1. INTRODUCTION

Rift Valley fever (RVF) is an arthropod-borne viral disease of ruminants, camels and humans. It is a significant zoonosis which may present itself from an uncomplicated influenza-like illness to a haemorrhagic disease with severe liver involvement and ocular or neurological lesions. In animals, RVF may be unapparent in non-pregnant adults, but outbreaks are characterised by the onset of a large number of abortions and high neonatal mortality. The virus (Phlebovirus) is usually transmitted by various arthropods. Human infections have also resulted from the bites of infected mosquitoes, most commonly the Aedes mosquito. Mosquitoes from six genera (Aedes, Culex, Mansonia, Anopheles, Coquillettidia and Eretmapodites), including more than 30 species, have been recorded as infected, and some of them are proven to have a role as vectors. Most of these species acquire the infection by biting infected vertebrate animals, but some (specifically Aedes spp.) pass the virus transovarially (vertical transmission). These infected pools of eggs can survive through desiccation for months or years and restart transmission after flooding; then other species (Culex spp.) may be involved as secondary vectors. Vertical transmission (from an infected female mosquito to eggs) explains how the virus can persist for many years or decades between outbreaks.

Transmission to humans can also occur through close contact with infected material (slaughtering, butchering, assisting with animal births, conducting veterinary procedures, etc) and also by ingesting the unpasteurized or uncooked milk of infected animals. To date, no human-to-human transmission of RVF has been documented.

RVF virus (RVFV) is recorded to occur from South Africa to Saudi Arabia including Madagascar. It occurs in varied bioclimatic ecotypes, ranging from wet and tropical countries such as the Gambia, irrigated regions such as the Senegal River Valley or the Nile Delta, to hot and arid areas such as Yemen or Chad. The occurrence of RVF can be endemic or epidemic, depending on the climatic and vegetation characteristics of different geographic regions. In the high rainfall forest zones in coastal and central African areas, it is reported to occur in endemic cycles which are poorly understood. Currently available evidence suggests that this may happen annually after heavy rainfall, but at least every 2-3 years otherwise. In contrast, in the epidemic areas in East Africa, RVF epidemics appear at 5 to 15 year cycles. These areas are generally relatively high rainfall plateau grasslands, which may be natural or cleared from forests. In the much drier bushed Savannah grasslands and semi-arid zones, which are characteristic for the Horn of Africa, epidemic RVF has manifested itself only a few times in the past 40 years, in 1961-62, 1982-83, 1989, 1997-1998 and 2007-2008. In addition, the possibility exists that RVF may spread outside traditionally endemic areas, or even out of the continent of Africa, mostly due to the large range of vectors capable of transmitting the virus. Such a situation occurred following the unusual floods of 1997-1998 in the Horn of Africa countries, with subsequent disease spread to the Arabian Peninsula in 2000.
3. SITUATION OF RVF OUTBREAK IN MADAGASCAR

3.1 Historical information

RVF in Madagascar was reported for the first time in 1979, with little impact on animal and human populations. However, in 1990-1991, several outbreaks with many abortions in cattle were described in the East Coast and the highlands near Antananarivo (Morvan et al., 1991). Between February and April 1991, unusual numbers of bovine abortions around Antananarivo (central highlands) were reported by official veterinary services.

The strains responsible for these outbreaks were closely associated to African RVF virus strains but different from the RVF strains previously isolated in Madagascar. Therefore, a virus introduction through, for instance, the import of live infected animals, could have been the source of the 1990 outbreak. (Morvan et al., 1992).

In 2006, Madagascar sent an official notification to the World Organisation for Animal Health (OIE) confirming the presence of RVF infection, but without clinical signs.

3.2 Outbreaks in animals

The Ministry of Agriculture (MoA) reported RVF in animals to the OIE on 9 April 2008. The cases were confirmed by the FAO/OIE Reference laboratory Onderstepoort in South Africa in February 2008. The outbreak started on 4 February 2008 in Avaradrano, Antananarivo, and affected 2 of 9 cattle. The OIE report is available at: http://www.oie.int/wahid-prod/public.php?page=single_report&pop=1&reportid=6952

The location of the current outbreak of RVF is within the province of Antananarivo-Avaradrano. This province and the surrounding ones are characterized by a low ruminant density with the exception of Ambatolampy with approximately 125 head/km². (Figure 1)

3.3 Human cases

As of 17 April 2008, the Ministry of Health, Madagascar reported a total of 418 suspected human cases including 17 deaths (case fatality rate 4%) of Rift Valley Fever from Alaotra Mangoro, Analamanga, Itasy, Vakinakaratra and Anosy Regions. Infection with RVF virus was laboratory confirmed in 59 human cases (WHO).

In Mayotte, disease surveillance has been intensified since February 2007 because of the risk of RVF from other East African countries. The Pasteur Institute in Paris confirmed positive cases of RVF in samples obtained from cattle (zebus mahorais). Since March 2007, additional surveillance has been initiated in animals and humans potentially exposed to RVF. Results of the enhanced surveillance activities are pending.

4. RISK ASSESSMENT FOR RIFT VALLEY FEVER OUTBREAKS

4.1 Monitoring of climatic indicators

Vegetation growth responds to increased rainfall, and variations in vegetation can be easily measured by satellite. In East Africa, vegetation index maps have been used together with ground data to monitor vector populations and RVF viral activity, which established a correlation between these two parameters. In a more prospective way, vegetation measurements can be used to forecast RVF before cases reach epidemic proportions. Data sets used in these predictions include satellite outputs, mainly from the Advanced Very High Resolution Radiometer sensor (AVHRR) on-board polar-orbiting satellites operated by the National Oceanographic and Atmospheric Administration (NOAA) of the USA, which are used to generate various indices which are correlated with rainfall (such as vegetation index [NDVI] or Cold Cloud Duration [CCD]). Predictive models have been greatly improved by the addition of Pacific and Indian Ocean Sea Surface Temperature anomaly measurements, together with the rainfall and NDVI data.

At FAO headquarters, near real-time climatic data such as rainfall estimates and NDVI indices obtained from Artemis1 are collected and processed to produce risk maps by calculating vegetation index and rainfall anomalies comparing current conditions to long-term mean conditions. Resulting maps show areas experiencing above normal rainfall. A major partner institution is the NASA Goddard Space Flight Center (USA) which produces RVF monthly risk maps based on the persistence of NDVI anomalies [extremes in vegetation growth].

Positive NDVI anomalies were recorded over most of the continent in February 2008 with the largest departures concentrated over Southwest Africa and over East Africa (Figure 2).
4.2 Situation in Madagascar

The area in Madagascar where the current cases are located was not predicted to be at risk by NASA, based on the correlation between disease risk and precipitation/NDVI anomalies (Justice et al, 1986, Linthicum, 1983). In fact, this area falls outside of the endemic RVF area predicted by the model (Figure 2). However, this is the same area where cases were identified in the 1990-1991 outbreak in Madagascar. It is therefore critical to identify the factors related to the emergence of RVF in this country. It may be that the ecology of RVF in this area is different than that identified on the mainland of Africa, and so it may be necessary to enhance or adjust how the models monitor indicators of RVF activity in this area. On the other hand, the location of reported cases in the central highlands may be related to disease detection rather than disease incidence.

4.3 Forecast

The regional weather forecast for the next three month period from June to August, carried out by the International Research Institute for Climate and Society (IRI), indicates that above-average rainfall is not expected for Madagascar and the southern part of Africa. However, the central part of Africa is predicted to see an increase in precipitation above the normal expected for this period.

**Considering that RVF outbreaks were reported in Kenya, Tanzania and Sudan in 2007, and South Africa is currently experiencing an outbreak of RVF, disease surveillance should be heightened and preparedness plans put in place throughout the Eastern part of the African continent. RVF surveillance efforts should be pursued in non affected areas since the disease can still spread.**

5. RECOMMENDATIONS

The situation of RVF in Madagascar is very serious because the two month delay in disease reporting may have facilitated the spread of the disease and the consequent confirmation of several human cases and deaths. This could indicate that the infection is well established in animals in this new epidemic. Areas where ecological factors are appropriate for disease emergence, or where movement of animals from infected areas are suspected, should be intensively monitored.

Preventive measures should include:

a. Conducting public awareness campaigns that inform animal owners of potential risk factors for RVF, including risks of moving animals into affected areas or introducing animals from affected areas into unaffected areas.

b. Increased disease surveillance

c. Institution of animal movement control to prevent infected animals moving to a new and potentially unaffected area

d. Strategic use of animal vaccination if it is decided to use vaccination (use of attenuated vaccines under outbreak situations is not recommended).

e. Use of mosquito repellents and mosquito nets over sleeping beds or cots

Countries located in the southern part of East Africa and islands close to Madagascar such as Mayotte or Comoros should increase activities on disease surveillance according to OIE standards, particularly in areas of these territories with previous occurrence of RVF. If there are no reports of clinical signs compatible...
with RVF, disease surveillance should focus on vectors (mosquitoes) and serology of susceptible ruminants only.

There is little official information in terms of international cattle trade to and from Madagascar. Madagascar’s only official exports over the past few years have been some shipments to nearby Comoros islands, while the only official imports have come from Mauritius and New Zealand (UN Comtrade, 2008). Importing meat or animals from Madagascar represents a high risk practice. However, countries should not apply trade restrictions to livestock imports from zones of Madagascar if disease surveillance is in place with negative results. Madagascar is a RVF infected country/zone with disease, meaning clinical disease in humans and animals has occurred within the past 6 months according to OIE status. Even in presence of disease or infection, the OIE Terrestrial Animal Health Code accepts trade of ruminants and meat from infected countries if certain specific conditions of quarantine or vaccination are met. This is based on the principle of timely and prompt notification of infection or disease to the OIE.

6. FAO IN ACTION

EMPRES (Emergency Prevention System for Transboundary Animal Diseases) programme provides, at an international level, an overall initiative for coordination of the RVF-Early Warning System, where data integration and analysis are performed before being disseminated to recipient countries, international organisations and key stakeholders in the form of RVF bulletins and risk assessments.

EMPRES promotes the use of remote sensing for forecasting RVF and other arbovirus occurrence and field validation studies in a country and on a regional basis: its use may allow for preventive measures to be instituted promptly, such as awareness and public service announcements over radio and television, early vaccination of susceptible livestock and rapid implementation of mosquito larval control methods.

Regarding the specific situation of RVF in Madagascar, FAO/OIE CMC-Animal Health, in collaboration with EMPRES and the World Health Organisation, have sent a mission to Antananarivo as a response to a request by national authorities. This mission will evaluate the situation of RVF in the field and will support the efforts of the Ministry of Agriculture and Ministry of Health to control RVF outbreaks in Madagascar.

FAO EMPRES encourages and offers technical assistance to countries in Southern and Eastern Africa to activate disease prevention and surveillance, early warning and to update contingency plans for RVF.

7. RFV RESOURCES

Background and additional information on RVF in livestock can be found at the following links:
- FAQ Recognizing Rift Valley Fever
  http://www.fao.org/DOCREP/006/Y4611E/Y4611E00.HTM
- FAQ EMPRES Watch: Possible RVF activity in the Horn of Africa
  http://www.fao.org/docs/eims/upload/217874/EW_hornaf-
rica_nv06_rvf.pdf
- FAO Rift Valley Fever
disease_rvf.asp
- FAO Preparation of Rift Valley Fever Contingency Plans
  http://www.fao.org/DOCREP/005/Y4140E/Y4140E00.HTM
- WHO Rift Valley Fever Fact Sheet
  html
- OIE Rift Valley Fever Disease Card
  http://www.oie.int/eng/maladies/fiches/a_A080.htm

8. BIBLIOGRAPHY

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mil/GEIS/SurveillanceActivities/RVFWeb/indexRVF.asp


ha.osd.mil/RVFWeb/index.htm


