



SALINITY INDICATOR PLANTS

LOCAL GOVERNMENT
SALINITY INITIATIVE

This booklet is based on information provided in *Spotting Salinity Using Indicator Plants*, which was produced by the NSW Department of Land and Water Conservation, Hunter Region in 1998, with assistance from the Hunter Catchment Management Trust and NSW Agriculture. Information contained in the plant description section and pictures of some species have been taken with permission directly from the 1998 publication.

Salinity Indicator Plants is part of the Local Government Salinity Initiative Series. Other booklets in the series include:

- Indicators of Urban Salinity
- Broad Scale Resources for Urban Salinity Assessment
- Site Investigations for Urban Salinity
- Roads and Salinity
- Building in a Saline Environment
- Introduction to Urban Salinity
- "Waterwise" Parks and Gardens.



Department of
Infrastructure, Planning and Natural Resources

First published 2005

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Salinity Indicator Plants
Local Government Salinity Initiative - Booklet No.8
ISBN: 0 7347 5442 6





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Salinity Indicator Plants

Introduction

Plants are sensitive to their environment. Their presence or otherwise at a particular location is influenced by climate conditions and soil characteristics as well as human, animal and other plant activity. "Salinity indicator species" are plants whose presence coincides with salinity in the plant root zone.

Salinity indicator species differ from region to region in NSW. This booklet provides a statewide overview of salinity indicator plants, which should be used in conjunction with region-specific literature and local knowledge. This booklet provides information on:

- a variety of urban salinity indicators;
- the impacts of salinity on plants;
- the general characteristic of salt-tolerant plants;
- using salinity indicator plant lists; and
- common salinity indicators to aid identification.

Salinity

The term "salinity" is used to describe both processes and impacts associated with salt and water, while also being a measure of the amount of salt in soil or water. Salinity may occur naturally or result from human changes to ecosystems which effect the movement and storage of water and salt in the environment. For example, urban development involves:

- clearing vegetation;
- reshaping the landscape through earthworks;
- the construction of freshwater, stormwater and sewerage systems; and
- irrigation.

These increase the volume of water and salt in the landscape and change how they move and where they accumulate.

Excess salt and water can then damage urban infrastructure and adversely affect plant communities. Salt can also concentrate in waterways and reduce water quality.

Salinity Indicators

A salinity indicator is a sign or symptom that suggests an area is experiencing the impacts of salinity. For example, a bare patch in the landscape may indicate a high salt concentration in the soil which is inhibiting plant growth. However, care should be taken in interpreting this phenomenon as it might also be caused by pedestrian activity that compacts the soil and inhibits plant growth. Further investigation is always needed to determine if salinity is indeed the cause of any symptom.



A variety of salinity indicators may be present at a site. Here there is a distinct vegetation change, there are bare areas, salt crystals and erosion. Photo: DIPNR

Salinity indicators other than salinity indicator plants include:

• salinity damage to buildings

Damage may include the crumbling of bricks and mortar, the presence of white salt crystals on exterior and interior wall surfaces, damp walls, the breakdown of render, bleaching of sandstone and the breakdown of cement. (See booklet "Indicators of Urban Salinity" for more detail.)



Crumbling bricks and mortar, the presence of rising damp and salt crystals are all indicators that suggest this building is affected by salinity. Photo: DIPNR

- **waterlogging**

Water is the medium by which salts move in the landscape. If salt is present in areas of water accumulation, those areas may become more saline as water evaporates.



A waterlogged area in Western Sydney. Photo: DIPNR

- **bare patches with or without salt crystals**

Concentrated salt levels in the landscape may reach a level which kills off the vegetation.



Bare areas are appearing in this landscape where vegetation is no longer established. Photo: DIPNR

- **soil erosion**

This may occur where salinity has resulted in the death of the protective vegetation cover and the changes to soil structure have made it more erodible, causing increased runoff.



Example of an erosion gully in a saline landscape. Photo: DIPNR

- **“puffiness” of soil when dry**

This can be an indication of sodic soil, or high sodium content soil which is prone to salinity and erosion.



Puffy soil. Photo: DIPNR

- **black staining**

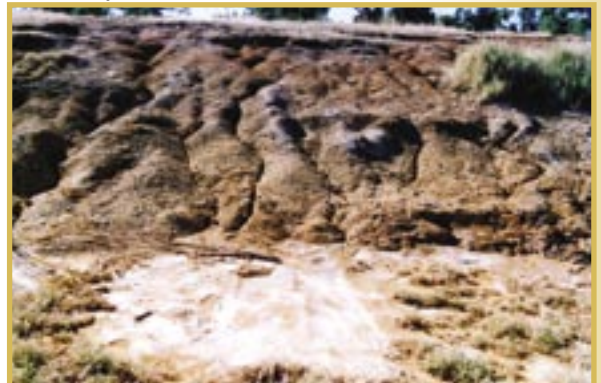
This occurs where iron in the soil is reacting with sulphate salts.



Black staining on soil surface. Photo: DIPNR

- **efflorescence**

This occurs where salt crystals form on the soil surface. Crystals can best be seen on a hot day when the water content of the soil has evaporated.



Visible salt crystals. Photo: DIPNR

- **clear water in rivers or streams**

This may occur where sediment has dropped out of suspension due to a high salt concentration in the water. A salty smell may also be detected.



Clear water in a stormwater channel. Photo: DIPNR

- **yellow, stunted, wilting or dead vegetation**

This may indicate that plant species cannot cope with the level of water and/or salt in the soil.



Dying and discoloured vegetation. Photo: DIPNR.

- **distinct changes in vegetation**

This may be caused by numerous influences, including changes in the concentration of salt and/or water in the soil.

For example, a stand of Swamp Oak (*Casuarina glauca*) appearing high on a slope, such as the one in the following picture, could indicate the occurrence of groundwater springs as this species generally prefers wet, swampy and saline areas. Groundwater springs and perched watertables are more common in urban and peri-urban environments due to changes in the volume and flow paths of water in the landscape.



Casuarina glauca at midslope may indicate the presence of groundwater springs. Photo: DIPNR



Subtle changes in vegetation can indicate a potentially saline area. Native grasses, such as Kangaroo Grass (*Themeda australis*) (A), are being replaced by a salt tolerant species, Couch (*Cynodon dactylon*) at (B). The presence of Spiny Rush (*Juncus acutus*) at (C) also indicates that the area is potentially saline. Photo: DIPNR

Salinity Indicator Species

Plants termed “salinity indicator species” are those commonly observed in saline and/or waterlogged areas.

Some species such as sea barley grass (*Hordedeuum marinum*) and spiny rush (*Juncus acutus*) do not appear anywhere else. However, many plants tolerant of wet and/or salty conditions, such as Casuarinas (*Casuarina sp.*) and saltbush (*Atriplex sp.*), also grow elsewhere.

Salinity indicator species also vary from region to region. For example:

- Saltbush (*Atriplex sp.*) can indicate saline sites in many regions of NSW but in the Far West region can be evidence of a well-managed pasture.
- Rhodes grass (*Chloris gayana*) is a useful salinity indicator in some areas of the north western region of NSW. However, it is so common in western Sydney, especially in soil-eroded areas rehabilitated with Rhodes

grass, that it isn't useful in narrowing down sites for salinity investigations.

Salinity indicator species are considered applicable to a given region when they:

- show a tolerance for the conditions experienced at saline and/or waterlogged sites; and
- dominate a given site by competition or colonisation as other species die out.

Vegetation that is susceptible to the effects of salt or waterlogging will die out as salt and/or water levels at the site increase. Only vegetation with some ability to cope with the conditions will remain or colonise. In this way, the mix of vegetation at a site may change markedly over a period of time as levels of salt and/or water change and plants with various salt tolerance levels start to dominate.

Further investigation should always be carried out to confirm if the vegetation is really indicating a saline soil, saline groundwater or a high watertable at the site. (See the brochure on Site Investigations for Urban Salinity).

The Impacts of Salinity on Plants

One or more of the following impacts affect plants at saline sites:

- waterlogging;
- osmotic effects; and
- toxicity.

As salinity processes are dynamic, characteristics may also change over time.

Waterlogging

Excess water in the root zone of plants limits oxygen availability and can cause anaerobic conditions. This can inhibit symbiotic micro-organism activity as well as prevent normal plant functions. It may also cause symptoms such as stunting, discolouration of foliage, defoliation, wilting and death in some cases unless the plant can adapt to these conditions. These symptoms are very similar to those caused by excess salt.

Osmotic effects

Plants require salts in small quantities to carry out the complex metabolic processes involved in photosynthesis and respiration. Salts play a role in water movement between the soil and root. The concentration of salt around plant roots in excess of an acceptable level to the plant will reduce its ability to take up water. Even though there may be plenty of water in the soil, accumulated salts decrease the osmotic potential or free

energy of water. This means the pressure difference between the water held in the root and the soil diminishes, reducing the movement of water from the soil into the root. This leads to dehydration and wilting in plant leaves and stems. A lack of water also limits plant metabolic processes including photosynthesis.

Toxic effects

Plants must absorb water to compensate for moisture lost through transpiration. In saline conditions, small amounts of salt will enter along with water so that the salt concentration inside plants, over time, may cumulatively become toxic.

Plant species vary in their sensitivity to or tolerance of salts. Some species will be affected by low concentrations, while others will tolerate high salt concentrations. Small changes of salt concentration along this gradient of sensitivity may have a similar impact to sudden large changes in salt concentration if a critical threshold of salt is reached.

Specific ion toxicity will affect plants in different ways. Internal structural components may be affected or plant processes may be inhibited. For example, excess bicarbonates can stunt plant roots and a range of salts will cause the leaf tips of plants to turn yellow.



Salt toxicity in citrus (*Citrus sp.*). Photo: NSW Ag

Characteristics of Salt Tolerant Plants

Some plants have physiological and biochemical adaptations that allow them to cope with salt. These plants are called halophytes. Halophytes occur naturally in mangroves and swamps, in areas affected by salt spray, along the seashore and in areas that have salt-affected soils. Some halophytes grow only in salty habitats, others cope with salty soils but do best in low-salt conditions.

Specific adaptations of halophytes that allow them to cope with salt include:

- **Succulence**

Succulent plants have fleshy leaves that contain a high proportion of water. This water dilutes salt, thus keeping salt levels low within the plant.

- **Short life cycle**

Some plants have adapted to complete one life cycle before the salt level in the soil becomes toxic and kills them.

- **Root filtering**

Salt is prevented from entering the roots of plants that have a greater osmotic pull or ability, such as mangroves and some grasses, to take up water from saline soils.

- **Salt glands or pumps**

Salt glands direct salt to intercellular spaces or pump it to organs that excrete salt through specialised cells at the leaf surface. Some saltbush have special glands that concentrate salt and pump it to expandable bladders attached to their leaves by thin stalks. These burst when full to release the salt.



(a) Saltbush (*Atriplex* sp.)



(b) Bladders that collect salt

Pictures: Raven et al. (1992) *Biology of Plants*

Using Indicator Plant Lists

Differences in soil and climate influence the different vegetation communities across NSW. Within each vegetation community, there will be some plants that are tolerant of saline soils, waterlogging and a combination of these conditions. This tolerance will change with the growth stage and general wellbeing of the plant. For these reasons, it is preferable to use indicator species lists that are specific to an area in combination with other site investigation techniques and local knowledge.

Botanical names should be used in preference to common names when referring to individual plants as confusion may arise when there are several common names for the one species, or when the same common name is used for more than one plant. For example *Sporobolus virginicus*, a grass common to saltmarsh areas along the coast of NSW, is commonly called salt-water couch or sand couch. People unfamiliar with this plant may confuse this species with the couch we commonly use as turf grass, *Cynodon dactylon*, which is also known as couch, common couch or coastal Bermuda grass. Similarly, *Juncus acutus* is commonly known in some areas as spiny rush and in other areas as spike rush.

Some indicator plant lists also include an indication of salt tolerance ranges for the different plants. Varying environmental factors, variations in testing procedure, variations within species, test methods, and the use of laboratory or field studies may influence test outcomes. For example, species found to be tolerant of a certain level of salt in the laboratory might not be tolerant of similar salinity levels in the field. Therefore, it is important to match the conditions under which the salt tolerance testing was done when using tolerance ranges as an indication of site conditions or for revegetation purposes

Much of the information we currently use in Australia on the salinity tolerance of vegetation comes from studies done in the United States. Agriculture WA has compiled a salinity tolerance list titled Salinity Tolerance of Plants for Agriculture and Revegetation. This list is available at www.agric.wa.gov.au/environment/salinity/measurement/Plant_salt_tolerance.htm and gives tolerance details for both natives and some exotic species based mostly on Western Australian data.



Three salinity indicators. Cumbungi (*Typha* sp.) (background), Spiny/Spike Rush (*Juncus acutus*) (centre) and Marsh Daisy (*Cotula coronopifolia*) (groundcover). Photo: DIPNR

Local Knowledge

Local knowledge is often the most useful source of information when it comes to finding out which species indicate salinity on a site by site basis, as well as which species can be used to regenerate areas affected by salinity.

Knowledge of local growing conditions and vegetation can be obtained from locally produced publications as well as from people who know the area well.

Collectively, local knowledge may provide answers as to why salinity is occurring at a particular location, or highlight certain activities that seem to trigger the appearance of saline and/or waterlogged sites.

In the Murrumbidgee/Murray Region, the Southern Salinity Team is currently producing a regional salinity indicator species list. Plants are categorised for their tolerance of:

- saline soil;
- waterlogged soil; and
- waterlogged soils with a high salt concentration.

Specific information such as this can help to pinpoint the salinity processes occurring on the site.

In the Far West Region of NSW and western Sydney, changes in vegetation can be a better indication of salinity than

the presence of particular species. For example, some of the soils of the Far West Region of NSW and western Sydney are naturally saline. In such areas, much of the native and introduced vegetation has some degree of tolerance to salinity. A change in vegetation can therefore indicate a change in conditions.

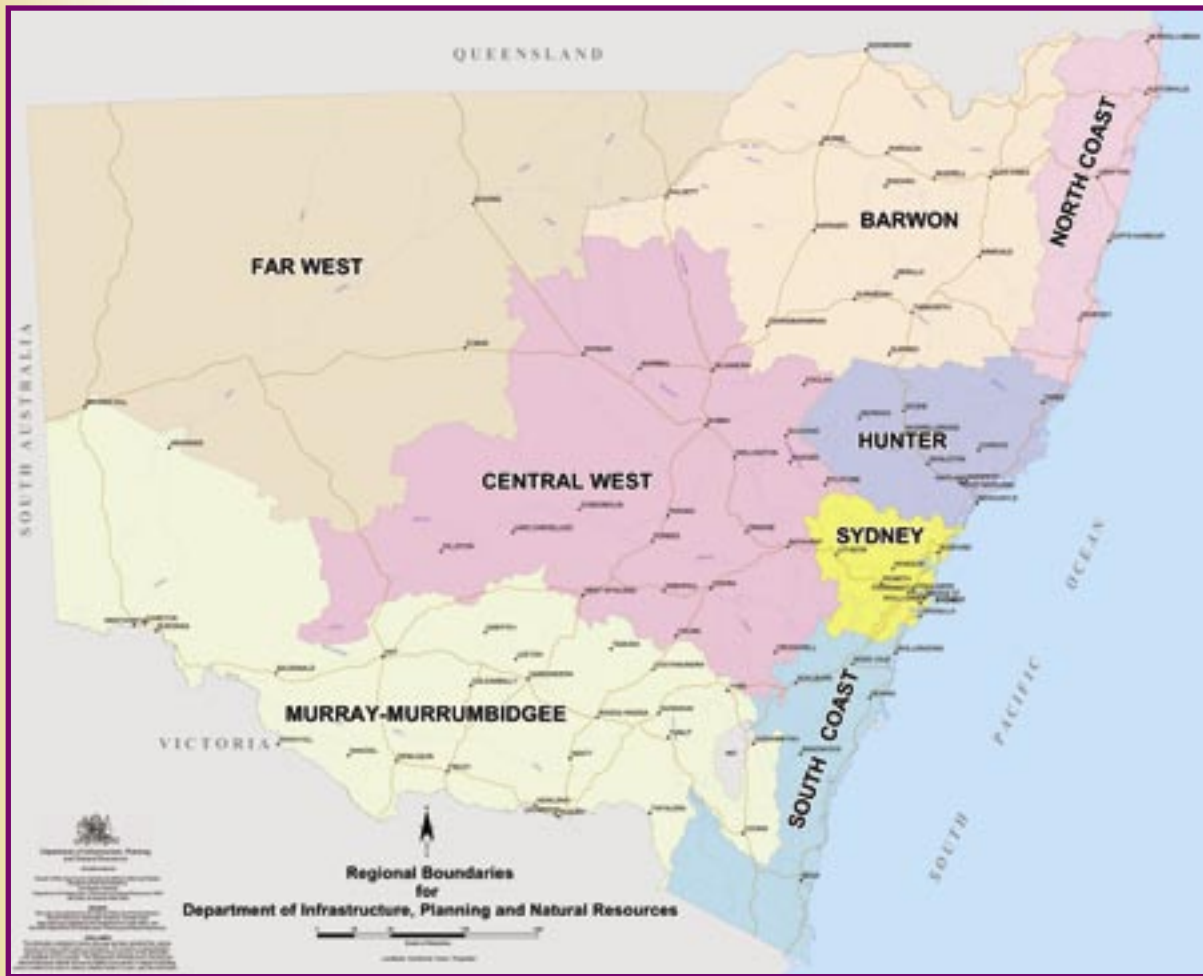
In an urban setting where the native vegetation has been cleared and the water cycle changed, the presence of saline and/or waterlogged areas may be highlighted when the more salinity tolerant species recolonise the disturbed areas. In coastal regions of NSW, indicator species such as common couch (*Cynodon dactylon*) and spike rush (*Juncus acutus*) are particularly adept at fulfilling this role.

Many of the salinity tolerant species in the North Coast Region are those that naturally occur around estuarine salt marshes. Species common to this area, apart from those noted on page 9, include *Juncus kraussii* and *Sporobolus virginicus*. Many of these estuarine species are not found in inland areas with similar conditions as there is no seed source for colonisation.



Cumberland Plain vegetation – remnant. Remnants often consist of a number of Eucalyptus species, predominantly *Eucalyptus moluccana* (Grey Box) which shows a moderate tolerance of salt, and *Eucalyptus tereticornis* (Forest Red Gum), which is tolerant of both moderate salt and water levels in soil. Photo: DIPNR

On the following page is a list of salinity indicator species used by the different DIPNR regions as illustrated below.



Indicator Plant Species found throughout New South Wales

Note: The presence of a species identified in the following list indicates the possibility of salinity but is not conclusive on its own. This list should be used in conjunction with other information suggested in this publication.

Salinity Indicator Species	Page	Far West Region	Barwon Region	North Coast Region	Hunter Region	Central West Region	Murrumbidgee/Murray Region	Sydney/South Coast Regions
Rhodes Grass <i>Chloris gayana</i>	10		○					
Cumbungi/Bullrushes <i>Typha sp.</i> <i>Typha orientalis</i>	10	○	○	○	○	○	○	○
Groundsel <i>Baccharis halmifolia</i>	11		○	○				
Paspalum <i>Paspalum diatatum</i>	12		○				○	
Spike Rush/Spiny Rush <i>Juncus acutus</i>	12	○	○	○	○	○	○	○
Black Roly Poly <i>Sclerolaena muricata</i>	13		○		○			
Sea Barley Grass <i>Hordeum marinum</i> <i>Critesion marinum</i>	13	○	○			○	○	○
Common Couch <i>Cynodon dactylon</i>	14	○	○	○	○	○	○	○
Native Panic <i>Panicum buncei</i>	14		○				○	
Annual Beard Grass <i>Polypogon monspeliensis</i>	15		○		○	○	○	○
Wild Aster <i>Aster subulatus</i>	15	○			○		○	○
Salt Sand-spurrey <i>Spergularia marina</i>	16				○	○		○
Water Buttons/Marsh Daisy <i>Cotula coronopifolia</i>	16			○	○		○	○
Swamp Oak <i>Casuarina glauca</i>	17			○	○		○	○
Wireweed <i>Polygonum aviculare</i>	17	○		○	○		○	○
Streaked Arrowgrass <i>Triglochin striatum</i>	18			○	○			○
Ruby Saltbush <i>Enchylaena tomentosa</i>	18	○			○		○	○
Sea Club-rush <i>Bolboschoenus caldwellii</i>	19				○		○	
Buck's-horn Plantain <i>Plantago coronopus</i>	19	○			○		○	○
Curly Rye Grass/Coast Barb Grass <i>Parapholis incurva</i>	20	○			○	○		
Stonecrop <i>Crassula sieberiana</i>	20				○		○	○
Native Reed/Common Reed <i>Phragmites australis</i>	21	○		○	○		○	○
Purslane/ Pigweed <i>Portulaca oleraceae</i>	21	○		○			○	○
Creeping Saltbush/ Australian Saltbush <i>Atriplex semibaccata</i>	22	○					○	○
Mat Saltbush /Orache <i>Atriplex prostrata</i>	22						○	○
Green Saltbush/Native Orache <i>Atriplex australasica</i>	22						○	○
Spreading Saltbush <i>Atriplex limbata</i>	22	○	○				○	

Plant Descriptions

This section provides some basic plant description information to facilitate identification of the species listed in the previous table.

Rhodes Grass

Chloris gayana

Family: POACEAE

Botanical description: (Cunningham et al, 1981)

General description: Tufted stoloniferous perennial grass, to 1m tall.

Stems: Smooth, usually branched, slightly kneeed at the base, the leafy stolons flattened, tough and wiry, readily rooting and shooting at the nodes.

Leaves: To 50cm long, 5-10mm wide when flattened, folded towards the base and tapering gradually to a fine point, with sparse long hairs in the upper surface especially towards the base, slightly rough on the upper surface.

Flowerhead: 6-18 spikes arranged in 1 or 2 whorls at the top of the stems, the spikes spreading-erect, 5-10cm long, brownish-green, becoming straw-coloured.

Time of flowering: Summer-Autumn.

Distribution in NSW: Common in NSW, especially in areas of habitation.

Habitat: Various. Often naturalised in situations adjacent to areas in which it has been sown for turf. Also in waste areas and along roadsides, usually in red earth soils but sometimes on heavy clays near swamps. Particularly suited to sandy soils or sandy loam soils.

Origin: South Africa. (Lamp and Collett, 1993)



Picture: Lamb and Collett, 1993

Cumbungi/Bullrushes

Typha sp.

Typha orientalis

Family: TYPHACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Robust, aquatic perennial rushes to 4 m tall, with stiff erect stems that arise



Picture and botanical drawings: DLWC - Hunter, 1998



from stout branched rhizomes.

Leaves: Occur in 2 rows along each stem, with leaf sheaths overlapping. Leaf blade is flat, linear, up to 2 m long and 20-30mm wide and may be spongy.

Flowers: Flowerhead is a dense compact spike that occurs at the end of each stem. They are cylindrical, velvety, brownish in colour and range from 10-25cm long.

Time of flowering: During the warmer months.

Distribution in NSW: Widespread.

Habitat: Swamps, margins of lakes and streams, irrigation channels and drains, including brackish water.

Origin: Native.

Groundsel

Baccharis halmifolia

Family: ASTERACEAE/COMPOSITAE

Botanical description: (Parsons et al. 1992)

General description: A densely branched, erect shrub 1 to 2.5 m high, occasionally becoming a small tree 6 to 7 m high, reproducing by seed but with the male and female flowers on separate plants.

Stems: Green at first, becoming brown with age; erect, woody, much branched above; bark of mature plants deeply fissured.

Leaves: Dull or pale green, waxy to the touch; alternate, broadly wedge-shaped, 2.5-5 cm long, 1.2 to 2.5 cm wide, with a few large teeth towards the apex; leaves near the ends of branches often tapered at both ends and without prominent teeth.

Flowers: Numerous, male and female flowers on separate bushes: male florets cream or pale yellow, carried in globular heads about 6 mm diameter; female florets white, in heads clustered at the ends of branches, maturing later than the male florets.

Seed: Straw-coloured or brown, ribbed, 3 mm long; topped by a conspicuous pappus of silky hairs to 1.2 cm long, giving the whole plant a fluffy appearance during the seeding period.

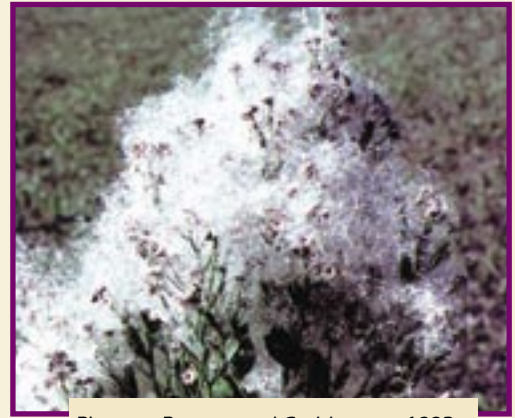
Root: A deep branching taproot, with numerous fibrous laterals in the upper soil.

Time of flowering: Autumn

Distribution in NSW: Coastal areas from Smoky Cape north into Queensland.

Habitat: Principally on disturbed open areas in humid warm-temperate to subtropical regions growing on a wide range of soil types. It thrives in saline semi-tidal areas and readily colonises low coastal swamps, degraded pastures and forests in which the understorey is regularly removed by fire or flood. Irrigation channels and coastal canals are other common sites of colonisation.

Origin: Native of the West Indies and the Atlantic and Gulf Coasts of North America, extending in an arc from Massachusetts through Florida to Mexico.



Pictures: Parsons and Cuthbertson. 1992



Paspalum

Paspalum diatatum

Family: POACEAE

Botanical description: (Cunningham et al, 1981)

General description: Perennial grass with a knotted base of very short creeping rhizomes, generally tall and tufted but spreading into a solid crown with leafy shoots when grazed or mown.

Stems: Erect, or kneeed at the base and ascending or spreading, moderately slender to stout, 40-75cm tall, flattened, hairless, smooth, unbranched or sparingly branched from the lower nodes, the nodes prominent, often purple.

Leaves: Dull green, flat or slightly keeled, smooth, shining, ascending or spreading, 6-45cm long, 3-12mm wide, hairless except for sparse hairs at the base, the margins roughened, the midrib prominent.

Flowerhead: An erect or nodding panicle, 7-25cm long, with 2-11 (usually 3-7) ascending, spreading or drooping dense "spikes" 3-11cm long arising singly and scattered on either side along the slender, flattened, often drooping main axis at the top of the stem, the axis of each spike about 1-1.2mm wide, flattened, narrowly winged with roughened margins,

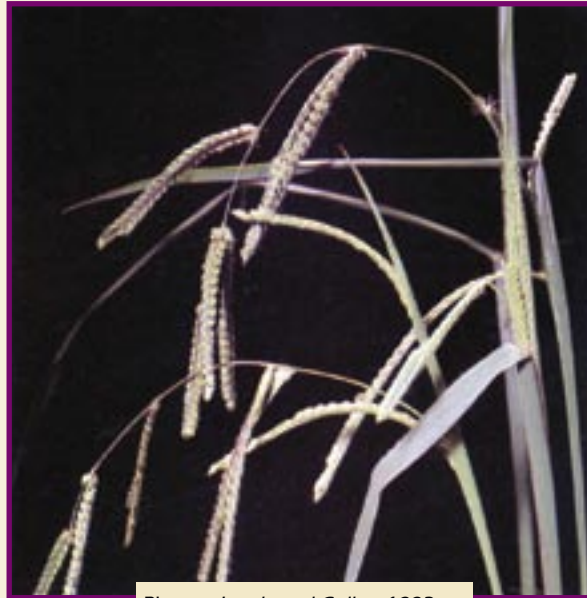
bearing numerous white hairs at the base and 4 rows of spikelets.

Time of flowering: Late Spring-Autumn.

Distribution in NSW: Found widely throughout NSW.

Habitat: Moist areas; in drainage lines along roadsides, in pastures, river banks and flats, irrigation drains and channels, gardens and lawns.

Origin: South America (Lamp and Collett 1993).



Picture: Lamb and Collett, 1993

Spike Rush/Spiny Rush

Juncus acutus

Family: JUNCACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Salt tolerant spiny perennial rush, which often forms a tussock in a hemispherical shape. It has long rigid cylindrical stems that grow up to 1.6 m high and contain pith. The stems bear the flower head. Fibrous root system. Often forms impenetrable thickets in favourable situations. A hardy



Picture and botanical drawings: DLWC - Hunter, 1998

weed that is difficult to eradicate.

Leaves: Similar to the stems, but without flowerheads. They are dark green and tipped with very sharp spines.

Flowers: Reddish brown, located near the stem summit.

Time of flowering: Spring to Summer.

Distribution in NSW: Common in the coastal, tableland and central/southern slopes regions.

Habitat: Humid or subhumid temperate regions, principally in low-lying, damp,

low fertility areas. In Australia it is commonly found as a weed of coastal flats, mine dumps and disturbed saline areas. (Parsons and Cuthbertson, 1992)

Origin: The coasts of western and southern Europe, Africa and North and South America. (Lamp and Collett, 1993).



Picture: DIPNR

Black Roly Poly

Sclerolaena muricata

Family: CHENOPODIACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description:

Hairless, hemispherical perennial, sometimes short-lived sub shrub, up to 1.5 m high, with slender tangled, rather brittle, branches.

Leaves: Linear-lanceolate, obovate or oblanceolate, flattened, not succulent and up to 20 mm long and 1-2 mm wide.

Flowers: Solitary, occurring in the leaf axils.

Time of flowering: Flowers and seeds are produced in Summer. (Parsons and Cuthbertson, 1992).

Fruit: Woody, with 5 slender spreading spines, the 3 longest 4-10 mm long and the two shorter spines often fused at the base of the fruit.



Picture and botanical drawings: DLWC - Hunter, 1998

Sea Barley Grass

Hordeum marinum

Critesion marinum

Family: POACEAE

Botanical description: (Cunningham, et al. 1981)/ (Bozon and Matters, 1989)

General description: Typical leafy grass with distinctive flowerheads. Spreading or erect, up to 25cm tall (but usually shorter) with smooth cylindrical stems. (Bozon and Matters, 1989)



Similar to barley grass (*H. leporinum* and *H. glaucum*), differing from those species in the absence of stem-clasping lobes on the leaves.

Also differing in that the awns of the florets of the 2 lateral spikelets of each trio are much shorter than those of the outer husks, whereas in barley grass the awns of the florets are much longer than the awns of the outer husks.

Leaves: Soft leaves tapering to the tip and incurled with a soft covering of hairs. (Bozon and Matters, 1989)

Flowerhead: A distinctive slightly flattened bristled cluster. (Bozon and Matters, 1989)

Time of flowering: Spring-early Summer.

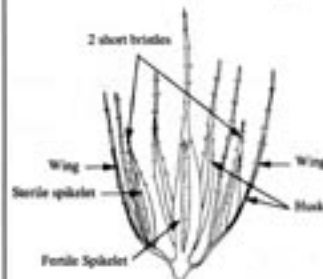
Distribution in NSW: Widespread.

Habitat: Usually on clay soils in low-lying and sometimes saline situations.

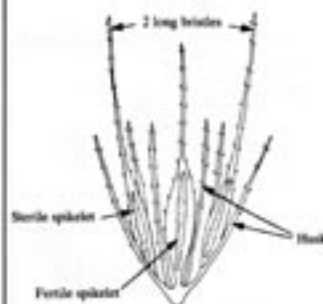
Origin: Europe/British Isles.

Barley Grass - Spikelet groups

Hordeum marinum - Sea Barley grass



Hordeum leporinum - Barley grass



In Sea Barley Grass one of the outer husks of each of the outer spikelets is broadly winged down one side. The two sterile spikelets are short.

In Barley Grass the outer husk is not winged and the two sterile spikelets are long.

Picture and botanical drawings/explanation: Bozon and Matters, 1989.

Common Couch

Cynodon dactylon

Family: POACEAE

Botanical

description: (NSW DLWC - Hunter, 1998)

General description:

A rhizomatous and stoloniferous mat-forming perennial grass with short, erect flowering shoots. Grows to about 0.3 m high.

Leaves: Greyish-green, up to 15 cm long and 1-4 mm wide.

Flowers:

Inflorescence

(flower bearing stem/flowerhead)

is digitate (hand-like) with 2 to 6 narrow spikes, up to 2.5 cm long.

Time of flowering: Flowers mainly in Summer and Autumn.

Distribution in NSW: Throughout.



Habitat: Frequent invader of disturbed areas, particularly on lighter soils. Widely cultivated as a lawn species and for pasture.

Origin: Tropical Africa and Indo-Malaysia. (Lamp and Collett, 1993)

Picture and botanical drawings:
DLWC - Hunter, 1998



Native Panic

Panicum buncei

Family: POACEAE

Botanical description: (Cunningham *et al.*, 1981)

General description: Slender tufted perennial grass, 30-80cm high.

Stems: Slender, smooth, hairless, not or sparingly branched, 3 to 4-noded.

Leaves: Flat or loosely folded, inrolled on drying, 10-20cm long and 1.5-5mm wide, slightly rounded into the sheath at the base, rather thin, smooth, lightly sprinkled with hairs on the lower surface, the margins whitish.

Flowerhead: A loose, lanceolate, often nodding panicle, 7-30cm long, carried well above the leaves, with loosely erect or spreading-erect

fine branches; lower branches to 17cm long, bare from the base for half of their length or more, then with several loosely appressed secondary branchlets to 7cm long, the secondary branches again divided into short branchlets bearing unusually two spikelets on stalks 1-3mm long and of equal lengths.

Time of flowering: Late Summer–Autumn.

Distribution in NSW: "...recorded only from near Nyngan in the central-east, where a few plants occurred in heavy grey clay soils in the mitchell grass community." (Cunningham *et al.*, 1981). Also on the Liverpool Plain. (National Parks and Wildlife website Sim *et al.*, 1983).

Habitat: Warm temperate to subtropical, arid areas with well-drained soil.

Origin: Native.

Annual Beard Grass

Polypogon monspeliensis

Family: POACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Slender tufted annual grass, ranging from 6-60 cm high. The culms (stems) are erect and hairless, often arising singly or sometimes in small tufts, which are usually branched near the base.

Leaves: Also hairless, flat, 5-20 cm long, 2-8 mm wide, often tapering to a fine point.

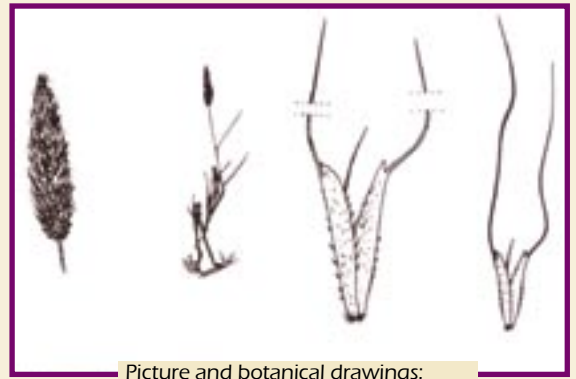
Flowers: The inflorescence is oblong, cylindrical and spike-like, up to 16 cm long and 6-20 mm wide, it is very dense, soft, pale-green to yellowish in colour and covered with fine bristles.

Time of flowering: Spring.

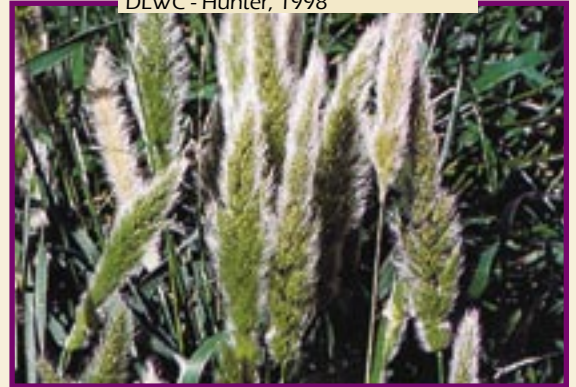
Distribution in NSW: Widespread, occurring in all botanic divisions except the Northern Tablelands.

Habitat: It prefers damp, disturbed areas, although it is also common on the edges of swamps and wetlands.

Origin: The Mediterranean region.



Picture and botanical drawings:
DLWC - Hunter, 1998



Wild Aster

Aster subulatus

Family: ASTERACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Erect, generally hairless annual or short-lived perennial herb that grows from 0.3-1.8 m high, with a reddish stem.

Leaves: Linear-lanceolate (1-15m long, 3-10 mm wide), alternate, with either entire or slightly toothed margins.

Flowers: Flowerheads occur in loose leafy panicles, where flowers are generally white, although they can be pink or pale mauve.

Time of flowering: Throughout the year.

Distribution in NSW: All botanic divisions.

Habitat: Seasonally wet or poorly drained land, including saline environments.

Origin: North America.



Picture and botanical drawings:
DLWC - Hunter, 1998

Salt Sand-spurrey

Spergularia marina

Family: CARYOPHYLLACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Small annual herb, with spreading to ascending branches (stems) to 35 cm high, which are often covered with glandular hairs towards the summit of the stems.

Leaves: Linear-lanceolate (1-4 cm long and 1-1.5 mm wide), distinctly fleshy and tipped with a sharp point.

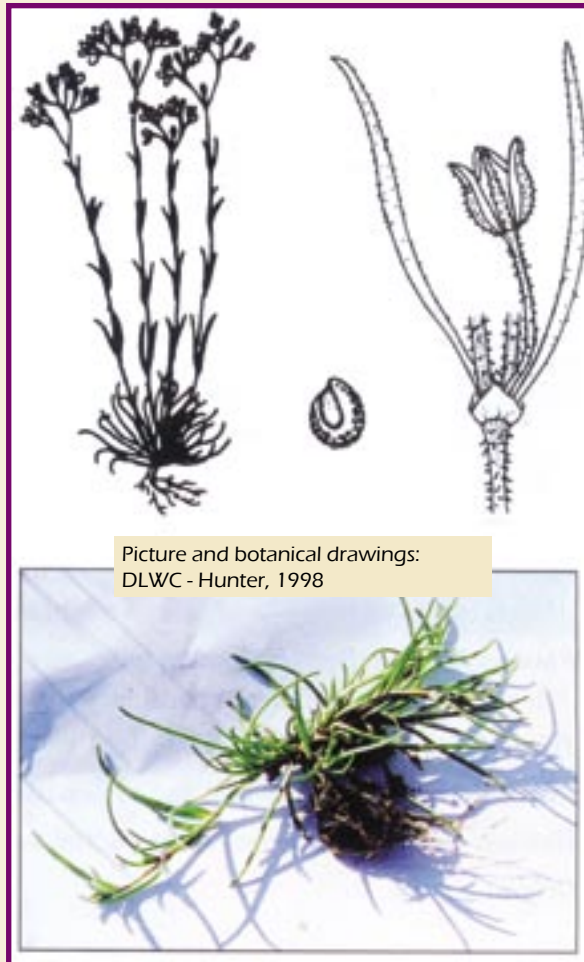
Flowers: Pink above with a whitish base.

Time of flowering: Spring.

Distribution in NSW: Widespread, although absent in the Northern Tablelands, North Western Slopes and the South Coast.

Habitat: Primarily occurs around the edges of salt marshes and other saline environments.

Origin: Europe and other temperate parts of the Northern Hemisphere.



Water buttons/Marsh buttons

Cotula coronopifolia

Family: ASTERACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Weakly ascending or spreading annual, hairless herb, with creeping, usually stout and succulent stems.

Leaves: Oblong to linear to irregularly/lobed shaped, alternate and fleshy, approximately 2 cm long, with either entire or toothed/lobed margins.

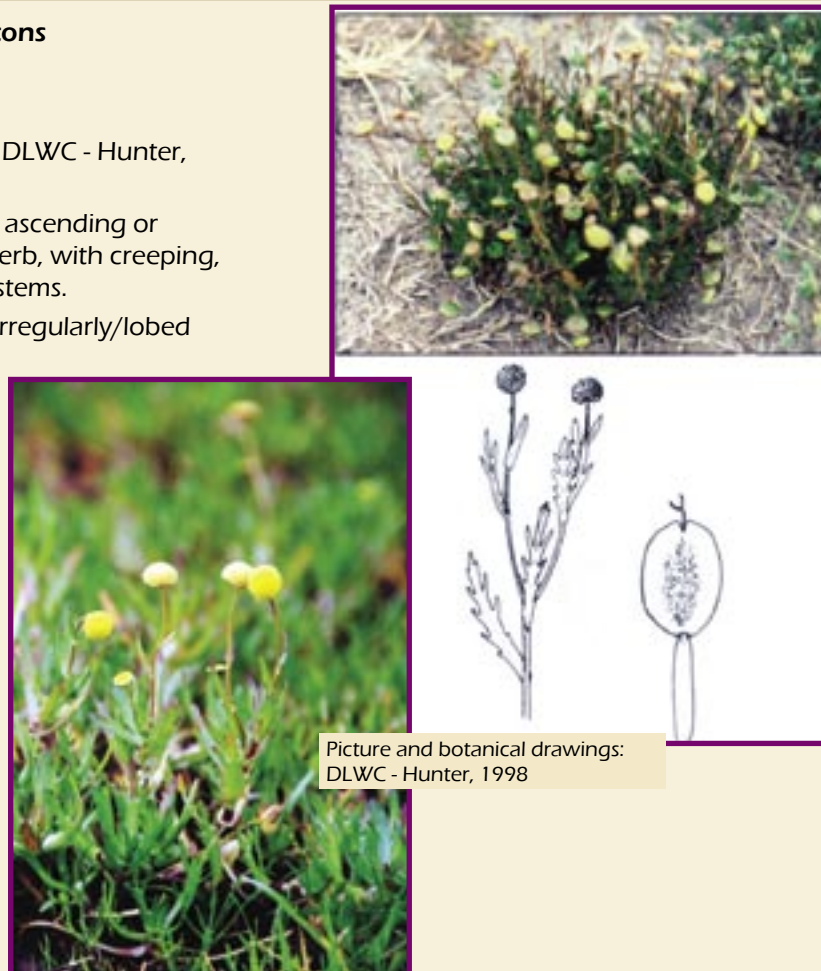
Flowers: Flowerheads are button-shaped (5-12 mm in diameter) and bright yellow.

Time of flowering: Often flowers during Winter and Spring.

Distribution in NSW: Occurs mainly along the eastern part of the Great Dividing Range.

Habitat: Grows in damp places, often in saline disturbed areas.

Origin: South Africa.



Swamp Oak

Casuarina glauca

Family: CASUARINACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Medium to tall dioecious (male and female flowers on different plants) tree, usually 8-20 m high, frequently producing root suckers. In saline environments this species may be stunted. Branchlets are drooping, smooth and cylindrical and blue-green or dull green in appearance. Often forms pure stands and can hybridise with *C. cunninghamiana* (River Oak).

Leaves: Appears leafless, but leaves are actually reduced to very small teeth that occur in whorls on the branchlets.

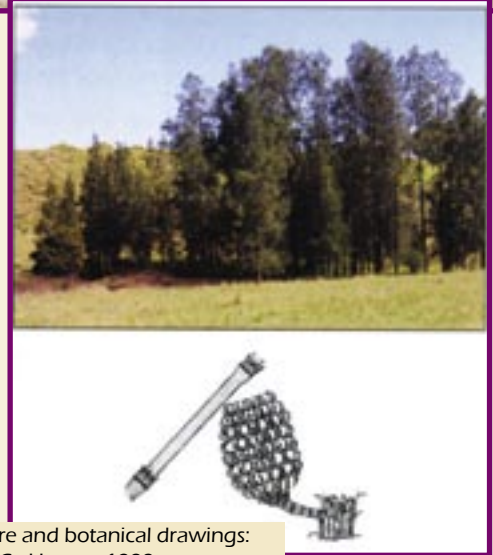
Flowers: Female flowers develop into cones, which are sub-globular in shape, with small valves. The male flowers occur on different plants, as short elongated spikes, often yellowish-brown in colour.

Time of flowering: Winter and Spring.

Distribution in NSW: Coastal and sub-coastal areas.

Habitat: Brackish situations along coastal streams and major rivers.

Origin: Native.



Wireweed

Polygonum aviculare

Family: POLYGONACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Prostrate to decumbent (spreading with the ends growing upwards) annual or short-lived perennial herb with long wiry stems (to 1 m long), which is often mat-forming.

Leaves: Alternate, narrow-elliptic to narrow-ovate, somewhat bluish green in appearance, 1-4 cm long and 3-15 mm wide, and decreasing in size towards the end of the stem. The leaves have a ring of papery tissue at the junction with the stem.

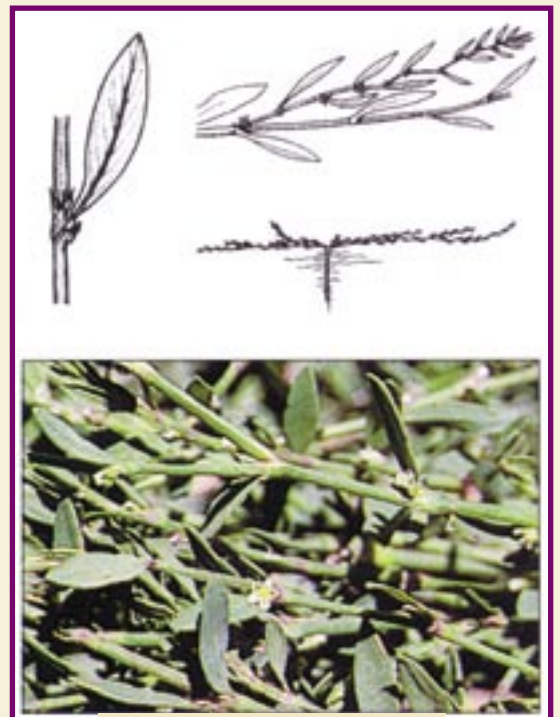
Flowers: Either white or pink, often in clusters of up to five, in the leaf axils.

Time of flowering: Mostly Summer to Autumn.

Distribution in NSW: Widespread.

Habitat: Often found on cultivated or disturbed land.

Origin: Europe.



Streaked Arrowgrass

Triglochin striatum

Family: JUNCAGINACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Slender, erect low-growing rhizomatous perennial to 30 cm high.

Leaves: Leaves to 30 cm long, 1-3 mm wide and arising in distinct tufts separated by several nodes along an extensive rhizome. Leaves erect and either cylindrical or flattened.

Flowers: Flowerhead is a spike-like racome (simple flowerhead ending in a non-floral bud), which contains 10-100 flowers, where each flower has a small pedicel (stalk of the flower).

Time of flowering: During the warmer months.

Distribution in NSW: Appears to be restricted to the coastal and sub-coastal region.

Habitat: Periodically inundated salt marshes or shallow saline environments.

Origin: Native.



Picture and botanical drawings:
DLWC - Hunter, 1998

Ruby Saltbush

Enchylaena tomentosa

Famiy: CHENOPODIACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Hemispherical or sprawling perennial shrub to 1m high, with long stems that are often clothed with woolly hairs.

Leaves: Alternate, linear (to 15 cm long), succulent, covered with fine hairs and blue green in colour, although drying to black.

Flowers: Small green flowers grow singly along the stem.

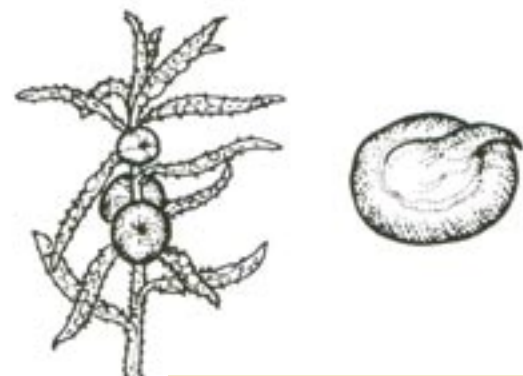
Time of flowering: Most of the year, mainly Spring and early Summer.

Fruit: A red (but sometimes green or yellow) translucent fleshy berry, 5-8 mm in diameter.

Distribution in NSW: Widespread.

Habitat: Variety of habitats, including saline environments.

Origin: Native.



Picture and botanical drawings:
DLWC - Hunter, 1998

Sea Club-rush

Bolboschoenus caldwellii

Family: CYPERACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Creeping rhizomatous perennial, usually bearing hard ovoid tubers. Culms (stems) up to 1.2 m, although they usually range from 30-90 cm.

Leaves: Can be longer than the culms, generally 2-7 mm wide, flat and grass-like.

Flowers: Flowerhead is umbel-like (compact head), consisting of 3-6 spikelets (individual flowers) and 1-3 leaf like bracts. Spikelets are straw coloured, golden or red brown, ranging from 1-2 cm long.

Time of flowering: Throughout the year, although primarily from October to April.

Distribution in NSW: Widespread.

Habitat: In swamps or along artesian bore drains in inland regions.

Origin: Native.



Picture and botanical drawings: DLWC - Hunter, 1998



Buck's-horn Plantain

Plantago coronopus

Family: PLANTAGINACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Annual or short-lived perennial herb, which can be slightly hairy, with a persistent taproot, up to 20 cm high. A common weed.

Leaves: All in basal rosette, either spreading or ascending. They are generally oblong, 1-7 cm long, 5-20 cm wide, often deeply lobed or with prominent linear teeth along the margins.

Flowers: Small, with green papery petals that occur in dense spikes, to 5 cm long.

Time of flowering: Spring and early Summer.

Distribution in NSW: Widespread in eastern areas.

Habitat: Disturbed sites and coastal environments.

Origin: Europe and south-west Asia.



Picture: DIPNR



Picture and botanical drawings: DLWC - Hunter, 1998



Curly Rye Grass/Coast Barb Grass

Parapholis incurva

Family: POACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Tufted, decumbent annual grass to 10 cm high.

Leaves: Leaf blades are hairless, finely pointed, with a prominent mid vein, up to 30 cm long and 2 mm wide.

Flowers: Inflorescence is a cylindrical stiff spike, which is erect and often curved, usually 3-10 cm long and purplish in colour. Spikelets without stalks, approximately 7 mm long, occur in hollows in the flower stem.

Time of flowering: Spring.

Distribution in NSW: Widespread, except for the Central and Northern Tablelands.

Habitat: Predominantly on saline areas.

Origin: The Mediterranean region.



Picture and botanical drawings:
DLWC - Hunter, 1998

Stonecrop

Crassula sieberiana

Family: CRASSULACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Erect or decumbent (spreading with the ends growing upwards) annual or perennial herb with stems up to 20 cm long, more or less branched and often succulent.

Leaves: Narrow-lanceolate, opposite, fleshy, grey-brown in colour (rarely reddish like other Crassula species), ranging between 4-10 mm long and 1-3 mm wide. They are loosely arranged along the stem.

Flowers: The inflorescence is a spike-like thyrsoid (one flower in each cluster raised on a rather long stalk well above the others), where individual flowers are small and usually pale yellow in colour.

Time of flowering: Spring and Summer.

Distribution in NSW: Widespread, occurring in all the botanic divisions.

Habitat: It occurs in most habitats, including saline areas.

Origin: Native.



Picture and botanical drawings:
DLWC - Hunter, 1998

Native Reed/Common Reed

Phragmites australis

Family: POACEAE

Botanical description: (NSW DLWC - Hunter, 1998)

General description: Robust, hairless perennial grass, up to 6 m high, with creeping rhizomes, often associated with aquatic or semi-aquatic environments. Its culms (stems) are cane-like, erect, rigid and usually unbranched.

Leaves: Mostly on the culms and are flat, 20-60 cm long, 10-30 mm wide and tend to break off at the leaf sheath when mature.

Flowers: Inflorescence is a dense, slightly nodding, soft, compact panicle, ranging between 15-30 cm long and 5-20 cm wide. It is silvery white at maturity.

Time of flowering: From Summer to early Winter.

Distribution in NSW: Widespread, occurring in all botanic divisions except the north Far Western Plains.

Habitat: Wet places, often emerging from water, especially at the edges of ponds, streams and in tidal waters.

Origin: Native.



Picture and botanical drawings:
DLWC - Hunter, 1998

Purslane/Common Pigweed

Portulaca oleraceae

Family: PORTULACACEAE

Botanical description: (Cunningham et al, 1981).

General description: Succulent prostrate annual forb, with thick and often reddish or brownish stems to 30 or 40cm long.

Leaves: Mostly alternate, fleshy, oblong-cuneate to obovate, 1-2cm long.

Flowers: Yellow, stalkless, solitary or clustered in the leaf axils, with 4-6 petals about 5mm long and scarcely exceeding the length of the sepals.

Time of flowering: Summer.

Distribution in NSW: Widespread throughout the region.

Habitat: On a very wide range of soil types and in most vegetation communities.

Origin: Native.



Picture: Lamb and Collett. 1993

Creeping Saltbush/Australian Saltbush

Atriplex semibaccata

Family: CHENOPODIACEAE

Botanical description: (Cunningham *et al.*, 1981)

General description: Prostrate perennial subshrub, with long slender, rather brittle stems.

Leaves: Greenish above, mealy-white below, 1-2cm long, oblong or lanceolate, often toothed along the margin.

Flowers: Monoecious, in small clusters in the leaf axils.

Time of flowering: Summer.

Fruit: Flattened reddish berries. (Bodkin 1993)



Picture: Cunningham *et al.* 1981

Distribution in NSW: Throughout.

Origin: Australia.

Other saltbush species include:

Mat Saltbush/ Orache

Atriplex prostrata

Family: CHENOPODIACEAE

Botanical description: (Cunningham *et al.*, 1981)

General description: Prostrate forb with slender stems.

Leaves: Ovate or lanceolate, grey-downy, 4-8mm long, the margins toothed or smooth.

Flowers: Monoecious, in small clusters in the leaf axils.

Time of flowering: Spring-Summer.

Distribution in NSW: The north, central and southern coast, and southern Tablelands. (Harden, 2002).

Origin: Native to Australia, Europe, Asia and North America

Spreading Saltbush

Atriplex limbata

Family: CHENOPODIACEAE

Botanical description: (Cunningham *et al.*, 1981)

General description: Procumbent perennial forb, with long rigid stems. Very abundant in good seasons but does not remain leafy in drought times.

Leaves: Obovate, scaly-white, 1-3cm long with smooth margins or broad shallow teeth.

Flowers: In clusters in the leaf axils, or male flowers are sometimes in interrupted spikes at the end of branchlets.

Time of flowering: Mainly Spring but can flower at any time of the year if conditions are favourable.

Distribution in NSW: Widespread throughout the northern section of NSW, south to about Booligal; more frequent in western areas.

Habit: Most prolific on sandy soils in drainage lines and flood-outs.

Origin: Native.

Green Saltbush/Native Orache

Atriplex australasica

Family: CHENOPODIACEAE

Botanical description: (Bodkin 1993)

General description: An annual plant, it grows to a height of 1 m with a spread of 1 m.

Stem: is erect, with straggling branches.

Leaves: Green, linear to lanceolate, and 10 cm long.

Flowers: Small and insignificant, occurring in terminal panicles.

Distribution in NSW: Coastal areas of NSW (Harden, 2000).

Habitat: A native of the coastal areas of Australia, it prefers salt marsh areas, and is drought and frost resistant.

Origin: Native.



Atriplex species

Fruiting bodies are used to differentiate between *Atriplex* sp.

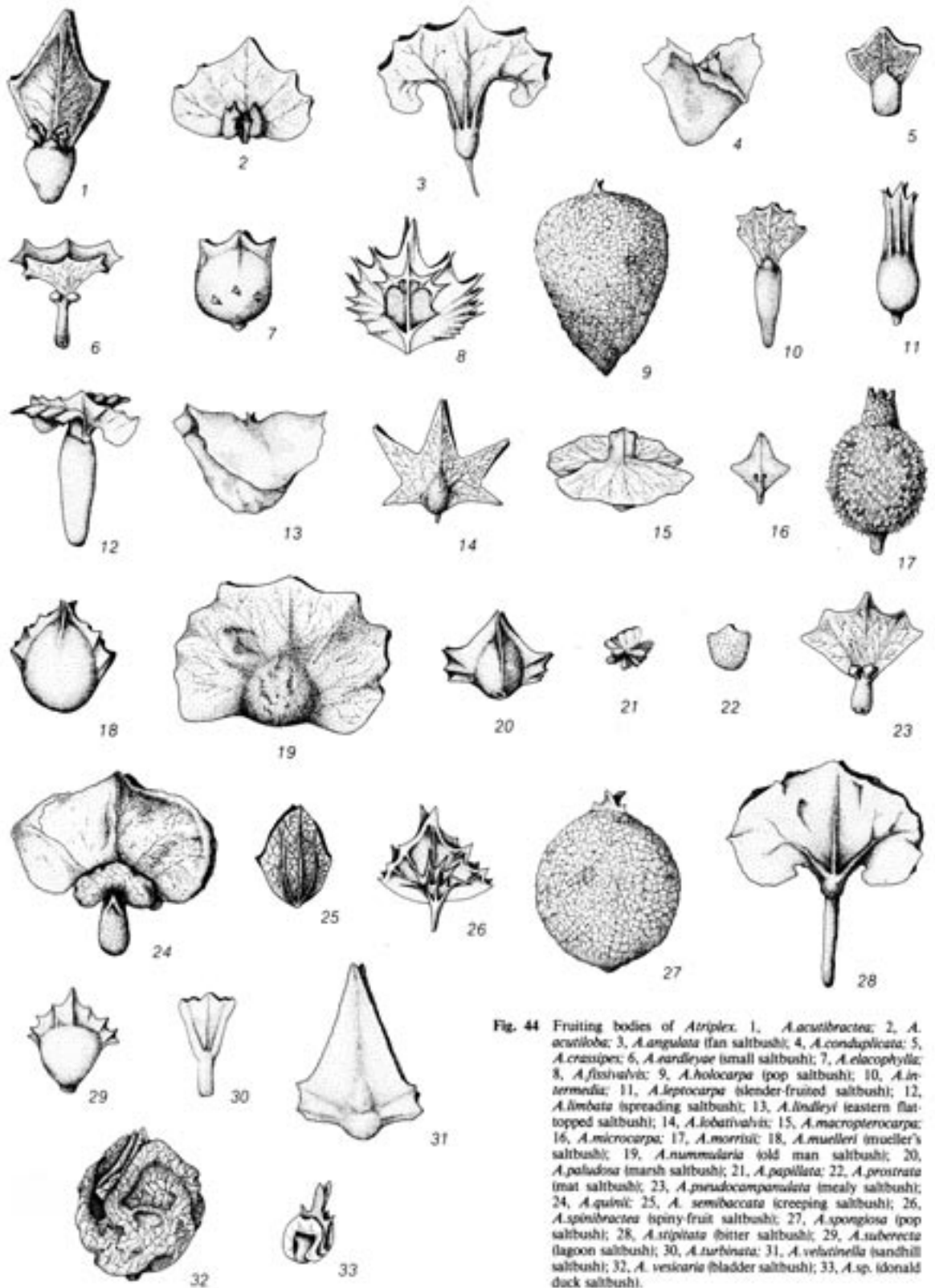
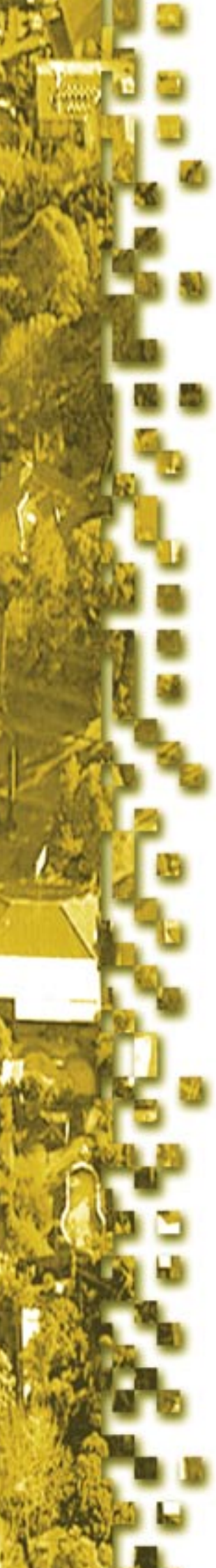


Fig. 44 Fruiting bodies of *Atriplex*. 1, *A. acutiloba*; 2, *A. acutiroba*; 3, *A. angulata* (fan saltbush); 4, *A. conduplicata*; 5, *A. crasipes*; 6, *A. hardleyae* (small saltbush); 7, *A. elaeophylla*; 8, *A. fissivalvis*; 9, *A. holocarpa* (pop saltbush); 10, *A. intermedia*; 11, *A. leptocarpa* (slender-fruited saltbush); 12, *A. limbatata* (spreading saltbush); 13, *A. ludleyi* (eastern flat-topped saltbush); 14, *A. lobatifolia*; 15, *A. macropterocarpa*; 16, *A. microcarpa*; 17, *A. morrisonii*; 18, *A. muelleri* (mueller's saltbush); 19, *A. nummularia* (old man saltbush); 20, *A. pallidosa* (marsh saltbush); 21, *A. papillata*; 22, *A. prostrata* (mat saltbush); 23, *A. pseudocomplanata* (mealy saltbush); 24, *A. quinii*; 25, *A. semibaccata* (creeping saltbush); 26, *A. spinibractea* (spiny fruit saltbush); 27, *A. spongiosa* (pop saltbush); 28, *A. tripartita* (bitter saltbush); 29, *A. tuberculata* (lagoon saltbush); 30, *A. turbinata*; 31, *A. velutinella* (sandhill saltbush); 32, *A. vesicaria* (bladder saltbush); 33, *A. sp.* (donald duck saltbush).

Picture: Cunningham et al. 1981

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Acknowledgments

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