

Is there safety in numbers? The effect of cattle herding on biting risk from tsetse flies

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Abstract. In sub-Saharan Africa, tsetse (*Glossina* spp.) transmit species of *Trypanosoma* which threaten 45–50 million cattle with trypanosomiasis. These livestock are subject to various herding practices which may affect biting rates on individual cattle and hence the probability of infection. In Zimbabwe, studies were made of the effect of herd size and composition on individual biting rates by capturing tsetse as they approached and departed from groups of one to 12 cattle. Flies were captured using a ring of electrocuting nets and bloodmeals were analysed using DNA markers to identify which individual cattle were bitten. Increasing the size of a herd from one to 12 adults increased the mean number of tsetse visiting the herd four-fold and the mean feeding probability from 54% to 71%; the increased probability with larger herds was probably a result of fewer flies per host, which, in turn, reduced the hosts' defensive behaviour. For adults and juveniles in groups of four to eight cattle, > 89% of bloodmeals were from the adults, even when these comprised just 13% of the herd. For groups comprising two oxen, four cows/heifers and two calves, a grouping that reflects the typical composition of communal herds in Zimbabwe, ~ 80% of bloodmeals were from the oxen. Simple models of entomological inoculation rates suggest that cattle herding practices may reduce individual trypanosomiasis risk by up to 90%. These results have several epidemiological and practical implications. First, the gregarious nature of hosts needs to be considered in estimating entomological inoculation rates. Secondly, heterogeneities in biting rates on different cattle may help to explain why disease prevalence is frequently lower in younger/smaller cattle. Thirdly, the cost and effectiveness of tsetse control using insecticide-treated cattle may be improved by treating older/larger hosts within a herd. In general, the patterns observed with tsetse appear to apply to other genera of cattle-feeding Diptera (*Stomoxys*, *Anopheles*, Tabanidae) and thus may be important for the development of strategies for controlling other diseases affecting livestock.

Key words. *Glossina*, cattle, feeding behaviour, microsatellite DNA, tsetse fly, Zimbabwe.

Introduction

Many animals are gregarious, a major benefit of which is thought to be the protection from predators provided by being close to other con-specifics (Hamilton, 1971), dilution effects (Foster & Treherne, 1981) or improved anti-predator vigilance (Bednekoff & Lima, 1998). Much of the work on this topic has

been concerned with classical predator–prey relationships, such as lions hunting cattle (Hamilton, 1971) and hawks attacking pigeons (Kenward, 1978). However, Hamilton's (1971) seminal paper on the 'selfish herd' also recognized that similar arguments might be applied to flies feeding on herds of ungulates. Several studies have shown that caribou (Bergerud, 1974), feral horses (Rutberg, 1987) and domestic cattle

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