

CHAPTER FIVE

5.1 Concluding remarks

Finally, having reached a point where the hosts, the parasite, humans and their dynamic relationship with one another and their environment have been investigated, a clearer understanding of the underlying causal factors associated with the transmission success of *Spirocerca lupi* to dogs has been achieved. The rate of urbanisation is accelerating with the effect that land previously used for grazing purposes is converted to urban and suburban environments (Pickett *et al.* 2001). These changes in landscape use coupled to altered dung beetle species assemblage structure have influenced the pattern of events observed in this host – parasite relationship. Furthermore, the social organization of domestic dogs (pets versus feral animals) and the availability of exposed excrement as a direct or indirect consequence of human behaviour played a pivotal role in the rate these parasites are transmitted to dogs.

Transmission rate is paramount to a parasite's fitness (Agnew & Koella 1999). On the one hand dung beetles may act as vectors for nematode parasites. On the other hand however, coprophagous dung beetles mediate several important ecosystem functions, such as nutrient re-cycling and parasite suppression, by removing dung from the environment for feeding and breeding purposes (Nichols *et al.* 2008). In so-

doing they provide valuable ecosystem services, such as the control of pest and parasite numbers (“biological pest control”), removal of the breeding medium for flies, and soil fertilisation (Nichols *et al.* 2008). A decline or local extinction of dung beetle populations would have dramatic short and long-term effects on ecosystem integrity, which make it all the more important to protect these processes since dung beetles are highly sensitive to human disturbances (Nichols *et al.* 2008). Assuming that dung beetles persist in the modified urban environment, eradicating them would not be a useful solution to controlling infection of dogs by *S. lupi*. There are now clear indications that dung beetles belonging to the genus *Onthophagus* are important vectors for this parasitic nematode of dogs. One could monitor one or more *Onthophagus* species populations to determine both the incidence of parasite eggs and the relative danger of dogs contracting spirocercosis from such populations.

Imposing proper sanitation and hygienic habits through health education in poor, resource-limited communities would contribute to the reduction in transmission of *S. lupi* to dogs. Provision of simple pit latrines and education about disposal of faeces where latrines are not available (by e.g. burying it) should go a long way in improving the current situation among dogs, especially in informal settlements. However, dog owners in wealthier neighbourhoods must take responsibility to remove their dogs’ faeces from the environment, not only from public spaces, but especially on private property as this is where the animals most likely spend most of their time. Formal institutions can aid in this process by providing disposable bags and bins in public open spaces, and impose fines on those who do not comply with

such regulations. This would surely help foster a moral culture of cleaning up after one's own dog.

Information should be made available to the lay public through popular literature about the underlying causes of spirocercosis and its transmission to domestic dogs, and about current advances being made in scientists' understanding of the dynamics of spirocercosis. People should be made aware of the fact that dogs *are* coprophagous despite the diet they are fed. This might foster a better understanding among dog owners about the transmission of this parasite to dogs and how it is sustained in the environment. The role of the intermediate dung beetle hosts in the transmission of this disease should be better communicated to veterinarians and veterinary students. There seems to be a lack of awareness of their exact role (at least in South Africa) in transmitting *S. lupi* to dogs. A possible solution would be to include veterinary entomology as part of the undergraduate curriculum.

Future research objectives

Refinement of sampling methods is required for studies on the associations between dung beetles and *S. lupi*. Although the method of pitfall trapping applied in this study is currently the standard method used in all studies on various aspects of dung beetle ecology and biodiversity, a new approach may be needed for studies on parasite prevalence in dung beetle populations. The degree to which dung beetles in urban areas are influenced by dung in the environment immediately surrounding a trapping site, may provide a false indication of the real prevalence of parasites in such populations. Comparative studies between pitfall trap results on prevalence of

infection and those obtained from collecting dung beetles directly from a host's faeces should be explored. Dung beetle sampling should occur more regularly throughout the year to obtain a clearer understanding of the parasite's fate during months of lower dung beetle activity. Sampling in urban areas should take place over longer periods at a time to maximise the catch, since dung beetles occur in much lower densities in urban environments than in natural areas. Similar studies should be conducted in rural environments, and over a wider geographical range with different climatic conditions, to improve our understanding of certain trends identified in this study and extend the list of suitable dung beetle intermediate hosts. The development of mathematical models based on data obtained from studies such as the current one would aid in making meaningful predictions about future trends in parasite burdens in scarabaeine host populations and transmission rates of *S. lupi* to dogs.