

Biology of the black-backed jackal *Canis mesomelas* with reference to rabies

A.A. MCKENZIE

Mammalian Research Institute, Department of Zoology, University of Pretoria, Pretoria, 0002 South Africa

ABSTRACT

MCKENZIE, A.A. 1993. Biology of the black-backed jackal *Canis mesomelas* with reference to rabies. *Onderstepoort Journal of Veterinary Research*, 60:367–371

The black-backed jackal is represented in rabies records from southern Africa and is suspected of playing an important role in the disease in this region. The basic biology of the species suggests that it does have certain characteristics that could make it an ideal rabies vector. However, the enigmatically low incidence of rabies in undisturbed jackal populations suggests that more subtle processes may be involved. It is suggested that jackal society is arranged in the form of cryptic packs and that disruption of the hierarchy through persecution may increase agonistic encounters and thence the incidence of rabies. Suggestions are made for the incorporation of the jackal in rabies control programmes without resorting to extermination.

INTRODUCTION

The black-backed jackal *Canis mesomelas* (hereinafter referred to as jackal) is a potentially important rabies vector in southern Africa (Cumming 1982; Meredith 1982) and is often persecuted as such (Brückner, Hurter & Boshoff 1978). Before commencing a discussion on the role of this species in the epizootiology of rabies, however, it is important to note that rabies may not necessarily spread through jackal populations in conservation areas. A simple model of infection—clinical rabies—aggression—conflict—*infective bite* may, therefore, not fully describe the behaviour of this ubiquitous small canid. It is therefore important to look at the basic biology of this species before concluding what role it plays in the rabies problem. This is the aim of the discussion that follows.

THE JACKAL AS A RABIES PROBLEM

The occasional transmission of rabies from rabid jackals to farm animals, to human pets, to hunting dogs or to humans is a very real possibility. How-

ever, predation by jackals is a perennial and more immediate problem wherever small stock are farmed in southern Africa (Rowe-Rowe 1975). As such, farmers and agricultural institutions have for a long time focused a considerable amount of energy on the eradication of this species (Du Toit 1904; Fitzsimons 1919), and any change in its status, or any unusual incidents, are the focus of attention and often of exaggeration (Van der Merwe 1953a). Given an already heavily biased view of the desirability of the species, any incident involving rabies in a jackal receives far more attention from the public than would an incident involving a less well-known species.

Cases of rabies involving jackals in southern Africa have been carefully documented (e.g. Brückner *et al.* 1978; Cumming 1982; Meredith 1982). In so far as these cases represent a potential threat to human life, the attention is warranted and justified. However, the immediate conclusion derived from the analyses—i.e. that the eradication of the jackal would solve the rabies problem—cannot be rigorously defended. Indeed, Meredith (1982) has warned against the folly

of indiscriminate poisoning based on such simplistic arguments. At first glance the jackal may well appear to be an ideal rabies vector—a potentially aggressive, territorial carnivore which can occur in relatively high densities in a wide range of habitats. If indeed this were the case, then areas with natural jackal populations should experience an equal, if not greater, incidence of rabies than areas where jackals are persecuted and controlled. Enigmatically, jackal populations in conservation areas display a low, or even non-existent, incidence of rabies (Cumming 1982; McKenzie 1990; De Vos, personal communication). This is despite these areas being adjacent to affected farming areas, even when there has been documented movement of rabid animals into the conservation areas from the adjacent farming areas. It has been suggested that jackals in conservation areas are part of a natural ecosystem that is resilient to the disease (De Vos, personal communication), although the mechanism of the resilience has not yet been elucidated.

The perception of the jackal as a rabies problem is inextricably linked to its association with domestic and feral dogs. These species show many similarities and have even been known to interbreed (Van der Merwe 1953a). An interaction of some sort is almost inevitable following contact between the two species and so rabies could potentially spread very easily from the one species to the other and back again (Cumming 1982). This aspect of the problem is extremely important for several reasons. First, rabies in jackals may reflect a primary problem in feral dogs in the same area, and *vice versa*. And second, dogs, in their close relationship with man, are the strongest potential link between rabies in jackals and rabies in humans. Direct physical contact between humans and jackals (rabid or otherwise) is a rare event. Furthermore, a bite from a jackal would elicit immediate preventative treatment, while a bite from a dog, originally infected by a jackal, may easily be ignored.

BASIC JACKAL BIOLOGY

Reproduction

Jackals are monogamous, and the pair bond may be life-long (Moehlman 1983). Mating occurs in June or July in association with increased vocalization (Skead 1973). The young are born between August and November after a two month gestation period (Fairall 1968, Rowe-Rowe 1978, Stuart 1981). The pups venture away from the den after three months, but remain confined to their natural home range for at least six months (Ferguson, Nel & De Wet 1983). After a year the young may disperse (Ferguson *et al.* 1983), or they may remain behind and act as helpers (Moehlman 1979), assisting the parents in raising the next brood. Bothma (1971) recorded a dispersal distance of 103 km.

Range and territory use

The adult home range is variable in size (Ferguson *et al.* 1983; Rowe-Rowe 1982; Hiscocks & Perrin 1988), probably as a result of differences in resource availability (Ferguson *et al.* 1983; Macdonald 1983). As mentioned above, young animals remain confined to the natal home range, while older juveniles move over areas that may be far larger (Ferguson *et al.* 1983). Within an adult pair's home range there is a core area which is intensively used. Only a small part of the total home range is used when prey is abundant, with wider-ranging movements occurring when prey is scarce (McKenzie 1990). Jackals will make use of clumped resources, and in these situations the home range may be very small although this is not necessarily the case (Hiscocks & Perrin 1988). As there is overlap of home ranges, the home ranges cannot be equated with true territories. The essential feature with respect to home range use is the extreme flexibility and adaptability of the species.

Habitat use

The jackal has a wide habitat tolerance, although in the wetter regions of southern Africa it is replaced by the side-striped jackal *Canis adustus* (Smithers 1983). Black-backed jackals are often associated with dense woodland habitat (Smithers 1983; Ferguson 1980). However, within a particular environment, individual jackals prefer to be associated with open terrain; when persecuted, preference may be given to denser vegetation to avoid being seen (Smithers 1983; McKenzie 1990). There are also seasonal changes in habitat use, with use of closed habitat increasing through winter as prey in open areas becomes scarcer (McKenzie 1990).

Activity

The basic activity pattern of the species is described by a bimodal peak, with the first peak in the evening and the second in the early morning (Ferguson, Galpin & De Wet 1988). This parameter is also markedly affected by persecution: in conservation areas there is a considerable amount of activity during daylight, while this becomes almost non-existent under persecution (Van der Merwe 1953a; Smithers 1983).

Territorial defence

Indirect defence of the territory is achieved through the use of scent marks (urine and faeces) as well as calling (Moehlman 1983). Faeces are often placed on prominent objects, so forming a visual marker (Ferguson 1980). Aggressive territorial interactions may be observed (Moehlman 1983), and there is a well developed repertoire of agonistic interactions and postures (Ferguson 1978). However, the existence of this repertoire is enigmatic if the pair is assumed to be the basic social unit—such behaviour

is usually indicative of a complex social system (Fox 1971; Kleiman & Eisenberg 1973) such as is found in canids that live in packs. In considering the potential formation of packs by jackals to defend resources, Lamprecht (1978) concluded that this possibility is eliminated by the presence of larger African carnivores that could outcompete even a large pack of jackals. However, co-operation in jackal society does extend beyond the family unit, and group formation for the purposes of hunting large prey has been documented (McKenzie 1990). Again, flexibility would seem to best describe this species.

Feeding

Jackals feed on a wide range of items, from fruits to medium-sized antelope (references in Skinner & Smithers 1990). They are opportunistic, generalist predators—a property which enables them to adapt to a wide range of habitats and to survive in areas which are developed for agriculture. Insects form an extremely important part of the diet in many areas. Jackals may also be selective—when hunting adult impala they have been found to select old and wounded individuals (McKenzie 1990).

Population density

Recorded population densities vary from one jackal/2–3 km² (Rowe-Rowe 1982) to 22 jackals/km² (Hiscocks & Perrin 1988). The latter was recorded at a seal colony which provided a predictable food supply. In semi-arid savanna a population density of 4–7 jackals/km² has been recorded (McKenzie 1990). High population densities are thus attainable, although fluctuations can be expected in response to changes in resource availability and dispersion.

IMPORTANT ASPECTS IN RELATION TO RABIES

From the above synopsis of jackal biology there are several aspects that are relevant to an analysis of the jackal as a potential rabies vector.

One of the requirements for a species acting as an important rabies vector is that it should be capable of attaining a moderate to high population density (Macdonald 1980). The jackal can appropriately be described as a highly adaptable, opportunistic species, and it is certainly capable of attaining high population densities. Furthermore, moderate to high densities can be maintained in agricultural areas despite persecution as a result of the adaptability of the species. Other medium to large carnivores are relatively easily eliminated under these same circumstances, thus removing competition and potential predation as limiting factors and thereby increasing the growth potential of the jackal population in these areas.

The density of jackals recorded in my own study in Botswana (4–7/km², McKenzie 1990) is probably at

the upper limit of population density for this species in a semi-arid savanna. The study area bordered on the northern Transvaal of South Africa, where rabies in jackals is a perennial problem (Brückner *et al.* 1978; Meredith 1982). Two cases of rabies were confirmed within the Botswana population—one in 1987 and one in 1988. Both animals were shot while showing marked inco-ordination and aggression, and both were in poor physical condition, indicating that the clinical disease had been manifest for at least several days. If the jackal was an ideal rabies vector, a rabies epizootic should surely have followed at least one of these events given the very high population density recorded. Enigmatically, however, no further cases were recorded in either year despite close monitoring of the animals in the area.

Another requirement for a species to be a suitable rabies vector is that there must be contact between individuals in the population (Meredith 1982). In this regard the jackal again appears to be ideal. The species is highly mobile and is large and easily visible. Furthermore, it goes out of its way to advertise its presence through calls and scent marks, and is highly inquisitive with respect to the activities and presence of conspecifics. The wide-ranging movements of sub-adults, the winter increase in home range, and the sharing of clumped resources, such as water and large carcasses, further increase the possibility of contact between individuals. Coupled with the apparent territoriality of mated pairs, the high contact rate would seem to create an ideal opportunity for conflict, aggressive interaction and the rapid spread of rabies from infected individuals to the rest of the population.

Territorial aggression and conflict has indeed been documented in jackals (Moehlman 1983). However, during 18 months of observations in Botswana (McKenzie 1990), I never recorded direct aggressive encounters other than bickering and posturing at carcasses. None of the latter ever involved biting. There was close co-operation between non-family members during hunting of adult impala, and encounters far beyond the 'territory' boundaries were unremarkable. Ferguson (1978) also recorded attenuated agonistic encounters at clumped resources. The repertoire of social interactions in this species suggests a large social unit in which there is a need for ritualized control of potential conflict. I suggest that while jackals may live in pairs, the true social unit is a much larger 'cryptic' pack in which interaction and cooperation is facilitated by the well-developed social cues. In these 'cryptic' packs the individuals are ready to co-operate when necessary, but function as apparently separate entities in the face of competition from the larger African carnivores. The implication of this interpretation of jackal biology is that the moderated aggression recorded in my study and by others at clumped resources may in fact be more important than the

presumed mutual tolerance of strangers. (Where clumped resources become predictable, and in the absence of other African predators, defence of resources by groups of jackals could potentially result in increased aggression. This has been recorded in the closely related golden jackal *Canis aureus* (Macdonald 1979)).

Hunting, trapping or poisoning of jackals in agricultural areas creates gaps in the population that can be filled by dispersing sub-adults from other areas or by expansion of neighbouring territories. Encounters between remaining residents and potential immigrants, and between different immigrants, are likely to be vastly different to those prior to persecution. Increased levels of aggression are likely until a new hierarchy is established, or until one immigrant has laid unequivocal claim to the vacant territory. Jackals are similar to coyotes *Canis latrans* in many respects (Van der Merwe 1953b). In the latter species, disruption of populations has led to increased levels of aggression (Springer 1982), although without the complication of the presence of rabies. The introduction of rabid jackals into disturbed and undisturbed populations is likely to have very different consequences. In the former, aggression by the rabid individual is likely to be matched by the respondent in order to establish the new social order. This could easily lead to physical contact and transmission of the virus. In the latter, suddenly elevated aggression of an individual may not necessarily lead to conflict, as ritualized interactions lead to the avoidance of physical contact and injury. Unless posing a direct threat, a strangely behaving individual could be avoided rather than confronted. This hypothesis needs to be tested, as it could help to explain the discrepancy in rabies epizootiology between agricultural and conservation areas.

TOWARDS AN ACTION PLAN

Control of jackals in order to control rabies is doomed to failure. The financial and administrative burden of such a programme is enormous. Yet despite the best efforts, the species is highly adaptable, and is able to avoid persecution with remarkable success. Furthermore, the contact potential of the species is high, maintaining the risk of transmission even in a depleted population. Finally, there is a possibility, which remains to be proven or disproven, that disruption may in fact increase aggressive interactions and thereby the transmission of rabies in the remaining population.

Direct transmission of rabies from jackals to humans is an unlikely event. Of far greater significance is the link provided by the domestic dog between the wild animal and the human victim. Compulsory dog inoculation would provide a cost-effective means of dramatically reducing the importance (and perhaps

even the incidence) of rabies in the jackal population. This is practised in Botswana, and should be done, at least regionally, in other African countries where the jackal occurs.

Preventive oral vaccination of jackals is unlikely to provide a panacea, largely because of the logistical and financial implications of an oral vaccination programme on the scale that would be required. Strategic oral vaccination during rabies outbreaks could well play a role, and here the timing would be important. The greatest increase in home range movements, and therefore in potential contact rate, occurs from mid-winter onwards. At this time young jackals are also dispersing. The wider movements are accompanied by increased use of paths and roads, making placement and monitoring of baits relatively easy.

The problem of jackal rabies is unlikely to be solved without further research. Useful methodologies and parallels can be derived from the vast literature on coyotes. Although foxes have also been intensively studied, there are many differences in the biology of these two species. A hypothetico-deductive approach to the sylvatic/agricultural discrepancies in rabies epizootiology could prove fruitful, while further studies on the basic biology of jackals should be encouraged.

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