

FILAMENTOUS RED ALGAE

Part III 2nd edition. Algae with well-defined whorl-branchlets

Red Algae.	With some 800 species, many of which are endemic (found nowhere else), southern Australia is a major centre of diversity for red algae. Classification is based on detailed reproductive features. Many species unrelated reproductively have similar vegetative form or shape, making identification very difficult if the technical systematic literature is used.
This key	Fortunately, we can use this apparent problem to advantage - common shapes or morphologies will allow you to sort some algae directly into the level of genus or Family and so shortcut a systematic search through intricate and often unavailable reproductive features. The pictured key below uses this artificial way of starting the search for a name. It's designed to get you to a possible major group in a hurry. Then you can proceed to the appropriate fact sheets within this website.
Scale:	The coin used as a scale is 24mm or almost 1" wide. Microscope images of algae are usually blue stained.

This key is *restricted* to

- algae consisting of *threads* (filaments) of cells growing in a single line (*uniaxial* algae)
- algae with neither *compact* wrappings (*cortication*) nor regularly arranged (pericentral) cells around main branches (axes). There may be a dense but loose, irregular or ropey sheath of rhizoids, however
- algae with *distinct* rings or opposite *short* side branches (*whorl-branchlets*)

The key includes Tribes in the Ceramiaceae such as the Sphondylothamnieceae, Antithamnieceae and Heterothamnieceae. Algae with compact wrappings (*cortication*) so complete that the basic filamentous construction is completely obscured are covered in a separate pictured key.

In Part III, only algae with **well-defined**, often well-separated whorl-branchlets are included. These algae are often inconspicuous epiphytes of other, larger plants.

Names follow Womersley (1998) as this continues to provide the most available and comprehensive descriptions of species. Recent name changes in the Website *Algaebase* have been added.

- 1a. plants 50-200 mm tall, gland cells (Figs 20, 27) *absent*; much-divided polysporangia (Fig. 4) may be present; axis bases often ropey with dense rhizoids; cells often large
..... 2
 Family Ceramiaceae, Tribe: Sphondylothamnieceae
- 1b. plants 5-40 mm tall, (except *Macrothamnion*, 200mm) often inconspicuous, attached to other algae; gland cells may be present; axis bases naked or with a light sheath of rhizoids
..... 6.
- 2a. cells long, visible to the naked eye; whorl-branchlets opposite or in rings of 3; polysporangia (Fig. 4) present, reproductive structures in claw-like reduced branchlets. Figs 1-4
..... *Involucrana* (2 species)
- 2b. cells microscopic, whorl-branchlets in rings of 2-5
..... 3.
- 3a. attachment pads (haptera) *without* finger-like extensions, whorl-branchlets 4, tip cells narrowing to a point. Figs 5-8
..... *Drewiana nitella*
- 3b. attachment pads (haptera) with finger-like (digitate) extensions. Fig. 9
..... 4.



Fig. 1. *Involucrana crassa*

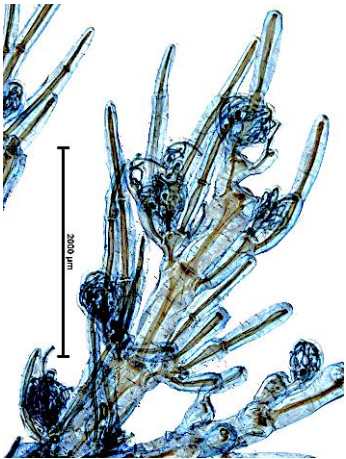


Fig. 2. *Involucrana crassa*: stalkless polysporangium in claw-like reduced branchlets



Fig. 3. *Involucrana crassa*: large axis cells; whorl-branchlets (whl br) in opposite pairs

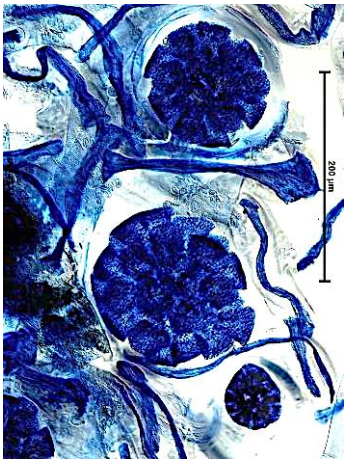


Fig. 4. *Involucrana crassa*: stalkless polysporangium in a whorl-branchlet

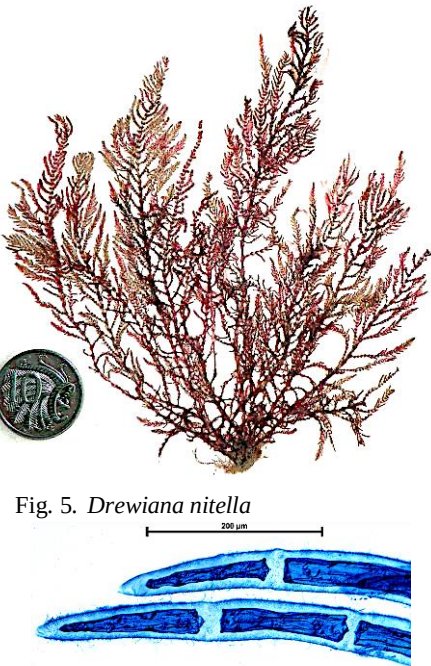


Fig. 5. *Drewiana nitella*

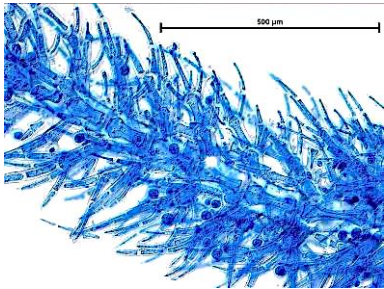


Fig. 6. *Drewiana nitella*: young axis with short whorl-branchlets bearing stalkless tetrasporangia

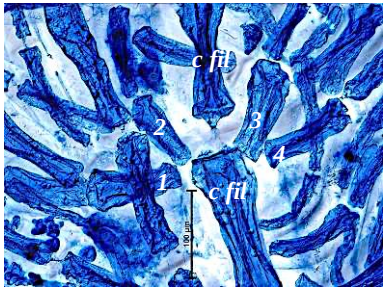


Fig. 8. *Drewiana nitella*: central filament (c fil) with a ring of 4 whorl-branchlets (1-4)

Fig. 7. *Drewiana nitella*: tip cells narrowing to a point

- 4a. tip cells *short, sharply conical*. Figs 9–12
 *Wollastoniella* (2 species)
 4b. tip cells *blunt or tapering gradually to a point*



Fig. 11. *Wollastoniella mucronata*: whorl-branchlets (*whl br*) ; axes (*ax*)

- 5a. whorl-branchlets usually in 2 rows (distichous), axes often ropey with rhizoids. Figs 16–18
 *Shepleya* (2 species)
 ⚠ Can be confused with *Involucraria*
 5b. whorl-branchlets usually radial; plants delicate, inconspicuous, grow on other algae. Figs 13–15
 *Mediothamnion* (3 species)
 5c. whorl-branchlets feathery (pinnate), plants to 200mm tall, axes often ropey with rhizoids 19.

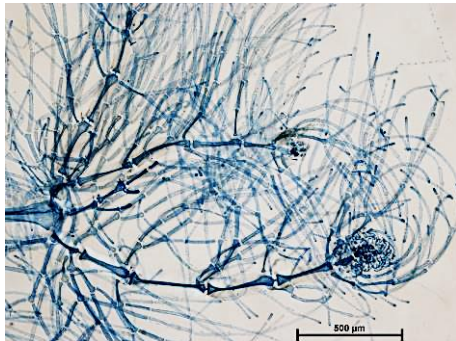


Fig. 13 (left) *Mediothamnion protensum* radial whorl-branchlets

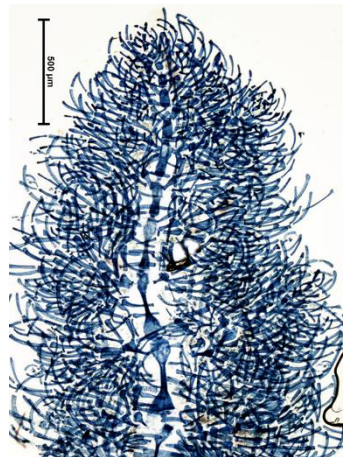


Fig. 14. *Mediothamnion halurus*: female reproductive structure (cystocarp) surrounded by whorl-branchlets

Fig. 15 (left:)
Mediothamnion halurus
 radial whorl-branchlets



Fig. 16. *Shepleya verticillata*: whorl-branchlets in 2 opposite rows

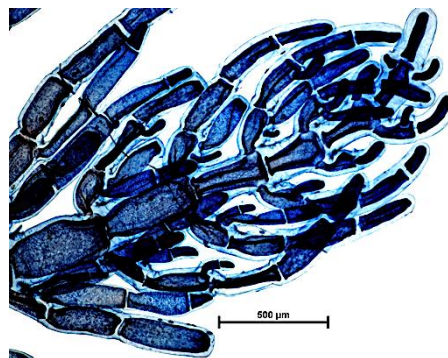


Fig. 17. *Shepleya watsii*: whorl-branchlets in 2 opposite rows

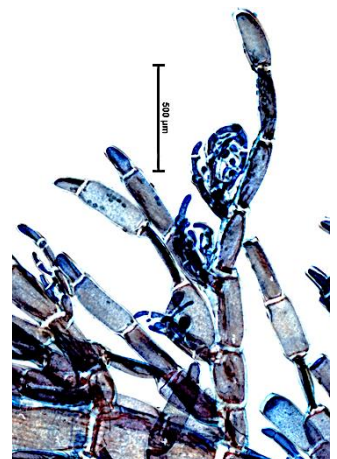


Fig. 18. *Shepleya watsii*: claw-like whorl-branchlets around tetrasporangia

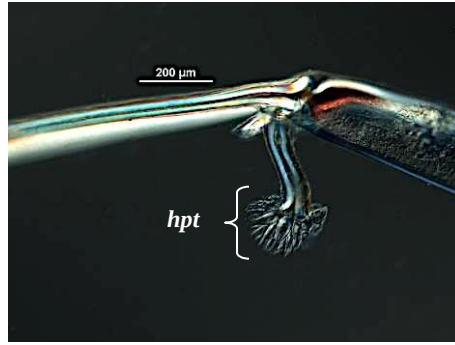


Fig. 9. *Wollastoniella myriophylloides*: finger-like attachment pad (hapteron, *hpt*)

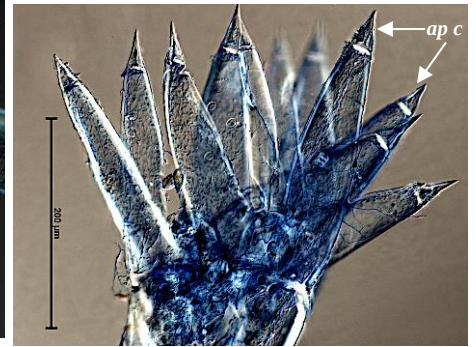


Fig. 10. *Wollastoniella mucronata*: short, sharp, conical tip cells (*ap c*) on a whorl-branchlet

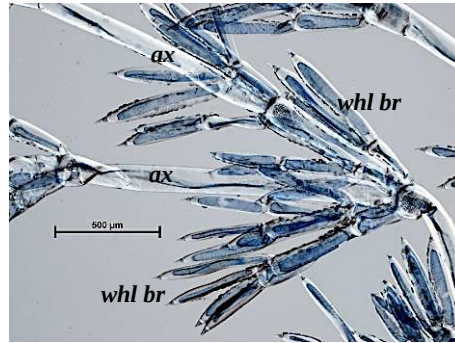
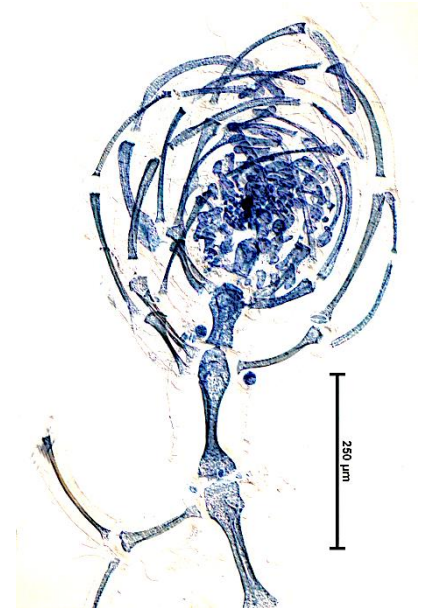
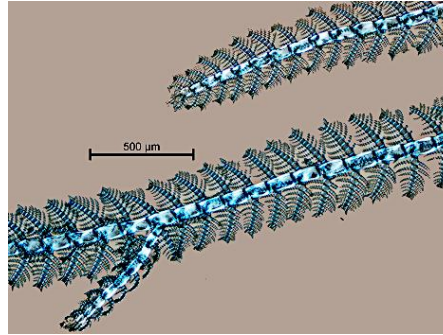
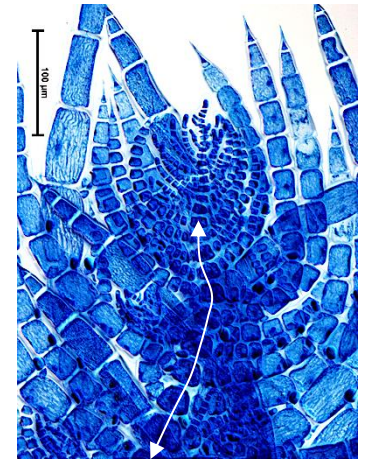
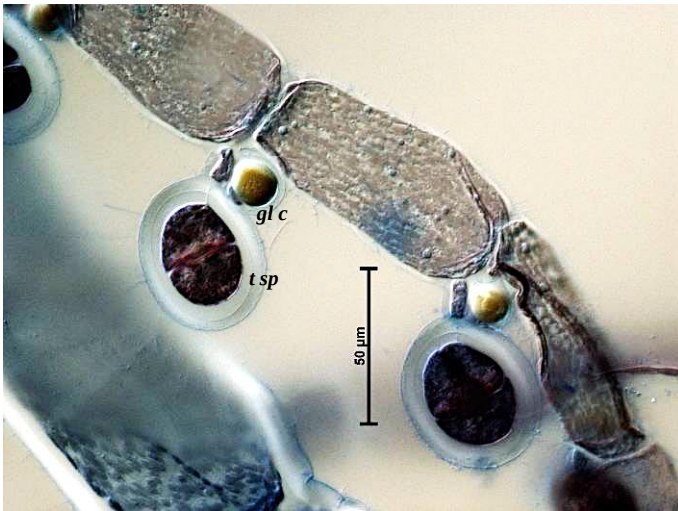
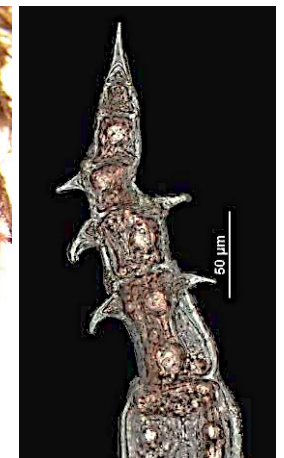
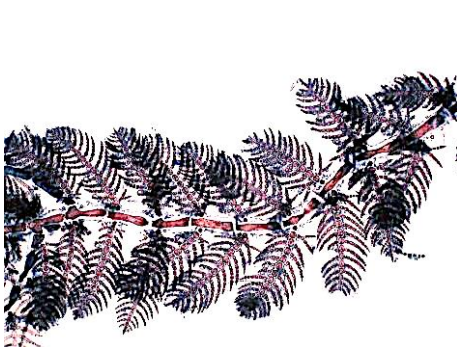
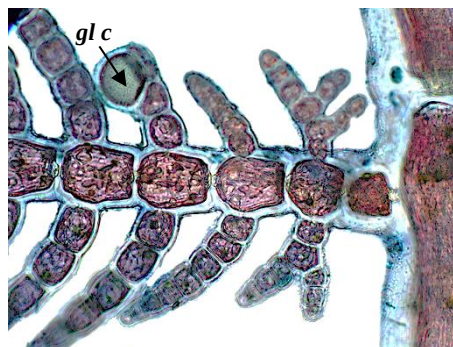
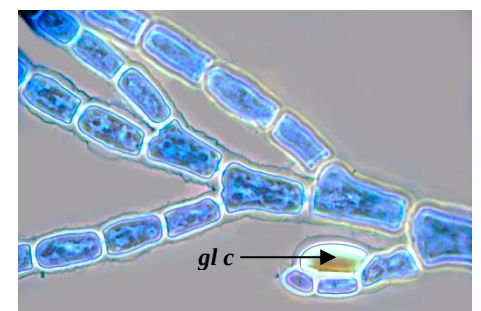


Fig. 12 *Wollastoniella mucronata* whorl branchlets (*whl br*) , axes (*ax*)



- 6a. gland cells usually *present* (see Figs 20, 23, 27) 7.
 6b. gland cells *absent* 19.
- 7a. gland cells on special 2 or 3-celled stalks (Figs 27, 28) **or** at tips of whorl-branchlets (Fig. 20); mature female structures (cystocarps) naked; whorl-branchlets opposite or in 2 rows 8.
 Family: Ceramiaceae, Tribe: Antithamnnieae
- 7b. gland cells lie along the cells of whorl-branchlets (see Figs 36, 48); whorl-branchlets radial or comb-like (pinnate) 10.
- 8a. plants small, gland cells at *tips* of whorl-branchlets; whorl-branchlets = 2 large, obvious + 2 small, obscure ones on each axis cell, branched like teeth of a comb (pinnate). Figs 19, 20 *Acrothamnion preissii*
- 8b. gland cells on special 2-3 celled stalks 9.
- 9a. plants 10-200 mm tall, whorl-branchlets 3 (2 in 1 species) per axial cell; minute stalks bearing the glands bear also tetrasporangia or male spermatangial clusters. Figs 21-25 *Macrothamnion* (3 species)
- 9b. plants 5-40 mm tall, whorl branchlets 2 per axial cell, oppositely (pinnate) or irregularly branched; gland cells on *separate* minute branches to tetrasporangia or spermatangial clusters. Figs 26-34 *Antithamnion* (11 species)

Fig. 19: *Acrothamnion preissii*Fig. 20. *Acrothamnion preissii*: gland cells (gl c) at whorl-branchlet tipsFig 21. *Macrothamnion pellucidum*Fig 22 (above, right): *Macrothamnion acanthophorum* axis (←→); 2 opposite whorl branchlets per axial cell; tip cells sharply pointedFig 23. *Macrothamnion acanthophorum*: tetrasporangia (t sp) and gland cells (gl c) sharing a common minute branchFig 24: *Macrothamnion pellucidum*Fig 25. *Macrothamnion pellucidum*: needle-point tip cell and hooked spines near ends of whorl-branchletsFig 26. *Antithamnion pectinatum* pinnate whorl-branchletsFig 27. *Antithamnion pectinatum*: gland cell (gl c) lying along a 3-celled stalk within a pinnate whorl-branchletFig 28. *Antithamnion cruciatum*: gland cell (gl c) lying along a 3-celled stalk within an irregularly branched whorl-branchlet

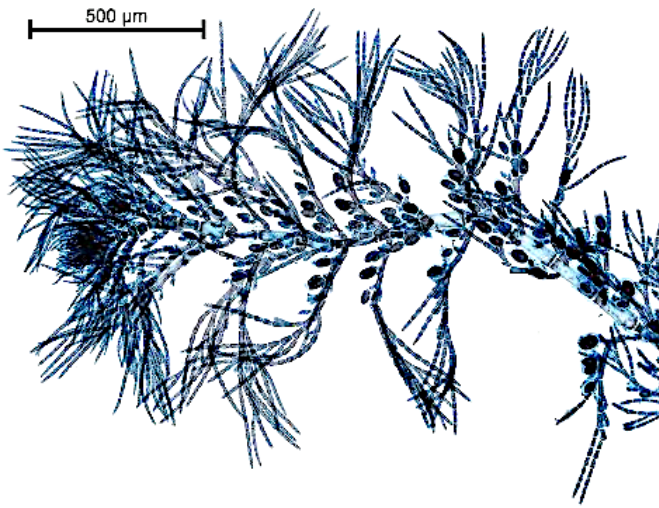


Fig 29. *Antithamnion cruciatum*
irregularly-branched whorl-branchlets with tetrasporangia basally

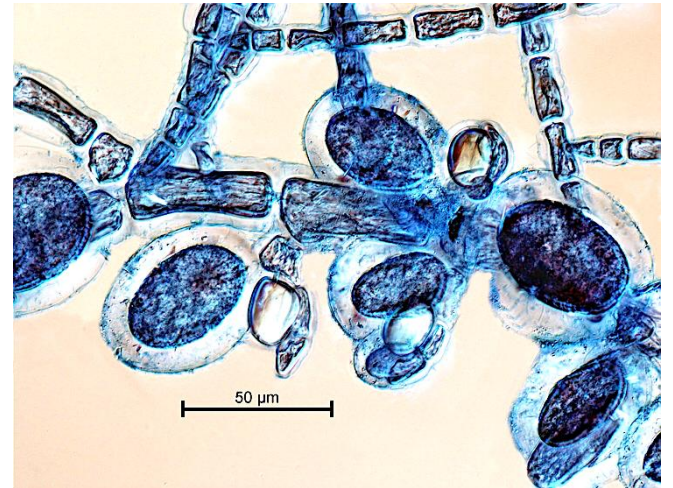


Fig 30. *Antithamnion cruciatum*: stalkless tetrasporangia and gland cells on minute, 3-celled branches



Fig 31. *Antithamnion hanovioides* on the blade of the seagrass *Posidonia sinuosa*

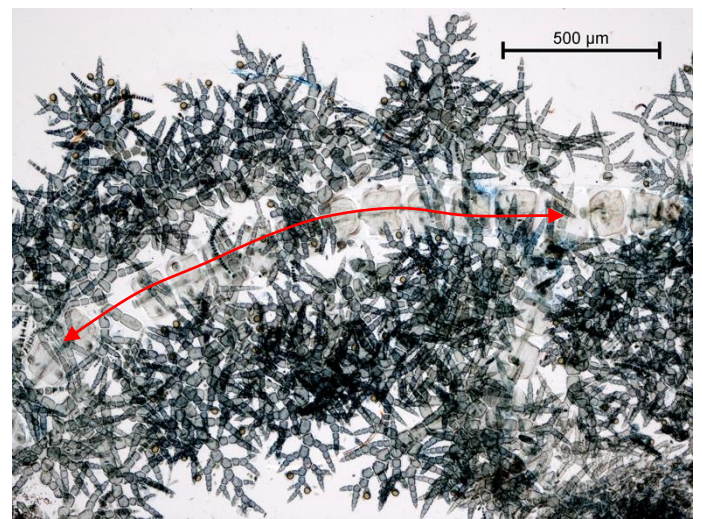


Fig 32. *Antithamnion hanovioides*: axis (↔) of box-shaped cells; whorl-branchlets rigid, pointed

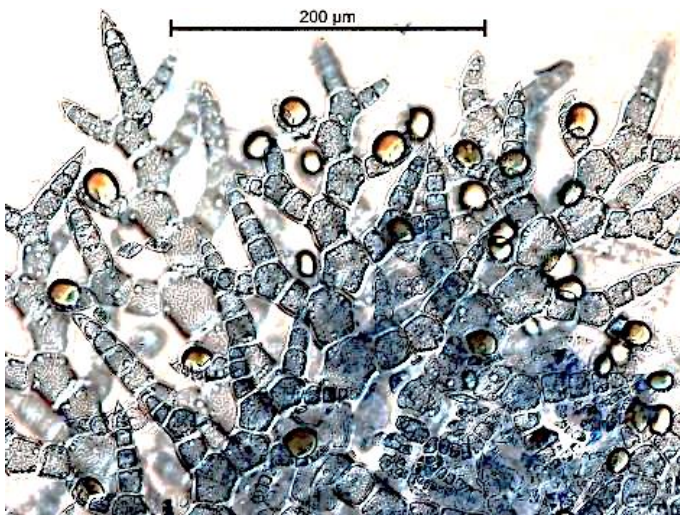


Fig 33. *Antithamnion hanovioides*: whorl-branchlets rigid, pointed; gland cells prominent



Fig 34. *Antithamnion gracilentum*: a red-brown fuzz on the end branches of the brown alga *Cystophora intermedia*

- 10a. plants mostly delicate, but range from 10-200 mm tall, lower parts sometimes wrapped densely in rhizoids, gland cells lying over only one cell of a whorl-branchlet, sometimes at an angle.
Figs 35-37 see also "A Miscellany of Red algae"
..... *Pterothamnion* (8 species)

- 10b. plants small, inconspicuous, 2-40 mm tall, mostly on larger algae; gland cells often overlap 2 whorl-branchlet cells. Figs 38-40.
..... 11.

Family: Ceramiaceae. Tribe: Heterothamnieceae

- 11a. parasites, with basal pads penetrating the brown algae *Hormosira*, *Cystophora* or *Platythalia*.
Figs 38-40
..... *Heterothamnion* (4 species)

- 11b. plants growing on the surface of other algae
..... 12.



Fig. 38. *Heterothamnion platythaliae*; fuzzy patches (arrowed) on the brown alga *Platythalia*



Figs 35, 36: *Pterothamnion flexile* (below) gland cell and tetrasporangia



Fig. 37. *Pterothamnion aciculare*: four radial whorl-branchlets from each axis cell

Fig. 37. *Pterothamnion flexile*: tetrasporangia (*t sp*) starting to divide cruciately; gland cell (*gl c*) at an angle to the whorl-branchlet cell



Fig. 39. *Heterothamnion platythaliae*: section through the *Playthalia* host showing the penetrating basal threads (*bas thr*)



Fig. 40. *Heterothamnion sessile*: upright tufts with basal pads, originally penetrating the host, torn from *Hormosira*

- 12a. usually 3 whorl-branchlets per axial cell, their basal cells *unbranched* (except *Antithamnionella glandifera*, Fig 44)
..... 13.

- 12b. usually 3-6 whorl-branchlets per axial cell, their basal cells *branched*
..... 14.

- 13a. whorl-branchlets vary in number (1-4 or more) per axial cell, usually *equal* in size. Figs 41, 42
..... *Antithamnionella*

- (3 species, excluding *A. glandifera*, (see opposite)
13b. whorl-branchlets mostly 3 per axial cell, *unequal* in size. Figs 45-48, next page
..... *Trithamnion* (4 species)

(next page)



Fig. 41: *Antithamnionella spirographidis*.

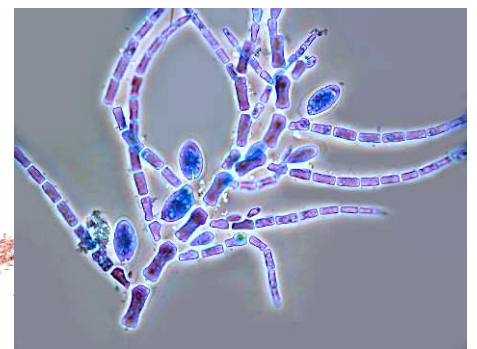
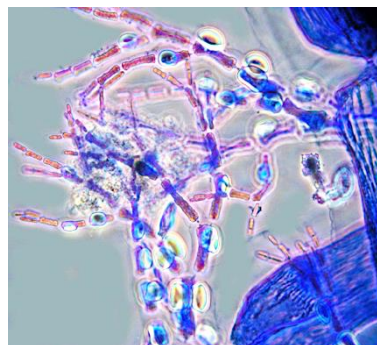
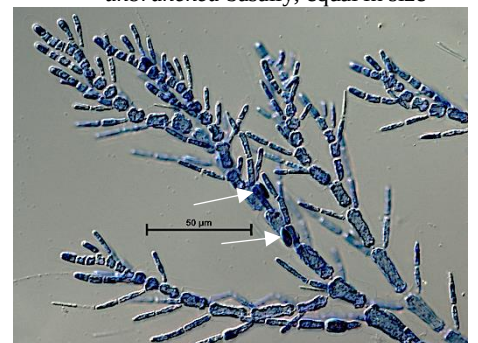


Fig. 42. *Antithamnionella spirographidis*: 1-2 whorl-branchlets per axial cell, *unbranched* basally, *equal* in size





Figs 45, 46: two magnifications of *Trithamnion vulgare*. Minute plants on the tips of the smallest branches (ramuli) of the green alga *Caulerpa brownii*



Fig. 47. *Trithamnion vulgare*: whorl-branchlets, 3 per axial cell, unbranched basally, one larger than the other, and bright gland cells

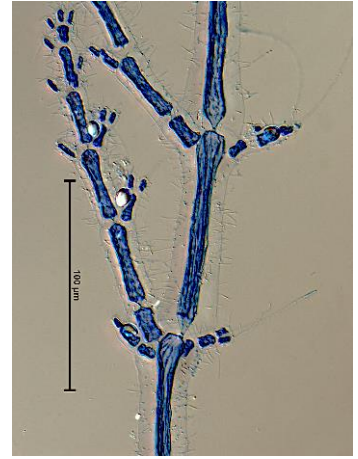


Fig. 48. *Trithamnion gracilissimum*: whorl-branchlets, 2-3 per axial cell, one very much larger than the other(s), and bright gland cells

- 14a. whorl-branchlets short, poorly branched, rings of branchlets well-separated. Figs 49, 50
 *Amoenothamnion*
 (including *Leptoklonium*) (3 species)
 14b. whorl-branchlets longer, if short, branched several times, rings of branchlets closer together when mature
 15.

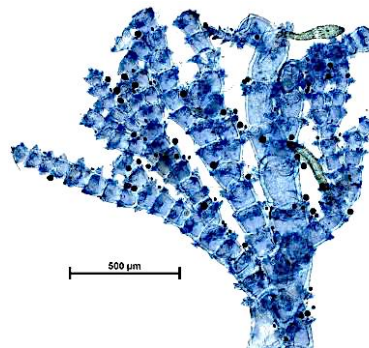


Fig. 49: *Amoenothamnion planktonicum*

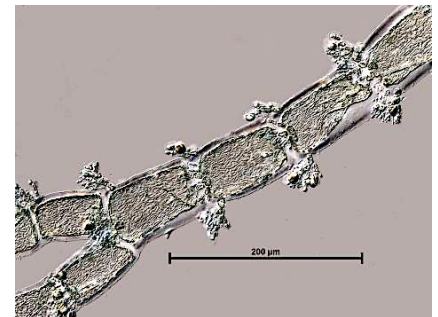


Fig. 50: *Leptoklonium fastigiatum*

- 15a. whorl-branchlets appearing feathery, actually of 2 large+ 2 minute and obscure whorl-branchlets per axial cell; plants attached by clumps of pads with finger-like tips. Figs 51, 52
 *Acrothamnopsis eliseae*



may be confused with
Antithamnion pectinatum

- 15b. whorl-branchlets not feathery, 3-5 per axial cell, equal in size
 16.

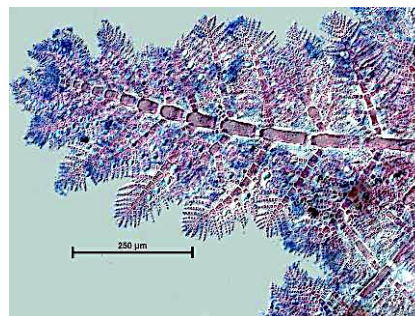


Fig. 51: *Acrothamnopsis eliseae*

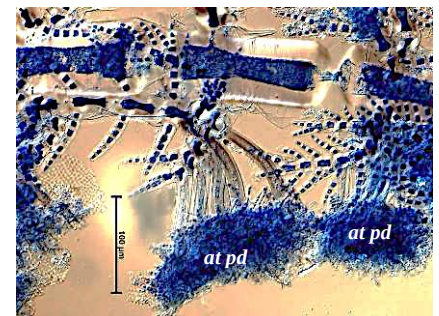


Fig. 52. *Acrothamnopsis eliseae*: clumps of attachment pads (at pd)

- 16a. tetrasporangia and male spermatangia in minute clusters lying in the angle between the whorl-branchlets and axial cells (adaxial). Figs 53, 54
 *Elisiella* (2 species)



diagnosis can
 be difficult

- 16b not as above 17.



Fig. 53: unstained *Elisiella arbuscula*
 minute bunches of tetrasporangia (arrowed) lying toward the axial cells



Fig. 54. *Elisiella arbuscula*: tetrasporangia (t sp) and gland cells (gl c) in a minute bunch removed from a whorl-branchlet

- 17a. whorl-branchlets 3 per axial cell. Figs. 55, 56
 *Scageliopsis patens*
- 17b. whorl-branchlets 4-5 per axial cell 18.

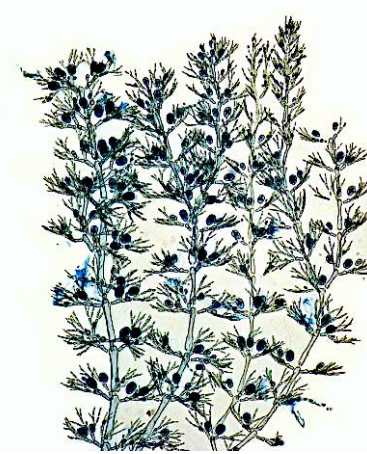


Fig. 55: *Scageliopsis patens*

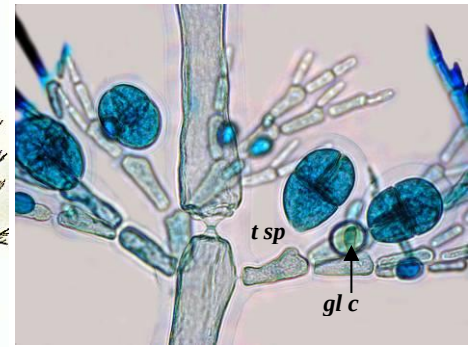


Fig. 56. *Scageliopsis patens*: gland cell (gl c), tetrasporangia (t sp) dividing into a cross pattern (cruciate), basal cells of whorl-branchlets branched

- 18a. minute spermatangia and tetrasporangia found at tips of whorl-branchlets. Figs 57-59
 *Perithamnion* (8 species)



May be confused with *Elisiella arbuscula*

- 18b. spermatangia and tetrasporangia in minute clusters near the base of whorl-branchlets. Figs 60-62
 *Tetrathamnion lineatum*



Diagnosis can be difficult



Fig. 57: *Perithamnion muelleri*

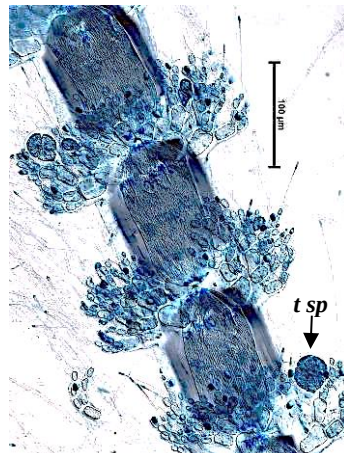


Fig. 58. *Perithamnion muelleri*: tetrasporangia (t sp) at tips of whorl-branchlets

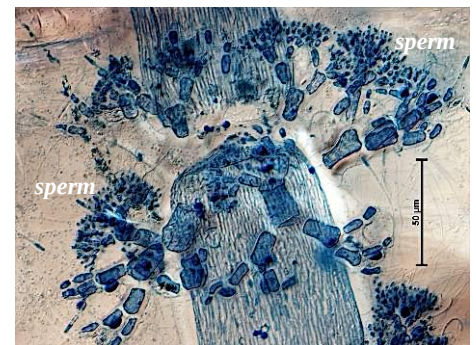


Fig. 59. *Perithamnion muelleri*: spermatangia (sperm) at tips of whorl-branchlets



Fig. 60: *Tetrathamnion lineatum*

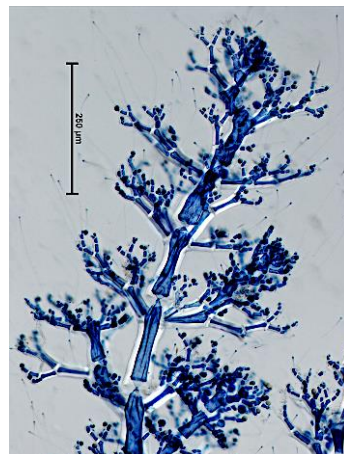


Fig. 61. *Tetrathamnion lineatum*: 4 whorl-branchlets per axial cell



Fig. 62. *Tetrathamnion lineatum*: spermatangial clusters (sperm) on basal cells of whorl-branchlets

- 19a. a pair of *opposite* whorl-branchlets equal in size per axis cell 20.
 19b. short feathery side branches appear to alternate along axes; microscopic investigation shows 3 whorl-branchlets per axial cell = 1 large and feathery + 2 two small, inconspicuous ones.
 Figs 63-65. See also **Part X: a miscellany of red algae** *Inkyuleea* (2 species)
 (as *Ballia mariana* and *B ballioides*, in Womersley 1998)



Fig. 63: *Inkyuleea ballioides*

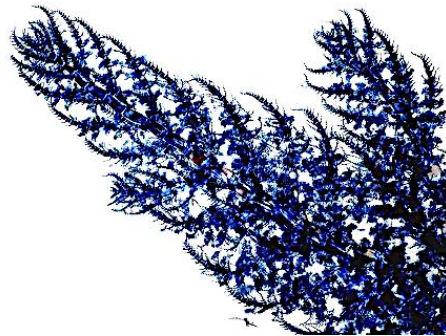


Fig. 64: *Inkyuleea mariana*

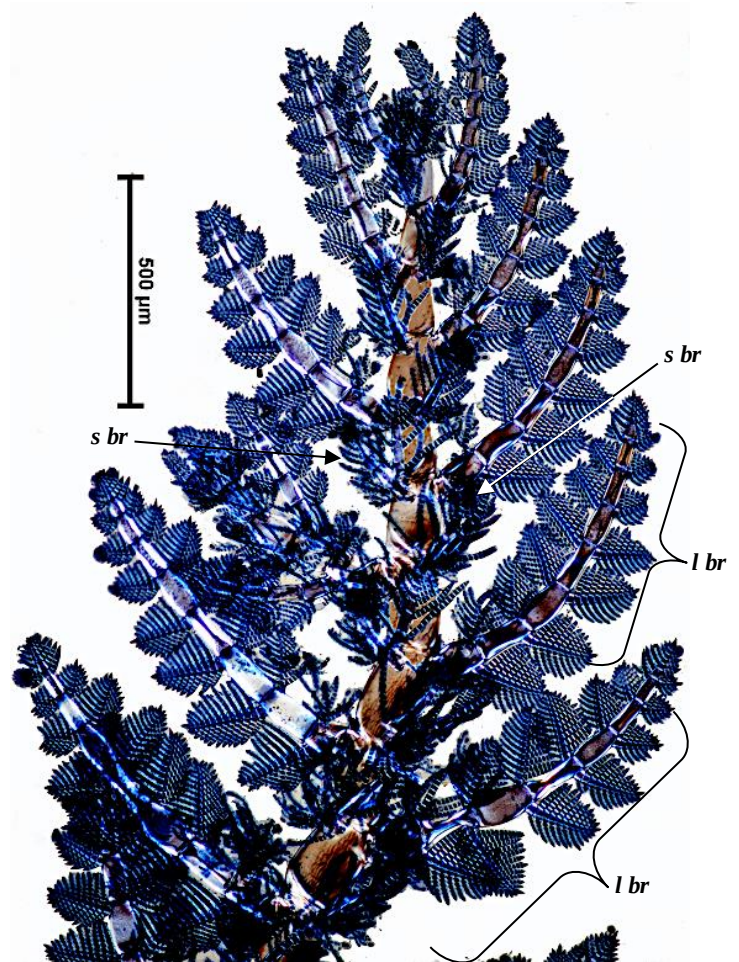


Fig. 65. *Inkyuleea ballioides*: whorl-branchlets –large (*l br*) and small (*s br*)

- 20a. basal cell of whorl-branchlets wedge-shaped; plugs between axis cells button-shaped; tetrasporangia in minute branches on basal cell of whorl-branchlets; axes heavily covered in rhizoids. Figs 66-71. See also *Ballia* (2 species), **Part X: a miscellany of red algae** *Ballia callitricha* common) Order: Balliales, Family: Balliaceae (Ceramiaceae, Tribe Pterothamniae in Womersley)
 20b. whorl-branchlet cells similar; cell plugs not button-shaped; tetrasporangia at tips of whorl-branchlets. Fig. 73 next page
 *Gymnothamnion* (2 species, 1 rare)



Fig. 66: *Ballia callitricha*
 (Tufted red alga, in Edgar 2008)

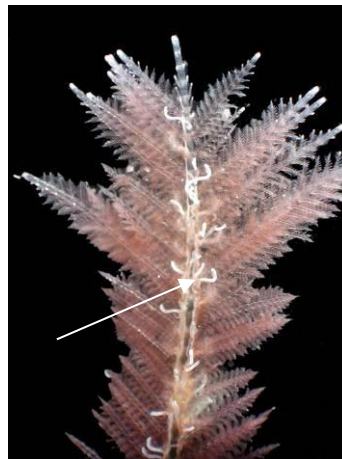


Fig. 67. *Ballia callitricha*: prominent tip cells; white bryozoan *Aetea anguina* tubes commonly found along the axis (arrowed)

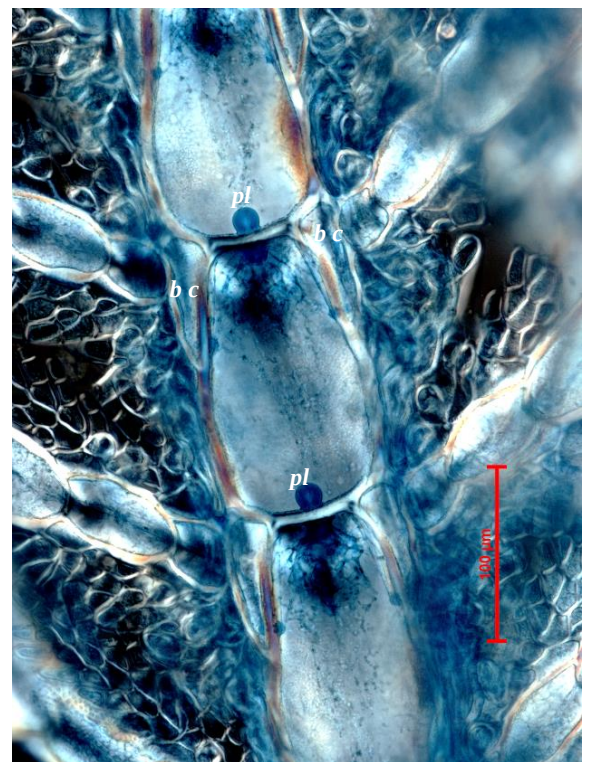


Fig. 68. *Ballia callitricha*: wedge-shaped basal cell (*b c*) of whorl-branchlets; button-shaped plugs between axis cells (*pl*)



Fig. 69a. *Ballia callitricha* commonly found with the epiphytic, disc-shaped form of the coralline red alga *Synarthrophyton patena* growing on it

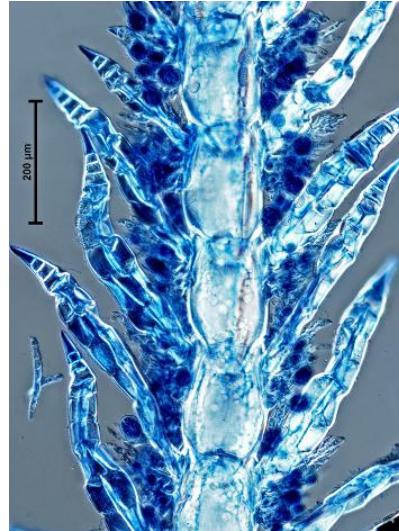


Fig. 70. *Ballia callitricha*: tetrasporangia clustered in minute branches (*t sp br*) between opposite ultimate branches (ramuli)



Fig. 71. *Ballia pennoides*: whorl-branchlets simple



Fig. 72. *Gymnothamnion nigrescens*: paired whorl-branchlets at right angles to axis cells; gland cells absent; a rare species

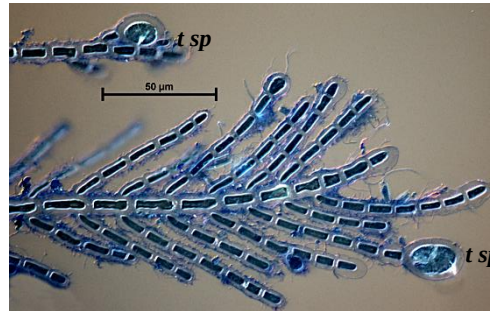


Fig. 73. *Gymnothamnion elegans*: paired whorl-branchlets at an acute angle to axis cells; gland cells absent; tetrasporangia (*t sp*) at tips, tetrahedrally divided

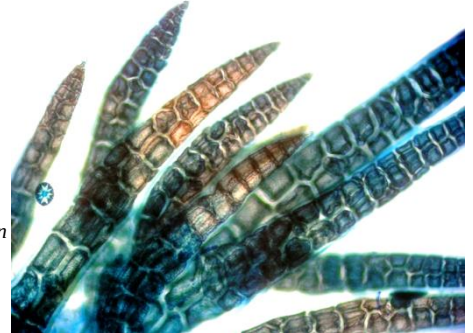
Look-alike algae

1. filamentous Rhodomelaceae

Some members of this Family such as *Echinothamnion hystrix* shown opposite look superficially like some *Antithamnion* species (for example, *A. hanovioides*). Seen under the microscope the Rhodomelaceae have blocks of flanking (pericentral) cells along filaments. This feature can be used to separate species in that Family from the Ceramiaceae Family described in the key above.

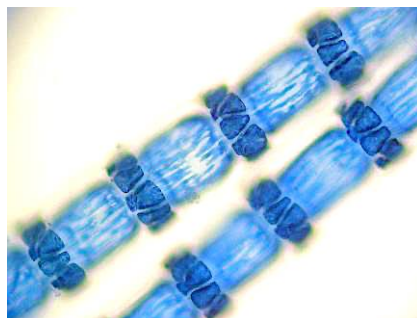


Echinothamnion hystrix

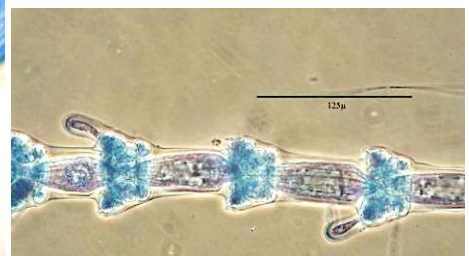


2. filamentous Ceramiaceae

In this Tribe of the Family: Ceramiaceae, small cells ring the shoulders of axis cells, often completely covering or *corticating* them. In some species, such as *Ceramium macilentum* and *C. puberulum* shown opposite, large gaps occur between corticating rings of cells and look superficially like whorl-branchlets. These corticating cells lie flat against the axis and should not be confused with true whorl-branchlets. There is a separate key (Part IV) that includes them.



Ceramium macilentum



Ceramium puberulum

SPECIES ILLUSTRATED IN THE KEY

species	author/s	page/s	name in <i>Algaebase</i>	author/s
<i>Acrothamnion preissii</i>	(Sonder) E.M. Wollaston	3		
<i>Acrothamniopsis eliseae</i>	Athanasiadis & Kraft	6		
<i>Amoenthamnion planktonicum</i>	E. M. Wollaston	6		
<i>Antithamnion cruciatum</i>	(C. Agardh) Nägeli	3, 4		
<i>Antithamnion gracilentum</i>	(Harvey) J. Agardh	4		
<i>Antithamnion hanovioides</i>	(Sonder) De Toni	4		
<i>Antithamnion pectinatum</i>	(Montagne) Brauner	3		
<i>Antithamnionella glandifera</i>	E. M. Wollaston	5		
<i>Antithamnionella spirographidis</i>	(Schiffner) E. M. Wollaston	5		
<i>Ballia ballioides</i>	(Sonder) Wollaston	8	<i>Inkyuleea ballioides</i>	(Sonder) H.-G. Choi, Kraft & Saunders
<i>Ballia callitricha</i>	(C. Agardh) Kützing	8		
<i>Ballia mariana</i>	Harvey	8	<i>Inkyuleea mariana</i>	(Harvey) H.-G. Choi, Kraft & Saunders
<i>Ballia pennoides</i>	Wollaston	9		
<i>Drewiana nitella</i>	(Harvey) E. M. Gordon	1		
<i>Elisiella arbuscula</i>	(J. Agardh) Womersley	6		
<i>Gymnothamnion elegans</i>	(Schousboe ex C. Agardh) J. Agardh	9		
<i>Gymnothamnion nigrescens</i>	(J. Agardh) Athanasiadis	9		
<i>Heterothamnion platythaliae</i>	Athanasiadis	5		
<i>Heterothamnion sessile</i>	E. M. Wollaston	5		
<i>Involucrana crassa</i>	(Hooker f. & Harvey) E.M. Gordon	1		
<i>Leptoklonion fastigiatum</i>	(Harvey) Womersley	6		
<i>Macrothamnion acanthophorum</i>	(Kützing) Womersley	3		
<i>Macrothamnion pellucidum</i>	(Harvey) Wollaston	3		
<i>Medeiothamnion halurus</i>	(Harvey) E. M. Gordon	2		
<i>Medeiothamnion protensum</i>	(Harvey) E. M. Gordon	2		
<i>Perithamnion muelleri</i>	(Harvey) Womersley	7		
<i>Pterothamnion aciculare</i>	(Wollaston) Athanasiadis & Kraft	5		
<i>Pterothamnion flexile</i>	(Wollaston) Athanasiadis & Kraft	5		
<i>Scageliopsis patens</i>	E. M. Wollaston	7		
<i>Shepleya verticillata</i>	E. M. Gordon	2		
<i>Shepleya wattsii</i>	(Harvey) E. M. Gordon	2		
<i>Tetrathamnion lineatum</i>	E. M. Wollaston	7		
<i>Trithamnion gracilissimum</i>	E. M. Wollaston	6		
<i>Trithamnion vulgare</i>	E. M. Wollaston	6		
<i>Wollastoniella mucronata</i>	(Harvey) E. M. Gordon	2		
<i>Wollastoniella myriophylloides</i>	(Harvey) E. M. Gordon	2		

REFERENCES

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Womersley, H.B.S. (1998) The Marine Benthic Algae of southern Australia Part IIIC. State Herbarium of South Australia