

Recent Incidence of Human Malaria Caused by *Plasmodium knowlesi* in the Villages in Kudat Peninsula, Sabah, Malaysia: Mapping of The Infection Risk Using Remote Sensing Data

ABSTRACT

Plasmodium knowlesi (Pk) is a malaria parasite that naturally infects macaque monkeys in Southeast Asia. Pk malaria, the zoonosis transmitted from the infected monkeys to the humans by *Anopheles* mosquito vectors, is now a serious health problem in Malaysian Borneo. To create a strategic plan to control Pk malaria, it is important to estimate the occurrence of the disease correctly. The rise of Pk malaria has been explained as being due to ecological changes, especially deforestation. In this research, we analysed the time-series satellite images of MODIS (MODerate-resolution Imaging Spectroradiometer) of the Kudat Peninsula in Sabah and created the "Pk risk map" on which the Land-Use and Land-Cover (LULC) information was visualised. The case number of Pk malaria of a village appeared to have a correlation with the quantity of two specific LULC classes, the mosaic landscape of oil palm groves and the nearby land-use patches of dense forest, surrounding the village. Applying a Poisson multivariate regression with a generalized linear mixture model (GLMM), the occurrence of Pk malaria cases was estimated from the population and the quantified LULC distribution on the map. The obtained estimations explained the real case numbers well, when the contribution of another risk factor, possibly the occupation of the villagers, is considered. This implies that the occurrence of the Pk malaria cases of a village can be predictable from the population of the village and the LULC distribution shown around it on the map. The Pk risk map will help to assess the Pk malaria risk distributions quantitatively and to discover the hidden key factors behind the spread of this zoonosis.