

FILAMENTOUS RED ALGAE Part X: a miscellany of red algae

PTEROTHAMNION, BALLIA and INKYULEEA

This key	Formal classification of algae relies on investigating microscopic reproductive features in detail. Often a complete set of reproductive stages is unavailable in the specimens to be investigated, making identification very difficult if the technical systematic literature is used. Fortunately, some algae grow in specific places and some have recognizable shapes that allow them to be sorted directly into the level of Family, Tribe or Genus and so shortcut a systematic search through intricate and often unavailable reproductive features. The pictured key below uses this artificial way of searching for a name. Then you can proceed to the appropriate fact sheets or further keys to refine your identification.
Limitations	The key generally starts with the large and obvious and then proceeds to the smaller and obscure species.
Images used below	Unfortunately, to use this key, microscopic investigation of specimens is essential. 
Scale	Unless acknowledged otherwise, all images have been made from pressed specimens or the extensive slide collection of the algal unit, State Herbarium of S Australia, collections generated by the late Professor Womersley and his workers over some 60 years. Images with dark backgrounds have been taken using phase contrast or interference microscopy to highlight transparent structures. Other images may be stained dark blue.
Names	The coin used as a scale is 24 mm or almost 1" across. The search for species follows that of Womersley, H B S. (1998) as it continues to provide the most comprehensive and accessible account. Recent changes are described below. \$ Denotes a common name used by Edgar, G J (2012).

ORIGINALLY:

in the *Marine Benthic Flora of southern Australia Part IIIC*, species of the Red filamentous genera *Ballia* and *Pterothamnion* were placed into Family: Ceramiaceae, Tribe: Pterothamniae because of some similarity of shape and reproductive features.

Recent workers (Choi *et al*, 2000):

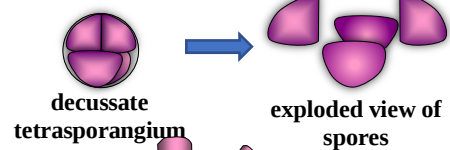
- have removed 2 species of *Ballia*, (*B. ballioides* and *B. mariana*), placing them into a new genus *Inkyuleea*
- retained 2 spp of *Ballia*, (*B. callitricha* and *B. pennoides*), added a new species, *B. nana* from a single collection in Port Phillip Bay, Victoria, and
- created a new Family and Order (Balliaceae, Balliales) for the redefined Genus: *Ballia* as it has unique cellular features differing from the Family: Ceramiaceae

THE TREATMENT IN THIS PICTURED KEY:

- recognises** the recent name changes of these species but **continues to group them** with *Pterothamnion* spp of the Tribe: Pterothamniae for ease of reference to Womersley's Marine Benthic Flora of southern Australia.
- unfortunately, identification of these species will require microscope investigation 

COMMON FEATURES:

SPORANGIA



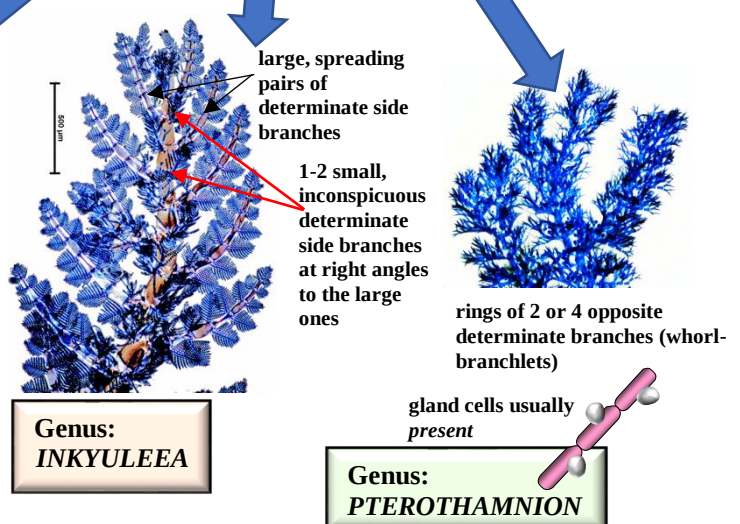
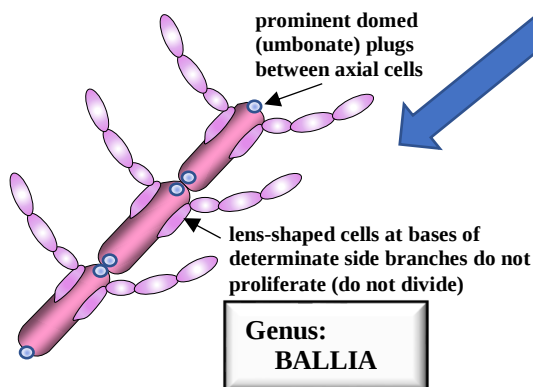
BRANCHING PATTERN

2-4 shorter side branches (determinate branches, also called whorl-branchlets) arise from each axial cell

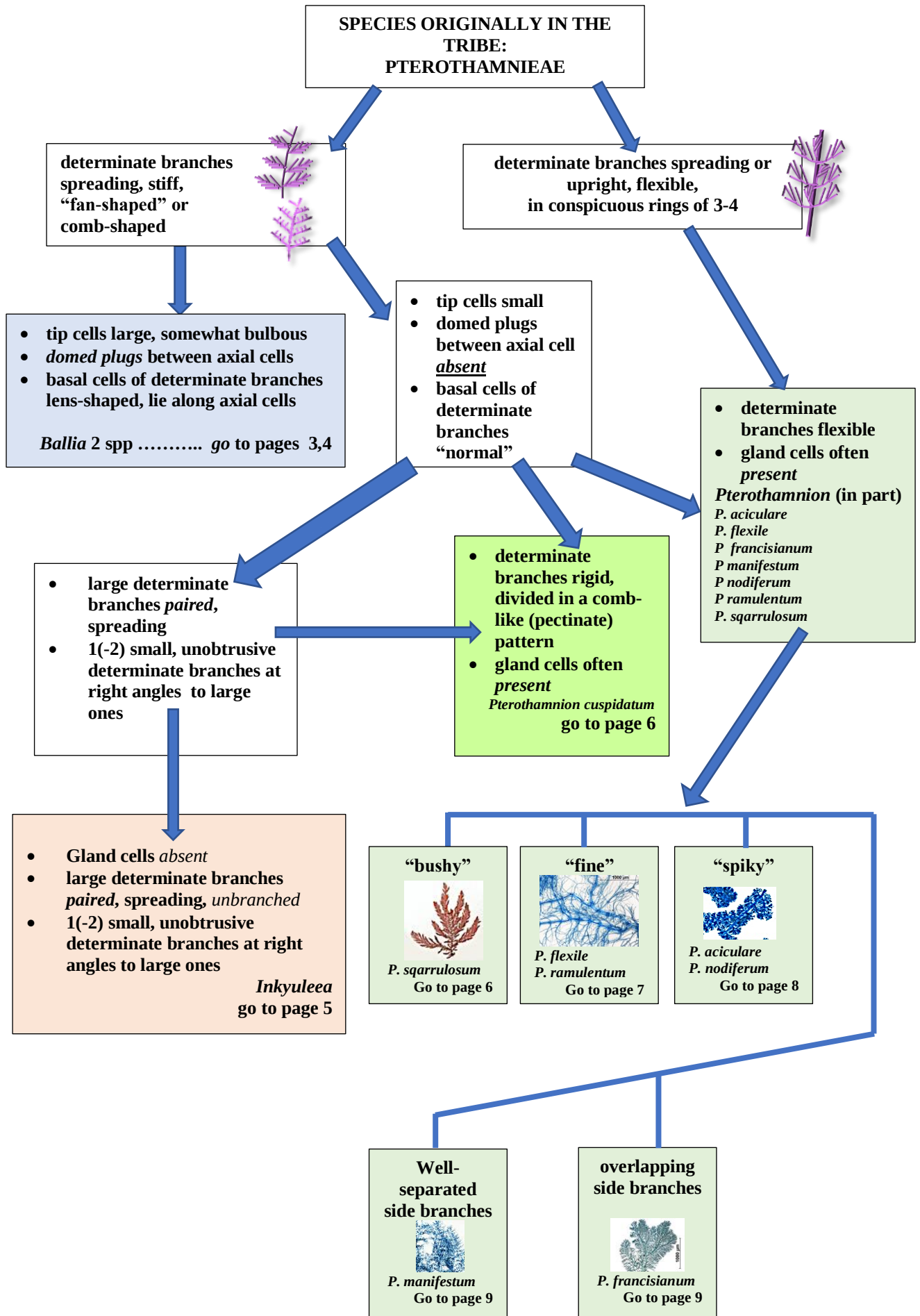
determinate branches may occur as 2 large ones and 1 (-2) small, obscure one(s) (arrowed in this diagram)

continuous-growing or indeterminate branches (axes) of naked cells

THE GROUP OF GENERA FOUND IN WOMERSLEY'S MARINE BENTHIC FLORA UNDER THE TRIBE: PTEROTHAMNIAE



SEARCH STRATEGY



Ballia callitricha (⁸ Tufted red seaweed)
a common, relatively deep-water species



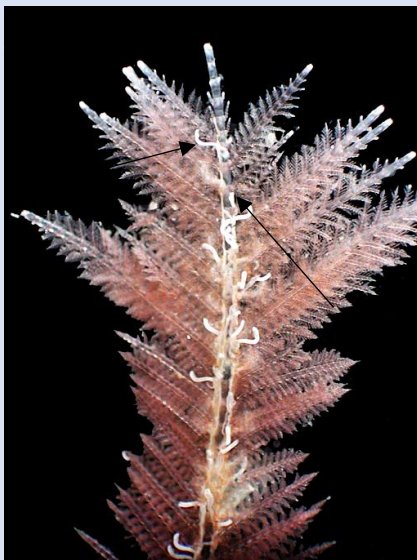
Ballia callitricha;
whole pressed plants



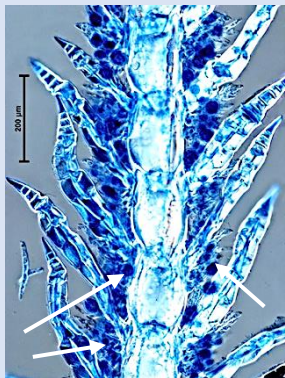
Ballia callitricha
fingernail-shaped coralline alga,
Synarthrophyton patens is a common epiphyte



Ballia callitricha
large-celled axis and ferny side branches



Ballia callitricha
upper plant parts;
prominent apical cells; white snake-like
tubes of the Bryozoan
Aeta (arrowed), a
common epiphyte



Ballia callitricha
clusters (arrowed) of
sporangia on small branches,
basal to the short laterals



Ballia callitricha
dried specimen; apical cells still large
and prominent



Ballia callitricha
axis with prominent domed pit connections (arrowed) between cells; a
lens-shaped
cell (c) lies flat against the axis at the base of side branches

Ballia pennoides

a species for which there are few records

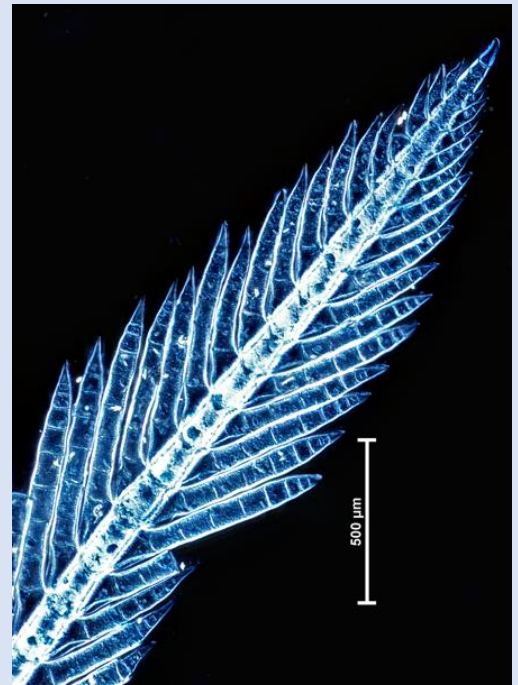


Ballia pennoides
pressed specimen; a fingernail-shaped coralline alga,
Synarthrophyton patens (arrowed) is a common epiphyte

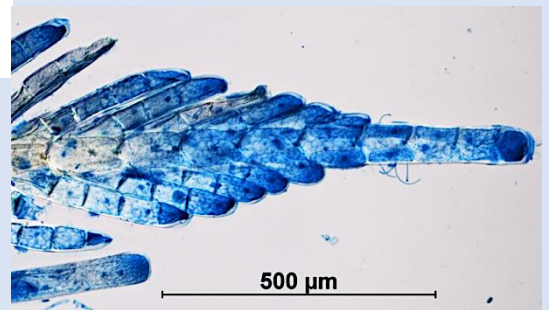


Ballia pennoides
upper parts of plants: detail of coated (corticated) axes and ferny side

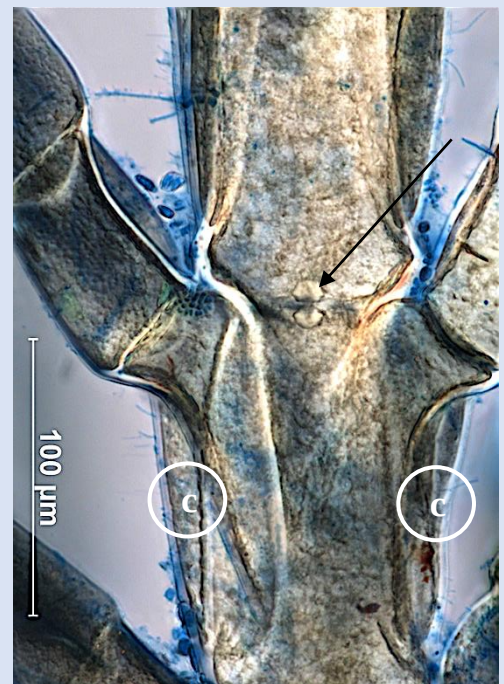
Ballia pennoides
axis with prominent domed pit connections (arrowed) between cells;
a lens-shaped
cell (c) lies flat against the axis at the base of side branches



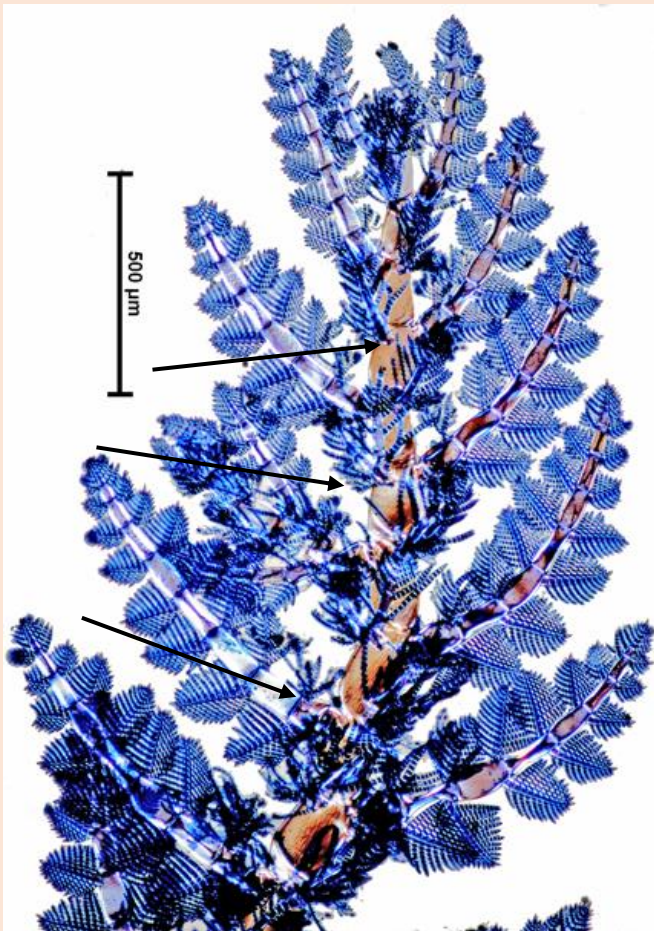
Ballia pennoides
microscope view of a feathery determinate branch



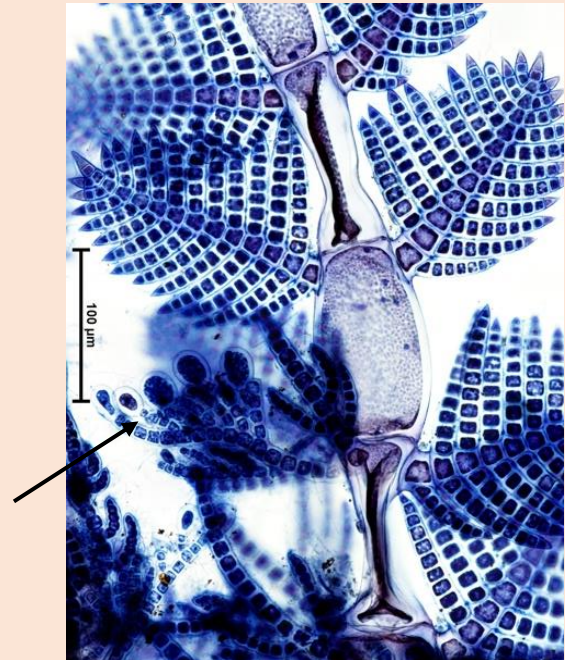
Ballia pennoides prominent tip cell



Inkyuleea ballioides



Inkyuleea ballioides pressed plant



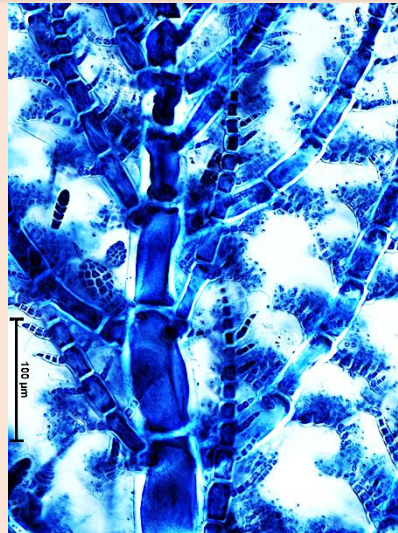
Inkyuleea ballioides

pairs of larger determinate branches divided further into pairs of opposite cell threads thus forming flat, fan-shaped branches; obscure, smaller determinate branches (arrowed) at right angles to the larger pair

Inkyuleea mariana



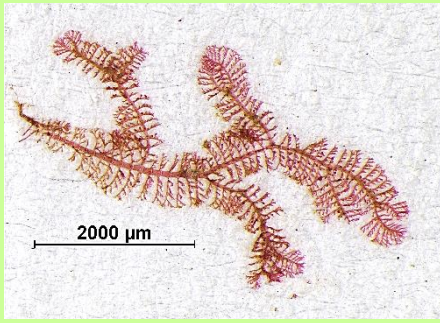
Inkyuleea mariana near plant tips



Inkyuleea mariana— male plant; pairs of larger determinate branches bearing opposite small branches with cloud-like spermatial clusters



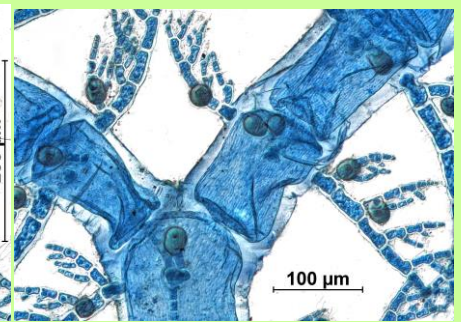
Inkyuleea mariana— branching pattern



Pterothamnion cuspidatum whole plant



spreading, rigid determinate branches

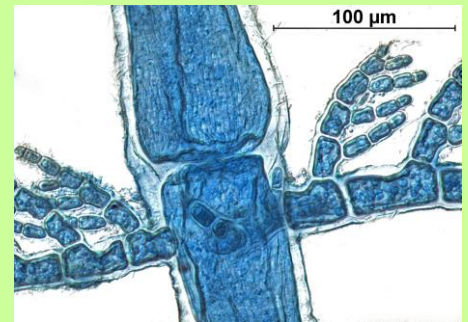


gland cells (arrowed)

Pterothamnion cuspidatum

- determinate branches rigid, divided in a comb-like (pectinate) pattern
- gland cells often present

Pterothamnion cuspidatum: pair of large, opposite determinate branches and single small determinate branch at right angles (arrowed)



Pterothamnion – remaining species

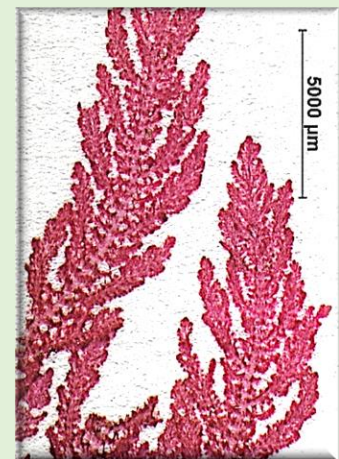
- determinate branches flexible
- determinate branches in conspicuous rings of 3-4
- gland cells often present

Pterothamnion squarrulosum

whorls of determinate branches:

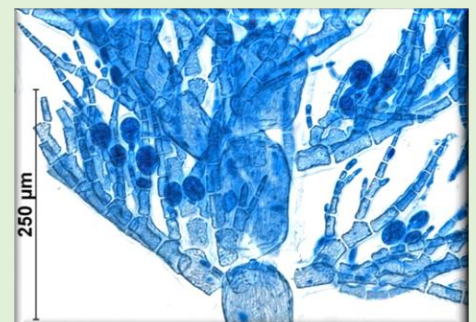
- spreading, “bushy”
- short and longer branches alternate

axial cells thick, naked



Pterothamnion squarrulosum: whole plant and detail of short and long determinate branches

Pterothamnion squarrulosum: large, naked axial cells near the plant base, efflorescent bunches of determinate side branches with densely stained tetrasporangia

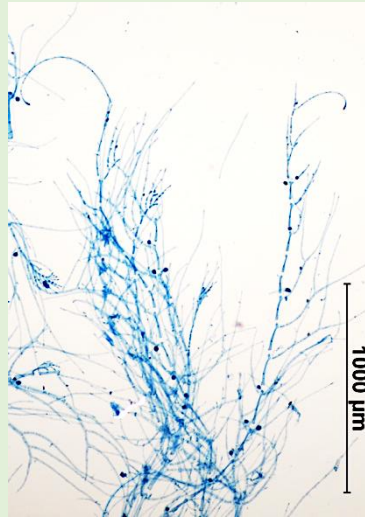


Pterothamnion flexile

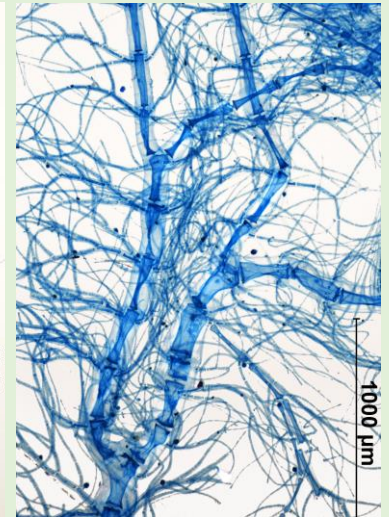
Extremely finely branched



Pterothamnion flexile:
extremely fine upper branches

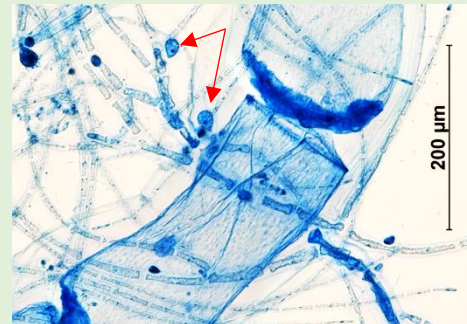


Pterothamnion flexile:
extremely fine upper branches



Pterothamnion flexile:
opposite, extremely fine determinate branches

Pterothamnion flexile:
large axial cells near
the plant base, fine
determinate branches
with tetrasporangia
(arrowed)



Pterothamnion ramulentum

whorls of determinate branches:

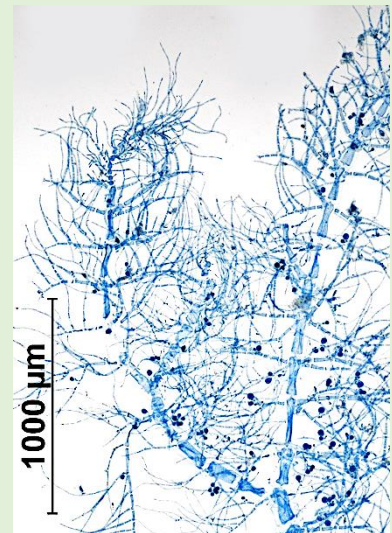
- spreading, thin
- well separated,
axial cells thick, naked



Pterothamnion ramulentum:
whole plants

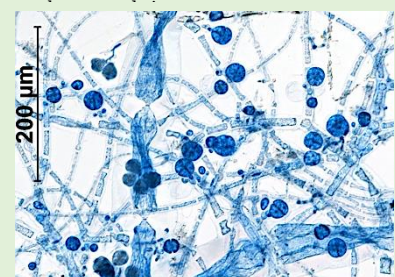


Pterothamnion ramulentum:
plant tips; dense determinate branches



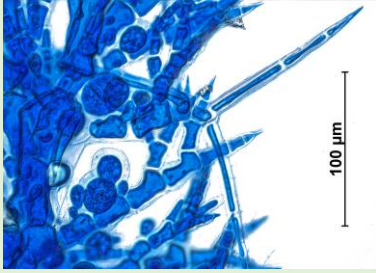
Pterothamnion ramulentum:
plant tips; fine determinate branches of

Pterothamnion ramulentum:
determinate branches about equal in size,
with tetrasporangia on minute branches

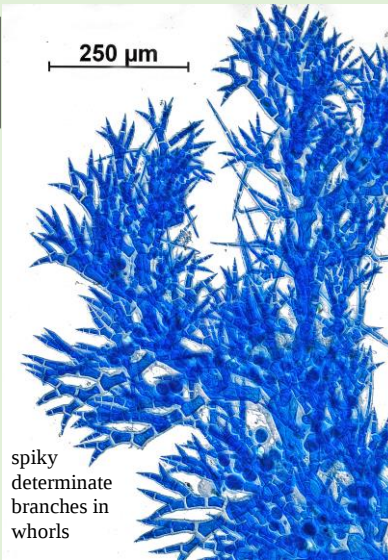


Pterothamnion aciculare

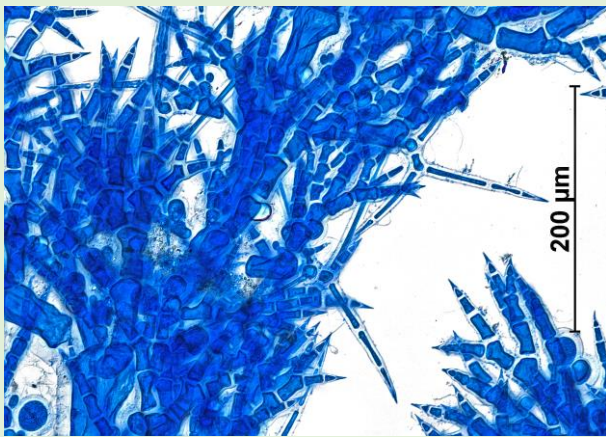
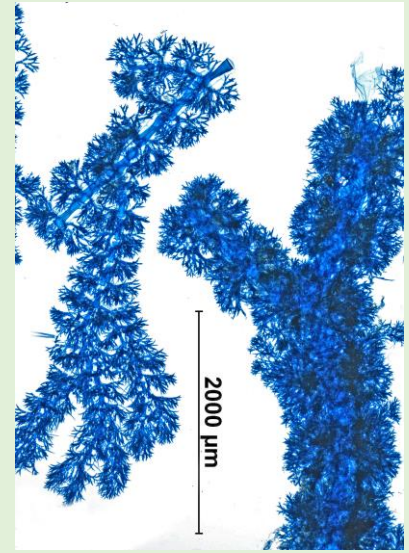
- whorl-branchlets ending in points
- 3-cornered spines often occur near plant tips.



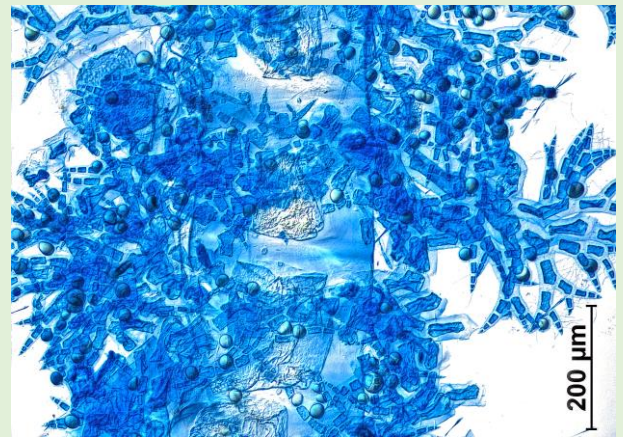
3-cornered spines (arrowed) often near plant tips.



spiky determinate branches in whorls



3-cornered spines; branches ending in points; tetrasporangia present



large-celled axis:
gland cells present (arrowed) in the rings of determinate branches

Pterothamnion nodiferum

whorls of determinate branches:

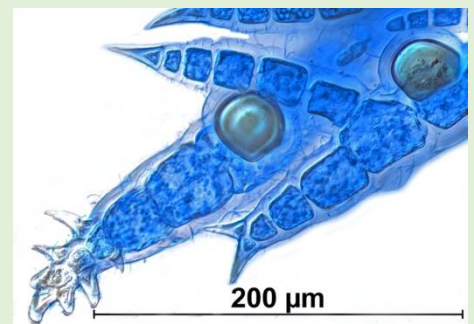
- spreading, spiky
- well separated, axial cells thick, coated (corticated)



Pterothamnion nodiferum:
thick, erect determinate branches ending in burrs and points; prominent gland cells



Pterothamnion nodiferum:
whole plant

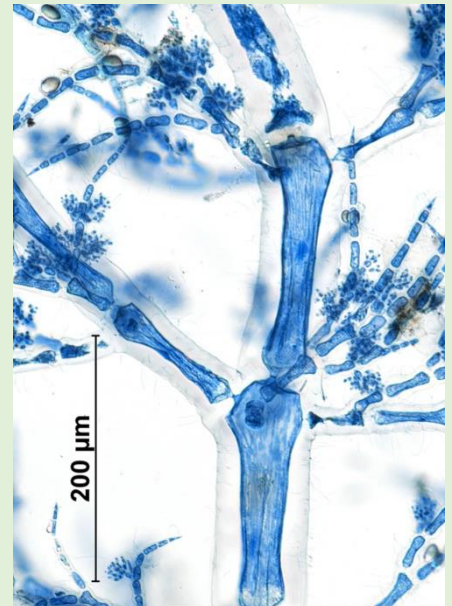


Pterothamnion nodiferum: determinate branches
above: spiky appearance
below: detail of tips and gland cells

Pterothamnion manifestum

whorls of determinate branches:

- spreading, thin
- well separated,
- axial cells thin, naked

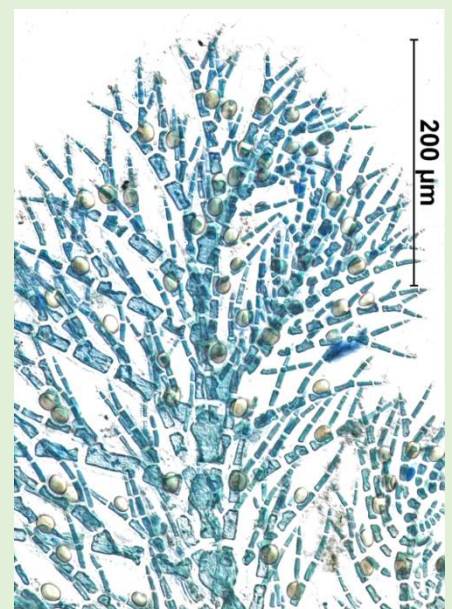
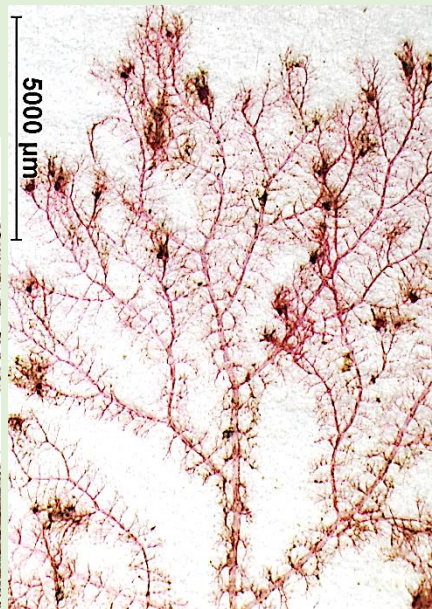
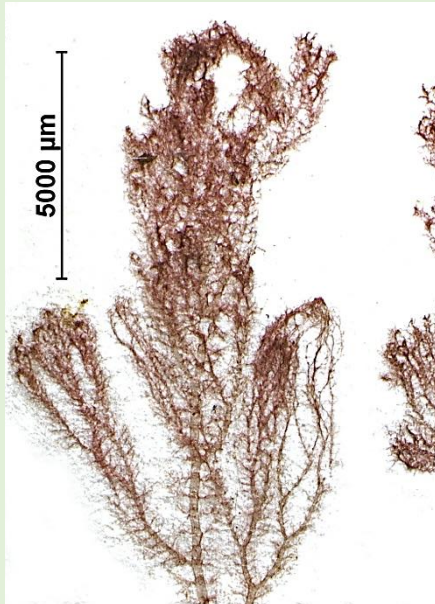


Pterothamnion manifestum: whole plants

Pterothamnion francisianum

whorls of determinate branches:

- spreading, thin,
- well separated,
- about equal in size

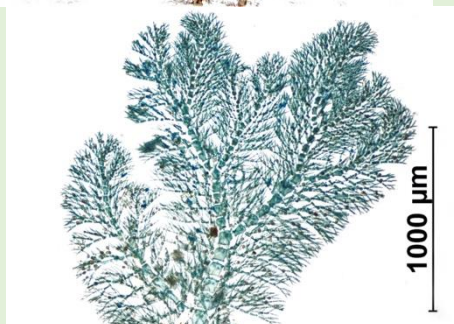


Pterothamnion francisianum

left and above: thin, overlapping whorled determinate branches

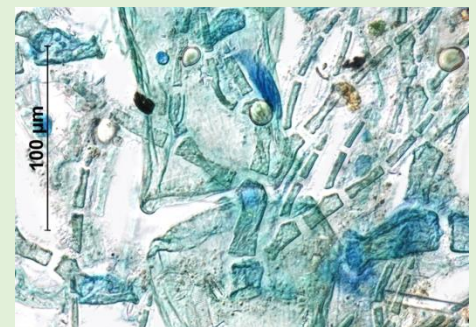
Pterothamnion francisianum

determinate branches with gland cells



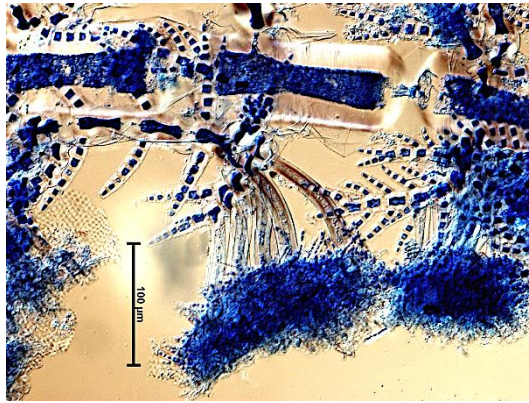
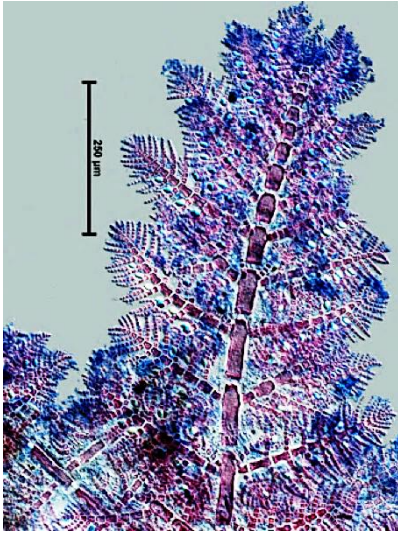
Pterothamnion francisianum

left :
fine determinate branches near plant tips
right:
large, naked axial cells near the plant base
with prominent gland cells in the whorled determinate branches



LOOK ALIKES

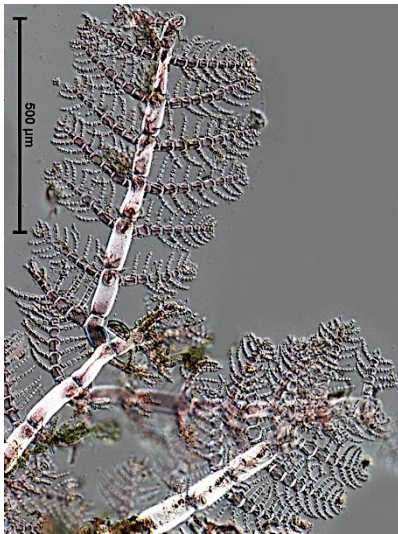
Many members of the Tribe: Heterothamnieae and other filamentous algae can be mistaken for the species illustrated above.



Acrothamnopsis eliseae (in the Heterothamnieae)

Differences:

- grows flat on Coralline algae
- unique clumped haptera present (see above)



Acrothamnion preissii (in the Antithamnieae)

Differences:

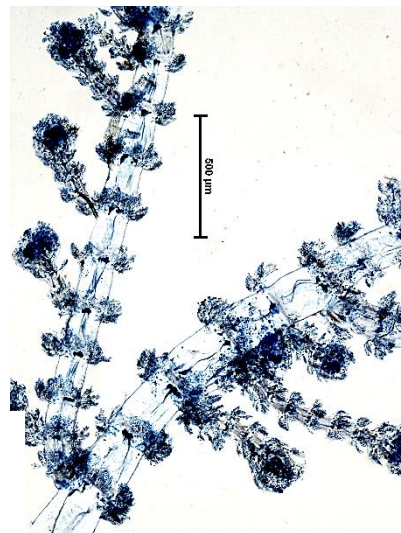
- grows flat on Coralline algae
- single prominent gland cell at tip of laterals

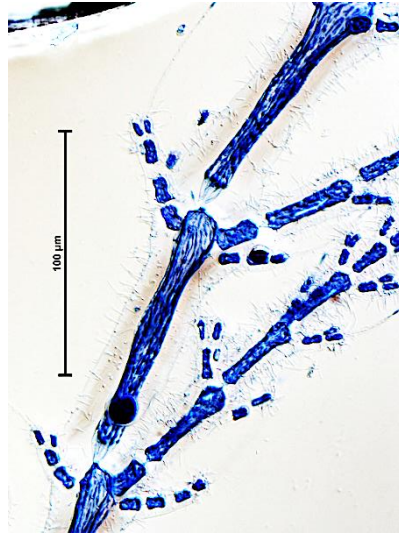


Perithamnion

Differences:

- 4-5 equal-sized determinate laterals (whorl-branchlets)
- tetrasporangia tetrahedrally divided, stalkless (sessile)





Trithamnion

Similarities

- 2 large and 1 small side branch in a whorl

Differences:

- tetrasporangia tetrahedrally divided, stalkless (sessile)

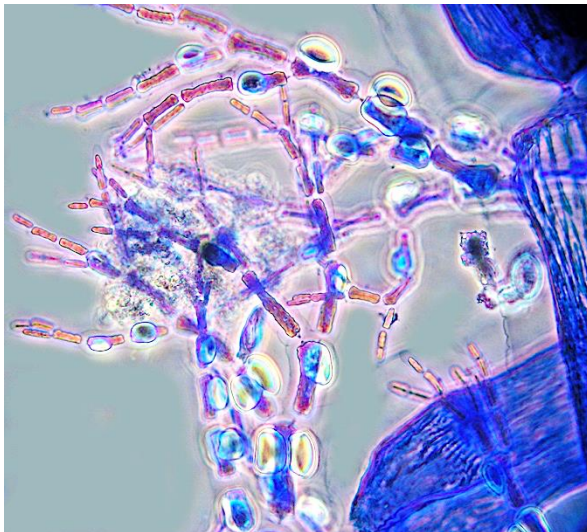
Antithamnionella

Similarities

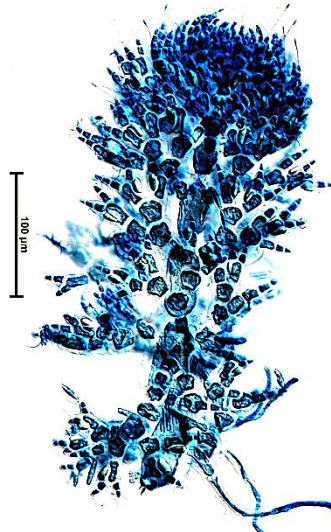
- several large and small side branches in a whorl
- some with prominent gland cells

Differences:

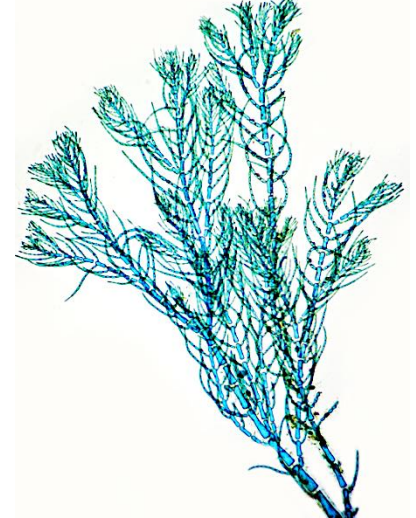
- tetrasporangia tetrahedrally divided, stalkless (sessile)



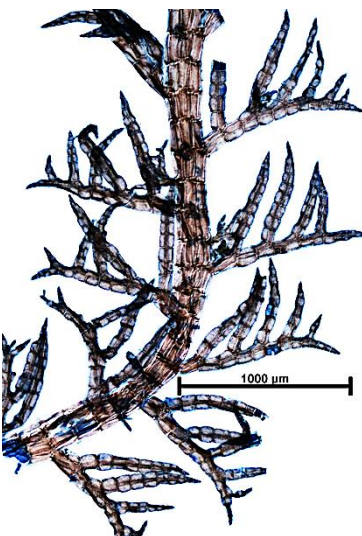
Antithamnionella glandifera



Antithamnionella multiramosa



Antithamnionella spirographidis



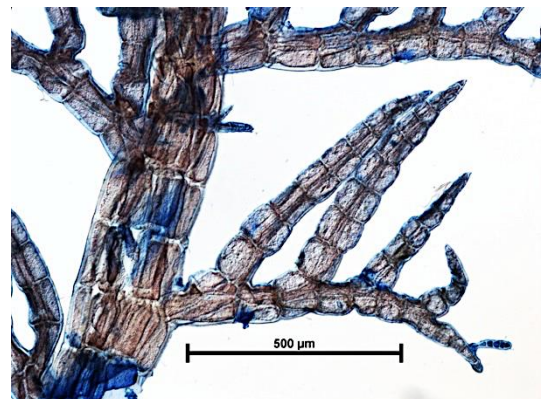
Dasyclonium

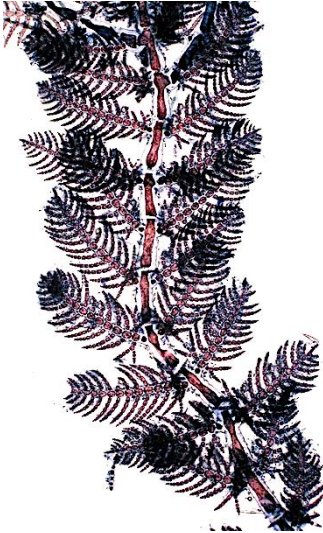
Similarities

- comb-like determinate laterals

Differences:

- mature axes and laterals coated (corticated) with bands of cells (pericentral cells)





Antithamnion pectinatum

Similarities

- filaments of naked cells
- feather-like determinate laterals

Differences:

- only 2, opposite determinate laterals (whorl branchlets) per axial cell
- gland cells lie across 2 bearing cells (see opposite)

SPECIES DESCRIBED

species	author(s)	page	name in Womersley 1998 if different	authors
<i>Ballia callitricha</i>	(C Agardh) Kützing	3		
<i>Ballia pennoides</i>	Wollaston	4		
<i>Inkyuleea ballioides</i>	(Sonder) H-G Choi, Kraft & G W Saunders	5	<i>Ballia ballioides</i>	(Sonder) Wollaston
<i>Inkyuleea mariana</i>	(Harvey)) H-G Choi, Kraft & G W Saunders	5	<i>Ballia mariana</i>	Harvey
<i>Pterothamnion aciculare</i>	(Wollaston) Athanasiadis & Kraft	8		
<i>Pterothamnion cuspidatum</i>	(Wollaston) Athanasiadis & Kraft	6		
<i>Pterothamnion flexile</i>	(Wollaston) Athanasiadis & Kraft	7		
<i>Pterothamnion francisianum</i>	(Wollaston) Athanasiadis & Kraft	9		
<i>Pterothamnion manifestum</i>	(Wollaston) Athanasiadis & Kraft	9		
<i>Pterothamnion nodiferum</i>	(J Agardh) Athanasiadis & Kraft	8		
<i>Pterothamnion ramulentum</i>	(Wollaston) Athanasiadis & Kraft	7		
<i>Pterothamnion squarrulosum</i>	(Harvey) Athanasiadis & Kraft	6		

REFERENCES

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Nuclear small-subunit rDNA sequences from *Ballia* spp (Rhodophyta): proposal of the Balliales ord. nov., Balliaceae fam. nov, *Ballia nana* sp. nov. and *Inkyuleea* gen. nov. (Ceramiales). *Phycologia* 39 (4), 272-287.

Edgar, G J (2012)

Australian Marine Life. 2nd edition. Reed New Holland

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