5 EFFECTS OF ROADS

The impacts of roads on fauna are far reaching and variable, from the most obvious impacts such as collisions to the less obvious like genetic isolation. Roads and their associated activities (e.g. borrow pits) have had significant impacts on the fauna of Australia.

The management of roadsides varies from active intervention to conserve natural resources, to continual mowing aimed at maintaining low grasses. Although vegetation can recolonise utility corridors, it is often maintained at an early successional stage by routine slashing or the spraying of herbicides. This has a significant impact upon the plants and animals living there.

Road systems in Australia appear to be distinctive in that many roadsides support strips of remnant forest, woodland or shrubland (Scott 1981; Grieves and Lloyd 1984; Walling 1985; Arnold et al. 1987; Hussey 1987; Bennett 1987). In the case of fauna, Hunt et al. (1987) demonstrated that roadside verges with a dense cover of native flora supported significantly higher numbers of native wildlife than barren or continually mowed roadside areas.

Studies examining the effects of roads on wildlife are often species specific and therefore, do not determine the impacts of roads on fauna in general. Sections 5.2 and 5.3 provide an overview of the direct and indirect impacts of roads on a variety of fauna species.

5.1 DIRECT IMPACTS

5.1.1 Road mortalities

The most obvious effect of roads is on the direct mortality of fauna caused by collisions with vehicles. The variety of wildlife that is killed on roads is considerable, with birds, mammals, reptiles, amphibians and invertebrates all falling victim. The death of fauna due to collisions with passing vehicles has been the centre of studies by biologists from all over the world, including Australia.

Numerous surveys to investigate the impact of road-kills on native fauna populations have been conducted in Australia. In most cases, these studies have targeted individual species. The impact of roads on Koalas have been well documented in recent years (see Prevett et al. 1992; Pahl 1992; Fanning 1992; Gardyne 1995 for reviews). Road kills of macropods have also been the centre of some studies (Coulson 1982). In Victoria and Tasmania, the threatened Eastern Barred Bandicoot (*Perameles gunnii*) has been the focus of numerous studies, including the value of road-kill counts to monitor changes in numbers of this species (Mallick et al. 1998).

Ehmann and Cogger (1985) documented the impact of road kills on amphibian and reptile populations,

estimating that some five million frogs and reptiles are killed annually on Australian roads. Bennett (1991) searched a half kilometre transect along a road in western Victoria, and recorded 419 carcasses of five species of frog, all being casualties of a single night following heavy rainfall.

Fauna most affected

The University of Southern Queensland investigated which species are most commonly recorded as road kills along one section of road in southern Queensland. These species (in no particular order) are listed in Table 5.2.

Table 5.1 Fauna species most commonly recorded as road kills in south-east Queensland (from P McConnell, University of Southern Queensland, unpublished results)

Faunal type	Species
Mammal	Northern Brown Bandicoot (*Isoodon macrourus*)
Mammal	Common Brushtail Possum (*Trichosurus vulpecula*)
Mammal	Red-necked Wallaby (*Macropus rufogriseus*)
Mammal	Brown Hare (*Lepus Capensis*)
Bird	Australian Magpie-Lark (*Grallina Cyanoleuca*)
Bird	Australian Magpie (*Gymnorhina tibicen*)
Bird	Tawny Frogmouth (*Podargus strigoides*)
Bird	Galah (*Cacatua rosecapilla*)
Reptile	Carpet Python (*Morelia spilota*)
Reptile	Bearded Dragon (*Pogona barbata*)

The bird species listed in Table 5.1 are likely to be killed on the road whilst foraging for seed or carrion. These animals, along with the reptiles probably using the road for basking, are not excluded from roads by fences. Other animals such as the mammals listed are likely to be hit by cars during natural movement patterns. The factors influencing road mortalities on such species are discussed below.

Reasons for mortalities

Certain species and certain life stages appear to be more vulnerable to road kills than others. Animals that are attracted to habitats or food resources found on roadsides and species that travel considerable distances each day (and therefore increase the likelihood of crossing roads) are generally at higher risk. For example, many road-kills of granivorous birds (those birds that feed primarily on grains) are attributed to grain spillage along roadsides and seeding grasses adjacent to roads (Hodson 1960, 1962; Vestjens 1973; Dhindsa et al. 1988).

In Victoria, more than 175 individuals of the threatened Regent Parrot (*Polytelis anthopeplus*) were killed at a single site in north-western Victoria where grain had spilt onto the road (Bird Observer 1980). The deaths of other bird species may occur while they are dust bathing (some birds often bathe in dust), or taking grit from the road edge (Hodson 1960, 1962; Brown et al. 1986), or while hawking (or hunting) for insects low over the road (Hodson 1962).

Roadside grasses are also a food source for large herbivores. In Australia, macropods such as the Eastern Grey Kangaroo (*Macropus giganteus*), Western Grey Kangaroo (*Macropus fuliginosus*), Red-necked Wallaby (*Macropus rufogrisens*), Swamp Wallaby (*Wallabia bicolor*) and Tasmanian Pademelon (*Thylogale billardieri*) are all vulnerable to road deaths (Johnson 1977; Coulson 1982; Osawa 1989). The distribution of sites where large herbivores are killed is generally non-random (Coulson 1982). Roads with generally high mortalities include those areas such as woodland-grassland interfaces, forested areas where the roadside provides good pasture, and sites where regular movement pathways cross roads.

Animals that regularly cross roads as part of their daily movement or migration paths also become victims. For example, frogs that cross roads to ponds during the breeding season are frequently killed in large numbers (Hodson 1960, 1966; Van Gelder 1973). Such mortality is highly seasonal. For example, 40% of the annual road mortality of the Common Frog (*Rana temporaria*) was recorded in a single week along a 3.2 km stretch of road in Britain (Hodson 1960). Mortality of snakes and lizards, attracted to road surfaces to bask are also markedly seasonal, most occurring in the warmer months (Vestjens 1973).

Small mammals that live in roadside vegetation (Adams and Geis 1983; Garland and Bradley 1984) and birds that live or nest there (Oetting and Casell 1971; Brown et al. 1986) are also vulnerable to collisions with passing traffic. For many species, the frequency of road kills is greatest during the breeding season. This is a consequence of greater movements by adult animals at this time (Haugen 1944; Vestjens 1973; Case 1975; Brown et al. 1986). In southern Australia, road kills of Australian Magpies (*Gymnorhina tibicens*) are primarily during the spring breeding season when large numbers of juveniles are killed. These deaths contribute largely to the annual tally of all road killed animals (37% of recorded casualties by Vestjens 1973; and 28% by Bennett, unpublished data). In rural areas, Australian Magpies commonly nest in roadside trees and the juveniles of such birds are often victims of road kills (Carrick 1963). Also, Koalas are usually killed in higher numbers on roads during the summer months when adult males travel considerable distances defending their territories or as young males disperse into new territories (Prevett et al. 1992).

Predators that frequent roads to feed on the carcass of road-killed victims are also common among the mortalities. In Australia, the Fox (*Vulpes vulpes*), Cat (*Felis catus*), Barn Owl (*Tyto alba*), Tawny Frogmouth (*Podargus strigoides*), Southern Boobook (*Ninox novaeseelandiae*), and several ravens (*Corvus* spp.) are regularly killed on roads (Vestjens 1973; Disney and Fullagar 1978; Brown et al. 1986; Thomas 1988). In more arid areas, the Wedge-tailed Eagle (*Aquila audax*) (see Figure 5.1) is commonly killed whilst feeding on road kills.

Figure 5.1 Wedge-tailed Eagle

Source: Queensland Museum

Figure 5.2 Southern Cassowary

Source: Queensland Museum

Many species, mainly mammal fauna, are killed at certain times of the day, especially dawn and dusk. This is due to the nocturnal activity patterns of many mammal species, who often travel at these times to feed. Many animals, particularly macropods, are hit on the outskirts of towns as many road users leave or enter towns at dawn or dusk (M. Ryan, Technology and Environment Division, Department of Main Roads pers. comm.). Measures to reduce fauna mortalities, particularly wildlife reflectors, may be beneficial in these areas (see Chapter 6 for details).

Impacts on populations

In general, it appears that for most common animals, particularly the smaller species, road kills do not exert a significant pressure on population dynamics or conservation status. Schmidly and Wilkins (1977) found that less than 1% of the rodent community living on three roadsides in east Texas were killed on roads over an annual cycle. Brown et al. (1986) found that of the 28,887 birds banded in their study area in Western Australia between 1977 and 1985, only ten banded individuals were found as road victims between January 1984 and December 1985.

However, for large animals, particularly those with restricted and declining distributions, and those that are regularly and repeatedly in contact with roads, such as for migration paths or daily movement for food, there is some evidence that road kills have a significant impact on the population. Harris and Gallagher (1989) stated that road kills in Florida are the major known source of mortality for most of the large endangered species including crocodiles, deer, bears and eagles. Over 50% of known deaths of the endangered Florida Panther (*Felis concolor*) since 1981 have been the result of road kills.

In Australia, road mortalities of threatened populations with low numbers of individuals can have a significant impact. For example, the remnant and declining population of the threatened Eastern Barred Bandicoot (*Perameles gunnii*), in the city of Hamilton, western Victoria, is under considerable threat (Brown 1989; Sheridan 1991). Specifically, Sheridan (1991) found that of the estimated population of several hundred (Arnold et al. 1990) 50–60 individuals are killed on roads annually.

In similar cases, Lee and Martin (1988) noted that on the busy tourist locality of Phillip Island Victoria, road mortality has emerged as a major factor associated with koala population decline. Saunders (1990) reported road kills of Carnaby's Cockatoo (*Calypotorhynchus latirostris*) to be a significant source of mortality for a declining population (approximately 14 pairs) at Manmanning in Western Australia.

Also, at Mission Beach in north Queensland, where the densest population of the threatened Southern Cassowary (*Casuarius casuarius*) (refer Figure 5.2, previous page) exists, nineteen of fifty-nine known birds fell victim to road kills in two years (Smith and Muller 1988; cited in Andrews 1990). The total loss had increased to twenty-five early in 1990 (Roberts 1990; cited in Andrews 1990). Roadside warning signs have not reduced these road deaths, and local residents are now being asked to stop feeding the birds as this attracts them to roadsides. These alarming figures have resulted in Main Roads funding a detailed project to identify movement corridors, and to provide additional measures to protect this keystone species. Findings from this project will be included in the second volume of this series.

5.2 INDIRECT IMPACTS

5.2.1 Edge effects

An edge effect is the result of disturbance causing two contrasting habitats to suddenly converge without any natural gradient. The edge is usually hostile to most native wildlife, and species from the natural interior of the habitat or 'core' of the habitat seldom inhabit the edges. Species with excellent dispersal abilities, and those capable of invading and colonising disturbed habitats, especially introduced predators and opportunistic native species able to colonise these areas, are attracted to road edges.

The fragmentation of habitats often leads to the formation of significant areas of edge habitat and a subsequent reduction in interior habitat. Many species not adapted to the levels of disturbance experienced in the edge habitat will be confined to smaller areas of interior habitat. These species are generally the ones that are less common and therefore of greater concern (Ranney et al. 1981). As such, core areas are of paramount importance for conservation and early road planning studies should aim to avoid such areas.

Edge effects are noticeable by differences in diversity, density and distribution of flora and fauna populations along roads and utility corridors. The presence of particular species usually found in this edge habitat is an early indicator of edge effects. A few widespread species can dominate edges. These patterns have been described for small mammals (Johnson et al. 1979; cited in Andrews 1990) and birds (Kroodsma 1985), and studies have indicated that the structural differences of the plants also add to the differences in faunal populations. For example, weeds such as Lantana (*Lantana camara*) and fauna such as the House Mouse (*Mus musculus*), Fox (*Vulpes vulpes*), feral Cat (*Felis catus*), Noisy Minor (*Manorina melanocephala*) and Torresian Crow (*Corvus orru*) commonly inhabit disturbed areas.

Edges have been described as 'ecological traps' following studies that showed some birds were attracted to the vegetation on edges to breed, only to lose their offspring through nest predation (Yahner 1988). Harris (1988) and Yahner (1988) warn that edges can have negative consequences for wildlife, especially those species dependant on large undisturbed areas. It is difficult to delineate the edge dimensions and to quantify the effect of the edge (Yahner 1988). Studies in the Amazon forest fragments show an avoidance of edges by interior forest birds noticeable more than 50 m into the forest.

5.2.2 Barrier effects

Barriers to fauna movement may be provided by infrastructure associated with roads (e.g. fencing), or by roads themselves. This section discusses the effects associated with these barriers.

Taylor and Martin (1987) (cited in Andrews 1990) list the detrimental effects of fences on wildlife, which include:

- Entanglement.
- The severing of access to essential natural requirements such as water supplies.
- The prevention of movement into suitable habitat areas.
- The disruption of seasonal movement.
- Overpopulation through limitations on dispersal.
- Increased human intervention through the use of fenced maintenance roads.

This illustrates the need to consider the use of fencing and to provide specifically-designed culverts or underpasses in association with fences. Fencing of roads is often intermittent, with some stretches of road fully or partially fenced, whilst others are fenced by landholders with stock fencing or not fenced at all. The type and extent of fencing is an important consideration for roads. These should be determined with the knowledge of the fauna species in the area, and the design characteristics (e.g. dimensions of underpasses) of the proposed roads.