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NEAR-INFRARED SPECTROSCOPY AS A COMPLEMENTARY AGE GRADING AND SPECIES IDENTIFICATION TOOL FOR AFRICAN MALARIA VECTORS

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Near-infrared spectroscopy (NIRS) was recently applied to age-grade and differentiate laboratory reared *Anopheles gambiae sensu strico* and *Anopheles arabiensis* sibling species of *Anopheles gambiae sensu lato*. In this study, we report further on the accuracy of this tool in simultaneously estimating the age class and differentiating the morphologically indistinguishable *An. gambiae s.s.* and *An. arabiensis* from semi-field releases and wild populations. Nine different ages (1, 3, 5, 7, 9, 11, 12, 14, 16 d) of *An. arabiensis* and eight different ages (1, 3, 5, 7, 9, 10, 11, 12 d) of *An. gambiae s.s.* maintained in 250 x 60 x 40 cm cages within a semi-field large-cage system and 105 female wild *An. gambiae s.l.,* were included in this study. NIR classified female *An. arabiensis* and *An. gambiae s.s.* maintained in semi field cages as < 7 d old or ≥ 7 d old with 89% (n=377) and 78 % (n=327) accuracy, respectively and differentiated them with 89% (n=704) accuracy. Wild caught *An. gambiae s.l.* were identified with 90% accuracy (n=105) whereas their predicted age were consistent with the expected mean chronological ages of the physiological age categories determined by dissections. These findings have importance for monitoring control programmes where reduction in the proportion of older mosquitoes that have the ability to transmit malaria is an important outcome.

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PREDATION EFFICIENCY OF *ANOPHELES GAMBIAE* LARVAE BY AQUATIC PREDATORS IN WESTERN KENYA HIGHLANDS

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The current status of the insecticides resistance in mosquitoes and effect of insecticides on non-targeted insect' species raised the need of alternative control methods for malaria vectors. Predation has been suggested as one of the important regulation mechanisms for malaria vectors in long-lasting aquatic habitats, but the predation efficiency of the potential predators is unknown. In the current study, we examined predation of backswimmer, tadpoles, Gambusia, Belostoma and dragon nymph on *Anopheles gambiae* larvae in semi-natural habitats. Predators were sampled from the habitats, and starved for 12 hours before experiments. Third instar larvae of *An. gambiae* were introduced into two types of microcosms at various larval densities, and the number of surviving mosquito larvae was monitored after 24 hours. We found that habitat type, larval density and predator species had positive impact on the predation rate of *An. gambiae* larvae. All predators have shown to be actively nocturnal. These results suggest that larval predators play a role in regulating larval population of malaria vectors. We are currently investigating the impact of predators in natural habitats.

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INSECTICIDE-TREATED BED NET (ITN) OWNERSHIP, USAGE AND MALARIA TRANSMISSION IN THE HIGHLANDS OF WESTERN KENYA

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Insecticide-treated bed nets (ITNs) are known to be highly effective in reducing malaria morbidity and mortality. However, compliance of ITN use varies among households and such variations in actual ITN usage may seriously limit the potential impact of the nets and cause spatial heterogeneity on malaria transmission. This study examined the ITN usage and underlying factors for among-household variation in ITN use in two highland sites of western Kenya. Cross-sectional surveys were conducted on ITN ownership (possession) and ITN compliance (actual usage) in occupants of randomly sampled houses in the dry and rainy season of 2009. Despite ITN ownerships reached more than 71%, ITNs compliance was low (<40%). There was also a seasonal variation in ITN compliance rate: compliance rate was significantly higher during rainy than dry season (40% vs. 34%). ITNs were perceived as very important for protection against mosquito bites and malaria by the resident during the rainy season when both malaria prevalence (11.8% vs. 5.1%) and vector densities (1.0 female/house vs 0.4 female/house) were significantly higher than dry season. Other important reasons for higher compliance rate during the wet season include: significantly high numbers of nuisance culicine mosquitoes and low indoor temperatures. Malaria prevalence in rainy season was about 30% lower in ITN users than in non-ITN users, but this was not significantly different during the dry season. In conclusion, in the malaria meso-endemic highland regions of western Kenya, compliance with ITN is relatively higher during rainy season than dry season, but the gap between ITN ownership and usage is high. Reasons for this gap particularly during the rainy season are yet to be known.

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GENETIC VECTOR CONTROL STRATEGIES TO REDUCE THE BURDEN OF MOSQUITO-BORNE DISEASES

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Vector-borne diseases impose an enormous health and economic burden around the world and new methods to control vector populations are needed. The Sterile Insect Technique (SIT) is an area-wide method of biological pest control whereby large numbers of a pest insect are bred, sterilized (currently by irradiation) and then released. The sterile insects mate with wild insects, but no viable offspring result from those matings. The SIT has been successful against agricultural pests, but is not in large-scale use for suppressing or eliminating populations of mosquito disease vectors. This is due in part to technical difficulties with the current technology. Genetic RIDL® technology (Release of Insects carrying a Dominant Lethal) is a proposed modification that involves releasing insects that are homozygous for a repressible dominant lethal genetic construct rather than being sterilized by irradiation, and could potentially overcome some of those problems. Using the arbovirus dengue as an example, I combine a vector population dynamics model with an epidemiological model to explore the effect of a programme of RIDL releases on disease transmission, and investigate the potential cost-effectiveness by applying estimates of the costs of RIDL-based SIT. Through mathematical modelling I find that this genetic control strategy could eliminate dengue from a human community in a timescale within one year, and at lower cost than the direct and indirect costs of disease that would be averted by doing so.