

# Management of Roads As Biolinks and Habitat Zones in Australia

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## Natural Features of Victoria

Victoria lies between 141° -150° longitude and 34° - 38° latitude and covers an area of 22.7 million ha in the south-eastern corner of Australia. The Great Dividing Range, running east west across the state and rising to nearly 2000 metres in the eastern half acts as a barrier to the moist south east and south west winds, and, together with the ranges proximity to the coast, causes the south of the state to receive more rain than the north. Average annual rainfall is variable between 250 mm for the driest parts of the Mallee to 2600 mm at Falls Creek in the alpine region. More rain falls in winter than in summer. To the south of Victoria, except for the island state of Tasmania, there is no land for 3,000 kilometres. This vast area of ocean has a moderating influence on Victorias winter climate, snow is rare below altitudes of 600m. To the north of Victoria the land mass of Australia becomes very hot in the summer and on several days at this time of the year the temperature may rise to between 35° c and 45° c, often with associated strong northerly winds. At these times wild fires are common and much of the vegetation communities in the region has adapted to periodic burns as a part of their evolutionary history.

Much of Victoria has been extensively cleared for large agricultural holdings, with only 30% of the original vegetation coverage remaining, the majority located within the higher and inaccessible altitudes or on non arable, depauperate soils. Only 3% of the remnants are located on privately managed land, the remainder are managed as part of the state forest, national park or crown land reserve network.

## The Network of Roads in A Fragmented Landscape

The length of roads and the area occupied by road systems is immense. The United States has 6.3 million kilometres of road reserves, in Australia there are approximately 870,000 kilometres of roads, of which by virtue of them being outside towns 780,000 kilometres are defined as rural. The area of rural roads in Australia is 3,120,000 square kilometres (ie assuming an average width of 40m).

Victorian roadsides represent an important component of the off-reserve land system, with a total of 160,000 kilometres of roads occupying approximately 500,000 ha, or 2.5% of the land mass, or 7% of public land. This compares to mainland Great Britain where road reserves occupy some 212,000 ha or approximately 0.9% of the land area. Only a small proportion of Victorian roads 3,000 kilometres of highways and freeways are managed for state government by the VicRoads corporation. The remaining 142,000 kilometres are managed by any one of 78 different local governments operating throughout Victoria.

The road network throughout south-eastern Australia is recognised as a significant component of the spatial landscape and the contribution of road reserves to connectivity and biolinks cannot be overlooked. The Roadside Conservation Advisory Committee of Victoria (RCAC) has been established since 1975 to provide a forum for government, agency and community organisations involved in the natural resource management of linear reserves and the management of the indigenous habitat located within the road reserve. The committee received formal status from the State

Government when it was convened as a Ministerial Advisory Committee in 1995 (with joint funding from the Department of Natural Resources and Environment and VicRoads). The current work program focuses on policy works, incorporating high conservation roadside habitats as components of Catchment Management Strategies, Regional Vegetation Plans, Victorian Planning Provisions (for native vegetation retention) and the review of legislation dealing with natural resource management as part of the Catchment and Land Protection Act (1994). The RCAC promotes conservation of roadside habitat and the protection and enhancement of indigenous vegetation and flora communities and provides advice and products to groups working within the road reserve.

Road systems within Australia appear to be distinctive in that many roadsides support strips of remnant forest, woodland, shrubland or grassland communities. The RCAC funds local communities to undertake conservation audits of regional roadsides (see later). With over three quarters of rural Victorian shires having completed some assessment of roadside reserves, a common pattern is emerging that indicates 50 - 60% of all Victorian roadsides retain medium to high conservation values. The vast network of vegetated linkages located within the Australian road system is a characteristic of our landscape and presents an unique challenge to our legislators to ensure adequate safeguards are in place to protect, maintain and enhance the habitat status provided by roadside vegetation.

Roadside vegetation can never substitute for properly managed reserves for wildlife conservation, however in many cases they may provide the only local examples of once wide spread communities. Roadsides within Victoria contain 25% of all rare and endangered flora species and communities listed under the Fauna and Flora Guarantee Act (1988). Roadside vegetation is of greatest value to native wildlife when it comprises remnant strips of intact natural vegetation rather than disturbed or planted vegetation. To maintain the natural values of indigenous vegetation the Victorian Conservation Strategy (1988) identified the preparation of Roadside Management Plans as a measure to manage and protect the native vegetation located on roadsides.

## The Challenge to Conserve the Disappearing Grassland Habitats

Grassy woodlands and grasslands were amongst the first areas of the state to be managed for grazing. With an extensive history of clearing less than 0.01% of the original grassland sites remain intact; understandably they represent one of the states most endangered plant communities.

With nearly half of the western plains remnant grassland sites located on roadsides it has become increasingly critical to ensure adequate roadside management strategies are in place to prevent further loss of this vulnerable plant community. Most remnant sites are small in size (under 1 ha), fragmented and have experienced various levels of site disturbance, next to roadsides sites, grasslands are most commonly confined to rail reserves or cemeteries.

Grasslands suffer from an identity crisis, many land managers fail to appreciate the unique suite of rare species contained within grassland communities. Managers and workers frequently find

difficulty in differentiating native grassland species from the more common suite of pasture grasses and grassy weeds. The ongoing management of grasslands has recently come under the review of the Grassy Ecosystems Reference Group (GERG) who are a referral group, reviewing research projects and onground works for state and federal funding agencies. GERG convenes conferences, workshops and site visits for organisations charged with the responsibility for managing grassland sites, or undertaking site maintenance or construction activities on roadsides. Vanessa Craigie (GERG Project Officer) is employed by the Department of Natural Resources and Environment as the Grasslands Project Officer to locate remnant sites and assist communities in recognising the value of grasslands and she helps develop appropriate management regimes for individual sites.

Craigie is responsible for co-ordinating events to raise community awareness of grasslands and recently has organised the registration and signage of over 200 sites. Signage alerts road users and roadworkers of sites that are 'Significant Roadside Areas'. Each sign has a pictorial representation of a regional grassland species. Craigie hopes that with a concentrated campaign to erect signs, people and agencies will recognise and value sites which at present are mistakenly identified as weedy or of low conservation value. The major fauna conservation objective is not as easily marketable as a warm, furry, cuddly critter. It requires considerable imagination to market the rare and endangered *Delma impar*, the striped legless lizard, a small snake-like reptile, with mature adults slightly thicker than a pencil and 30 cm long.

GERG and the Roadsides Conservation Advisory Committee are working to ensure standard procedures are established for planners and contractors involved with roadside grassland remnants. Standard guidelines review legislative responsibilities and promote appropriate ecological management (burning, slashing regimes) grazing exclusion, the use of herbicides and the appropriate selection of species have been distributed to all local government offices and to Fauna and Flora Planning Officers. A roadside in western Victoria provides a vivid example of what can go wrong when procedures are not followed, it was identified as having vulnerable grassland remnants and had been listed as a site on the National Estate. The road was sign posted by the Department of Natural Resources and Environment as a significant grassland remnant, and the local government planning office was provided with a map of the site. The Local By-laws Officer responsible for issuing stock droving permits was not informed of the importance of this site, the erection of road signage or the restrictions placed on the site. The local community became concerned when it woke one holiday morning to find 800 head of sheep being grazed on rare and endangered grass species! Understandably the procedure for issuing stock droving permits has since been tightened, lines of communication improved, and multiple copies of maps prepared and distributed. Seemingly an easy solution, but those people who needed to know were either not informed, or the last to be consulted. A regional approach to the movement of stock is now being co-ordinated with representatives from the RCAC, Victorian Farmers Federation, 17 south western Victorian councils, 3 Catchment Management Authorities, Department of Natural Resources and Environment (Flora and Fauna Planning Officers, Ecosystem Co-ordinators), Country Fire Authority, VicRoads, Veterinary Officers and the Victorian Travelling Stock Association. It is hoped that a consistent and acceptable approach to procedures for identifying stock routes will be possible and all key players are involved in discussions to develop final recommendations for high conservation value grassland sites.

#### Assessment of Roadside Conservation Values

The Roadsides Conservation Advisory Committee has recognised a need to audit and map the status of roadside vegetation and in 1983 funded two masters students, Grieves and Lloyd to develop a method to rapidly assess Victorian roads. Community volunteers with limited botanical experience are able to participate

in a 'windscreen survey' of roadsides to identify and map the conservation status of roadside vegetation. It is not intended that these maps replace more detailed botanical surveys, however it is a useful first cut and provides baseline information to be incorporated into a management plan. It creates opportunities for communities to participate in assessing roadside vegetation and the skills developed enables a more informed community involvement during the development of roadside management plans.

The RCAC has prepared a manual on the assessment method and working in collaboration with Greening Australia holds training days for volunteers. The method has a high implementation rate, 75% of Victorian rural shires have completed some basic assessment and mapping of roadside vegetation. Community volunteers in the Bairnsdale/Tambo Shires (an area noted for its sparse population) recently assessed and mapped 2,000 kilometres of roadsides, an enormous task given that these two shires encompass more than 10,000 square kilometres and have a wide representation of plant communities extending from coastal to alpine regions.

#### Biolink Projects

The West Wimmera Tree Group operating from the rural township of Nhill in the north-west region of Victoria received funding from Environment Australia, (formally the Australian Nature Conservation Agency, a Federal Government agency group funding vegetation and natural resource initiatives) to survey roadsides in a 5,000 square kilometre gap between the Little Desert and Big Desert Wilderness National Parks and develop a network of roadsides to create a corridor between the two national parks. It is an area of the state containing many former stock routes with road reserves commonly extending to three chains wide.

The project, known as the Big to Little Desert Biolink Corridor Management Plan, is located in an area of the Wimmera which has less than 5% of its original vegetation cover. However it is region rich in species diversity, the majority located within the road network. It was in this area that Bill Middleton (1988) observed more than 130 species of birds in a single roadside strip 2.5 kilometre long and 70 m wide (a total of 85 species recorded from regular transects, 30 species breeding within the area).

The project report identified a network of 100 kilometres of roads as corridor gaps. Project consultant, Mr Rob Scalzo recommended revegetating these gaps to create a corridor network spanning over 1,800 kilometres of roadsides, possibly the largest roadway corridor network to be created as a biolink within Australia. The project represents a shift in government and community expectations and understanding of native vegetation clearance, as it was only 25 years ago that the last 12 kilometre wide connection of vegetation was cleared for agricultural production. A priority list for revegetation sites concentrates on two and three chain road reserves. Revegetation plans have been developed within the principles outlined by Saunders and Hobbs (1991) for developing corridors, promoting that a wide corridor is better and easier to manage and the selection of species should provide all strata of the original vegetation structure. Community interest in this project has seen a commitment by the Hindmarsh Shire to support revegetation works to reduce the planned implementation period from 20 to 5 years.

#### Species Dependency on Roadside Corridors

Geoffrey Allen, the Ecosystem Co-ordinator with the North West Region of the Department of Natural Resources and Environment has identified many roadside vegetation communities throughout the Mallee Region that provide important habitat for bird species. The landscape is characterised by a low rainfall of 250 mm/annum and by properties cleared of vegetation to permit large scale agricultural enterprises (predominantly broad acreage wheat and sheep farming). It is a region with a small, conservative and stable population with scattered townships of less than 200 people. A high proportion of roadsides provide the only locations for quality remnants within the region.

The Blue Bonnet Parrot, *Psephotus haematogaster*, a locally rare species has been found to be heavily dependent on roadside vegetation. Recent surveys have located populations exclusively within roadside remnants and not in adjoining paddocks. Despite the isolated nature of settlement, mortality rates from roadkills have been significant. Allen has opted for a direct approach with adjoining landholders and raises awareness of the vulnerability of the Blue Bonnet in meetings with individual landholders and attending public meetings. He has overlaid road maps with the territories of the Blue Bonnet to demonstrate the importance of roadside vegetation, and uses these in talks and discussions with local communities. He is hoping an increased appreciation by local residents of the Blue Bonnet Parrot and a knowledge of the territory range will result in a change in driving habits (slower speeds and greater observation) and a subsequent decrease in roadkill mortalities

Open cut gypsum mining within the Mallee is destroying key roadside links used by the Regent Parrot, *Polytelis anthopeplus*, a Victorian localised and threatened species listed under the Flora and Fauna Guarantee Act (1988). This species, which nests within Redgum forests adjoining the Murray River, uses the connected network of high conservation roadsides as flightways to reach feeding areas within adjacent Mallee habitat. The predominance of Regent Parrots within the vegetated road corridor results in road kills. More than 175 regent parrots have been found killed at a single site where grain had been spilled during transportation. At present major losses from roadkills is accepted as no engineering or ecological solution exists. A corridor use study is required to determine long term requirements and viability of the species, until a solution is found this endangered bird will remain vulnerable to road mortality.

The Grey-crowned Babbler, *Pomatostomus temporalis*, was once a wide spread bird species within a range of woodland and open forest communities throughout Victoria, the species is now extinct or rare in most irrigation and agricultural districts as they do not inhabit areas extensively cleared of trees. Only 433 family groups of Babbler remain in Victoria, the species is afforded a level of legislative protection by being listed as a rare and threatened species under the Flora and Fauna Guarantee Act (1988).

Populations of Grey-crowned Babbler require habitat areas that have:

1. woodlands on more fertile soils
2. almost continuous tree cover (with few gaps in tree cover greater than 100m), Babbler either feed on trees or on the ground within about 10m of trees. They also depend on trees for nest sites and nesting material
3. a scattered understorey of small trees or shrubs (Eucalypt saplings, Golden Wattles or Bulokes 2 - 8m high for nest sites, shelter and protection from predators)
4. a sparse ground layer of litter and short grasses (Babbler spend .
5. Large rough-barked eucalypts for feeding on (especially box trees)

These conditions are rarely present within the cleared agricultural landscape and it is not surprising that 70% of all Grey-crowned Babbler groups are now located on vegetated, high conservation value roadsides.

#### In Defense of the Babbler

Strathbogie Shire in north eastern Victoria contains one third of the known population of Grey-crowned Babbler, with more than 95% of the Babbler groups dependant on roadside vegetation. Dr Doug Robinson has been studying the species in the Strathbogie district and has become increasingly alarmed at the species decline resulting from a combination of the following causes:

1. fire protection works (reduction of leaf litter and introduction of conditions favouring grass and weed species)
2. altered salinity and subsequent loss of vegetation
3. installation of utilities (and vegetation clearance activities to maintain access or a safe working environment of the assets)
4. invasion of weeds resulting from site disturbance
5. higher mortality of Grey-crowned Babbler on upgraded or sealed roads carrying faster traffic
6. grazing of stock, resulting in compaction of soils, simplification of the ground layer, and death of trees from stock rubbing and eating bark

Robinson has been a tireless campaigner for the rights of the Babbler and was frustrated at the apparent lack of awareness in the Babbler by the local community and local government planners and engineers. His defence of the birds culminated with a 2 page feature article in the local paper (if you've lived in a small rural community you will be aware this means it was a major story!) with the Shire Engineer defending the need to upgrade roads, maintain services and provide adequate fire prevention activities and Robinson putting the case for the Babbler. Something needed to be done, and at this stage the Roadsides Conservation Advisory Committee became involved with Robinson and the Shire in the preparation of a Roadside Management Strategy. Outcomes of facilitated community workshops were formally adopted by the shire and incorporated into a policy document that identifies actions allowing biodiversity conservation and road maintenance activities to sit side by side. These agreed outcomes reduce habitat destruction and minimise disturbance to roadside vegetation when installing cut-off drains, clearing drains, establishing sight lines, grading road surfaces and parking and turning plant and machinery. Environmental specifications were prepared and incorporated into tender documentation. Contracts were conditional on works practices being implemented within the guidelines outlined in the Strathbogie Roadside Management Strategy

Early in the preparation of the roadside management plan it was identified that unsympathetic works practices contributed to major modification of roadside habitats. Much of this loss resulted from a general ignorance of conservation values and habitat requirements of Grey-crowned babbler. A map was prepared that showed the location of Babbler colonies and distributed to roadworkers, Shire planners and engineers who had little appreciation of the number, sites or importance that the local road network contributed to the distribution of the Babbler. The RCAC held workshops promoting environmentally friendly best-works practices, these workshops promoted:

- identification of Babbler
- discussion of habitat requirements
- legislation protecting the species
- minimum disturbance of high conservation sites
- establishment of defined works zones and delineation of works exclusion areas
- use of environmental markers to define areas of known babbler colonies (these are discrete signs that indicate to contractors and workers that they are to avoid mowing or disturbing the area between any two markers)
- educational signage of roads containing Babbler colonies

Rather than creating a confrontational meeting with workers, the sessions sought to involve the workers in developing 'Babbler friendly' works practices, and they resulted in a conservation ethos that had previously been hidden or masked. This touches deeply into the psyche of the macho, roadworking persona, and it is as if the workshops gave permission for workers to care about the future of a small bird.

A community reference group (comprising members of the local conservation society, LandCare groups, Department of Natural Resources and Environment, the Manager of Technical Services and a Councillor) was convened to review the annual road maintenance and construction works program and to ensure roads with Babbler populations had guidelines included into operational plans. (Note: LandCare groups comprise members from local communities who have a total catchment management approach to the sustainable development of properties within a common catchment). Robinson is working with the local Sheep Pen Creek LandCare Group and has received funding from Federal government for revegetation projects that will extend Babbler habitat onto adjoining private properties.

Signage has been installed on roads containing Babbler populations. The early involvement of the local community prior to the erection of signs has meant the signs have not been vandalised or become the target for shooters. The signs remain undisturbed, a symbol of Babbler support. This is a pleasing result given the past history of roadside management, and a turn around in local government response in a little under 3 years. It indicates that even in the 1990's talking to, and involving communities in decisions is not outdated and is as relevant today as it has ever been.

#### A Penguin Parade is Placed Under Curfew

Solutions to roadkill of birds are 'thin on the ground'. Early work by VicRoads on the road safety implications of large flocks of several thousand Galahs, *Kakotie roseicapilla* or Sulphur Crested Cockatoos, *Kakotie galerita* feeding on roadside grain-spills suggested that rather than remove the grains (fundamentally using a large vacuum cleaner like road-sweeper) staff spray spilled grain with a green dye to camouflage individual grains. Either the lack of colour sensitivity, excellent vision or sense of smell meant this novel solution was not effective on modifying feeding responses, so trials were discontinued. Recent discussions have considered the use of biodegradable Garlic sprays (or similar) to render the grains unpalatable to the birds. The search for alternatives continues. Programs focussing on modifying human rather than fauna responses are meeting with some success, in particular, the results of two programs centred around two bird species, the Grey-crowned Babbler and Fairy Penguin, *Eudyptula minor* provide examples of co-ordinated programs that have maintained important habitat areas and reduced the number of roadkills.

The 24,000 strong seasonal Fairy Penguin colony *Eudyptula minor* at Phillip Island (100 kilometres south-west of Melbourne) is the largest concentration to occur within mainland Australia. It is a major ecotourism destination with a value of A\$100+ million annually to the Victorian economy. The colony, or Penguin Parade as it is affectionately known by most Victorians, is highly regarded and is considered as a cultural/ environmental icon by most Victorians.

Phillip Island is a recreational coastal resort with many residential subdivisions, the Summerland Bay Estate immediately adjoining the penguin beach having a significant impact on the penguin colony. In 1986, following the loss of 50 birds on roads within the subdivision in a single night (usually 1-2 penguins are lost to roadkill each night) the use of fencing and installation of underpasses was considered. These solutions were rejected as either too expensive or having too great an impact on the penguins through the division of the colony into subregions. Unlike natural corridors that generally follow environmental or topographic contours roads can divide habitats, creating barriers and limiting socialisation and breeding. Following a rigorous consultative phase that at times was not supportive of controls on use of the roads, it was agreed it would be easier to control human access rather than modify penguin behaviour. An evening curfew was established to limit vehicle access to roads adjoining the colony and a barrier was installed at the entrance to Summerland Bay Estate during peak penguin activity (in winter from dusk to 10/11pm, in summer to 12/1am). Non residents were restricted from entering the area, with a 100% exclusion from areas of the estate with no housing. Since the

introduction of the curfew there has been a 10 fold reduction in penguin deaths from roadkill. With the growing importance of Phillip Island as an ecotourism destination the state government has introduced the ultimate in human modification and has undertaken to buy back land and demolish houses within the estate and ultimately return the area to the penguins.

Rangers at the penguin colony have designed a penguin proof step to limit penguin access to roads that were outside the Summerland Bay curfew zone. It was noticed that the flightless penguins exhibited a preference for cleared pedestrian tracks, which acted as conduits to roads. Whilst the penguin is a superb swimmer it is less than elegant on dry land, in fact the species could almost be described as awkward, so much so the penguins could not climb overhanging steps. The simple solution of installing a 5 cm overhang on the bottom two steps was successfully used to limit penguin access to roads.

#### Reflections on Small Mammals

Tasmania, Australia's only island state located at the extreme south eastern end of Australia is well known internationally for its World Heritage listed Wilderness Areas. However closer to home it also has a reputation for the large numbers of wildlife killed on roads adjoining those same wilderness areas. Jed Gillian working for the Tasmanian Department of Transport has been involved in trials to reduce wildlife mortality rates on the tourist roads leading to the Cradle Mountain National Park. He is concerned with the loss of Eastern Spotted Quolls, *Dasyurus viverrinus* a small nocturnal predatory mammal (body 28-45 cm, tail 17 -28 cm) that once occupied most of the coastal forests of south-eastern Australia, but is now restricted to Tasmania. Upgrading and improving the roads has resulted in increased vehicle speeds and consequently a corresponding increase in the number of Quoll killed on roads. Aware of the success of reflectors on deer in America, Gillian installed reflectors on roadsides where mortality rates were highest. He noticed a reduction in mortality rates, and he contributes this to an increased driver awareness of wildlife on the road as a result of the installation of signs and reflectors. He has installed quoll proof fences to prevent access to roads, and installs longitudinal drains and culverts along the road to provide safe hiding places for Quolls disturbed by lights. Whilst these measures are based on controlling, or understanding Quoll behaviour Gillian believes that the package of road design features he has incorporated into the road design reduces wildlife roadkill by modifying human responses. He is not convinced that they were effective in causing Quolls to avoid roads when cars were present. The use of chicanes, reduced speed zones and reflectors create an driver awareness of the surroundings and results in modified driving responses. Gillian says its more a case of training the drivers than controlling the Quolls.

Reflectors have also been trialed by Peter Goldstraw, Fauna Management Officer with the Department of Natural Resources and Environment at Warrnambool in south-west Victoria. He installed and monitored reflectors along a one kilometre stretch of road in an effort to reduce the loss of Eastern Barred Bandicoots, *Perameles gunnii*. This small nocturnal mammal (similar in size to a quoll) has an extremely reduced range on mainland Australia, and is only found in sustainable populations around the township of Hamilton. The species is the subject of an intensive captive breeding program and any losses from roadkill are seen as significant. Installation of the reflectors at a height effective for small fauna species proved difficult in the test site (Chatsworth Road, Hamilton) due to taller grass species growing within the road reserve. The height of the reflected light appeared more suitable for modifying the behaviour of Swamp Wallabies, *Wallabia bicolor* and Potoroos, *Potorous tridactylus* and reflectors were subsequently installed on the Warrnambool Walgett Road in a bid to reduce the number of roadkills of these species. Monitoring of the Hamilton site has indicated a slight decrease in roadkill numbers, but it was difficult to attribute this to the success of the reflectors.

A surprise finding during recent autopsies of road-killed bandicoots indicated, unexpectedly, most were suffering from Toxoplasmosis and the mortality rates formally attributable to roadkill of a normal and healthy population had been considerably overestimated.

#### Shining the Light on Rock Wallabies

Determining exact numbers of Proserpine Rock Wallabies, *Petrogale persephone* is difficult as this endangered species is geographically restricted to 20 colony sites in bolder piles within elevated coastal vine forest near the popular Whitsunday Tourist islands of Queensland. The population is presumed to be in the vicinity of 300-500 individuals, the loss of some 14 animals to roadkill is considered significant. Extended drought conditions have seen the rock wallabies move onto the roadsides rich in green pick, this altered movement pattern makes them more vulnerable to roadkill. There is an additional concern that roadkills of more robust specimens (the weaker individuals succumbing to drought) may lead to a loss of genetic variability in the very small subgroups and lead to possible extinction of colonies.

Barry Nolan, District Ranger with the Queensland Department of Environment has installed squareflex wildlife reflectors as part of an 18 month trial to reduce roadkill numbers of rock wallabies. An initial trial was required at the insistence of the Queensland Department of Main Roads to determine if the installation of reflectors at 20 metre spacings would constitute a traffic hazard to drivers. Having determined negligible impact Nolan was given approval to install the reflectors on three sites. He has followed up with a regular roadside spraying program to reduce roadside weeds and indicates this is critical to the success of the trial. Reduction of the rampant and tall growing roadside Guinea Grass (an introduced weed species):

1. allows the reflectors to function as designed
2. increases driver visibility and therefore ability to respond to rock wallabies on roadsides
3. reduces the ability for the Rock Wallabies to hide on the roadside
4. reduces the green pick on the side of the road. Guinea grass is high in sugar content and during times of drought is an attractive fodder to rock wallabies.

Like Gillian in Tasmania, Nolan is uncertain if the reflectors by themselves are effective in modifying rock wallaby behaviour, but feedback from local residents indicates an increased awareness of the animals on the road at night.

Education programs in new residential subdivisions located within rock wallaby habitat areas have been used in conjunction with the wildlife reflectors. Nolan has noticed an increased custodial role by the locals as a result of this focus on the species. The Mt Lucas Residents Association (one of these new subdivisions) has asked for signs to be erected to notify visitors of the importance of the rock wallabies within the area. It is important to acknowledge the role of on-site rangers like Nolan in fostering this sense of community ownership. A growing awareness to the vulnerable future of the rock wallaby has been effective in modifying human response to the animals near roadsides..

#### Road Rules for Koalas

The construction of the \$51 million (Aus), 6 kilometre Calder Freeway bypass of the township of Woodend, approximately 60 kms north west of Melbourne is currently in progress. The area is considered to have regional significance for flora and fauna conservation and a stable population of koalas, *Phascolarctos cinereus*. A 1991/92 survey of roadkills along a 8 kilometre section indicated that one koala and two kangaroos were killed per week.

The ability for koalas to utilise linear patches of vegetation as movement corridors has not been thoroughly investigated, but Pat Prevett, a researcher with Ballarat University College concluded after studies of koala behaviour in the area around Ballarat that koalas were capable of crossing large areas of open ground. Biosis Research Pty Ltd was commissioned by VicRoads to assess flora and fauna values of land affected by the upgrade of the Calder Highway - Black Forest Section. The Black Forest section of highway is currently a four lane undivided road and is already a partial barrier to wildlife. Widening the existing highway is unlikely to significantly increase the current level of barrier effect unless fenced. Constructing a freeway parallel to it is likely to create a double barrier, but traffic numbers on the older section will be reduced considerably. Consultation with residents by Biosis Research indicated the importance of life style choices for a bush environment with kangaroos, wallabies, koalas, echidnas, wombats and many birds associated with the Black Forest area.

Given the patchy distribution of native vegetation, landscape planting's associated with the new freeway construction (using indigenous species and local provenances) will provide opportunities to increase the level of connection between vegetation remnants. Native forest cover was assessed within a 10 kilometre radius of proposed works to provide a detailed assessment of existing habitat connections in the local area. Corridors between the Macedon Ranges and the Wombat State Forest were seen as critical in preventing isolation of small populations of wildlife species, in particular koalas and kangaroos. Protection of wildlife corridors is identified as a management requirement in the draft Black Forest Roadside Management Plan prepared by the RCAC in 1993. Koala/kangaroo proof fencing was incorporated into the design to reduce the loss of wildlife and to funnel animals into two major corridors that were linked with a road tunnel and culvert. A limited amount of research into koala proof fencing has been conducted. Preliminary work by Prevett suggests that 250 mm of loose cyclone-mesh rigging extended from a standard 2200 mm crank-post cyclone-mesh fence prevents koala access. The fence option proposed for the Woodend By-pass is a standard 2200 mm high mesh fence with a solid vertical footing extending to 1200 mm above ground level. The use of a smooth 'colorbond sheet metal' rather than concrete (which can be climbed by koalas when cracks occur) has been successfully used at the Phillip Island Nature Reserve and on the Ballarat freeway to prevent koalas from entering access ramps. Fencing at Phillip Island had only been breached by koalas 3 times in as many years, providing sufficient evidence for this method to be used for the 10 kilometres of fence required.

In order to reduce the probability of koalas being directed around the end of koala proof fencing VicRoads extended fences beyond the end of the new roadway into sub-optimal habitat areas. The landscape architect for the project, Damian Collopy relocated a run-off dam to allow it to be incorporated into the fencing alignment and create a strategic barrier. This also reduced the requirement for extensive use of colorbond fencing. Koala food trees were avoided in new landscape works and existing trees will be cleared from the median for a distance of 100 -200 m into the highway from the end of the fencing. Given the presence of open pasture at the southern end of the study area, the potential for the southern limits of the koala-proof fencing to develop into major roadkill hotspots is low. A koala guard of 1200 mm high clear PVC plastic sheeting 0.8 mm thick will be secured around the base of any existing trees adjacent the fence that have overhanging limbs or connecting canopies.

A wildlife link was identified at Slaty Creek, midway along the new freeway route. Normally a culvert would have been incorporated into the road design at this point, with 2 - 3 culverts required at a total cost of \$500,000 (Aus). The engineering requirements to maintain drainage and flow lines provide an excellent opportunity to design a wildlife tunnel. An elevated bridge will enable the wildlife corridor to be maintained at an additional cost of \$3.5 million (Aus). This road bridge will have a 12m clearance with a minimum width of 64 m between the base of the

freeway retaining walls. The design of the bridges (there will be two, one for each of the divided carriageways) will permit the retention of 1,000 square metres of remnant riparian vegetation. This area will be protected from disturbance during construction and has been designated an excluded works area. Construction techniques will ensure 25 m tall eucalypt trees growing within the works exclusion zone will be protected and incorporated into the landscape design to provide visual continuity and maintain flight ways and a corridor connection for the small marsupial Sugar Gliders *Petaurus breviceps*.

A 165 m long, drainage culvert will bisect the freeway and has been designed to function as a wildlife tunnel. Two 1.4 m diameter pipes will be constructed side by side with a 0.2m difference in invert levels, the higher pipe providing a route which will remain dry, except for periods of peak flow. Similar designed koala tunnels have been installed on the Western Highway at Ballarat. Evaluation of the tunnel using video monitoring was trialed, but vandalism and theft of equipment occurred. It is proposed to trial a method described by Triggs, that a bed of moist river sand be used to provide a daily record of paw prints. This method is cheap, effective and does not catch the attention of the public. Despite the installation of tunnels and fenced 'funnels' koala roadkills are still occurring at Ballarat, indicating this form of 'funnel tunnel' may not provide a suitable koala crossings.

#### Tunnelling for Love

Road tunnels have been designed for the tiny and endangered marsupial, the Mountain-pygmy Possum, *Burrhamys parvus*. This species is currently restricted to very small areas above the snowline in the vicinity of Mount Hotham and smaller ranges in the Australian Alps. When snow lies a metre or more deep over shrubs, the Mountain Pygmy-possum continues to be active in runways close to the ground. The development of a popular ski resort at Mount Hotham bisected the range of the possum and a purpose built tunnel was constructed to allow access of the fragmented possum population. The press promptly named the tunnel the 'Love Tunnel' as its prime purpose was to reduce the seasonal roadkills of the love-lorn male possums, who roamed the mountain in a rampant spring mating frenzy prior to collapsing and dying to leave the females to give birth to next seasons males. Video surveillance indicated the exhausted males used the culvert to secure safe passage under the road, but that a canny fox *Vulpes vulpes*, an introduced feral pest animal, had learnt the tunnel provided an easy banquet of succulent, but rare and endangered male pygmy possum. Traps were laid and the fox was eventually shot, but this example highlights the need for ongoing monitoring and evaluation of wildlife tunnels.

#### Whistling for A Roo

Various techniques have been trialed to prevent vehicles colliding with kangaroos, so far most without success. That vast numbers of kangaroos are killed on roads is accepted and the installation of roo-bars on most four wheel drives and country vehicles is accepted as a standard accessory.

A large old male Red kangaroo, *Macropus rufus* may stand up to 1.5 - 1.8 m tall and be three times the weight of mature females, the road safety implications of collision, for both the animal and vehicle passengers can be fatal. Most kangaroo species are gregarious, moving in groups ranging from a few dozen to several hundred individuals, and most country drivers have experienced at least some incident with a kangaroo on roads at dusk, a time of the day with extreme reduced visibility, roos are fast moving and quite literally jump in front of speeding cars without warning. A 10 kilometre section of road in the Girraween National Park in Queensland has consistently recorded four kangaroo deaths per week, with Rangers distressed at being required to destroy injured and dying road victim animals.

Various road authorities have sought solutions for kangaroo roadkill, many have trialed reflectors, but the effectiveness as

deterrents has not been substantiated. They are expensive, \$28 (Aus) per unit equates to \$5,400 Aus per kilometre for the reflectors lone, without the cost of installation, signage and ongoing maintenance. As with the use of reflectors for other species it appears that whilst the use of reflectors contributes to an overall awareness, they don't provide a solution by themselves.

Kangaroo fencing has been installed on a 2.8 kilometre section of the Hume Highway (a heavy trafficked national highway and the major road link between Sydney and Melbourne) adjoining the Chiltern State Forest near the Victorian, New South Wales border. This fence restricts the movement of animals and has reduced the incidence of kangaroo roadkills at this point. However fencing is a costly solution and only practical along short stretches of a major freeway network, to consider fencing as an option throughout rural Victoria would be expensive and impractical.

Recent overseas experience with the use of sonic and wind whistle devices attached to vehicles to warn wildlife of oncoming vehicles has been trialed. The introduction and marketing of a air propelled and sonic whistles under innovative names such as the 'Shu Roo' gave people hope this would finally provide an effective deterrent. Static models have been trialed in the low rainfall areas of the mallee to deter kangaroos from stock watering points, initial results have not substantiated whistles as an effective method to deter kangaroos. The use of whistles on moving vehicles may provide comfort and a sense of the security to the driver but it still need to be demonstrated they are a useful tool to prevent kangaroos from hopping into the path of oncoming vehicles. The hunt for the perfect roo scarer continues.

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