Key to species of Ulva (and Entheromorpha)

For historical reasons the key is separated to Ulva and Ulva (Entheromorpha). Ulva (Entheromorpha) is Ulva that contains two distinct layers which are separated from one another.

Since a comprehensive study into the species of Enteromorpha in the Eastern Mediterranean has not yet been undertaken, we have decided to include, in this key, species that probably exist in the region. The key is based upon the research of Prof .

G. Giaccone (Longo and Giaccone, 1994), and we are grateful to him for his gracious permission to use it. Preparations :

1. It is important to collect examples of holdfasts. Their connection to the substrate and the location of side branching must be examined
2. A lateral cross-section of the thallus, about 1 cm above the holdfast, must be made to examine the difference between Enteromorpha and Ulva
3. A slide of the thallus segment must be prepared for an overview of the cellular arrangement; is there a split from the thallus, and is its lip smooth or dented? This overview should also show the shape of the cells, the structure of the chloroplasts and the number of Pyrenoids. Sometimes, a cross section must be made
4. A potassium iodine solution (l2KI) is recommended to accentuate the Pyrenoids, which are round, contain protein and are used to manufacture starch. They therefore do not colour with potassium iodine. The number of Pyrenoids is an important element in defining species (one should always take into account that before a cell's division, the number of Pyrenoids doubles

.5 Live material and damply preserved materials should be identified. A dry material should be soaked for several hours in seawater and glycerine before examination.

Key to species of Ulva

1. The two layers of the thallus differ from each other (not the same); one looks like Ulva lactuca and the other like Ulva latevirens **..... → Ulva bifrons**

*1. The two layers are similar . ... → 2

2. The thickness of the thallus at the bottom, above the rhizoid (suprabasal) is more than 150 .m (150-500) ..... → 3

*2. The thickness of the thallus is less than 150 .m ..... → 5

3. Several thin, elongated thalli near the base that then widen, resemble a spatula. An overview reveals that the cells are arranged in lines in two directions (weave). The species has not yet been identified in the Mediterranean ..... **→ Ulva spathulata**

*3. The thallus is solitary. Cellular arrangement, not as above..... →. 4

4. The 'leaf' edge is dented. Simple or complex proliferation is evident (the protrusion is comprised of several cells) ..... → **Ulva laetevirens = Ulva rigida**

*4. The thallus is elongated like a ribbon. The cells are scattered, and the 'leaf' edge is smooth. Pyrenoids 1(2). The species has not yet been observed in the Mediterranean ..... → **Ulva australis**

5(3). The cells are arranged in rows. Usually, a single Pyrenoid ..... → 6

*5. The cells are not arranged in rows, or else some are and some are not. Single one or several Pyrenoids ..... → 9

6. The thallus is elongated and thin. Its cross-section measures less than 50 .m→ 7

*6. The thallus is multishaped. The cross-section is larger than 50 .m → 8

7. The cross-section measures 25-30 .m. An overview of the cells measures 30-25 x 6-5 .m ..... → **Ulva linearis**

*7. The cross-section measures 48-52 .m. An overview of the cells measures 25-16 x 17-8 .m ..... **Ulva neapolitana**

8(6). 2 to 6 Pyrenoids ..... → 9

*8. Usually a single Pyrenoid..... → 11

9. Usually, a single thallus measuring about 100 .m in width. The thallus edge is dented in simple manner (slight protrusions measuring a cell's width to three). The species has not yet been observed in the Mediterranean ..... → **Ulva scandinavica**

*9. The thallus is less than 100 .m thick ..... →. 10

10. Several branches emanating from the base of the holdfast are evident, The lower part of the thallus is narrow, like a stalk. It measures 75-85 .m in width. Pyrenoids 1-3 ..... **Ulva rotundata**

*10. The thallus is about 90-95 .m. The branches resemble long ribbons with no apparent petiole. Some thalli emanate from the holdfast. Pyrenoids 2-4 ..... → **Ulva fasciata**

11(8). The cells are not arranged in rows. The thallus measures about 100-15 .m in width ..... → **Ulva olivascens**

*11. The cellular arrangement is irregular: some cells are arranged in rows, some are scattered ..... → 12

12. The thallus is 110-130 .m in width. The thallus edge has tooth-like protrusions. The species has not yet been observed in the Mediterranean ..... → **Ulva taeniata**

*12. The thallus is about 80-95 .m thick. Its edge is smooth. Its upper part is narrower than that which is closer to the holdfast ..... → 13

13. The cells measure in overview about 80-95 .m. The upper part of the thallus measures 40-45 .m. There is slight perforation along the 'leaf' edge..... → **Ulva curvata**

*13. The cells, in overview, measure 12 x 16 .m or 14 x 15 .m. The cells are square or rectangular. The upper part of the thallus measures about 25-28 .m. The species has not yet been observed in the Mediterranean ..... → **Ulva gigantean.**

Key to species of Ulva (Enteromorpha)

Ulva (Entheromorpha) is Ulva that contains two distinct layers which are separated from one another

1. The thallus is branched (should be confirmed with microscope) ..... → 6

*1. The thallus is not branched ..... → 2

2. The thallus is flattened or sometimes flattened and sometimes tubular ..... → 3
*2. The thallus is tubular ..... → 5

3. The edge of the thallus is often curled. A microscopic over view reveals proliferation (indentation) along the 'leafs' edge. The cells are arranged in vertical and sometimes lateral lines. 2(1) Pyrenoids ..... → **Enteromorpha linza**

*3. The thallus is flattened and not proliferated (not dented)..... → 4

4(3,6). An overview reveals the cells are cells are scattered; 2 Pyrenoids. .....
……..→ **Ulva (Enteromorpha) intestinalis**

*4. An overview reveals the cells arranged in rows,1 Pyrenoid.

……..→ **Ulva (Enteromorpha) compressa**

5(2). The thallus is tubular. An overview reveals the cells arranged in lateral lines, tooth-like chloroplasts. 3-6 Pyrenoids Mediterranean species
..... → **Ulva (Enteromorpha) aragoensis**

*5. The thallus is filamentous. An overview shows cells arranged in lateral lines. The chloroplast resembles a lobe Many Pyrenoids 2-5(8). Atlantic Ocean species.
..... → **Ulva (Enteromorpha) ralfsii**

6. Manifold branching.....→.7

*6. Sparse branching..... → 4

7. An overview reveals proliferation (indentation). Branching is single or double-lined. Cells are arranged lengthwise. Chloroplasts resemble lobes. 1 Pyrenoid
..... → **Ulva (Enteromorpha) prolifera**

*7. Plants without proliferation at the edges ..... → 8

8. Branching resembles thorns. Cells arranged in rows are evident along the thallus' upper part, but are scattered along the lower part, Pyrenoids 2-10.
..... → **Ulva (Enteromorpha) ramulosa**

*8. Branching is elongated, sometimes one row of cells, sometimes two. ..... → 9

9. Cells are arranged in both lateral and vertical rows. The chloroplast is dented (dented). 1-2 Pyrenoids .....→ **Ulva (Enteromorpha) flexuosa**

*9. Cells are scattered along the lower part of the thallus and in lateral lines only along the top part. The chloroplast resembles a tooth. 3-5-10 Pyrenoids

..... → **Ulva (Enteromorpha) clathrata**