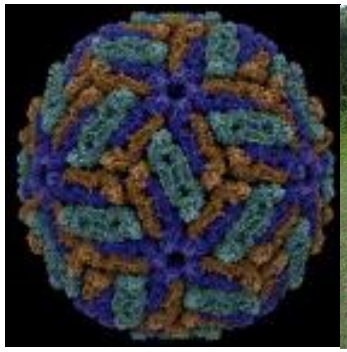
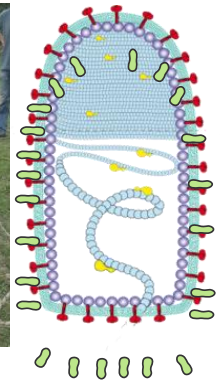
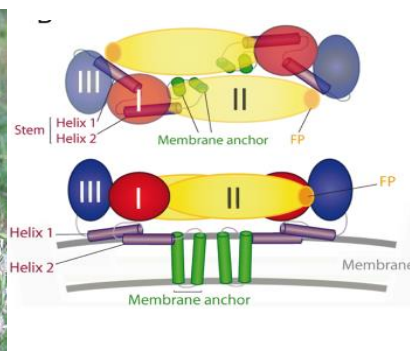
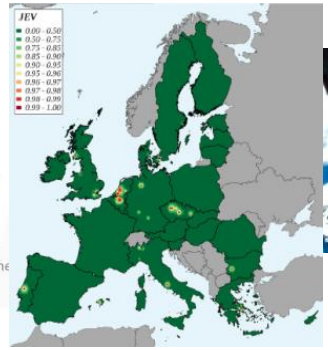
West-Nile Virus









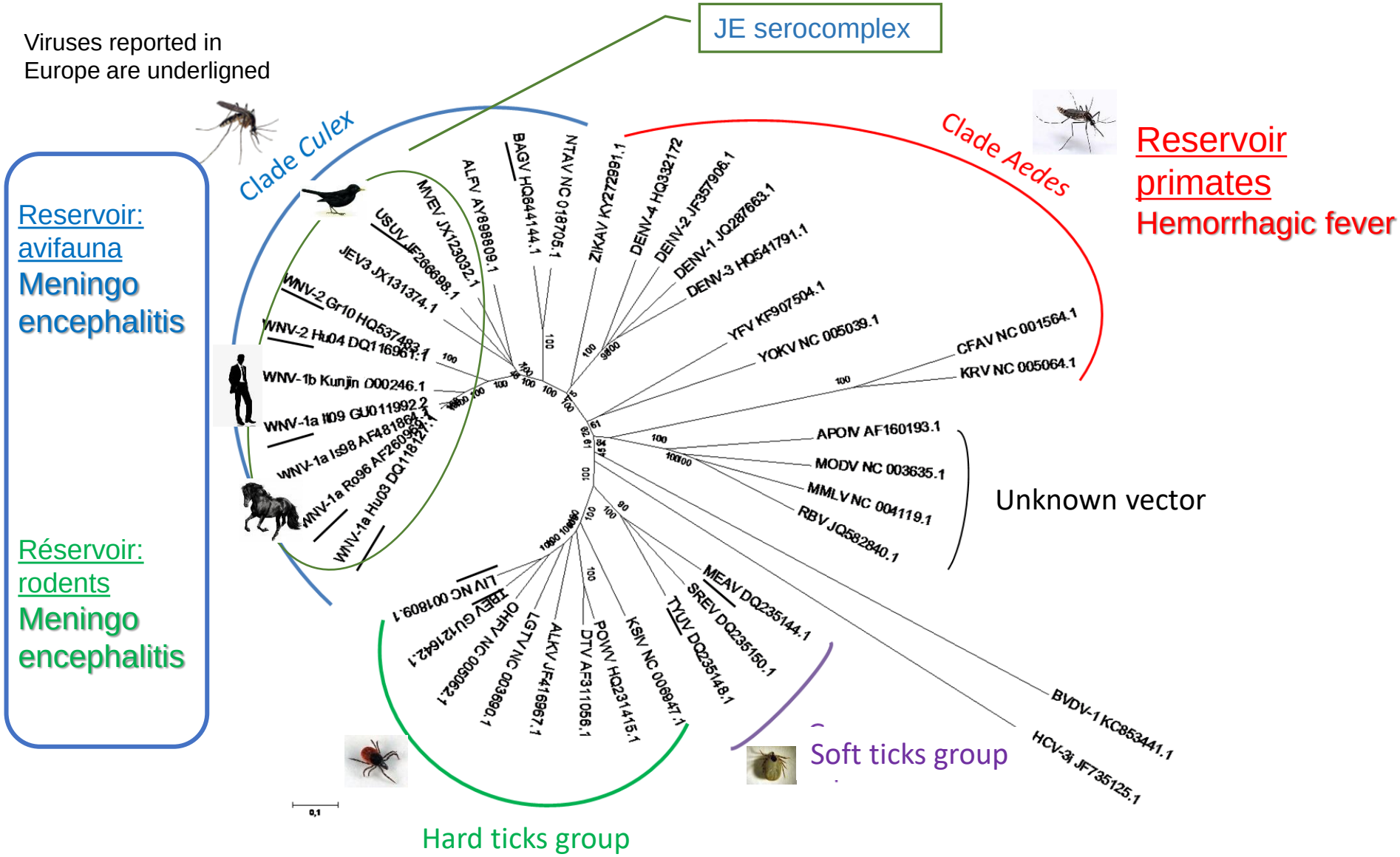

Gaëlle GONZALEZ

EU-RL for equine diseases

NRL for WNV in France

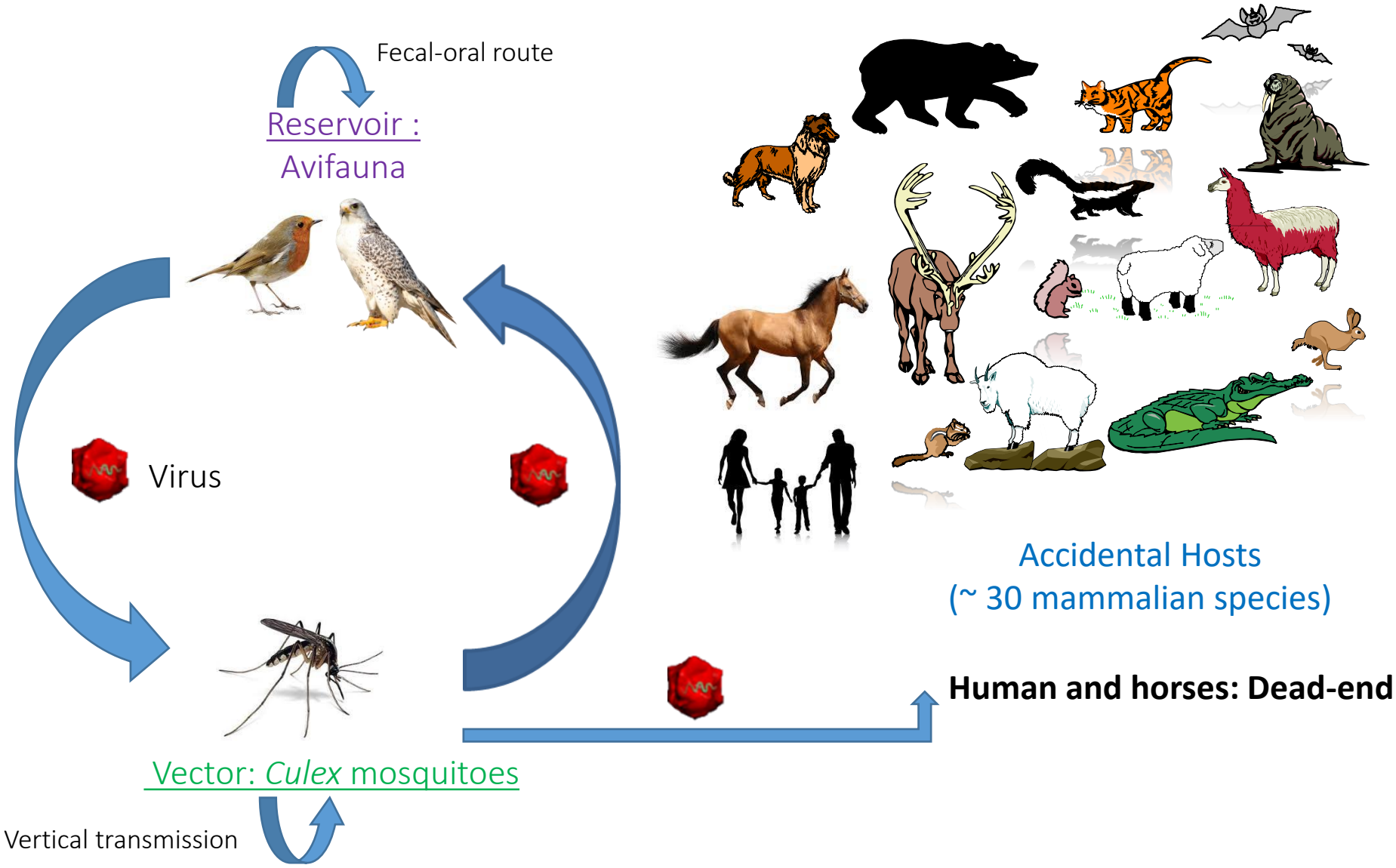
Gaelle.gonzalez@anses.fr

West-Nile virus: an emerging virus



Beck et al, IJERPH, 2013

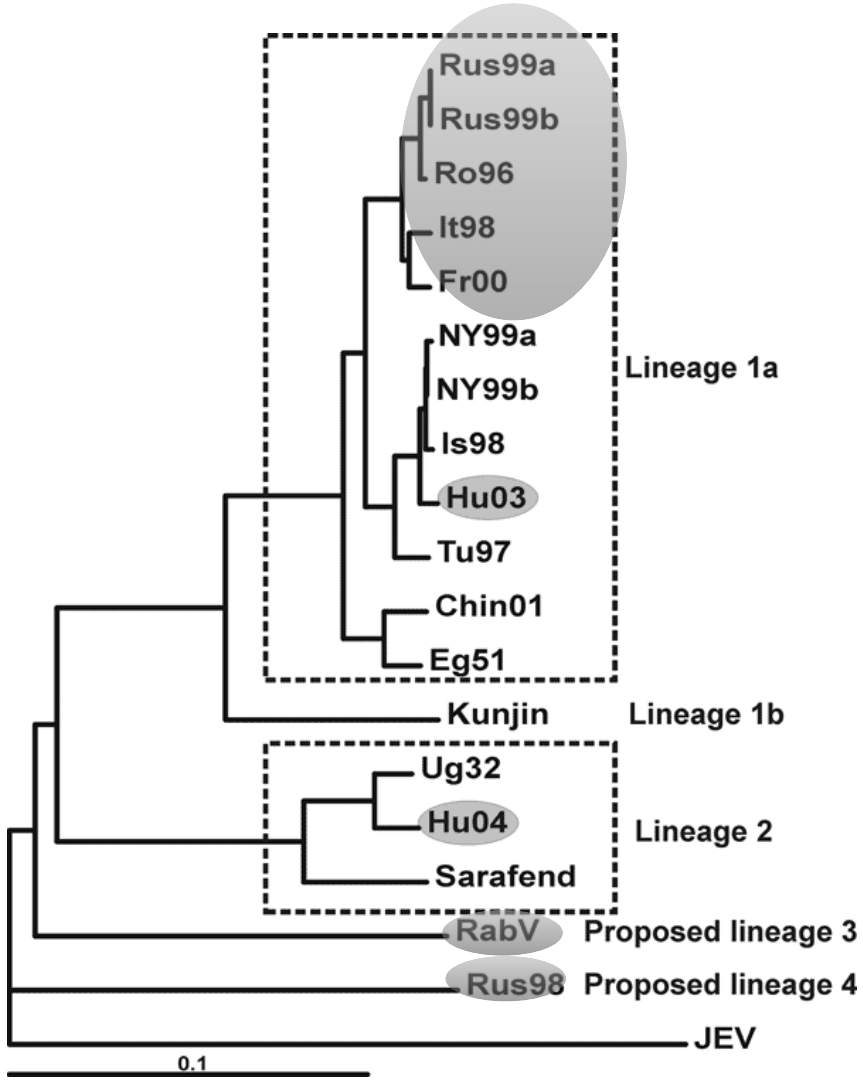
Transmission Cycle



WNV Phylogenic diversity

WNV **pathogenic strains** to Humans and **horses** belong to **lineages 1, 2 and 5**

European strains in grey



Lineage 1 : Worldwide distribution
Europe, The USA, the Middle East, India (lineage 1c), Africa and Australia (clade 1b, Kunjin)

Lineage 2 : Africa, Europe
Sénégal, Ouganda, R.C.A, Kenya, Madagascar, Hongrie, Grèce, Roumanie

Lineage 3 et 4 : Central Europe

Lineage 5 : India

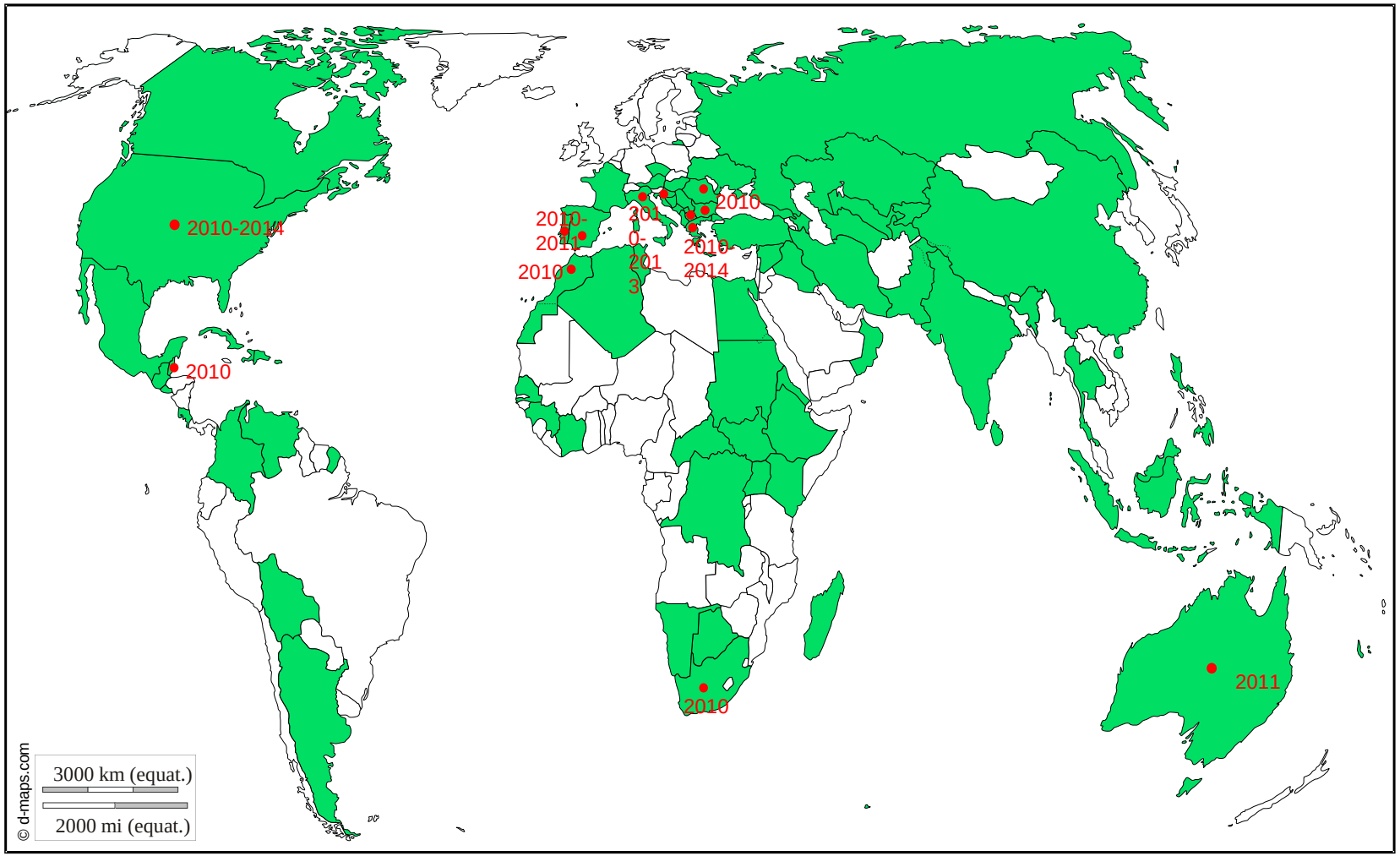
Bakonyi T et al., EID, 2006

Geographical distribution of WNV

Originating from Africa

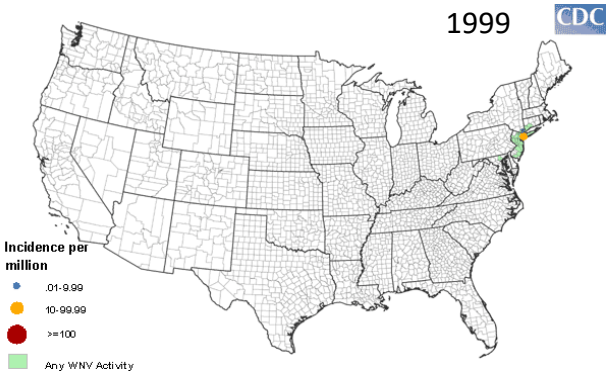
Discovered in 1937 in Uganda

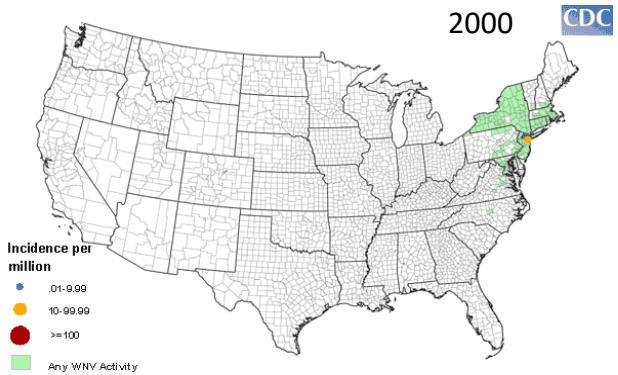
Circulating on the 5 continents
(except Antartica)

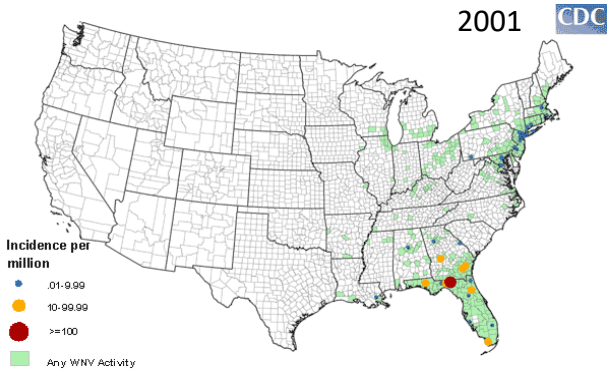


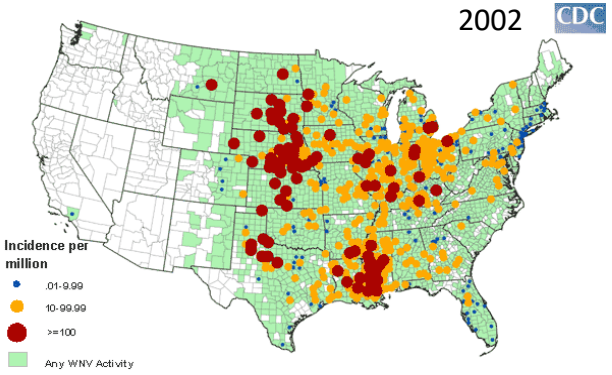
Lecollinet et al., 2020

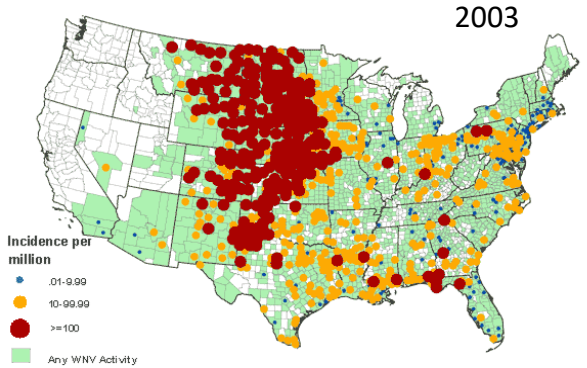
WNV emergence and dissemination in the USA

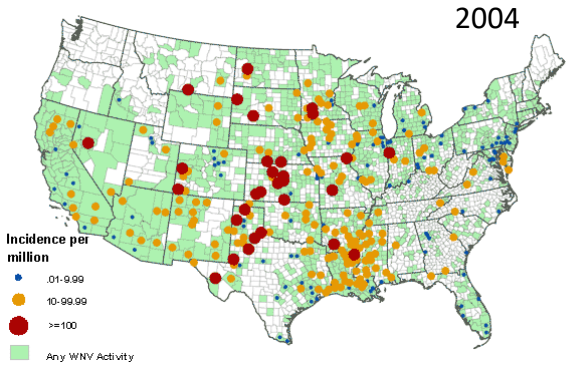


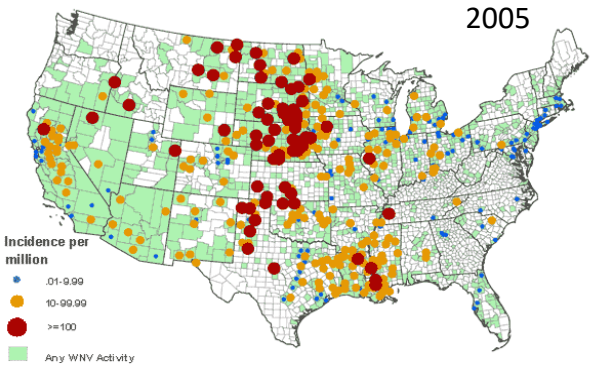


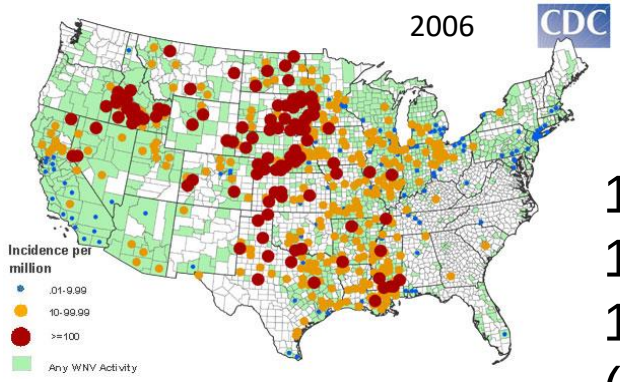












1999-2010 : >30 000 human cases and 1200 deaths
1999-2002 : >57000 corvids deaths
1999-2009 : >24000 equine cases
(2002 : around 15000 cases et 4500 deaths)

Mosquitoes Vectors in the United States and in Europe

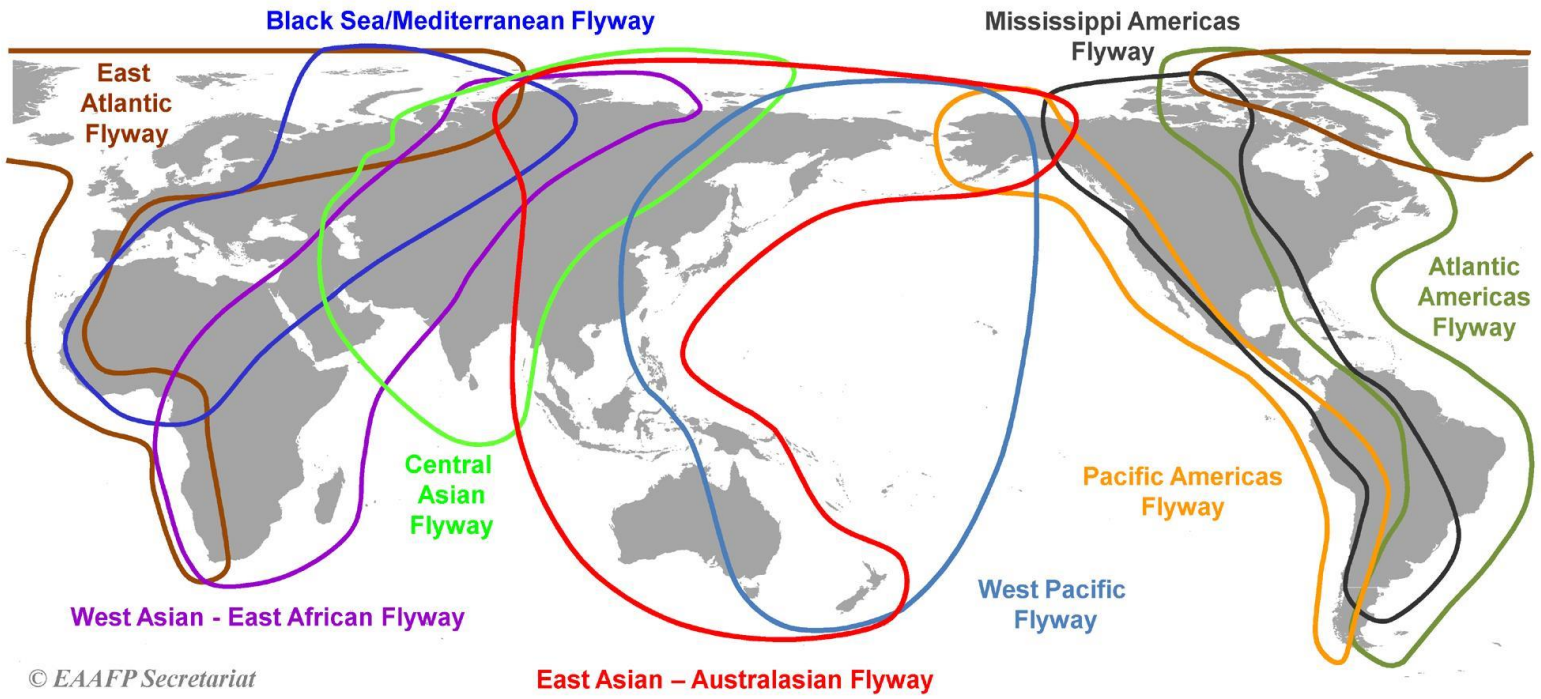
USA : 64 species infected by WNV (CDC), less than 10 are considered as the main vectors (Hayes et al., 2005)

Etats-Unis	Europe
Culex pipiens (Nord)	***Culex modestus*** (Fr, Rus)
Culex quinquefasciatus (Sud)	***Culex pipiens*** (Ro, Tch, Por, Rus)
Culex tarsalis (Ouest)	***Culex antennatus***
Culex restuans (Nord Est)	***Culex univittatus*** (Por)
Culex salinarius	
Culex nigripalpus	
Taux miminaux d'infection (nombre de pools de moustiques positifs pour le virus West nile par 1000 moustiques)	
0.07-5.7	0.09-0.62

Zientara et Lecollinet, 2010

Avifauna: key role in long distance transport of the virus and local amplification

Viruses regularly introduced from the African cradle



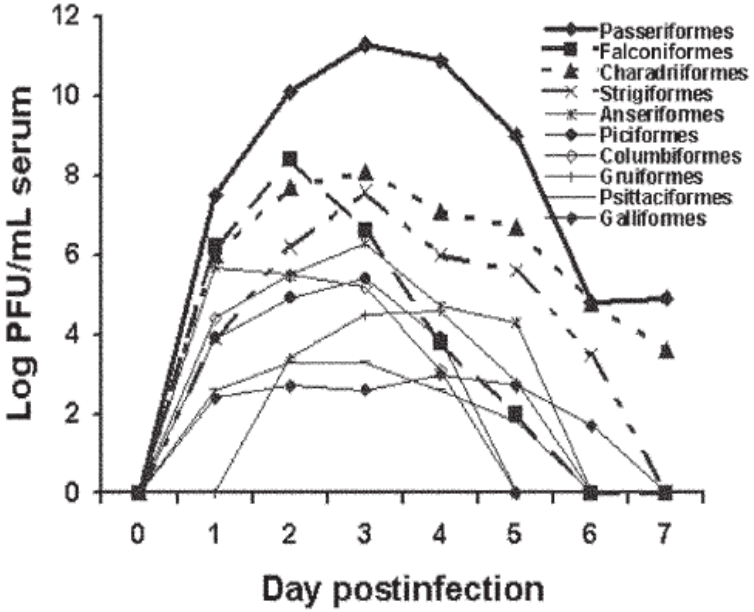
In Europe: rare and isolated mortalities (corvids, other passerines, diurnal raptors)




Lecollinet et al, 2013

Disease in birds

- Weakness, lethargy
- Emaciation
- Sedentary lifestyle
- Difficulty balancing, shaking
- Difficulty walking, perching or flying
- Inadequate response to danger



Komar et al, 2003

More than 250 species infected in the USA but some are resistant to the infection (Galliformes (chicken, turkey), Pigeons, Cranes)

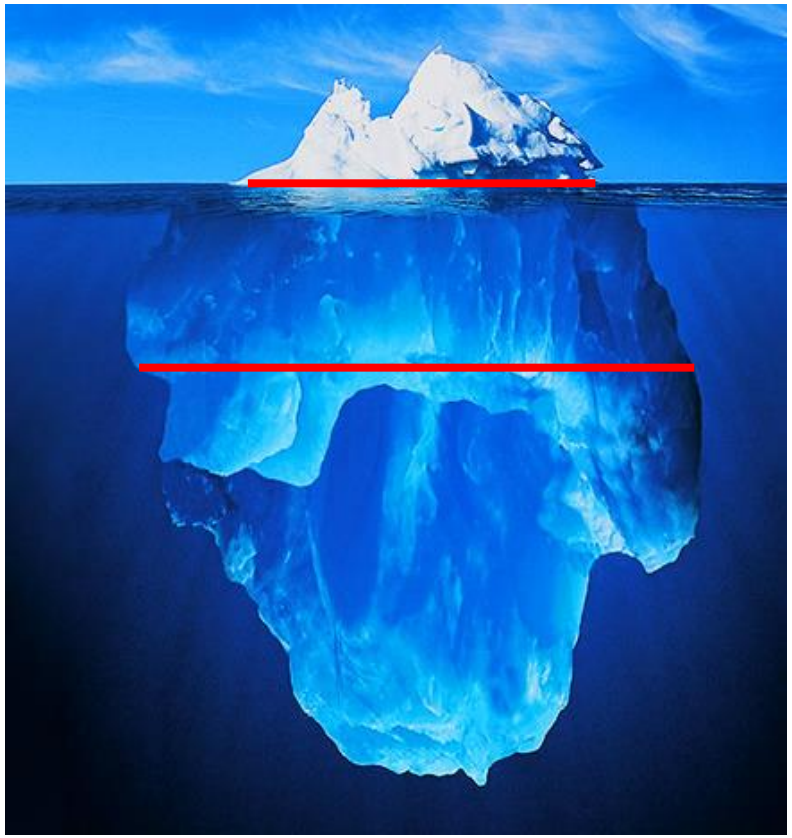
Disease in Horses

Incubation period: 3 – 15 days

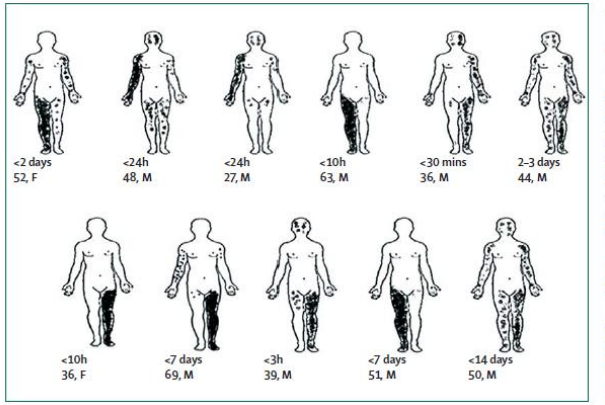
Neurological symptoms (WNND) : 1-10%
Lethality rate: 20-57% (horse), 10% (humans)
Ataxia, Paralysis, etc.

Mild illness: < 20%
Flu-like symptoms (West-Nile Fever)

Subclinical infection: 70-79%



Dr P. Garcia, 2015

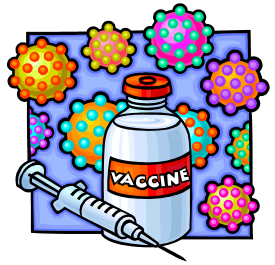


WNND: West-Nile Neuroinvasive Disease

Kramer et al, Lancet, 2007

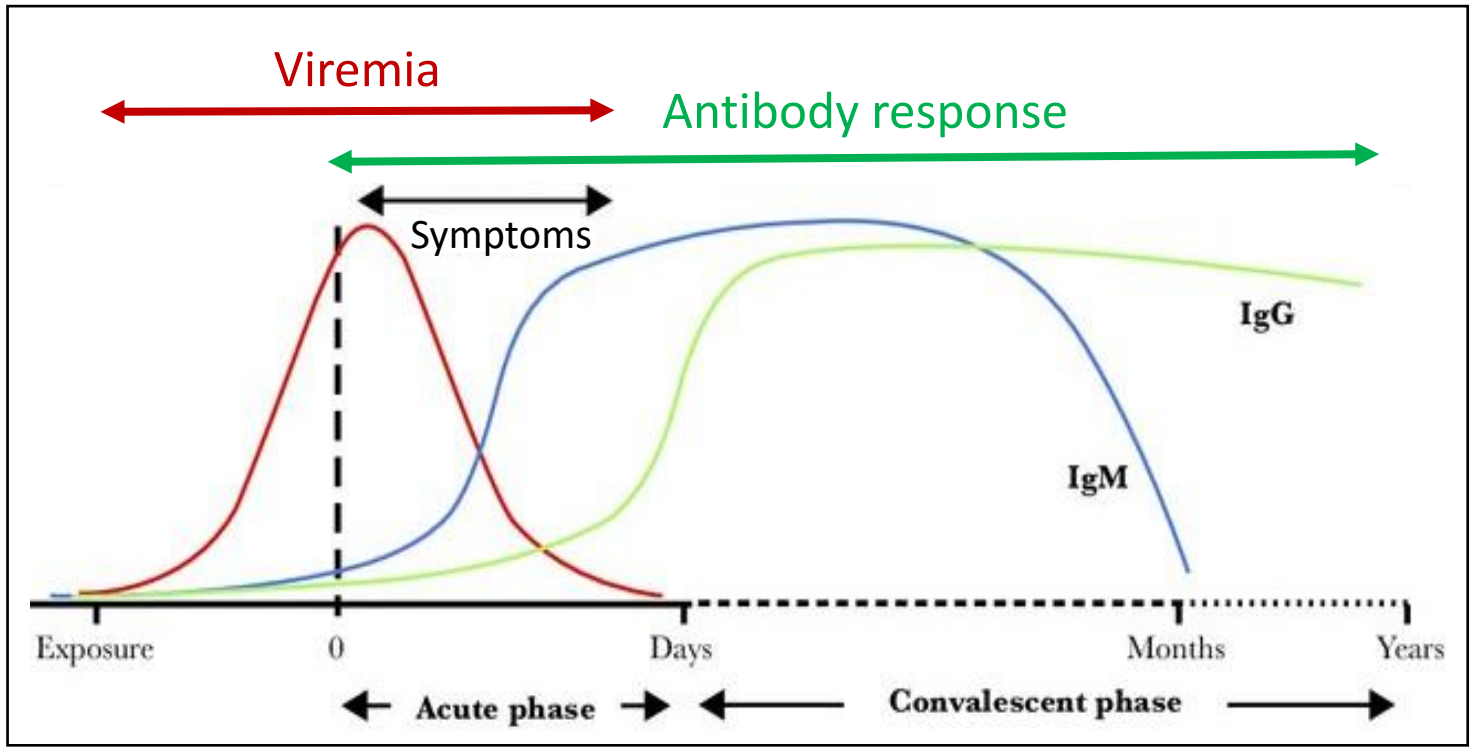
No antiviral treatment available

Symptomatic and **comfort treatment** (infusion, anti-inflammatory, protection and care against self-harm...)



3 inactivated vaccins available in Europe

- Short viremia (3 to 7 days post-infection)

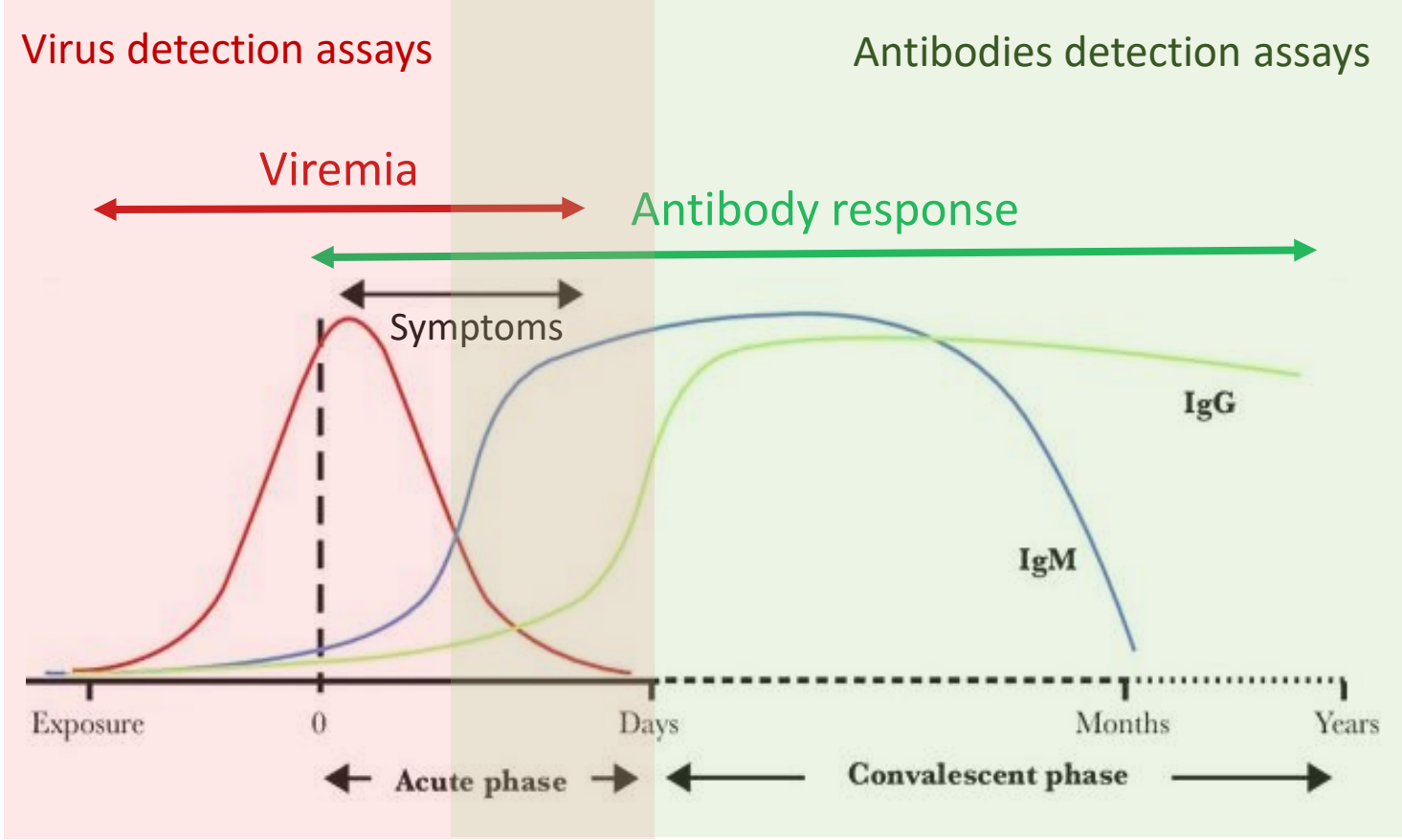


Schematic representation of the typical kinetics of flaviviral infections

(adapted from Goncalves A. et al., 2017)

Credit: C.Migné

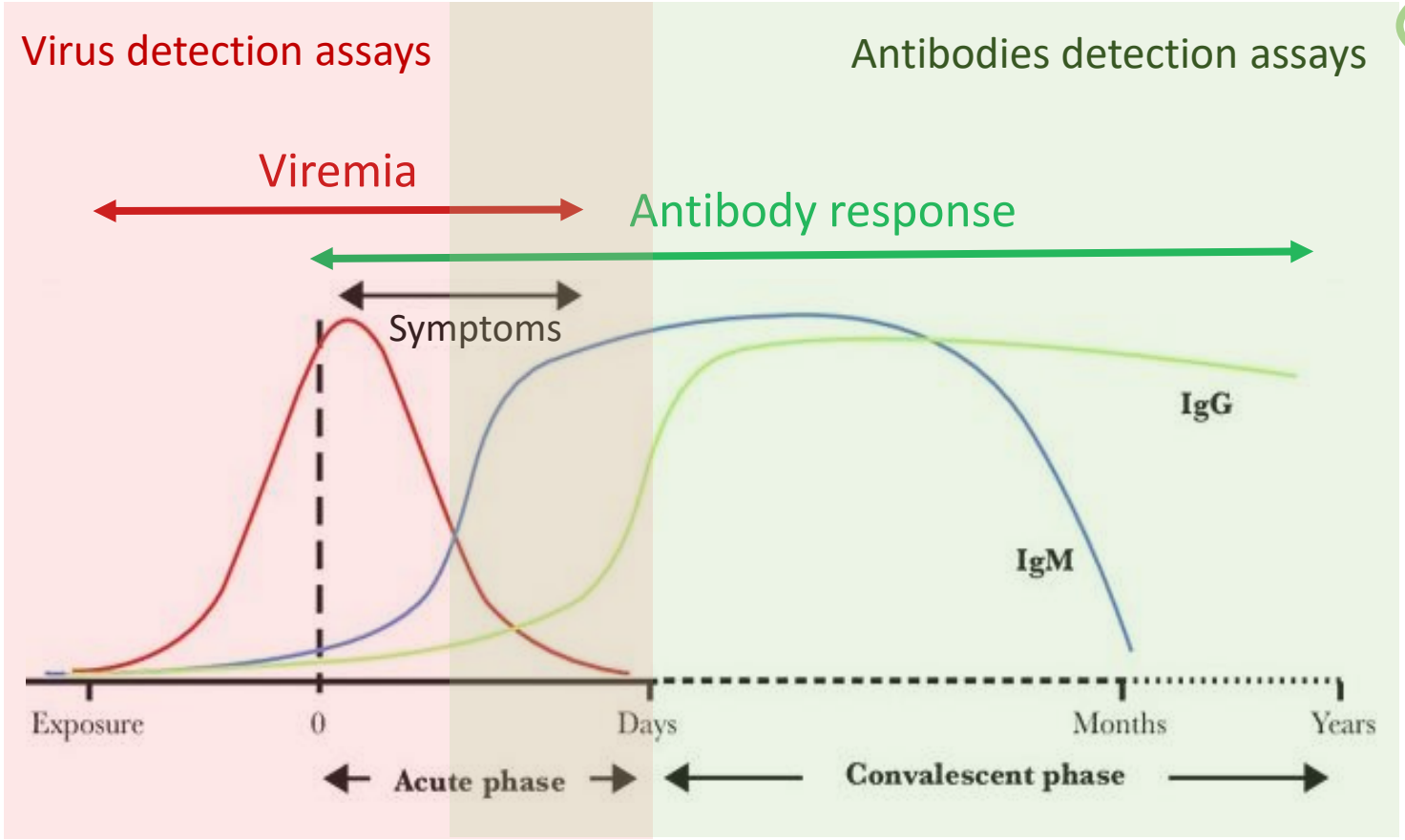
Diagnostic of WNV infection



(adapted from Goncalves A. et al., 2017)

Diagnostic of WNV infection

Blood-EDTA,
Cerebrospinal fluid
Urines
Brain



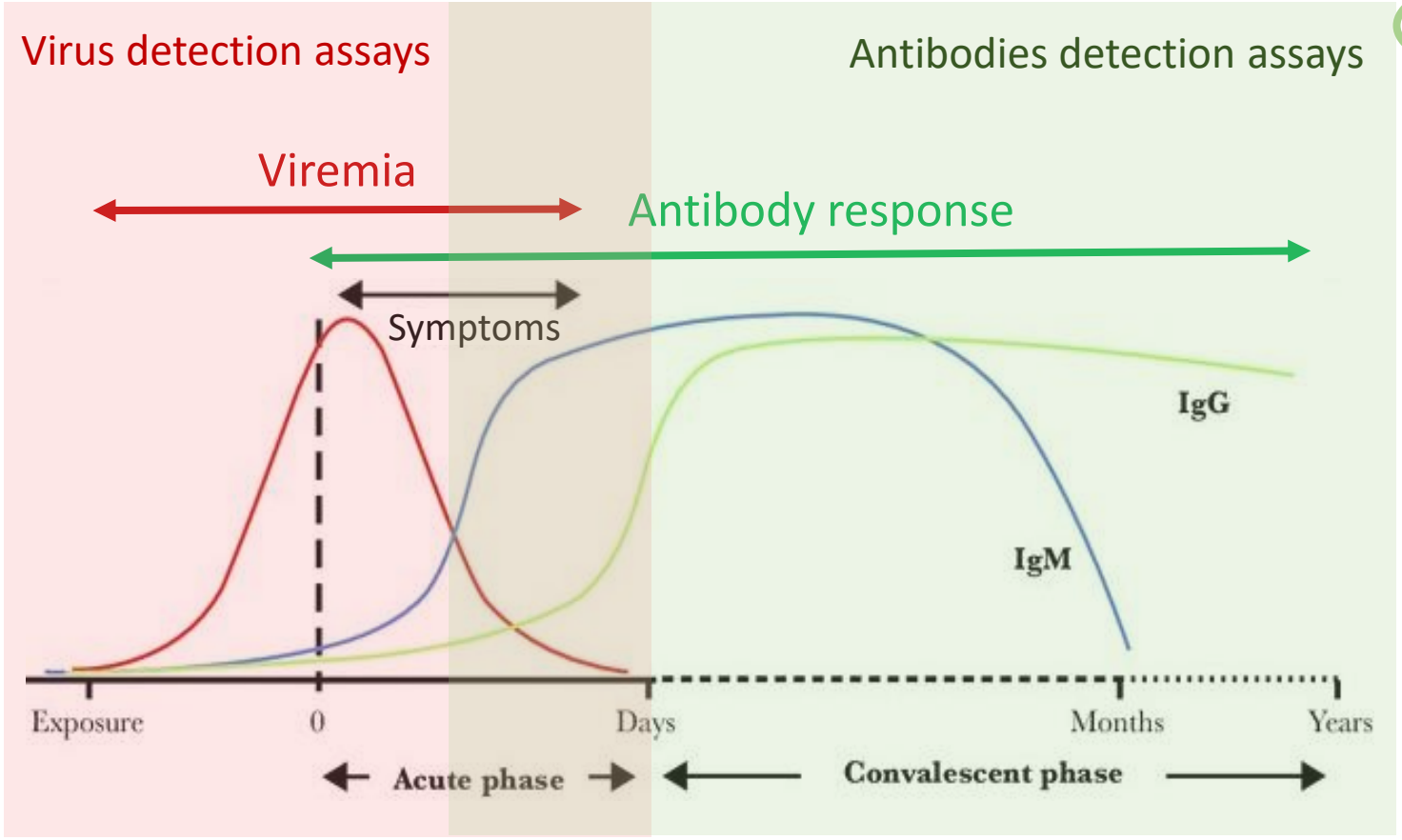
Sera and plasma

(adapted from Goncalves A. et al., 2017)

Diagnostic of WNV infection

Blood-EDTA,
Cerebrospinal fluid
Urines
Brain

- ❑ Molecular detection of WNV genome by RT-qPCR
- ❑ Virus isolation



Sera and plasma

- ❑ MAC ELISA (IgM)
- ❑ IgG ELISA
- ❑ VNT

(adapted from Goncalves A. et al., 2017)

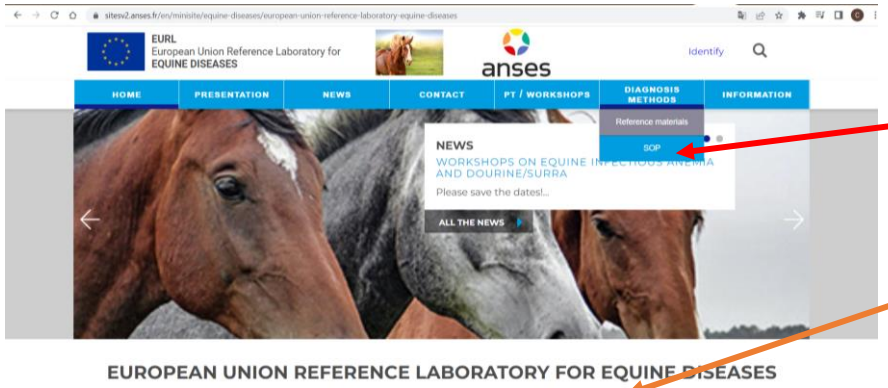
European Union reference laboratory for equine diseases

website : https://eurl-equinediseases.anses.fr/

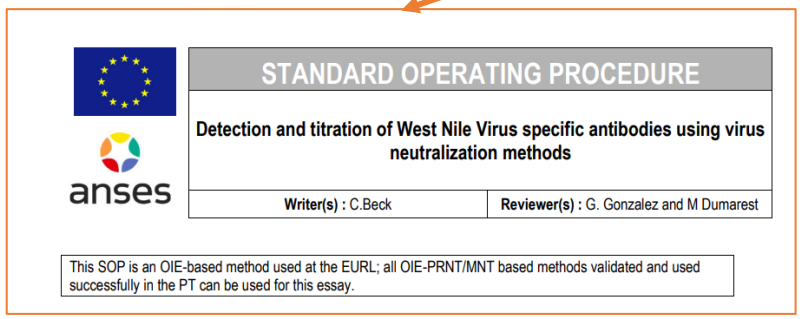
COMMISSION REGULATION (EC) No 180/2008

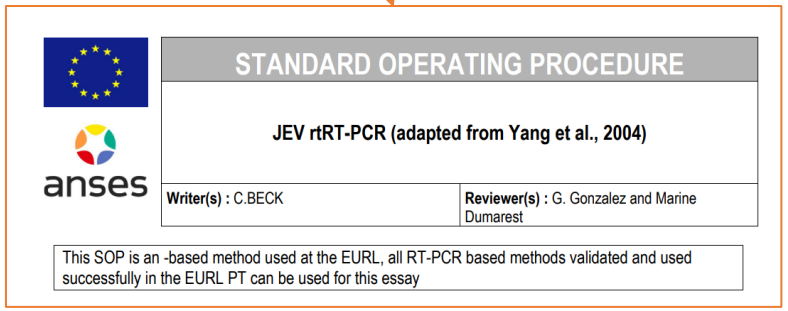
of 28 February 2008

concerning the Community reference laboratory for equine diseases other than African horse sickness and amending Annex VII to Regulation (EC) No 882/2004 of the European Parliament and of the Council



Providing Standard Operating Procedure (SOP)



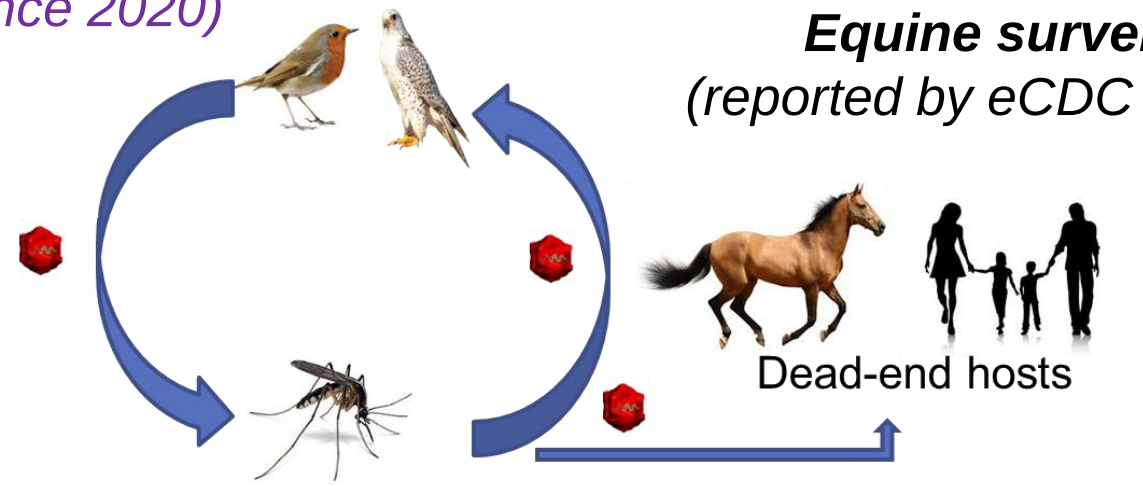


"One health" approach for WNV surveillance in Europe

West Nile virus (WNV) infection is notifiable in humans, equids and birds in the European Union

Bird surveillance
(reported by eCDC since 2020)

Equine surveillance
(reported by eCDC since 2017)



Entomological surveillance

Human surveillance

Bahuon et al, Rev Sci Tech OIE, 2016

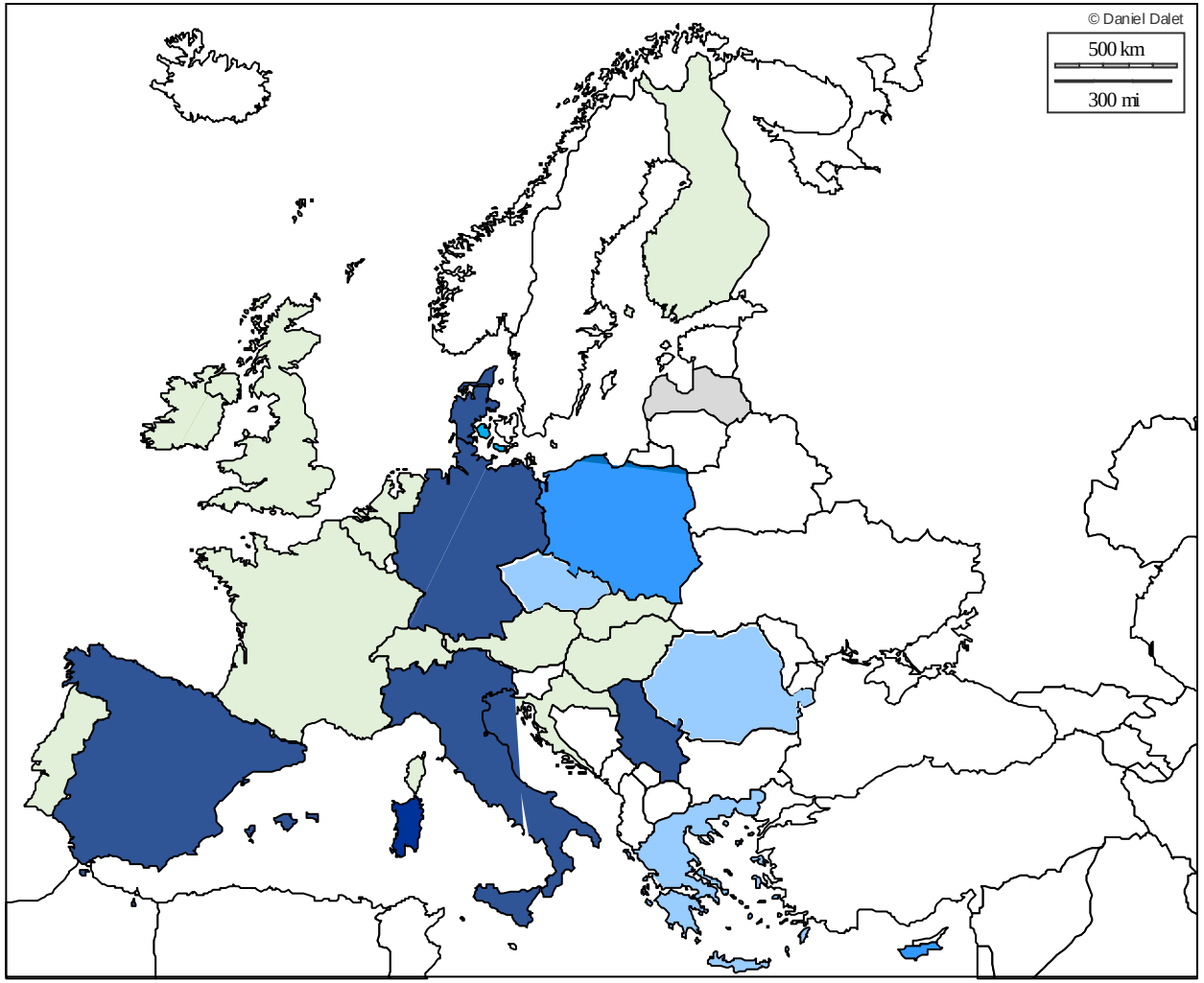
Objectives of WNV surveillance

- Early detection of WNV circulation in birds, mosquitoes and mammals including humans and horses

- To assess the risk of WNV transmission to humans through blood donations, organ and tissue transplants

- Take appropriate management and warning measures

Surveillance system implemented in the EU

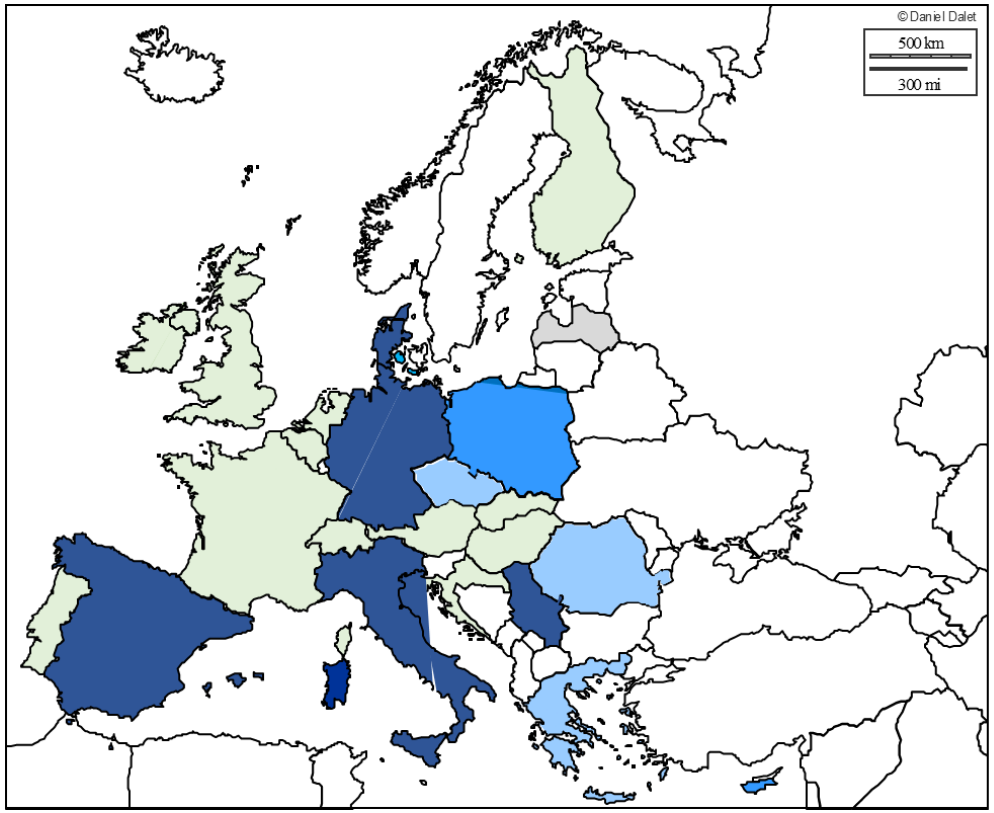


- Active Surveillance

- Passive Surveillance

No surveillance system

Surveillance system implemented in the EU



- Active Surveillance

- Passive Surveillance

No surveillance system

Random molecular **screening** in wild birds and mosquitoes

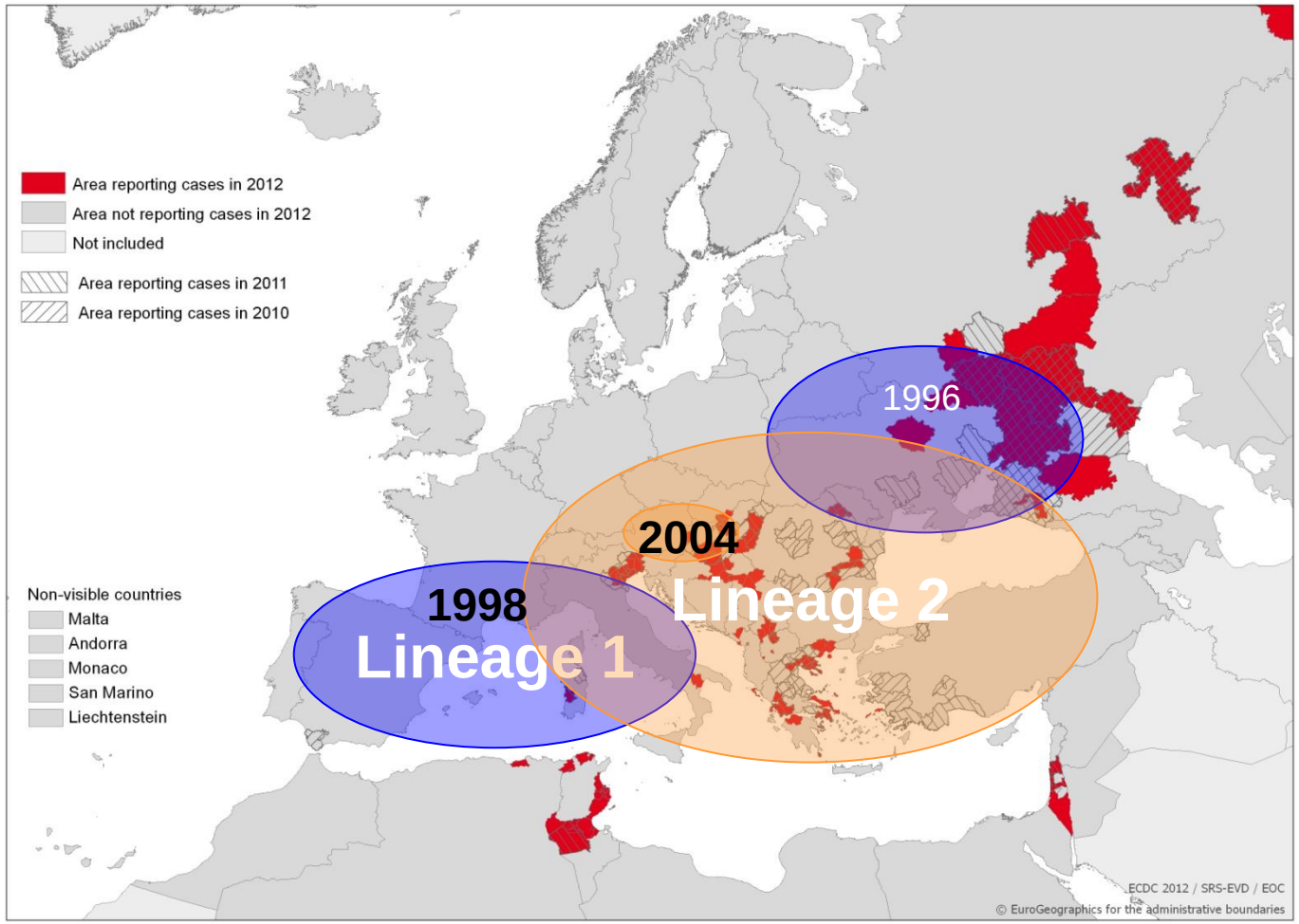
Serological **screening** of equines around a positive case

Use of **sentinels**

On **symptomatic equines**
On bird carcasses

WNV in Europe

- 1996 et 1998: Emergence of WNV lineage 1 in Romania et Italy
- 2004: Emergence de WNV lineage 2 in Hungury

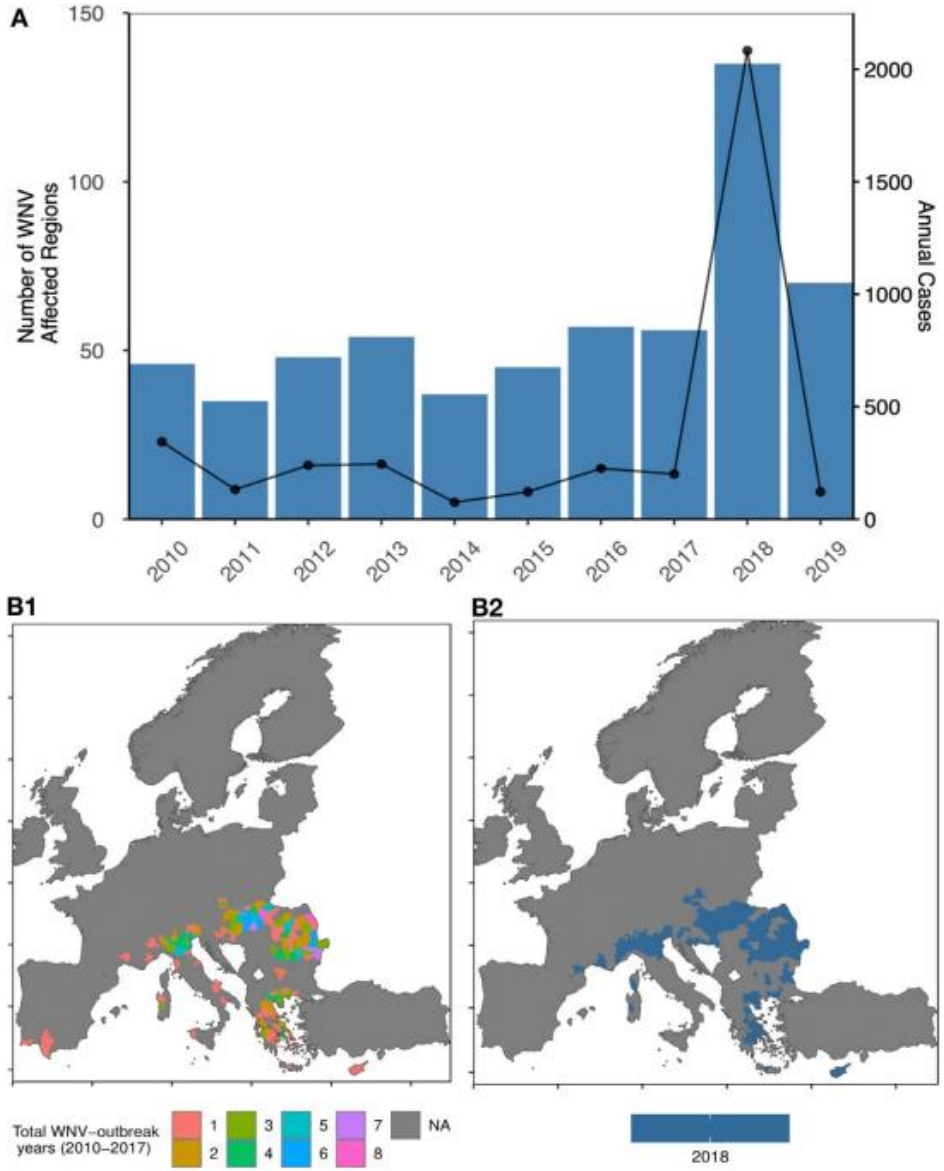


Rapid expansion of the geographical distribution of WNV-lineage 2 in Greece (2010), Italy, Romania, Spain

WNV in Europe

- Since 2010, increase of equine and human outbreaks incidence

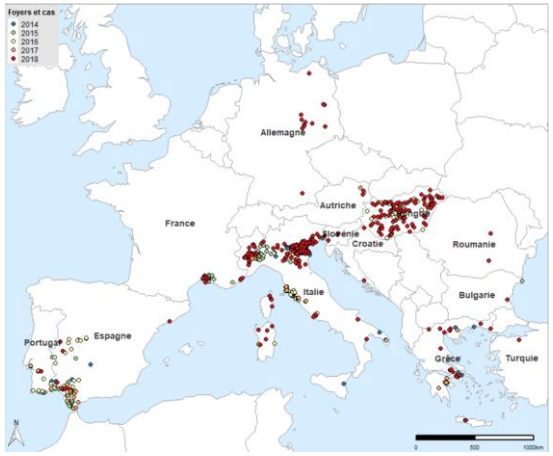
- **2018**, geographical extansion to Northern and central Europe
  - First equine and bird cases detected in Germany in 2018
  - First cases dtected in wild avifauna in The Netherlands in 2020
  - First case detected in the UK in 2022



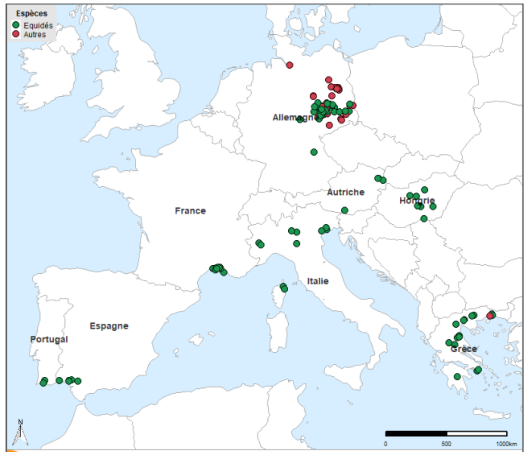
Farooq Z. et al, 2022, The Lancet

WNV in Europe

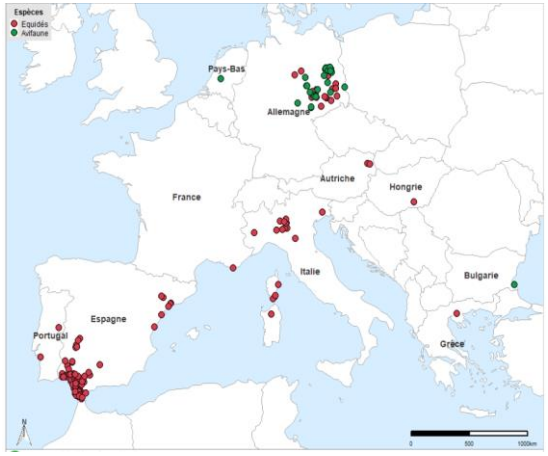
2014-2018



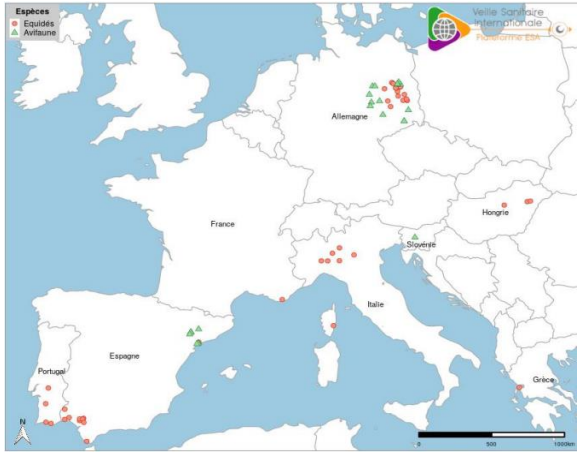
2019



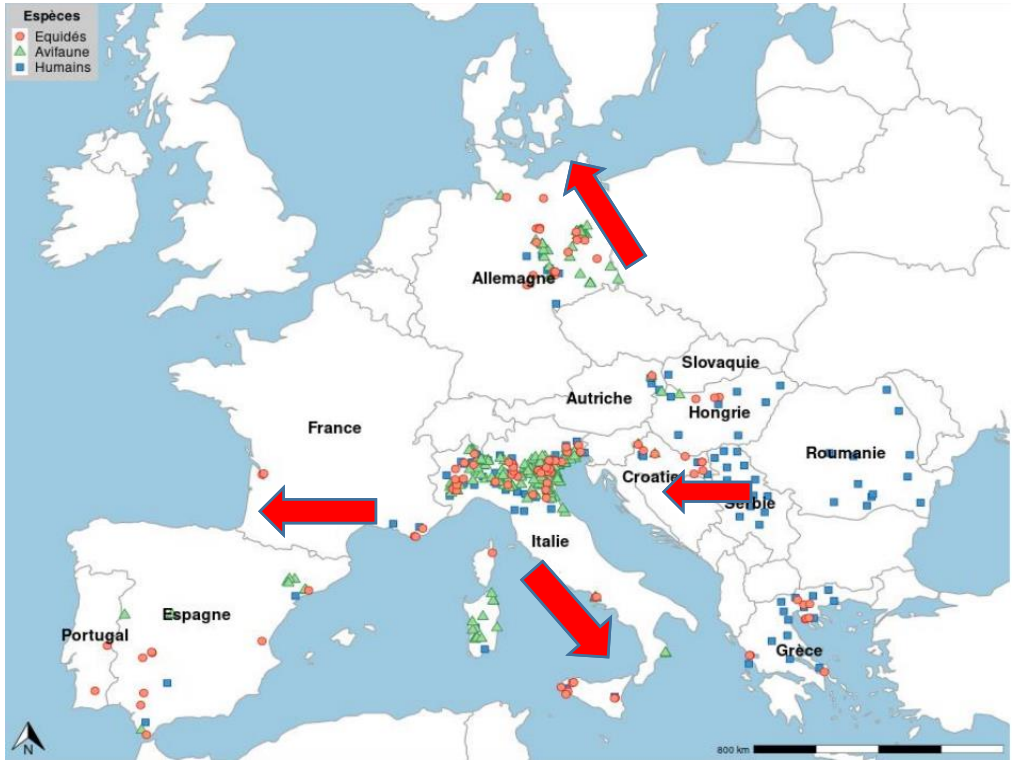
2020



2021

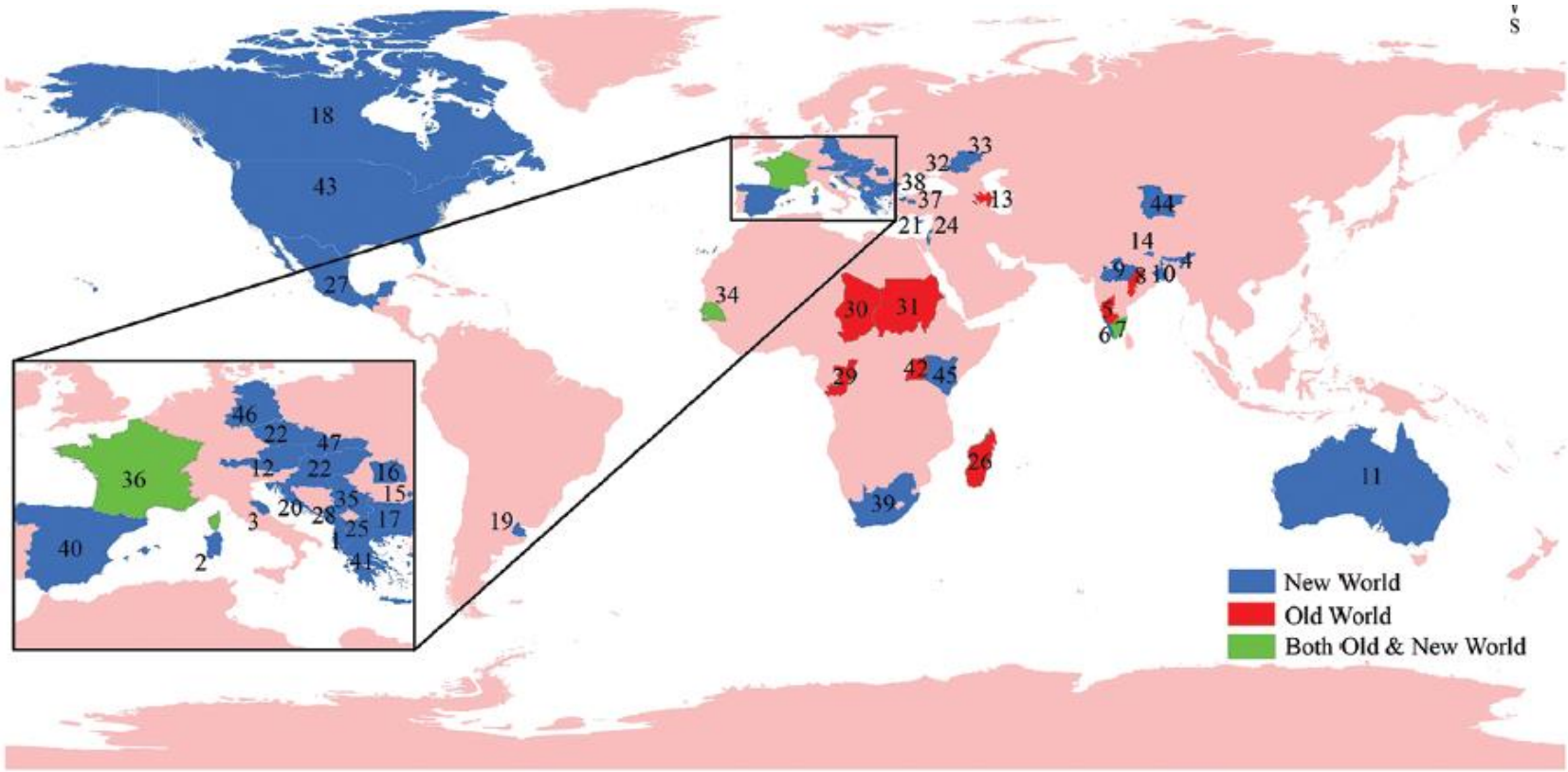


2022



(source : N. Dheilly, Commission Européenne ADIS, eCDC)

WNV in Asia and Pacific regions



Sl No.	Country	Lineage	Sl No.	Country	Lineage	Sl No.	Country	Lineage	Sl No.	Country	Lineage
1	Albania	II	13	Azerbaijan	I	25	Macedonia	II	37	Turkey (Eskisehir)	I
2	Italy (Sardinia)	II	14	Nepal (Bharatpur & Kathmandu)	I	26	Madagascar	II	38	Turkey (Bursa region)	II
3	Italy (Ancona)	II	15	Romania (Bucharest)	I	27	Mexico	II	39	South Africa	II
4	India (Assam)	V	16	Romania (Transylvania)	II	28	Montenegro	II	40	Spain	I & VI
5	India (Karnataka)	V	17	Bulgaria	II	29	Republic of the Congo	II	41	Greece	II
6	India (Kerala)	I	18	Canada	I	30	Chad	II	42	Uganda	II
7	India (Tamil Nadu)	I & V	19	Argentina (Chaco)	I	31	Sudan	II	43	United States	I
8	India (Chhattisgarh)	I	20	Croatia	II	32	Russia (Rostov Oblast)	II	44	China (Xinjiang)	I
9	India (Madhya Pradesh)	I	21	Cyprus	II	33	Russia (Volgograd)	II	45	Kenya	I
10	India (West Bengal)	I	22	Czech Republic	II &III	34	Senegal	VII, VIII & I	46	Germany (Eastern Part)	II
11	Australia	I	23	Hungary	II	35	Serbia	II	47	Slovakia	II
12	Austria	IX & II	24	Israel	I	36	France	II			

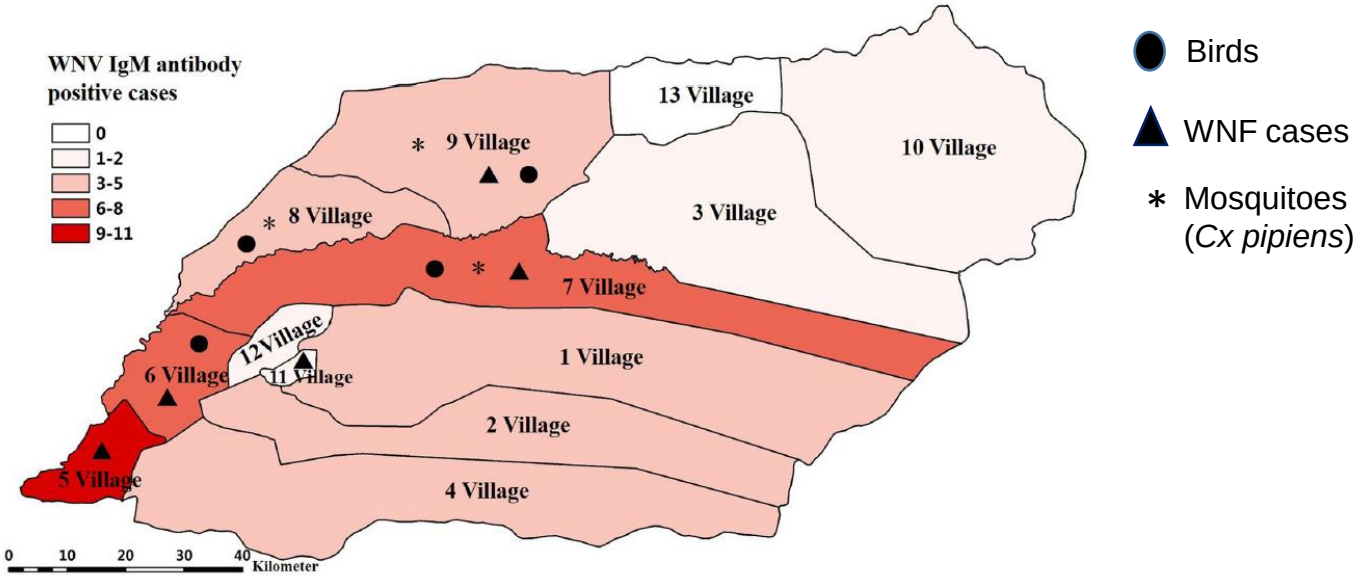
- WNV detected in humans in Asia and Pacific regions
- Need to implement an integrative surveillance system

Chowdhury et al, 2021

WNV in Asia and Pacific region: China

- Entomological and Human surveillance: first detection of WNV-L1 **in 2011** in 5 mosquito pools in Kashi Region, Xinjiang

Lv, Z. *et al. Emerg. Infect. Dis.*(2014).

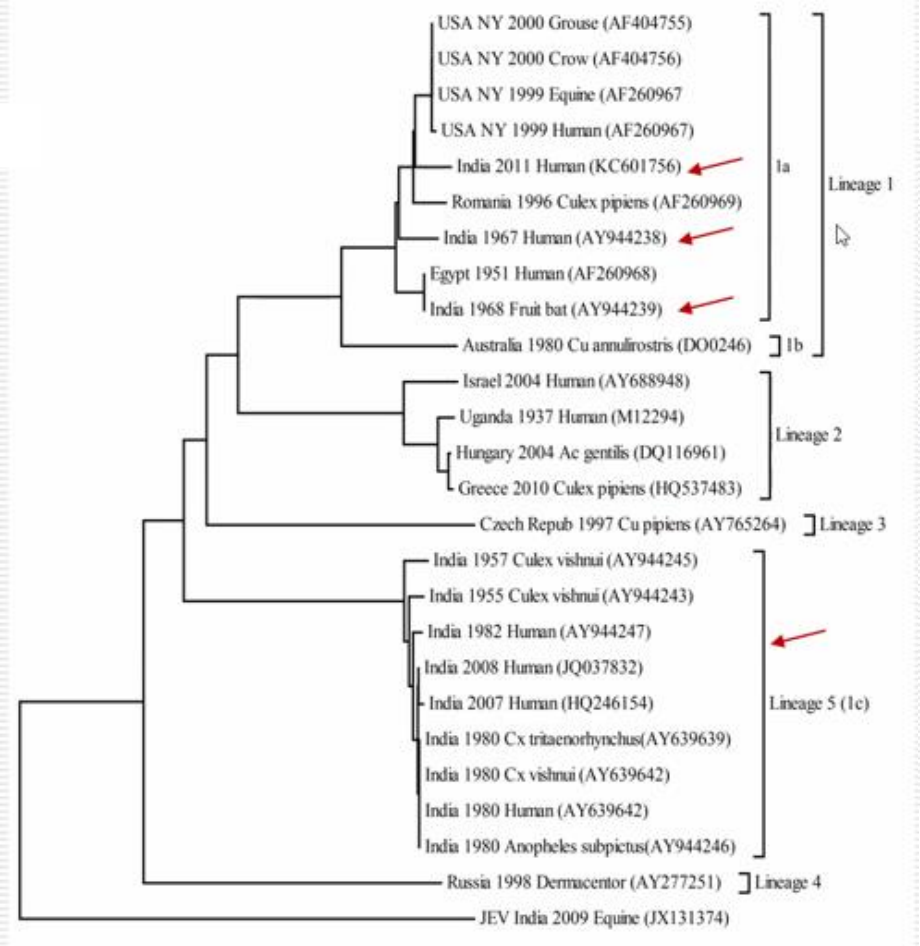


Lv, Z. *et al. Emerg. Infect. Dis.*(2014).

Human – Animal – Vector surveillance in Xinjiang from 2013 to 2016

- Low incidence in humans from 2013 to 2016
- Laboratory testing of cattle, sheep and chicken
- Need to persue the implementation of an integrative surveillance system: Human – Animal – Vector

WNV in Asia and Pacific region: India



- WNV in humans in Mumbai (1952)
- WNV isolated from human, bats, pigs and mosquitoes in India (**Lineage 1a and 1c**)
- In 2006, WNV **lineage 1c** detected in Assam
- WNV (**Lineage 1a**) outbreak in Ernakulam, Kerala in 2011
- Seven year old boy from Malappuram (Kerala) died of WNV. Crow mortality in the region due to WNV (March 18, 2019)
- Forty seven-year-old man die due to WNV in Thrissur district, Kerala (29 May 2022)

Credit: Dr Baldev Gulati

WNV in the equine population in India

ELISA

Screening test	Blocking ELISA Results	Serodiagnosis based on VNT		% sensitivity	% specificity
		POS	NEG		
Blocking ELISA	Positive	34	7	97.14	85.86
	Negative	1	22		

Circulation of WNV in the equine population

State	No. tested	No. Positive by HI (%)	No. Positive by VNT (%)
Punjab	82	2 (2.43)	2 (2.43)
Uttarakhand	312	13 (4.16)	12 (3.85)
Rajasthan	323	12 (3.71)	11 (3.40)
Gujarat	308	4 (1.29)	4 (1.29)
Madhya Pradesh	71	6 (8.45)	6 (8.45)
Total	**1096**	**37 (3.37)**	**35 (3.19)**

Credit: Dr Baldev Gulati

Conclusion: **WNV Preparedness Challenge**

- Proven circulation of WNV in equids in Asia and Pacific regions
- Underevaluation of WNV positive cases in equids (due to JEV endemisation)
- Urgent need to implement an integrative surveillance system and a real time reporting system of equine suspicious cases drawing on European surveillance systems
- Standard operating procedures and trainings available at the EURL for equine diseases

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