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# LETTER TO THE EDITOR

## PROPORTIONALITY BETWEEN LIGHT TRAP CATCHES AND BITING DENSITIES OF MALARIA VECTORS

The use of human biting (or landing) collections to sample *Anopheles* is a logistically complicated procedure, but is a crucial part of conventional estimation of transmission and exposure rates for malaria. Hence the work of Lines et al. (1991), suggesting that the numbers of *Anopheles* (and *Culex*) caught by light traps in East Africa is approximately proportional to the numbers caught by human bait, represented an important advance. Their results implied that the ratio of trapping efficiencies of the two methods does not depend on abundance, suggesting that light traps might provide a relatively easy way to estimate both the vectorial capacity and the entomological inoculation rate. However, Mbogo et al. (1993) claimed that in Kilifi, Kenya, this proportionality was not observed.

Careful examination of the results of the two studies suggests that the difference in conclusions stems from a statistical misunderstanding. Both studies compared the numbers of mosquitoes caught in biting collections ($x$) and matched light traps ($y$), and used the method of Altman and Bland (1983) to determine whether the ratio of numbers of mosquitoes caught by the two methods depended on overall abundance. This involved regressing $z = \log(x + 1) - \log(y + 1)$ on $[\log(x + 1) + \log(y + 1)]/2$.

In the Kenyan study, there was a significant regression coefficient, which implies that $z$ depends on the overall abundance of mosquitoes. This was interpreted to mean that the ratio of trapping efficiencies varies with the abundance of mosquitoes.

The mosquito densities recorded by Lines et al. (1991) were higher than those of Mbogo et al. (1993), who explicitly commented on the low mosquito densities in Kilifi. Many of the Kilifi samples did not contain any mosquitoes at all. This is why the response variable chosen for the regression was $\log(x + 1) - \log(y + 1)$ rather than $\log(x) - \log(y)$. If the ratio $x/y$ is a constant, then the quantity $\log(x) - \log(y)$ is also constant but this is not true of $\log(x + 1) - \log(y + 1)$, which is highly dependent on mosquito abundance at low values of $x$ and $y$ (see Fig. 1). At high values of $x$ and $y$, the approximation $\log(x + 1) \approx \log(x)$ is better and thus $z$ does indeed become more or less constant. This is what was observed by Lines et al. (1991).

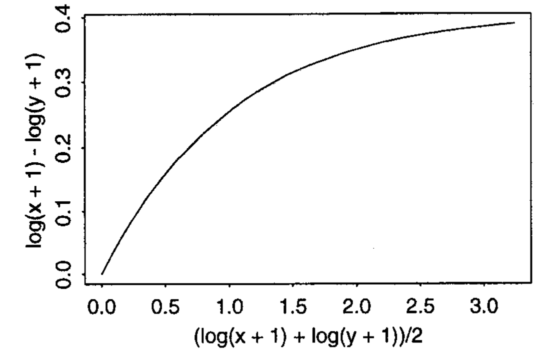


Fig. 1. Relationship between $\log(x + 1) - \log(y + 1)$ and abundance for low values of $x$ and $y$ where $x = 1.5y$.

The data presented by Mbogo et al. (1993) do in fact give the impression that $z$ is independent of abundance at high densities, and therefore that the apparent dependence on abundance can be attributed to the application of a formula for $\log(x)$ to $\log(x + 1)$-transformed mosquito counts. With sparse data of counts of mosquitoes it is important to consider the validity of such transformations. It is often more appropriate to use Poisson regression techniques, with allowance for overdispersion if necessary (McCullagh and Nelder 1989). An additional advantage of such methods is that they are able to correctly weight the observations with low mosquito densities, which are disproportionately influential in the analysis of Mbogo et al. (1993).

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