

## 2.001

### Productivity of malaria vectors from different habitat types in the western Kenya highlands

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**Background:** Mosquito Larval Source Management (LSM) could be a valuable additional tool for integrated malaria vector control especially in areas with focal transmission like the highlands of western Kenya if it were not for the need to target all potential habitats at frequent intervals. The ability to determine the productivity of malaria vectors from identified habitats might be used to target LSM only at productive ones.

**Methods:** Each aquatic habitat within three highland sites in western Kenya was classified as natural swamp, cultivated swamp, river fringe, puddle, open drain or borrow pit. Three habitats of each type were selected in each site in order to study the weekly productivity of adult malaria vectors from February to May 2009 using a sweep-net and their habitat characteristics recorded.

**Results:** All surveyed habitat types produced adult malaria vectors. Mean adult productivity of *Anopheles gambiae sensu lato* in puddles (1.8/m<sup>2</sup>)

was 11 - 900 times higher than in the other habitat types. However, puddles were the most unstable habitats having water at only 43% of all sampling occasions and accounted for only 5% of all habitats mapped in the study areas whilst open drains accounted for 72%. Densities of anopheline late instar larvae significantly increased with the presence of a biofilm but decreased with increasing surface area or when water was flowing. Taking stability and frequency of the habitat into account puddles were still the most productive habitat types for malaria vectors but closely followed by open drains.

**Conclusion:** Even though productivity of *An. gambiae s.l.* was greatest in small and unstable habitats, estimation of their overall productivity in an area needs to consider the more stable habitats over time and their surface extension. Therefore, targeting only the highly productive habitats is unlikely to provide sufficient reduction in malaria vector densities.

## 2.002

### The impact of long term intensive itn use on *Anopheles Gambiae* 2LA Chromosomal inversion in Western Kenya

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**Introduction:** The 2La chromosomal inversion, which is polymorphic in *Anopheles gambiae*, a major vector of malaria, has been associated with mosquito resting behavior and its adaptation to microclimatic differences in humidity. Reports from various studies indicate that 2La arrangement is more common in mosquitoes found resting indoors where nocturnal saturation deficit exists. This study focused on evaluating the effect of long term ITN use on 2La chromosomal inversion of *An. gambiae* in Western Kenya.

**Methodology:** *Anopheles gambiae* mosquitoes were collected from Asembo, the site of large scale ITN trial with high coverage since 1999 and Seme where high coverage was attained in 2006. Samples analyzed were collected in 1996, 2000, 2005, 2008 and 2009 for Asembo and 2000, 2005 and 2008 for Seme. A PCR assay using primers designed for 2La and 2La+<sup>a</sup> proximal breakpoints was used and fragments analyzed on agarose gel.

**Results:** In Asembo the frequency of 2La inversion decreased from 93.75% in 1996 to 19%

in 2005 and remained low through 2008 and 2009. Similarly in Seme, the frequency decreased from 55% in 2000 to 25% in 2005 remained low in 2008.

**Conclusion:** These results suggest that long term use of ITNs impacts phenotypic adaptation of *An. gambiae*. The decrease in 2La inversion frequency suggests ITNs has selected against indoor resting behavior in *An. gambiae*. A similar impact has been observed in Western Kenya where long term ITN use has led to shift in population structure whereby *Anopheles arabiensis* which tends to rest outdoors predominates. Such finding have implications for vector control; selection for mosquitoes with propensity to rest outdoors, means that vector control methods relying on indoor resting behavior could be less efficacious. A thorough understanding of the impact of vector control measures on vector population is critical in ensuring that control measures remain effective.

### 2.003

#### **Sand fly surveillance and the development of leishmaniasis risk assessments in East Africa.**

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**Background:** Leishmaniasis represent a group of neglected tropical diseases found throughout the Horn of Africa and East Africa. The current prevalence is largely unknown and underreported. Phlebotomus sand flies are the vectors in the old world. *Phlebotomus orientalis* is the proven vector for visceral leishmaniasis (VL) in Sudan and Ethiopia while *P. martini* is the vector in Kenya and Uganda. Accurate information on sand fly population density, distribution, and species diversity is crucial for the development and implementation of targeted prevention and control efforts.

**Objective:** The objective of this study was to assess vector diversity, distribution and, using GIS mapping techniques, develop a surveillance system for detecting and monitoring changes in these variables in East Africa. Sampling was done in five sites in Kenya (Isiolo, Garisa, Wajir, Lamu and West Pokot), and two in Tanzania (Arusha and Kilimanjaro regions).

**Methodology:** Sand flies were collected using CDC light traps baited with 0.5 kg dry ice from October 2008 to April 2010. Sites in Kenya were visited twice per year while Tanzania once in July 2010 for a period of five nights on each visit.

**Results:** Over 20,000 sand flies were collected. A representative sample of 6,843 specimens were identified. *P. orientalis* was found in Isiolo (974), Wajir (328) and Garissa (620) while *P. martini* in Garissa (2) West Pokot (78) and Tanzania (17). *Sergentomyia* species were found in all sites. In Wajir, 52 *S. heischi* were also sampled.

**Conclusions:** The presence of *P. orientalis* and *P. martini* in Garissa and *P. martini* in Tanzania are the first to be documented. This suggests that the potential to contract VL may be more widespread in East Africa than previously thought. Sampling of *S. heischi* in Wajir indicates that it is more abundant than historically documented.

## 2.004

### **Malaria vectors species diversity and malaria transmission in Malindi district along the Kenya coast**

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**Background:** Malaria vector temporal and spatial distribution is key in describing malaria transmission intensity within a locality. Malaria transmission is greatly affected by mosquito control measures reducing human-vector contact and drugs affecting gametocyte stages of malaria parasites in humans. This study examined the malaria vector species diversity and malaria transmission pattern in Malindi district along the Kenyan coast.

**Materials and Methods:** Malaria vectors were sampled using Pyrethrum Spray Collection (PSC) in 20 villages falling within 4 sub-locations of Malindi District. The data collection was done between August 2008 and December 2010. Collected mosquitoes were identified morphologically into species and *An. gambiae* complex was further analysed using rDNA PCR techniques. The mosquitoes were cut transversely between thorax and abdomen. The heads and thoraces of all anopheline mosquitoes were tested using a *P. falciparum* sporozoite enzyme linked

immunosorbent assay (ELISA). The fully blood fed abdomens were tested for the blood meal sources using ELISA technique. Tests were assessed visually for positivity.

**Results and Conclusion:** A total of 4,286 *Anopheles* mosquitoes were collected of which 67.52% (n = 2,894) were *An. gambiae* s.l. and 32.48% (n = 1,392) *An. funestus*. Further analysis using rDNA PCR technique of 595 *An. gambiae* s.l. showed that *An. arabiensis* was the most predominant species accounting for 93.02%, *An. merus* 5.00% and *An. quadriannulatus* 1.97%. The overall *P. falciparum* infection rate was 3.66% for *An. gambiae* and 0.94% for *An. funestus*. Conclusively, this study showed that *An. arabiensis* and *An. funestus* are the primary malaria vectors in Malindi district and low malaria transmission is occurring within the villages. This implies that malaria control programs within Malindi district should be enhanced to significantly reduce malaria transmission.

## 2.005

### ***Phlebotomus (Larrousius) orientalis* (Diptera: Psychodidae) as a probable second vector of visceral leishmaniasis in Kenya.**

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**Background & objectives:** A study was conducted in Merti Division of Isiolo District, Eastern Province, Kenya where epidemics of visceral leishmaniasis (VL or kala azar) caused by *Leishmania donovani* Laveran and Mesnil had been reported. Merti is located at latitude 1.066488° N, longitude 38.657372° E and at an elevation of 347 m above sea level. Transmission dynamics of disease (kala azar) in this focus are not well known.

**Methods:** For this reason, in an attempt to identify the vector, sand fly trapping was initiated. Two villages (Biliqi and Ollagana) were purposely

selected for the sand fly collection based on previous cases of kala azar reported in the area. Sand flies were trapped using CDC light traps, which were set in the evening at 1800 hr and collected at 0600 hr the following morning. All the sand flies were dissected, mounted and identified in Nairobi.

**Results:** A total of 424 sand flies were caught and identified. The sand flies composed of five *Sergentomyia* (95.76%) and two *Phlebotomus* species (4.24%). The two *Phlebotomus* species caught were *P. orientalis* (3.77%) and *P. saevus* (0.47%). The *Sergentomyia* species were *S.*

## Category: Entomology

*schwetzi* Adler, Theodor and Parrot (54.48%), *S. bedfordi* Newstead (1.89%), *S. squamipleuris* Newstead (9.43%), *S. clydei* Sinton (28.54%) and *S. magna* Theodor (1.42%).

**Interpretation & conclusion:** Two phlebotomine sand fly species namely *Phlebotomus (Larroussius) orientalis* Parrot, the known vector

for the disease in Sudan and *P. saevus* Parrot and Martin were found to be sympatric in the study site. In the absence of the *P. (Synphlebotomus) martini* Parrot, the confirmed vector for kala azar in Kenya, *P. orientalis* could be the only possible vector for kala azar in the Merti study area.

**Key words:** Kala azar, *Phlebotomus*, *Sergentomyia*, *Leishmania*, Kenya, Isiolo, Sudan, *Acacia seyal*, *Prosopis juliflora*, *Balanites aegyptica*

## 2.006

### Mosquito midgut protease modulation by salivary gland homogenate and *plasmodium*

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**Background:** Mosquito saliva and salivary glands are central to the interaction between vector, parasite and mammalian host with the role of saliva in the successful location of host blood vessels, manipulation of host haemostatic and immune responses during blood meal acquisition well established. However, saliva's role in mosquito physiology and vector-parasite interactions post blood meal acquisition remains poorly understood. Both proteases and protease inhibitors are reported in the sialotranscriptomes of the female anopheline mosquito, suggesting saliva may contribute to blood meal digestion and/or *Plasmodium* development in the midgut.

**Methodology:** Chymotrypsin, trypsin and aminopeptidase levels were compared in midguts of female mosquitoes fed on blood only (Blood); *Plasmodium* infected (Blood + gametocytes); and *Plasmodium* infected augmented with salivary gland homogenate (Blood + gametocytes + SGH). Analysis of variance (ANOVA) was used to model the variability in enzyme levels and Tukey HSD employed for comparisons between groups where differences were found to be significant.

**Results:** Significant down-regulation ( $P < 0.001$ ) of chymotrypsin and trypsin at 18 hr post blood feeding (PBF), and up-regulation ( $P < 0.001$ ) of aminopeptidase peaking at 24 hr PBF was observed in the (Blood + gametocytes) mosquitoes compared to the control (Blood) suggesting serine proteases may be detrimental to *Plasmodium*. Conversely, up-regulation of aminopeptidase, an integral part of the midgut microvilli that facilitates midgut invasion by ookinete, may be beneficial to *Plasmodium*. The addition of SGH to infective blood meal evidenced further down regulation of chymotrypsin and trypsin ( $P < 0.001$ ) at 18 hr PBF compared to control (Blood). However, *Plasmodium's* up-regulation of aminopeptidase was abrogated by SGH with significant suppression evidenced ( $P < 0.001$ ) at 24 hr PBF compared to control.

**Conclusion:** This is the first study documenting saliva's protease inhibition *in vivo* and demonstrates the need for further studies to elucidate its mode of action and potential as a novel transmission blocking strategy.

## 2.007

### Evaluation of insecticide treated Durable Lining in Rural Houses for control of malaria vectors in western Kenya

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**Background:** Conventional, insecticide treated bed nets (ITNs) and now long lasting impregnated nets (LLINs) and IRS have become the primary tool for national malaria control programs in Kenya and elsewhere in Sub-Saharan Africa. Achieving high net coverage and adherence to net use remains a major challenge. Material durability of LLINs is also now proving to be much shorter than expected. Thus the need to develop alternative means of controlling malaria vectors to supplement the use of ITNs.

**Objective:** To evaluate the efficacy and acceptability of insecticide treated durable lining for control of malaria vectors in rural houses in western Kenya

**Methodology:** We assessed the efficacy of insecticide treated Durable Lining (DL) in reducing malaria transmission and DL acceptability in 10 paired rural villages in western Kenya. Five villages each were used as non-intervention and intervention villages respectively. We installed treated and untreated durable wall linings in the sleeping rooms of the treatment in the intervention and non-intervention villages then houses monitored host-seeking and indoor resting

densities of mosquitoes monthly. Further, we monitored malaria prevalence in young children and administered acceptability questionnaires in the non-intervention and intervention villages respectively.

**Results:** Overall, indoor resting densities of *An. gambiae* s.l. and *An. funestus* in villages with DL were respectively 70% (p = 0.02) and 60% (p = 0.005) lower compared to the control villages over the study period. Malaria prevalence was significantly lower (P<0.001) amongst households with treated DL than households with untreated linings. Similarly, lower anaemia levels were recorded in treated DL villages compared to the non-intervention villages. Further, a significantly higher number of the households 95% (475/500) perceived DL to be beneficial in controlling malaria vectors.

**Conclusion:** These results confirm the acceptability and efficacy of DL as an effective and suitable malaria prevention tool. DL provides an alternative to IRS and may be used in combination with, or as an alternative to LLINs depending on the context.

## 2.008

### Pilot study: Towards a solution to malaria vector control using eco-friendly systems.

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Larval control of malaria vectors has been historically successful in reducing malaria transmission, but largely fell out of favour with the introduction of synthetic insecticides and bed nets. However, an integrated approach to malaria control, including larval control methods, continues to be the best chance for success, in view of insecticide resistance, the behavioural adaptation of the vectors to changing environments and the difficulties of reaching the poorest populations most at risk.

Larvicidal activity of partially purified extracts of seeds of *Jatropha curcas*, *Ximenia americana* and *Mutsengezi* on different instars of *Culex quinquefasciatus* was estimated.

**Objective.** The present study was an attempt to find new larvicidal products from aqueous extracts of *Jatropha curcas*, *Ximenia americana* and 'Mutsengezi' to control mosquitoes.

#### **Method.**

This pilot study describes a method whereby seeds of the *Jatropha curcas*, *Ximenia americana* and 'Mutsengezi' can be used to reduce larvae of

## Category: Entomology

*Culex quinquefasciatus* abundance in a way that is low cost and can be implemented by residents of rural villages in Malindi. This is a laboratory investigation conducted at MALINDI-KEMRI LABs, at the Coast. The seeds were collected from areas around Malindi town. 50g of dried seeds were ground into a coarse form using a pestle and mortar. The coarse material was divided into weights 0.5 to 10 grams, put into weighing boats 8x8 cm. 10 ml of distilled water was added. 10 mosquito larvae collected straight from habitat by dipping method were inoculated. A control boat with no larvicidal agents, and 10 larvae was set simultaneously. The boats were kept at room temperature.

Mortality was observed after 24 hours. Second experiment was done to find the dilution at which 50% of the inoculated larvae died. A stock suspension of 5-10 /10ml of distilled water was diluted at two-fold 1:10-1:160 in triplicates. 10

larvae were inoculated as above and kept at room temperature for 24 hours.

**Results:** It was found that dilutions of 1:80 of both *Jatropha curcas* and *Ximenia americana* ( from 5g/10ml stock suspensions) were able to kill over 50% of the larvae inoculated after 24 hours. A 1:80 dilution of 10g/10 ml distilled water stock suspension of *Catunaregam caffra* (Mutsengezi), was able to kill over 50% of inoculated larvae at the same period.

**Conclusion.** With a high abundance of these plants around Coast, the results suggests that larval control using local plant products can offer a sustainable solution to malaria vector control in the Coastal region. Aqueous extracts of local plants are eco-friendly and readily available. This being a pilot study, there is need for funds for a bigger project to determine plants of larvicidal importance.

## 2.009

### Evaluation of Kenyan mosquito species as vectors of West Nile Virus

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**Background:** West Nile virus (WNV) belongs to the family Flaviviridae (genus *Flavivirus*). Infection with WNV is characterized by fever, a mild and self limiting illness or severe encephalitis in humans. WNV has been isolated in mosquitoes and human samples in Kenya but the vectors have not been well defined.

**Objective:** To evaluate the potential of several field-collected mosquito species from the Rift Valley province to transmit WNV.

**Methodology:** Mosquitoes were collected from Baringo and Naivasha using CO<sub>2</sub>-baited CDC Light traps and identified to species by morphological means using taxonomic keys. Infection, dissemination and transmission rates were determined by assaying mosquitoes orally exposed to WNV infected chickens (*Gallus gallus* L.). Engorged mosquitoes were incubated for 7-21 days before being allowed to feed on 1-3 day old naïve chickens. The mosquito bodies and legs were triturated separately and assayed for infection on Vero cells by plaque assay. Chickens were bled 1

day later and plaque assays were performed to determine if the mosquito transmitted WNV.

**Results:** All mosquito species tested in this study were susceptible to infection with WNV and developed disseminated infections. *Cx. quinquefasciatus* had the highest infection rate (72%), followed by *Cx. univittatus* (53%) *Cx. vansomereni* (50%), *Ma. africana* (50%), and *Ma. uniformis* (38%). The differences in infection rates between these species were not statistically significant,  $p > 0.05$ . *Cx. quinquefasciatus* also had the highest transmission rate (44%), followed by *Cx. univittatus* (25%) and *Cx. vansomereni* (17%). The two *Mansonia* species mosquitoes did not transmit the virus.

**Conclusion:** *Culex* mosquitoes appear to be the most significant vectors of WNV in Kenya. However, the vector competence of diverse mosquitoes for WNV transmission may vary geographically and from species to species, hence more field collected specimens should be tested to identify important vectors and regions most at risk of WNV transmission.

## 2.010

### Isolation of tickborne viruses from ticks: Health risk implications among pastoralists in Kenya

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**Background:** Arboviruses are viruses transmitted by arthropods such as ticks, and cause clinical syndromes in humans, ranging from febrile illnesses to life-threatening hemorrhagic fever. Some of the tickborne viruses like CCHF are of great public health importance.

**Aims:** Our aim was to determine the tickborne viruses circulating among pastoral communities in Isiolo and Garissa Districts of Eastern and North Eastern provinces respectively.

**Methods:** From 2007 - 2008, ticks were sampled from two regions (Garissa and Isiolo) which are in the arid part of Kenya. Ticks were physically detached from livestock with the assistance of livestock owners.

**Results:** Over 22,700 ticks, 56.2% from Garissa and 43.8% from Isiolo, were collected and identified into 9 species. Overall, predominant species was *Rh.pulchellus* (54.8%). This was also

the predominant species both in Garissa (24.3%) and Isiolo (30.5%). In both sites cattle was the only host infested by all the species collected and was the preferential host for *Rh.pulchellus*, followed by camel and Goat. Thirteen viruses were isolated, 8 from Isiolo and 5 from Garissa. 4 Dhori isolates were obtained from *Rh.pulchellus*, 2 from Isiolo ticks collected from camels and 2 from Garissa ticks collected from cattle. 7 Dugbe virus (DUGV) were obtained from *Rh.pulchellus* (2 from Isiolo camels; 3 from Isiolo cattle and 2 from Garissa cattle) and 1 from *Boophilus annulatus* (Garissa camel). 1 Dugbe-like virus was obtained from *A.gemma* (Isiolo cattle).

**Conclusion:** These results indicate that tick-borne arboviruses are circulating in Garissa and Isiolo. However their significance to human health is unknown since no human targeted study has been conducted to establish exposure to these viruses.

## 2.011

### Distribution & Diversity of Mosquito Vectors of Arboviruses in Selected Regions of Kenya: an Indicator of Disease Risk

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**Background:** Arboviruses, transmitted by arthropods, cause clinical syndromes in humans ranging from febrile illnesses to hemorrhagic fevers. Defining the spatial and temporal distribution of vectors and viruses is important for understanding disease epidemiology and planning effective control strategies.

**Methodology:** Mosquitoes were sampled in ten regions from 2006 - 09 using CO<sub>2</sub>-baited CDC light traps and human landing collections and identified to species morphologically.

**Results:** Mosquitoes (363,923) were collected and identified into 85 species, 25 of them vectors of arboviruses actively transmitted in Kenya: chikungunya (CHIKV), dengue (DENV), Rift Valley fever (RVFV) viruses. *Aedes mcintoshi* and *Ae. ochraceus*, were abundant in the N. E. province, and *Mansonia uniformis* and *Ma.*

*africana* in the Rift Valley. Both areas were foci of the 2006/07 RVF outbreak and the species implicated as principle vectors respectively. *Ae.ochraceus*, *Ma. africana* and *Ma. uniformis* were also found in Nyanza province, a non RVF endemic area while *Ae. circumluteolus* was abundant in Nyanza and Western which have not had RVF outbreaks for long. *Ae. aegypti*, a vector of DENV, CHIKV, and yellow fever virus (YFV), was predominant in Coast province where DENV and CHIKV are endemic. Few *Ae. aegypti* were collected from Western or Nyanza where these diseases have also been identified, or N. E. province with no transmission history. The observed abundance of WNV vectors, such as *Culex quinquefasciatus*, in Rift Valley and Nyanza indicate that these regions are at risk of WNV transmission.

**Conclusions:** Arbovirus vectors are well distributed throughout Kenya both in regions with previous history of outbreaks and where arbovirus transmission to humans has not been recently reported. This highlights potential for re-

emergence of viral diseases in these vulnerable populations. There is need to map countrywide species distribution and abundance so as to plan focused control measures since there is correlation between vector population and disease outbreaks.

## 2.012

### Effects of long-lasting insecticidal nets and zooprophyllaxis on mosquito feeding behaviour and density in Mwea, central Kenya.

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**Background & objectives:** Zooprophyllaxis is a strategy that can control malaria by attracting mosquitoes to domestic animals that act as dead-end hosts. The objective of this study was to establish the effects of zooprophyllaxis and long-lasting insecticidal nets (LLINs) on malaria transmission in an agro-based ecosystem with seasonal transmission.

**Methods:** The mosquito samples were collected indoors using the space spray catch method before and after intervention between October 2005 and March 2006 to determine the mosquito densities and the feeding patterns of *Anopheles* spp in Mwea, Kenya.

**Results:** A total of 4148 mosquito samples were collected, out of which 11 (0.2%) were tested positive for sporozoites. Ten were *Anopheles gambiae* species and one was *An. funestus* species. Results on blood meal ELISA showed that in the household categories that used bednets and kept one cow there was a decrease in relative change ratio (post-/pre-intervention) of 87.5 and 19.6% ( $p < 0.05$ ) in human and cattle blood intake respectively. For households that kept 2–4 cattle

and used bednets, there was a decrease in cattle blood index (CBI) by 61.9% and an increase in human blood index (HBI) by 2%, which was not significant ( $p > 0.05$ ). In households with >4 cattle and bednet, there was significant reduction ( $p < 0.05$ ) in CBI of 37.5% as compared to the reduction of 10.3% in HBI. The ratios of man biting rates (MBR) decreased significantly, as you move up from households with one cattle with or without LLINs to households with more than four cattle with or without LLINs with a regression coefficient of  $-0.96$ ;  $SE = 0.834$ ;  $p = 0.017$ . Similarly, the HBI decreased significantly with the regression coefficient of  $0.239$ ;  $SE = 0.039$ ;  $p = 0.015$  ( $p < 0.05$ ) especially in households with >4 cattle.

**Interpretation & conclusion:** This study demonstrated that there were additive effects of zooprophyllaxis and LLINs in the control of mosquito density and reduction of human risk to the mosquito bites. However, in Integrated Vector Management (IVM), the number of animals per household should not be more than four

**Key words** Cattle biting index – human biting index – long-lasting insecticidal nets – man biting rates – mosquitoes –zooprophyllaxis

## 2.013

### **Tungiasis (jigger infestation) in Rural Kenya: Prevalence and Risk Factors**

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**Background:** The parasitic skin disease tungiasis (caused by the sand flea *Tunga penetrans*) occurs in resource-poor communities in Latin America, the Caribbean and Sub-Saharan Africa. Information on prevalence and risk factors for infestation in rural Kenya where it's endemic is nonexistent. Children drop out of school as they are unable to walk and face the challenge of stigmatization and discrimination. To fill this gap, a cross-sectional study was undertaken in Murang'a South district, central Kenya

**Objective:** To describe the prevalence of tungiasis (jigger flea infestation) and associated risk factors in a sentinel group (children 5-12 years of age) in rural Central Kenya.

**Methods:** A cross-sectional study was carried out in Murang'a South district during high transmission season (dry season, August – September 2009). A total of 385 randomly selected households was visited. Children were examined for presence of tungiasis, and a questionnaire was

administered to collect demographic, behavioral and environmental data.

**Results:** Prevalence of tungiasis was 57% (218/385; 95% CI=51.7%-61.6%). Itching (89.1%) was the most common associated symptom, followed by pain upon pressure (67.3%), sleep disturbance (58.2%) and walking difficulties (53%). In multivariate logistic regression analysis the following independent factors were identified to be associated with tungiasis: living in houses with an earthen floors (adjusted OR=3.84; 95%IC: 2.09-7.06), walking barefooted (OR=3.28; 1.78-6.04), having a common resting place outside the house (OR=2.36; 1.01-5.51) and presence of rats on the compound (OR=1.69; 1.03-2.75).

**Conclusion:** Tungiasis is highly endemic in rural Central Kenya and associated with considerable morbidity. The disease is associated with poverty. There is dire need to fight jigger infestation for Kenya to achieve vision 2030. Modifiable risk factors were identified that should be the focus of sustainable and effective control measures.

## 2.014

### **Responses of ovipositing *Anopheles gambiae* females to the presence of *Culex* egg rafts and larvae**

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**Background:** Mosquitoes spend the first part of their lifecycle in aquatic habitats, and, therefore, the choice of an appropriate oviposition site has an important influence on maternal reproductive success. Field observations have demonstrated that gravid *Anopheles gambiae* Giles s.s. (Diptera:

Culicidae) are selective in their choices of oviposition sites. Immature stages of *An. gambiae* s.s. are rarely found in water that contains *Culex quinquefasciatus* Say immatures.

**Objective:** The objective of this study was to see how oviposition selection behaviour of *An. gambiae* s.s. was affected by volatile

emissions associated with different densities of eggs and/or larvae of *Cx. quinquefasciatus*.

**Methodology:** To investigate the role of olfactory cues in the oviposition behaviour of *An. gambiae* s.s., a 'double-cup' oviposition set-up, previously developed at ICIPE, was used.

**Results:** At a low density of *Cx. quinquefasciatus* egg rafts (1 – 15 egg rafts/100 mL water) *An. gambiae* s.s. females laid more eggs in the treatment water than in the control, with a maximum of twice as many in the treatment water at 5 egg rafts/100 mL water. At higher egg raft densities and for all of the treatments that included *Cx. quinquefasciatus* larvae, oviposition decreased

significantly in the treatment dishes in a density-dependent manner.

**Conclusions:** Our results show that *An. gambiae* s.s. females exhibit varying oviposition response patterns depending on the density of larvae and/or eggs of *Cx. quinquefasciatus* present in the water. The presence of *Cx. quinquefasciatus* larvae deterred oviposition by *An. gambiae* s.s. females at all densities tested. The general pattern of our laboratory results indicates that *An. gambiae* s.s. actively avoids ovipositing in pools already occupied by *Cx. quinquefasciatus* juveniles. The avoidance of *An. gambiae* s.s. to water containing *Culex* juveniles appears to be mediated by volatile olfactory signals.

## Track 2: Entomology

Venue: Training Center (Foyer)

### 2.015

#### **Pilot Study: Laboratory investigations into the activity of Kenyan plant products to Mosquito larvae in Malindi.**

Anderson k Mwangudza .

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**Introduction:** The development of resistance among vector species to a widening range of toxic broad spectrum insecticides, their high costs, and scarcity in developing countries has led researchers to seek alternative methods of vector control especially those originating from plants. The aim of the study was to pilot an investigation towards the activity of some plants extracts against mosquito larvae as means of vector control.

**Methods:** 50 g of plants parts were grinded using pestle and mortar, the mashed materials were then used to test their larvicidal activity against wild mosquito larvae. 5g of the mashed products was used in the extraction using water. 10ml of water was passed through and then

filtered using cotton gauze. This was used as stoke solution. 1:80 dilution was then tested in triplicates. 10 mosquito larvae were then put into each plastic boat 8x8 cmm. Observation was done 24 hours for mortality rates.

**Results:** At 1:80 dilution there was 86% death rates of all larvae except the late 4<sup>th</sup> stages which pupated immediately.

**Conclusion:** *Jatropha curcas* seed aqueous extracts can be an effective larvicide to be used in controlling mosquito vectors by rural communities. At the same time it is biodegradable as opposed to use of mineral oils and is cheap and readily available to the common man.

### 2.016

#### **Main malaria vector distribution and current status of insecticide resistance in Kenya**

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**Background:** Understanding malaria vectors distribution is important in generation of spatio-temporal information on species diversity, vector densities and transmission dynamics. Knowledge of current insecticide resistance status of vectors helps in planning interventions. Such information is important in developing strategies that facilitate improved vector control resulting in significant reduction of morbidity and mortality of vector-borne diseases.

**Objectives:** (1) To develop an updated country database on entomological profiles of malaria vectors in Kenya (2) To develop a current database of malaria vector insecticide resistance status in Kenya.

**Methods:** Data was obtained from published literature through Pubmed and Hinari searches while unpublished literature data was acquired from thesis, conference abstract, MoH reports, and research institutions reports. Each data source was assigned a specific identification code and entered into Ms excel. Base maps were then generated using ArcGIS.

**Results:** *Anopheles gambiae* were largely distributed in western Kenya particularly Lake

Victoria region and along the coast region with isolated focal presence in central Kenya. Similar distribution though at lower level was observed for *An. arabiensis* while *An. merus* was limited to Kenyan coast. *Anopheles funestus* was widely distributed ranging from coastal Kenya through central to western regions. Insecticide resistance (*kdr*) to Pyrethroids (permethrin, deltamethrin, lambda-cyhalothrin) and DDT was documented from Western Kenya only. The insecticide resistance to pyrethroids was documented for both *An. gambiae* s.s and *An. arabiensis*. However, resistance to DDT has been documented in *An. gambiae* s.s only.

**Conclusions:** Malaria vector distribution data is largely limited to area where intense research has been conducted over time. Pyrethroids remain effective in the control of malaria vectors in Kenya as shown by the isolated and low *kdr* resistances among the vector species. From literature, Kenya has scanty data on the insecticide resistance in which more work need to be done to establish the resistance situation.

## 2.017

### **Infectra kit- vector and rodent holding apparatus for infection transmission experiments in the laboratory**

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Infection Transmission kit (Infectra kit) is a laboratory apparatus developed by the Kenya Agricultural Research Institute (KARI) - Trypanosomiasis Research Center (TRC). It was developed for the purpose of assisting scientists working under laboratory conditions carry out infection transmission studies involving the vector and the rodent therefore creating a safe environment in the laboratory. It enables both the rodent and the vector to be in contact with each other for as long as possible with minimal human involvement giving the scientist free time to attend to other activities as the two interact independently. It ensures that the rodent is protected from stress and possible death which may occur before the end of the experiment due to mishandling by the scientist or technical personnel. It also ensures the safety of the scientist from self infection by the

infected vector or a bite by the rodent. It can also be used to restrain the rodent while taking a blood sample from the tail or carrying out either the intravenous or intraperitoneal injection using a syringe and needle. Control of vector borne diseases requires an understanding of the parasite transmission mechanism and this would be difficult to study under the field conditions. Controlled studies will therefore be necessary and this can only be realized under the laboratory conditions. Infectra kit apparatus therefore comes in handy. This technology has a Kenyan patent (KE/P/04/00409). It has successfully gone through an international examination and has a PCT No. PCT/KE2006/000014 and is now published by World Intellectual Property Organization (WIPO) reference No. WO/2006121222.

## 2.018

### Determination of vectorial potential of *mansonia* species in the transmission of *wuchereria bancrofti* in Tana-Delta District, Coast-Kenya

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Centre for Biotechnology Research and Development, Kenya Medical Research Institute

**Background and Objectives;** *Wuchereria bancrofti* is a parasitic infection which is transmitted by different species of mosquitoes. Mosquitoes of *Anopheles*, *Culex* and *Aedes* species are known to transmit *W. bancrofti* parasites. The study aimed at determining the potential of *Mansonia* species; *Ma. africanus* and *Ma. uniformis* in the transmission of *W. bancrofti*.

**Methods:** This was a cross sectional study in which mosquitoes were collected from six randomly selected villages of Tana Delta district, Kenya. Gravid traps, CDC light traps and Pyrethrum spray methods were used in

mosquito collection. Mosquitoes were morphologically identified and *Mansonia* species selected for dissection in search of *W. bancrofti* infective larvae stages and/or *W. bancrofti* DNA analysis by PCR assays.

**Results:** A total of 1632 female mosquitoes were collected. Of these, 236 representing 14.5% were identified as *Mansonia* species. Two filarial larvae of stage two (L<sub>2</sub>) were obtained from dissections.

**Conclusion:** There was no evidence that *Mansonia* species play a role in the transmission of *W. bancrofti*.

## 2.019

### Shading by Napier grass reduces malaria vector larvae in natural habitats in western Kenya highlands

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**Background:** Increased human population in the highlands has led to reclamation of natural swamps resulting in the creation of habitats suitable for the breeding of *Anopheles gambiae*, the major malaria vector in the region, hence the need to restore the reclaimed land and reverse their suitability for vector breeding.

**Methodology:** Napier grass shaded and non-shaded water channels in 2 sites in Western Kenya highlands Lunyerere and Emutete were compared for the presence and density of mosquito larvae, species composition and the water temperature.

**Results:** Shading reduced the Anopheline larval densities by 75.5% and 88.4% (P < 0.001) and *An. gambiae s.l* densities by 78.1% and 88% in both sites respectively.

Shading reduced the maximum, minimum and average water temperatures by 5.7°C, 5.0°C and 5.0°C (P < 0.001) and 1.3°C, 4.0°C and 2.8°C respectively in both sites respectively.

*An. gambiae s.l* was the dominant species irrespective of whether the channels were shaded or not, constituting 83.2% and 73.1% of total anopheline larvae in one site and 44.5% and 42.3% in another site non-shaded

*Category: Entomology*

and shaded channels respectively. Majority (97.4%) of *An. gambiae s.l* belonged to *An. gambiae s.s* sibling species while *An. arabiensis* constituted a mere 2.6%.

A significant negative correlation ( $P = 0.0039$ ) was found between the height of grass and minimum water temperature in Lunyerere. This association was significant

( $P = 0.0415$  and  $0.0455$ ) for minimum and average temperatures respectively in Emutete.

**Conclusion:** The outcomes demonstrate how simple environmental strategies can have on vector densities and the expected malaria transmission in surrounding areas.