

# **Epidemiology of Rift Valley fever in arid zones: Example from Mauritania**

**WHO R&D Blueprint meeting on clinical trial design - RIFT VALLEY FEVER, 1  
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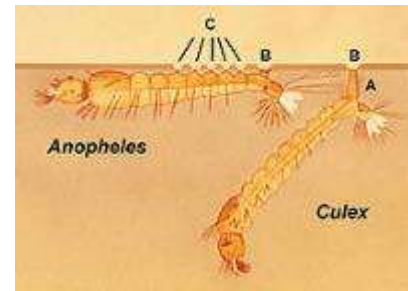
# INTRODUCTION

## What's RVF?

Zoonosis due to a virus belonging to the genus Phlebovirus and transmitted by arthropods, of at least 6 genera, in particular the genera *Aedes* and *Culex*

hosts

Affects domestic and wild ruminants and the man as well



# INTRODUCTION

## Where the RVF occurs?

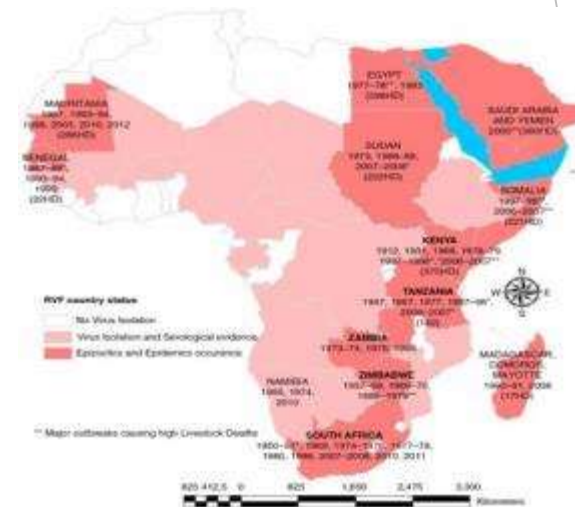
Considered initially mild and localized, the disease has proven the opposite since its extension in Egypt in 1977, then in West Africa (1987) and subsequently in the Arabian Peninsula (2000).

Disease present in sub-Saharan Africa

In Egypt ,

In the Indian Ocean

In Saudi Arabia and Yemen



Distribution spatio-temporelle des foyers cumulés de rift de 1977 à 2012 (Nanyingi et al., 2015).

Ecological Zones favorable to the disease



Irrigated valleys

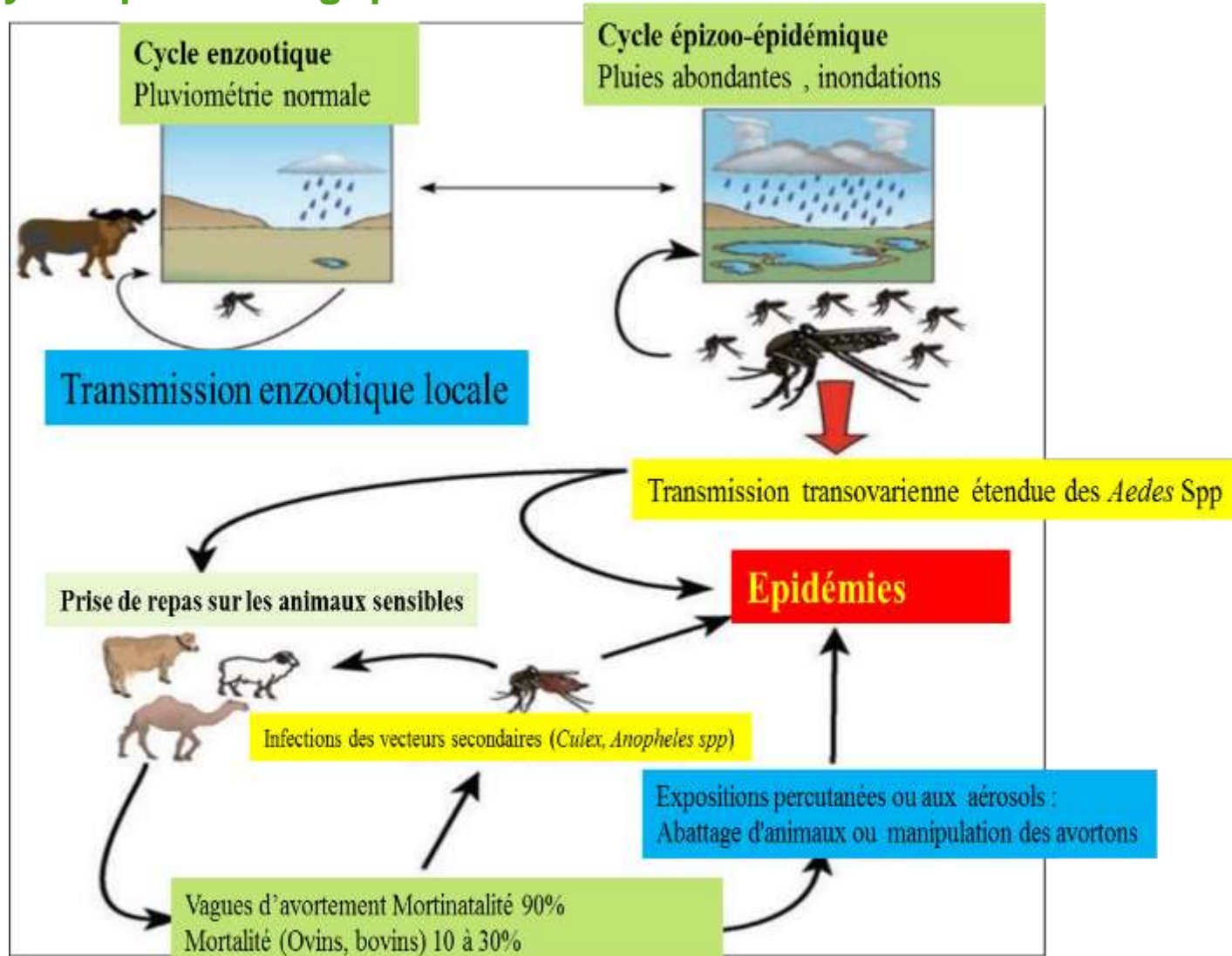


Temporary or permanent water ponds



# INTRODUCTION

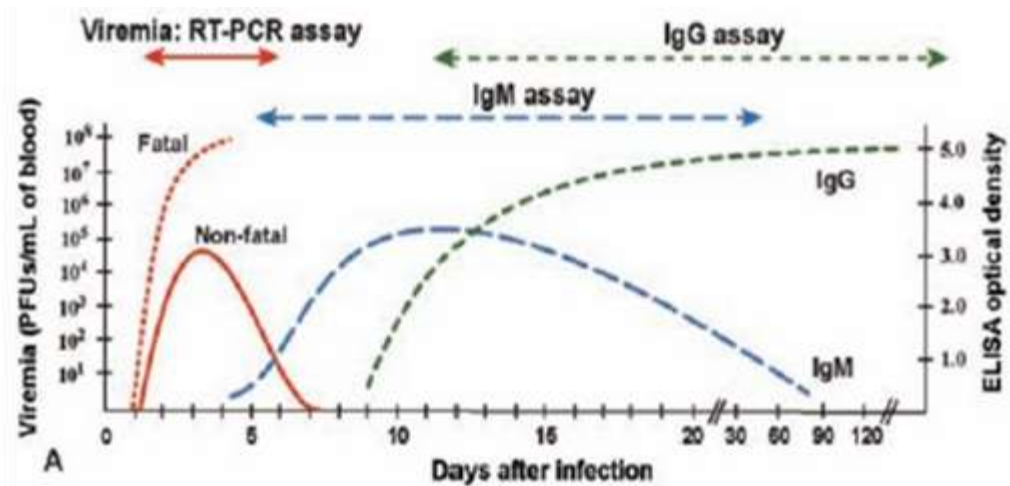
## Cycle épidémiologique



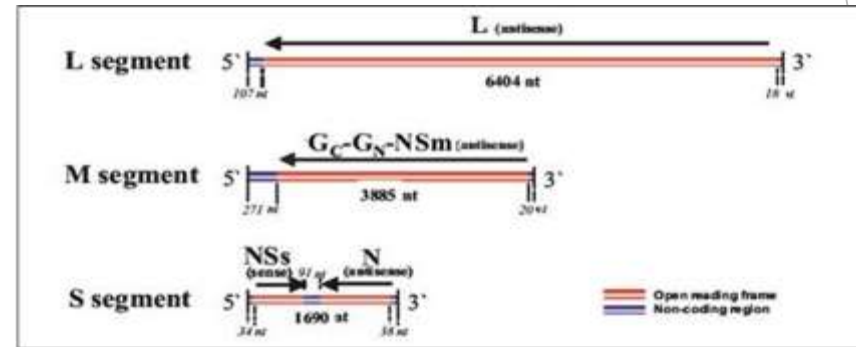
Cycle de transmission de la FVR (Bird, et al., 2009)

# INTRODUCTION

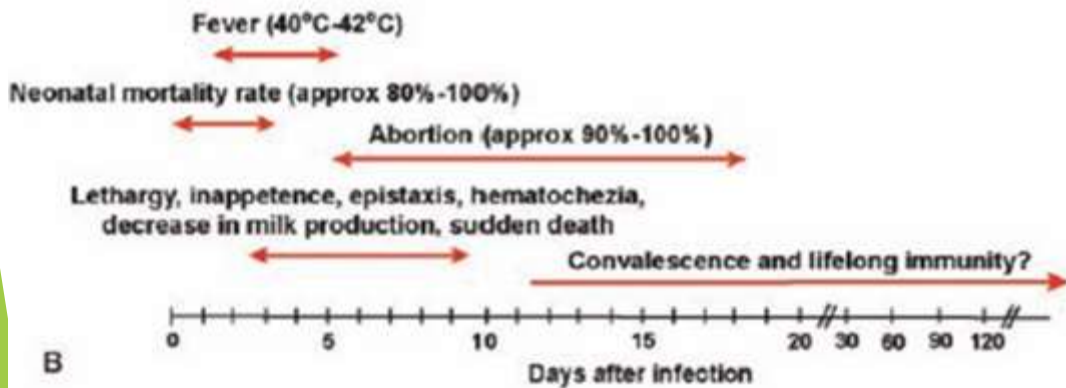
## Diagnosis of the disease



Cinétique de la virémie et de l'apparition des anticorps anti-FVR chez les animaux (Bird et al., 2009)



Représentation du génome du virus de la FVR de la souche MP12 (Flick & Bouloy, 2005)



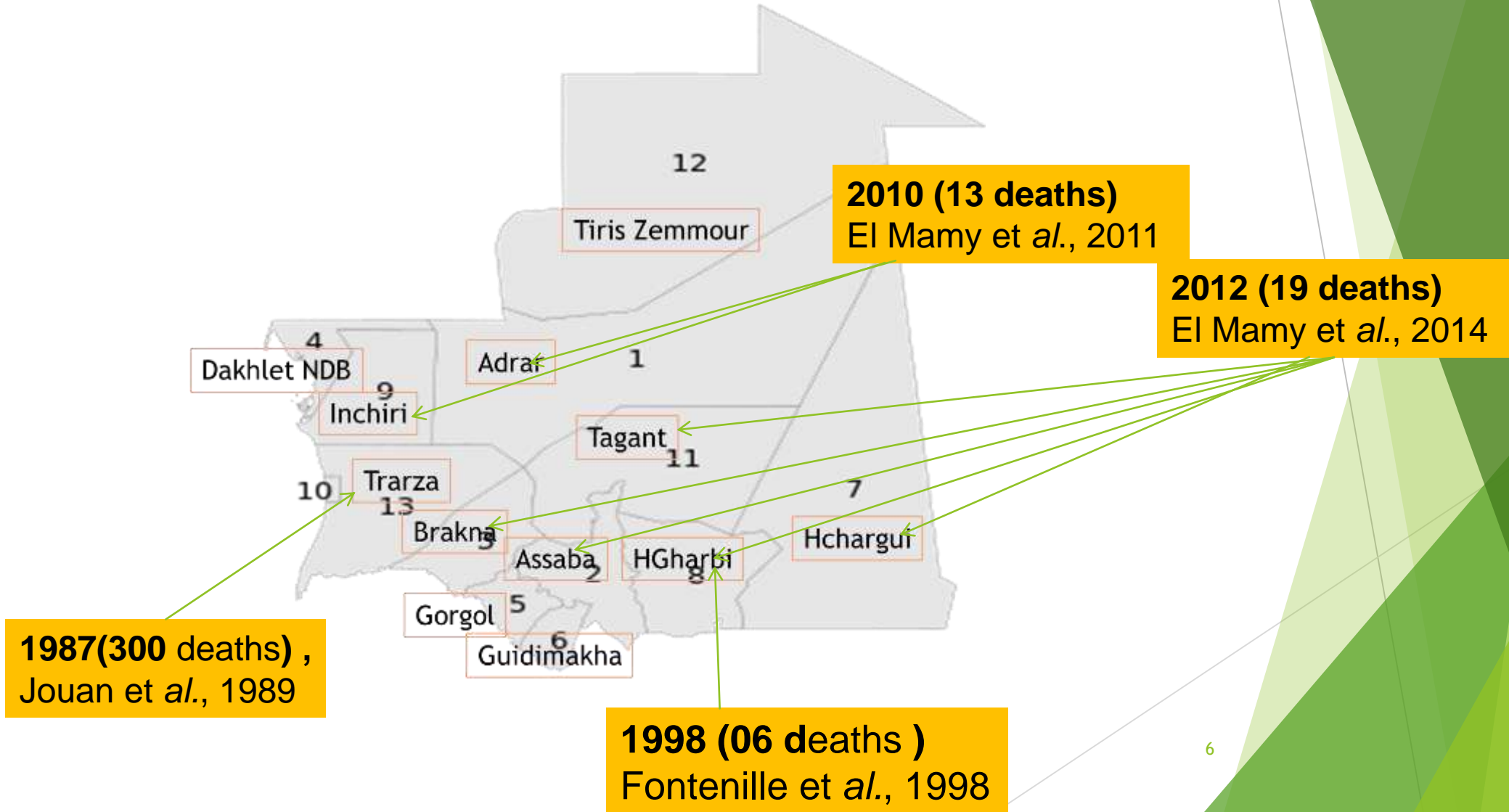
Cinétique des symptômes observés chez les animaux (Bird et al., 2009)

## Diagnostic de confirmation

- PCR et isolement viral
- Mise en évidence d'IgM lors d'un foyer de suspicion

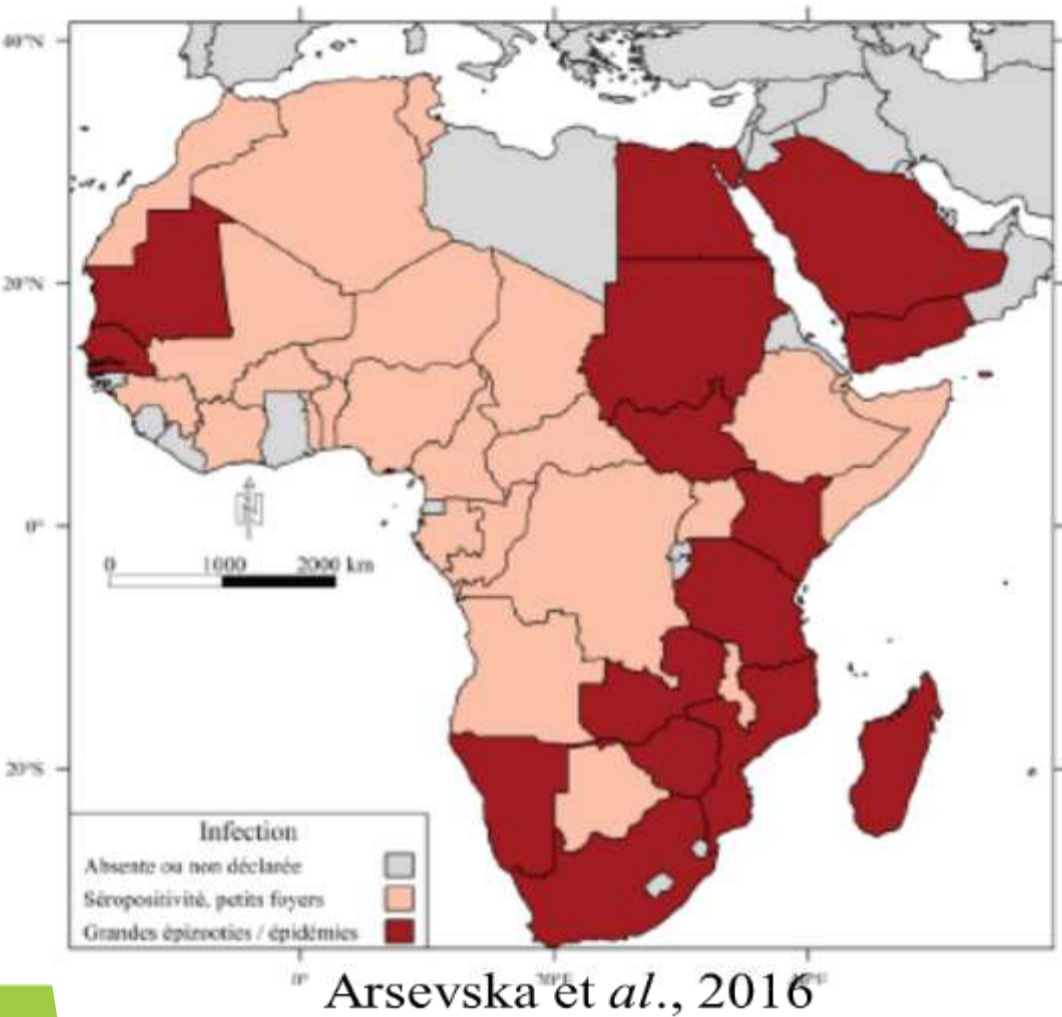
# INTRODUCTION

## RVF and Mauritania: A reminder of the main epidemics



## INTRODUCTION

### The situation of RVF in Mauritania and in the subregion



**Mauritania and Senegal have regular epidemics of RVF.  
The virus also circulates in all neighboring countries**

# problematic

Repeated epidemics resulting in several deaths and serious economic losses

Ecological zones favorable to the

disease



Irrigated valleys

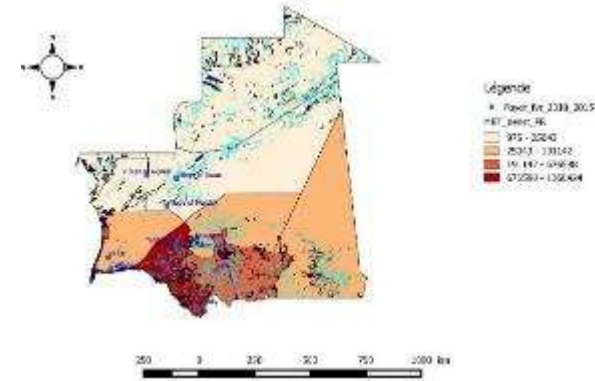


Temporary or permanent water ponds

A livestock in perpetual motion



ECONOMIC AND HEALTH IMPACT



Ecological zones favorable to the disease vectors



## Problématique

► **What are the factors and mechanisms involved in the emergence of the RVF virus in Mauritania?**

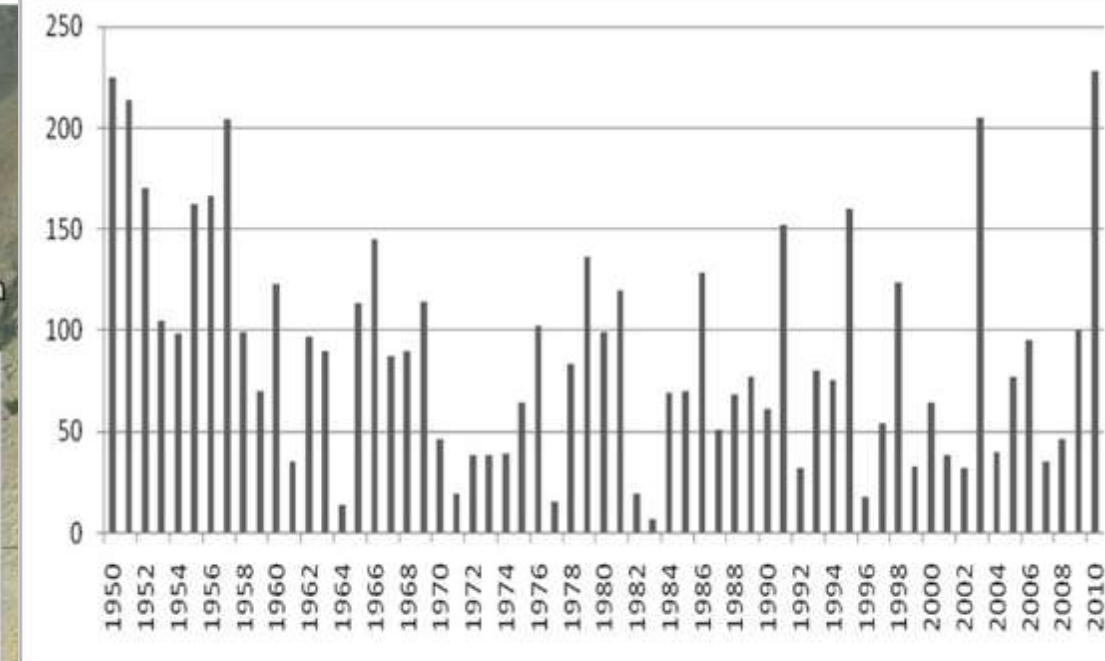
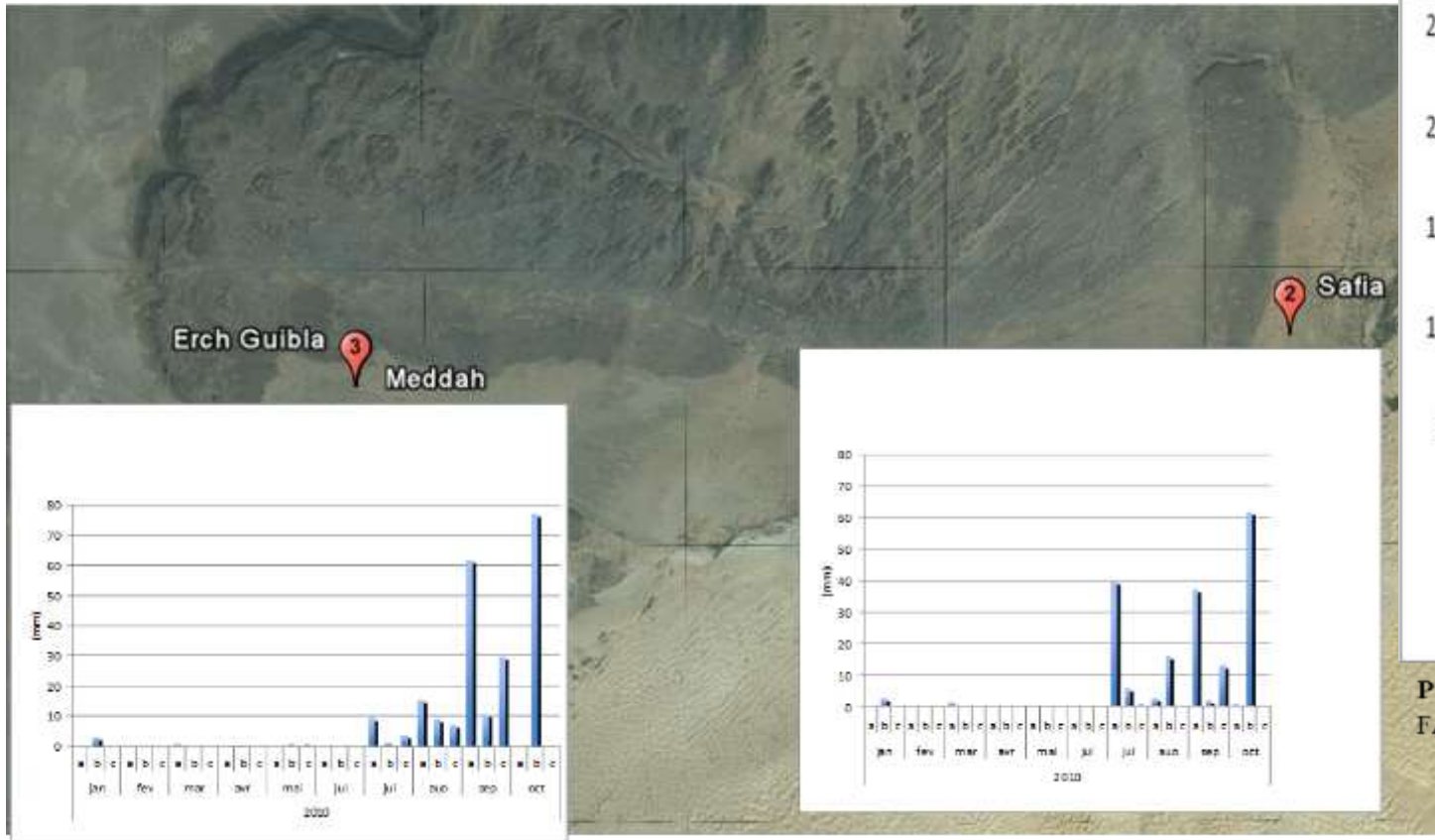
► **What is the role of environmental factors?**

**What is the role of the camel species?**

**What is the link between animal mobility and RVF epidemics?**

# DESCRIPTION OF EPIDEMICS OCCURED

## Epidémie/Epizootie de FVR dans le Nord du pays, Adrar, 2010



Précipitations totales (en mm) à Atar (région d'Adrar), de 1950 à Oct. 2010. Source: CLIMPAG / FAO ClimNet and meteorological service of the Ministry of Rural Development, Mauritania.

**Climatic factors: Effect of rainfall in the 2010 epidemic**

# DESCRIPTION OF OCCURED OUTBREAKS

## Epidemic / Epizootic of RVF in the North of the country, Adrar, 2010

... and favorable to mosquito populations

Emerging factors: A modified environment ...



The Adrar in 2010. It is exceptional to see this type of landscape in this desert area

# DESCRIPTION OF OCCURED OUTBREAKS

## **Epidemic / Epizootic of RVF in the North of the country, Adrar, 2010**

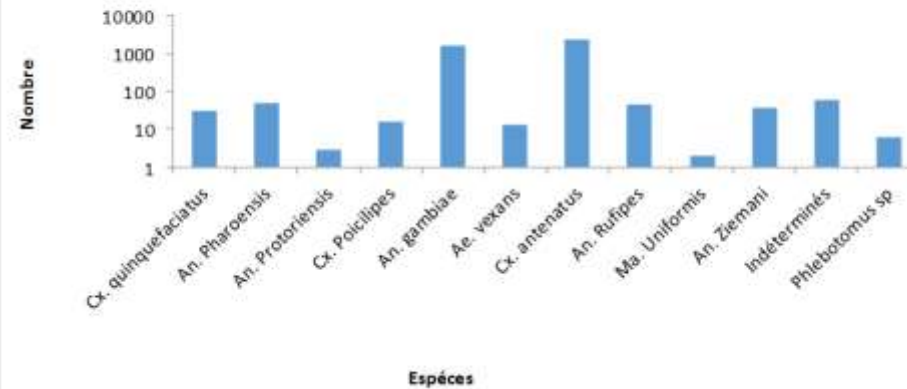
- ▶ **The optimal conditions for amplification of the RVF virus are combined:**
  - ▶ **Ponds filled with water**
  - ▶ **Abundant populations of mosquitoes**
  - ▶ **Sensitive animals**
  - ▶ **Abundant green pastures that attract more animals**
- 
- **Abortion waves in small ruminants and camels, haemorrhages**
  - **Human Cases**

# DESCRIPTION OF OCCURED OUTBREAKS

## Positive point: A multisectoral response



### Espèces de moustiques récoltés dans l'Adrar en 2010



Diversity of mosquitoes collected by the teams of the National Institute of Public Health Research (INRSP) and the Pasteur Institute of Dakar (IPD) from 28/11 to 10/12/2010

# RESULTATS ET COMMENTAIRES

## Epidémie/Epizootie de FVR dans le Nord du pays, Adrar, 2010

### Résultats d'analyses entomologiques de l'IPD

N° Terrain	Nombre	Espèce	Départements (Mough)	Commune	Localité	RT-PCR 2	Isolement
51	64	<i>Cx antenatus</i>	Aoujeft (Adrar)	El Medah	Savia	Positif	Négatif
68	50	<i>Cx antenatus</i>	Aoujeft	El Medah	Savia	Positif	Positif
70	50	<i>Cx antenatus</i>	Aoujeft	El Medah	Savia	Positif	Positif
71	50	<i>Cx antenatus</i>	Aoujeft	El Medah	Savia	Positif	Positif

**For the first time, in Mauritania, RVF virus has been isolated from *Cx antenatus***

## RESULTATS ET COMMENTAIRES

### Epidémie/Epizootie de FVR dans le Nord du pays, Adrar, 2010



Clinical signs observed in camels and goats

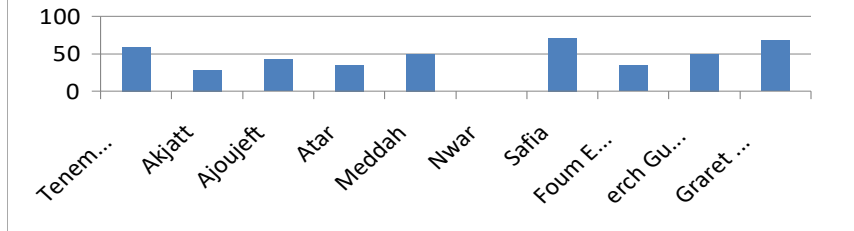
Several authors have shown seroprevalences in camels (Di Nardo et al., 2008 Western Sahara, El Harrak et al., 2011 in Morocco, Davies et al., 1985, Britch et al., 2013 and Abdallah et al., 2016). Kenya, Al-Afaleq et al., 2011 in Saudi Arabia), but the animals remain clinically healthy

**For the first time a confirmation diagnosis of RVF is related to clinical signs observed in camels**

# RESULTATS ET COMMENTAIRES

## Epidémie/Epizootie de FVR dans le Nord du pays, Adrar, 2010

Séroprévalence IgM en Adrar e 2010



Liste des prélèvements reçus au CIRAD envoyés par l'ISRA.

No CIRAD	N°ISRA	Origine	Espèce-Lieu	Date isolement	RT PCR sur serum	isolement (ECP+)
<a href="#">Lnerv/24010-16</a>	S 16	Sérum	Chèvre	6/10/2010	Négatif	Faiblement POSITIF (non spécifique)
<a href="#">Lnerv/25010-24</a>	S 24	Sérum	Dromadaire Site de Ajourjett- Localité Lensayédi	6/10/2010	POSITIF	POSITIF
<a href="#">Lnerv/25010-30</a>	30	Sérum	Dromadaire Site de Ajourjett- Localité Lensayédi	6/10/2010	POSITIF	POSITIF
<a href="#">Lnerv/26010-Yk7</a>	7	Sang	Dromadaire Site Atar- Localité Agiadi	8/10/2010	POSITIF	POSITIF
<a href="#">Lnerv/26010-Yk0</a>	SN	Sérum	Dromadaire Site Atar- Localité Agiadi	8/10/2010	POSITIF	POSITIF

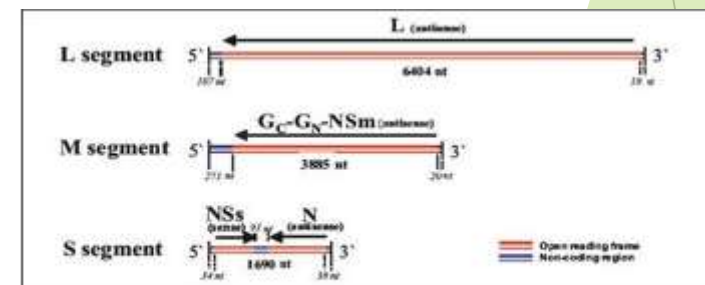
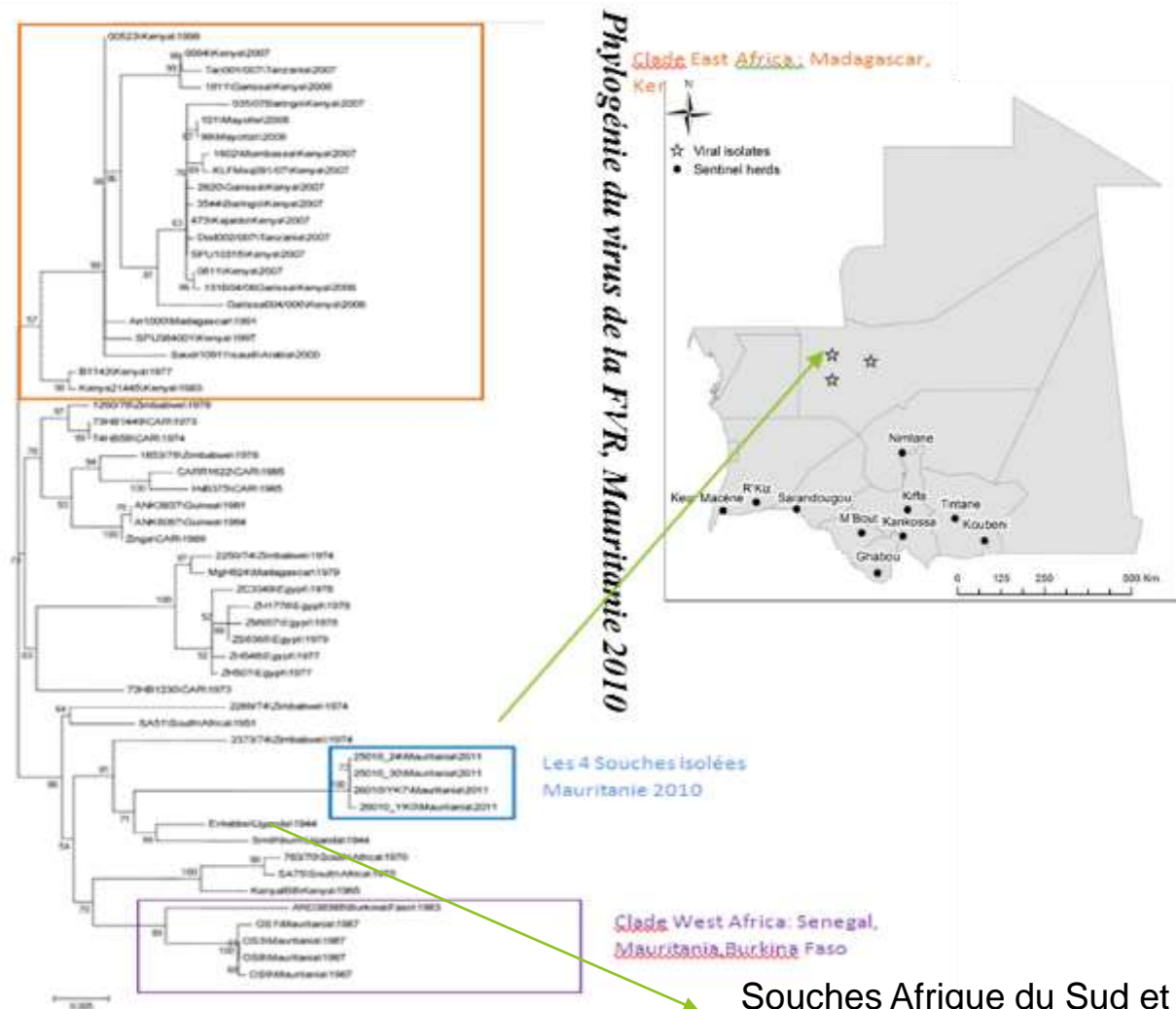


**Positive PCR and isolation on camelina sera, associated with clinical symptomatology**



# RESULTATS ET COMMENTAIRES

## Epidémie/Epizootie de FVR dans le Nord du pays, Adrar, 2010



Représentation du génome du virus de la FVR de la souche MP12 (Fleick & Bouloy, 2005)

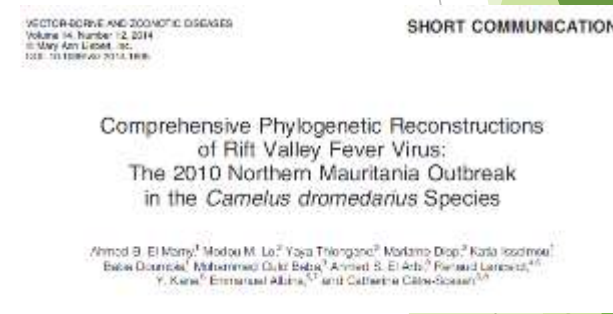
Souches Afrique du Sud et du Zimbabwe

# RESULTATS ET COMMENTAIRES

## Epidémie/Epizootie de FVR dans le Nord du pays, Adrar, 2010

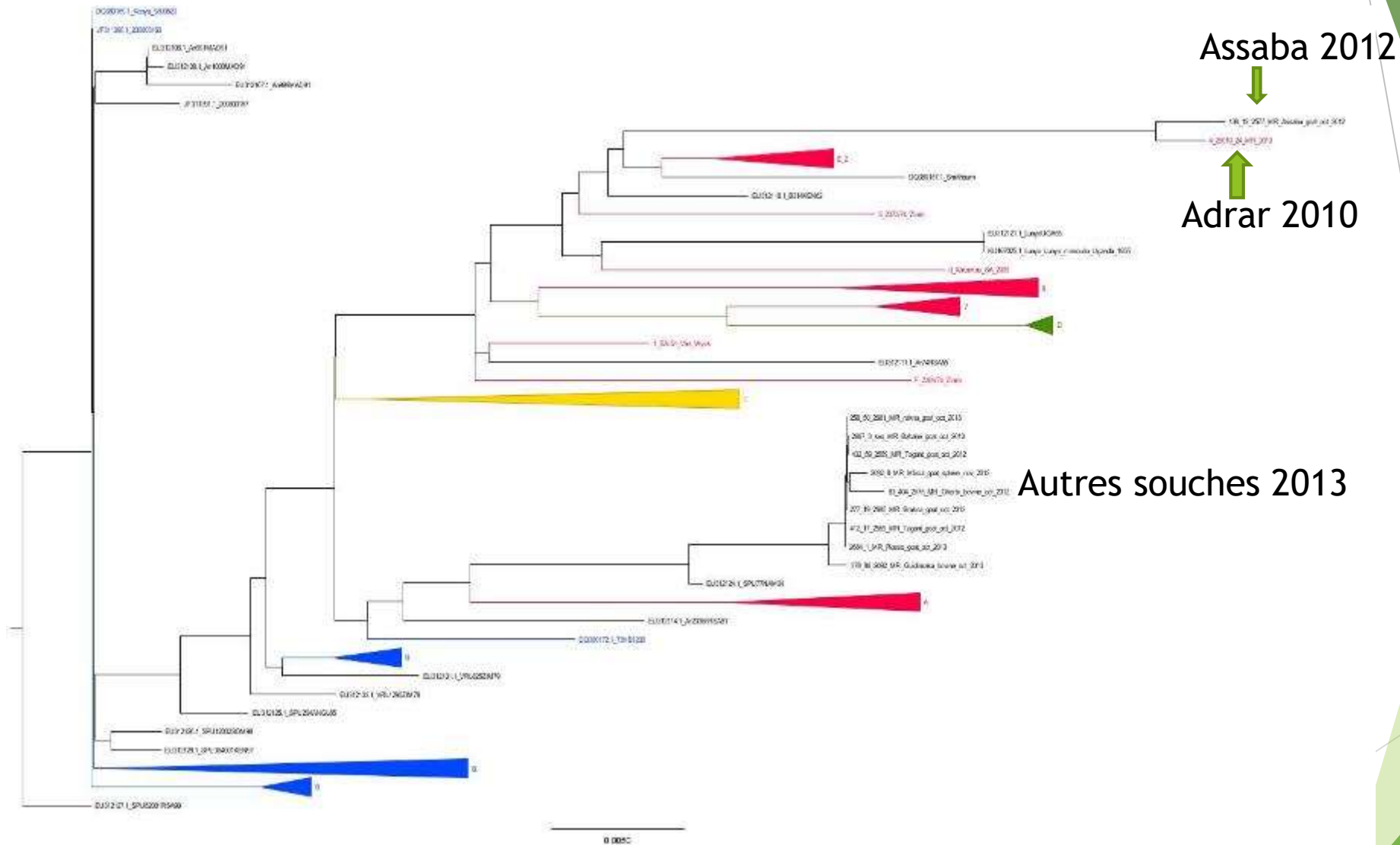
Ces travaux ont été valorisés par 3 articles

- **El Mamy A.B.**, Baba M.O., Barry Y. et al., 2011. Unexpected Rift Valley fever outbreak, northern Mauritania. *Emerg Infect Dis.* **17**: 1894–1896.
- **El Mamy A.B.**, Lo M.M., Thiongane Y. et al., 2014. Comprehensive phylogenetic reconstructions of Rift Valley fever virus: the 2010 northern Mauritania outbreak in the *Camelus dromedarius* species. *Vector Borne Zoonotic Diseases* **14**: 856–861.
- Arsevaska E., Lancelot R., **El Mamy A.B.** et al. Situation épidémiologique de la FVR en Afrique de l'Ouest et du Nord, *Bulletin épidémiologique, santé animale et alimentation* No 74, ANSES, Juin 2016,



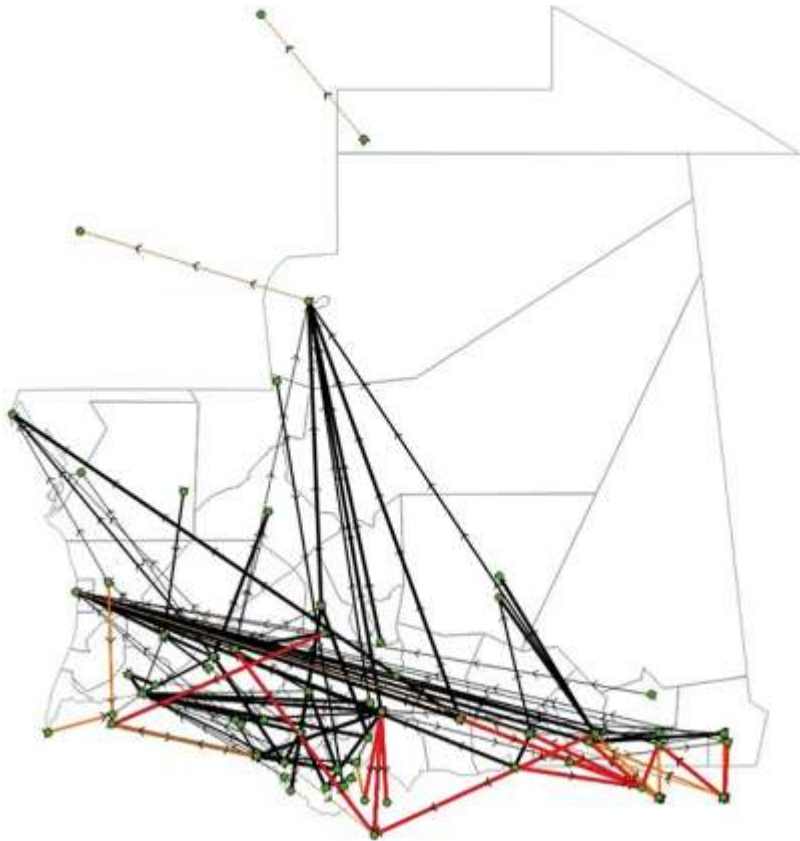
14/11/2019

# RESULTATS ET COMMENTAIRES

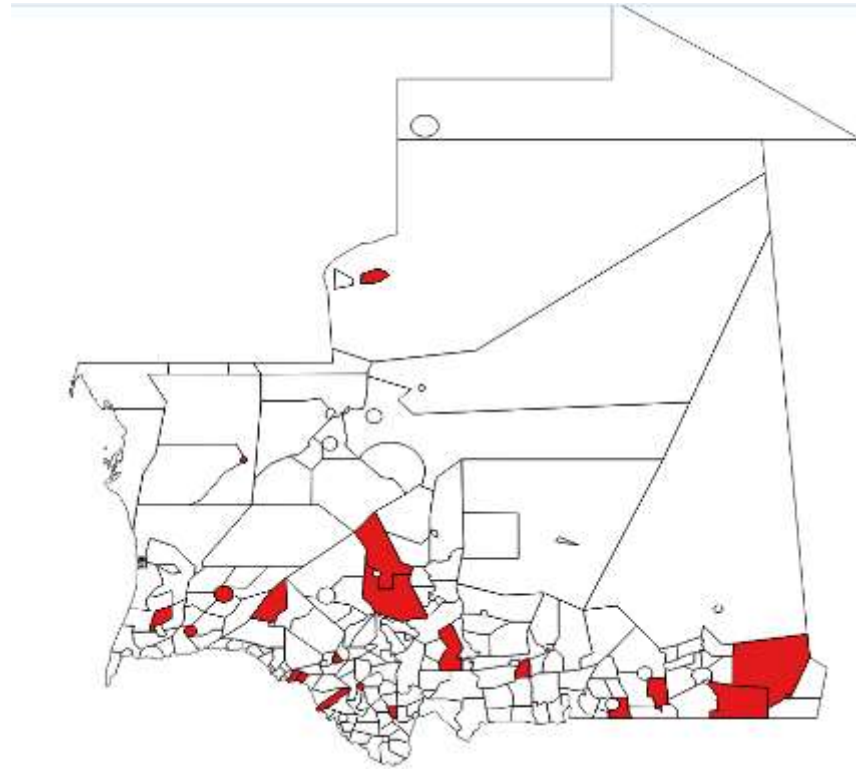


**Links between virus strains: of the ten strains isolated from the 2012/2013 epidemic, only one is close to strain isolated in 2010**

## What is the extent of animal mobility in Mauritania ?



**Flows generated by mobility survey data in 2014**



**The maps show the importance of these movements and therefore the possibilities of diffusion of a pathogen**

# Epidémie/Epizootie de FVR de 2012/2013 en lien avec la mobilité animale

The results of the 2012 epidemic were valued by the following article in the journal RASPA

**EL Mamy AB.** Kane Y., EL Arbi AS. et al., 2014b. L'épidémie de la Fièvre de la Vallée du Rift en 2012 en Mauritanie. *Revue Africaine de Santé et de Production Animales*. **12** : 5pp. EISMV, Dakar.

*Revue Africaine de Santé et de Productions Animales*  
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## Résumé

La fièvre de la Vallée du Rift (FVR) est une zoonose à caractère zoonotique due à un virus appartenant au genre Phlebovirus et transmise par des moustiques, en particulier des genres *Aedes* et *Culex*. Considérée initialement comme bénigne et localisée, la maladie a été dévastatrice et a largement touché les populations humaines en Égypte en 1977, puis en Afrique de l'Ouest en 1987. Elle a atteint la péninsule arabique en 2000. En Mauritanie, la FVR est jusqu'ici à l'origine de quatre épidémies en 1987, 1988, 2010 et 2012.

En septembre 2012, une épidémie de FVR a touché le pays faisant 19 décès sur 38 cas confirmés. Cette épidémie, la plus élanque dans l'histoire de la FVR en Mauritanie a touché les régions des deux Hodh de l'Assaba, du Tagant, du Brakna, du Gorgol et du Trarza. Les espèces animales les plus touchées ont été le bœuf et les petits ruminants.

Une enquête sérologique rétrospective a permis de collecter 1868 sérum associés à 221 cas d'avortements incluant 202 sérum détectés positifs en IgM. (RASPA 12 (3-4) : 159-175).

Mots-clés : Fièvre de la Vallée du Rift - Dromédaire - Zoonose - Mauritanie

## DISCUSSION

**RVF / Recurrent Households in Mauritania**  
**Different epidemics between 1987 and 2015 (1987 in Trarza, 1998 in Hodh EL Gharbi, 2003 circulation in the majority of sentinel sites, 2010 in Adrar and Inchiri, 2012 in wilayas of south and south-east)**

➡ **virus circulates in the majority of Wilayas**

➡ **risk factors related to outbreaks of these epidemics still unknown**

**Lack of data and analysis related to animal mobility**

**Unknown role of certain species in the spread of the disease,**

**Lack of valorisation of climatic and entomological data**

**Multisectoral coordination: track of better control of RVF epidemics**

**Factors and mechanisms involved in the maintenance of viral circulation leading to emergence (animal mobility, climatology)**

➡ **Dromedary and RVF: What status for this species**

➡ **Strategies to improve surveillance and reduce emergence risks in Mauritania and the sub-region (sentinel animals, entomological surveillance, mathematical models, targeted vaccination)**

# DISCUSSION



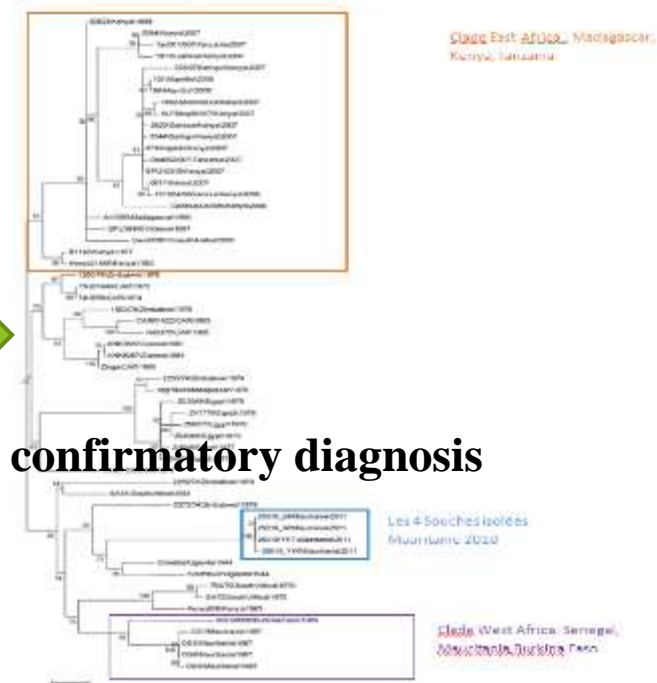
**In 2010, the first human victims died following the handling and consumption of the meat of a sacrificed sick camel (El Mamy et al., 2011)**



For the first time



**Clinical signs associated with a confirmatory diagnosis with viral isolation**



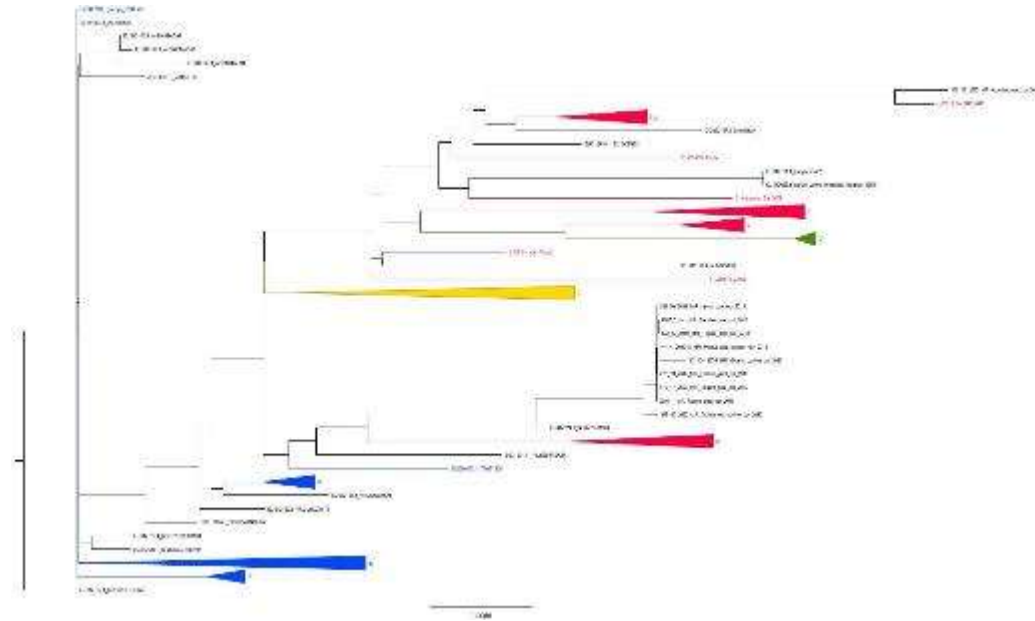
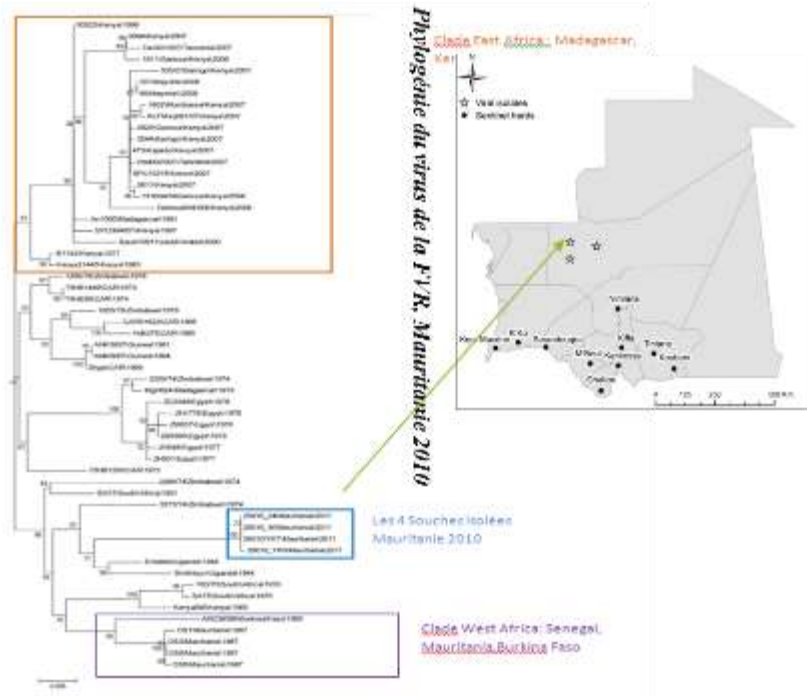
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REVIEW OF THE STATUS OF CAMEL REGARDING THE RVF

# DISCUSSION

## Mobilité animale



The diversity of strains isolated from one epidemic to another tend more towards the hypothesis of new introductions and thus to a role attributed to the movements of animals



# DISCUSSION

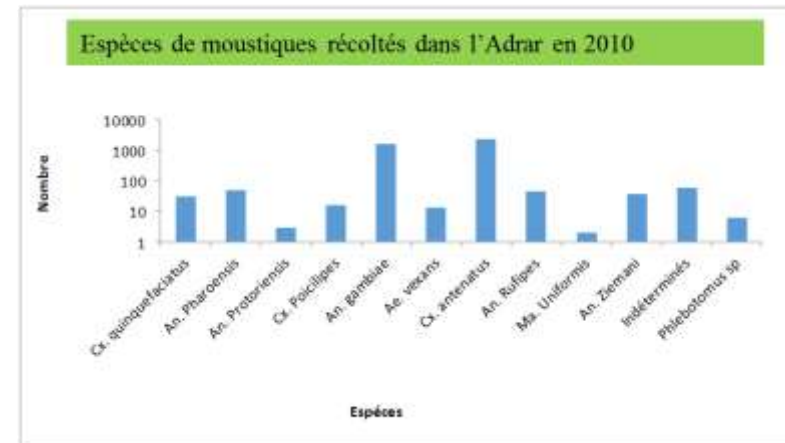
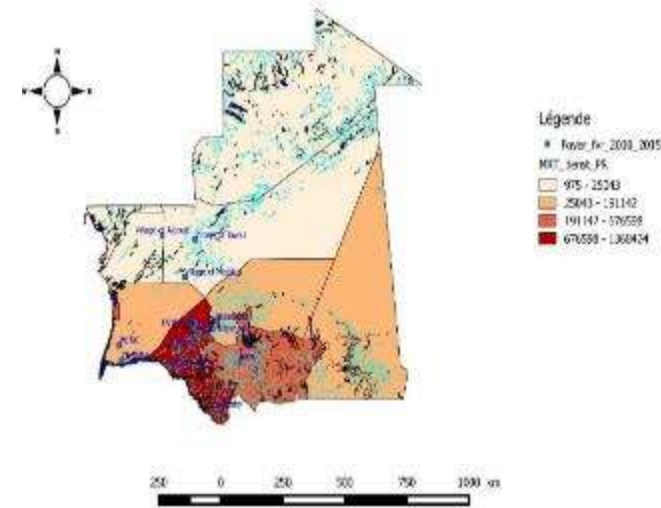
## Environmental factors

As with any vector-borne disease, the epidemiology of RVF is strongly related to the vector-host-environment triad.

Species involved: *Culex poicilipes*, *Culex antennatus* and *Aedes Vexans*

Surveys in Mauritania remained limited and late, suggesting that there may be other species involved

New vector: Isolation of FVR virus in *Culex antenatus*

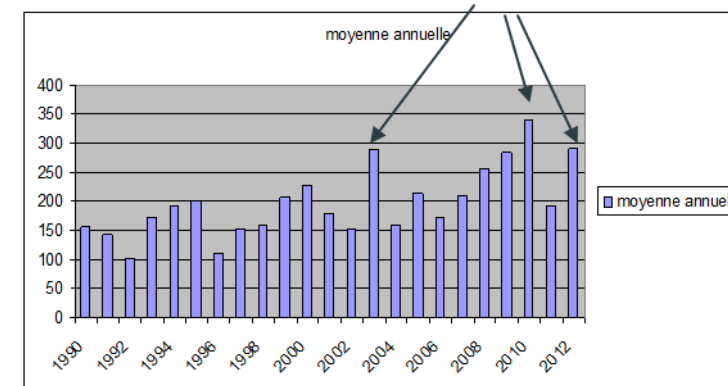
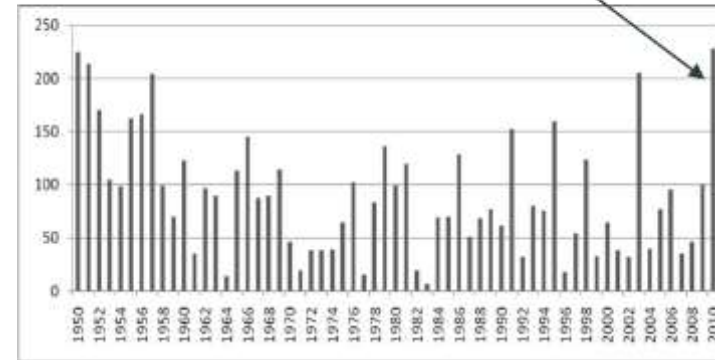


# DISCUSSION

## Integration of predictive models

- Models developed in East Africa (Anyamba et al., 2001, 2009 and 2010)
- Technological advances in satellite imagery have allowed the use of images with a finer spatial resolution.
- It is now possible to develop high-resolution models from SPOT13 satellite imagery (5 to 20 m pixel size), Ikonos (1 m) or QuickBird (60 cm) (Tran et al., 2005).

FVR 2010



Correlated RVF events with an increase Rainfall

## DISCUSSION

### Targetted vaccination

**Herd vaccination is considered one of the most effective control measures to limit the spread of epizootics such as RVF (Ikegami et al., 2015).**



**However, there is great difficulty in the availability of a satisfactory vaccine at all levels**



**Clone 13 candidate of hope**

# Perspectives of Human vaccination

- ▶ **Vaccinate the Breeders**
- ▶ **Slaughterhouses staff**
- ▶ **Veterinarian**
- ▶ **Members of the Rapid Response Teams**
- ▶ **The vaccine will be appreciated as it is cheaper and provides lasting immunity**



**THANKS FOR YOUR  
ATTENTION**

