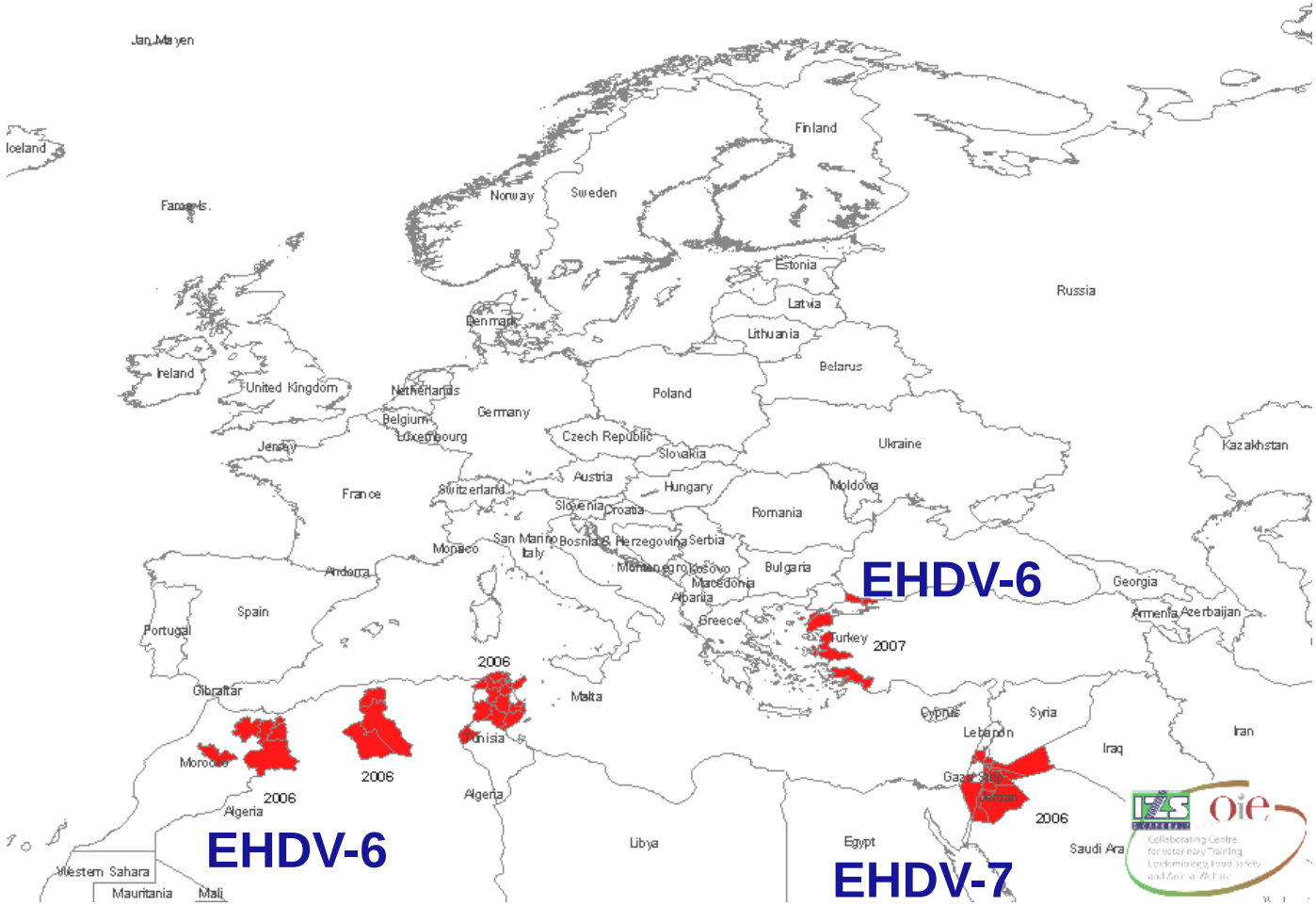
European Food Safety Authority

Epizootic Haemorrhagic Disease
Risk of introduction and spread

Ana Afonso- Animal Health and Welfare Unit

Recent EHD outbreaks (2006-2007)



Terms of Reference

- **the significance of the presence, origin and occurrence of EHD in susceptible species (specially livestock animals) in the EU neighbour countries**
- **the possibility of EHD to spread to and within the EU and to persist.**
- **the role played by different vectors and the means to control them.**
- **the possible measures to control and eradicate the disease including surveillance, control of vectors, availability of suitable vaccines and other elements.**

Working Group

- Mariano Domingo (Chairman)
- Moez Sanaa (Risk assessor)
- Philip Mellor
- William Wilson
- Giovanni Savini
- Yadin Hagai
- Imaldedin Aradaib

- Stephane de LaRocque (FAO)
- Pierre Pastoret (OIE- Observer)
- Federica Monaco (IZS – Observer, Art 36)

EHDV

Reference strains - Institute for Animal Health (IAH) Pirbright UK and at the Arthropod-Borne Animal Diseases Research Laboratory (ABADRL), USA.

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

a:EHDV serotype 3 (Ib Ar 22619) is proposed to be the same serotype as EHDV-1

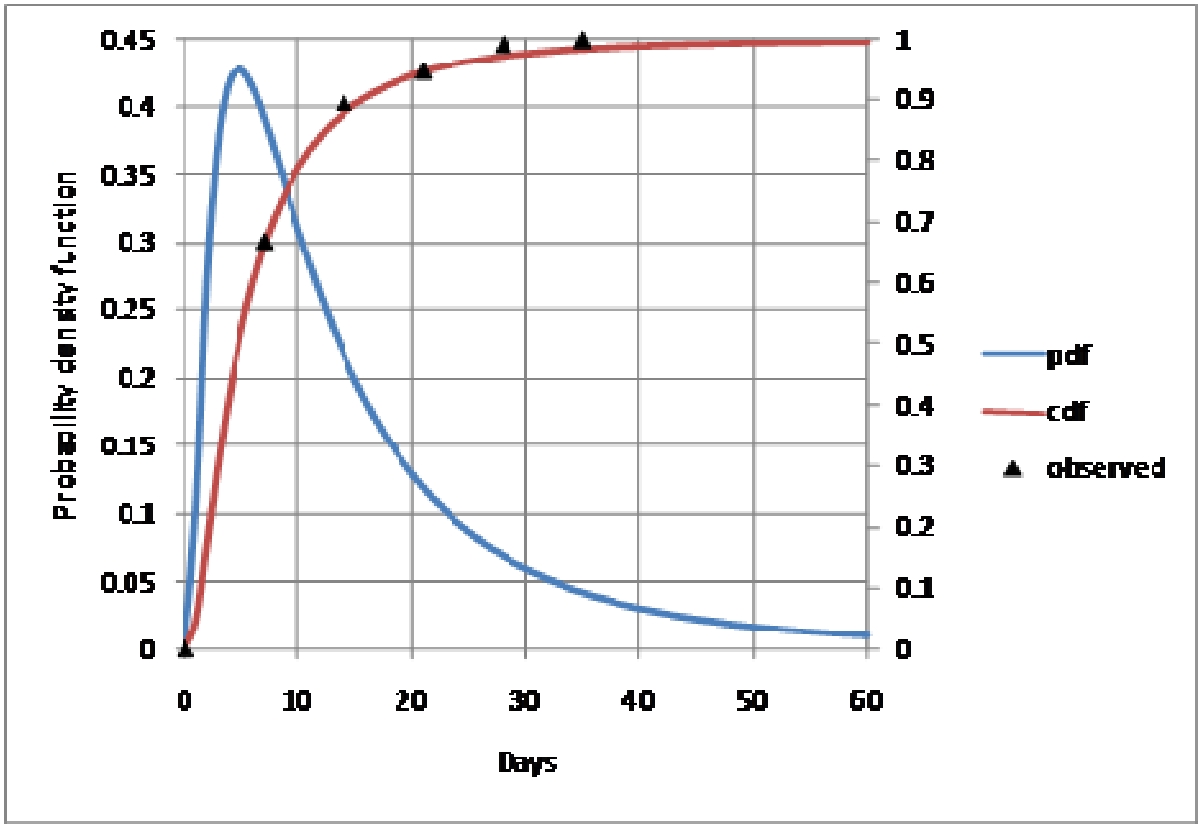
- Uniform, internationally accepted criteria for EHDV serotype classification and a reviewed list of reference strains and antisera should be established
- Reasons for differences in viral virulence are not understood.

Susceptible hosts

Common name	Infection	Clinical disease	Serotype/detection
Cattle	Nat	yes no	2 (Serol) 2 (VI) (Serol)
	Nat	yes	2 (Ibaraki) (VI) (Serol)
	Nat	yes	6 (VI)
	Nat	yes	7(VI)
	Nat	no	5 (Serol)
	Nat	no	1, 2, 5, 7, 8 (VI)
Sheep	Exp	no	1 (VI)
Goat	Nat	no	2, 6 *(Serol)

- There is a considerable lack of information about the susceptibility and the epidemiological role of many domestic and wild ruminant species.

Pathogenesis of infection



- Duration of viraemia in cattle and white-tailed deer may exceed 50 days

Immunity

- Like with BTV infection with a particular EHDV serotype confers protection against the infection by homologous serotype. Duration of this protection is unknown but indirect field evidences suggest it may last for life.

- A partial cross-protection has been demonstrated between the North American serotypes EHDV-1 and EHDV-2. It is not known if this phenomenon also occurs between other serotypes.

- No cross-protection exists between EHDV and BTV.

Morbidity and Mortality in cattle

serotype	location	Date of start	Date of end	Apparent morbidity	Apparent mortality	Morbidity per herd	Case fatality rate
2 (Iba)	Japan	Sep 59	Nov 59	**1.96 %***	**0.2%***	**0.01-12.6% a**	**10.3%**
2 (Iba)	Japan	Sep 60	Nov 60	**1.16%***	**0.06%***		**5.8%**
2	USA	Aug 96	Oct 96			**Up to 20%**	
7	Israel	Sep 06	Nov 06			**5-80%**	**Less than 1%**
6	Morocco	Jul 07	Sep 07	**18% (329/1814 animals)**	**2.2%**		
6	Algeria	Jul 06		8%	0.5%		

* total of animals in districts involved in the outbreaks

a depending on district

Clinical signs and lesions: cattle

- Intermediate to high morbidity, low mortality
- Fever, anorexia, weakness, respiratory distress, salivation and nasal discharge, ulcers or erosions of the oral cavity
- Non-distinguishable from BTV-8
- Significant decrease in milk production.

From Temizel et al., 2009

Courtesy of Yadin Hagai

Diagnosis

- Clinical signs are similar to BTV-8
- RT-PCR for detection of infection (duration of positivity)
- Competitive ELISA (cELISA) for detection of EHDV serogroup specific antibodies.

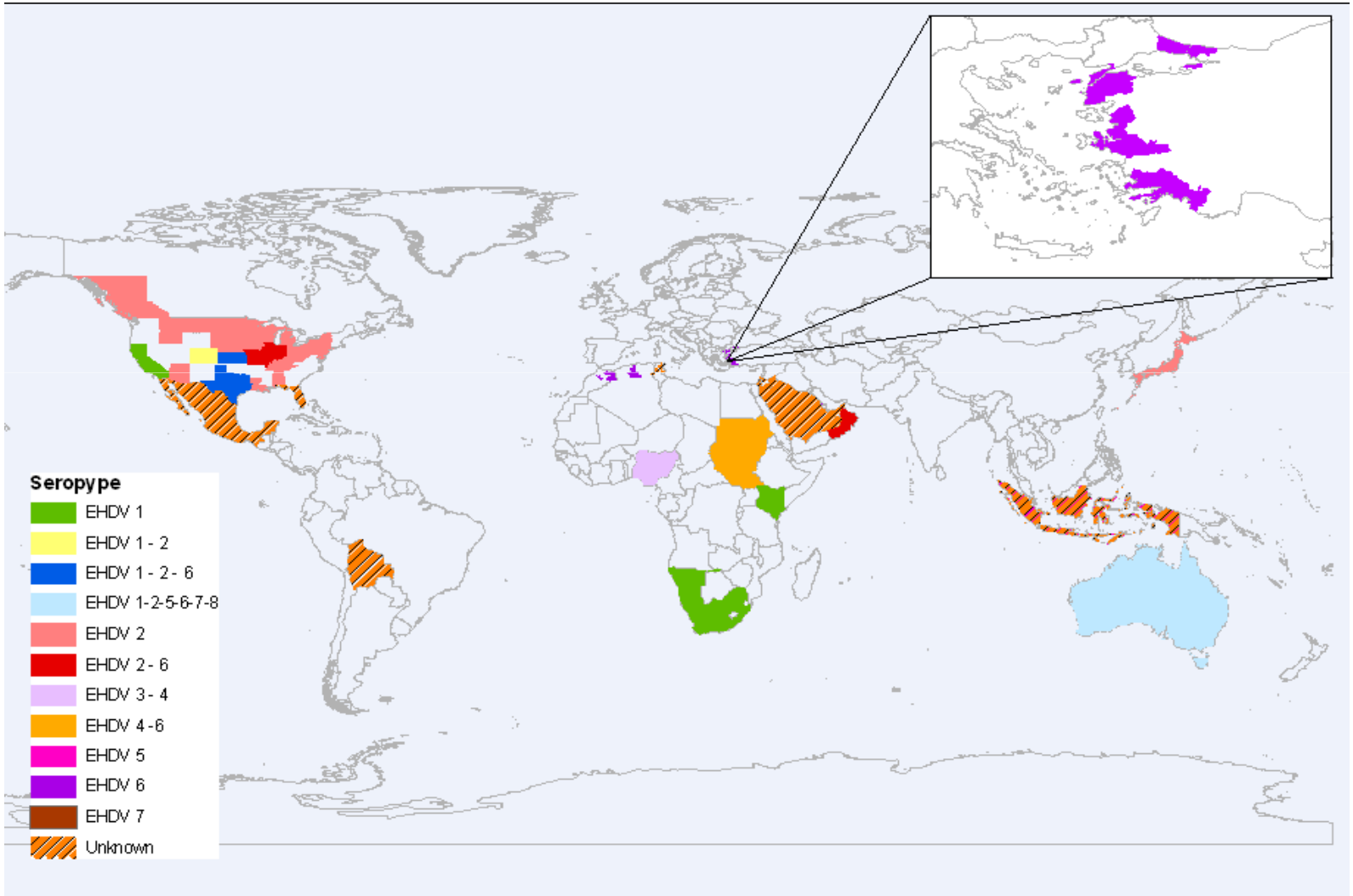
None of these techniques are commercially available.

Vectors

- There is no scientific evidence to suggest that mosquitoes have a role in the transmission of EHDV.
- Can the same vector of BTV be vectors of EHDV?

Species	BTV	EHDV	Abundance in Mediterranean E	Abundance in temperate E	Indoor /outdoor
Culicoides imicola	y	y	+++	-	+/+
Obsoletus complex	y	y	+++	+++	+/+
C. dewulfi	Y PCR	nk	+	+++	+/+
C. chiopterus	Y PCR	nk	+	+++	+/+
Pulicaris complex	y		+++	+++	+/+
C. pulicaris	y	nk	+	+(+)	
C. newsteadi	maybe	nk	+++	+	
C. lupicaris	maybe	nk	(-)	(+)	
C. punctatus	maybe	yes	+(+)	+++	

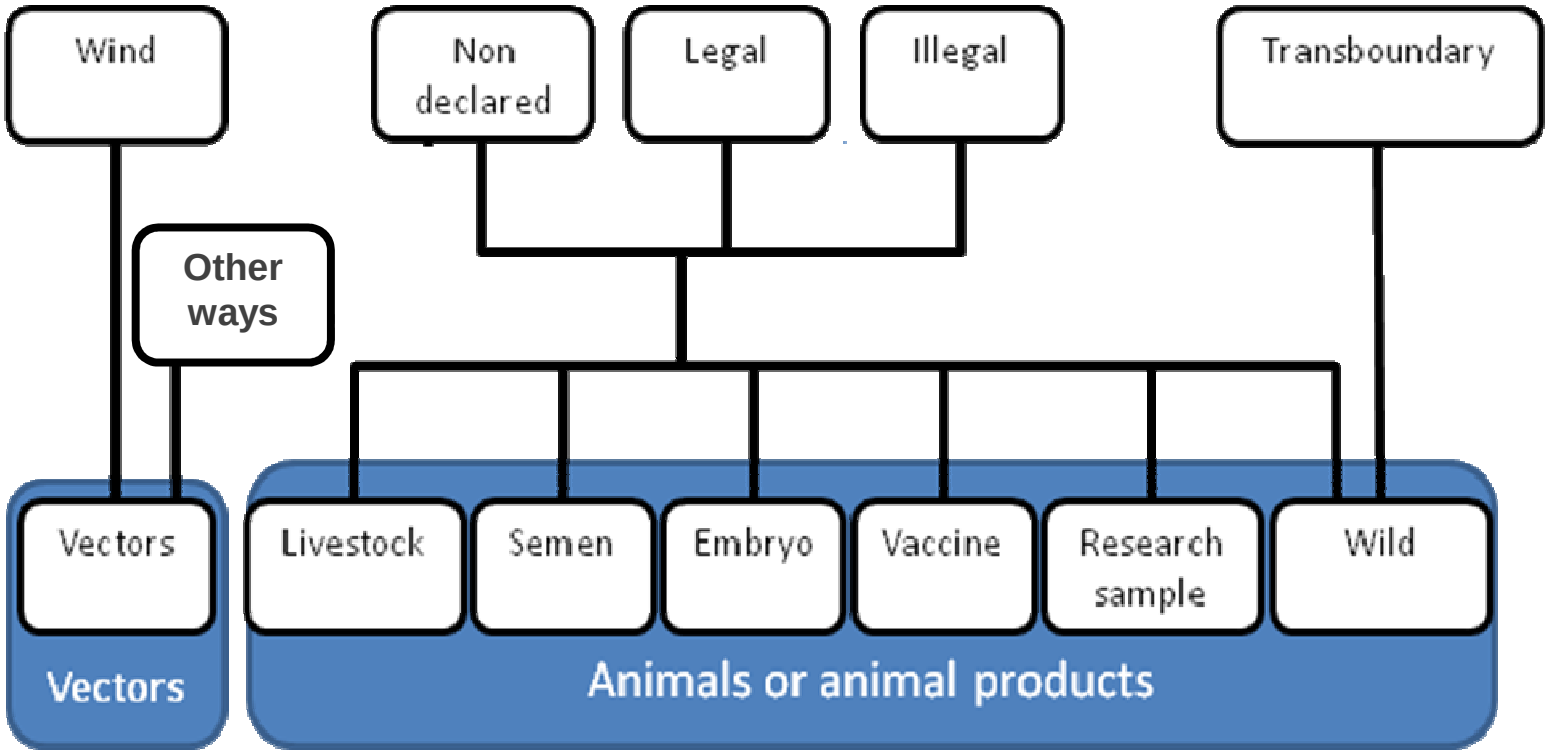
Geographic distribution



Epidemiology

- The reasons for the **different distributions of BTV and EHDV** that have a similar host range and are transmitted by similar species of Culicoides have yet to be elucidated.
- The factors leading to **emergence** of EHDV-6 in North America, and of EHDV-7 in Israel (previously reported only in Australia) are unknown.
- The knowledge on the circulation of the different EHDV serotypes is scant in many parts of the world.
- **Reassortment of EHDV strains** has been observed in the field

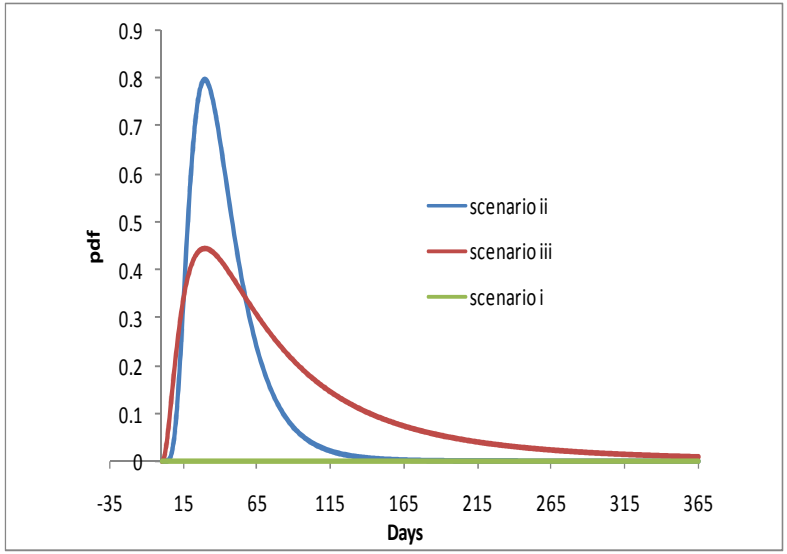
Risk pathways



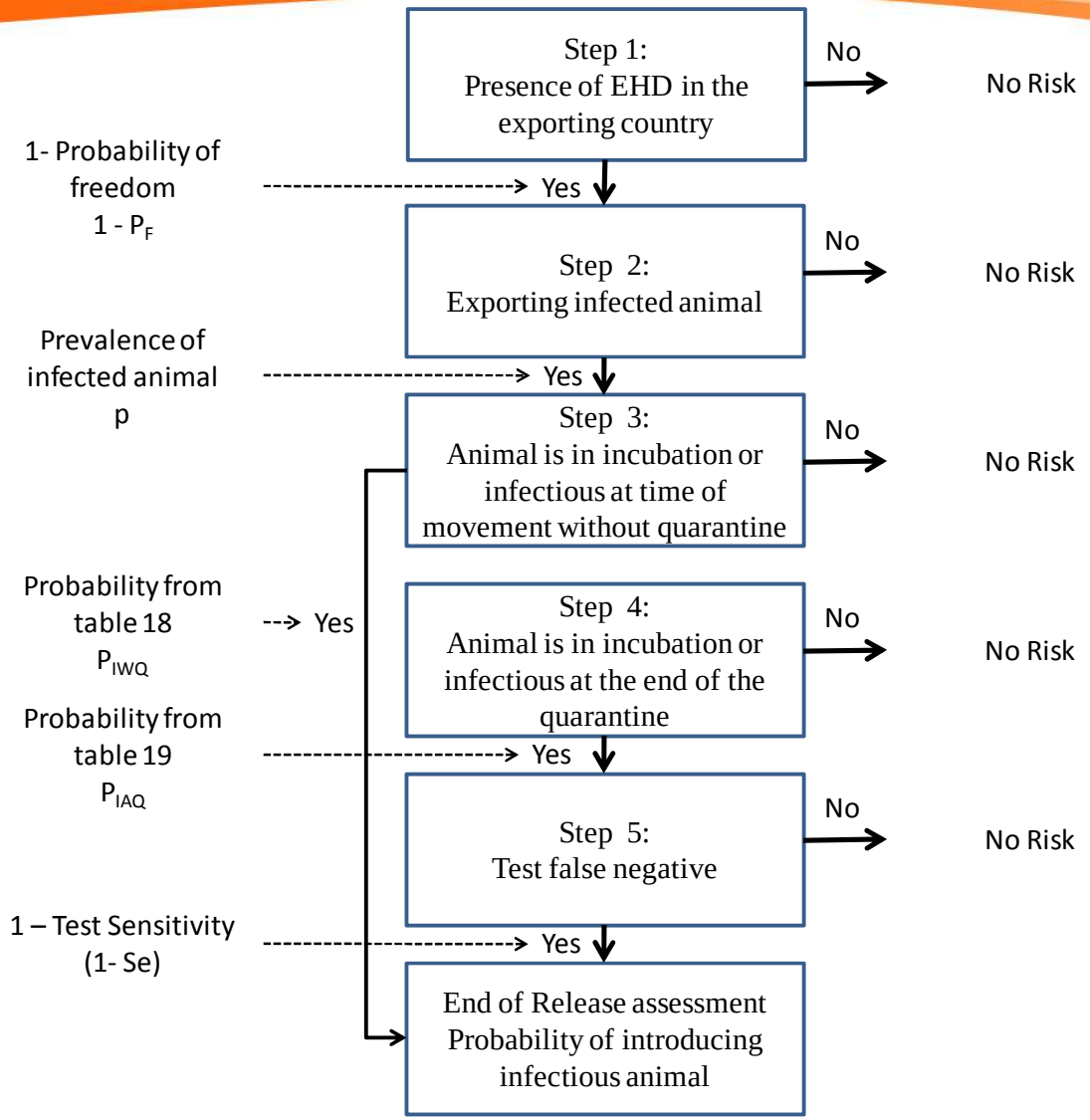
Via imported animals

3 conditions for the imported animal:

- **Has origin in an infected area**
- **Is infected prior to the movement**
- **Is in incubation or viraemic – days post infection at the time of movement should be less than the viraemia duration**



Via imported animals



If prevalence is 1% and probability of freedom is 0

Expected number of an infected animal being in incubation or viraemic at time of arrival to an EU MS.

*Number of animals per million of animals imported

	Animal Movement		
EHD infection	Uniform(1,365)	Triangular (15,30,45)	Triangular (90,120,150)
Uniform (1,365)	390*	390	390
LogNormal(3.4,0.5)	230	3370	30
LogNormal(3.4,0.9)	230	2420	120

If prevalence is 1% and probability of freedom is 0

Expected number of an infected animal being in incubation or viraemic at time of arrival to an EU MS after quarantine of 40 days and testing.

*Number of animals per million of animals imported

	Animal Movement		
EHD infection	Uniform(1,365)	Triangular (15,30,45)	Triangular (90,120,150)
Uniform (1,365)	0.12*	0.12	0.12
LogNormal(3.4,0.5)	0.07	0.61	0.03
LogNormal(3.4,0.9)	0.06	0.46	0.05

Consequence assessment (Gubbins et al 2007)

When an infectious animal is introduced into one geographic area, the risk of EHDV transmission depends on:

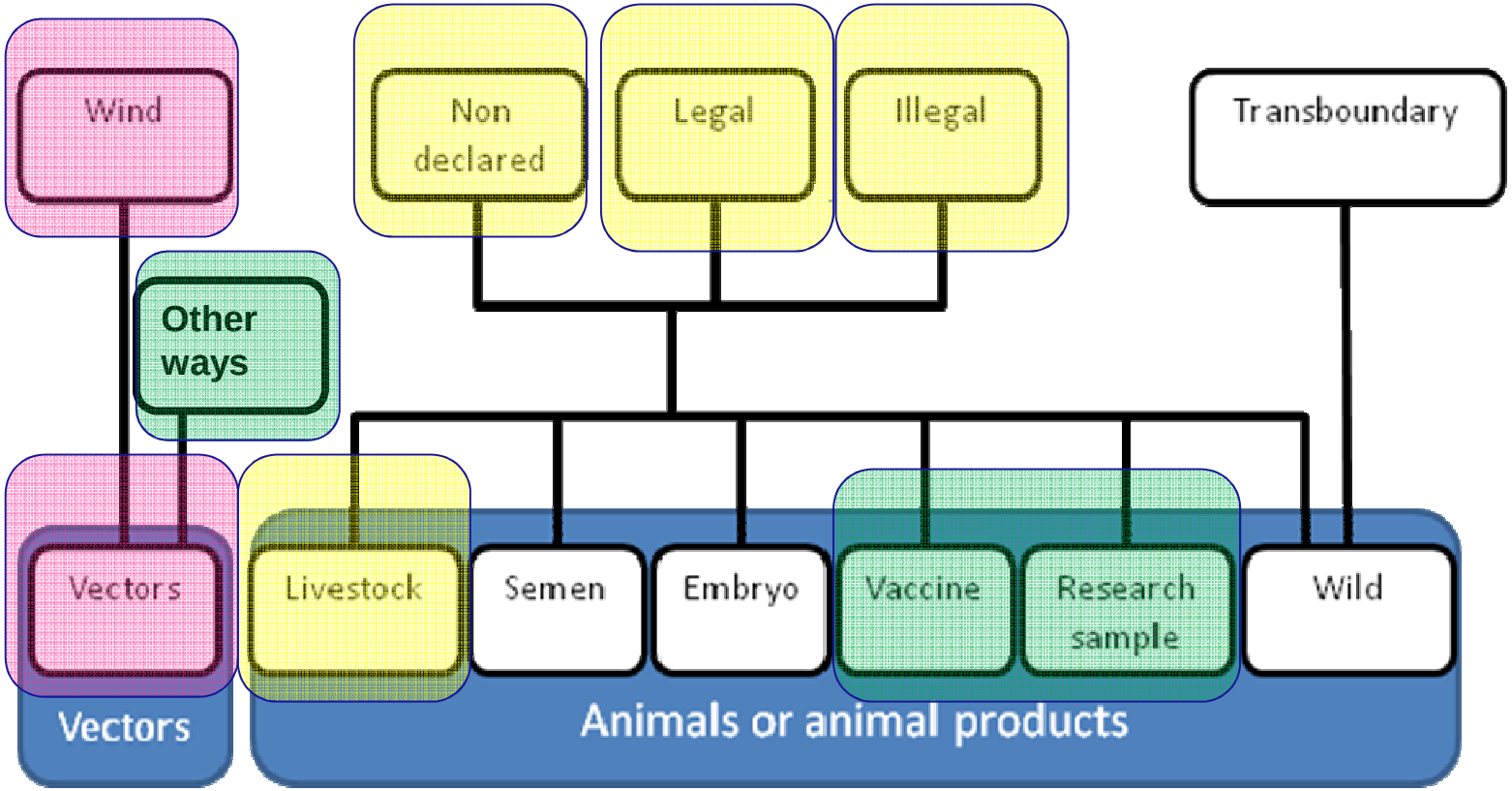
- **viraemia duration** (d)**;**
- **the number of vector per animal (**m**);**
- **the number of bites per animal and per day** (a function of C)**;**
- **the probability that infection is transmitted from an infectious animal to a susceptible vector per bite** (β_{hv})**;**
- **the incubation period in vectors (v function of Temperature)**
- **the survival of vector individuals (1/μ = σ function of Temperature)**
- **the probability that infection is transmitted from an infectious vector to a susceptible animal per bite** (β_{vh})

Conclusions

- When quarantine (40 days) and testing for EHDV are in place the probability of importing an infectious animal into a EU MS was considered negligible.
- Without quarantine and testing the probability of introducing an infectious animal was considered not negligible and could be high depending on the animal origin and season of movement. .
- Following EHDV introduction by an infectious animal the risk of exposing susceptible animals during periods of vector activity in EU MS was considered high.
- **The risk of introduction and spread could be considered negligible when quarantine /testing are applied but without quarantine and testing it is moderate to high depending on the temperature.**

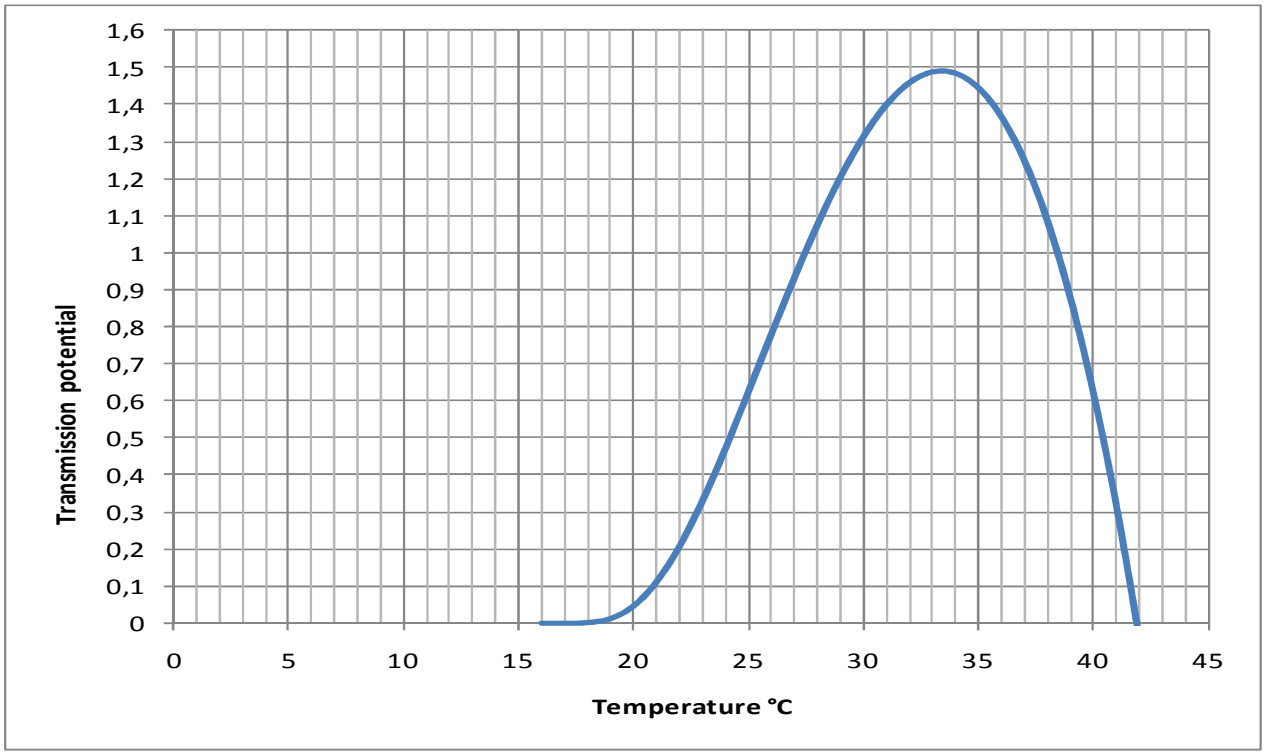
Via infectious vectors

- Qualitative assessment based on PREVIOUS EXPERIENCE with BTV serotypes



Consequence assessment

- the transmission potential of an infected vector to a susceptible animal could be presented as a function of temperature:



Conclusions

- The risk of introduction of EHDV into the EU from neighbouring countries by wind dispersal of vectors was assessed as high

Wilson and Mellor 2008

Other routes of entrance

- There is no information available regarding EHDV introduction via germplasm to allow for risk estimation or to infer any valid conclusion.

- The risk posed by contaminated vaccines for EHDV introduction was considered negligible for EU authorized medicinal products.

Conclusions

- Vector abundance and climatic conditions would be favourable to sustain EHDV circulation; therefore, presence of EHDV in neighbouring countries poses a significant risk for introduction and establishment of EHDV in EU.

Recommendations

- Surveillance in high risk areas - early detection of disease introduction.
- In case of an outbreak :
  - detection of infected animals, epidemiological investigation, restriction of movements, long term surveillance.
  - If viraemic animals should be detected in a previously free area culling or slaughter of these animals .
  - Mitigation measures on the *Culicoides* vector.
- Vaccines (no EHD vaccines are commercially available).

Thank you for your attention