

EPIZOOTIC HAEMORRHAGIC DISEASE

Stéphan Zientara, Corinne Sailleau, Emmanuel Bréard, Damien Vitour
ANSES-Animal Health Laboratory



World Organisation
for Animal Health
Founded as OIE

Ça saute quand même super
haut, un cerf...



Virology

Epidemiology

Disease

Diagnosis

Prevention

Ça saute quand même super haut, un cerf...



Virology

Epidemiology

Disease

Diagnosis

Prevention

— Class: *Resentoviricetes* Phylum: *Duplornaviricota*

— Order: *Reovirales* Class: *Resentoviricetes*

— Family: *Sedoreoviridae* Order: *Reovirales*

+ Genus: *Cardoreovirus* Family: *Sedoreoviridae*

+ Genus: *Mimoreovirus* Family: *Sedoreoviridae*

— Genus: *Orbivirus* Family: *Sedoreoviridae*

Species: *African horse sickness virus* Genus: *Orbivirus*

Species: *Bluetongue virus* Genus: *Orbivirus*

Species: *Changuinola virus* Genus: *Orbivirus*

Species: *Chenuda virus* Genus: *Orbivirus*

Species: *Chobar Gorge virus* Genus: *Orbivirus*

Species: *Corriparta virus* Genus: *Orbivirus*

Species: *Epizootic hemorrhagic disease virus* Genus: *Orbivirus*

Species: *Equine encephalosis virus* Genus: *Orbivirus*

Species: *Eubenangee virus* Genus: *Orbivirus*

Species: *Great Island virus* Genus: *Orbivirus*

Species: *Ieri virus* Genus: *Orbivirus*

Species: *Lebombo virus* Genus: *Orbivirus*

Species: *Orungo virus* Genus: *Orbivirus*

Species: *Palyam virus* Genus: *Orbivirus*

Species: *Peruvian horse sickness virus* Genus: *Orbivirus*

Species: *St Croix River virus* Genus: *Orbivirus*

Species: *Umatilla virus* Genus: *Orbivirus*

Species: *Wad Medani virus* Genus: *Orbivirus*

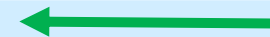
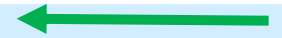
Species: *Wallal virus* Genus: *Orbivirus*

Species: *Warrego virus* Genus: *Orbivirus*

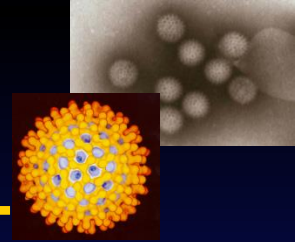
Species: *Wongon virus* Genus: *Orbivirus*

Species: *Yunnan orbivirus* Genus: *Orbivirus*

+ Genus: *Phytoreovirus* Family: *Sedoreoviridae*



Epizootic hemorrhagic disease virus (EHDV)



Family *Reoviridae* ; Genus *Orbivirus*

VP2

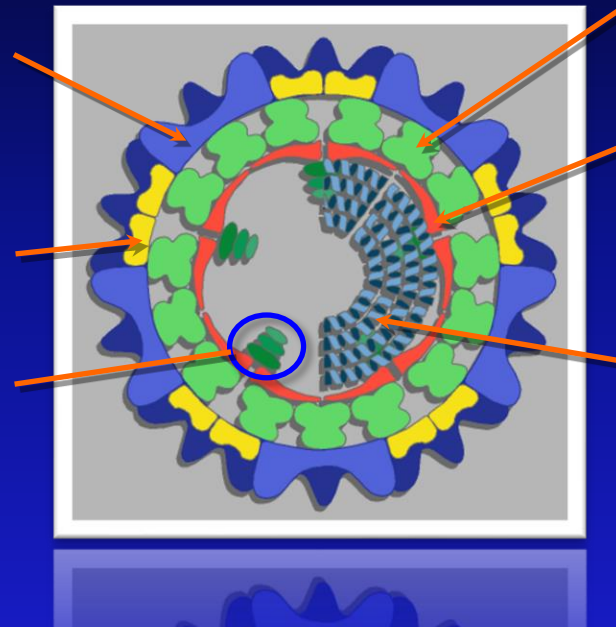
- binding to the receptor, virus entry
- neutralisation, type specificity

VP5

- virus entry

transcription complex :

- VP1 : RNA polymerase
- VP4 : capping enzyme
- VP6 : RNA helicase



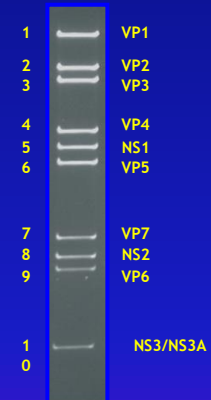
VP7

- conserved among serotypes

VP3

virus genome:

10 segments
dsARN



5 non structural proteins (NSP):

- NS1: pathogenesis and morphogenesis of EHDV (tubules)
 - NS2: RNA packaging and encapsidation
 - NS3/3A: virion release
- NS4: replication and counteracting host antiviral defense
 - NS5 ?

Réassortiment

Although recognised earlier in the south-eastern United States,

EHD was first described after a severe outbreak of the disease in **white-tailed deer** (*Odocoileus virginianus*) **in New Jersey in 1955**

Shope R.E., Macnamara L.G. & Mangold R. (1960). – A virus-induced epizootic hemorrhagic disease of the Virginia white-tailed deer (Odocoileus virginianus). J. Experim. Med., 111, 155–170



Review

Epizootic haemorrhagic disease N.J. Maclachlan, S. Zientara, G. Savini & P.W. Daniels

Rev. Sci. Tech. Off. Int. Epiz., 2015, 34 (2), 341-351



**Ibaraki strain of EHDV2
isolated from infected cattle in 1959 in Ibaraki, Japan**

Mer du Japon

Honshū.
Island

Japon

Ibaraki

Osaka
大阪

Tokyo
東京

Mer Jaune

Mer de Chine
orientale

8 serotypes

Reference strains							
EHDV-1 USA1955/01	EHDV-2 CAN1962/01 Alberta EHDV-2 (Ibaraki virus) JAP1959/01	EHDV-3[M.Dom1] NIG1967/01	EHDV-4 NIG1968/01	EHDV-5 AUS1977/01	EHDV-6 AUS1981/07	EHDV-7 AUS1981/06	EHDV-8 AUS1982/06

Table 3: Commonly accepted reference strains in the ds RNA virus collection at Institute for Animal Health (IAH) Pirbright, UK and at the Arthropod-Borne Animal Diseases Research Laboratory (ABADRL), USA.

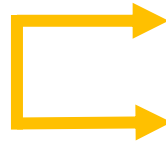
SCIENTIFIC REPORT submitted to EFSA

Scientific Review on Epizootic Hemorrhagic Disease¹

2009

Prepared by Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise
"G. Caporale"

7 serotypes



EHDV-1 New Jersey
EHDV-2 Alberta, Ibaraki & CSIRO 439
EHDV-3 Ib Ar 22619 ^a
EHDV-4 Ib Ar 33853
EHDV-5 CSIRO 157
EHDV-6 CSIRO 753
EHDV-7 CSIRO 775
EHDV-8 DPP 59

Reference strains							
EHDV-1 USA1955/01	EHDV-2 CAN1962/01	EHDV-3[M.Dom1] NIG1967/01	EHDV-4 NIG1968/01	EHDV-5 AUS1977/01	EHDV-6 AUS1981/07	EHDV-7 AUS1981/06	EHDV-8 AUS1982/06
	EHDV-2 Ibaraki virus JAP1959/01						

Table 2. Commonly accepted reference strains in the ds RNA virus collection at Institute for Animal Health (IAH) Pirbright, UK and at the Arthropod-Borne Animal Diseases Research Laboratory (ABADRL), USA.

SCIENTIFIC REPORT submitted to EFSA

Scientific Review on Epizootic Hemorrhagic Disease¹

Prepared by Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise
"G. Caporale"

Virus Research 145 (2009) 200–210

Contents lists available at ScienceDirect

Virus Research

journal homepage: www.elsevier.com/locate/virusres




Genetic and phylogenetic analysis of the outer-coat proteins VP2 and VP5 of epizootic haemorrhagic disease virus (EHDV): Comparison of genetic and serological data to characterise the EHDV serogroup

S.J. Anthony^{a,b,*}, S. Maan^a, N. Maan^a, L. Kgosana^a, K. Bachanek-Bankowska^a, C. Batten^a, K.E. Darpel^{a,c}, G. Sutton^b, H. Attoui^a, P.P.C. Mertens^a

Putative new serotypes

Wright, I. M. 2013: Serological and Genetic Characterisation of Putative New Serotypes of Bluetongue Virus and Epizootic Haemorrhagic Disease Virus Isolated From an Alpaca. North-West University, South Africa

Infection, Genetics and Evolution 53 (2017) 38–46



Contents lists available at ScienceDirect

Infection, Genetics and Evolution

journal homepage: www.elsevier.com/locate/meegid



Research paper

Characterization of genome segments 2, 3 and 6 of epizootic hemorrhagic disease virus strains isolated in Japan in 1985–2013: Identification of their serotypes and geographical genetic types



Hiroaki Shirafuji ^{a,*}, Tomoko Kato ^a, Makoto Yamakawa ^b, Toru Tanaka ^c, Yutaka Minemori ^d, Tohru Yanase ^a

> [Emerg Infect Dis.](https://doi.org/10.3201/eid2612.191301) 2020 Dec;26(12):3081–3083. doi: 10.3201/eid2612.191301.

Novel Serotype of Epizootic Hemorrhagic Disease Virus, China

Heng Yang, Zhuoran Li, Jinping Wang, Zhanhong Li, Zhenxing Yang, Defang Liao, Jianbo Zhu, Huachun Li

PMID: 33219797 PMCID: [PMC7706924](https://pubmed.ncbi.nlm.nih.gov/PMC7706924/) DOI: [10.3201/eid2612.191301](https://doi.org/10.3201/eid2612.191301)

South Africa



EHDV-9?

Japan
(1998)



EHDV-10?

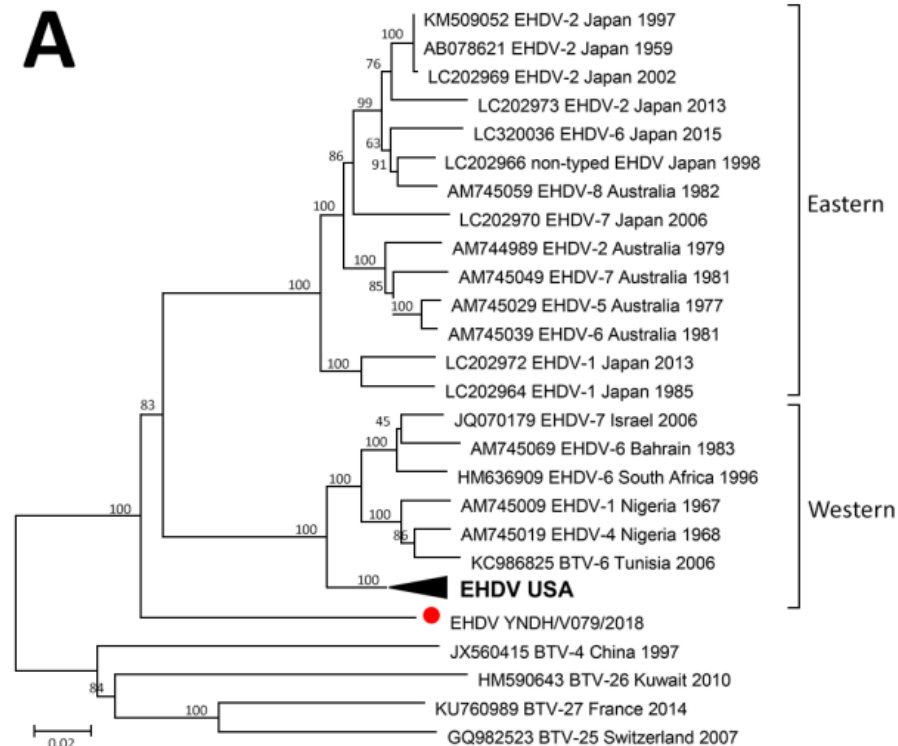
China
(2018)



EHDV-11?

Seg3

A



Seg2

B

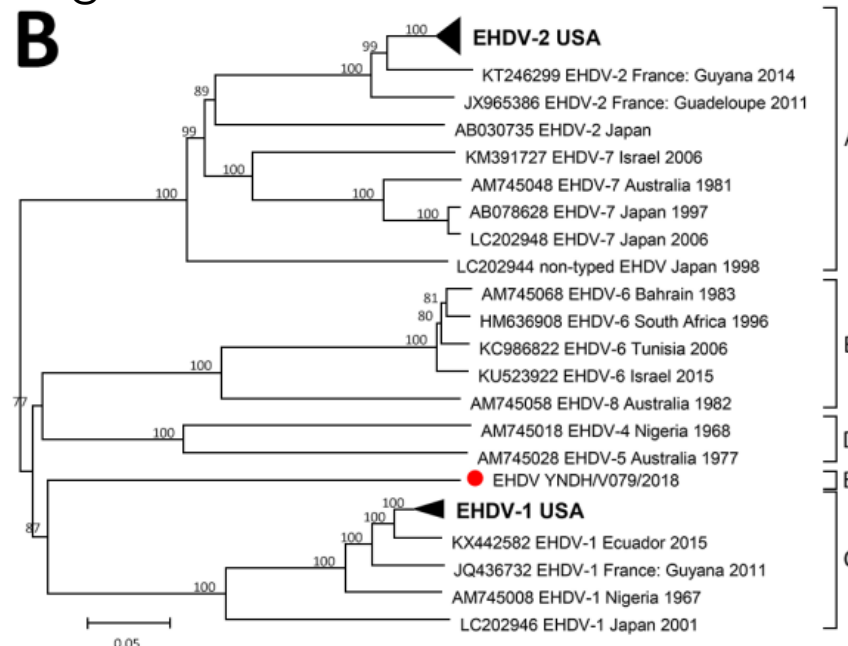


Figure. Phylogenetic analyses of EHDV based on segment 3 (A) and segment 2 (B) of YNDH/V079/2018 from Mangshi County, Yunnan Province, China (red dot), compared with other global EHDV isolates. The following convention was used to identify sequences: GenBank accession no., EHDV-serotype, country, isolation year. Eastern and Western topotypes of segment 3 and A–D groups of segment 2 were assigned as described by Anthony et al. (2,10); a distinct segment 2 group of the strain YNDH/V079/2018 isolated in China (2) is marked as group E. The nontyped strain from Japan isolated in 1998 is included in accessic LC202944 (4). We did not include the nontyped strain from South Africa, due to the lack of sequence infor strains were used as the outgroups. Number at each branch indicates a bootstrap value. Scale bars indica site. BTV, bluetongue virus; EHDV, epizootic hemorrhagic disease virus.



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journal homepage: www.elsevier.com/locate/virusres

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Prevention

Scientific Review on Epizootic Hemorrhagic Disease¹

Prepared by Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise
"G. Caporale"

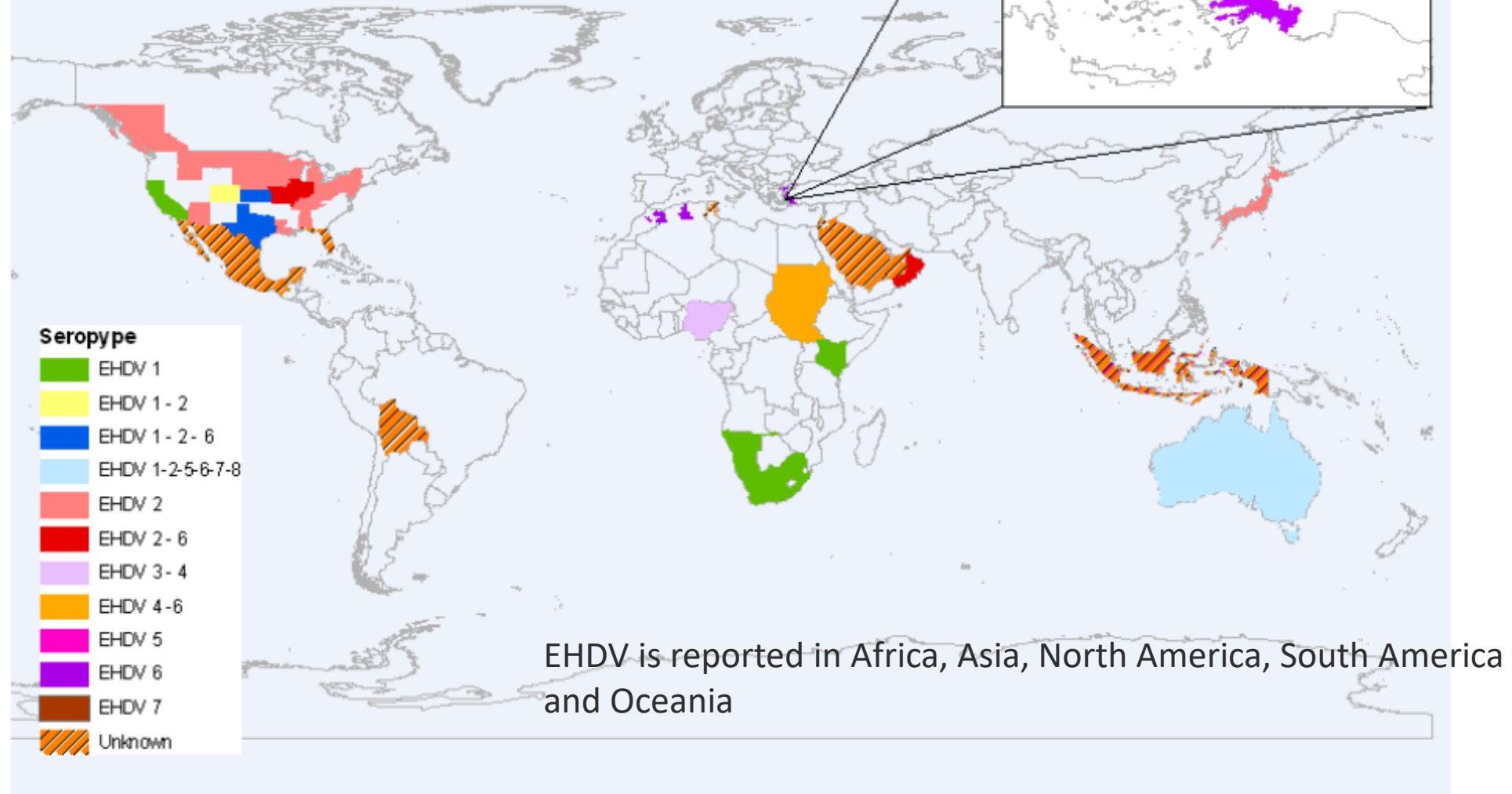
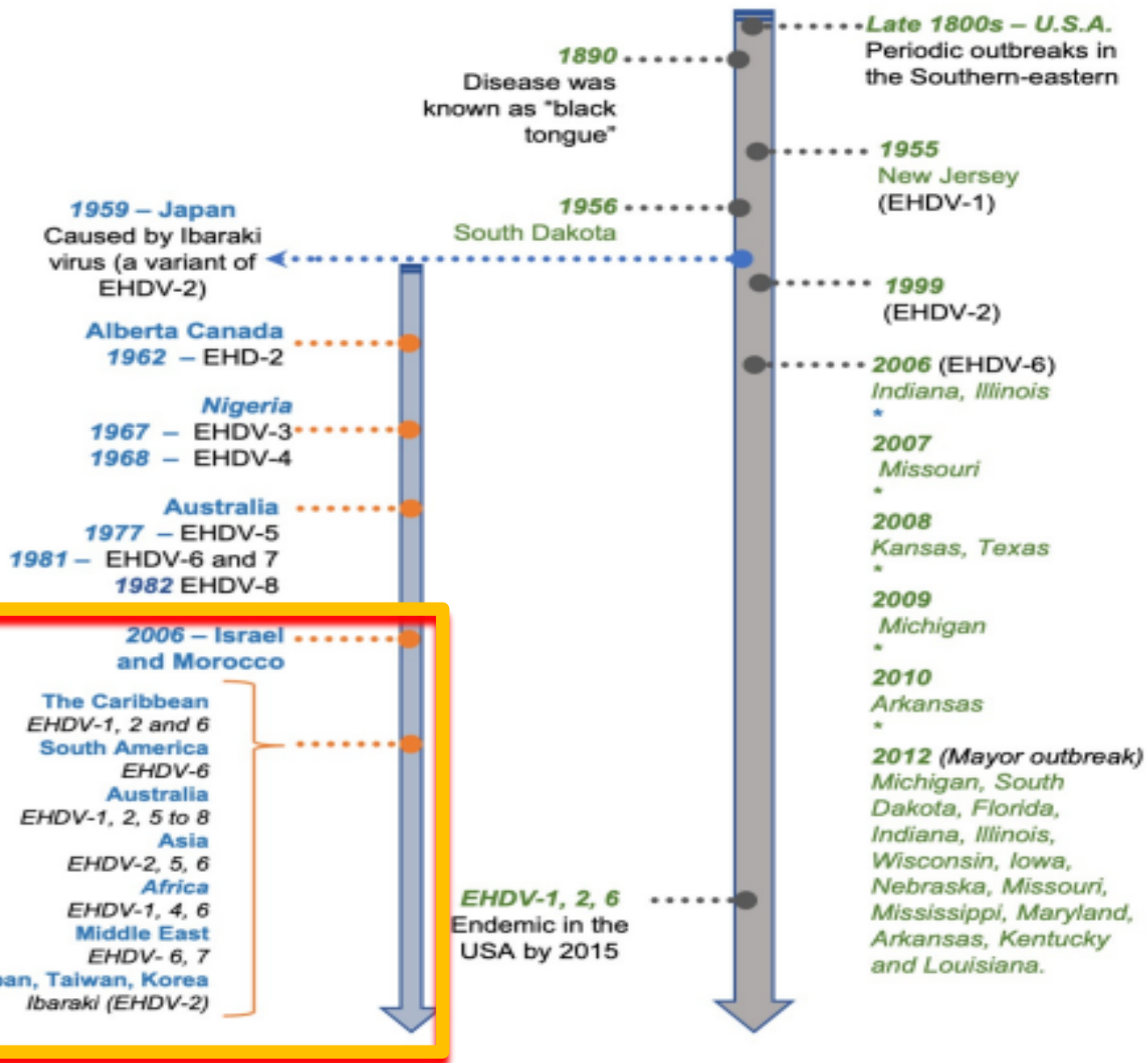


Figure 2: Map with the localization of the EHDV infection worldwide. The map summarizes the data of tables 6, 7, 8, 10 and 12. Where no geographical details as district/province etc, are not reported, the whole country has been indicated as infected.

Epizootic Hemorrhagic Disease Virus (EHDV)

Worldwide

United States of America



Review

Bluetongue and Epizootic Hemorrhagic Disease in the United States of America at the Wildlife–Livestock Interface

Nelda A. Rivera ^{1,*}, Csaba Varga ², Mark G. Ruder ³, Sheena J. Dorak ¹, Alfred L. Roca ⁴, Jan E. Novakofski ^{1,5} and Nohra E. Mateus-Pinilla ^{1,2,5,*}



ELSEVIER

Veterinary Microbiology

Volume 106, Issues 3–4, 10 April 2005, Pages 157–165



2005

Bluetongue virus in the French Island of Reunion

E. Bréard ^a, C. Sailleau ^a, C. Hamblin ^b, S. Zientara ^a



ELSEVIER

Veterinary Microbiology

Volume 155, Issues 2–4, 23 March 2012, Pages 191–197

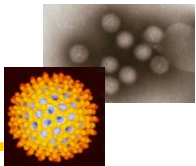
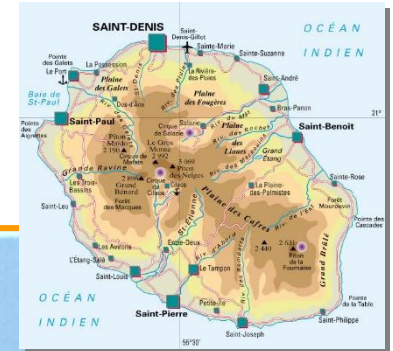


2012

Co-circulation of bluetongue and epizootic haemorrhagic disease viruses in cattle in Reunion Island

Corinne Sailleau ^a, Gina Zanella ^a, Emmanuel Breard ^a, Cyril Viarouge ^a, Alexandra Desprat ^a, Damien Vitour ^a, Micheline Adam ^a, Laurent Lasne ^b, Arnaud Martrenchar ^c, Labib Bakkali-Kassimi ^a, Laura Costes ^b, Stéphan Zientara ^a

La Réunion Island



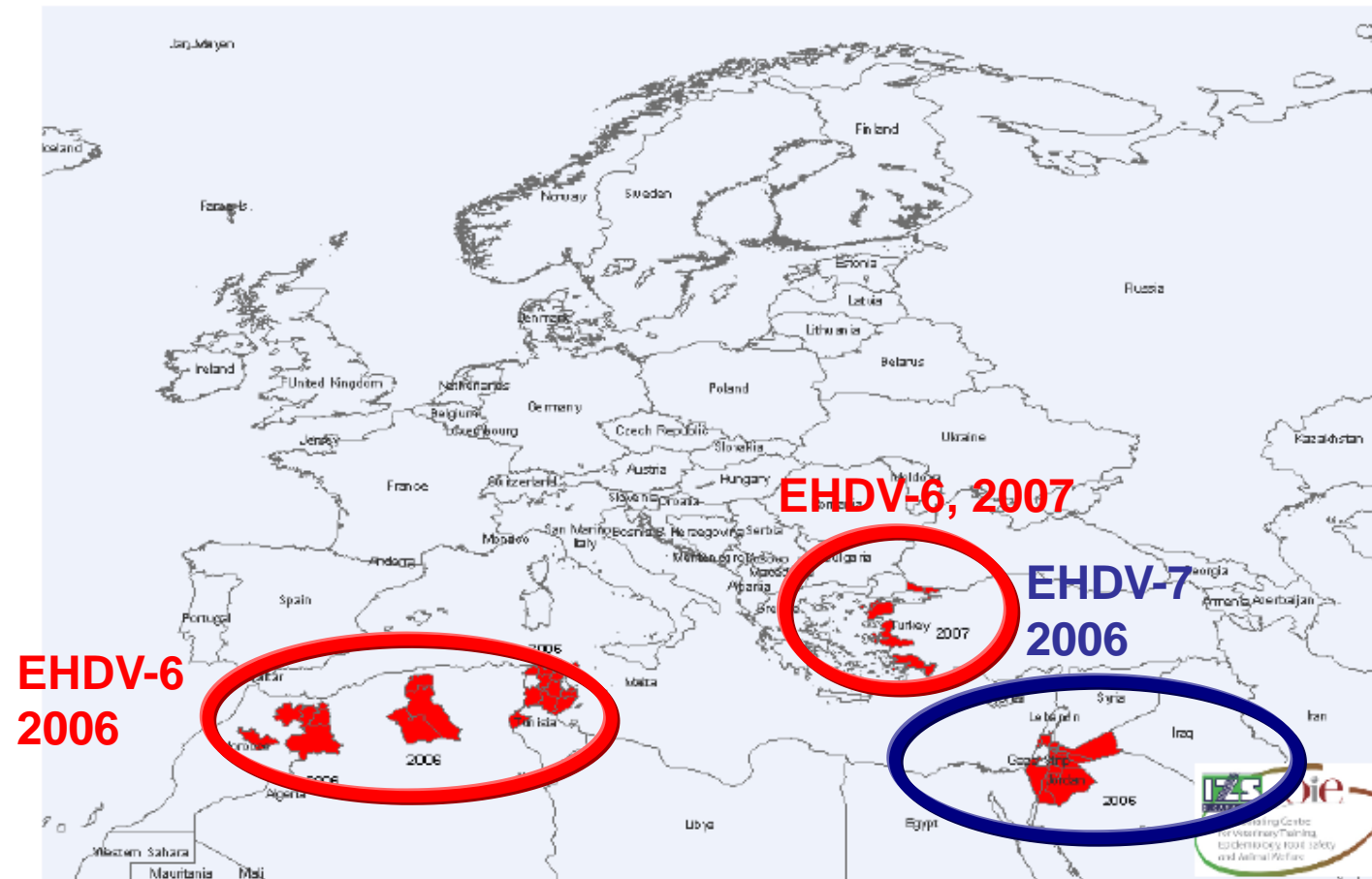
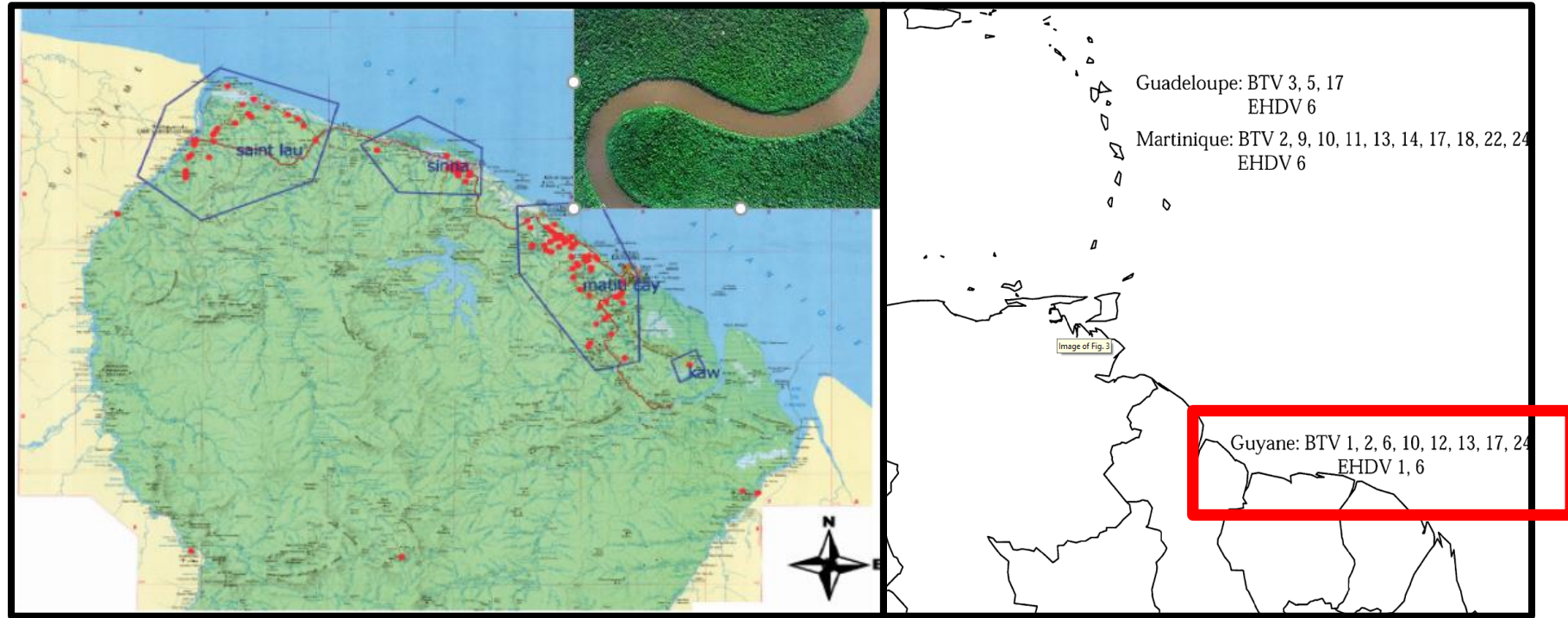


Figure 1: Map with the localization of the most recent outbreaks (2006-2007) in countries bordering the Mediterranean Basin. Where no geographical details as district/province etc, are not reported, the whole country has been indicated as infected. More details about the outbreaks are reported in Table 9.

French Guiana: study in 2011 and 2012



Bovine sampled in herds localized in

- agricultural land
- near the coast

Mainly sampled from June to August 2011-2012



Contents lists available at [ScienceDirect](http://www.sciencedirect.com)

Veterinary Microbiology

journal homepage: www.elsevier.com/locate/vetmic



Identification of bluetongue virus and epizootic hemorrhagic disease virus serotypes in French Guiana in 2011 and 2012

Cyril Viarouge^a, Renaud Lancelot^{c,d}, Germain Rives^b, Emmanuel Bréard^a,
Manuelle Miller^b, Xavier Baudrimont^b, Virginie Doceul^a, Damien Vitour^a,
Stéphan Zientara^a, Corinne Sailleau^{a,*}

Isolation (2013 – 2020):

- 1st passage: KC cells or embryonated eggs ; 2nd passage: BSR cells

60 BTV isolates: 14 serotypes (1, 2, 3, 6, 10, 11, 12, 13, 14, 17, 18, 19, 22 and 24)*

8 EHDV isolates: 3 serotypes (1, 2, 6)

*: in blue: new serotypes detected



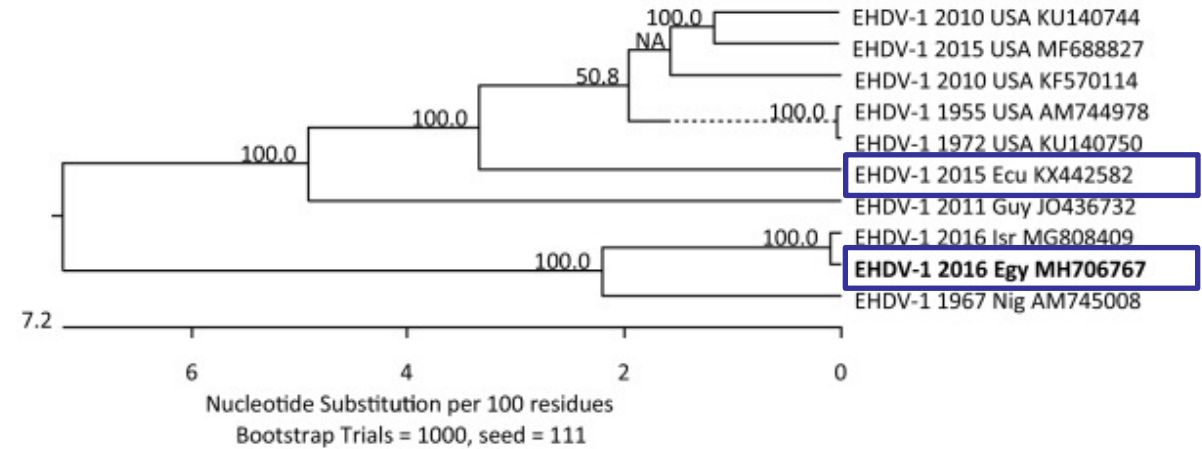
EHDV-1



Research paper

Presence of bluetongue and epizootic hemorrhagic disease viruses in Egypt in 2016 and 2017

Sahar Ahmed ^a, Mohamed Abd El-Fatah Mahmoud ^b, Cyril Viarouge ^c, Corinne Sailleau ^c, Stephan Zientara ^c, Emmanuel Breard ^c  



SHORT COMMUNICATION |  Full Access

Novel serotype of bluetongue virus in South America and first report of epizootic haemorrhagic disease virus in Ecuador

J. Verdezoto, E. Breard, C. Viarouge, H. Quenault, P. Lucas, C. Sailleau, S. Zientara, D. Augot, S. Zapata 

> [Vet Ital.](#) 2018 Mar 31;54(1):87-90. doi: 10.12834/VetIt.973.5129.2.

Epizootic haemorrhagic disease virus circulation in Tunisia

EHDV-6 in 2012
(positive serologies)

Selma Mejri ¹, Sameh Ben Dhaou, Marwa Jemli, Emmanuel Bréard, Corinne Sailleau, Soufien Sghaier, Mohamed Zouari, Alessio Lorusso, Giovanni Savini, Stephan Zientara, Salah Hammami

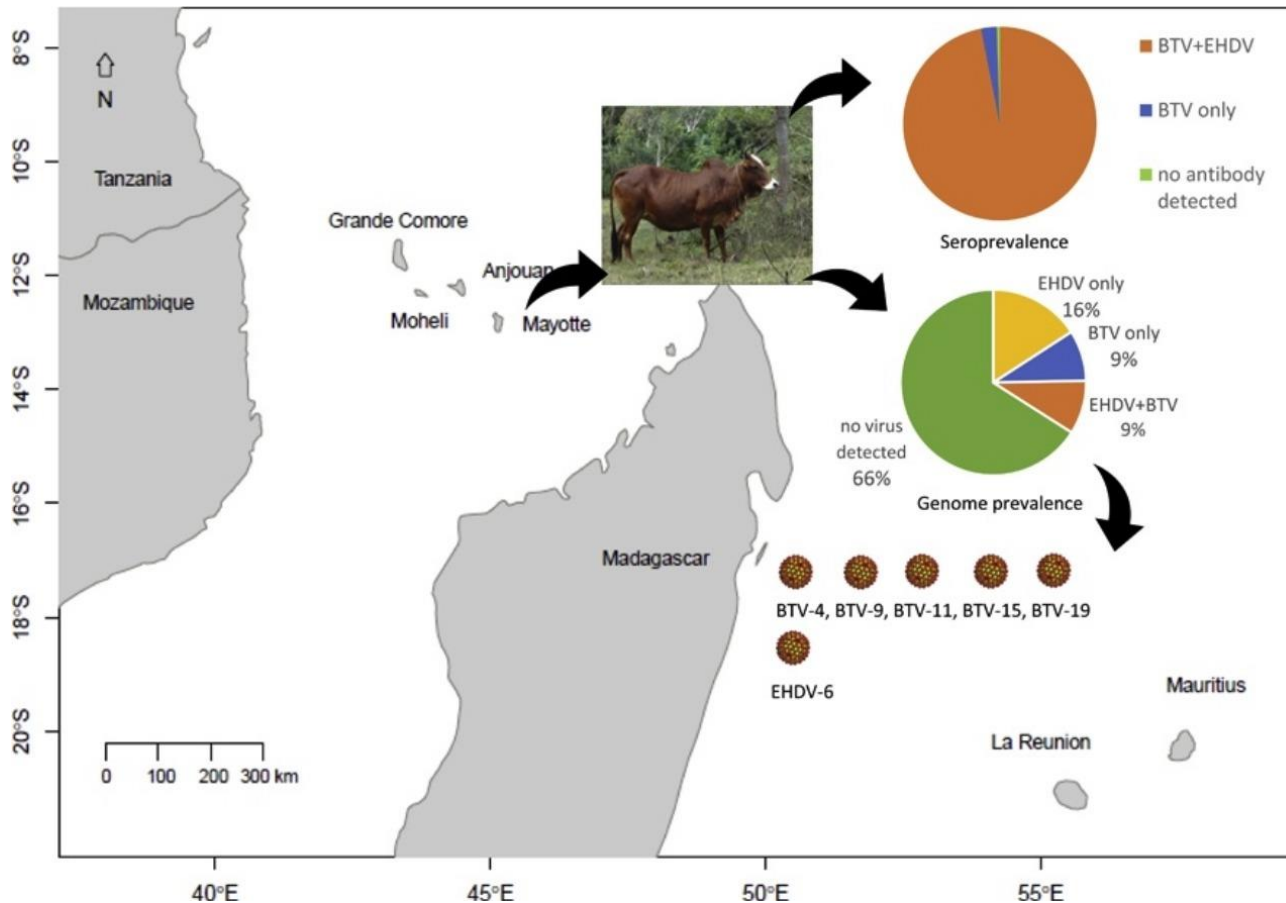


Article

Epizootic Haemorrhagic Disease Virus Serotype 8 in Tunisia, 2021

Soufien Sghaier ¹, Corinne Sailleau ², Maurilia Marcacci ³ , Sarah Thabet ¹, Valentina Curini ³ , Thameur Ben Hassine ⁴, Liana Teodori ³, Ottavio Portanti ³ , Salah Hammami ⁵, Lucija Jurisic ^{3,6}, Massimo Spedicato ³ , Lydie Postic ² , Ines Gazani ⁷, Raja Ben Osman ⁸, Stephan Zientara ², Emmanuel Bréard ² , Paolo Calistri ³ , Jürgen A. Richt ⁹ , Edward C. Holmes ¹⁰ , Giovanni Savini ³, Francesca Di Giallonardo ¹¹  and Alessio Lorusso ^{3,*} 

EHDV-1, EHDV-2, EHDV-6, and EHDV-7 recently associated with illness and death in cattle in Asia, the Mediterranean Basin, South Africa, North America, **and Reunion/Mayotte Islands**



EHDV-6

2019



Acta Tropica
Volume 191, March 2019, Pages 24-28



Evidence of bluetongue and Epizootic Haemorrhagic disease circulation on the island of Mayotte

Laure Dommergues ^a, Cyril Viarouge ^b, Raphaëlle Métras ^{c, d}, Chouanibou Youssouffi ^a, Corinne Saillieu ^b, Stephan Zientara ^b, Eric Cardinale ^{d, e}, Catherine Cêtre-Sossah ^{d, e}

Epizootic Haemorrhagic Disease virus serotype 8 in Tunisia, 2021

Soufien Sghaier¹, Corinne Sailleau², Maurilia Marcacci³, Sarah Thabet¹, Valentina Curini³, Thameur Ben Hassine Liana Teodori³, Ottavio Portanti³, Salah Hammami⁵, Lucija Jurisic^{3,6}, Massimo Spedicato³, Lydie Postic², Ines Gazani⁷, Raja Ben Osman⁸, Stephan Zientara², Emmanuel Breard², Paolo Calistri³, Juergen A. Richt⁹, Edward C. Holmes¹⁰, Giovanni Savini³, Francesca Di Giallonardo¹¹, and Alessio Lorusso^{3*}



Figure 1. Clinical signs in cattle. (A) Teat erosions, (B) Oral congestion and erosions, (C) Submandibular oedema, conjunctivitis, and lacrimation, (D) Nasal discharge and mucosal erosion.

Table 1. Blast results for nucleotide and amino acid sequences for the Tunisia 2021 strain.

Segment	blastn output strain (accession number)	% Identity
1	Israel 2006 ISR2006/04 serotype 7 (KM391733)	98.58
2	Australia 1982 CPR_3961A serotype 8 (AM745058)	77.0
3	Tunisia 2006 2577 serotype 6 (KC986825)	96.59
4	Nigeria 1967 IbAr22619 serotype 1 (AM745010)	93.44
5	South Africa 1996 M44/96 serotype 6 (HM636911)	97.55
6	Australia 1982 CPR_3961A serotype 8 (AB078633)	71.53
7	South Africa 1996 M44/96 serotype 6 (HM636913)	98.01
8	South Africa 1996 M44/96 serotype 6 (HM636914)	98.31
9	Israel 2006 ISR2006/04 serotype 7 (KM391738)	97.63
10	Nigeria 1967 IbAr22619 serotype 1 (AM745016)	95.95

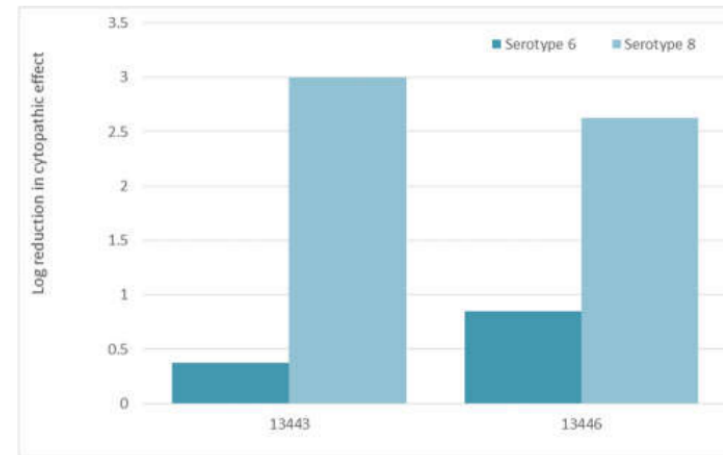
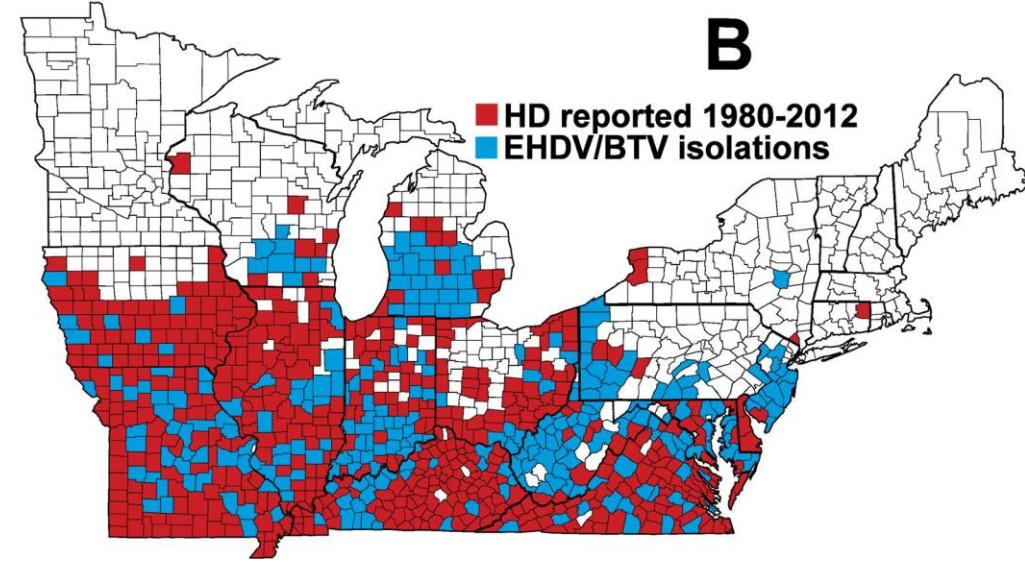
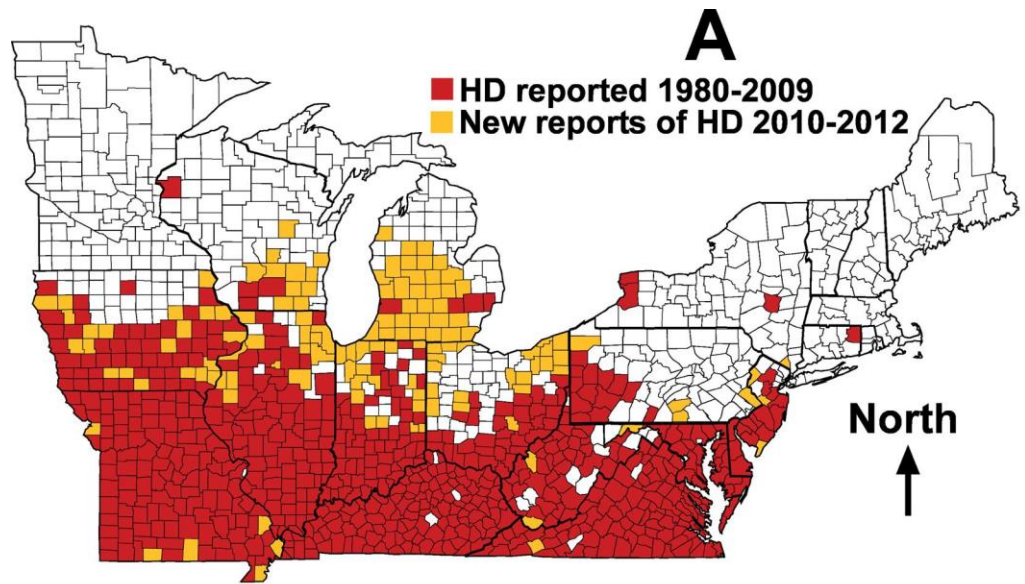


Figure 2B. Values represent the log reduction in cytopathic effects (neutralisation). A two-way reduction of at least two logs is considered to classify a virus as belonging to the serotype of the antibody which neutralized it.



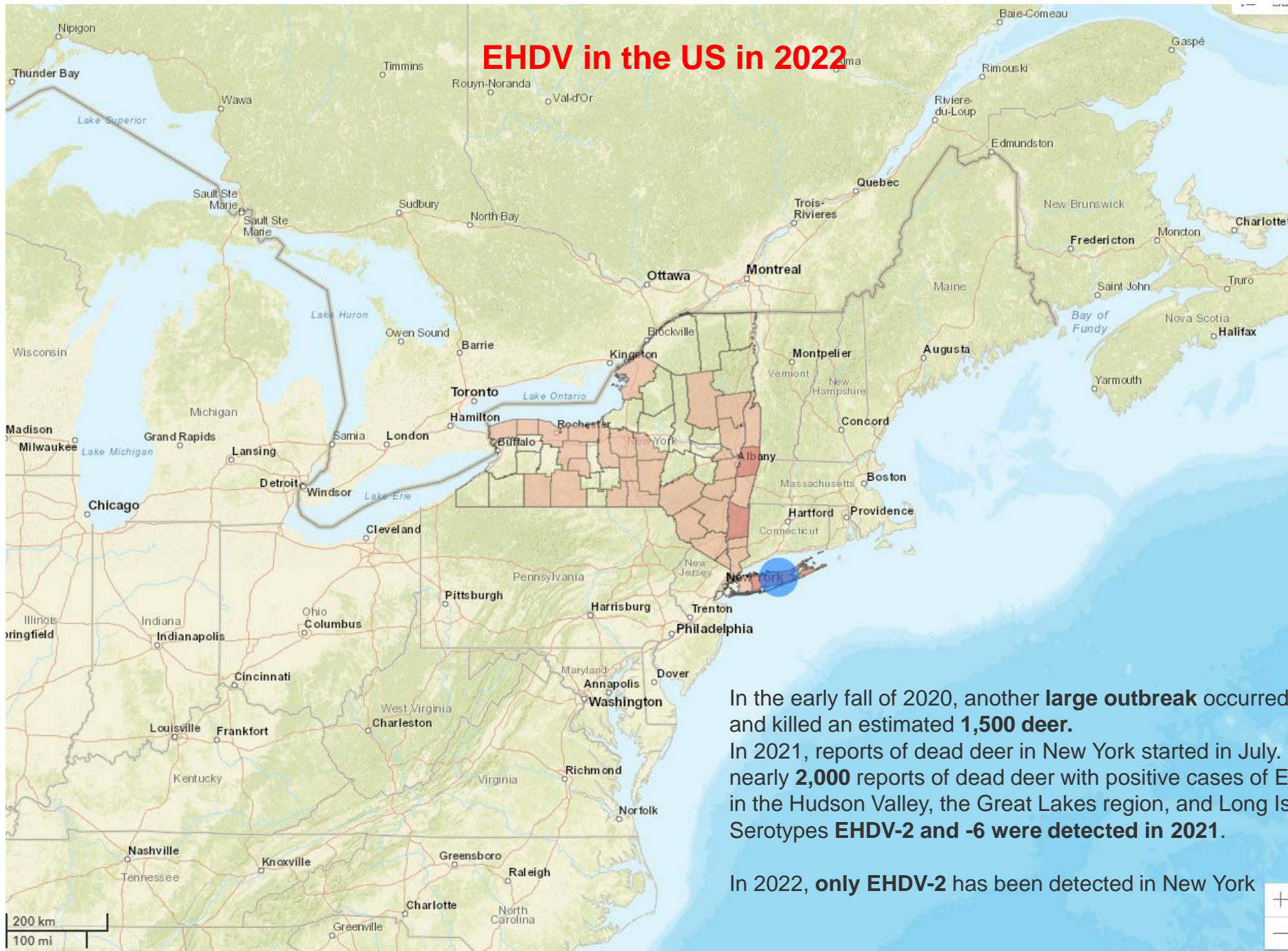
1 April 2015 [Translator Disclaimer](#)

APPARENT INCREASE OF REPORTED HEMORRHAGIC DISEASE IN THE MIDWESTERN AND NORTHEASTERN USA

David E. Stallknecht, Andrew B. Allison, Andrew W. Park, Jamie E. Phillips, Virginia H. Goekjian, Victor F. Nettles, John R. Fischer

[Author Affiliations +](#)

EHDV in the US in 2022



In the early fall of 2020, another **large outbreak** occurred in the lower Hudson Valley and killed an estimated **1,500 deer**.

In 2021, reports of dead deer in New York started in July. This outbreak resulted in nearly **2,000** reports of dead deer with positive cases of EHD confirmed in 15 counties in the Hudson Valley, the Great Lakes region, and Long Island.

Serotypes **EHDV-2** and **-6** were detected in 2021.

In 2022, **only EHDV-2** has been detected in New York

Sardinia

- 8 November 2022 first confirmation in Europe of EHDV in a bull
- 4 holdings with infected animals
- Serotype 8 as the one circulating in Tunisia
- Wild animals: 15/11/2022 a deer caught in Pula (Cagliari Province) was detected positive with RT-PCR in blood. Spleen and lymph nodes were RT-PCR negative, so the infection was recent
- Surveillance Plan is implementing by the Region with the scientific support of the Regional Veterinary Epidemiology Centre, the National Reference Centre for Veterinary Epidemiology, Programming, Information and Risk Analysis and the National Reference Centre for Exotic Diseases of Animals



bioRxiv
THE PREPRINT SERVER FOR BIOLOGY

bioRxiv posts many COVID19-related papers. A reminder: they should not guide health-related behavior or be reported in the

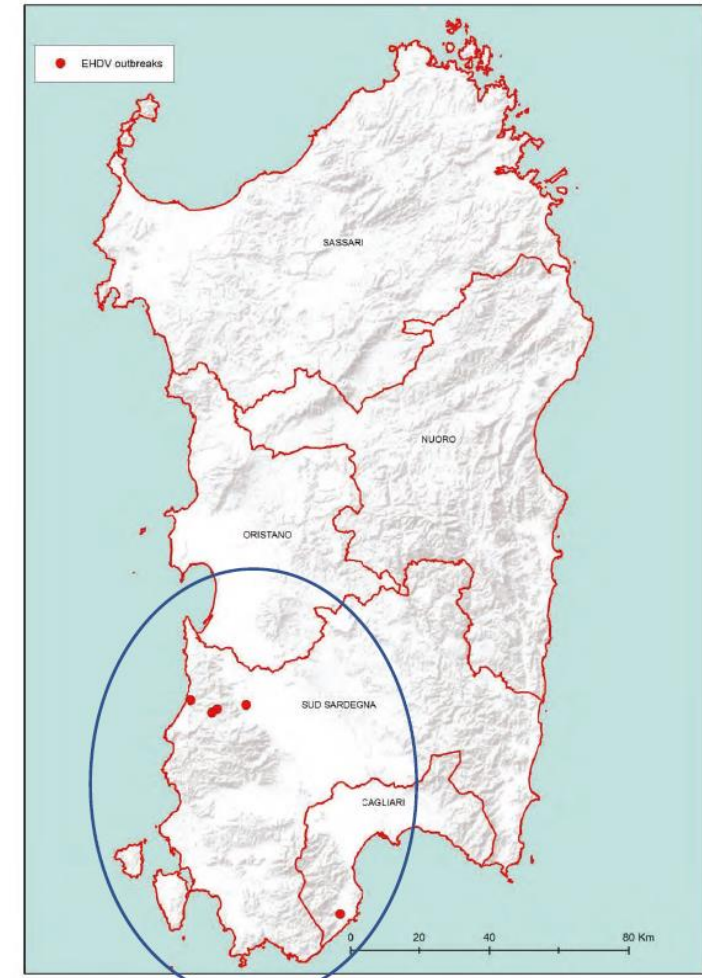
New Results

[Follow this preprint](#)

First Detection of Epizootic Haemorrhagic Disease virus in the European Union, Italy-2022

Alessio Lorusso, Stefano Cappai, Federica Loi, Luigia Pinna, Angelo Ruiu, Giontonella Puggioni, Annalisa Guercio, Giuseppa Purpari, Domenico Vicari, Soufien Sghaier, Stephan Zientara, Massimo Spedicato, Salah Hammami, Thameur Ben Hassine, Ottavio Portanti, Emmanuel Breard, Corinne Saillieu, Massimo Ancora, Daria Di Sabatino, Daniela Morelli, Paolo Calistri, Giovanni Savini

doi: <https://doi.org/10.1101/2022.11.23.517495>



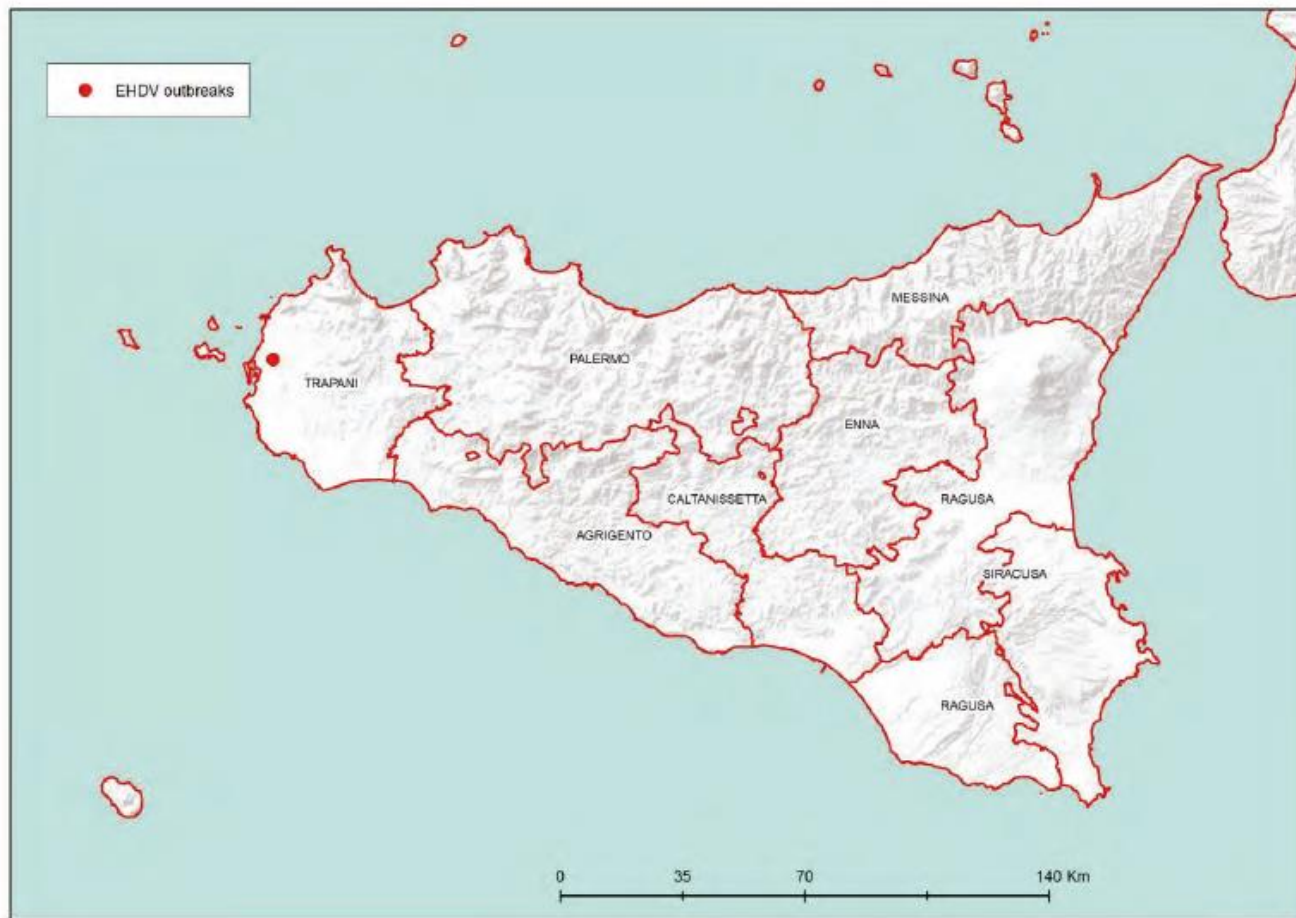
The first infected animal



Alessio Lorusso, IZST

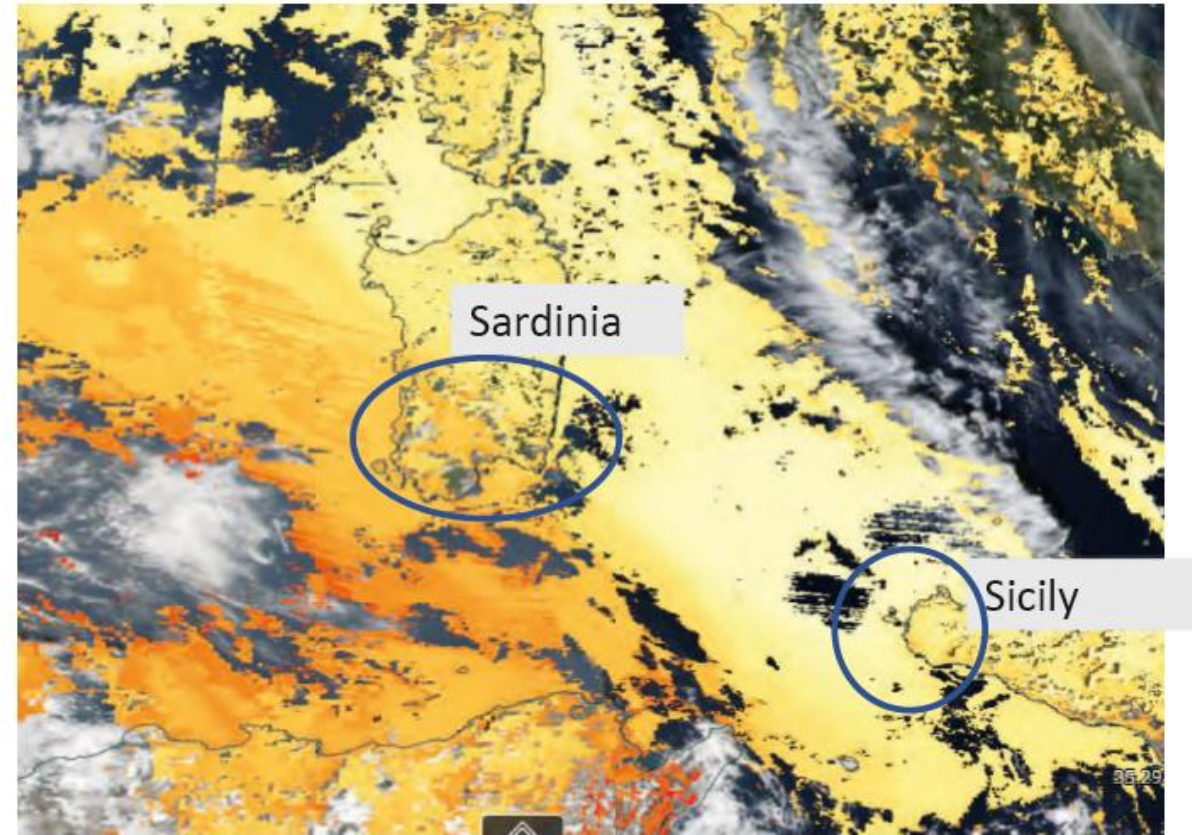
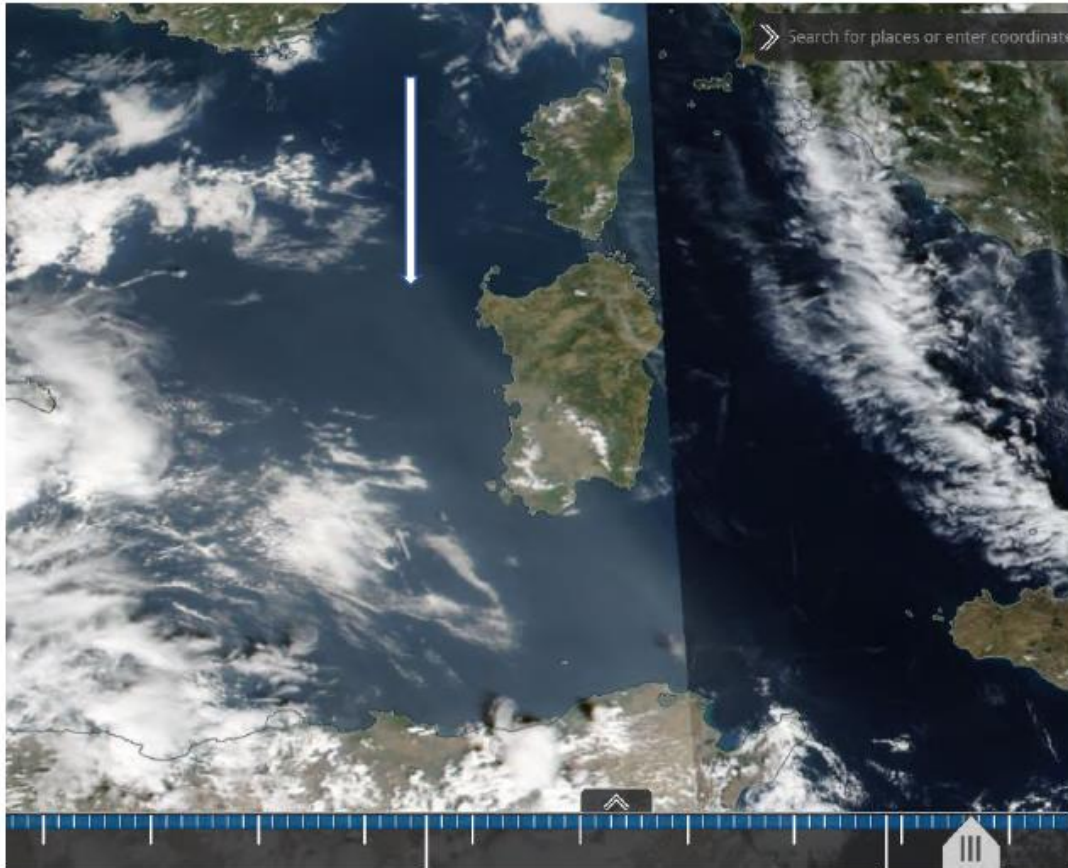
Sicily

- 1 Farm with 8 infected animals (3 with symptoms) RT-PCR and ELISA on a total of 26 animals tested
- Scialorrea, depression, fever, bloody gumline, hot and strongly reddened udders
- 1 cow died and the others healed



When EHDV has arrived in Italy?

All information we have, seem to confirm that the disease would be arrived between the end of September and at the beginning of October, due to the storm and seeds coming from the north Africa (Tunisia).



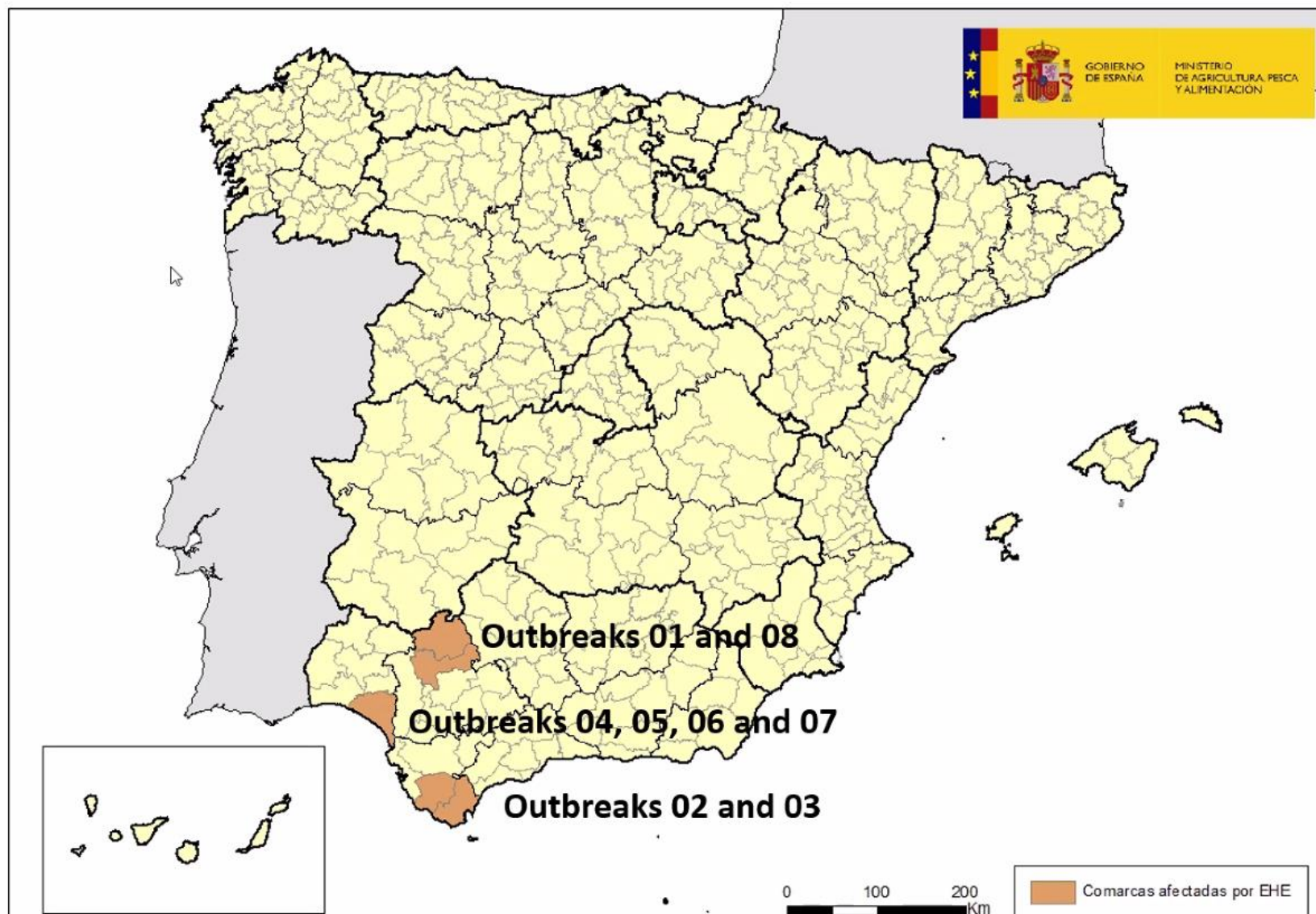
Detection of EHDV in cattle farms in Cádiz and Seville (Outbreaks 2022/01 and 02)

- Clinical suspicion in cattle from farms in Cádiz and Seville communicated to the VOS of Andalusia on November 15 and 16, 2022.
- Detected symptoms: fever, lesions in the oral mucosa, lameness due to inflammation of the coronary labrums.
- Blood samples resulted negative by BTV RT-PCR and confirmed EHD positive (RT-PCR and serology) at LCV on Nov 18, 2022.
- Official communication to the EU ADIS of two outbreaks of EHD on November 18, 2022. **EHD detected for the first time in Spain**
- A Farm in Seville that received deers from Cádiz, informed mortality in deers, which could explain the rapid jump between the two affected areas. Deer serum samples from this farm for serological studies pending to be received at LCV.



New EHDV outbreaks (until 30.11.22)

- ✓ New outbreaks (03 and 08) in the same areas
- ✓ Four new outbreaks (04, 05, 06 and 07) in free area in the province of Huelva
- ✓ All the outbreaks have affected bovines and have been detected by passive surveillance



2022

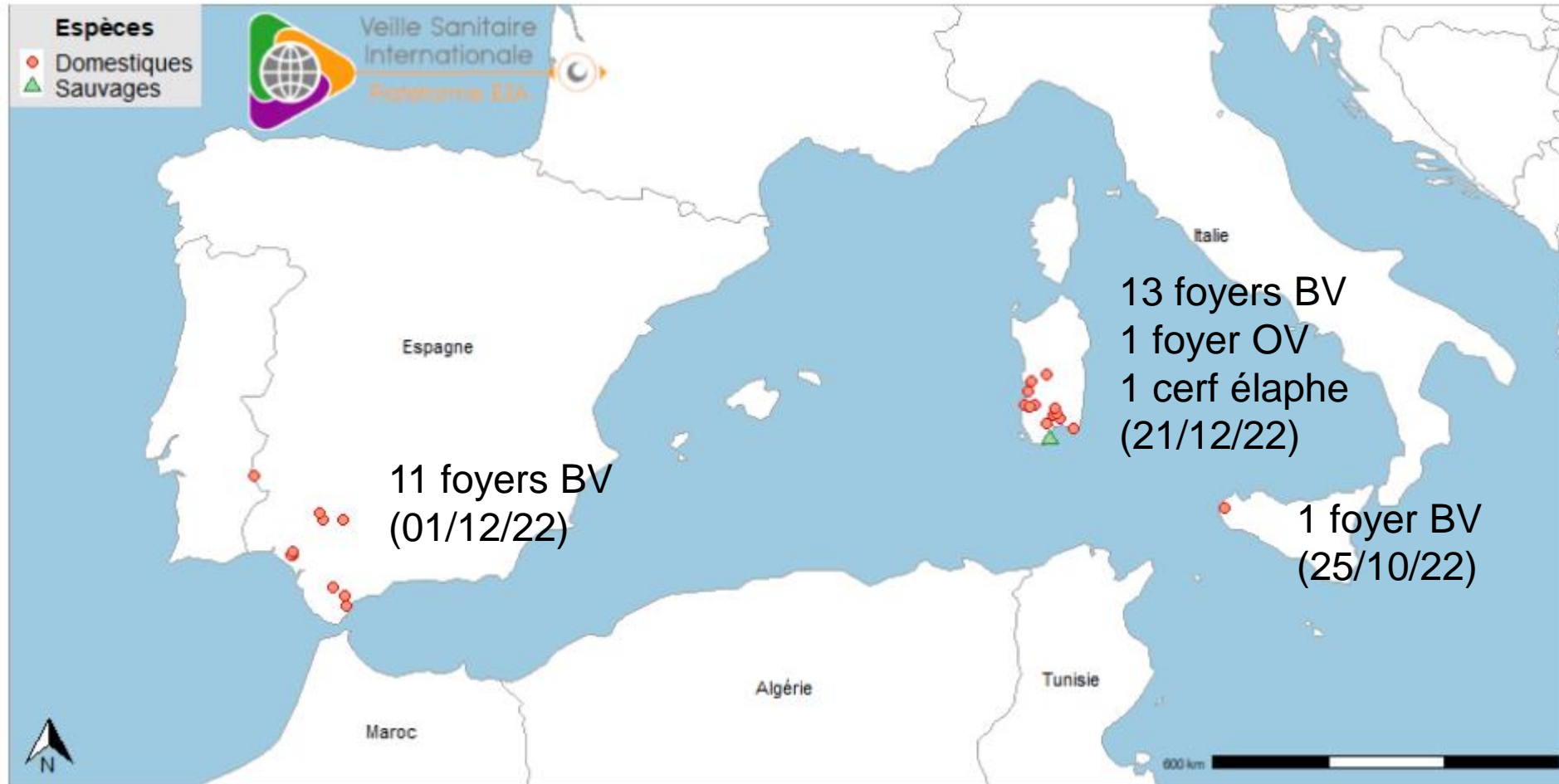


Figure 1. Localisation des foyers de maladie hémorragique épizootique (EHD) détectés depuis le 25/10/2022 (date de détection du premier foyer) (source : Commission Européenne ADIS le 06/02/2023).

1. EU intervention: Animal diseases

- ✓ EU intervention limited to listed and emerging diseases

List of diseases – 63 diseases

- Article 5(1) (most important diseases) – **FMD, CSF, ASF, HPAI, AHS**
- Article 5(2) – Annex II (amended by Regulation (EU) 2018/1629)



- ✓ Listed diseases prioritised and categorised:

Category A: immediate eradication (normally not present in the EU)

Category B: compulsory eradication throughout the Union

Category C: optional eradication in Member States

Category D: measures to prevent from spreading through movements between Member States or entry into the Union

Category E: notification and surveillance within the Union

Restrictions on the movement of live animals of susceptible species (cattle, sheep and goats) for intra-community trade

- EHD is categorized as a **D+E disease**, in accordance with Regulation (EU) 2018/1882, so it is a disease subject to surveillance on which **measures must be taken to prevent its introduction into the Union and its spread in connection with animal movements between Member States**
- In accordance with the provisions of Regulation (EU) 2020/688, **live movements to other Member States are restricted when they come from farms located within a minimum radius of 150 km around the outbreaks detected.**
- **Control measures at the national level that are not harmonized at the EU level**, are established by the Member State.

Virology

Epidemiology

Disease

Diagnosis

Prevention

Why Epizootic Haemorrhagic Disease of **DEER** ?







- Fever
- Weakness
- Inappetance
- Excessive salivation
- Facial oedema
- Hyperaemia of the conjunctiva
- Mucous membranes of the oral cavity
- Coronitis
- Stomatitis

Fulminant EHD characterised by excessive bleeding (haemorrhagic diathesis), dehydration, diarrhoea, and death.



Transmission by
Culicoides sonorensis

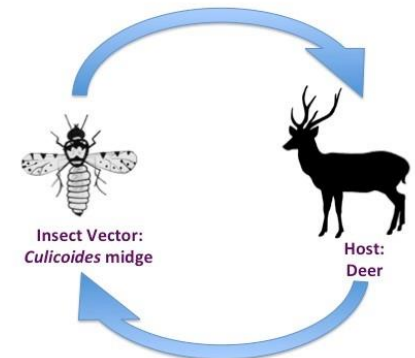
other species

- C. insignis*
- C. mohave*
- C. debilipalpis*
- C. obsoletus*
- C. scoticus*
- C. paraensis*
- C. spinosus*
- C. stellifer*

...



Disease Transmission Cycle of Epizootic Hemorrhagic Disease (EHD)





90% fatal in deer

- EHD can occur in different forms related to the viral serotype and the species involved.
- EHDV serotypes **1, 2, 6,7 and 8** are responsible for clinical disease in cattle (no clinical signs in small ruminants).



Table 1. Reported BTV and/or EHDV infection with or without clinical signs in wild and captive ruminant host species in the USA.

Ruminant Species			Detected (✓)	
Family	Common Name	Latin Name	BTV	EHDV
Cervidae	White-tailed deer	<i>Odocoileus virginianus</i>	✓	✓
	Mule deer	<i>Odocoileus hemionus</i>	✓	✓
	Black-tailed deer	<i>Odocoileus hemionus columbianus</i>	✓	✓
	Elk (wapiti)	<i>Cervus canadensis</i>	✓	✓
	Rocky Mountain Elk	<i>Cervus elaphus nelsoni</i>	✓	✓
	Axis deer	<i>Axis axis</i>	✓	✓
	Fallow deer	<i>Dama dama</i>	✓	✓
	Sika deer	<i>Cervus nippon</i>	✓	✓
	Yaks	<i>Bos grunniens</i>		✓
	Père David's deer	<i>Elaphurus davidianus</i>		✓
	Moose	<i>Alces alces</i>		✓
Bovidae	Cattle	<i>Bos taurus</i>	✓	✓
	Mountain goat	<i>Oreamnos americanus</i>	✓	
	Bison	<i>Bison bison</i>	✓	✓
	Blackbuck antelope	<i>Antilope cervicapra</i>	✓	✓
	Gerenuk	<i>Litocranius walleri</i>	✓	
	Bighorn sheep	<i>Ovis canadensis</i>	✓	✓
	Dall sheep	<i>Ovis dalli</i>		✓
	Bongo antelope	<i>Tragelaphus eurycerus</i>		✓
	Roan antelope	<i>Hippotragus equinus</i>		✓
	Lesser kudu	<i>Tragelaphus imberbis</i>		✓
	Dama gazelle	<i>Nanger dama</i>		✓
Antilocapridae	Pronghorn	<i>Antilocapra americana</i>	✓	✓
Camelidae	Alpaca	<i>Vicugna pacos</i>	✓	

Epizootic haemorrhagic disease virus (EHDV) mainly infects deer, but sheep and cattle can also be infected.

Associated diseases:

EHDV has become an emerging disease **in cattle**, and was added to the World Organisation of Animal Health list of notifiable diseases in **May 2008**.

- Loss of appetite
- Fear of humans lost
- Extensive haemorrhages
- Weakness
- Excessive salivation
- Rapid pulse and respiratory rate
- Fever
- Blue tongue from lack of oxygenated blood
- Breaking of hooves caused by growth interruptions
- Diarrhoea
- Unconsciousness
- Death

The first cow with hemorrhagic conjunctivitis in Israel, end of August 2006, firstly suspected as BEFV infection

EHDV7



> [Vet Ital. 2016 Sep 30;52\(3-4\):343-351. doi: 10.12834/VetIt.641.3154.2.](#)

Unusual clinical manifestations in Israeli ruminant populations infected with Orbiviruses

[Velizar Bumarov](#)¹, [Natalia Golender](#), [Diza Rotenberg](#), [Jacob Brenner](#)

Affiliations + expand

PMID: 27723046 DOI: 10.12834/VetIt.641.3154.2



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Rapid body weight loss



> Vet Ital. 2016 Sep 30;52(3-4):343-351. doi: 10.12834/VetIt.641.3154.2.

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Affiliations + expand

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EHDV infection: “parchment skin”

> [Vet Ital.](#) 2016 Sep 30;52(3-4):343-351. doi: 10.12834/VetIt.641.3154.2.

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PMID: 27723046 DOI: 10.12834/VetIt.641.3154.2



EHD: Cow, oral mucosa :
mouth. Multiple blunted and
congested papillae.



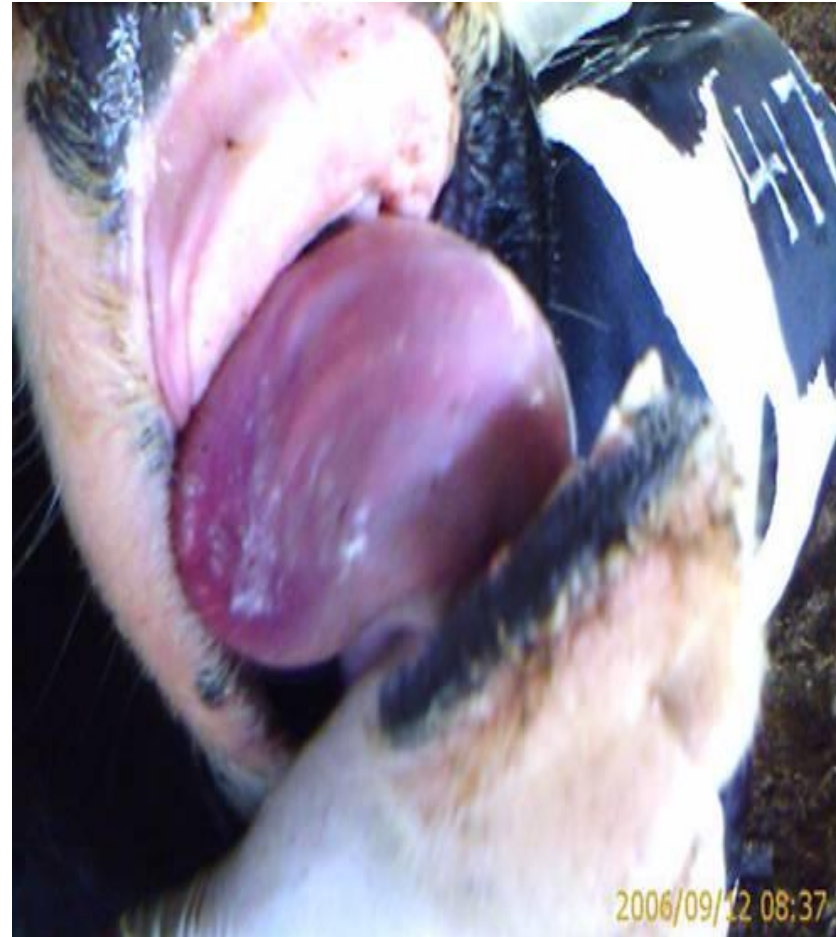
> [Vet Ital.](#) 2016 Sep 30;52(3-4):343-351. doi: 10.12834/VetIt.641.3154.2.

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EHDV infection: bluetongue(-like)



Teats and utter petechia and discoloration

> [Vet Ital.](#) 2016 Sep 30;52(3-4):343-351. doi: 10.12834/VetIt.641.3154.2.

Unusual clinical manifestations in Israeli ruminant populations infected with Orbiviruses

Velizar Bumbarov ¹, Natalia Golender, Diza Rotenberg, Jacob Brenner

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Affiliations + expand

PMID: 27723046 DOI: 10.12834/VetIt.641.3154.2

Petechial lesions on the buccal tips and papillae

Virology

Epidemiology

Disease

Diagnosis

Prevention

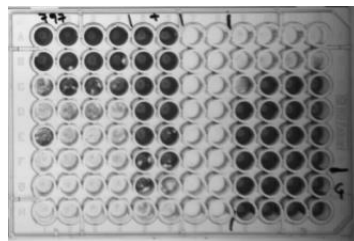
Diagnosis

Serology ← Serum

- AGID (BTV cross-reaction)
- ELISA (commercial kit Innovative diagnostics)



- IFI
- Serum neutralisation: **typing**



Virology ← spleen, blood (EDTA)

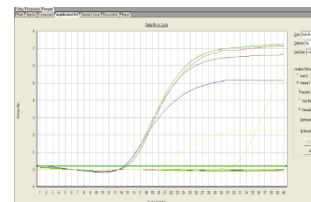
- ECE (IV)



- Newborn mice (brains)
- cell cultures BHK 21, Vero, KC cells, ...

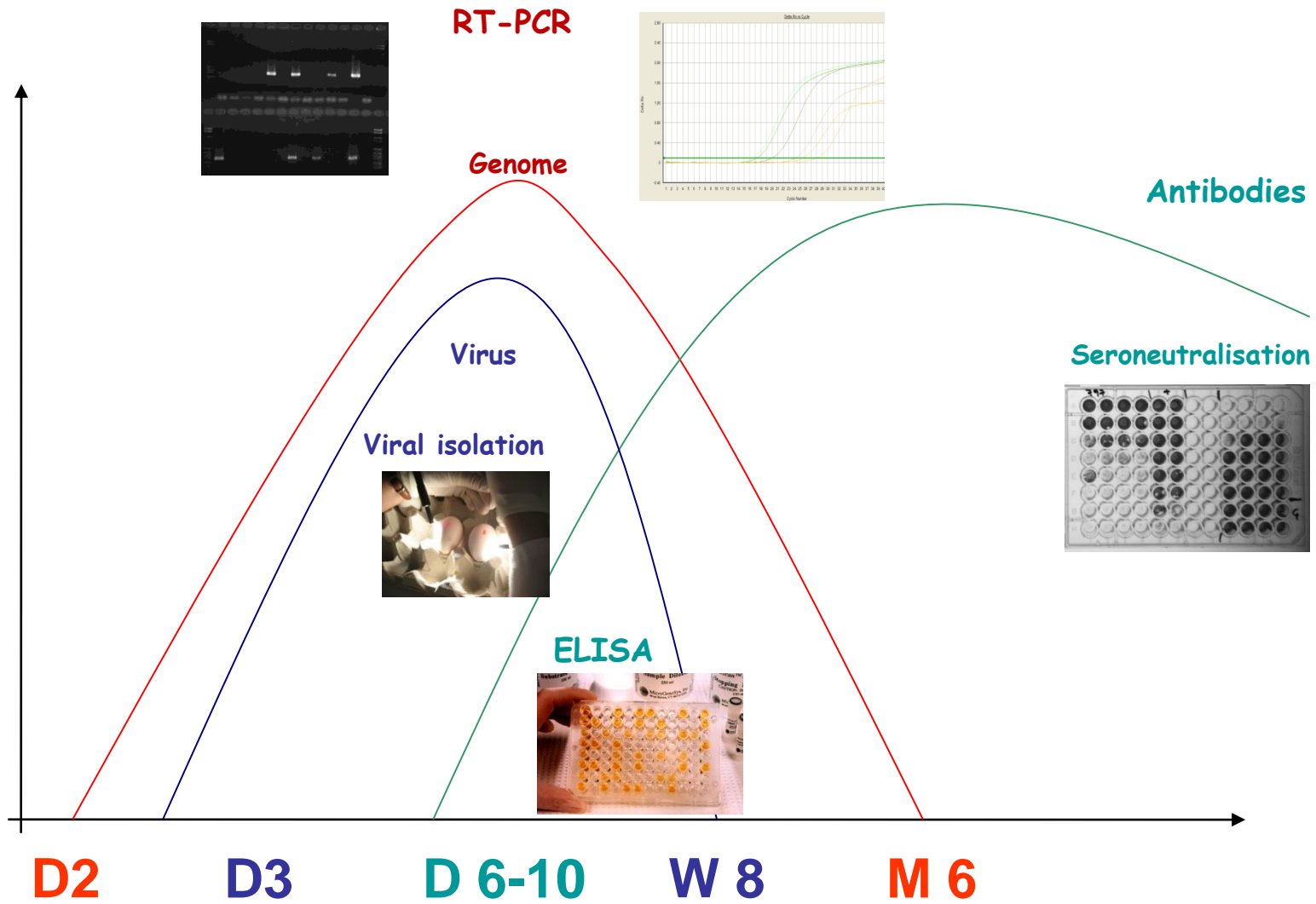
Genome detection (Pan EHDV + typing)

- rtRT-PCR group and type



- Virus neutralisation: typing

Diagnosis (Kinetics)



CHAPTER 3.1.7

EPIZOOTIC HAEMORRHAGIC DISEASE (INFECTION WITH EPIZOOTIC HEMORRHAGIC DISEASE VIRUS)

SUMMARY

Epizootic haemorrhagic disease (EHD) is a vector-borne infectious noncontagious viral disease of domestic and wild ruminants, primarily white-tailed deer (Odocoileus virginianus) and cattle. Sheep, goats and camelids might also be susceptible, but usually do not develop overt disease.

EHD virus (EHDV) is transmitted between ruminant hosts by species of Culicoides biting midges, thus EHD infections are strongly seasonal. White-tailed deer is the most severely affected species, with the peracute form having a high mortality rate. In cattle, clinical signs occur rarely but fever, anorexia, dysphagia, emaciation, ulcerative stomatitis, lameness, respiratory distress and erythema of the udder have been reported.

Detection of the agent: *EHDV belongs to the family Reoviridae, genus Orbivirus, and shares many morphological and structural characteristics with the other members of the genus, in particular bluetongue virus (BTV).*

EHDV particles are non-enveloped but have a double capsid with an icosahedral symmetry. Within the virus core, 10 double-stranded RNA genomic segments code for seven structural proteins (VP) and at least four nonstructural proteins (NS). The protein VP2 of the outer core is the major determinant of serotype specificity, while the VP7 of the inner core possesses the serogroup-specific antigens. At least seven distinct serotypes have been identified and two new putative serotypes; there is however, some uncertainty regarding the exact number of serotypes and a panel of reference strains of EHDV is not yet officially recognised.

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VIAROUGE C., BREARD E., ZIENTARA S., VITOUR D. & SAILLEAU C. (2015). Duplex Real-Time RT-PCR Assays for the Detection and Typing of Epizootic Haemorrhagic Disease Virus. *PLoS One*, **10**(7):e0132540.

Virology

Epidemiology

Disease

Diagnosis

Prevention



-Vaccines to control EHDV infection are not widely available.

-Exception is Ibaraki disease (EHDV-2), for which both inactivated and live attenuated vaccines exist in Japan



“KYOTOBIKEN” IBARAKI DISEASE LIVE VACCINE

Prevention of Ibaraki disease

10 doses (10 mL)

-In the United States, only locally produced autogenous inactivated vaccines for immunisation of farmed deer are available

Randomized Controlled Trial > [Vaccine](#). 2016 Mar 14;34(12):1430-5.

doi: 10.1016/j.vaccine.2016.02.003. Epub 2016 Feb 11.

Innocuity of a commercial live attenuated vaccine for epizootic hemorrhagic disease virus serotype 2 in late-term pregnant cows

Massimo Spedicato ¹, Irene Carmine ¹, Liana Teodori ¹, Alessandra Leone ¹, Ottavio Portanti ¹, Valeria Marini ¹, Maura Piscicella ¹, Alessio Lorusso ², Giovanni Savini ¹

Epizootic hemorrhagic disease virus (EHDV)	CLP ^a	VP7, VP3	Two doses (prime: 500 µg; boost: 250 µg)	Rabbit	Not challenged	Incomplete Fruend's adjuvant	Induction of VP3- and VP7-specific antibodies.	[246]
	VLP ^a	VP2 (EHDV- 1),VP5,VP7,VP3	Two doses (prime: 500 µg; boost: 250 µg)	Rabbit	Not challenged	Incomplete Fruend's adjuvant	Neutralization against EHDV-1. Mild neutralization against EHDV-2 and EHDV-6.	
	VLP ^a	VP2 (EHDV- 6),VP5,VP7,VP3	Not evaluated in animal model	-	-	-	-	[248]

^a Recombinant baculovirus expression system; ^b plant-based expression system; ^c increased survival rate; ^d reduction or absence of viremia; ^e reduced body weight loss.



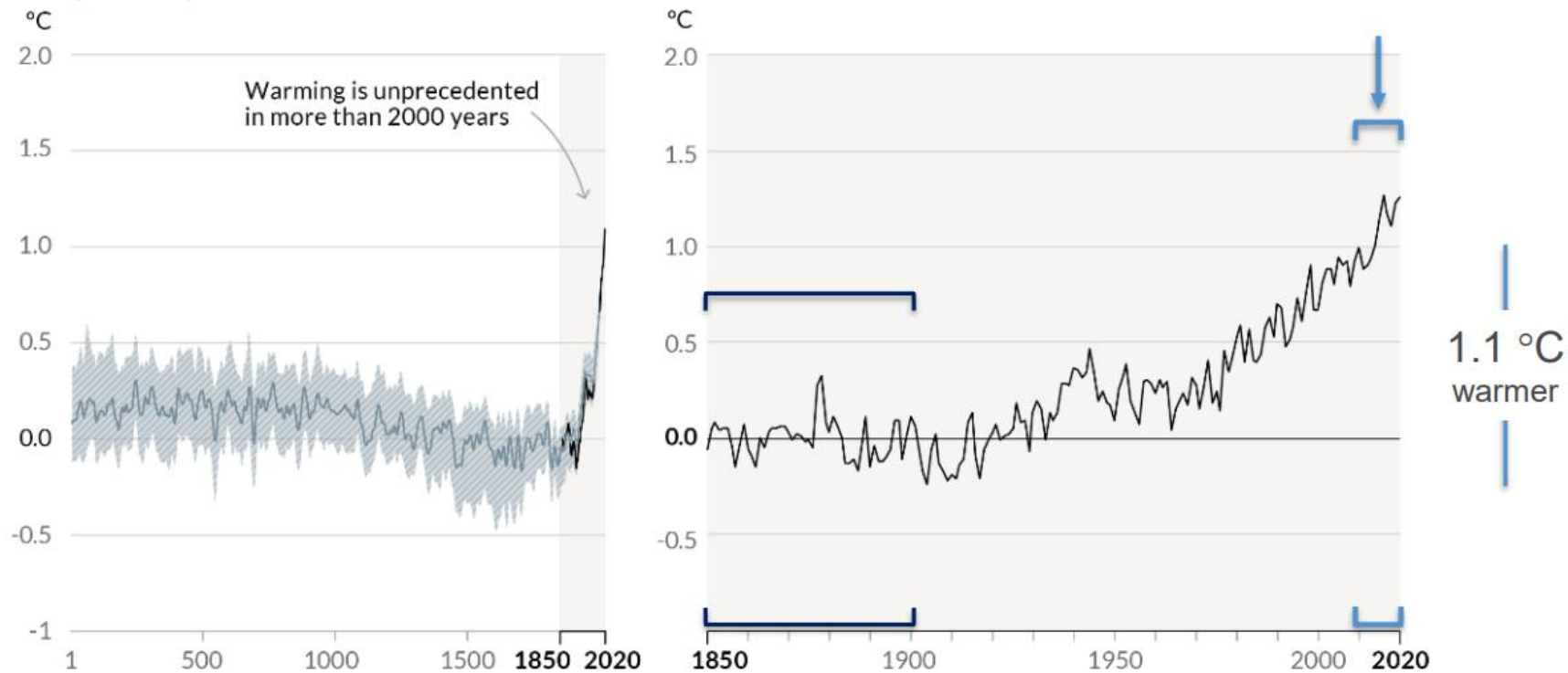
Review

Nanoparticle- and Microparticle-Based Vaccines against Orbiviruses of Veterinary Importance

Luis Jiménez-Cabello ^{1,2}, Sergio Utrilla-Trigo ¹, Natalia Barreiro-Piñeiro ², Tomás Pose-Boirazian ², José Martínez-Costas ², Alejandro Marín-López ³ and Javier Ortego ^{1,*}

Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years

Changes in global surface temperature relative to 1850-1900



METEO

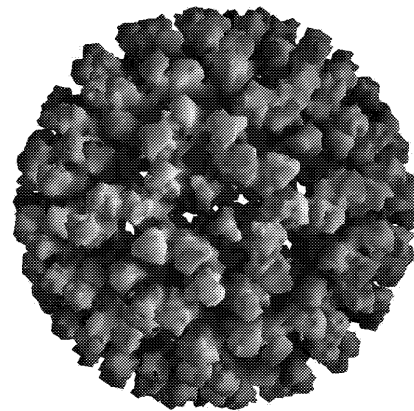
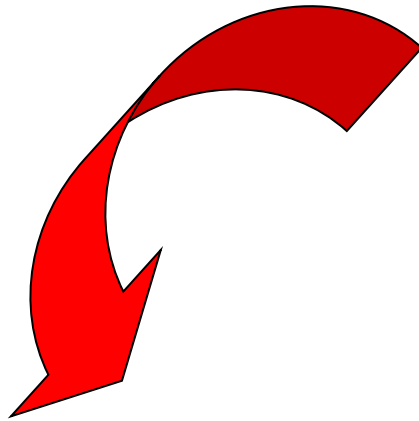
JUILLET 2022, L'UN DES PLUS CHAUDS JAMAIS ENREGISTRÉS DANS LE MONDE, SELON L'ONU



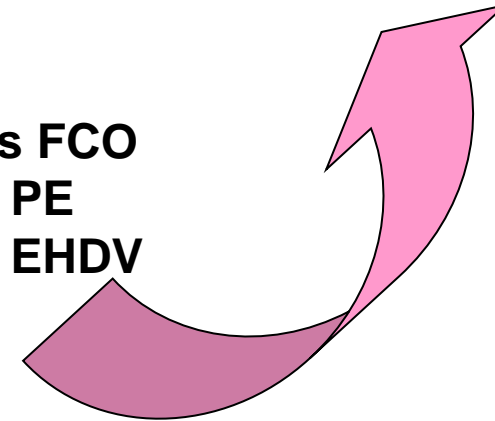
Le mois dernier, "une vague de chaleur très prolongée et très intense a touché certaines parties de l'Europe", écrit l'OMM qui avait appelé à une "prise de conscience".



Orbivirus



36 sérotypes FCO
9 sérotypes PE
7 sérotypes EHDV



Vecteur : *Culicoides*
(*imicola*,...)
> 1 500 espèces



FCO en Europe de 1979 à 1998...



été **2006**

Emergence en 2006

Nouveau sérotype

Nouvelle région

Nouveau tableau clinique

8

9

2

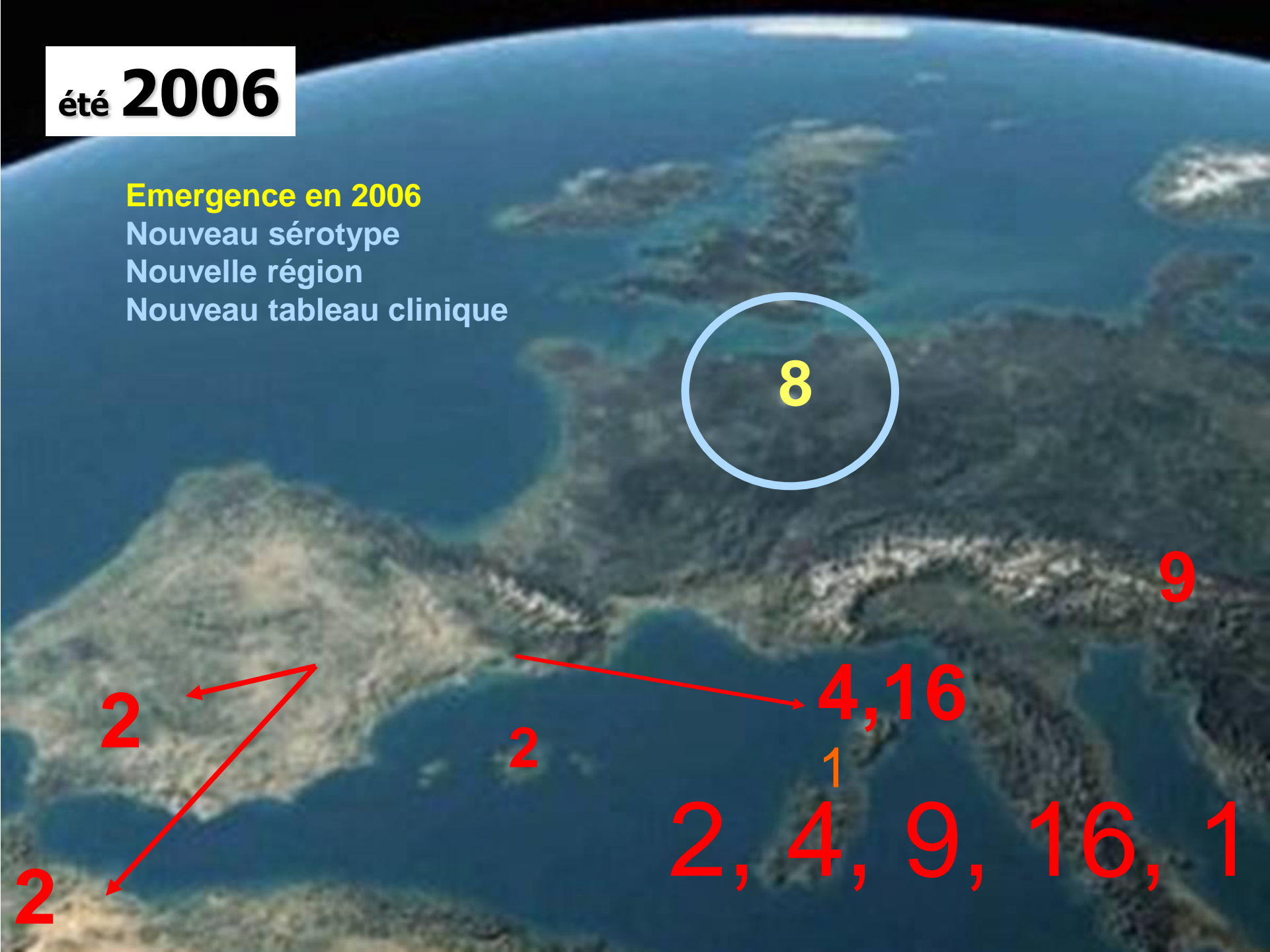
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4, 16

1

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2

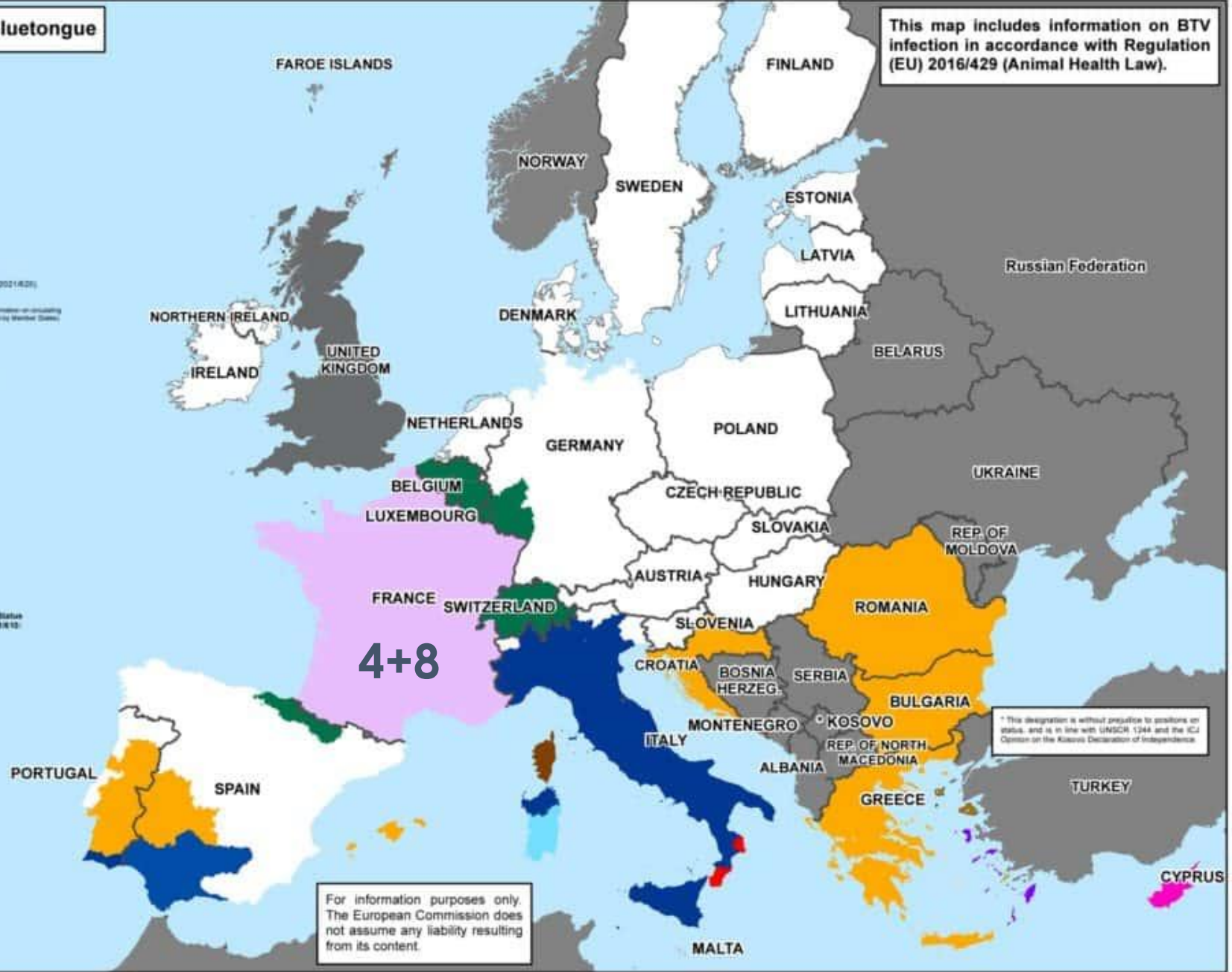


28 July 2022 - Bluetongue

This map includes information on BTv infection in accordance with Regulation (EU) 2016/429 (Animal Health Law).

- FREE STATUS**
(According to CRF (EU) 2021/625)
- NO STATUS:** (with additional information on circulation of viruses provided by Member States)
- F (8)
 - I (1,4)
 - T (1,2,4,8,16)
 - X (4,16)
 - Y (8,4)
 - A3 (4)
 - A4 (1,4,8,16)
 - A5 (1,3,4)
 - A6 (1,4,16)
 - A7 (4,16,8)
 - AB (16)

Areas pending deletion as Free Status in Implementing Regulation 2021/610:
- Isles Baleares (Spain)



For information purposes only. The European Commission does not assume any liability resulting from its content.

* This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.

WOAH team



Emmanuel Bréard



Corinne Sailleau



Lydie Postic



Mathilde Turpaud



Damien Vitour



Trial Haut-Koenigsbourg 2021 Article 109km - Chertif

Tableau 1. Nombre de foyers domestiques et de cas d'EHD en Europe par pays et par espèce (source : Commission Européenne ADIS le 23/01/2023).

Pays	Date de détection du premier évènement	Bovins	Ovins	Cervidés sauvages
Espagne	15/11/22	11	0	0
Italie (Sardaigne)	28/10/22	13	1	1
Italie (Sicile)	25/10/22	1	0	0
Total Europe	25/10/22	25	1	1