CHAPTER 1

INTRODUCTION

The Guy Fawkes River Brumby
~By Bruce Brislane

'From unseen camps far in the gorges, brumbies come to graze
Across the ridges slope and o'er the plain,
For close by, the river passes where grow the sweetest grasses
Kept green by fertile soil and summer rain'...

1.1 Introduction

For millennia, humans have been altering landscapes and changing the species composition of their surroundings. The introduced domestic horse *Equus caballus* has been a part of the Australian environment for over 200 years and has subsequently established free-ranging populations in many parts of the continent. The term 'free-ranging' refers to animals that are reared in open or free environments (Delbridge, 2001), and 'ecology' is defined as the scientific study of the interactions that determine the distribution and abundance of organisms (Krebs, 1985). Free-ranging horses are more prevalent in Australia than in any other continent and their ecology here has only recently been explored. With estimates well exceeding 300,000 individuals in the Australian landscape (Dobbie *et al.*, 1993), there is growing concern among land managers, conservationists and animal welfare groups over limiting adverse economic and environmental implications. Understanding interactions that free-ranging horses have with the environment, and awareness of impacts they can cause, will perhaps, lead to better management programs.

In the past few decades there has been research conducted on the ecology of wild and free-ranging equids in North America, South America, Africa, Asia and Europe. Some of this research will be discussed through the course of this thesis. Significant studies have also contributed to the knowledge of free-ranging horses in Australia and New Zealand, which will be reviewed as well. The majority of Australian research on free-ranging equids has been conducted in the Northern Territory, where the main concentrations are located. In the Alice Springs district, Wurst (1987) investigated different management options, Berman and Jarman (1987, 1988) examined the ecology and environmental impacts of free-ranging horses, and Dobbie and Berman (1990) explored movement, home range and fertility-control. In the Victoria River district, Black (2000) studied the abundance, distribution and habitat-use of sympatric free-ranging equids. Limited research has been conducted in other locations. In the Northern Territory, Berman (1991) investigated different methods of controlling free-ranging horse density. In Victoria and New South Wales, Dyring (1990) determined impacts and analysed habitat preference of free-ranging horses on sub-alpine and montane areas and Walters (pers. comm., April 2001) examined population ecology of free-ranging horses in the Australian Alps.

In Guy Fawkes River National Park (GFRNP), both Taylor (1995) and Andreoni (1998) conducted research relevant to the environmental impacts of free-ranging horses. Taylor (1995) investigated the potential for horses to disperse viable exotic seeds through their faeces, and Andreoni (1998) explored free-ranging horse impacts along the Guy Fawkes River (GFR) valley. Findings from these studies have provided information on impacts in certain areas. However, some types of damage, such as bark-chewing, may be site specific and are discussed in Chapter 4. Lack of research on free-ranging horse ecology in temperate eastern Australia makes it difficult to determine impacts in many habitats that are associated with the region. There is limited information on the ecology of the free-ranging horse population on the woodland plateaux of GFRNP, and virtually no information exists on the patterns and impacts of their chewing and stripping the bark from trees.

The focus of this thesis is on evaluating population density, habitat-use, distribution and bark-chewing impacts of free-ranging horses on Paddy's Land woodland plateau in northern GFRNP. The study aims to contribute knowledge towards the understanding of free-ranging horse ecology

on the plateau and surrounding gorge system. It is anticipated that the information generated will assist the NSW National Parks and Wildlife Service (NPWS) with future management. Before discussing the specific questions addressed and methods of the study, the first chapter provides a review of issues associated with the ecology and management of free-ranging horses in Australia. History, environmental impacts and management options are presented, and community attitudes towards free-ranging horses are discussed. The focus is then directed to the history of horses in GFRNP and the issues leading to the helicopter culling operation of October 2000. A report on the cull (English, 2000) is discussed followed by a study into the heritage values (HWP, 2002) of GFRNP horses. After defining the research aims, the thesis proceeds with a description of the study region, the study species and the research project.

1.2 History of Horses in Australia

Horses were the last of the common livestock to be domesticated about 2,500 to 5,000 years ago (Clutton-Brock, 1987). Use of domestic horses spread throughout Asia, eventually to Europe and now exists in most continents. The presence of equids is recorded around 1800 BC in early historical records kept in the ancient civilisation of Mesopotamia (Mason, 1984 in Black, 2000). Economic exploitation of equids included industry, agriculture and transportation and had become well established in Europe by the Iron Age (Zeuner, 1963 in Black, 2000). European livestock accompanied the Australian settlers and horses were introduced with the arrival of the first fleet in 1788 (Dobbie *et al.*, 1993). Horses adapted well to the environmental conditions and by 1820, approximately 3,500 horses were thought to reside in eastern Australia.

Horses were first used for agriculture and this led to the selection of robust stock. After horseracing became prevalent in 1810, there was an influx of thoroughbreds from England (Barrie, 1956 in Dobbie *et al.*, 1993). As thoroughbred bloodlines began to dominate, there was an improvement in racehorses, stock and workhorses. This makes our ability to interpret horse biology, in adaptive terms, complicated because their gene pool has been altered by artificial selection. Through selective breeding, humans have modified the natural design of the horse to serve different purposes. The domestic horses of today only partially resemble their wild ancestors but still share some similar traits. Basic behavioural and physiological characteristics were not altered significantly by domestication (Waring, 1983). Domestic horses can still easily adapt to a wild pattern of existence, and free-ranging horses show survival traits typical of species that have never been domesticated (Waring, 1983). Their behaviour is flexible enough to enable reproduction under a broad spectrum of ecological conditions, and they are able to withstand diverse climatic extremes (Berger, 1986).

A number of terms have been used to describe Australian wild horses. Because their ancestors were domesticated, the wild horses of Australia are generally referred to as 'feral' (Berger, 1986). The term feral refers to animals that have 'reverted from domesticity to a wild existence' (McKnight, 1976). The term 'Brumby' is also commonly used. Its exact origin is unknown but the name could be attributed to Sergeant James Brumby's horses, which were set free in the 1830s. Alternatively, it may have been derived from an Aboriginal word for wild horse, 'booramby', or it may have been derived from an Irish word for colt, 'bromaigh' (Morris, 1988 in HWP, 2002). Although these terms are commonly used, I chose to use the term 'free-ranging' to describe horses in this thesis. I selected this term because Guy Fawkes horses are not fenced in and they are free to

roam, more or less, where they like. Additionally, there appear to be negative and positive connotations with the terms feral and Brumby respectively. The horses come from mixed origins, history and management. My goal was to remain objective to eliminate bias. The history of antecedents of Guy Fawkes stock is unknown but it is thought that they are a mixture of released horses, ones whose ancestors have been in the valley for one, a few or many generations (P. Jarman, UNE pers. comm., June 2002).

Robust stock horses profoundly influenced the exploration and pastoral development of Australia (McKnight, 1976). Cattle and sheep grazing gradually occupied most suitable areas, and by the second half of the 19th century, development was expanded into the more remote arid regions. Extensive pastoralism was the major influence that encouraged the establishment of free-ranging horse populations by the absence of fencing combined with infrequent musters. Other sources include horses that strayed or were abandoned when stations failed (McKnight, 1976). The deliberate release of stallions into free-ranging herds was a common practice to enhance a stock horse supply and is a practice that continued in Guy Fawkes until very recently (P. Jarman, UNE pers. comm., June 2002).

Horses left over from the British Indian Army remount trade also contributed to free-ranging populations (Dobbie *et al.,* 1993). The heritage values associated with current herds that are genetically linked to the war horses have management implications, which will be further discussed in section 1.9. The first record of horses escaping into the bush was in 1804 (Rolls, 1969 in Dobbie *et al.,* 1993). By the 1830s, free-ranging horses were plentiful in the hills around Sydney, and between 1830 and 1850, horse numbers in eastern Australia rose from 14,000 to 160,000. By the late 1860s, free-ranging horses were recognised as pests requiring some degree of management (Dobbie *et al.,* 1993).

The continent of Australia now contains the largest population of free-ranging horses in the world. In 1987, estimates indicated a population size between 300,000 and 600,000 (Berman & Jarman, 1987). Occupying habitats that cover over half of Australia, free-ranging horse numbers are likely to increase without management. The domestic horse population in Australia is estimated to be approximately 650,000-700,000 (Clement *et al.,* 1990 in Dobbie *et al.*, 1993). There is potential for domestic horses to escape and add to the free-ranging populations, which presents a risk requiring careful management.

Free-ranging horse populations have been described from the equator to the temperate-boreal forests, in deserts and high rainfall regions, at low altitudes on river deltas, islands and in high altitude mountainous regions (Linklater *et al.,* 2000). They mainly occur in remote semi-arid and monsoonal areas containing a natural water supply and little human development. Although they are best adapted to open grassy plains and savanna, free-ranging horses occupy a wide range of habitats in Australia. They occupy most of the habitats that provide suitable resources but prefer grassland and shrub steppe habitat where pasture and drinking water are relatively abundant (Strahan, 1998). Major concentrations occur throughout most of the extensive cattle raising districts of the Northern Territory (NT) and northern and western Queensland. The NT contains most of the free-ranging horses in Australia. In fact, over ten years ago, the NT population alone was approximately four times larger than the estimated population size of 40,000 free-ranging horses in North America where the family Equidae first evolved (McCort, 1984 in Berman, 1991).

Substantial numbers of free-ranging horses occur in Western and South Australia, and smaller populations exist in Victoria and New South Wales. As of the early 1990s, there were no positive accounts of free-ranging horses in Tasmania or the Australian Capital Territory. However, a decade has passed and horse presence may now be evident. The majority of available data are either questionable or old and new figures are needed (Table 1.1a, Table1.1b and Figure 1.1). Free-ranging horse populations in Australia appear to be very versatile and can withstand different climates and varying environmental conditions. Density estimates reveal that preferred habitats include areas near natural waterholes or dams, open forests, remote tableland country, mountainous terrain and high plains.

Table 1.1a Estimated sizes of free-ranging horse populations in each State and Territory of Australia (Adapted from Dobbie *et al.*, 1993).

State / Territory	Estimated Population	Source
Northern Territory	206,000	Graham *et al.*, 1982 & 1986
Queensland	100,000	Mitchelle *et al.*, 1982
Western Australia	10,000 – 20,000	Dobbie *et al.*, 1993
South Australia	3,000 – 10,000	Dobbie *et al.*, 1993
Victoria	1,000 – 3,000	Dyring, 1990
New South Wales	5,000 – 10,000	Dobbie *et al.*, 1993
Tasmania	0+	Dept. Primary Ind. & Fish (DPIF) 1991
Australian Capital Territory	0+	Dyring 1990

Table 1.1b Estimated sizes of free-ranging horse populations on NSW NPWS reserves (Adapted from English, 2001).

NSW Region	Reserve	Estimated no. of Horses	Comments
North Coast	Yuraygir NP Guy Fawkes River NP	30 80+ 127+	- Post Oct. 2000 cull. Chapter 3 of this thesis indicates a larger population
Northern Tablelands	Oxley Wild Rivers	135 counted 200 estimated	Support: NPWS Northern Tablelands
Hunter	Barrington Tops NP Mt. Royle NP	50 Less than 10	- Post recent cull
Blue Mountains	Southern Blue Mountains NP, Kanangra-Boyd NP, Yerranderie & Warragamba Catchment area	100 or less	Managed by Sydney Catchment Authority but soon to come under NPWS control
Far South Coast	Wadbilliga NP	12	Appears to be increasing
Snowy Mountains	Kosciuszko NP	3000+	Walters pers. comm. 2001

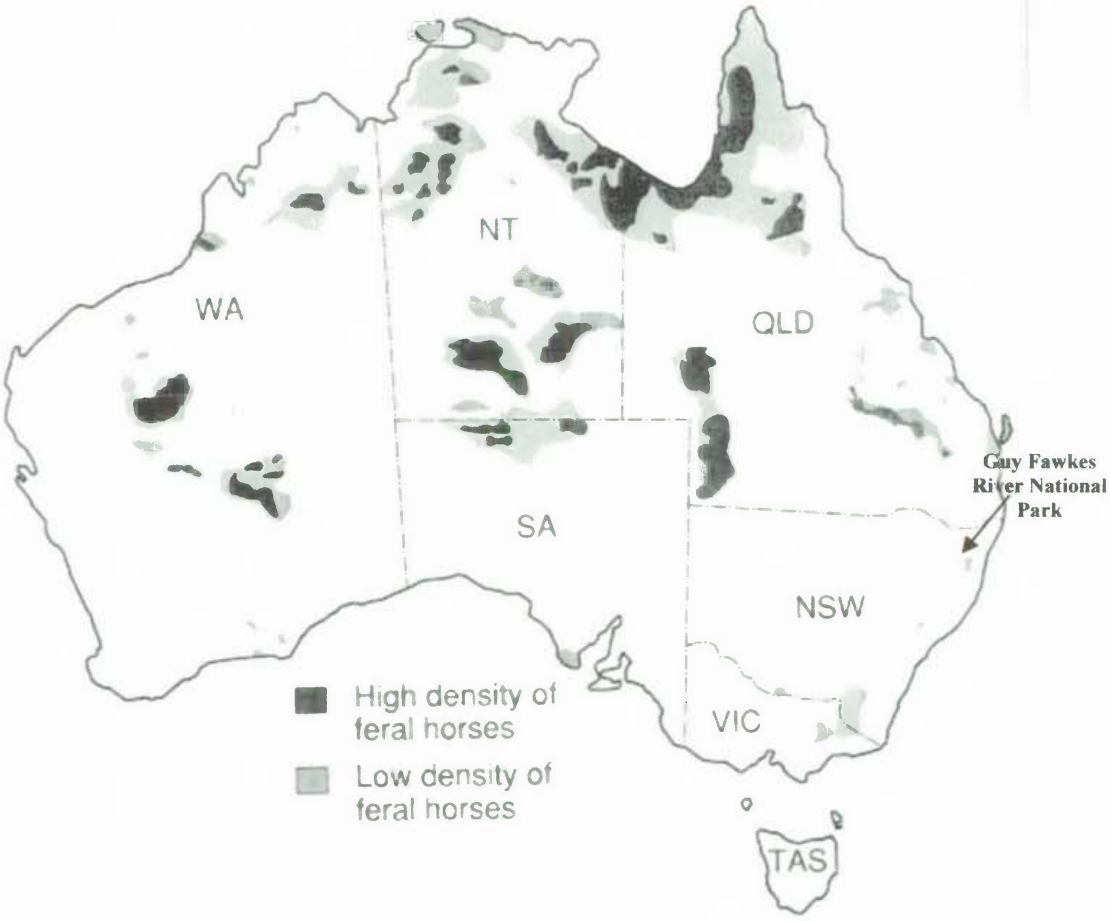

Figure 1.1 Free-ranging horse distributions in Australia (Adapted from Dobbie *et al.,* 1993).

1.3 Environmental Impacts

As with many introduced species, there can be adverse impacts associated with free-ranging horses. When present in large numbers they can cause both environmental impacts and economic disadvantages. Research overseas has illustrated environmental impacts of free-ranging horses. Regarding the indirect effects of free-ranging horses on estuarine communities on Shackleford Banks of eastern USA, Levin *et al.* (2002) found that horse-grazed marshes had less vegetation, a higher diversity of foraging birds, a higher density of crabs and a lower density of fish species than marshes not grazed by horses. In Levin *et al.* (2002) researchers tested if horse removal of *Spartina* affected predation of marsh-associated fish. They found that potential for predation on fish in un-grazed marshes was higher than in grazed marshes. When horses removed shelter provided by the *Spartina,* fish obtained shelter in the burrows of Xanthid crabs and became prey. This is just one example that illustrates the chain of events that can take place and alter ecosystem stability when introduced free-ranging horses are present. In Australia, horses contribute to direct and indirect changes. However, the changes are difficult to quantify because of the influence of confounding factors such as varying seasons, weather conditions, cattle use, kangaroos, rabbits, foxes, and changes in burning practices (Dobbie *et al.*, 1993). Research has determined that short and long-

term environmental changes (Table 1.2a) and direct and indirect environmental impacts (Table 1.2b) are associated with the presence of free-ranging horses in the Australian environment (Berman & Jarman, 1988).

Table 1.2a Short and long-term environmental impacts caused by horses (Adapted from Berman & Jarman, 1988).

Short-Term Environmental Changes	Long-Term Environmental Changes
• horse tracks, which disturb soil and create paths by repeated travel along certain routes • dung and urine scald • plants damaged by trampling, grazing, and browsing • depletion and fouling of water supplies • soaks dug in sandy creek beds • collapse of native wildlife burrows • visual and auditory changes to the Australian bush	• accelerated erosion by soil disturbance and removal of vegetation • changes in species composition as a result of selective grazing • restricted distribution of native wildlife through the removal of suitable habitat soaks dug in sandy creek beds • decreased frequency and intensity of grass fires as a result of the removal of ground fuel • seed dispersal of both native and introduced species

Table 1.2b Direct and indirect environmental impacts caused by horses (Adapted from Berman & Jarman, 1988).

Direct Environmental Impacts	Indirect Environmental Impacts
• horse tracks • horse pads • piles of dung • damage to plants by trampling • ground laid bare by grazing • damage to shrubs by browsing • water holes depleted by drinking • water holes made dirty • visual changes • auditory changes	• accelerated erosion by removal of vegetation and disturbance of the soil with hard hooves • change to pasture species composition by selective grazing or differential plant response to grazing • restriction of the distribution of native animals by removal of their food and shelter • fewer grass fires because of vegetation removal

Areas of high-quality habitat that provide refuges for many native species have been severely degraded by introduced herbivores during periods of low rainfall (Strahan, 1998). Morton (1990) suggested that unmanaged introduced herbivores have been one of the major factors in the

disappearance of medium-sized native mammals (Morton, 1990 in Strahan, 1998). The removal of suitable habitat by overgrazing in times of drought can destroy habitats and restrict distribution of native mammals. The potential competition between free-ranging horses and native herbivores is assumed to exist but requires investigation to assess severity. Drought years intensify the situation where horses both accelerate erosion by soil disturbance and remove vegetation in fragile ecosystems.

Research has determined impacts from free-ranging horses in montane environments. In southeastern Australia, Dyring (1990) suggested that free-ranging horses in sub-alpine and montane areas of Victoria and NSW compact soil and alter vegetation by trampling. She noted that dry soil is susceptible to compaction whereas wet soil is more prone to structural damage. In her study, Dyring (1990) found that areas frequented by horses had reduced plant diversity and fewer individual plants. Introduced plants were also found more commonly along horse tracks and in areas used by free-ranging horses. Irreversible damage to riparian areas has also been found to occur from grazing and trampling. Dyring's (1990) findings suggest that free-ranging horses reduce the abundance of *Sphagnum* moss while searching for food along stream banks. This increases the potential for runoff and accelerates soil erosion (Dyring, 1990). Horse hooves also churn up peaty soils at stream banks and drinking points, which can lead to breakdown and siltation (Dyring, 1990).

Evidence suggests that direct seedling germination from horse dung is possible (Dyring, 1990, 1991; St. John-Sweeting & Morris, 1990; Janzen, 1981, 1982; Wallander *et al.* 1993; Welch, 1985; Whinam *et al.,* 1994 in Taylor, 1995). If viable seeds are dispersed through faeces, a change in vegetation composition may result. Taylor's (1995) research regarding seed dispersal from horse manure in GFRNP added to the debate in the literature about the impact of plants germinating directly from horse manure. Taylor (1995) concluded that horses could disperse the viable seeds of native and weed plants in their faeces. Her results were taken from laboratory tests, and she suggested that germination be studied *in situ* before determining the potential for seedling establishment and dispersal via faeces within the Park (Taylor, 1995). Seed germination via faeces on the plateau is explored in Chapter 3.

Andreoni's (1998) research in GFRNP suggests that erosion impacts from free-ranging horses are greatest in the woodlands rather than casuarina and grassland areas of the Park. Her results also show that horse use appears to be ubiquitous across all three vegetation types analysed within the study area (Andreoni, 1998). Because her research focused on the GFR valley floor, Andreoni (1998) recommended further investigation into impacts extending up the gorge and on plateau areas surrounding the GFR valley. It is certain that free-ranging horses accelerate erosion in Australia and GFRNP, so this study focused on bark-chewing and stripping damage to trees, an impact that had not previously been investigated. Impacts are investigated in Chapter 4. Apart from environmental impacts, free-ranging horses can contribute to economic difficulties. Pastoralists experience economic disadvantages when large numbers are present on their properties. Free-ranging horses can compete with cattle for feed and water, damage fences, water troughs and pipes, disturb stock at watering points and interrupt cattle musters. They can also cause problems by mating with domestic mares and by serving as reservoirs of exotic equine diseases (Dobbie *et al.*, 1993).

1.4 Management Options

There are many different control methods that can be used for management of free-ranging horses (Table 1.3). The effectiveness of methods depends on different factors such as the degree and form of damage, density of horses to be controlled, area of land involved, seasonal conditions, topography, and operator experience (Dobbie *et al.,* 1993). During control operations, free-ranging horses may be harvested for commercial gain, killed with no return, or captured alive and either domesticated or relocated to a sanctuary. Fertility-control drugs can also be administered. No single method is likely to offer effective control when numbers are high, but using a combination of methods may enhance success (Dobbie *et al.,* 1993).

Table 1.3 Management techniques used for free-ranging horse control in Australia (Adapted from Dobbie *et al.*, 1993).

Techniques Used for Management of Free-Ranging Horses in Australia
• trapping at water points using attractants and lure mares • mustering with lure mares, helicopters, motorbikes or on horseback • fencing to either exclude horses from sensitive areas or to drive horses to trap site • shooting from the air or ground • herd relocation • immobilization and lethal injection • fertility-control

The two main live-harvesting methods currently used in Australia are trapping at water points and helicopter mustering. There are several advantages associated with trapping at water points. There can be minimal stress to animals, operations are cost effective, money can be gained from the sale of captured horses and there can be opportunities to leave traps unattended if bayonet entrances are used (Dobbie *et al.,* 1993). Even though trapping at water points can yield captures, the technique may be restricted to times when there are few places for horses to drink, and untimely rainfalls can disrupt the operation. Trapping can also take up to several days to perform, and horses may be injured if impatiently handled (Dobbie *et al.,* 1993). Other trapping methods include using salt or feed as attractants and automated traps. Whilst feed does not usually attract free-ranging horses, it allows the trap yard location to be independent of water (Dobbie *et al.,* 1993). Using lure mares is an option but only attracts free-ranging stallions from the immediate area. There must be good local knowledge of horse behaviour and movement patterns for trapping success (English, 2001).

Helicopter mustering enables gathering horses over a wide area and includes country that is inaccessible by vehicle. This is likely to be the most commonly used method of removing horses from national parks (English, 2001). This management option brings monetary gain from captured horses, rainfall has less influence on the success of mustering than it does with trapping, and helicopter mustering can be a faster operation than trapping (Dobbie *et al.,* 1993). When well planned, suitably resourced and properly conducted this method has the potential to capture significant numbers of horses (English, 2001). Despite advantages, the use of helicopters is expensive and more stressful on horses than trapping. There are risks of accidents, and horses that escape learn to avoid helicopters. Inexperienced pilots may push horses too fast or too far causing exhaustion, injury or separation of foals from mares. This option is only practical when horse numbers are high in rugged terrain (Dobbie *et al.,* 1993). Mustering is also carried out with

coacher horses and motorbikes instead of helicopters. This option is often less expensive and results in minimal injuries to the horses. Mustering is suitable for flat open country when trapping is impossible but requires skilled motorbike riders.

Mustering on horseback poses low financial risk and enables mounted riders to traverse rough terrain (Dobbie *et al.*, 1993). Only small areas can be mustered at a time when working from the ground, and this option can present problems such as damage to fragile ecosystems and low capture rates. Although there are usually fewer injuries to horses using this method, opposition from animal welfare groups is still common because of their concerns about the psychological trauma caused to the horses (Dobbie *et al.,* 1993).

Fencing is used either to block horses from certain areas or to direct them into areas where they are more easily controlled. Fencing off watering points can assist in conservation management and increase trapping success. Strategically placed exclusion fences can provide long-term results. However, fences are impractical to place in remote areas and horses can suffer if they are left with few watering points. Fences are expensive, they require regular inspections and they are difficult to construct, but can assist in trapping success. Exclusion Fencing methods were attempted for vegetation monitoring in this research and are discussed in Chapter 5.

Shooting free-ranging horses from the air has been banned in national parks in NSW but ground shooting may be used under certain circumstances (English, 2001). Helicopter shooting usually occurs when populations are large and in need of direct management (Dobbie *et al.,* 1993). The practice has drawn major media attention to management authorities responsible for free-ranging horse control in the past 2 decades. Whilst helicopter shooting is very controversial, it quickly reduces free-ranging horse numbers in areas where they cannot be mustered or trapped (Dobbie *et al.,* 1993). Wounded animals are quickly followed and killed to reduce suffering when trained shooters are used. There is both national and international concern over large-scale helicopter shooting because, although considered one of the most humane methods, wounded horses could escape and suffer. This point has been proven by the recent cull in GFRNP and is further discussed at the end of this chapter in section 1.8. Other disadvantages of this method include high costs and no monetary gains to finance the operation.

Ground shooting is not suitable for large-scale control but is used to supplement harvesting and mustering methods (Dobbie *et al.,* 1993). Shooting from the ground makes it more difficult to follow up wounded animals and enables some horses to escape before they are shot. Field slaughtering of free-ranging horses for pet meat is permitted only in Western Australia and the northern sector of the Northern Territory. Further investigation is required before this method is used in region-wide management (Dobbie *et al.,* 1993). Darting and lethal injection is seen as more humane than most other lethal techniques. However, it is very costly, labour intensive and requires that close proximity be achieved for effective shooting (Dobbie *et al.*, 1993).

Non-lethal options include herd relocation, free-ranging horse reserves, tourist reserves, adoption schemes and fertility-control. Relocation to suitable reserves facilitates genetic retention of particular free-ranging herds. Horse reserves present the opportunity for visitors to view horses closely and can facilitate research into fertility-control and other methods. These applications have benefits but are not considered practical for wide-scale control of free-ranging horses in Australia (Dobbie *et al.,* 1993). Herd relocation is expensive, and suitable relocation sites must be available.

Even though horses may suffer during capture and transport, this method is still favoured by some groups opposed to lethal control. Reserves are costly to maintain, have limited applicability and require ongoing management. Despite the disadvantages, reserves are necessary when populations have genetic conservation values. Adoption schemes are rarely used in Australia due to the low demand and high costs involved (Dobbie *et al.,* 1993). Further discussion on reserve options for Guy Fawkes horses is offered at the end of this chapter in section 1.9.4.

Fertility-control is seen as one of the most humane non-lethal methods of free-ranging horse control but there are numerous difficulties with this method in Australia. It is not realistic for large-scale control where horses are widely dispersed and difficult to approach. This method gives no immediate reduction in free-ranging horse damage. Fertility treatments must be administered annually to remain effective, and there is no permanent drug currently available. There is also no effective means for delivering a suitable drug, and dart-delivery can cause injury and destabilise free-ranging horse social structure (Dobbie *et al.,* 1993). There currently exists a need for further research on fertility-control methods in Australia (English, 2000).

The ecology and management of free-ranging horses in Australia is both a complicated and controversial topic. There is wide-scale geographic distribution, and numerous different habitat types are occupied by free-ranging horses. Management is deemed necessary to both maintain the natural biodiversity of the Australian environment and reduce economic losses to pastoralists. Many different control methods exist which provide options for different situations. Regardless of the selected method, it is important to consider environmental implications of removing free-ranging horses from certain ecosystems. Potential management problems can arise. The risk of fire hazard can also be heightened along river systems if horses no longer graze the introduced grasses and increased rabbit activity may result (Dobbie *et al.*, 1993). Managing ecosystems that have been altered by many different exotic species is a difficult task. The benefits of free-ranging horse removal, such as recovery of vegetation and increases in native species diversity, must be weighed against the implications of allowing persistence in certain areas.

1.5 Public Attitudes

Free-ranging horses pose a challenging management task in Australia with various levels of public opinion and concern. Most groups accept the idea that free-ranging horses require management but there are many different viewpoints on the control techniques to be used. The degree and method of management is often under scrutiny, which has led to a high profile for free-ranging horses and their management in the past few decades. Passions run deep among certain interest groups, and there large debate over minimising the environmental damage caused by horses in the most humane way (Dobbie *et al.,* 1993). Interest groups must be involved in management plans of control for long-term success. If the public does not agree with and support the chosen operation, it will not be sustainable (O'Brien, 2001).

There is a potential source of conflict among landholder groups because they all aim for different levels of management. Conservationists and pastoralists generally favour free-ranging horse management but for different reasons. Conservationists' favour culling free-ranging horses because of the damage they cause to native flora and fauna (SSCAW, 1991 in Dobbie *et al.,* 1993). Pastoralists experience economic losses when free-ranging horses are present on their properties, so

they promote lethal control operations. Aboriginal people tend to accept the presence of free-ranging horses, unless financial incentives for their removal offer benefits to the communities (Dobbie *et al.,* 1993).

There are certain groups such as the Waler Horse Society of Australia (WHSA) and the Australian Stock Horse Society (ASHS) who advocate the retention of genetic material and favour lawful protection of free-ranging horses. Preserving the genetic values of GFRNP horses is discussed further in section 1.9. Animal welfare groups show the most opposition towards certain methods of free-ranging horse control. They oppose the inhumane treatment of animals and prefer that non-lethal control measures be used. Major animal welfare groups that play a role in Australia include the Royal Society for the Prevention of Cruelty to Animals (RSPCA) and the Australia and New Zealand Federation of Animal Societies (ANZFAS). The Senate Select Committee on Animal Welfare (SSCAW) is a committee of senators and works with these groups to ensure the humane treatment of animals. The RSPCA supports the culling of free-ranging animals provided the practices are implemented humanely (Dobbie *et al.,* 1993). They believe that control programs should be well coordinated and carried out by trained operators so that unnecessary stress to the animals is avoided. ANZFAS prefers to see non-lethal methods such as fertility-control, free-ranging horse reserves and tourist herds used whenever practical. They have stated that the current management of free-ranging animals in Australia is 'ad hoc, opportunistic and based on methods that give only short-term reduction of density' (SSCAW, 1991 in Dobbie *et al.,* 1993).

Both the RSPCA and the ANZFAS are opposed to commercial use of free-ranging horses, and both disagree with aerial shooting because they believe it causes unnecessary suffering to the animals (Dobbie *et al.,* 1993). This point will be discussed further in sections 1.8. Many animal welfare groups have opposed techniques for the mustering and long-distance transport of captured horses for quite some time because of the stress to the animals involved. Because of these concerns, the animal welfare groups mentioned above are in favour of the development of research into non-lethal techniques. Opposition to culling makes management difficult in Australia because of the widespread and inaccessible free-ranging horse populations that exist.

1.6 History of Horses in GFRNP

Europeans first settled the plateau land to the east of Guy Fawkes River for agricultural purposes in the late 1830s. The Guy Fawkes and the Little Guy Fawkes Stations form the foundation of cattle and horse grazing in the southern region of what is now the GFRNP area. From the middle of the nineteenth century, this area accounted for thousands of hectares of unfenced land, on which large numbers of horses and cattle were raised (HWP, 2002).

Horse breeding was a lucrative business in the Guy Fawkes River area during the nineteenth century because of the development of the remount trade. During the 1830s, the British Army in India began to notice the quality and availability of horses in the colony of New South Wales, and an important export market was soon established (HWP, 2002). This is where the term 'Waler' comes from, the horse from the colony of New South Wales. The Australian colonial-bred horse became famous as a war-horse (Figure 1.2).

Walers were bred and sold in two or three different 'weight' grades, light and heavy Cavalry. They were initially purchased by the British Army and soon used as Cavalry mounts for officers and troops (HWP, 2002). Free-ranging Australian horses were tamed and used in the Boer War during the late-nineteenth, early-twentieth century, and served as the Australian Light Horses from 1914-1918. Many horses were bred specifically for the remount trade for the Australian Army. All in all, more than a half million Waler horses left Australia for oversea markets (HWP, 2002).

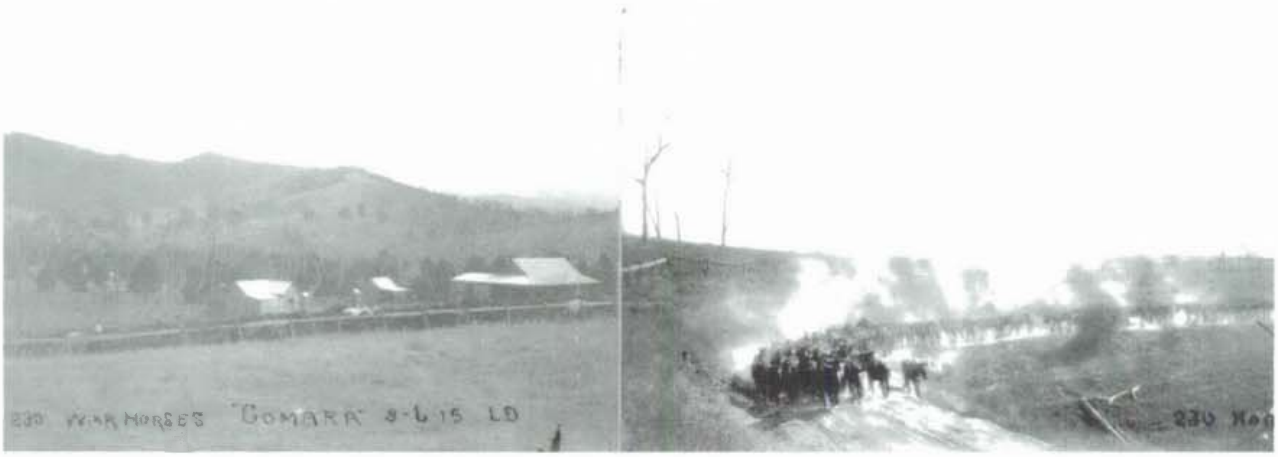

Figure 1.2 Australian war horses: Free-ranging horses captured from the Macleay River en route to Kempsey (Photo by Fred Drew, 1915; courtesy of Debbie Stevenson).

Guy Fawkes River horses share physical attributes with the mountain Brumby (Figure 1.3). Mountain Brumbies are strongly muscled, heavy boned and noted for agility and speed in mountainous country (Berman, 1998 in Strahan, 1998). Their conformation appears to have formed from a substantial genetic contribution from draught horses, which were once used in the mountain timber industry (Berman, 1998 in Strahan, 1998). Strongly muscled and boned mounts are well suited to the demands of the rugged environment.

Figure 1.3 Harem stallion showing morphological similarity to draught horses. Photo taken in February 2003, western Paddy's Land Plateau.

Before the purchase of land by the NSW NPWS, property owners or leaseholders controlled most unclaimed horses. The first known record of capturing unclaimed horses by local residents was in 1931 (HWP, 2002). Because of a shortage of labour during the First and Second World Wars, management of free-ranging horses became less controlled and populations increased. First-hand accounts drawn from a history of sightings indicate small numbers of horses on the top country and along the rivers of the northern half of the Park as early as the 1930s (HWP, 2002). In the southern areas of GFRNP, free-ranging horse sightings were not recorded until the 1970s, after the Park was established but some locals say sightings were evident before that.

The NPWS conducted counts of free-ranging horses starting in 1979. From 1979 to 1989, the survey area included MacDonald's Spur, Phantoms Creek, Guy Fawkes River, Aberfoyle River, Combolo Homestead, Long Plain, Kitty's Creek, Sara River and Ballard's flat. From 1996 to 2000, aerial surveys were conducted along the rivers and adjoining slopes. Surveys did not include the western plateau country (B. Nesbitt, NSW NPWS pers. comm., September 2002). The estimates indicated an increasing population (Table 1.4). However, the increase appeared to be small and management of unclaimed horses ceased until the early 1990s.

Table 1.4 NSW NPWS survey of free-ranging horses in GFRNP (B. Nesbitt, NSW NPWS pers. comm., September 2002).

Year	Month	Method	Number of Horses
1979	April	NPWS Ground count	3
1979	August	NPWS Aerial count	0
1980	June	NPWS Aerial count	65
1981	March	NPWS Aerial count	60
1981	December	NPWS Aerial count	14
1982	July	NPWS Aerial count	40
1987	June	NPWS Aerial count	99
1989	July	NPWS Aerial count	79
1996	February	NPWS Aerial count	180
1996	Unknown	NPWS Aerial count	139
1997	June	NPWS Aerial count	121
1998	April	NPWS Aerial count	152
1998	December	NPWS Aerial count	133
2000	May	NPWS Aerial count	187
2000	October	NPWS Aerial count	283
2000	October	NPWS Aerial cull count	606

From 1992, the NPWS undertook a series of mustering and trapping horse control operations using local horsemen, NPWS staff and helicopters (Table 1.5). Despite some success, only 176 horses were removed from the Park between 1992 and 1999. This led to an uncontrolled population of horses distributed along the Guy Fawkes River in both the northern and southern areas of the Park by late 2000.

Table 1.5 Summary of free-ranging horse control trials in GFRNP from 1992-2000. (B. Nesbitt, NSW NPWS pers. comm., September 2002)

Year	Control Technique	Number of Times Technique Trailed	Number of Horses Captured or Killed
1992	Roping	2	7 captured
1992/93	Chemical immobilisation – darting	2	28 captured
1993	Mustering into steel yard trap – electric tape wings	1	0 captured
1993	Mustering into steel yard trap – shade cloth wings	3	28 captured
1994	Mustering into steel yard trap – Hessian wings	1	27 captured
1995	Mustering into light net trap – Hessian wings	3	19 captured
1995 – 1999	Mustering into heavy net trap – light net plus Hessian wings	7	57 captured
2000	Helicopter horse culling	1	606 killed

1.7 NSW NPWS Helicopter Culling Operation

After a prolonged drought, severe bush fires burned nearly 60% of the Park starting in early September 2000 (English, 2000). Increasing numbers of horses were seen along the Guy Fawkes River by helicopters involved in the firefighting. The horses were noted to be in very poor condition. Plans were put forward in September 2000 to continue with mustering and trapping. However, environmental conditions in the Park became so severe that the helicopter culling of horses in GFRNP was considered for the first time in October 2000. The NPWS staff conducted an aerial survey on 18 October 2000 and the culling was done over a period of 3 days starting on 22 October. In total, 606 horses were shot and killed (English, 2000). The NPWS was unaware that the free-ranging horse population had reached these high numbers (B. Nesbitt, NSW NPWS pers. comm., September 2002), since the aerial survey on 18 October had revealed only 283, a figure that was itself higher than any previous aerial count in the Park.

1.8 English's Report on the Cull of Free-Ranging Horses in GFRNP

Following the cull, the Minister for the Environment, Bob Debus, commissioned an independent review to examine the protocols and procedures for the culling of horses by the NPWS. The review was carried out by Associate Professor Tony English who is Head of the Department of Veterinary Clinical Sciences, Faculty of Veterinary Science at the University of Sydney and President of the Australian Veterinary Association's Wildlife Special Interest Group (English, 2000). English examined the reasons for the Service initiating the culling of Guy Fawkes River horses, and how the operation was planned and carried out.

Shooting from helicopters was considered by the Senate Select Committee on Animal Welfare to be the only practical method for a quick, large-scale and humane culling of large animals in inaccessible locations (Dobbie *et al.,* 1993). The NSW Pest Animal Council, which has RSPCA membership, and the Australian Veterinary Association share this view as long as the shooting is done by trained and accredited personnel operating under strict guidelines as part of a Government Pest Control Program (English, 2000). According to English (2000), all of the NPWS shooters in the Guy Fawkes River operation were Feral Animal Aerial Shooter Trained (FAAST) and accredited. During a briefing on the morning of 22 October, FAAST protocols were emphasised with the heart/lung target area verified in a telephone call from the FAAST Management Committee (English, 2000). The 'fly back' rule was implemented which states that the helicopter must fly back over every horse in a group that had been shot before another group was pursued.

A field investigation was carried out in early November, and one horse was found alive with two bullets in the killing zone. This incident resulted in a field investigation to examine 67 randomly located horses that had been shot. Initially the RSPCA filed a large number of charges against the NSW NPWS. A local veterinarian, acting on behalf of the RSPCA, examined the horses and concluded that there was no evidence of inhumane treatment (English, 2000). Through negotiations and compromise, charges were refined. The Director General of NSW NPWS stated that 'although independent experts found the operation was carried out professionally, humanely and according to strict protocols, the Service accepted there was evidence that one and possibly up to four horses suffered as a result, albeit unintentionally. The fact that even one horse did not die swiftly as intended caused the Service great concern and, for this reason, the Service stated that management of horses would be different in the future' (B. Nesbitt, NSW NPWS pers. comm., July 2003). Deputy Chief Magistrate Henson accepted the Service's plea, found that no conviction should be recorded and dismissed the charges on 4 July 2002.

After conducting the review and after a public meeting of stakeholders, English (2000) recommended establishing a Heritage Working Party to examine and document claims that 'free-ranging horses in GFRNP have significant heritage values sufficient to warrant their being managed on that basis'. If horses were found to have heritage values, he suggested that they be humanely removed and managed in a suitable location by interested parties. English also recommended the establishment of research projects to provide a better basis for the development and monitoring of a future free-ranging horse management program. In addition, he recommended that funding be made available for studies on improving the methods for assessing the impacts of free-ranging horses in Australia and on options for their management in a range of habitats (English, 2000).

1.9 Heritage Working Party Report on the Horses of GFRNP

On 22 March 2001, the Minister for the Environment announced that a study would be conducted into the heritage values of horses in GFRNP. The composition of the Heritage Working Party (HWP) included Chairperson Frank Nicholas who was recommended by English as a qualified scientist, four local individuals with historical knowledge and interest in the horses, a representative of the Waler Horse Society of Australia and Brad Nesbitt, Dorrigo District NSW NPWS Pest Species Officer (HWP, 2002). The method of operation was to record all evidence on public record to encourage a relationship between stakeholders and the NPWS.

1.9.1 Key Findings

The Working Party released the Report on the Horses of the GFRNP on 5 July 2002. Throughout deliberations, the *NSW Heritage Manual* was followed to examine claims of the horses having heritage values. The Working Party concluded that the horses are important in the cultural history of the Guy Fawkes River area. The horses were said to have a special association with a group of important persons involved in the cultural history of the area (HWP, 2002). They were also said to have a strong association with sections of the community and, they 'demonstrate the principle characteristics of an item of significant national cultural heritage' (HWP, 2002). For these reasons, the Working Party concluded that GFRNP horses had significant local heritage values sufficient to warrant their being managed on that basis.

1.9.2 Evidence

The Executive Summary in the HWP Report documented evidence to support the findings. The evidence revealed that horses have been bred in parts of what is now the GFRNP for more than a century. A large number of horses were bred in the area, specifically for the remount trade from the 1890s until the early 1940s, and were drafted for use by the Light Horse in the New England district during the Second World War. They have thereby become part of the Waler legend (HWP, 2002).

Dr. Gus Cothran, leading researcher for the Equine Parentage Verification and Research Laboratory at the University of Kentucky, conducted a genetic study. His findings indicated that Guy Fawkes River horses have relatively high genetic similarity with Arabian-type breeds (Figure 1.4) and/or saddle and harness light horses. Cothran genetically linked Guy Fawkes River horses to Walers and determined that they have a low level of inbreeding. He established that these horses represent a mixture of different breeds, with a continual introduction of outside blood and rather than diminishing their heritage significance, it shows that 'Guy Fawkes River horses are a good example of the Australian wild horse or Brumby', and they 'embody the romantic notions that are associated with Brumbies' (HWP, 2002).

1.9.3 Public Perception

The local perception of the Guy Fawkes River free-ranging horse population encompasses several aspects. Sections of the public feel that the horses deserve historic preservation because they represent horse types bred for the remount trade, and because circumstantial evidence indicates that they are representative of the bloodlines of Saladin (Figure 1.4) (HWP, 2002). The original Saladin was a creamy stallion, a colour termed 'bay', in the Dungog District during the 1870s. A mating with his female offspring produced another creamy stallion, which became famous as a sire of hardy and creamy stock horses throughout the northern tablelands (HWP, 2002). Sections of the public also seem to have strong social and cultural associations with capturing and using wild horses from the area, and free-ranging horses in GFRNP are 'highly regarded because of their wild origin, historical associations and natural ability' (HWP, 2002).

Figure 1.4 Example of free-ranging horses in GFRNP with characteristics of Arabian (both), and creamy Saladin bloodlines (right). Photo taken in January 2003, on the eastern plateau.

1.9.4 Management Implications

Because the Working Party has concluded that the GFRNP horses have significant local heritage values, management will now be based around those results. The management of free-ranging horses in GFRNP will continue but with limited control options. Since the October 2000 culling operation reduced the population significantly, there is opportunity to incorporate methods such as herd relocation, a reserve and fertility-control measures. These options could assist in protecting the conservation values of the Park and protecting the heritage values and wild characteristics of the horses. Establishing a reserve could provide opportunities for research, tourism and other human interests. At this stage, a local community-based steering committee, including representatives from the Heritage Working Party and other interested stakeholders are developing the most appropriate methods to humanely remove the horses from the Park.

The intention will be to concentrate on the plateau top country where passive trapping will be implemented (B. Nesbitt, NSW NPWS pers. comm., July 2003). Passive trapping includes fencing large areas to familiarise horses with them and slowly closing gates to minimise shock. A variety of techniques will be used to minimise stress and prevent social destabilisation while handling horses. Capture trials will be used to assist management in developing the most appropriate plan. Impacts on the population's social structure and behaviour are unknown so they will be taken into account, and exercises will be modified accordingly (B. Nesbitt, NSW NPWS pers. comm., July 2003). The newly purchased Paddy's Land woodland plateau, which is now relieved of the intense stock grazing pressures, provides a suitable location for mustering and removal of free-ranging horses from the Park. Management and control of free-ranging horses on National Park estate is in accordance with the National Parks and Wildlife Act of 1974 and must take place to ensures the protection of native wildlife and vegetation communities.

After removal, horses will be relocated to a large property where horses can be contained and their wild characteristics preserved. A property in Dorrigo will provide a short-term location for the horses where they will be further educated in preparation for fostering, adoption and breeding to protect their genetic integrity (B. Nesbitt NSW NPWS pers. comm., July 2003). Establishing a free-ranging horse reserve will require careful planning and participation by stakeholders. Environmental assessments preceding removal of horses requires resource data to justify the number of horses removed (Crane *et al.,* 1997). Essentially, I argue that science must reveal both the interactions that free-ranging horses have with the environment and the ecological consequences and implications of their presence on the plateau before an effective long-term ecosystem management plan can be developed.

1.10 Research Aims

Producing a current population estimate, obtaining information on habitat-use and distribution, and assessing environmental impacts are all vital components in understanding the ecology of free-ranging horses on Paddy's Land plateau. Recognising the need for objective evaluation of free-ranging horse ecology in GFRNP, the aims of this study are to:

- investigate density, habitat-use and distribution of free-ranging horses on Paddy's Land plateau;
- analyse the past and present phenomenon of bark-chewing impacts to trees both across the woodland plateau landscape and within heavily damaged patches; and
- conduct an exclosure pilot study for testing the application and design of a monitoring study of stock grazing impacts to herbaceous vegetation.

1.11 Research Study

This thesis examines the relationship between free-ranging horses and their environment in northern GFRNP. Cattle remain in certain locations of the study region and, for reasons remaining to be discussed, they will be included in certain analyses. It is anticipated that this study will contribute to the understanding of the free-ranging horse ecology within the boundaries of the

selected study region. It is also hoped that certain impacts associated with the horses that reside there will be revealed and better understood.

1.12 Thesis Structure

After presenting the study region's attributes and discussing the characteristics of free-ranging horses in Chapter 2, general methods are discussed. The next three chapters concentrate on methods, statistical processes and results. Evaluations of density, habitat-use and distribution of free-ranging horses are presented in Chapter 3; evaluation of the biological impact, bark-chewing, is presented in Chapter 4; and evaluation of exclosure methods for assessing impacts of stock on herbaceous vegetation is presented in Chapter 5. Each chapter concludes with a discussion of main findings, implications and recommendations, and the last chapter provides synthesis and conclusion of the study. Results apply to the plateau on which the study is focused. However, some ecological results may contribute to our understanding of free-ranging horses in other open forest and woodland areas.