TDR-IDRC RESEARCH INITIATIVE ON VECTOR BORNE DISEASES IN THE CONTEXT OF CLIMATE CHANGE

FINDINGS FOR POLICY MAKERS

TRYPANOSOMIASIS IN ZIMBABWE

Tsetse-borne Trypanosomiasis in an Age of Climate Change

The background

Economic realities indicate that neither government nor stock owners are prepared to prioritise large spending on the control of trypanosomiasis nor of its tsetse vectors. However, climate change will see areas on higher ground in countries like Zimbabwe become more suitable for tsetse populations. This would inevitably tend to lead to an increased risk of human, and animal, African trypanosomiasis (HAT and AAT).

These problems are exacerbated by increasing contact between tsetse, humans and their livestock. This is as a consequence of population growth, and expansion into previously unpopulated game areas. It is unclear to what extent the above changes in tsetse distribution are likely to happen, given unknown future changes in climate and in human and livestock numbers and their distribution.

There is some uncertainty around the exact changes in future temperature and climate – whether these will mirror those of the past few decades or whether the rate of change will accelerate or decelerate. It is therefore critical to continue monitoring the disease and climate variables in the future.

About the project

This policy brief forms part of the research project on *Human African Trypanosomiasis: alleviating the effects of climate change through understanding human-vector-parasite interactions.*

This programme is implemented by TDR-WHO, with funding support from the International Development Research Centre (IDRC) and in technical collaboration with WHO's Department of Public Health and Environment (WHO-PHE), WHO's Regional Office for Africa (WHO-AFRO), and the International Research Institute for Climate and Society (IRI), Columbia University, New York, USA.

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Research Approach

1 Analysed meteorological records from Rekomitjie Research Station stretching back nearly 60 years.

2 Monitored tsetse and trypanosome infection levels in, and adjacent to, the Zambezi Valley in the neighbourhood of Rekomitjie Research Station.

3 Investigated the relative efficacy and cost-efficacy of using insecticide vs trypanocide treatment of cattle as disease control interventions.

4 Developed recommendations for the restricted application of insecticides to minimise damage to dung fauna during tsetse and trypanosomiasis control operations.

5 Developed innovative models for tsetse and trypanosomiasis population dynamics, particularly as these processes will be affected by climate change.

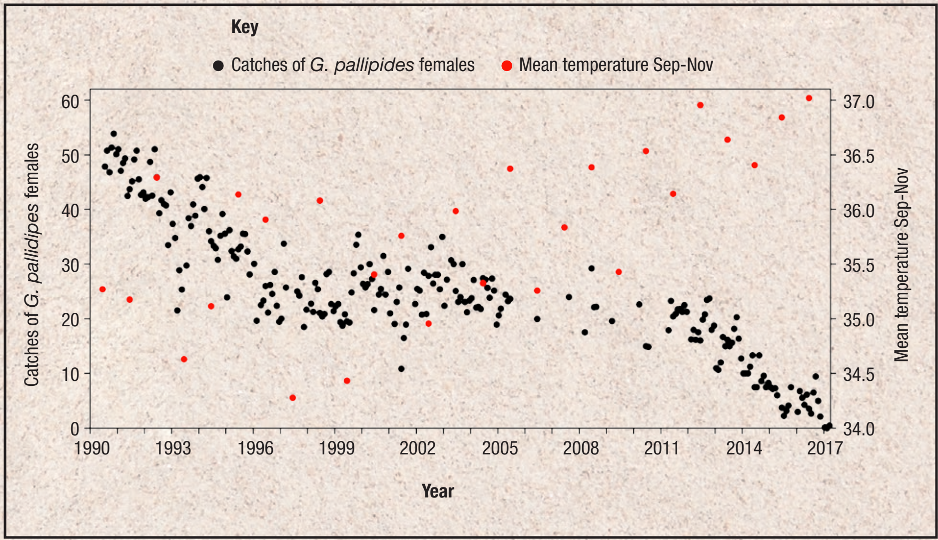
6 Carried out fundamental studies to improve understanding of processes determining mortality and reproductive rates of tsetse, required for the above modelling.

7 Full details of experiments carried out, and the workers involved, are available on www.vbd-environment.org

Results

1 Our analysis shows that there have been increases in temperature at Rekomitjie that are higher than global average increases. These increases have been most severe in October and November, the hottest months of the year. This is when tsetse mortality is already at its highest.

Graph showing an increase in temperature at Rekomitjie and a decrease in fly density



2 Our research suggests that the tsetse and trypanosomiasis risk will be strongly dependent on the extent of future changes in climate. Temperature increase in the Zambezi Valley of Zimbabwe may be so severe in the coming decades that tsetse populations will decline in these very hot parts of the country. However, with increasing temperatures, cooler areas higher up the escarpment are predicted to become more favourable to tsetse.

3 We find that, where there are cattle in a tsetse area, the best method for controlling the flies and trypanosomiasis is to use restricted application of pyrethroid insecticides.

4 Fundamental research has thrown new light on the methods for estimating tsetse mortality and of studying the previously unknown area of the events surrounding larviposition.

Recommendations:

DISEASE CONTROL AND MONITORING

1 **Ensure the continued operation of Rekomitjie Research Station**

The station has been central to the vast majority of advances in tsetse and trypanosomiasis control during the past 50 years, and continues to be by far the most productive tsetse research station in Africa. It must be maintained and strengthened in order to provide support for control operations as well as to provide further research.

2 **Continue monitoring vector population levels, and incidence of HAT and AAT**

The uncertainty regarding future climatological changes makes it imperative that we continue to monitor vector population levels and the presence of trypanosomes in the tsetse vectors and their mammalian hosts in the neighbourhood of the Zambezi Valley of Zimbabwe.

3 **Promote the use of Restricted Application of Pesticides (RAP) on cattle**

This provides the most effective and cost-effective means of vector and disease control in situations where there are cattle in tsetse areas.

4 **Continue and expand climatological monitoring in Zimbabwe's Zambezi Valley**

As tsetse populations are sensitive to climatic changes, it is imperative that we continue to monitor climate variables. It is particularly important that the virtually unbroken series of records, going back for nearly 60 years at Rekomitjie Research Station, continues.

5 **Quantify interactions between trypanosomiasis and other vector-borne diseases**

Use the finding of the current Project to provide the basis for a One Health approach to managing vector-borne diseases of humans and livestock (e.g., malaria, tick-borne diseases such as East Coast Fever, Rift Valley Fever). At a practical field level, expand the methods and studies developed in our Project to other tsetse-infested areas of eastern and southern Africa, particularly countries such as Kenya, Uganda, Zambia and Malawi that border the countries involved in the current Project.

6 **Contribute to WHO's strategy for eliminating Rhodesian HAT**

At a policy level; this should include, though not be limited to, attendance of selected key Project members at stakeholder meetings.

7 **Promote a comprehensive, integrated, multi-sectoral approach to increasing resilience to vector-borne diseases under climate change conditions.**

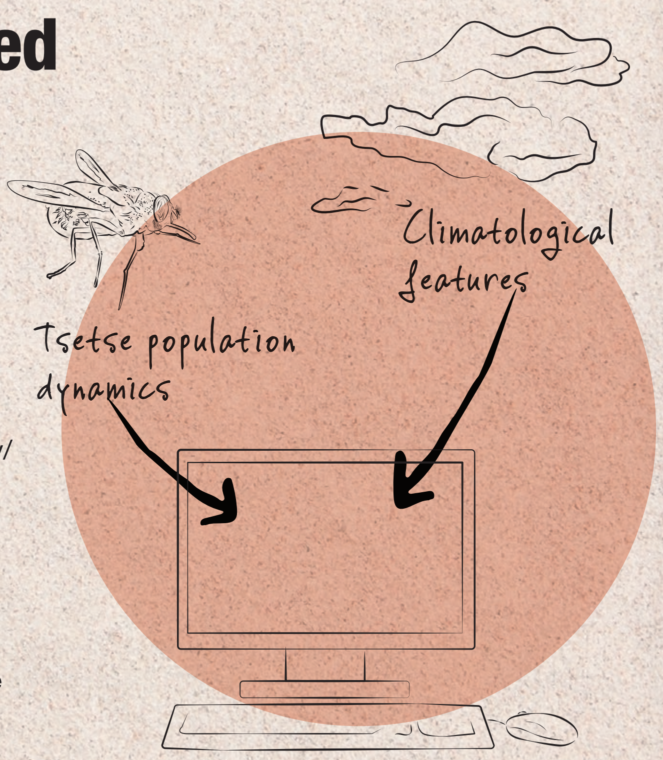
8 **Focus on most pressing needs**

Given the unavoidable uncertainty of climate change projections, the most pressing need is to strengthen current disease control efforts to reduce disease rates, manage short-term climate risks and to increase resilience of long-term climate change.

9 **Continue support for applied research for policy and practice.**

Recommendations continued

RESEARCH PRIORITIES: FURTHER DEVELOP MODELS OF TSETSE AND TRYPANOSOMES POPULATION DYNAMICS



Models of tsetse population dynamics and climatological features need to be further developed.

Progress in this area has demonstrated the important link between temperature changes and tsetse population dynamics. More refined models should take into account climatological features, particularly detailed temporal changes in temperature and humidity/saturation deficit.

The models should incorporate findings of tsetse reproductive ecology into demographic and epidemiological models using insights from evolutionary ecology on how mothers can shape both population responses to environmental change and offspring disease susceptibility. These studies provide integral parts of the modelling.

The models should incorporate findings on relationships between tsetse population dynamics and host density and distribution. They should take account of habitat fragmentation resulting from deforestation and human settlement, and the creation of residual patches of suitable tsetse habitat. Such changes should be used in the modelling to predict future trends in relation to changes in ecological and climatic variables and to assess impacts of tsetse control interventions on the dynamics of tsetse and trypanosomiasis. Model-types should include, but not necessarily be limited to, those using ordinary and partial differential equation, spreadsheet simulation, and agent-based modelling.

PRACTICAL ACTIVITIES IN SUPPORT OF VECTOR AND DISEASE CONTROL INITIATIVES:

i. Develop tools to assess whether tsetse and trypanosomes are developing resistance to insecticides and drugs. Work with industrial and academic partners to develop new methods and strategies to overcome resistance.

ii. Develop novel molecular tools and radar tracking methods to track the movement of tsetse populations.

iii. Develop a laboratory in Zimbabwe for using Polymerase Chain Reaction (PCR) to characterise all trypanosome strains in Zimbabwe.

iv. Genetically characterise tsetse in Zimbabwe, calculate genetic distance, genetic drift and identify potential invading populations.

v. Carry out morphometric analysis of existing collections of over 400,000 tsetse wings collected at Rekomitjie Research Station. This is important as a check on whether morphometric changes can indeed be used as a tool for identifying genetically isolated populations that can be targeted for eradication.

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