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**Comment on article by De Meeus *et al.* (2019)**

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Control programmes against vector-borne diseases often aim to stop pathogen transmission by increasing vector mortality. This may be compromised if vector population dynamics change as populations decline. Quantifying possible effects of reduced density, when populations are sparse, is however difficult because insufficient individuals can be sampled. As De Meeus *et a*l. [1] propose, population genetics could provide insights in this area. From an analysis of published data, they conclude that the dispersal of tsetse flies increases ~100-fold with population reduction, thereby threatening the success of trypanosomiasis control operations.

Evidence for the authors' claim is presented in Fig. 1, involving a regression of dispersal distance against population density. These results do not however prove that reduced density will cause increased dispersal during control of any given tsetse species. The data are from multiple species and locations and from populations not subject to vector control.

Differences in dispersal rates between species exist, relating to fly size, ecological niche and host-seeking strategies [2]. Analysis including multiple species would therefore need to consider these factors. Even if adequate data were available for a single species in a single location, we ask the authors to provide a plausible hypothesis for the mechanism behind an increase in dispersal with increased mortality rates in a control operation.

Under natural conditions, tsetse populations of lower density may have relatively high dispersal rates, but this would not be the case for a population reduced by control efforts. In areas of contiguous habitat and high density of hosts, flies will not have to move far to find food and suitable microclimate, resulting in low dispersal and high density. The opposite will be true in areas of more fragmented habitat. Dispersal and density could therefore be correlated, explaining the observation for a given species in Fig. 1, but this is no evidence that one causes the other and indeed no evidence that artificially induced mortality would increase dispersal.

The authors state that Box 3 shows that a negative density-dependent dispersal has long been known in tsetse. Box 3 however argues that as density declines flies can feed more readily, implying that it is not necessary to travel so far to find a host, thus tending to reduce dispersal. The authors also state that in areas of high tsetse density, immigrants have low feeding success and high mortality, but no references are provided to support this claim. Moreover, incongruously, the authors also imply that immigrants become "safely settled" in sparse populations sustained by invasion.

The results of the regression analysis are also unrealistic. In Zimbabwe, the rate at which female *G. pallidipes* and *G. morsitans* moved from high density areas into a block subject to aerial application of insecticide was ~800m/day [3] - consistent with the high mobility of marked flies in uncontrolled populations nearby. If we use the regression presented in Fig. 1, the daily displacement of a very sparse population would be ~100 times greater, at ~80km/day, a rate incompatible with the fly’s energy budget [4].

Van Sickle *et al.* [5] demonstrated that sustained and extensive killing of adult tsetse reduced the mean age of the residual population, especially by a several-fold enhancement of the proportion of flies that are around one week old. Coupled with the fact that the flight capacity of young tsetse is limited [6], means that daily dispersal will tend to decline, not increase, when control reduces the population density. The poor mobility of young populations must decrease the efficacy with which they encounter killing devices, but this hardly matters because young populations cannot prosper, since females <2 weeks old do not reproduce.

Even if we did allow that dispersal increases by two orders of magnitude as control proceeds, we could still not accept that this threatens the success of operations. Indeed, control would become more successful since the residual population would emigrate from the operational area at increased rates and those flies that did not depart would have a greatly enhanced rate of encountering killing devices. Furthermore, if the proportion of emigrating flies was indeed relatively high in any residual population in the controlled area, the fact that the population density there has been reduced substantially would mean that the absolute number of flies going to the uncontrolled areas nearby would tend to increase but little, if at all, and hence would be of minor concern to control officers.

**References**

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