Malaria: a Vector-Borne Disease Risks in a Warming World

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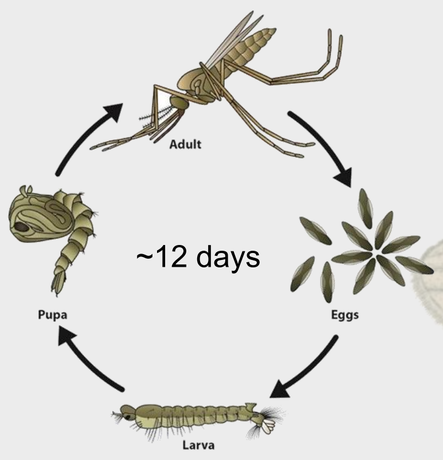
Introduction

- Climate change increases temperatures around the globe[1]
- Several human diseases bound to tropical and subtropical climate might shift spatial distribution with continuous warming[2]
- Malaria is an important tropical vector-borne disease transmitted by infectious *Anopheles* mosquitoes[5]
- We investigated the distribution and temperature-dependent spatial shifts of malaria in relation to the potential risk to humans in sub-Saharan Africa

Questions

- How does climate change influences the life cycle *Anopheles* mosquitoes, a main vector for malaria?
- How will the spatial distribution change within predicted climate scenarios in the future?
- How might this change affect human populations across sub-Saharan Africa?

Malaria



- Female *Anopheles* need blood meals to fuel egg maturation
- **Highly temperature dependent**
  → high temperature faster development
- Lay eggs into waterbody
  → water dependent, eggs cannot dry out
- Female range usually within 2km of hatching waterbody

Temperature dependency

- Vectors initially benefit from warming, up to a certain threshold (34 °C)[5]
- General range expansion of malaria with increasing temperatures[5,6]
- Less optimal suitable areas for transmission caused by aridization[5,6]
  → Reduction in waterbodies for *Anopheles* reproduction

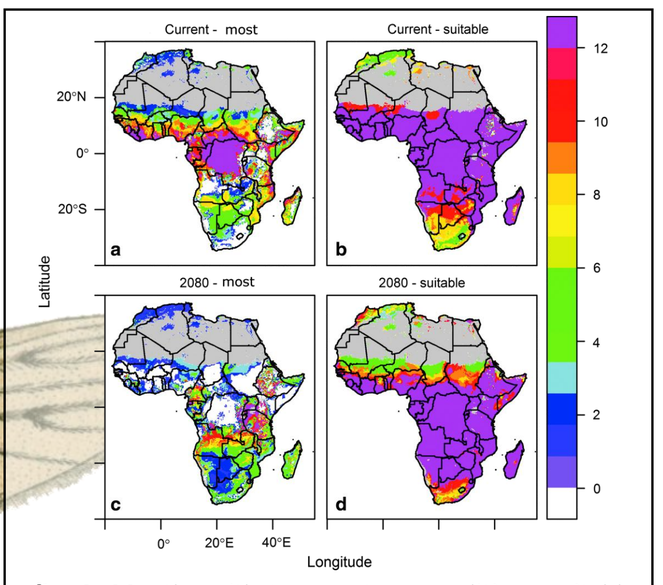


fig. 1: Months with temperature conditions suitable for malaria transmission (indicated by the color scale), shown for present day (a,b), projected for 2080 (c,d). The panels show the 25 % of the most suitable areas (a,c) and 100 % of the suitable areas (b,d) [6]

People at risk[5,6]

- Shift in seasonality and geography, towards seasons and areas that were previously too cold[5,6]
- Projections indicate declining infection risk in current malaria hotspots in the future, mainly in West Africa[5,6]
  → Former high-risk areas might experience a decrease in malaria infections
- Current low-risk areas turn to future high-risk areas, mainly in East and Central Africa
- Many people who were not threatened in the past could live in malaria risk areas in the future[5,6]
  → Missing medical suppliance and possible immunity might lead to epidemic outbreaks

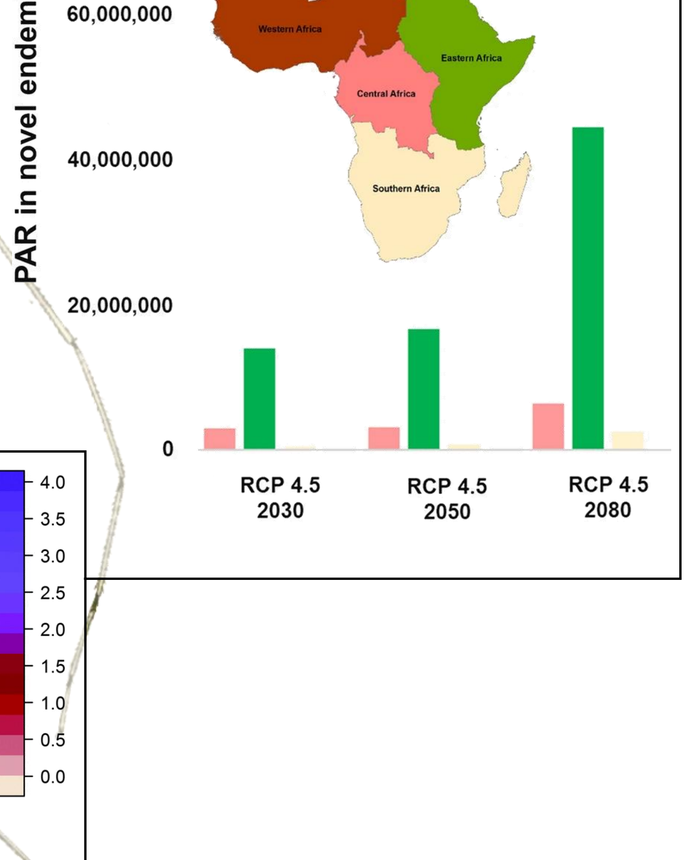


fig. 2 (left): Potential number of people at risk (PAR) in predicted future high-risk areas in a moderate climate model (RPC 4.5) [5]

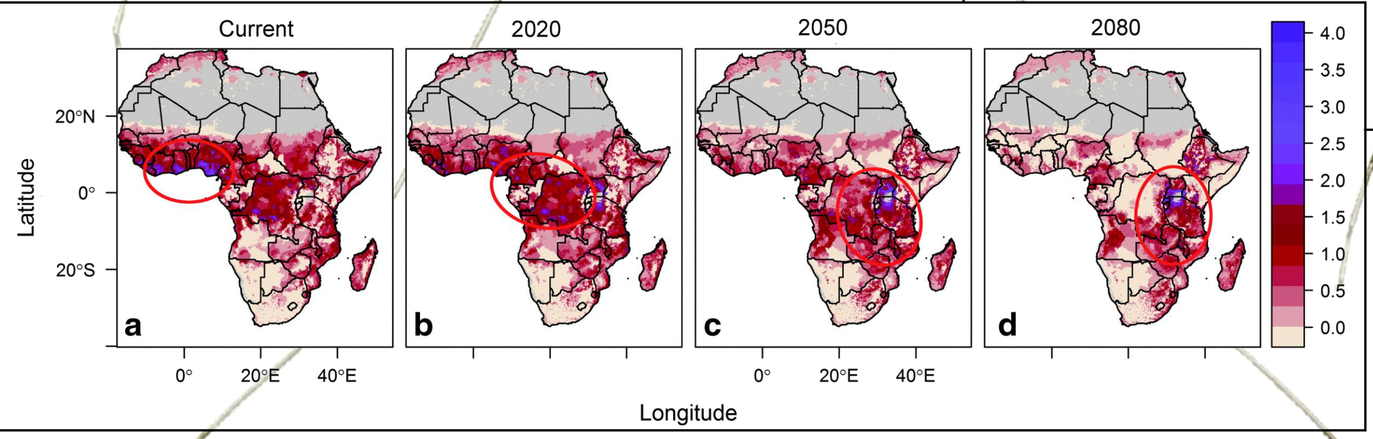


fig. 1: Potential population risk from malaria, combining temperature suitability and population density within different timeframes. Red outlines indicate risk hotspots with particularly high vulnerability[6]

Conclusion

- Climate change might alter spatial and temporal distribution of malaria - a vector-borne disease
- Changes in disease hotspots can significantly shift the risk within the population of sub-Saharan Africa
- Future models could enable early countermeasures against expected epidemic outbreaks

References

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