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CYPLUS
CAPE YORK PENINSULA
LAND USE STRATEGY

LAND USE PROGRAM

ANIMAL AND WEED PESTS OF CAPE YORK PENINSULA

J. Mitchell & G. Hardwick
Land Protection Branch, Queensland Department of Lands
1995

LANDS

CYPLUS is a joint initiative of the Queensland and Commonwealth Governments

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(CYPLUS)

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Note:

Due to the timing of publication, reports on other CYPLUS projects may not be fully cited in the BIBLIOGRAPHY section. However, they should be able to be located by author, agency or subject.

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CAPE YORK PENINSULA LAND USE STRATEGY
STAGE I

PREFACE TO PROJECT REPORTS

Cape York Peninsula Land Use Strategy (CYPLUS) is an initiative to provide a basis for public participation in planning for the ecologically sustainable development of Cape York Peninsula. It is jointly funded by the Queensland and Commonwealth Governments and is being carried out in three stages:

Stage I - information gathering;
Stage II - development of principles, policies and processes; and
Stage III - implementation and review.

The project dealt with in this report is a part of Stage I of CYPLUS. The main components of Stage I of CYPLUS consist of two data collection programs, the development of a Geographic Information System (GIS) and the establishment of processes for public participation.

The data collection and collation work was conducted within two broad programs, the Natural Resources Analysis Program (NRAP) and the Land Use Program (LUP). The project reported on here forms part of one of these programs.

The objectives of NRAP were to collect and interpret base data on the natural resources of Cape York Peninsula to provide input to:

evaluation of the potential of those resources for a range of activities related to the use and management of land in line with economic, environmental and social values; and
formulation of the land use policies, principles and processes of CYPLUS.

Projects examining both physical and biological resources were included in NRAP together with Geographic Information System (GIS) projects. NRAP projects are listed in the following Table.

Physical Resource/GIS Projects	Biological Resource Projects
Bedrock geological data - digitising and integration (NR05)	Vegetation mapping (NR01)
Airborne geophysical survey (NR15)	Marine plant (seagrass/mangrove) distribution (NR06)
Coastal environment geoscience survey (NR14)	Insect fauna survey (NR17)
Mineral resource inventory (NR04)	Fish fauna survey (NR10)
Water resource investigation (groundwater) (NR16)	Terrestrial vertebrate fauna survey (NR03)
Regolith terrain mapping (NR12)	Wetland fauna survey (NR09)

Physical Resource/GIS Projects	Biological Resource Projects
Land resource inventory (NR02)	Flora data and modelling (NR18)
Environmental region analysis (NR11)	Fauna distribution modelling (NR19)
CYPLUS data into NRIC database FINDAR (NR20)	Golden-shouldered parrot conservation management (NR21)
Queensland GIS development and maintenance (NR08)*	
GIS creation/maintenance (NR07)*	

* These projects are accumulating and storing all Stage I data that is submitted in GIS compatible formats.

Research priorities for the LUP were set through the public participation process with the objectives of:

> collecting information on a wide range of social, cultural, economic and environmental issues relevant to Cape York Peninsula; and
> highlighting interactions between people, land (resource use) and nature sectors.

Projects were undertaken within these sector areas and are listed in the following Table.

People Projects	Land Projects	Nature Projects
Population	Current land use	Surface water resources
Transport services and infrastructure	Land tenure	Fire
Values, needs and aspirations	Indigenous management of land and sea	Feral and pest animals
Services and infrastructure	Pastoral industry	Weeds
Economic assessment	Primary industries (non-pastoral, non-forestry)	Land degradation and soil erosion
Secondary and tertiary industries	Forest resources	Conservation and natural heritage assessment
Traditional activities	Commercial and non commercial fisheries	Conservation and National Park management
Current administrative structures	Mineral resource potential and mining industry	
	Tourism industry	

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EXECUTIVE SUMMARY

1. Information was collected on the distribution and abundance level of the animal and weed pest species occurring in the CYPLUS area. The information was collected from past pest survey GIS data and from ground survey and interview methods.

2. Relevant information on the biology, impact, control methods, legislation and management principles for the identified pest species is also presented.

3. Seven species of animal pest species were recognised, the feral pig, dingo/wild dog, feral horse and feral cats were identified as having the greatest pest capacity.

4. Forty one weed species are discussed, thirty seven occurring within the CYPLUS area, with discussions on four weed species with the most potential as a future pest in the CYPLUS area.

5. Low population levels and large tracks of land cause management levels to be minimal. Adequate property management is the key to pest management.

6. The majority of the CYP general community perceives animal and weed issues as a low priority. The long term impact of these pests are not conspicuous to the community and other prominent concerns affecting the CYP generally override the pest issue.

7. The potential of animal and weed pest impact is a major consideration that must be taken into account when developing future management plans for CYP. Weeds and animal pest have the potential to be the principal problem for future management of CYP.

8. The level of pest management is highly dependent on the resources available. Labour, materials and economic considerations are the major constraint to implementing management plans for pest species in CYP.

9. Pest management on aboriginal lands is a complex issue and needs to be addressed.

10. The threat of importation of exotic diseases or exotic weed species is a major consideration for this region. The potential of a serious outbreak is very high and management plans specific to this region need to be developed.

11. Commercialisation of the major animal pest species is a possibility.

12. The problem of animal pests and human health issues needs to be addressed.

1.0 INTRODUCTION

The Australian continent has for so long been the isolated evolutionary cradle of unique species of plants and animals. The recent (in evolutionary terms) invasion of a whole host of animal and plant species has caused major problems for the ecosystem. The introduction of exotic species and the resultant competition with native species has had a major impact on ecological processes within the Australian environment.

The Australian Science and Engineering Council reported that exotic animal and plant species are one of the major issues facing the tropical savanna landscape. Land degradation caused by plant and animal pests is a serious problem and effects the economic sustainability of industries and also the biodiversity and ecological processes of the tropical ecosystems.

Cape York Peninsular has suffered from limited development due to its large area, limited infrastructure, relatively small localised populations, and seasonal harsh environmental conditions. The social and physical management problems associated with the region also influence the attitudes of the community to animal and plant pests. The management of the enormous social and physical concerns of the Cape tend to engulf the perceived small problems of animal and plant pests. Pests are perceived as a side issue to be addressed when other more pressing issues have been overcome.

The purpose of this report is to put the concept of pest management in the right perspective and to highlight the impact of animal and plant pests that is generally overlooked or not given due consideration in management discussions of the region.

This report will present information on impact assessment, control techniques and management plans for the known animal and plant pest species that occur in Cape York. Information will also be presented on the distribution and abundance of these pest species and presented as a data layer for inclusion into the CYPLUS GIS systems.

2.0 METHODOLOGY

The principal tasks of this consultancy are highlighted below. Methods were employed to resolve these tasks for animal and plant pest species in 4 stages i.e

Stage 1. Reference Data Collection

Pest Animals.

Collect information describing current distribution of feral and pest animals in Cape York Peninsular, general ecology, control containment strategies, and opportunities for use. Relate distribution to ecosystems.

Weeds.

Collect information describing present and potential distribution of weed species, general ecology, control containment strategies and quarantine hazards. Overlay distribution on vegetation communities.

Stage 2. Field survey

Pest Animals.

Survey for new information, and refine and update information on distribution through field survey and collection of expert opinion.

Weeds.

Field work to refine information through expert opinion and survey.

Stage 3. Results presented as a CYPLUS Geographical Information System layer

Pest Animals

Update GIS coverage on distribution of feral and pest animals.

Weeds

Update GIS coverage on present and potential distribution

Stage 4. Presentation of a final written report

Pest Animals

Prepare a project report which includes methods for control and containment of feral animals, economic impact, commercial or subsistence use, general or environmental impacts native flora and fauna communities under threat, potential feral species and current government policies.

Weeds

Prepare an overview report describing general environmental impacts of weeds, control methods, potential weed species, economic significance and current government policies.

2.1 Methods

2.1.1 Stage 1. Reference Data Collection

The scientific literature was search for reference to weed and pest animal species directly related to Cape York Peninsular, tropical regions or for general ecological references, particular attention was attributed to population distribution or abundance references.

Land Protection Branch technical reference material on weed and animal pest control, ecology and distribution were referenced. The reference material pertinent to CYP were compiled into a booklet which was given to participating interviewees. The booklet was used as an incentive for interviewee to complete the survey form and also to act as a reference source. The booklets were well received by all landholders and organisations.

Expert opinions were collect from a number of professional sources.

Department of Primary Industries - Animal Health Branch
- Forestry Service
- AQIS

Commonwealth Scientific and Industrial Research Organisation
Department of Environment and Heritage
Lands Department - Far Northern Region
Cook Shire Council.

Previous survey results for CYP were recalled. The GIS system "Pestinfo" on pest animal distribution and abundance within Queensland was accessed for information on the CYP region. This GIS data was downloaded from the data storage unit at Robert Wicks Research Centre (Inglewood) and transferred to the QLIS compatible system in the Brisbane based Land Protection Branch head office. The hard copy survey result of weed distribution for CYP (1987) was referenced and distribution maps recognise.

Pestinfo was conducted over a 10 month period during 1981-82 and subsequently in 1984 and 1986, as ground survey to quantify the size and density of 14 vertebrate pest populations and to identify and delineate preferred habitat areas for each species in all shires of Queensland including CYP. The major aim of the survey was to define key areas of the State where significant populations of vertebrate pests harbour.

The survey was carried out on a shire-by-shire basis for ease of map interpretation and to enable pest populations to be defined from fixed reference points. The survey was conducted on a interview basis in which selected personnel within each shire were individually interviewed. This detailed information was then transposed onto 133 cadastral shire maps by hand. A report "Vertebrate Pests of Queensland" (Mitchell et al. 1982) was produced detailing the methodology employed and the results obtained.

The results of this initial survey have now been computerised. This has been achieved by digitising the distribution and density boundaries derived from the hard copy maps. This information is used to overlay base data sets such as cadastral information, geographical information such as roads, rivers and towns; and environmental data sets.

Pest population attributes digitised include distribution patterns and population density assessments for 14 vertebrate pest species;

Dingo/feral dog	*Canis familiaris*
Feral pig	*Sus scrofa*
Fox	*Vulpes*
Feral goats	*Capra hircus*
Feral camels	*Camelus dromedarius*
Feral donkeys	*Equus asinus*
Feral horses	*Equus caballus*
Deer	*Dama, Cervus elaphus, Cervus timorensis, Axix axis*
Feral cattle	*Bos indicus, Bos taurus*
Buffalo	*Bubalus*

The system can delineate animal pest distributions and produce this information in map form on any desired scale (50m to 15000km). The basic unit is the Shire (Local Government Authority), and is the foundation of the pest distribution digitisation and file storage and management. Individual files have been established which records the distribution pattern of individual pest species illustrated above, for every shire of Queensland. Thus for the 133 shires it is possible to produce a distribution map of the 14 pest species. To this distribution a density criteria can then be assigned. Population levels are based on the density criteria established in the original survey 1981-82. Thus for each pest distribution within a given shire, the distribution can be divided into areas of different pest density according to the criteria information observed.

A weed survey conducted in 1987, (Hardwick 1987) identified thirth nine weed species which formed the basis of this survey. These species were presented as colour photograph in the pest booklet described below.

2.1.2. Task 2. Field Survey

A field survey was undertaken to :-

Validate existing survey data.
Upgrade information where data was incomplete or inaccurate.
Survey areas where previous surveys was not conducted.
Collect expert opinion and landholder survey data
- areas not covered from previous surveys
- areas where previous survey data is deficient

A 14 day ground survey was conducted utilising three mobile teams acting independently. Each team surveyed for the presence and relative population levels of weed and animal pest species. Surveys were conducted by traversing creek lines and tracks,(walking or driving) and observing the presence of species or in the case of animal pests, their signs. A criteria for the animal pest density levels were taken from the original pest survey (Mitchell 1982) (Table I).

TABLE I. CRITERIA FOR ASSESSMENT OF ANIMAL PEST POPULATION DENSITY

PEST SPECIES	DENSITY LEVEL	CRITERIA
PIG	VERY HIGH	Abundant fresh signs, droppings and diggings Many sightings day and night Large groups over 50
	HIGH	Many fresh signs, many diggings Sightings day and night Groups of 20 to 50 present
	MEDIUM	Moderate signs, mainly diggings Sightings mainly at night Groups up 20 mainly small groups and individuals.
	LOW	Few signs mainly some diggings Few sightings mainly at night Small groups, mainly individuals
BRUMBY	HIGH	Many tracks and signs Many sightings Groups of stallion with many mares
	MEDIUM	Some tracks and signs Some irregular sightings Stallion with small group of mares
	LOW	Occasional tracks and signs Few sightings Mainly individuals or small groups
FERAL CATTLE	HIGH	Many groups of unbranded cattle Low management levels
	MEDIUM	Unbranded individuals, mainly bulls Low management levels
	LOW	Occasional unbranded bull Average management levels
DINGOES	HIGH	Abundant tracks and signs Sightings day and night Some groups up to 10-15
	MEDIUM	Tracks and signs present Some sightings mainly at night Mainly individuals and small groups
	LOW	Some tracks and signs Occasional sightings Individuals or pairs, few small groups
CATS RABBITS FOXES DEER FERAL CATTLE	PRESENT	Some signs or sightings
	ABSENT	No signs or sightings

Landholders, who in the opinion of the survey team were an expert data source were personally interviewed when possible or a survey form was left for completion. A total of 35 survey forms were distributed. A booklet describing the description of the known weed and animal pest accompanied the survey form to standardise data collection and to supply future reference material to landholders. Expert opinion was also collected from government organisations, aboriginal communities and companies whenever possible.

2.1.3 Task 3. GIS data presentation.

The information collected was presented as a data set from a GIS established by the Land Protection Branch. This GIS "Pestinfo" was established to develop a computer-based pest field recording system for woody weeds, herbaceous weeds and vertebrate pests. The system was used as a means of providing pest related data which is suitable for analysis and evaluation for management decisions to be made and for day to day recordings for the Regional Inspectors employed by the Branch.

Information was collected on a property by property basis which supplied the basis unit for the GIS database. Properties were determined from the Lands Department DCDB GIS, where individual parcel of land were collectively amalgamated into a property basis using Arc\View software. The distribution and abundance data for each animal or plant pest species is presented in Arc\Info format. Animal pests are presented as a density criteria (described above) for each property basis. Weed species are presented as a presence or absence data only for each property basis. Hard copy maps for each animal or plant pest species are presented as an appendix to this report.

2.1.4. Task 4. Final Report.

This report presents all the data collected from external sources and from the field survey.
Animal pests and plant pests are segregated into separate sections for this report. Pest species are discussed individually and include information on their general ecology, ecological and economic impact, legislation, control techniques, management plans and commercialisation aspects.

3.0 FERAL AND PEST ANIMALS

3.1 Introduction

Australia has at least 26 species of introduced mammals that have established wild populations. Domestic animals and their descendants that have gone wild are known as feral animals. Wild animal species that have been introduced into the Australian wild are termed exotics or introduced pests. Animal pests whether feral or exotic are collectively termed vertebrate pests. A vertebrate pest is an animal that has a significant net deleterious effect on a valued resource (Braysher 1993).

Many of these vertebrate pests cause major economic and/or environmental damage. The full impact of these introductions has still to be determined, animal pests now affect almost every aspect of the national economy and the community.

The economic impact of vertebrate pests is impossible to determine. Vertebrate pests cause major losses to agricultural production and involve landholders in expensive continuing control programs. They compete with domestic stock for food, damage crops, predate on livestock, and damage physical structures (fences, watering points, roads). In some areas vertebrate pests force landholders into less economic forms of production.

Some of the economic impact are more subtle but are believed to be substantial. Heavy total grazing pressure from domestics and animal pests change the fire regime of rangelands leading to the invasion of unwanted scrub species. Grazing pressure can also lead to land degradation through erosion, soil compaction, and changing species composition. Changes to the nutrient and water cycles in degraded areas can severely influence future production from these areas.

Because many of the vertebrate pests are feral from domestic stock they carry diseases that effect the livestock industries. Attempts to implement disease control can be impeded by the presence of feral animals. The potential of vertebrate pests to act as reservoir of exotic disease can nor be overstated. Control of exotic disease outbreaks will be extremely difficult where animal pest that carry the disease are present. Exotic disease that are considered to be the greatest threat of entering Australia are shown in Table 2.

The degree to which vertebrate pest are capable of transmitting diseases to domestic stock varies. The effectiveness of vertebrate pests as vectors depends on their distribution, population density, contact rates between individuals and association with susceptible species. The time taken to identify exotic disease outbreaks in rangeland situations is also important in determining the level of control required.

The impact of vertebrate pests on the natural environment has increasingly become of major concern. Because vertebrate pests did not evolve in this environment they do not fit into the natural ecosystem. Lack of natural control influences have seen the explosion of these pest populations after introduction. The only true natural controlling influence on many vertebrate pests is drought.

Vertebrate pests compete with native species for food water and shelter. In conditions where resources are scarce, vertebrate pests can be more competitive to the detriment of the native species. Land degradation can also impact on native species. Many of the smaller native marsupials have evolved without the presence of significant carnivorous predators. Vertebrate pests such as the cat and fox have had a significant effect on some native populations.

A number of animal species can be described as vertebrate pest in Cape York i.e.

Feral Pig	*Sus scrofa*
Feral Cat	*Felis cattus*
Feral Dog	*Canis familiaris*
Dingo	*Canis familiaris dingo*
Feral Horse	*Equus caballus*
Rabbit	*Oryctolagus cuniculus*
Fox	*Vulpes vulpes*
Toad	*Bufo marinus*
Deer	*Cervus timorensis*
Rodents	Numerous *Rattus* and *Mus* species
Birds	Numerous species

3.2. Feral Pigs

3.2.1 Introduction

Feral pigs (*Sus scrofa*) are one of the most prolific and potentially the most devastating of Australia's animal pest species. They are regarded as a principal pest species in many countries of the world.

Feral pigs are found in all habitat types throughout Queensland (Mitchell *et al.* 1982). The feral pig is a great survivor, and coupled with its high level of intelligence (higher then a dog) has been able to colonise all habitats and proliferate in most. Of particular recent interest is the management of feral pigs in the "dry" and "wet" tropical regions of Australia. Commonwealth and State authorities are beginning to realise the extent of the problem in northern regions and the enormous risk they pose in terms of long term ecological damage, economic losses and potential disasters such as exotic disease outbreaks.

The Commonwealth's "Initiatives on Feral Pests" has established a range of initiatives aimed at reducing the impact of feral pests, including feral pigs, on agricultural production and the environment. National guidelines for managing the major pest animals are being prepared by the Bureau of Resource Sciences under the guidance of the Vertebrate Pest Committee of the Standing Committee on Agriculture. One particular initiative is a systems approach to the management of feral pigs in the tropics.

3.2.2. Ecological and Economic Impact

To understand the "threat" of feral pigs to Cape York, information is required on the quantitative impact of feral pigs on this environment. Clarification of the impact of feral pigs in terms of season, severity, diversity and situation is a fundamental component of developing a management plan.

The identification of the true or qualitative impact of feral pigs is difficult. Impact may be defined as obvious or visual, such as diggings or vegetation damage, or their effect may be obscure and only discernible over an extended time frame. McIlroy (1993) suggests that impact also needs to be assessed as chronic or acute, and seasonal or constant, to enable the extent and timing of control programs to vary according to the nature of the impact.

The perception of feral pig damage by the Cape York community is generally one of alarm. However the overriding problem is the lack of factual information on feral pig impact and the difficulty in obtaining an accurate picture of the damage being caused. Impact can be direct or indirect as outlined by McIlroy (1993), may be seasonally influenced, acute or chronic, periodic or constant, and varies according to people's perceptions. Situations should also be identified where future impact is possible.

Feral pigs cause significant economic losses to both crop and livestock production throughout Australia estimated to be $80m/annum (Hone and Robards 1981; Tisdell 1982). Very few agricultural enterprises are safe from some form of feral pig damage. Destruction of crops, market gardens, orchards, native and improved pastures, fences, watering facilities and predation of lambs are commonly reported. The pig is also believed to play an important part in the spread and propagation of noxious weeds, and there is some evidence to suggest that the pig and plant pests may live in symbiosis with each other (Mitchell *et al.* 1982). Feral pigs are reservoirs of numerous endemic diseases and potential vectors of exotic diseases such as foot and mouth (Martin 1972; O'Brien 1989; Saunders and Bryant 1988). With a succession of good seasons and the accidental introduction of an exotic disease, such as foot and mouth, the results could be without precedent in our natural disasters (Allen 1984).

Little scientific work has been conducted in Australia to determine the degree of feral pig impact on the environment. Feral pigs are believed to cause significant environmental damage through the destruction of habitat (Bratton 1975), competition for food, predation, disease transmission and erosion (Tisdell 1982), and can influence ecological processes such as succession and species composition.

The main visual impact of feral pig damage is soil disturbance due to their searching behaviour for plant roots and soil invertebrates. Most perceptions of damage by feral pigs focus on their rooting up of soils especially in moist conditions along streams or swamps, lagoons etc. Moist soils are a major influencing factor on the distribution of feral pigs, as the dry season progresses the locations of moist soils tend to concentrate pig populations in these areas hence suffering severe damage. Although animal signs do not necessarily correlate with population density or activity (Hone 1988), rooted ground has been used as

an index of the impact of feral pigs on various environments (Bratton 1975; Alexiou 1983; Hone 1988; Bowman and Panton 1991).

The effect of rooting on soil nutrient cycling and erosion is largely unknown. There is a general perception that the extensive rooting of coastal lowlands streams and marine habitats that occurs during the late dry, causes extensive erosion problems during flooding in the wet.

The undesirable aspects of feral pig activities in a range of habitats throughout the world have been documented (Bratton, 1975 (United States); Ralph and Maxwell, 1984 (Hawaii); Lesourret and Genard 1985 (France); Coblentz and Baber 1987 (Ecuador); Thompson and Challies 1988 (New Zealand); Bowman and McDonough 1991 (Australia)). Research on the detrimental impact of pigs on a tropical environment have been restricted to studies in Hawaii (Baker 1976; Ralph and Maxwell 1984; Mueller-Dombious *et al.* 1981; Cooray and Mueller-Dombious 1981; Stone and Loope 1087; Stone and Anderson 1988).

McIlroy (1993) lists the potential impact of pigs as habitat degradation, predation, economic losses to neighbours, hosts or vectors of endemic or exotic diseases, and the effect of pig control, particularly hunting, on non-target animals.
Destruction of pandanus (*Pandanus spiralis),* feather palms (*Archontophoenix alexandrae*) rhizomes of *Helmholtzia sp. (Liliaceae)* and fruits of *Normanbya normanbyi* and *Elaeocarpus angustifolius*. have been documented in the wet tropic regions.

Direct damage observed during this survey include trees and shrubs undermined or pushed over, plants broken by chewing tusking, rubbing, or the passage of pigs; road edges and table drains eroding, road surface damage, erosion in water courses, and microhabitat effects such as logs and rocks moved. Of particular significance are the swamps and streams of the coastal lowlands where the damage to large areas is total.

The effect of feral pig predation on small ground dwelling mammals, birds and reptiles and soil invertebrates, is unknown. The presence of egg shell, feathers, mammal fur and bones in faecal samples observed indicate that predation may be occurring (carrion consumption is another possibility). A number of small mammals and birds were found dead during this survey, some apparently being eaten by feral pigs, but the cause of death could not be attributed to pig predation.

Turtles have been reported to be killed in large numbers by pigs in receding swamps in the Northern Territory (R. Kennett *pers. comm.*). Although no evidence was seen, I believe that pig predation on freshwater crayfish, frogs and turtles would occur in freshwater habitats frequented by feral pigs.

Beetles and insects found in faeces during this survey, may be an important dietary item as they contain 60% crude protein (McIlroy 1993) and may represent an important source of protein during the dry season. The influence of high protein items such as earthworms and insects may have a major effect on the behavioural patterns of feral pigs in this environment.

Feral pigs can be hosts or vectors of a number of endemic diseases and parasites that can effect other domestic and native animals and also humans. The major diseases of concern are leptospirosis, *leptospirs spp.*, brucellosis, *Brucella suis*, meliodosis, *Pseudomonas pseudomallei.* and tuberculosis, *Mycobacterium spp.*

Leptospirosis is the most common bacterial disease in feral pigs. Pavlov (1991) found infection rates in feral pigs of 10.6% in study sites south of Coen, 3.8% in sites north of Coen and 2.1% on Prince of Wales Island.

This bacterium causes Weil's disease in humans and can be contacted through intake of urine contaminated food or water or contact with urine through broken skin or wounds during field butchery. The disease can occur from living in close association with infected pigs or handling them in hunting or penned feral pigs. For example most aboriginal communities live in close association with feral pigs and actively utilise them for food. Feral pigs were seen during the survey foraging in the middle of Lockhart River aboriginal community. A range of other animals can also be infected with leptospirious, particularly cattle and rodents

Brucellosis is a serious and long-lasting illness in humans and is being detected in increasing numbers of people who hunt or butcher feral pigs (Robson et al. 1993). Norton and Thomas (1976) found 34% of a sample of feral pigs in Northern Queensland were infected while Pavlov (1991) detected 7.1% at Lakefield National Park, 5.9% at Lockhart River and 4.8% at Bertihaugh Station. The disease risk from human consumption is dependent on the appropriate cooking, traditional cooking over open fires etc is generally not sufficient to adequately cook all of the carcass so infection is possible.

Meliodosis, a sometimes fatal disease in humans can be passed to humans via contamination of skin wounds and abrasions, or by hand to mouth when handling or field butchering feral pigs. Pavlov (1991) found 23.9% of feral pigs were infected in sample sites south of Coen, 21.2% north of Coen and 18.3% on Prince of Wales Island. The bacterium that causes Meliodosis lives in the soil and is brought to the surface by extensive waterlogging.

Tuberculosis is common in feral pigs in Western Australia and the Northern territory. Pavlov (1991) did not find any TB infected feral pigs in his study of Cape York.

Viral diseases also occur in feral pigs in Cape York. Pavlov (1991) found 14% of the feral pig sample was infected with Ross River Virus and 34% were infected with Murray Valley Encephalitis.

Feral pigs are susceptible to a wide range of parasitic helminths. Parasites found in Cape York and their incidence of infection, include Stomach Worms (85%), Kidney Worms (80%), Thorny Headed Worm (33%), Lungworm (13%), and Sparganosis (61%) (Pavlov 1991). Trichinella spiralis is a common parasite of feral pigs in U.S.A. and Europe and is infectious to humans, however this parasite has not been recorded in Australia to date.

Sparganosis infects feral pigs and migrates into the muscle bundles. If the carcass is inadequately cooked this parasite may survive and infect humans. Migration of the spargama through organs can lead to a range of medical conditions in humans.

Feral pigs can act as hosts or vectors of a number of exotic diseases and parasites of livestock, particularly foot and mouth, other vesicular diseases and african swine fever. Outbreaks of any of these diseases would have severe repercussions for both Australia's export and domestic livestock industries. Foot and Mouth for example would cost Australia up to $9 billion in lost export trade, even if the disease was contained immediately. If the disease persisted cost could be in the order of $3 billion per year. Significant social upheaval could follow as well as major changes in land use in some parts of Australia. Control of an exotic disease outbreak in Cape York could be difficult. Firstly the detection of the disease especially in feral pigs may not occur until after the disease is widespread throughout the population. Seasonal wet conditions would hamper control techniques and the lack of access would restrict the effectiveness of any control program.

Contingency plans formulated for an exotic disease outbreak have been developed, however the difficulty of control and movements of feral pigs would severely compromise these plans.

Of major concern is the potential for Screw Worm Fly Chrysomia bezziana to become established in Cape York. This fly is perceived by Federal authorities as Australia most direct exotic threat. The fly is endemic to New Guinea and could invade Australia through the passage of pigs or other animals between New Guinea and the Islands. Feral Pigs and Rusa deer on Prince of Wales Island could become hosts for this fly enabling its passage to the mainland. If established on the mainland feral pigs would become important host of this exotic pest.

Screw Worm Fly invades wounds and natural orifices of animals feeding on living flesh and causing severe debilitation, loss of production and death of domestic animals. This fly also infects wounds in humans if untreated.

3.2.3. Control techniques

Feral pigs are difficult to control for a number of reasons: they are nocturnal, wary and inhabit inaccessible areas, reproduction potential is high necessitating repeated control programs, omnivorous feeding habits cause problems of bait selection and free feeding, and large home ranges requires large control areas for effective control.

Strategies need to be flexible to correspond to the changing conditions found throughout the Cape. Also important conservation issues influence and limit the control strategy employed in certain circumstances. Korn *et al.* (1994) discussed the most relevant options for control of feral pigs as local eradication, strategic sustained control and no management.

(a) Local Eradication.

Eradication involves the permanent removal of all pigs within an area. Eradication is dependant on;

- Individuals being killed at a rate faster then they can replace their losses, reproducing or immigration from surrounding areas.
- Technical and financial resources must be sufficient to continue the program till the last individual is removed.
- Perimeter control must be established to avoid immigration.

Eradication has the advantage of eliminating all adverse impact of feral pigs including impact(s) not yet identified. Eradication is generally only considered feasible in small select areas or where the cost of eradication is offset by the benefits gained. For example high priority conservation areas such as localised populations of rare or threatened flora or fauna species or areas of special significance. Also high visitation areas where pig impact has a direct impact on the aesthetic values of the visit also should be considered. Economic considerations must be taken into account as eradication is generally considered to be an expensive control option.

(b) Strategic sustained control.
This management options involves reducing the density of feral pigs to a level where the benefits (known or perceived) are maximised compared to the cost involved. The benefits could be in the form of reduced economic losses, perceived protection of conservation values, greater community participation in control operations.

Establishment of a known threshold level where the pig impact is tolerable compared to the cost involved is difficult. This threshold level will also differ compared to differing community values and also due to seasonal conditions. Conservation and tourist groups may regard even a low population of feral pigs to be unacceptable whereas hunting groups may regard reducing populations to low level reducers the quality of their sport.

The annual increment (births and immigration) must be removed to maintain the population at the threshold level. This must be maintained in perpetuity or the population will quickly reach pre control levels. The timing of removing the increment is dependant on the population level removed at each control exercise. for instance removing 95% of the population initially may result in follow up control to be required every 2 years. At least 70% of the population must be removed annually to maintain population levels at threshold densities.

The benefits in pig control in relation to the cost involved must be identified. This relationship is not necessarily linear, for example removing a small number of feral pigs from a high conservation sensitive area may result in maximising the protection of a threatened species. In contrast reducing a high proportion of feral pigs in a given area may not significantly reduce their impact.

McIlroy (1993) and Mitchell (1993) advocated in the wet tropics region, implementing a priority ranking scheme to identify particular areas which should receive priority pig control. A ranking scheme could also be used to identify optimum timing of control efforts and also identify the level and type of control required to achieve the desired benefits. A ranking scheme within Cape York, would be difficult due to the diverse interests of the community.

(c) No Control

This option is dependent on quantifying the perceived and real impact of feral pigs. If the impact is sufficiently small or the cost of control significantly high then no pig control may be an option. The option of no control may be possible in selected areas of the Cape. For instance where pig impact is not regarded as severe, lack of high conservation species values or visitor access and high control cost due to logistic or geographical factors may mean control options to be prohibitive. Large tracks of inaccessible areas would qualify for this option. The benefits derived from controlling pigs in these areas would never justify the cost involved, the limited financial resources would be better off being spent in higher priority areas.

Control methods for feral pigs include trapping, shooting (aerial or ground) dogging, fencing and poisoning. When developing a control strategy one must assess the area where control is to be conducted, accessibility, economic costs, feasibility of success and community attitudes. The current techniques available for feral pig control are presented below.

For reasons of economy, efficiency and accessibility, poisoning is considered the most appropriate for achieving large scale control but may not be suitable for all situations (O'Brien *et al* 1986; O'Brien *et al.* 1988; Saunders *et al.* 1991). When poisons can be safely used this is the most effective method of removing the bulk of the pig population with the least effort and cost.

Hone (1986) identified 17 variables (control parameters) that influence the probability of success of a poisoning program. He recognised four parameters which control operators can regulate, bait abundance, bait dispersal, bait availability over time and poison concentration.

Baiting strategies such as prefeeding using attractive highly palatable bait material, the use of odours or additives to entice pigs, correct placement of bait material to maximise the encounter rate of pigs with baits, and the correct toxin concentration will improve control effectiveness. The concentration of toxins should be related to known bait intake to ensure that an appropriate amount of the toxin is ingested and sufficient bait material is available for all pigs at the site.

The major problem with poison baits is attracting the pig, i.e. the pigs have to find the bait. Increasing the "detectability" of baits must increase the effectiveness of this control technique. A major problem is the influence of the local diet preference of feral pigs. A bait used successfully in one location may be ineffective in another due to the food component availability. For example in cane areas, a grain bait would be ineffective once the pigs were living on the cane. An effective attractant might alleviate this problem.

Attractants could also decrease the problem of bait placement, i.e. bring the pigs to the bait and not take the bait to the pigs. Attractants may also lead to a decrease in the density of baits or the total quantity of bait material required. More easily found and more target specific baits means more baits will be available to pigs, thereby reducing the quantity required to achieve similar effectiveness.

The practice of offering non-toxic bait (free-feeding) is intended to familiarise target animals with bait and to increase the number of target animals feeding. The high proportion of animals in O'Briens et al. (1988) study that ingested only bait material or insignificant amounts of other materials suggest that pigs had learnt that an alternative, locally abundant food source was available, and had switched promptly and often completely to using it.

Hone (1983) evaluated an attempted eradication of feral pigs using a combination of poisoning and shooting, in a 50 km area of western N.S.W. He reported a 73% reduction in the pig population due to poisoning alone. Hone and Robards (1980) modelled pig dynamics and control, and showed that annual control programs each having a 70% instantaneous kill can significantly lower pig abundance in 3-4 years. Giles (1980) also suggested a 70% kill rate was necessary to reduce feral pig population over 12 months.

The main form of chemical poisoning is with 1080 (sodium monofluoroacetate). This toxin is the most widely used management technique for the control of feral pigs and used by all vertebrate pest control organisations within Australia.

From an environmental point of view 1080 has some advantages. Unlike other poisons it does not accumulate in the food chain and breaks down in the soil to harmless substances as a result of fungal and bacterial action. Rain leaches the poison from baits and high air temperatures assist in decomposition of the poison. Rapid leaching and decomposition of the bait might be expected in the wet seasonal conditions of the tropics. Principal advantages of this poison are it's high toxicity to some vertebrate pest species; feral dogs, cats and foxes in particular, it is odourless, tasteless and colourless, humane in comparison to other poisons, safe and easy to handle with a latent period that allows pigs

to disperse from feeding areas prior to death, thereby reducing bait shyness, and increasing effectiveness.

There is considerable variation in susceptibility between various species of animals. In general, birds show considerably more resistance than mammals and cold-blooded animals, such as reptiles and fish, are more resistant still. Dogs are the most susceptible of all animals to 1080.

Another way of looking at the relative susceptibility of various species is by comparing the amount of standard 1080 carrot bait which would have to be eaten to cause toxicity and death. A rabbit would have to eat 0.03kg of bait; however a human would have to eat 0.5kg to 1.5kgs, 0.2kg of bait would be toxic to a pig. The LD_{50} for pigs is less then 4.11mg 1080/kg body weight (O'Brien 1988).

Problems with the use of 1080 have been identified by McIlroy (1983) and Hone and Kleba (1984). These include the absence of an antidote, vomiting which could lead to secondary poisoning, some bait shyness has been recorded and the ability of some pigs to survive an apparent lethal dose.

Hone (1983) found no effect on non target species in his study, with the exception of rabbits and foxes (which is a bonus). No native birds, mammals or reptiles were found dead or showed symptoms of 1080 poisoning.

Alternative poisons to 1080 have been used for feral pig control, legally or illegally. These include the commercially available CSSP (phosphorus), strychnine. organophosphate insecticides (Luci-jet and phosdrin), and anticoagulants (warfarin) (Saunders *et al.* 1990).

CSSP is not recommended by the Land Protection Branch due to it's toxicity to a wide range of species, it is slow acting and inhumane, and causes secondary poisoning. Organophosphates are illegal for pig control and strychnine requires a permit from the Health Department for use in vermin control.

Field trials conducted by Saunders *et al.* (1990), and McIlroy *et al.* (1989), have demonstrated the effectiveness of warfarin as a control technique (58% to 99% reduction in pig population). Warfarin is a slow acting poison, 4 - 17 days latent period, highly acceptable to pigs over long periods and highly toxic to pigs as either an acute or chronic dose. Feral pigs have a low LD 50 to warfarin, 3mg/kg compared to 5mg/kg for dogs. Pigs do not vomit following warfarin poisoning and tissue warfarin levels decline rapidly reducing the probability of secondary poisoning. Warfarin also has an effective antidote (Vitamin K1) for the treatment of accidental poisoning.

Warfarin is currently approved for use in NSW as a feral pig control poison. The Land Protection Branch through the Robert Wicks Research Station is currently conducting research into the development of a warfarin "pellet" for use with meat baits. This pellet will act as a slow release agent, suppling a chronic dose for a number of days after ingestion. The nature of Warfarin poisoning means the poison is more toxic as a chronic dose. The pellet will alleviate the requirement of supplying the poison to the pig

population as free feed over the recommended three days, thus acting as a one shot poison bait.

Trapping can be an important technique for reducing pig populations especially in circumstances where other control techniques are not possible or food or water resources are limited. This technique is especially suited to high conservation value areas, as traps can be designed to be species selective and pose minimal or no danger to non-target species. The key elements are appropriate trap design, suitable placement, maintenance of the door mechanism, and adequate inspection when the trap is "set". Trapping is particularly suited to small areas of high significance, such as rare of endangered species reserves or in high tourist visitation areas.

However trapping methods are limited in effectiveness due to the proportion of the population that is untrappable. This may be due to pigs having an inherent fear of traps, or unsuitable bait type in terms of not being seasonally acceptable (protein is sought after in the dry season, McIlroy 1993), or bait material is not attractive enough to entice pigs into the trap. The major factor to consider is the number and distribution of traps in relation to the home range or movements of pigs (Saunders 1988). Sufficient traps are required to be distributed in a given area so pigs have a probability of encountering a trap. Insufficient numbers of traps, or areas where traps cannot be placed, will ensure a proportion of the population do not have access to a trap. This factor is especially important where large areas are inaccessible, or have limited access. In Saunders (1988) trapping research, 49% of the population were not trappable due to being outside the traps sphere of influence and 19% were untrappable due to their trepidation towards traps. He recorded a population reduction of 40% in his study area which is insufficient for beneficial population control. Trapping is also labour intensive and is not a rapid method of population control. Eradication or sustained control of the population in sensitive inaccessible areas may be difficult to maintain by trapping alone. Natural increases due to immigration and breeding may out-produce an ineffective trapping program.

The potential of the trapping technique may be fully realised in areas which meet certain requirements, including the limitation or concentration of a resource required by pigs, adequate access, availability of labour requirements and bait materials. There are several basic trap designs with a multitude of variations possible to suit individual requirements or materials on hand.

The panel trap is constructed of at least four panels of weldmesh arranged in a rectangular pattern. The weldmesh should be 2m to 3m long and a minimum height of 1.5m. The panels are supported at the corners and panel centre by star pickets with the mesh being securely tied to the pickets to prevent lifting. The one-way gate arrangement may vary with vertical or horizontal swinging gates or a funnel system. Panel traps have the advantage of being relatively easy for one man to construct and dismantle and can be transported easily.

The silo trap is superior in strength and capacity to panel traps and easy to construct if a number of people are available. It is designed by using 1.5m high roll of flexible weldmesh arranged in a circular pattern. The circumference of the trap is determined by

circumstances, ten metre lengths being suited for small groups of pigs, when the frequent movement of traps is desirable or when only small areas are available. The design can easily incorporate a number of door designs. Star pickets prevent lifting and the traps can be further strengthened to withstand large impacts by stretching wire across the top of the trap from post to post.

The box trap is essentially a panel-trap incorporating a floor and roof. The trap is portable but suitable for individuals or small groups only. The design is particularly useful in urban areas when the likelihood of escape needs to be minimised, and disposal is uncomplicated by transporting the pigs and trap together to another area.

The importance of the design and action of the one way gate is often neglected. The gate mechanism is the most significant aspect of trap effectiveness. Various designs are available for diverse situations.

The self sprung funnel gate is the simplest gate design to construct and is used extensively. Mesh panels are arranged in a "V" funnel arrangement, fixed together at the top, which requires the pigs to squeeze through the opening into the trap. The mesh panels are forced together by tension on the mesh or a spring arrangement which prevent the pigs from exiting. The tension should be adjusted to facilitate easy opening for small pigs, with just sufficient tension to return the mesh together. The funnel gate main disadvantage is the force required to push open the panels may deter timid or small pigs.

Vertical gates pivot at the top of a frame and rely on gravity to close the gate. This gate can incorporate a trip wire mechanism for timid pigs. The design is more difficult to construct, closes noisily which may frighten away other pigs in the area, and the closed gate deters remaining pigs from entering once the first pig in the trap activates the gate. This gate design is excellent for box traps in situations where an individual pig is required to be caught.

Side swinging gates are similar to the vertical gate, requiring a frame to operate, but are hinged from the side and require a spring or counter weight arrangement to close the gate. This gate is easily opened for small pigs and closes quietly and slowly so as not to alarm the captured pigs. A trip wire arrangement can also be incorporated into this design.

The development of a trapping strategy is essential if trapping is to be effective as a management technique. Firstly inspections of likely feral pig habitats, swamps, creek lines, forest retreats etc, should reveal areas of recent pig activity. Free feeding sites should be established in these areas by depositing small amounts of bait material throughout the immediate area or along trails. Monitor and replenish these sites for several days to accustom pigs to the bait material and maximise the number of animals attracted to the area. Once sufficient activity is observed at some sites, trap materials can be deposited at the site for two to three days to accustom the animals to the smell of the steel mesh. If feeding at the site continues, the trap may be partially erected (leaving a wide entrance way) and the feed material placed inside the trap. The door can be erected following signs that the pigs are confident of feeding within the trap but leaving the gate

wired open. Following a few days of further feeding within the trap, the door can be "set". This step by step method will maximise the number of animals captured.

Caley *(pers comm)* studied the factors effecting the success rate of traps in tropical riverine habitat complex in Northern Territory. He found from 1740 captures that the most significant variable effecting trap success was season; the highest capture rate occurring during the late dry and the lowest occurring during the late wet. He suggested that this distinct difference between seasons reflects the large seasonal changes in food availability. Saunders (1988) identified factors affecting trap success as placement of baits on tree lines, and the presence of recent pig activity. Fox and Pelton (1977) found the presence of recent pig activity, season and vegetative type influenced the capture rate of feral pigs in the USA.

Hunting may be classified into ground or aerial shooting and dogging. Ground shooting may be accomplished by individual hunters stalking the pigs, groups of hunters chasing pigs into more accessible shooting terrain, spotlight shooting or opportunistic shooting from vehicles. Rifles, long bows and cross bows are used by different hunters.

There are an estimated 100000 to 200000 pig hunters in Australia who may kill 0.5 million feral pigs per year (Tisdell 1982), but there is little information available on hunting effectiveness in forests or hunting effects on pig movements. The information available suggests that ground shooting is of little value in reducing the population sufficiently unless in small isolated pockets, where access is possible (Fox and Pelton 1977; McIlroy and Saillard 1989). Sparse information is available on the use of hunting as a technique in an integrated control program, however hunting is generally regarded as a mopping up exercise to eliminate residual populations after a control program relying on other techniques.

Helicopter shooting is claimed to be effective in inaccessible areas where pigs are concentrated and able to be observed from the air. Thick forest vegetation precludes the use of this technique because of sightability. However in more open forests or marina plains and swamps where pigs may be concentrated, helicopter shooting is cost effective and may eliminate pig populations.

In suitable terrain in NSW and QLD, helicopter shooting is a popular and effective method of controlling pig populations for the short term reduction of agricultural damage (Bryant *et al.*). This technique is also the principal technique advocated in contingency plans for eradicating feral pigs during exotic disease emergencies (Hone and Bryant 1981).
Saunders and Bryant (1988) accounted for 946 pigs using helicopter shooting, (39.2 pigs/hr at a cost of $11.77 per pig) during a hypothetical outbreak of Foot and Mouth exotic disease.

Hunting with dogs increases the probability of encountering feral pigs particularly in dense vegetation. Dogs are able to locate and flush pigs that normally conceal themselves when hunters approach. Dogging can be used to flush pigs that survive a poisoning or trapping program.

McIlroy and Saillard (1989) conducted a hunting study near Canberra using dogs, and found that hunting removed only 13% of the population known to be in the area. Barrett (1978) recorded a 20% reduction in feral pigs populations in California due to hunting with dogs. In the Hawaii Volcanoes National Park, systematic hunting with trained hunters and experienced dogs, reduced the population to very low or zero densities in fenced areas of 1-18km^2. The combination of hunting and fencing, while successful, is also expensive ($US 6800km^2) with only 0.86 pigs captured per hunt (Barrett 1978). McIlroy (unpublished data) studied hunting success in New Zealand and concluded that "sustained" hunting in one area appeared to restrict the feral pig population density to 3-8 pigs per km^2 compared with 43 pigs per km^2 in a nearby lightly hunted area.

Pig proof fencing is used to protect crops, pastures and lambs from feral pig damage throughout Australia (Hone and Atkinson 1983). Fence designs have been suggested by Pharoah 1976; Giles 1977; Plant 1980; Anon 1987; Hone and Atkinson 1983; Allen 1984. Hone and Atkinson (1983) tested various fence designs and found electrification significantly reduced the number of pigs crossing fences. They also reported that most fence designs were not completely pig proof but only reduced the pig movements across fences. They suggest a netting design with small apertures is required, coupled with electrification to be pig proof.

Electrification is the cheapest and simplest method of modifying existing fences to pig proof standard. Electrifying conventional sheep mesh fences greatly increases their effectiveness and minimises maintenance requirements due to pig damage (Allen 1984). For fencing to be effective the fence needs to be constructed prior to pigs becoming habituated to crossing the area. Once the pigs are aware of a food or water source, placing a fence in their path will generally be unsuccessful. Pigs have been known to charge electric fencing, squealing in anticipation of a shock, but still successfully breaching the fence. A combination of netting and electric wires is more successful in preventing pigs crossing. The economics of fencing need to be considered, and depends on the efficiency of the design, initial and annual costs, area enclosed, perimeter length, life of the fence and the value of the area being protected.

3.2.4 Feral Pig Management Plans

The control of this pest over large areas and in difficult terrain involves the implementation of a fully formulated management strategy conducted over a long time frame. Control programs also have to consider economic and environmental factors, and risk assessment to non-targets concerns. However the benefits derived from a reduction of the feral pig population also have to be considered. This cost - benefit relationship needs to be fully understood prior to a management plan being implemented.

Consideration must be given to the level of population reduction necessary to achieve the impact threshold required, and whether this reduction is achieved by sustained control or eradication. McIlroy (1993) discusses priority ratings to enable decisions to be made on the level of control required, including when to implement control and appropriate control strategies. However the paucity of available information may prohibit the recommendation of long-term management strategies. Short-term management solutions will require an adaptive management approach to monitor and evaluate, which necessitates

the continuation of research programs to develop innovative techniques or refine established techniques and strategies.

Research is essential if an effective feral pig management system is to be developed. Information is required of pig behaviour, biology and ecology and quantification of ecological impact before any long term management strategy can be formulated. A range of biological, technical, climatic, economic, and political factors can directly and indirectly influence pest animal management. These same factors also provide the opportunities and constraints for improving pest management. If applied research is to achieve practical advancement in pig management, than all relevant factors need to be considered (Norton and Pech 1988).

A decision analysis process as proposed by Norton and Pech (1988) is required to determine the factors affecting the feasibility and acceptability of control strategies. Strategies must meet certain criteria such as being technically possible, practically feasible, economically desirable, environmentally acceptable and politically advantageous. Research will enable a decision matrix or model to be established to enable qualified management decisions to be made.

The first management process is to determine if a problem exists. The problem needs to be defined in terms that are measurable, or alternatively quantify the extent of the problem. Techniques need to be established to measure and determine the scope of the problem. Objectives and performance indicators can then be set once the size and extent of the problem is defined.

The second process is to collect the data required to evaluate the problem. Data on feral pig impact in the Cape is generally not available, so this assessment process will indicate where research is required.

The third process is to place the problem in its social and biophysical context. Identify the stakeholders and the decision makers to allow compatibility of objectives between the two. Conflicting management objectives have in the past, and at present, lead to dissension between the Cape York community.

McIlroy (1993) proposes a ranking model which enables managers to prioritise feral pig control effort based on scoring areas according to their conservation value or importance, and weighting these values according to the level of pig impact on these values.
The model needs adequate and accurate data to produce a workable feral pig management plan. Research to enable factual data to be collected is required before a model can be adopted.

3.3. DINGOES / FERAL DOGS

3.3.1 Introduction

The dingo Canis familiaris dingo (Meyer 1793) is the largest and most widely distributed mammalian carnivore in continental Australia. The dingo is found widely throughout the Australian mainland from the remote tropical north coast areas through the hot central deserts to the cold mountainous regions of the south east.

The first recorded indications of dingoes was by Jan Carstens in 1523 who observed mastiff-sized tracks on the shores of the Gulf of Carpentaria. The best known reference from the early navigators is that by Dampier in 1688 describing two or three beasts like "little hungry wolves - lean like so many skeletons, being nothing but skin and bones". Cook during his voyage in 1770 also observed dingoes along the east coast. (Iredale 1947)

The dingo is a member of an equatorial group of primitive dogs distributed throughout New Guinea, South-east Asia and Northern Africa. It is thought to be a relatively new addition to the Australian fauna with its origin uncertain, but it is thought to have been introduced by aboriginals. Whether on arrival it was a partly domesticated animal, subsequently becoming feral, or whether it was truly a wild dog is also uncertain.The greatest problem in defining the dingo is that there is no proof of the identity, ancestry, affinity, place of origin, or precise time of arrival in Australia of the animal.

The dingo presence in Australia highlights the remarkable way in which the composition of the Australian mammal fauna has been shaped by its isolation. Elsewhere in the world,the Carnivora and the hoofed animals, are the most diverse and most successful of all mammal groups. Other continents possess numbers of species of the Order Carnivora yet Australia has only one native terrestrial, non marsupial member of this Order and native no hoofed animals at all. According to Ride (1970) we should admit we regard the dingoes as native animal simply because they were here before we (the Europeans) arrived.

It is becoming increasingly apparent that many dingoes troublesome to graziers are not true dingoes but hybrids or domestic dogs that have become wild through being abandoned or have strayed. The problem of identifying dogs is compounded by the fact that it is extremely difficult to detect the differences between dingoes, feral dogs or hybrid in the field. Differences can usually only be determined by very close examination and even then differences are only based on heresay evidence or guess work, more scientific techniques need to be developed. Some laboratory techniques that may be useful for discrimination between dingoes and domestic dogs include (a) chromosome banding, (b) biochemical studies of blood protein, (c) red cell enzyme metabolism, and (d) cranial measurement characteristics.

Dingoes (dingoes/wild dogs/hybrids) inhabit a surprisingly broad range of habitats within Queensland. All areas of the State have some dingoes except for a few areas protected by the Dingo Barrier Fence and the more highly populated areas of the east coast.

Initial survey results (Mitchell 1982) indicate the dingo population in the State ranges from a maximum of 350,000 to a minimum figure of 200,000. High density areas have been reported in the West of the State and also along the Great Dividing Range. Between these areas lies the pastoral zone (Mitchell grass plains) which constitutes the major sheep belt of Queensland. This pastoral area is protected by the Dingo Barrier Fence and is also supported by annual 1080 baiting campaigns. This chemical and physical barrier reduces dingo movement into the sheep region from the dingo populated forested ranges areas.

Generally, dingoes prefer uninhabited areas of eucalyptus forests or scrub when available or desert shrub lands for their major habitats. These habitats almost exclusively occur in the rough terrain of the central highlands and Great Dividing Range, the arid west and the uninhabited woodlands of the north.

3.3.2 Impact.

Dingoes are the largest mammalian carnivores extant in Australia and like the wolves and coyotes in North America have long been regarded as serious predators of domestic animals and considerable effort has been directed towards its eradication or control since European settlement. Many examples exist in Queensland rural areas of exceptional economic losses to stock due to dingo predation. The sheep industry in particular has long claimed that in some areas of Queensland heavy predation has reduced the profitability of sheep farming to non-economic levels.

In some cattle areas particularly in the smaller breeding holdings dingoes are thought responsible for the majority of deaths of calves between birth and branding. Landholders have suggested in some cases that cattle production would be uneconomical without intensive dingo control programs.

In more extensive cattle areas particularly in the Western areas of the State, dingo populations are tolerated to various extents. The reasons for this range from the belief that dingoes do a good job in reducing kangaroo, rabbit and feral pig numbers, to the fear or uniformed views of the current poisoning techniques used.

From about six weeks old, calves begin to congregate in groups usually with only 1 or 2 cows near them. Usually they do not go to water with the cows as a single cow will sometimes act as nursemaid around the calves and chase any dingoes that appear. Dingoes often hunt around watering points in the afternoons or mornings to pick up straggling calves after the herd has walked out to graze. These isolated calves are very vulnerable to dingo attack. An example was on "Meadowbank" in North Queensland where out of 40 orphaned calves, 20 were killed by dingoes and 12 were bitten but survived. Of 40 calves with mothers 20 were killed by dingoes with 10 being bitten but surviving. These figures support the observations that it is not only weak or other debilitated calves that are taken by dingoes.(Rankine 1968).

Other examples of economic losses attributed to dingo predation include "Magara", a property in north Queensland which increased their calving percentage by 50% since the introduction of chemical control of dingoes in 1970. "Delta Downs" also in north

Queensland increased the branding of calves by 2,200 per year since the introduction of dingo baiting campaigns. (Mitchell 1982)

The extent of dingo predation is often difficult to assess as some landholders find it difficult to determine the number of breeders on their property let alone the calving percentage. Without accurate records the losses attributed to dingo predation are difficult to obtain so predation loss estimates rely on specific property examples which may not be accurate.

Although dingoes prefer native game species to livestock, there are occasions when serious stock losses will result from attacks by dingoes or wild dogs, especially when sheep are concerned. Although many sheep may be killed in such an attack they seldom show signs of being eaten. This type of attack is sporadic and usually confined to small areas. There is some evidence to suggest that these situations may result from bitches teaching young pups or adolescent dogs being playful and not hungry (Green and Catling 1977). According to Merrell (1985) this behaviour is the main economic impact of the dingo and if dingoes only killed sheep and calves for food, their impact would be relatively insignificant.

In Corbett's (1974) study several dingoes were trapped close to, or even among sheep populations, yet no killings occurred. Even when there was killing, trappers sometimes trapped many dingoes before killing ceased, indicating that not all dingoes kill sheep. He cites an example where 300 sheep were killed or maimed in 2 months of 1966. Although a total of 27 dingoes were caught in the area, the killing only stopped when a certain pair of dingoes were trapped.

These isolated cases of predation can be quite severe however only a low percentage of the dingo population may be responsible. Domestic dogs or hybrids may also be responsible for significant predation. Corbett (1974) quotes example of known domestic dogs killing 60 sheep in six weeks and 140 sheep in 1968 killed by forestry workers domestic dogs.

Dingoes harbour an extensive array of parasites all of which are common to the domestic dog. Some of these parasites and diseases debilitate and even kill domestic dogs, and may therefore be responsible for a degree of natural biological control of dingoes. For example, there was an outbreak of distemper across the huge expanse of the Barkley Tableland in 1969-70 that killed many dingoes, up to 90% in some localities (Newsome et al 1973).

In the eastern highlands, dingoes carry a heavier load of parasites than in central Australia. The most important parasite of dingoes and wild dogs in south-east Australia is the hydatid tapeworm (Echinococcus granulosus) (Stevens 1981). This parasitic worm is probably present in a very large percentage of wild dogs and dingoes, but is very rare in domestic dogs in the same area. The hydatid worm is important because its intermediate stage (hydatid cysts) is found in man, domestic animals and native animals. The disease can be fatal in man and may also kill some native animals.

Table II.
HELMINTH PARASITES OF DINGOES AND FERAL DOGS IN VICTORIA
(COMAN 1972)

SPECIES	NUMBER OF OCCURRENCES	INCIDENCE (%)
Taenia pisiformis	81	40.5
T. serialis	37	18.5
T. hydatigena	15	17.5
Echinococcus granulosus	124	62.0
Spirometra erinacei	14	7.0
Dipylidium caninum	4	2.0
Toxocara canis	27	13.5
Uncinaria stenocephala	99	49.5
Cyathospirura dasyuridis	4	2.0

Durie and Rick (1952) examined 11 dingoes in Queensland and found 9 to be infected with Echinococcus granulosus. They suggested that the parasite is maintained by a dingo-wallaby sylvatic cycle in some areas of the State and that the high incidence of hydatids in cattle from these areas was a sequel to the contamination of pastures by infected dingoes. A sylvatic cycle for hydatids, involving the dingo and larger macropods, was proposed by Gemmell (1959) for some areas of New South Wales. Dingoes and wild dogs harbour a number of other parasites such as sheep and cattle bladderworms (a tapeworm in dogs whose intermediate stage is seen as large watery bladders attached to the gut of sheep and cattle).

Dogs can also become infected with mange, distemper, hepatitis and a variety of other diseases. If rabies were introduced into Australia, dingoes would be important carriers. In coastal areas, the tick Ixodes holocyclus can cause tick fever, and in Gippsland at least a nematode Filaroides cesleri encysts in the bronchia, occluding air passages. Both can kill domestic dog pups. Canine distemper and hepatitis are also probably the most promising pathogens that could be developed for biological control of dingoes.

Dingoes or wild dogs are a problem in some areas due to the risk problem of an outbreak of an exotic disease. Rabies is possibly the exotic disease where the dingo population would be most significant as this disease depends for its survival on a reservoir population of wild carnivores. If rabies were to become endemic here, the fox, dingo and possibly feral cat would be most important in maintaining the "sylvatic" cycle. It is well known in many areas that foxes and dingoes venture close to human habitation and domestic dogs. It is therefore easy to see how these animals, if rabid, would threaten the human population either directly through bites, or indirectly by infecting domestic dogs. (Shields 1983)
Hydatid disease is a major problem of dogs and domestic stock in many parts of Australia but it is not commonly recognised that there are strains and species of the hydatid parasite that are exotic to Australia. Some of these exotic strains could cause greatly increased risks to stock if they were to arrive here, e.g. there is an English strain of hydatid that effects horses (the Australian strains do not).The hydatid parasite is also capable of

causing severe illness or even death in humans. Care should be taken when handling dingoes or feral dogs caught in the wild.

This parasite is also believed responsible for the loss of domestic dogs particularly working dogs in rural areas where dingoes are present. Recent research has indicated the incidence of the hydatid parasite in dingoes as high as 77% in north Queensland (Durie and Riek 1952).

Dingoes and wild dogs harbour a number of other parasites such as sheep and cattle bladder worm, and also roundworms and hookworms. Dingoes can also harbour mange, distemper, hepatitis and a variety of other diseases which can effect the domestic dog population. (Coman 1972)

3.3.3. Control techniques.

Dingoes/wild dogs are declared animals under the Rural Lands Protection Act and as such all property owners in Queensland are required to control dingoes/wild dogs on their properties. Early management strategies for dingoes focussed on eradication of the species. Assessment of the efficacy of control campaigns was generally based on circumstantial evidence.

Dingo control methods include mechanical (trapping, shooting and fencing) and chemical (poison baits). A planned strategy using a combination of these methods that also considers dingo behaviour will enable effective management of the dingo population.

SHOOTING
Shooting is an opportunistic method, mostly used for control of small populations or individual problem animals, and is best combined with organised drives.

TRAPPING
Trapping is time consuming and labour intensive. The success of trapping (using leg hold traps and snares) depends on the skill of the operator. Trapping is predominantly used in areas with low populations and to control 'problem' dingoes/wild dogs.

Trapping by inexperienced operators may prove detrimental if a dingo is exposed to a carelessly prepared and presented trap and subsequently escapes. Such animals may become 'trap shy', or be maimed to such a degree that they can only prey on more easily caught domestic stock.

For humane reasons and to prevent escape, poisoning traps with strychnine is recommended to quickly kill captured animals.

There has been extensive research by Land Protection Branch into potential lures/dingo attractants. Tuna oil, asafoetida and a mixture of dog faeces and urine have been found superior attractants to dingoes. The attractiveness of such material however varies with seasons and the behavioural stage of the animal. No lure has yet been found that is consistently attractive to all dingoes/wild dogs.

Traps are best placed on the dog's boundary pad. Here the dog is most likely to find and investigate the decoy/odour. Dingoes scent posts on a known pad can be found by walking with a domestic dog on a lead. Trap placement in relation to the scent post can be optimised by observing the dogs behaviour as he approaches. Factors to consider are

- where on the bush he smells
- placement of feet while urinating/defecating
- how he approaches and where he scratches in relation to the pad and scent post

Traps are not target specific, and should therefore be set in situations which are less likely to catch other animals. Avoid setting traps close to waterholes. Soft-catch® traps are more humane than steel leg hold traps, and their use is therefore recommended.

FENCING

Fencing suitable for the exclusion of dingoes is expensive to build and requires continual maintenance to repair damage caused by fallen timber, floods and animals. However, a properly maintained fence can restrict movement back into an area where dingoes have been controlled.

Electric fences suitable for dingoes have been developed. Electrifying a fence creates a fear of the fence itself and deters dingoes/wild dogs from approaching. For fencing to be successful, it must be possible to eliminate dingoes from within the fence. The fence must be maintained in good order, and occasional mopping-up measures employed to remove intruding animals.

POISONING

1080 poison baits are the most economic, efficient, humane and effective method of controlling dingoes, especially in inaccessible or extensive areas. Baits can be laid quickly in large numbers by hand, from vehicles, and from aircraft.

Currently there are two poisons legally available for dingo control. These are 1080 (sodium monofluroacetate) and strychnine. A health department permit is necessary to purchase strychnine. 1080 can only be obtained through licensed Department of Lands and Local Authority operators.

The use of poison baits will achieve control of the majority of predating dingoes. Problem dingoes that avoid baits can then be trapped, shot or fenced out to provide additional control. Baits may be selectively positioned to avoid killing non-target species, as the dingoes keen sense of smell enables them to find baits intentionally buried in sand or otherwise hidden.

Smearing blood from the bait onto objects surrounding the buried bait will enhance location by the dingo/wild dog. Alternatively a fresh hide or carcass could be dragged along the ground and baits buried along this scent trail.

These bait placement techniques help to

- reduce the risk of poisoning non-target species
- minimise bait removal by non-target scavengers
- keep the bait moist (longer palatability)
- deter ants (ant-covered baits are believed to be less attractive to dingoes)

A month should be allowed for the major effects of baiting to be realised. Heavy rain within two weeks of baiting can leach 1080 from the bait.

MANAGEMENT CONSIDERATIONS
Historically, much dingo control was "ad-hoc" and control achieved was relatively ineffective. Often packs were fractured into smaller units, removing natural population regulation by dominant females. Subsequent breeding by young bitches and the production of multiple litters favoured rapid growth in dingo populations. Control operations that maintain an artificially low population density effectively increase the relative amount of food available to survivors, as well as allowing an increase in the abundance of prey. Under such conditions, vacant territories would be occupied quickly and the potential for younger or subordinate bitches to raise litters successfully would be enhanced.

The consistent finding that dingoes move over relatively small ranges has produced a conclusion that efforts to control dingoes (or wild dogs) should be restricted to livestock grazing land and to a limited 'buffer zone' of 10-15 km. The buffer zone would vary according to the region.

The buffer zone should be kept as free of dingoes as possible by regular baiting, otherwise immigrating dingoes could be prevented from settling and move on into livestock grazing areas.

The timing of control should consider seasonal variations in the availability of water, and then target watering points. The phase of the biological cycle could also influence the likelihood of dingoes coming into contact with baits, and should be considered. Many graziers bait twice a year to get adult dingoes during their peak in activity associated with breeding, and then again in September to get naive pups and juveniles.

A suggested practice is to lay baits in the cooler months when birds and goannas are less active and dingoes more active. This also usually coincides with a quite period in livestock management. Poison baiting would still appear the most economical and least environmental damaging of available control techniques.

3.4 Feral Horses

There are none of the original species of wild horses in the Northern hemisphere left in their natural habitats. Today all "wild" horses are feral descendant from the domestic horse. Horses were the backbone of the pastoral industry and accompanied european spread throughout Australia. As mechanisation replaced the stock horse and the mounted cavalry, many horses were simply left to roam and established feral populations. The

definition of feral horses or "brumbies" is difficult in rangeland conditions as many pastoralists regard any horse on their property as a domestic horse, even though they have never been domesticated. Also domesticated horses who roam over land such as National Parks are regarded as feral even though they are not wild in the true sense of the word.

The greater mobility of horses over cattle allow them to graze further from water then cattle. This is a major impact on the environment as it allows the area of impact of introduced herbivores to be extended. Horses are in direct competition with domestic cattle, consuming the same quantity of pasture,weight for weight, and preferring the same pasture species. Feral horses also cause considerable damage to fences and watering facilities and are known to sometimes protect watering points from cattle and marsupials. Feral horses cause severe land degradation problems due to soil compaction, overgrazing, erosion causes, species selectivity and upsetting fire patterns.

The availability of food and water are the only controlling influence on feral horse populations in Cape York. Diseases and dingo predation account for minimal population regulation.

Control techniques for feral horses range from trapping, fencing and ground and aerial shooting. Trapping is practised in the Northern Territory as the primary control technique, horses destined for the commercial meat trade. In Queensland large scale shooting programs have been implemented in western areas on a periodic basis.

3.5 Feral Cats

Feral cats have become one of the most successful widespread feral animal introductions. Feral cats are found in all habitats of Australia, from the arid deserts to tropical forests to alpine snowfields and urban garbage tips. They are extremely adaptable and intelligent animals and can survive under extreme environmental conditions.

Cats probably arrived in some areas of Australia prior to European settlement. Cats were probably introduced into the Northern Territory by Macassan traders or Dutch shipwrecks and Captain Cook could have released cats from the grounded Endeavour. On his journey through Cape York in 1928, Thompson wrote of abundant cat tracks being seen on his journey down the Coleman River (Thompson 1985). These cats could have been derived from Captain Cook releases. Cross (1990) states that the feral cat apart from the dingo, may have been the first true feral animals in Australia's history. Fauna surveys in Cape York in 1928-29 by Donald Thompson (Dixon and Huxley 1985); 1985 (Winters and Atherton 1985) at Weiper and at McIlwraith Ranges in 1985 (Winters and Atherton) described the presence of cats.

Estimates of the feral cat population in Australia average at 18 million with an estimation of 1 to 1.5 million in Queensland. There is a fine line between the definition of a feral and domestic cat. Feral applies to those that do not live closely with or depend on humans. There are also semi domesticated rural and urban cats that have some degree of dependency on humans and also domestic cats that roam. It is not sufficient to consider the impact of feral cats alone as no fixed line can be drawn between feral and domestic cats.

The Weipa fauna survey (Winter and Atherton 1985) recorded that the majority of sightings were within 15km of the township and the authors stated that the township may be acting as a source of the feral cats.
The impact of feral cats on conservation values of Australia is impossible to estimate. Feral cat problems are not readily perceivable to the general public. Feral cats are true predators although some scavenging does occur in tough times. Small mammals are the major prey source with animals of the size of the rabbit generally being the upper weight limit, although feral cats are significant predators of the endangered bridle nail tail wallaby. The Endangered Species Program of the Australian National Parks and Wildlife service recognise cats as threats to the survival of endangered native wildlife, although little scientific information is available. Cats are known to hunt and kill over 100 species of native birds, 50 mammals, 50 reptiles and numerous insects and frogs. In most southern areas of Australia the rabbit makes up a significant weight portion of the cats diet, together with introduced rodents. However the smaller native animals are eaten proportionally in greater numbers to make up the diet. In areas where the rabbit does not occur such as in Cape York, the cat must switch to alternative native species. Two cats were autopsied from the Weipa region and stomach content consisted of skinks, a monitor, geckoes, spiders, and bird remains.

The average domestic cat is responsible for killing on average 25 native animals a year. With approximately 3 million domestic cats in Australia, this represents a loss of 75 million native animals per year to domestic cats. In terms of feral cats, each cat needs 300gms of flesh each day to survive. If feral cats ate only native animals, each feral cat would need 70 native animals a week, 3,600 a year to survive. This could represent 12,000 million native animals are killed each year by feral cats. Feral cats have also been responsible for significant predation on endangered or rare native species. A number of native species have been exterminated on Islands by feral cats, and the Bilby, Ruferous Hair Wallaby, Bridled Nailtailed Wallaby and Eastern Barred Bandicoot are threatened by feral cats. A single feral cat was responsible for reducing the population of threatened rock wallabies in the Chillagoe district.

Cats are not only a problem as predators, they are also responsible for transmitting human and domestic animal diseases. Feral cats are capable of distributing the infective stages of parasites that cause diseases. The protozoan parasite Toxoplasma gondii is of particular concern because it can cause congenital abnormalities in infected pregnant women. This disease can also threaten the conservation of small native animals such as bandicoots.

Cats also spread other disease such as Sarcosporidiosis, cat-scratch fever and ringworm.

The feral cat is also potentially vectors of serious exotic diseases, particularly rabies. Their wide distribution and movement patterns, and the difficulty of control would cause problems with any rabies outbreak particularly in remote locations such as Cape York.

With the realisation in recent years of the environmental impact of cats a great deal of interest has been shown in developing specific control strategies for feral cats.
Cats are notoriously hard to control with presently available control techniques. Baiting is the primary control technique suitable for broad scale cat population control. The

developments of cat specific attractants has shown some potential in New Zealand. Cats are also killed incidentally to dingo 1080 poisoning campaigns conducted in Cape York. Trapping (cage traps) are an effective method of cat control in urban areas where semi-feral cats are problems around dumps etc. Shooting is an opportunistic method of cat control but is not effective for population reduction in rural situations. Night shooting is effective in localised areas around dumps etc. dependant on the vegetation cover. Biological control is an option that must be considered for areas such as Cape York. Research is looking at virus carrying sterilant genes as a means of reducing the breeding potential of feral cats thus ultimately reducing cat populations.

3.6 Feral Cattle

The definition of feral cattle is a very complex issue. In regions such as Cape York where most properties are inadequately fenced it is difficult to define cattle in a way that satisfies everyone. Low levels of management on most properties ensure that a proportion of cattle are unmusterable so could be regarded as feral, however to the property owner these cattle are still part of the herd. Management on most properties consist of harvesting cattle and this will never ensure a clean muster so some cattle will invariably be missed and may be regarded as feral.

A number of factors encourage the formation of feral cattle population in Cape York. Firstly the physical environment such as areas of dense vegetation, rainforests, heathlands and swamps make mustering extremely difficult. Large areas of infertile country with resultant low carrying capacity make mustering uneconomical. Seasonal conditions prevent cattle management in the wet season due to roads being closed and flooding. Cattle management is practised only during the dry season (Shield 1987).

Secondly large areas of Cape York have no cattle management process although they are grazed by substantial herds of cattle. For example National Parks, reserves and aboriginal community lands are not actively managed for cattle so all cattle on these lands can be regarded as feral. Some National Parks still have grazing leases but the majority regard the presence of cattle as a management problem. Unfenced boundaries between these lands and cattle properties further confound the problem.

Thirdly the availability of labour on rural properties has been greatly diminished in recent years. Mustering costs have greatly increased and what labour is available is expensive and often inexperienced.

The major significance of feral cattle is their potential for transmission of endemic and exotic diseases. Exotic disease such as Foot and Mouth and the screw-Worm Fly *(Chrysomya bezziana)* would be catastrophic for the Australian economy. Many of these disease are currently in our northern neighbouring countries. Movements of animals either traditional or illicit across these borders could see the introduction of a wide range of exotic diseases impacting on all rural industries and also on human health. The threat of an exotic disease outbreak in Cape York can not be emphasised to much.

Control of feral cattle is restricted by large areas of terrain not suitable for mustering or not allowed to be mustered, seasonal wet conditions, and economic consideration. Trapping is the most practical method of control although not the most effective. Other methods of control include aerial and ground shooting, bull catching from horses and vehicles and aerial mustering.

Feral cattle should be recognised as a pest species and control techniques developed for their effective management, especially in the context of exotic disease containment. The barrier fence and buffer zone established is a technique to stop the spread of disease if it is imported into the tip or the Islands, this will not stop exotic diseases if the disease is introduces elsewhere on the Cape.

- the definition of feral cattle is not clear
- large areas of land are not cattle controlled
- constraints to cattle management include the physical environment and economic considerations.
- disease issues are the main impact of feral cattle.

3.7 Cane Toads

The Cane Toad is not a declared pest in Queensland, however the toad is regarded as a threat to the environment. The toad is an introduced amphibian, brought in for biological control of sugar cane insect pests. Because of its omnivorous, voracious diet and the existence of suitable environmental conditions, the toad has rapidly colonised all of eastern Queensland and all of Cape York. The only limiting factors to the toads advance are the availability of water for breeding and tolerable temperatures. Cape York provides a suitable habitat for toads, populations will become endemic to most of the region.

The poisonous paratoid gland of the toad results in death to almost all animals that ingest or mouth a toad. Only a few freshwater snakes (Keel snake) are resistant to the poison. The toad was thought responsible for decimating native animal populations, however the current thinking suggests the effect of the toad on native species is not as drastic as first thought. However the fact still remains that the toad is an introduced pest and is responsible for upsetting the ecological balance. Some research has been directed at the development of a biological control agent.

3.8 Rusa Deer *Curvus timorensis*

Rusa deer were initially released on Friday Island in 1912 thereby invading the nearby Prince of Wales Island. Deer were also release on Possession island in 1914. The population was estimate to be less then 1000 by the Australian Vertebrate Pest Committee in 1979. There have been a number of reports of deer being seen on the Australian mainland mostly many years previously. 50 head are known to have been released onto the east coast of Cape York at Escape River and other reports suggest releases at Jacky Jacky Creek. It is generally considered that no deer inhabit the mainland now.

3.9 Other Animal Pests

3.9.1 Rabbit

Although domestic rabbits were brought to Australia with the first fleet, the first recorded importation of wild rabbits was by a Mr. Austin of "Barwon Park", Victoria, in 1859. From there, rabbits rapidly spread over the whole of southern Australia. Rabbits were first reported in south-western Queensland in the 1880's but it is now thought that the spread was due to transportation by humans as much as by natural migration.

Rabbits now inhabit vast areas of Queensland. High density infestations are common in the Granite Belt, south-western Darling Downs, Maranoa, southern Warrego and Far South-West. Moderate infestations are scattered throughout the north-western Darling Downs and North Burnett. Scattered, low-density populations can be found in much of the remainder of the State.

Breeding throughout the year is limited by two main factors.

1. Summer heat lowers the fertility of the male;

2. Green feed (preferably short) is necessary to trigger off breeding.

These factors may also explain why rabbits have not spread in large numbers into the northern part of Australia.

Myxomatosis is a pox disease which occurs naturally in South America. It was released here in the early 1950's and initially killed over 99 per cent of infected rabbits. The position is now quite different due to two factors. Firstly, the change in the virus itself ... the Myxomatosis strains now in the field, through selection, the rabbit has achieved a degree of resistance. A rabbit which recovers from an attack, no matter how weak the strain, is virtually immune for life. An immune doe passes on immunity to its kittens during lactation. When lactation ceases, the kittens lose this immunity but retain a certain amount of resistance. This means that rabbits now have greater powers of resistance than their ancestors had back in the early day of Myxomatosis. The two known vectors of Myxoma virus are mosquitoes and rabbit fleas. The main carriers are mosquitoes, and although there are more than 100 species in Queensland, only three species have been pinpointed as carriers. It is obvious that inoculation campaigns timed to correspond with the seasonal build-up of these species should have the greatest chance of success.

To assist in the spread of Myxoma, the European rabbit flea (Spilopsyllus cuniculi) was released in Queensland in 1972 in the Goondiwindi and Roma Divisions. In 1973 further flea releases were made from Stanthorpe in the south-east to Thargomindah in the west. In all experimental flea release areas, Myxomatosis appears to be having a depressant effect on young rabbit populations.

Poisoning, using 1080 impregnated bait, gives instant relief in rabbit problem areas. The bait materials mainly used are carrots, pellets and oats, with carrots obtaining the best results all-year round. Pellets and oats obtain reasonably good results under favourable

conditions. The rabbit is a very selective feeder when grazing and applies the same selectivity to bait materials. The bait is laid using the conventional trailing methods it obtains the best results and is the most convenient for inspection and determining when country is safe for restocking.

Another 1080 poisoning method used is known as "Tarbaby". This is a multi-purpose grease impregnated with 1080. It is placed on the floor of the burrow or hollow log using a grease gun. The rabbits walk through it and, being hygienic animals, they immediately start cleaning themselves ingesting 1080 in the process. This method is only effective in low-density population areas with particular soil types. Sandy soils are unsuitable for the application of this technique.

Poisoning alone will only control rabbits for short periods as a remnant of the population is always left (due to bait selectivity). Populations can build up again very quickly if left unchecked.

To assist poisoning follow-up work such as clearing of harbour and ripping of warrens may be carried out. In some areas this is a slow and costly process but gives much longer periods of control.

The areas where follow-up work after poisoning may be required are re-inspected at intervals and any burrows found open are fumigated. This is done by attaching a T-piece to the exhaust tail pipe of a vehicle. The T-piece is loaded with Larvacide ... a chloropicrin gas mixed with power kerosene ... which is blown into the burrow through a hose. Kerosene is added to give off smoke so that the operator can locate any unsealed openings; the gas can be effective only when all openings are sealed off.

Other methods of follow-up control are shooting and trapping. To ensure rabbit populations remain low or are eliminated (in very small, isolated areas) the shooting is carried out during early morning, later afternoon or at night using a spotlight. These are the hours when rabbits are moving about and grazing. Trapping is carried out by setting traps wherever rabbit signs are located.

The rabbit has been "declared" under the Rural Lands Protection Act (1985) and as such it is the responsibility of every landholder in the State of Queensland to destroy rabbits on their holdings. The Land Protection Branch will assist, wherever possible, in having Regional Inspectors available to offer expertise to landholders in dealing with rabbits. Certain items of equipment may be made available.

The introduction to Queensland and selling of rabbits is not permitted and rabbits may be kept only with a Permit for educational, scientific and zoological purposes.

3.9.2 Fox

The European Red Fox was deliberately introduced into Australia in the 1860's. First released near Melbourne for sporting purposes, it's subsequent spread was remarkable: by 1893 it had become a nuisance in north-eastern Victoria and by 1917 it had reached the region west of Kalgoorlie, Western Australia.

Next to the dingo and feral dog, the fox is the largest terrestrial predator in mainland Australia, far bigger than any carnivorous marsupial. It is found in habitats ranging from desert to fringes but is absent from tropical Australia and Tasmania. It does not appear to favour any particular habitat, its local distribution probably being determined by food supply and adequate refuge.

Although predominantly carnivorous, the fox is an opportunistic predator and scavenger. The fox has a diverse diet, ranging from rabbits, hares, rodents, frogs and birds to invertebrates such as beetles, grasshoppers and earthworms. It has been regarded as a serious predator upon native fauna and livestock but clear evidence is lacking; only in areas of dense forest or scrub is there any indication that it relies heavily on native fauna as a food source. Recent studies on sheep losses in Australia indicate that it has been over-rated as a predator of otherwise viable lambs. One study of over 4,000 lamb deaths in Western Australia showed that although 40 percent of carcases were eaten by foxes less than two per cent had been killed by the predator. Most of the deaths were due to mismothering, starvation and disease.

Red Foxes have been observed to fish, wading stealthily through shallow marshes. In season, fruits such as blackberries and apples can form as much as 90 per cent of the diet.
Being true opportunists, they will cache even unfavoured prey for future use and appear to have a good memory for the location of these larders.

Mange and distemper are thought to be important causes of mortality in wild populations of foxes.

Rabies (the virus disease which is nearly always fatal to man and animals) is fortunately not present in Australia. However, throughout the world all genera of foxes are capable of contracting and spreading the disease. Millions of foxes have been slaughtered overseas in unsuccessful attempts to control the disease, but foxes have such resilience that populations can withstand about 75 per cent mortality without further declining. The best hope for eliminating rabies may lie in oral vaccination - accomplished by air-dropping fox baits containing anti-rabies vaccine. Preliminary trials in Switzerland and Canada have shown that up to 74 per cent of foxes will eat the bait. However, an effective killer vaccine suitable for oral administration has yet to be perfected. If rabies ever reached Australia, control of foxes would be a major problem in eradicating the disease.

Control of foxes is carried out in Queensland. Options available for control include poisoning, trapping, shooting and fencing.

There is no doubt that foxes are often destroyed as a consequence of 1080 baiting programs for the control of dingoes/wild dogs.

3.10 Commercial Use of Animal Pests in Cape York

3.10.1 Introduction

The commercial trade in wild animals and their products is small compared to mainstream rural animal industries. The commercial use of native and wild/feral animal products have been expanding in recent years with the prospect of continual growth (Ramsay 1994). Provided the industry continues with humane, sustainable harvesting techniques the commercial use of this resource will provide potentially profitable supplements to domestic rural industries. This harvesting can also contribution to achieving conservation and pest management goals.

Vertebrate pest have the potential to improve the economic and social conditions of aborigines in rural Australia. Utilisation of pest animals as a resource can provide employment for aboriginal communities and provide economic returns for a resource that is often wasted or under utilised.

Several species of introduced and native wild animals have significant export potential. A rough estimate of the value of this trade is $132-$156m. Although the value of this industry is small compared to the Australian economy, their local significance should not be underestimated, particularly where they generate export trade from rural areas where opportunities are limited. Many rural landholders are searching for opportunities to diversify their enterprises, and new animal industries could offer profitable alternatives to existing rural industries some of which are suffering poor economic returns. The commercial use of animals that cause agricultural and environmental damage is an innovative and cost-effective way of managing these pests. The difficulty of this approach is balancing the cost returns from the industry with the management needs to reduce the economic and environmental damage associated with the pests.

The key factors that contributed to the success of this industry is wild animal populations are generally abundant and widespread, reproductive rates are high and the required capital necessary to operate in the industry are generally low. Products of wild animals have attributes that appeal to certain market places such as the low fat content and freedom from contamination of rural chemicals etc. Impediments to the industry are public attitudes, legislative structures, environmental constraints, animal welfare concerns and integration with normal pest control activities.

The largest wild animal commercial industry in Australia is the kangaroo industry, $50-$60m, followed by the feral goat, $27-$28m; horse, $22-$25m; and wild boar or feral pig, $15-$20m. Wild animal industries have much potential especially when development is considered in cooperation with existing animal industries. Development could generate significant social, economic and environmental benefits for the Cape York community if appropriately developed and managed.

3.10.2 Feral Pig

Feral pigs are harvested in the wild state and sold as game pig meat (wild boar) to several overseas countries. Game pig meat has a strong and distinctive flavour and fetches higher prices then domestic pig prices in European countries. European consumers prefer the flavour and have a long cultural tradition of eating wild pig meat that is killed by hunting. The international trade in wild pig meat is valued at $48m (1990).

Commercial harvesting and export of Australian wild boar for the game meat trade began in 1980. The industries structure consists of shooters (part time recreational hunters, to full time professional kangaroo and pig hunters), who supply pig carcasses shot in the wild to game meat processes who operate "chiller boxes". The chilled carcasses are transferred to licensed game meat processing abators where they are inspected by AQIS inspectors and either boned out or frozen as a carcass. Some 200 chiller boxes are currently operating in N.S.W. and Queensland.

The highest annual production of wild boar in Australia occurred in 1992 when 271,133 carcasses were processed. Game pig meat is exported to Germany, Poland, Hungary, France and Italy.

A number of factor influence the harvesting of game pig meat. Special veterinary issues and conditions exist when suppling game pig meat to some imparting countries, Germany,France and italy require the all carcasses be tested for the nematode parasite (Trichinella spiralis) even though this parasite has never been detected in Australia. The parasite is infectious to humans and can cause death through paralysis of the respiratory muscles. (Geering and Forman 1987). Outbreaks have occurred in Europe due to the consumption of poorly cooked infected pig meat.

A parasite Sparganosis is responsible for the rejection of a significant proportion of inspected carcasses especially in tropical Queensland. The incidence of this parasite in Cape York is extensive and is one of the major factors influencing the commercial utilisation of feral pigs in Cape York.
Pavlov (1991) recorded Sparganosis in 61% of feral pigs sampled in Cape York and 10% in Prince of Wales Island.

Short term environmental conditions such as the seasonal wet season can influence game pig meat harvesting. Reduced access to hunters and restricted vehicle access will prevent most pig harvesting in the Cape York Wet season, especially as the highest pig populations occur in areas more susceptible to wet conditions, (swamps and rivers). Also the wet season coincides with the highest overseas demand and subsequent highest prices thus the best time to harvest is also the period when harvesting is very reduced. long term environmental influences such as prolonged drought will also significantly reduce pig populations.

The most significant influence on the viability of the industry is the price payed for the meat. Prices payed to shooters vary with the international prices due to seasonal demand and variable supply. Prices are payed per kilogram of dressed carcasses at the chiller boxes and vary according to the weight of the carcasses, larger carcasses receiving

premium rates. A minimal weight of 20kg dressed is accepted. Prices can range from $0.30/kg to $1.50/kg. When prices are high more hunters enter the industry and hunting is extended into more remote areas, thus placing more pressure on pig populations. Low prices make it unattractive to part time hunters or for travel to remote areas.

Another influence that is particularly pertinent to'Cape York is the distance to markets, or more specifically to the licensed abattoirs. Only two licensed game meat processing plants exist in Queensland, Longreach and Brisbane. Transport cost and the need to transport the chilled carcasses on a weekly basis to the abattoirs is prohibitive. As the current situation exists, game pig meat industry in Cape York is restricted to southern areas only, only with the introduction of processing plants in the Cape York particularly in the high pig population areas, will the industry be viable.

The commercialisation of feral pigs in Cape York is impeded by :-

- distance to markets
- high incidence of sparganosis
- relative low prices paid to harvesters by commercial operators
- seasonal wet season
- low awareness of the industry or the potential benefits by the rural industries and in particular the Aboriginal communities of Cape York.
- significant high cost associated with establishing processing plants in the region.

Commercialisation of the feral pig resource could provide export income particularly to the depressed rural industries in the Cape, provide employment to the community particularly the aboriginal communities and reduce the environmental impact of feral pigs particularly in sensitive ecosystems and maintain the biodiversity of large areas of the Cape.

3.10.3 Feral Horses

Feral horses have been used for commercial purposes since at least 1860s primarily for hides and hair. Today the commercial use of feral horses in Australia is for the production of pet meat, meat for human consumption, and hides and hair for domestic and export markets (Ramsay 1994). Horse meat can be sold in all states of Australia. Field slaughtering is only permitted in Western Australia, in Queensland captured feral horses, usually trapped, must be transferred to licensed knackeries for slaughter.

In 1992, 47 333 horses were slaughtered in export abattoirs; with 8850 tonnes worth $23.8m being sold for human consumption. Most of the exported horse meat is exported to Japan predominantly as pet food for use in animal parks to feed carnivores. In 1988 some 600 tonnes (5000-6000 horses) were exported worth approximately $0.8m. Some 10,000 horses annually are utilised for the pet food trade in Australia.

There are a number of animal welfare and stock quality concerns associated with the capture and transportation of feral horses. Feral horses are very susceptible to injury and stress during transport. Only one abattoir exists in southern Queensland, so transportation costs and animal welfare issues are particularly important to the feral horse industry in Cape York.

The commercialisation of feral horses in Cape York is impeded by :-
- distance to processing abattoirs
- seasonal conditions
- animal welfare issues

3.10.4 Feral Cat

Feral cats can be harvested for their fur. Most of the commercial harvesting occurs in the cooler parts of Australia due to better quality fur produced. No special licence is required to hunt feral cats. A high quality tabby fur is the most valuable type fetching up to $22 each in 86-87 when prices were high. Almost all cat furs are exported due to the relative small fur coat industry in Australia. The world fur industry is in decline, however with the growing concern of the damage feral cats cause to the environment, harvesting of feral cat furs may offset the cost involved in greater control pressure.

3.10.5 Deer

Deer are valued as an important game species, although legally protected as a protected species in the past, new legislation regards deer as a feral animal that can be hunted with a permit. Deer are also harvested for breeding stock for use in commercial breeding herds or in captive hunting situations. The Rusa Deer of Prince of Wales Island have the potential to attract game hunting enterprises.

3.10.6 Other Animal Pests

The low population numbers of rabbits and foxes preclude the commercialisation of these species for Cape York.

3.11 Management Strategies For Animal Pests

3.11.1 Defining the problem.

The first step in developing a management plan is to determine the real or perceived problem associated with the pest species. All components of the problem need to be identified and quantified if possible. The pest status of vertebrate pests can vary with time and with the attitude of the observer. For example feral pigs are perceived as a pest only at certain times or in particular situations, i.e pests to predominantly mature cane and in close proximity to agricultural production. Banana growers also change their perception of the pest status of feral pigs accordingly to the economic returns for bananas. High returns ensure any pig damage is an economic loss and control is instigated. Low return for bananas ensures pig damage is tolerable with pigs then perceived as beneficial for fruit fly control (cleaning up waste bananas) and as a recreation and food source. "Failure to obtain a broad perspective of the problem can prevent effective management" (Braysher 1993).

The problem should be defined in terms that measure the harmful impact, economic or environmental. Management in the past has focused on pest animal abundance as the ultimate objective of management. Unless abundance has a quantified relationship with the level of impact then the use of population abundance in measuring the performance of management plans is of limited value.

Environmental impact terms are difficult or impossible to value in dollar units. While economic impact values can be expressed in dollar units the availability of this data is not always available. Also the extent of the problem is not always sufficiently quantified, is the problem evenly distributed or occurs in certain areas, what is the temporal distribution of this impact ?

The problem definition of vertebrate pest in Cape York is not possible at this time due to the unavailability of sufficient data. Environmental impact values is a social perception and has not been defined in real terms. Although the economic impact values have been partially defined for some agricultural industries, no data is available for the true economic impact values for Cape York.

One aspect of vertebrate pest management that is often overlooked is defining the social issues associated with impact and control. Another issue is community views on feral pigs are variable. Pig management in some sections of the community entails amateur hunting with dogs, guns and knives. This seems to be the traditional method of pig control in this region and is practised by a large proportion of the rural community. Some section of the community regard the pig as a resource in terms of recreational hunting for pleasure or food and as a source of economic return from the commercial pig box operators.

Defining the management problem in realistic terms is only the first step in developing a management plan, interim and long-term goals need to be identified and monitored. Setting management aims that recognises conservation and agricultural production objectives and objectives for particular situations need to recognise goals, an achievable time frame and performance indicators. The control options available also need to be defined and assessed for the particular situation. Strategic management is based on the concept of adaptive management in which the management plan is flexible, responds to changing economic, environmental and pest circumstances. The best practice control options will be developed from integrating available strategies in a systematic management program.

For this situation defining management goals is difficult due to the contrasting management objectives of the various stakeholders, objectives are often complex and suffer from lack of available quantitative information. Past control operations concentrated on reducing the pest animal population as the major objective. Current management plans emphasise the need to reduce the impact to accessible levels tolerated by the stakeholders. Thus population control to very low levels may not be necessary, achievable or economically viable. In addition a lot of intangible impact by vertebrate pests are impossible to measure. Feral pigs for example, the impact in terms of erosion, soil moisture retention, predation on beneficial soil invertebrates, nutrient cycling etc has not been defined. Indeed many landholders are not aware of these indirect cost to

agricultural production. Rural producers perceive impact only in terms of direct, mainly visual, economic losses.

To many landholders, setting vertebrate pest management objectives entails total eradication which is unachievable. Also their objectives stop at the farm boundaries and not much interest is shown in regional management which is the best way of achieving effective control. Education of landholders, especially by showing a working model is the best method of increasing the effectiveness of pig management on a regional basis.

Management objectives need to incorporate the framework of current vertebrate pest management (Braysher 1993) i.e.

- Recognition of the need to manage land systems and take into account the links between the components (land production, biodiversity, ecological systems).

- Identification of the stakeholders within the system and the need to involve all stakeholders in policy development and the decision making process.

- Decline in the traditional government orientated pest control services.

- Vertebrate pest impact is considered to be a major endangering process to many native species, particularly the endangered species.

- Extensive reduction and fragmentation of native habitat makes native populations vulnerable to the impact of vertebrate pests.

- Biodiversity depends on appropriate management of wildlife outside protected reserves.

- Economic considerations of primary producers makes cost effective pest control essential.

Objective and performance indicators need to be established and monitored to determine the success or otherwise of control options. For example determining the desired outcome and a time frame for achieving this outcome must be established. A performance indicator to measure achievement and a criteria for failure also need to be established.

3.11.2 Implementation of management Plan

The development of a vertebrate pest management plan for Cape York has to consider a range of key concepts that are specific for this environment. Key concepts include a range of biological, technical, climatic, economic and political factors that will directly or indirectly influence pest animal control and the damage they cause. From the information available and from observations I have listed what I believe are some of the key concept below.

1. Development of management plans for aboriginal community has to address the conflicting cultural and social issues associated with pest animal management.

2. The current infrastructure of Cape York does not allow for large scale management plans to be developed. Low scattered population over vast areas of Cape York do not facilitate high levels of pest management being achievable.

3. Economic concerns are a major consideration in developing management plans for this region. National Parks also have to address the issue of financial resources being allocated for pest management plans.

4. Disease risks associated with utilising vertebrate pests for human consumption ned to be addressed.

5. Utilisation of vertebrate pests as a resource should be developed.

3.12 Results For Animal Pest Survey

From past survey data, expert opinion and from survey results, a snapshot of the distribution of animal pest can be presented. The distribution and density estimates represent one moment in time, as the density and distribution is markedly influenced by a range of environmental and human presence influences. The seasonal weather patterns are the predominant influence on distribution while the level of rainfall during the wet season is the predominant influence on density levels.

3.12.1 Feral Pigs

Feral pigs are distributed widely throughout the CYP. From the survey results all participants recorded pigs being present. I believe that all areas of CYP have feral pigs present at some time. The influence of the seasonal weather patterns has a profound effect on the distribution.

The availability of surface water for drinking during the dry is the most important factor affecting distribution. Feral pigs must drink daily and due to pigs susceptibility to very hot conditions they need to wallow to cool off. During the late dry, distribution is determined by the availability of water. Ecosystems that meet this requirement endure high density levels during the dry. This includes persistent swamps, and riverine habitats. Most of the dry interior or range country has a low clumped distribution around permanent water sources such as bores, dams and natural water holes.
Distribution during this dry season distinctly follows ecological boundaries.

During the wet season the wide availability of water and the subsequent plant growth enables pigs to forage widely. Distribution patterns tend to spread although preferred habitat areas are still utilised fully. During this season pigs are distributed through the CYP, occupying all habitats.

Density criteria also follow this seasonal pattern. During the late dry preferred habitats endure very high density levels. Levels of 20+/km^2 have been reported from aerial surveys ( ) on the marina swamps on the west coast. For the aboriginal community of aurukun this could represent a conservative pig population around 200,000 pigs inhabiting this habitat during the dry season. Aerial survey during the dry season in Lakefield National Park recorded average population levels of 4/km^2, very high densities were observed in the preferred habitats for pigs, river frontage and swamps.

The 1981 survey suggested that over 1 million pigs inhabited CYP. From expert opinions and from landholder survey results, I believe that the total feral pig population in the CYPLUS area for 1994 would be somewhere between the 1 to 2 million level.

3.12.2 Dingoes\Feral Dogs

Dingoes and feral dogs inhabit all non-settled areas of CYP. The closer to settled areas the higher the probability of the dogs being domestic or dingo hybrids. With the increasing influx of pig hunters with dogs, there appears to be an increase of domestic dogs being seen in high density pig areas. High density areas for dingoes appear to occur on the aboriginal community lands, National Parks and lands where low management occurs. The main controlling influence on dog numbers appears to be poisoning campaigns carried out by graziers. Density levels ranged from high in some aboriginal lands and in most National Parks. Closer settled areas and high management levels recorded medium to low levels.

3.12.3 Feral Horses

Brumbies occur throughout the CYP generally in low numbers. In areas where low management occurs brumby numbers can be high. The major concentration of brumbies occurs on the west coastal regions. During the dry season brumbies concentrate on permanent water sources. The original survey estimated approximately 20000 brumbies inhabited CYP, however for this survey I believe 5000 - 10000 brumbies are now in the CYPLUS area.

3.12.4 Feral Cats

Feral cats inhabit all areas of CYP generally in low numbers. Little is known of the social organisation and behaviour of feral cats. Generally feral cats are solitary animals, all cats seen during this survey were solitary. Jones and Coman (1982) recorded in semi-arid Victoria a population density of 2 cats per km. If this was transferable to Cape York, a population of 600 000 feral cats could inhabit the Cape, however the unavailability of rabbits would restrict this population density. Even a conservative estimate of 1 cat per 2km would recognise 150 000 cats inhabiting Cape York. Some interviewees suggested a higher concentration of feral cats occur closer to major settlements.

3.12.5 Feral Cattle

As stated before the definition of feral cattle is difficult. All areas with not a high management level would be assumed to harbour some feral cattle. All National Parks reported cattle being present although the question of their feral status was debatable.

3.12.6 Cane Toads

Cane toads are now present in all areas of CYP. The toads appear to have reach the top section of CYP only in the past 2 years. Numbers are not high, however the potential exist for a significant population explosion if environmental conditions are favourable.

3.12.7 Deer

Rusa deer are present on Prince of Wales Island. Liberation of deer on other islands and on the mainland in the past appear to have failed as no other survey interviewee reported deer present. Little is known of the ecology of these deer, population levels appear to be limited by seasonal conditions.

3.12.8 Other Animal Pests

Rabbits and foxes have been reported at Lakeland Downs although the population levels appear to be very low.

3.13 Animal Pest Legislation

Animal Pests under the Rural Lands Protection Act, 1985, are now referred to as 'declared animals'. Each declared animal is assigned to a particular category, depending on the degree of control required. For example, animals are required to be eradicated (eg. rabbit), reduced in number (eg. dingo), or not allowed to be introduced into the State (e.g feral buffalo).

The basic idea behind the categorisation system is that it provides an indication of the standard of control desired. This is considered preferable to a blanket duty to eradicate all declared species.

For the purposes of the Act, the following categories have been assigned to vertebrate pests:

Category A1 ..	introduction of these animals is prohibited;
Category A2 ..	animals not native that must be destroyed;
Category A3 ..	keeping and selling is prohibited;
Category A4 ..	introduction subject to prescribed conditions and restrictions;
Category A5 ..	numbers to be reduced and kept under restrictions;
Category A6 ..	keeping and selling subject to prescribed conditions and restrictions;
Category A7 ..	native animals that require a management program.

Animals may be assigned more than one category; for example, the dingo is included in categories A1, A3 and A5.

For the purposes of the Act a declared animal means an animal of category A2, A5 or A7 and, as such, responsibility for control rests with the landholder. The Rural Lands Protection Board will assist wherever possible in having its Regional Inspectors available to offer expertise to landholders in dealing with animal pests and may make certain items of equipment available.

Declared animals have been included under the following headings:

Domestic mammals which are feral or become feral from time to time or which may run wild or be at large:

Brumbies	A2, A4, A6
Feral Buffalo	A1, A2, A6
Feral Camel	A2, A4, A6
Feral Donkey	A2, A4, A6
Feral Goat	A2, A4, A6
Feral Pig	A1, A2, A6.

Mammals which may not be introduced or kept and the numbers of which must be reduced and kept under restrictions:

Dingo	A1, A3, A5
Dingo hybrids and domestic dogs run wild	A1, A3, A5

Mammals which may not be introduced into or kept in Queensland and which must be eradicated:

Fox	A1, A2, A3
Rabbit	A1, A2, A3
Hare	A1, A2, A3

The Act provides for permits to be issued for category A1 and A3 animals for scientific or educational purposes or for the purpose of exhibiting the same or of providing an entertainment. These animals are not allowed to be kept as pets, under any circumstances in Queensland.

4.0 WEEDS

4.1 Introduction

There are many definitions of a weed, but perhaps the most appropriate is that " a weed is a plant in the wrong place" or that "a weed is a plant growing in a place set aside for other plants'.

Even plants useful in their own place can be weeds if they are growing in land set apart for other plants. For example, linseed is a valuable crop plant but linseed plants in a crop of grazing oats are not only undesirable, but also potentially dangerous since they are potentially poisonous to stock. Under such conditions, the valuable crop plant becomes a weed. Following an intensive survey of the Cape York Cyplus area for weed species a list of weeds found is listed below ; some of these weeds are Declared under the Rural lands Protection Act 1986, others are weeds that are causing problems such as pasture competition, or may cause stock poisoning, or just nuisance weeds, some may be a problem in the future.

Quarantine inspection of imports of pasture seed, fodder, grain and other agricultural imports is an essential barrier to the introduction of unwanted pests. Current import legislation does not adequately restrict import of seeds and plants that could be a threat to Queensland, plants and seeds of plants that could become a threat still manage to enter Australia. Another problem is that some plants may not be a weed in the cooler southern climates but could easily become a threat to the warmer tropical climates of northern Australia.(eg Thunbergia, Singapore Daisy)

Weeds such as Siam Weed, Alligator Weed, Mimosa Pigra can, if they become established cost the Queensland economy many millions of dollars from lost agricultural production, as well as the environmental damage associated with competition and the lack of natural control which these weeds may have in there native country. Siam weed has been found on the Tully river recently and an eradication program has been initiated in this area.

Pest management is an important part of property management planning, to undertake successful pest control the landholder should be able to determine the priorities for pest management. A program to stop land degradation by exotic plant invasion is a major undertaking. It cannot be achieved simply by allocating finance in the annual budget. Without setting objectives and defining the means to achieve them, any gains will be due to good luck than good management.

4.2 Steps in Constructing a Plan

Step 1 Identify/Define the Problem

- Pest plants targeted eg rubbervine, chinee apple
- Prioritise pest plants depending on a distribution survey, costing and viability to control.

Step 2 Set Goals

Develop Program ie
- survey of density (scattered/medium/dense)
- draw a map of the infestations

Step 3 Develop Strategies

- size of infestation
- methods of control
- seasonal conditions
- economic situation
- accessibility
- draw up a budget

Step 4 Identify Driving and Restraining Forces

Driving Forces

- competent operation
- pest management plan/policy
- availability of funding
- reduction of pest populations
- legislation (Rural lands Protection Act)

Restraining Forces

- economic(downturn in rural economy)
- lack of funding
- incentives for landholders to control
- size of problem(to large to be economically viable)
- incentives(tax rebates. etc)

Step 5 Evaluate Strategies

Create a financial plan

- cost of solution/method
  - herbicide
  - labour
  - other (fencing/fire)

- follow up treatment/on going treatment

Step 6 Allocate Tasks and Times

Calender of Activities

- planned approach
- seasonal conditions
- economic restrictions

Step 7 Evaluate Progress

- follow up treatment
- on going treatment

The Department of Lands, as well as Landholders have a responsibility to control weeds and other pests on their properties. As most of Queensland is leasehold all lease conditions should be enforced and any new, and renewal of leases should carry a condition that; a management plan be drawn up incorporating a pest management plan for that property. This should include National parks and Aboriginal Lands.

4.3 What is a Declared Plant?

A declared plant is a plant considered a serious enough pest to warrant its control being enforced under legislation. This legislation being the Rural Lands Protection Act 1985.

LEGISLATION

Under the Rural Lands Protection Act 1985, an occupier of private land is required to control declared plants on that land. The Local Government for the area may issue a notice on the occupier or owner (or both) requiring that certain declared plants be controlled on that land by a specified date. Should the owner or occupier not comply with the direction contained in such a notice by the specified date, Local Government may authorise any person to enter the said land and carry out the requirements of the direction. The expenses incurred in carrying out this action are then charged to the owner or occupier. Local Government and other Government Departments are also required to control declared plants under their control.

4.4 Categorisation of Weed Pests in Queensland

Category P1 ... **Refers to plants whose introduction into the State is <u>PROHIBITED</u>**

Category P2 ... **Refers to plants which are to be <u>DESTROYED</u>**

Category P3 ... **Refers to plants whose numbers and/ or distribution are to be <u>REDUCED</u> throughout the state or the relevant parts thereof.**

Category P4 ... **Refers to plants which are to be <u>PREVENTED FROM SPREADING</u> from the places in which they occur in the state or the relevant parts thereof.**

Category P5 ... **Refers to plants which should be controlled only on land under the control of a Government Department.**

4.5 Plant Pests Found in Survey

	COMMON NAME	BOTANICAL NAME	CATEGORY
1.	Rubber Vine	*Cryptostegia grandiflora*	P3
2.	Hyptis	*Hyptis sauveolens* *Hyptis pectinata* **	
3.	Wild Tobacco Tree	*Solanum auriculatum*	
4.	Calotrope	*Calotropis procera*	
5.	Sicklepod	*Senna obtusifolia* *Senna tora*	P3
6.	Water Hyacinth	*Eichhornia crassipes*	P3
7.	Salvinia	*Salvinia molesta*	P3
8.	Dark Blue Snake Weed	*Stachytarpheta cayennensis*(DB) *S. jamaicensis(LB)* *S. mutabilis*(Pink)	
9.	Knobweed	*Hyptis capitata*	
10.	Chinee Apple	*Ziziphus mauritiana*	P3
11.	Lantana	*Lantana spp*	
12.	Sida	*Sida retusa* *Sida acuta* *Sida cordifolia* *Sida rhombifolia*	
13.	Giant Devils Fig	*Solanum hispidum*	

14.	Castor Oil Plant	*Ricinus communis*	
15.	Milkweed	*Euphorbia heterophylla*	P3
16.	Trefoil Rattlepod	*Crotalaria medicaginea*	
17.	Khaki Weed	*Alternanthera pungens*	
18.	Noogoora Burr	*Xanthium occidentale*	P3
19.	Mother of Millions	*Bryophyllum spp*	
20.	Calopo	*Calopogium mucunoides*	
21.	Thornapple	*Datura stramonium*	P3
22.	Navua Sedge	*Cyperus aromaticus*	P3
23.	Grader Grass	*Themeda quadrivalvis*	
24.	Urena Burr	*Urena lobata*	
25.	Japanese Sunflower	*Tithonia diversifolia*	
26.	Bellyache Bush	*Jatropha gossypifolia*	
27.	Pond Apple	*Annona glabra* **	
28.	Candle Bush	*Cassia alata*	
29.	Cassia (Old Laura,Coen)	*Cassia siamea*	
30.	Bauhinia (Old Laura)	*Bauhinia alba*	
31.	Grewia spp (Old Laura)	*Grewia asiatica*	
32.	Thunbergia	*Thunbergia spp*	P2
33.	Mossman River Grass	*Cenchrus echinatus*	
34.	Chinese Burr	*Triumfetta rhomboidea*	
35.	Siam Weed	*Chromolaena odorata* **	P1
36.	Coffee Senna	*Senna occidentalis*	
37.	Giant Sensitive Tree	*Mimosa pigra* **	P1

38.	Small Devils Claw	*Martyania annua*	
39.	Parkinsonia	*Parkinsonia aculeata* **	*P2*
40.	Prickly Acacia	*Acacia nilotica* **	P2
41.	Mesquite	*Prosopis spp* **	P2

42. Potential and Existing Exotic Grass Pest Species

Urochloa
Para grass
Guinea grass

Attachments:

39. Parkinsonia PESTFACT Department Lands Qld
40. Prickly Acacia PESTFACT Department Lands QLD
41. Mesquite PESTFACT Department Lands QLD
42. Managing Woody Plants in Grazed Ecosystems:

4.6 Plant Descriptions

1. Rubber Vine *Cryptostegia grandiflora*

Rubber vine is the most potentially devastating weed present on Cape York, it has the ability to invade the whole of the Cape especially along the river systems. The environmental damage to the native flora is a real problem, it creates harbour for feral animals including feral pigs and cattle.

The northern most boundary of this weed is the Coleman River and King River a tributary of the Coleman. Lakefield National Park has infestations on the rivers running through the park, these include the Normanby, Laura, and Kennedy Rivers.

The Mitchell River catchment has the most extensive rubbervine infestation in Queensland the catchment is 72,000 sq Kilometres and approximately 80% of the rivers are infested with the weed spreading out from onto the black soils forming large thickets in most areas eg Wrotham park, Rutland Plains, Kowanyama and Kolata.

The impact of Rubbervine:-

a) Cattle cannot access water points along the rivers and creeks;

b) Mustering of some of the areas has become impossible because the cattle hide in the thick infestations and become impossible to remove.

c) The Department of Primary Industries encountered serious trouble obtaining clean musters, thus hindering progress of the Brucellosis and Tuberculosis Eradiation Scheme.

e) Rubbervine also has some effect on the tourist trade in the Gulf and the Cape by reducing access to fishing holes, and camping areas.

Reasons for the Plant Spreading:-

a) Drought and heavy stocking rates have the effect of reducing ground cover, thereby reducing the competition for the weed. The heavy black soils are high in nutrients and retain more moisture than the sandy soils therefore the rubbervine plant can establish and persist longer.

b) Lack of control measures; Most landholders have on controlling weeds until they become a real problem, especially on large holdings.

Future Spread of Rubber Vine and Control

Rubber vine is spreading slowly, but it is spreading, and has become a major concern to most landholders involved. The seed is spread by wind, water, vehicles, and animals. Small areas can be controlled by chemicals, slashing or fire; People should be encouraged to start working on strategic areas. Biological control may be the only answer on the large infestations along the major river systems.

A biological control agent *Maravalia cryptostegiae* (a rust) has been released at strategic points of rubbervine infestations. The rust spores have transferred to the host plants in most cases, we expect after a few good wet seasons that the rust will start to cause significant damage to the rubbervine plants.

Suggested strategies for Control of Rubbervine

Vitelli J S, Tropical Weeds Research Station, Charters Towers

Scattered Infestations (1-100 plants/Ha)

* First priority in a control program

* Control plants using basal bark spray or cut stump method

Medium Infestations (100 - 2000 plants/Ha)

* Foliar spray plants and or

* Basal bark spray or cut stump plants

* Follow up initial treatment

Dense Infestations (over 2000 plants/Ha)

* Lock up paddock (ie excluding stock)

* Inaccessible infestations along gullies and creeks should be aerially treated with herbicides(Feb- Mar)

* Where terrain is suitable use mechanical treatment(for example cutter bars, ploughing or discing),(June to September). Stick rake and burn the cut plants, OR use aerial application of herbicides)

* Follow up with a burn in November-December (Need a good hot burn)

* Basal bark spray scattered plants

* Thick regrowth areas may require additional mechanical or aerial treatment depending on terrain and accessibility.

* Re-sow with improved pastures where possible or re- establish native pastures after initial treatment.

* Follow up treatment will be required to keep the property clean. If the program is to become successful, follow up is essential.

* An alternative to initial mechanical and chemical treatment is to lock up and exclude the paddock for a period of 18 months to generate sufficient fuel for a hot fire. Treat regrowth as previously mentioned. Resow with improved pastures.

2. Hyptis *Hyptis sauveolens*

Hyptis is a native of tropical America which has spread to most of the worlds tropical regions.

This weed inhabits most of Cape York and Gulf of Carpenteria, it is mainly in areas that have been burnt off every year, heavy stocking rates allow the plant to establish as the competition from native pastures is reduced.

It is a troublesome weed in improved pastures, its strong smell renders it unpalatable and, not being eaten by stock, it can become the dominant plant and compete with useful species.

Hyptis was apparently recorded in Northern Australia by Leichardt on his expeditions, there are stories that it was introduced to the Palmer River by the chinese who used it as a herbal tonic.

Description

Annual, erect,woody-based herb with hairy,4-angled stems, dull green leaves with a strong aromatic smell when crushed, and conspicuous calyxes with their rims extended into 5 stiff bristles about 5 mm long; leaves opposite stalked, lance shaped, pointed at the tip, rounded to heart-shaped at the base, shallowly serrate, 3 to 10 cm long and 2 to 7 cm broad; flowers small, lavender, about 5 mm long, usually arranged in few-flowered clusters in the forks of the upper leaves.

Dispersal:-

The seed remains in the spined burr which catches on fur clothing and other fibrous materials. It also floats on water, and some movement occurs as seeds in mud on animal hooves, machinery and other vehicles.

3. Wild Tobacco Tree Solanum mauritianum

Description

Large spreading shrub or small tree, mostly 3 to 4 metres high; stems branched; leaves up to 30 cm long, 10 cm wide, yellowish-green above, paler beneath, thickly covered with dense felty hairs giving them a velvety feel,tapered at both ends with short, stout stalks and 2 ear shaped, leaf stipules at the base where the leaf joins the stem; flowers lavender blue; in dense flat topped bunches at the ends of the branches; bunches 15 cm across, individual flowers about 12 mm across; fruits round,about 1.5 cm across, yellow when ripe.
This plant is a pest of improved pastures,roadsides and creeklines it is established on the coastal fringe or high rainfall areas

Control

This weed can be controlled easily with good management practices.

Chemical control may included cut stump with Garlon 600 (Dow/Elanco)1-60, overall spray with Grazon DS (Dow/Elanco) or Starane(Dow/Elanco) READ THE LABEL FOR CORRECT RATES

4. Calotrope *Calotropis procera*

This shrubby plant is found along the Mitchell River system and areas along the coastal sand dunes of the Gulf. Kowanyama, Rutland Plains and Dunbar.

ORIGIN

Calotropis is a native of India. It is thought to have been introduced to Australia from India during one of the Queensland gold rushes, possibly as seeds in the packing of a saddle or as an ornamental.

Description

Large spreading shrub or small tree, mostly 3 to 4 m high; stems branched; leaves up to 30 cm long, 10 cm wide, yellowish-green above, paler beneath, thickly covered with dense felty hairs giving them a velvety feel, tapered at both ends with short, stout stalks and 2 ear-shaped, leaf like stipules at the base where the leaf joins the stem; flowers lavender blue; in dense flat topped bunches at ends of branches; bunches 15 cm across, individual flowers about 12 mm across; the fruit is 7.5 to 10 cm long, containing numerous seeds, each having a parachute of silky hairs; seedpods yellow when ripe.

DISPERSAL

The fruit ripen from November to February. When ripe, the fruit burst and release the seeds which can be carried long distances by wind, cattle readily eat this plant even though it contains toxins. Few deaths have been reported, and it is said to have a high protein content.

The plants regenerate strongly when damaged.

Control

Prompt action is essential to eradicate isolated patches of Calotropis to prevent the weed from getting established in a new area.

Cut stump with Garlon 600 + Diesel, 1-60

5. Sicklepod *Cassia obtusifolia*

HABITAT

Found in the humid tropics in most soil types but tends to grow better on the high nutrient soils of the wet tropics.

ORIGIN AND DISTRIBUTION

Sicklepod is a native of the Caribbean region, it has become widespread throughout the tropics. It is a troublesome weed of row crops in the United States and causes problems in India, Malaysia, Java, the Philippines and some Pacific islands, yet it is an important dietary aid in parts of Africa.
It seems to have been introduced to Australia during World War 11 and is presently confined to the higher rainfall (over 1650 mm annually) districts of coastal Queensland and the Top End of the Northern Territory. It causes some problems in sugar cane, tobacco and pastures in North Queensland.

The worst areas in the CYPLUS region occur around Iron Range, Wujal-Wujal, Bloomfield, Cooktown, Hopevale, Starke and surrounding areas and a small area on the Wenlock River where the Iron Range road crosses the river. There is a small infestation on Bamboo Holding.

Dispersal

Spread of sicklepod is wholly by seeds. They have no specific dispersal mechanism, so that movement is mainly by water, soil mud, fodder or vehicles and through the digestive system of animals.

Problem

Sicklepod can invade and completely dominate pastures, or become a major weed of many crops within two or three growing seasons. It is not eaten by domesticated livestock although both cattle and horses will eat the mature seed, which can pass through the animal and germinate in the dung. This is the most common spread from one property to another.

Sicklepod develops large seed reserves in the soil which may germinate at any time of the year under favourable conditions; once a seed population develops, sicklepod remains a potential problem for a number of years

Seed reserves of up to 2000 seeds per m2 have been recorded in a dense stand at Mackay. Some of the seeds will remain viable for up to 15 years.

Control

Control of sicklepod is difficult and can be obtained only with a sustained combination of all available methods including good pasture management. Pasture species such as *Brachiaria decumbens* combined with a chemical control program and low stocking rates can reduce the infestation considerably.

Chemicals such as Grazon DS Dow/Elanco can be used in the early stages of growth of the plant with good results.

Slashing does not eliminate the sickle pod but can reduce the plants vigour allowing the pasture species to compete with this weed.

Another control in some areas eg Iron Range National Park, tree planting programs may be an option in controlling this plant by shading.

6. WATER HYACINTH *Eichhornia crassipes*

Description

An erect floating perennial herb, reproducing from stolons and seed.

Stems erect, to 60 cm long and bearing flowers; or horizontal(stolons), about 10 cm long and producing new plants from terminal buds. There are two types of leaves some are long, narrow and stand erect; others are almost round and curved upwards with edges somewhat undulate; both are smooth, glabrous, glossy and with semi-parallel veins

following the curvature of the leaf. Leaf stalks are up to 50 cm long with bladder like swellings, either bulbous or elongated, which consist of large air cells enabling the plant to float on water.

Flowers are bluish, funnel-shaped, 4 to 7 cm in diameter, with 6 lobes or petals, the upper lobe with a yellow blotch in the centre surrounded by a darker purple; produced in spikes about 15 cm long on stalks about the same length, each spike consisting of about 8 flowers.
The fruit is a narrow, 3 celled capsule about 1 to 1.5 cm long, containing up to 300 seeds.

Origin and Distribution

Water hyacinth originated in the Amazon River Basin of South America. It has spread to all tropical and sub tropical countries, it is regarded as one of the most serious weeds of the world. It spreads rapidly, making waterways impassable to boats and destroying the habitat of waterbirds and fish. It can cover the entire surface of freshwater lakes, rivers,irrigation channels and drains. The leaves of Water Hyacinth transpire much more water into the atmosphere than would be lost by normal evaporation. The decaying organic matter from heavy infestations can make water unfit for livestock or human use.

Water Hyacinth was introduced to the Brisbane are as an ornamental pond specimen in the early 1900s. Valued for its floral presentation it was released into ponds throughout Queensland. Flooding further spread the plant into creeks and river systems where it flourished and became a nuisance.

Seeds are set in February and March. A large number of tiny seeds are produced in each fruit. The seed can stay dormant for many years, making it difficult to eradicate an established infestation. Seeds can be dispersed by water or birds. The plant is spread mainly by vegetative reproduction.

The main infestation in the CYPLUS area is around Kowanyama and Rutland Plains, how it got into this area no one knows.

Potential distribution of Water Hyacinth would be all the river systems along the warm tropical areas of Northern Australia.

Control

It is uneconomical to use chemical control in this area; biological control is the only option possible, there are two weevil insect available *Neochetina bruchi and Neochetina eichhorniae* these insects are working very well in the warm tropics of Australia.

7. SALVINIA *Salvinia molesta*

Description

A fern which floats on the water surface, but not typically fern-like; mature leaves light to yellow green, brown when dead. Leaves folded and compacted with the inner (upper surface covered with long, stiff, water-repellent hairs; about 35 mm long. Young leaves almost flat and round, about 12 mm across. Stems branched, parallel with water surface, with two leaves and trailing, branched, filamentous "root" arising from each joint. Spore capsules borne alternately on special "stems" amongst "roots". No fertile spores are borne; all reproduction is by plant pieces.

Distribution and Habitat

Salvinia is a native of South America and was first reported in Queensland in 1953. It has now been recorded from isolated bodies of water from northern Queensland to the New South wales border and west to Mount Isa. Many infestations can be traced to plants discarded by aquarium fanciers.

It grows mainly on slowly moving streams or still water ponds. Under suitable conditions it can multiply extremely rapidly and can cover the entire water surface in a short time. Mats to 400 mm thick and made up of many layers of stems can form and can make water surfaces virtually impenetrable.

The distribution of this weed in the CYPLUS area is very small with a small patch around the town of Cooktown, but the potential for this weed to spread throughout the streams of the Cape is of major concern.

Control

Chemical control of salvinia can be effective but wetting the plant can be difficult, largely because of the compaction of mature populations and the non wettable upper leaf surface.

Biological control is the most effective method of removing salvinia. The release of a weevil *Cyrtobagous salviniae* in 1981 was very successful on Lake Moondarra (Mount Isa). This insect works very well in the warmer tropical climates of North Queensland.

8. DARK BLUE SNAKE WEED *Stachytarpheta urticifolia*

Description

Four snakeweeds occur in Queensland varying in flower colour from pink to red and pale blue to dark blue; hybrids have been reported. The snakeweeds are clump-formed perennials with woody rootstocks and rather tough, branched stems; leaves are opposite, lance shaped and toothed or untoothed and usually taper at the base into a short stalk; flower spikes are stiff but not straight, up to 50 cm long in one species, and about 5 mm wide; individual flowers consist of a slender tube and 5 petals, each blooming in rotation from the bottom of the spike upwards, the lower part of each flower sunk into a depression in the flower stalk and protected by a pointed bract.

Distribution and Habitat

Snakeweeds are native to the tropical Americas but have now become established in coastal Queensland, probably as escapees from garden culture. The different species have colonised different parts of the state according to preferred environments; dark blue snakeweed occurs all along the coast but is commonest in the wetter areas of North Queensland.

All the different coloured snake weeds occur all along the higher rainfall areas of the CYPLUS area mainly along the eastern coastal strip.

Control

Careful management of new pasture is essential, avoid over grazing, Brachiaria pastures compete very well with this weed.

2,4-D amine with a wetter gives good results when sprayed on this plant. IT IS IMPORTANT TO READ THE LABEL BEFORE USE.

9. KNOB WEED *Hyptis capitata*

Description

A perennial plant with several erect stems up to 2.5 m high, widely and loosely branched; stems square in cross-section, green; leaves opposite, widely spaced along the stems, bright green to 12 cm long, 5 cm wide, tapered at both ends, margins toothed; flowers white, small, in compact globular heads on long stalks up to 5 cm long in the forks of the leaves; seeds small black, when ripe they rattle when the heads are shaken.

Distribution and Habitat

Native to tropical Central America(southern Mexico to Panama). Occurs on the tropical wet lowlands and foothills from Ingham to Bamaga.

Knobweed was first recorded in Australia on the South Johnstone River near Innisfail, Queensland, in 1937. It is only found in high rainfall areas of North Queensland, it invades pastures and cultivation especially in damp, low-lying areas. It is also found in badly managed pastures and along roadsides.

There is heavy infestations in the Temple Bay area, Iron Range and Cape Tribulation to Cooktown on the coast.

Dispersal

Dispersal is mostly by seed. The fruit is well adapted for dispersal, readily adhering to wool, fur, clothing, and fibrous materials, as well as farm machinery and other vehicles. Some seed is also spread by water.

Control

Good pasture management eg slashing before flowering followed by nitrogen fertiliser to promote pasture growth.

2,4-D Amine works well on this weed when it is young.

10. CHINEE APPLE *Ziziphus mauritiana*

Description

A low spreading tree up to 6 m high and 10 m in diameter but usually smaller, densely branched from about ground level and forming thorny thickets; branches zig-zag in shape with a leaf and a thorn at each angle; leaves alternate, glossy green above, almost white underneath; flowers small and inconspicuous; fruit succulent, rounded, about 2.5 cm in diameter, pale yellow when ripe and with a pleasant acid flavour.

Distribution and Habitat

Chinee apple is a native of Mauritius, India and south-west China. It grows in the sub-coastal areas of central and north Queensland, particularly around Rockhampton, lower Burdekin, Townsville and old mining towns such as Charters Towers, Chillagoe, Mt Surprise and there is an infestation around Kowanyama.

Mainly restricted to the drier tropics with annual rainfall less than 1200 mm. Although there is a tendency to grow along watercourses, it can grow to dense stands on dry exposed hillsides. It occurs on a wide range of soil types in association with different vegetative groups, some of the soil types on which the species has successfully established are coarse textured sands, deep alluvial soils, shallow surfaced solodic soils and cracking clay soils, it has no marked preference for any soil type or vegetative association.

It does not normally establish under a canopy of other trees.
Dense infestations produce impenetrable thickets which seriously hamper stock management and reduce pasture productivity and accessibility.

Dispersal

Mature trees produce large quantities of fruit which is readily eaten by stock, birds (black cockatoos) and humans assisting the spread of the seed.

Control

Large infestations can be knocked down with a bulldozer pushed into a heap and burnt; follow up with chemical control on the seedlings and suckers.

Small areas can be controlled with basal bark treatment with Starane 200(Dow/Elanco) 1-30 with Diesel. This must be applied when the plants are at a rapid growth stage, usually around flowering.

11. LANTANA *Lantana camara*

Description

Lantana is a heavily branched shrub which can be found growing as compact clumps, dense thickets, or even rambling or climbing. The stems are square in cross section with backwardly curved prickles along the edges; leaves are bright green above, paler beneath, mostly about 6 cm long, with rounded-toothed edges.
Flowers can appear most of the year and are clustered in compact heads about 2.5 cm across. Colours vary from pale cream to yellow, white pink, orange, red, lilac and purple. The glossy rounded fruits are fleshy and purplish-black when ripe.

Distribution and Habitat

Lantana is native to the tropical and sub-tropical regions of Central and South America. Now it occurs throughout most coastal and sub coastal areas of Queensland. It grows in a wide variety of habitats from dry hillsides to wet, heavily shaded gullies.

Many lantana types are poisonous to stock, most cases of poisoning occur in stock newly introduced into country where toxic forms occur; young animals seem to be most at risk. Stock bred on infected country seem to usually avoid lantana unless forced to eat it due to lack of other feed.

Lantana infestations in the CYPLUS area occur mainly along the eastern coast of the Cape.

Control

Biological Control

Since 1914, twenty-three insects have been introduced into Australia, of these,four are of major importance.
These include two leaf mining beetles, one sap sucking bug and a leaf-mining fly.

These insects in Queensland have reduced the vigour and competitiveness of lantana in some areas, while other areas lantana remains a problem.

Management

Treatment of large infestations of lantana with herbicides is not feasible. The use of fire as part of a management program
is essential for the control of dense infestations.

Suggested control program:

- exclude stock for at least 12 months to establish fuel load)

- burn in the hot dry months, prior to rain.

- sow improved pastures(consult DPI Agronomist)

- allow pasture establishment before grazing

- spot spray regrowth where necessary.

- follow up spot spraying for the next few years.

12. SIDA *Sida acuta/retusa/cordifolia/rhombifolia*

Description *Sida Retusa*

Sida species are usually a robust perennial with twiggy stems, tough, greenish bark and a strong taproot; alternate leaves, dull green above, greenish grey beneath,irregularly rhomboidal in shape, toothed on the edge in the upper part, 2.5 to 5 cm long 1 to 2 cm wide; flowers pale yellow, on slender stalks; seeds in small pods of 10 parts in a circle enclosed by a seed cup, each part with two sharp points at the top.

Origin and Distribution

Also known as Paddys lucerne is endemic throughout the tropics, including Australia, it is thought to originate in the east and west Indies. It is now common along the whole of the eastern and northern coasts of the continent and also occurs sporadically inland. It is very common in Cape York especially in improved pastures that have been overstocked, around homesteads, high traffic areas and disturbed areas.

Paddys lucerne is spread by seed only. Its finely barbed awns are ideally suited to catch in wool, fur, clothes,and other fibrous material. Seeds may also be spread by water, mud on hooves and boots, farm machinery fodder and seed.

Control

Seedling plants are susceptible to early post emergent herbicides such as 2,4,D, MCPA, but plants become resistant to most herbicides as they mature. Rope wick application of Glyphosate can give good control. Good pasture management can and lower stocking rates can also reduce the problem.

A number of insects have been released to try and control the problem, but they do not seem to handle the dry season on the Cape, they have established near Cairns, north of Cooktown,and Helensvale where the dry season is not so dramatic.

13. Giant Devils Fig *Solanum hispidum*

Description

A large coarse, thorny shrub up to about 5 m high with stems and undersides of leaves thickly covered with a mat of rusty hairs; leaves up to 30 cm long and 20 cm wide on 12 mm long leaf-stalks, usually deeply divided into pointed lobes; stems, leaf-stalks and leaf veins with scattered large thorns; flowers white, star shaped with a cone of yellow stamens, carried in stalked clusters below the leaf joints; fruits globular,about 12 mm across, yellow when ripe.

Distribution and Habitat

Native to America.Occurs only on the Eastern coastal region of Queensland. The main areas of infestation in the CYPLUS area are around Bloomfield, Cooktown, Iron Range and Helensvale.

It is usually found in run down and well watered pastures and along silty creek banks. Dispersal is usually birds eating the fruits and passing the seeds through the digestive system.

Control

Control can be achieve by good pasture management, or chemical control either overall spraying with Grazon DS (Dow/Elanco)1-300 water with a wetter, Glyphosate or cut stump treatment with Garlon 600 and Diesel at 1-60.

14. CASTER OIL PLANT *Ricinus communis*

Robust perennial up to 2.5 m high with soft woody stems. The leaves are alternate, divided into segments like the palm of the hand, with seven to nine deep cut lobes; the leaf blade is 15-30 cm long and 10-60 cm across with stalks 20-30 cm long.

The creamy-white flowers are either male or female and are borne separately on the same plant; they are 1.0-2.5 cm in diameter. The fruit is a capsule, with many clustered

together; it is prickly with brownish mottled seeds 12 mm long. There are a number of cultivated varieties.

Origin, Distribution and Habitat

Castor oil plant is a native of Africa and Euro-Asia and has been introduced to most countries of the world.

A frequent escape from cultivation in warm-temperate and subtropical regions, caster oil plant commonly occurs along gullies, watercourses and roadsides as well as in vacant lots, neglected gardens and other waste places.

Its distribution in the CYPLUS area is restricted to around Edward River Community.

Properties

The seeds are highly toxic, *ricin* a toxic phytotoxin, if injected the lethal is dose about 0.0001 mg/kg of body weight.

The seed can be detoxified by heating above 50 degC and used in the manufacture of paints, plastics, explosives, rayon and perfumes. It is also highly prized as a lubricant in the manufacture of hydraulic fluids.

Control

Small areas can be dug out, large areas can be sprayed with 2,4,D Amine, Glyphosate, Grazon DS.

15. MILK WEED *Euphorbia heterophylla*

Description

An erect usually unbranched annual herb 30 to 80 and occasionally 400 cm high, containing a milky sap and reproducing only by seed; stems robust glabrous and hollow; leaves alternate, simple or lobed, of variable size;crowded together towards the top of the stems. Flowers yellow, shortly stalked, small cup-shaped structures, grouped together into flat dichotomously branched inflorescences; each cup without petals or sepals but with conspicuous glands and subtended by large yellowish green radiated leaf bracts with creamy patches at their base. Fruit a hard coated, red-blotched, 3-lobed capsule about 5 mm diameter. Seed grey to black, subglobular to 1 mm diameter.

Origin

A native of tropical and sub tropical America, milkweed has spread to most of the tropical world and some of the wormer temperate regions.
Its means of entry into Australia is not known but it may have been introduced as an ornamental or in crop or pasture seed.

Properties

Overseas milkweed is a major weed of crops such as cocoa, coffee, cotton, cowpeas, maize, peanuts,sorghum, sugarcane, and soybeans. Because of its rapid growth, milkweed competes with seedlings.

Distribution

Coombetta Lodge at Chillagoe is the only reported sighting in the CYPLUS area to date.

Control

Because seeds germinate at any time during the growing season, control is difficult, the seeds can germinate from depth adding to the plants aggressiveness. In a cropping situation pre-emergent herbicides should be used as well as cultivation.
2,4D Amine can knock out seedlings and Grazon DS may be used in non crop situations on larger plants.

16. TREFOIL RATTLEPOD *Crotalaria medicaginea*

Description

An annual to 60 cm high; pubescent with oppressed, fusiform hairs; leaves 3-foliate; terminal leaflet narrow-obovate-cuneate to subtriangular, rarely linear, +or- truncate, 4-20 x 2.5-7 mm; lateral leaflets slightly smaller. Racemes few-many-flowered, 1-10 cm long. Flowers 6-8 mm long. Petals yellow; keel spirally twisted at apex. Seedpods rounded 3.5 to 5 mm long and broad.

This species extends from India through Malaysia to China and to Western Australia, Northern Territory, Queensland and Northern New South Wales, and is a native of southern Asia.

Dispersal is usually by the pods exploding throwing the seeds also water can help to disperse the seeds.

Habitat

Found throughout the Cape York area, can be poisonous to livestock.

Control

Areas can be slashed before seeding, or fenced off from livestock; they do not readily eat this plant but reports of deaths have occurred.
Chemical control with 2,4D amine at the early stages of growth or Grazon DS for mature plants.

17. KHAKI WEED *Alternanthera pungens*

Habitat

Tropical and sub-tropical regions growing on mainly light soils in areas with high temperatures. It has become a troublesome weed in rural towns, occurring commonly on nature strips, playing fields,caravan parks and saleyards.

Description

A prostrate creeping perennial(occasionally annual) herb, reproducing by seed, roots and stems taking root at the nodes.

Stems are reddish, prostrate, trailing, to 60 cm long, with finely toothed soft silky hairs; several stems arising from each crown; roots formed at stem nodes.

Leaves are in opposite pairs of unequal size, to 4 cm long but commonly 2 cm numerous, oval or ovate, shortly stalked, glabrous or sparsely hairy, prominently veined on underside.

Flowers inconspicuous, surrounded by sharply pointed chaff coloured bracts, occurring in clusters in leaf axils.

Fruit chaff-coloured prickly burr about 1 cm long.

Origin and Distribution

Khaki weed is a native of tropical America and has become widely distributed throughout the world. It occurs as a weed of neglected areas, roadsides and old mine areas.

Dispersal is mainly by the burrs on the seeds clinging to tyres, clothing, and fur, another method of dispersal is by fodder being moved from one area to another especially during drought times.

It was recorded in Queensland in 1910. Khaki weed is scattered throughout the CYPLUS area including Palmerville, Cooktown, Kowanyama and Weipa.

Control

Having a large taproot makes this plant difficult to kill, it can be cultivated but follow up cultivations have to be carried out to kill seedlings.

Chemical control can be effective on seedlings Dicamba and amitrole T. Grazon DS with picloram is effective on large mature plants before flowering.
It is important to spray or control the seedlings before they develop the large taproot.

18. NOOGOORA BURR *Xanthium occidentale*

Description

A robust, sparingly branched annual up to 2 m high, sometimes more, rough to touch; leaves alternate, broad, mostly 10-15 cm in diameter, the edges with irregular teeth or lobes; male flowers in a few clusters along slender stalks at the ends of the branches, soon dropping off; female flowers in clusters on the lower part of slender, terminal, flower-bearing branchlets and in clusters in the forks of the leaves, persistent, developing into hard,woody, spiny burrs; burrs when ripe brown, about 2.5 cm long, densely beset with hooked spines and two stout straight spines at the end; two seeds in different compartments of the same burr, one germinating the first year, the other remaining dormant until a subsequent favourable season.
The seedlings are poisonous to stock usually at the two leaf stage of growth.

Origin

Noogoora burr originates in North America and is now widely spread throughout 28 countries. This weed is thought to have been introduced to Australia with cotton seed imported from either the Mississippi Delta region of the United States or from India and was first recorded at Noogoora station, a sheep and cattle property on the Brisbane river, in the 1860s.

Distribution

Most creeks and rivers in the CYPLUS area are infested with noogoora burr.

Control

This weed is an annual so if seeding is prevented then control can be made possible. If the plant has seeded then it can take up to 6 years to eradicate it. Flooding can bring new seed from upstream properties so continuing surveillance must be undertaken following a wet season.

Dispersal can be from several methods including water, mud on vehicles, clothing, fur, wool, and fodder.

Chemical control can include 2,4D, Tordon 50D and MCPA can be used with good results on plants before flowering, they become harder to kill as the mature.

Introduced biological control agents have some effect on the plant; the stem boring insect *Epiblema strenuana* introduced to control parthenium attacks the plant reducing the seeding capabilities. A rust *Puccinia xanthii* accidentally introduced can cause severe damage to the plant at certain times of the year, especially when the weather cools to approximately 28 deg C. The rust causes damage to the leaves with the classic rust blotches the seeds are affected as well reducing the viability of the seeds.

19. MOTHER OF MILLIONS *Bryophyllum spp*

Description

Slender erect perennial succulent plant, with pinkish-brown or greyish stems,to 60 cm high. Leaves waxy, numerous, in pairs or 3s, almost cyndrical, slightly channelled above, 3-10 cm long, pinkish mottled with violet-brown, stalkless,toothed and often bearing foliage buds near the tip, initially erect,later horizontal or drooping. Flowers whitish,or red-dish-orange, tubular, 4 or 5-lobed, 2.5 cm long, longer than the calyx, borne in clusters about 10-12cm diameter at the ends of the stems, with individual flowers drooping from the underside of the cluster. Fruit consisting of 4 segments. Flowering usually September.

Origin

Tropical Africa

Habitat

Mother of Millions is a garden escape usually found near towns and villages. In the Cape it is found around old mining towns such as in the Palmer River area, Cooktown and some of the Aboriginal Missions Kowanyama and Bamaga.

The small foliage buds drop readily, develop roots and establish quickly to form a colony, hence the common name.

This plant has been associated with poisoning in cattle,so it is best to keep hungry stock away from infested areas.

Control

Small areas can be cut, heaped up, sprayed with diesel and burnt.
Large areas can be sprayed with herbicides such as Grazon DS with water and a wetter 1-30.

20. CALOPO *Calopogonium mucunoides*

An introduced legume for fodder for cattle; it is a vigorous, winding creeper from South America, now wide spread in localities with sufficient moisture all over the tropics.

In about 5 months it forms a dense mat of foliage 30-60 cm high, and is a perennial but not long lived. In Indochina, it is usually ploughed under at the beginning of the dry season. It produces seeds profusely in 7-8 months from sowing, and reseeds itself freely.

In Asia this plant is mainly used for soil cover and green manure, but in some countries the protein rich foliage and seeds are used for fodder even if the hairy stems and leaves reduce palatability.

In areas like Iron Range this plant is competing with the native flora with its aggressive climbing and smothering capabilities. It is a major plant around Bamaga, Weipa, Lockhart River, Hopevale, and most other places around the coastal fringe of the Cape.

Dispersal is mainly by sowing of tropical legume pasture species, the seed is pasted through stock, birds and other animals that eat the seed.

Control

Calopo has a percentage of hard seed which will germinate for several years, this means follow up programs may have to be undertaken.

Chemical control can be achieved with 2,4D on young plants, Grazon DS or Starane can be used on mature plants.

In the Iron Range area tree planting programs may be introduced to control this weed as it is susceptible to shading.

21. THORNAPPLE *Datura spp*

Description

Robust annual herbs growing to about 1 m high; stems erect, repeatedly forked, smooth; leaves mostly borne towards the ends of the branches, dark green, mostly large, with edges shallowly scalloped, emitting an unpleasant smell when crushed; flowers long, tubular, white except in some species; fruits globular, covered with prickles of various shapes and sizes; seeds plentiful, dull black, yellow, grey or brown.

Origin and Distribution

Tropical regions of Central and South America. One species *D. leichhartii* is believed to be a native of the dry parts of Australia.

Thornapples are widespread throughout Australia, occurring in all states but are of most importance in Queensland and northern New South Wales where they compete with many crops. All parts of the plant are poisonous to stock and humans.

The only report of a siting of thornapple on the Cape was at Bamaga, this may have been introduced as an ornamental and escaped.

Control

Isolated plants can be pulled before fruit is formed. Thornapples are susceptible to 2,4D at the seedling stage, but become more resistant as they mature. Atrazine, Diquat, Paraquat and Glyphosate are effective also.

An introduced insect; the three lined potato beetle, *Lema trilineata*, was discovered in Queensland in the 1970s, as well as feeding on potatoes defoliates thornapples in some seasons.

22. NAVUA SEDGE *Cyperus aromaticus*

Description

A vigorous aggressive perennial sedge 30-60 cm high, but occasionally reaching 2 m, reproducing by seed and rhizomes.

Stems A straight, rather stout short-internoded basal rhizome is topped by an elongated 3-angled terminal internode or scape 30-60 cm long or longer; buds on each second node of the basal rhizome produce tillers.
Leaves Clustered at the base of the stem and rather drooping, 3-ranked, linear-lanceolate, 5-15 cm long, 3 mm wide.
Inflorescence Silky white, ovoid or cone-shaped, subtended by 3 long leaf-like bracts alternating with 3 shorter ones; florets inconspicuous, 1-seeded.
Seed A dark brown to black, ovoid achene with a slight beak.

Habitat and Origin

Humid and subhumid tropics, occurring on a wide range of soils especially in hot wet open spaces. It is regularly found in ditches, on roadsides and lawns, extending into pastures, rootcrops, rice,and occasionally sugarcane.

Navua sedge is native of tropical Africa, Madagascar, Mauritius and Seychelles. It was accidentally introduced to North Queensland in the 1970s.

IN the CYPLUS area this plant has invaded areas around Cooktown and Bloomfield areas.

Control

Spot spraying small patches with glyphosate will control this weed. Large areas can be cultivated and competitive pasture species sown.

23. GRADER GRASS *Themeda quadrivalvis*

Description

Grader grass is a strong-growing tufted grass usually growing in dense patches.

An annual grass growing up to 2 m in height,**stems** erect and cane like; **leaves** well spaced, long and narrow, seedheads long and branched, with short leaves throughout; **seeds** have bent brown bristles at the end and are surrounded by leaflike structures and clusters of hairs with swollen bases. As the plant matures, the seedhead droops and the

whole plant becomes brown. In favourable conditions growth is rapid; the plant can reach 2 m in 6-8 weeks, flower within 5-6 weeks and have ripe seed present at 10 weeks.

The plant looks similar to Kangaroo grass, but Kangaroo grass is shorter, lacks hairs on the seeds, is a perennial grass and a valuable native pasture.

Distribution and Habitat

Grader grass is a native of India and was introduced accidentally into Queensland over 50 Years ago. Probably in pack saddles or packaging. It has spread rapidly along the East Coast and gradually spreading into the drier areas of Queensland. It is common along roadsides and railway embankments especially after grading. It is spread by vehicles, removal of soil, contaminated fodder, crop and pasture seed.

Problem

Grader grass competes with native and introduced pastures; burning reduces ground cover allowing grader grass to establish. Drought can encourage establishment of grader grass when ground cover is reduced by overgrazing.

Control

When establishing new pasture make sure the seed is free of contamination.
Fire as management tool may have to be modified. Burn once every 3-4 years rather than annually. Burn early in the season rather than late. Maintain improved pasture to allow competition with grader grass.

Chemical control

Grader grass can be controlled by herbicides, but in many areas sensible management practices will greatly reduce the problem.

Gramoxone can be used where native or improved species are present, Gramoxone will damage both the grader grass and th pasture but perennial pastures will regenerate in some cases.

Glyphosate is non selective and is not recommended except where grader grass is the only remaining grass. After spraying with glyphosate pasture seed will have to be established to compete with any grader grass seedlings.

24. URENA BURR *Urena lobata*

Description

A tall annual or short-lived perennial burr to a height of about 3.5 m but often only half this; branches slender, bark tough; leaves covered with short hairs, grey-green above, grey beneath, varying in size but mostly 5 to 7.5 cm across, as broad as long, the edges divided into several shallow blunt, triangular lobes, alternate, on slender stalks; flowers

pink, hibiscus like, about 2 cm across, on short stalks in the leaf forks; fruit a rounded burr, about 12 mm across, eventually breaking into 4 or 5 one-seeded pieces.

Distribution

Urena burr was found all over Cape York, particularly river and creek frontages and cleared areas and along roadsides, it has formed dense stands in some areas crowding out useful species. Urena burr is readily spread by the burrs clinging to animals fur and clothing.

Control

Cultivation,hand pulling or grubbing will control it; good pasture management with low stocking rates will allow pastures to compete with urena burr.

Urena burr is susceptible to spraying with 2,4d in its young stages of growth. Other chemicals for broad leaf weeds will control it also.

25. JAPANESE SUNFLOWER *Tithonia diversifolia*

Description

Robust perennial with erect,coarse stems, 1 to 3 m high; stems dull green, pithy in the centre; leaves alternate, dull green above, paler and velvety beneath, 10 to 20 cm long and 5 to 10 cm wide, deeply divided into about 5 pointed, serrated lobes, wedge-shaped at the base, tapered into a long stalk; flower heads large, sunflower-like, bright golden yellow, 6 to 10 cm across, on long, stout stalks at the ends of the branches and in the forks of the upper leaves; seeds narrow, brown,slightly flattened, silky-hairy, about 6 mm long, crowned with a few flat, papery scales and two week awns.

Distribution

Japanese sunflower is a common weed of roadsides, railway embankments and vacant town allotments on coastal Queensland.
Bloomfield and cooktown areas have infestations of this weed.
The seed is spread by water, contaminated stock fodder and contaminated seed.

Control

Starane, Grazon Ds, Brushoff and 2,4D will control this weed, slashing, ploughing and grubbing are other methods of control.

26. BELLYACHE BUSH *Jatropha gossypifolia*

Description

An erect shrub or small tree with one to several stems arising from the herbaceous crown, 2 to 3 m high, reproducing from seed and suckers from the root.

Stems are thick, rather soft, one to several, coarsely hairy, 1 to 2 m long; exuding a watery sap when injured. Leaves are deep purple and sticky when young, bright green when mature; alternate, stalked, rounded or obovate, about 10 cm diameter,
deeply divided into 3 lanceolate lobes; margins and stalks covered with hairs. Flowers purple with yellow centres, small, in clusters on branched stalks in upper leaf axils. Fruit, an oblong, 3-lobed capsule about 1.2 cm long and 1 cm wide. Seed is dark coloured, about 8 mm long.

Habitat

Humid and subtropical scrublands, where it is often cultivated as an ornamental. In Australia, it now occurs as a relict weed around abandoned homesteads and mine sites and extends into degraded rangelands. Dispersal is by seed the capsules split open throwing the seed some distance; spread is also by water, mud on hooves and tyres.

Origin

A native of the Caribbean region, bellyache bush was introduced as an ornamental to a number of countries including Australia.

The only infestation known of this weed on the CYPLUS area is on the Palmer River at Palmerville.

Control

Dig out and burn single plants, especially seedlings. Overall spray large areas with Starane or Grazon DS.

27. POND APPLE *Annona glabra*

Pond apple is a aggressive tree, it can invade a wide range of habitats especially low lying melaleuca and mangrove areas along the coastal strip. It can form dense thickets which can totally take over the native flora.
Pond apple is a close relation to the custard apple and the rootstock of this plant can be used for commercial grafting.
The fruit of the pond apple is similar to custard apple but the flesh is less palatable.

Distribution

Sightings have been recorded from Innisfail to Cooktown with some heavy infestations around the Daintree area.

The infestation in Cooktown is behind the council depot and around the caravan park near the council depot.

Control

Treatment of isolated plants with Tordon TCH gives good results. Large areas could be knocked down with a bulldozer them followed up with chemical control; following this tree planting programs might be a possibility, or pasture establishment could be another option depending on the situation.

28. CANDLE BUSH *Cassia alata*Description

Description

A sparingly branched shrub 2 to 3 m, occasionally 4 m high, reproducing by seed and suckers. Stems thick and pithy, 1 to 2 m long. Leaves pinnate, 45 to 75 cm long, 12 to 25 cm wide, consisting of 8 to 14 pairs of ovate-oblong leaflets, each 5 to 12 cm long, 2 to 5 cm wide, with rounded to cordate bases; leaf stalks without glands but persistent stipules form at base.

Flowers golden yellow to orange, 2 to 3 cm diameter, in terminal or axillary racemes 30 to 60 cm long. Fruit a brownish pod, 15 to 25 cm long, 1.5 to 2cm wide; with dorsal and ventral wings. Seed dark brown, flat triangular-shaped, 4 to 5 mm across at the base.

Origin and Distribution

A native of tropical America; its entry into Australia is not certain but it was present in Darwin before 1891.

Distribution in the CYPLUS area is confined to the settled area eg Lockhart River and Bamaga in disturbed areas around these settlements.

Dispersal is usually by man as this plant is used as an ornamental, dumped garden refuse helps in the spread of this plant, it is a potential major pest of wetlands, evidence of this has shown up in areas of New Guinea where this plant has invaded wet areas.

Properties

Candle bush develops readily on disturbed areas, the shrubby growth forms dense thickets. It is particularly aggressive in areas of high rainfall.

Control

Isolated plants can be removed by digging out and burning, making sure all the roots are removed. Large patches can be controlled with chemicals eg Grazon DS.

29. CASSIA *Cassia siamea*

30. BAUHINIA *Bauhinia alba*

31. GREWIA *Grewia asiatica*

These three species have been listed because they are causing concern on the Laura River from the Old Laura homestead down stream about 7 kilometres. Grewia is spreading away from the river mainly by birds eating the fruit.

The three species are introduced plants probably bought in as ornamentals around the homestead and have escaped.

Control should be undertaken by DEH before the problem becomes out of control.

Control

1/ Basal bark with Garlon 600 + Diesel at 1-60

2/ Frill cut with Tordon TCH at recommended rates for timber control as listed on the label.

32. THUNBERGIA *Thunbergia grandiflora/laurifolia*

Description

An erect woody perennial vine, to 15 m high depending on the support, reproducing from tubers and seeds.

Stems are robust; leaves bright green,older dark green; opposite, shortly stalked, rough; to 20 cm long, usually 3 to 5 nerved from the base, pointed-ovate or base heart shaped, edge either entire or sparsely and irregularly lobed or toothed. Flowers pale blue with yellow throat, whitish on outside, trumpet shaped with 5 rounded flared lobes, one noticeably larger than the others; to 8 cm long, 6 to 8 cm across; borne on clusters on long drooping branches with individual stalks 4 to 5 cm long; calyx green and streaked with purple or red.

Fruit a spherical capsule with a long tapering tail, the whole about 3 cm long.

Dispersal is by ornamental plants from nurseries or tubers dumped in rubbish dumps or along creeks. Once established the plant can be dispersed by tubers breaking off in floods or by seed.

Origin and Distribution

Thunbergia originated in northern India. It was introduced as an ornamental in many tropical and sub tropical areas including Australia.

This plant is very aggressive in the tropical areas and has a tendency to compete with the native flora especially the wet tropics. It can completely take over and eventually kill the vegetation it smothers.

Mossman, Cooktown and Bloomfield in the CYPLUS area have these plants present mainly as ornamentals in gardens. In some areas it has spread to neighbouring creeks.

Potential distribution is all the wet tropics areas where the plant has the capabilities of total destruction of the wet rain forest species, especially along the riverine systems.

Control

It is a difficult plant to control because of the large tuber system under the plant. Seedlings can keep germination for several years after the main plant has been controlled.

The only chemical available for control of this plant is **Arsenal**(Cyanamide). Seedlings can be controlled with Glyphosate.

33. MOSSMAN RIVER GRASS

Description

Annual grass with erect stems forming loose tufts; leaves pale-green, flat rather stiff, tapering towards the tip; seed-heads narrow, spike-like, with many closely packed burrs which fall off readily when ripe; burrs about 4 mm across formed of a ring of stout, broad, spiny bristles joined together at the base, clinging closely to hair and clothing and sometimes skin.

Origin and Distribution

A native of tropical America. Its mode of entry into Queensland. It is not known but is thought to have entered during the gold rush 1860s.

Most coastal dunes along the whole east coast have Mossman River grass. This weed has infested many of the rivers on the Cape also.

Control

It is essential to prevent seeding. This can be achieved by burning and grubbing of isolated plants. Spraying of larger areas with Glyphosate is successful but follow up is necessary to control seedlings.

Mossman river grass is difficult to control in most cases because it usually grows amongst other grasses.

34. CHINESE BURR *Triumfetta rhomboidea*

Description

A perennial, much branched shrub 1 to 1.3 m high; stems brown, bark tough; leaves with short hairs, alternate, rounded at base, usually prominently 3-lobed, edge toothed, varying in size but mostly 5 to 7.5 cm across; flowers small yellow, borne in clusters along the upper branches; fruit a prickly burr, 6 mm in diameter not breaking when ripe.

Distribution

This weed is found in many areas of the Cape, it is a weed of roadsides, fallow land and disturbed areas. Urena burr is also called Chinese burr but Urena burr may be easily distinguished by its pink flowers and the larger fruit which breaks into pieces.

Control

Slashing may reduce the infestation in some cases, it is also susceptible to 2,4D and other broad leaf chemicals.

It is more of a nuisance plant in the cape rather that a problem weed.

35. COFFEE SENNA *Cassia occidentalis*

Description

Annual or short lived perennial; stems erect, woody, sparingly branched; leaves pinnate, consisting of 4-5 pairs of leaflets fairly widely spaced along a common stalk which has a depressed, knob-like dark gland on the upper side near the base; leaflets pale green, 2.5-6.5 cm wide, rounded at base, narrowed to a pointed tip; flowers yellow, in open bunches on a short common stalk in the forks of the upper leaves; pods 7.5-12.5 cm long, plump but slightly flattened, dark brown with paler longitudinal stripes along the edges; seeds dark brown, slightly shiny.

Distribution and Habitat

This species is widely distributed in tropical countries throughout the world. In Australia, it is naturalised in Queensland, Northern Territory, and Western Australia.

Scattered colonies of this plant occur all over Cape York along creeks and disturbed areas, the seeds are dispersed by flood water, machinery, vehicles and mud sticking to animals and vehicles.

Control

Coffee senna is easily controlled by herbicides, 2,4D amine or ester. Good pastures compete readily with this plant.

36. GIANT SENSITIVE TREE *Mimosa pigra*

Description

When mature, mimosa is an erect much branched prickly shrub reaching a height of 3 to 5 m, reproducing by seed and suckers. Stems greenish at first but becoming woody, to 3m long, initially covered with short stiffened hairs, which give it a rough texture, and randomly scattered slightly recurved prickles 5 to 10 mm long.

Leaves bright green; 20 to 25 cm long, bipinnate, consisting of about 15 pairs of opposite primary segments 5cm long, each with numerous pairs of sessile, narrowly lanceolate leaflets which fold together when touched or injured and at night; pairs of prickles sometimes occur between the branchlets on the main leaf stalk.

Flowers are pink or mauve, small, regular, numerous, grouped into globular heads 1 to 2 cm diameter; heads borne on stalks 2 to 3 cm long, 2 in each leaf axil; corolla 4-lobed with 8 pink stamens.

Fruit. A thick hairy, 20 -25 seeded, flattened pod, borne in groups in the leaf axils, each 6.5 to 7.5 cm long and 7 to 10 mm wide; turning brown when mature and breaking into 1 seeded segments.

Seed. Brown or olive green, oblong, flattened, 4 to 6 mm long, 2 mm wide.

Origin and Distribution

Mimosa pigra is a native of Tropical America where it occurs in a wide belt extending from Mexico through Central America, the Antilles, Colombia, Peru, and Brazil to northern Argentina.

Introduced into other areas as an ornamental or as a cover crop, it is now widespread as a serious weed in Africa, India, northern Thailand, Indonesia, the Philippines and some Pacific islands. In Australia, mimosa is confined to the Top End of the Northern Territory where it has been present for many years.

This plant is a potential threat to the wet marine plains of Aurukun and other areas such as Lakefield National Park. It is well suited to any area where the wet season floods out away from the main river system.

Dispersal of mimosa is well suited for transport by animals and man; they pass undigested through the digestive tract of animals, stick to fur and clothing and in mud, to machinery. The most important means of spread is water, especially flood waters, which carry the hairy pod segments downstream and onto the floodplains adjacent to rivers.

Problem

This aggressive prickly shrub forms impenetrable thickets 4 to 5 metres high, making infested areas inaccessible to man and animals. It interferes with stock watering, irrigation projects and recreational use of waterways. It can also move away from the rivers where it smothers pastures, reduces the available grazing areas and makes mustering difficult, it can also the natural habitat in conservation areas.

It can colonise areas very quickly especially the wet flood plains where it is adapted. In the Adelaide River flood plain, mimosa increased from a few plants in 1976 to 8000 ha in seven years.

Control

Quarantine must be considered as an essential part of any control program. removal of sand or gravel from the area should be avoided. Stock should be held in a holding paddock several days before removal. Destroy any seedling plants before they seed in the holding paddock.

Chemical control may be used; root absorbed granules work well on the black clays of the seasonal flood plains.
Cut stump and basal bark applications also give good control. Dicamba applied as cut stump treatment in the wet season is probably the most cost effective herbicide. Glyphosate, hexazinone, tryclopyr and tryclopyr + picloram + 24D give good results also. A biological control program has been trialled with limited success but continuing biological control is ongoing with some fungal pathogens.

37. SMALL FRUIT DEVILS CLAW *Martynia annua*

Description

An erect rank-growing squash-like herb from 1.3 to 2 m high, reproducing from seed. Stems green,robust, much branched and covered with spreading glandular hairs. Leaves, large, pumpkin like to 12.5 cm across, opposite, edged with 5 to 7 shallow lobes, clothed with glandular hairs exuding a slimy sap when touched. Flowers pale mauve or lavender, in short spikes at ends of branches, tubular, 4 to 6 cm long, tube spotted yellow or red and terminating in 5 spreading lobes with a prominent purple spot between each lobe. Fruit a green fleshy oblong follicle when young, grey to black and woody when mature, 3 to 4 cm long, 1 to 1.5 cm wide, tapered into a longish beak; splitting along the upper surface and beak into 2 valves, crested with short spines; claws short compared with the body of the follicle. Seed, brown to black, oblong, rather flat, 2 to each pod, tending to remain in the pod.

Origin and Distribution

Native of Mexico was introduced as an ornamental to most of the warmer parts of the world. In the CYPLUS area it is found along the Mitchell River and its tributaries eg Macleod river.

The sharp dorsal spines are said to injure livestock by working into the hooves, mouth parts and other parts of the body,

Dispersal is by the seed pods clinging to animals, water also assists in the spread of this plant. Removal of sand or soil from infested areas along water courses can promote dispersal as well.

Control

Single plants can be pulled before flowering. Large infestations can be controlled with 2,4D or Grazon DS.

38. Weed species with the potential to infest the CYP.

PARKINSONIA	Appendix II
PRICKLY ACACIA	Appendix III
MESQUITE	Appendix IV
SIAM WEED	Appendix V

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APPENDIX I.
FERAL PIG MANAGEMENT ON ABORIGINAL LANDS IN CAPE YORK.

1. INTRODUCTION

Exotic weeds and feral animals are recent plant and animal introductions to Australia. They are not part of the country's native flora and fauna. Introduced deliberately or by accident, most of these species entered Australia without their natural controlling organisms. Released from these restraints, and often with ecological niches available because of land degradation from inappropriate land management practices, many introduced species have flourished to the detriment of indigenous species. Exotic weeds and feral animals are now major contributors to land degradation across Australia.

The feral pig is one such species. Attempts to reduce its impact have until recently relied on legislation requiring landholders to destroy animals. Feral pigs have increased in both numbers and distribution since this legislation was introduced. If feral pig impact is to be contained in the vast and sparsely populated landscape of Cape York, alternative strategies will need to be devised.

1.0 FERAL PIGS IN AUSTRALIA

1.1 Feral pigs: the problem

Feral pigs *Sus scrofa* are a major vertebrate pest in Australia (O'Brien 1987). They are derived from domestic pigs which were introduced and released by early European settlers. Feral pig numbers are now estimated to exceed 13.5 million (Hone 1990).
Pigs are rooting omnivores that affect a variety of ecosystems. They cause economic damage to crops and pastures (Hone 1980; Tisdell 1982), predate on livestock (Pavlov et al. 1981), and cause considerable damage to watering points, roads and fences. This agricultural damage is estimated to cost more than $70 million annually (Tisdell 1982).
Feral pigs also cause serious environmental damage to all habitats in which they occur, though this damage has only recently begun to be quantified. Pigs concentrate near billabongs and watercourses, where they cause erosion and silting (Wilson et al. 1992a). Their rooting habit disturbs soil, thereby introducing and spreading weeds and possibly the root rot fungus responsible for tree dieback. Feral pigs also prey on native species (Crome & Moore 1990, Mitchell 1993).

Feral pigs carry diseases and parasites transmissible to both humans and domestic livestock (Tisdell 1982). The major endemic diseases are leptospirosis, brucellosis, meliodosis, tuberculosis and sparganosis. However, it is their potential role as a reservoir and vector of exotic disease, particularly foot-and-mouth (FMD) disease, which is of most concern. Johnston (1982) estimated the cost of an outbreak of FMD in Australia at A$2 billion in the first year (1982 prices).

Strategies have been developed by the Bureau of Rural Resources (BRR) to respond to a detected outbreak of exotic disease in feral pigs, but any control method presupposes that the disease has first been detected. Detection is really the problem. Hone and Pech (1990) estimate that for Australia as a whole, the chance of detecting a case of FMD in

feral pigs under the present opportunistic detection scheme is only 0.0015. A disease could be present for years before it was identified by relevant authorities. The most important element therefore of any feral pig management plan should be to increase the chance of detecting exotic disease.

1.2 Legislation concerning feral pigs

The feral pig in Queensland is a declared animal pest under the Rural Lands Protection Act, and as such it is the responsibility of all landholders to control them on their land. This regulatory approach to pest animal management aims at eradication, and places the financial burden on individual landholders.

This legislation was shaped to address the concerns of primary industries affected by feral pigs. Mandated eradication placated this lobby and was inexpensive for government, since producers bore the cost. However, the environmental degradation caused by feral pigs is now of more concern to land managers than when the current legislation was enacted.

Changing community attitudes and increased environmental awareness has raised public awareness of the impact of exotic pests on Australian fauna and flora, and there is now an appreciation of the need to control such pests even in wilderness areas. Though such control benefits the whole community, under current legislation the costs incurred are usually borne only by individual landholders.

1.3 Control of feral pigs

Currently, recommended methods for pig control include trapping, shooting, hunting with dogs, and the use of poison baits. The degree to which control is undertaken varies throughout the state, generally in proportion to the economic loss caused by pigs in that area.

There persists in many segments of the community the perception that eradication would be achieved if sufficient funds were made available. The reality however is that eradication is not possible for most introduced pest species in Australia (Bell, in Bloomer & Bester, 1992). Feral pigs have increased in both numbers and distribution since legislation was introduced, so in reality the goal has been to have as 'few as possible'. To achieve this, reducing the cost per kill has been a focus of much pest research. However, cost-benefit analyses that take into account the relationship between damage, pest density and control are lacking (Ramsay 1994). Exotic pests remain widespread despite the best efforts of governments and landowners.

1.4 The game meat industry

Recent years have seen the development of a significant industry that views exotic animals as a resource rather than a problem. Most Australians are surprised to learn that more export income is generated by the export of wild pig (game) meat than from the commercial pork industry. Australia is the world's largest exporter of wild boar meat,

supplying 20-30% of the international trade and earning $10-20 million per annum (Ramsay 1994), $18 million in 1993 (Mitchell, J. pers.comm., Sept 94).

To be accepted as game meat, animals have to be shot in the field, partly eviscerated, and delivered to a field chiller within two hours (Ramsay 1994). Carcases are then transported to a processing works. Presently, Brisbane has the only such processing establishment in Queensland. Approximately 300 carcases are needed to fill a field chiller, and this must be dedicated to feral animals.

The game meat industry also provides an important employment alternative for some remote communities which were traditionally reliant on the pastoral industry for income. Such diversification can relieve pressure on the land and allow better management, as people are not so dependent on variable seasonal conditions and single market fluctuations (Barrow 1991). Also, more people can remain in the community, allowing it to maintain its viability and social structure.

Variable environmental conditions however also have a major impact on the supply of wild animals for commercial harvesting. But whereas primary producers have access to mechanisms to smooth their income across variable seasons (eg the Income Equalisation Deposits scheme), this is not presently available to game meat harvesters (Ramsay 1994). Effective risk management is essential in these industries if their infrastructure is to remain intact under varying conditions.

Generally though there has been little government assistance for the development of these industries, whereas pest control activities and research attract millions of dollars annually.

2.0 FERAL PIGS IN CAPE YORK

Cape York is a remote and sparsely settled area of Australia. Until stage one of the Cape York Peninsula Land Use Strategy (CYPLUS), little attention had been paid to the Cape by either government or the public. Land use revolved around the cattle industry and mining. Feral pig control consisted of baiting programs conducted by the Department of Lands Regional Inspector, and were directed towards areas of high pig activity around human habitation.

Feral pigs are widely distributed throughout the wet-dry tropics of Northern Australia (Bayliss and Yeomans 1989). However, though mobs in excess of 500 have been recorded on the marine plains of Cape York (Toms, B. pers. comm., Sept 94), reliable estimates of the Peninsula's total feral pig population are not available. The evasive nature of pigs makes estimation of population size extremely difficult, especially in the vast and remote, sparsely populated areas of Cape York.

It is unlikely Cape York carries higher feral pig populations than other similar areas in Australia, and densities will be dependent on both the land type and season. Caley (1993) found densities of pigs were much higher in floodplain and wetland habitats than in woodland and forest habitats, as the net primary production of tropical swamps is estimated to be 3-5 times higher than tropical savanna or deciduous forest. During late dry season, induced food shortages will concentrate pigs along rivers and other water

sources, thereby concentrating damage on the most productive and sensitive areas. It is possible that the last few years have seen a substantial increase in Cape York feral pig numbers as a result of the Brucellosis and Tuberculosis Eradication Campaign (BTEC). It is reported that up to 24,000 head of cattle were field shot and left to rot in the Aurukun, Kowanyama and Edward River area during 1988-89 as part of destocking programs (Toms, B. pers.comm., Sept 94) - such a food source would certainly have been utilised by feral pigs. These increased numbers would not however be sustainable, and there would have been a considerable increase in environmental pressure once destocking finished and the pigs sought alternative food sources.

Mitchell (1993) recorded extensive feral pig damage to the marine plains of Lakefield National park, and feral pigs have all but destroyed billabongs around Kowanyama by rooting for lily bulbs and bulkuru (Sinnamon, V. pers. comm., Sept 94). Feral pigs are also reported to dig turtle eggs on the west coast beaches near Bamaga (Christian, C. pers. comm., Sept 94).

It is the exotic disease threat though that is of particular concern in Cape York. The proximity of the Cape to south-east Asia, where FMD is endemic, and the possibility of foreign boats landing without being subject to quarantine measures has always made the area a high risk for exotic disease introduction. However, the rapidly growing tourist industry in north Queensland has added a new dimension to this risk.

It is quite possible for a traveller to fly into Cairns from a FMD-infected country such as Thailand, and in less than 12 hours be in a rainforest resort or camp near Cape Tribulation. Until recently refuse areas associated with such places were not fenced, and feral pigs were known to scavenge in them. Feral pigs also eat human excreta. If a traveller were to illegally bring in contaminated food, or were themselves infected with disease, the feral pig population could easily become infected.

3.0 ABORIGINAL ATTITUDES TO FERAL PIGS

3.1 Pre 1770

There has been some speculation that the pig's presence in Cape York predates European settlement. Cassels (1983) speculated that wild boar may have migrated to Northern Australia from Papua New Guinea in prehistoric times, and pig-like animals are depicted in prehistoric rock art found in north-eastern Australia (Clegg & Fethney 1988). However, there is no Aboriginal word recorded for pigs in any of the rain-forest dwelling Aboriginal dialects (Irvine, in Pavlov et al. 1992); and an extract from the *Queenslander*, 20th July 1895 reads 'An Aboriginal woman from the north Queensland coast told a European visitor in 1895 that feral pigs had eaten large amounts of traditional food. "I think altogether we die soon", she lamented, "pig-pig eat him yams, plum fall down, wild pigs too much eat" (Pavlov et al. 1992). Furthermore, it was not till 1948-50 that feral pigs were observed by the Yarrabah Aboriginal community, subsequent to which cassowary and scrub turkey populations were said to decline (Thomas, H. pers. comm., July 94).

3.2 Present attitude

In some areas, eg. Milingimbi, Ramingining and Maningrida in central Arnhem Land, traditional Aboriginal communities resent the damage pigs wreck on traditional food sources (Wilson et al. 1992b). Such an attitude was not expressed by any of the Cape York communities or advisers contacted. Vegetables and other foodstuffs are generally readily procurable in these communities, but feral pigs are favoured as a protein source. In fact, feral pigs are both an important food source and social event for Aboriginal communities of the Cape (Roberts, C. & Christian, P., pers. comm., Sept 94).

Roberts also reports that the two Islander and three Aboriginal communities near the tip of Cape York obtain 20-30% of their meat from feral pigs, and would probably consume in excess of 1,000 animals per year. The pigs are thoroughly inspected before eating, with the first cut being through the brisket to inspect fat quality and look for cysts, followed by inspection of internal organs. Feral pigs in the area are generally very healthy (there is only a 2% rejection rate for diseased wild carcases across the state, whereas domestic pigs have a 11% rejection rate). Any pigs considered suspicious are taken to Bamaga DPI, whereupon samples are sent to Townsville for analysis (Christian, P. pers. comm., Sept 94).

One of the major health concerns to Aboriginal communities is increased blood pressure and diabetes incidence resulting from a high fat diet and processed foods. However, meat from wild animals has a lower total lipids percentage and higher polyunsaturated to saturated fat ratio than that from domesticated animals (Sinclair & O'Dea 1987; Sinclair 1988; in Wilson et al. 1992b). O'Dea (1988) suggests that increased availability of meat from wild animals for human consumption benefits people following cholesterol-lowering diets.

Pigs are not the only feral animal that has been incorporated into Aboriginal diet. The buffalo was quickly adopted as a food source in north-central Arnhem Land, where the rules for division of a macropod were used for dividing the kill between members of the community (Altman 1987). Rabbits and feral cats also have been incorporated into Aboriginal diets in central Australia.

These exotic animals are also free from Aboriginal consumption taboo. Such taboo in the past gave elders a degree of authority and control within the community, which has now been eroded by many factors including the introduction of feral animals.

3.3 Aboriginal land management

Pre-European Aboriginal communities in Cape York were characterised by kin groups of 10 to 50 people with recognised homelands or 'country' (Chase & Sutton in Smyth 1994). Several hundred kin groups existed across Cape York, with coastal groups generally having smaller living areas than inland groups because of greater resource availability. Chase and Sutton also consider that compared to inland Australia, Cape York Aboriginals were extremely sedentary and better described as foragers than nomadic people.

A complex system of taboos regulated species harvest and consumption, thereby preventing over-exploitation and enabling sustainable land management. This attitude is still apparent in today's communities, who talk about 'taking only what you need'. Aboriginal culture however was severely disrupted by European settlement, and contemporary population distribution is now concentrated in a few specific locations. While there has been a conscious decision by Aboriginal groups across Australia to return to clan lands for reasons of both living standards and preservation of cultural values (Altman 1987), this outstation movement will never return populations to pre-European numbers or distribution. Therefore traditional land management practices developed on the historical demographic base may no longer enable sustainable land management of today's environment. The philosophy of taking only what is needed collapses when there are 3,000 or more people doing likewise in a small area.

Similarly, the adoption of new technology eg rifles, four wheel drives and outboard motors, has enabled greater harvest over larger geographic areas. This has recently been the subject of much public controversy. The Native Title Act 1993 allows hunting, fishing, and gathering by traditional owners:

(a) for the purpose of satisfying their personal, domestic or non-commercial communal needs; and

b) in exercise or enjoyment of their native title rights and interests.

Significantly, this provision contains no protection for endangered species. This has resulted in public opposition and the setting up of a lobby group called 'Sanctuary', whose aim is to prevent hunting in Queensland national parks.

Many people object to the use of vehicles and rifles by Aboriginals for hunting, and argue that traditional hunters should use traditional weapons. Such an attitude attempts to lock Aboriginal culture into circa-1770, and denies the reality that cultures are dynamic, and continually evolve due to external influences. Aboriginal culture was evolving pre-European contact, though the rate of change was not as pronounced as that post contact. But even if hunters were limited to using spears, the present population distribution could quickly lead to over-exploitation of resources in one area whilst other areas could see a species breed beyond the carrying capacity of the country. It is not the method whereby animal's are killed that is important for sustainable land management and maintenance of biodiversity, it is the number.

The Cape York environment is the result of long-term human management. Traditional Aboriginal society used kin group areas and cultural taboos to prevent over-exploitation of natural resources, while mainstream Australian society now uses closed seasons and bag limits to accomplish the same thing. Western science has developed population sampling and other tools that enable environmental monitoring for a species preservation, while Aboriginals used oral history based on millennia of observations. The Aboriginal method might not be dynamic enough to incorporate the effects of rapidly increasing populations and new technology on today's environment, but it possibly contains an understanding of intricacies and interactions that western science has overlooked. Marrying the two methods could allow improved land management.

4.0 A MANAGEMENT PLAN FOR CAPE YORK'S FERAL PIGS

There is a view in the broader Australian community that the number of feral pigs on Aboriginal lands demonstrates that these communities are not meeting their social responsibilities - that is, they are poor land managers. But if one considers where in Queensland intensive feral animal control does occur, it is only where there are demonstrated economic benefits from such operations. Failure to control pigs over and above hunting for food suggests that Aboriginal communities do not perceive feral pigs as a problem, or at least not one warranting a lot of effort.

The Aboriginal view appears to be that environmental damage caused by pigs is offset by their value as a resource. Scientific claims that they will devastate the environment could be difficult to accept when pigs have been present for some generations but Aboriginal communities are still intact. Certainly the impact of feral pigs on Aboriginal culture must pale into insignificance when compared with that other foreign invader - Europeans.

4.1 Why a management plan

Feral pigs are just as much a fact as European settlement. But while science might demonstrate pigs environmental impact and exotic disease threat, the fact remains that the regulatory approach to feral animal control has failed to eradicate them even from areas that suffer quantifiable economic loss. It would be foolish to imagine Cape York, where damage is largely environmental, would be any different.

The current pest animal legislation also fails to recognise the export earning capacity of the game meat industry, and the benefits it may have for remote communities eg alternative income, recreation, and relieving hunting pressure on native species.

Both traditional Aboriginal and western land use strategies attempt to manage the environment so it's value does not diminish with time. Successful integrated and sustainable resource management requires innovative strategies to deal with:

- constraints imposed by climatic extremes, especially in tropical northern Australia;
- stringent economic circumstances that enforce cost limits on resource management;
- population growth;
- competing and often conflicting views.

So we should not lock land management into achieving one specific paradigm - eg eradicating pigs. Feral pigs certainly have a negative impact on the environment, but just as certainly they are not going to be eradicated. Land management needs strategies that minimises feral pig impact using realistic and available resources.

4.2 Conventional strategies for feral pig management

Studies of the seasonal movement of feral pigs suggest that strategic baiting programs during the dry season, when pigs are concentrated predominately on marine plains, could reduce pig populations by as much as 70%. This strategy forms the basis of the planned response to a detected FMD outbreak (Caley 1993). Such a program would however be vigorously opposed by the Aboriginal communities of Cape York (Toms, B. pers. comm.,

Sept 94). In the absence of an exotic disease outbreak it would be viewed as wanton destruction of a resource for no discernible benefit.

Attempts by the BRR and Department of Lands to establish a game meat industry in the Cape have to date failed due to logistics. Chiller boxes had to be barged into Aurukun, as boxes overlanded never arrived in working order; but pigs were being caught 100 km away and could not be delivered within the required time. Kowanyama also trialled commercial harvesting, but discontinued due to problems caused by the pig hunters.

Detection of exotic disease is the most immediate requirement of any feral pig management strategy. Department of Primary Industries Quarantine officers conduct regular inspections of dinghies and planes travelling south across Torres Strait, and there is a feral animal buffer fence erected across the Cape 25 km south of Bamaga (Christian, P. pers. comm., Sept 94). But this does not address the problem of detecting an outbreak elsewhere on the Cape. This requires regular and extensive sampling of the feral population, but the vast unpopulated area of Cape York precludes regular inspections by government officers - the traditional approach to such operations.

4.3 Alternative strategies for feral pig management

The location of many Aboriginal communities is often because the land was considered worthless by graziers, and so original residents were not displaced or the area was set aside as a reserve. Many areas still are of marginal economic value to mainstream industries. Employment prospects in Aboriginal areas are generally not good

But Aboriginal communities account for the majority of Cape York's population, and their people travel widely. Most importantly, these communities are there because they want to be there! They do not require travel costs, locality allowances, overtime etc to live where they do. Alternative feral pig control strategies should recognise the value of these established communities in remote areas, and at the same time try and provide tangible return benefits for them.

Often the popular conception is that these communities exist on welfare and are a drain on society. But who would live in these areas if residents were lured elsewhere to 'real' jobs? It is these residents that enable the continued existence of fuel supplies and stores utilised by the very people who criticise Aboriginal communities whilst travelling Cape York. Many rural areas of Australia are suffering because of population losses resulting from political decisions. Australia is fortunate that there are communities still happy to live in remote areas, and should recognise their value and find ways of providing enhanced employment and infrastructure to maintain them.

4.3.1 Detecting exotic disease

It has been pointed out that Aboriginals are already selective in the pigs they eat, examining animals for disease symptoms or parasites. If Aboriginals were further educated about the threat exotic disease poses to Australia, and how to recognise disease symptoms, and an effective reporting system could be established, the chance of detecting

a disease outbreak on Cape York would be boosted at relatively little cost. Furthermore, the value of remote Aboriginal communities to greater Australia would be demonstrated.

4.3.2 Reducing feral pig impact

Aboriginals form the majority of Cape York's population. If feral pig impact is to be successfully minimised in the long term, Aboriginals will need to be directly involved, and not just on Aboriginal lands. Modern scientific findings need to be presented to traditional owners in a manner that is both understandable and can be combined with traditional knowledge to assist these communities to better manage their environment.

Information required by land owners would include:

- the species potential to reproduce, cause environmental damage or harbour disease;
- the game meat industry;
- population and distribution survey figures;
- methods available for control and/or utilisation (Wilson et al. 1992b).

The Kowanyama community has demonstrated its ability to manage both their environment and the impact of external factors such as fisheries. While this model might not be suitable for other communities and situations, it does demonstrate that solutions can come from within and do not have to be government initiatives. Education empowers communities to assess their circumstances and decide their most appropriate future. A BRR supported rabbit commercialisation project in the Northern Territory in 1990 resulted in reduced alcohol consumption and increased community morale, and served as a catalyst for community members to learn radio skills, first aid and basic mechanics. The key to the success of the project however was identified as strong community leadership (Wilson et al. 1992b).

The game meat industry is an obvious possibility for pig control on the Cape despite previous failures. Mobile abattoirs costing $700,000 currently operate in South America (Mitchell, T. pers. comm., Sept 94), and a similar operation was under development in South Australia in 1992. The flexibility afforded by this technology could make a game meat industry viable in Cape York by allowing use of smaller chiller boxes that could be processed locally, rather than being transported to Brisbane. Live cattle exports out of Karumba are currently being considered. If this port were to open, a game meat industry on the Cape could be more cost effective then elsewhere in Australia.

Marketing of the product is another factor: *a harvest by native people in native fashion of a wild clean free animal* could return a premium on the international market. Safari-type hunting trips are another possibility, with a fee charged for the right to hunt on Aboriginal land and possibly for a guide service. While the impact of such an operation on actual pig numbers would be minimal, it could generate income that could be used for other projects. A similar process is already operating in Kowanyama, where camping fees are charged for access to fishing areas.

Other alternatives are bound to exist - they just haven't been thought of. The pigs on Cape York are a constant, Aboriginals on Cape york are a constant: we need to think what variable we can change to arrive at a desirable outcome.

5.0 Conclusion

Aboriginal culture has proved itself resilient and adaptable through its survival of the past two centuries. There is growing local and international recognition of its uniqueness via its music and art. Native Title legislation has validated the historical Aboriginal association with their land. But there is a need to further recognise Aboriginals as contemporary land managers, rather than only think of them as historical managers of a pre-European Australia.

This will best be achieved through the integration of traditional knowledge with modern ecological studies to improve the information base and provide a wider range of options for better management on Aboriginal land. What is also needed is a willingness to consider unconventional solutions to the problems encountered in achieving truly sustainable land management.

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PESTFACT

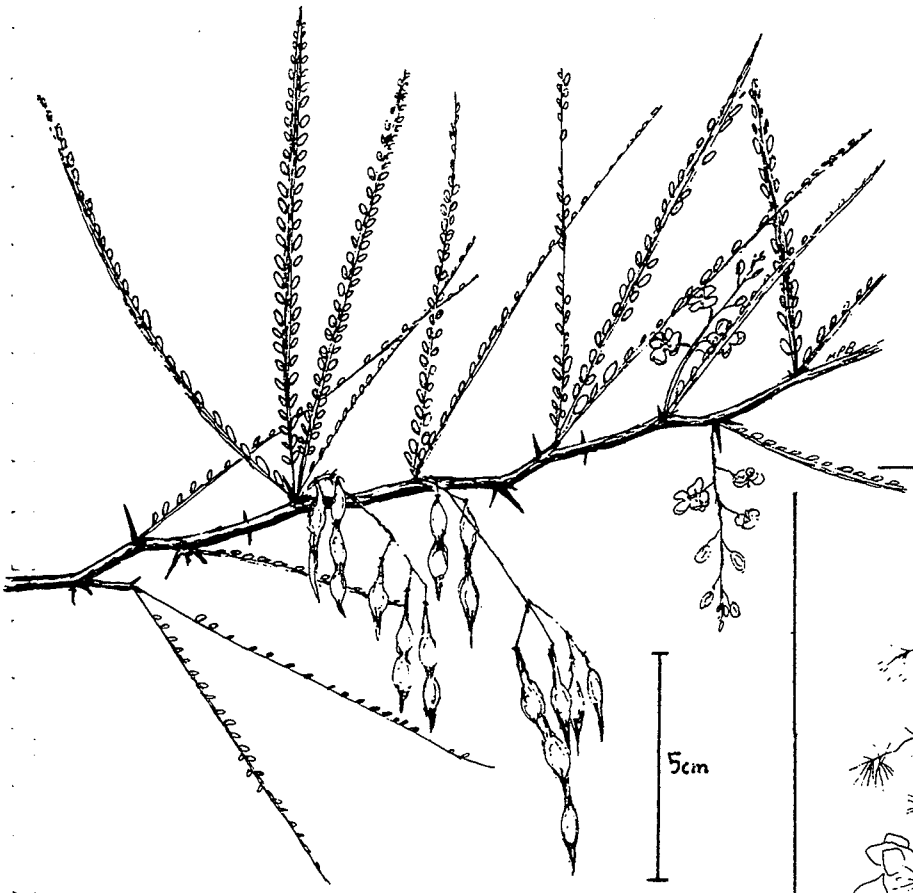
LANDS

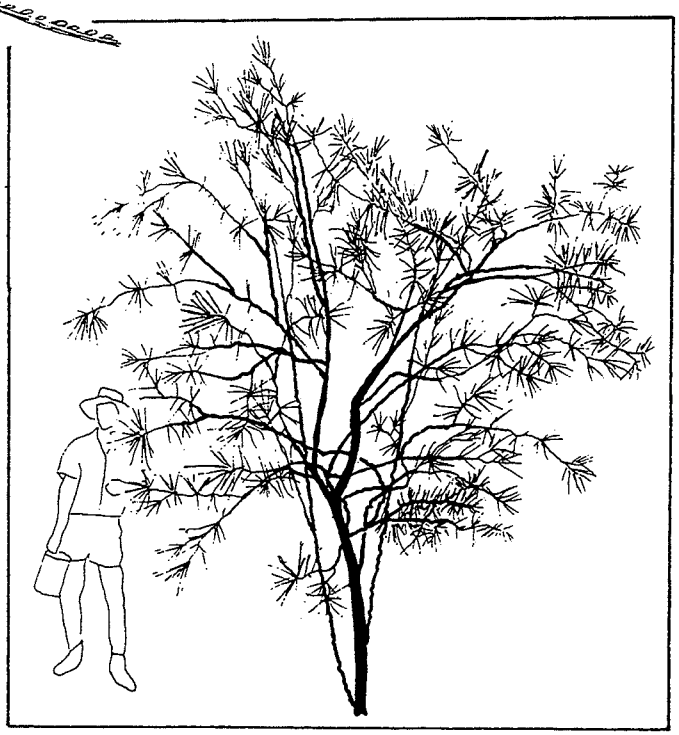
P036/E0294/P0294

Parkinsonia

DECLARED

Jerusalem thorn or jelly bean tree
Parkinsonia aculeata





DESCRIPTION

A hairless shrub or small tree, rarely to 10 metres high. Slender green photosynthetic zig-zag branches armed with sharp spines. Leaves with a short, spine-tipped stalk, leaf branches 20 to 40cm long, flattened with small, oblong leaflets along each edge. Flowers yellow, fragrant, five petalled, each on a long, slender drooping stalk. Seeds oval, hard, about 15mm long, borne in pencil-like pods 5 to 10cm long, constricted between the seeds.

LIFE CYCLE

Parkinsonia is fast growing, flowering mainly in early summer of its second or third year of growth, although flowering can occur opportunistically to exploit variable seasonal conditions. Pods mature in late summer, float on water and are hence readily dispersed by flood waters. Seeds have a thick and extremely hard coat and so remain viable for many years to allow germination under favourable conditions. Seeds require wet soil conditions for several days to induce germination.

THE PROBLEM

Parkinsonia can form dense, and often impenetrable, thorny thickets along watercourses and bore drains. This restricts access of stock to drinking water and can make mustering virtually impossible. The seeds ability to float means flooded country is particularly susceptible to invasion by parkinsonia. Some infestations on the Barkly Tableland are now up to several kilometres across. Such infestations provide a harbour for feral pigs, which can predate on livestock, damage crops, and seriously degrade the environment.

HABITAT AND DISTRIBUTION

Parkinsonia is thought to be native to tropical America but has spread throughout the world as an ornamental and shade tree.

As parkinsonia is adapted to an extremely wide range of soil types, there is little doubt that it will continue to spread through watercourses and adjoining areas throughout the sub-humid and semi-arid environments of Queensland. The most vulnerable area would appear to be the Channel Country and downstream into the Lake Eyre catchment.

DECLARATION DETAILS

Parkinsonia has been **declared** under the Rural Lands Protection Act (1985 - 1987). Declaration is on a catchment basis to reflect the importance of flood waters as the main vector for the spread of this weed.

The declaration is:

Category **P3** for the Fitzroy, Burdekin and Lake Eyre River systems;
except for the shires of Diamantina, Barcoo, Quilpie and Bulloo,
where the declaration is **P2**.

Category **P3** for the Gulf River systems;
except the shires of Mareeba and Aurukun,
where the declaration is **P2**.

Elsewhere in Queensland declaration is **P2**.

Category **P2** .. the plant **must be destroyed.**
Individual landholders are required to destroy all plants on the land concerned.

Category **P3** .. the number and density of infestations must be **significantly and progressively reduced.**
Individual landholders are required to destroy all plants or take other action as approved by the local government in accordance with the act.

BIOLOGICAL CONTROL

Two species of insect proven to attack only parkinsonia have been introduced into Australia. These are:

Seed beetle *Mimosestes ulkei*

Field release of this insect commenced in late 1993 in central and north Queensland. *Mimosestes* feeds on the developing seed. It is too early to confirm either field establishment of this insect or the impact it is likely to have on parkinsonia.

Sap-sucking bug *Rhinacloa callicrates*

Rhinacloa feeds on the leaves and stems of parkinsonia, and can result in severe distortion of parkinsonia shoots. Colonies are now established in central, southern and north Queensland, though field populations have not built up to levels which would inhibit plant growth.

MANAGEMENT STRATEGIES

Mechanical Control
Initial clearing by bulldozing, blade ploughing or ripping is effective, except

- it is restricted to reasonably level areas away from watercourses
- clearing will hasten seed germination, necessitating follow up control either mechanically or chemically

Establishing improved pasture will aid in managing parkinsonia by competition.

Fire
Fire will destroy seedlings if sufficient fuel load is present, but mature plants will usually survive.

HERBICIDE CONTROL

Herbicides registered for the control of parkinsonia are listed in the table overleaf.

Foliar (overall) spray
This is a very effective method for control of seedlings up to 1.5m tall. Spray leaf and stems to point of runoff. A wetting agent (2ml/L of spray mixture) must be used.

Basal bark spray
For stems up to 15cm diameter, carefully spray completely around base of plant to a height of 30cm above ground level. Larger trees may be controlled by spraying to a greater height, up to 100cm above ground level.

Plants should be actively growing and preferably flowering. Field experience has shown that good soil moisture is essential for effective control.

Because parkinsonia infested areas are often subject to flooding, care is needed to ensure mud and flood debris does not prevent spray penetration to the bark. The trunk may need to be cleared before spraying. Addition of petrol or A-1 jet fuel will aid penetration.

Cut stump treatment
May be performed at any time of year. Cut stems off horizontally as close to the ground as possible. **Immediately** (within 15 seconds) swab cut surface with herbicide mixture.

Spot gun
Use one dose of herbicide per metre of tree height. Place doses close to tree trunk, either with spot gun on clear bare ground, or underground with ground injector. Rain or sufficient soil moisture is required before herbicide is taken up by plant.

Do not use near watercourses or within a distance equal to at least twice the height of desirable trees.

FOR FURTHER INFORMATION CONTACT

Regional Inspector
c/- nearest Department of Lands office

Brochure partly funded by Rural Lands Protection Fund

Herbicides registered for the control of parkinsonia

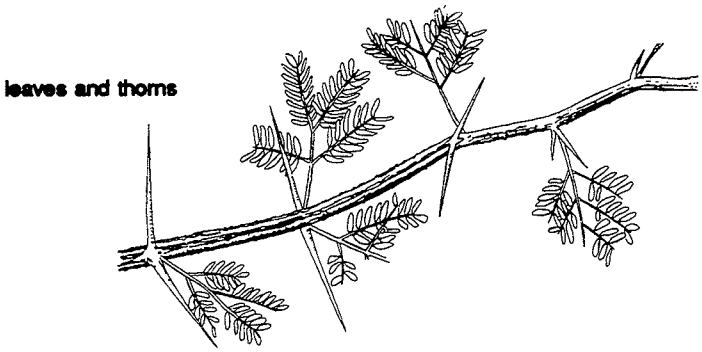
Application method	Tradename/ Herbicide	Rate	Cost $/100L spray solution	Optimum stage and time	Remarks
Foliar (overall spray)	Grazon DS®/ picloram & triclopyr	0.35L/100L	$12.80	Seedlings less than 1.5m tall and actively growing	Wet plant thoroughly. Use wetting agent. May damage pasture legumes.
Basal bark	Garlon 600®/ triclopyr	1.7L/100L diesel	$154.00	Plant must be actively growing.	Good soil moisture essential.
	Access®	1L/60L diesel	Not available	As above. Stems up to 5cm diameter.	This product due for release in Queensland early 1994.
Cut Stump	Garlon 600®/ triclopyr	1.7L/100L diesel	$154.00	Any time of year.	Cut close to ground level and treat **immediately**.
	Access®	1L/60L diesel	Not available	As above	This product due for release in Queensland early 1994.
Soil Application	Velpar L®/ hexazinone (via spotgun)	4mL/metre height	11¢/spot	Any time, but needs moisture to activate chemical.	Do not apply near desirable trees (minimum distance = twice tree height).
	Gridball®/ Hexazinone	4.7Kg/Ha or 3 pellets per plant	11¢/pellet	As above	As above

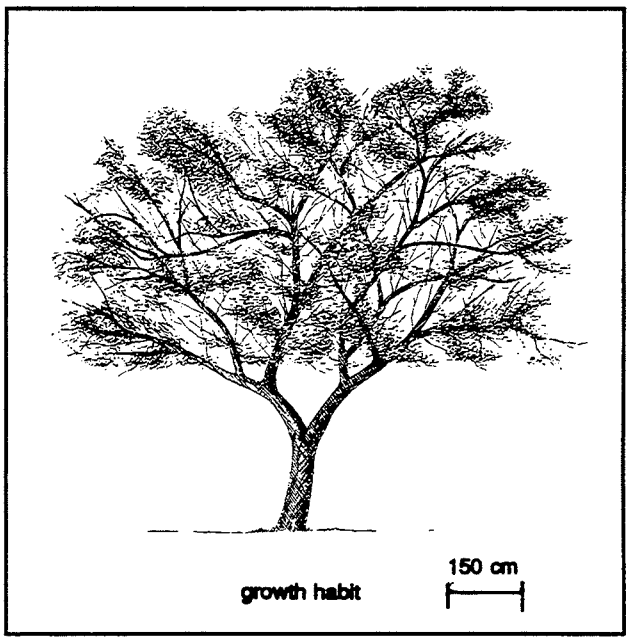
PESTFACT

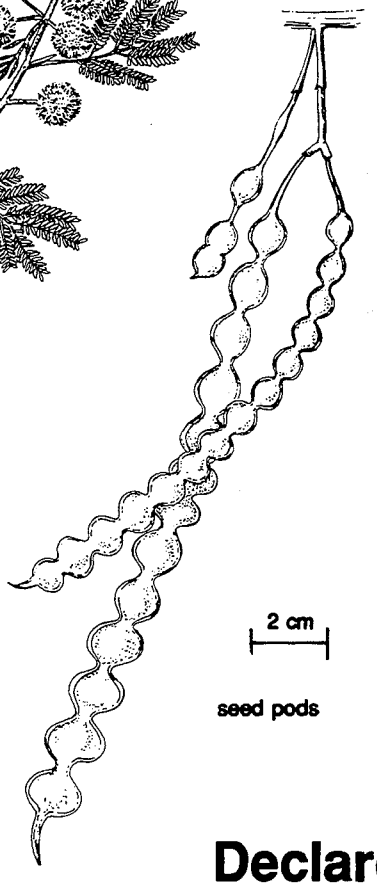
LANDS

Prickly acacia

Acacia nilotica







Declared

DESCRIPTION

Prickly acacia is a thorny shrub or small tree growing 4-5m high, occasionally to 10m. The umbrella shape of the prickly acacia tree and the pods are characteristic features.

Young shrubs form dense thorny thickets, while mature trees are usually single stemmed, with spreading branches which have lost most of their thorns.

Bark on saplings has a tinge of orange and/or green. Older trees have dark, rough bark.

Leaves are finely divided and fern-like, with 4-10 pairs of leaf branches and 10-20 pairs of narrow green leaflets on each branch. Pairs of stout thorns, usually 5-10cm long, grow at the base of the leaves. Golden-yellow, ball-shaped flowers, about 1cm across, grow on stems from leaf joint with, 2-6 flowers per group.

Pods are 10-15cm or longer, flat, with narrow constrictions between the seeds and grey when ripe.

P009/0194E/0194P

THE PROBLEM

Prickly acacia was introduced into Queensland for shade and fodder early this century. Now it can be found throughout the state, with widespread infestations in areas of north west Queensland. Once established along bore drains, the trees spread into adjacent grassland.

Seven million hectares of the mitchell grass plains is infested with prickly acacia and following a good wet season this could become 7M hectares of prickly acacia forest.

Thorny thickets interfere with mustering, movement of stock and access to water. Trees along bore drains use valuable water, make maintenance of bore drains more costly, and provide seed to increase the spread of prickly acacia. Pasture decreases as tree size increases because little grows under the canopy as the tree outcompetes pasture for water.

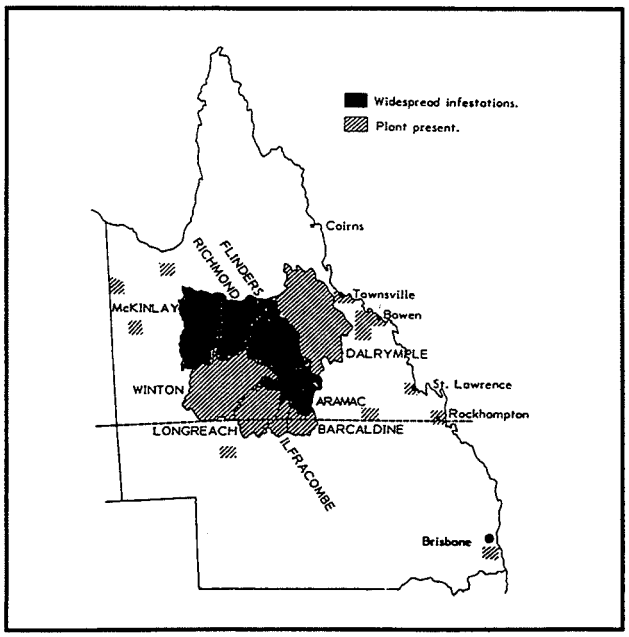
Do not be mis-led into using prickly acacia as a short-term protein source when in the long-term your property could become a thorn scrub.

HABITAT AND DISTRIBUTION

The variety of *Acacia nilotica* found in Australia, subspecies *indica*, is a native of Pakistan. It has been cultivated in many parts of tropical Queensland for its shade and fodder value of leaves and pods. It is now naturalised in many areas.

A 1975 survey of nine western Queensland shires indicated nearly 30% of these shires were infested with prickly acacia to some degree with 50% of one shire infested. About 5 million hectares have low density infestations, 1.25 million hectares medium density, and nearly 0.5 million hectares are heavily infested (Fig. 1).

Figure 1. Infested shires



Climatic conditions over most of Queensland are suitable for the growth of prickly acacia and the plant is well adapted to the climatic and soil conditions in one third of the state.

DECLARATION

Prickly acacia is a declared plant under the provisions of the *Rural Lands Protection Act* .

Shires of major infestation are Aramac, Bowen, Flinders, McKinlay and Richmond where it is declared as:

Category P3 ... where plants are to be reduced in numbers and distribution.

Elsewhere in Queensland the declaration is:

Category P2 ... where plants must be destroyed.

MANAGEMENT STRATEGIES

The following strategies are recommended for landholders to limit the spread of prickly acacia.

1. Map prickly acacia areas on your property before commencing control:
   - a coordinated management strategy can then be devised, minimising wasted effort
   - seedlings from treated areas could emerge for perhaps the next ten years
2. Try to eliminate all prickly acacia along bore drains, creeks, drainage lines and dams:
   - these trees will produce seed in most years
   - one medium sized tree can produce 175,000 viable seeds per year
   - seeds can remain viable in the soil for at least 7 years
   - water flow spreads the problem downstream to other parts of the property or to neighbouring properties
   - neighbours upstream should also be encouraged to carry out control programs
3. Consider replacing open bore drains with piped water:
   - trees along bore drains are the main seed producers
   - additional advantages of controlled waters are the ability to trap animals on water and administer supplements via water
4. Clean up least infested paddocks first by removing isolated trees
   - preventing a problem is easier than curing it
   - good management involves keeping some paddocks clean

5. Do not let cattle or sheep graze where mature pods are available (pods ripen from late October onwards):
   - insects can destroy much of the seed on the ground
   - cattle relish pods and spread the seed throughout paddocks and properties. A large percentage (43%) of undigested seed passes through cattle. Sheep also spread prickly acacia by regurgitating about 15% of seed eaten, while goats regurgitate about 24%. This seed does not have the associated manure to assist germination (sheep pass only 2% viable seed).
6. Run sheep instead of cattle in prickly acacia infected paddocks, wherever possible:
   - sheep do not spread seed as effectively as cattle (see above)
   - sheep graze more heavily than cattle do on seedlings
7. Quarantine cattle and sheep when moving them from infested paddocks to clean areas:
   - prickly acacia seed can take up to 6 days to pass through an animal
   - seed also travels in mud packs on animals' feet
8. .Do not let trees become thick:
   - trees reduce grass production
   - as many as six plants per m^2 may be lying dormant in the soil underneath a moderate to thick prickly acacia stand. A 1% germination will produce a forest; 10% germination may lead to an impenetrable thicket
9. Do not overgraze:
   - conserve perennial grasses
   - a good stand of grass should reduce establishment of woody weed seedlings by competing for soil moisture and nutrients
10. Supplement animals with nitrogen at critical stages (eg lambing, weaning or in drought)
   - dry mitchell grass pastures in most years have inadequate levels of protein for optimum production. This is especially so with pregnant and lactating animals. If the prickly acacia is removed, denying animals a source of protein, supplements of non-protein nitrogen such as urea may be required.

BIOLOGICAL CONTROL

Prickly acacia is readily attacked by certain native insects associated with Australian native acacias and other native plants. Generally, leaf-feeding, sap-sucking, root, pod and seed feeding insects attack actively growing prickly acacia.

Bark and wood-feeding insects prefer stressed and dying plants. Native insects can weaken prickly acacia and can contribute to the death of plants when other stresses are involved.

Large areas of dieback of prickly acacia occurred throughout western Queensland infestations during the 1970's and 1980's. A combination of several factors can result in dieback, namely the exposure of roots to air and organisms in deep cracking soils, root predation by cicada nymphs and secondary attack by insects and diseases on stressed plants.

The native seed-feeding beetle *Caryedon serratus* (Coleoptera:Bruchidae) infests prickly acacia and other woody weeds including mesquite (*Prosopis spp.*), parkinsonia (*Parkinsonia aculeata*) and mimosa bush (*Acacia farnesiana*).

A survey of other potential biological control agents commenced in Pakistan in 1979. Of four species introduced into the Department of Lands, Alan Fletcher Research Station quarantine laboratory, only two species were approved for field release. A green-shoot boring moth *Cuphodes profluens* (Lepidoptera: Gracillaridae) did not establish widely.

The seed-feeding beetle *Bruchidius sahlbergi* (Coleoptera:Bruchidae) is well established. The level of control exerted by *Bruchidius* can vary from 0% to 80% and depends on the availability of mature seed pods.

When pods are scarce due to stock grazing, floodwaters or climatic conditions, *Bruchidius* populations decline. Higher insect populations occur where a permanent reservoir of pods is present. However, the impact of this beetle on prickly acacia's potential seed production is minimal, where up to 70kg of pods or 300 000 seeds per tree along bore drains has been recorded.

Further research for other biological control agents in Kenya commenced in late 1989. A number of insects were identified as possible biocontrol agents though mature trees are required for testing. Research is continuing on these potential agents.

HERBICIDE CONTROL

Table 1. Herbicides registered for the control of prickly acacia

Situation	Chemical	Rate	Costs[1] per specified rate	Comments
pastures; commercial and industrial land; rights of way	fluroxypyr (Starane[R])	0.5 L/100 L	$13	foliar spray,add wetting agent plants < 1.5 m tall
		1 L/100 L diesel	$26 + diesel	basal bark when actively growing or cut stump any time of year
pastures; commercial and industrial land; rights-of-way	triclopyr (Garlon[R])	0.83 L/100 L diesel	$53.50 diesel	basal bark when actively growing or cut stump any time of year
non agricultural land	2,4-D ester	1.25 L/100 L	$18	basal bark when actively growing or cut stump any time of year
non agricultural land	diesel	straight		basal bark when actively growing or cut stump any time of year
irrigation channels, bore drains, turkeys nests	diuron[2] 500 g/L	64 L/ha	$470	3 day withholding period
	800 g/kg	40 kg/ha		
	900 g/kg dry flowable	35.5 kg/ha	$506	

Note 1. costs are priced from Brisbane January 1994 and are subject to change over time and locations. They are included to show approximate costs of each treatment relative to each other.
2. diuron is an abrasive chemical and may damage many pumps. The use of a diaphram pump is recommended.

Basal bark spray

For stems up to 15cm diameter, carefully spray completely around the base of the plant to a height of 30cm above ground level. Thoroughly spray into all crevices. Larger trees may be controlled by spraying to a greater height, up to 100cm above ground level. The best time for treatment is during autumn when plants are actively growing and soil moisture is good.

Cut stump treatment

At any time of year, cut stems off horizontally as close to the ground as possible and immediately (within 15 seconds) swab the cut surface with the herbicide mixture.

Irrigation channels

Channels and drains must be empty of water. Spray a one-metre strip into the mud in the channel or drain. Wait for at least 3 days for the diuron to bond to the mud before slowly allowing water in again. Water must not be used in domestic water supply or supplied to desirable shade trees for 7-14 days after reopening the drain.

For further information contact:

Land Protection Officer
C/- any Department of Lands office

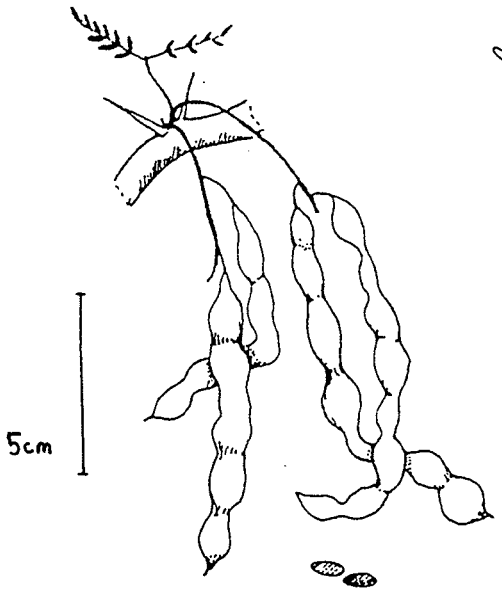
Brochure partly funded by the Rural Lands Protection Trust Fund.

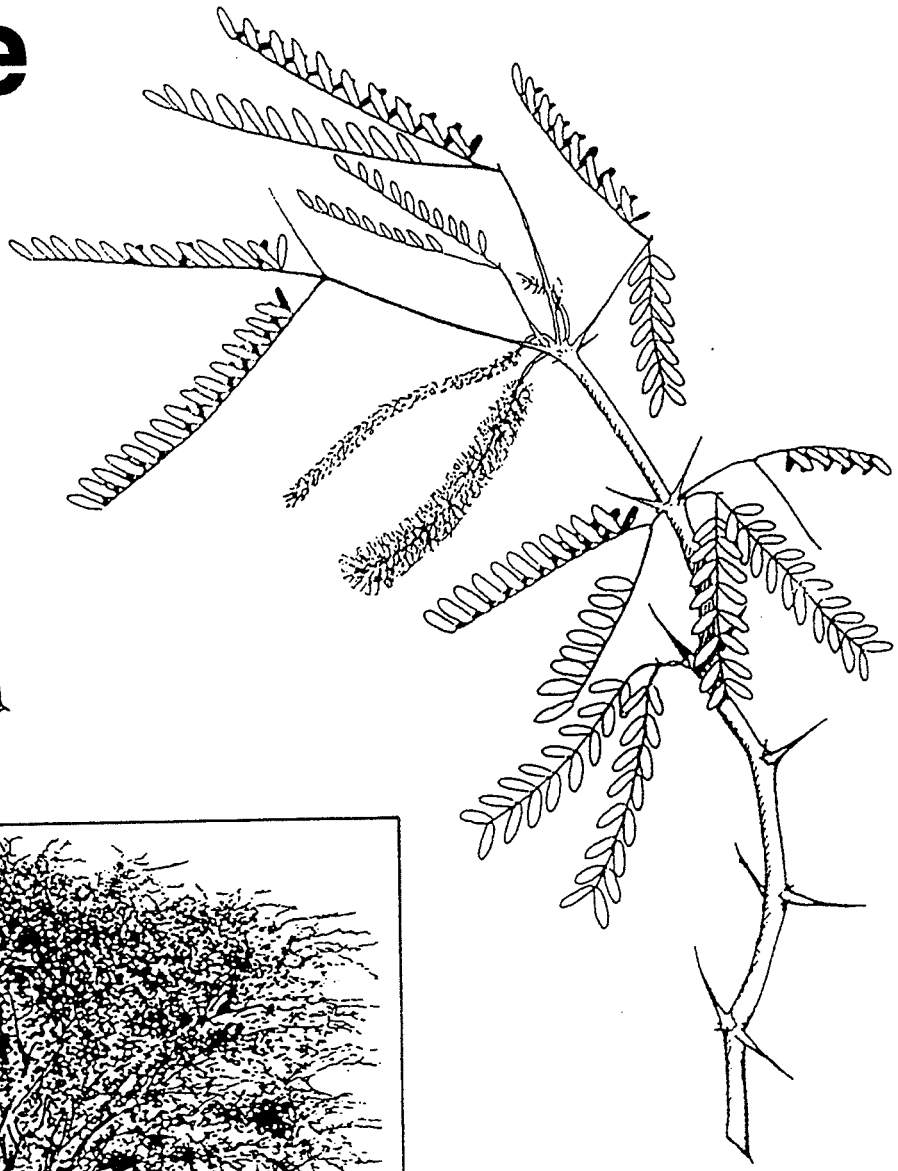
PESTFACT

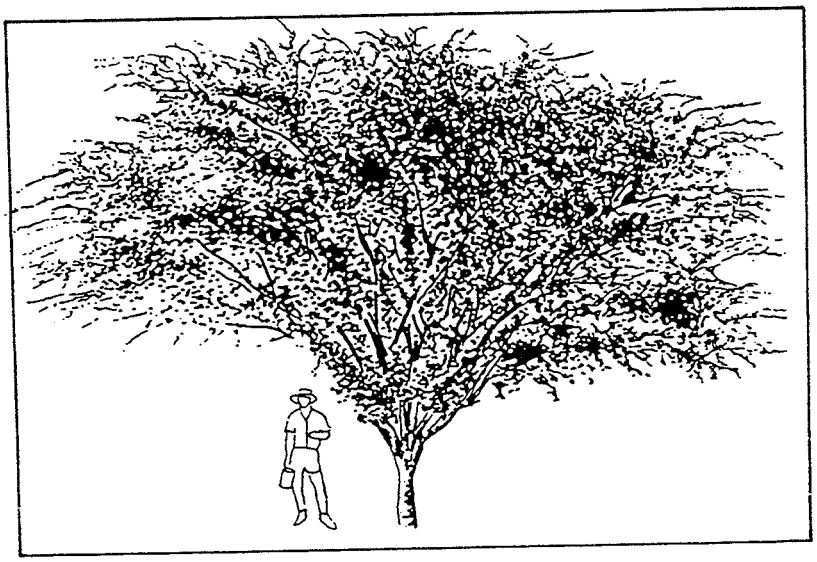
LANDS

Mesquite

Prosopis spp







DECLARED

DESCRIPTION

The various mesquite species are also known as algaroba, Cloncurry prickle bush, or Quilpie algaroba. These thorny trees grow to 15m, usually with a main single stem and spreading canopy. Mesquite sometimes grows as smaller trees with branches drooping to the ground.

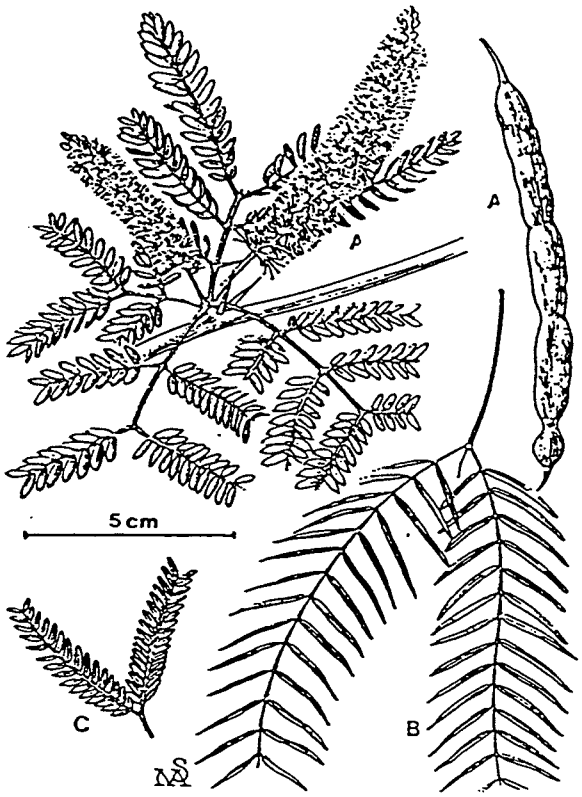
Older bark is rough and grey or brown. Small branches have smooth bark, dark red or green in colour, and a zigzag shape. The trees can appear rather untidy with individual zigzagged twigs sticking out beyond the main canopy.

Leaves are fernlike with 1-3 pairs of leaf "branches", each "branch" with 6-18 pairs of leaflets. Leaflets vary from oval-shaped to long and narrow depending on the species. Foliage is usually dark green but can be blueish green.

Small greenish-cream "lamb's tails" flowers grow near ends of branches in wattle-like spikes, 5-8cm long. Seed pods are 10-20cm long, straight to slightly curved, smooth, with slight constrictions between the seeds. When ripe, the pods are straw-coloured, or purplish in some species. Each pod contains between 5-20 hard seeds.

Mesquite

a. *Prosopis limensis* (Syn. *P. pallida*)
b. *Prosopis* hybrid
c. *Prosopis flexuosa*



THE PROBLEM

Mesquite, once a favoured shade tree around homesteads, has spread significantly in Queensland and unless checked, will continue. Although sparse stands of *Prosopis* trees may provide shade and some fodder for stock, dense impenetrable thickets of mesquite can often form. Many infestations are along waterways, both natural and manmade. Even in rangeland it is an aggressive competitor. *Prosopis* thickets can shade out other vegetation, interfere with mustering and block access to watering places. The sharp spines can injure animals and puncture vehicle tyres. Mesquite is a hard plant to kill. Seeds can lay dormant for years, and mesquite seedlings can therefore reappear in areas that had been previously cleared.

HABITAT AND DISTRIBUTION

Prosopis species are native to North and South America. These were introduced to Australia as ornamentals in station homesteads or town gardens, and used in mine dumps and other soil stabilisation programs. Over time, *Prosopis* has spread along waterways and floodplains, along roadsides, and in horse-paddocks near homesteads. Seeds are spread by floodwaters and also in the dung of horses and cattle.

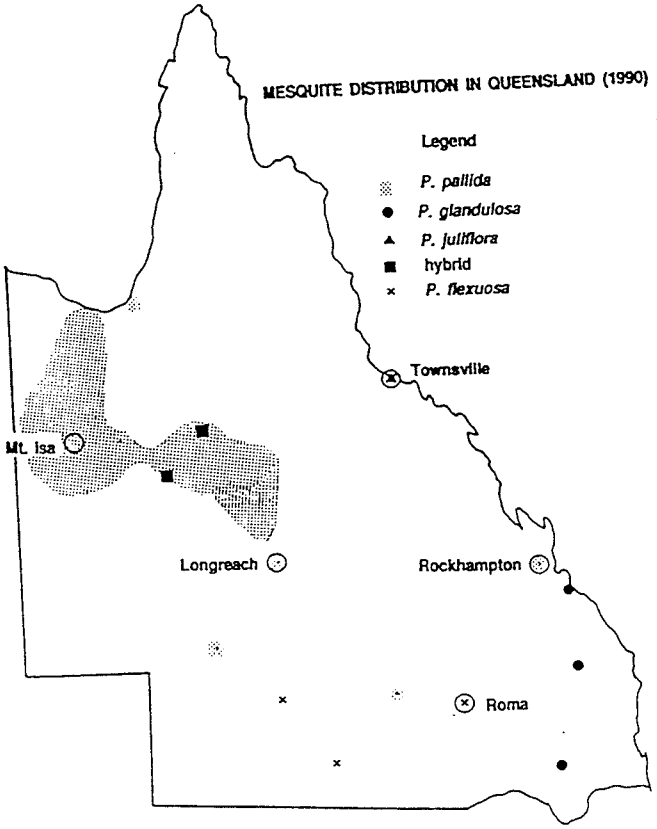
The accompanying map shows the major distribution of the various mesquite species in Queensland.

DECLARATION DETAILS

Mesquite is a declared plant under the provisions of the Rural Lands Protection Act. The declarations for the various species are:

- *P. glandulosa* and *P. limensis,*	**Category P3**
- *P. flexuosa* (Quilpie mesquite),	**Category P2**
- All other *Prosopis* species,	**Category P1 and P2**

P1 - Introduction into Queensland is **prohibited**
P2 - Plants are to be **destroyed** throughout Queensland
P3 - Numbers and/or distribution are to be **reduced** throughout Queensland



CONTROL

Mechanical

Mesquite may be grubbed out using grubber attachments on dozers and tractors. Best results are achieved when soil moisture is sufficient to allow machinery to work with minimum strain, but soil is dry enough so the root system desiccates (late autumn/winter for a normal wet season).

Fire

Fire has been effective against *Prosopis limensis* in and around Hughenden when there is sufficient fuel for the fire. The problem is that there is seldom sufficient grass and debris to fuel a fire where *Prosopis* is a problem.

Chemical

Herbicide recommendations for mesquite are given in the attached table.

For further information contact

Regional Inspector
c/- nearest Department of Lands office

Brochure partly funded by Rural Lands Protection Fund
P037/E0294/P0294

Herbicides for the control of mesquite

	Tradename/Herbicide	Rate	Optimum Stage and Time	Remarks
Basal Bark	Garlon 600®/ triclopyr	1L/60L diesel	Plant must be actively growing	For plants up to 20cm stem diameter. Wet stem thoroughly from ground to 45cm height.
	Access® (registration due 1994)	1L/60L diesel	As above	For plants up to 5cm diameter. Wet stem thoroughly from ground to 30cm height.
Cut Stump	Garlon 600®/ triclopyr	1L/60L diesel	Any time of year	Stems should be cut close to ground level and treated **immediately**
	Access® (registration due 1994)	1L/60L diesel	As above	As above

PESTFACT

LANDS

Siam weed

Chromolaena odorata

Declared

Figure 1
Potential distribution of siam weed in Australia

Siam weed *(Chromolaena odorata)* is considered to be one of the world's worst weeds.

In July 1994, several clumps of siam weed were found for the first time in Australia along the Tully River near Mission Beach in North Queensland. Early detection and eradication are vital, as siam weed has the potential to spread across northern Australia and down the eastern coastline.

The Department of Lands strategic control team is working with other government departments and the community to eradicate this weed.

If you find this weed in your area, or see something which may be siam weed, please contact the Department of Lands Innisfail office on (070) 61 4215, or your nearest Department of Lands office.

POTENTIAL IMPACT

If established in Australia, siam weed has the potential to seriously degrade land used for agriculture, forestry and conservation purposes throughout coastal Queensland, as well as parts of coastal NSW, Northern Territory and Western Australia. Agricultural industries at risk are grazing, horticulture, sugar and timber, in particular tree crops and grazing in some areas.

Siam weed is particularly suited to highly productive land types in areas where the annual rainfall exceeds 1000 mm per annum. (Potential distribution is shown in Figure 1.)

Native vegetation throughout coastal, high rainfall areas of Queensland is at risk of invasion and degradation by siam weed. Siam weed readily invades remnant patches of rainforest and creek or river bank vegetation, although it grows poorly under dense rainforest canopies. Cape York and the World Heritage listed Wet Tropics region in particular are at risk.

In the dry season, dense thickets of siam weed could cause more frequent and intense bushfires.

Siam weed is known to have caused cattle deaths and abortions in other tropical countries where stock have been handfed with contaminated fodder. It may also cause skin complaints and asthma in allergy-prone people.

STOPPING THE SPREAD

Siam weed seed may be spread in Tully River sand if it is used unsterilised in plant and palm potting mixtures.

Other possible means of spread are through pasture seed sold from the Mission Beach area, cross country sports, contract slashing, mowing and earthmoving operations and through backpackers camping in infested areas.

The seeds have tiny barbs which stick to clothing, footwear, animals, vehicles and machinery. These are also blown by wind.

DECLARATION DETAILS

Siam weed is a declared plant under the provisions of the *Rural Lands Protection Act 1985*. In all shires of Queensland it is classed as category P1 (where introduction into Queensland is prohibited) and category P2 (where discovered, it is to be destroyed).

DESCRIPTION

Siam weed has a similar growth habit to lantana, soft green hairy leaves which are roughly triangular in shape, soft round stems which become woody when old or at the base. It has no prickles and produces masses of white or pale lilac flowers in the winter.

Blue top (billy goat weed) is similar to siam weed, but can be distinguished by crushing a leaf. Siam weed leaves have a slightly sweet, pungent smell.

Siam weed can form dense tangled bushes 2-3 m tall in open land, and can climb up to 20 m on trees. The root system is fibrous and shallow in most soils. Several stems develop from the crown and regrowth occurs rapidly after destruction by fire or slashing.

After flowering, masses of small brown seeds are produced, each with a parachute of white hairs. These are blown long distances and germinate immediately after rain, though there appears to be some seed dormancy. The stems die back in the dry season but reshoot after rain.

WORLDWIDE DISTRIBUTION

Siam weed has spread throughout the tropical and subtropical areas of the world. It is now widespread in central, western and southern Africa, tropical America, India and south-east Asia.

It is still spreading rapidly, particularly through the Philippines, south-west China and South Africa.

CONTROL OF SIAM WEED

The following chemical rates have recently been approved (see table below).

Further trials are being conducted at the Department of Lands' Tropical Weeds Research Centre to find suitable herbicides for different applications.

Although biological control research has been initiated, no effective agents have been found so far. Biological control has been generally unsuccessful overseas.

PO43/0894E/0894P

Chemical	Product Name	Rate	Comments
picloram + triclopyr	Grazon DS	1:300 parts water + BS 1000 wetting agent @ 10ml per 100 litres water	overall spray
triclopyr	Garlon 600	1:60 parts diesel	basalbark