Rift Valley Fever – Vector Reservoirs, Inter-epidemic maintenances of the virus

RVF Workshop – An integrated Approach to Controlling Rift Valley Fever (RVF) in Africa and the Middle East. Jan 27th - 29th Cairo, Egypt.

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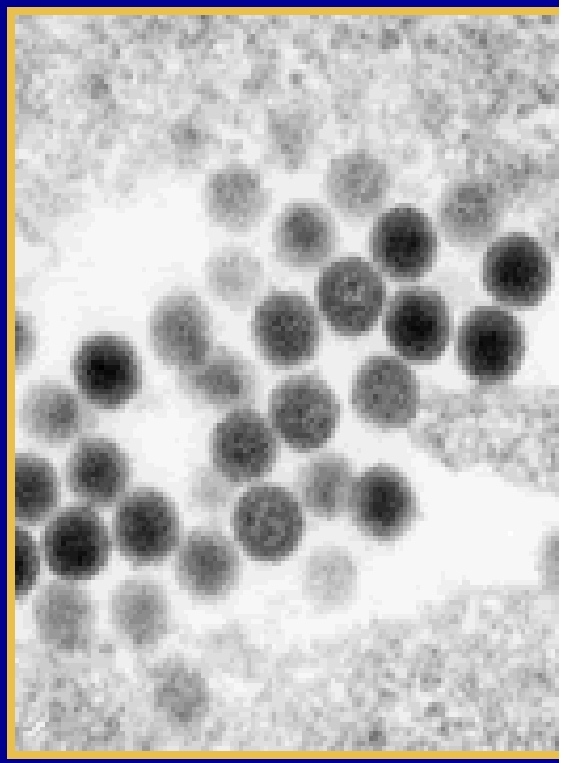
RVF, Introduction

- Mosquito-borne disease caused by a Phelebovirus, Bunyaviridae family
- Affects wide range of mammals - man and domestic livestock
- Epidemics prone disease, impacting human/animal health
- Devastating economic and social consequences.



Epidemic Transmission Cycle

"dambo" with TOI eggs

1. Abnormal sustained flooding

Amplifiers

2. Large mosquito populations

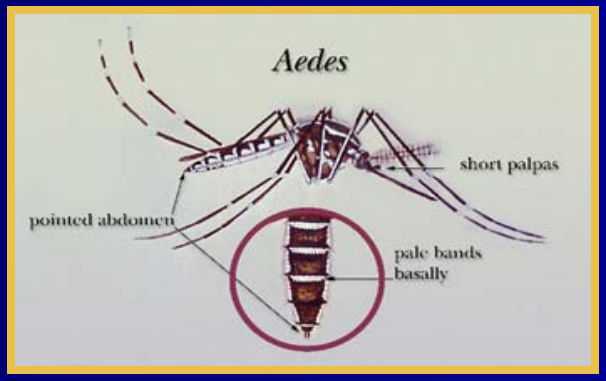
OTHER ROUTES: Contact with infected animal blood, tissue & milk

RVF – vector species diversity

Genera:

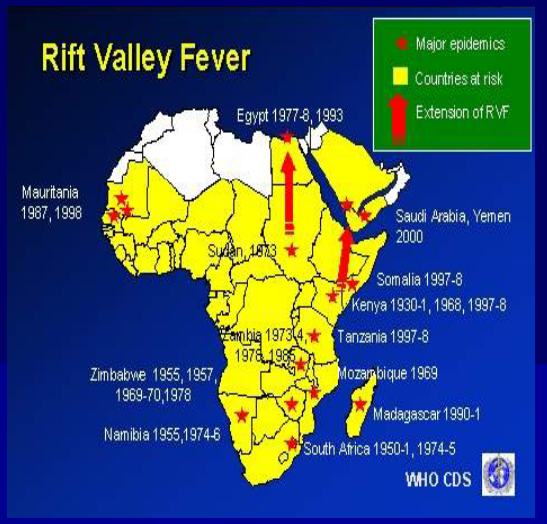
Aedes
Culex,,
mansonia
Amblyomma
variegatum
Culicoides.

- RVFV isolated from wide range of vector species
- Experimentally, a wide variety of species can transmit RVF
- There is world wide distribution of potential vector of RVFV
- e.g Recent studies in France and Tunisia (2008) found competent vectors



!! Hence likely spread of the virus.

VECTORS IN MAJOR OUTBREAKS



- Kenya 1950/1951 – Over 100,000 livestock dead
  - Vectors not documented
- Egypt – 1977 - First Major human involvement
  - vectors *Culex pipiens*.
- West Africa 1987 – Senegal & Mauritania
  - Irrigation project + heavy rains
  - Vectors – *Ae. vexans, Ae. Ochraceous, Culex poicilipes*
- East Africa/Kenya 1997/98 – Kenya, Tanzania, Somalia --.
  - Human and animal catastrophe
  - Entomologic investigations NOT documented
- Saudi/Yemen - 2000/2001
  - Vectors – *Ae. Vexans arabiensis, Cu. tritaeniorhynchus*
- East Africa/Kenya 2006/07 – Kenya, Tanzania, Somalia
  - Due to earlier detection (than 97/98)
  - Peak timing of extensive entomologic surveillance

INTEREPIDEMIC VECTORS

Previous inter-epidemic surveys
Implicated many species
as RVF vectors in Kenya

Aedes	***Culex***	***Mansonia***	***Anopheles***
mcintoshi	*zombaensis* *vansomereni*	*africanus*	*pharoensis*
circumluteolus	*theileri* *antennatus*		*christyi*
dentatus	*rubinotus*		*squamosus*

KENYA OUTBREAK 2006/07

- In October/Nov 2006, reports of heavy persistent rains in NEP- Kenya + severe flooding
- On 22nd Dec 2007, outbreak of RVF was declared by GK.
- On 14th Dec GEIS/WRP & KEMRI surveillance team moved to Garissa to asses impact of flooding
- Entomologic survey continued through the outbreak

OBJECTIVES OF RVF OUTBREAK RESPONSE

Laboratory testing of entomologic collections from Garissa, Kilifi, Baringo and Kirinyaga was done:

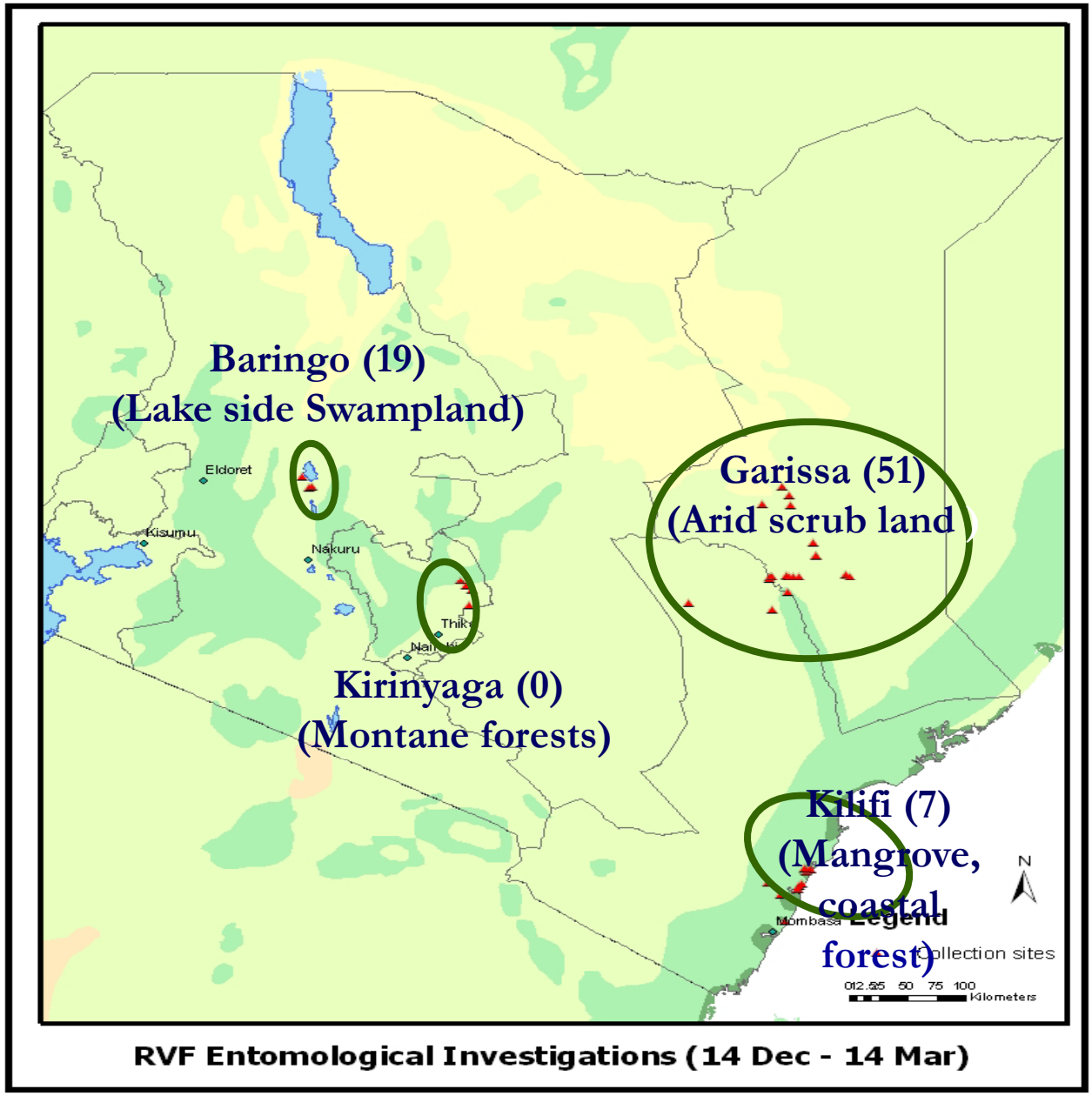
- To determine and document vector species involved in RVF outbreaks in the diverse ecologies.

Later

- To determine the competence of implicated vectors.

- Determine their host preference.

THE SAMPLES CAME FROM DIVERSE ECOLOGIES IN KENYA




Kilifi


Baringo


Garissa


Garissa

MOSQUITO COLLECTION

- Mosquitoes sampled using standard CO^2 baited light traps
- Set overnight around affected homes, villages, animal pens
- Trapped mosquitoes taken in the morning

MOSQUITO IDENTIFICATION

A team effort

TESTING SAMPLES FOR RVF VIRUS

Each species was grouped in pools (up to 25/pool).
Those with blood in gut were
set aside for subsequent host ID.

Pools homogenised in
medium with serum
and antibiotic supplements

RVFV RNA extracted
from
homogenates

RNA amplified by RT-PCR
(using RVF Specific primers)

Amplified
RVF confirmed
by sequencing PCR
product

TESTING - CAPACITY BUILDING

PROCEDURES WITH LAB SAFETY
BSL-3

Homogenisation of mosquito pools
and virus RNA extraction

PCR LABORATORY

Virus RNA amplification and detection

LAB TEST RESULTS

VIRUS DETECTION IN MOSQUITO SPECIES IN GARISSA

SPECIES	SITES	TESTED POOLS	% PROPORTION OF COLLECTION	RVF +VE POOLS
Ae. mcintoshi	Garissa	500	42.3	26
Ae. ochraceous	Garissa	450	30.0	23
An. squamosus	Garissa	88	5.9	2
TOTAL		1038	78.2%	51

VIRUS DETECTION IN MOSQUITO SPECEIS FROM KILIFI

Ae. pembaensis	Kilifi	65	23.2	1*
Cx. poicilipes	Kilifi	100	38.6	3
Cx. bitaeniorhynchus	Kilifi	22	8.0	3*
TOTAL		187	69.8	7

*First time detection of RVFV in species

VIRUS DETECTION IN MOSQUITO SPECEIS FROM BARINGO

Cx. quinquefasciatus	Baringo	75	4.0	1
Cx. univittatus	Baringo	8	0.3	1
Ma. uniformis	Baringo	804	66.8	15
Ma. africanus	Baringo	327	20.2	2
TOTAL		1214	**91.3**	19

INFECTION RATES GARISSA

SITE	RVF+ Sp	IR*	LIMITS	DENSITY
ElHumow	*Ae. ochraceous*	2.54	1.53 – 3.98	6,192
	Ae. mcintoshi	2.38	1.48 - 3.64	"
	An squamosus	1.11	0.20 – 3.64	"
Kurabul	*Ae. mcintoshi*	2.0	0.53 – 5.41	178
	Ae. ochraceous	1.97	0.52 – 5.33	"
Dertu/Shan	*Ae. ochraceous*	10.65	1.97 – 36.11	30
	Ae. mcintoshi	1.25	0.07 – 6.08	"
Desai	*Ae. ochraceous*	1.11	0.20 – 3.63	516
	Ae. mcintoshi	0.83	0.15 – 2.71	"

Pooled infection rates – Bias corrected maximum likelihood infection rate/1000

INFECTIONS RATES BARINGO AND KILIFI

SITES	RVF + Sp	IR	LIMITS	TOTAL
Logumgum (Baringo)	*Cx. Univittatus**	18.01	1.32 – 118.01	5,269
"	*Ma. uniformis*	0.89	0.52 – 1.44	"
"	*Cx. quinqefaciatus*	0.71	0.04 – 3.42	"
"	*Ma. africana*	0.33	0.06 – 1.08	"
Gongoni (Kilifi)	*Cx. bitaeniorhyn*	6.92	1.84 – 18.94	63
Tezo	*Cx. poicilipes*	1.28	0.34 – 3.46	"
Uyombo	*Ae. pembaensis*	0.65	0.04 – 3.17	"

IMPLICATION

Garissa/Baringo

- 77 RVFV isolates, 51 (66%) from Garissa – 19 (24.6%) from Baringo.
- Garissa and Baringo reported highest numbers of suspected human cases
- Both pastoralist zones. Livestock are kept in large herds aids virus amplification.
- Both - flood prone terrain, & high temperatures
- suited for high mosquito densities, rapid virus growth in vectors (short EIP) and hence higher transmission rates.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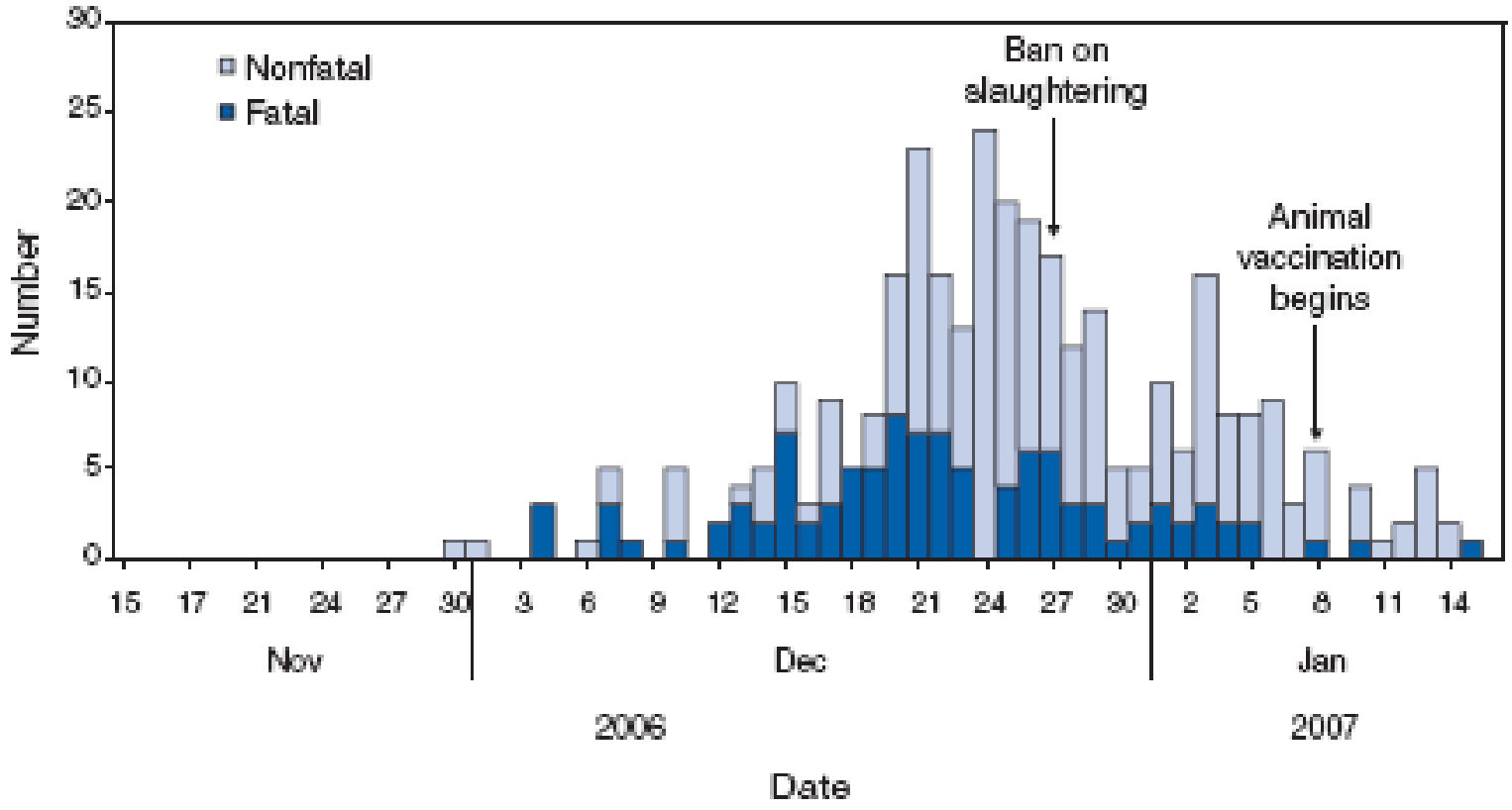
DISCUSSION

- This is one of the most comprehensive entomologic survey undertaken in a RVF outbreak in Kenya.
- Attributed to the pre-existing surveillance activities by GEIS&KEMRI
- Findings indicate that different mosquito species serve as epizootic and/or epidemic vectors of RVFV in different ecologic settings in Kenya
- Virus infected species included previously known and new ones
- This presents a complex epidemiologic pattern of RVFV in Kenya
- Any effort to come up with control strategies must put this into account

FIGURE 3. Number of reported Rift Valley fever cases (n = 330), by date of illness onset — Kenya November 2006–January 2007*



*As of January 25, 2007, for cases with known date of onset.

The average number of days between key events

19 Oct — 30 Oct — 17 Nov — 30 Nov — 11 Dec — 14 Jan

WHO declared human index case

GEIS early warning out — EMPRES warning to gov'ts

How effective disease prevention can be achieved? - Stop the transmission!

1. Advanced Larviciding will:
   - avoid high vector densities
   - reduce vector infection rates
   - reduce virus transmission & amplification
   - reduce animal exposure <<< human exposure

3. Adulticides – During outbreak to reduce transmission – Too late

4. Livestock -insecticide treatment (pour on)?
   -movement of livestock from vector swarms

SUGGESTIONS

- Vector surveillance necessary in outbreak hotspots/regions during IEP:

  - to facilitate early detection/prevention

  - Identify IEP maintenance mechanism

  - Localise emergence zones (vectors/reservoirs)

- Analysis of blood in fed specimens

  - Extent virus transmission to human by mosquitoes,

  - Identification of other possible reservoirs, the range of other hosts involved.

Acknowledgements

- KEMRI
- USAMRU Kenya - GEIS
- CDC – Kenya
- CDC - Fort Collins
- NAMRU 3
- USAMRIID
- NASA, Godard Earth Science
- USAID
- Kenya's MOPH&S and MOHS + their staff, Garissa, Kilifi, Baringo AND Kirinyaga

AND TO THE PEOPLE

THANK YOU