



Vector-borne diseases: Nature and reality of the threat

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13/12/2018; Brussels

VBD -emergence: 'when' rather than 'if'

- Establishment?
- Spread?
- Overwintering?
- Control measures?
- Impact?

CONFIRMED TWO CASES OF DENGUE CONTRACT IN SPAIN

October 9, 2018 Health 8 Views

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West Nile fever cases higher than previous 5 years

West Nile fever cases so far exceeds the total number of the last five years. Between 7-13 October, 85 human cases were reported in Italy, Romania, Greece, France, Hungary, Bulgaria, Austria and the Czech Republic.

[Weekly update](#)

[West Nile fever monitoring](#)

[Ebola outbreak in the Democratic Republic Congo](#)

[European Health Forum Gastein 2018](#)

[EU Agencies meet in Brussels under ECDC chairmanship](#)

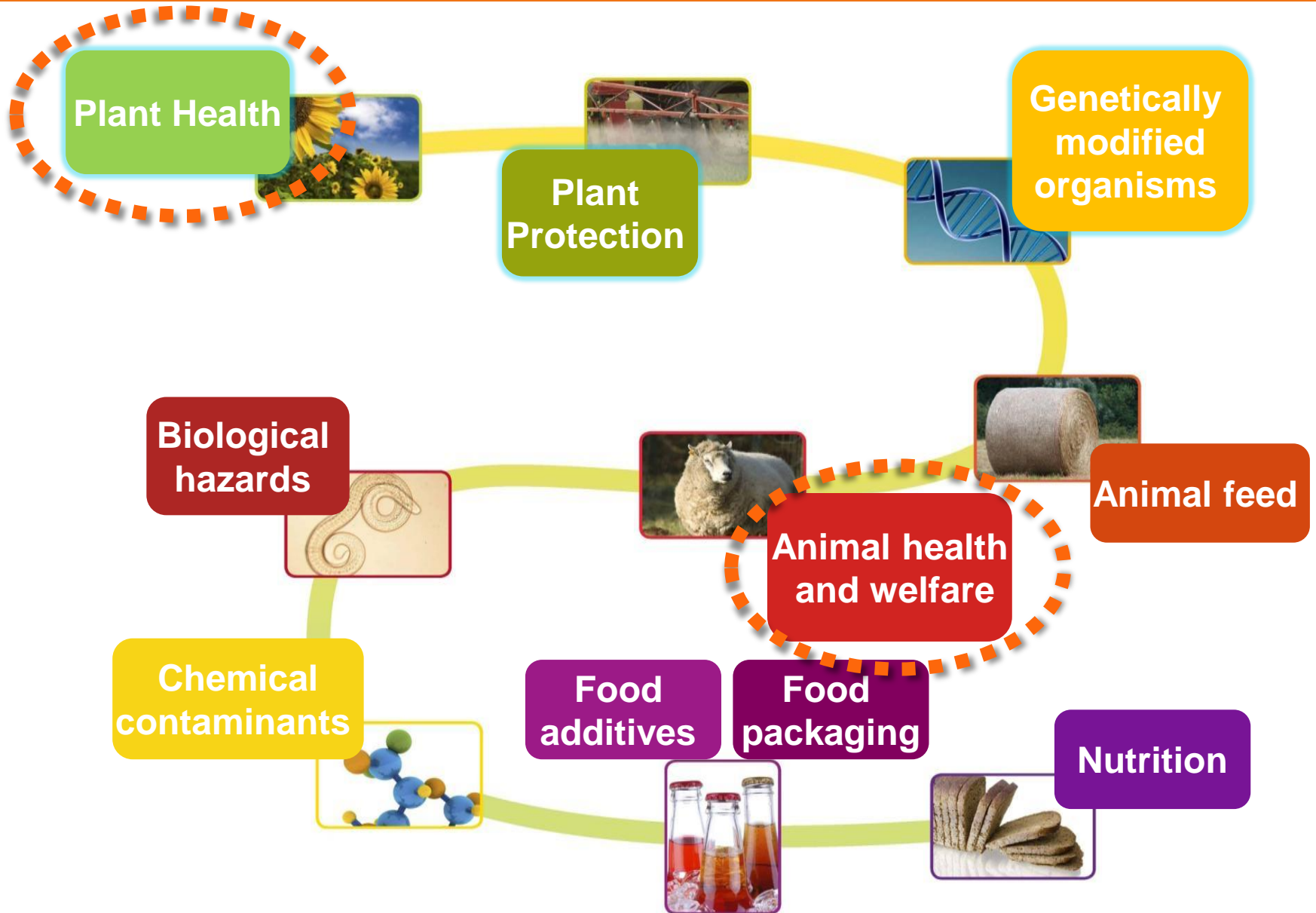
Conclusions EFSA conference - 2018

- Globalization brings complexity and generates particular drivers for infectious diseases, but the control of those drivers may be outside the sphere of direct influence of the risk managers.



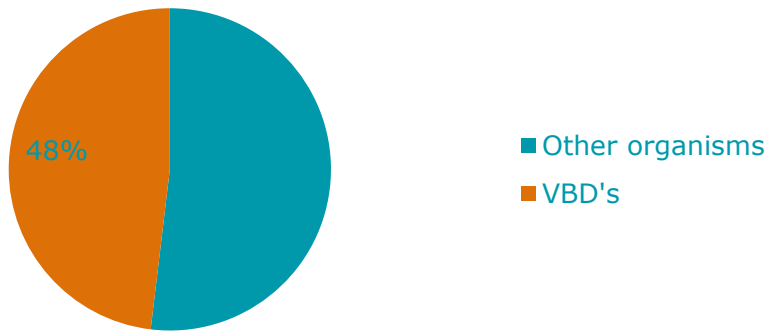
- Integrate education and prevention to vector-borne diseases into animal and public health policies
- Guide the decisions for vector control by the understanding of the disease pathogenesis and epidemiological conditions.
- Develop standardised and validated vector-monitoring programs and implement those at international level as a tool for continuous surveillance and assessment of potential threats.
- **Increased collaboration >>Increased preparedness**

EFSA's Panels dealing with vector-borne diseases

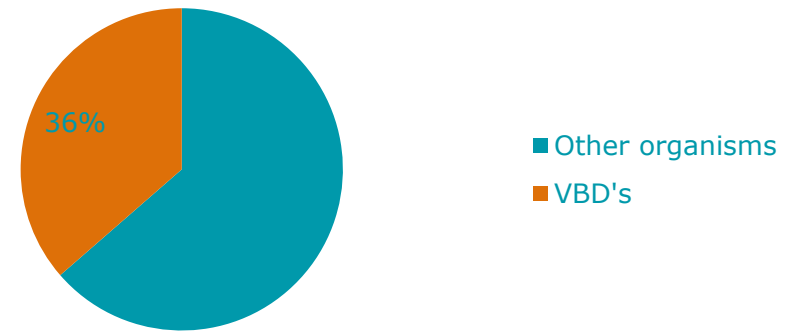


Pathogens dealt with in ALPHA outputs

AHAW VBD's in EFSA 2004 - 2018



PLH VBD's in EFSA 2007 - 2018



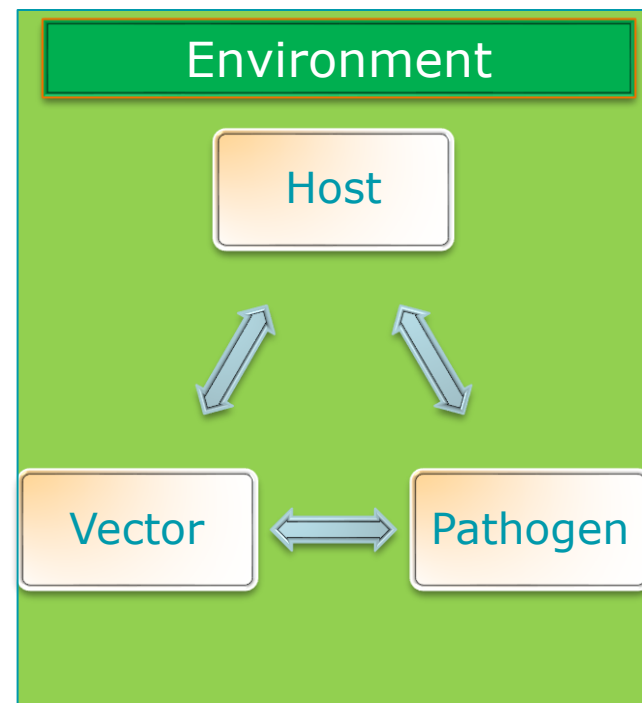
ALPHA: One-health approach

- Climate change, social and political instability, changes in landscape : potential drivers for their introduction
- Complex interaction between host, pathogen and environment > complex diseases to prevent and control

-**Human VBD's**: 17% of the estimated global burden of all infectious diseases

-**Animals VBD**: bluetongue virus: ~1.4B \$USD in economic losses in France in 2007 alone (Tabachnik et al. 2008)

-**Plant VBD**: citrus tristeza virus (an aphid-borne disease) has killed tens of millions of citrus trees worldwide, and currently threatens California orange crops

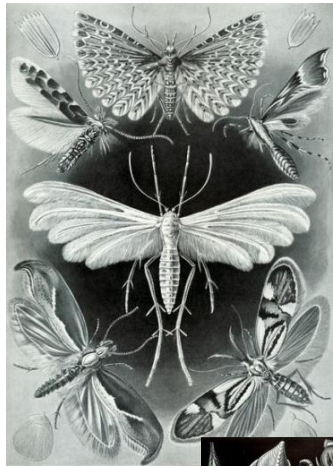


VECTORS

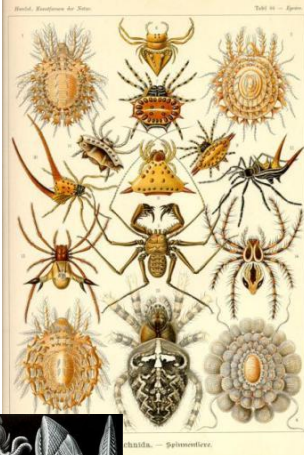
ANIMALS AND/OR HUMANS

Vector species: the largest part are blood-sucking **arthropods**

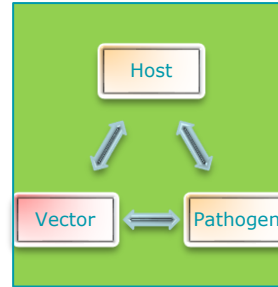
Insects (6 legs)



Arachnids (8 legs)



Other creepy stuff



Insects (6 legs)



Snail (1 leg)

PLANTS

Arachnids (8 legs)



Nematodes (no legs...)



And...some fungi transmitting viruses
(like *Synchytrium endobioticum*)

HOSTS

ANIMALS AND/OR HUMANS

When this is over I am going to need a lot of mosquito repellent!

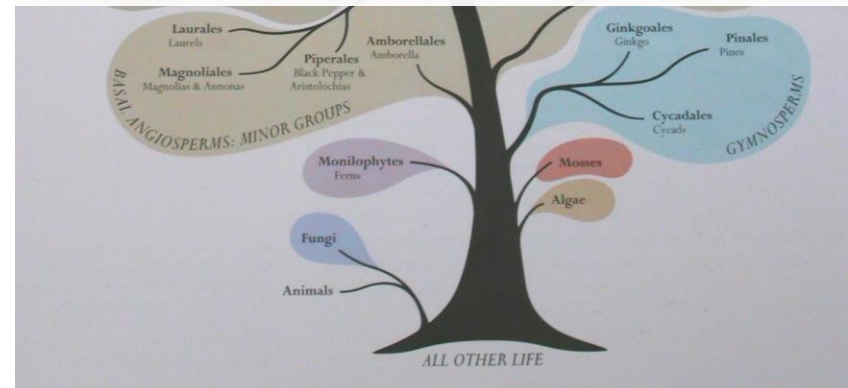


- Large range of animals (pets, livestock, wildlife, e.g. rodents, birds...)
- Humans
- Both animals and humans (=zoonotic VBD)

PLANTS

Tree of Plant Evolution

- Very large range of plant species: (ca. 300 000 species):
- Herbaceous crops (cereals, legumes, forage, vegetables ...)
- Fruit trees and bushes
- Forest trees
- Wild plants in natural habitats
- Wild crop relatives
- Ornamentals (cut flowers, pot plants, landscape and amenity trees)



LIFE CYCLE

ANIMALS AND/OR HUMANS

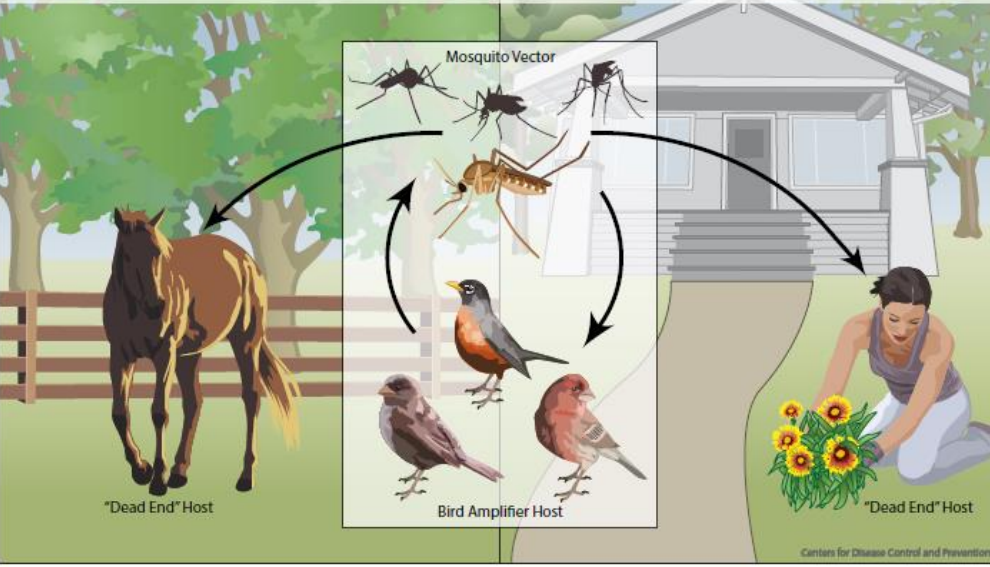
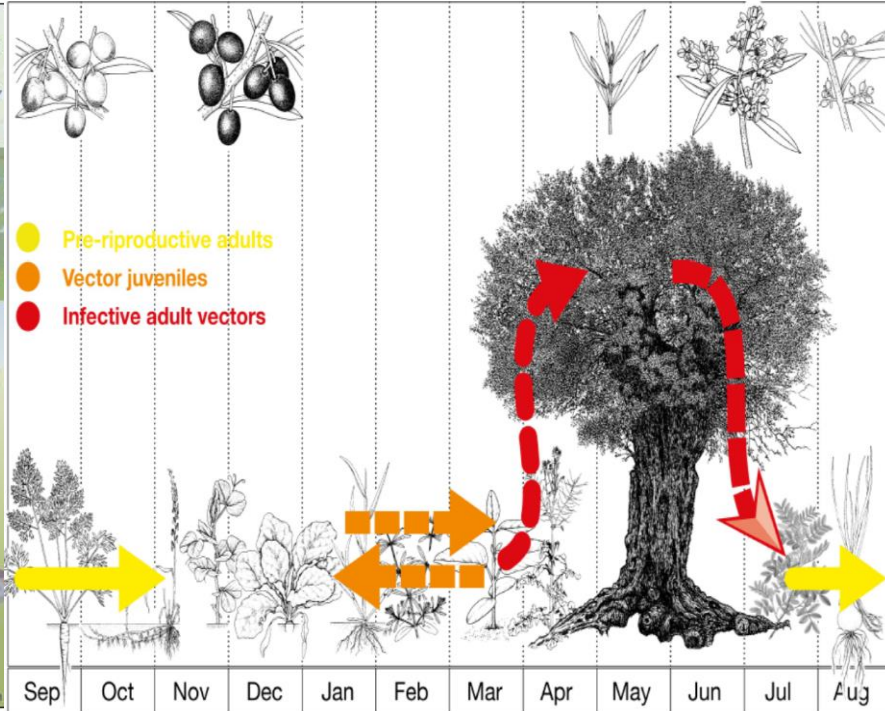
PLANTS

West Nile virus

Xylella fastidiosa

In nature, West Nile virus cycles between mosquitoes (especially *Culex* species) and birds. Some infected birds, can develop high levels of the virus in their bloodstream and mosquitoes can become infected by biting these infected birds. After about a week, infected mosquitoes can pass the virus to more birds when they bite.

Mosquitoes with West Nile virus also bite and infect people, horses and other mammals. However, humans, horses and other mammals are 'dead end' hosts. This means that they do not develop high levels of virus in their bloodstream, and cannot pass the virus on to other biting mosquitoes.



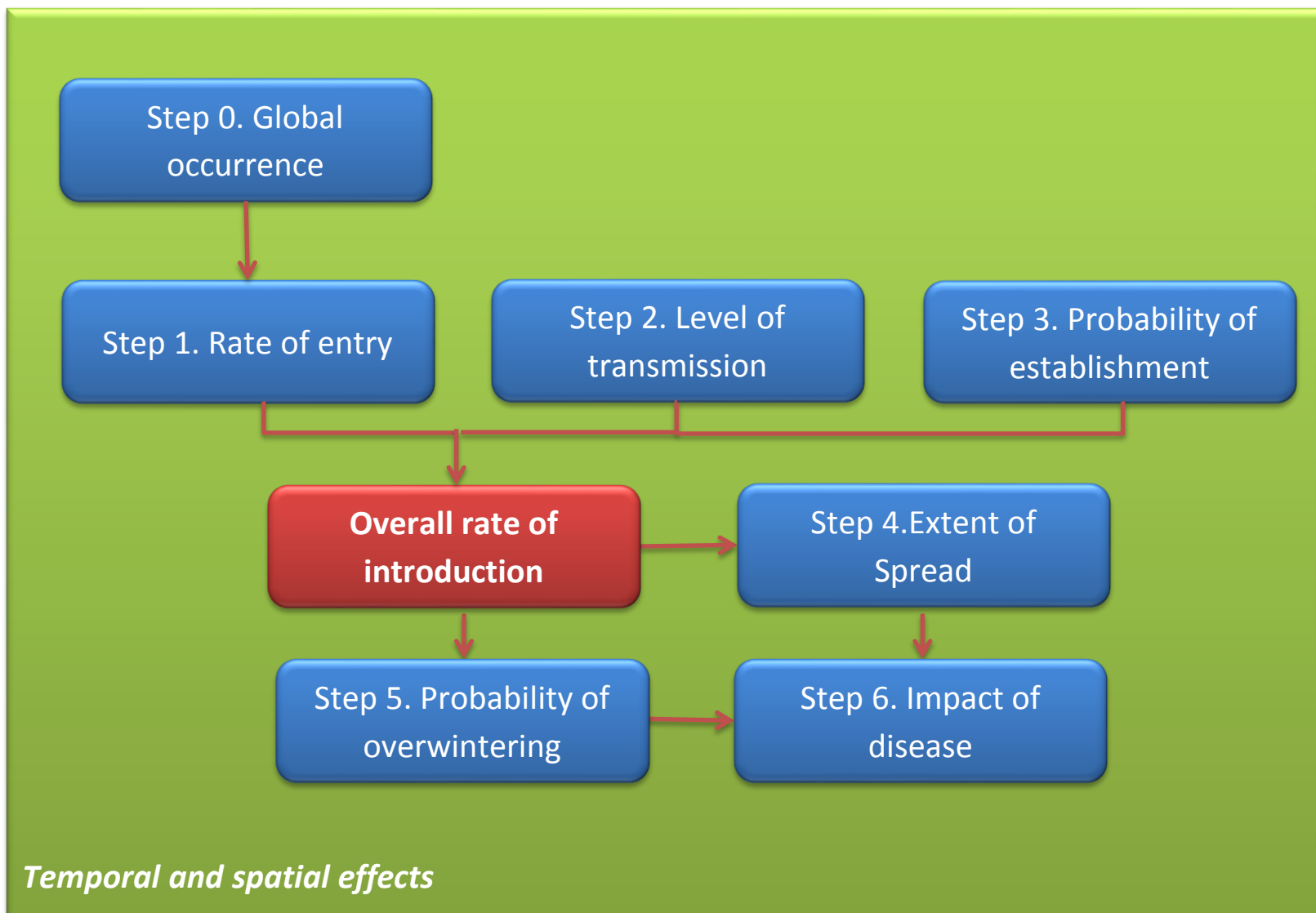
Mandates and terms of reference

ANIMALS AND/OR HUMANS

PLANTS

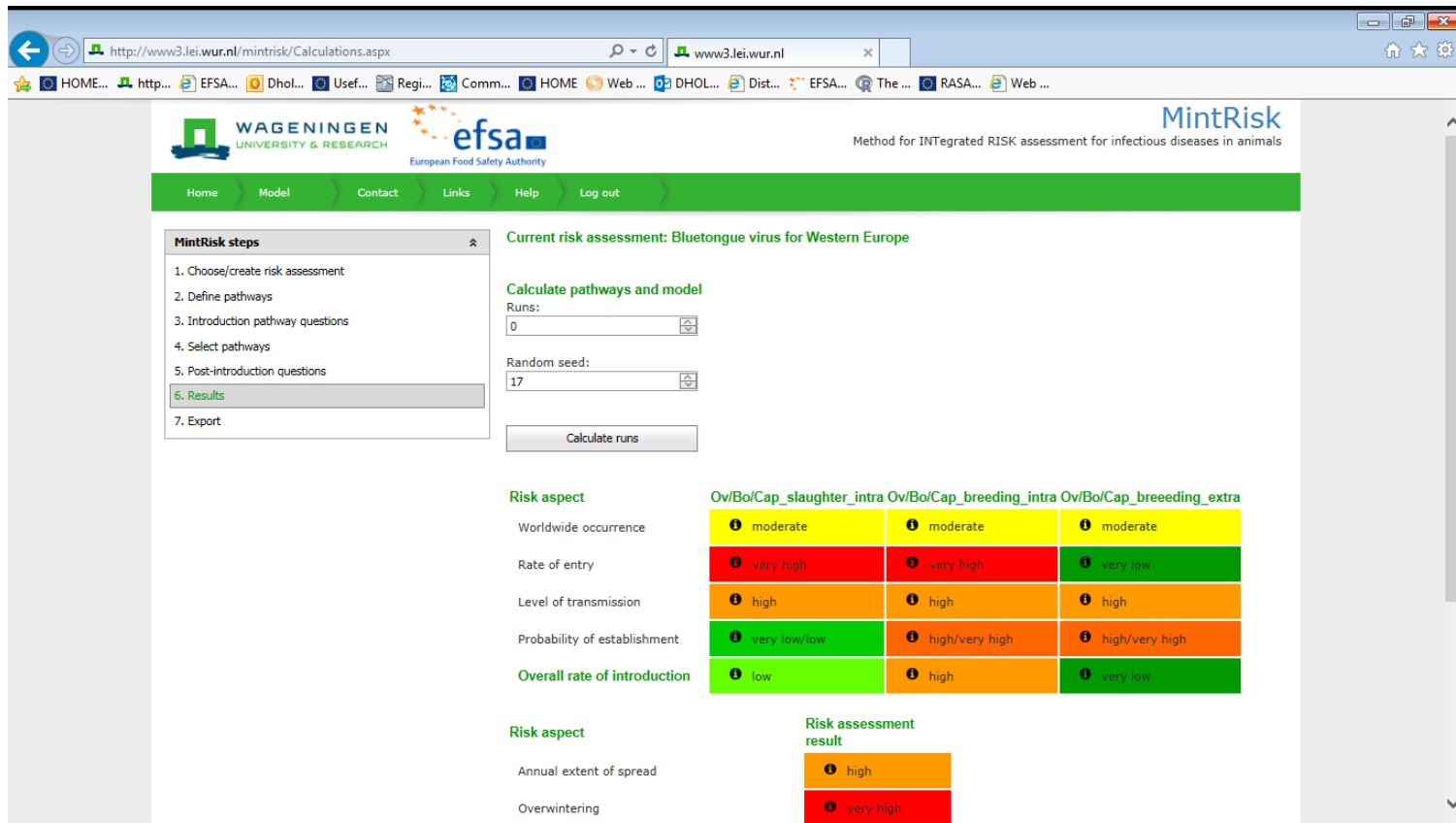
- Global occurrence?
- Probability of introduction?
- Extent of spread?
- Probability of endemicity?
- Impact of introduction and spread?
- Prevention and control

FEVER: FRAMEWORK FOR EMERGING VECTOR-BORNE DISEASES



METHOD FOR INTEGRATED RISK ASSESSMENTS

<http://www3.lei.wur.nl/mintrisk/Calculations.aspx>



The screenshot shows the MintRisk web application interface. The browser address bar displays the URL <http://www3.lei.wur.nl/mintrisk/Calculations.aspx>. The page header includes the logos for Wageningen University & Research and the European Food Safety Authority (EFSA), along with the text "MintRisk Method for INTEGRATED RISK assessment for infectious diseases in animals".

The main content area is titled "Current risk assessment: Bluetongue virus for Western Europe". It features a sidebar on the left with "MintRisk steps" including: 1. Choose/create risk assessment, 2. Define pathways, 3. Introduction pathway questions, 4. Select pathways, 5. Post-introduction questions, 6. Results (highlighted), and 7. Export.

The central panel shows the "Calculate pathways and model" section with input fields for "Runs:" (set to 0) and "Random seed:" (set to 17), and a "Calculate runs" button.

Below this, a table displays risk assessments for various aspects across three scenarios:

Risk aspect	Ov/Bo/Cap_slaughter_intra	Ov/Bo/Cap_breeding_intra	Ov/Bo/Cap_breeding_extra
Worldwide occurrence	moderate	moderate	moderate
Rate of entry	very high	very high	very low
Level of transmission	high	high	high
Probability of establishment	very low/low	high/very high	high/very high
Overall rate of introduction	low	high	very low

Below the table, another section shows the "Risk assessment result" for two aspects:

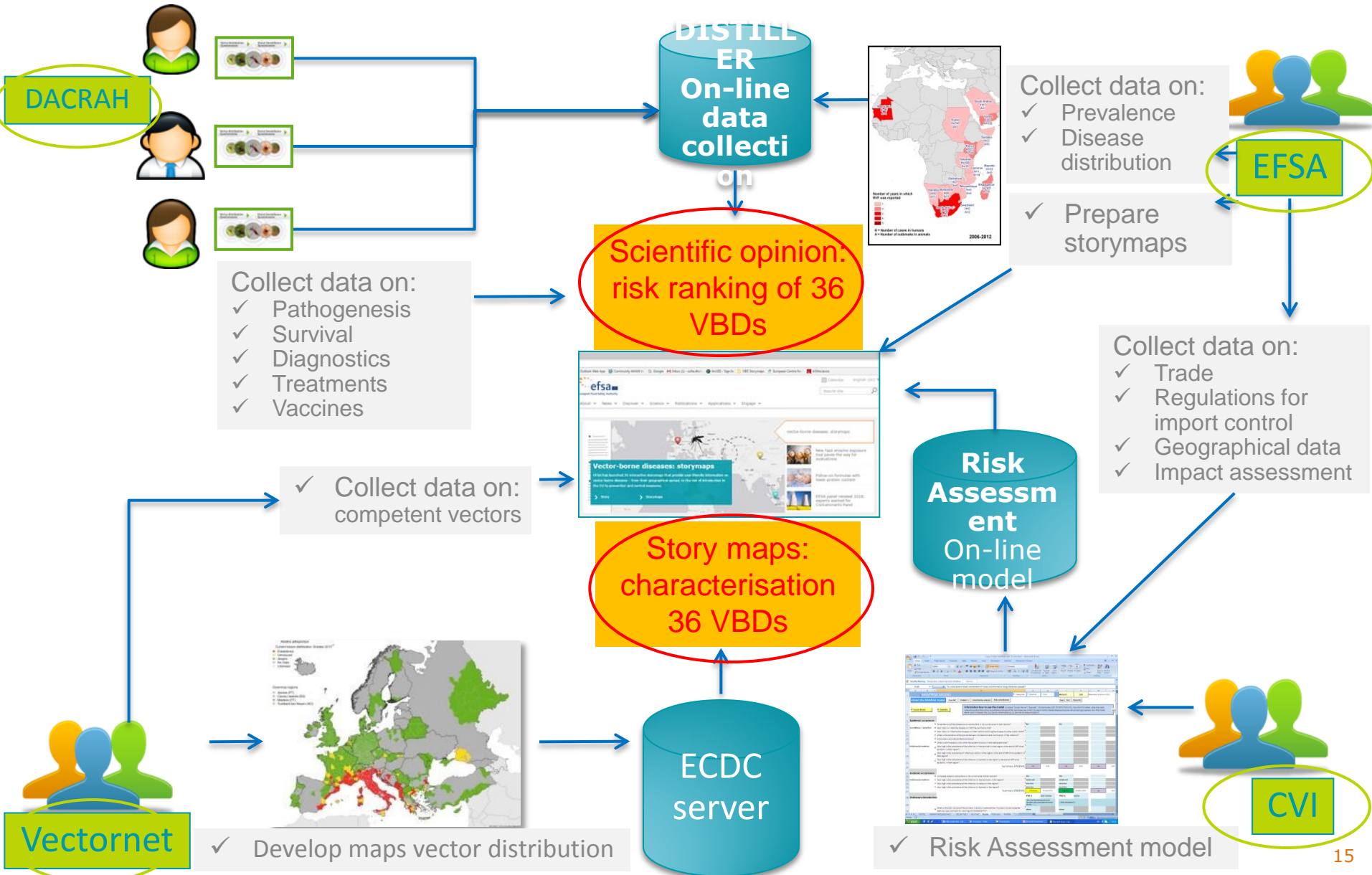
Risk aspect	Risk assessment result
Annual extent of spread	high
Overwintering	very high

- **EXAMPLE: Mosquito-borne diseases**

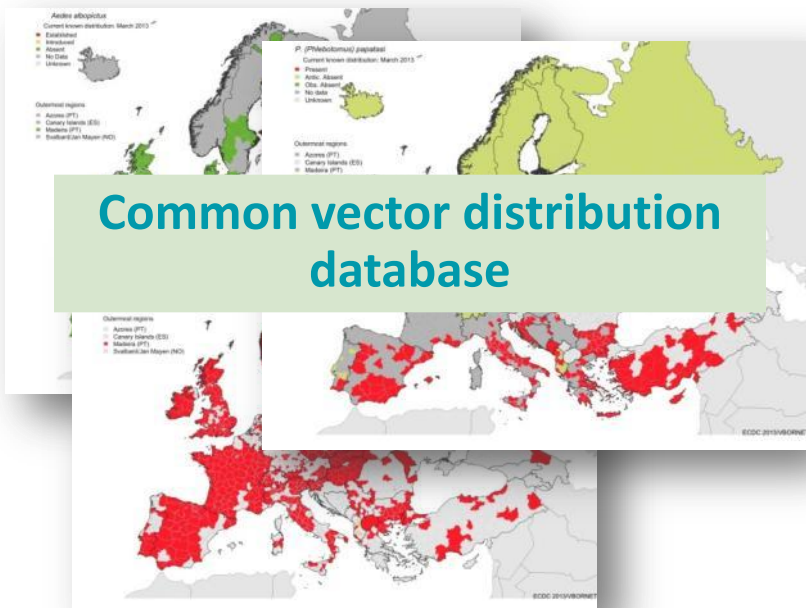
Characterisation of mosquito-borne diseases

	MBD's	Pathogens Species	OIE notifiable	Hosts									
				Deer	Wild boar	Cattle	Sheep	Goats	Pigs	Horse	Dogs	Birds	Humans
1	CVV	Bunyamwera virus virus	No	X		x	X	x	x	X			
2	EEEV	Eastern equine encephalitis virus	Yes							X			x
3	GETV	Getah virus	No		X					x	X		
4	HJV	Highlands J. virus	No							X			
5	JEV	Japanese encephalitis virus	Yes		X					x	x		x
6	MIDV	Middelburg virus	No								x		
7	PHSV	Peruvian horse sickness virus	No								x		
8	RVFB	Rift Valley fever virus	Yes	X		x	X	x					x
9	SLEV	St. Louis encephalitis virus	No							x			
10	VEE	Venezuelan equine encephalitis virus	Yes								x		x
11	VSV	Vesicular stomatitis virus*	No	X		x	X	x	x	x			
12	WEEV	Western equine encephalitis virus	Yes								x		X
13	WSLV	Wesselsbron virus	No	X		x	X	x					
14	YUOV	Yunnan orbivirus	No				X	x			x		

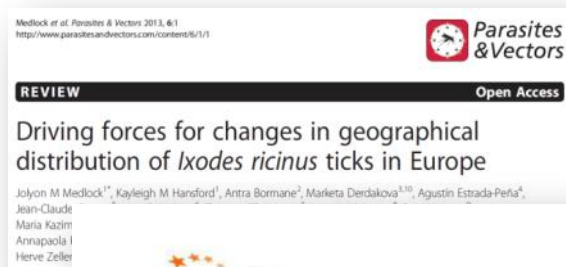
COLLABORATION AND ORGANISATION OF ASSESSMENT



VectorNet: ECDC- EFSA-collaboration

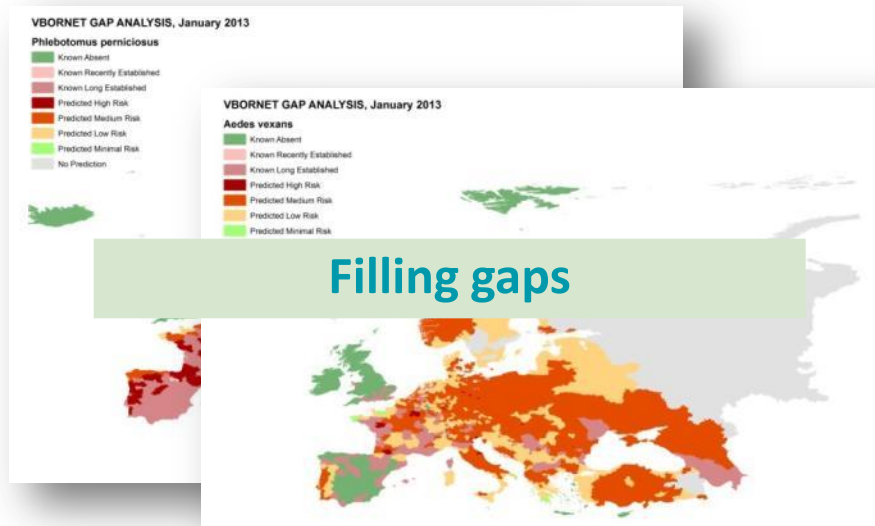


Common vector distribution database



Support from entomologist network to risk assessments and opinions

fections and mean Basin¹
published on



Filling gaps

Improved human and animal health in Europe


Vector-borne diseases map journals

EFSA's vector-borne disease map journals

Characterization of 36 vector-borne disease

Sort by: Date | **Title** | Type | Ratings | Avg. Rating | Comments | Views

African Horse Sickness (AHS)



4,440 views

African swine fever (ASF)



3,887 views

Aino virus (AINOV) infection



2,066 views

Akabane virus (AKAV) infection



2,383 views

Alkhurma hemorrhagic fever virus (AHFV)



1,687 views

Bhanja virus (BHAV) infection



1,700 views

Bluetongue virus (BTV)



3,298 views

Bovine ephemeral fever (BEFV)



1,850 views

Bunyamwera virus (CVV) Cache Valley virus infection



1,444 views

Crimean Congo Haemorrhagic Fever (CCHF)



2,031 views

Eastern equine encephalitis (EEE)



1,800 views

Epizootic haemorrhagic disease (EHDV)

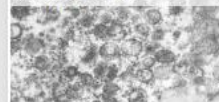


1,888 views

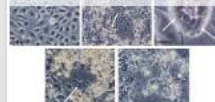
Equine encephalosis virus (EEV)



Gatah virus (GETV)



Heartwater syn. Cowdriosis



Vector-borne diseases

Click on the vector borne disease links to find a short characterization of each of the diseases, including a summary of the characteristics of the disease agent, the transmission, the geographic distribution, the potential vectors involved, the impact of the disease on animal health and welfare and a summary of the available prevention and control measures. Additionally, the results of the risk assessment of the Animal Health and Welfare Panel of the European Food Safety Authority, carried out in 2017 are summarised per disease. Spotted an error or a missing source in the displays, please kindly contact vbd@efsa.europa.eu.

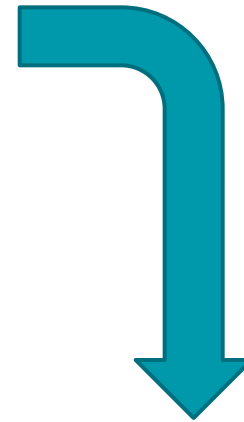
[Click here](#)

EXAMPLES OF THE STORY MAP ONLINE

Japanese encephalitis (JEV)

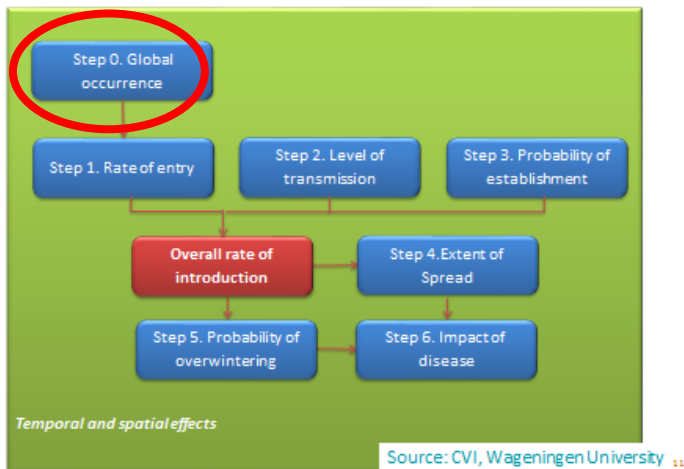


Global occurrence



Global occurrence

FEVER: FRAMEWORK FOR EMERGING VECTOR-BORNE DISEASES



1. What is the geographic distribution of the VBD in the world?



2. How likely is it that the VBD is notified to the OIE?



3. What is the relative size of the infected area?



4. What is the duration of undetected spread?



5. What is the frequency of the epidemics in the infected area?



6. What is the prevalence?

Global occurrence

Mosquito borne virus	Abbreviation	Australia and New Zealand	Northern America	Central America	Caribbean	South America	Northern Africa	Eastern Africa	Middle Africa	Western Africa	Southern Africa	Western Asia	Eastern Asia	South-Eastern Asia	Southern Asia
Bunyamwera virus	CVV		X	X	X	X									
Eastern equine encephalitis virus	EEEV		X	X		X						X			
Getah virus	GETV												X	X	X
Highlands J. virus	HJV		X												
Japanese encephalitis virus	JEV												X	X	
Middelburg virus	MIDV							X	X	X	X				
Peruvian horse sickness virus	PHSV	X				X									
Rift Valley fever virus	RVFV						X	X	X	X	X	X			
St. Louis encephalitis virus	SLEV		X	X	X	X									
Venezuelan equine encephalitis virus	VEE			X		X									
Vesicular stomatitis virus	VSV		X			X									
Western equine encephalitis virus	WEEV		X	X	X	X									
Wesselsbron virus	WSLV							X	X	X	X			X	
Yunnan orbivirus	YUOV	X			X								X		X

Annual rate of entry

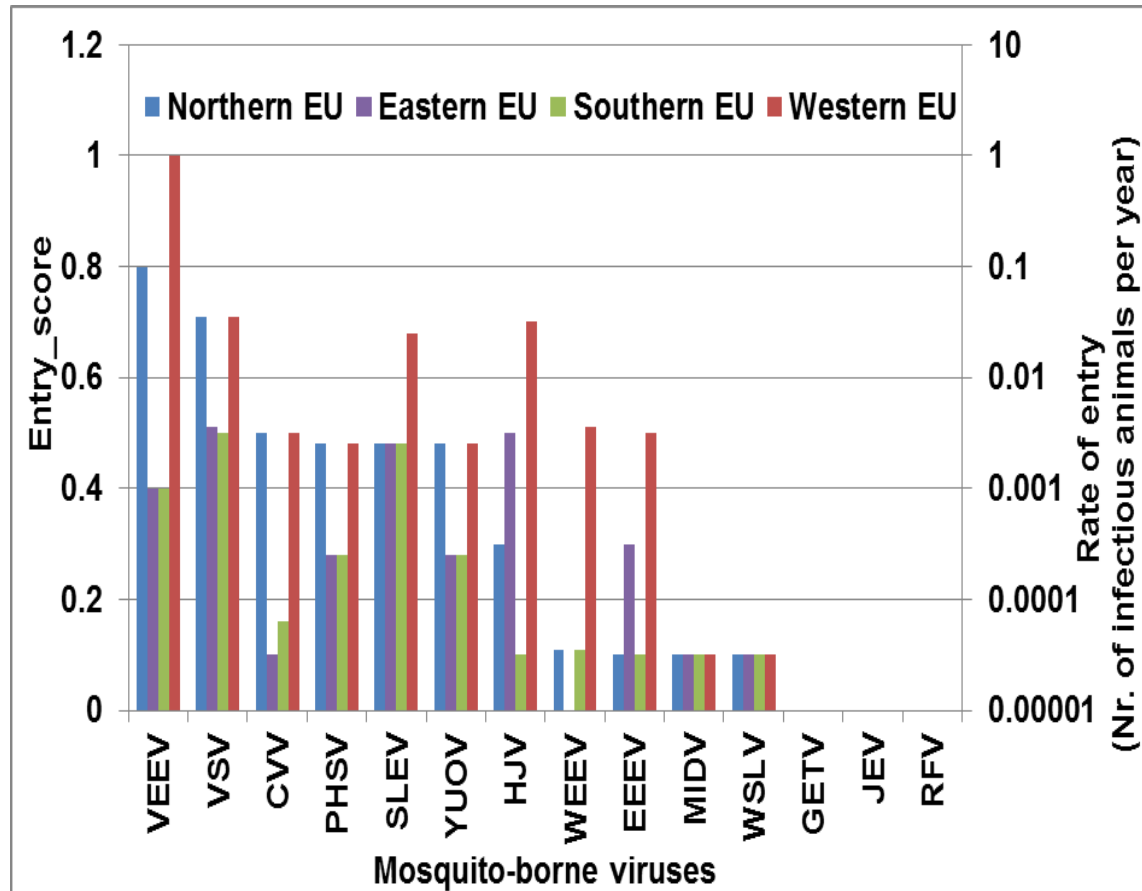
7. What are the total numbers /volumes of animals/commodities moved along the pathway?



8. What is the probability of passing through the preventive/control measures before/at transport?



9. What is the probability that a viable VBD-agent is still present upon arrival in the area at risk?



Level of transmission

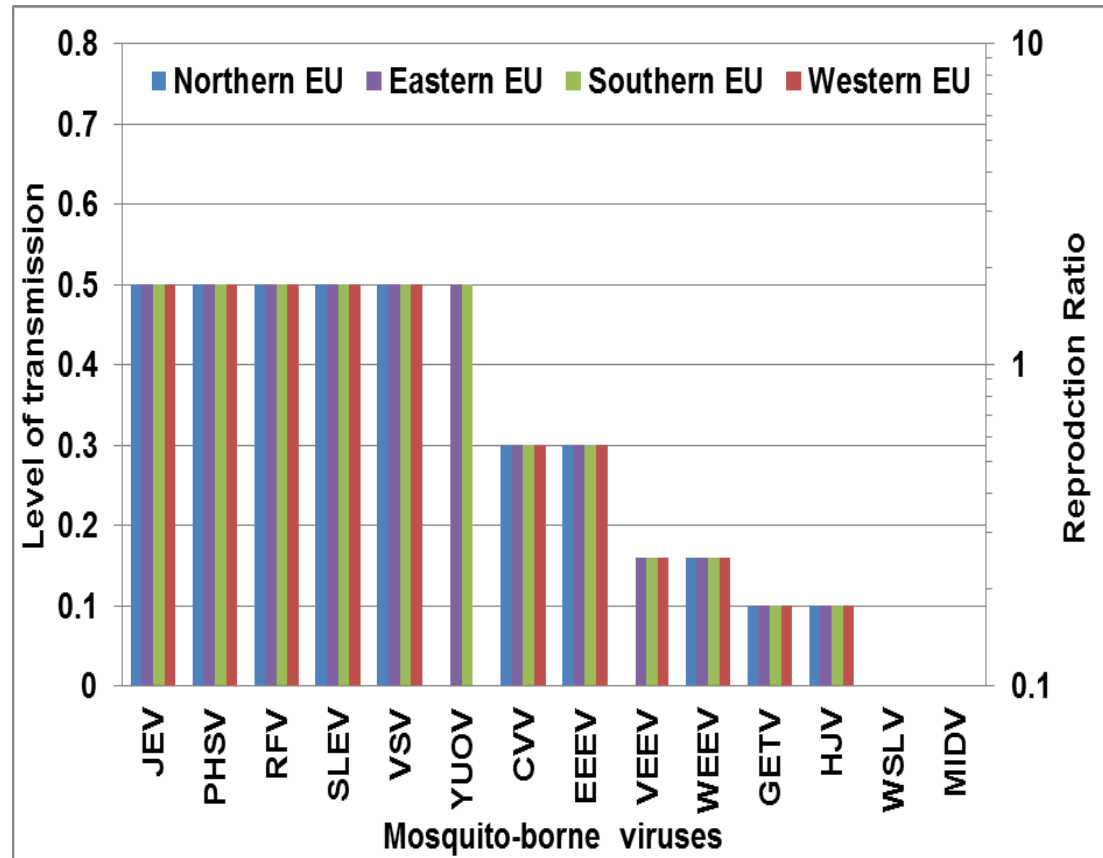
10. What is the distribution of possible competent vectors in the area at risk?



11. What is the estimated value of the basic reproduction ratio?



12. Which fraction of the host population is susceptible?

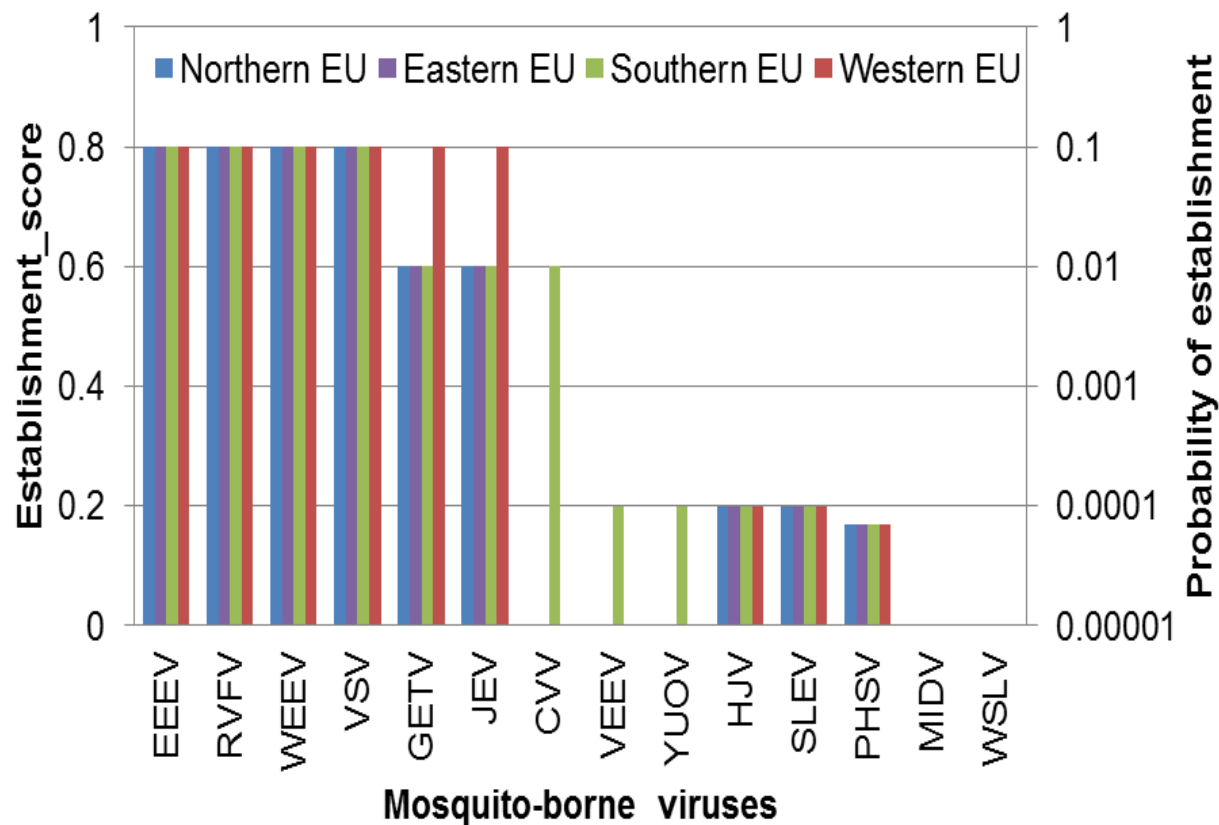


Probability of establishment

13. What is the probability of infecting a first local (indigenous) vector or host, given the pathway of entry and the expected region and time of entry ? (1st transmission step)



14. What is the probability of infecting a first local vector (given first infection of an indigenous host) or host (given first infection of an indigenous vector)? (2nd transmission step)



Annual rate of introduction

Global occurrence



Annual rate of entry



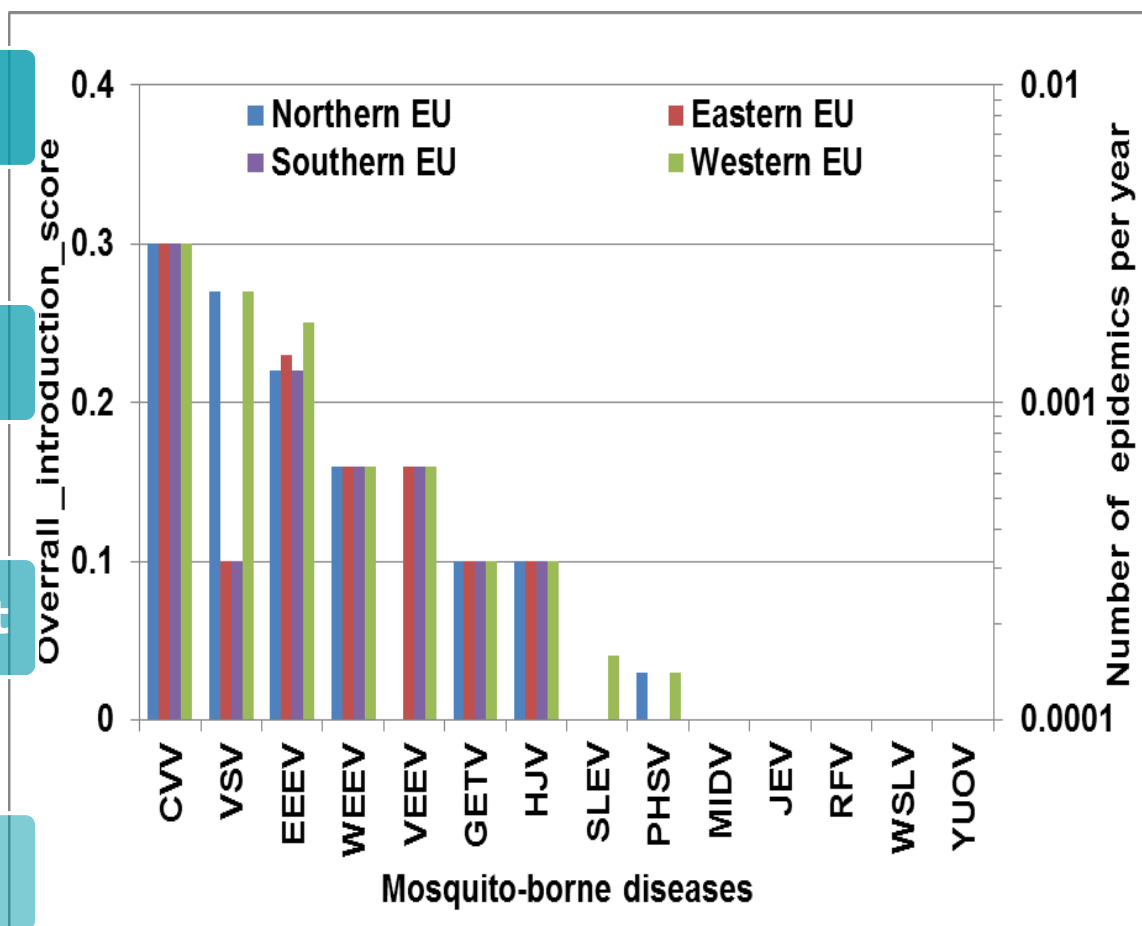
Level of transmission



Probability of establishment



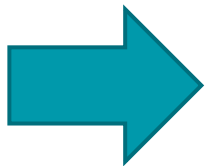
Annual rate of introduction



■ Challenges?

Irreconcilable differences?

Big data <ul style="list-style-type: none">• Animal movements• Populations	No data <ul style="list-style-type: none">• Crucial epidemiological parameters (vector capacity?)
Risk management <ul style="list-style-type: none">• Urgent response• No time	Risk assessment <ul style="list-style-type: none">• Prevention• Need more time
Complex methods <ul style="list-style-type: none">• Epidemiological models• Systematic reviews• Expert elicitation processes	Simple methods <ul style="list-style-type: none">• Rapid tools• Expert opinion



Preparedness!!

Keep assessments up to date: living reports/living opinions

Collaboration

COLLABORATION: TENDER FOR VECTORNET ON-GOING

A collaborative approach to data collection activities on vectors and pathogens they transmit

- 1.To collect existing published or unpublished information on the geographical distribution of priority vectors;
- 2.To further develop/maintain Network of medical, veterinary entomologists and public health professionals working in the field of vectors or vector-borne diseases;
- 3.To deliver ad-hoc scientific advice to support ECDC and EFSA;
- 4.To carry out targeted entomological surveillance.



DEADLINE:



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