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Short Research Communications

Comparative performance of light trap types, lunar influence and sandfly abundance in Baringo district, Kenya

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Phlebotomine sandflies are vectors of leishmaniases and viral infections as well as being a biting nuisance. In Kenya, *Leishmania donovani* is transmitted by *Phlebotomus martini* (Diptera: Psychodidae) whereas vectors of *L. major, L. tropica* and *L. aethiopica* are *P. duboscqi, P. pedifer* and *P. guggisbergi* respectively[1,2].

Baringo district has an arid to semi-arid climate and is a home to a wide range of sandfly species[3]. It boasts of 11–17 sandfly species[3,4]. Historically, robust capture sites have been found in the vicinity of the town of Marigat where sandfly habitats include human habitations, pit-latrines, animal sheds, termite hills, animal burrows and tree holes[4,5]. Termite mounds have been found to harbour greater numbers of man-biting sandflies than other resting places and have been shown to be a habitat of importance to the epidemiology of visceral leishmaniasis (VL)[3–5].

The lunar cycle is known to influence adult flight behaviour of many insects including those of the order Diptera, particularly Culicidae[6]. In one study, few sandflies were attracted to light traps during full moon[7]. Limited studies have been carried out in Kenya to demonstrate an influence of the lunar cycle on phlebotomine sandfly abundance.

Although sandflies have great medical significance besides being biting nuisances, few studies have focused on determining the most efficient trapping strategies[8]. One study involved comparing a CDC light trap, two types of updraft traps that were designed for trapping sandflies in the field and a sticky trap near Marigat animal burrows[9]. Results indicated that one of the updraft traps collected relatively more sandflies and both updraft traps were more consistent in terms of sandflies caught than other traps. The more improved blacklight (UV) updraft and downdraft light traps are thought to attract more sandflies than white incandescent light but they have not been widely tested on Kenyan sandfly species.

The current paper presents data on sandfly abundance in Marigat in three different locations and two lunar phases as well as relative performance of the CDC miniature light trap, updraft blacklight and downdraft blacklight traps.

The study was conducted in Marigat area that is located within Marigat administrative division of Baringo district, Rift valley province, Kenya. Baringo district covers an area of approximately 10,000 km^2. The area is semi-arid standing at an altitude between 530 and 685 m with several rocky hills rising above this level. The vegetation is generally sparse due to over-grazing by livestock and consists mainly of thorny bushes and Acacia trees with little ground vegetation. The annual rainfall is usually between 635 and 762 mm, but there is no sharp division into wet and dry seasons, with some rain falling in most months[3]. The Kalenjin communities, who are the main inhabitants, keep goats, sheep and cattle. Only areas restricted to the irrigation schemes grow various crops. Trapping points from three study locations, Perkerra, Rabai and Loboi, were selected based on easy accessibility even during rainy season.

Vector sampling was done using the following unbaited traps from John W. Hock Company, Gainesville, FL, USA: (i) the standard CDC miniature trap model 512 with white incandescent light bulb; (ii) downdraft blacklight (UV) trap model 912, which is similar to CDC miniature light trap but includes a blacklight tube support and ballast; and (iii) an updraft blacklight (UV) trap model 1312, which is an inverted form of the downdraft blacklight trap. All traps were operated by 6V rechargeable batteries.

The three traps were set up in each of the three trap locations 0.3 m above the ground and about 100 m apart near inactive termite mounts, animal sheds and rodent burrows. Thus, nine traps were in operation for six nights every month from January to June (two trapping periods coinciding with the full moon and new moon lunar phases) and later for three nights from July to December 2005. Traps were switched on at 1800 hrs and collections were made the following day at 0600 hrs. Trap catches were used to characterize each of the three sites with respect to sandfly species and density. The study also allowed the determination of the most effective sampling trap to target sandfly vector species.

Captured sandflies were aspirated from collection bags into paper cups with a screen on one end and closed on the other (one paper cup per collection bag). They were knocked down using chloroform and emptied on white sheet of paper for sorting. Sandflies were then put in cryo-vials (labelled according to collection date, trap type and location), stored on dry ice and transported to the laboratory for further processing.

After determining the sandfly sex and physiological status, only females were processed due to the interest in them as nuisance biters and/or leshmaniasis vectors. Their heads were excised for species identification. The heads were mounted on a slide with the ventral part facing upwards using gum chloral. After allowing the slides to dry for 1–2 days, the ciberial armatures were observed for species identification using identification keys[10].

Data were recorded in MS Access database and imported into STATA 9.2 for analysis using non-parametric methods. Sandfly numbers were compared using Mann-Whitney or Kruskal-Wallis tests depending on the number of groups involved.

A total of 9889 female sandflies falling into 11 species were collected over the whole year. Of this number *P. martini* and *P. duboscqi* contributed 0.5 and 3.3% respectively. Overall, *S. schwezi* (36.6%) and *S. clydei* (30%) were the most abundant with their numbers being highest in Perkerra. The numbers for *Phlebotomus* species remained <50 each month. *Sergentomyia* species with numbers <50 were classified under one group of 'others'. They included *S. adleri*, *S. africanus*, *S. graingeri* and *S. inermis*.

There were no differences in the numbers of *P. duboscqi*, *S. clydei*, *S. bedfordi* among the three sites; Loboi, Perkerra and Rabai (p >0.05). There were differences however when *P. martini* (χ^2 = 20.802, p <0.0001) and *S. swchetzi* were compared (χ^2 = 9.770, p = 0.0076). Significantly more *P. martini* sandflies were collected in Rabai than in both Perkerra (z = –3.912, p = 0.0001) and Loboi (z = –3.704, p = 0.0002). There was no difference in the numbers of *P. martini* collected in Loboi and Perkerra (z = 1.630, p = 0.1032). The numbers of *S. schwetzi* were higher in Perkerra than in Rabai and Loboi (p < 0.05).

The numbers of sandflies collected during the two lunar phases are shown in Fig. 1. The difference between the total number of sandflies collected during

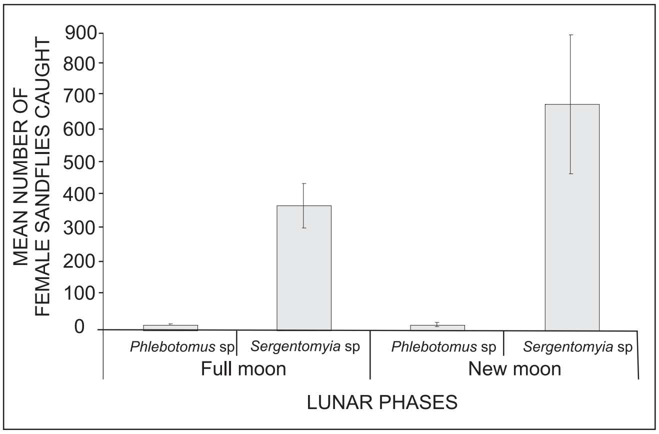

Fig. 1: Mean (± SE) of female sandflies caught in Marigat during two lunar phases

the new moon and full moon phases were not significant for both *Sergentomyia* (z = 1.191, *p* >0.05) and *Phlebotomus* sandfly species (z = 0.004, *p* >0.05).

In trap performance comparisons, the total number of sandflies collected throughout the year was used. The average numbers of sandflies caught per trap per night are shown in Fig. 2. The three types of traps were not significantly different in caught *Sergentomyia* sandfly numbers ($\chi^2 = 4.751$, $p > 0.05$). On the other hand, there was a significant difference in the number of *Phlebotomus* sandfly species collected by the three traps ($\chi^2 = 12.424$, $p < 0.05$). CDC miniature light traps collected significantly more *Phlebotomus* sandfly species than downdraft (z = –3.259, *p* <0.05) and updraft (z = 2.759, *p* <0.05) trap types.

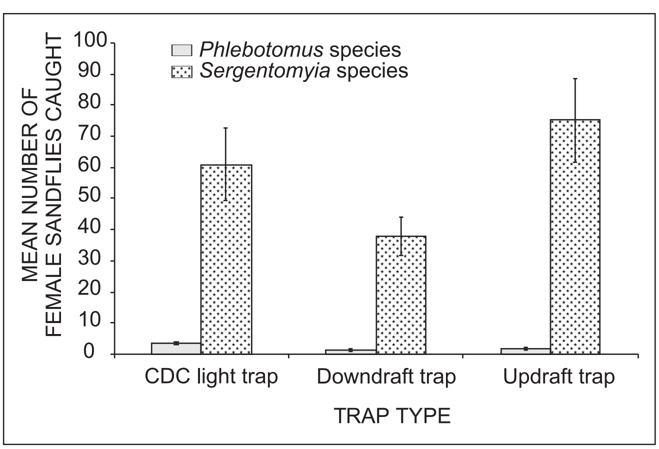

Fig. 2: The mean (± SE) number of female sandflies caught in Marigat per trap per night

There was no difference between the down draft and updraft traps in the number of *Phlebotomus* collected (z = –0.620, *p* >0.05).

Physiological status for only 3210 sandflies was determined. There was no significant difference in the number of fed, unfed and gravid *Sergentomyia* sand flies caught by the three different traps (*p* >0.05). The case was the same with *Phlebotomus* species. The numbers of unfed *Sergentomyia* sandflies were significantly more than the total of fed and gravid ones (*p* >0.05). Only one gravid *Phlebotomus* sand fly was caught in the study. The sum of the number of gravid and fed *Phlebotomus* sandflies were therefore significantly less than the number of unfed sandflies (z = 14.428, *p* <0.0001).

Effective vector population sampling is necessary in predicting vector-borne disease outbreaks and determining when and where to apply control measures to prevent/suppress such outbreaks. Sandfly sampling method and habitat type influence the diversity and abundance of species in a collection activity. In the current study, 11 species of sandflies were collected from around various habitats using different types of light traps. *P. martini* and *P. duboscqi* contributed 3.8% of the total collection. Exit-entry traps placed in termite mound vent openings yielded a similar result in the same area[5]. Another study involving use of CDC miniature light traps and sticky traps for sandfly collection resulted in *S. schwetzi* and *P. martini* being the most abundant species accounting for 42.3% and 34% respectively[4]. These investigations carried out in the same area indicate that it is imperative for sandfly vector surveillance studies to be carried out using same collection methods, obviously considering the sandfly species required. Due to different sampling methods used, it was not possible to establish population dynamics of *Phlebotomus* species from the 1960s to this study of the 2000s. Over all, it is important to choose a sampling method which approximates the human bait collections in terms of anthropophilic species composition. More searches for sampling methods are needed so that sandflies caught are representative as possible of the fauna in various habitats. In particular, more studies of relative attraction of lights of different wavelengths and intensities for different species would be rewarding[11].

It is evident that there are many factors that determine sandfly species distribution in space besides the presence of what are generally regarded putative habitats. Termite mounds that have been found to harbour *P. martini*[5] are found in all the three trapping locations but this species was significantly abundant in Rabai than in Perkerra and Loboi. Therefore, in the event that the reservoirs for *L. donovani* are present in Rabai, the parasite would readily be picked for further transmission due to high *P. martini* density. Other important determinants of *P. martini* distribution need to be unravelled in order to better understand the epidemiology of *L. donovani*, causative agent of VL, in Marigat and other areas where the species is the vector. Man-biting *S. schwetzi* being more abundant in Perkerra than any of the other locations reveals the species preference for forested or bushy environment which is characteristic of the site.

Based on the premise that in the absence of moonlight, sandflies would exhibit positive phototaxis and be attracted to light traps, a maximum catch would be expected during a new moon. The current study did not capture any difference in the numbers of both *Sergentomyia* and *Phlebotomus* sandflies collected in the lunar phases. These results imply that sampling of both genera can be undertaken at any time of the lunar phase. On the contrary, most captures of *Lutzomyia* species occurred on darker nights in Brazil[12]. Response to light traps in the lunar phases, therefore, seems to vary among sandfly species and better catches can only be realized if phototaxis orientation of the target species is known.

In the current study, the miniature CDC traps and blacklight (UV) traps did not attract *Sergentomyia* sandflies differently. On the other hand, CDC miniature light traps caught more *Phlebotomus* species than the blacklight traps. Therefore, when sampling especially *P. martini*, one of the sandfly species of medical importance in Kenya, the light trap of choice should be the CDC miniature trap. It should however be noted that use of mouth aspirators in the preferred habitats of these species of sandflies catches more[3]. CDC light traps were also found to be more effective in collecting total number of individuals of mainly *Phlebotomus* species of sandflies in Turkey[13]. CDC light traps become more important epidemiologically especially when a significant positive correlation was detected between *Lu. peruensis* Shannon sandfly numbers collected by the trap and human baited catches[14]. One of the main limitations for the use of CDC light traps is that some sandflies respond to light of different distances ranging from 2–5 m[11,14], hence, the need for many of them to effectively sample large areas.

A good representation of the sandfly physiological status can be achieved by the use of any of the three traps since no segregation against a particular status was observed in both *Sergentomyia* and *Phlebotomus* species even when the number of unfed sandflies in this study was significantly higher than that of gravid and fed ones.

In conclusion, *P. martini* and *P. duboscqi* contributed 3.8% of the total collection. *P. martini* was significantly more abundant in Rabai than in Perkerra and Loboi while *S. schwetzi* was more abundant in Perkerra. There was no difference in the numbers of both *Sergentomyia* and *Phlebotomus* sandflies captured in new and full lunar phases. CDC miniature light traps caught more *Phlebotomus* species than the blacklight traps but no difference was found in *Sergentomyia* species. Equal numbers of fed, unfed and gravid female sandflies were captured by the three types of traps.

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