Chapter 3

COMPOSITION, STRUCTURE AND DISTRIBUTION OF TREELESS VEGETATION ON VICTORIA'S NORTHERN RIVERINE PLAIN AT THE TIME OF EUROPEAN SETTLEMENT

Abstract

A study of indigenous vegetation references in the historical literature (accounts of earliest explorers, squatters and settlers) and survey records was undertaken in order to reconstruct vegetation patterns across Victoria's Northern Riverine Plain at the time of European settlement. Emphasis was placed on the distribution, structure and composition of treeless plains vegetation. This vegetation occupied about 4000 km^2, mainly in the west of the region, on heavily textured soils not subject to inundation where mean annual rainfall drops below about 450 mm. Today it is estimated < 2.5% of this vegetation remains in variable condition, primarily on private land and poorly reserved. Woodlands and shrublands dominated by *Eucalyptus largiflorens* and *Muehlenbeckia florulenta* occurred in seasonally flooded low lying areas. Sandier soils associated with the riverine plain and adjacent geological formations were occupied by woodlands dominated by *Callitris* spp., *Eucalyptus* spp. and *Allocasuarina luehmannii*. The composition, structure and ecological function of treeless plains vegetation has been significantly modified since European settlement. The results of this study closely align with the conclusions drawn for grasslands in the southern Riverina of NSW.

Introduction

Over the last 160 years the natural vegetation of south-eastern Australia has been subject to unprecedented change at the hands of European immigrants. The fertile lowland grassy plains of this region have been extensively utilised for domestic stock grazing, cropping and irrigation which has resulted in widespread vegetation clearance, species extinctions and weed invasion. Only a minute proportion of these ecosystems remains as small and often isolated refugia vulnerable to a wide range of threats (Lunt 1991; McDougall and Kirkpatrick 1994).

Understanding the former condition of indigenous vegetation, involves marrying observations of existing remnant vegetation (and its relationship with the physical environment) with the

interpretation of historical sources (Cronk 1989; Fensham 1989), a process often termed reconstruction. Note: whilst it is not known whether or not the previous vegetation communities were stable, it is likely that they were either relatively stable or dynamic as controlled by predictable environmental and management variables.

Reconstruction provides both an impression of the former composition of the vegetation and a catalogue of the factors which have precipitated change, and contributes to a framework for understanding vegetation dynamics and disturbance ecology. Reconstruction is increasingly being utilised in the study of threatened ecosystems to also quantify conservation status, assist in the development of conservation management strategies, assess revegetation options, establish land use benchmarks and document the legacy of both Aboriginal and European heritage (Jeans 1978; Woodgate and Black 1988; Fensham 1989; Lunt 1991; McDougall and Kirkpatrick 1994).

The Northern Riverine Plain of Victoria, and the adjacent region in southern NSW, once supported extensive areas of grassy treeless plains or natural grasslands (Woodgate and Black 1988; Lunt 1991; Foreman 1993; McDougall and Kirkpatrick 1994). However, some grasslands of the south-eastern Riverina of NSW have been described as “disclimax”, having developed after the destruction of the *Acacia pendula - Atriplex nummularia* shrubland alliance (Moore 1953*a*; 1953*b*). Moore’s conclusion is based on the historical accounts of early explorers, pastoralists, surveyors and newspapers, as well as oral history, remnant vegetation and grassland dynamics under grazing. Disclimax vegetation “is defined as the modification of the climax [created and] maintained in a relatively stable condition by the activities of man and domestic animals” (Moore 1953*b*). The term "anthropogenic” has been used to refer to the vegetation known to be modified by human activity from a formerly “natural” condition in European reconstructions (Cronk 1989).

The aims of this paper are to: (a) map the distribution of natural grasslands across the Northern Plain at the time of European settlement from historical maps; (b) document environmental associations of grasslands, by comparing the historical maps with soil and land system maps; (c) describe the composition and structure of grassland vegetation at the time

of European settlement; (d) describe the vegetation changes recorded by the historical records; and (e) discuss whether the existing remnants are natural or disclimax. The study area location, geology, geomorphology, climate and soils have been described in Chapter 2.

Methods

Historical Information Sources

All known historical sources were examined for references relevant to vegetation composition in the region - particularly natural treeless plains. The key sources included: (a) detailed accounts of the first European explorers and adventurers, (b) journals and diaries of the squatters and early European pastoralists, (c) government survey maps, and (d) artistic representations of the landscape.

The records of surveyors are diffused over the entire region. Such records include maps of pastoral runs (prior to 1850), early cadastral divisions such as counties, parishes and even individual allotments (1850 to 1870) as well as broad maps of the general nature of the landscape. These early survey maps (held in the Melbourne Central Plans Office, Treasury Place, Department of Natural Resources and Environment) were examined for vegetation references, especially the location of “treeless or open plains”. Because most areas containing references to grasslands were west of the Goulburn River, the western portion of the Northern Plain was studied in most detail. All other information sources were obtained from historical literature held in various libraries.

Map Analyses, Grassland-Environment Relations and Regional Distribution Mapping

Most historical maps contained only general references to the broad localities of grassland and non-grassland areas, often without clear boundaries. However, the grassland - woodland boundaries were documented in particular detail over a squatting run in the Fernihurst area, south-east of Boort (reproduced in Munro 1993 pp. 36-37, see Chapter 2). The soils of the same area were mapped by the Victorian Agriculture Department in the 1960’s and 70’s as part of a push to expand irrigation into the western reaches of the Northern Plain (Skene 1971). The historical vegetation boundary map and the detailed soil type map were

superimposed and compared to determine the soil types on which the various vegetation types occur.

On the assumption that the vegetation - soil relationship demonstrated in the Fernihurst area applies elsewhere, grassland soils were identified and mapped across the entire region. This process was assisted by the consistent identification of “treeless plain” soils in all other soil surveys undertaken in the Northern Plain (Johnson 1952; Skene and Poutsma 1962; Skene 1963; Skene and Harford 1964; Skene and Sargeant 1966; Sargeant *et. al.* 1978; Badawy 1984). The production of generalised pre-European vegetation maps from land systems and soil types has been used elsewhere in the lowland plains of south-eastern Australia (Fensham 1989; Lunt 1991).

Aerial photographic interpretation (API) and more recently, satellite imagery have been used for monitoring tree density changes, tree decline and the extent of remnant woodland vegetation in fragmented agricultural landscapes (Woodgate and Black 1988; Fensham 1989). Some original tree cover can still be found in both dryland and irrigated agricultural districts, and therefore the potential exists for reconstructing the composition and distribution of both woodlands and grasslands. API was used to check grassland boundaries derived directly from soils maps, and to define grassland boundaries in areas where sufficiently detailed soil maps were not available. The extent of tree decline since European settlement (Woodgate and Black 1988), means that API is considered a less reliable technique for mapping the former extent of grasslands than techniques based on soil mapping.

Remnant Vegetation

On the basis of the historical maps, areas likely to have originally supported grassland vegetation were searched across all land tenures (roadsides, rail reserves, miscellaneous public land and private property) for remnants. The current nature of vegetation of these refugia was sampled using quadrats and the results are documented and discussed elsewhere (Chapter 2). The composition, structure and distribution of quadrat vegetation was compared with the descriptions of vegetation in the same areas derived from the various historical information sources. The broader composition and structure of grasslands at the

time of European settlement are speculated upon using incidental indigenous species lists derived from degraded refugia throughout the region. Note: whilst reasonable criteria were used to select remnants for sampling (see Chapter 2), there is still considerable subjectivity involved and each site may or may not accurately represent what the vegetation originally looked like.

Results

Literature Records

The key explorer of the region was Major T. L. Mitchell who passed through the Northern Plain (near Cohuna) after approaching from the north-west along the Murray River in June and July 1836 (Mitchell 1965). George Augustus Robinson approached the region from the south along the Goulburn River to its confluence with the Murray River which he followed through Echuca to the Cohuna area before taking a similar route to Mitchell into western Victoria in March and April 1843 (Clark 1988). Joseph Hawdon drove cattle from near Albury to Adelaide through parts of the region in January and February 1838 (Anon. 1952). Edward Curr, a squatter occupying land east of the Campaspe River, documented his exploration of the surrounding plains during the 1840's in his memoirs some forty years later (Curr 1965).

These accounts include references to 4 major ecological themes: (a) the variegated landscape of treeless plains and other vegetation types; (b) the widespread presence of shrubs across the open plain country; (c) the nature of the ground layer over the treeless plains; (d) disturbance, aboriginal management and ecological dynamics; and (e) contrasting descriptions of the same landscape.

Variegated Landscape of Treeless Plains and Other Vegetation Types

A number of authors commented on the variegated nature of the landscape, for instance: Joseph Hawdon, on 30 January 1838, south east of Cohuna (Anon 1952): "The appearance of the country is perfectly level, there being a succession of plains, here and there intersected by a narrow belt of pine trees."

Joseph Hawdon, on 3 February 1838, north of Mitiamo (Mount Hope) (Anon 1952): “In all directions spread immense plains, here and there intersected by belts of trees, which in the wet seasons mark the watercourses.”
Joseph Hawdon, on 10 February 1838, in the Kerang and Swan Hill area (Anon 1952): “On the plains appear semi-circular ridges crowned with clumps of cypress pine trees.”
George Robinson, in April 1843 (Clarke 1988): notes the co-occurence of “pine trees and Hee oak [sic]” on sandy soils.

Hawdon’s specific reference to timber in watercourses implies that drainage channels, widespread across the plains, were formerly dominated by trees and not grassland. The semi-circular ridges Hawdon also refers to are probably lake side lunettes (Macumber 1991) which are today virtually devoid of indigenous vegetation. This account suggets that lunettes were formerly dominated by cypress pine (probably *Callitris glaucophylla* and/or *C. gracilis* because only these species are found in the region today) at least in the Kerang area. Since settlement cypress pine has been systematically removed from the region because of its superior timber values and the prized loamy soils on which stands are found (LCC 1983). In fact, in the Northern Plain today, cypress pine is rarely found off the granitic sands of the Terrick Terrick Ridge and associated State Park (LCC 1983). The explicit preference for sandy soils as mentioned by Robinson suggests cypress pine was common on beds of shoe-string sands deposited by ancestral palaeo-channels (Macumber 1991) possibly explaining the “intersected narrow belts of pine trees” frequently recorded across the treeless plains.

The probable identity of all species mentioned in the historical literature throughout this chapter is listed in Appendix 3.1.

Widespread Presence of Shrubs Across the Open Plain Country

Four quotes record the widespread presence of shrubs:

Joseph Hawdon, on 31 January 1838, south east of Cohuna (Anon 1952): “The [plains] have a great number of bushes similar to those found on the sea coast, with juicy rather salt tasted leaf.”

George Robinson, on 3 April 1843, south of Cohuna (Clarke 1988): “The plains are.. studded with clumps of Banilla [sic] - main plant - a small main plant and pigs face.”

George Robinson, on 4 April 1843, in the Loddon River area (Clarke 1988): “The country from the river. and all around this as far as the eye can see is beautiful grassy plains (wiry grass) and Banilla [sic] with belts and copses of trees.”

Edward Curr, in the 1840’s (Curr 1965): "In places, as for instance around Mount Hope and the Terricks,..the salt-bushes obtained the height of 12 feet, standing twenty or thirty feet apart; in other localities a dwarf variety of this plant prevailed, and grew so close [together] as almost to crowd out the grass entirely.”

The terms “salsolaceous plants”, “salsola” and even “Banilla” (probably “Barrilla” which is Spanish for and is likely to mean “saltbush” in this context) are likely to refer to plants of the family Chenopodiaceae (salsolaceous - “belonging to or resembling [plants of] the genus salsola”. salsola - “a genus of plants belonging to the Chenopodiaceae, found on sea-coasts and salt impregnated soils of warm and temperate regions.” Murray *et. al.* 1961). Whilst few species are mentioned, it is clear that more than one species (and probably many) were present as at least two distinct layers, one up to a height of about 3 metres (12 feet) and the other perhaps about 1 metre tall. Furthermore, on the basis of Curr’s account, the larger salt-bushes were present in densities of about 80 individuals per ha and the small shrubs occasionally formed closed shrublands consisting of thousands of individuals per ha. These Figures suggest that the cover of shrubs varied greatly from probably > 50% (“almost crowd out the grass entirely”) down to < 10% (assuming an average radius of 2 m). It is believed that the larger salt-bush was *Atriplex nummularia* because it is one of the few chenopods that achieve the height described by Curr and there are remnant stands to the north in the Leitchville and Kerang areas. Examination of remnant vegetation suggests the composition of the shrub component was diverse and heterogeneous as an enormous variety of indigenous

(and often rare) shrub species are still present throughout the region where stock grazing has been absent or relatively infrequent (see later in Chapter).

Nature of the Ground Layer Over the Treeless Plains

A number of quotes refer to the nature of the ground layer vegetation:

Thomas Mitchell, in 1 July 1836 (Mitchell 1965): Whilst proceeded towards the Loddon, Mitchell reports ponds surrounded by "Yarra" trees and scrub of *Casuarinae* before crossing a plain of *Anthistiria* grass at a location approximately north west of the current township of Jarklin.

Joseph Hawdon, on 29 January 1838, in the Echuca area (Anon 1952): “I found there an old lame man collecting bulbous roots on the plain.”

Joseph Hawdon, on 30 January 1838, south east of Cohuna (Anon 1952): “Very little grass grows on [the plains], but they are covered with salsuginous plants.”

Joseph Hawdon, on 3 February 1838, north of Mitiamo (from Mount Hope) (Anon 1952): “The land [was] of the worst description; the plains have a thin sprinkling of small tufts of grass, but are for the most part covered with the salsuginous plant, vulgarly called pig’s face.”

George Robinson, 28 March 1843 (Clarke 1988): “The Campaspe plains over which we travelled are thinly grassed [one clump] to 2 foot of soil.”

George Robinson, on 3 April 1843, north of Mitiamo (Clarke 1988): “The plains are thinly grassed.”

Edward Curr, in July 1841, east of Rochester (Colbinabbin plains) (Curr 1965): “the grass, though at the distance it presented the appearance of a sward, consisted of sparsely-scattered tussocks of the finest descriptions; the wire grass, however, largely predominating over the kangaroo grass. As it was then winter, the interstices were filled with luxuriant herbage; the yam generally, and in some cases the myrnong or native carrot. Inferior grasses and weeds - [are] now unfortunately abundant.”

According to these accounts, at least in some places the ground layer was dominated by pig’s face; probably a species of Aizoaceae, possibly *Disphyma clavellatum* because large populations are still present in related vegetation in the Kerang area. Tussock grasses and forbs were apparently scattered in amongst the pig’s face. However, to the south (Colbinabbin

plains) the vegetation consisted entirely of a variety of tussock grasses and interstitial herbs; pig's face was not mentioned and presumably absent. Robinson's account suggests tussock grass densities of about 6 tussocks per m^2 and Curr suggests even sparser growth of very large and robust clumps under some circumstances. This compares to densities of between 100 and 120 tussocks per m^2 recorded from a existing long-grazed remnant near Mitiamo (see Chapter 4). Today's grass tussocks are probably also considerably less robust and substantial than those described by Curr because of the impact of continuous domestic stock grazing.

It is not clear what grass species were present, but references are made to "Dorothonia grass" (probably *Danthonia* spp.), "wire grass" (possibly *Lomandra effusa* because of its firm and grass-like appearance and general abundance in the region today), and "kangaroo grass" (possibly *Themeda triandra*, although some people still know the widespread *Stipa aristiglumis* under the same vernacular). Whilst *T. triandra* is found today in a number of remnants mainly in the south of the region, Mitchell provides evidence that it was formerly more abundant at least along sections of the Loddon River. He refers to a plain of *Anthistiria* on the Loddon River, west of Mitiamo which was probably *Anthistiria australe* or *A. ciliata* which are synonyms for *T. triandra* (Willis 1972). It is possible this species was formerly more widespread in the Northern Plain than it is today, especially in the south, since it is known to be very sensitive to grazing (Stuwe and Parsons 1977; McDougall 1989). Because some tussock grasses in the historical accounts were apparantly favoured by grazing (Curr 1965 pp. 86, descibes how a thicker sward of grass developed under grazing and in the absence of fire), it is likely that the species referred to are what is found in the better remnants today (i.e. *Danthonia* spp. and *Stipa* spp.). The survey accounts indicate maximum grass growth occurred during the winter and spring months, suggesting summer active species such as *Enteropogon acicularis*, *Sporobolus caroli* and *Chloris truncata* were subdominant then as they are today. Curr refers to the clayey plains as "calcined and barren" (Curr 1965), suggesting little litter was present in between the sparse grass tussocks, especially during the drier months of summer and autumn.

Least information exists on the herbaceous component of the flora. Species mentioned include: “anguillaria” (Mitchell 1965), a synonym for *Wurmbea* spp. (Willis 1970, 1972; Ross 1993); “yam” (Curr 1965), possibly *Microseris lanceolata* (vernacular - yam daisy or native yam); and “myrnong or native carrot” (Curr 1965) also *Microseris lanceolata* (because this plant has carrot like roots). Whilst some of these species are rare in grasslands today, many others were probably eliminated very early on and consequently the precise forb composition remains at best speculative.

Disturbance, Aborigine Management and Ecological Dynamics

Several quotes relate to natural disturbances and aboriginal land management at the time of European settlement:

Joseph Hawdon, on 31 January 1838, south east of Cohuna (Anon 1952): Both emus and kangaroos are “pretty numerous” and “in great numbers”.

Edward Curr, 1840’s (Curr 1965): "As regards the Kangaroo.. on average, these animals, it is thought, consume as much grass as a sheep and where a few score had originally existed there soon came to be a thousand. With this class of vegetation [treeless plain vegetation] great changes have occurred, and at Mount Hope (as in country generally in which it grew), stocking has almost destroyed it. The pig's face, once general in that country, has also disappeared, a luxuriant growth of grass having taken its place. The same might be said of cotton bush and other plants... The aborigines would set fire to the grass and trees both accidentally and systematically for hunting purposes. Living principally on wild roots and animals, he tilled his land and cultivated his pastures with fire; and we shall not perhaps, be far from the truth if we conclude that almost every part of New Holland was swept over by fierce fire, on an average, once every five years... I have noticed not only that crops now grow where formerly they would not, and that grass is more plentiful, but that one begins to of late miss on our clayey plains the calcined and barren appearance of thirty years ago [writing in 1870’s to 1880’s] , the result no doubt of the grass being feed off by stock, instead of being periodically burnt, as it used to be... Gradually the tussocks got feed down by sheep and cattle, they stooled out; and the seed got trampled into the ground around them, and in the absence of bush-fires grew, so that a sward more or less close resulted, such as we see at present.

Constant feeding has cultivated this propensity, and year by year the grass is more inclined to stool."

George Robinson, on 4 April 1843, south east of Boort (Clarke 1988): "The [aborigines] had been here very recent; some of the grass had been burnt and was quite fresh and close by we found their camp counting 8 huts."

These historical accounts provide direct evidence of the presence and impacts (on vegetation) of aborigines, fire, stock grazing, soil disturbance and native herbivore grazing on the treeless plains. Curr noted an increase in tussock grass abundance over the initial decades of pastoral use and attributed this change to stock grazing and the absence of fire. Curr also blames these same factors for the disappearance of pig's face, associated salt-bushes and other plants.

Curr portrays the region's aborigines as resident agriculturalists ("tilling" and "cultivating" his "pastures") deliberately and systematically manipulating their environment with fire, which helped them obtain their principle food sources of animals and wild roots (Curr 1965). So widespread were the burning practices that Curr estimated most of the region was burnt at an average frequency of every five years, effectively as a regional mosaic. Whilst Curr refers to aboriginal burning, few specific events are recorded in the historical references - only Robinson refers to recent burning in April 1843 (Clarke 1988). The structure of the vegetation in combination with frequent burning would have maintained low quantities of fine fuel as supported by Curr's comments: "in extolling its pastures, I refer not to the quantity of forage, which is low, but to the quality, which is super-excellent." (Curr 1965, pp. 93).

Native herbivores such as the emu and kangaroo were reported in a number of sources as numerous and abundant even before stock were introduced in large numbers. During the 1840's Curr reports an apparent explosion in kangaroo numbers causing problems for pastoralists. It is speculated that this increase in numbers may be linked to the change in tussock grass abundance because these animals are largely graminivorous.

Curr noted that weeds (presumably exotic volunteer species) were abundant in 1841 west of Rochester (Colbinabbin area) (Curr 1965). This invasion can be almost exclusively attributed to the introduction of domestic stock, although by the 1870's cropping was common-place in the region (Munro 1993), a practice that disturbs the soils and provided the opportunity of a whole new suite of exotic plants to emerge.

Contrasting Descriptions of the Same Landscape

Some accounts of the landscape are in stark contrast to one another, for instance:
Major Mitchell, on 30 June 1836, north of Mitiamo (from Pyramid Hill) (Mitchell 1965): "The view was exceedingly beautiful over the surrounding plains.. The scene was different from anything I had ever before witnessed. A land so inviting and still without inhabitants... the first European intruder on the sublime solitude of these verdant plains."
Joseph Hawdon, on 3 February 1838, north of Mitiamo (from Mount Hope) (Anon 1952): "The land [was] of the worst description; the plains have a thin sprinkling of small tufts of grass, but are for the most part covered with the salsuginous plant, vulgarly called pig's face."
George Robinson, in 1843, on the Loddon River south east of Boort (Clarke 1988): "My flattering anticipations of travelling down the course of a pretty river with beautiful grassy banks were totally disappointed."
Edward Curr, in 1840's, writes with respect to pastures (Curr 1965): "it is interesting to recall for a moment, the opinions of our early explorers as to their value, were it merely to remind us how wide they were of reality. The most superficial examination of their pages shows that they habitually denounced as unprofitable wastes,.. large tracts of country,.. which experience has proved equal perhaps to anything in any part of the world."

Mitchell's explorations were perhaps more political than scientific as he had been sponsored by the government to discover new lands and encourage their settlement. Furthermore, in the context of this his third major expedition, for the previous several months he had been travelling over vast homogenous plains and was relieved to encounter granite hills. In combination with the mildness of the season, Mitchell's initial description of the Northern Plain was probably tainted with a hint of exaggeration and romanticism (Foreman 1993). The contrasting comments from Hawdon and Robinson of clear disappointment reflect both their

high expectations and the harshness of the summer period. Curr notes that explorer accounts were just as prone to negative as well as positive exaggeration.

It is interesting to note that Mitchell fails to document the presence of salt-bushes on the plains north of Mitiamo (surrounding Mount Hope), as all others have been quite emphatic. Perhaps Mitchell, who had spent the last few months travelling through country dominated by vegetation of a succulent nature, was not bothered to repeat documentation of either its description or presence. Whereas in stark contrast, Hawdon, Robinson and later Curr, travelled and explored mainly in Victoria where such vegetation is less abundant. Furthermore, all three came initially from the south of the state where salt bushes are only conspicuous along the coast (Foreman 1993).

Old quotes from the original explorers of the region proved to represent the key historical source for reconstructing the nature of the vegetation at the time of European settlement. Whilst the observations must be carefully interpreted in context and are often ambiguous, they contain a wealth of information and insight that would otherwise not be possible from all other sources (i.e. illustrations and survey maps).

Illustrations

The earliest known illustrations of grassland landscapes in northern Victoria were produced by Ludwig Becker, during the Burke and Wills expedition to central Australia (Tipping 1979). The expedition passed through the region between Bendigo and Swan Hill (via Mount Hope) in August and September 1860. Ludwig Becker, who was employed as a scientific officer for the expedition, painted a number of water-colour pictures of the plains around the Terrick Terrick range (Tipping 1979). “View from Mount Hope. Pyramid Hill bearing S. 30. W.” (1 September 1860, No. 4 reproduced in Tipping 1979) depicts the plains surrounding the outcropping granite formations as a complex mosaic of treed and treeless vegetation (Fig. 3.1*a*). “Crossing the Terrick Terrick Plains” (29 August 1860, No. 2 reproduced in Tipping 1979) and “Terrick Terrick Hills bearing N. 6. W. Dist: 13 miles...” (30 August 1860, No. 3 reproduced in Tipping 1979) both portray the plains south of where Mitiamo is today (see Chapter 2) as treeless and

dominated by low tussock-forming grass-like plants, with copses of short and open woodland in the background (Fig. 3.1*b* and 3.1*c*).

"Corroboree held at night. Fernyhirst Felix Eugen Montago Scott." taken of Dja Dja Wrung clansmen probably at Fernihurst Estate in 1856 (Dallas Evans pers. comm.) (located on a range of metamorphic hills where the homestead is still located today) depicts an open box woodland with no understorey shrubs (reproduced in Munro 1993, pp. 13). Similar scenes are shown in the sketches and illustrations by some of the early pioneers in the region such as Fredrick Race Godfrey (held at the Victorian State Library) and earlier Thomas Mitchell ("The Yarrayne" reproduced in Munro 1993, pp. 18).

Historical Maps

Annotations from numerous maps provided an indication of the broad composition, structure and distribution of indigenous vegetation at the time of European settlement. Typical annotations referred to the general nature of the landscape: "open plains" or "extensive grassy plains", although occasionally additional information regarding the composition and structure of the vegetation was also provided: (area south of Cohuna) "Extensive level plains, salsolaceous plants and very rich grass and herbage winter and spring, interspersed with clumps of box forest and polygonum swamps" (Fig. 3.2).

The frequently recorded species, "gum and polygonum" in the context of depressions or swamps are probably references to *Eucalyptus camaldulensis* (river red gum) and *Muehlenbeckia florulenta* (tangled lignum) because both are typical of inundated remnants today. Similarly, "box" probably refers to *E. microcarpa* (grey box) and *E. melliodora* (yellow box) which are also widespread dominants of remnant woodland vegetation, although *E. largiflorens* (black box), typical of ephemeral swamps and drainage lines in the region today, could also be included. "Honeysuckle" is recorded in the east around the Goulburn River and is probably *Banksia marginata* which was recorded as widespread both east and west of the Campaspe River in Everett (1869). This species is now considered extinct in the region, although old individuals are known from the southern Riverina of NSW (Phil Maher pers. comm.).

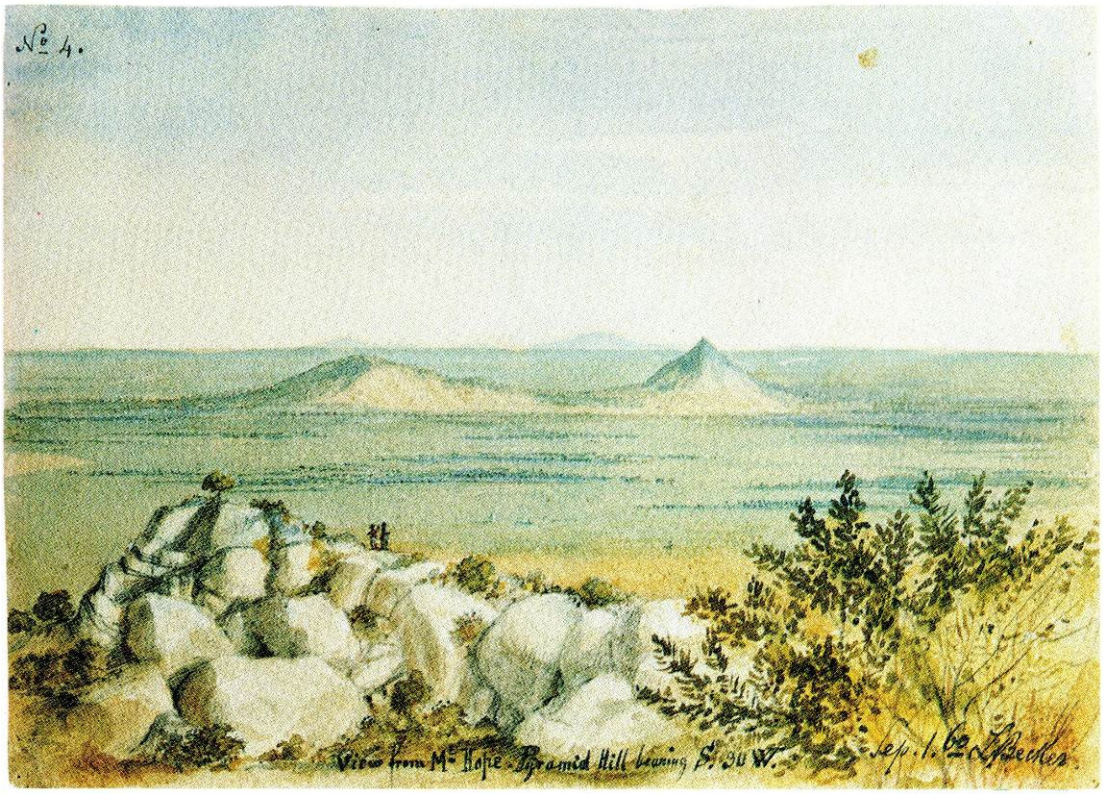

Fig. 3.1. (a) View of treed and treeless vegetation on plains surrounding Pyramid Hill by Ludwig Becker, entitled "View from Mount Hope. Pyramid Hill bearing S. 30. W." 1 September 1860. (reproduced in Tipping 1979).

Fig. 3.1. (b) View of treeless plains south of Mitiamo showing ground vegetation detail and open woodland copses in background by Ludwig Becker, entitled "Crossing the Terrick Terrick Plains" 29 August 1860. (reproduced in Tipping 1979).

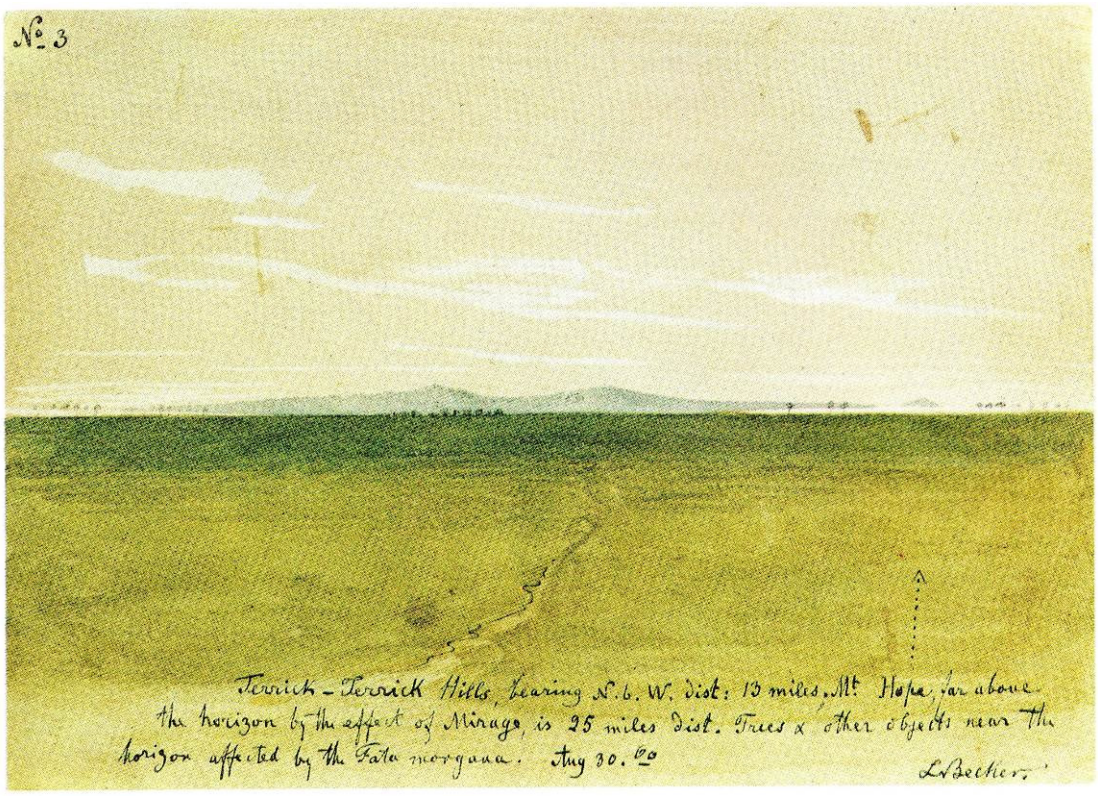

Fig. 3.1. (c) View of treeless plains south of Mitiamo with the Terrick Terrick Range in the distance, entitled "Terrick Terrick Hills, bearing N. 6. W. Dist: 13 miles Plains. Mount Hope far above the horizon by the effect of Mirage, is 25 miles Dist. Trees and other objects near the horizon affected by the Fata morgana" 30 August 1860. (reproduced in Tipping 1979).

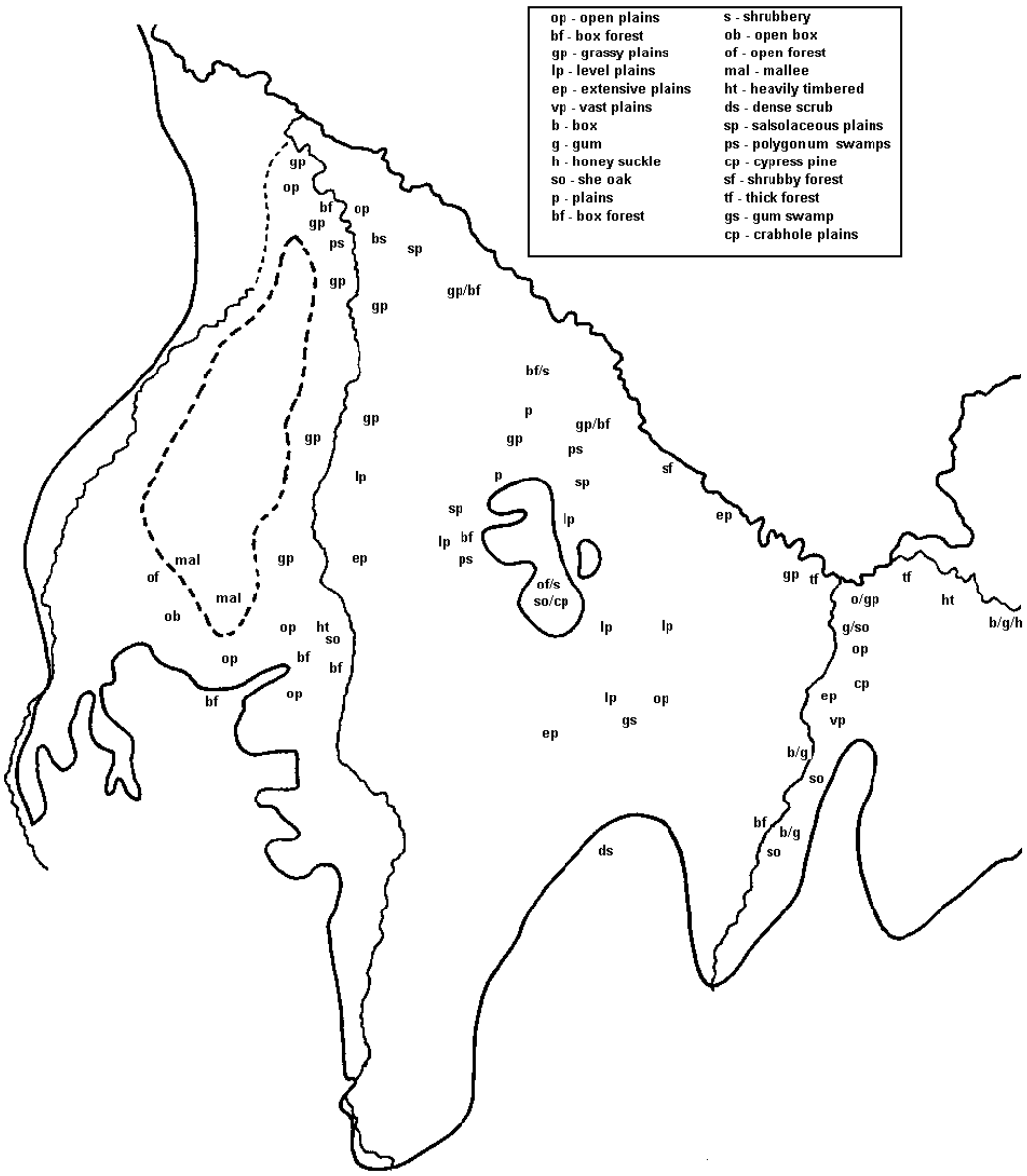

Fig. 3.2. Selected vegetation annotations recorded on historical survey maps in the western half of the Northern Plain.

Grassland - Environmental Relations; Soils Maps

The vegetation of the Powlett Plains, near Fernihurst (formerly part of the Fernihurst squatting run) was mapped very accurately in 1859 (Fig. 3.3*a*). The feature of the map is the detail of the boundary between "(well grassed) Box Forest" and "(richly grassed) Open Plains" mapped over a total area exceeding 25,000 ha. Direct comparison of this vegetation map with the detailed soil type map (Skene 1971) over 42% of this area, shows that the grassland-woodland boundary broadly corresponds with soil types (Fig. 3.3*b*). Grasslands in this region primarily occur on clay loam (surface horizon texture) soils of the Riverine Plain with the dominant soils being: Kinypaniel clay loam and friable clay, and Fernihurst clay loam and

friable clay (note that the friable clay component represents the depressions and puffs of gilgai which frequently occur as a complex mosaic with the more stable clay loam soils) (Table 3.1). These soils are the dominant component of the “treeless plain landscape unit” described in Skene (1971) and are widespread in the southern portions of the Mid-Loddon district. In total, six of the 23 soil types within the Fernihurst study area form part of this “landscape unit” (Table 3.1). Box forest (woodland) tends to be dominant on all other soil types, although it usually occurs on soils with a surface texture lighter than clay loam (Table 3.1, Skene 1971).

Soils in this area reflect topographic position, with the lightest textured soils with free drainage at the highest elevations along the Fernihurst metamorphic ridge, ranging down to the heaviest textures (worst drainage characteristics) in the lowest swamps and depressions subject to frequent inundation. Grassland vegetation tends to occupy the region in between - very flat Riverine plains with moderate to heavily textured soils not subject to inundation as Skene (1971) explains:

> “[Treeless Plain].. is easily the most extensive landscape unit, and is marked by an almost level plain having little topographical relief, and practically devoid of trees. However, black box grows in some of the drainage lines. Lignum is associated with most of the low-lying situations which are seasonally inundated.”

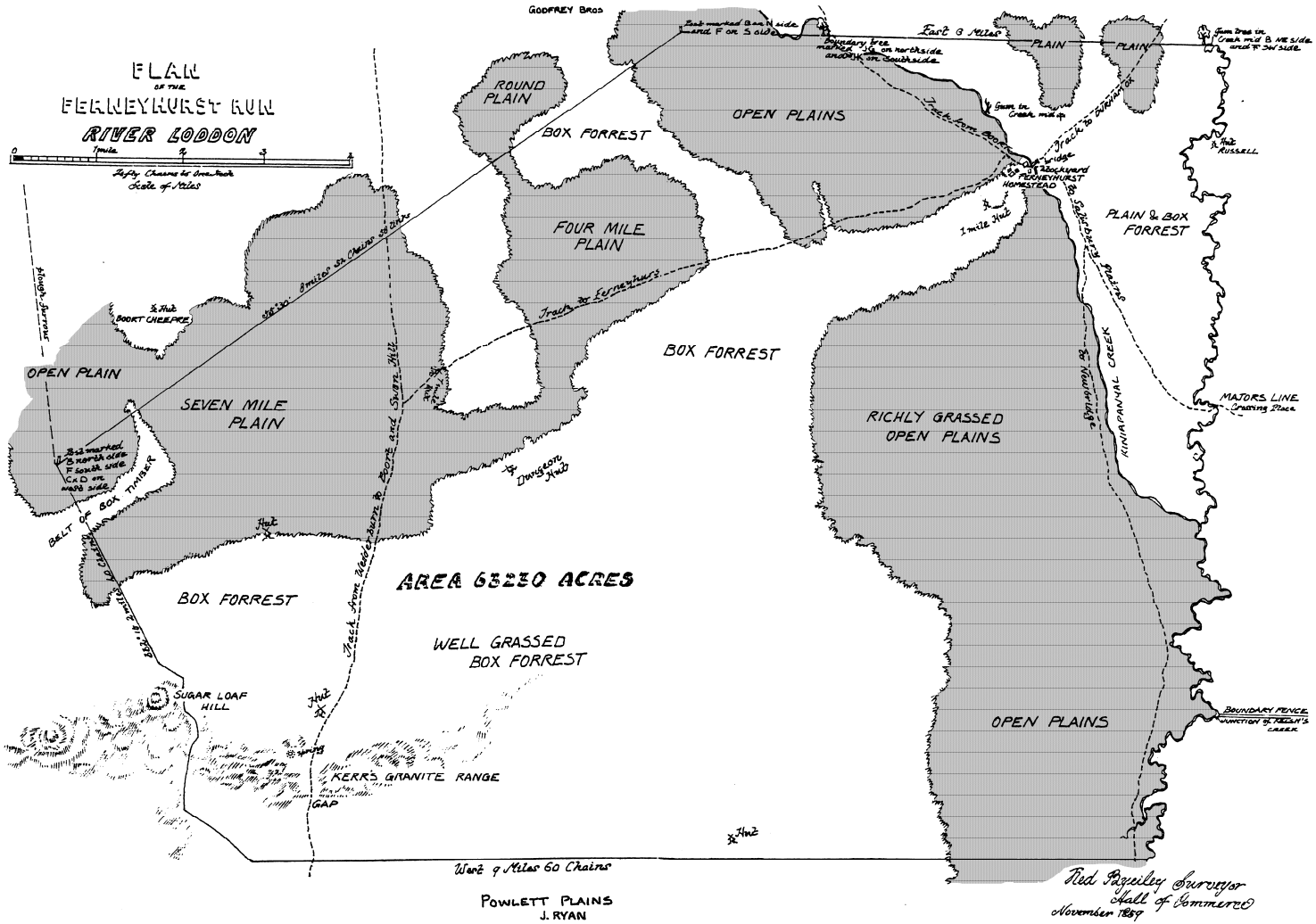

Fig. 3.3. (a) Plan of the Ferneyhurst run (Loddon River) in 1859 depicting major water courses, lease boundaries, thoroughfares, dwellings and vegetation boundaries (grassland area shaded).

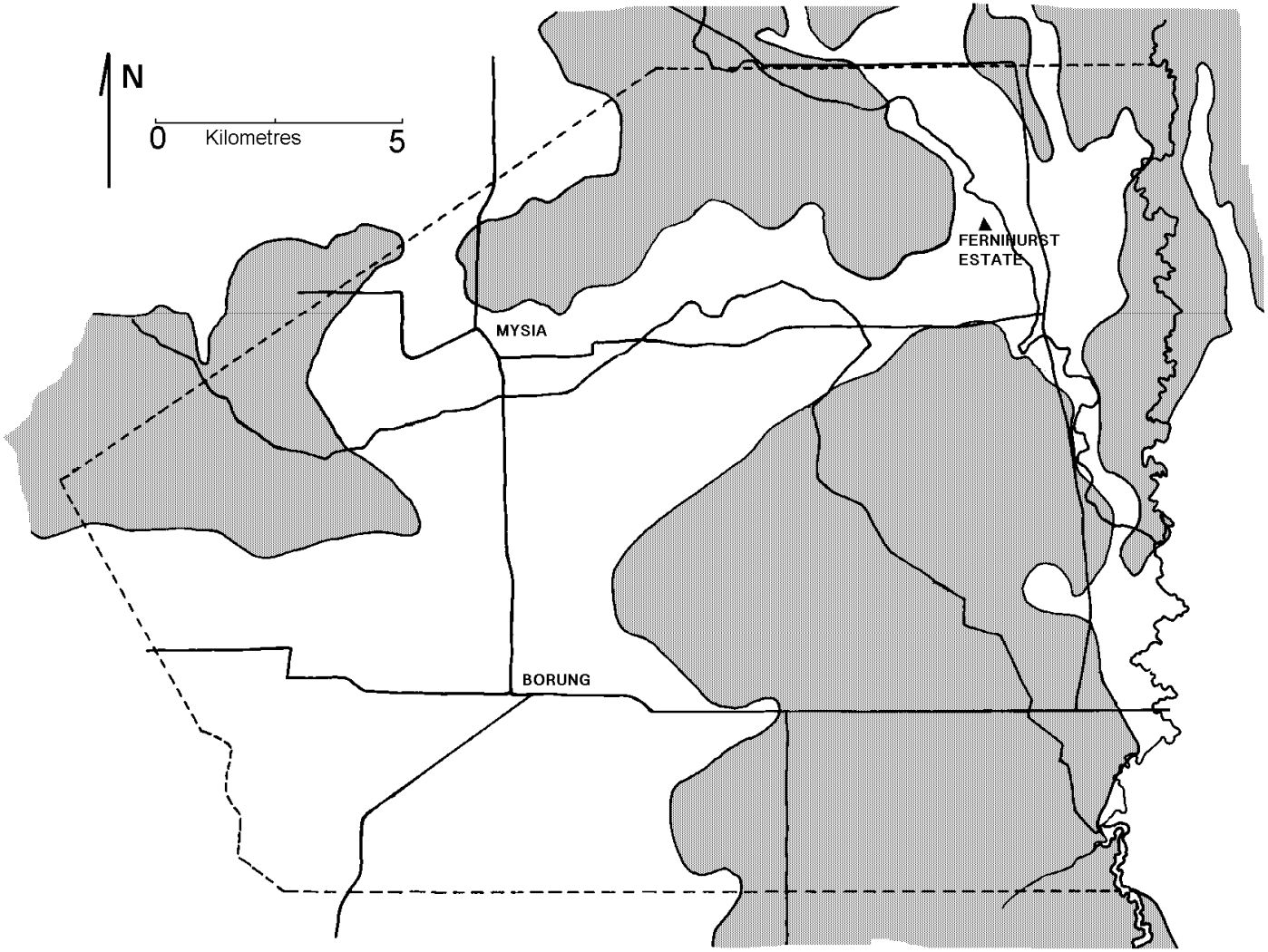

Fig. 3.3. (b) Map of identical area depicting grassland distribution (shaded) derived from soils and API information.

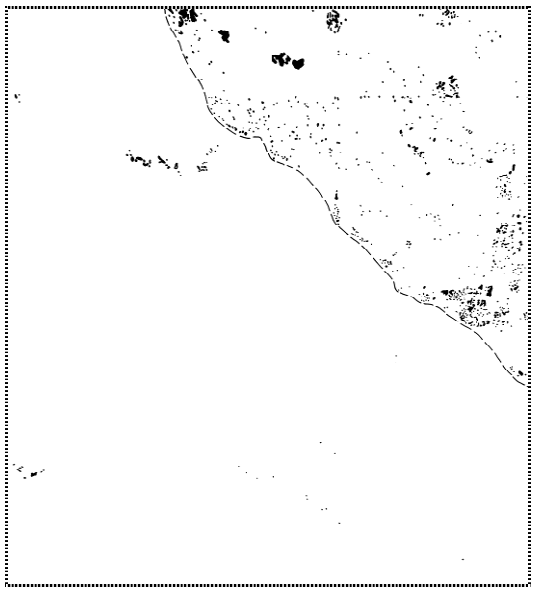

Fig. 3.4. Aerial photographic interpretation of tree cover derived from a 1:25,000 photograph taken near Raywood; Mitiamo 1:100,000 mapsheet Run 14, No. 77 on 21 December 1990. Dashed line represents generalised grassland - woodland boundary.

Table 3.1. Proportion of soil types in part of the Fernihurst district which were mapped as "box forest" or "open plains" in 1959. Tex = surface horizon soil texture; P = plain, open; BF = box forest; Tot = total open plain and box forest; % = proportion of open plain, box forest or total area. CL - clay loam; C - clay; FSL - fine sandy loam; L - loam; SCL - silty clay loam. TP - soils mapped as "treeless plain" in Skene (1971).

Soil Type	Tex	P (ha)	BF (ha)	% P	% BF	Tot (ha)	% Tot
Fernihurst clay loam TP	CL	2934	475	44	12	3410	32
Kinypaniel clay loam TP	CL	830	507	13	13	1337	13
Fernihurst clay loam/friable clay TP	CL	604	0	9	0	604	6
Fernihurst clay loam/Kinypaniel clay loam TP	CL	36	0	1	0	36	0
Kinypaniel clay loam/friable clay TP	CL	22	0	0	0	22	0
Totals, clay loam				**67**	**25**		
Boort clay/Myella loam	-	32	0	0	0	32	0
Unclassified depression	-	0	20	0	1	20	0
Unclassified high land	-	144	158	2	4	302	3
Unclassified soils	-	97	202	1	5	299	3
Yando clay TP	C	190	18	3	0	208	2
Swamp soil, type 2	C	28	113	0	3	141	1
Tragowel clay TP	C	21	0	0	0	21	0
Swamp soil, type 3	C	5	64	0	2	69	1
Boort clay	C	0	35	0	1	35	0
Swamp soil, type 1	C	0	57	0	1	57	1
Wandella clay	C	0	8	0	0	8	0
Mysia fine sandy loam	FSL	229	317	3	8	546	5
Mysia loam	L	1155	1385	17	35	2539	24
Myella loam	L	218	391	3	10	609	6
Wychitella loam	L	14	0	0	0	14	0
Loddon silty clay loam	SCL	57	192	1	5	249	2
Totals, all other soils				**33**	**75**		
Grand Totals		6616	3943			10558	100

The relationship between soil type and the distribution of treeless plains, supported by the comparison with a 19 th century map at Fernihurst, is reflected in the arrangement of soil types into "landscape units" in Agricultural Department soil mapping (Johnson 1952; Skene

and Poutsma 1962; Skene 1963; Skene and Harford 1964; Skene and Sargeant 1966; Skene 1971; Sargeant *et. al.* 1978; Badawy 1984). Each of these mapping projects classifies soil types into broader "landscape units" that consistently include "treeless plain". Whilst the grassland soils identified at Fernihurst are extensive in the Mid-Loddon district, they gradually change to the north and east where they are replaced by very similar soils still classified under the "treeless plain landscape unit". In cases where "treeless plain" soils have a clay texture, it is presumed they have remained "treeless" because of the lack of inundation.

In areas, where detailed soil mapping had not been undertaken, API of remnant tree cover was used to broadly define the woodland - treeless plain boundary (Fig. 3.4).

Treeless Plain Distribution at the Time of European Settlement

Based on the above reconstruction, the treeless plains vegetation of the Northern Plain was primarily restricted to the western half of the region and occupied 3992 km^2 (Fig. 3.5). It was most abundant across the lower Loddon, Avoca and Campaspe River catchment plains. In the west, such vegetation extended into the Wimmera where Connor (1966*a*, 1966*b*) and Anon (1966) report large expanses of treeless plains in the Horsham district between the Wimmera River and the Yarriambiack Creek. About 20 km east of the Campaspe River, along a boundary approximating the 450 mm annual rainfall isohyet, the treeless plains merged into box woodland. Although some historical sources suggest the existence of treeless plains even east of the Goulburn River, the eastern half of the region was originally dominated by box, pine and honeysuckle woodlands (Hodgkinson 1856; Everett 1869; Duncan 1982).

The actual distribution of this vegetation was far more complex than is shown on the map because it represents a summary of great detail (see Skene 1971). Furthermore, historical references indicate that the plains were frequently transected by narrow belts of timber on both the lighter textured prior stream ridges and inundated drainage channels. On the basis of this framework, the distribution of different indigenous vegetation forms throughout the region is probably linked to soil types.

The Agriculture Department soil surveys assigned each soil type to a broader landscape unit characterised by unique vegetation types using API and field observations (Table 3.2 derived from Skene 1971). The topographical variation within the mapped expanses of treeless plains reflect different soil types and often strikingly different indigenous vegetation.

Table 3.2. Relationship between soils and vegetation in the Mid-Loddon district.
Source: Skene (1971)
GB - Grey Box (*Eucalyptus microcarpa*); YB - Yellow Box (*E. melliodora*); Ca - Casuarina (probably *Allocasuarina luehmannii*); NG - native grasses; ex - exotic species; BB - Black Box (*E. largiflorens*); WG - Wallaby Grass (*Danthonia* spp.); DB - Dillon Bush (*Nitraria billardierei*); Se - Seablite (*Suaeda* spp.); Sa - Samphire (probably *Halosarcia* spp.); TS - Trailing salt-bush (prob *Atriplex* spp.): Li - Lignum (*Muehlenbeckia florulenta*); RG - Red Gum (*E. camaldulensis*); Ma - Mallee species (*Eucalyptus* spp.); Be - Belar (probably *Casuarina pauper*). wl - woodland, sl - shrubland, gl - grassland. Riv - Riverine Plain; Par - Parilla sand or Marine Plain; Gran - granite (see Macumber 1991)

Landscape Unit	Dominant soils	Geology	Vegetation Structure	Dominant species
Prior Stream Woodland	Yarrawalla fine sandy loam	Riv	wl	GB, YB, Ca
	Yarrawalla loam	Riv	wl	GB, YB, Ca
	Mologa loam	Riv	wl	GB, Ca
	Lyndger loam	Riv	wl	GB, Ca, YB
	Mysia loam	Riv	wl	GB, YB, Ca
Treeless Plain	**Fernihurst clay loam**	**Riv**	**gl**	**NG, ex**
	Kinypaniel clay loam	**Riv**	**gl**	**occasionally BB**
	Marcona clay	**Riv**	**gl**	**-**
	Kerang clay	**Riv**	**gl**	**WG, DB, Se, Sa, TS**
	Tragowel clay	**Riv**	**sl**	**L**
Low Woodland	Boort clay	Riv	wl	BB
	Wandella clay	Riv	wl	BB, Li, RG
Mallee Plain	Marmal loam	Par	sl	Ma
	Marmal clay loam	Par	sl	Ma
Ridge and Lake Complex	Catumnal loam	Par	wl	GB, Ca, YB
	Catumnal clay loam	Par	wl	GB, Ca, YB
	Coombatook sandy loam	Par	wl?	BB, Be, RG
	Coombatook sandy clay loam	Par	wl?	BB, Be, RG
	Woolshed sandy loam	Par	wl, sl	GB, Ma
	Woolshed loam	Par	wl?	-
Ironstone Gravelly Ridgeland	Wychitella clay loam	Par	wl, sl	Ma, YB, Ca, GB
Granite Highland	Terrick sandy loam	Gran	wl	MP, YB, Ca
	Terrick sandy clay loam	Gran	wl	MP, YB, Ca