PASTURE SPECIES EVALUATION ON MELVILLE ISLAND NORTHERN TERRITORY

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I INTRODUCTION

In response to a request from the Department of Aboriginal Affairs a research project was initiated to evaluate a range of pasture species on Melville Island. The request arose because of the possibility that the Aboriginal people of the Island might undertake a cattle project utilising the Seventeen Mile Plain area (also known as Yapilika) of the Island. The Plain appeared to offer scope for low cost development of improved pastures due to the light nature of the tree vegetation.

The environment of the area is sufficiently different from the mainland, that it would have been difficult to directly extrapolate pasture species recommendations from elsewhere in the Northern Territory. As a result it was decided to test the performance of a range of pasture species over a number of seasons. The choice of species to be tested was based on results from pasture trials elsewhere in the Northern Territory where conditions most closely approximated those at the Plain. The species varied from those adapted to seasonal inundation to those capable of existing in well drained environments as the problem of the seasonal water regime was considered to be of vital concern.

This report describes the pasture species research carried out on the Island and relates experience from this research to guidelines for future pasture development in the area.

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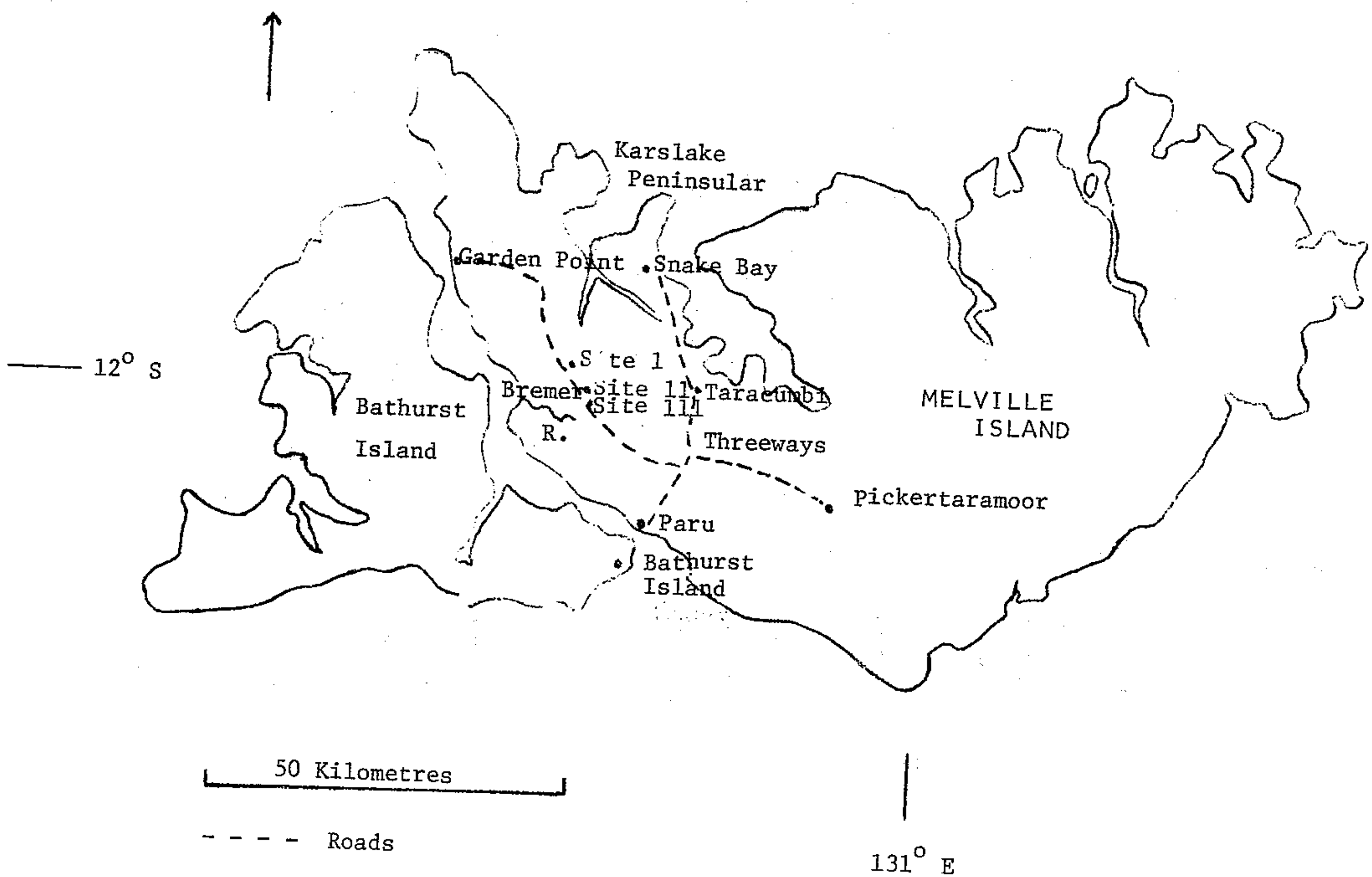
MAP 1

MELVILLE ISLAND



II EUROPEAN LANDUSE ACTIVITIES ON MELVILLE ISLAND

The first European settlement on the Island was at Fort Dundas, south of Garden Point, in 1824. Attempts were made to grow vegetables and raise livestock but these were generally unsuccessful. A variety of crops were grown and buffaloes, sheep and pigs were introduced from Timor. The settlement was abandoned in 1827.

During the period of Mission development on the Island there has been successful production of fresh vegetables for consumption by the Missions. The success of the production appeared to be closely related to the level of skills of the management involved at any particular time. From time to time livestock have been introduced but up to the present time no stable livestock industry has developed.

The Island currently has a population of buffaloes and wild horses which generally tend to run on the south eastern region. See Appendix I.

The most significant land use activity at present is based on forestry with the development of both introduced and existing timber stands.

The Island was subject to uncontrolled timber getting from late in the Nineteenth Century and it is only since the early 1960's that any forest management and control has been exerted. The establishment of Forestry Branch operations on the Island, initially at Snake Bay, and then at Pickertaramoor, involved plantations of Cypress Pine (*Callitris intratropica*) and later Caribbean Pine (*Pinus caribea*).

An area of 2804 ha of pine plantation at various stages of development now exists. In addition there is 1034 ha of natural mixed softwood and hardwood forest protected from fire in the Pickertaramoor area.

TABLE I

Areas of Pine Plantations on Melville Island 1976

AREA	SIZE (ha)
Snake Bay	772
Pickertaramoor	1907
Three ways	50
Seventeen Mile Plain	75
Total:	2804

Production of treated timber and sawn hardwood has been carried out at periodic intervals over the past few years. This has only been from natural forests as the plantation trees have not yet reached a usable size.

There has not, to date, been any stable agricultural industry developed on the Island.

III RESEARCH ON MELVILLE ISLAND

The main biological studies carried out have been by the Forestry Research Institute and the Forestry Branch. These have included timber surveys, vegetation studies of specific areas, investigations into the ecology of eucalypt communities, evaluation of plantation management practices and evaluation of possible new species for timber production.

The study most applicable to agricultural development on the Seventeen Mile Plain is by Lacey (1973). This showed that many of the woody species on the Plain possess rhizomes containing numerous dormant buds which are able to replace aerial shoots damaged by fire. Therefore any form of disturbance may stimulate a severe regrowth problem.

A survey of land units of the Seventeen Mile Plain was carried out by van-Cuylenburg and Dunlop (1973). This made it possible to define individual areas of development potential within the Plain.

Previous pasture research carried out on the Island was related to establishment using burning techniques and initial response of Townsville stylo to superphosphate. Two sites were established in 1965 at Taracumbi and the Karslake Peninsular. Townsville stylo was successfully established and there was a usual response to superphosphate. Sorghum intrans was completely controlled by the burn at Taracumbi, however the perennial grasses at Karslake Peninsula were only checked enough for legume establishment. (Stocker/Sturtz, unpublished).

IV CLIMATE

The climate is monsoonal with most of the rain falling between November and April. The variability of rainfall during individual months is high and may be two or three times as large as annual values. The incidence of rainfall in only half the year causes a distinct wet and dry season and this is the greatest limiting factor to pastoral production.

The lack of a consistent and stable European population on the Island has resulted in only recent climatic records being available. Rainfall has been measured on Melville Island only since 1964, but measurements have been taken on Bathurst Island since 1913. (See Appendix II).

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Van Cuylenburg and Dunlop (1973) outline a hypothesis put forward by Mr R Chaytor of Pickertaramoor that a high rainfall exists across Melville Island. Wind directions, local topography and rainfall figures to date add support to this hypothesis. The Seventeen Mile Plain is in the belt.

Rainfall records from Threeways are presented as being the closest to what may have occurred on the experimental areas (Figure I).

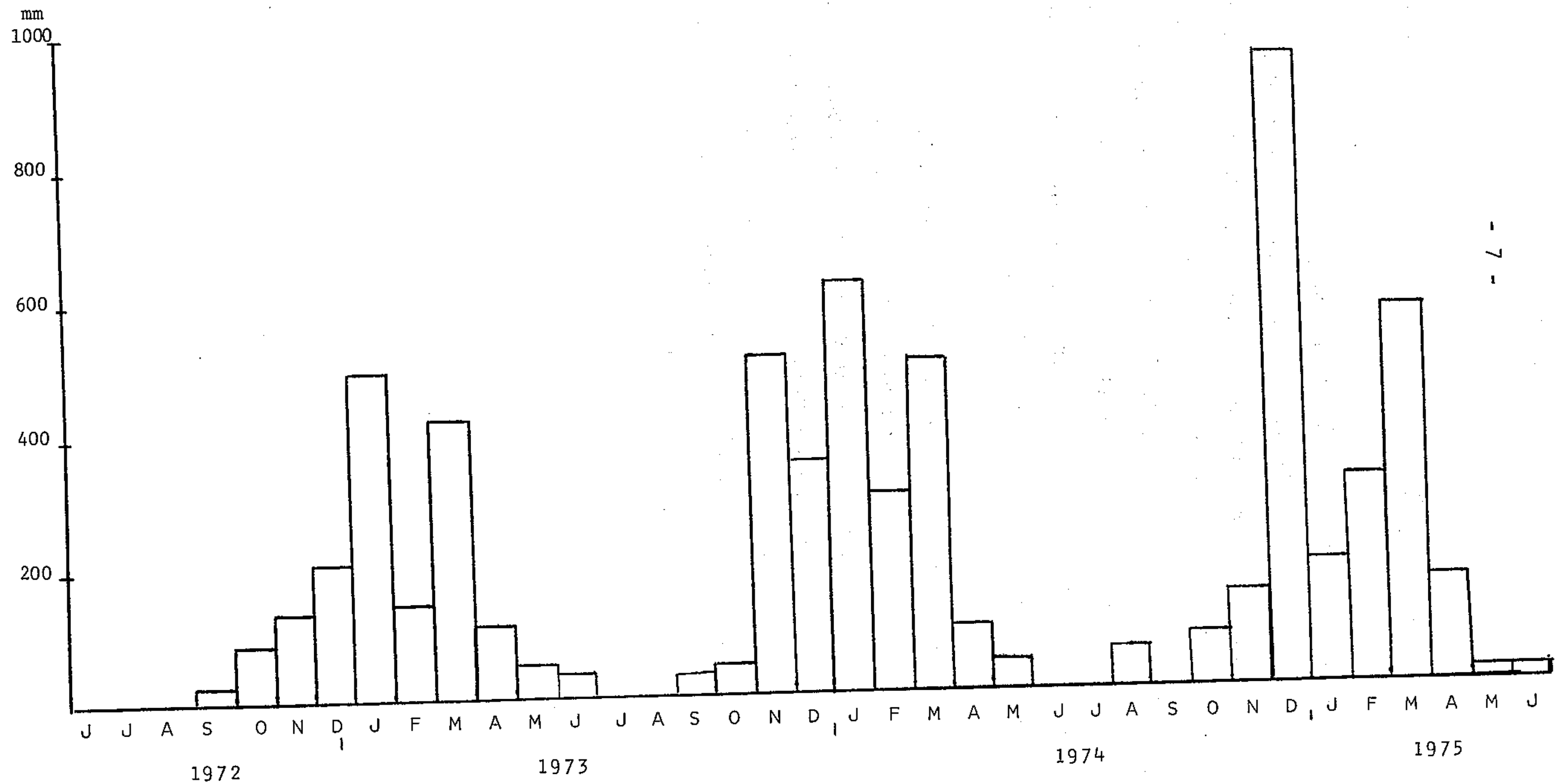
The experimental sites are approximately 10 km from Threeways (see Map I).

Temperatures on the Island do not generally limit plant growth. A comparison of Pickertaramoor and Darwin temperatures is given in Appendix III. The apparent higher diurnal range at Pickertaramoor may even aid plant growth by reducing plant respiration rates at night. This higher diurnal range may be attributed to the occurrence of onshore/offshore winds similar to those found on islands elsewhere in the world. Local inhabitants stress the Island has a far more pleasant climate than experienced in Darwin.

As a result of the lower night temperatures on the island, dry season dews are probably heavier than on the mainland. These dews have a detrimental effect on standing dry forage. The slightly longer wet season experienced on the island also affects standing forage but would give perennial species a longer growing season.

FIGURE 1

RAINFALL - THREEWAYS
JUNE 1972 - JUNE 1975



V VEGETATION

Stocker (1969) described the vegetation of the Karslake Peninsula mainly in terms for forestry potential. The Peninsula is some 30 Km to the North East of the Plain, and this vegetation study has limited application. However van Cuylenburg and Dunlop's (1973) report contains detailed descriptions of the vegetation types on the Plain. Observations and records taken during the course of these experiments coincide with their classifications.

The most important aspects of the vegetation are the general lightness of tree cover which would aid clearing or development of pastures under the canopy, and the regrowth mechanism displayed by the woody perennials which would hinder the development of a stable pasture if disturbance was too great. These features were taken into account in the experiments by minimising or avoiding disturbance.

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TABLE II

Vegetation and Soils of Experimental Sites

SITE NO	LAND UNIT	SOIL	VEGETATION	TRIALS
1	4c	Lateritic yellow earth (Koolpinyah family) Gn 2.24	Low woodland, tall shrubland *Grevillea pteridifolia*; *Tristania sp*; *Livistonia sp*; *Acacia sp*; *Petalostigma sp*; *Terminalia sp*; *Eucalyptus porrecta*; *Eriachne avenacea*; *Eulalia mackinlayi*	I; IV
11	5a	Sandy red earth (Killuppa family) Gn 2.11	Low woodland, tall shrubland, *Banksia dentata*; *Tristania sp*; *Acacia sp*; *Planchonia sp*; *Petalostigma sp*; *E. ptychocarpa*, *Melaleuca sp*; *Eugenia bleeseri*; *Etetradonta*; *E porrecta*; *Eriachne avenacea*; *E squarrosa*; *Eulalia mackinlayi*	I II III IV
111	5a	Sandy red earth (Killuppa family) Gn 2.11	As for Site 11 *Alphitonia sp* present	1; 1V

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VI SOILS

The soils of the Plain have been classified by van Cuylenburg and Dunlop (1973). The trials covered two main soils types - both of which are representative of reasonable sized areas.

Details of soil classification are given in Table II and Appendix IV.

Some features of the soils displayed during the course of the experiments were :-

i) At the various times of plot preparation and maintenance the sites were able to be traversed with equipment.

ii) The water holding capacity of Sites II and III appeared to be good, although this finding is at variance with later observations of similar soils on the mainland.

iii) Preliminary chemical analysis of the soils illustrate a general lack of available nutrients. The soil phosphorus levels were below 2 ppm. (bicarbonate test) in soil samples tested. Appendix V.

iv) Site 1 was poorly drained and in January 1973, a water table was found at 13 cm. Sites II and III did not at any stage have a detectable water table above 50 cms depth.

VII LOGISTICS OF THE TRIALS

The sites to be used for the trials were chosen prior to the land unit survey and during a visit in the dry season. Five sites were chosen on the basis of vegetation and soil characteristics. Experiments were planned for all of these sites but due to accessability problems in the wet season only three were sown. The three sites sown were adjacent to the Garden Point - Threeways road. (See Map 1)

The execution of agronomic field trials under the existing physical circumstances was somewhat more difficult than on normal stations or agricultural areas. Similar problems however could be encountered in a commercial enterprise in the same area. It is for this reason that the following comments are made.

Access to the Island was by air and this affected the methods used in the trial by ruling out any mechanical plot cutting due to transportation limitations. Machinery and transport was borrowed from the Forestry Branch at Pickertaramoor.

The area of the trials was virgin land and was cleared by hand and with a light slasher.

During the dry season much of the Island is burnt either by the aboriginals or by 'fire bombing' by the Forestry Branch. Firebreaks had to be established around each site to prevent burning of the plots.

The Plain supports some wallabies which made frequent depredations on Site II, often selecting only the improved species. All areas were fenced with varying degrees of success.

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Trial III

Following two years of observation on the performance of the Stylosanthes sp introductions in the observation plots (Trial IV) it was decided to establish a trial to compare the performance of the most promising selections. This was also done in view of the increasing interest in this genus as a source of future pasture plants in Northern Australia.

The design was a randomised complete block with three replications. The plot size was 3 x 2 m.

1. Townsville Stylo (*Stylosanthes humilis*)
2. Stylo (*S guianensis*, cv Cook)
3. Caribbean Stylo (*S hamata* cv Verano)
4. *S viscosa* CPI 34904
5. *S scabra* CPI 40205
6. *S scabra* CPI 40292
7. *S scabra* CPI 34925
8. *S scabra* CPI 40289

Seed was sown at 4 kg/ha onto a cultivated seedbed in December 1974. This trial was only carried out at Site II.

In all plots seed was sown directly onto the cultivated soil surface.

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Trial IV

Single plots of promising Stylosanthes sp introductions were established at each site at the time of establishment of Trial 1. Identical land preparation treatments to Trial I were applied. Species were sown at 10 kg/ha. Plot size was 2 x 3 m.

Introductions used were as follows :-

1. S viscosa CPI 34904
2. S scabra CPI 40205
3. S scabra CPI 34926
4. S guyanensis CPI 34906
5. S hamata CPI 38842 (cv Verano)

An annual dressing of 125 kg/ha of single superphosphate was applied to all trials by broadcasting.

IX MEASUREMENTS

Detailed observations were made at least twice per wet season by the author with additional observations being made by personnel from Garden Point and Pickertaramoor. Establishment counts were recorded for Trials I, II and IV.

Dry matter cuts were taken at the end of each wet season (May/June) from two quadrats ($1m^2$) in each plot with material being transported to Darwin for drying, weighing and chemical analysis.

Prior to cutting Trial I in 1973 and 1974 an estimation was made of the percentage cover of woody perennial plants on each plot.

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X RESULTS

Trial I

(a) Establishment

The results of establishment counts are given in Table III.

Weather conditions were ideal for the establishment of pastures when Trial I was sown. This was particularly important for the vegetatively propagated grasses that require very moist conditions for establishment. In the uncultivated plots establishment was poorer due to lack of tilth and strong competition from perennial grasses.

TABLE III

Establishment Counts, Trial I (Plants/m^2)

Species	SITE I		SITE II		SITE III	
	Uncultivated	Cultivated	Uncultivated	Cultivated	Uncultivated	Cultivated
Calopo	4	23	18	15	10	14
Townsville Stylo	2	6	6	6	2	8
Schofield Stylo	35	76	60	36	18	32
Para Grass	10	3	2	2	1	4
Pangola Grass	0	2	0	3	0	1
Hymenachne	4	3	1	3	0	2

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The high establishment of the grasses of Site I may be attributed to the loose lateritic gravelly soil at this site enabling easy root entry under moist conditions.

(b) Plant Growth and Health

The results for dry matter production are given in Table IV.

The most prolific dry matter producers were Schofield Stylo and Calopo. These species have some problems for pasture development due to the former being susceptible to overgrazing and the latter being unpalatable during the growing season. However, Calopo would be a very good pioneer species for early development work.

Nutrient deficiencies were suspected because of yellowing of leaflets of some Schofield stylo plants.

Pangola grass established and persisted well but symptoms of rust were found on plants of Site II in 1973. This was one of the first positive recordings of rust (*Puccinia oahuensis*) on this species in the Northern Territory.

Townsville stylo was overall a poor producer, principally because of the high rainfall and long wet season. Excellent growth occurred but plants were affected by *Colletrotrichium gloeospiodes* which caused leaf spots and stem cankers. (Sonoda *et al* 1974, Pitkethley pers comm). This reduced growth rates. The carry-over feed value of Townsville stylo forage in this area would be low due to high humidity and heavy dews during the dry season (Anonymous).

The two grasses adapted to seasonally inundated conditions, Para and Hymenachne, survived on some plots. It was unusual for these species to survive in such seasonally dry areas and it is suspected that they would die out if heavily grazed.

(c) Forage Chemical Composition

The results for chemical composition are given in Table V. The overall protein content of the forage (whole plants harvested in May/June) produced in Trial I is acceptable considering the soil conditions and stage of growth of the plants at sampling. The low protein contents of the grasses both native and introduced illustrate the need for a legume-based pasture.

The low phosphorus levels in the forage are a problem which may limit animal production. All samples contained less than 0.18% phosphorus which is the level regarded as adequate for most classes of cattle (Cohen 1975).

The low levels of potassium in the forage can be attributed to the low soil potassium levels. The available analysis figures suggest a likely response to applied K (see Appendix V).

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TABLE IV

Dry matter production of six species under two establishment methods over three years (Trial I)

LAND PREPARATION (Lp)	SPECIES (Sp)	SITE I 1973	SITE I 1974	YEAR AND SITE (kg/ha) SITE II 1973	SITE II 1974	SITE II 1975	SITE III 1973	SITE III 1974	SITE III 1975
Uncultivated	Schofield Stylo	245	1675	185	1330	1535	275	2950	3622
	Para	0	0	5	0	0	0	0	0
	Calopo	40	10	165	85	1380	135	515	2920
	Pangola	0	0	0	20	225	0	0	415
	Townsville Stylo	5	0	25	755	65	40	535	655
	Hymenachne	0	0	0	0	0	0	0	0
Cultivated	Schofield Stylo	525	8685	115	4780	2115	785	10380	5095
	Para	735	5	280	0	0	990	1505	2345
	Calopo	655	2460	995	3120	5895	790	5555	3090
	Pangola	160	1655	220	1410	4690	420	3785	4100
	Townsville Stylo	140	50	10	60	0	995	2875	2075
	Hymenachne	160	0	100	0	0	35	195	0
		ns.	ns.	Sp** Lpx	ns. Sp**	Lp* Sp**	ns.	ns.	Sp*
					Lp x Sp**				

** p ⩽ 0.01   * p ⩽ 0.05   ns. = not significant

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TABLE V

Quality of forage produced by species in Trial I

	SITE I		SITE II					SITE III				
	1973	1974	1973	1974	1975			1973	1974	1975		
	CP%	CP%	CP%	CP%	CP%	P%	K%	CP%	CP%	CP%	P%	K%
Stylo	13.3	11.5	12.2	11.2	12.6	0.173	0.313	10.7	10.9	10.9	0.12	0.36
Calopo	14.4	7.0	12.0	11.2	11.3	0.104	0.254	10.5	10.3	12.5	0.13	0.297
Hymenachne	5.2	-	9.3	-	-	-	-	10.6	7.3	-	-	-
Para Grass	4.7	7.9	6.4	-	-	-	-	4.7	4.2	4.7	0.09	0.28
Townsville Stylo	8.3	11.5	16.4	11.7	11.7	0.15	0.274	12.9	14.2	13.2	0.11	0.31
Pangola Grass	7.3	3.7	6.9	3.2	3.6	0.088	0.176	8.3	3.5	3.7	0.08	0.12
Native Grasses	3.69		4.47					4.13				

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(d) Woody Species Competition

The results for regrowth of woody perennials are given in Table VI.

A method has to be used to reduce the competition of the native species when the introduced species are sown. Usually the only problem is native grasses, and strategic wet season burning has worked very well in the Darwin region (Stocker and Sturtz, 1966). However in this situation native woody perennial species compete readily with the establishing pasture. These woody perennials possess rhizomes which assist their regeneration following fire or soil disturbance, Lacey (1974).

The most common woody perennials competing with the introduced species were :-

Site I Petalostigma sp, Acacia sp, E porrecta

Site II Tristania sp, Acacia sp, Planchonia sp, Petalostigma sp, E ptychocarpa, E porrecta, E tetradonta

Site III Tristania sp, Acacia sp, Alphitonia sp

The reduction in cover of woody perennials with cultivation is clearly demonstrated but it is obvious two passes with a light disc harrow did not completely aliminate the competition. The importance of a

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vigorous pasture sward in combatting this competition should not be dismissed in future development. However unless established pastures remain vigorous it would be very likely that this regrowth would rapidly re-colonize improved pasture swards.

The slight increase in cover of woody perennials from 1973 to 1974 illustrates this point.

TABLE VI

Effects of Land Preparation on Woody Perennial Regrowth

	PERCENTAGE COVER					
	SITE I		SITE II		SITE III	
	1973	1974	1973	1974	1973	1974
Uncultivated	22	30	21	27	14	11
Cultivated	4	15	9	10	1	4

Trial II

Results for establishment, production and quality of the grasses tested in Trial II are given in Tables VII and VIII, respectively. "Whittet" Kikuyu appeared to be out of its environmental range because it showed poor vigour and many plants died in the second season. This is similar to its performance elsewhere in the Northern Territory.

TABLE VII

Establishment of Grass Species Trial II

SPECIES		PLANTS/m^2
P plicatulum	(Plicatulum)	22
P coloratum	(Makarikari)	17
P cladestinum	(Kikuyu)	22
B decumbens	(Signal)	20.5

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The most vigorous species in the trial were Signal grass and Plicatulum the latter producing the most dry matter. The quality of these species grown under these conditions of low soil nitrogen was scarcely better than native grasses. Added to this, experience in the Northern Territory has shown Plicatulum to be unpalatable to stock, (Ford, pers comm). Signal grass does have better palatability than Plicatulum but has proved in some areas to be more difficult to establish.

The trial has indicated the performance of alternative grasses which could be grown in the area - the species have shortcomings but offer worthwhile alternatives to Pangola grass. The main problem with the grasses is their low quality - this can only be overcome by using companion legumes and high phosphate application. The use of nitrogen fertilizer in this situation would be uneconomical.

TABLE VIII

The Dry Matter Production and Quality of Forage Produced by Four Grass Species Over Two Years

	1974				1975			
	kg/ha	CP%	P%	K%	kg/ha	CP%	P%	K%
P plicatulum	1544	4.6	0.054	0.733	2758	2.5	0.058	0.344
P maximum	63	5.6	0.06	0.835	805	2.9	0.058	0.293
P clandestinum	318	8.2	0.083	1.105	1625	-	-	-
B decumbens	1419	5.4	0.059	0.786	1818	2.1	0.058	0.332
	n.s.				n.s.			

n.s. = not significant

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Trial III

The results for dry matter yield and quality of the Stylosanthes tested in Trial III are given in Table IX.

The yields of most perennial Stylosanthes sp was typically low in the first year of establishment but could be expected to increase dramatically in the second year. The experiment was only measured in the first year so the yields presented do not illustrate the true potential dry matter production of the species. However the figures give an insight into the species' ability to establish and produce in the first season. Townsville stylo was included in the experiment for completeness even though it had already been evaluated in the area. These introductions may replace Townsville stylo in some areas, therefore any testing is made more meaningful if Townsville stylo is included for comparison.

The dry matter yields of these species was very low but their protein levels were adequate. As in the other experiments the level of phosphorus in the forage produced was low.

TABLE IX

The Dry Matter and Quality of Forage Produced by Stylosanthes sp during 1974/75 Wet Season

	DRY MATTER kg/ha	CP%	P%	K%
S humilis Townsville Stylo	92	12.2	0.108	0.782
S hamata cv Verano	157	12.0	0.095	0.723
S guianensis cv Cook	155	13.0	0.125	0.821
S scabra 40289	282	14.0	0.12	0.841
S scabra 34925	152	12.7	0.095	0.762
S scabra 40292	462	11.9	0.11	0.821
S scabra 40205	172	14.2	0.085	0.997
S viscosa 34904	494	11.7	0.053	0.684
	n.s.			

n.s. = not significant

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Trial IV

The establishment results and observations on the performance of *Stylosanthes* tested in Trial IV are given in Tables X and XI, respectively.

TABLE X

Establishment of *Stylosanthes sp* in Trial IV
(plants/m^2)

SPECIES	SITE I		SITE II		SITE III	
	uncultivated	cultivated	uncultivated	cultivated	uncultivated	cultivated
S viscosa 34904	0	10	10	11	24	4
S scabra 34925	0	1	1	1	0	5
S scabra 40205	3	2	4	2	6	3
S guianensis 34906	0	7	12	3	8	10
S hamata cv Verano	0	5	2	2	14	5

These observation plots proved to be valuable in assessing the potential of the species in this area, and the suitability of individual introductions.

The observations indicated that *S hamata* cv Verano performed poorly in this environment. Experience in other areas of the Northern Territory suggests this species is best suited to the lower rainfall areas (below 1000 mm) of the Top End.

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TABLE XI

Summary of Observations on the Performance of Stylosanthes Species

INTRODUCTION		COMMENTS
S viscosa	34904	Vigorous, colonized adjacent plots, appeared to flower throughout the wet season, dense growth generally to 30-40 cms.
S scabra	34925	Good growth in some plots, very little increase in stand density through re-seeding, growth to 40 cms.
S scabra	40205	Tall growth in some plots, up to 1m, very little increase in stand density through reseeding.
S guianensis	34906	Generally poor growth, plants often selected by wallabies, growth to 30-40 cms.
S hamata cv Verano		Poor growth and vigor in most plots, plants weak, and swards did not thicken up. High proportion of leaf drop in early dry season. Growth to 30 cms.

These perennial Stylosanthes have the ability to make use of the longer wet season and therefore offer potential for the area. However some may have problems in regenerating from seed under the season conditions to give stability to the pasture sward over a number of years. This specific problem can only be solved by a further period of research.

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XI DISCUSSION AND APPLICATION OF THE RESULTS TO THE DEVELOPMENT OF THE SEVENTEEN MILE PLAIN

Possible avenues for future pastoral development can be derived from the results and experience gained in the trials. Since the physical problems of experimental work at a remote site are similar to those experienced by a developing commercial enterprise, it is proposed to include discussion of these problems.

The results show that a fairly wide range of commercial and experimental pasture plants will grow on the Plain. However it is not known at this stage whether these species, grown alone or in mixtures, will develop into stable long term pastures. The maintenance of stable pastures is very important for long term planning and budgeting.

It has not been possible to maintain a stable grass/legume pasture over a long period in the Darwin region. However, experience in the Darwin area has shown the most stable pastures to be Pangola grass based. It is therefore felt more research is required to test the long term stability of possible pasture species and management systems.

The Plain does offer potential for agricultural development providing its limitations are realised and are taken into account in the development plans and budgets. Many of the natural limitations are discussed by van-Cuylenburg and Dunlop (1973). The large variation in soil type over small areas will necessitate pasture species adapted to a broad range of soils. The inaccessability of the Plain during the wet season will require road construction and/or movement of animals to higher land during the wet season.

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Even though the soils supported improved species with substantial annual application of superphosphate, levels of phosphorus in the unfertilized soils were very low. The costs of maintaining soil phosphate at levels adequate for high producing grass/legume pastures may be high and further work on maintenance phosphate requirements is necessary. Recent experience on the mainland suggests some Top End soils may also have other nutrient deficiencies. It is suggested that if further agronomic research is to be done in the area the soils be investigated for potassium, sulphur and trace element deficiencies as well as responses to superphosphate.

If intensive beef production using heavy applications of superphosphate and high stocking rates on improved pasture is developed the possibility of trace element deficiencies within the livestock should not be overlooked. This has occurred elsewhere in Australia in intensive beef cattle enterprises in high rainfall locations - a common deficiency being copper.

The initial removal of the light native vegetation does not appear to pose a problem. Similar vegetation has been cleared at low cost at Heathlands on Cape York Peninsula in North Queensland. Here the cane chopper roller is used to break down material following pulling, so a disc plough can be passed over the country. It is suggested that cultivation on the plain be kept to a minimum to reduce erosion risks. A suitable implement to do this would be a trailing, tandem, heavy duty, disc harrow. The only problem would be the successful suppression of subsequent regrowth of the woody species. This would be worst on the areas with species possessing rhizomes. Vigorous pasture swards would minimise the problem however other management strategies may be required.

It has been suggested that an integrated livestock/forestry project be investigated for the development of the country. A project of this nature would have distinct advantages due to the diversified nature of the enterprise. Gardiner (1971) considers that grazing should be combined with plantation forestry to reduce fire risk and to improve the ecology of the plantation.

There is no reason why the principle of integrated livestock/ forestry production should not be considered for the Plain, however a full technical and economic assessment is required before a firm decision can be made.

As a result of local experience on Melville Island Mr R Chaytor considers cattle could be grazed amongst P caribea trees after three years growth with approximately ten years of grazing being available from any one area. The present maximum rotation of P caribea is estimated to be 40 years - this means 25% of the plantations would always be available for grazing.

A total plantation area of 16,000 ha rotated in perpetuity, has been suggested for the island. This would give 4,000 ha of grazing at any one time. A system of this nature may have potential but the cost of providing fencing and water to such a large area of land for only a short term use would increase overall costs. However, if use was made of low cost electric fencing the costs would be reduced. The problem of water supply in many areas would be difficult to overcome without high initial capital investment.

Different planting densities and thinning regimes would also have to be looked at using P caribea. In the past some Cypress pine has been grown on the island but P caribea has proved superior and it is unlikely further Cypress pine plantings will be carried out. Furthermore virtually no grass grows under Cypress pine in existing plantations so it

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would be of no use in combination with livestock enterprises.

On the limited evidence available it is suggested a combination of intensive pasture development on the Plain and grazing the upland pine plantations be investigated rather than a development based only on improved pastures, or only on improved pastures in plantations. This approach would give flexibility and the availability of upland wet season grazing at a low development cost.

Intermittent grazing of the plots by wallabies was a problem of the overall experimental programme. It is suggested this may be a problem in initial commercial, improved pasture areas. Wallabies have proved to be a big problem in some other areas of the Northern Territory when establishing relatively small areas of improved pastures although damage has diminished as areas increase.

The costs of transporting materials, equipment and fertilizer to the island appear to be the greatest disadvantage of the area. This could be somewhat reduced by the construction of a barge landing close to the Plain served by all-weather access roads. A possible landing site exists on the northern arm of the Bremer River which is adjacent to the Plain. (Chaytor pers comm).

Disposal of produce (beef) must also be considered. At the initial stages of development, the output from the project would have to be geared to local demands and a local slaughter-house would be necessary. Later there may be scope for exporting live cattle to the mainland, or direct to overseas markets, but decisions on these later stages of development can be made only in the light of economic circumstances at the time.

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It must be remembered the Plain has advantages over virgin land elsewhere on the island and in the Northern Territory. These advantages are :-

1. There are few introduced weeds on the Plain compared to elsewhere on the island. Weeds are a major problem of improved pastures in the Top End and problem species occurring elsewhere on the island include _Sida spp_, _Hyptis suaveolens_, _Pennisetum pedicellatum_ and _Digitaria spp_. Therefore any agricultural development must aim to exclude these weeds which would damage the stability and productivity of improved pastures. Some weed seeds were carried to the experimental sites on machinery, but the resulting plants were removed from the plots, indicating the need for care to preserve the weed-free status.

2. At present there appears to be few cattle in the vicinity of the Plain and few on the island. This affords the opportunity of developing herds of cattle free from ticks and diseases such as brucellosis and tuberculosis.

The above two situations could be a distinct advantage however they would involve a small scale quarantine situation, including effective weed seed and animal disease quarantine measures. While this may appear arduous, it would result in lower costs of production in the longer term.

XII CONCLUSION

This series of experiments has investigated the problem of finding suitable pasture species for an unusual area of country in the Northern Territory. The results have shown

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some common pasture legumes and grasses will establish and grow in this environment. The quality of forage produced is poor reflecting the low nutrient status of the soil but it is felt high quality forage could be produced in the area once correct fertilizer applications were developed. Small areas of Stylosanthes spp introductions indicate the potential of these species for the area - this group of plants warrants further study.

The main problems facing improved pastures on the Plain are soil nutrient levels and types of management required to promote long term pasture stability. These problems can only be solved by further research in the area.

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APPENDIX 1

The only figures available on introduced livestock on Melville Island are from Mr R Chaytor of Pickertaramoor. The figures are based on estimates made by the Division of Agriculture and Stock some years ago.

Buffalo	-	3000 head mostly in the South Eastern part of the island.
Cattle	-	70 head in the Kilu Impini and Arrimi Creek areas.
Horses	-	Unknown but probably slightly less than the number of buffalo.
Donkeys	-	5 and apparently 1 mule.

APPENDIX II

(a) Average Annual Rainfall for Melville and Bathurst Islands

Garden Point	(1964-72)	1895 mm
Pickertaramoor	(1964-72)	1600 mm
Snake Bay	(1964-72)	1560 mm
Bathurst Island	(1913-72)	1400 mm
Threeways	(1971-76)	1993 mm

(b) Annual Rainfall Threeways 1971-76

1971	1469.6 mm
1972	1429.0 mm
1973	2341.6 mm
1974	2815.8 mm
1975	2178.6 mm
1976	1727.2 mm

Source : Pickertaramoor records

APPENDIX III

Mean Temperatures - Darwin - Pickertaramoor
(Compiled by Mr R Chaytor, Pickertaramoor)

	DARWIN	PICKERTARAMOOR	DIFFERENTIAL
January	28	28	0
February	28	27	1
March	29	28	1
April	29	26	3
May	28	24	4
June	26	21	5
July	25	20	5
August	27	22	5
September	28	25	3
October	29	26	3
November	30	27	3
December	29	28	1

Source - Darwin
Obtained from chart of comparative world temperatures.

Source - Pickertaramoor
Records 1968-72

DARWIN

	MAXIMUM	MINIMUM	MEANS
January	32.4	25.2	28.8
July	30.6	19.7	25.1
Whole Year	32.6	23.6	28.1
Extreme Maximum	40.5		
Extreme Minimum	10.4		

Source - Bureau of Meteorology, Darwin PO records, 82 years.

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PICKERTARAMOOR - TEMPERATURE - 1968-72

MEANS	MAXIMUM	MINIMUM
January	34.1	22.3
February	32.1	22.6
March	32.7	23.0
April	32.4	19.7
May	31.0	16.2
June	29.5	13.3
July	28.9	10.7
August	30.3	14.3
September	32.3	16.8
October	34.0	18.6
November	34.2	20.3
December	33.7	21.7

Highest Maximum 36.7 on 9/1/70, 3/10/71 and 15/11/71

Lowest Minimum 2.8 on 12th and 23rd July, 1970

Source - Pickertaramoor records

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APPENDIX IV

SITE I

Great Soil Group	:	Yellow Earth (Lateritic)
Soil Family	:	Koolpinyah
Series	:	No II
Parent Material	:	Unknown, but possibly exposed lateritized upper cretaceous sediments
Principal Profile Form	:	Gn 2.24

SOIL PROFILE DESCRIPTION

Soil Depth (cm)	Horizon	Soil Description
0 - 6	A_1	Very dark greyish brown (10yr 3/2) sandy loam, dry slightly hard, pH 5.5 5% ironstone nodules.
6 - 25	A_2	Dark yellowish brown (10yr 4/4) sandy loam, moist friable, pH 5.5 5% ironstone nodules.
25 - 80	B_1	Yellowish brown (10yr 5/6) sandy clay loam, moist friable, pH 6.0 5-20% ironstone nodules, weakly and strongly cemented.
80 - 100	B_{12}	Extremely mottled gravel pan.
Drainage		These soils are superficially well drained, but the mottled gravel pan perches soil water in the subsoil and causes some drainage impedance.

Source - van-Cuylenburg and Dunlop (1973)

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SITE II AND III

Great Soil Group	:	Red earths (sandy)
Soil Family	:	Killupa
Series	:	No II
Parent Material	:	Tertiary sandstone colluvium
Principal Profile Form	:	Gn 2.11

SOIL PROFILE DESCRIPTION

Soil Depth (cm)	Horizon	Soil Description
0 - 5	A_1	Dark reddish brown (5yr 3/3) loamy sand - sandy loam, dry slightly hard. pH 6.0
5 - 30	A_3	Dark reddish brown - reddish brown (5yr 3/3 - 4/4) sandy loam, moist friable. pH 6.0
30 - 60	B_{11}	Red (2.5yr 4/6) sandy loam - sandy clay loam, moist friable. pH 5.5
60 - 150	B_{12}	Red (2.5yr 4/6) sandy clay loam, moist friable. pH 5.5
Drainage		Well drained.

Source - van-Cuylenburg and Dunlop (1973)

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APPENDIX V

SOIL ANALYSIS RESULTS

A. SITES I AND III

	SITE I			SITE III		
Depth (cm)	pH 1:5 H_2O	Cond.m.ohms cm^{-1}	Avail P	pH 1:5 H_2O	Cond.m.ohms cm^{-1}	Avail P
0- 6	5.3	0.015	N.d.	5.5	0.019	N.d.
6-12	5 4			5.4		
12-18	5.6	0.011		5.4	0.008	
18-24	5.5					
24-30	5.4	0.009		5.3		
30-36				5.3	0.008	
36-42				5.4		
42-48				5.4	0.009	

B. SITE II (0 - 12 cms)

pH (1:5 H_2O) 5.5

% Total soluble salts 0.01%

Cation exchange capacity 4.0 m.e. %

Exchangeable ions K^+ 0.08 m.e. %

Exchangeable ions Na^+ 0.06 m.e. %

Exchangeable ions Ca^{++} 1.54 m.e. %

Exchangeable ions Mg^{++} 0.70 m.e. %

Available phosphorus (bicarbonate method) 2.0 p.p.m.

Organic carbon 2.067%

Organic matter 3.56%

Source - Division of Agriculture & Stock, Soils Laboratory