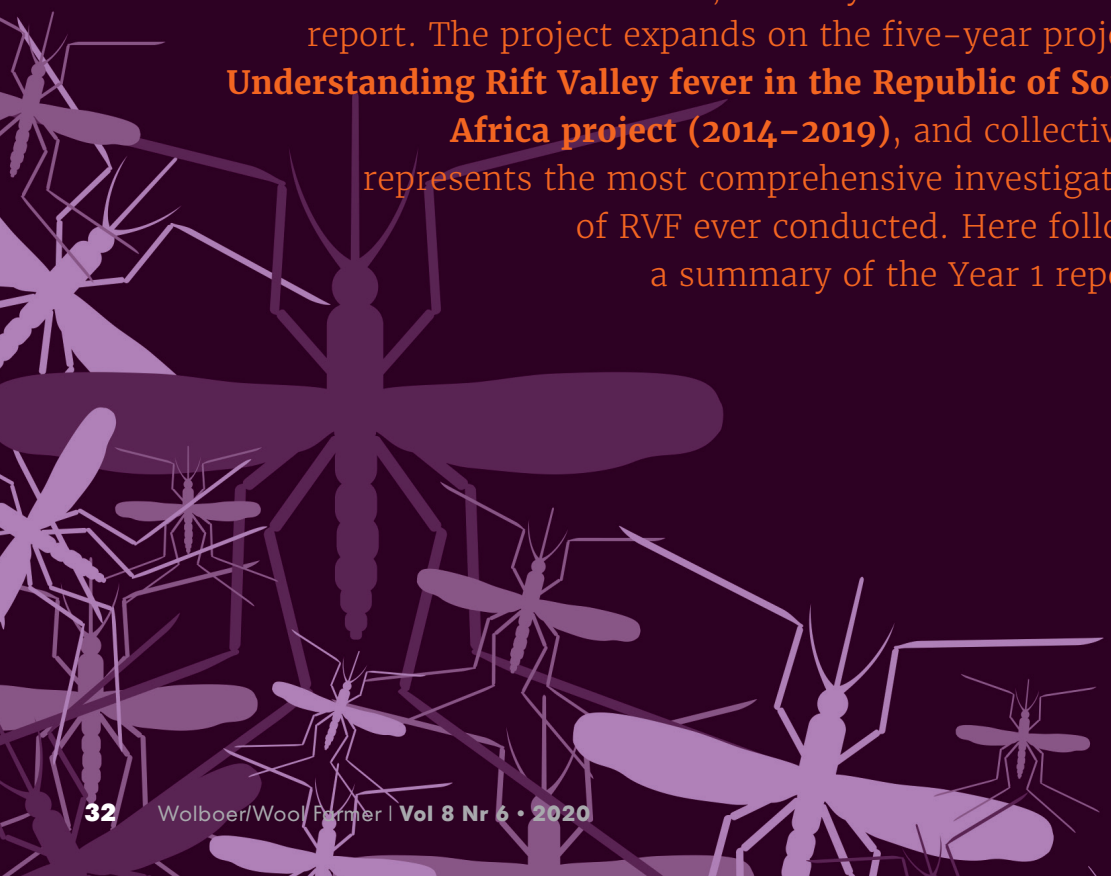
RESEARCH REPORT

Rift Valley fever project (Year 1)

The comprehensive research project, **Reducing the Threat of Rift Valley fever (RVF) through ecology, epidemiology and socio-economics (2019–2024)**, coordinated by the National Institute for Communicable Diseases (NICD), the University of Pretoria (UP), and EcoHealth Alliance, recently released its Year 1 report. The project expands on the five-year project, **Understanding Rift Valley fever in the Republic of South Africa project (2014–2019)**, and collectively represents the most comprehensive investigation of RVF ever conducted. Here follows a summary of the Year 1 report.



The new project expanded the diverse group of participating partners from governmental, non-governmental, academic, and private organisations, both domestic and international, to investigate impacts of the Rift Valley fever virus (RVFV) and improve the capacity to predict local outbreaks.

Specifically, the project is investigating the socio-economic impact of RVF at individual and national levels and will integrate previous results with satellite-collected weather data to develop an early warning system.

We are also continuing our important long-term investigations in the Free State, of:

i) the RVFV infection rate in sheep between outbreaks;
ii) how long antibodies persist in sheep following vaccination with Smithburn vaccine; and
iii) understanding seasonal dynamics in mosquito populations.

We also expanded our work into north-eastern KwaZulu-Natal (KZN), where only a few small RVF outbreaks have previously been reported, but our team members have found evidence that the RVFV is silently circulating in local domestic ruminants. This One Health project is working toward examining the economic cost of RVF across sectors and cost-effectively preventing future outbreaks.

The project covers a 40 000 km² region of the Free State and Northern Cape, including the areas hardest hit during the 2010 to 2011 outbreak. We are also working in a 1 000 km² region of north-eastern KZN.

Socio-economic impacts of RVF

We conducted the first One Health cost estimate of the economic costs associated with RVF in South Africa. Building on robust work previously done by the Agricultural Research Council (ARC), we reached out to institutions within and outside of the livestock sector to establish the impact of RVF. We estimated that between 2003 to 2018, at least R1,8 billion was spent on costs associated with RVF in South Africa, which were primarily born by the livestock sector (85% of all costs, including animals lost, trade impacts, etc.), the financial sector (8%, including lost tax revenue), the human health and productivity sector (5%, including loss of productivity during illness, treatment, and loss due to premature death), and the environment and natural resources (2,5%, which may be higher due to potentially unseen higher wildlife losses).

We also found that the investment in the prevention and mitigation of outbreaks (e.g. vaccination) was low relative to losses associated with outbreaks over the 15 years in South Africa. There was very low investment in prevention before the 2008 to 2011 RVF outbreak, with a spike in RVF vaccine sales during the outbreaks that later declined with time after the outbreaks.

A socio-economic questionnaire will be circulated to heads-of-households to better understand the cost of RVF born by individual livestock owners themselves. These will be distributed in KZN with the One Health baseline survey in Year 2 and in the Free State and Northern Cape region in Year 3.

Mosquitoes, RVF, and the environment

We have continued long-term research on climate and mosquitoes that may transmit the RVFV on five farms in the Free State and started new surveillance at three sites in KwaZulu-Natal (KZN).

Climate and weather

The past season (September 2019 to May 2020) was characterised by below-average

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rainfall in the west (–100 mm) and higher than average rainfall in the east of the study area (+150 mm) in the Free State and Northern Cape. In KZN, the study sites had below normal rainfall for the entire season (–50 mm), even though rainfall was generally above average in the greater KZN region. As we move into the 2020/2021 season, there is an established La Niña climate pattern over the Pacific Ocean, which usually means there is a chance for rainfall over South Africa, elevating the potential for a RVF outbreak.

Early warning system

Working from previously developed models to predict the risk of an RVF outbreak, we are developing an early warning system for South Africa. This year we integrated satellite data collected on vegetation (normalised difference vegetation index; NDVI) with the previous model and are currently working on integrating livestock population data into the model. Furthermore, we have updated the model so that we will be able to produce a new risk map every day, instead of once a month. Work on the early warning system is ongoing.

Mosquitoes

Over 25 525 mosquitoes were collected in the Free State this season and are still being identified. Work was delayed due to the COVID-19 pandemic lockdown that was instituted during the peak mosquito production months of April. We also collected (n = 2 000) mosquitoes each month in KZN (through March), which have been identified and are ready for RVFV polymerase chain reaction testing.

Long-term domestic ruminant study and KZN baseline survey

After obtaining the required approvals, we continued the sheep cohort study of the RVFV in vaccinated and unexposed sheep in the Free State. We sampled 165 vaccinated sheep that have survived from the previous study and will continue in the study. We consolidated our unexposed sheep on farms that are not vaccinating for RVF and have added one additional farm. Thus, we are monitoring 400 sheep on four farms for RVFV infection. All sheep were sampled in June and September, 2020.

An analysis of questionnaire data from farmers during the 2010 RVF outbreaks was done to determine which environmental and animal factors were most important to predicting whether a farm was affected by RVF and how severe the outbreak was.

Identifying these risk factors can provide critical information to farmers who are making decisions as to whether or not to

Mosquito traps set up in the Free State (left) and KwaZulu-Natal (right).

vaccinate their livestock when RVF risk is high. While we identified risk factors that were associated with higher numbers of abortions or deaths on the farm during 2010, we could not discern the important risk factors linked to whether or not a farm had RVFV on their farm. This highlights the importance of this research being done during an outbreak, when the RVFV diagnosis can be confirmed by diagnostic testing.

The team is ready to start the baseline survey of livestock in KZN. They will do so once we are able to start sampling people as well so that we can sample both at the same time (using a One Health approach). We are currently planning to start this work in Year 2.

Communication, training and the future

Communicating with our collaborators and stakeholders is essential for the success of the project. We began introducing the project to provincial and district veterinary and public health officials as well as the local communities in KZN. This was disrupted by the pandemic but will be reinitialised as soon as we are able to safely conduct our research.

Two masters' students that worked on the project graduated this year. We also began training a postdoctoral fellow and

Collecting samples from the cohort sheep.

a PhD student. In the past year, two more scientific articles were published and three more have been submitted or will be submitted shortly. Prior to the COVID-19 pandemic, and virtually since the pandemic, 16 presentations were given in South Africa and across the globe about the work on RVF in South Africa.

As we enter Year 2, the project will continue to conduct field and laboratory work, including the long-term mosquito sampling and cohort sheep study; the One Health baseline study of antibodies against RVFV in people and livestock in KZN; the first socio-economic survey to identify RVF impacts among heads-of-households in KZN; further characterisation of pans in central South Africa; and progress on an early warning system.