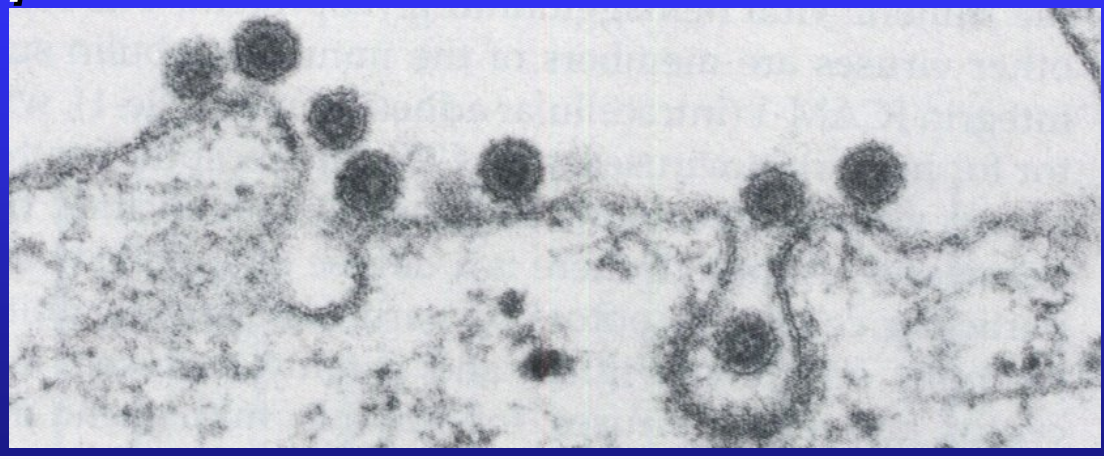
Chikungunya Virus – Where to next?

Ann M. Powers, Ph.D.

Division of Vector-Borne Infectious Diseases
Centers for Disease Control and Prevention



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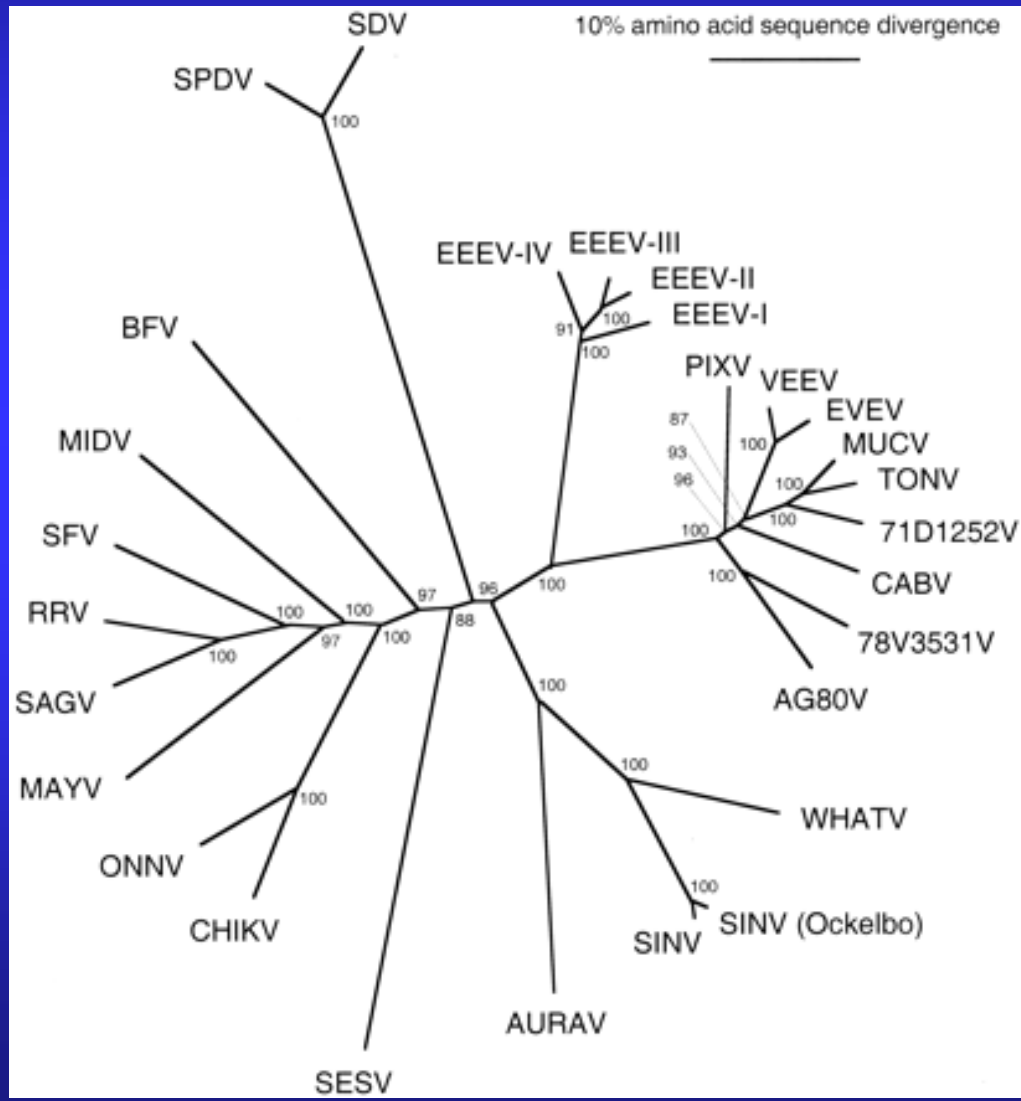
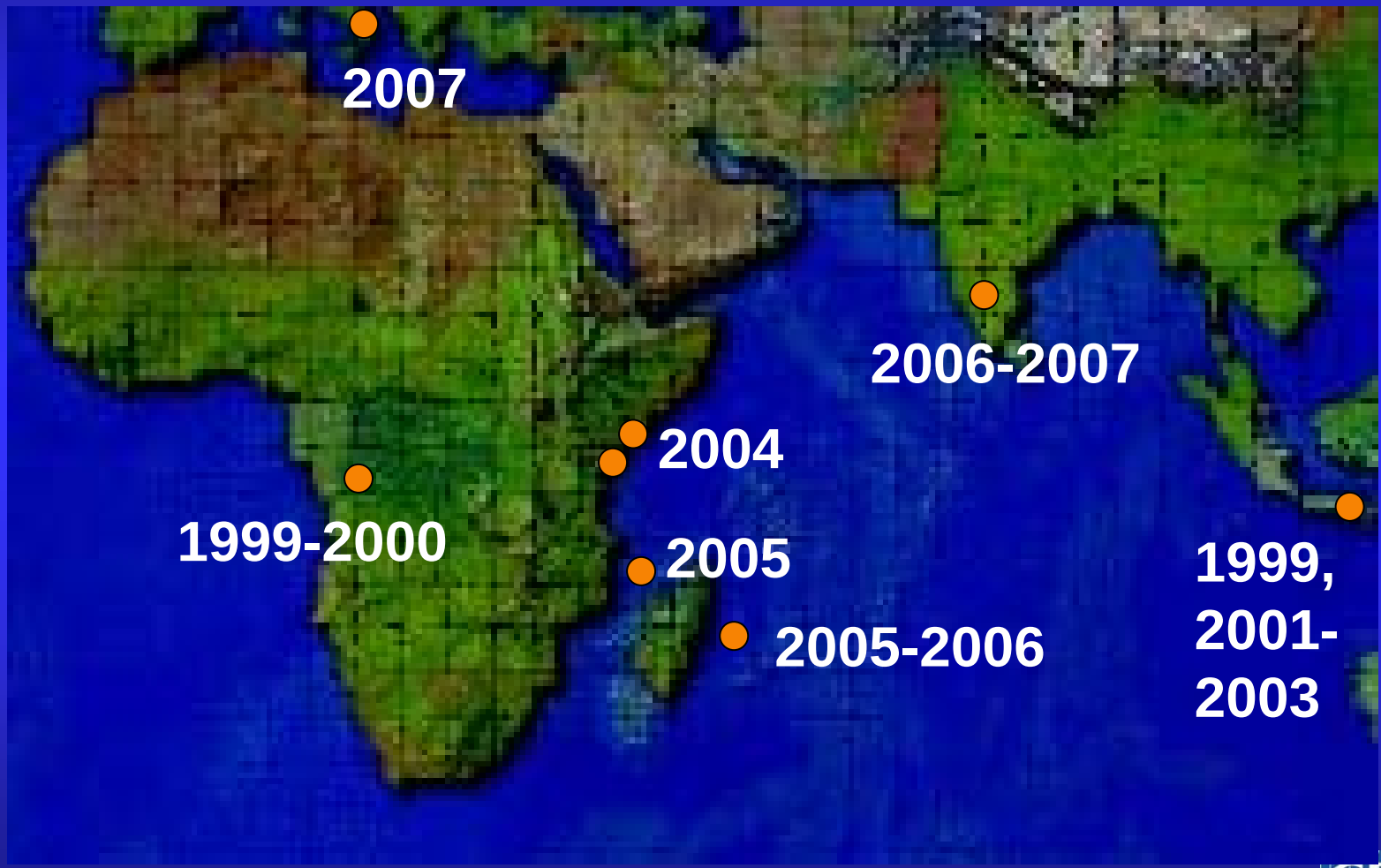
Alphaviruses - overview

- *Togaviridae; Alphavirus; 32 spp.*
- Vector-borne: primarily culicine mosquitoes
- Zoonotic
- Global distribution
- Diverse clinical presentation



Recent Outbreaks of CHIKV



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Re-emergence of CHIKV: 2004-2007

Timeline

First cases identified in East Africa

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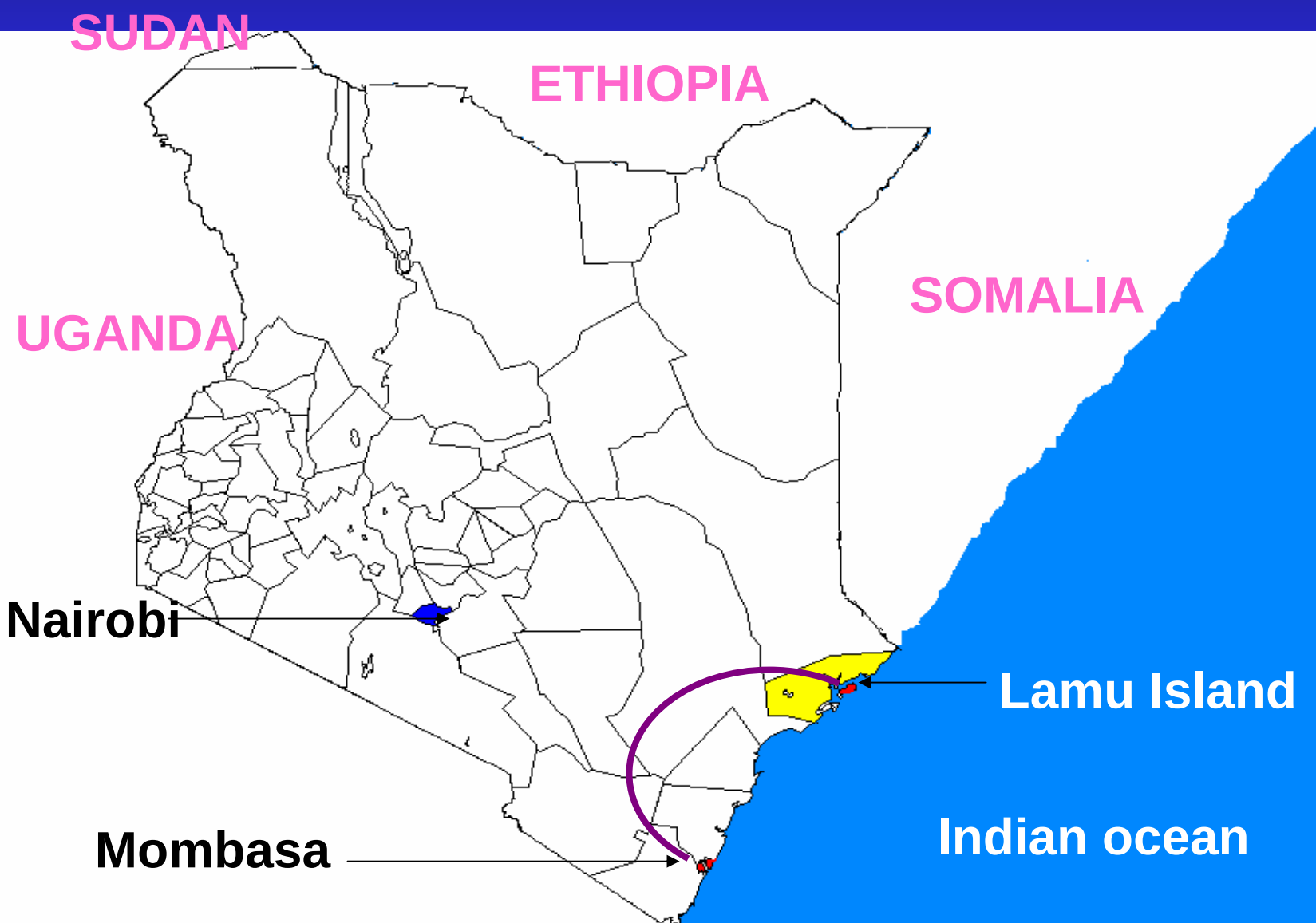
Kenya


SUDAN
ETHIOPIA
SOMALIA
UGANDA
Nairobi
Lamu Island
Mombasa
Indian ocean

Lamu Island Outbreak

- **July 2004, unusual increase of “malaria” cases**
- **Severity of joint pains unusual**
- **91% blood smears negative for Malaria**
- **Out of 10 sera, IgM Ab to CHIK detected in 3 sera**

Clinical presentation (N=56)

Symptom	Cases	%
Joint pains	54	96
Fever	51	91
Muscle aches	45	80
Headache	38	68
Retroorbital pains	31	55
Back pains	27	48
Anorexia	22	39
Rash	20	36

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CHIKV-associated rheumatism

polyarthritis and multiple tenosynovitis of wrists and fingers

hypertrophic tenosynovitis of one ankle
(Dr. F Simon, Laveran Military Hospital, Marseille, France)

swelling observed in the right knee of a CHIKV infected patient
(Dr Adil Fakim, Mauritius)

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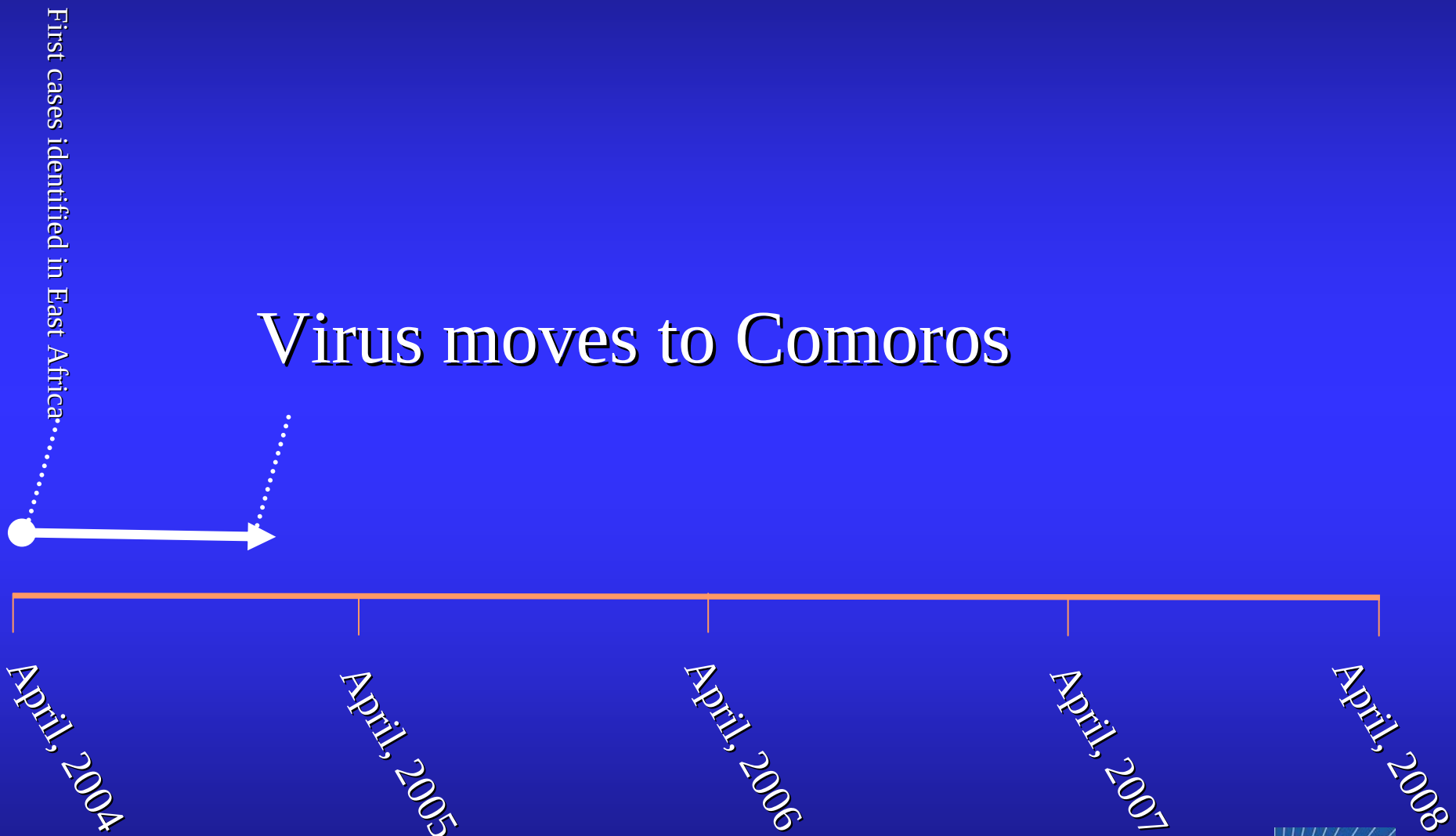
Magnitude of Outbreak

- The attack rate was 75%.
- 13,500 persons (95% CI 12,458-14328) infected. (Lamu population=18,000)
- 86% of cases hospitalized/ stayed home in bed for a mean of 7 days (range 1-90).

Timeline



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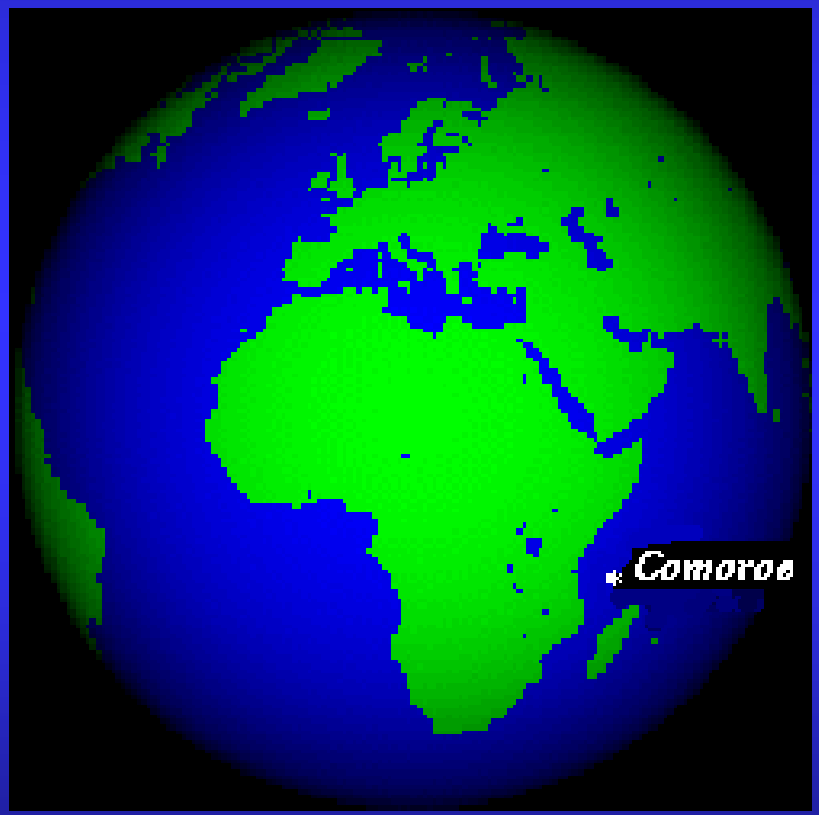
Comoros Island Outbreak



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Comoros Island Outbreak

- Suspected Dengue outbreak reported in February 2005.

- 25 Sera analyzed
  - All negative for Dengue
  - 9 positive for IgM CHIK Antibodies
  - 6 positive for CHIK by PCR

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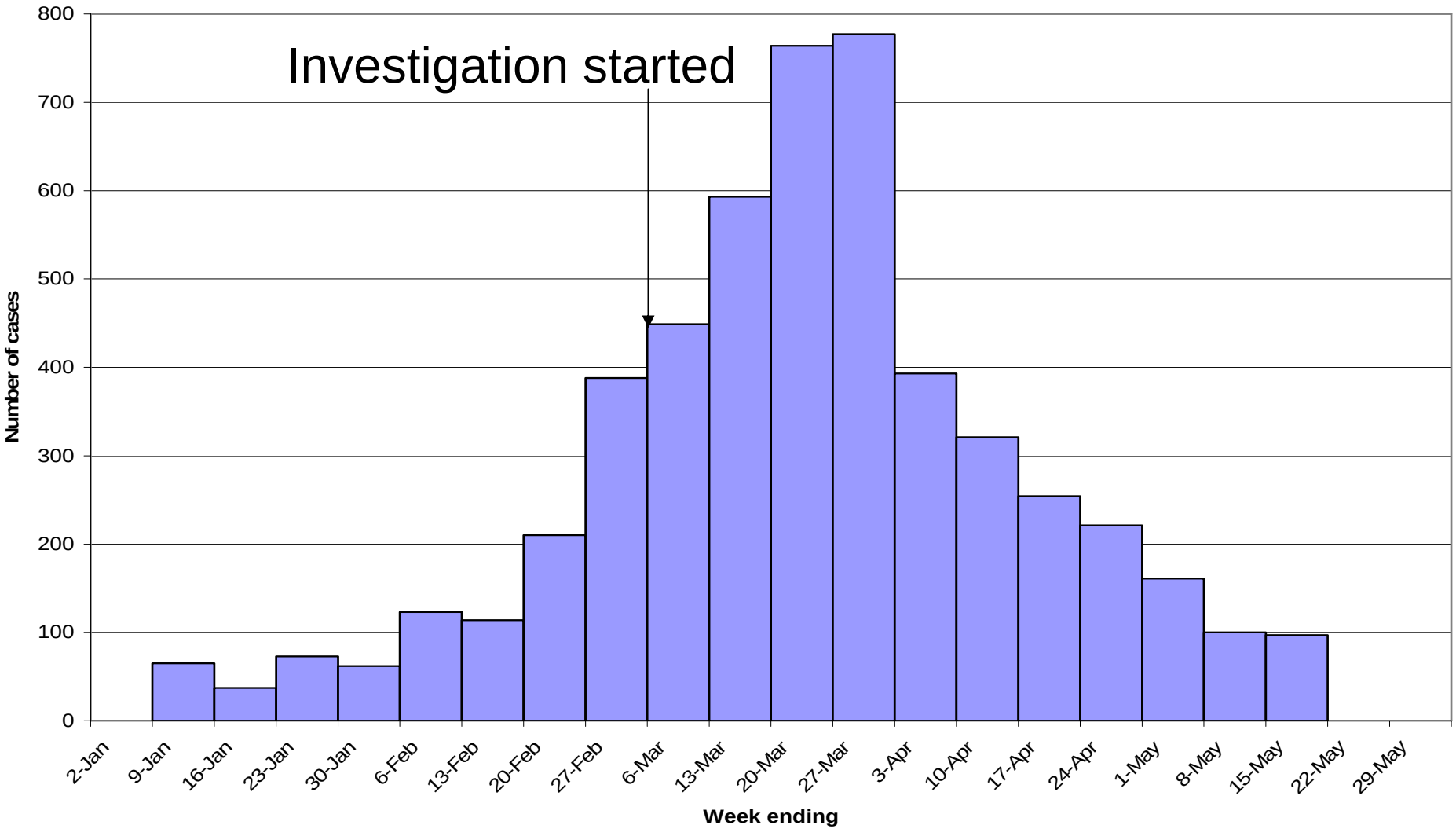
Epidemic curve



Magnitude of Outbreak

- Attack rate of infection was 63%
- 214,830 persons (95% CI 196,757-233,244 persons) infected on Island.
- 79% of cases hospitalized/ stayed at home in bed, mean = 6 days (range 1-30 days)
- 52% missed work or school for a mean of 7 days (range of 1-40 days)

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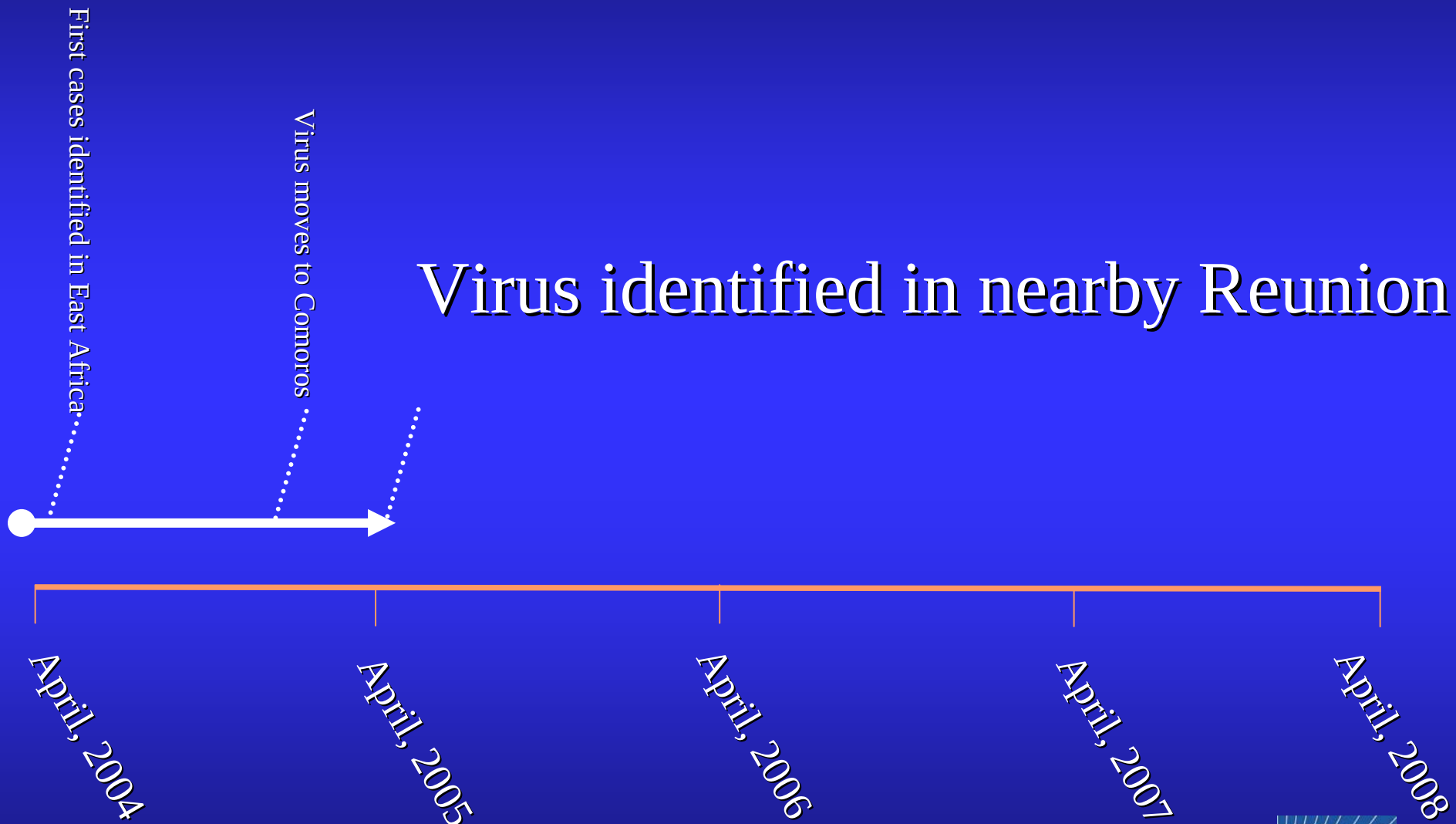
Species	Method	Sex	Number	pools	+ Pools	MIR
A.aegypti	Asp	Male	60	8	0	-
A. aegypti	Asp	Female	65	11	2	30.8
A. aegypti	HLC	Male	392	34	0	-
A. aegypti	HLC	Female	944	81	2 (1*)	2.1
A. simpsoni	HLC	Female	65	6	0	-
A. bromeli	HLC	Female	10	1	0	-
A. vittatus	Asp	Female	1	1	0	-
A. simpsoni	HLC	Female	41	3	0	-
Aedes. sp	Asp	Female	42	4	2	47.6
Culex	HLC	Female	74	5	0	-
Culex	Asp	Female	354	16	1	2.8
Culex	Asp/ **HLC**	Males	189	9	0	-

Container type	No with water	No. with *Ae. aegypti*	Container Index
Cistern tanks	81	23	28.89
Jars, bowls, Basin	79	41	51.59
Pits and septic tanks	43	0	0
Buckets, pots	111	32	28.8
Tyres	17	10	58.82
Cans & tins	44	15	34.09
Bottles	24	1	3.57

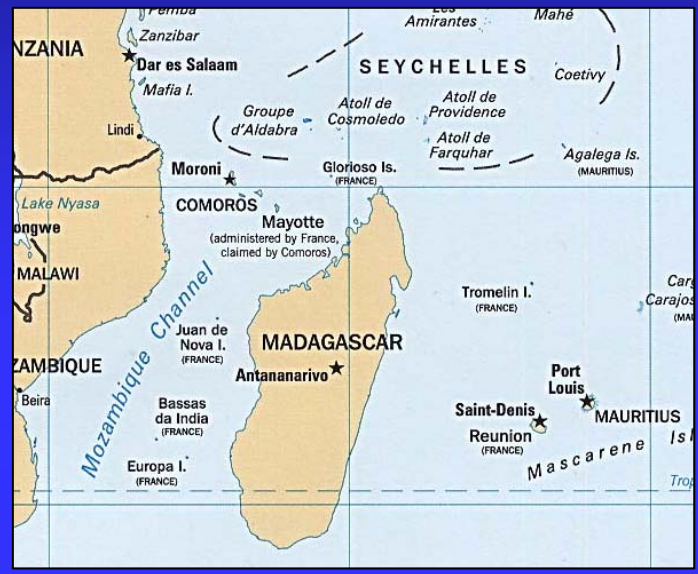
Overall larval indices

- Overall container index = 31.1 (% of containers with *Ae. aegypti* larvae).
- House index = 68 (% houses with *Aedes larvae*)
- Breteau index 126 (Number of positive containers per 100 houses).

Timeline


First cases identified in East Africa
Virus moves to Comoros
Virus identified in nearby Reunion
April, 2004
April, 2005
April, 2006
April, 2007
April, 2008

La Reunion Outbreak



- First cases: March 2005
- Major increase in cases during summer rainy season (mid-December – April, 2006)
- Total number of cases estimated at 244,000

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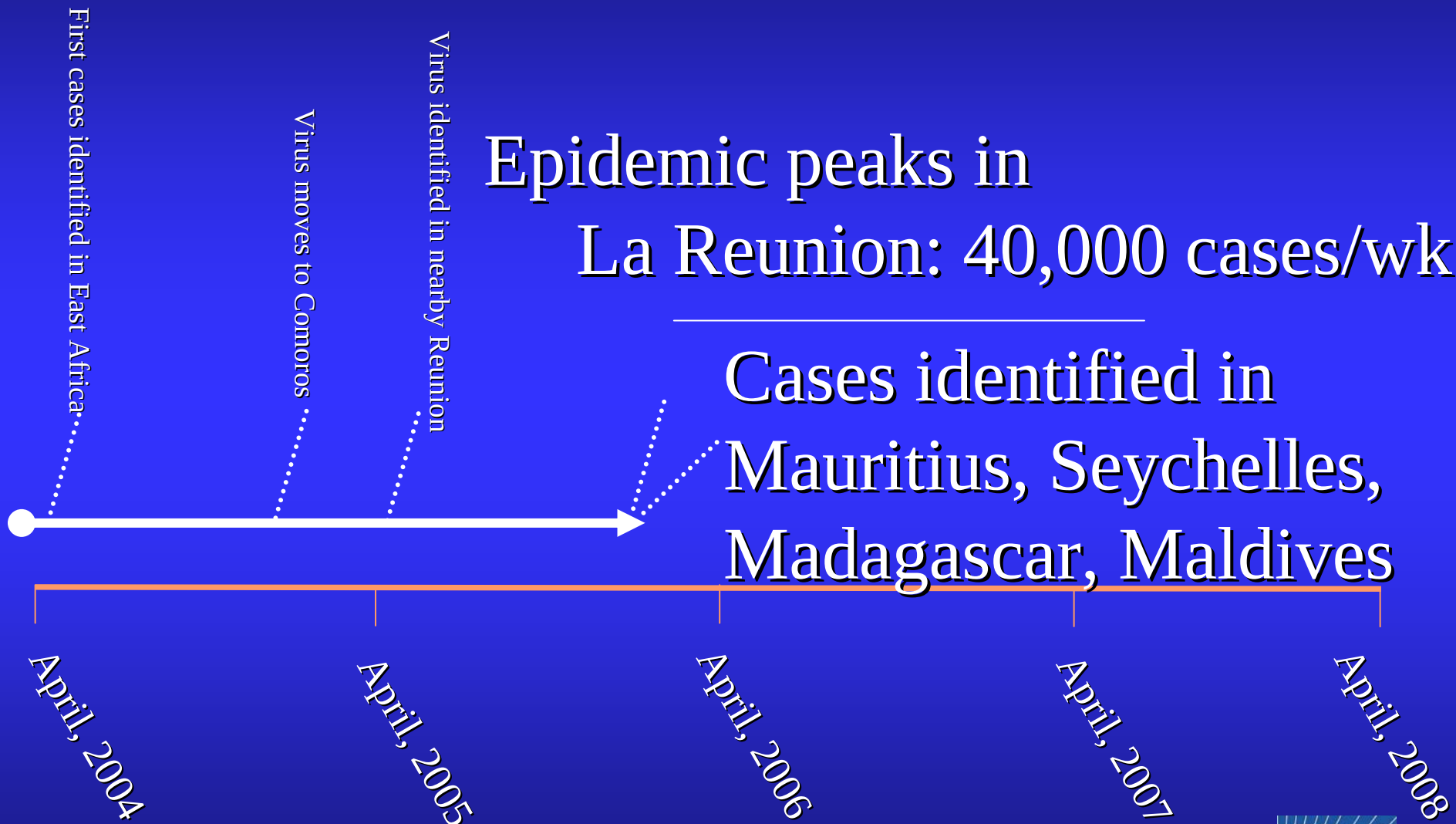
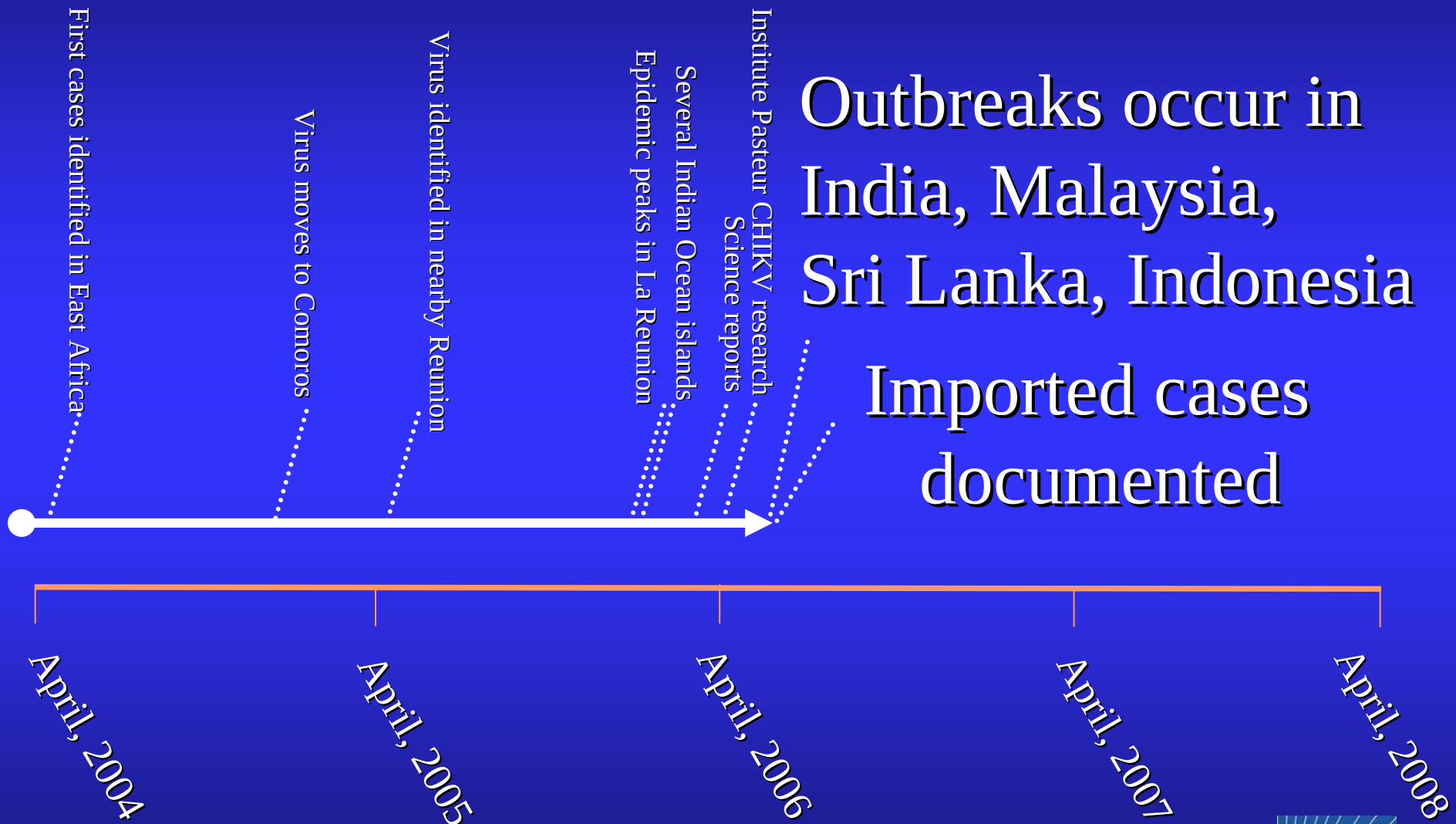
Timeline


First cases identified in East Africa
Virus moves to Comoros
Virus identified in nearby Reunion
Epidemic peaks in
La Reunion: 40,000 cases/wk
Cases identified in
Mauritius, Seychelles,
Madagascar, Maldives
April, 2004
April, 2005
April, 2006
April, 2007
April, 2008

Timeline



Outbreaks occur in India, Malaysia, Sri Lanka, Indonesia

Imported cases documented

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Imported Cases of CHIKV

- Canada
- Hong Kong
- UK
- Belgium
- Czech Republic
- Germany
- Norway
- Switzerland
- Australia
- France
- **Italy**
- Corsica
- Sri Lanka
- Singapore
- USA
- Spain
- Japan
- Taiwan

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CHIKV in Italy

Timeline

April, 2008

Outbreak resurges in India
A → V: albopictus

April, 2007

Outbreak explodes in India

Imported cases documented
Outbreaks occur in India,
Malaysia, Sri Lanka, Indonesia
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April, 2006

Several Indian Ocean islands
Epidemic peaks in La Reunion

Virus identified in nearby Reunion

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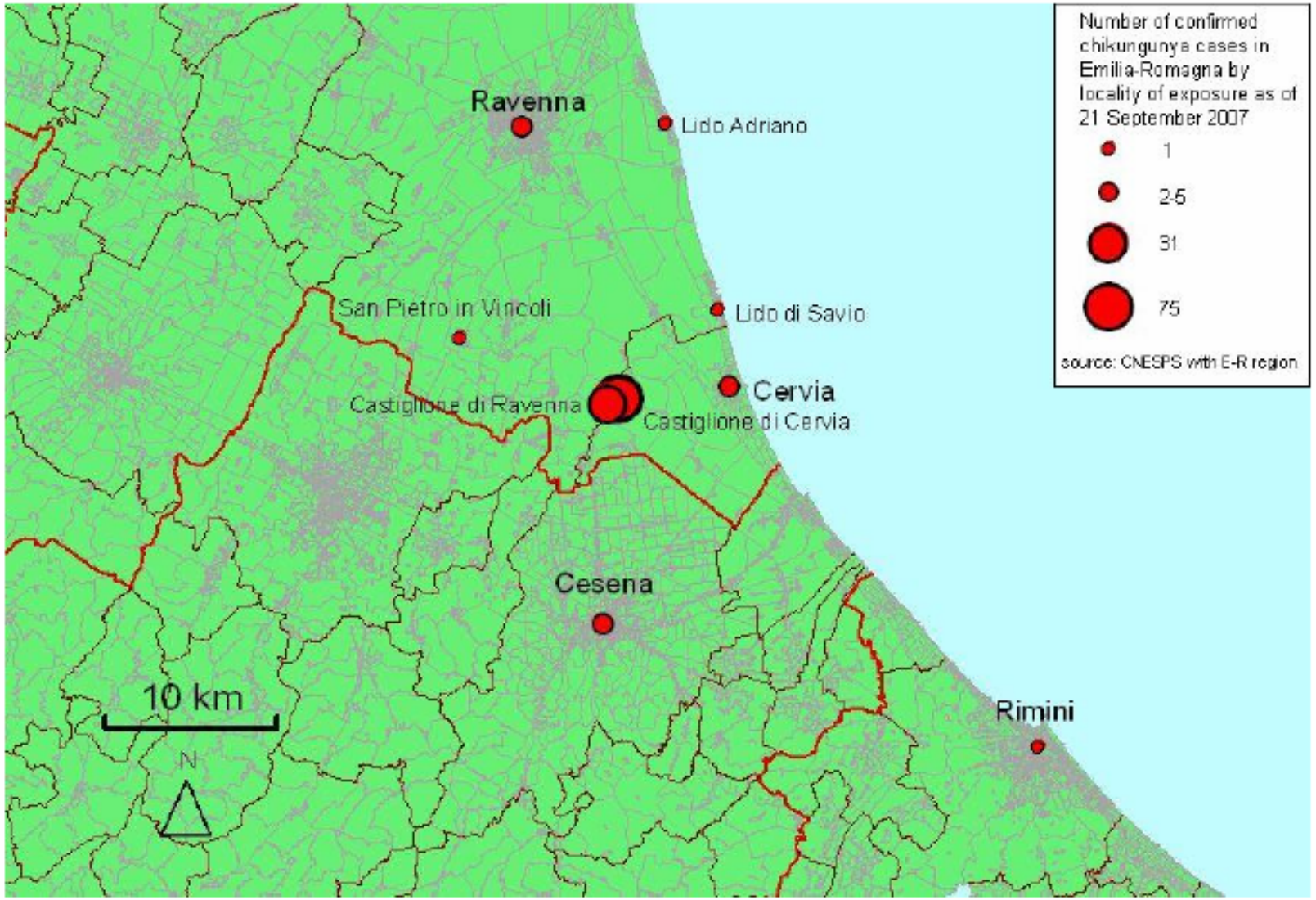
Virus moves to Comoros

First cases identified in East Africa

April, 2004

Confirmed cases of CHIKV in Italy



Chikungunya outbreak in Italy: Description of the outbreak

- Epidemiological situation
  - 4 July – 15 October
  - 245 suspected cases (200 confirmed)
  - Index case returning from India, symptomatic on 23 June
- Geographical spread
  - Most cases from Castiglione di Ravenna & Castiglione di Cervia
  - Secondary transmission established in neighbouring cities of Ravenna, Rimini, Cervia and Cesena

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Italian Outbreaks

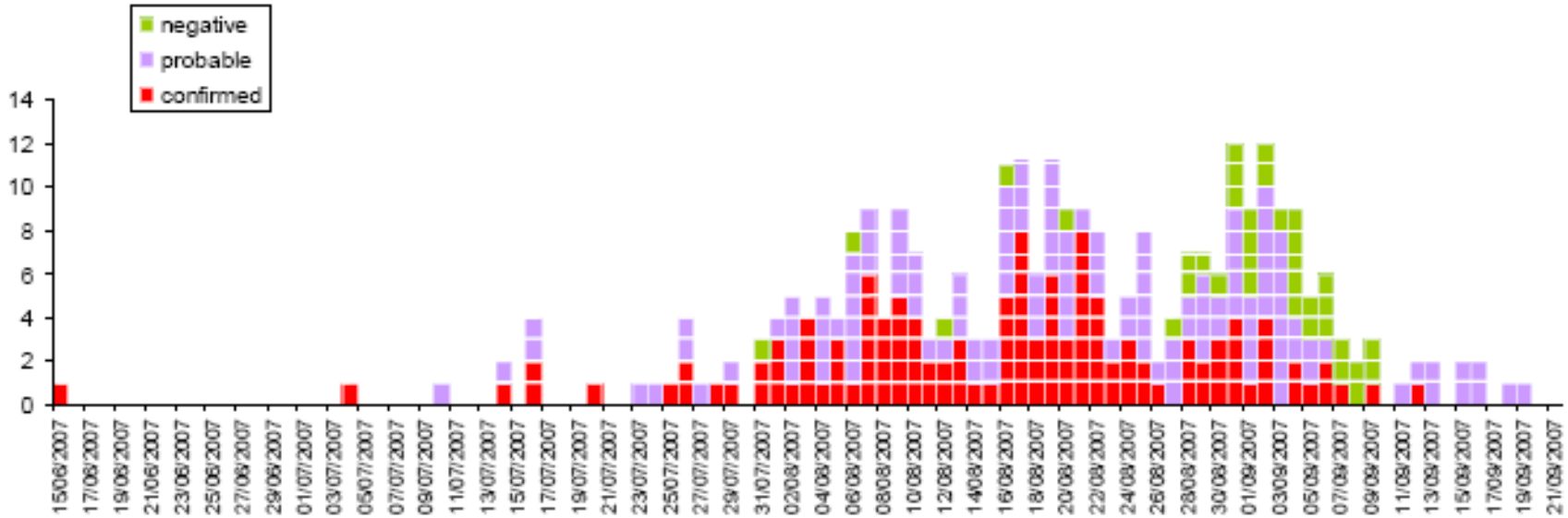

Figure 1. Distribution of suspected chikungunya fever cases by date of onset of symptoms, region of Emilia-Romagna, 15 June - 21 September 2007 (n = 292)

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Factors Affecting Emergence/Outbreaks

- Environmental/ecological conditions
- Abundance of mosquito egg laying habitats
- Completely naïve pop
- Alternate vector(s), new ecological niches involved
- Viral genetics / mutations

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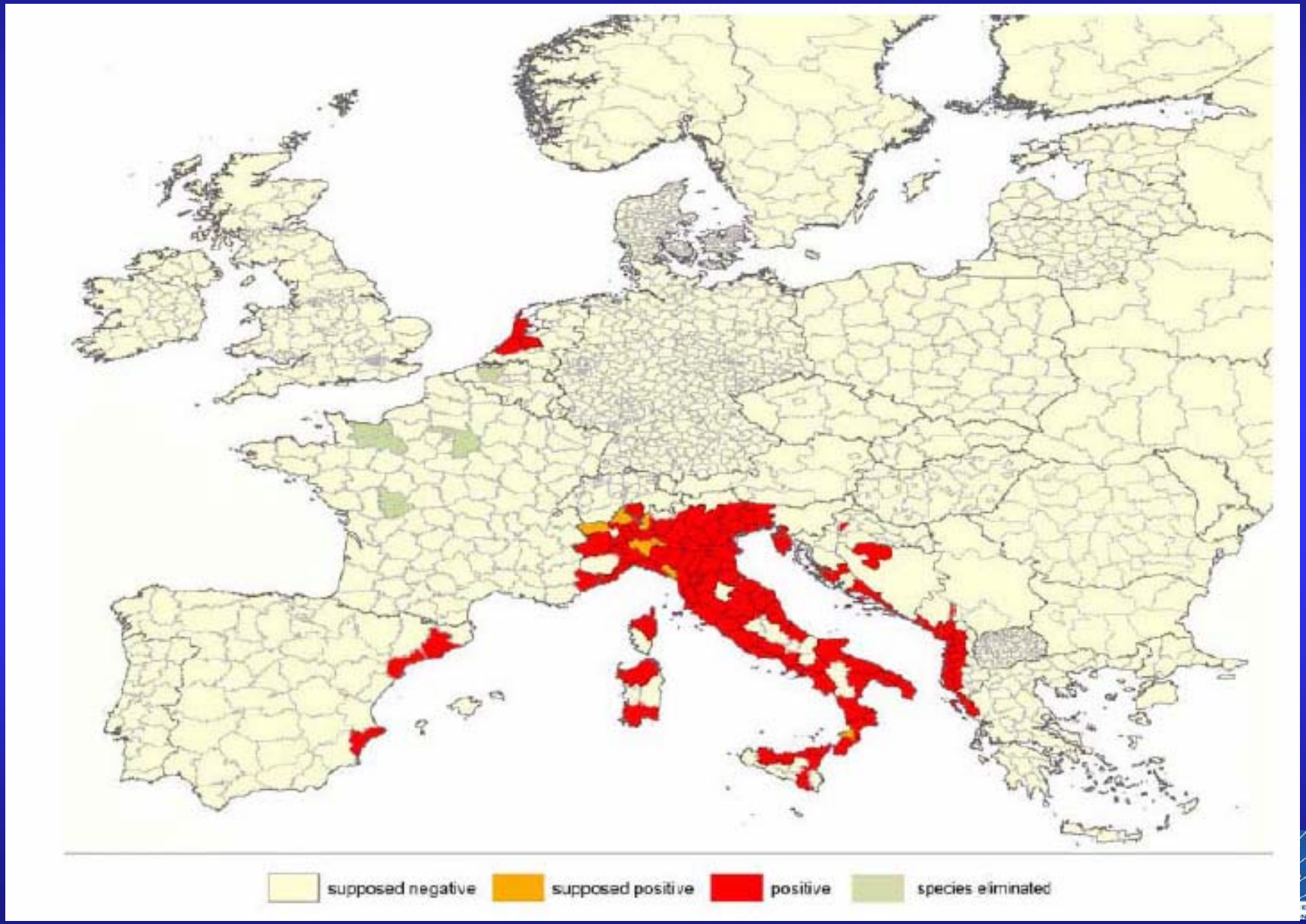
Distribution of Aedes albopictus in Europe



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Timeline

E1 mutation shows enhanced transmission in albopictus

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Imported cases documented
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Several Indian Ocean islands
Epidemic peaks in La Reunion

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April, 2004

Aedes albopictus as a vector of CHIKV

OPEN ACCESS Freely available online

PLoS one

Two Chikungunya Isolates from the Outbreak of La Reunion (Indian Ocean) Exhibit Different Patterns of Infection in the Mosquito, *Aedes albopictus*

Marie Vazeille[1], Sara Moutailler[2], Daniel Coudrier[2], Claudine Rousseaux[3], Huot Khun[4], Michel Huerre[4], Julien Thiria[5], Jean-Sébastien Dehecq[5], Didier Fontenille[6], Isabelle Schuffenecker[7], Philippe Despres[8], Anna-Bella Failloux[2]*

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PLoS PATHOGENS

A Single Mutation in Chikungunya Virus Affects Vector Specificity and Epidemic Potential

Konstantin A. Tsetsarkin, Dana L. Vanlandingham, Charles E. McGee, Stephen Higgs*

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Timeline

???

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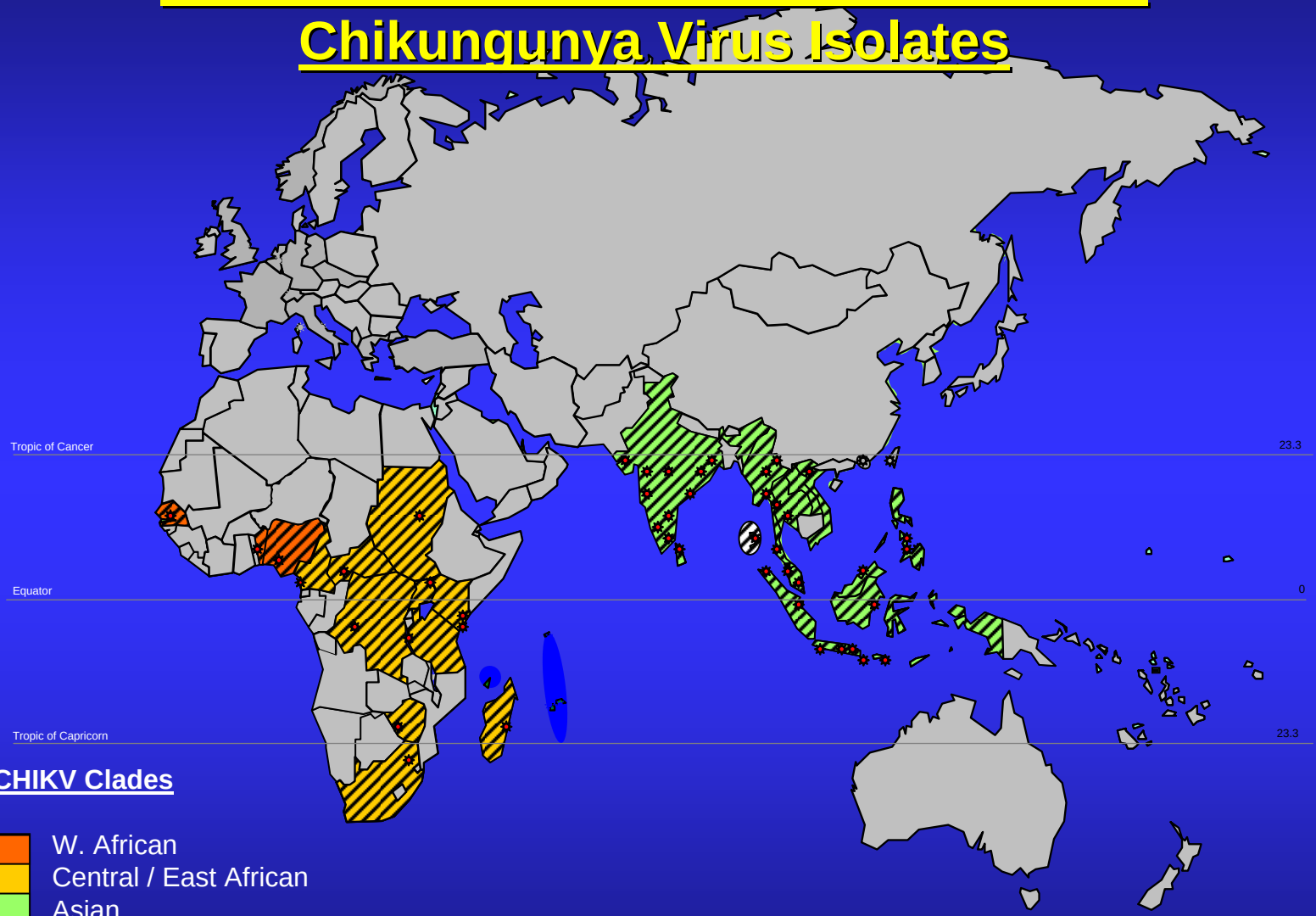
Geographical Distribution of Identified Chikungunya Virus Isolates



CHIKV Clades

- W. African
- Central / East African
- Asian
- Locations from which CHIKV has been isolated from individuals
- Countries with endemic CHIKV activity

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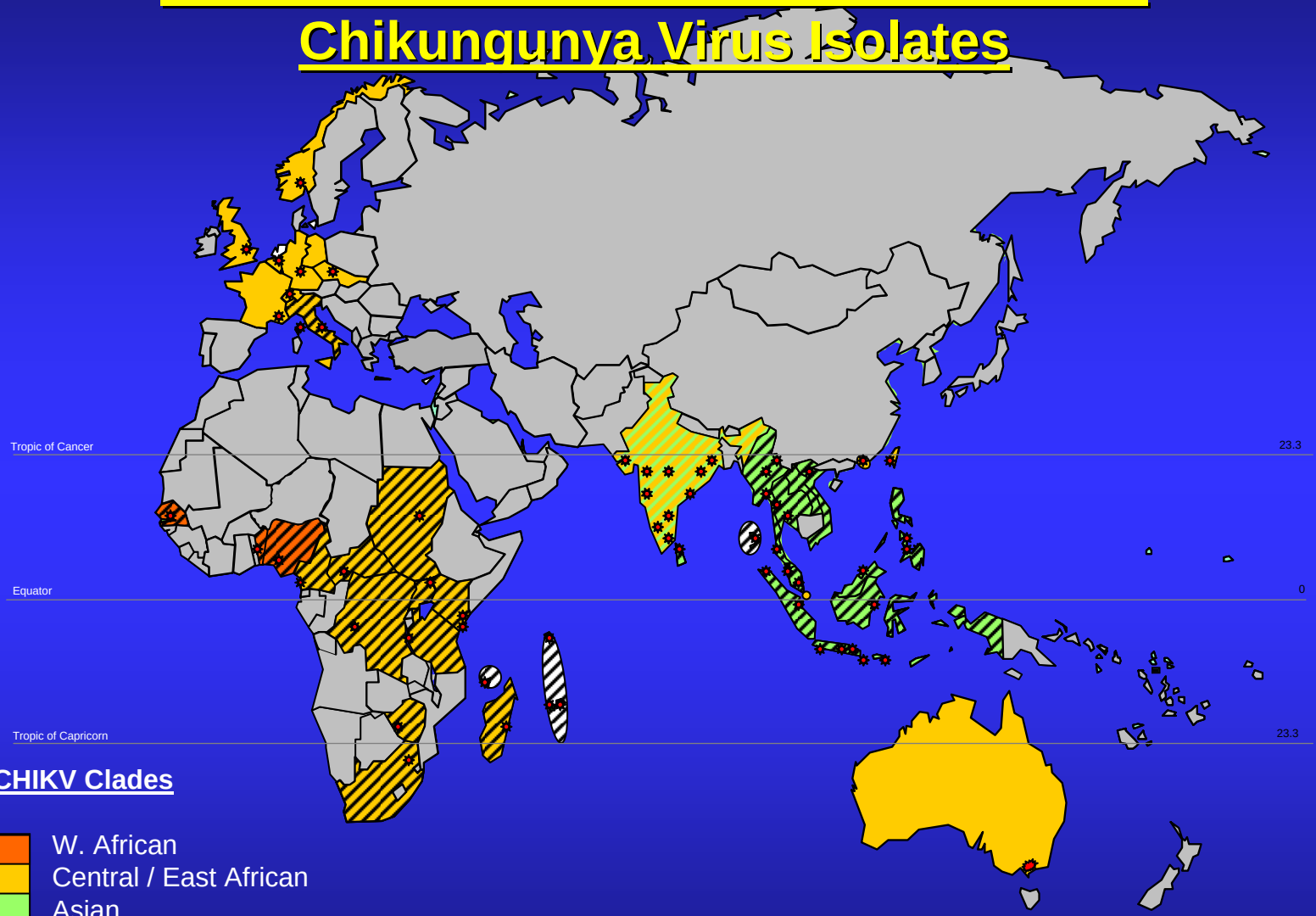
Geographical Distribution of Identified Chikungunya Virus Isolates



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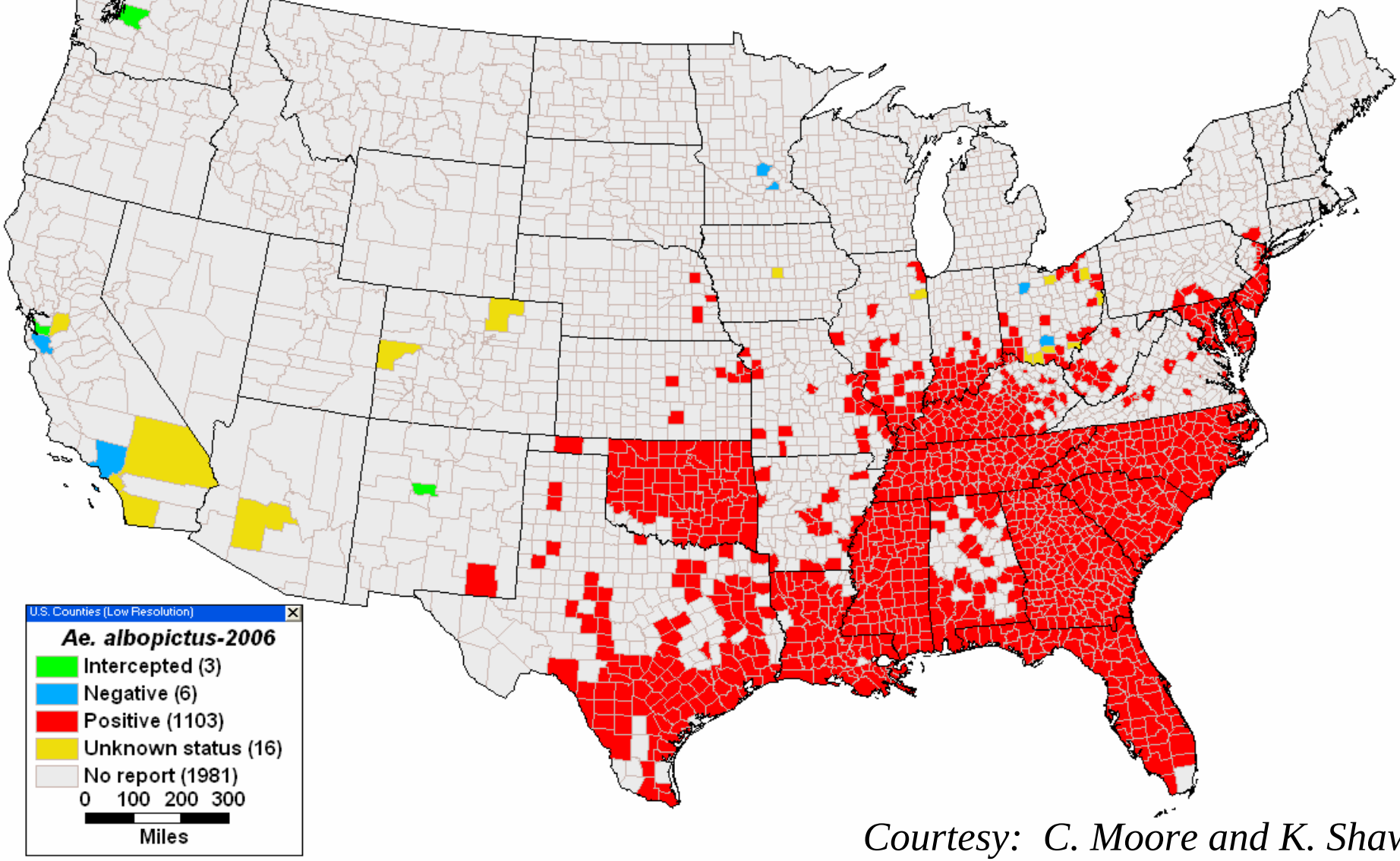
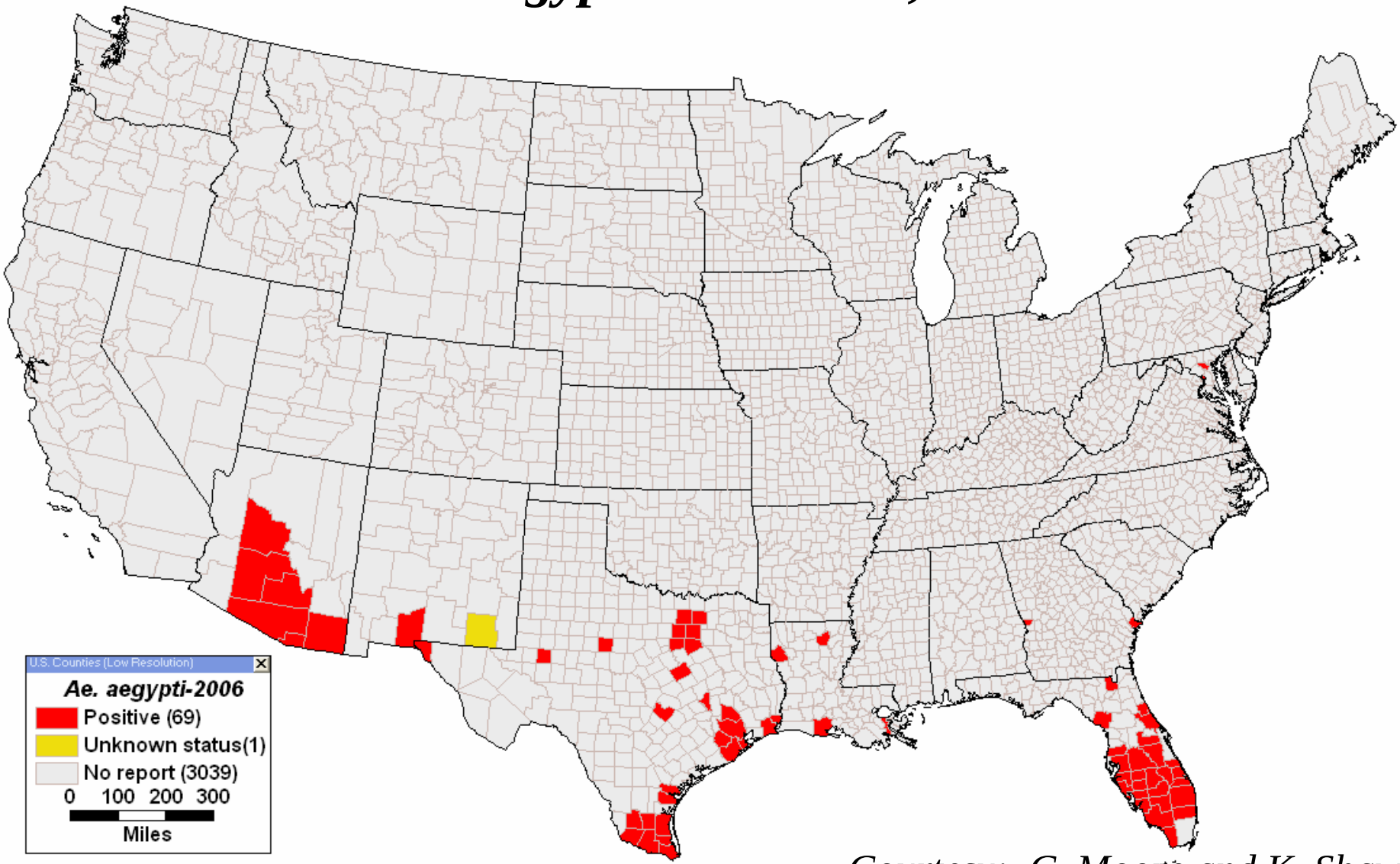
Aedes albopictus in the U.S., 2006



Courtesy: C. Moore and K. Shaw

Aedes aegypti in the U.S., 2006



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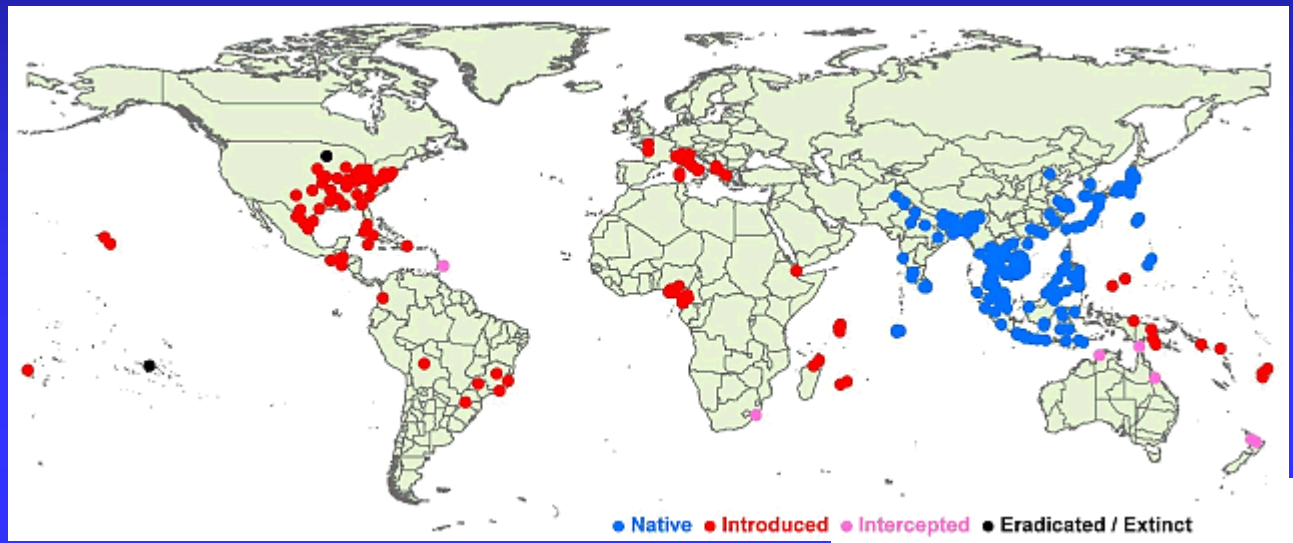
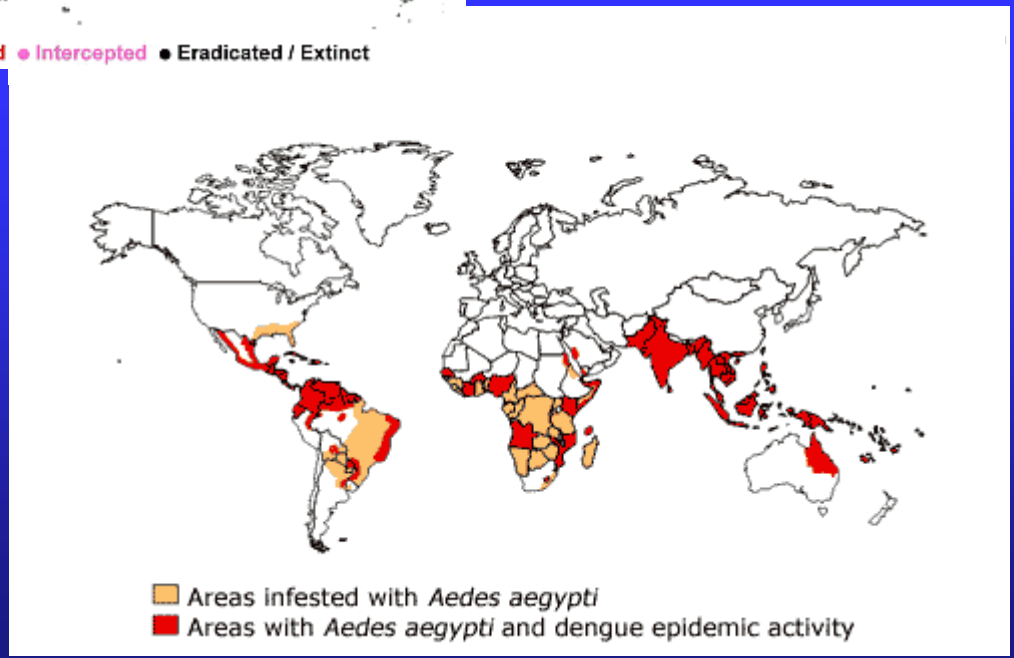
Areas at risk



Aedes albopictus

Aedes aegypti



Acknowledgements

- MOH, Kenya
  - Charles Njuguna
  - Charles Nzioka
  - Rosalia Mukina Kalani
- MOH, Comoros
  - Yahaya Ali Ahmed
  - Mlindasse
- USAMRU-Kenya
  - Sheryl Bedno
  - Clayton Onyango
  - Victor Otieno
- KEMRI, Kenya
  - Rosemary Sang
- FELTP, Kenya
  - Tetteh C
- University College, Dublin, Ireland
  - Brian Sheahan
- IEIP, Kenya
  - Rob Breiman
  - Heather Burke
  - Kariuki Njenga
- WHO, AFRO
  - Naphtali Agata
  - Yokouide Allarangar
- WHO, Comoros
  - Mamadou D Ball
- CDC-Ft Collins
  - Jeremy Ledermann
  - Christopher Logue
  - Jennifer Brown
  - Barry Miller
  - Roy Campbell
  - Robert Lanciotti
- Institute Medicine Tropical (Marseille, France)
  - Hughes Tolou
  - Fabrice Simon

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