

Rift Valley Fever - 3. Epidemiology



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- ≡ Geographic distribution
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- ≡ Vectors
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Objective and themes

Objective and themes



Start 

Geographic distribution

The **disease** was historically confined to the countries of **sub-Saharan Africa**.

Evidence of RVFV circulation has also been found in Libya, Egypt, Western Sahara, Madagascar, Yemen and Saudi Arabia as well as serological findings in Tunisia, Morocco, South West Algeria, North East Western Sahara, Western Sahara, Turkey, Iraq and Iran.

The first appearance of RVFV outside the African continent - in the Arab Peninsula- (September 2000) was attributed to the ecological characteristics of the Tihama* regions, which are identical to those in the western valley floor of the Rift Valley in Ethiopia and Eritrea.

i *The Tihama regions are located in the western areas of the Rift Valley outside of sub-Saharan Africa.

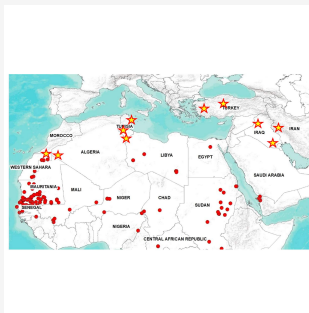
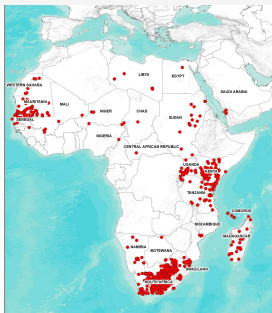
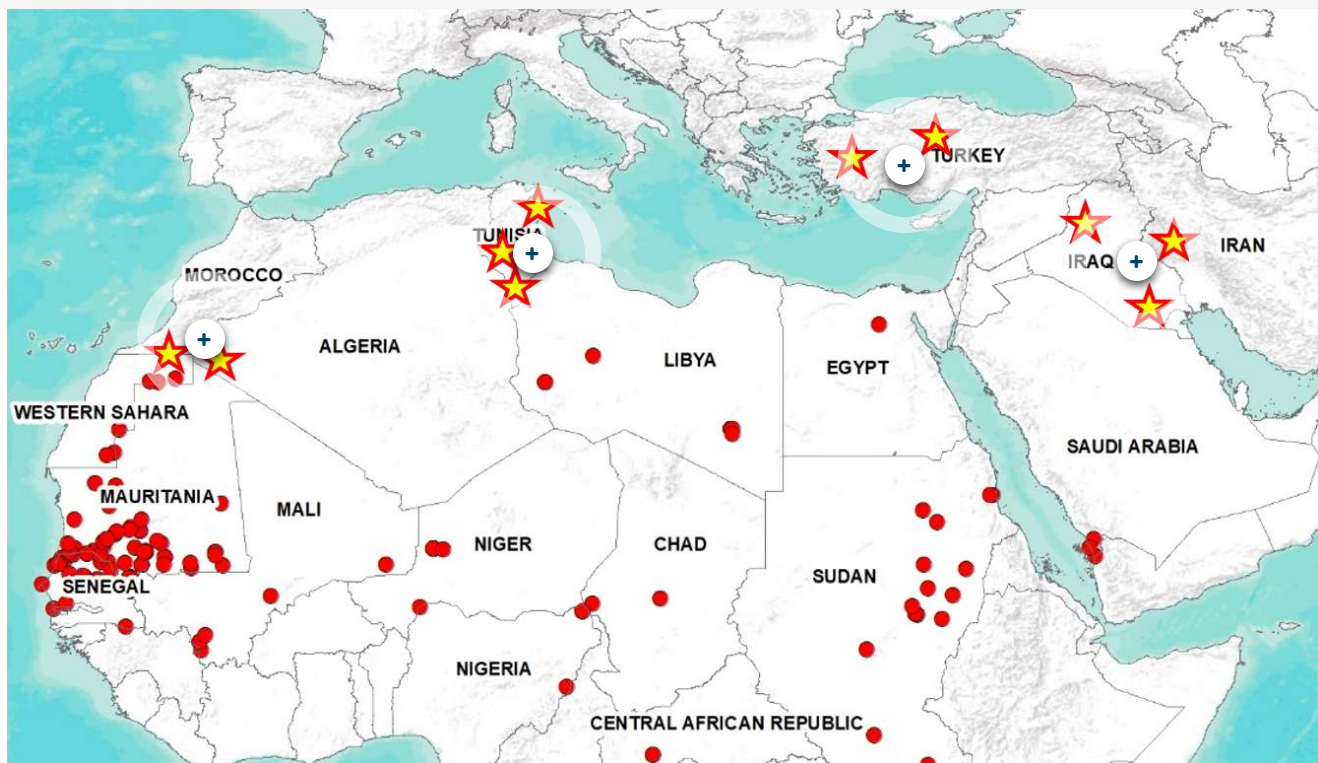
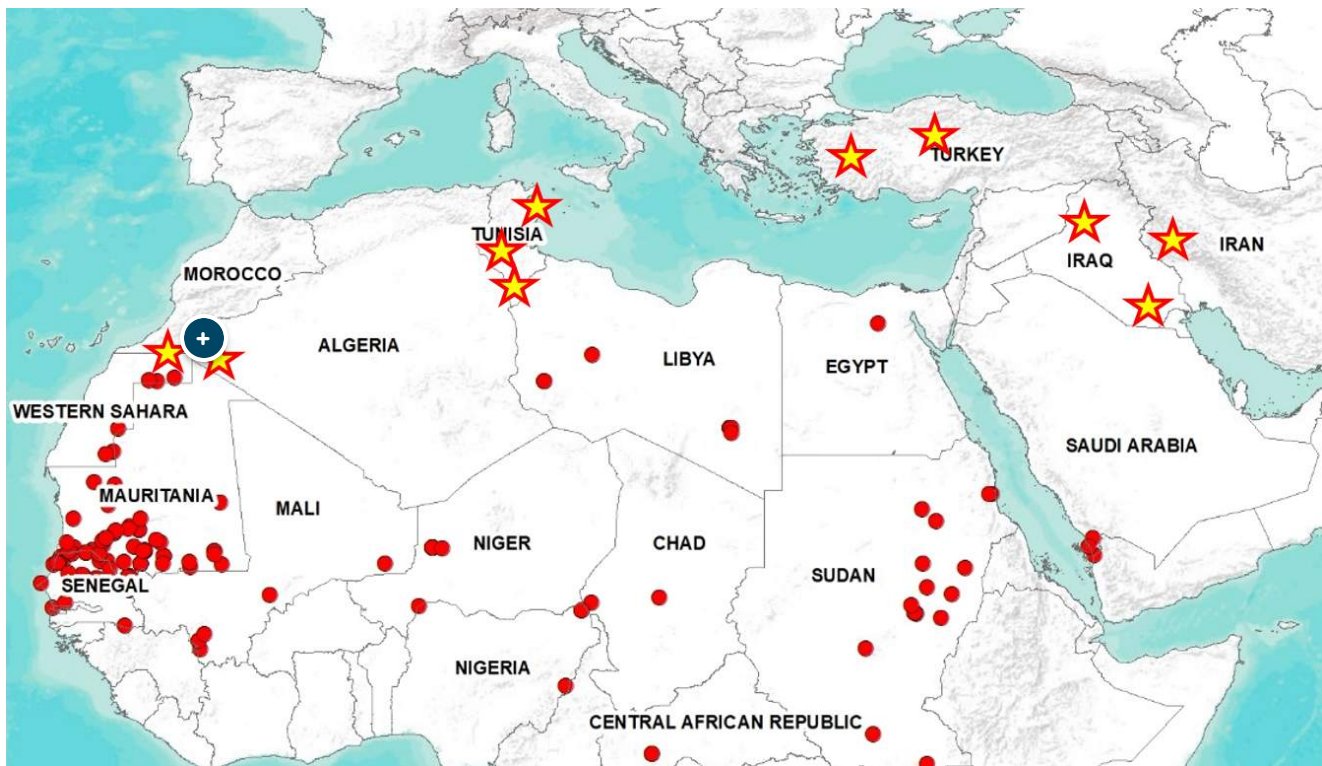


Figure 1. RVF confirmed outbreaks (animals and humans) from 2004 to 2021 (updated to 10th of February 2021).
Data Source: Global Animal Disease Information System, Empres-I © FAO

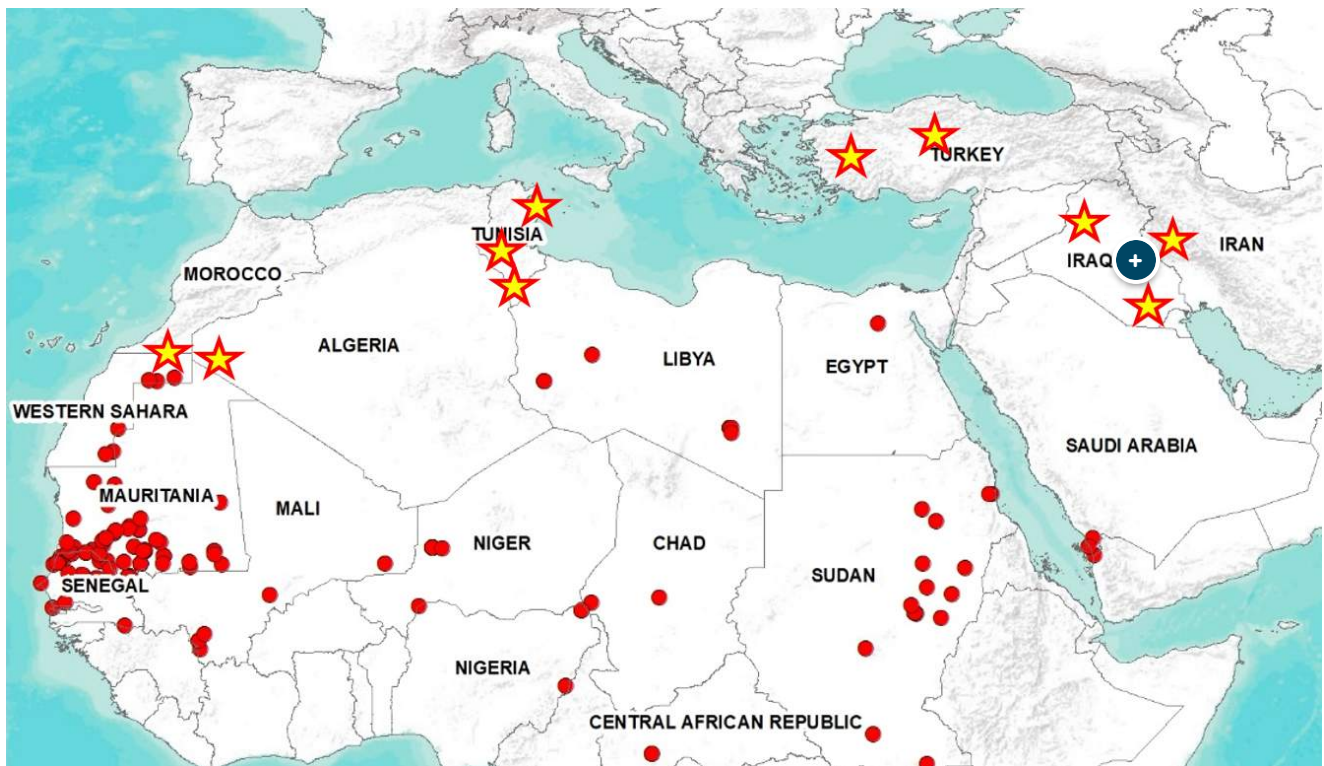
Figure 2. Serological findings (stars) in North Africa and Middle East.
Data Source: Global Animal Disease Information System, Empres-I © FAO
(Dots indicate the confirmed outbreaks)





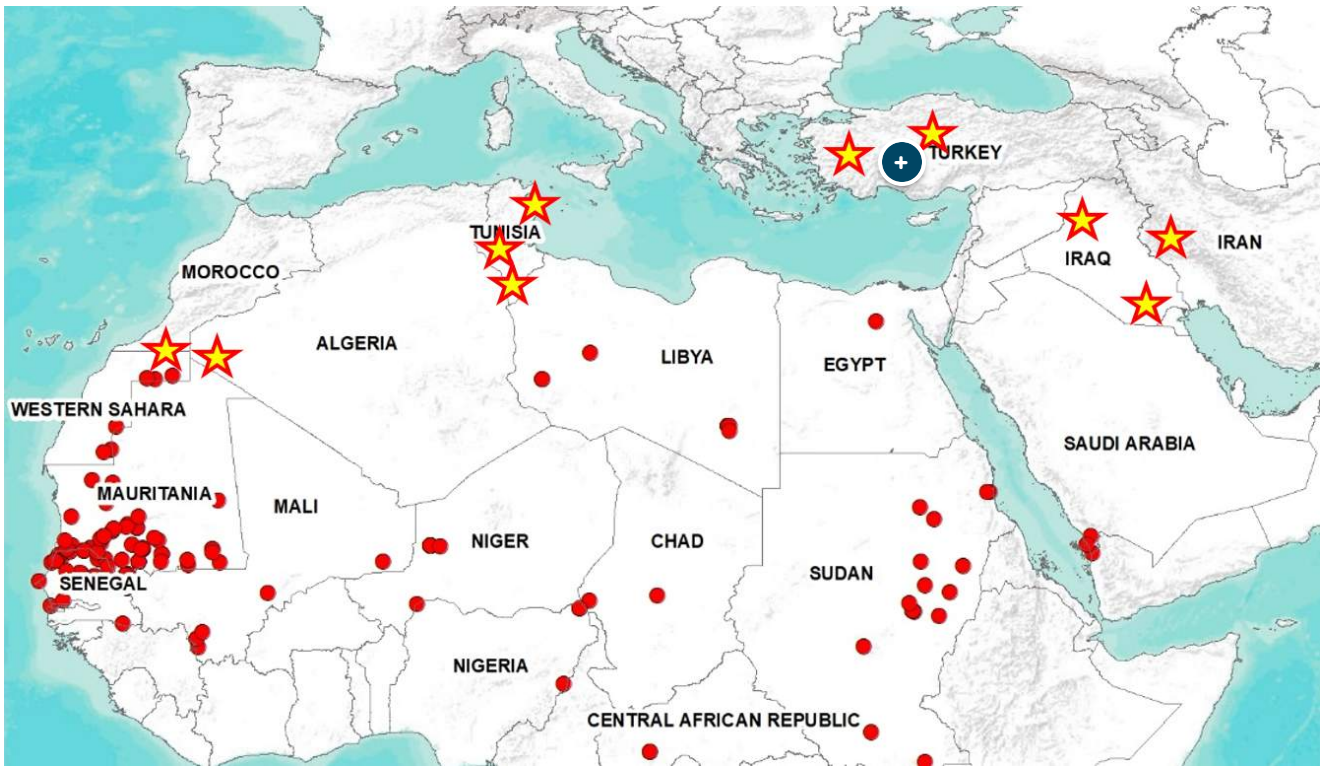
Serological findings in Morocco, Western Sahara and Algeria

Country	Sampling Period	Region, Province, Area	Species	N samples	Lab Test	Results	Publication
South West Algeria	March to April 2008	Refugee camps wilayas in <u>Tindouf</u> province and <u>Dahkla:1</u> And <u>Bir Lehlou: 1</u> <u>Tifarit: 4</u> <u>Mehaires: 1</u>	sheep	461	C-ELISA	1.12% positive IgG	Di Nardo et al., 2014
North East			goats	463			
Western Sahara			camels	58			
Western Sahara	2009	<u>Dahkla</u> <u>Smara- Laayoune</u>	camels	100	C-ELIS, VN	15% positive	<u>Harrak et al., 2011</u>
Morocco		Tata				negative	



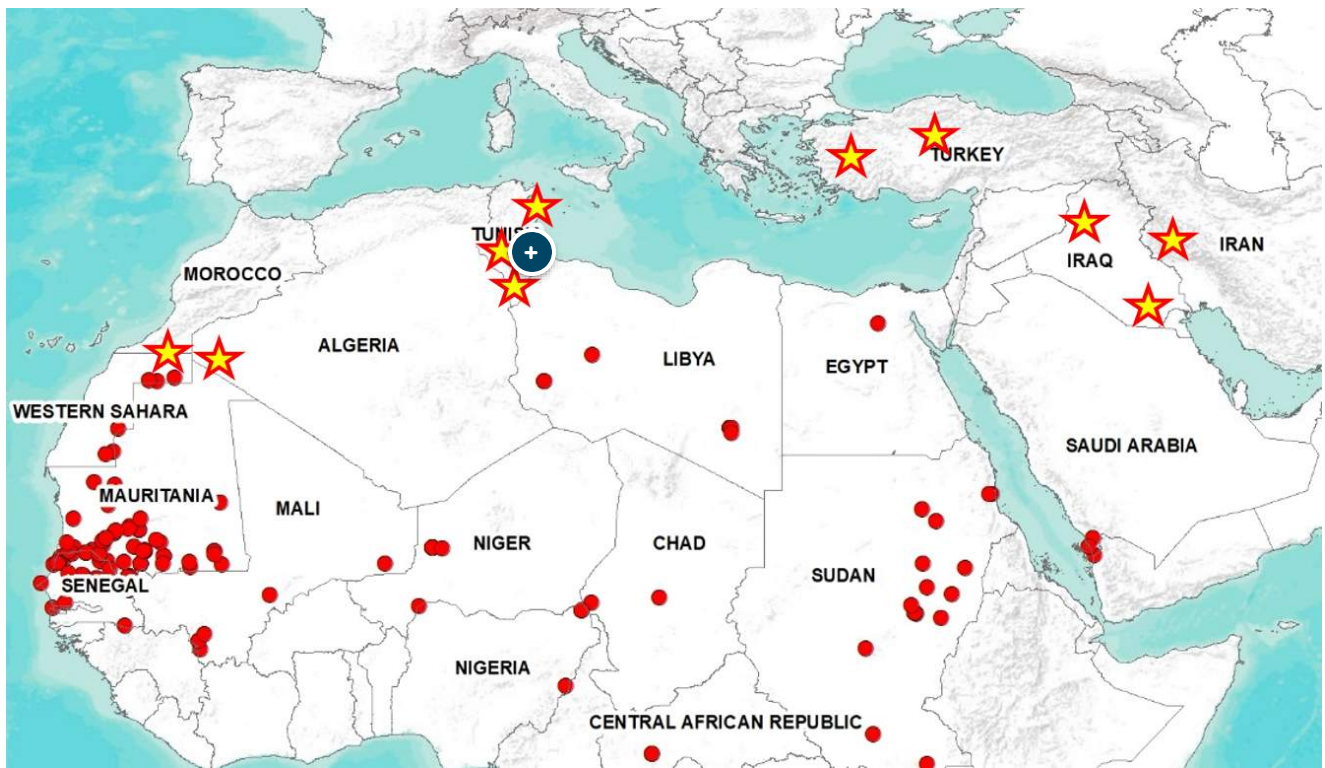
Serological findings in Iran and Iraq

Country	Sampling Period	Region, Province, Area	Species	N samples	Lab Test	Results	Publication
Iran	Jan. to Dec. 2016	Kurdistan	cattle	118	C-ELISA IFA	1.69% positive	Fakour et al., 2017
			goats	28		negative	
			sheep	142		2.11 % positive	
Iraq	Unknown, before 2012	Basrah	sheep	1215	C-ELISA	8.89% positive	Rahman Kadhum Muhsen, 2012
	Oct. 2012 to Febr. 2013	Ninavah	sheep	184	C-ELISA	1.08% positive	Aghaa O.B. et Rhaymah M., 2013
			goats	184		4.88% positive	



Serological findings in Turkey

Country	Sampling Period	Region, Province, Area	Species	N samples	Lab Test	Results	Publication
Turkey	not mentioned	not mentioned	children	110	RT-PCR	negative	Yilmaz et al., 2017
					IgG ELISA, WB	3.64% positive	
			cattle	200	RT-PCR	negative	
					IgG ELISA, WB	4.5% positive	
	sheep	160	RT-PCR	negative			
			IgG ELISA, WB	3.75% positive			
2009-2012	Aydin	camel	72	C-ELISA	1.3% positive	Gur et al., 2017	
July to August 2005	Sanliurfa	gazelle	82	C-ELISA	negative		
Oct. 1999 to 2001	Ayfonkarahisar Amasya Samsun Ankara	water buffalos	352	C-ELISA	9.94% positive		
			58	C-ELISA	negative		



Serological findings in Tunisia

Country	Sampling Period	Region, Province, Area	Species	N samples	Lab Test	Results	Publication
Tunisia	summer 2014	Sousse Mahdia Sfax	humans	219	RT-PCR	negative	Bosworth et al., 2016
					IFA	1.37% IgG positive 6.84% IgM positive	
	2017-2018	Gabes Kebili Tozeur Tataouine	camels	470	C-ELISA	34% IgG positive	Selmi et al., 2020

Data source: Global Animal Disease Information System, Empres-I © FAO



Hosts

The **natural hosts** of this disease are **domestic and wild ruminants, including camels**.

Among **wild animals**, the African buffalo (*Syncerus caffer*) is very susceptible and infection causes abortion.

Abortive forms due to **RVF** have also been found in **antelopes** (*Antidorcas marsupialis*) and **blesboks** (*Damaliscus albifrons*).

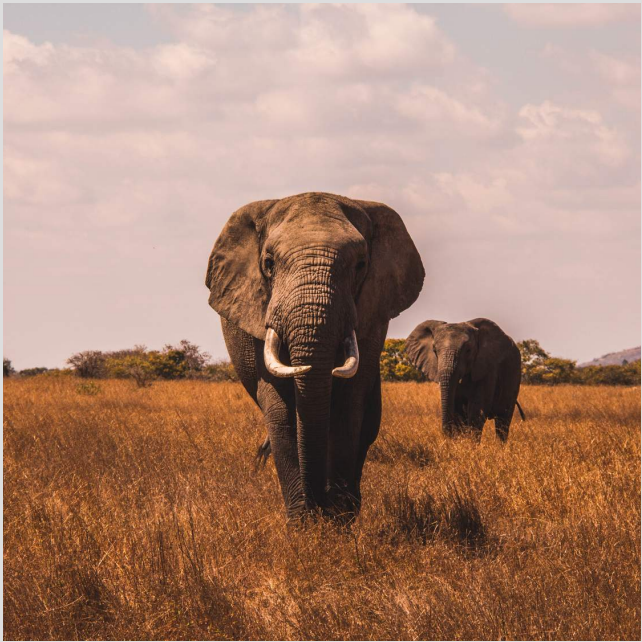
The **Zinga virus***, which has been identified as **RVF virus** has been isolated in warthogs (*Phacochoerus aethiopicus*).

i ***Zinga virus**. Virus Zinga strains have been isolated from several pools of mosquitoes collected in Perinet area, 130 km far from Tananarive, at the Institut Pasteur of Madagascar in 1980. Although this virus is pathogenic for man, it seemed to give only a mild illness and did not appear to constitute a problem of Public Health. But today it is seen in quite a different way; since the WHO Center for Arbovirus Reference and Research of New Haven has shown the serologic identity between virus Zinga and another arbovirus, Rift Valley Fever virus.

Source: Rift valley fever and Zinga virus: a pathogenic arbovirus in man and animal new for Madagascar. Mathiot C, Ribot JJ, Clerc Y, Coulanges P, Rasolofonirina N. (Arch Inst Pasteur Madagascar, 51(1):125-133, 01 Jan 1984)

Specific antibodies were found in:

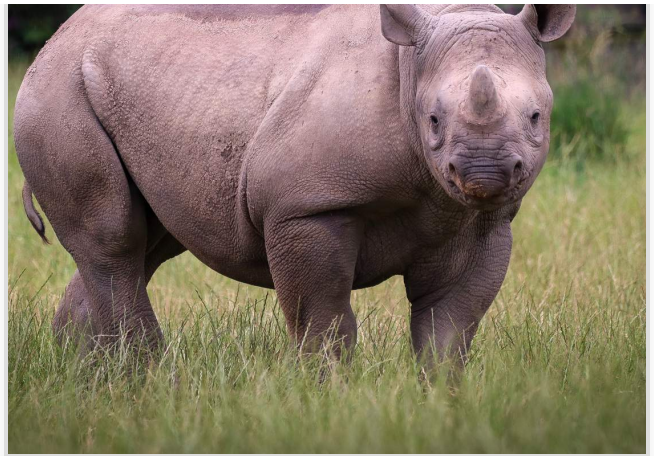
ELEPHANTS



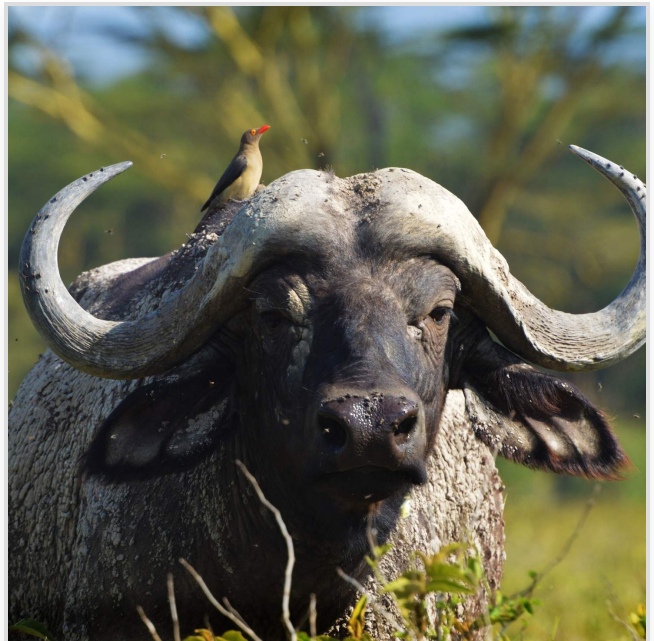
HIPPOPOTAMI



BLACK RHINOCEROSSES



BUFFALOES



ANTELOPES



WHITE RHINOCEROSSES



This **finding** raises the spectre that wild animals may act as a **reservoir**.

Humans are **susceptible** to the disease, whereas **birds**, **reptiles** and **amphibians** are refractory.



African buffalo (*Syncerus caffer*)



Antelopes (*Antidorcas marsupialis*)



Blesboks (*Damaliscus albifrons*)

The **severity** of **RVF** depends on the **species** and **age** of the animal affected.

The figure showing the **morbidity and mortality*** can be obtained from the **laboratory/literature**.

In outbreaks, infection depends on:

i ***morbidity and mortality**. In humans the case-fatality reported in the course of various epizootics varies from 1 to 2%.

In outbreaks, infection depends on:

- the dose;
- the host's immune status;
- other predisposing factors.

Mortality >70%	High mortality 10-70%	Serious but rarely fatal diseases	Develop antibodies	Unsusceptible
Lambs	Sheep	Humans	African monkey	Birds
Kids	Calves	Cattle	Horses	Reptiles
Mice		Goats	Cats	Amphibians
Rats		African buffaloes	Dogs	
Kittens		Asian Buffaloes	Pigs	
Puppies		Monkeys	Rabbits	
		Camels	Guinea pigs	

The table shows the species that are susceptible to infection.

Source: Swanepoel, R. & Coetzer, J.A.W., 2004, 'Rift Valley fever', in J.A.W. Coetzer & R.C. Tustin (eds.), Infectious diseases of livestock with special reference to Southern Africa, Oxford University Press, Cape Town

Which of the following animals are not susceptible to the disease?

- Camels
- Sheep and goats
- Buffaloes
- Turtles

SUBMIT



Methods of transmission

RVF is a **vector-borne** disease mainly transmitted by several genera of **mosquitoes**.

Direct transmission is possible through contact with:

- organs and body fluids of viraemic animals;
- aerosol exposure.

During inter-epidemic periods the virus is maintained by **transovarial transmission** in *Aedes* mosquitoes.

Transovarial transmission is responsible for endemic outbreaks.

Heavy rainfall with persistent flooding is the main reason for the onset of epidemics in endemic areas.

Flooding leads to an explosive increase of mosquitoes numbers.



Culex pipiens female.

Eggs of the genus **Aedes** resist prolonged periods of drought* and require flood water in order to hatch.

i *Unlike other culicids, **Aedes** eggs do not require an aquatic environment for egg deposition and are able to resist long periods of drought.

Infected eggs give rise to infected mosquitoes, which disseminate the virus.

The **receptive animals amplify the virus** and secondary mosquito species enable the infection to explode rapidly into epidemics of considerable size.

Viraemic animals are a source of infection for livestock and abattoir workers.

The **main routes of human transmission** are:

- abrasions;
- cuts;
- blood aerosol during slaughter;
- mosquito bite



Culex pipiens male, detail of the antennae and palps.

Complete the following sentences:

Rift Valley Fever is a viral disease transmitted by of the *Aedes* and *Culex* genera.

Heavy with persisting flooding is the main reason for the onset of epidemics in endemic areas. Flooding leads to an explosive increase of

mosquito numbers.

..... amplify the virus and secondary mosquito species enable the infection to explode rapidly into epidemics of considerable size.

receptive animals

rainfall

mosquitoes

SUBMIT



Vectors

The RVFV can be transmitted by different species of vector mosquitoes.

Transovarial transmission has been demonstrated in the **Aedes** species, which would explain the presence of the virus in arid regions in the absence of reservoirs.

Other arthropods such as **ticks** or **biting flies (tabanids)** can transmit the disease.



Cx. pipiens larva

The virus undergoes various phases in the **vectors**:

- the eclipse period depends on the species* and the temperature. During this phase multiplication of the virus occurs in the intestine of the insect;
- a new multiplication cycle in the salivary glands.

In Southern and Eastern Africa, **RVF** epizootics arise around "dambo areas".*

*species

The eclipse period of the RVF virus lasts from 7 – 12 days in *Culex pipiens* and approximately 29 days in *Aedes aegypti*.

*dambo areas

Dambos are wetland areas typically present in central and eastern Africa. They are generally found in higher rainfall flat plateau areas, and they can be completely dry for years until floods occur following heavy rainfall.

Probably, the existence of a **reservoir** (a wild vertebrate, probably a rodent) may explain the virus's persistence during the **inter-epizootic periods**.

It has not been possible to isolate the virus in rodents living in such areas and **the natural reservoir of the virus has not yet been identified**.

It is thought that mosquitoes function as both vector and virus reservoir in the **Sahelian areas**.

In some areas domestic animals (sentinel herds) can develop antibodies to the virus without clinical signs.

It is probable that the virus does not completely disappear between epizootics but circulates with a **low incidence rate in domestic animals** until climatic conditions become favourable for a new epizootic.



Factors favouring spread

One of the factors favouring the RVF spread is the presence of water (irrigation, rice field) and rainfall.*

Human interventions which change the ecology of the area* have an effect on the spread of the disease.

*rainfall

The large epizootics which occurred in the past in South and East Africa were associated with significant flooding while in Egypt they occurred after large-scale irrigation work.

*ecology of the area

One of the characteristics of the epizootic in Egypt was the construction of a dam leading to the flooding and irrigation of new areas, creating new breeding sites for the mosquitoes.

It is possible that **new outbreaks** can occur at any time in **Africa** even in predominantly arid regions, given the establishment of several rural development projects which could have a severe ecological impact through the building of new irrigated areas and dams.

For further information

EFSA Panel on Animal Health and Welfare (AHAW); Scientific Opinion on Rift Valley fever. EFSA Journal 2013;11(4):3180. [48 pp.] doi:10.2903/j.efsa.2013.3180.

[CLICK HERE](#)

Which of the following mosquito genera is not able to transmit the RVFV?

- Aedes
- Culex
- Anopheles
- Phlebotomus

[SUBMIT](#)



Summary

**Summary
of the concepts
presented**



Start 