ABSTRACT

The work described in this thesis is an investigation of various aspects of the interaction between haematophagous Diptera, the atmosphere and plumes of host odour containing carbon dioxide (CO_2). Experimental efforts were divided into three parts.

In Part One, the main question asked concerned the range at which CO_2 from a host animal can be detected by a notional tsetse fly against fluctuating background concentrations of atmospheric CO_2 with regard to differences in season, habitat and micro-meteorological conditions. The diurnal structure of background concentrations of atmospheric CO_2 was bi-modal, with higher fluctuations in riverine woodland, in the wet season and during the night, early morning and late afternoon compared to those in the dry season in the Zambezi Valley, Zimbabwe. Fluctuations were still larger in moist evergreen thicket in KwaZulu-Natal, South Africa. Plume CO_2 signals appeared as a series of bursts of varying strength and intermittency which were generally difficult to distinguish from fluctuating background CO_2 concentrations, particularly in dense vegetation and at distances >30-60m from the odour source.

In Part Two, the effects of background CO_2 concentrations, wind structure and other meteorological conditions on the responses of tsetse and other biting flies to natural or synthetic host odour plumes containing CO_2 were investigated in different seasons and habitats. During dry season studies in Zimbabwe, biting flies did not locate a host odour source in an artificially noisy CO_2 environment. Catches of biting flies remained unaffected when four host odour plumes were released individually or collectively, even though more bursts were detected from an array of partially overlapping odour plumes compared to a large single plume. During wet season studies in Zimbabwe, catches of tsetse, but not Stomoxyinae, were concentrated at a source of host odour regardless of the presence of a visual stimulus. Flies also arrived at random during the continuous release of host odour plumes, which was attributed to the effects of dense vegetation and confusing wind parameters. A study of the diurnal activity of biting flies in Zimbabwe and South Africa revealed U-shaped catch patterns for *Glossina morsitans morsitans* Westwood, *G. pallidipes* Austen and *G. brevipalpis* Newstead, but catches of *G. austeni* Newstead were highest during the middle of the day when background concentrations of atmospheric CO_2 still fluctuated considerably.

In Part Three, electroantennogram (EAG) responses of *G. m. morsitans* and *G. austeni* to changes in CO_2 concentration with regard to different background concentrations of CO_2 were recorded in laboratory studies in the UK. Flies appeared to adapt to each background concentration. Responses to a concentration series of CO_2 stimuli at each background level were higher for *G. austeni* than for *G. m. morsitans*; however, the responses did not differ significantly, which was attributed to large variation between insects.

The results are discussed with regard to the host location behaviour of tsetse and other tropical, diurnal biting Diptera.