THE DISTRIBUTION OF BLACK SPEAR GRASS (*HETEROPOGON CONTORTUS*) IN TROPICAL QUEENSLAND

R. F. ISBELL

ABSTRACT

The distribution of black spear grass in tropical Queensland is shown on a map. Three categories of abundance are delineated; scattered (30,500,000 ac), prominent (15,000,000 ac), and dominant (3,200,000 ac). Spear grass is associated with a wide range of grass species throughout its area of occurrence which lies mainly between the 20 inch and 60 inch mean annual isohyets.

The species occurs on a very wide range of soils and it seems likely that management factors such as grazing intensity and burning have been of major importance in the spread of the species since European settlement. The role of spear grass — Townsville lucerne pastures is briefly discussed; such pastures are likely to be of greatest importance south of approximately 19°S latitude.

INTRODUCTION

Heteropogon contortus (spear grass, black or bunch spear grass) is widespread in the eastern tropics and sub-tropics of Queensland (Shaw and Bisset, 1955, Tothill, 1966). The former authors delineated a zone in eastern Queensland in which spear grass was an important pasture component and they proposed the name spear grass region. At this time the northern limits of this region were not known.

In recent years extensive field traversing in tropical Queensland in connection with regional soil mapping, and publication of broad-scale botanical surveys for several areas (Perry and Lazarides, 1964; Pedley, 1967; Story, 1967; Speck, 1968), have enabled a much more detailed picture of the distribution of spear grass in tropical Queensland to be drawn. It is from these sources that the accompanying map (Fig. 1) has been compiled. Additional information has been obtained from various field officers of the Queensland Department of Primary Industries in relevant localities.

As well as discussing the present distribution of the species, some thoughts are also offered in this paper on likely reasons for the apparent increase in the occurrence of the species since European settlement.

DISTRIBUTION AND AREA

Spear grass is known to occur almost throughout the length and breadth of Queensland but it is only in the eastern parts of the State that it assumes importance. Its distribution in tropical Queensland is shown in Fig. 1. It is important that the criteria adopted for portraying the relative abundance of the species be clearly understood.

Spear grass absent

In many localities in this category occasional plants or small areas will be found. These usually occur along roads or stock routes, adjacent to station homesteads or towns, or in occasional small paddocks. The essential feature is that the species is not a normal component of the native pastures.

* C.S.I.R.O., Division of Soils, Townsville, Queensland 4810

Spear grass occurs as scattered plants through the native communities

Area: 30,500,000 acres

In this category spear grass usually occurs as a small and often highly variable component of the native pastures. It is often locally prominent, and occasionally dominant, adjacent to roads and on stock routes, in small paddocks and clearings adjacent to station homesteads and towns, around stock watering points, or in certain edaphic situations. In some areas of course the species may be absent. It is not possible to map these exceptions other than at a very detailed scale.

Spear grass is a prominent member of the native communities

Area: 15,000,000 acres

This category is for situations where the species is very common but does not normally constitute the dominant member of the ground community. However, it is often locally dominant in small areas, again commonly adjacent to roads and on stock routes, in small paddocks and clearings around station homesteads and towns, around stock watering points, or in certain edaphic situations. In some small areas throughout this unit only scattered plants may occur and in some instances the species may be absent.

Spear grass is the dominant species of the native communities

Area: 3,200,000 acres

In this category spear grass is more common than any other species in the ground flora. Locally of course there can be considerable variation over small distances but a feature of this category is the frequent presence of almost mono-specific stands.

It is emphasised that the above categories have been established on the basis of visual assessment which is necessarily very subjective. However, it is considered that the categories are distinctive enough when considered in relation to the scale of the map to afford a realistic picture of the current distribution of the species in tropical Queensland.

SPECIES ASSOCIATED WITH SPEAR GRASS

The greatest area of spear grass occurs under various eucalypt woodlands or open forests. Less commonly the species occurs in grasslands. In some areas, particularly towards the south-east, the original tree communities have been greatly modified by ringbarking.

A wide range of grasses are associated with spear grass, as might be expected from the diversity of climatic and edaphic situations in which the species occurs. It is not possible nor is it necessary to give a complete list but some grass genera and species are of particular importance in various parts of the region.

One of the few species that is present in varying degrees in almost all areas is *Themeda australia* (kangaroo grass). In most northern areas (except Cape York Peninsula) it is normally the major associated species, with giant spear grass (*Heteropogon triticeus*) also often common. Genera that also occur throughout the spear grass region, although varying locally in prominence, include *Bothriochloa, Aristida, Eragrostis, Chrysopogon, Dichanthium,* and *Chloris.* These are mostly perennial mid-height grasses and edaphic as well as climatic factors help determine which particular genera and species are the most common associate of spear grass in any given locality. In the drier western and north-western margins of the region spinifex (*Triodia mitchellii*) may occasionally be associated with spear grass and other genera (particularly *Aristida* and *Bothriochloa*) in a mosaic-like pattern. In parts of Cape York Peninsula *Sorghum plumosum* may be characteristically associated.

FACTORS INFLUENCING DISTRIBUTION

There seems little doubt that the distribution of spear grass in eastern Queensland has greatly changed since the advent of European settlement. Although early records are few, histories of early pastoral settlement such as Murphy and Easton (1950) for part of southern Queensland and Bolton (1963) for North Queensland, stress the spread of spear grass as being one of the main factors which dictated a change-over from sheep to cattle grazing. This present paper is largely concerned with the current distribution but inevitably some comment must be made as to likely reasons for the spread of spear grass in eastern Queensland.

Climatic Factors

In tropical Queensland spear grass occurs in areas ranging from 20 inches to 60 inches mean annual rainfall. The greater occurrence however is situated between the 25 inch and 40 inch mean annual isohyets. The higher rainfall occurrences are mostly restricted to the Mackay-Proserpine and Cooktown areas and there are few occurrences below 20 inches. The west-north-westerly distribution trend north of about 20°S latitude may in part be a reflection of rainfall as in this region the annual isohyets also deflect in this direction.

With decreasing latitude in tropical Queensland the seasonality of the rainfall becomes more pronounced, e.g. considering two centres with the same mean annual rainfall such as Emerald and Charters Towers (24.5 inches), the percentage falling in the summer months of October to March inclusive is 73% and 83% respectively. In southern and central Queensland the winter component of the rainfall is higher than for northern areas. Tothill (1966) has shown that spear grass exhibits considerable morphological and phenological variation. Flowering is largely governed by day length but the seasonal pattern of rainfall distribution has selected only those day lengths which promote flowering within the rainfall season. Hence in more northern areas late maturity prevails, in contrast to the much greater range in maturity types in central and southern areas.

Bisset (1962) has suggested there is evidence for an increase or decrease of the amount of spear grass in central western Queensland following a succession of years of above or below average rainfall respectively. As this area represents the lower rainfall margin of the spear grass zone it seems quite likely that the relative abundance of the species at any point in time would be at least partly determined by preceding high or low rainfall years, and thus the western limits of the species may fluctuate considerably. Field observations suggest that above or below average rainfall conditions have a similar effect in parts of northern Queensland.

Edaphic Factors

Spear grass occurs on a very wide range of soils in tropical Queensland. Although such soils may differ markedly in morphology, nutrient status, and physical properties, it is still possible to make some generalisations. Most importantly, spear grass occurs much less commonly on certain heavy clay soils. This fact largely explains many of the abrupt changes in central Queensland where non-spear grass areas occur immediately adjacent to areas where the species is very common. The precise nature of the limiting factors in these instances is not known, but some indirect evidence is available. Thus, in the black earth region of the Central Highlands (e.g. Clermont-Emerald) spear grass is virtually absent on the deeper dark basaltic clays of the plains yet it is often very common on the clays of the low stony rises. Bisset (1962) has also drawn attention to this and other similar occurrences. Both soils are usually heavy clays at the surface, the chief differences being that the soils of the plains are deeper, have slower external and internal drainage and tend to have coarser natural structural aggregation in the self-mulching surface soil. This latter would conceivably be of importance in germination.

However, this situation is not always consistent, as on similar basaltic clays in the Nebo area spear grass may be prominent on apparently similar deep dark heavy clays as well as on associated low stony rises.

The great majority of the soils supporting spear grass have surface textures ranging from sandy loam to clay loam, and profile morphology appears to play only a minor role. Similarly, external and internal drainage are modifying factors only, but as a rule spear grass tends to be absent from very badly drained sites where water is likely to be ponded for considerable periods.

The nutrient status of soils supporting spear grass varies widely. The species occurs on a variety of soils ranging from infertile sands to highly fertile clay loams or clays. In general though the species is less likely to be common under conditions of extremely low fertility, such as occurs with various very sandy soils which may range from deep loose sands to shallow stony varieties.

The species is obviously tolerant of low levels of soil nitrogen, phosphorus and sulphur, but there is some field evidence that the species cannot tolerate high levels of salinity. Often it appears that limiting edaphic conditions are reached when a number of adverse factors such as extremely low nutrient status, poor moisture relationships, very restricted internal drainage and, moderate levels of salinity occur together. The solonetzic soils of the Townsville-Bowen region afford an example. Spear grass seldom grows on these soils even where they occur as small islands in a surrounding sea of spear grass.

With regard to the distribution map it may be said that in general abrupt changes from one category to a much higher or lower category are largely due to edaphic factors. However, there are some important exceptions which are discussed later.

Management Factors

Burning

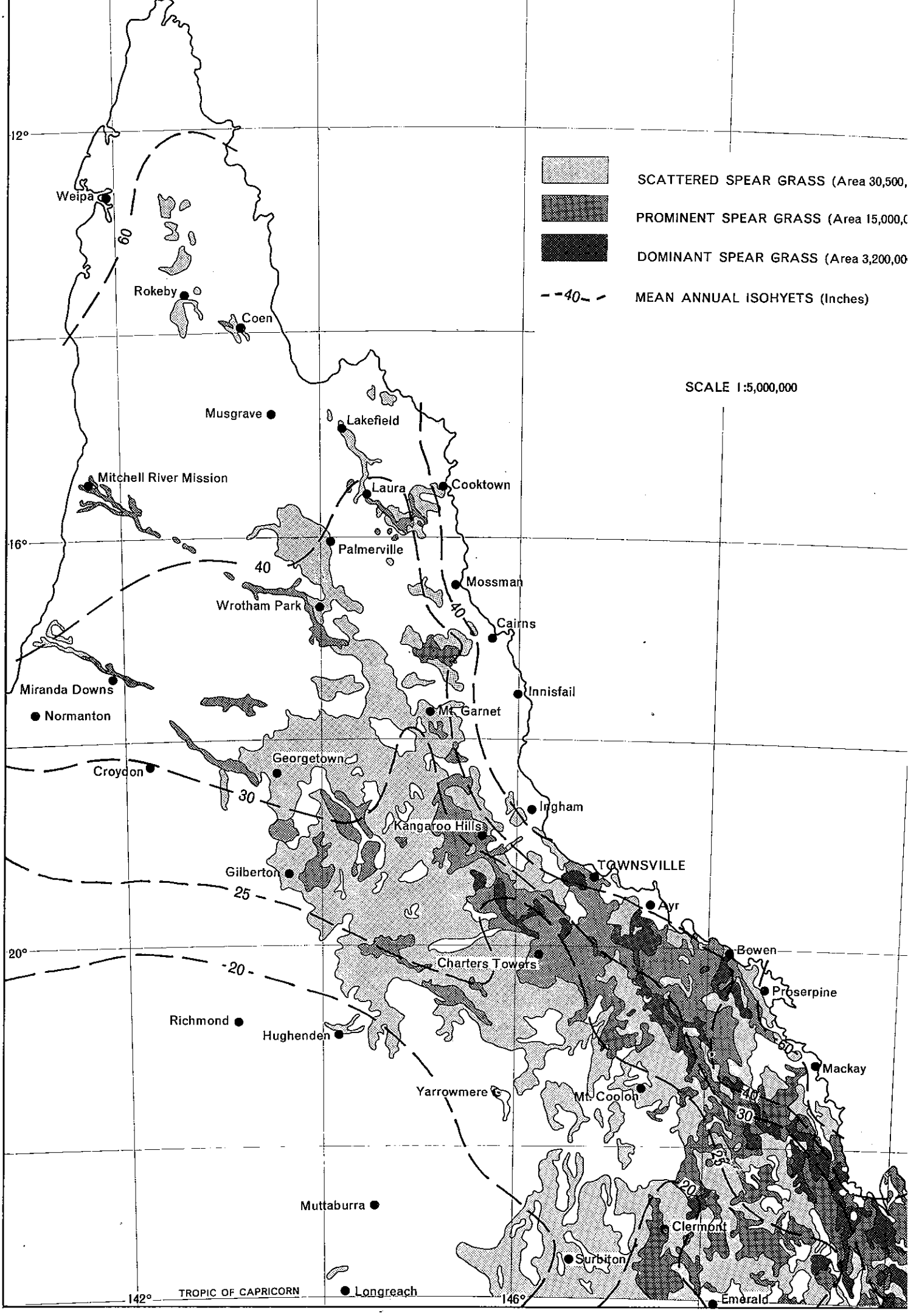
Annual burning during the dry season is common practice over most of eastern Queensland and Shaw (1957) and Tothill (1969) have shown experimentally that this practice greatly favours an increase of spear grass in native pastures. Shaw and Tothill found that the main effects of burning that increased the proportion of spear grass in their ungrazed treatments were (1) established plants are resistant to fire (2) fire favours germination of seed, and (3) fire reduces the ground cover of other species. However, *Themeda australis* was not present in Shaw's plots and he pointed out that burning in the absence of grazing does not always result in dominance of spear grass. Such instances are afforded by railway enclosures and cemeteries, both of which are commonly dominated by *Themeda australis*. Conversely, Bisset (1962) stated that spear grass has been observed to increase on grazed areas that have not been burnt for periods ranging from 12 to 30 years, but these observations were made near the western margin of the distribution range of the species.

Although there is little direct evidence concerning the frequency of fires prior to European settlement, records of explorer's journals indicate that fires were certainly common. It seems doubtful therefore, that burning alone can be regarded as a major factor influencing the distribution of spear grass in eastern Queensland.

Grazing

It is evident that grazing favours spear grass at the expense of other palatable native species such as kangaroo grass. Although there is little experimental evidence there are widespread field indications that grazing pressure is of great importance in the spread and distribution of spear grass. Unfortunately, there are few, if any, instances where the additional role of fire can be excluded.

Field evidence and historical records suggest that except in more northern areas *Themeda australis* was probably much more widespread throughout the spear grass zone in the past than it is today. This is indicated by various refuge areas where grazing has either been absent or restricted. Examples that may be cited (apart from reserves previously mentioned) include waterless areas on some pro-


SCATTERED SPEAR GRASS (Area 30,500,
PROMINENT SPEAR GRASS (Area 15,000,(
DOMINANT SPEAR GRASS (Area 3,200,00
40
MEAN ANNUAL ISOHYETS (Inches)
SCALE 1:5,000,000
12°
16°
20°
142°
146°
TROPIC OF CAPRICORN
Weipa
Rokeby
Coen
Musgrave
Lakefield
Mitchell River Mission
Laura
Cooktown
Palmerville
Mossman
Wrotham Park
Cairns
Miranda Downs
Normanton
Innisfail
Mt. Garnet
Georgetown
Croydon
Ingham
Kangaroo Hills
TOWNSVILLE
Gilberton
Ayr
Bowen
Charters Towers
Proserpine
Richmond
Hughenden
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Yarrowmere
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perties, and areas of steep hilly or mountainous land. In both cases grazing intensity can be assumed always to have been much lower than is normal for the particular property or district. In many such instances throughout central and northern Queensland *Themeda australis* is almost invariably dominant. It is widely recognized that this species is very susceptible to grazing pressure.

Further evidence at the individual property scale is provided by the widespread greater incidence of spear grass in more heavily stocked situations such as stock routes, small paddocks near homesteads, and adjacent to watering points in large paddocks. On the broader scale there is a regional trend for property size to increase and stocking rates to decrease in a general northerly and westerly direction over much of the region where spear grass is found today. This corresponds generally with a decrease in spear grass occurrence. In fact, there is also a reasonably close parallel between the distribution of black spear grass and the early pastoral settlement pattern in tropical Queensland. It is often in outlying situations that illuminating evidence may be found. Examples are the occurrence along frontages to major rivers as in parts of the Gulf region, or occurrences in the relatively more heavily stocked areas of some regions, e.g. around Coen in Cape York Peninsula.

It is also worthy of note that excessive grazing pressure can apparently eliminate spear grass. Blake (1944), Miles (1949) and Bisset (1962) have indicated that under very heavy grazing spear grass may be replaced by less palatable species such as *Bothriochloa decipiens, Aristida* spp. and various annuals. More recently in the Townsville region C.S.I.R.O. Division of Tropical Pastures (1968) has shown that the percentage of spear grass in Townsville lucerne pastures can be reduced by heavy stocking rates. Thus, spear grass dominance seems to result from grazing at a certain pressure.

There is little direct evidence concerning the effect of timber treatment. Story *Timber treatment*
(1967) gives an example from the Nogoa River area of central Queensland where a paddock contained an unfenced but regular block of ring-barked *Eucalyptus populnea* over spear grass, sharply divided from live *E. populnea* over *Chrysopogon.*

It seems likely that timber treatment has had at least some effect, if only indirectly in that timber removal or killing is normally followed by greater grass growth, thus allowing a higher stocking rate than previously existed. This situation is particularly relevant in parts of the southern spear grass region, where timber treatment is much more common than in northern areas.

THE IMPORTANCE OF SPEAR GRASS AS A PASTURE SPECIES IN TROPICAL QUEENSLAND

Shaw and Bisset (1955) have drawn attention to the role of spear grass as a pasture component in subtropical Queensland. More recently Shaw (1961) and C.S.I.R.O. Division of Tropical Pastures (1968) have indicated the large increases in beef cattle production that can be obtained by introducing the annual legume Townsville lucerne (*Stylosanthes humilis*) into spear grass pastures and fertilizing with superphosphate. In view of the large areas of tropical Queensland where Townsville lucerne may be expected to be climatically adapted it is worth looking briefly at the likely future role of spear grass—Townsville lucerne pastures.

In the first instance it is quite clear from the distribution map that such pastures are likely to be most wide-spread south from about Townsville and to a lesser extent in a north-westerly one extending through Kangaroo Hills towards Georgetown. North of 19°S latitude (near Townsville) there are only two million acres on which spear grass is prominent and no mappable areas where it is dominant. The overall general lack of spear grass in the Gulf region and Cape York Peninsula is noteworthy and the productivity of Townsville lucerne—native pasture in these regions is yet to be assessed. It is possible, however, that in parts of these

more northern regions spear grass may increase in the future following higher stocking rates and timber treatment.

The second important point is that not all areas of spear grass will be suitable for growing Townsville lucerne. Climatically, the lower limit for productive Townsville lucerne pastures is likely to be somewhere between 20 inches and 25 inches mean annual rainfall. Edaphically, on current knowledge and experience, it is known that Townsville lucerne will apparently not persist on certain soils such as self-mulching clays and some medium-surface-textured red soils. On this basis then it is estimated that of the 18,200,000 acres of land on which spear grass is either dominant or prominent, some six million acres are edaphically unsuited on the basis of present knowledge for the establishment of persistent productive Townsville lucerne-spear grass pastures. A further 500,000 acres of spear grass land is unlikely to be developed because of adverse topography.

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