

The new vegetation

Perhaps the most significant vegetation change that has come with the establishment of present land use is the creation of an agricultural landscape of tussock grassland, sown pasture and crops. This has replaced vegetation of entirely different growth forms, and has introduced new species and a new structural form of vegetation—the swards of the exotic sown pastures.

The pastures are either perennial, such as those of the wetter coastal valleys, or annual, where they may alternate with a variety of crops. They are composed of introduced legumes and grasses, and are grazed to a low sward. Cropping is based on the cyclic domination of single species stands. The best example of this is the annual wheat crop, which for part of the year covers about 120 000 km².

Sown pastures now dominate over 400 000 km² or more than 5% of

the continent. They also form the understorey to a further 50 000 km² of open woodland in the south-east. Once established, most of the pasture grasses are self-generating, while many of the native species decline under livestock grazing. Without the addition of fertilisers, however, their grazing value is similar to that of the native species.

The addition of legumes to pastures increases soil nitrogen as well as the amount of protein available to domestic stock, but they also

require fertilisers to become well established. The rise to dominance of the legume pastures across southern Australia, most notably that of subterranean clover (*Trifolium subterraneum*), came with the widespread application of superphosphate during and after the 1920s. Since then the identification of trace element deficiencies in many regional soils has improved pasture establishment.

In tropical Australia the search for suitable legumes to accompany the numerous introduced grasses and to increase the grazing value of northern pastures has seen the introduction of a variety of species. These are mostly from tropical Africa and America and include several species of *Stylosanthes*, such as Townsville stylo (*S. humi-*

lis) and the widely sown Siratro (*Macroptilium atropurpureum*). But there are still few persistent legumes suited to the heavier clay soils of the brigalow country, so pasture sowings in these areas are usually of pure grasses, such as buffel grass (*Cenchrus ciliaris*), Rhodes grass (*Chloris gayana*) and Guinea grass (*Panicum maximum*).

The area occupied by tussock grasslands has increased by about half and now covers around 9% of Australia. As well as this expansion in area, present land use has led to changes in density and floristic composition within the grasslands. These grasses are also the understorey in a wide range of vegetation types, as depicted on the Grass Cover map opposite.

Salinity

Land salinisation is a consequence of the widespread removal of natural vegetation, unforeseen when the major clearing for agriculture began. The process which has led to the salinisation of productive farmland in the WA wheatbelt (pictured) and the lower Murray River basin is primarily the result of reduced transpiration, increased groundwater recharge and rising water-tables.

There are vast areas of naturally saline soils throughout Australia and most of these overlie saline, and often quite shallow, groundwater bodies. In many such areas there is a salt-adapted flora, most notably saltbush, bluebush and samphires.

Dense deep-rooted vegetation acts as a natural pump by cycling much of the water which enters

the soil back into the atmosphere through transpiration. With the removal of this vegetation the natural balance between infiltration and transpiration is broken and the amount of water which enters the groundwater increases. The level of the water-table gradually rises as a result and eventually reaches the surface in low-lying areas, killing the vegetation. Salt is further concentrated in these seepages by evaporation.

Major clearing began in the WA wheatbelt and the lower Murray basin during the 1920s and the problems of land salinisation only became apparent in the 1970s. In WA about 3500 km² have been affected and this area is increasing. Along the lower Murray the problem is increased by the addition of large amounts of irrigation water to the shallow saline groundwater.



Weeds

Some plant species have proved very difficult to control and become serious weeds when they impinge upon economic activities or the integrity of natural areas. Plants are given weed status for a variety of reasons, such as toxicity to stock, competition with desirable species or spoilage of agricultural products.

The weeds in Australia are both native and exotic species. Native plants have become pests in agricultural areas where they compete with plants of agricultural value. The bracken fern (*Pteridium esculentum*) and the woody weed shrubs are native

species which compete with forage grasses.

Of the thousands of introduced species, many that have become well established are now classed as weeds and are permanent additions to the flora. They are generally confined to disturbed lands but there are exceptions such as the blackberry (*Rubus fruticosus*), which is a major weed in areas receiving more than 750 mm of rainfall across southern Australia.

Blackberry is not only a pest of grazing lands but has also displaced native shrub species along stream banks in largely natural bush. Others have found

unoccupied ecological niches, such as *Acacia nilotica* on treeless clay plains where no native *Acacia* species occur, or the numerous weeds of grassland which have increased with the grazing of native grasses.

Certain agricultural weeds are found only on soils with high nutrients and appear only after pasture improvement. Cape weed (*Arctotheca calendula*) and a number of the thistles fall into this category. Others occur largely on poor soils. Many weed plants originated from Europe, the Mediterranean region or South Africa.

A well-known example is Paterson's curse (*Echium plan-*

tagineum), a Mediterranean garden plant introduced to SA in the 1850s. It spread rapidly, was recognised as a problem in NSW by the 1880s and is now widespread in the eastern States.

Paterson's curse is also known as Salvation Jane in the drier parts of SA (pictured) where it provides some valuable feed, yet in quantity it may be poisonous to stock. It is also considered a valuable honey plant and this has led to recent controversy over the release of a potential biological control organism. Honey producers saw this as a threat to a valuable source of early-season pollen and nectar.



There has been a decline in the foliage cover of the tropical Mitchell grass vegetation over much of its range as a result of continuous grazing by both cattle and sheep. There has also been a general decline in native grass cover throughout the semi-arid woodlands and shrublands, although this is not often apparent on the maps. Long-term cover changes may be difficult to detect in inland areas where the foliage cover of grasses is subject to enormous fluctuations.

Shifts in species composition have also been widespread. The introduction, both accidental and deliberate, of a large number of exotic grasses has created obvious floristic changes but within the native grasslands there have also been

shifts in the relative dominance of different species under grazing.

Most of the grasses which now occur in temperate woodland areas of the south-east are part of grazing-induced disclimax communities of short, cool-season grasses such as *Stipa falcata* and *Danthonia* species. These areas were formerly dominated by taller perennials which grew during the warm season, in particular *Themeda australis* and *Stipa aristiglumis* (Moore 1970). Grazing disturbed the balance which maintained these species in favour of winter growing and annual types. In pasture-improved areas there has been an increase in exotic annuals such as *Vulpia* and *Bromus*. *Themeda* has withstood grazing in summer rainfall areas and remains an

important component of the northern grasslands.

Introduced grasses have replaced native species particularly under intensive management. Most native grasses are slow-growing and are adapted to low nutrient soils, so they tend to be disadvantaged by the intensive grazing and added fertilisers of modern agricultural practice. In the south-west of WA the native grasses were rapidly displaced by grazing and the industry is now entirely based on sown pasture species.

In addition to the 146 genera of grasses that are native to Australia, there are now also 64 naturalised exotic genera. Most of these new genera have a temperate origin, and are represented in the pas-

tures and crops by such genera as *Lolium*, *Phalaris*, *Vulpia*, *Hordeum* and *Triticum*. Some widespread introduced grasses of tropical origin, such as *Cenchrus*, *Brachiaria*, *Panicum*, *Paspalum* and *Pennisetum*, are from genera which also have native Australian species (Clifford and Simon 1981).

The process of the rise and decline of species is as old as the continent itself, but the vegetation has been rapidly and fundamentally changed by the introduction of thousands of new plant species over the last 200 years. Many of these, such as crop and pasture plants, are restricted to cultural landscapes, but even in largely unmodified areas the flora has been permanently changed by the invasion of naturalised exotic species.

Grass cover

In the last 200 years the total area of tussock grassland has risen from 500 000 km² to over 700 000 km². This overall increase actually masks some apparent losses of grassland, most notably to *Acacia nilotica* woodland over 50 000 km² of Mitchell grass country in Qld.

A better indication of the total increase in the coverage of grasses is given by includ-

ing all vegetation types with a grassy understorey, as most such areas are grazed and many woodlands, shrublands and even forests have been modified to increase their grazing potential. The total area of vegetation with a ground cover of tussock or sward grasses, which includes the sown pastures, has risen from about 38% to its present coverage of 50% of the continent.

Even this is an underestimate of the extent of grasses, because the map coding system identifies at most two layers of vegetation. As a consequence, where other understorey types occur over grass, it is not shown.

This map shows the extent of tussock grasslands, sown pastures and other vegetation with a grassy understorey. The green areas are the original grassy vegetation types and

the blue areas are increases, mainly in agricultural areas, but also in pastoral country where the thinning of woody natural vegetation has increased the prominence of grasses.

The areas in western NSW where a grassy understorey has been reduced by dense shrub growth stand out as the major loss of grasses, although other examples where grass cover has declined do not appear.



The next 200 years?

The period 1990 to 2000 has been designated the Decade of Land Care in Australia. There is worldwide concern that time is running out for natural ecosystems exploited by humans. Australia has the advantages of a small population and large natural areas, but the retention of part of the woody vegetation cover is no less important if agricultural production is to be maintained and further environmental crises of our own making are to be avoided.

The role of the loss of tree and shrub cover in contributing to the growing environmental problems facing this country has now been recognised. Retaining trees actually enhances the long-term productivity of agricultural land by

protecting soils, providing shelter and reducing salting.

It is now Australian Government policy to attempt to replace some of the billions of trees which have been removed, mostly from agricultural areas. Among the initiatives on the environment is the establishment of baseline data on the distribution and condition of natural resources. This is seen as essential for monitoring the predicted greenhouse effect changes and as a first step to balanced decision making, but the real work of rehabilitation and conservation must take place on the ground.

We have reached a critical stage in the development of this country's vegetation resources. There has been a gradual change in people's attitudes to the use of the land, yet

in the last decade thousands of square kilometres of natural vegetation were cleared on the margins of agricultural areas. This trend may be reversed in many areas in the coming decade as efforts are put into regeneration and replanting. The strength of present community concern is seen in farmers and conservation groups joining forces to plan the rehabilitation of degraded farmland.

The management of native forest resources has also reached a turning point, as the reconciliation of the dual roles of timber production and conservation comes under close investigation. There are proposals for an expansion of eucalypt plantation forests to rival the area of pine plantations, which would see a return to forest vegetation in parts of its former range.

