

## What are they?

Some marine algae exist as low “mats” or “turfs” (also called “turving” or “turf-like” algae by some workers). As the names imply, “mats” are flat and spreading, “turfs” are more upright like miniature mown lawns or grazed pastures, however, both terms are pretty subjective. Some mats heavily grazed by molluscs may be so low that they slip into the category of “crusts”.

Generally, the term “turf” has been used to describe:

- **communities** — mainly intertidal some running into shallow water — consisting of mixed species, all with a low profile.
- or
- **a single species** — its natural form, or a shape modified by heavy grazing.

Some workers expand their definition to include all those algae smaller than the brown algal canopy of a community. These algae should probably better be described as *understorey* species.

## Mat & turf species described in this key

Edgar, G & Shepherd, S A (2013) in *The Ecology of Australian temperate reefs*, CSIRO, described turf algae as thread-like, or leafy species in early stages of growth, ~ 10-20 mm tall. The key below uses this definition where possible, but strays to describing larger leafy and

filamentous plants that bloom seasonally on reefs and form dense, low mats a few cm high.

## Where are they found?

Some turfs may suddenly appear seasonally, often as a response to increased water temperature, light and dissolved nutrients. Others occur as permanent zones in the intertidal distributed according to a balance between resistance to radiation/drying and the distribution of animal grazers. They can be used to define zones on reefs, related to tidal levels.

## Limitations

Only macrophytes, those with some features that can be seen by the unaided eye, are considered below. Unfortunately, microscopic investigation will also be needed for definitive identifications.

## Images used below

Unless acknowledged otherwise, all images come from pressed specimens or the extensive slide collection of the algal unit, State Herbarium of S Australia, collections generated by Professor Womersley and his workers over some 60 years. Those with dark backgrounds have been taken using phase contrast or interference microscopy to highlight transparent structures. Other images may be stained dark blue.

## Scale

The coin used as a scale is 24 mm or almost 1” across

- 1a. plants forming a broken band of growth a few mm high on rock just above high tide (the supra-littoral zone), kept wet by wave splash, crumbling when dry, heavily grazed by small blue snails at lower levels ..... marine lichens (combination of fungus and microscopic alga) ..... 2.
- 1b. not as above ..... 3.
- 2a. dry plants orange-yellow. Fig. 1. .... *Caloplaca* spp
- 2b. dry plants black. Fig. 2. .... *Lichina* spp
- 3a. plants bright green ..... 4.
- 3b. plants dark red, red, amber or brown ..... 11.
- 4a. plants leafy or with narrow ribbon-like branches, bright yellow-green and with crinkled edges. Figs 3-7. .... *Ulva* (Sea lettuce) (including species with hollow parts, once placed into *Enteromorpha*) See **Southern Australian Groups at a glance: *Ulva***
- 4b. plants thread-like, yellowish, dark green or blue-green ..... 5.



Fig. 1: *Caloplaca* on boulders at Petrel Cove, SA



Fig. 2: *Lichina pygmaea*, Yorke Peninsula, SA being grazed by blue, littorinid snails (about 4 mm tall)



Fig. 3: *Ulva* mats exposed at low tide on mud flats of the Port River, S Australia, during December, plants attached to shell fragments



Fig. 4: *Ulva* (*Enteromorpha*) *compressa* mats at the edge of a flat reef, exposed at low tide during December, Rapid Bay, S Australia

Fig. 5: *Ulva* (*Enteromorpha*) *linza*, plants with broad blades



Fig. 6: *Ulva*, closely cropped on a boulder, with dead barnacles, Port River, S Australia



- 5a. under the microscope, threads can be seen as rows and columns of many box-shaped cells forming hollow tubes. Figs 7-12.

..... *Ulva*

(Note: species with hollow parts were once placed into a separate genus, *Enteromorpha*)

See **Southern Australian Groups at a glance: *Ulva***

- 5b. under the microscope, threads can be seen as single lines of elongate cells ..... 6.

- 6a. cross-walls **absent** (except where reproductive organs form); plants form sparse turfs exposed at the edges of reefs or estuaries at low tide, amongst sand. Figs 13, 14.

..... *Vaucheria* species in the Xanthophyceae (Yellow-green Algae)

- 6b. cross-walls **present** ..... 7.

- 7a. threads branched ..... 8.

- 7b. threads unbranched ..... 10.

- 8a. branching regular or irregular, cross walls occur at branches

..... 9.

- 8b. branching irregular, contents of side branches **continuous** with parent cells; plants in dense mats or cushions. Figs 15-17, (next page).

..... *Cladophoropsis* 3 spp, 1 rare, 1 sp forms floating balls

- 9a. branching regular, cells usually elongate, hairs **absent**, root-like rhizoids, if present, **not** tapering. Figs 18-22 (next page). 1 sp forms small floating balls,

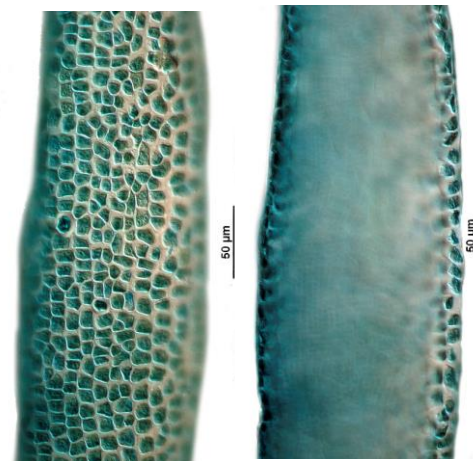
..... *Cladophora*

See **Southern Australian Groups at a glance:**

***Cladophora* species groups I–III**

- 9b. branching irregular, cells irregularly shaped, often **bulging**, hairs may be **present**, root-like rhizoids tapering to a fine point. Figs 23, 24 (next page).

..... *Wittrockiella salina*



Figs 7-9: *Ulva (Enteromorpha) ralfsii*, plants  
7. coarse hair-like appearance  
8. surface view of cells  
9. the hollow core seen after focusing through the surface



Fig. 10: *Ulva (Enteromorpha) clathrata*

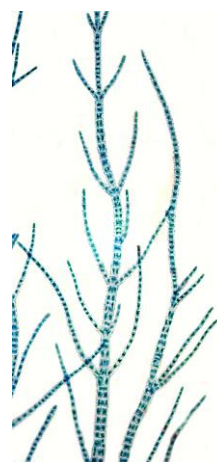


Fig. 11: *Ulva (Enteromorpha) paradoxa*

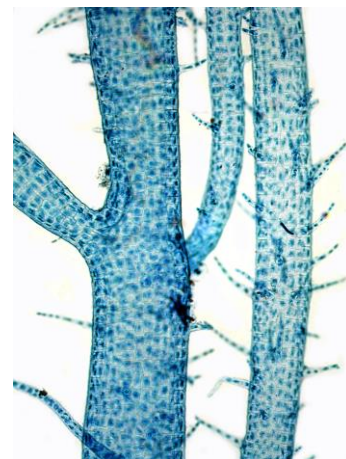


Fig. 12: *Ulva (Enteromorpha) paradoxa*



Fig. 13: *Vaucheria*: branched threads lacking cross walls, swollen ends



Fig. 14: *Vaucheria*: thick-walled female structure, twisted male structure (arrowed)



Fig. 15: *Cladophoropsis herpestica*, from Elliston, S Australia, in shaded parts of the lower intertidal



Fig. 16: *Cladophoropsis membranacea*, forming low cushions at Cape Lannes, S Australia

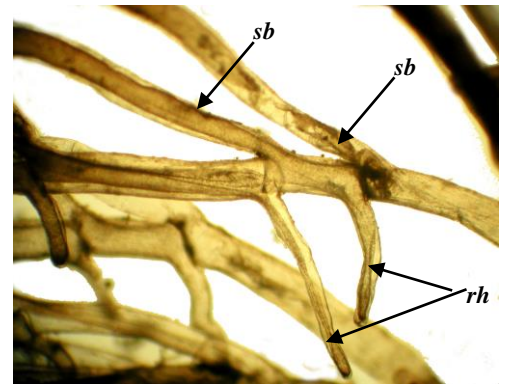


Fig. 17: *Cladophoropsis herpestica*, side branches (*sb*) lack cross walls at their bases, and rhizoids (*rh*) arise from the bases of axial cells



Fig. 18: *Cladophora coelothrix*



Fig. 19: *Cladophora coelothrix*, branching pattern

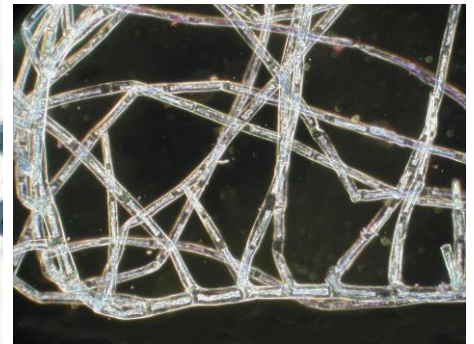


Fig. 20 *Cladophora subsimplex* branching pattern of horizontal and upright branches



Fig. 21: *Cladophora aegagropiloidea*: plants in rounded balls

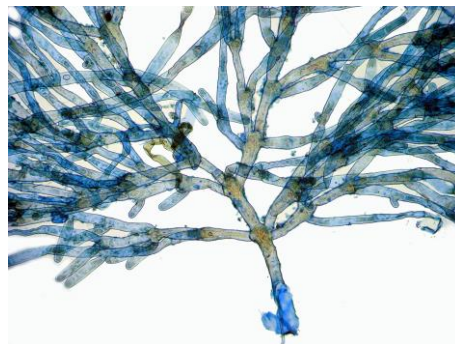
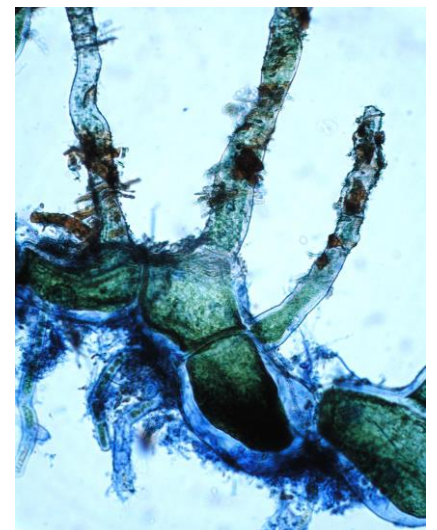


Fig. 22: *Cladophora aegagropiloidea*: microscope detail of branching cells



Fig. 23: *Wittrockiella salina*

Fig. 24: *Wittrockiella salina*: microscope detail of irregularly shaped cells



- 10a. threads coarse (> 0.7mm wide)  
plants often loose lying. Figs 25-27.  
..... *Chaetomorpha* 8 spp  
See **Southern Australian Groups  
at a glance: *Chaetomorpha***),
- 10b. threads fine (< 0.6 mm wide),  
forming tangled mats or loose-lying  
strands. Figs 28-33.  
..... *Rhizoclonium* 4 spp  
See **Southern Australian Groups  
at a glance: *Rhizoclonium***



Fig. 25: *Chaetomorpha linum*, detail of a thread



Fig. 26: *Chaetomorpha linum*



Fig. 27: *Chaetomorpha valida*



Fig. 28: *Rhizoclonium riparium*



Fig. 29: *Rhizoclonium tortuosum*, mixed with sea grass blades from intertidal mud flats

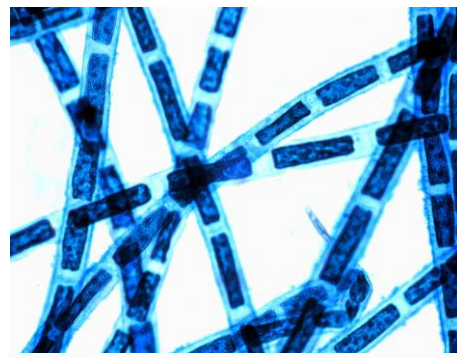


Fig. 30: *Rhizoclonium tortuosum*, detail of threads



Fig. 31: *Rhizoclonium curvatum*

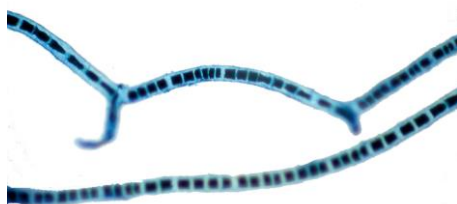


Fig. 32: *Rhizoclonium curvatum*, detail of threads in arcs between rhizoids

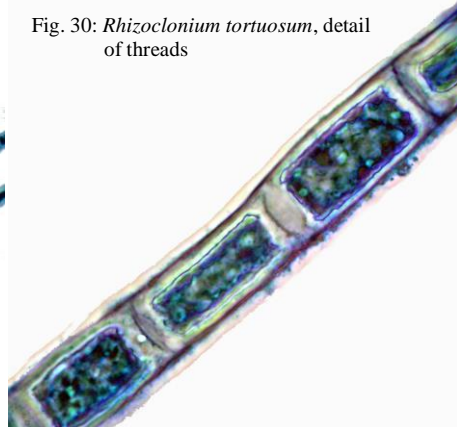


Fig. 33: *Rhizoclonium tortuosum*, detail of thread, net-like chloroplasts

- 11a. plants pink, red to red-brown ..... 12.  
 11b. plants brownish, bleaching yellowish  
 ..... 16.

- 12a. plants pink to red, some bleaching to white, all **limey, brittle and jointed**; at outer edges of reefs. Figs 34-40.  
 ..... coralline red algae  
 See **Pictured keys of common southern Australian marine plants: coralline red algae**

- 12b. hair-like or gristly, **not** limey; ..... 13.

- 13a. plants hair-like, of dark red threads; <1mm wide; cells in a single line, with girdles and coatings of microscopic cells; may be attached to other turf plants. Figs 41-45.  
 ..... *Ceramium* spp, *Centroceros*, *Polysiphonia* spp

See **Pictured key to southern Australian algae: filamentous red algae Master key**

- 13b. plants red, some bleached to yellow, branches >1 mm wide, many cells wide  
 ..... 14.



Fig. 34: *Cheilosporum sagittatum*, turf, shallow water, Aldinga reef edge, SA



Fig. 35: *Cheilosporum sagittatum* arrow-shaped sections of jointed branches



Fig. 36: bleaching coralline turf with brown algae, reef edge, Second Valley, SA



Fig. 37: *Corallina officinalis*



Fig. 38: *Haliptilon roseum*, Stokes Bay, SA. Photo: D Muirhead



Fig. 39: *Corallina officinalis*, detail of jointed branches



Fig. 40: *Haliptilon roseum*, detail of branches



Fig. 41: *Ceramium pusillum*, branch tips, cell girdles showing beneath coatings of additional (corticated) cells



Fig. 42: *Ceramium cliftonianum* forms entangled masses

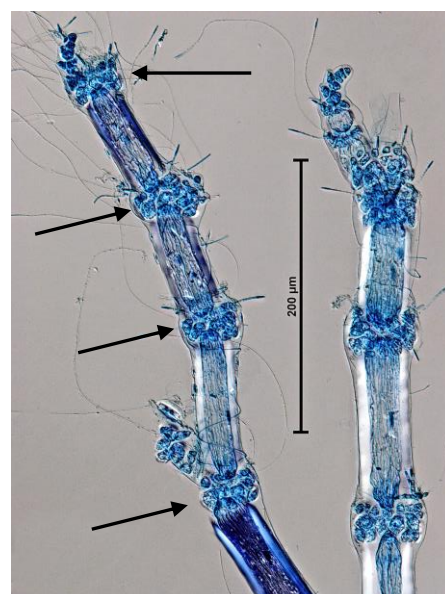
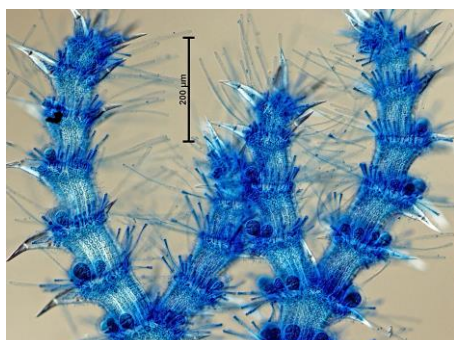


Fig. 43: *Ceramium cliftonianum* detail of thread-cells with girdles of smaller cells (arrowed)



Fig. 44: *Polysiphonia isogona* turf

Fig. 45: *Centroceros clavulatum*, spiny tips

14a. plants forming tangled masses of somewhat flattened, **hollow**, branches narrowed at the base; sporangia in minute circles in side branches. Figs 46- 48.

..... *Lomentaria monochlamydea*

14b. plants stubby or in tangled masses, hair-like or gristly, branches solid, cylindrical, tetrasporangia scattered in short side branches ..... 15.

15a. plants stubby or in tangled masses; cross sections show a core of rounded cells and, in some species, clusters of brightly-lit, minute, extremely thick-walled cells. Figs 49-55.

..... *Gelidium* spp, *Gelidiella* spp, *Capreolia implexa*, *Pterocladia* spp  
See **Southern Australian species of Gelidiaceae at a glance**

15b. plants with tangled, thin branches or stubby, gristly branches; cross sections show a core of well-spaced, many-armed cells. Figs 57-59 (next page).

..... *Gigartina brachiata*, *G. densa*  
See **Southern Australian species of Gigartinaceae at a glance**



Fig. 46: *Lomentaria monochlamydea*



Fig. 47: *Lomentaria monochlamydea*, detail of branching pattern

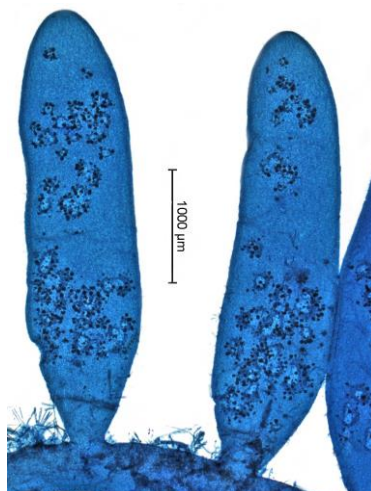


Fig. 48: *Lomentaria monochlamydea*, tetrasporangial clusters in scattered rings on side branches



Fig. 49: *Gelidium crinale*, forming hair-like turfs bleaching at the tips



Fig. 50: band or zone of red algal turf, mainly *Gelidium*, exposed between waves on granite, West I., SA



Fig. 51 *Capreolia implexa*, often mistaken for *Gelidium pusillum*

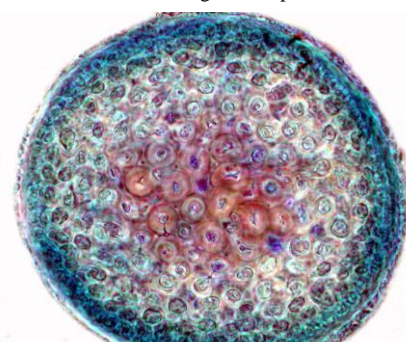


Fig. 52: *Gelidium crinale*, cross section

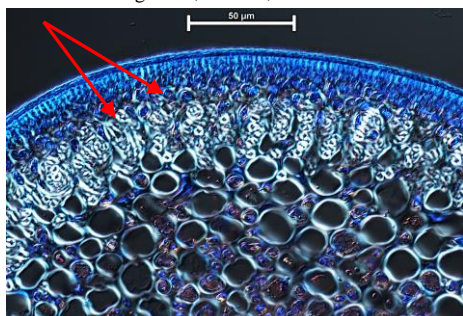


Fig. 53: *Gelidium asperum*, edge of a cross section with a core of rounded cells and brightly lit clusters of minute, extremely thick-walled cells (arrowed)



Fig. 54: *Gelidium pusillum*, with thin, gristly branches



Fig. 55: *Gelidiella ramellosa*



Fig. 56 *Gelidium australe*



Fig. 57: *Gigartina brachiata*, tangled masses, often with faint white bands on branches



Fig. 58: *Gigartina densa*, growing in stubby, gristly clumps at the lower edges of reefs in rough waters

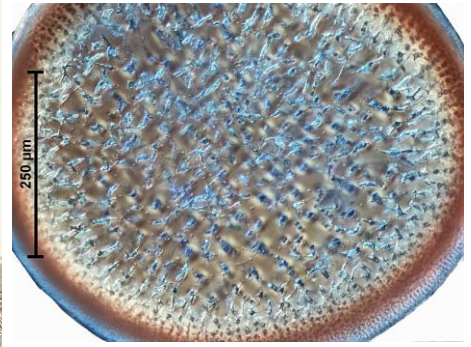


Fig. 59: *Gigartina brachiata*, cross section

- 16a. plants fan-shaped, fans ~ 20-40 mm across, lying flat on reefs, fluorescing blue under water Figs 60-64.

..... *Lobophora* spp, *Lobospira*  
*Padina* spp., *Zonaria* spp

See **Southern Australian species of Dictyotaceae at a glance**

- 16b. plants thread-like, brown or bleaching green or yellow, fouling other algae Figs 65-67.

..... See **Turf and fouling algae I: Ectocarpaceae**



Figs 60, 61: *Lobophora variegata*, two views of flat masses (arrowed) at the reef edge, Cape Jervis SA



Fig. 62: *Padina elegans*, fan-shaped blades, edges in-rolled, lie flat on reefs



Fig. 63: *Lobospira bicuspidata*



Fig. 64: *Zonaria spiralis* mat



Fig. 66: *Fucus vesiculosus* (stained blue)  
Whyalla, SA



Fig. 65: *Hincksia sordida*, Whyalla, SA

Fig. 67: *Ectocarpus*, with spore sacs

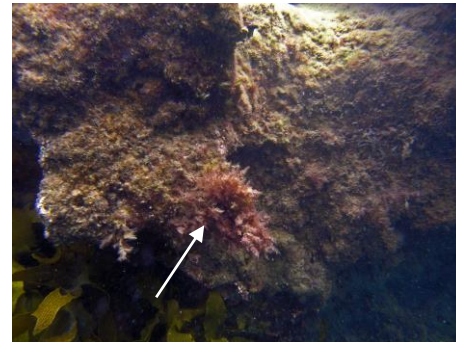
## EXAMPLES OF TURF HABITATS IN SOUTH AUSTRALIA



Closely cropped turf of mixed species, greens (mainly *Ulva*) and reds (*Gelidium*) at the edge of the reef, Port Willunga



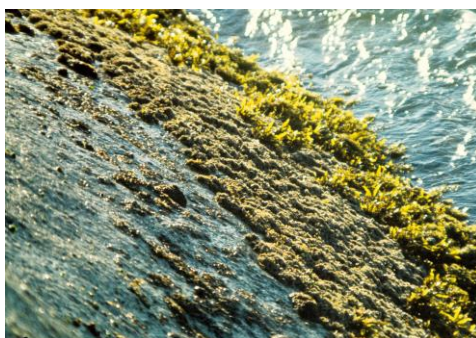
Red algal turf above green, at the edge of the reef, Port Willunga



Underwater view reef edge, Aldinga, turf of mixed red species and an emergent *Laurencia* plant (arrowed)



Seastar, *Petricia vernicina*, on turf including fan-shape *Lobophora*, characteristically fluorescing blue-green underwater, also sponges and pink, encrusting coralline red algae, 5m deep, Port Noarlunga



Slanting view of coralline turf (uppermost) and basal leaves of *Sargassum* on a granite boulder, exposed between waves, West Island



*Ulva* mats exposed at low tide, Robe reef platform



Zones on a concrete wall, West Beach marina, Adelaide: 1 = green *Chaetomorpha*; 2 = dark red *Gigartina brachiata*; 3 = bright red *Lomentaria monochlamydea*; 4 = *Ulva*



Broken red algal turf (arrowed) (*Gelidium*) bleached yellow, above the bead-like, brown canopy species, *Hormosira*, at low tide, Slipway reef, Robe