

Vector-Borne Diseases: Impact of Climate Change on Vectors and Rodent Reservoirs
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Modelling of temperature-dependent Malaria risk in Lower Saxony, Germany

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Abstract

One of the effects of climate change can be the change in geographic distribution and intensity of transmission of vector-borne diseases such as malaria. Given the most conservative estimate of change, these diseases are expected to occur, compared with the past and present, at higher latitudes or altitudes. A slight rise in ambient temperature and rainfall can extend the duration of the season in which mosquito vectors are transmitting malaria. The parasites that they transmit usually benefit from increased temperatures, as both their reproduction and development are then increased, too. Thus, it seems prudent to examine potential effects on the transmission length due to the predicted climate changes. Lower Saxony (Northwest Germany) is a former malaria region with highest incidences of *Anopheles atroparvus* and malaria tertiana along the coastal zones before malaria had finally become extinct in the early 1950s. Nevertheless, the *Anopheles* mosquitoes which transmit the malaria pathogens have still been present in Lower Saxony up to now. This together with the climate change related implications gave reason to investigate whether a new autochthon transmission could take place if the malaria pathogen is introduced again in Lower Saxony. Thus, the spatial and temporal structure of temperature driven malaria transmissions was investigated using the basic reproduction rate (R_0) to model and geostatistically map areas at risk for an outbreak of malaria tertiana due to measured (1947-1960, 1961-1990, 1985-2004) and predicted (2020, 2060, 2100, each best case and worst case scenario) air temperatures. The respective risk maps show that the period of potential malaria tertiana transmissions in terms of R_0 could be expected to increase from two months in the past to six months in the future in Lower Saxony. Past and recent findings of *Anopheles atroparvus* coincide with those regions where the potential malaria transmission length accounts for 4 months in 2060 (best case scenario) and for 6 months in 2100 (worst case), respectively, and, in addition, where malaria tertiana occurred up to the 1950's. The geostatistically estimated malaria risk maps were intersected by a map on ecological land units. This approach made an ecoregionalisation of the risk estimation possible.

Keywords: Climate Change; Ecoregionalisation; Malaria; Predictive mapping; Reproduction rate

