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A Probability Model of Vector Behavior: Effects of DDT Repellency, Irritancy, and Toxicity in Malaria Control[1]

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ABSTRACT: A probability model of how DDT residues may function within a malaria control program is described. A step-wise organization of endophagic behaviors culminates in a vector acquiring a human blood meal inside the house. Different vector behaviors are described, epidemiologically defined, temporally sequenced, and quantified with field data. Components of vector behavior and the repellent, irritant, and toxic actions of insecticide residues are then assembled into a probability model. The sequence of host-seeking behaviors is used to partition the total impact of sprayed walls according to the three chemical actions. Quantitatively, the combined effect of repellency and irritancy exert the dominant actions of DDT residues in reducing man-vector contact inside of houses. These relationships are demonstrated with published and unpublished data for two separate populations of *Anopheles darlingi*, for *Anopheles gambiae* and *Anopheles funestus* in Tanzania, and *Anopheles punctulatus* in New Guinea.

Keyword Index: Probability model, malaria control, vector behavior, DDT, *Anopheles*.

INTRODUCTION

Efficient vectors of human malaria typically move to a house, enter, and bite indoors. These activities are interrupted by intervals of resting. The acts of entering and exiting a house involve finding and entering openings in a physical barrier (the house wall), so they are distinct from movement or flight from one location to another. House entering and indoor biting (endophagic) behaviors are epidemiologically important because they influence the likelihood that a mosquito will bite a human and imbibe an infectious blood meal or transmit malaria. Endophagic behaviors are equally important in malaria control to the extent that an insecticide may prevent vectors from entering a sprayed house or stimulate vectors to exit a house before they bite.

Practically every important vector of malaria exhibits insecticide avoidance behavior (Elliott and de Zulueta 1975 and Lockwood et al. 1984). Yet the epidemiological significance of these chemically-induced behaviors is controversial. In this paper we describe a model for defining the importance of repellent and irritant actions of insecticide residues. The term excito-repellent will be used to describe all chemically-

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