REGIONAL PASTURE DEVELOPMENT AND ASSOCIATED PROBLEMS II NORTHERN TERRITORY

J. D. STURTZ,* P. G. HARRISON* AND L. FALVEY*

ABSTRACT

Cattle under minimal management levels have been exploiting native pastures in the Northern Territory since about 1870. *Continued increases in numbers and poor management have resulted in serious overgrazing and erosion in parts of the Alice Springs, Barkly Tableland and Kimberley Districts. Work is now in progress on basic and applied studies in these areas to determine long term safe land use policies compatible with continued animal production.*

In the areas receiving > 750 *mm A.A.R. little impetus to increase cattle numbers occurred until the widespread use of Townsville stylo in the* 1960's. *Other species are also useful in this area but there is still a number of situations where no suitable pasture species is available.*

Establishment, management and nutrition of improved pastures is discussed and deficiencies in present knowledge highlighted. Weeds and diseases are an increasing problem in improved pastures, and the importance of seed supply and technology in sustaining the expansion of sown pastures is stressed.

Non-technical aspects including land tenure, economics, infrastructure, management and extension advice also impose constraints on development. These may be as important as technical problems in restricting expansion.

Some guidelines for future research projects are briefly enumerated.

PASTURE DEVELOPMENT—1824 to 1960

Exploitation of pastures for animal production commenced in the 1820's with the importation of buffaloes and bantengs to military settlements on the north coast. Although the settlements were soon abandoned buffaloes were later to occupy most of the wet, subcoastal plains.

The first areas permanently settled were in central Australia around 1870, and settlement further north rapidly followed. By 1884 there were almost 100,000 cattle with approximately equal numbers on northern, eastern and southern stations. As the cattle population grew, greater proportions of the total herd developed in the Alice Springs, Barkly Tableland and Victoria River districts. The British breed stock then in use were better adapted to the drier climates and better quality native pastures in these districts than to the humid conditions and poor quality native pastures of the Darwin and Gulf district. After their introduction, about 1880, ticks and redwater fever became endemic throughout the Darwin and Gulf, and in the northern Barkly Tableland and Victoria River districts. Distance from southern and eastern markets also favoured development in the drier areas.

Pastoral production methods, based exclusively on grazing of native pastures with minimal management, remained largely unchanged for about 80 years. The major activity was an annual dry season muster for branding, castration and drafting of saleable animals.

The cattle population reached a plateau of about 1-1.2 million head in the early 1940's, and thereafter fluctuated mainly in response to seasonal conditions. There was little economic incentive to increase production as net returns, after selling at distant markets, were low. However not all the problems of further pastoral development were economic as some were technological. As previously mentioned the local

*Animal Industry and Agriculture Branch, N.T.

British breed cattle were poorly adapted to the poor quality pastures, heat and ticks of the northern areas. The very low protein content of the dry season pastures also limited the productivity of this area. In the more arid areas low rainfall and drought, combined with the limited range of management opportunities under the very extensive conditions, restricted productivity. For most of the era there was no organised and continuing research into the pastoral industries. After the Second World War the C.S.I.R.O. established the Katherine Research Station, and the Animal Industry and Agriculture Branches were formed.

PASTURE MANAGEMENT AND DEVELOPMENT

1. *Grazing*

Grazing management, or rather the lack of it, is thought to have been responsible for changes in pasture composition and productivity in some districts although evidence is scanty.

The impact of grazing was least in the Darwin and Gulf district where low quality during the dry season limited pasture utilisation to about 5% of dry matter (Norman 1966). Grazing at rates higher than commercially practised is now known to result in rapid botanical changes towards annuals or less palatable perennials (Arndt and Norman 1959; Archer unpublished data; Wesley-Smith unpublished data). Exceptions were the sub-coastal and Marrakai areas where high buffalo and pig populations resulted in the reduction of swamp grasses such as *Hymenachne acutiglumis* (Byrnes 1972) and the partial replacement of annual upland grasses initially by Townsville stylo and later by the weeds *Sida* spp. and *Hyptis suaveolens*.

In the Alice Springs district excessive grazing, particularly during droughts, resulted in serious erosion and pasture degeneration in susceptible areas (Condon, Newman and Cunningham 1969). Valuable grazing species such as northern bluebush (*Chenopodium auricomum*), Mitchell grasses (*Astrebla* spp.), southern bluebush (*Kochia astrotricha*) and bladder saltbush (*Atriplex vesicaria*) were reduced and replaced by less stable or palatable species such as buckbush (*Salsola kali*), twinleaf (*Zygophyllum* sp.), *Sidas* and *Abutilons*. Condon *et al* thought the higher cattle populations that were maintained during droughts with the greater use of bores in the post-war period, had greater impact than the pre-war period when pasture resting occurred as cattle retreated to the few permanent natural waters.

From the 1947-48 survey of the Barkly Tableland by Christian *et al* (1954) we can conclude that overgrazing was not a general problem at that time since they considered the area could support a higher cattle population. Localised overgrazing around some bores on the Mitchell grass plains, and of small areas of bluebush was observed, as was general overgrazing in the more rugged northern areas where stock were uncontrolled because of abundant natural waters. On the plains a form of pasture spelling was recognised with cattle congregating around temporary surface waters in the "wet" and around the bores in the "dry". Recent revisits to some original C.S.I.R.O. photosites indicated major botanical changes although it is too early to state the extent and cause of the changes.

Pasture degeneration and soil erosion were most severe in the Victoria River district, particularly in the west. Robinson (1971) considers overgrazing the main cause, but also draws attention to factors such as: presence of inherently unstable soils, difficulty of stock control due to the rugged and well-watered nature of the country, alternation of extended droughts and occasional heavy monsoonal rains, and the restricted number of natural stockroutes and staging areas. The eastern, southern and northern areas of the district were not as severely affected, although serious local erosion or degradation occurred where there were very palatable species, or cattle concentrated along streams. A large feral donkey population (Letts 1964) contributed greatly to the degradation.

2. *Fire*

Native, tropical tall grass pastures in the Darwin and Gulf, and Victoria River Districts were burnt annually or biennially in the dry season to produce a "green pick" and as an aid to mustering and tick control. The annual grasses produce no significant regrowth (Stocker and Sturtz 1966) while that from the perennial pastures at Katherine is only 100-200 kg ha^{-1}. (Arndt and Norman 1959) and may be negligible if no rain falls after burning (Smith 1960). Greater regrowth occurs in moist areas. The crude protein content of the regrowth is only marginally increased while nothing is known about its relative digestibility. Many of the native pastures are fire dependent (Stocker 1966) and the past practice represents a better alternative than attempted fire exclusion with inevitable catastrophic wild-fires. An unintended benefit may have been the maintenance of open forests and woodlands.

Outside the tropical tall grass areas regular and widespread burning was not practised. Occasionally rugged or inaccessible areas were burnt to assist wild-fire control, as was spinifex for its palatable regrowth and as an aid to mustering (Rose unpublished notes, NTA) (Christian *et al* 1954).

PASTURE INTRODUCTION

Nicholas and Maurice Holtze, father and son curators of the Darwin Botanic Gardens (1869-1911) were responsible for the first recorded introductions of improved pastures into the Northern Territory. Although their primary interest was in crops, some of their pasture introductions, para grass, Guinea grass and some legumes still exist today. Accidental introductions included *Cenchrus* spp. (buffel grasses) from Afghan camel trains in Central Australia, Townsville stylo, in hay introduced to Point Stuart about 1916, and leucaena around Darwin. None of these early introductions were utilised in commercial beef production to any significant extent.

The systematic introduction and testing of improved pasture species recommenced after the Second World War with the establishment of the C.S.I.R.O. Katherine Research Station and the Animal Industry and Agriculture Branches.

TECHNICAL ASPECTS OF RECENT PASTURE DEVELOPMENT IN THE N.T.

Species

The last two decades have seen the commercial use in Australia of many new or improved species for tropical pasture production. Many were initially selected for subtropical conditions rather than the tropical monsoonal conditions of the Northern Territory, and while a vast improvement over native pastures, they have generally shown some deficiencies as evidenced by commercial sowings. In 1974 the total area of improved pasture in the monsoonal region was estimated to be 138,000 ha of which 88% was Townsville stylo, 9% para grass, 2% improved grass/Townsville stylo and less than 1% other legumes. This illustrates reliance on a very few adapted species when obviously a much greater range is needed for the varied environments of the Northern Territory.

Table 1 lists some of the more commonly accepted species for sown pasture in the N.T. and their respective areas of use. The list is not exhaustive and does not include those currently being tested, some of which show considerable promise. The seasonally flooded coastal plains and the arid areas of the dry tropics (650-750 mm) have no proven legumes, although some potential species are under test. Even those species rated as "good" in Table 1 have their problems, and some of these will be discussed later.

TABLE 1

Relative performance of some pasture species for regions of the Northern Territory

Species	Common/ Cultivar Name	Regions				
		Flooded	Wet monsoonal (>1,000 mm) Water-logged	Upland	Dry monsoonal (650–1,000 mm)	Arid (<650 mm)
(i) legumes						
Stylosanthes humilis	Townsville stylo	—	*	* *	* *	—
S. hamata	Verano stylo	—	*	* *	* *	—
S. guyanensis	Cook, Endeavour, Schofield stylos	—	*	* *	*	—
Calopogonium mucunoides	calopo	—	* *	* *	—	—
Macroptilium atropurpureum	Siratro	—	*	* *	*	—
Leucaena leucocephala	leucaena	—	*	* *	*	—
Macroptilium lathyroides	phasey bean	*	* *	*	—	—
Centrosema pubescens	centro	—	*	*	—	—
Clitoria ternatea	blue pea	*	* *	*	*	—
Vigna luteola	Dalrymple vigna	*	* *	*	—	—
Vigna sinensis	Cowpea	—	—	* *	* *	—
Lablab purpureus	lablab	—	—	* *	* *	—
(ii) grasses						
Digitaria decumbens	pangola	—	* *	* *	*	—
Brachiaria decumbens	signal	—	*	* *	*	—
Urochloa mosambicensis	sabi	—	—	*	* *	—
Paspalum plicatulum	plicatulum	—	* *	* *	—	—
Cenchrus ciliaris	buffel	—	—	*	* *	* *
Cenchrus setigerus	birdwood	—	—	—	* *	* *
Astrebla spp.	Mitchell	—	—	—	*	* *
Brachiaria mutica	para	* *	* *	*	—	—
Hymenachne acutiglumis	hymenachne	* *	—	—	—	—

* * good * fair, — unsuitable.

Major problems facing the development of pasture species in the N.T. are the variety of environments, the large number of potential plants to evaluate, and the difficulty of testing and fitting new species into existing extensive, and new, semi-intensive, pastoral production systems.

Establishment

With Townsville stylo aerial spreading has been generally very successful. Stocker and Sturtz (1966) pioneered a low cost technique of sowing seed into undisturbed woodlands following burning of annual *Sorghum spp* native pasture. The

technique has been used on perennial native pastures although follow-up grazing is generally required to control competition from grass regrowth and sometimes heavy grazing alone is used. Other methods used include broadcasting a mixture of fertilizer and seed on to a rough seed bed prepared by a single pass with a large offset disc, again between trees, or conventional drilling of seed and fertilizer after clearing. Clearing or thinning trees by mechanical or chemical means is usually not practised unless the area is required for purposes other than grazing, e.g. seed, hay or crop production. There is considerable debate on clearing versus non-clearing. Available evidence suggests that trees often aid establishment, and subsequent pasture production is only reduced in the denser forests. The harsh climatic conditions of the N.T. pose a major problem in establishing pasture. Rapid, low cost methods are vital for continued pasture development as large areas must be covered and sowing times are limited by rapid drying and high temperatures at the soil surface. The present low cost techniques may be unsuitable for some existing and possibly many potential species, and, even for Townsville stylo, the ratio of plants established to viable seed sown is quite low under sub-optimal conditions. Higher seeding rates can offset this to some extent, but at a price. Methods of overcoming this loss by seed coating, or by reducing hard seed contents would be of great benefit for better pasture establishment.

Grazing management after sowing can be an important factor in successful establishment although much specific information is lacking. With Townsville stylo the requirement may vary from nil to heavy grazing depending on the success of earlier attempts at grass control. For most grass/legume mixtures on virgin land, heavy first year grazing is essential if grass dominance is to be avoided. In favourable situations calopo, siratro and tall stylos can compete without follow-up grazing in the establishment year.

Most existing establishment techniques have been developed for virgin lands and are not satisfactory for re-establishing more productive pastures on previously developed lands often dominated by broad-leafed and/or annual grass weeds. Cheaper establishment techniques are also required for vegetatively propagated species and for seasonally flooded land.

Our understanding of natural regeneration of some species from seed is inadequate, e.g. Siratro and phasey bean apparently produce large quantities of seed, yet their regeneration is poor or erratic.

Grazing management

Overall stocking rates of properties improved with Townsville stylo vary according to the percentage improved with those having less than 10% improved carrying 1 : 8-16 (beast : ha), those with 20%-30% carrying 1 : 3-6, and those with 40%-60% carrying 1 : 2-5. The more developed properties tend to set stock while the less developed tend to save Townsville stylo for the dry season. The latter practice contrasts with Queensland where use of Townsville stylo is favoured in the wet and native pastures in the dry (Winks 1972). When Townsville stylo is saved for the dry season, heavy grazing early in the wet season is beneficial in minimising annual grass invasion although phosphate and grass seed supplies, and climatic and soil conditions are also important (Torsell 1973; Woods and Dance 1970). The maximum paddock size of set stocked, commercial Townsville stylo pastures is about 700-800 ha. Paddocks with separate blocks of Townsville stylo and native pasture, or upland and floodplain, both sown to Townsville stylo, have proved difficult to manage.

With buffel or sabi grass/Townsville stylo pastures high stocking rates (greater than 1 : 1 on good soils) are necessary to maintain the legume. Few commercial producers are prepared to use such rates. In the higher rainfall areas high stocking pressures on waterlogged or flooded soils can lead to soil pugging and pasture deterioration. Calopo competes without careful grazing management and for this reason is gaining greater acceptance than alternative legumes, even though it may have other deficiencies.

Nutrition

Townsville stylo responds to initial superphosphate applications on all soils except Blain sand, the response varying from moderate on the red earths to high on granite sands and some laterites. Although there is considerable knowledge about maintenance requirements under plot conditions, little is known about maintenance requirements under grazing. This is a serious deficiency. In the past producers have applied 50-200 kg ha^{-1} superphosphate initially and 25-100 kg ha^{-1} maintenance, although there is a tendency towards lowered initial, and low or nil maintenance dressings. This has been partly dictated by economic conditions, but also by observations of poor response to maintenance applications and greater annual grass invasion in pastures given higher levels.

The phosphate requirements of only a few other species have been examined. Calopo has similar or slightly higher requirements than Townsville stylo while para grass apparently has very low requirements. Given continued high prices for phosphatic fertilizers, new species must have low phosphate requirements or high efficiency.

There are indications of potassium deficiency on several soils in the higher rainfall area. Responses to sulphur have occurred on many of the lighter soils and some heavier soils of the high rainfall areas. In some cases the sulphur requirements cannot be fully provided by standard superphosphate. Of the minor elements only zinc has given a response, unlike Queensland, where molybdenum deficiency is apparently common.

Nitrogen fertilizer is not widely used although a few producers apply 50-200 kg ha^{-1} N for specific purposes such as hay, seed, irrigated pasture or weaner feed production.

Weeds

Weed species have assumed far greater importance in the Northern Territory as pasture development has proceeded. Species such as *Sida acuta* and *Hyptis suaveolens* and some annual grasses are of increasing importance in practically all Townsville stylo pastures through competition and reduction of land available for desirable species. On native pasture in the dry monsoonal area the woody weeds, *Calotropis procera, Acacia farnesiana, Parkinsonia aculeata,* can constitute a problem. Increasing frequency of these is generally, though not always, associated with over-grazing. Apart from reducing good grazing land their dense thickets are difficult to muster.

While mechanical or chemical weed control measures may be available, the extent of the problem over large areas, including Crown land, makes control impractical. Control in the future must rely heavily on species capable of competing with weeds.

Seed production

Seed production technology for many of the species being used is still being worked out and most have a short history of commercial development. Hence it is not surprising that commercial yields of seed from many species is unsatisfactory. Often the plants produce high seed yields, but compromises in management, harvesting and processing result in lowered final yields. Improved seed production techniques are considered vital to increased pasture development. Where satisfactory yields can be obtained, such as in Townsville stylo, wide fluctuations in supply, and consequently price, have plagued those attempting pasture improvement and seed production.

There is also the problem of low or unreliable germination in both legumes and grasses. Methods are available which could be adopted commercially to reduce hard seed in most legume species (Harrison unpublished data). Further work is required to understand dormancy mechanisms and improve the reliability of grass seed germination. Seed longevity under tropical conditions is short, and generally seed

cannot be carried over from season to season without some means of protection. This causes problems for both buyers and sellers of seed. Cheap effective methods of overcoming this loss are required.

Arid zone

Both producers and scientists are becoming more aware of their limited knowledge of the arid zone pasture lands and the consequences of past management practices. Range condition trend studies have been commenced by the Animal Industry and Agriculture Branch, and C.S.I.R.O. are actively studying arid zone ecosystems.

Testing of exotic species, particularly for soil conservation reclamation work, has received increasing emphasis, and reclamation is proceeding at a few localities. Pasture and animal productivity have been examined at Victoria River Research Station since 1969. Experience since then indicates that, except on extremely denuded or unstable areas, controlled stocking of the different pasture communities will allow degraded pastures to gradually recover, and overall stocking rates and herd productivity to be maintained or increased.

Diseases and Insects

While there is thought to be no serious disease or insect problem with existing pastures, resistance to insects and diseases must be considered in the testing of new species. Isolated areas of Townsville stylo have been killed by bacterial wilt near Batchelor (Aldrick 1971), anthracnose is a potential threat to some Stylosanthes, and on occasions grasshoppers have selectively devastated Townsville stylo at Katherine.

OTHER CONSTRAINTS TO PASTURE DEVELOPMENT

Most of the land in the Northern Territory is held by large properties of 250-10,000 km^2. Massive financial resources will be required to develop these properties and this must necessarily be spread over a long period of time.

Prior to 1967, when the legislation was amended, some institutions considered pastoral leasehold tenure to offer insufficient security for investment in more intensive forms of production. Whether the existing land tenure system is the most satisfactory remains debatable. Covenants require, where appropriate, minimum stocking levels, pasture improvement, fencing, water development, yards, dwellings etc. However covenants in themselves do not necessarily ensure optimum development, and the best use of funds. They may be difficult to police, or change to meet new economic or technological situations. In arid areas concentration on minimum stocking levels may be ill-advised and drought destocking requirements may be more appropriate. The lease-hold system is of necessity geared to the "average" situation and does not cope well with the wide range of producers' abilities and aspirations.

The incentive to develop improved or native pastures is primarily subject to economic limitations. Future development could be expected to largely reflect the immediate economic situation and producers' expectations for the future. Even in the higher rainfall areas where native pastures are of particularly low quality, the economics of sowing improved pasture are marginal or negative for most producers in the present climate of drastically lowered returns and increased costs. For example, between 1970 and 1975 beef returns have approximately halved, while superphosphate prices, which accounted for 25-35% of operating costs, have increased about three fold. Currently only properties with large financial resources are able to invest in future productivity to any extent, other investment being restricted to immediate needs.

The Northern Territory has a relatively short history of more intensive agricultural development. As a result the infrastructure necessary for properties to diversify into other forms of primary production is inadequately developed. Even where an

opportunity could be demonstrated, e.g. in pasture seed production or bull production, the short history plus widely fluctuating demand and supply situations renders development difficult. Produce from many of these ancillary industries is essential for continued pasture development. Services such as aerial spreading, bulk fertilizer handling and machinery servicing suffer similar problems. The result of these inadequately developed supporting industries is increased costs for pasture development.

The level of management and workforce expertise is best in the extensively managed beef properties with their long history of similar production methods. It is less, but very variable, on the more intensively developed properties using improved pastures and Zebu cross cattle in the higher rainfall areas. In all areas a transient workforce, isolation, and changes in relative wage levels and conditions is rendering the acquisition of the necessary expertise more difficult.

Extension services from government agencies are undeveloped compared with other areas of Australia. In the Northern Territory, where pasture development is in its infancy, the need for advice and follow-up is critical. Tentative recommendations based on limited knowledge must be assessed regularly to determine reasons for success or failure and a firm link established between producer and research worker.

The remarks in this section indicate that pasture development will proceed slowly. On commercial properties where successful development is progressing it has been based on a balance of proven techniques with limited experimentation.

FUTURE RESEARCH

Major objectives for future research are listed below.

1. *Species*
   (a) legumes for seasonally flooded or waterlogged lands.
   (b) legumes for semi-arid areas
   (c) adapted species capable of competing with weeds and of better quality
2. *Establishment*
   (a) further development of low cost methods
   (b) methods for resowing developed areas
3. *Nutrition*
   (a) phosphorus maintenance requirements under grazing
   (b) nutritional requirements of new species
4. *Arid zone*
   (a) stable plant and animal production
5. *Seed*
   (a) better seed production, storage and field establishment
6. *Grazing management*
   (a) understanding of grazing management requirements of species
   (b) grazing management systems suited to industry

REFERENCES

ALDRICK, S. J. (1971)—*Trop. Grassl.* **5**: 23.

ARNDT, W. and NORMAN, M. J. T. (1959)—Aust. C.S.I.R.O. Div. Land Res. Reg. Surv. Tech. Pap. No. 3.

BYRNES, N. (1972)—"A collection of papers related to the Northern Territory buffalo industry" (N.T. Branch Aust. Soc. Anim. Prod.).

CHRISTIAN, C. S., NOAKES, L. C., PERRY, R. A., SLATYER, R. O., STEWART, G. A. and TRAVES, D. M. (1954)—Aust. C.S.I.R.O. Land Res. Ser. No. 3.

CONDON, R. W., NEWMAN, J. C. and CUNNINGHAM, G. M. (1969)—*J. Soil Conserv. Serv. N.S.W.* **25**: 47.
LETTS, G. A. (1964)—*Aust. Vet. J.* **40**: 84.
NORMAN, M. J. T. (1966)—Aust. C.S.I.R.O. Land Res. Tech. Pap. No. 28.
ROBINSON, C. S. (1971)—Anim. Ind. Agric. Br. Tech. Bull. No. 6.
SMITH, E. L. (1960) *J. Range Manage.* **13**:197.
STOCKER, G. C. (1966)—*Aust. For.* **30**: 223.
STOCKER, G. C. and STURTZ, J. D. (1966)—*Aust. J. Exp. Agric. Anim. Husb.* **6**: 277.
TORSELL, B. W. R. (1973)—*J. Appl. Ecol.* **10**: 463.
WINKS, L. (1972)—*Trop. Grassl.* **7**: 201.
WOODS, L. E. and DANCE, R. A. (1970)—*J. Aust. Inst. Agric. Sci.* **36**: 45.