Natural Resources
Eyre Peninsula

Samphires
of the Eyre Peninsula

Contents

This pocket guide covers the samphires of the Eyre Peninsula region. Please take this guide to the plant, not the plant to the guide!

Samphires are the dominant life form in our temperate saltmarshes, and the variety of these amazing plants reaches a peak in southern Australia.

What are samphires?

Samphires, or glassworts, are succulent herbs and small shrubs belonging to the tribe Salicornieae within the family Chenopodiaceae. These unusual looking plants have jointed (articulated) branches that look like a string of beads. These articles provide the structure of the plant and function as both leaf and stem. The succulent articles are the location for photosynthesis, they have a large water-holding capacity and are where the plants accumulate organic compounds to help them retain water and manage their internal salinity. These adaptations allow samphires to thrive in very dry locations, or in tidally inundated areas that are "physiologically dry" because all the water present is saline.

The name "samphire" is a corruption of "Saint Pierre" or Saint Peter, the patron saint of fishers, and reflects the preference of these plants and their overseas relatives for growing in saline flats near the coast, although in Australia these plants are frequently found inland, adjacent to our extensive salt lakes. Fishers pickled the low-growing, sward forming species and samphire pickle ("sampha", "sampkin" or "sea pickle") is still commonly served in European and British pubs.

The ash from burnt samphire is very alkaline. Barilla ash was made from burning mangroves and saltmarsh plants to obtain an alkaline ash and this was used in glassmaking (hence "glasswort") and soap making from Medieval times. This use continued in less prosperous communities and early Australian settlements right up into the 1800's.

Where are samphires found?

The remarkable water-holding capacity and salinity tolerance of samphires results in them being the dominant plant species in temperate and Mediterranean saltmarshes, and around inland salt lakes and saline scalds.

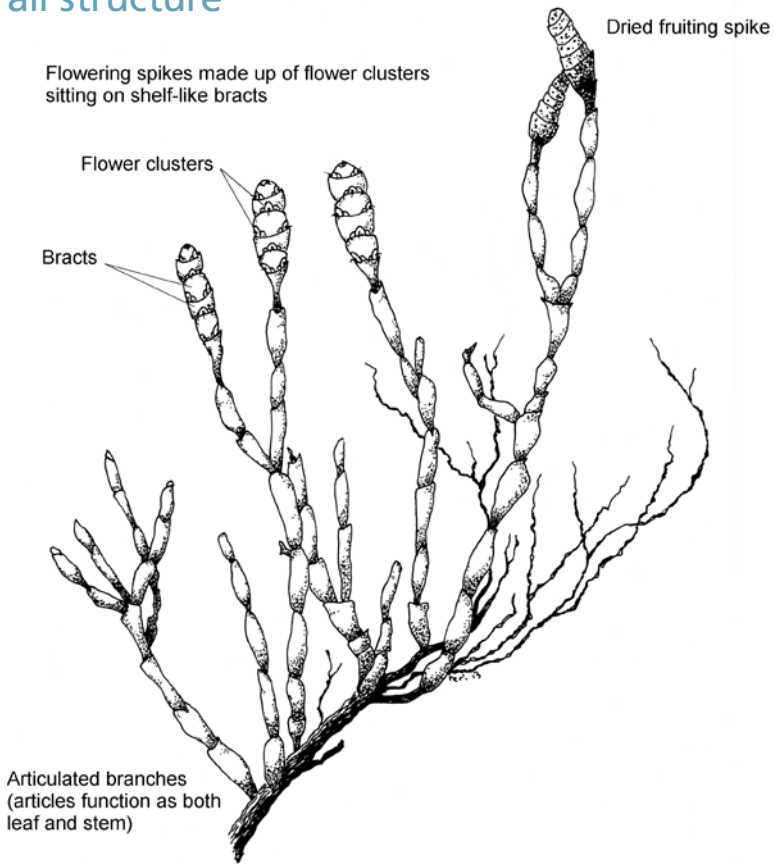
The southern saltmarshes of Australia have been afforded protection under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as a vulnerable ecological community (Threatened Species Committee 2013).

Saltmarshes are tidal wetlands. As such they function to sediment land-sourced runoff so that water reaching the marine environment is clean. These tidal wetlands also contribute to fisheries productivity, as crab and gastropod larvae released from the populations living in the saltmarsh provide an excellent food source for juvenile fish (Mazumder *et al*, 2004).

Threats

Threats to saltmarshes include the draining and filling of marshes for use as industrial or residential land and dredging to form marinas. More localised impacts include dumping, grazing, use of the areas by off-road vehicles, and weed infestation. Climate change in Australia has been accompanied by measurable sea level rise over the past half century and mangroves both in South Australia (Coleman 1998) and around Australia have begun to colonise across the saltmarsh, which is being squeezed between the mangroves and developed areas (Saintilan & Williams 1999).

Overall structure



Telling samphires apart

Look closely

If you have a hand lens or a dissecting microscope you can see details that differentiate various samphire species. Seed colour, shape and ornamentation are particularly helpful, so the seeds of each species are illustrated in this guide.

Palisade cells

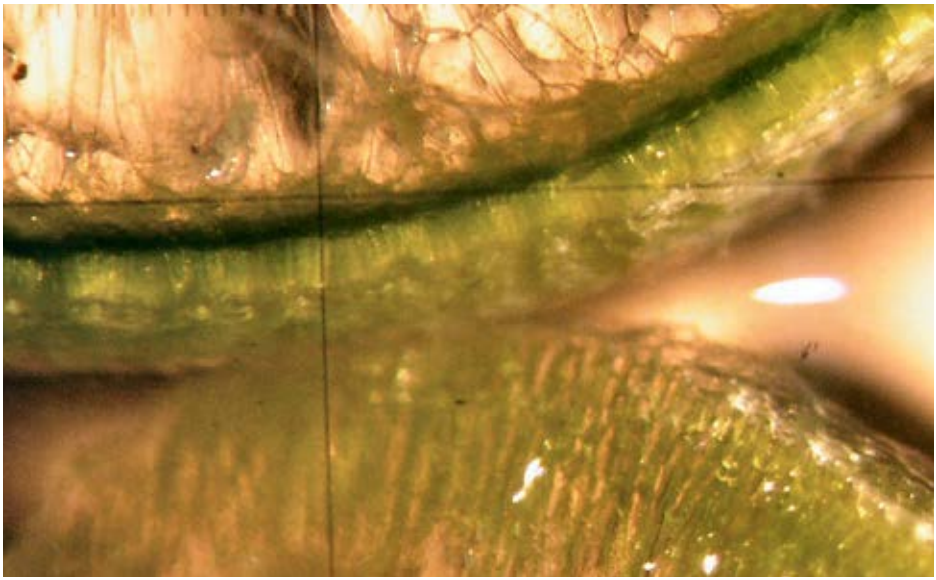
If you cut a samphire article in cross section you will see that under the surface epidermal (skin) cells there are green layers that contain the chloroplasts where photosynthesis takes place. Below this, closer to the centre of the stem, you will see clear water holding cells surrounding a central stele (vascular bundle). The structure of the green layer (called the palisade) varies in different samphires.

In almost all samphires the palisade is thick, and formed from several layers of similar green cells. Occasional clear "passage cells" can be found in the palisade and a reflection of these clear cells can be glimpsed in the reticulated surface patterning of the epidermis. This palisade arrangement is typical of C3 plants, which have either a temperate distribution or are restricted to very wet habitats in tropical climates.

In one local species (*Tecticornia indica*, Brown-headed Samphire) the palisade comprises two distinct layers. The upper layer contains clusters of green photosynthetic palisade cells located below each stomata, separated by larger clear cylindrical cells. Below this is a layer of tightly packed, dark green, thick walled, cuboid cells. Viewing the articles with a hand lens will reveal the "clusters" of green palisade cells, and a cross-section will show the narrow palisade with a dark green line underneath the palisade. This specialised 2-layer arrangement of the palisade is typical for C4 plants, which often grow in hot climates and indeed Brown-headed Samphire is very widespread with related subspecies found across tropical as well as temperate Australia.

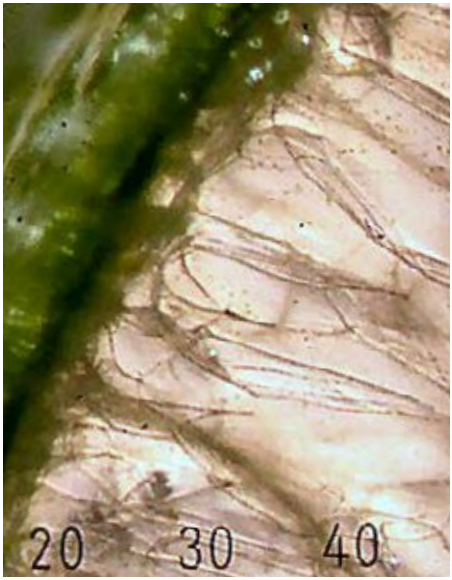
Sclereids

In the two *Sarcocornia* species you may see sclereids, or stone cells, in the palisade tissue. These hard cells impart a gritty texture to the plant tissue. The sclereids of the two species are different and this can help you determine which species you have in the absence of flowering material. If you examine the palisade of the Thick-headed Glasswort under a microscope you will often see spirally thickened sclereids, while in the Bearded Glasswort the sclereids are thickened and lack the obvious spirals.



Cross-sections of *Tecticornia indica* (top) and other Tecticornia species

Oblique view of *T.indica* showing clustered palisade cells.



Cross section of *T. indica* showing the underlying layer of dark green cubic cells, and the irregular look of the clustered palisade cells above that.

Other things to look for

Growth forms

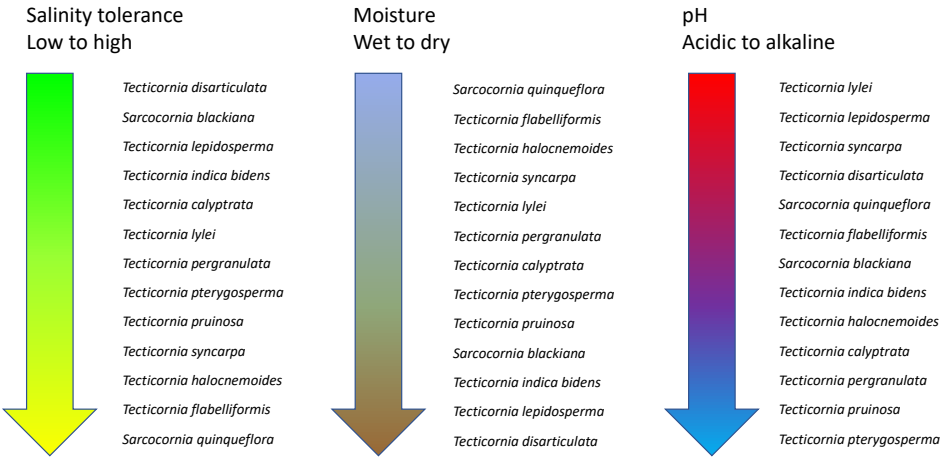
When you look at a saltmarsh you may see samphires of different growth forms – some are a lawn-like sward and others grow as densely branched small shrubs.

The sward-forming samphires may be *Sarcocornia quinqueflora* (Bearded, or Beaded Glasswort), *Sarcocornia blackiana* (Thick-headed Glasswort) or *Tecticornia flabelliformis* (Fan or Bead Samphire). Bearded Glasswort is always decumbent, that is, it puts down roots from stem nodes and grows from "runners" forming a dense mat. Thick-headed Glasswort can grow in a similar manner where it grows in wet conditions, however where it occurs in drier situations it forms a tufted dwarf shrub.

Mature Fan Samphire plants are usually dwarf shrubs, but the juvenile plants may grow so closely together that overall they form a sward like *Sarcocornia*.

Fruiting spikes

Look at the fruiting spikes. Are the seeds held on the bush for a year or so, or do the seeds blow away as soon as they ripen? Are the fruiting spikes hard or soft, light or dark coloured, do they break up or hold together? Do they grow at the end of the branch (terminal) or are they intercalary (the branch soon starts to grow on, past the end of the fruiting spike)? Are the seeds black, reddish brown, creamy or yellow and are they smooth or covered in small bumps?

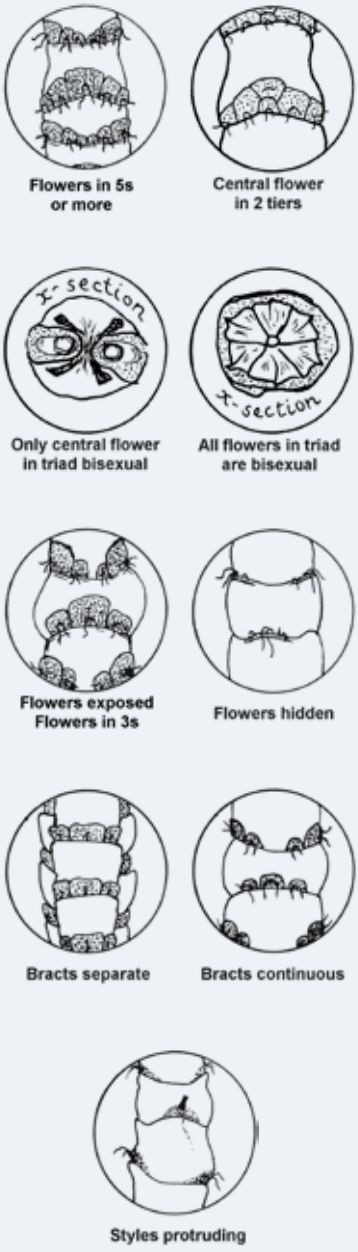


Location

The overall size and shape of the plant as well as its location in the environment often aids identification. The Shrubby Samphire *Tecticornia arbuscula* grows much larger than most of the other samphires and prefers habitats along the edge of tidal creeks just inland from the mangroves. The Bearded Glasswort *Sarcocornia quinqueflora* also likes regular tidal inundation.

Open saline clay pans (sabkhas) are very hostile environments. The low growing samphires found on these pans are usually *Tecticornia halocnemoides* (Grey Samphire) or Fan Samphire, both of which can tolerate hypersalinity (salinity much greater than that of seawater).

Assistive diagrams



Comparing local samphires

This table provides comparative features for the species of samphire found in the Eyre Peninsula region. Rare species and different species from other regions may not identify correctly using only this table.

	Flowering spikes								Fruits	
If you have flowering spikes you can quickly place your specimen into one of the four boxed groups below. The additional columns provide further, or alternate, features to help determine the species.	Flowers in groups of five or more	Central flower sometimes 2-tiered	Flowers in triads, but only central flower bisexual	Flowers in triads, all flowers bisexual	Flowers exposed, spike may have undulate outline	Flowers hidden, spike may have smooth outline	Opposite bracts separated	Bracts continuous	Protruding style/s	Cap covering the seeds
S quinqueflora	✓				✓			✓		
S blackiana	✓	✓			✓			✓		
T arbuscula			✓		✓✖			✓	✓	
T disarticulata			✓		✓		✓			
T moniliformis			✓			✓✖		✓		
T tenuis			✓			✓		✓		
T flabelliformis				✓	✓		✓			
T pterygosperma				✓	✓		✓✖	✓✖		
T lepidosperma				✓	✓			✓		
T pergranulata				✓	✓			✓		
T halocnemoides complex				✓	✓			✓		
T lylei				✓	✓			✓	✓	
T indica subsp *bidens*				✓		✓		✓		
T pruinosa				✓		✓		✓		
T syncarpa				✓		✓		✓		
T calyptrata				✓		✓		✓		✓

		Seeds					Plant		
Fruiting spikes generally terminal (branches do not grow on past fruit)	Branches grow on beyond the fruiting spike	Seeds white to gold with raised scales	Seeds circular & creamy-white, U-shaped embryo, with hairs or nipples	Seeds relatively smooth & golden	Seeds black, large, mammilate ornamentation	Seeds variously deep gold, reddish or brown, embryo to one side (curved or straight), variously ornamented	C4 anatomy throughout articles	Low growing or tufty, with branches that can set roots at nodes	Branches slender like casuarinas, nipple shaped fruits
			✓					✓	
			✓					✓	
✓				✓					
✓				✓					
	✓(pithy fruit)			✓					
	✓(woody fruit)			✓					
✓						✓			
✓		✓(spiky)							
✓		✓(ruffles)							
✓					✓				
✓						✓			
✓						✓			✓
✓				✓			✓		
✓				✓					
	✓					✓			
	✓					✓			

Species profiles

Sarcocornia quinqueflora (Bearded or Beaded Glasswort)

Sarcocornia quinqueflora (Bearded Glasswort) is usually a decumbent low-growing samphire about 15cm tall that forms extensive swards or meadows landward of the mangrove fringe. Meadows form when the plants develop roots at the joints along their prostrate branches. In drier conditions, or where the species grows with other bushy samphires such as *Tecticornia arbuscula*, it may grow more erectly to about 50 cm high or even form a scrambling subshrub.

Bearded Glasswort is frequently found in tidally inundated areas that are submerged twice daily, such as estuaries and saltmarsh flats. It is also found further inland around salt lakes, but always in very wet situations. The extensive swards change colour seasonally and are frequently punctuated with bare "pans" that hold water at low tide. This species is one of the most common coastal samphires in tidal areas.

The flowering spikes can be very long, up to 50 mm, although they are usually shorter. The opposite bracts are united (continuous, forming a cup) and the flowers are arranged in a single-row forming a cymule of 5–9 florets on either side of each bract of the flowering spike. The central floret in each cymule tends to be oblong or wedge shaped. During flowering, the paired stigmas of the ovary that protrude from each floret form an encircling "beard" around the flower spike.

The fruiting spikes are pithy in texture and the almost circular seeds are a little over 1 mm long, with an opaque creamy fawn colour. The seeds are decorated with acutely

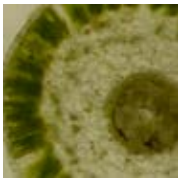
tapering projections that may have a hooked end. Inside, should the outer testa be stripped away, the embryo can be seen tightly bent into a horseshoe shape.

Sarcocornia quinqueflora meadows are recognised as providing important habitat for several species of migratory shorebirds and for Neophema parrots. The *Sarcocornia* zone of coastal saltmarshes is the preferred habitat of the small mud crab, a keystone species for many estuarine fisheries, as the larvae of these crabs provides a major food source for juvenile fish.

A significant threat to bearded glasswort is sea-level rise. Rising levels of inundation result in mangroves migrating landward across wide estuarine glasswort meadows. In response, Bearded Glasswort migrates landward across other habitats. Other local threats include the impacts of inappropriate use of off-road vehicles, clearance to provide hard stand areas for boats and loss resulting from intensive bait digging.


Autumn


Beard


Cross section


Fruit


Seed

Sarcocornia blackiana (Thick-headed Glasswort)

Sarcocornia blackiana (Thick-headed Glasswort) is very similar in its general appearance to *Sarcocornia quinqueflora*, particularly where the two species grow in proximity in wet conditions, forming dense mats. In drier conditions where the Bearded Glasswort does not occur, the Thick-headed Glasswort tends to grow a distinct, tufted shrub that may reach 60 cm high, although it still tends to develop adventitious roots along its decumbent branches at the nodes. In these drier conditions the plants usually form thicker articles than when they are found in wet conditions.

If you examine the palisade tissue of the Thick-headed Glasswort under a microscope you will often see spirally thickened "sclereids" (hard cells than impart a gritty texture to the plant tissue). The closely related Bearded Glasswort has thickened sclereids that lack the obvious spirals.

The Thick-headed Glasswort is at its most distinctive in the field when the flowering spike thickens up as the fruit start to ripen. The spike may reach 8 mm in diameter. As with the Bearded Glasswort, the opposite bracts are united (continuous) and the flowers are arranged in opposite linear groups (cymules). The number of florets can be 5–13 on either side of the spike, and the central flowers may appear in two rows (sometimes the lower florets can be so shrunken that this may not be easily observed). This doubling of the central

florets is the best aid to identification in the field, for flowering and fruiting specimens.

The fruiting spike is pithy and as the fruits ripen the spike turns a light fawn colour. When the fruitlets have dropped from the spike you may still be able to see the evidence of the double tier of the central florets as a double set of dips in the axis of the spike.

The structure of the seeds (observed under magnification) will also separate the two *Sarcocornia* species. Thick-headed Glasswort seeds are almost circular and an opaque creamy fawn colour, however they are often a little larger than the seeds of the Bearded Glasswort (up to 1.4 mm compared to 1 mm for the latter) and the hairlike projections are papillose, which means that they have a nipple-like or globular end, instead of being acute or hooked as seen in the Bearded Glasswort.

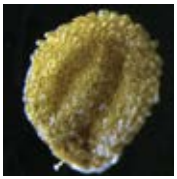
Thick-headed Glasswort is not found as commonly as Bearded Glasswort. It grows in periodically waterlogged soils, but may also be found on limestone platforms that are wet by sea spray.


Flower


Spiral sclereids


Young fruit


Old fruit


Seed

Tecticornia arbuscula (Shrubby Samphire)

The largest of the local samphires, *Tecticornia arbuscula* (Shrubby Samphire) can grow to 2 m high. It is found most commonly in the riparian zone of tidal creeks, just landward of the mangroves where inundation with fresh tidal water is regular, or landward of shelly ridges that allow percolation of seawater. This species decreases in size the further it grows from a water source. Intertidal Shrubby Samphires may seem to be salinity tolerant, yet they tend not to penetrate along smaller tidal creeks with hypersaline brine, preferring brackish conditions.

Shrubby Samphires tend to occur in very tidally wet areas and the dense branches and ascending form of this species results in the development of thick shrub lands, where bushes grow in close proximity protecting them from off-road vehicle disturbance and weed invasion. However their closeness to the mangroves means they are amongst the first samphire species to be impacted as mangroves move inland as a result of sea level rise.

The short (only a few articles long) flowering spikes are usually (not always) terminal. They occur on both the main and small lateral branches, so can be oriented in all directions. The supporting bracts of the flowering spikes are continuous and cup-like, almost completely covering the opposite triads of flowers.

Each triad has only one bisexual flower – the central one.

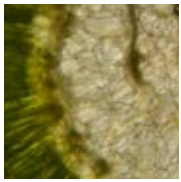
The two flowers on either side of the central flower are male and can only be seen when their pollen anthers push out from between the bracts. The central female flower has a solid style with two stigmas, which can easily be seen protruding on opposite sides of the flowing spike. The style hardens and persists in the fruiting spike and can be seen protruding long after the fruit has shrivelled to dryness. Fruits can be held on the plant for some time although the spike eventually breaks up into separate articles that fall away. A few old fruits can be found on the bushes at all times of the year. The single protruding style in the flowering and fruiting spikes is the most obvious spotting feature of Shrubby Samphires.

Seeds of the Shrubby Samphire are enclosed in a hard, vaguely pyramid-shaped pericarp which, once cracked, reveals the narrow 1.5 mm long seeds (more than twice as long as they are broad). The seeds are golden brown, transparent and unornamented. The embryo is almost straight and lies next to a large volume of perisperm.


Old fruit


Flower


Early fruit


Cross section


Seed

Tecticornia disarticulata (Plains Samphire)

Growing widely across inland Australia, *Tecticornia disarticulata* (Plains Samphire) is not necessarily associated with salt lakes or the coast. The species occurs on low salinity, sometimes alkaline, soils and can tolerate very dry conditions. As a result, it may be found on gravelly hill sides, on clay pans and limestone, as well as on near-coastal supratidal plains. Plains Samphire grows to 1.3 m tall but is commonly much shorter. Specimens growing near the Rifle Range at Whyalla are only about 0.3 m tall.

This species is usually a densely branched small shrub. While the articles, flowering and fruiting spikes are bright green, the plants often have distinctly black older branches (once the articles slough off).

The flowering spikes are 5–10 mm long and commonly contain five or more articles that are terminally and laterally positioned on the branches. The supporting bracts of the flowering spikes are not continuous – the opposite bracts are free (or almost free) from each other. The flower triads (groups of three flowers in opposite pairs) are exposed, with only one bisexual flower in each triad. The central bisexual flower is much larger than the two male flowers either side of it, which gives the exposed flowering arrangement a triangular appearance. The two small male flowers are hardly noticeable until their pollen anthers push out from between the bracts.

The style of the central bisexual flower is enclosed within the flower but the thread-like double stigmas can often be seen protruding

on opposite sides of the flowing spike till they shrivel. The fruiting pericarp is fused to the smaller lateral flowers, so that once the mature fruiting spike breaks up it separates into bracts and compact triads containing a single seed. Both the free opposite bracts and the triangular flower faces are seen easily in the field, providing a useful aid to recognition.

The golden brown seeds of the Plains Samphire are enclosed within a very tough pericarp which eventually splits longitudinally to reveal the seeds. The seeds are about 1 mm long, transparent and unornamented. The slightly curved embryo lies next to a large volume of perisperm.

Plains Samphire occurs in dry areas, and although they are not known to be palatable to stock, the plants (similarly to most of the bushy samphires) are brittle and easily impacted by trampling and off-road vehicle use. While there is little or no published information on threats to the species, fragmentation and the resulting erosion are likely to be ongoing threats.


Black stems


Bracts & flowers


Dry fruit spike


Pericarp


Seed

Tecticornia moniliformis (Vase or Ruby Glasswort)

On the Eyre Peninsula *Tecticornia moniliformis* (Vase or Ruby Glasswort) is found in moderately saline near-coastal depressions that are seasonally wet (for example, the depression inland of the ferry terminal at Lucky Bay), and on shelly sand rises within Waxy Samphire (*Tecticornia pruinosa*) depressions such as those north of Streaky Bay. The species has been observed on the margin of sabkhas including those at Arno Bay and commonly occurs adjacent to inland and near-coastal salt lakes, on the slopes above the winter inundation line. An example of the latter type of location is Seagull Lake in the Sceale Bay Conservation Park.

While Vase Glasswort may grow to 1 m tall it is usually shorter, in the 0.6–0.8 m range. It is a brittle, much-branched small shrub.

The vegetative articles are dull green but do not have a bloom (waxy coating that can be rubbed off). The upper margins of the articles form a smooth thickened membrane that has apiculate (pointed) tips.

The flowering spikes are just a few articles long, found terminally and laterally on the branches, and are often yellow or red. The flowering articles are quite round when compared to the vegetative articles. The supporting bracts are continuous and hide the flower triads. Sometimes the stigmas of the one bisexual flower in each triad and the pollen anthers of the adjacent male flowers in each triad may poke out from behind the pointed tips of the bracts.

Fruits are pithy and often vase, urn or pearl shaped. Where several fruits occur along a

branch they may look like a string of beads, hence the scientific name "moniliformis". The fruits are retained on the plant for some time and new growth may occur beyond the fruit. The fruits are fairly soft and break up easily releasing a single seed from each of the opposite triads within the fruit. Vase Glasswort seeds are golden brown and between 1–1.5 mm long, with no ornamentation. The embryo is slightly curved and lies next to a bulge of perisperm.

Ball-shaped galls are often a prominent feature of Vase Glassworts. The galls can be seen from some distance as they are often a darker, purplish colour and are at least double the diameter of any fruits on the plants.

Vase Glasswort has only recently been recognised on the Eyre Peninsula, previously being recorded as a short form of Shrubby Samphire (*Tecticornia arbuscula*) that seemed to occur on the landward side of sabkhas and near-coastal saltlakes. Distribution mapping and threat analysis for the species needs further work.

Apiculate articles

Flowers

Vase fruits

Growing on

Seed

Tecticornia tenuis (Slender Glasswort)

Tecticornia tenuis (Slender Glasswort) occurs on saline soils that contain, or overlie, clay. It is not a coastal samphire, occurring widely across inland Australia. In the Eyre Peninsula region it is rarely recorded, although it has been found in the past at Franklin Harbor and grows north of Whyalla. Slender Glasswort is found more commonly at Port Augusta, where it grows as a co-dominant in a saltbush association with *Atriplex paludosa*, along with *Maireana pyramidata, Atriplex vesicaria, Sarcozona* sp, *Disphyma crassifolium* adjacent the salt lakes east of town.

The shrubs are low growing, only about 0.6 m tall, but often over a metre across, with long slender, light green articles that have a broad, slightly lobed margin along each upper edge.

The flowering spikes of Slender Glasswort are readily recognisable as they are nearly 2 cm long, comprising 5–10 articles, with the lower ones being fatter than the upper ones. While the flowering spikes initially grow terminally and laterally on the branches, after flowering the branches grow on for a couple of centimetres. This new growth may wither as the fruits develop.

The bracts of the flowering spikes are continuous – they can be traced right round the flower spike. The flower triads, comprising a central bisexual flower and male lateral flowers, are hidden inside the cup-like bracts. Only the occasional stigmas from the central bisexual flower may show, along with anthers containing pollen from the adjacent male flowers in each triad.

The fruiting spike is hard and woody, usually elliptical in shape but very occasionally with constrictions that make it look bead-like. The fruits may be covered with the shrivelled remains of the bracts, but once this material is scraped away the woody pericarp underneath proves difficult to break, so the seeds are rarely extracted. They are effectively buried in the branch. In some varieties of Slender Glasswort this is so marked that the seeds are only shed when branches are broken off and decay.

Use of a mortar and pestle reveals that Slender Glasswort has smooth, light brown seeds, which are long for samphires – between 2.5–3 mm. The seeds are slightly curved and those seen on the Eyre Peninsula have had a dark umbilicus opposite the embryo.

Although stock find the shrubs unpalatable, the plants are brittle and easily impacted by trampling and off-road vehicle use. This, combined with the dry habitats the plants are found in, suggests that recovery may be slow for stands of this species that are degraded.

Slender articles grow on

Flower spikes

Stigma & pollen

Fruits

Seed

Tecticornia flabelliformis (Fan or Bead Samphire)

In the warmer months of the year, *Tecticornia flabelliformis* (Fan Samphire) is a tufted-looking bright apple-green dwarf shrub that is usually less than 20 cm high. Its branches tend to spring from low on the plant, are not much divided and have large terminal flowering spikes, so the plant does not have a "bushy" look to it, unless it is very old. In fact, when swathes of juveniles are seen the plants can look like a sward of *Sarcocornia*. This samphire is the only one in the region that is considered to be deciduous, with its fleshy articles turning red and sloughing away in the coldest months of the year, leaving small twisted dry branches. As a result this samphire species is often overlooked in surveys, unless they are undertaken after late October and before early April, when the bright colour of the articles makes the plants readily visible.

The prominent flowering and fruiting spikes seen in summer are commonly 20 mm long and may reach 40 mm in wetter locations. Close examination of the spikes shows that the bracts supporting the exposed triads (groups of three) of bisexual flowers do not continue right around the spike, but instead appear to be separate.

Seeds of this species are a little less than 2 mm long and are translucent yellow to brown in colour, with minute pointed protrusions round the outer edge of the seed (over the curved embryo) but smooth over the sides where the white perisperm can be seen.

Fan Samphires are listed as a Vulnerable species under the EPBC Act as they have a very restricted range and require distinct soil conditions that are not common. They are found on small areas of coastal sabkhas

(salt clay pans) like those at Arno Bay or on salt lakes, including Seagull Lake south of Streaky Bay. The plants are gypsophiles and grow on the clay pans where there is wet saline clay above hardened layers of soil impregnated with gypsum (fragipans). The salt concentration in these soils is very high.

These specific soil conditions provide a habitat that precludes other species. Small changes to the soil moisture or salinity result in Fan Samphires being outcompeted by other samphires. For example, additional tidal inundation sees the Fan Samphire replaced with *Sarcocornia* species, while additional drying allows *Tecticornia halocnemoides* (Grey Samphire) to invade the Fan Samphire niche.

Threats to Fan Samphires include grazing (the flowering and fruiting spikes taste sweetish and the plants appear to be preferentially grazed), off-road vehicle use and alterations to the hydrology of the sabkhas by road building, dredging, and extraction of the underlying salt water.

Bract

Deciduous

Pollen

Tuft

Seed

Tecticornia pterygosperma (Whiteseed, or Winged-seed Samphire)

Tecticornia pterygosperma (Whiteseed Samphire) is a spreading, densely branched, mid-green shrub. Its green articles often have a "bloom" (that can be rubbed off) that gives the plants a milky look, compared to the darker *Tecticornia pruinosa* (Waxy Samphire) they frequently grow amongst. This is especially noticeable if the plants are flowering, as the reddish flower spikes can appear softly pink due to the dusty bloom.

Isolated plants growing on gypsum dunes often spread widely, while rarely growing more than 50 cm high. More often this species is found growing in chenopod shrublands in saline depressions, or on the higher margins of salt lakes and in these locations the plants tend to spread less.

Specimens on the Eyre Peninsula are found in the more northerly, drier areas: Whiteseed Samphire occurs in a large depression west of Kyancutta, on gypsum ridges edging acid salt lakes in the Minnipa-Kyancutta area and south of Streaky Bay where it is found on the upper margins of near-coastal salt lakes and the Calpatanna depression.

Flowering specimens are readily recognised, as this samphire's terminal spikes of flowers are unusual – the triads of bisexual flowers exceed the supporting bracts and bulge outwards, looking like turban rings. Each individual floret has three lobes, with the bottom, semicircular lobe overlapping the two upper lateral lobes. The bracts that support the flowering triads are continuous, however they may appear

separate because the flowers sometimes hide part of the bracts. The flower spikes are up to 30 mm long with 3–15 articles.

During fruiting the bracts shrivel leaving prominent whorls of fruitlets on the spikes. The fruitlets fall entire, with the seed and sticky mucilage still enclosed in the shiny papery envelope.

Seeds of Whiteseed Samphire are about 1.5 mm long and initially white, gradually turning a fawn colour. The surface of the seeds is covered in blunt spiky ribs, giving them a hedgehog appearance, quite unique to this species.

The status of this species was not assessed in recent regional species assessments (Gillam & Urban 2009) as there were taxonomic issues in herbarium records for the species. Stock do not seem to graze this species, but its presence in gypsum-rich areas may mean it could come under threat from mining, either for extraction of gypsum or for the associated minerals found in gypsum-dominated acid salt lakes that are currently being prospected.


Bloom


Turbans


Fruit whorls


Shiny perianths


Seed

Tecticornia lepidosperma (Sea Asparagus or Sea Beans)

In the southerly, damper parts of the Eyre Peninsula in winter-wet depressions you may find the tall slender Sea Asparagus, *Tecticornia lepidosperma*. It has been recorded at Pillie Lake, in Kellidie Conservation Park, in depressions associated with Duck Lake near Wangary and in depressions near Edillilie that drain towards Lake Wangary.

The seasonally wet depressions favoured by Sea Asparagus are often surrounded by *Melaleuca* trees, and the depressions themselves host a range of brackish-tolerant samphires and herbs including Blackseed Samphire (*Tecticornia pergranulata*), Brown-headed Samphire (*Tecticornia indica*), Bearded Glasswort (*Sarcocornia quinqueflora*), Thick-headed Glasswort (*Sarcocornia blackiana*) and Creeping Brookweed (*Samolus repens*).

Sea Asparagus is an erect, pale green, slender shrub growing to 1 m tall. Older articles, lower down the branches, turn red as salt is sequestered away from the fresh growing tips. Long, cylindrical branches with relatively large barrel shaped articles give the plant its resemblance to asparagus.

The terminal flowering spikes of this species are elongated, most frequently about 5 cm in length but occasionally reaching over 10 cm, with many articles. The upper part of the flower spike is frequently tapered to a narrow tip. The triads of bisexual flowers initially hide inside the bracts with only the stigmas showing, but as the flowers mature they swell somewhat and become visible above the continuous rings of bracts.

Each fruitlet in the triads is held separately

from the others. As the fruitlets fall, the back of the enveloping perianth is torn away so that part of the seed apex is exposed. The entire empty fruiting spike remains on the plant after the seeds fall: the central stele and remains of the bracts looking like a pagoda.

The seeds of Sea Asparagus are about 1.5 mm long and, like the Whiteseed Samphire (*Tecticornia pterygosperma*), they are initially white, gradually turning a fawn colour. The surface decoration of the seeds is distinctive – a series of 5–7 ruffled ribs run along the length of the seed surface, marking the location of the strongly curved, almost semicircular embryo below that wraps around the perisperm.

Sea Asparagus has a State conservation rating of Rare (Gillam & Urban 2009). It is more common in Western Australia and is frequently found in areas with active dryland salinity occurring, where it colonises into wetlands that are becoming salt-affected. It may serve similarly as an indicator for emerging salinity issues on the Eyre Peninsula.

Barrel shaped articles

Long spike

Flowers

Pagoda

Seed

Tecticornia pergranulata subsp. *pergranulata* (Blackseed Samphire)

Tecticornia pergranulata (Blackseed Samphire) is a low shrub that can reach half a metre in height when it grows in an upright manner. It sometimes grows in a lower, more spreading form. Blackseed Samphire have articles that tend to be dull and the colour varies widely from a dusty blue-green through green to pinkish purple. The size of the articles varies considerably.

Flowering and fruiting spikes of Blackseed Samphire are terminal on the branches and upward facing lateral branchlets. The spikes may reach 5 cm long. Blackseed Samphire have continuous bracts that circle the spike and are partially obscured by the opposite triads of flowers, producing a "bow-tie" appearance. The silhouette of the fruiting spike tends to be undulating, reflecting the orientation of the flowers in the alternating bulges of the bracts.

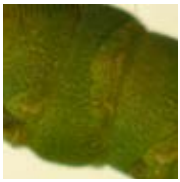
The seeds of Blackseed Samphire are retained in the fruiting spikes on the plant for a considerable time. The spikes tend to become softly corky and hang down from the branch tips, so that for much of the year the bushes appear to be covered with lambs' tails. Hidden in the corky spikes are the seeds, which are round to oval, black (sometimes reddish-black) and opaque. The seeds are a little less to a bit more than 1 mm long. Simply rubbing the grey fruiting spike between your fingers allows the black seeds to fall out into your palm, where they are very visible amongst the light grey detritus of the fruiting spike. This is the most obvious spotting feature for Blackseed Samphire.

The distinctive black seeds are ornamented

with mammilate projections that are packed tightly into concentric ribs. In most plants these ribs extend over the entirety of the seed, however there are some varieties where the seeds are reddish black and the ribbing does not extend to the centre of the seed faces.

Blackseed Samphire is less tolerant of salinity than many other species, and is the dominant samphire along the higher, inland edges of estuarine saltmarshes and in brackish wetlands. This species commonly co-occurs with *Tecticornia lepidosperma* (Sea Asparagus) in seasonally damp depressions such as those near Duck Lake and along Shepperd Road near Edillilie. It also occurs on slightly elevated shelly sand ridges in saltmarshes dominated by other species of samphire. The habitat preferred by Blackseed Samphire is often characterised as "high marsh" and this habitat is frequently used for grazing. In many areas high marsh has been cleared to allow planting of salt tolerant (mostly exotic) pastures.


Crushed fruit


Flower


Flowering


Fruit spike


Seed

Tecticornia halocnemoides subsp. ***halocnemoides*** (Grey Samphire)

Tecticornia halonemoides subsp. *halocnemoides* (Grey Samphire) is not always grey. The rather small articles (3-5 mm long) can be green or red and may be glossy or dull. Grey Samphires are very variable, but the two most commonly observed varieties of this subspecies in the Eyre Peninsula are both low growing. On the pans of salt lakes the smallest type grows to about 10 cm tall and has small twisted grey branches with just a few gem-like, translucent, ruby articles. Somewhat upslope grows a form that is highly branched but very low, forming a shrub generally between 15–25 cm high, usually with a contorted grey woody trunk. The articles along branchlets of this form also soon fall away, and only a few short dull articles remain evident at the ends of the dry branchlets.

The flowering and fruiting spikes are terminal (at the ends of the branches) and can be up 2.5 cm long, comprising more than a dozen articles. Although the bracts are continuous around the spike, the triad clusters of flowers are large and obscure much of each bract, giving the bract a "bow-tie" appearance. The bracts bulge where there are no flower clusters, so the outline of the spike tends to have an undulating silhouette.

All three flowers in each triad are fertile, and the seeds are held for only a short time on the plants. Each fruitlet is like a papery bag, formed by the drying perianth (flower) and holds a small (1 mm) reddish-brown opaque seed that is ornamented with tiny raised bumps over the outer edge of the seed and that has a slightly rippled surface overlying the sides. In late autumn the papery fruitlets with ripe seeds blow away from the plant, leaving the empty bracts remaining on the plants. These empty remains look like small Japanese pagodas

standing on the tips of the branches, until the winter storms knock them from the bushes.

This samphire is very common. It tolerates a wide range of tidally and seasonally waterlogged saline habitats and can tolerate extended periods of dryness and very high salinity. Saltmarshes that receive only occasional tidal inundation are often dominated by this species, which is also widely found edging near-coastal sabkhas and on the pans and palustrine margins of salt lakes including Seagull Lake south of Streaky Bay, where it is found on slightly drier and higher land than the Fan Samphire *Tecticornia flabelliformis*.

Threats to this species include off-road vehicle use, and "reclamation" of is habitat by filling, usually for coastal residential or industrial lands. Placement of roads across saltmarshes often results in the hydrological "stranding" of large areas of this species. While the adult plants rarely die outright in this situation, new recruitment ceases and the old plants become less resilient.

Fruit spikes

Flowering

Pagoda shapes

Pollen

Seed

Tecticornia halocnemoides subsp. aff. ***longispicata*** (Gulf Grey Samphire)

Gulf Grey Samphire (*Tecticornia halocnemoides* subsp. aff. *longispicata*) is a very different subspecies of *Tecticornia halocnemoides.* This plant may actually be subspecies *longispicata*, rather than just a species with "affinity" to that subspecies; however, it has some differences to the described subspecies. It is found close to the sea rather than inland, tolerates very saline rather than somewhat saline conditions, and it grows very much larger than the described subspecies. Gulf Grey Samphire is a bright apple green upright shrub with grey, smooth-barked branches. It can reach the remarkable height of 1.3 m where it grows in the intertidal zone behind the mangroves at the head of Spencer Gulf. Smaller specimens occur on the edges of sabkhas at Whyalla and near Cowleds Landing.

The rather small articles (3–5 mm long) of Gulf Grey Samphire are glossy green. There are only a handful of articles on each branch underneath the very elongated flowering spikes. The flowering and fruiting spikes are terminal on the ends of the main and lateral branches and can be up 8 cm long, comprising dozens of articles. Although the darker green bracts are continuous around the spike, the light green triads of flowers are large and obscure much of each bract, giving the bract a "bow-tie" appearance. The flower triads are slightly larger than the bracts, and the triads from each "level" nearly touch those on the level above, so the long slender spikes have a smooth cylindrical outline.

The individual flowers have three lobes, with

the two lateral lobes overlapping the lower lobe of each flower. All three flowers in each triad are fertile, and the seeds are not held for any length of time on the plants.

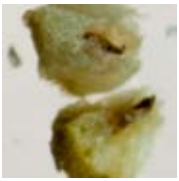
The drying perianth (flower) forms an envelope for the small (1 mm) pale brown opaque seed, which is ornamented with tubercles over the outer edge of the seed and has a relatively smooth surface overlying the side faces. When the ripe seeds fall from the plant the base of each papery perianth tears, exposing the outer edge of the seed inside.

This samphire occurs in areas that are tidally wet for at least some of the time. It has been poorly reported in the past making it difficult to determine its conservation status and threats. As the species occurs in low energy coastal environments it is likely to be threatened by "reclamation" of the areas it lives in by filling for coastal residential or industrial lands, or for infrastructure such as roads and rail.

Spikes

Flower lobes

Immature perianths



Torn perianths

Seed

Tecticornia lylei (Casuarina Samphire or Wiry Glasswort)

Tecticornia lylei (Casuarina Samphire) is bushy, dull green shrub that can reach 1 m high although specimens seen at Lake Yaninee only attain 0.7 m. The branches spring vertically, largely parallel to each other, from the root. This growth form in combination with the dark colour and narrowness of the articles can lead to the shrubs being mistaken, from a distance, for stunted *Casuarina* plants.

The narrow cylindrical branchlets are made up of thin articles that are usually longer than they are wide, with an obvious upper margin and apiculate leaf lobes.

The flowering spikes of Casuarina Samphire are terminal and located at the ends of the branch tips. They may reach 20 mm in length and are initially the bracts are the same colour as the articles. As the flowers mature into fruits they turn orange, a further feature that is evocative of male *Casuarina* flowers. The flower triads are exposed, and as they mature the fruitlets bulge out above the pointed tips of the supporting bracts. Each flower in a triad is held separately from the others so that you can easily see the individual fruitlets.

The pericarp that surrounds the seed has a convex outer face that pushes the face of the fruitlet outward beyond the perianth and this, along with the persistent base of the style (which is often visible), gives the fruiting spikes a mammilate appearance.

Fruits fall as soon as they are ripe leaving the empty fruiting spike on the plant. The remnant spikes are fragile and eventually break off the plants. The fallen fruits are pithy, not hard, and are easily separated to extract the seed. The dark red-brown seed is relatively large at 1.5 mm long. The seed edge where the curved embryo lies is decorated with minute mammilate projections, packed tightly together into several concentric rows, while the side faces of the seed are smooth.

Casuarina Samphire occurs well down on beaches adjacent to gypsum dominated acid salt lakes. On the Eyre Peninsula it is found on the margins of acid salt lakes in the Minnipa-Kyancutta area and it occurs just north of the region, at Lake Gilles.

Until recently the acid and saline conditions favoured by Casuarina Samphire were a habitat only threatened by gypsum mining. Recently, however, acid salt lakes including the large depression at Kyancutta and Lake Yaninee have seen interest from miners looking to extract lithium, boron and potassium.

Apiculate lobes

Fruiting spike

Remnant spike

Fruits

Seed

Tecticornia indica subsp. *bidens* (Brown-headed Samphire)

Tecticornia indica subsp. *bidens* (Brown-headed Samphire) prefers well drained soils of only moderate salinity. Locally it can be found in sandy elevated areas above the "beaches" edging the sabkhas of Arno Bay and in seasonally wet depressions like those along Shepperd Road near Edillilie.

Brown-headed Samphire is a sturdy blue-green to yellowy-green shrub that can reach 2 m high, although it is usually shorter than this. The large, stout articles can reach 1 cm long, and have "keels" on their lobes, as do the flower spikes. The keels may be clear or coloured, and sometimes have a reddish hue. The epidermis (skin) of the articles, when examined with a hand lens, shows an unusual clustered arrangement of the green palisade cells, as it is a C4 species. Cross-sections of the articles reveal a single layer of palisade cells underlain by a narrow band of tightly packed, dark green cuboid cells (see "Telling samphires apart").

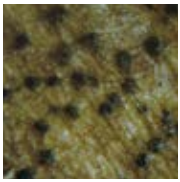
The flowering and fruiting spikes of Brown-headed Samphire have a smooth outline, with even cup-like bracts that almost conceal the triads of bisexual flowers. The lowest bract of each spike is larger and more deeply lobed than the slightly smaller bracts above. The mature fruiting spike is corky to feel and remains on the plant for much of the year, gradually changing colour from straw to grey. Small nodules, hardly noticeable on the newer fruiting spikes, gradually darken and form small black spots across the surface of the older spikes. Wet spikes swell and soften and eventually fall apart.

Extracting the seed is tricky, as it is surrounded by a very hard pericarp. Cracking the fruitlets open tends to result in bits of fruitlet and seed flying off in all different directions. If you manage to obtain some seeds you will observe that the golden brown seed is a little less than 1 mm long, smooth, unornamented and translucent. The straight to slightly curved embryo may be visible through the seed's testa as a darker area along the seed's outer edge, with a large light coloured perisperm adjacent to it.

While Brown-headed Samphire is considered to be widespread in Australia, it is not particularly common, probably because it occurs on land that has potential for other uses. Much of this species' habitat has been converted to agriculture.

In northern parts of the Eyre Peninsula *Tecticornia indica* subsp. *leiostachya* may occur. It is usually a smaller plant, and notable differences include articles often with fringed margins, the lower fruiting bract being smaller than the upper ones, and the fruit retaining its straw colour on aging and drying.


Epidermis


Small nodules


Keel


Fruit spike


Seed

Tecticornia pruinosa (Waxy Samphire or Bluish Glasswort)

Tecticornia pruinosa (Waxy Samphire or Bluish Glasswort) is another species that prefers well drained soils of moderate salinity. It is often found where alluvial soils have washed into the edge of a saltmarsh forming a "fan" of soil that may be a distinctly different colour to the rest of the soils in the saltmarsh.

This species is very common, occurring in the high marsh where saltmarsh intergrades with saltbush and coastal dune habitats, along embankments in saltmarshes and edging sabkhas along the coast. It also occurs inland, where it grows in depressions and adjacent to salt lakes. The drier nature of the soils utilised by this samphire makes the species vulnerable to damage from off-road vehicles and other forms of trampling.

Waxy samphire is a solid looking low shrub that may reach a metre high but is more usually around 40 cm tall. The bush is generally a dull (waxy looking) blue-green in colour and has medium sized articles, usually between 5–8 mm long. The older articles often become flushed with pink or purple in winter.

The flowering spikes are terminal on the branches and laterals. The flowering spikes of the waxy samphire are usually less than 3.5 cm long and have a smooth outline, with overlapping bracts. These bracts continue right around the spikes in smooth rings that totally conceal the opposite triads of flowers.

The bracts remain swollen in the fruiting spike, which is spongy or corky to feel. Fruiting spikes remain on the plant for much of the

year, gradually changing colour from light to dark brown as they mature. The mature fruiting spikes break easily into rings that reveal the opposite triads of fruitlets in a star shaped pattern. The breaking up of the fruiting spikes prevents the branches from "growing on" beyond the fruits.

The fruitlets are fibrous pyramids that easily separate from each other. The perianth can be split apart to reveal the seed, which is covered in a thin, membranous dark brown pericarp. The golden brown translucent seed is small (about 0.7 mm) and smooth, although it sometimes has a slightly grainy appearance over the outer edge where the almost straight embryo is located. The lighter coloured, abundant perisperm forms an obvious lateral bulge next to the embryo.

In the field the dark brown, smooth fruiting spikes that break apart easily, revealing the star pattern of fruitlets is fairly distinctive, and this provides a helpful aid to identification.


Bracts


Flower spikes


Fruit spikes


Seed


Seed arrangement

Tecticornia syncarpa (Bracelet Samphire or Fused Glasswort)

Tecticornia syncarpa (Bracelet Samphire or Fused Glasswort) is a low shrub commonly growing to a maximum of around 0.5 m, although it is recorded in other parts of Australia as growing somewhat taller than this. It tends to either form a low erect bush about as wide as it is tall, or it may sprawl, forming a ground hugging low mound.

Bracelet Samphires are generally found on the higher beaches around the edges of salt lakes inland and around coastal playa lakes. The species can be observed on the margins of the salt lake adjacent to Bratten Road near Tumby Bay.

The vegetative articles of Bracelet Samphire have "apiculate" lobes, that are almost miniature keels. As a result, the articles are often described as "heart shaped". In colour the articles are mid to bright green and are often suffused with a red blush.

The flowering spikes, between 1–7 articles long, tend to be a lighter green and initially form at the ends of the branches, however the branch tips quickly grow on past the flowers and later the fruits. These intercalary fruit spikes look like sets of bracelets on the branchlets, hence the common name of Bracelet Samphire.

The bracts of the flowering spikes are continuous, completely encircling the spike and almost entirely obscuring the triads of flowers. Only the very tip of each flower is visible. The outline of the flowering spike may be smooth or undulate, depending on how "bulgy" the bracts are.

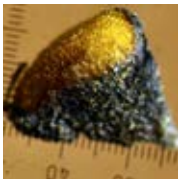
In each triad of flowers the individuals are joined together and the triads are also joined to the bract above, leading to the second common name, Fused Glasswort. As the fruiting spike matures the intervening bracts shrink a little, so that the triads of fruits become obvious and the fruiting spike tends to have an undulate outline.

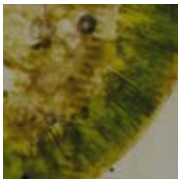
The fruitlets are quite leathery, so extracting the seeds can be a challenge as the pericarp obstinately sticks to the seed. Once free of the perianth, the seeds can be seen to be covered with a crusty dark brown pericarp that is usually torn at the base, revealing the relatively large (a little more than 1 mm long) golden brown seed. The seed is opaque with a distinct granulation of concentric lines over its longer edge.

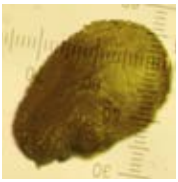
Tecticornia syncarpa was not evaluated in Gillam & Urban (2009) and so its conservation status for the region is unknown. Further distribution mapping for this species would help inform its threat and conservation assessment.


Bracelet


Flower


Pericarp


Section


Seed

Tecticornia calyptrata (Capped Samphire)

Tecticornia calyptrata (Capped Samphire) is a small shrub recorded in a salt lake depression west of Kyancutta. The plants there were about 0.2 m tall, although it is recorded in other parts of Australia as growing to 0.8 m height. The shrubs are densely branched and the vegetative articles of Capped Samphire are quite round, with small "apiculate" upper lobes. In colour the articles are dusty green to pink, and often have a bloom that can be easily rubbed off.

The flowering spikes may be terminal at the ends of the branches or oriented in opposite pairs along the branches, and may be up to 20 mm long, although all the specimens seen at Kyancutta had shorter flowering spikes than this. The branch tips usually grow beyond the flowers, and later the fruits. The old (intercalary) fruits can be seen below the current season's flowering spikes. The fruiting pairs lower down the branches also tend to persist on the plant across at least one season, as small spurs.

The bracts of the flowering spikes are continuous and cup-like, completely encircling the spike. The triads of flowers are totally obscured, with only pollen and stigmas protruding from the bracts. The individual flowers in each triad are fused together.

As the fruiting spike matures, the pericarp around each seed hardens on its outer edge, forming a cap, while remaining membranous closer to the axis of the spike. Often the cap has the hardened remnants of the style decorating its centre as a small conical projection. Gradually the flowering parts

(perianths) and bracts shrink, and the cap of each seed becomes visible on the surface of the fruiting spike.

The joined fruitlets disconnect easily from the spikes and the capped seeds are simply separated. The seeds are golden brown, about 1 mm long and have a straight embryo to one side, marked with indistinct rows of fine granulations on the testa. A bulging perisperm lies next to the embryo, and the seed coat over the perisperm is smooth or faintly wrinkled.

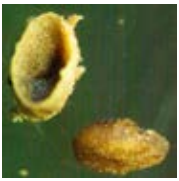
Capped Samphires are generally recorded in the margins gypseous salt lakes, where they may occur downslope from Waxy Samphire (*Tecticornia pruinosa*), or in depressions where rain water pools in winter. They have only recently been recognised in the Eyre Peninsula. Distribution mapping and threat analysis for the species needs further work. Recent prospecting of acid salt lakes including the large depression at Kyancutta raises the prospect that the species may be threatened in the future by mining of minerals such as lithium, boron and potassium.

Apiculate articles

Intercalary & flowering spikes

Fruiting spikes

Cap in spike



Seed & cap

Glossary

Apiculate – ending abruptly in a short point.

Article – jointed organ that functions as leaf/stem of the plant.

Bract – small leaf-like structure that forms a "shelf" under the flower clusters.

C3/C4/CAM plants – photosynthesis and respiration in plants varies according to the environment they find themselves in. The names reflect the carbon pathways in the plants, but essentially C3 plants are the most common, they open their stomata in the day and live in temperate conditions, C4 and CAM plants have evolved ways to utilise higher light intensities and temperature and conserve water used in respiration. C4 plants are usually tropical or are summer annuals, CAM plants live in arid areas.

Cortical – relating to the outer fleshy material between the stem and the epidermis.

Cymule – smaller form of the "cymose" flowering arrangement where the main axis of the flowering arrangement ends in a flower.

Decumbent – branches lie on the ground but turn up at the ends.

Gypsophiles – plants that live in gypsum-rich environments.

Intercalary – where the branch continues to grow on after flowering, leaving fruits inserted along the stem.

Keels – projecting ridge along the middle of a flat or convex surface (similar to a boat).

Mammilate – similar shape to mammary glands.

Ornamentation – patterns of ridges and lumps found on seeds.

Palisade cells – long cells filled with chlorophyll, aligned perpendicular to the upper leaf surface.

Papillose – covered with papillae (small nipple-shaped structures).

Perianth – floral envelope, comprises the calyx (sepals) and corolla (petals).

Pericarp – the fruit wall (around the seed).

Perisperm – nutritive material next to the embryo, found inside the seed.

Sabkhas – supratidal salt flats or playas, forming along arid coastlines that are characterised by salt, gypsum and carbonate within a mineral clay matrix.

Sclereid – strongly thickened cell, also called a stone-cell.

Spike – flowers and fruits of samphires have a simple spike-shaped arrangement.

Stele – the central core of the stem, root or fruits of a vascular plant.

Stigma – point or head of the style of the female reproductive apparatus.

Stomata – minute pores on leaf used in respiration.

Style – narrow upper part of the female reproductive apparatus, that sits atop the ovary and below the stigma/s.

Testa – seed coat.

Triad – group of three flowers.

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Acknowledgements

Text and photographs by Peri Coleman.

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www.naturalresources.sa.gov.au/eyrepeninsula

Acknowledgements

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