VEGETATION OF THE MULGA LANDS WITH SPECIAL REFERENCE TO SOUTH-WESTERN QUEENSLAND

D. E. BOYLAND*

ABSTRACT

Mulga lands of Australia support many plant associations, usually floristically and structurally simple, low in height and vegetal cover. Within these associations distinct layers occur which behave independently of one another.

This paper deals mainly with the mulga associations of south-western Queensland and adjoining areas which influence the environment of the former areas. Both are related to landscape form of the area.

Structurally the mulga associations in Queensland range from open forest to sparse tall open shrubland but occur mainly as tall shrubland or tall open shrubland. Grove patterns are present.

A total of 316 *species was recorded from the study area. Fifty-two percent of the species are included in the families Gramineae, Leguminosae, Chenopodiaceae and Compositae.*

INTRODUCTION

Mulga (*Acacia aneura*) lands are defined as areas where mulga predominates or contributes significantly to the biomass of the ecosystem, and adjoining areas which influence the environment of the former areas.

Mulga associations extend in a discontinuous belt from the Western Australian coast across the southern edge of the central deserts to western New South Wales and south-western Queensland with another area of substantial size north of the central arid area in the Northern Territory and altogether occupy about 1,500,000 km^2 occurring mainly on pedalferric soils (Everist, *in press*). In Queensland mulga associations are 326,000 km^2 in extent (Burrows and Beale, 1969) and occur mainly in the semi-arid and arid south-western regions of the state.

Data on the broad structure and composition of mulga associations abound (Collins (1923), Blake (1938), Crocker and Skewes (1941), Melville (1947), Condon (1949), Jessup (1951), Perry (1960), Wilcox (1960), Holland and Moore (1962), Perry and Lazarides (1962), Speck (1963) and Hall et al (1964)) but except for Burrows and Beale (1969) and Everist (1949), there is little detailed information on the structure and composition of various mulga associations.

MULGA LANDS OF SOUTH-WESTERN QUEENSLAND

The vegetation of mulga lands can be related to geomorphology. As a result of various degrees of weathering of the original tertiary landscape different horizons have been exposed and each has a distinctive land form, soil and vegetation. In places remnants of the original landscape remain. The width of the exposed horizons is a function of slope and is governed by the degree of dissection. Frequently the upper and lower segments of the catena are absent or condensed to form a narrow belt.

* Botany Branch, Department of Primary Industries, Meiers Road, Indooroopilly, Brisbane.

Various plant communities are associated with the five landscapes described by Dawson (1973) (see Fig. 2 previous paper). The basic unit of classification used is the association in the sense of Beadle and Costin (1952). Structural formations are as defined by Specht (1970) except that the stratum contributing most to the biomass and not the tallest stratum is considered predominant.

Landscape 1. *Dissected residuals*

Mulga usually contributes little to the biomass of the various associations.

On scarps, lancewood (*Acacia petraea*) shrubby low woodland to low open woodland is a constant feature. In places bendee (*A. catenulata*) shrubby tall shrubland occurs on the lower more gently sloping zone of the scarps. When both associations are present they usually grade into one another forming a continuum. The depth and stability of the soil and resultant moisture relations are probably the principal factors governing distribution of these associations.

Various low open shrublands to low shrublands with bastard mulga (*Acacia clivicola*) predominant occur on dissected tops of low hills and undulating plains associated with the scarps. Bastard mulga may form monospecific stands but stunted plants of mulga, *Hakea collina*, desert gum (*Eucalyptus papuana*) and *E. exserta* may be present. Ground flora is sparse. Limited areas of rock grass (*Eriachne mucronata*) open tussock grassland with western bloodwood (*Eucalyptus terminalis*) emerging are developed on gently undulating to rounded plains associated with the dissected residuals.

Landscape 2. *Transported detritus and dissected residuals of the laterite and silcrete land surface*

This landscape includes most of the "mulga country" in Queensland and usually mulga predominates in the vegetation. In places associations vary in general appearance due to different growth forms of mulga (see Everist, 1949) which depend on the age and density of the plants and biotic influences, though ecotypes apparently exist. A broad short phyllode form (*A. aneura* var. *latifolia?*) and a narrow-long phyllode form have different ranges though there is considerable overlap, with the latter preferring more xeric situations.

On run-on areas (Boran or Humeburn land system) on gently undulating to flat plains, mulga-poplar box (*Eucalyptus populnea*) tall shrublands are developed. In places mulga occurs in pure stands forming open scrub with shrub densities up to 2000 per ha and, in higher rainfall areas, up to 5000 stems per ha (Everist, in press). Low shrubs of *Cassia* spp. and *Eremophila* spp. (especially *E. gilesii*) may form dense understorey layers. Ground flora is variable with kangaroo grass (*Themeda australis*) and blue grass (*Dichanthium* spp.) occurring in favourable situations. Towards the eastern limits of distribution mulga-poplar box associations grade into poplar box woodlands.

Outcrops (Wanko land system) carrying mulga sparse tall open shrubland may occur on the gentle undulating plains. Density of the mulga shrubs varies from less than 5 up to 150 per ha. Mulga may form a mono-specific upper layer but is more frequently associated with scattered low trees and shrubs including dead finish (*Acacia tetragonophylla*). Short grasses and forbs give a variable but usually sparse ground cover.

In some situations (Bierbank and Berella land systems) mulga tall open shrubland to tall shrubland forms groves on the gentle lower slopes of the undulating plain.

Pediments and eroded lower slopes (Grotto and Wanko land systems) support gidgee (*A. cambagei*)—mulga tall open shrubland. Gidgee is predominant with up to 150 trees per ha but mulga with up to 100 shrubs per ha contributes significantly to the biomass. Scattered low shrubs occur and ground cover is sparse. Mulga sparse tall open shrubland is developed on the shallow red-earths with silcrete cover in this segment of the landscape. Other associations, very limited in extent, occurring in this zone include mountain yapunyah (*Eucalyptus thozetiana*) open woodland, bowyakka (*Acacia* sp.)-gidgee tall shrubland, bowyakka-mountain yapunyah tall open shrubland, turpentine mulga (*A. brachystachya*)-mulga tall open shrubland and brigalow (*A. harpophylla*)-gidgee open woodland.

Landscape 3. Sand plains overlying upland land surfaces

The gently undulating plains support a relatively uniform vegetation of predominantly mulga-woollybutt (*Eragrostis eriopoda*) tall open shrubland. In places the mulga is so sparse that the association is structurally a woollybutt open tussock grassland with 25 to less than 5 emerging mulga shrubs per ha. Scattered low shrubs including hopbush (*Dodonaea attenuata*), *Cassia* spp. and *Eremophila* spp. may be present with *Eremophila* spp. forming dense stands in places. Desert poplar (*Codonocarpus cotinifolius*) occurs sporadically but is more prevalent in areas partially disturbed by clearing or fire. Other scattered trees include beefwood (*Grevillea striata*) and western bloodwood, the latter usually associated with shallower soils. In places (Wanko land system) mulga sparse tall open shrubland and rock grass—western bloodwood open tussock grassland may occur on outcrops in the plain.

Run-on areas support mulga $\pm$ poplar box tall open shrubland. In some situations poplar box may predominate but rarely does it form pure stands.

On the sand plain margins, mulga tall open shrubland often forms groves on the gentle slopes.

Landscape 4. Sand plain associated with prior alluvial deposits

Mulga-poplar box shrubby tall open shrubland is extensively developed. Usually mulga is predominant but in places poplar box forms open woodland with only scattered mulga present. A lower shrubby layer is often well developed composed mainly of *Cassia* spp., a hop bush and *Eremophila* spp. Run-on areas support mulga $\pm$ poplar box tall shrubland. Budda bush (*Eremophila sturtii*)-hop bush shrubby shrubland is developed on the margins of the sand plain and adjoining alluvia.

Adjacent alluvia support various eucalyptus woodlands or gidgee woodlands or a mixture of both.

Landscape 5. Dunefields

Vegetation of the dunes is diverse and mulga is a major component of only a few associations. Mulga rarely forms monospecific stands but combines with low trees or shrubs to form tall open shrubland or emergent layers in open tussock grasslands or open hummock grassland.

Mulga associations are developed on the interdune flats and stable lower extended flank of the dunes. On low stable dunes mulga even occurs on the crests. Associations include mulga shrubby tall open shrubland and mulga-whitewood (*Atalaya hemiglauca*) forby tall open shrubland. In far south-western Queensland mulga-*Acacia calcicola* tall open shrubland may occur on reticulate dunes. In some spinifex (*Triodia basedowii*) hummock grasslands, mulga forms an emerging upper storey with low trees and shrubs including *Acacia* spp., *Eucalyptus* spp., *Hakea* spp. and *Grevillea* spp.

VARIATION IN STRUCTURAL FORMATION

Structurally, mulga associations range from open forest to sparse tall open shrubland but occur mainly as tall shrubland and tall open shrubland. In western Queensland mulga was recorded in 95 sites being dominant or co-dominant in 82 sites.

Of these sites, 67 were tall or tall open shrublands. Mulga also forms understorey strata in layered woodlands or emergent layers in hummock or tussock grasslands. The physiognomic complexity of mulga associations decreases along a gradient from a favourable environment to a harsh environment. In Queensland, there is a variation from open forest to tall open shrubland with a corresponding decrease in annual precipitation from 500 mm (approx.) to 200 mm (approx.).

PLANT GEOGRAPHY OF MULGA ASSOCIATIONS IN SOUTH-WESTERN QUEENSLAND

Except for Everist (1949) detailed floristic data for mulga associations are not available. In far western Queensland a total of 316 species was recorded from 149 genera belonging to 54 families. Of these species 89 are woody perennials and 39 are perennial grasses or forbs. Though shrubs are the predominant growth form, the number of different shrub species present compared with other plants is relatively low. This is well established in Queensland with Everist (1949) recording 69 species and Burrows and Beale (1969) only 56 woody perennials in various mulga lands. The other 188 species are annual grasses or forbs, a large number of which are semiarid and arid "wides" with apparently no specific ecological affinity. Distribution of species on the various landscapes is given in Table 1. Variation in the number of woody perennial species present in the broad groupings can be explained in terms of available habitats. The dissected residuals and redistributed lower slopes have more habitats than sand plains which are relatively uniform in soil and relief. Sand plains exhibit less species diversity.

Twelve families (Table 2) comprise 75 per cent of the flora. Gramineae, Leguminosae, Chenopodiaceae and Compositae total approximately 52 per cent of the flora. It is normal for the flora of most regions to be predominated by Gramineae, Leguminosae and Compositae but rarely do these families comprise over 40 per cent. The large number of Chenopods is characteristic of the arid and semiarid lands of Australia and, to a lesser degree, many other countries. The family Myoporaceae also contributes significantly, with best expression on red earths and lithosols in the more arid regions. Large genera include *Acacia* (17 species), *Eremophila* (14 species), *Bassia* (13 species), *Eragrostis* (12 species), *Cassia* (9 species), *Ptilotus* (8 species) and *Aristida* (7 species).

TABLE 1

Distribution of species, genera, families on the various landscapes

	Landscape 1	Landscape 2		Landscape 3	Landscape 4	Landscape 5 (Dunes)	Overall
		Red earth > 30 cm deep	Red earth < 30 cm deep				
No. of Species	103	137	123	57	49	106	316
No. of Genera	54	76	73	42	31	70	149
No. of Families	26	32	34	20	17	35	54
No. of Woody Perennials	44	25	33	13	11	31	89

TABLE 2

Families contributing more than 5 per cent to the flora of Mulga associations

Family	Genera	Species	Woody Perennials	Perennial Grasses and Forbs
Gramineae	32	68	0	27
Leguminosae	9	39	29	0
Chenopodiaceae	8	32	0	5
Compositae	17	26	1	0
Myoporaceae	2	15	15	0
Amaranthaceae	2	10	0	0
Euphorbiaceae	4	10	2	0
Malvaceae	3	10	0	5
Myrtaceae	2	8	8	0
Cruciferеae	4	7	0	0
Goodeniaceae	3	7	2	0
Solanaceae	2	7	2	0

PATTERN IN MULGA ASSOCIATIONS IN SOUTH-WESTERN QUEENSLAND

In central and western Australia, mulga communities on gentle slopes can exhibit a grove pattern (Perry, 1970). Groving has also been observed in mulga in far western Queensland associated with two different soil complexes. The pattern is very diffuse in places and frequently merges with mulga tall open shrubland developed on run-on areas. Structurally, the vegetation in the grove area varies from tall shrubland to tall open shrubland, the height of the predominant stratum from 5 to 7 (rarely 8) m with a considerable variation in projective foliage cover from 5 to 25 per cent and a corresponding density variation of 200 to 500 shrubs of mulga per ha. The ground layer up to 1 m high ranges from 10 to 30 per cent projective foliage cover. Composition is variable with either forbs or grasses predominating, depending on local variation in habitat and seasonal conditions. Vegetation of the intergrove is usually not permanent. Shrubs are lesst han 10 per ha and the groun cover is usually sparse but may range up to 25 per cent projective foliage cover. In more arid areas a very distinct groving pattern is developed. Structurally the vegetation ranges from tall open shrubland to tall shrubland with the height ranging from 4 to 6 m. The projective foliage cover varies from 5 to 15 per cent with a corresponding density range of 150 to 300 shrubs per ha. Ground flora varies but usually perennial grasses are well developed, associated with depressions. Intergrove areas support little vegetation. In this grove pattern there is visual evidence of within grove contagion. Mulga grows on the margin of the depressions giving a clumping effect.

Pattern probably exists in the eastern mulga associations in view of Anderson's findings (1970), but statistical methods are needed to recognize it.

ENVIRONMENTAL INFLUENCE ON VEGETATION

Climatic factors determine what plants can grow, but land form and edaphic factors usually govern the distribution of plants within a region. The importance of land form is its water controlling ability. Physiographic features control run off, surface drainage and redistribution of water available for plant growth. Plant associations are more complex on run-on areas and their biomass is higher. Precipitation, the major source of water, varies in seasonal and annual distribution and reliability. It is known that mulga requires winter rain to persist (Davies, 1968; Farmer *et al.*, 1947). Little data are available of the effect of other climatic factors on the vegetation of this region.

In the mulga lands of south-western Queensland the level of available nutrients is low (Dawson, pers. comm.) and undoubtedly the principal edaphic factors governing plant growth are physical texture and soil depth. These basically control the distribution of moisture in soil and the amount of water available for plant growth. In similar rainfall areas on red earths in western Queensland, mulga shrub density ranges from less than 10 per ha to 200 per ha with a corresponding increase in soil depth from 10 cm to 100 cm. Soil type also governs the distribution of plant associations, with abrupt disjunctions occurring between associations related to soil type variation. Mulga tall open shrubland is developed on red earths (Gn 2.12, Northcote classification, 1965) with texture contrast soil (Dy 1.42, Northcote classification, 1965) supporting poplar box-mulga woodland on adjacent areas on the same plain.

The distribution of plant associations cannot always be explained in terms of climatic and edaphic factors. Natural catastrophes and seasonal history, frequently unrecorded, may influence the distribution of plant associations. Often one single set of circumstances can eliminate an association from an area.

Data on the influence of fires on mulga associations are few. The effect of fire depends on intensity which is governed by the amount of fuel, the time of the day and the time of year. In the fires of the fifties, day time fires killed mulga while night fires in the same area killed only the lower branches (Everist *et al.*, 1958). In far western Queensland the effect of fire on the ecosystem appears to be very deleterious. In places there is a reduction in mulga numbers with an increase in species such as desert poplar and hop bushes.

VEGETATION IN OTHER MULGA REGIONS

On the lower flood plains in the south of the Murchison district, Western Australia, monospecific stands of mulga occur with *Cassia* spp. and *Eremophila* spp. in clearings (Melville, 1947). The upper layer of most communities of the Wiluna-Meekatharra area is dominated by mulga (Speck, 1963). Most communities have well developed shrubby layers with various *Eremophila* spp. present. Mulga-spinifex communities with or without other scattered trees also occur with mulga-*Kochia pyramidata* alliance widespread in those parts of the area with saline soils. The mulga associations of Western Australia appear to be more shrubby than those of Queensland. The mulga-spinifex communities are not extensive in Queensland and the mulga-*Kochia* alliance is virtually absent.

Mulga associations in the Northern Territory are best developed on plains adjacent to mountains and hills where they are extensive on coarse to medium textured red earth soils (Perry and Lazarides, 1962). Stands of mulga are either groved or randomly distributed. Eighteen understorey communities are associated with mulga and two of these (woollybutt and short grasses and forbs) were most common. These associations seem to be more closely allied to the mulga associations of Queensland than to those of Western Australia.

In north-western South Australia, mulga forms a woodland of variable density on the deepest sands, becoming more scattered on shallower sands and sparse or absent on the heavier textured calcareous soils (Jessup, 1951). *Kochia* spp. are absent from the deep sands and the ground flora comprises kerosene grass (*Aristida contorta*) and *Enneapogon* spp., with woollybutt and *Monachathea paradoxa* on sandy rises. On the shallower soils *Kochia* forms a conspicuous lower layer, and with increasing clay content mulga and turpentine mulga (*Acacia brachystachya*) become very sparse.

These associations differ from the mulga associations of Queensland by the presence of the mulga-*Kochia* communities. Myoporaceae do not appear to be as prevalent as in Western Australia.

Various mulga associations are developed in north-western New South Wales (Beadle, 1961). Brown acid soils on level alluvial country support mulga with or without poplar box, ironwood (*Acacia excelsa*), belah (*Casuarina cristata*) and gidgee. Ground flora is mainly woollybutt on the sandy soils with wire grasses (*Aristida* spp.) on the more compact soils. Deep sands and sand hills carry mulga in pure stands or associated with belah and rosewood or boonaree (*Heterodendrum oleifolium*). Undulating and hilly country also support monospecific mulga stands or mulga-poplar box-ironwood associations with an understorey of wire grasses and sparse herbage on brown acid soils. *Dichanthium* spp. and kangaroo grass occur in more favoured situations. On skeletal soils mulga forms shrublands with sparse saltbush (*Atriplex* spp.), *Kochia* spp. and *Bassia* spp. Many of these features are common to the mulga associations of Queensland but there are differences. Mulga-poplar box associations are restricted to these two states. The mulga-*Kochia* spp. association is not well developed in Queensland. In the Barrier district of New South Wales, mulga forms monospecific stands but also occurs as co-dominant with other *Acacia* spp. (Collins, 1923). As in many mulga associations in Western Australia, Myoporaceae are prominent as secondary floristic components.

From the literature it appears that all mulga associations have some common features. Usually the plants form structurally simple associations, low in height and vegetal cover. They usually exhibit distinct layering with only a few species contributing significantly to the biomass of each stratum. These layers appear to be independently distributed (Perry, 1960).

The associations occur mainly as tall shrublands and tall open shrublands, with the open-forest formation unique to Queensland. In New South Wales and Queensland, mulga may occur as an understorey in a woodland but apparently this is, restricted to the mulga associations near the eastern limits of distribution.

Floristically, mulga regions are relatively poor. Gramineae, Leguminosae. Compositae, Chenopodiaceae and Myoporaceae contribute significantly to the flora and large genera include *Acacia*, *Bassia*, *Cassia*, *Eremophila*, *Aristida* and *Eragrostis*

CONCLUSION

Mulga lands are not a single plant community but comprise many varied plant associations. There is need for broad phytosociological studies if "in depth" studies are to be extrapolated intelligently to other areas. Broad studies of this kind also indicate areas where future "in depth" studies are needed.

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