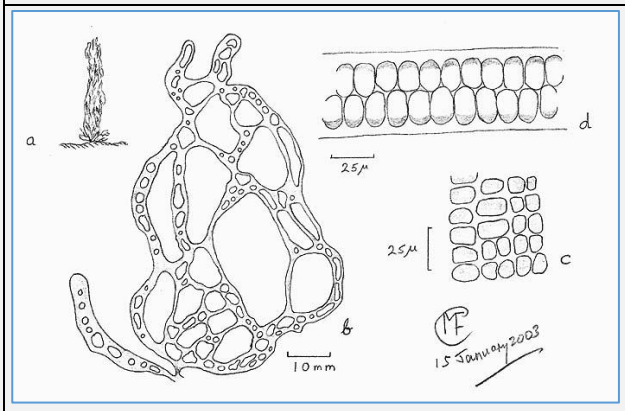
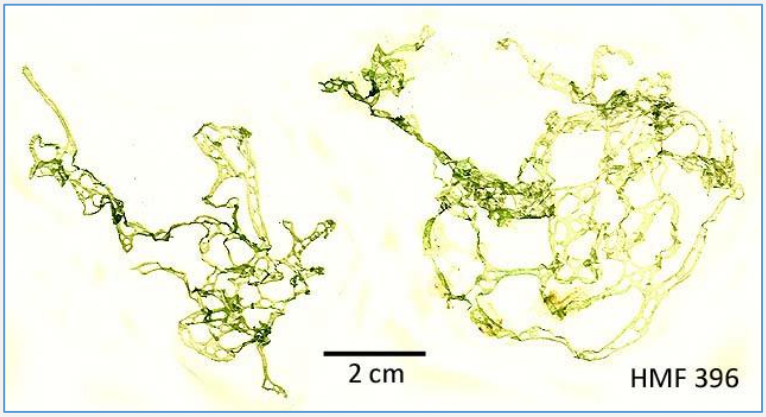
Material examined

HMF 396, 6.1.2003, Hikkaduwa, southern shelf at the mouth of the lagoon, submerged 0.5 m, epilithic, entangled with other algae amidst *U. lactuca*.

HMF 403, 19.1.2003, Puttalam lagoon, Uchchimuni, <1 m, entangled on other algae and obstructions on sand. Light green perforated ribbons apparently torn from larger fronds.

References

AlgaeBase (2021)
Coppejans et al, 2009: 82, Fig. 57
Dixit, 1970: 104
Silva et al, 1996: 742
Teo & Wee, 1983: 23, Fig. 11

Ulva reticulata
 ***Ulva reticulata*** Forsskål, 1775 a. Habit: thallus in natural position, viewed from the side. b. Portion of thallus spread out. c. Cells in surface view. d. Cells in transverse section.


Ulva rigida C. Agardh, 1823

Morphology Light to bright green, thalli <25-27-55-80 mm high. A number of fronds arise from a short, attenuated base, fronds broader than high when spread out, sub-orbicular to elongate oval, lobed, margin entire, ruffled, rolled, and folded into rosettes, attached by an attenuated base; few perforations with smooth margins seen in one collection.

Anatomy Blade of 2 cell layers, 50-57.5-75 µm thick; cells in surface view squarish, polygonal, or rounded, distinctly taller than wide in cross-section, 10-12.5-15-17.5 µm x 25-27.5 µm (width x ht), chloroplasts filling the outer 1/3. Margin with minute multicellular teeth with rounded apices 20-40 µm high.

Ecology Beruwela, Barberyn Reef: attached to stones and dead seagrass stalks in shallow pools on the reef crest and in the lagoon to 0.3 – 0.5 m depth. Gregarious on the reef crest.

Discussion Coppejans et al (2009) describe *Ulva pertusa* Kjellman, 1897 from Sri Lanka, a species now accepted as *U. australis* Areschoug, 1854 (AlgaeBase). It is said to be morphologically similar to *U. lactuca*, differing in the number of pyrenoids—a single pyrenoid per cell, rarely two, whereas in *U. lactuca* there are 1-2 or 3 pyrenoids per cell. *U. rigida* is said to have 2 – 5 pyrenoids per cell. The collections described in this article have not had pyrenoid numbers determined, so the accuracy of the determinations may be questionable—especially of those determined as *Ulva rigida*, in this section.

Material examined

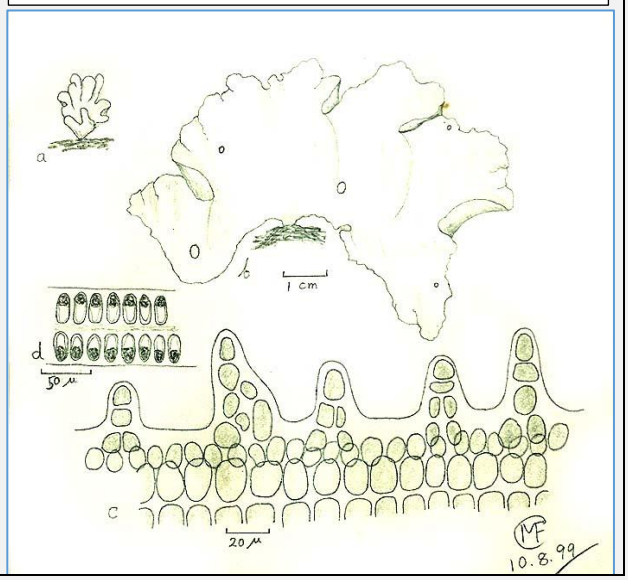
HMF 158, 24.7.1999, ?rigida, Beruwela, Barberyn reef lagoon, 0.5 m in lagoon, attached to stones, dead shells.
HMF 232, 13.5.2000, Beruwela, Barberyn reef, Intertidal reef flat.
HMF 347, 8.4.2001, Beruwela, Barberyn reef, 0.3-0.5 m, subtidal in sheltered lagoon.

References

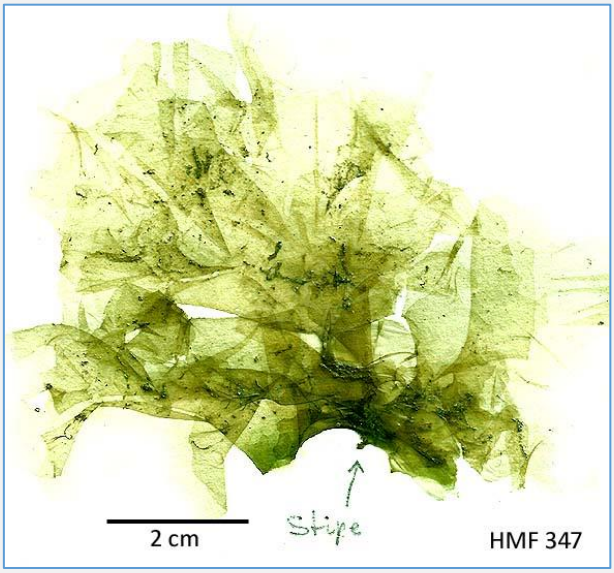
Coppejans et al, 2009: 82, Fig. 58
Durairatnam, 1961a: 18
Guiry, G.M. in Guiry, M.D. & Guiry, G.M. 05 January 2022. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. https://www.algaebase.org; searched on 08 February 2023
Mallikarachchi, 2004: 35, 140, photo 4
Mallikarachchi, 2013a: 16, 35, Fig. 1-D

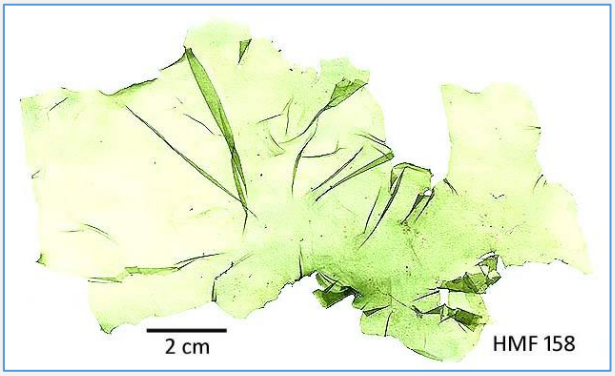
Ulva rigida C. Agardh, 1823

Ulva rigida
Ex situ, photographed in water, viewed from the side with the point of attachment below.
HMF 232, intertidal reef flat, Barberyn Reef, Beruwela.
13.5.2000



Drawing at right:
HMF 158, Barberyn Reef lagoon, Beruwela.
a) Viewed from the side in natural position.
b) Thallus spread out.
c) Cells of the margin, showing multicellular teeth.
d) Cells in transverse section showing di-stromatic construction with elongated cells, the chloroplasts crowded at the outer ends.





Ulva rigida C. Agardh, 1823

Herbarium scans

HMF 347, lateral view of a rosette showing stipe attaching to small stones on the sandy bottom, submerged 0.3-0.5 m, in sheltered lagoon.

HMF 158, thallus spread out, reef crest and lagoon, Barberyn Reef, Beruwela.

BIBLIOGRAPHY

Coppejans, E., Leliaert, F., Dargent, O., Gunasekara, R. and De Clerck, O. 2009. *Sri Lankan Seaweeds, Methodologies and field guide to the dominant species*, ABC Taxa, Vol. 9, Belgian Development Corporation.

Dixit, S.C., 1970. Species list of Indian marine algae III. *Journal of the University of Bombay* **39**(Sc.): 99-130.

Durairatnam, M., 1961. Contribution to the Study of the Marine Algae of Ceylon. *Bulletin No. 10, Fisheries Research Station*, Ceylon.

Guiry, M.D. in Guiry, M.D. & Guiry, G.M. 04 July 2022. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. https://www.algaebase.org; searched on 10 November 2022

Hayden, H.S., Blomster, J., Maggs, C.A., Silva, P.C., Stanhope, M.J. and Waaland, J.R., 2003. Linnaeus was right all along: Ulva and Enteromorpha are not distinct genera, *Eur. J. Phycol*. (August 2003), 38: 277 – 294.

Mallikarachchi, U., 2004. *A study of the taxonomy and distribution pattern of algae on the southwest coast of Sri Lanka with special reference to anthropogenic effects*. Thesis, Master of Philosophy, University of Ruhuna, unpublished.

Mallikarachchi, U., 2013 (a). *Taxonomic survey of seaweeds along the coastal belt of Sri Lanka* (*Part I - Eastern Coastal Segment*). Report to Biodiversity Secretariat, Ministry of Environment, Sri Lanka. Marine & Coastal Resources Conservation Foundation.

Silva, P.C., Basson, P.W. and Moe, R.L., 1996. *Catalogue of the Benthic Marine Algae of the Indian Ocean*. University of California Publications in Botany, Vol. 79. University of California Press.

Teo Lee Wei and Wee Yeow Chin, 1983. *Seaweeds of Singapore*. Singapore University Press, National University of Singapore.

MF: 9.2.2023