SEAGRASSES

edge of a seagrass meadow, 2 m deep, Cape Jervis, SA

banks of seagrass wrack, Semaphore Beach, SA

fibre spindles from matted seagrass rhizomes in wrack, Semaphore Beach, SA

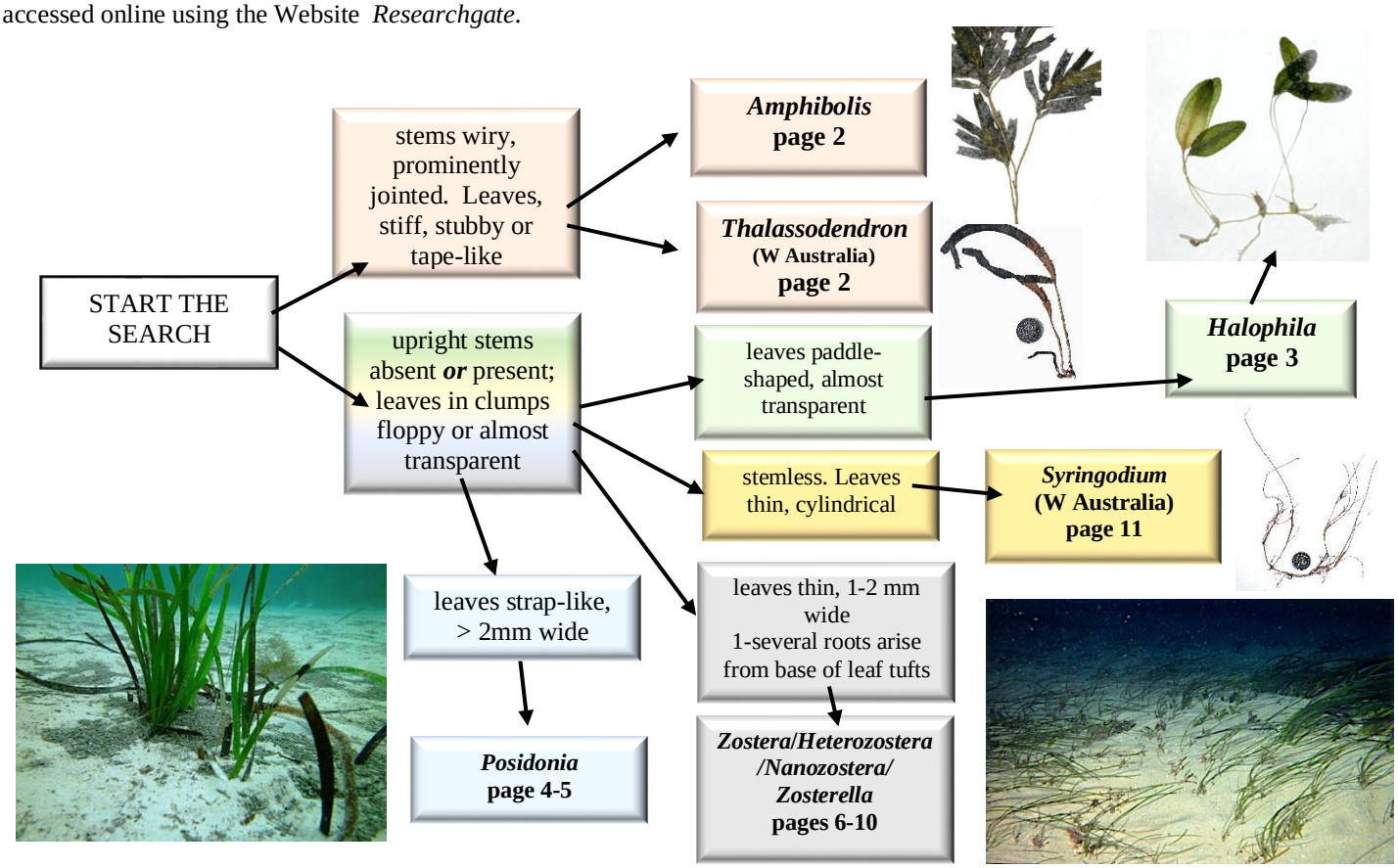
Sea grasses are vascular plants with true roots, stems, leaves and flowers. Most are found as meadow-like communities in relatively shallow, temperate seas of Australia. They grow in sedimentary substrates (mud and sand). Their horizontal runners (rhizomes) and roots help stabilize sediments. The seagrass meadows are being lost due to dredging, damage from unsuitable boat moorings, outwash of soil from agricultural land and pollution. Excessive nutrients from wastewater of urbanized areas create algal blooms in the water column and on the seagrass surfaces and this has largely resulted in the loss of seagrasses in many coastal metropolitan areas. Often this loss is accompanied by damaging coastal erosion and costly attempts at sand replacement on beaches.

Seagrasses are food and shelter for marine invertebrates, “nurseries” for commercial fishes; they recycle nutrients when they become wrack on beaches and tidal mud-flats.

Classification of seagrass species depends upon reproductive features, but some species can reasonably be identified from their vegetative appearance.

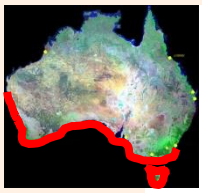
Names for species in this treatment follow those of Robertson, E. I. *in* Womersley, H.B.S. (1984) *The marine benthic flora of southern Australia Part I* as that publication continues to be a comprehensive and accessible set of descriptions of seagrasses and available on-line in the *eFlora* of the State Herbarium of S. Australia. Newer names from *Algaebase* and some common names have been incorporated below.

Waycott, M *et al* (2014) *A guide to southern temperate seagrasses* Victoria CSIRO, has an extensive pictorial identification tool of seagrasses and this should be used for getting a species within the more difficult genera and species complexes.. It can be accessed online using the Website *Researchgate*.



Amphibolis
Sea nymphs

Amphibolis antarctica



- leaves may be twisted
- leaf sheaths (arrowed) ***free*** for most of their length
- leaf tips truncate (cut across) with 2 sharp marginal points

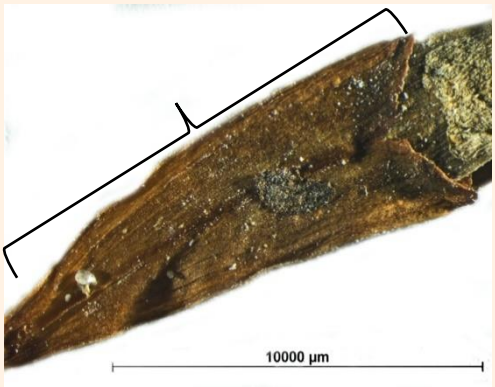
leaf sheaths (arrowed) and jointed stem

stiff leaves clustered towards stem tips

leaf tips: truncate, sharp marginal points

Amphibolis griffithii

- leaves usually ***not*** twisted
- leaf sheaths (bracketed) overlap for most of their length
- leaf tips broadly notched



leaf sheaths (bracketed)

leaf tips: broadly notched

Thalassodenron pachyrhizum

- leaves curved, up to 7 cm long
- leaf sheaths(arrowed) overlap only at the base
- leaf tips with serrated margins

Halophila
Paddlegrasses

A "complex" of species exists in Australia and in tropical waters globally
Waycott, M *et al* (2014) *A guide to southern temperate seagrasses* Victoria CSIRO describes 4 species found in temperate waters, and the two most often found in southern Australian waters are illustrated below

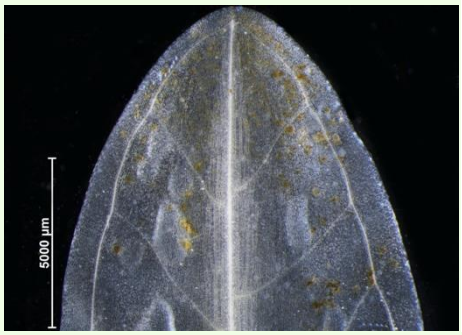
Halophila australis

Leaves are
- thin, delicate, almost transparent
- usually, paired, above a tuft of roots from a horizontal rhizome
- shape is variable, usually oval-shaped, ***narrowed*** towards the base, L/B = 3-4, 50-60 mm long
- 14-16 cross veins meet the mid vein at about 45^0
- shape and size of leaves can vary – many samples of plants may be needed to successfully separate specimens from the next species

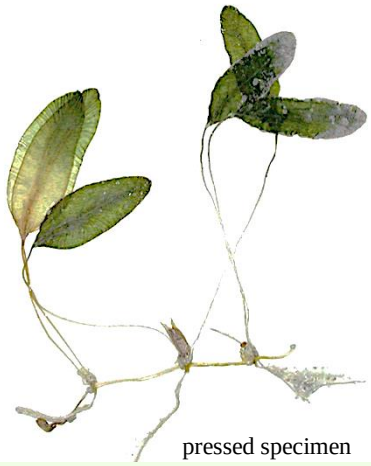
diagnosis can be difficult

Halophila meadow

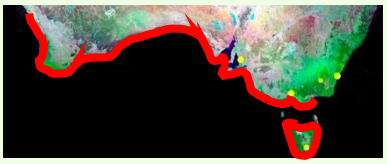
detail of leaves, narrowing basally



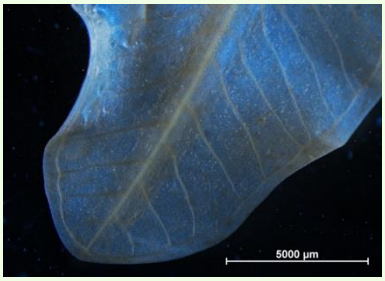
backlit preserved (bleached) leaf showing veins



pressed specimen



Halophila ovalis

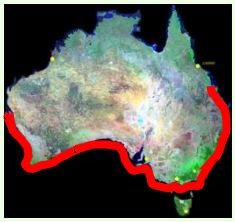


backlit preserved (bleached) leaf showing veins

diagnosis can be difficult

Leaves are
- thin, delicate, almost transparent
- usually, paired, above a tuft of roots from a horizontal rhizome
- shape is variable, usually oval-shaped, ***rounded*** at top and bottom, L/B = 2-3 (but variable), 10-30 mm long
- 10-12 cross veins meet the mid vein at wide angles
- shape and size of leaves can vary – many samples of plants may be needed to successfully separate specimens from the next species

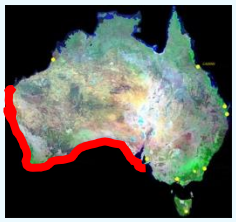
flower bud arising between 2 leaves in a preserved (bleached) specimen



Posidonia
Tapegrasses

basal sheaths to leaves becoming fibrous-shaggy-straw-like

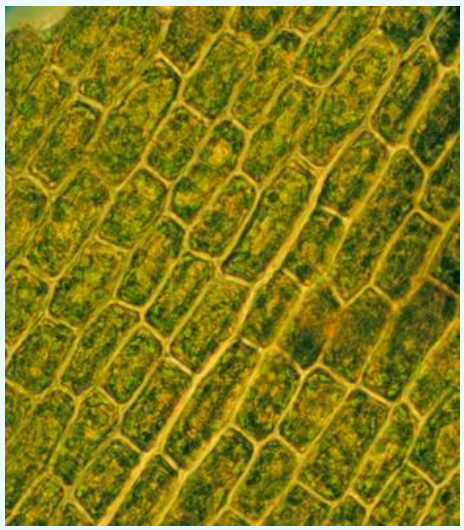
Posidonia coriacea
(as ***Posidonia ostenfeldii*** **in Algaebase)**



Leaves

- thick, stiff, upper surface concave
- leaf tufts wrapped basally in yellow to grey sheaths, becoming ***fibrous*** and shaggy
- ***narrow,*** about ***2-3 mm wide***

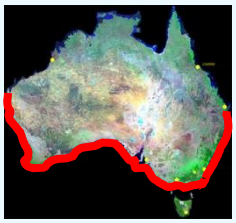
Posidonia australis



surface cells with ***straight*** cell walls

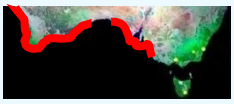
Leaves

- flexible, in tufts of 2-4
- leaf tufts wrapped basally yellow to grey sheaths
- sheaths disintegrating becoming ***fibrous*** and shaggy
- surface cells with ***straight cell walls***
- leaves wide, ***10-15 mm wide***



Right – bases to leaf tufts:
fresh specimen (upper),
pressed specimen (lower)

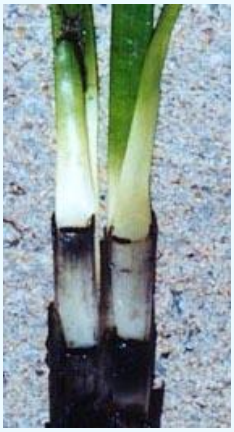
Posidonia sinuosa



Leaves

- flexible, in tufts of 1-2
- leaf tufts wrapped basally with ***dark, smooth*** sheaths ***concave*** at tips
- leaf sheaths ***not*** disintegrating into fibres but forming pale ***straws***
- surface cells with ***wavy*** cell walls
- ***4-8 mm wide***

dark leaf sheaths, concave at tips



Right:
surface cells with ***wavy cell walls***

dense meadow of *Posidonia sinuosa*, Kangaroo Island, SA

pressed specimens

pressed specimens: detail of old leaf sheaths shredded into ***straws***

Posidonia angustifolia

Leaves

- flexible, in tufts of 2-4
- leaf tufts wrapped basally with yellow to grey sheaths, becoming ***fibrous*** and shaggy
- surface cells with straight cell walls
- leaves ***4-6 mm wide***

pressed specimen: detail of old leaf sheaths shredded into ***fibres***

Problems with Eelgrasses (Family: Zosteraceae) (*Zostera/ Heterozostera/Nanozostera/Zosterella*)

Eelgrasses are a recognisable group of thin-leaved, flowering plants found worldwide, growing in marine, shallow-water, sedimentary environments. Confusion over the separation of genera and species in this group continues and contrary names are used for Australian species in census lists and popular descriptions on Websites.

Initially two of the genera were separated on microscopic features

Zostera **= *2* side vascular bundles in cross sections of runners**

Heterozostera **= 4-12 vascular bundles in cross sections of runners**

and,

superficial features often used to identify plants in the field were

- ***Zostera*** plants - ***larger*** with a small, closed ***sheath*** about the leaf base
- ***Nanozostera*** and ***Heterozostera*** - ***smaller*** plants but with a ***larger, open sheath*** about the leaf base

Some species were separated on the shape of leaf tips, although this had to be attempted using more than one leaf as leaves can vary considerably in these features on the one plant.

- ***Zostera capricorni*** – leaf tip truncated or chopped across 
- ***Zostera muelleri*** and ***Heterozostera nigricaulis*** – notched 
- ***Zostera mucronata*** – with 3 points 

Number of roots on runners (rhizomes) arising beneath leaf tufts was also used, but this was too variable to be of much use. 

Recent [3]workers have found overlap with all these characteristics in Eelgrass species. Analysing genetic material they decided that only a single genus *Zostera* and 3 Sub-genera – *Zostera, Heterozostera and Zosterella* could be justified.

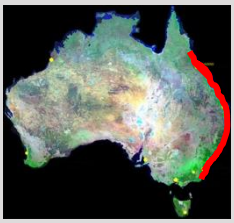
In the current confusion an existing authority that can be followed when determining species is that of J. Kuo (2011) ***in*** **Flora of Australia volume 39** ABRS/CSIRO.

Recent name changes are to be found on the Website *Algaebase.com*

HOW TO SEPARATE SPECIES IN "SEAGRASSES AT A GLANCE"

The mix of names for genera and species and the current ways of separating them are provided below so that you can find them in other Websites and herbarium lists.
A handy start to separating species is to consider their Australian distribution found below in the maps adjacent to the species names.

Zostera capricorni
(as *[2]Nanozostera capricorni* *in* Algaebase)

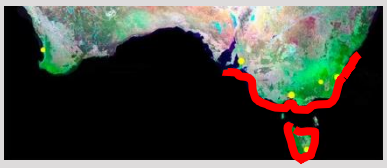


Leaves
- truncate (chopped across at tips)
- ***4 (-5) veins***
- 7-25 cm long

Root numbers: at origin of leaf bunches: ***variable***

an eastern Australian species, with an anomalous record (drift specimens?) from Kangaroo I. SA

Zostera muelleri
(as *[2]Nanozostera muelleri* *in* Algaebase)

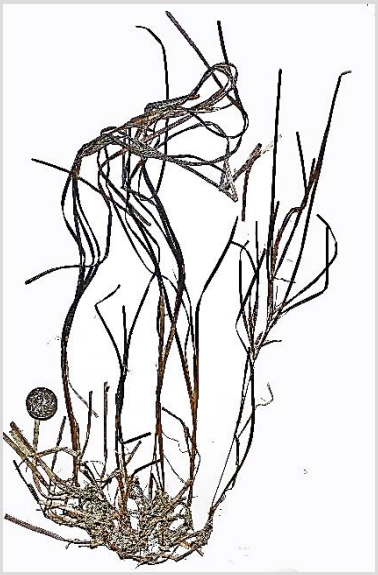


Leaves
- notched at tips
- ***3 veins***
- 5-10 cm long but estuarine form 10-20 cm long

Root numbers: at origin of leaf bunches: ***variable***

generally found in calm water habitats

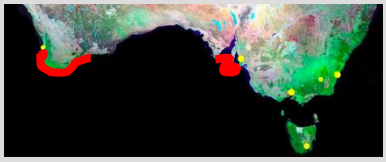
short-leaved form from Aldinga, mid-reef pools



long-leaved form from Onkaparinga estuary SA

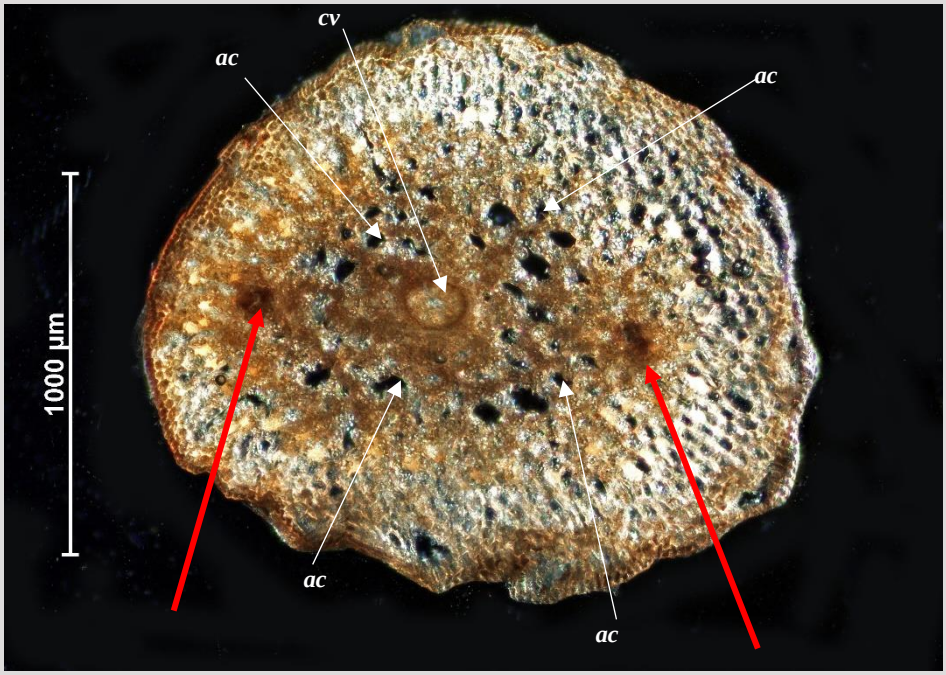
notched leaf tip

Zostera mucronata
(as [2]*Nanozostera mucronata* *in* Algaebase)

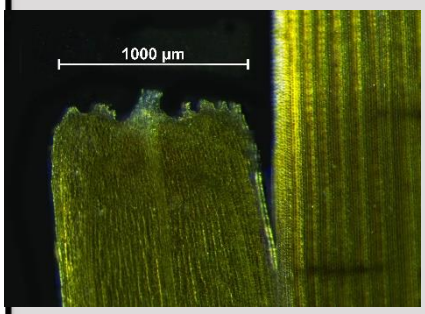


Leaves
- tips truncate (chopped across at tips) and may have 3 minute points (tridentate)
- ***1 vein***
- 0.6-5.0 cm long

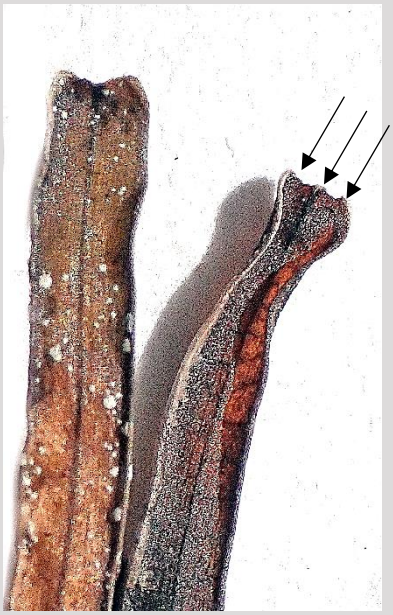
Root numbers: at origin of leaf bunches: ***2 only***

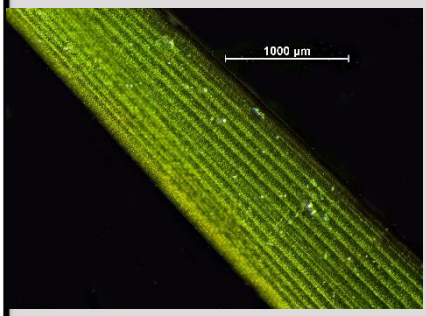


cross section of a runner:
- central vein (***cv***) and only ***two*** vascular bundles in outer layers (red arrows)
- air channels (***ac***) ring the central vein



leaf tip with points (mucronate) (above, left), lengthwise air channels brightly lit in mid-leaf on right and in below image



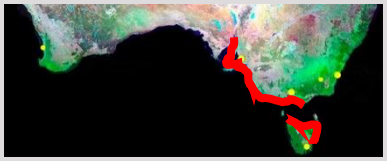


air channels (not veins) brightly lit in a backlit leaf

two roots emerging from a runner at the base of a leaf tuft

dried leaves:
a mucronate tip with the points is arrowed

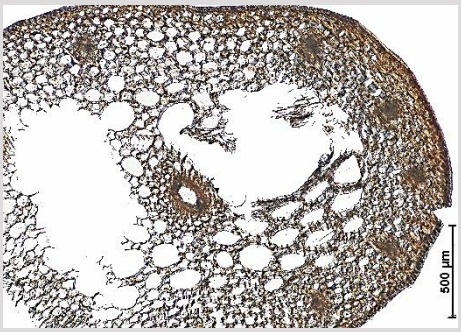
Heterozostera tasmanica (as *Zostera tasmanica* in Waycott *et al*)



Leaves;
- 3-4 per shoot
- up to 32 cm long, thin, 0.5-2 mm wide
- cell surface ***smooth***
- leaf sheaths 1***.7-7.5 cm long***
- ***leaf tip rounded with a tiny slit***

Runners (rhizomes):
- cross section shows a central vein, ***11-12*** lateral vascular bundles and air channels

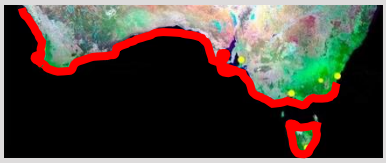
Upright stems:
- ***absent***



cross section : some tissue torn either side of the central vein and 6 of the peripheral vascular bundles shown

detail of a vascular bundle

Heterozostera nigricaulis

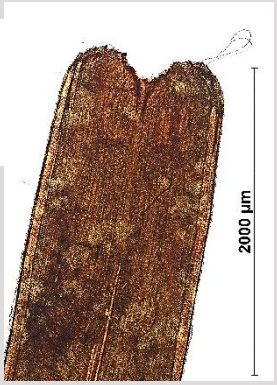


Leaves:
- 2-5 per shoot
- up to 16 cm long; 0.5-2.0 mm wide
- cell surface with ***tiny bumps***
- leaf sheath ***1-6 cm long***
- ***leaf tip rounded with a distinct notch***

Runners (rhizomes)
- cross section shows a central vein, ***11-12*** lateral vascular bundles and air channels
- 0.5 – 3.0 mm wide

Upright stems:
- of indeterminate growth
- ***black and wiry***

tip of a leaf: central and marginal veins, and notched tip



Heterozostera polychlamys **(as *Zostera polychlamys* in Waycott *et al***

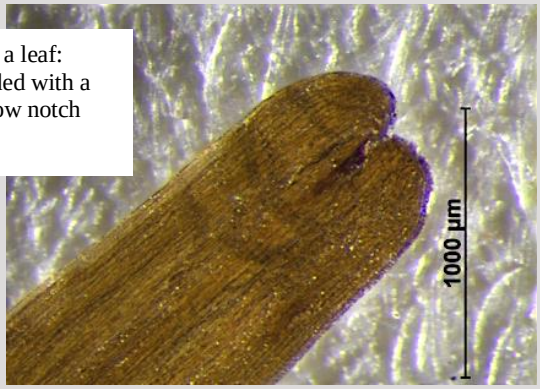
Leaves:
- 3-4 per shoot
- up to 22 cm long; 0.7-3.0 mm wide
- cell surface ***smooth***
- leaf sheath ***3-5 cm long***
- ***leaf tip rounded with a shallow notch*** sometimes with teeth

Runners (rhizomes)
- 25-35 mm wide

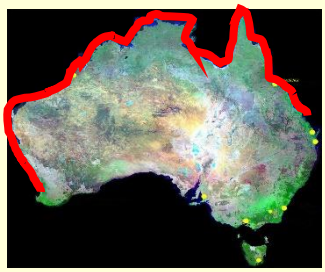
Upright stems:
- of indeterminate growth
- ***pale and wiry***

W Australian plants are found in shallow water, S Australian records are from very deep water (20+ m)

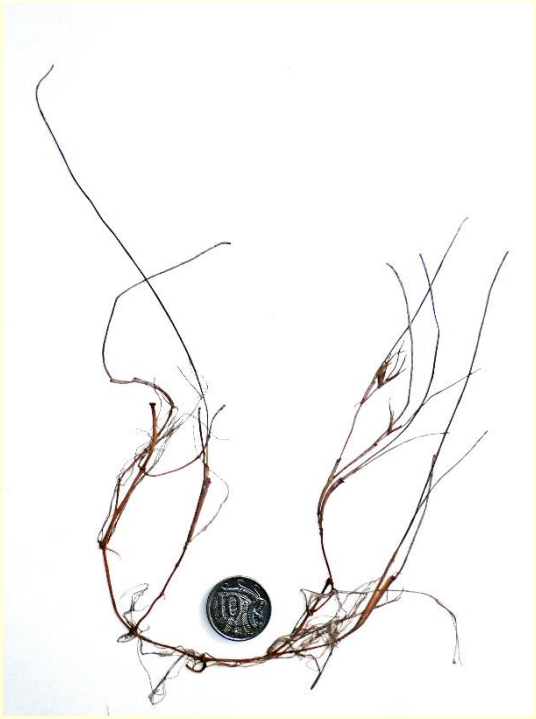
tip of a leaf: rounded with a shallow notch



Syrinodium isoetifolium



Leaves
- ***cylindrical, with air channels***, float when detached
- may branch
- arise in tufts from a buried runner (rhizome)



SPECIES ILLUSTRATED

species	author/s	page
Amphibolis antarctica	(Labillardière) Sonder & Aschersen *ex* Aschersen	2
Amphibolis griffithii	(J.M. Black) Hartog	2
Halophila australis	Doty & B.C. Stone	3
Halophila ovalis	(R. Brown) J. D. Hooker	3
Heterozostera nigricaulis	J. Kuo	9
Heterozostera polychlamys	J. Kuo	10
Heterozostera tasmanica	(G Martens *ex* Ascherson) Hartog	9
Heterozostera tasmanica	(Martens *ex* Aschersen) Hartog	9
Nanozostera capricorni	(Ascherson) Tomlinson & Poluszny	7
Nanozostera mucronata	(Hartog) Tomlinson & Poluszny	8
Nanozostera muelleri	(Irmisch *ex* Ascherson) Tomlinson & Poluszny	7
Posidonia angustifolia	Cambridge & J. Kuo	5
Posidonia australis	J. D. Hooker	4
Posidonia coriacea	Cambridge & J. Kuo	4
Posidonia ostenfeldii	Hartog	4
Posidonia sinuosa	Cambridge & J. Kuo	5
Syringodium isoetifolium	(Aschersen) Dandy	11
Thalassodendron pachyrhizum	Hartog	2
Zostera capricorni	Ascherson	7
Zostera mucronata	Hartog	8
Zostera muelleri	Tomlinson & Poluszny	7
Zostera nigricaulis	(J Kuo) S.W.l. Jacobs & D. H. Les	9
Zostera polychlamys	(J. Kuo) .W.l. Jacobs & D. H. Les	10
Zostera tasmanica	Martens *ex* Aschersen	9

REFERENCES

[1] Waycott, M *et al* (2014) **A guide to southern temperate seagrasses** Victoria CSIRO
[2] Tomlinson, P.B. & Posluzny, U. (2001). Generic limits in the seagrass family Zosteraceae. T*axon* 50: 429-437
[3] Les, D H *et al* (2002) Systematics of Seagrasses (Zosteraceae) in Australia and New Zealand. *Systematic Botany* 27 (**3)** pp.468-484
[4] J. Kuo (2011) ***in* Flora of Australia volume 39** ABRS/CSIRO