

Tree-kangaroos on the Atherton Tablelands: Rainforest Fragments as Wildlife Habitat

**Information for Shire Councils, land managers and the
local community**

July 2000



**By the Tree Kangaroo and Mammal
Group**



Natural Heritage Trust
Helping Communities Helping Australia



TREE - KANGAROO
& MAMMAL GROUP

Forward

Greetings....

I am one of the famous Lumholtz's Tree-kangaroos, or "tree-climbers", found only in the Wet Tropics of far north Queensland. I live in a patch of scrub (rainforest) on the Atherton Tablelands, a beautiful mountainous region just inland from Cairns, which supports dairying, agricultural, and tourism industries, and previously supported a strong timber industry. Thankfully for me, there is quite a bit of rainforest left on and around the Tablelands, though these days, much of it is broken up into forest fragments in between human residential and farming areas.

The future of my species, and of many of the hundreds of other wildlife species which live around the Atherton Tablelands, depends on how these remaining fragments of rainforest are managed. My mother used to tell stories passed down through the generations about the Old Days when scrub once covered almost all of the Tablelands, back in the days when Aboriginal groups were the only human inhabitants living alongside wildlife. Times change, and like everyone, we must go with the changes. But we can only change so far .

My ancestors have seen much of our home-country and livelihood destroyed over the past 150 years, as the Atherton Tablelands has been developed. These days, it's sometimes a struggle for the young ones of my species to find enough of their own nearby territory when it comes time for them to make their way in the world. Many never even make it into their new homes....my mother has many, many stories of our relatives who have been killed by motor vehicles and roaming dogs.

We know we cannot turn back time, and we know the human species, like us, has its own needs. We are here to live alongside the human species, and we believe our homes and lives can go alongside your homes and lives.

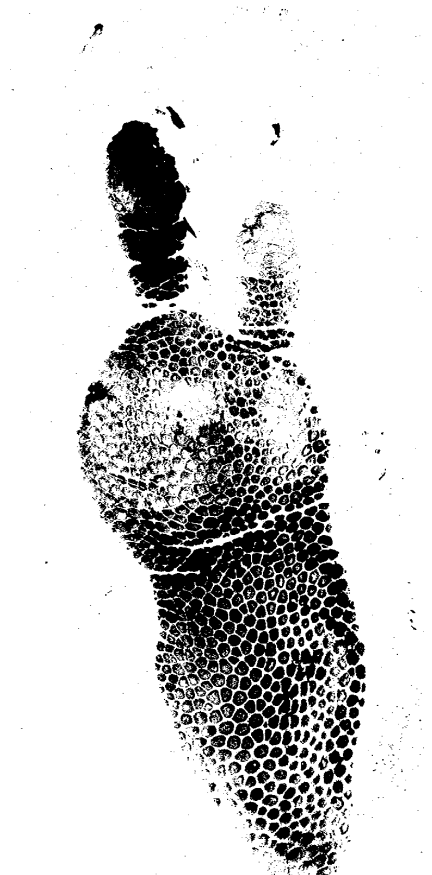
We as a tree-kangaroo species have not the power to change our environment as you do. So we ask that you do what you can to secure a future for us and the other wildlife-residents of the Tablelands, as you go about securing your own future.

We hereby support the efforts of the Tree Kangaroo and Mammal Group in providing this document, containing information about what you can do to manage the remaining rainforest for wildlife habitat, including that for tree-kangaroos, on the Atherton Tablelands.

Sincerely yours,

Muppie

(*an indigenous name for tree-kangaroo*)





Photograph 1. Lumholtz's Tree-kangaroo eating a leaf. Note black face, pale forehead, black paws and long pendulous tail (photo - Margit Cianelli).

About The Authors: The Tree Kangaroo And Mammal Group

The Tree-Kangaroo and Mammal Group (TKMG) Inc. is a community group based on the Atherton Tablelands in far north Queensland. The Group was formed in 1997 by local residents concerned about the plight of Lumholtz's Tree-kangaroo. Whilst still maintaining this focus, the Group has since broadened its interest to include the conservation of all of north Queensland's rich mammal fauna. Recent projects address the conservation of Lumholtz's Tree-kangaroo, and north Queensland subspecies of the Spotted-tailed Quoll and the Yellow-bellied Glider. TKMG has become a strong and active group on the Tablelands. Members come from all over the world, although most are local residents from diverse backgrounds such as ecologists and zoologists, farmers, teachers, artists, wildlife carers, eco-tourism operators and publicans.

The aims of the Tree Kangaroo and Mammal Group are as follows

- to conserve tree-kangaroos and other far north Queensland mammals by promoting the public awareness and knowledge of these animals;
- to undertake and assist with studies into their habitats;
- to liaise with groups and organisations with similar objectives.

The group meets 7:30pm on the first Thursday of each month, at the Malanda Hotel. Visitors and new members are always welcome. For further information, please contact:

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Cover photographs:

Panoramic view of Atherton Tableland from Butchers Creek area (photo - Carol Schmidt)
Lumholtz's Tree-kangaroo up tree (photo - Beth Stirn)

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Summary

- **Rainforest vegetation on the Atherton Tablelands provides important habitat** for Lumholtz's Tree-kangaroo and many other species of wildlife.
- **Rainforests and the wildlife they contain contribute significantly to our way of life** on the Tablelands, economically, ecologically, aesthetically and spiritually.
- The **protection and rehabilitation of rainforest by private landholders** is important for the long-term conservation of tree-kangaroos and other wildlife on the Atherton Tablelands.
- **Retaining and re-establishing rainforest throughout the agricultural landscape** on the Atherton Tablelands at whatever scale is possible is important to provide wildlife habitat and refuge from dogs for tree-kangaroos. This means that remnant patches of rainforest, vegetation corridors linking larger forest fragments and even individual trees in people's backyards or paddocks all have an important role to play in helping support tree-kangaroos and other wildlife.
- **Rainforest rehabilitation can assist the conservation of Lumholtz's Tree-kangaroo on the Atherton Tablelands.** For maximum effect, revegetation projects should aim to link existing Atherton and Evelyn Tableland rainforest fragments to the much larger rainforest areas on the ranges to the west of the Tablelands.
- **Road-kills are a significant cause of death for Lumholtz's Tree-kangaroo.** Measures to prevent road-kills, such as reducing traffic speed, incorporating wildlife underpasses into road designs, and deterring tree-kangaroos from roadsides may be particularly important in areas where tree-kangaroos are frequently run over.
- **Dog attacks are also a significant cause of death for Lumholtz's Tree-kangaroo.** The restraint of roaming dogs is an issue that dog-owners and local councils can help address.
- **Raising the profile of Lumholtz's Tree-kangaroo** and its needs will help the community adopt measures to conserve habitat for tree-kangaroos and other wildlife.

Section 1: Introduction

About This Document

This document is a local strategic plan for the management of Lumholtz's Tree-kangaroo on the Atherton Tablelands, focusing on the management of rainforest fragments as habitat, and the reduction of threatening processes. The 'Atherton Tablelands' in this document refers to the Tablelands area between Ravenshoe in the south and Julatten in the north, including both the Atherton Tableland and the Evelyn Tableland.

The document is provided as a reference for anyone who is interested in how best to manage native vegetation on the Atherton Tablelands for wildlife needs, especially for Lumholtz's Tree-kangaroo. The major long term aim is to have information from this strategic plan incorporated into local planning documents and acted upon by local authorities, government agencies, rehabilitation and other interest groups. Another aim is to encourage local landholders to manage their land in a way which supports tree-kangaroos and other wildlife. A third aim is to contribute to habitat protection by increasing public awareness of the importance of the fragments as wildlife habitat.

This document draws on information obtained from the *Community Survey of the Distribution of Lumholtz's Tree-kangaroo*, which was conducted by the Tree Kangaroo and Mammal Group in 1998/1999 in the Atherton Tablelands area between Julatten and Ravenshoe. It also uses existing knowledge of tree-kangaroos and their needs, including ideas generated in a community workshop conducted by the Tree Kangaroo and Mammal Group in 1999 about ways to reduce the threats that roads and dogs pose to tree-kangaroos. The entire project involving the survey and this document has been funded from the Natural Heritage Trust under the Bushcare program, with an enormous contribution of time and expertise from members of the Tree Kangaroo and Mammal Group.

Background on Tree-kangaroos

Lumholtz's Tree-kangaroo (*Dendrolagus lumholtzi*), also locally known as a tree-climber or a tree-climbing kangaroo, is classified as Rare under Queensland's Nature Conservation (Wildlife) Act (1994). Lumholtz's Tree-kangaroo is classified as Rare because it is restricted to the 'Wet Tropics' of far north Queensland, from approximately the Carbine Tablelands in the north to the Herbert River Gorge near Ingham in the south (Map 1), which includes the Atherton Tablelands. It is one of two species of tree-kangaroos found in Australia, the other being the Bennett's Tree-kangaroo which is found from approximately north of the Daintree River to Cooktown. Both are unique to Australia. At least eight other species of tree-kangaroos are found in neighbouring New Guinea. Indigenous names for Lumholtz's Tree-kangaroo include 'boongary'¹⁰, and 'muppie'³² or 'mabi'³.

Lumholtz's Tree-kangaroo lives in rainforest (scrub) and occasionally the adjacent wet eucalypt forests with a rainforest understorey. They are primarily leaf-eaters, occasionally eating fruits or flowers. They are mainly nocturnal, but are also sometimes active during the day, especially around dawn and dusk. They are marsupials and give birth to one young at a time. The young are thought to spend about 250 days in the pouch, and further remain with the mother for up to two, or even three years^{3, 18, 33}. Lumholtz's Tree-kangaroo is essentially a solitary animal, with social contact limited to the relationship between a female and her young, brief interactions between males and females for mating purposes, and occasional fights between males^{3, 18}.

Lumholtz's Tree-kangaroo can be recognised by its bear-like face and small rounded ears, large and powerful arms compared to ground-dwelling kangaroos, and very long straight furred tail. When moving across the ground, tree-kangaroos hop like other kangaroos, although tree-kangaroos hold their tail up in the air. When in the trees, however, tree-kangaroos are able to move their hind legs independently if required (i.e., they can 'walk'), quite unlike almost all ground-dwelling kangaroos.

The two Australian tree-kangaroos can be difficult to tell apart, as their general body colour, particularly that of Lumholtz's, can be quite variable – this sometimes leads to claims that Bennett's Tree-kangaroo has been seen on the Atherton Tablelands. The best distinguishing features are the colouring of the face: in Lumholtz's, the face is almost black (Photograph 1), with a distinctly paler forehead giving the impression of a black facial mask or the wearing of a pale sweat-band; whereas Bennett's has a paler, less contrasting facial pattern. The tail markings also differ, with Bennett's tail being much lighter on the top surface than the underside. There is a possibility the distributions of the two species overlap in the Carbine Tablelands area, but this has not yet been documented. Lumholtz's Tree-kangaroo is the only species known from the Atherton Tablelands.

Lumholtz's Tree-kangaroo spends the majority of its time in trees. However, it will readily come down to the ground to travel between individual trees or forest fragments, which is when it is most at risk from being hit by vehicles or attacked by dogs. Tree-kangaroos can travel long distances between rainforest patches, particularly sub-adults searching for their own territories^{10, 16}.

Two separate studies in rainforest fragments near Yungaburra have shed light on the social organisation of Lumholtz's Tree-kangaroo. In these forests, females occupy home ranges of about 0.7 to 2 ha, which are exclusive of other females. Males occupy larger home ranges (about 2 to 4 ha), which overlap with several females and only partly with other males^{16, 18}. This social arrangement is also displayed by Bennett's Tree-kangaroo¹² and many other mammal species, and is probably typical of Lumholtz's Tree-kangaroo throughout its range. However, the size of the home range required by Lumholtz's Tree-kangaroo is likely to vary considerably between different forested areas. Systematic surveys have found that tree-kangaroos were most abundant at high altitudes, on fertile soils and in the seasonally dry parts of the Tablelands⁶. In fact, the forest fragments near Yungaburra where Lumholtz's tree-kangaroo has been studied appear to support unusually high densities of tree-kangaroos^{6, 15, 16, 18}. Individual tree-kangaroos are likely to require much larger home ranges elsewhere.

The total number of Lumholtz's Tree-kangaroo is unknown. One estimate put the number of Lumholtz's Tree-kangaroo in continuous forest on the Tablelands at about ten or twenty thousand⁵. Some additional thousands of individuals are likely to be supported in the rainforest fragments on private land, on the basis of population densities reported for forest fragments in good habitat areas^{16, 18}. The long term viability of tree-kangaroo populations will depend upon the current and future impacts of loss of habitat and of habitat connectivity, mortality from vehicles, dogs or disease, and perhaps external factors such as global warming^{5, 15}. A primary interest of the Tree Kangaroo and Mammal Group is to ensure that the current status of Lumholtz's Tree-kangaroo is maintained and that the species does not become Endangered. Maintaining good populations of tree-kangaroos in the forest fragments on the Atherton Tablelands is a key element to this goal.

Forests on the Atherton Tablelands

The Atherton Tablelands is situated in the mountain ranges behind Cairns in far north Queensland, Australia. Much of its original forest cover was cleared in the early part of the 20th century for agriculture and dairying due to the rich volcanic soils²⁶. The remaining vegetation exists as forest fragments across the predominantly agricultural landscape (Photograph 2 and 3). There are also significant areas of forest on the steep slopes to the east and south of the Tablelands, which are protected as part of the Wet Tropics World Heritage Area.



Photograph 2. Aerial photograph of Upper Barron, Atherton Tableland, with numerous rainforest fragments of varying sizes and thin riparian strips of forest along the creeks (photo - Queensland Department of Natural Resources)

The native vegetation of the Atherton Tablelands region consists mostly of various types of rainforest, which vary in structure and floristic composition with climate and soil fertility²¹. To the west, the rainforest is bordered by a thin segmented band of wet eucalypt forest, which quickly grades into open eucalypt woodland as rainfall declines. North of about Atherton and Yungaburra, the rainforest also is replaced by eucalypt forest for the same reason.

These remaining rainforest fragments on the Atherton Tablelands and elsewhere in the Wet Tropics are exceptionally important as habitat for a rich diversity of fauna, including many rare and threatened species such as Lumholtz's Tree-kangaroo, the Cassowary (*Casuarius casuarius*), and several species of endangered frogs. In fact, though the rainforests of the Wet Tropics cover only *one tenth of one percent* of the land surface of Australia, they support the highest diversity of species anywhere on the continent, with:

- 36% of Australia's mammal species (including 58% of Australia's bat species);
- 60% of Australia's butterfly species;
- 50% of Australia's bird species;
- 37% of Australia's freshwater fish species;
- 25% of Australia's frog species; and
- 23% of Australia's reptile species²³.

There are many reasons for conserving remnant rainforests, in addition to that of conserving the wildlife which lives in them. Forests provide a wide range of environmental and economic benefits to landholders and the community, including various forest products, the control of erosion, the provision of shelter for stock, the provision of clean water, and opportunities for eco-tourism. Forests also hold significant cultural and spiritual values for both indigenous and non-indigenous members of our community. They act as a window to our past, beautify the landscape, and provide a haven to the weary soul.

The Tree Kangaroo and Mammal Group supports all of these reasons for conserving the local rainforests, but because of our particular expertise and interests in fauna and especially tree-kangaroos, we offer this document from the perspective of managing vegetation for wildlife habitat.

Why Protect Tree-kangaroos?

This document focuses on Lumholtz's Tree-kangaroo to demonstrate the importance of conserving rainforest fragments and their wildlife on the Atherton Tablelands. We acknowledge that the conservation of some other wildlife species may require a slightly different approach to tree-kangaroos. However, most measures we are proposing to address the needs of tree-kangaroos, for example retaining habitat, reducing road-kills or controlling roaming dogs, will also benefit a wide range of other wildlife.

Lumholtz's Tree-kangaroo is an ideal species to protect and promote, because:

- it's a unique kind of mammal (a kangaroo up a tree!), found only in this small section of far north Queensland;
- its distribution is centred on the Atherton Tablelands, and it can therefore encourage a sense of pride and ownership amongst the Tablelands community;
- it has the potential to become a real tourism-drawcard for the Atherton Tablelands, bringing economic benefits to the area. The Atherton Tablelands is definitely the best place in the world to see a tree-kangaroo in the wild;
- it is a native animal which does not pose any threat to people, to our crops and orchards, or to our domestic animals. Therefore, all members of the Tablelands community, regardless of peoples background, can appreciate tree-kangaroos;
- it is a large, charismatic, "cute and furry" mammal which easily wins people's affection; and
- it needs our protection if it is not to become endangered.

There are many examples across Australia where small communities have benefited financially from adopting and promoting a wildlife species as 'their' animal. For example, visitors from all over the world flock to Kangaroo Island in South Australia to see the Glossy Black Cockatoo, as

the result of a community effort on the island. Other examples include Monkey-Mia in Western Australia and its dolphins, and Phillip Island in Victoria and its fairy penguins. Lumholtz's Tree-kangaroo has immense potential to bring similar economic benefits to the Tablelands.

Section 2: The Community Survey of Lumholtz's Tree-kangaroo

In 1998 and 1999, the Tree Kangaroo and Mammal Group conducted two community-based surveys on the distribution of Lumholtz's Tree-kangaroo, the first in the Malanda postal district, and the second in remaining postal districts on the Tablelands between Julatten and Ravenshoe. The majority of residents in these areas were sent a questionnaire asking them to provide details of their sightings of tree-kangaroos and other relevant information. The survey was designed to obtain detailed information on the historical and current distribution of tree-kangaroos, as well as to document local anecdotal knowledge on these remarkable animals. A community-based survey was chosen to obtain this information for several reasons including efficiency (tree-kangaroos are difficult to survey by standard field-survey methods), the relative ease of obtaining information on the distribution of tree-kangaroos on private land, and because a community-based survey would also raise public awareness of tree-kangaroos.

Eight hundred people returned information to us, providing us with information on well over 2000 records of sightings of alive and dead Lumholtz's Tree-kangaroos. Full details of the results and methodology are listed in the Survey Report²⁰ which is available from the Tree Kangaroo and Mammal Group. The main conclusions of the survey were:

- 1) Lumholtz's Tree-kangaroo is largely restricted to higher elevation rainforests from the Carbine Tablelands, the Atherton Tablelands and Kirrama region, as far south as the Herbert Gorge. It has a continuous distribution within this range (Map 1).
- 2) The Tableland area between Atherton and Ravenshoe forms the core of the distribution of Lumholtz's Tree-kangaroo. Optimal habitat for the species occurs in remnant rainforests on fertile basalt soils in the western two-thirds of this Tableland area and the higher elevation rainforests around the Tablelands, including the Herberton and Cardwell ranges (Map 2).
- 3) Conservation of Lumholtz's Tree-kangaroo on the Atherton Tablelands will require the protection and enhancement of remnant rainforest by private landholders, as most remnants on the Tablelands occur on freehold land. Additionally, threats to tree-kangaroos from roads and roaming dogs need to be reduced to enable tree-kangaroos to disperse between remnants.

Section 3: Threatening Processes to Tree-kangaroos

Background

Wildlife habitat encompasses the essential elements of an animal's 'home', such as those things that provide it with food, refuge, nesting resources and access to a mate. Threatening processes are those things which impact upon one or more of these essential elements.

For many animals, the most important threatening process is the loss of habitat from the clearing of native vegetation, and the associated loss of connectivity between remaining patches of habitat. However, even when habitat and habitat connectivity are secure, human activity around the remaining areas of native vegetation can impact upon the ability of those forests to effectively provide refuge and shelter for wildlife. For example, introduced animals, roads and motor vehicles

cutting through habitat, and direct human 'predation' through shooting, hunting or poisoning, can have significant impacts upon wildlife numbers (e.g. Spotted-tailed Quolls which are often killed when they raid poultry yards²). Traditionally, tree-kangaroos were hunted as a food source by some Aboriginal groups, but there appears to be little direct human 'predation' on Lumholtz's Tree-kangaroo today. These days, the human activities that most adversely affect tree-kangaroos are 'incidental', including loss of habitat and mortality from motor vehicles and dogs. The Community Survey conducted by the Tree Kangaroo and Mammal Group found that there was considerable public awareness and concern of these threats facing tree-kangaroos²⁰.

Loss of Habitat and Loss of Habitat Connectivity

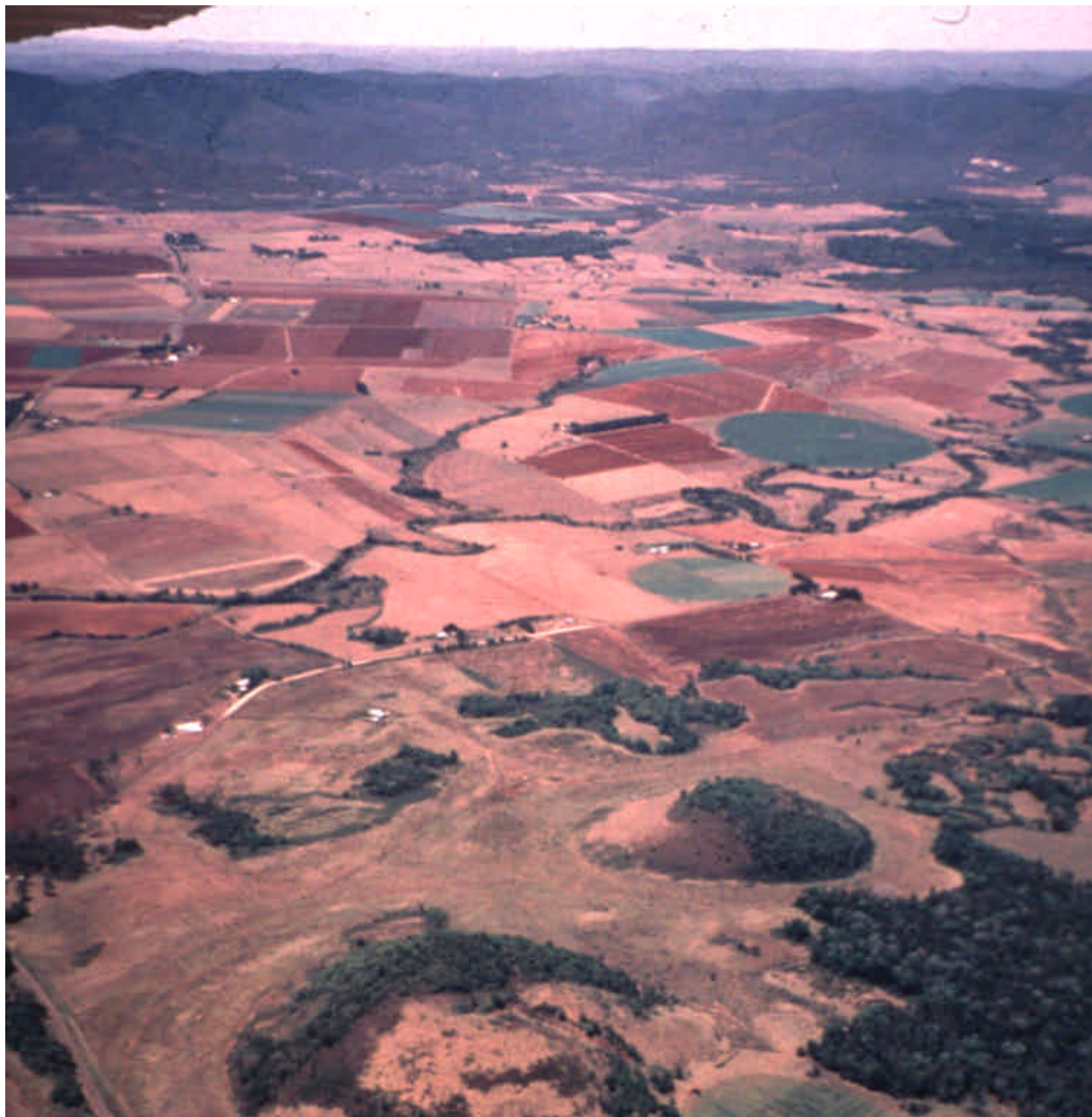
Loss of habitat from the clearing of native vegetation has an obvious and direct impact upon wildlife: without habitat, there is no food, refuge or mates, and without these, wildlife cannot survive. The best land for agriculture is often also the best land for wildlife: for example, clearing of rainforest on the Atherton Tablelands has been concentrated on the fertile basalt soils²⁶, yet the community survey conducted by the Tree Kangaroo and Mammal Group, and the surveys of ecologists, indicate that these fertile soils support forests which provide high quality habitat for Lumholtz's Tree-kangaroo (Photograph 3)^{6, 16, 20}.

The clearing of native vegetation also tends to reduce the remaining habitat to a series of small fragments. This 'fragmentation' of habitat can have significant indirect impacts upon wildlife, for example by reducing the capacity for animals to disperse between the remaining patches of vegetation. Populations of animals in small fragments are particularly dependent on habitat connectivity for access to a variety of food and nesting resources, access to new territories when required, and access to genetic variability in mates which is required for the long-term viability of the populations. The fragmentation of habitat also produces 'edge' effects, where the increased amount of 'edge' to the forest leaves the fragment vulnerable to the penetration of biotic (e.g. weeds, feral animals) and abiotic (e.g. climate) factors. In rainforests, these edge effects have been measured as having impacts on a scale of tens to hundreds of metres into the forest. Small or narrow fragments are those most affected by edge effects⁹.

Effects of Habitat Loss on Tree-kangaroos

Loss of habitat has had a major impact on populations of tree-kangaroos on the Atherton Tablelands. Tens of thousands of hectares of forest on fertile soil, presumably prime habitat for tree-kangaroos, has been cleared in the Atherton Tablelands area over the last century²⁶.

A recent study documented the response of tree-kangaroos to land clearing in a rainforest remnant near Yungaburra: resident tree-kangaroos simply did not move to nearby habitat when their forest was cleared, but remained in the forest debris of their original territory and eventually died from dogs attacks, starvation and disease^{14, 16}. It appears, therefore, that tree-kangaroos are strongly attached to their individual territories. The clearing of a forest may not only affect tree-kangaroos living in it, but also the populations living in nearby forest fragments that are supported by the dispersal of individuals from the cleared forest. Likewise, the extensive clearing of the fertile basalt soils on the Atherton Tablelands is likely to have impacted on tree-kangaroo populations in the surrounding areas of more marginal habitat, because the high quality Tableland forests probably acted as a source population for the region⁵.



Photograph 3. Aerial view of the northern more cleared end of the Atherton Tableland (photo-Graeme Newell).

Effects of Habitat Fragmentation on Tree-kangaroos

Tree-kangaroos appear to be relatively tolerant of habitat fragmentation for several reasons^{8, 17}. Firstly, tree-kangaroos seem to prefer to eat many species of trees and vines which are favoured by disturbance and thus common on the edges of, and within, remnant rainforests¹⁸. Secondly, tree-kangaroos are well able to disperse: for example, the Community Survey obtained numerous records of tree-kangaroos up to 10 km from the nearest large rainforest patch²⁰. Many of the dispersing individuals are sub-adult males, looking to establish an independent territory. For example, one sub-adult male was found to roam over an area of several hundred hectares during a six month period (compare this with the 1 – 2 ha used by adult tree-kangaroos in the same forest)¹⁶. Small, isolated rainforest patches are particularly dependent on dispersal for the persistence of tree-kangaroos and other wildlife^{7, 8, 15}. For example, a tiny patch of rainforest (1 ha) along Topaz Rd near Malanda consistently supported at least three resident females plus young in the 1990's, but no resident males³³. Nevertheless, tree-kangaroos were able to persist in

that fragment because males from nearby remnants were able to disperse to the fragment to mate with the resident females.

Tree-kangaroos are able to disperse across cleared sections from one fragment of forest to another. More than once, respondents to the Community Survey reported their surprise at finding a tree-kangaroo up a single tree where the nearest group of trees was a considerable distance away! Tree-kangaroos also turned up occasionally in unexpected places such as residents' backyards, paddocks, orchards, and tea or other crop plantations, and several road-kills were reported some distance away from the nearest rainforest fragment. However, without trees to take refuge in along the way, dispersing tree-kangaroos are vulnerable to being killed by dogs, and are also liable to be killed by cars when crossing between remnants^{14, 20}.

For this reason, tree-kangaroo populations still require some kind of connectivity between rainforest fragments to survive in the long-term. Furthermore, unlike tree-kangaroos, certain other wildlife species on the Atherton Tablelands (e.g. the Lemuroid Ringtail Possum) do not cross cleared gaps between rainforest fragments^{8, 17, 24}. Direct habitat connectivity is essential for the long term survival of these species in remnant rainforests.

Threats to Tree-kangaroos from Roads

The most obvious impact that roads have on wildlife is direct mortality resulting from collisions with cars. Certain species and life-stages seem to be more susceptible to being killed on roads than others. Lumholtz's Tree-kangaroo is a vulnerable species: individuals actively come to the ground to cross between trees and forest patches, they can travel considerable distances especially as dispersing sub-adults, and they prefer many of the trees and vines which flourish along road-sides. Roads can also affect wildlife populations by fragmenting their habitat (Photograph 4), which is particularly significant for animals which require continuous forest cover for dispersal, such as the Lemuroid Ringtail Possum.

Results from the Community Survey confirm that road-kills are indeed an important cause of mortality for Lumholtz's Tree-kangaroo. Two hundred and fifty records of road-killed tree-kangaroos were obtained in the survey, most from the last decade and on the Atherton Tablelands²⁰. Margit Cianelli, the wildlife carer who has collated many of these records, reports that a considerable proportion of tree-kangaroos are being killed early in the morning when residents are on their way to work and tree-kangaroos are still active²⁷. Most of the road-killed tree-kangaroos were young males, presumably seeking a territory. Whether or not tree-kangaroo populations will be able to be sustained in the long term if such rates of mortality continue, is unknown. Regardless, it makes sense to reduce the road-kill rate if at all possible.

Several distinctive 'black-spots' for tree-kangaroo road-kills on the Atherton Tablelands were revealed in the Survey, based on the numbers of road-kills reported (Maps 3 and 4). These include:

- the Kennedy Highway between Upper Barron and Longlands Gap (either side of "The Crater")
- East Evelyn Rd, Sluice Creek Rd and the Kennedy Highway in that vicinity;
- The Gillies Highway in the vicinity of the Yungaburra State Forest (the Curtain Fig Tree scrub);
- The road between Tarzali and Millaa Millaa; and
- Winfield Bridge over the North Johnstone River, just east of Malanda.



Photograph 4. The main Malanda to Millaa Millaa road situated close to tree-kangaroo habitat in a rainforest fragment (photo - Carol Schmidt).

These are the areas where actions to prevent road-kills need to be targeted.

The number of tree-kangaroos killed on roads may increase as roads on the Tablelands are upgraded to increase the road width, increase the amount of traffic, and/ or allow traffic to travel faster. One road upgrade of concern is the East Evelyn road, also known as McHugh Rd, which connects Millaa Millaa with the Kennedy Highway and Ravenshoe. Of particular concern is the 2 - 3 km section locally known as “Gentle Annie” near the Millaa Millaa lookout which passes between the World Heritage listed forests of the Hugh Nelson Range and Mount Fisher. The East Evelyn Rd, already a ‘black-spot’ for tree-kangaroo road-kills, is to be upgraded to enable high-speed travel by large trucks in 2000. The Queensland Department of Main Roads is aware of the concerns of the Tree Kangaroo and Mammal Group regarding this upgrade, and have included several large 3 m high culverts as wildlife underpasses in the road design. The effectiveness of these underpasses will be monitored by scientists from the Rainforest Cooperative Research Centre (CRC) and James Cook University.

The East Evelyn Rd upgrade is a good opportunity to determine what works and what doesn’t with respect to fauna crossings in the Wet Tropics, particularly with respect to tree-kangaroos. What is learnt from this exercise will be of immense interest to the ecological community, and will have significant implications for future road developments.

Threats to Tree-kangaroos from Dogs

Dogs can be wonderful and sensitive pets, companions, and farm-hands, truly deserving their title “Man’s Best Friend”. However, without dog-owner responsibility, they can also be one of native fauna’s worst enemies in fragmented habitat areas (Photograph 5).

How many stories do you know of your own dog, or someone else’s, killing wildlife? It is a natural instinct for a canine to chase and kill, whether for food or for sport. We acknowledge that it is not a dog’s fault when it is left to roam and chases or kills wildlife, but is the responsibility of

the owner to control their dog. Dog owners sometimes believe their dogs do not do any harm, because they say “my dog never kills anything, he just likes to chase animals and then let them go”. What many people do not realise, however, is that even if an animal survives being chased by a dog or shaken by a dog’s teeth, they often die later from shock, myopathy (a stress-related disease involving the breakdown of muscle tissue), or internal injuries³¹.

Tree-kangaroos have an advantage over ground-dwelling wildlife, such as bandicoots and pademelons, in that they can seek refuge from predators like dogs by climbing up trees. Nevertheless, tree-kangaroos are still often killed by dogs, just as birds are often killed by cats even though birds can fly. Tree-kangaroos are particularly vulnerable to being attacked by dogs when they are dispersing between isolated remnants or trees.

Thirty-one records of tree-kangaroos being killed by dogs on the Atherton Tablelands were collected in the Community Survey, mostly from the last decade. The actual number of tree-kangaroo deaths from dogs is likely to be far greater, because, unlike road-kills, dogs do not always leave a carcass where people may come across it. Given this, we believe that dogs are an important source of mortality to tree-kangaroos, particularly in closely-settled areas. How much of an impact these deaths have on local populations of tree-kangaroos, and whether or not tree-kangaroo populations will be able to be sustained long term if such rates of mortality continue, are unknown.

Though the survey data does not show clear ‘black-spots’ for dog attacks (Maps 3 and 4), it can be assumed that any wild or domestic dog roaming uncontrolled is a potential threat to tree-kangaroos, particularly when in the vicinity of important habitat. Dogs are also a threat to other wildlife species in the Wet Tropics, notably the Cassowary. There have been several reports of Cassowary deaths caused by dogs in rural areas and along the edges of residential development, as well as Cassowary killings by pig dogs during hunting¹.

Very occasionally, a dog will come off second best when it attacks a tree-kangaroo, for a tree-kangaroo in self-defence can inflict wounds with its exceptionally sharp claws. However, this is a rare exception, and tree-kangaroos do not attack, only act in self-defence when they themselves are attacked.



Photograph 5. Dingo with dead tree-kangaroo (photo - Peter Trott)



Photograph 6. Solitary tree in paddock can act as a refuge for a tree-kangaroo (photo - Carol Schmidt).



Photograph 8. Tree-kangaroo road sign (photo - Carol Schmidt).



Photograph 7. Aerial view of a narrow rainforest riparian strip plus plantation along a creek meandering through grassy paddocks (photo- Andrew Dennis).

Tree-kangaroo Deaths from Disease

Little is known about the diseases that affect tree-kangaroos. The most commonly recorded is meliodosis, which is a soil organism that is known to cause death in captive tree-kangaroos. However, research and anecdotal evidence indicate that disease may be a small but significant cause of mortality for tree-kangaroos, and that mortality from disease may increase with stresses placed upon tree-kangaroos from loss of habitat, and interactions with dogs and cats.

Three sick adult Lumholtz's Tree-kangaroo from the wild have been examined by a local vet over the past four years³¹. One of these tested positive for dramatic infestations of a protozoa called 'toxoplasmosis' (*Toxoplasma gondii*), which may have contributed to its death caused by secondary pneumonia. Toxoplasmosis is a primary gastro-intestinal protozoa in cats, and is thought to be transferred between animals through contact with feral or domestic cat faeces. It is known to secondarily affect tree-kangaroos, some other wildlife, and even unborn children during pregnancy. This animal had been taken to the vet after its rainforest habitat had been cleared. The two other sick tree-kangaroos had incidental infestations of an unknown protozoa. These two tree-kangaroos were blind and may have had degeneration of the retina due to an unknown virus. One of these died from secondary tick paralysis.

These three animals were found in different places across the Tablelands: Longlands Gap, Thomas Road in Yungaburra, the Malanda Falls Environmental Park. It is possible, therefore, that toxoplasmosis or another protozoa is widespread in the wild tree-kangaroo population. It seems that whilst these conditions do not actually cause death, they can cause problems when the animal is stressed for other reasons, i.e., contracting pneumonia, tick infestation, experiencing a dog attack or vehicle collision, being raised as an orphan by a carer, or just old age³¹. Further research will be required to understand the extent of infestations, the exact modes of transmission, associated stress factors, and the effects of protozoa on the tree-kangaroo population.

Tree-kangaroo Deaths from Hunting

Traditionally, Aborigines hunted Lumholtz's Tree-kangaroos as an occasional food source, and the meat was proclaimed to taste good^{3, 10}. However, not all groups killed and ate tree-kangaroos, for example the Dulguburra clan of the Mamu people near Jordon Creek in the Palmerston area did not hunt the tree-kangaroo as it was, and still is, their totem³². Hunting may also have been generally forbidden in some important habitat areas^{3, 13}.

From the early days of European settlement, there are many stories of tree-kangaroos being shot as they came out of the scrub by white residents, for the pot or to feed the dogs. There appear to have been only limited attempts to hunt the animal for its fur: for example, Eddie Collins, formerly of Kirrama station, remembers going hunting with his Uncle and Aboriginal guides in the 1940's, and shooting 32 tree-kangaroos for their skins.

The shooting of tree-kangaroos for museum specimens by naturalists was also common in the 1800's and early 1900's when tree-kangaroos were considered a new and fascinating species, and the occasional specimen was taken up to the 1970's. Since then, a change in our values and changes in available technology (DNA technology) has meant that tree-kangaroos are no longer killed in the name of science.

Today, the hunting and shooting of tree-kangaroos for food, dog-food, sport, skins or science is no longer a major issue. Instead, the major threats to the species arise from loss of habitat, from road-kills and from roaming dogs.

The Future for Tree-kangaroos?

Whilst Lumholtz's Tree-kangaroos are present in reasonable numbers across much of the Atherton Tablelands at the moment, their future will strongly depend on how the remaining rainforest habitat is managed. There are numerous examples of once common animals disappearing from human-dominated landscapes, for example the Koala from coastal valleys in south-east New South Wales¹¹. If remnant rainforest patches, particularly on basalt soils, continue to be cleared or reduced in size on the Atherton Tablelands, core habitat of Lumholtz's Tree-kangaroo will be lost.

Even if habitat is maintained, mortality from cars and dogs may seriously threaten the long-term conservation of tree-kangaroos in some remnant forests. Particularly at risk are tree-kangaroo populations occupying small fragments or marginal habitat which are dependent on a steady stream of dispersing individuals, especially where those remnants are near busy roads, in a rural residential area with many dogs, or simply a long way from source populations. For example, extensive clearing of forests on fertile soils in the Tolga and Kairi area has left only small remnants such as the Tolga Scrub, separated from potential source populations of tree-kangaroos in the Herberton Ranges, Wongabel State Forest and the Curtain Fig Scrub, by vast areas of crops, paddocks, urban development and busy roads. Tree-kangaroos have virtually disappeared from this area, even though the forest type once supported in this area is known to carry very high densities of tree-kangaroos^{6, 15}.

Our management of remnant rainforest patches on the Atherton Tablelands and of the threats of roads and dogs, will determine whether the Lumholtz's tree-kangaroo retains its present conservation status of Rare (meaning it has a limited geographical range), or heads down the path to becoming Endangered or even eventually Extinct.

Section 4: Management Options

Background

The following recommendations are aimed at reducing the threatening processes to Lumholtz's Tree-kangaroo and their habitat in the Atherton Tablelands region. Most of the recommendations will also benefit other local native fauna species, and allow rainforest ecosystems to function better as wildlife habitat.

The recommended actions are listed under the following headings:

- Protecting Tree-kangaroo Habitat and Improving Habitat Connectivity;
- Reducing Road-kills of Tree-kangaroo;
- Reducing Dog Attacks on Tree-kangaroos; and
- other methods.

The recommended actions may be suitable for one or more levels of the community including individual landholders, rainforest rehabilitation groups, shire councils, schools, government departments and their planners, and the tourism and media industries.

Protecting Tree-kangaroo Habitat and Improving Habitat Connectivity

Protecting Rainforest on Private Land

Remnant forests on private land on the Atherton Tablelands are a stronghold for Lumholtz's Tree-kangaroo habitat. Thus, these forests need to be protected and enhanced where appropriate.

Options to Protect Rainforest on Private Land:

- **the removal of disincentives** for landholders to retain remnant forests on their properties. There is a perception by some landholders who own remnant forests that higher rates are levied on their properties than on comparable properties which have been cleared. This perception provides no incentive for a landholder to retain remnant forest. The land valuation schemes and consequent council rates calculations need to reflect current society's values and conservation values, as well as traditional land "improvements". Removal of these disincentives may involve the revision of both the current Department of Natural Resources (DNR) land valuation formula and the council rating policies used to calculate rates for property owners.
- **the creation of incentives** for private landholders to retain native vegetation on their properties. The provision of council rate rebates for landholders who conserve important wildlife habitat on their property has been successful in other shires such as the Johnstone Shire, which offers a reduction in rates for the proportion of each property under a voluntary conservation agreement in Cassowary habitat areas. We acknowledge rate relief systems can be difficult for councils to implement, particularly in shires with a low rate base. One option for councils may be green levies to the wider community to cover a reduction in rates for landholders conserving remnant rainforest on their property, similar to the system operating in Brisbane City Shire. A public survey could determine the community acceptance of such a scheme on the Atherton Tablelands.
- the establishment of **voluntary conservation agreements** between landholders, and local councils or state governments, for the protection of important wildlife habitat on part or all of their properties. Options for landholders on the Tablelands include (see contact list at back for contact details):
 - *Nature Refuge Voluntary Conservation Agreements*: these agreements are between the landholder and the Queensland Parks and Wildlife Service, and are usually attached to the land title in perpetuity, therefore also binding the successive owners. In return for the agreement, the government may provide assistance (e.g. fencing, advice on pest control or on flora/fauna) for the protection of the land under agreement. These agreements are tailored to suit the management needs for each property, and the landholder maintains ownership of and management responsibility for the land, continuing to carry out normal activities on the property in accordance with the agreement;
 - *Statutory Covenants*: a new amendment to the Land Act will allow covenants to be registered on the property title for heritage, land use or conservation purposes. Administrators of these Covenants and the relevant contact persons are still to be determined;
 - *Land for Wildlife Agreements*: these are non-binding arrangements which acknowledge and assist landholders who are managing some or all of their property as wildlife habitat, or who are working at integrating nature conservation with other land uses such as agriculture or nature tourism. There are no joining fees, and benefits to members include free access to information on managing wildlife habitat, and recognition and support for their efforts in contributing to nature conservation;
 - *Shire Conservation Agreements*: these agreements between landholder and councils, sometimes tied to rate rebates for the landholder, currently do not exist on the Atherton

Tablelands. Other Shires in the region such as the Johnstone and Cardwell Shires have their own conservation or land management agreements. We recommend that the Shires on the Atherton Tablelands consider setting up similar schemes.

- the **realisation of private benefit** from the conservation of remnant vegetation, such as ecotourism or the ecologically sustainable harvesting of forest products. Such benefits provide a direct incentive to conserve vegetation and are already being realised by some landholders on the Atherton Tablelands. The Tree Kangaroo and Mammal Group proposes that a series of case studies be developed to demonstrate examples where the conservation of rainforest on a property is compatible with other property activities such as dairying, agriculture, rural residential development or ecotourism.

Rehabilitating Rainforest

Rainforest rehabilitation, restoration or re-establishment may involve the following elements: site preparation (removal of weeds in an area before planting); revegetation with indigenous species of trees (native to the specific area); weed control within existing rainforest; fencing to exclude cattle from revegetated areas as the trees grow; and ongoing maintenance of the revegetated sites until such time as the trees are established. The book, “Repairing the Rainforest” gives excellent information about re-establishing rainforest in north Queensland’s Wet Tropics⁴, and is available from TREAT and the Wet Tropics Management Authority (see contact list at back for contact details).

Tree-kangaroos are likely to benefit from the re-establishment of rainforest at a range of scales throughout the agricultural landscape of the Atherton Tablelands. Small patches of rainforest, vegetation corridors linking larger forest fragments, “fingers” or peninsulas of vegetation extending from individual forest fragments, and even individual trees in backyards or cleared paddocks are all potentially useful as tree-kangaroo habitat, sources of food and refuge from dogs (Photographs 6 and 7). Tree-kangaroos have been observed feeding on young trees in revegetated areas^{28, 29}, which means that the tree-plantings now occurring throughout the Tablelands are likely to be of benefit to tree-kangaroos within a few years. However, young trees cannot fully support the weight of a tree-kangaroo and do not provide refuge from dogs. Hence, purpose-built shelters may need to be included within replanted areas to enable them to be fully utilised by tree-kangaroos. Artificial nesting structures (nest-boxes) will also be necessary for other rainforest animals to utilise revegetated areas, particularly species like the Lemnoid Ringtail and Herbert River Ringtail possums and rainforest owls, which nest in old hollow trees or large old epiphytes in natural forests^{5, 22}.

Revegetation schemes should also consider the inclusion of known tree-kangaroo food plants in their planting stock. A list of known food plants has been distributed to rehabilitation groups on the Atherton Tablelands, and is also available from the Tree Kangaroo and Mammal Group. However, it must be borne in mind that our knowledge of the food plant preferences of tree-kangaroos is not comprehensive, and individual tree-kangaroos may also have their own preferences for certain species of trees^{14, 18, 30, 33}. In general, therefore, the best guideline for revegetation is to plant a diverse range of species which are indigenous to the specific area, which, when in rainforest areas, will probably include tree-kangaroo food plants anyway.

Options for Rainforest Rehabilitation:

- continued **funding for fencing and revegetation incentives** for landholders and rehabilitation/environmental groups from state and federal governments;

- **incentives for private landholders** to revegetate native vegetation on their properties. These may involve councils seeking funding or re-allocating funds to cover a reduction in rates for landholders who revegetate parts of their property with indigenous rainforest species, particularly in important wildlife habitat or habitat linkage areas;
- **demonstration of the benefits of combining rainforest revegetation with other property objectives**, such as dairying, agriculture, rural residential development and eco-tourism, via case studies.

Improving Habitat Connectivity

Revegetated areas may not only provide additional habitat for tree-kangaroos and other wildlife, but, if well planned, may assist the dispersal of individuals across the wider landscape. For this reason, many revegetation schemes aim to act as a corridor linking one patch of rainforest with another. At present, very little is known about the characteristics which determine whether revegetated areas are successful as wildlife corridors, but there are two broad issues to consider:

Firstly, what is the role of the corridor within the landscape? The most effective corridors are likely to be those that connect small or isolated remnants with source populations in large remnants or continuous forest of good habitat. For Lumholtz's Tree-kangaroo, optimal habitat appears to occur in remnant rainforests on fertile basalt soils in the western two-thirds of the Atherton Tablelands and the Herberton and Cardwell ranges to the west of the Tablelands^{6, 15, 20, 25}.

Secondly, what are the specific habitat features included in the corridor? At this scale, the most effective corridors are likely to be those that provide food and nesting resources for target species, and minimises exposure to predators or other threats. For tree-kangaroos, some of these specific requirements include known food plants and refuge shelters, discussed previously.

Options for Improving Habitat Connectivity:

- For tree-kangaroos, corridors are needed **to connect the remnant forests on the Tablelands with the forested ranges to the west** of the Tablelands (the Herberton, Hugh Nelson and Cardwell Ranges, including Mt Baldy and Mt Fisher).
- For other species, such as the Cassowary and the Musky Rat-kangaroo, **corridors which link fragments to the continuous rainforest in the east** of the Tablelands, such as Donaghy's corridor between Lake Barrine and Gadgarra State Forest, will be valuable²².
- The **design of corridors** needs to consider potential increases in wildlife mortality if animals are directed towards dangerous areas such as busy roads or residential developments with many dogs.

Reducing Tree-kangaroo Road-kills

There is very little practical information, at present, regarding specific measures which might reduce the number of tree-kangaroo or other animals in the Wet Tropics being killed on roads. The following recommendations are considered reasonable in the light of current knowledge.

Improving Knowledge on Road-kills

Options:

- **determine ‘black-spots** for road-kills for specific wildlife species. Based on records of road-killed tree-kangaroos collected in the Community Survey (Maps 3 and 4), road-kill black-spots for tree-kangaroos include:
 - the Kennedy Highway between Upper Barron and Longlands Gap (either side of “The Crater”);
 - East Evelyn Rd, Sluice Creek Rd and the Kennedy Highway in that vicinity;
 - The Gillies Highway in the vicinity of Yungaburra State Forest (the Curtain Fig Tree scrub);
 - The road between Tarzali and Millaa Millaa; and
 - Winfield Bridge over the North Johnstone River, just east of Malanda.
- **conduct research into the behavioural responses of specific wildlife species to roads**, and the impacts of road-kill rates on the viability of their populations. The response of wildlife to roads is likely to differ between different species. A species-specific understanding is required to develop effective and appropriate practices to prevent road-kills.
- **monitor road-kills** and the effects of measures implemented to prevent road-kills.
- **establish clear protocols for liaison and consultation** between the Queensland Department of Main Roads and environmental groups and government agencies regarding environmental aspects of road upgrades and developments, as well as implementing current departmental recommendations for improving environmental practices¹⁹.

Slowing Traffic In Priority Road-kill Areas

Options:

- **signage**: while signs indicating fauna crossing areas undoubtedly raise public awareness, they do not appear effective in reducing road-kills (Photograph 8). Signs appear to slow down tourist drivers, but not locals who are frequently exposed to the sign. Many of the tree-kangaroos killed on the Kennedy Highway near Upper Barron where the tree-kangaroo crossing road signs are located, appear to be killed early in the morning when residents are on their way to work and tree-kangaroos are active²⁷.
- **speed bumps or other traffic calming features** are effective in reducing the speed of vehicles. However, these measures may be politically undesirable, as drivers generally wish to get where they are going as fast as possible. Nevertheless, such measures may be necessary in important habitat areas should other measures fail. These measures are more likely to be accepted if they are implemented as part of a road upgrade or development, or with community consultation.
- **reduction of the legal speed limit** in the black-spots, including:
 - a) a permanent speed reduction,
 - b) a reduction at certain times of the day, as occurs in the vicinity of schools around start and finish times, if it can be demonstrated that road-kills primarily occur during specific times, or
 - c) a seasonal reduction, if it can be demonstrated that road-kill rates have significant seasonal variation.

In the case of tree-kangaroos on the Atherton Tablelands, option b) may be appropriate. However, any speed limit reductions will only be effective if they are regularly enforced, and therefore they should be planned and implemented in consultation with local Police.

- **Driver education:** The effectiveness of all the above actions are likely to be increased if implemented in conjunction with a public awareness raising campaign. School children are often the most open to education, and this will contribute to long-term change in society values.

Deterring Animals From Roads In Priority Road-kill Areas

Options:

- **audible strips** (sometimes called ‘rumble strips’), placed across the road in black-spots. These strips, which make a loud noise as vehicles drive over them, aim to frighten wildlife away from the road as vehicles approach without requiring the driver to slow down. For motor-cycle safety reasons, these strips should be designed with a non-slip surface.
- **reflectors** placed strategically along road sides so that vehicular light is reflected back into the forest: These rely on vehicles having their lights on during peak road-kill times. This strategy has been implemented in an attempt to reduce road-kills of the Proserpine Rock Wallaby.
- **‘roo-shoos’:** small inexpensive plastic devices mounted on vehicle bumper bars, emitting a high pitched whistle as air passes through, apparently detectable by wildlife like kangaroos as the vehicle approaches. These would need to be trialed to see if their ‘whistle’ is able to be detected by, and deter, tree-kangaroos or other wildlife in the Wet Tropics.
- **roadside vegetation mowing/ pruning:** this measure enhances the visibility of wildlife to drivers and may also deter some species from approaching the road. Keeping roadside grass under control can be a major task in the Wet Tropics, especially during the wet season, but is probably an important activity for reducing wildlife mortality on the roads. It is possible that the pruning of roadside rainforest trees may also reduce road mortality if it occurs at specific times of the year when new growth attracts animals like tree-kangaroos. However, it would be crucial to maintain canopy closure over at least some sections of roads to ensure habitat connectivity for wildlife species such as the Lemuroid Ringtail Possum which do not come to the ground²⁴.
- **roadside vegetation design:** narrow strips of rainforest trees along road sides look nice, but they are unlikely to offer much additional habitat and they may encourage tree-kangaroos to cross the road. For example, if a rainforest fragment is on one side of a road and the other side of the road is cleared except for a thin strip of trees, tree-kangaroos living in the fragment may be attracted across the road to feed on those trees and risk being run over in the process.

Allowing The Safe Movement Of Fauna Between Habitat Areas

Options:

- **Improved road designs** which avoid areas of important wildlife habitat and which incorporate wildlife crossing points. Road upgrades are opportunities to redesign roads to make them more ‘friendly’ for wildlife and habitat protection. The Bambaroo Hills upgrade south of Ingham and the Cardwell Bypass are examples of where roads have been re-routed during the planning stage to minimise impacts on endangered species (in these cases, the Mahogany Glider).
- **designated fauna crossings:**
 - a) **fauna underpasses:** road bridges over small valleys are likely to be the most effective fauna underpasses as they retain continuous habitat under the road. A cheaper option is to incorporate culverts in a road as fauna underpasses. There are no data on the size of culverts required for wildlife species like tree-kangaroos and cassowaries, but the general feeling

amongst experts is “the bigger the better”. The Queensland Department of Main Roads manual on fauna sensitive road designs is consistent with this view, stating that the use of large structures (in excess of 6m wide by 3m high) is likely to promote passage of such fauna¹⁹.

In liaison with the Tree Kangaroo and Mammal Group and the Rainforest CRC/ James Cook University, the Queensland Department of Main Roads has agreed to include three large culverts (3.4 m high x 3.7 m wide), specifically for fauna movement, in the East Evelyn road upgrade near Millaa Millaa. What is learnt from the construction and monitoring of these culverts will be of immense interest to the ecological community and will have significant implications for future road developments.

b) features to **channel wildlife through underpasses**

Culverts alone are highly unlikely to attract tree-kangaroos or any other fauna. Additional features, such as appropriately designed plantings of indigenous rainforest species, careful use of natural features (e.g. gullies), engineering works (utilising dirt from cut and fill) or fencing may be required to funnel animals through culverts. Fencing is an expensive option, but has proven effective in reducing road-kills elsewhere, e.g. Koalas on the Sunshine Coast Motorway¹⁹. The Tree Kangaroo and Mammal Group will soon be trialing fencing designs specifically aimed at preventing tree-kangaroo movement, based on the ‘floppy-top’ fence designs used to prevent koalas moving onto the Brunswick Heads Bypass in northern NSW¹⁹.

Culverts may also require materials such as rocks, logs, vegetation and refuge poles to be positioned inside them and around their entrance/ exits, to encourage wildlife to use them, and to provide important shelter from predators who may take advantage of the crossing point. Raised ledges or smaller pipes within larger culverts may also encourage the movement of smaller mammals and reptiles.

c) **arboreal crossings**: overhead structures, e.g. built from ropes or wires, are unlikely to be utilised by tree-kangaroos, but these structures may be important for smaller arboreal animals such as the rainforest ringtail possums²⁴.

Reducing Dog Attacks On Tree-kangaroos

Actions to reduce tree-kangaroo and other wildlife deaths from dog attacks seek mainly to control roaming dogs. One path of options involves community education, where dog owners are targeted with awareness raising activities encouraging them to do the right thing. Another path of options is to encourage good practice through legislation. Both of these types of actions can complement each other.

There is national legislation regarding options for dog control, but it is up to individual councils to adopt aspects of this legislation, forming their own “local laws”, previously known as “by-laws”. It is important to note that any legislation or guidelines will not be effective unless they are enforced. All of the local councils on the Atherton Tablelands have local laws regarding dogs on their books, but enforcement of these laws requires a commitment of resources which are not always available. However, we believe the issue is of such importance that if resources are not currently available, we recommend that additional funds be sought. It is also important that the enforcement of local laws are humane toward the offending dog. It is not the dog’s fault if it is left to roam or if it chases wildlife, but rather is the responsibility of its owner.

Options:

- **education through schools** about how dogs can hurt tree-kangaroos and other wildlife, incorporating messages about how owners can care for their dogs as well as local wildlife, e.g. don't allow your dog to roam uncontrolled, register and desex your dog;
- **information pamphlets for landholders** on the impact of dogs on tree-kangaroos and actions that landholders/dog owners can take to reduce those impacts. Such pamphlets could be sent out with rates notices to landholders, distributed to dog obedience clubs, or distributed through the networks of Department of Primary Industries and farming groups;
- **dog-obedience training**, which can help train dogs in refraining from chasing wildlife;
- **the control of roaming domestic and farm dogs**. A dog should not be allowed to roam uncontrolled outside of its owner's property. On large properties containing wildlife habitat, the restraint of dogs even within the property is an issue, particularly at night when a lot of wildlife is active. The control of roaming dogs outside their owners property requires a strong commitment from, and the necessary funds within, local councils to enforce local laws regarding this matter. Incentives to encourage dog-owners to be responsible for their dog, such as substantial fines for owners of dogs found roaming wild, or free desexing clinics, may assist in dog control.

The compulsory registration of dogs may aid in the identification of roaming dogs and their owners. Some regions in Australia have introduced microchip implantation to aid dog registration and identification, but this is an expensive exercise;

- **the control of wild dogs**. Wild dogs are already subject to baiting in problem areas, but baiting is thought to have a significant detrimental effect on native carnivores such as the Spotted-tailed Quoll (Burnett 2000). Trapping or shooting may be preferable for this reason. The de-sexing of dogs, as well as cats, which are not kept for breeding purposes would also help to limit the numbers of feral animals going into habitat areas;
- **the promotion of Lumholtz's Tree-kangaroo** as an asset to the Tablelands which deserves our protection;
- **media coverage** of the destruction that dogs can cause to local wildlife, to raise community awareness of this issue;
- **dog and cat free residential estates** when rainforest areas are developed;
- incentives to use **Cassowary-proof traps** rather than dogs within the feral pig control industry.

More Ways To Conserve Tree-kangaroos and Their Habitat

Promoting and Raising Community Awareness of Lumholtz's Tree-kangaroo

In general, raising the profile of Lumholtz's Tree-kangaroo in our community, and raising community awareness of tree-kangaroo needs, will help the community accept and adopt measures which are necessary to conserve tree-kangaroos and their habitat. Recommendations include:

- **The promotion of Lumholtz's Tree-kangaroo as a wonderful and unique symbol of the Atherton Tablelands**. Lumholtz's Tree-kangaroo could be featured on tourist maps and interpretation boards around the Atherton Tablelands region. The Eacham Shire has recently adopted Lumholtz's Tree-kangaroo as their **official shire mascot**, upon recommendation by the Tree Kangaroo and Mammal Group. This is an important action for both the Shire and the future of tree-kangaroos on the Tablelands.
- **The creation and advancement of eco-tourism opportunities** featuring Lumholtz's Tree-kangaroo on the Atherton Tablelands. Nowhere else on the planet can tree-kangaroos be

encountered as readily as they are on the Tablelands. Tourists are already drawn to the Tablelands to see tree-kangaroos and tourism operators can play an extremely important role in promoting the conservation needs of tree-kangaroos.

- **Featuring Lumholtz's Tree-kangaroo in local school curriculums.**
- **The production of an educational booklet** developed for locals and tourists with information, studies, and stories on Lumholtz's Tree-kangaroo.
- **Raising the profile of Lumholtz's Tree-kangaroos**, locally, nationally and internationally, via documentaries and articles in journals, popular magazines and local print-media.

Improving Our Understanding of Lumholtz's Tree-kangaroo and their Habitat Requirements

Our understanding of the ecology of Lumholtz's Tree-kangaroo is still in its infancy, although important work has been conducted on aspects of their distribution, food preferences, home range and social organisation, response to disturbance, and husbandry^{6, 7, 8, 15, 16, 17, 18, 25, 27, 31}.

Further research is required in the following areas to help us properly understand and conserve this unique species:

- subjecting the Community Survey results to a more sophisticated analysis in an attempt to remove biases towards densely populated/ frequently visited areas. Similarly, using data on traffic volumes to obtain an objective assessment of the road-kill data from the Community Survey;
- extending the community survey of tree-kangaroo sightings to residents of the lowlands, to test the assertion that Lumholtz's Tree-kangaroo is essentially restricted to upland forests.
- determining of the overlap, if any, between the distribution of Lumholtz's and Bennett's Tree-kangaroos;
- determining the relative abundance of tree-kangaroos in continuous forests, especially poorly surveyed areas away from the road network. Systematic surveys have so far been restricted to forests bisected by roads, as abundance has been determined by spotlight counts^{6, 25}.

Estimating abundance away from roads will require the development of suitable survey methodology (e.g. dung counts). Such surveys could test the generality of the patterns of abundance determined from spotlight surveys, compare abundance near roads or the forest edge with abundance deep in continuous forest, and would resolve the current assertion that the Atherton Tablelands provides optimal habitat for Lumholtz's Tree-kangaroos;

- developing practical methods to minimise road-kills;
- developing practical methods to allow tree-kangaroos to use newly rehabilitated rainforest.
- understanding the population dynamics and population viability of tree-kangaroos in remnant rainforests.

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Contact List

NB: the below telephone numbers all have the prefix (07) if telephoned from outside Queensland

Tree-kangaroos and other mammals

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ph: c/o Margit Cianelli (07) 4095 0292

Rainforest Rehabilitation Groups

- Trees for the Atherton and Evelyn Tablelands (TREAT)
PO Box 1119
Atherton Qld 4883
ph: c/o Centre for Tropical Restoration, 4095 3406
- Queensland Parks and Wildlife Service Centre for Tropical Restoration
PO Box 21
Yungaburra Qld 4872
ph: 4095 3406
- Wet Tropics Tree Planting Schemes,
(administered by North Queensland Afforestation):
 - Herberton Shire - c/o Herberton Shire Council, Ravenshoe, Ph: 4097 6159
 - Eacham Shire - Winfield Park, ph: 4096 5354
 - Atherton Shire – c/o Atherton Shire Council, ph: 4091 0700

Landcare and Integrated Catchment Management (ICM) Groups

- Malanda & Upper Johnstone Catchment Landcare Assoc. Inc
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Malanda Qld 4885
ph: 4095 3932
- North Johnstone and Lake Eacham Landcare Association
Lot 3 Anderson Rd
Malanda Qld 4885
ph: 4095 3932
- Millaa Millaa Landcare Committee
MS 1166
Millaa Millaa Qld 4886
ph: 4097 2120
- Atherton Shire Landcare Committee
PO Box 90
Tolga Qld 4882
ph: 4095 8257
- Barron River Catchment ICM Association
PO Box 1054

Mareeba Qld 4880
ph: 4092 8555

- Eastern Tinaroo Landcare group
PO Box 91
Yungaburra Qld 4872

Dog Control

- Tablelands Dog Obedience Club - ph: 4091 2986
- Atherton Shire Council - ph: 4091 0700
- Eacham Shire Council - ph: 4096 5311
- Herberton Shire Council - ph: 4096 2244
- Mareeba Shire Council - ph: 4030 3900

Landholder Voluntary Conservation Agreements:

- *Nature Refuge Voluntary Conservation Agreements:*
Queensland Parks and Wildlife Service regional extension staff
PO Box 834
Atherton Qld 4883
ph: 4091 4262
- *Statutory Covenants:* yet to be determined
- *Land for Wildlife Agreements:*
North Qld Afforestation Association
ph: 4041 2593; 0418 412 596

Wildlife Rescue (for the care of injured wildlife)

- Margit Cianelli, ph: 4095 0292
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Others

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- Wet Tropics Management Authority (WTMA)
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