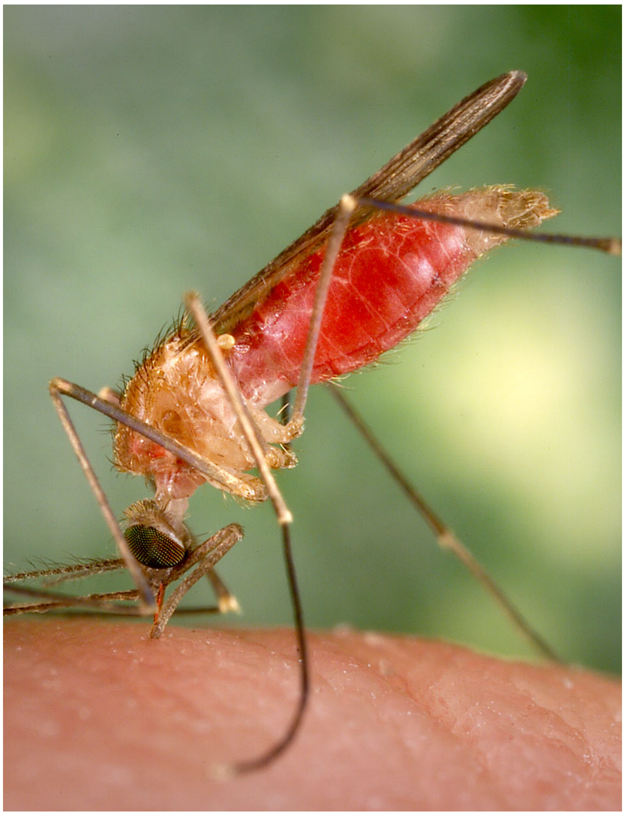
MAPPING MALARIA TRANSMISSION IN AFRICA

New environmental maps created by a team led by University of Lincoln researchers provide the most accurate picture yet of malaria risk across Africa. The maps model the likely impacts of global warming, highlighting river corridors as potential year-round focal points of malaria transmission.

University of Lincoln research has:

- Shed new light on malaria transmission in the Barotse floodplains of the upper Zambezi River, revealing why public health interventions against malaria mosquito have not been as successful in the region.
- Applied a new continental-scale hydrological model focused on river corridors and drainage networks, rather than just rainfall, creating a new understanding of areas at most and least risk of malaria transmission.
- Used future climate scenarios to map likely changes in malaria transmission created by global warming.



***Credit:** CDC/ James Gathany, 2014. Lateral view of a feeding female* Anopheles gambiae *mosquito*

Public health interventions against malaria are focused on protecting people within their homes, using bednets and indoor spraying of houses with insecticides. In many cases, including in Zambia, these approaches, together with better drugs, have been effective in reducing the prevalence of the disease. However, in the Western Province of Zambia, which has a population of 1.1 million people, such interventions were not working as well as in other regions. In fact, prevalence amongst under-5s was 10% in 2019, twice as high as 2010 levels. Researchers at the University of Lincoln wanted to find out why.

Working as part of a collaboration involving the Zambia Ministry of Health, Zambezi Water Resources Management Authority, the University of Barotseland and Zambezi EcoHealth Partnership, along with UK collaboration from the the University of Leeds and Aberystwyth University, the Lincoln team examined the relationship between the ecology and environment of the Barotse floodplain, which dominates the region, and the transmission of the disease. They have used their approach and findings to create new continental malaria maps.

UNDERSTANDING THE BAROTSE

The first stage of the study focused on developing an understanding of why malaria rates in the Barotse floodplains were increasing, when efforts to tackle the disease were more successful in other parts of Zambia. By combining different pieces of information – including data about Zambezi hydrology, mosquito surveys, time series satellite radar and models of seasonal river inundation – the team discovered an unexpectedly high diversity in species of malaria-spreading mosquitoes in Western Province. Crucially for disease control, they found that almost all of these mosquitoes were 'secondary vector species', not the usual 'primary' species found in most areas. Rather than biting people at night and indoors, as primary vectors tend to do, secondary vectors predominantly bite people outdoors during the day and at dusk. This means that standard interventions used against mosquitoes – bednets and house spraying – are less effective.

FROM NATIONAL MAPS TO MAPPING THE CONTINENT

The secondary species of mosquitoes found in the Barotse floodplains are abundant along river corridors and drainage networks. These habitats, therefore, need to be considered in addition to rain puddles and other temporary shallow water bodies, which provide the most suitable habitat for the primary species.

Each year, there are an estimated 228 million cases of malaria and 405,000 malaria deaths globally. More than 90% of these are in Africa. Research has focused on mapping current malaria cases in Africa in order to predict which areas will be most susceptible in the future. By shifting the focus from rainfall to river corridors, research at Lincoln has advanced understanding of malaria transmission in Africa.

Using the new knowledge from Zambia as a basis, the team then extended the malaria climatic suitability mapping to the whole of the African continent, applying a continental-scale hydrological model to estimate the availability of mosquito breeding habitat beyond that created by rainfall alone. The maps create a much more complex and realistic information set, highlighting river corridors as potential year-round focal points of transmission. By incorporating climate change models in the maps, the team has shown how malaria rates are likely to change up to 2100. The team used these findings to create national maps showing the likely environmental risks of malaria transmission across Zambia.

IMPACT ON POLICY

In this collaborative project, Lincoln researchers have discovered why public health interventions against malaria in Zambia were not working as well in some areas of the country, creating knowledge that can now be used to shape future interventions and national strategies in pursuit of the goal to eliminate malaria. The flood mapping approach can also be applied to the control and management of other climate-related challenges such as HIV treatment, maternal and child healthcare, where flooding inhibits access to health facilities.

The extension of this mapping approach to the rest of the African continent – made available on a new knowledge platform – has created high quality, high resolution environmental information that can be used by countries across Africa to prepare for future challenges. By demonstrating where the environmental changes present a challenge for malaria control, public health policy makers can define where to direct resources and most appropriate interventions in the future.

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Policy briefing #004
April 2021
https://policyhub.blogs.lincoln.ac.uk