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A SURVEY OF KOALA ROAD KILLS IN NEW SOUTH WALES

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ABSTRACT: Between 1984 and 1990, 75 koalas (*Phascolarctos cinereus*) from the central northern coast of New South Wales (Australia) were presented for necropsy due to motor vehicle accidents. The koalas consisted of 44 males and 31 females. Fifty one of these were between 2 and 7 yr (39 males and 12 females). The greater proportion of koalas, especially males, were struck by vehicles between June and December. The main injuries detected were head injuries (44), hemoperitoneum (16), limb injuries (16), hemothorax (15) and spinal injuries (7). Nine koalas were not dead at the time of the accident but died later following complications from the trauma. Twelve koalas had evidence of underlying disease at the time of accident. Ten of these had either conjunctivitis, cystitis, prostatitis, periovarian cysts, endometritis or a combination of the diseases. All 10 koalas still had good body condition. It is suggested that healthy young to middle-aged males are particularly prone to vehicular accidents during the mating period. This has implications for the management of local koala populations.

Key words: Koala, *Phascolarctos cinereus*, motor vehicle accidents, specified injuries, underlying disease, survey.

INTRODUCTION

Motor vehicle accidents are known to be an important cause of severe injury and death in koalas (*Phascolarctos cinereus*) (Obendorf, 1983; Canfield, 1987). These reports and others have assessed the impact of traumatic deaths by including them in general mortality surveys (Butler, 1978; McKenzie, 1981; Weigler et al., 1987). It has been stressed that koalas killed by motor vehicles are commonly in good condition and without underlying disease (Canfield, 1987; Weigler et al., 1987). Therefore, their loss may have a significant effect on the survival and reproduction of local populations. Not all koalas struck by motor vehicles die immediately, and local veterinarians are often asked to examine and treat injured koalas. Although any injury can occur through a motor vehicle accident, it is probable that some injuries are more common. An indication of these more common injuries, the risk of treatment complications and the possibility of underlying disease may be useful to veterinarians in determining the prognosis for koalas hit by motor vehicles. Consequently, this article presents information on 75 koalas killed by motor vehicles.

METHODS

Seventy-five chilled or frozen koalas were received for necropsy from the north coastal strip of New South Wales, centered around Port Macquarie (30°30′ to 31°58′S, 152°30′ to 152°58′E), between September 1984 and October 1990. All had been found on or by the side of roads, and survived varying periods after impact. Details of age and sex are presented in Table 1. Koalas were aged according to records kept on individuals by the Koala Preservation Society of New South Wales (Port Macquarie, New South Wales, Australia 2444), and by wear of premolars and molars (Martin, 1981). Most koalas were weighed and many were measured for crown-rump lengths (nuchal crest to the base of the tail). The koalas were examined externally for injuries before exposing abdominal and thoracic organs by a midline approach. Limbs, head and back were examined in detail. Body condition was assessed from muscle mass and fat deposits in the axillary and inguinal regions and the abdominal and thoracic cavities. The presence of fat deposits and well rounded muscles (particularly the temporal, infraspinatous and supraspinatous muscles) were considered to reflect good body condition. Koalas without observed fat deposits but with well rounded muscle masses were still classified as having good body condition. Moderate body condition was suggested by no fat reserves and flattened muscles. Poor body condition was suggested by muscle wasting. In cases of suspected disease, tissues were taken for histological examination. These were processed routinely and embedded in paraffin. Six to 10 μm sections were stained with haematoxylin and eosin, or special stains when warranted.

TABLE 1. Details of koalas killed by motor vehicles in New South Wales, Australia.

Koalas	Age distribution			Total
	1 to 2 yr	2 to 7 yr	>7 yr	
Females	8	12	11	31
Males	4	39	1	44
Total	12	51	12	75

RESULTS

During the period of study, koalas were more commonly killed by motor vehicles from June to December (Table 2). The increased number of road kills from August to December consisted largely of male koalas. All except four males killed in this period were aged between 2 and 7 yr. Apart from koalas which had lost weight following treatment for injuries most koalas had good body condition. Twenty two male koalas between 2 and 7 yr, without underlying disease and in good body condition had an actual weight range of 5.8 to 10 kg and an actual CRL range of 51 to 63 cm. Their ratio of weight to CRL gave an actual range of 0.102 to 0.161 (mean 0.130, standard deviation [SD] 0.014). Nine female koalas over 2 yr, without underlying disease and in good body condition had a weight range of 4.9 to 6.9 kg, a CRL range of 49 to 56 cm and a ratio of weight to CRL range of 0.092 to 0.128 (mean 0.091, SD 0.009). However, these results do not take into consideration that differences in body condition would occur between the mating and non-mating periods. For example, fat reserves were not usually present in most sexually-active males during the mating season which mainly occurs from September to January for the Port Macquarie region.

The main injuries caused to koalas struck by motor vehicles were head injuries (44 koalas), limb injuries (16), hemothorax (15) and spinal injuries (7). Many of the koalas had multiple injuries and therefore, the total numbers of injuries do not correlate with the number of koalas. Of the 44 koalas having head injuries, 20 had multiple fractures of the cranium and face (including the mandibles), and extensive intracranial damage and hemorrhage; 12 had fractured mandibles: six had fractures to the maxillae or other nasal bones; and six had extensive bruising with intracranial hemorrhage. Twelve of the animals had aspirated copious amounts of blood prior to death. Most of the 32 koalas with mandibular fractures had complete, displaced breaks 2 to 5 cm adjacent to the symphysis. Causes for the hemothorax present in 15 koalas included fractured ribs (two cases), diaphragmatic rupture and herniation (two cases) and ruptured trachea. However, in the majority of cases an exact cause was not determined. In contrast, causes for the 16 koalas with hemoperitoneum were obvious: nine had lacerated livers, three had rupture of the caecum or large colon, and three had abdominal wall tears.

TABLE 2. Monthly distribution of koala road kills in New South Wales, Australia.

Month	Males	Females	Total
January	2	—	2
February	—	3	3
March	3	—	3
April	—	2	2
May	—	2	2
June	4	4	8
July	3	2	5
August	8	5	13
September	4	3	7
October	6	3	9
November	10	4	14
December	4	3	7
Total	44	31	75

Sixteen koalas had appendicular skeletal fractures or injuries. There were seven fractured femurs (one koala had both femurs fractured), six fractured pelvices, four dislocated hips, two fractured clavicles, one fractured tibia, one fractured radius and ulna, one shattered stifle and one shattered tarsus. Spinal injuries were present in seven koalas and included six severed spinal columns (four mid to caudal thoracic, one caudal lumbar and one mid cervical) and one intraspinal hemorrhage. Miscella-

neous injuries included an inguinal hernia and a hemopericardium due to a lacerated atrial wall. Evidence of past bilateral teres ligament rupture was a common finding in koalas greater than 2 yr of age and was thought to be due to arboreal activities rather than due to vehicular trauma.

Nine koalas, presented for necropsy, had not died at the time of the accident or shortly after but after complications had occurred. Two koalas developed pneumonia, one developed conjunctivitis and poor body condition, three had non-union healing of fractures (one femur and two mandibles), one developed an infected dislocated left hip while two developed poor body condition despite apparent healing of injuries. Twelve (16%) koalas presented for necropsy had underlying disease consisting of prostatitis/cystitis (three), periovarian cysts/cystitis (three), periovarian cyst/endometritis (one), periovarian cyst (one), conjunctivitis/cystitis (one), conjunctivitis (one), unexplained poor body condition (one) and scoliosis (one). All except one of these koalas had good body condition. In those with good body condition and with measured weight to CRL ratios, four males had ratios of 0.108, 0.115, 0.130 and 0.138 while three females had ratios of 0.114, 0.114 and 0.115. These values were within the determined ranges for koalas killed by motor vehicles but without underlying disease.

DISCUSSION

This study, although limited by the fact that not all road accident deaths would have been detected and sent for necropsy, does establish clear trends for koalas killed by motor cars along the mid north coast of NSW. The seasonal variation in deaths was mainly due to increased numbers of males in the period from late winter (August) to early summer (December). This was not entirely unexpected as the mating season occurs primarily in the spring and summer in this region, and males would be expected to be exhibiting greater movements just prior to or during this period (Koala Preservation Society of New South Wales information newsletter). A similar clustering of deaths was found by Weigler et al. (1987) who, although not distinguishing between females or males, found car or dog trauma deaths peaked during the spring season for a Queensland koala population. Mating seasons are known to vary among koala populations depending upon climate but for most there is a peak in spring (Smith, 1979).

Although the age structure of the koala population centred around Port Macquarie is unknown, the finding that most males killed were between 2 and 7 yr is probably a reflection of their enhanced movements due to sexual activity and the fact that many up to the age of 4 or 5 are still establishing their home range. Young males are known to disperse from their mother's range after the age of 2, and may not settle until 2 to 3 yr later (Lee and Martin, 1988). This appears to correspond to the onset of puberty and the reaching of sexual maturity which is usually during their 3rd and 4th years (Smith, 1979).

Road kill studies in other species have also emphasised seasonal variation and peaks in mortality. Coulson (1982) studied road-kills of macropods on a section of highway in Central Victoria and found an autumn peak over 2 yr. The majority of deaths were of adult males. Davies et al. (1987), in their study of road kills in European badgers (*Meles meles*) showed peaks of mortality in spring and late summer but there were no significant differences between the total numbers of males and females killed. These authors, although not aging their animals, did not consider that the dispersal of young animals contributed to the seasonal peaks of mortality.

From this study, although most injuries were detected, certain types were more common. This may be related to conformation, posture and gait of koalas. Since koalas are more likely to be on the move at night, particularly around dusk and less so around dawn, motor vehicle lights may

momentarily fix their attention and cause them to look up. This may explain the commoness of head and thorax injuries, particularly to the front part of the head (i.e., the mandibles). It could be speculated that the head of the distracted koala would be at the level of the vehicle's front protector bar and particularly prone to injury. Other injuries would be the result of impact and wheel crushing. Aspiration of blood through head injuries may be particularly important in contributing to death.

In this study, 16% of the koalas had underlying disease. This is in contrast to the results of Weigler at al. (1987) who found an insignificant proportion of their traumatised koalas to have underlying disease. Many of the diseases affecting the koalas in the present study are purported to be due to chlamydial infection (Brown et al., 1987). Koalas with these diseases commonly waste away and die (Brown et al., 1987). However, the koalas suffering from cystitis, periovarian cysts, endometritis and conjunctivitis in the present study appeared to be little affected systemically as they were in relatively good condition and had a crown-rump-length to weight ratio within the determined range for the koalas killed by motor vehicles without underlying disease. Of course, the fact that some koalas struck by motor vehicles do have underlying disease could result in complications for those that survive the initial impact and are treated for injuries.

The finding that most koalas struck by vehicles are healthy, sexually active animals has implications for management of local populations. The loss of this group of koalas, particularly the young to middle-aged males, will inevitably alter the age structure and sex ratio of the local population. Management of local roads and the education of motorists are mandatory to diminish this loss.

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