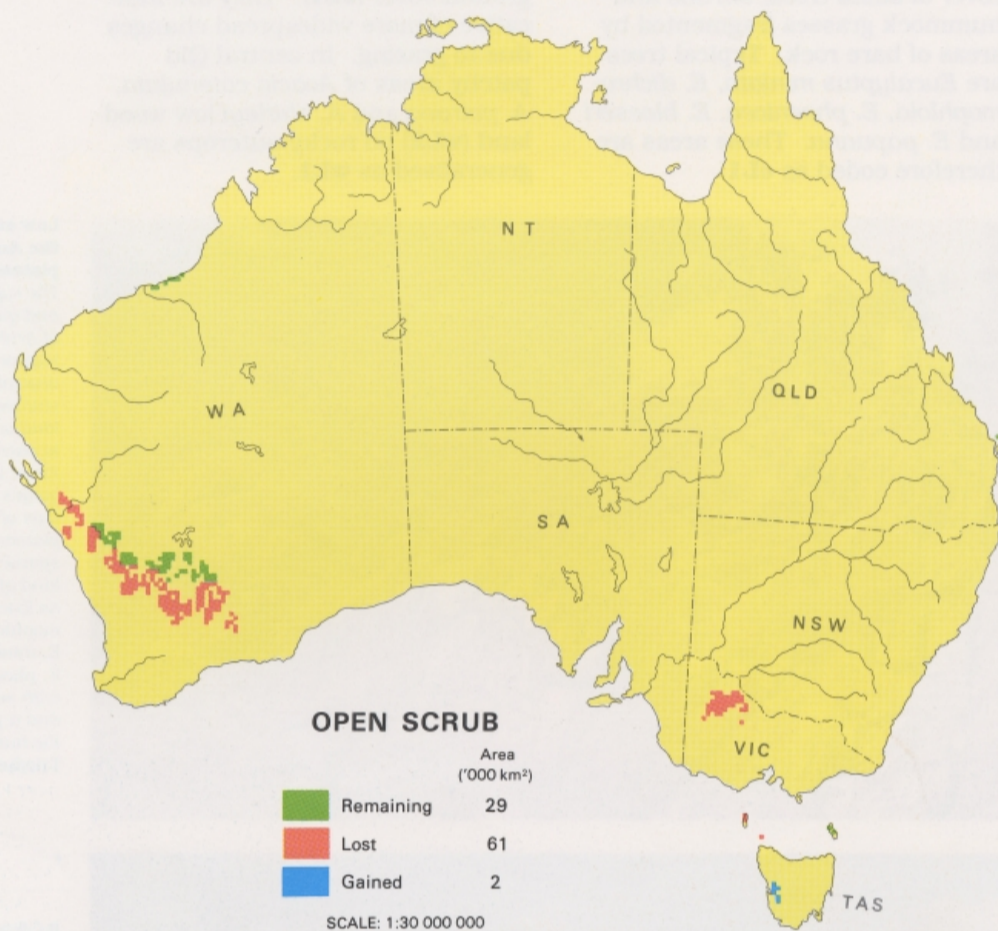


Tall shrubs

Open scrub Shrubs >2 m high; 30–70% foliage cover

S3

The open scrubs are dense formations of tall shrubs and, like the related heaths, are found on low nutrient or waterlogged soils. As closed scrubs (S4) are more restricted and often occur as dense patches within open scrub, they have not been separated from S3 on the maps.



Mallee open scrub

At its south-eastern margin in Vic, the mallee vegetation achieved open scrub density (more than 30% foliage cover) with an understorey of tussock grasses. Nearly all of this vegetation has now been cleared for cropping or grazing. The photo shows a remnant patch of mallee open scrub near Sea Lake, western Vic.



Casuarina open scrub

The open scrubs of south-western WA occur on sandy or gravelly soils inland of the wheatbelt. This kind of vegetation is dominated by a number of *Acacia* and *Allocasuarina* species, including *Allocasuarina campestris* and *A. acutivalvis*. The increased frequency of fires near settled areas has changed parts of this formation to scrub-heath. This photo illustrates a disturbed open scrub near Hyden (WA) with regenerating shrubs in the foreground.



In eastern Australia open scrubs occur on sandy areas and rocky exposures along the coast and formerly also covered a large area of calcareous soils in western Vic. In WA they extend into drier areas on sandy or gravelly soils. *Acacia* and *Casuarina* scrubs were formerly widespread from north of Geraldton to near Norseman in the south-west, while to the north pindan scrubs occur on the coastal plains east of Port Hedland.

Various genera dominate open scrub vegetation, including *Acacia*,

Banksia, *Casuarina*, *Melaleuca*, and *Leptospermum*. *Eucalyptus* is also a dominant, typically in the distinctive multi-stemmed 'mallee' shrub form. The dense mallees which once covered large areas west of Swan Hill (Vic.) formed open scrubs.

Open scrub frequently forms mosaics with other vegetation types such as woodland, closed scrub, various combinations of shrubland and heath in areas regenerating after fire, and sedgeland in waterlogged areas.

Open scrub with low shrubs

S3Z

The largest mapped areas of this subform are in south-western WA, on infertile sandy soils in a zone where annual rainfall ranges from about 225 mm to more than 300 mm. The tallest stratum is dominated by numerous species of *Acacia* or *Allocasuarina*. Only the type dominated by *Acacia* appears on the Present Vegetation map but there is a wider range on the Natural Vegetation map (**wS3Z**, **wcS3Z**, **cwS3Z**, **cS3Z**). The dominant species include *A. acuminata*, *A. coolgardiensis*, *A. neurophylla*, *A. quadrimarginea* and *A. resinomarginea* as well as *Allocasuarina acutivalvis*, *A. campestris* and *A. corniculata*.

Some stands shown on the Natural Vegetation map (**ecS3Z**) also include mallees such as *Eucalyptus foecunda* and *E. transcontinentalis*. The lower stratum consists of sclerophyllous shrubs, many of them ericoid (heath-like), from a range of families including Myrtaceae and Proteaceae.

Many of these open scrubs have been modified under settlement. Some areas show structural changes related to frequent burning (**cwS2Z**, **xZ3**), while others have been cleared and sown to seasonal crops and pastures (**yfF3**).

There are only a few small mapped areas in eastern Australia. On poor stony soils in central Vic. there are examples of natural or modified open scrubs dominated by shrubby species of *Eucalyptus* (mallees such as *E. behriana* and *E. viridis*), with a lower stratum that includes species of *Acacia* and *Cassinia* (**eS3Z**).

Parts of Fraser Island (Qld) and the Bass Strait islands carry vegetation mosaics generalised as mixed open scrub (**xS3Z**). The dominant genera include *Banksia*, *Casuarina*, *Acacia* and *Melaleuca*. Some former examples on the Bass Strait islands have been thinned out by disturbance (**xs2Z**) or cleared and sown to exotic pastures (**yfF3**).

Open scrub with hummock grasses

S3H

The pindan vegetation of the Kimberley region is mapped in part as *Eucalyptus* low open woodland with a lower stratum of *Acacia* tall shrubs (**eL1wS**). Under the lower rainfall further south, there are few trees and the tall shrubs become dominant. Thus the vegetation is

mapped as *Acacia* open scrub with hummock grasses (**wS3H**). The same pindan species of *Acacia* are present but *A. pachycarpa* may be more prominent. The ground layer is dominated by the hummock grasses *Plectrachne schinzii* and *Triodia pungens*.

Open scrub with tussock grasses or graminoids

S3G

The Natural Vegetation map shows several examples in north-western Vic. dominated by mallee species of *Eucalyptus*. Most mallee vegetation is mapped as tall shrubland (**eS2**), but shrub density was higher and foliage cover was more than 30% at the south-eastern margin of the mallee in Vic. This dense mallee, which usually had a sparse grass understorey, is mapped as open scrub (**eS3G**).

Most former areas of this vegetation type have been cleared for seasonal cropping and native pastures. Small unmapped relic

stands contain numerous species of *Eucalyptus*, including *E. dumosa* and *E. oleosa*, over such tussock grasses as *Stipa* and *Danthonia*. Sparse low shrubs are also present in some places.

As discussed under closed forest, a large area of open scrub (**xs3G**) in western Tas. appears to be the product of a series of fires in former *Nothofagus* forest (**nM4**). There are numerous shrubs, including species of *Acacia* and *Leptospermum*, with a diverse ground layer containing graminoids such as Cyperaceae and Restionaceae.

Tall shrubland Shrubs >2 m high; 10–30% foliage cover

S2

Two of Australia's best known inland vegetation types—mallee and mulga—occur within this category, though they have been extensively modified by European land use. Much former mallee land now lies within the wheatbelt and large areas of mulga tall shrubland have been reduced to open shrubland by more than a century of grazing.

Tall shrubland with low shrubs

S2Z

This widely occurring subform is most commonly dominated by mallee eucalypts or by *Acacia*. *Eucalyptus* tall shrublands with low shrubs (**eS2Z**) are widespread across southern Australia, mainly within the 200–450 mm annual rainfall range and on a variety of soils including calcareous earths, sands and alkaline duplex soils. Dominant species include the widespread *E. oleosa*, *E. gracilis*, *E. incrassata* and *E. foecunda*, and also *E. eremophila* in WA. Other genera are occasionally co-dominant, for example species of *Myoporum* (**eqS2Z**) or *Melaleuca* (**meS2Z**).

Under higher rainfalls the low shrubs are usually dense, typically sclerophyllous and often ericoid. This understorey is floristically diverse and includes members of the Proteaceae and Myrtaceae (especially species of *Melaleuca*). With decreasing rainfall it contains fewer species and is more open. There may also be sparse tussock grasses such as *Stipa*, or the hummock grasses *Triodia irritans* or *T. scariosa*. Towards the lower rainfall limit the Chenopodiaceae, including *Atriplex* and *Maireana*, tend to dominate. Soil factors also play a part in understorey distributions.

The distribution of this vegetation is much more extensive on the Natural Vegetation map. Some areas have been modified by thinning, burning and sheep grazing. Where annual rainfall exceeds 280 mm, most stands have been cleared and sown to seasonal crops, with native or exotic pastures.

Acacia tall shrublands of this subform (**wS2Z**) occupy much of central-western WA and parts of the interior of SA. They occur within the 150–250 mm annual rainfall range on various soils, including red and calcareous earths, alkaline duplex soils, sands and shallow soils over rock or hardpan. *A. aneura* is the most widespread dominant species, but is replaced by *A. ramulosa* and *A. linophylla* on the southern and western margins of this vegetation type, and by *A. xiphophylla* in the north-west.

The growth form of *A. aneura* is generally that of a tall shrub, although the tree form is attained on favourable sites. The low shrubs include numerous *Eremophila* species. There is a variable ground layer of tussock grasses (such as *Aristida*, *Danthonia* and *Eragrostis*) and forbs (including species of *Ptilotus* and of Asteraceae). On

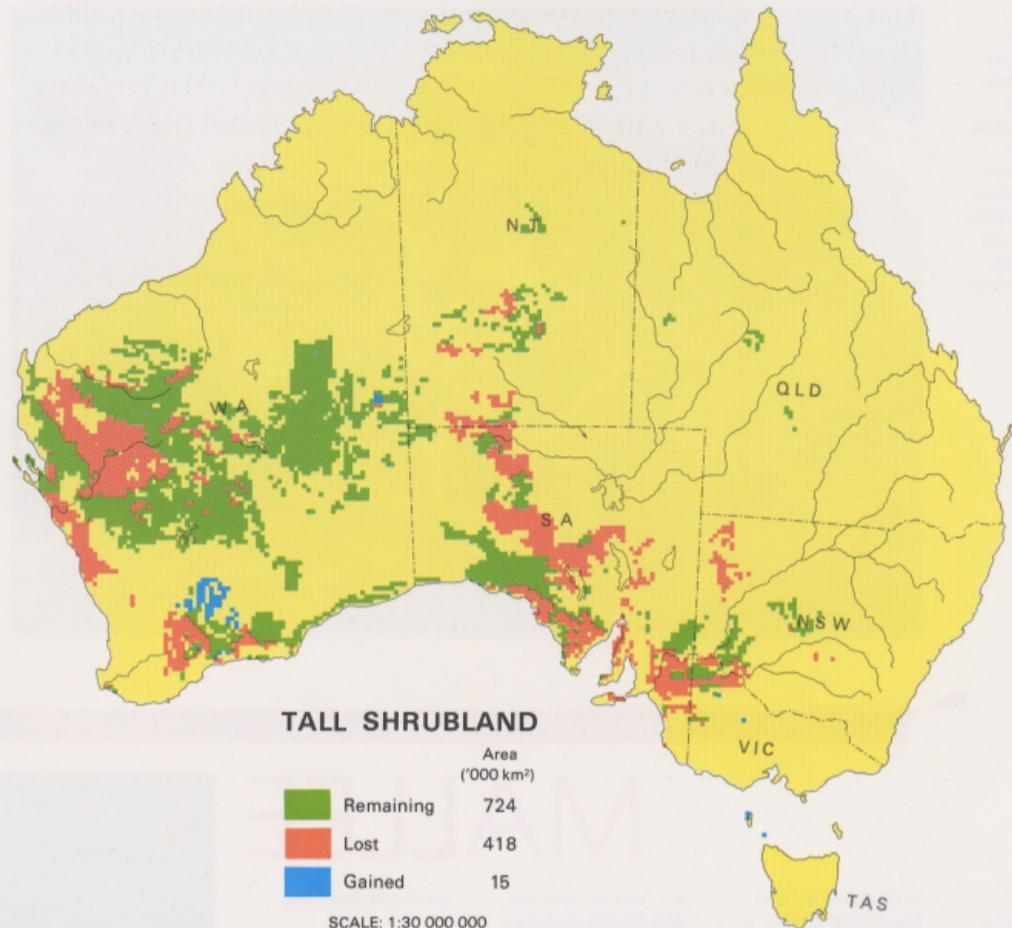
calcareous and saline soils, especially in SA, *Atriplex* and *Maireana* dominate the low shrub layer.

In many areas within the *Acacia* tall shrublands grazing has reduced either the upper stratum (e.g. to **wS1kZ**), or the low shrub stratum—especially palatable species of *Eremophila* (e.g. to **wS2G**). Over a large area in WA there has been a substantial reduction of both shrub strata, and also the ground layer (Wilcox and McKinnon 1972). These former areas of **wS2Z** are now coded as **wS1**.

Examples with a range of genera in the tallest stratum (**xS2Z**) are associated with infertile soils, including some coastal dune systems. Those which occur on sandy soils in the south-west of WA correspond to the 'scrub-heaths' of Beard (1969). *Banksia*, *Grevillea* and *Acacia* are common in the tallest stratum. The dense lower stratum consists of many different sclerophyllous shrubs from such families as Proteaceae and Myrtaceae. Along the coast of NSW and southern Qld, patches of similar vegetation occur on very infertile soils within the mapped limits of *Eucalyptus* open forests.

Scrub-heaths were much more prominent in the natural vegetation. They are naturally subject to fires and pass through a dense low shrub stage during regeneration. Large areas in WA are now coded as **xZ3** because the frequency of recent fires has prevented the development of the mature stage. Apart from areas modified by frequent burning, there are others which have been cleared and sown to seasonal crops and pastures (**yF3**). The infertility of the soil is overcome by massive applications of fertiliser.

A similar type (**xS2Z**) occurred in the natural vegetation of the Flinders Ranges in SA. The tall shrubs included species of *Acacia*, *Eucalyptus* and *Myoporum* over such low shrubs as *Eremophila*, *Cassia* and *Dodonaea*. The ground layer included grasses (*Stipa*, *Danthonia* and *Enneapogon*) and forbs such as *Sclerolaena*. The shrubs have been reduced under pastoralism (**xS1yG**) and limited areas have been cleared for crops and native pastures. The present areas shown as **cwS2Z** east of the wheatbelt in WA and **xS2Z** on the islands off Tas. are the result of the modification of open scrubs by burning or grazing.



Mallee shrubland over low shrubs
A remnant patch of mallee eucalypt vegetation with a dense understorey of *Melaleuca* low shrubs (**eS2Z**). This small area near Pingaring lies well within the WA wheatbelt.



Scrub-heath near Hyden (WA)
This vegetation type is found on infertile sandy soils in inland south-western WA. In the natural stands of scrub-heath there is a range of shrubby genera (**xS2Z**), including *Allocasuarina*, *Banksia*, *Hakea* and *Callitris* (pictured). Some areas of scrub-heath have been cleared in recent decades along the eastern margin of the wheatbelt.

Mallee over hummock grass
Ridge-fruited mallee (*Eucalyptus incrassata*) and *Triodia* species in the Hattah-Kulkyne National Park, north-western Vic. Hummock grass understoreys are common in mallee areas on sandplains and render such vegetation highly flammable.



Tall shrubland with hummock grasses

S2H

Some of the mallee shrublands in southern Australia have an understorey of hummock grasses of the genus *Triodia* (eS2H). These are associated with calcareous or sandy soils. These soils may favour the growth of hummock grasses rather than low shrubs, but in addition the shrubs may be suppressed by fire. The highly flammable *Triodia irritans* is commonly found in these shrublands, particularly on light and sandy soils, and this species provides fuel for very intense fires (Noble and others 1980). Some former areas in the south-east have been cleared and sown to seasonal crops with native pastures.

Areas dominated by *Acacia* (wS2H, weS2H) occur across north-central and north-western Australia, largely on sandplains or dissected country. *A. aneura* is the most widespread species but *A. stipuligera* and *A. lysiphloia* are prominent in the north, as are *A. stowardii* and *A. shirleyi* in the east. The hummock grasses include *Triodia basedowii* and *T. purgens*. *A. aneura* and *T. basedowii* dominate a vegetation mosaic found on areas of dissected laterite plateau in the Gibson Desert. This mosaic, described by Beard (1968) as 'mulga parkland', is generalised as wS2H.

MALLEE

The term 'mallee' describes eucalypts with a multi-stemmed habit and the vegetation dominated by them. Mallee eucalypts have branches arising from an underground mass of woody stem tissue (lignotuber) and are structurally classed as tall shrubs.

Most mallee vegetation ranges from 3–9 m in height, although there are some exceptional stands over 10 m such as those of *E. diversifolia* on Kangaroo Island (SA). The number of branches varies from a few

large stems in 'bull' or 'big mallee' (right), to the many narrow branches of 'whipstick mallee' (lower right). Mallies are fire tolerant and produce new shoots from the lignotuber after burning.

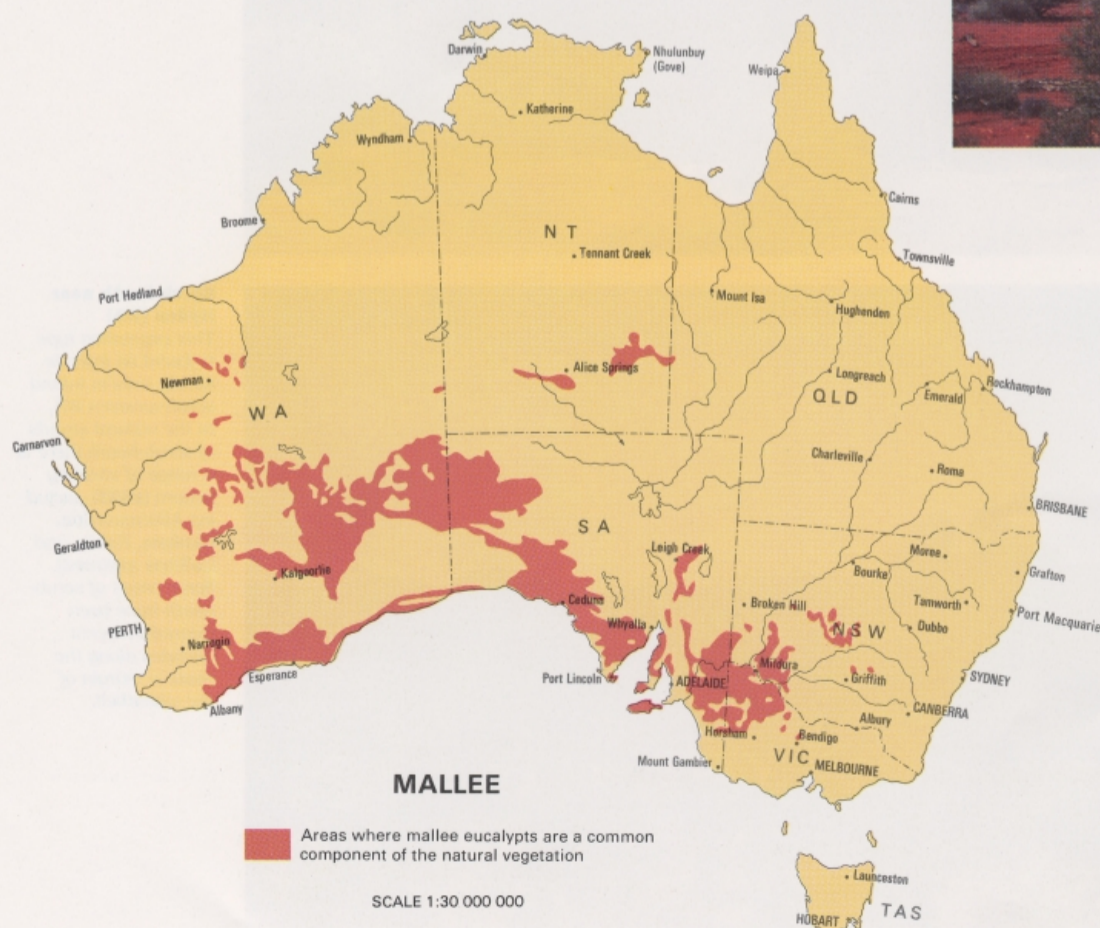
Many of the areas dominated by mallee shrublands occur across southern Australia on a range of calcareous soils within the 250–380 mm annual rainfall zone (Parsons 1981). Outside these core areas much mallee vegetation occurs as tall open shrubland, such as the mallee-heaths of southern coastal

WA (eS1xZ) and the widespread arid mallies found on sandplains in the Great Victoria Desert and north of the Simpson Desert (ewS1tH).

There are over 100 mallee species of *Eucalyptus*. Most occur in WA, though some, such as *E. oleosa*, *E. gracilis*, *E. foecunda*, and *E. incrassata* are widespread in both the east and west of the continent. Some species may occur in either tree or shrub form. Mallee vegetation is also found on rocky soils in some mountainous areas in

southern Australia.

The understorey varies with both soil and rainfall. Shrub understoreys range from dense thickets of *Melaleuca* or *Casuarina* in the 'broomshrub mallee' to the more widespread heath-like or xeromorphic low shrub layers. Infertile sandy soils in drier areas have a highly flammable *Triodia* hummock grass understorey. The heavier soils of the arid zone typically have an understorey of sparse grasses or annuals, or of semi-succulent low shrubs including chenopods.



S2

Tall shrubland with tussock grasses

S2G

Of the different vegetation types that are dominated by *Acacia aneura*, the most widely distributed is tall shrubland over tussock grasses (**wS2G**). There are many examples of this type in areas where annual rainfall is less than 250 mm. It is found on a range of soils including massive red earths, alluvium, shallow soils over rock or hardpan and also the interdune areas of some sand-dune country.

In some places *A. aneura* occurs in groves. The ground layer usually includes some perennial grasses, especially *Eragrostis* and *Danthonia*, and also a seasonally fluc-

tuating grass and forb component including *Aristida* and *Erneapogon*, *Helipterum*, *Ptilotus*, *Sida* and *Sclerolaena*. *A. aneura* undergoes longer term fluctuations in cover in response to prolonged drought (Beard 1968). Other species of *Acacia* may be associated with *A. aneura*, including *A. brachystachya* in the south and *A. loderi* in the south-east.

As the map of Present Vegetation shows, large areas of this vegetation type (**wS2G**) have been modified under pastoralism and this is usually reflected in a reduction of the tallest stratum to **wS1yG**.

The Fortescue Valley in the Pilbara region of WA now has a very sparse ground layer and the area is coded as **wS2**. Some former areas of **wS2Z** in the interior of WA have been modified to **wS2G** through the reduction of palatable low shrubs by grazing stock.

The Present Vegetation map also shows small areas of this subform in south-eastern Australia dominated by mallee species of *Eucalyptus* (**eS2G**, **eqS2G**). Some of these represent modifications of former tall shrubland with low shrubs, but others may be natural.

Tall shrubland with other herbaceous plants

S2F

In WA the *Acacia* tall shrublands with low shrubs (**wS2Z**) are replaced along their south-western margin by another type in which the low shrub layer is less prominent and the ground cover consists of seasonal forbs (**wS2F**). There are numerous species of *Acacia*, inclu-

ding *A. ramulosa* and *A. linophylla* in the south and *A. xiphophylla* in the north. The seasonal ground layer consists largely of Asteraceae including species of *Helipterum*, *Myriocephalus* and *Podolepis*. Some areas of this type have been modified under grazing (**wS1zF**).



MULGA

Mulga is a widespread and well known Australian vegetation type. The mulga lands occupy about 500 million ha, or about 20% of the continent. Mulga vegetation ranges in form from open forests up to 15 m high in Qld to sparse shrublands in desert areas, but occurs most commonly as tall shrubland or low woodland. The two photos show plains north of Alice Springs (NT) blanketed by mulga tall shrubland (**wS2G**).

The term mulga usually includes the widespread *Acacia*

aneura (mulga) and the closely related species *A. linophylla* (bowgada), *A. brachystachya* (umbrella mulga) and *A. ramulosa* (horse mulga), also *A. stowardii* (bastard mulga). The 'Mulga' map shows the areas where these species are a dominant or a common component of the natural vegetation (see also the Acacias map on page 15).

Most of the mulga lands are used for livestock grazing. Mulga foliage is an important source of drought relief fodder. Graziers in eastern

Australia have felled mulga for fodder or to increase pasture growth. Dense regeneration occurs in some areas, notably in the 'soft mulga' lands of south-western Qld, but in drier areas mulga does not regenerate to its former density.

In many parts of Australia, grazing the mulga lands has resulted in the reduction of the dominants, the low shrubs, or even of all three layers. These changes in the vegetation are often accompanied by soil erosion. Assessing the effects of the

grazing animals, and of rabbits, is complicated by the fact that mulga undergoes a cyclic pattern of decline and regeneration in response to prolonged drought. Much of the degradation of mulga lands took place from the 1880s to the 1930s.

In some grazed areas a dense layer of inedible low shrubs has appeared. The increase in these 'woody weeds' is particularly severe north and west of Bourke and Cobar in western NSW, and has significantly reduced the carrying capacity of these areas.

