REGIONAL PASTURE DEVELOPMENT AND ASSOCIATED PROBLEMS I NORTHERN WESTERN AUSTRALIA

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ABSTRACT

The Kimberley region of Western Australia comprises some 32 million hectares of arid to semi-arid country supporting one hundred and three pastoral properties. About two thirds of a million predominantly Shorthorn cattle graze native pastures under open range conditions with a minimum of improvements and virtually no herd control. Widespread pasture degradation and erosion due to overgrazing of native pastures is being treated through management procedures involving grazing control and some cultural treatment in selected locations.

Early pasture improvement and plant introduction work at Kimberley Research Station were disappointing, but recent studies with pangola grass and leucaena at K.R.S. and with Stylosanthes *sp. in the higher rainfall areas and birdwood grass in the drier areas show considerable promise.*

EXISTING KNOWLEDGE & PRESENT SITUATION

The Kimberley region of northern Western Australia comprises approximately 32 million hectares of country lying from 14-20°S latitude and 125-130°E longitude and, by definition, within the tropics. It has been described (Teakle 1944) as a vast dome capped by sandstones interbedded with basalts and comprised of rugged mountain ranges and hill country of little or no pastoral value; fertile river flats and vast grassy plains which provide the most useful grazing; large areas of sandy country, referred to as Cockatoo Sand in East Kimberley or Pindan in West Kimberley, of moderate to low carrying capacity. The southern edge of the region which merges into desert is mainly soft spinifex country of low carrying capacity but providing a useful drought reserve. The coastal flats in the Derby-Broome area are characteristically saline with *Sporobolus virginicus* and the succulent drought resistant undershrub samphire as the major components. Buffel grass and kapok bush have colonised the less saline sections.

Geology

The geology of the area is fairly complex with rocks ranging from extremely ancient to relatively young. Jurassic sediments underlie much of the sandy Pindan country of West Kimberley while Permian sandstones and shales are prominent in East Kimberley where they give rise to large areas of sandy country exemplified by the Cockatoo Sands near Kununurra. Upper Cambrian limestones and mudstones cover a considerable area in the upper Ord River valley where soils associated with these formations have proved exceptionally prone to erosion, while Lower Cambrian basalts in the same area are associated with important areas of grassland. In both East and West Kimberley grasslands also occur on cracking clay plains associated with the main streamlines and limestone areas.

Climate

The area has an arid to semi-arid monsoonal type climate, characteristically hot and wet in the summer (wet season) and warm and dry in the winter (dry season). The months of May to August are relatively cool with maximum and minimum daily temperatures of about 32°C and 16°C respectively. In the remaining months

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maximum temperatures exceed 35°C and in October-November often exceed 38°C. Evaporation is high and ranges from 1000 mm to 2500 mm per year, with the highest evaporation rates occurring in the latter part of the dry season.

Rainfall is unreliable and ranges from over 1000 mm in the north-west coastal areas to less than 250 mm on the southern perimeter and is confined to the four month period November to February with January and February the wettest months. Useful rains can occur in October and March. Duration of useful pasture growth ranges from approximately 19 weeks near Kalumburu in the extreme north-west, to a low of 10 weeks at Hall's Creek.

History and development

A fully documented record of the history and development of the Kimberley area has been prepared by Bolton (1954). The first official mention of Kimberley appeared in 1837-38 following an expedition into the area by Captain Grey. Two attempts at settlement in West Kimberley were made in 1865 but were unsuccessful.

Alexander Forrest explored the region in 1875-78 and in 1883 John Forrest, with other pastoralists from established properties in the south-west of Western Australia, moved into West Kimberley and settled along the Fitzroy River. They were woolgrowers from relatively small properties and practised paddocking of their stock. The East Kimberley was colonised in the years 1884-85 by cattlemen from Victoria, Queensland and New South Wales.

The East Kimberley cattlemen introduced the open range system of grazing, a method easily adapted to local conditions and which still prevails on most properties, with stock treated as feral animals with little or no control over breeding or grazing. Properties average about 300,000 ha in size, are mostly company owned, and are generally poorly equipped with artificial waters or fences to control the movement of cattle. Mustering takes place annually between April and September to collect saleable bullocks and to brand calves. Bulls run with the herd the year round and conceptions can occur in any month. Heavy breeder and calf losses occur most years in late dry season, but these losses are generally accepted by pastoralists as an inevitable result of the harsh environment.

Shorthorn cattle introduced in the 1880's still predominate and appear reasonably well adapted to local conditions. Cattle numbers reached a peak of about 700,000 in 1916-17 and, despite the opening up of new country with artificial waters, numbers have dwindled to about 678,000, reflecting the deterioration in carrying capacity of the unimproved native pastures.

Sheep numbers along the Fitzroy River valley reached a peak of about 300,000 in 1912 but due to a combination of low wool prices, rising production costs, lowered lambing percentages and reduced carrying capacity there has been a dramatic reduction in sheep numbers and a complete changeover to cattle production.

In the absence of fences and with a minimum of artificial waters, stock have consistently overgrazed the more attractive and productive pastures along the river frontages and alluvial flats. Severe pasture degradation has occurred and erosion is widespread in both East and West Kimberley. The overall situation closely resembles the conditions described by Payne and Hutchison (1963) for the semi arid regions of East Africa.

Kimberley pastures have affinities with both the arid and high rainfall parts of Northern Australia. The grassy ground storey resembles that of the higher rainfall tropical areas, while other elements have affinities with arid environments where many of the trees and shrubs are edible. Pasture constituents throughout the region vary with soils, rainfall and former grazing pressure, but rainfall and length of growing season are the major factors in determining pasture quality and quantity.

In the 90 years since settlement the sheep and cattlemen have exploited the native pastures with controlled breeding, weaning, supplementation and pasture management virtually unknown. Apart from recent introductions of Townsville stylo

to North Kimberley pasture improvement has not been undertaken at the station level.

Pasture and fodder crop research

Most of the pasture and fodder crop research work so far has been carried out at Kimberley Research Station (K.R.S.), established in 1946 but biased towards irrigated crops aimed at the integration of the beef cattle industry with the Ord River Irrigation Project (Nunn 1967). The establishment of the 40,000 ha (approx.) Fitzroy Pastoral Research Station (F.P.R.S.) for beef cattle experimental work, near Fitzroy Crossing, in 1968, has provided station scale facilities for investigating and demonstrating dryland pasture management methods that could have widespread application.

Native pastures respond rapidly to the summer rains and soon provide a flush of palatable and nutritious forage, but in the long dry months that follow growth ceases and the pasture becomes a rank stand of dry material which decreases in nutritive value and digestibility as the season progresses. Declining protein and phosphorus content of mature pastures have generally been regarded as the major elements affecting livestock, but work at K.R.S. by Robinson and Sageman (1967) has shown that the balance of such important dietary constituents as calcium, phosphorus, protein and energy undergo marked changes as the pastures dry off.

Lamond (1969), from his surveys in north Queensland, concluded that a major reason for low turnoff from even the better managed properties was the chronic under-nutrition of pregnant and lactating cows grazing native pastures. Norman (1965) and Robinson & Stewart (1969) have shown that nutrition can be improved in the dry season even under extensive pastoral conditions by grazing Townsville stylo pastures or by the use of protein supplements.

Tropical grasses suffer from a mediocre digestibility even at their best (Minson and Milford 1966) and a rapid fall in digestibility and intake as the plants mature (Milford and Minson 1965). The superior quality of legumes in this respect points to the importance of finding suitable legumes for combining with tropical grasses both under natural rainfall conditions and irrigation.

Durack (1945) recognised the need for a legume based pasture and reported carrying capacities of 5 beasts ha^{-1} on a lucerne (*Medicago sativa*) Rhodes grass (*Chloris* sp.) mixture over a two year period on irrigated levee soils. Carrying capacity on a Rhodes grass pasture without the lucerne fell to 2 beasts ha^{-1}. These findings were confirmed at K.R.S. in the early 1950's where Langfield (personal communication) reported vigorous grass growth in the year of planting, followed by a decline in vigour which could be reversed with applications of nitrogen. Lucerne proved unsuited to the heavy Cununurra clay soils and suffered badly from "little leaf" virus attack. Of the many pasture legumes tested at K.R.S. the only one to survive any sufficient length of time in these early trials was *Clitoria ternatea*. It did not recover well from close grazing or mowing and, due to its twining habit, proved troublesome to cut and bale for hay.

Parbery (1966) reported that sorghum sp. grew well throughout the year and Anon (1970) calculated that sorghum grain production coupled with grazing of regrowth to fatten young store cattle would be profitable, but with increased fertiliser and labour costs and reduced beef prices this no longer applies. Four varieties of oats and three varieties of *Vicia* (vetch) were introduced to the station about 1963 and grown singly and in combination as a winter crop (Parbery 1968). Dry matter production was not significantly changed by incorporating the vetch with the cereal, but protein yields increased as the proportion of the vetch in the mixture increased.

Pangola grass (*Digitaria decumbens*) was tested at K.R.S. in the early 1950's but yields were disappointing. More recent work, based on Evans' findings in Queensland has produced better yields with heavy applications of nitrogenous fertilisers. The need for a cheap source of N was recognised.

In 1963, Parbery, working at K.R.S., reported substantial protein yields from a group of tree or shrub legumes and of these *Leucaena leucocephala* showed the greatest vigour after cutting. Peruvian leucaena planted in 1969 and 1974 in association with pangola grass produced mimosine toxicity problems at some levels of stocking and low daily weight gains at others. Work with pangola-leucaena mixtures is continuing at K.R.S. with particular attention to the selection of types with lower mimosine content.

Townsville stylo (*Stylosanthes humilis*) was established at K.R.S. in the 1948-50 period but abandoned. It performed poorly on the irrigated heavy clay soils and although it did better on the levee type soils it suffered from grass competition and rainfall appeared inadequate in all but above average seasons. Holm, in association with other northern Australian workers, is testing a wide range of *Stylosanthes* types in the higher rainfall areas of North Kimberley where several selections appear superior to Townsville stylo. These include selections of *S. scabra* and *viscosa*, which are true perennials, and *S. hamata* which is similar to Townsville stylo but with some ability to perennate.

At the station level, Townsville stylo was established at Kalumburu Mission in about 1942-43, where it has persisted and remained productive despite heavy year-round grazing under a 1000-1200 mm rainfall. Five or six comparatively new stations, established in North Kimberley over the past 8-12 years, have embarked on pasture improvement programmes based on Townsville stylo.

Kapok bush (*Aerva javanica*) (Nunn & Suijdendorp 1954) was introduced to the West Kimberley region by Fitzgerald in 1952, and since that time has been used extensively in association with buffel and birdwood grasses in the large scale regeneration of degraded and eroded pastoral country (Fitzgerald 1968). Improved pastures based on birdwood grass and kapok bush have been established in the Pindan country in the Broome-Derby areas adjacent to port and meatworks facilities and receiving a relatively assured 600-650 mm rainfall. Suppression of weed competition and control of wattle seedlings and regrowth are critical factors in the establishment year.

The Camballin project merits a brief mention. Located on a floodplain and drawing water from the Fitzroy River, the former rice growing area changed to grain and fodder sorghum crops to supply local stations and feed their own livestock. The owners, The Australian Land and Cattle Company, run seven cattle stations, control between 40,000 and 50,000 cattle, run a modern feedlot with a 4,000 head capacity, and have acquired an interest in the Derby Meatworks. Given better control of the waters, through a dam upstream, most of the present agronomic problems could be eliminated although the economic ones could remain.

GAPS IN EXISTING KNOWLEDGE

There are many gaps in our existing knowledge but the following spring readily to mind—

1. *Levels of pasture utilisation.* Very little is known about the correct level of utilisation of native pastures consistent with maximising production without destroying the basic resource.

2. *Pasture management systems.* A better management system to replace the much criticised "open-range" system has not been successfully demonstrated, while the economics of fencing and water supply installation on a station scale to permit full herd control have not been fully examined in the Kimberley situation.

3. *Pasture legumes for lower rainfall areas.* There is still a pressing need for a productive pasture legume capable of growing in the lower rainfall (500-750 mm) areas of Kimberley. Very little is known about the local legumes except, perhaps, some of their toxic properties, e.g. *Crotolaria* and *Indigofera* spp.

4. *Seasonal utilisation of pastures.* There is strong argument for increasing stocking rates to cope with the seasonal flush of growth, but this raises the problem of feeding the extra animals later in the dry season. Little information is available on our drought reserve types such as the *Triodea* and *Plectrachne* spp. In spite of high costs fodder conservation may have a place in new management systems. The economics of feeding sugar cane to beef cattle should also be investigated. Kapok bush offers distinct possibilities as a high protein forage in the dry season, but there is a palatability problem. A search for better strains of this plant seems warranted.

5. *Fertiliser requirements for improved pastures.* There is an urgent need to determine the minimum levels of N and P fertiliser required for the successful establishment and maintenance of productive legume based pastures in North Kimberley in view of current high fertiliser and transport costs.

6. *Management of regenerated pastures.* A lot more work needs to be done in developing suitable techniques for the management of regenerated pastoral country to permit useful grazing without further degradation.

7. *The extent and nature of pasture degradation and soil erosion.* The occurrence and severity of pasture degradation and soil erosion on Kimberley properties is recognised but the extent and nature of it has not been fully documented. Further regional surveys are required.

8. *Range condition and trend.* Insufficient detailed information is available concerning the reaction of native pastures to the grazing pressures being applied. The pastoralist should also be made aware of trends in pasture condition.

9. *Browse species.* With their increasing popularity the Brahman type cattle in Kimberley could ultimately replace the traditional Shorthorn herds. Should this eventuate it is interesting to speculate whether more attention will have to be given to the browse type pasture species about which we know so little.

10. *Health problems.* If large areas of North Kimberley are developed as improved pastures, additional disease hazards may arise under the expected heavier stocking rates.

RESEARCH PRIORITIES

Determining research priorities is difficult with so much still to be done but the following fields require further investigation:

1. *Regional vegetation and erosion surveys.* More surveys are necessary to assess range condition, evaluate pastures, map erosion and recommend "safe" carrying capacities aimed at preventing further deterioration of pasture lands. These surveys are basic to future pastoral area management and research.

2. *Utilisation levels of native and improved pastures.* Improved techniques are required for assessing "safe" levels of use of any given pasture to permit full utilisation without permanently damaging the pasture.

3. *Seasonal utilisation of pastures.* Further research is needed to determine ways and means of utilising the seasonal flush of growth and to study the economics of dry season supplementary feeding.

4. *Tropical pasture legumes.* A more vigorous testing programme of introduced and indigenous legumes suited to the lower (350-750 mm) rainfall region is suggested.

5. *Fertiliser requirements for improved pastures.* Further studies are required to determine soil fertility levels and fertiliser requirements on the soil types recently delineated as suitable for Townsville stylo establishment in North Kimberley (Kubicki & Beer unpublished).

6. *The management of regenerated pastoral country.* Techniques for the regeneration of degraded and eroded pastoral country have been demonstrated at Ord River

and elsewhere but methods of correctly managing regenerated country still require further elucidation. Current work at Ord River and proposed studies in the Northern Territory could be relevant.

7. *Monitoring of range condition and trend.* Improved techniques for monitoring range condition and trend require further study. The use of aerial photography, satellite imagery and other remote sensing aids are promising fields.

8. *Pastoral area Extension work.* A critical examination of Extension methods in pastoral areas is suggested to determine more effective methods of influencing management decisions affecting pasture management.

Finally, there is a need for better liaison and exchange of information and ideas between research workers in the field of tropical pasture research in northern Australia.

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