BTSF
ACADEMY

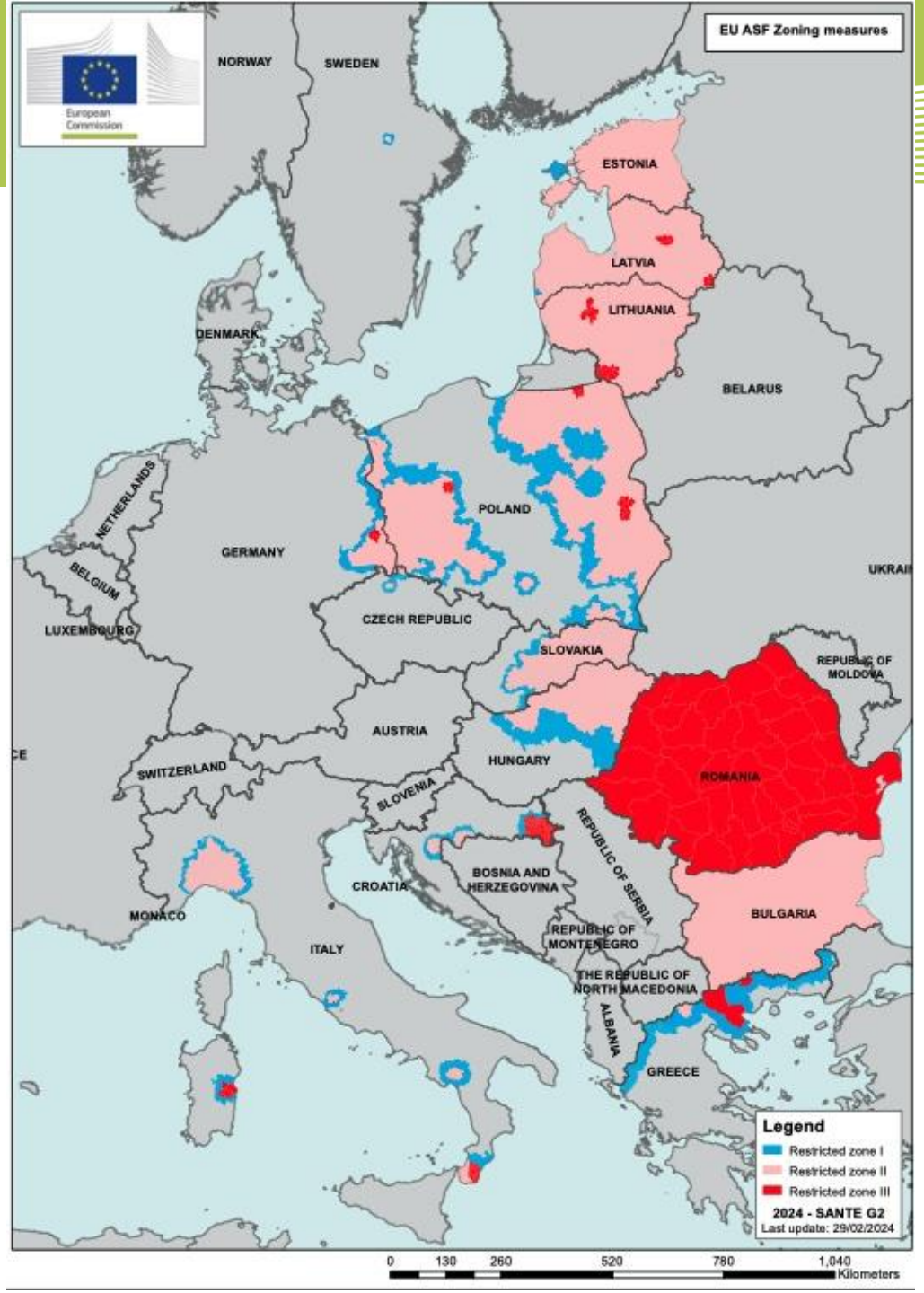
Organisation and implementation of training activities to strengthen understanding, implementation and enforcement of EU law in the area of Sanitary and Phytosanitary (SPS) standards in EU Member States and neighbouring non-EU countries

STM on African swine fever

Vittorio Guberti

ASF Epidemiology in wildboar

Serres 12 March 2024



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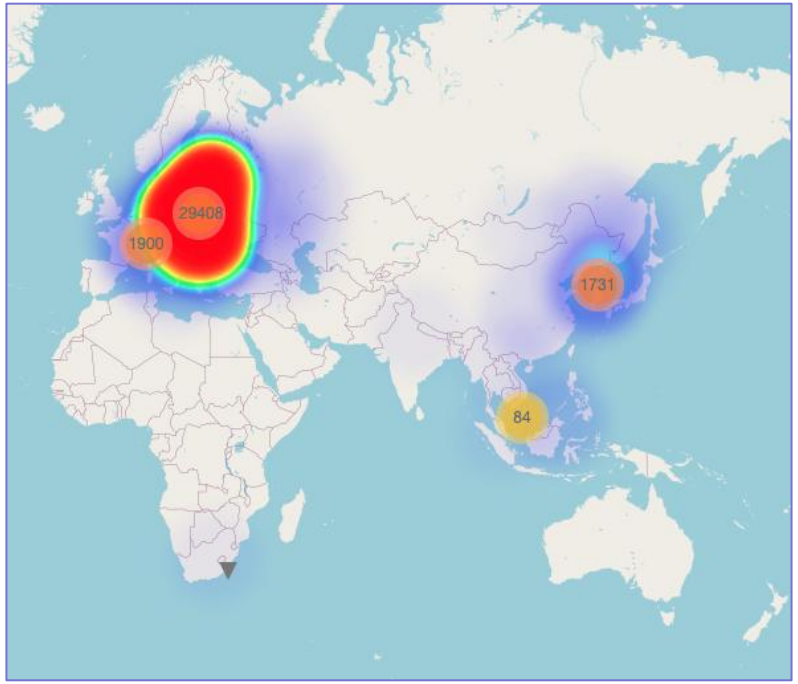
In the EU only:
More than 500.000 kmsq of Infected areas/forests Inhabited by 1.500.000 – 3.000.000 Wild boars



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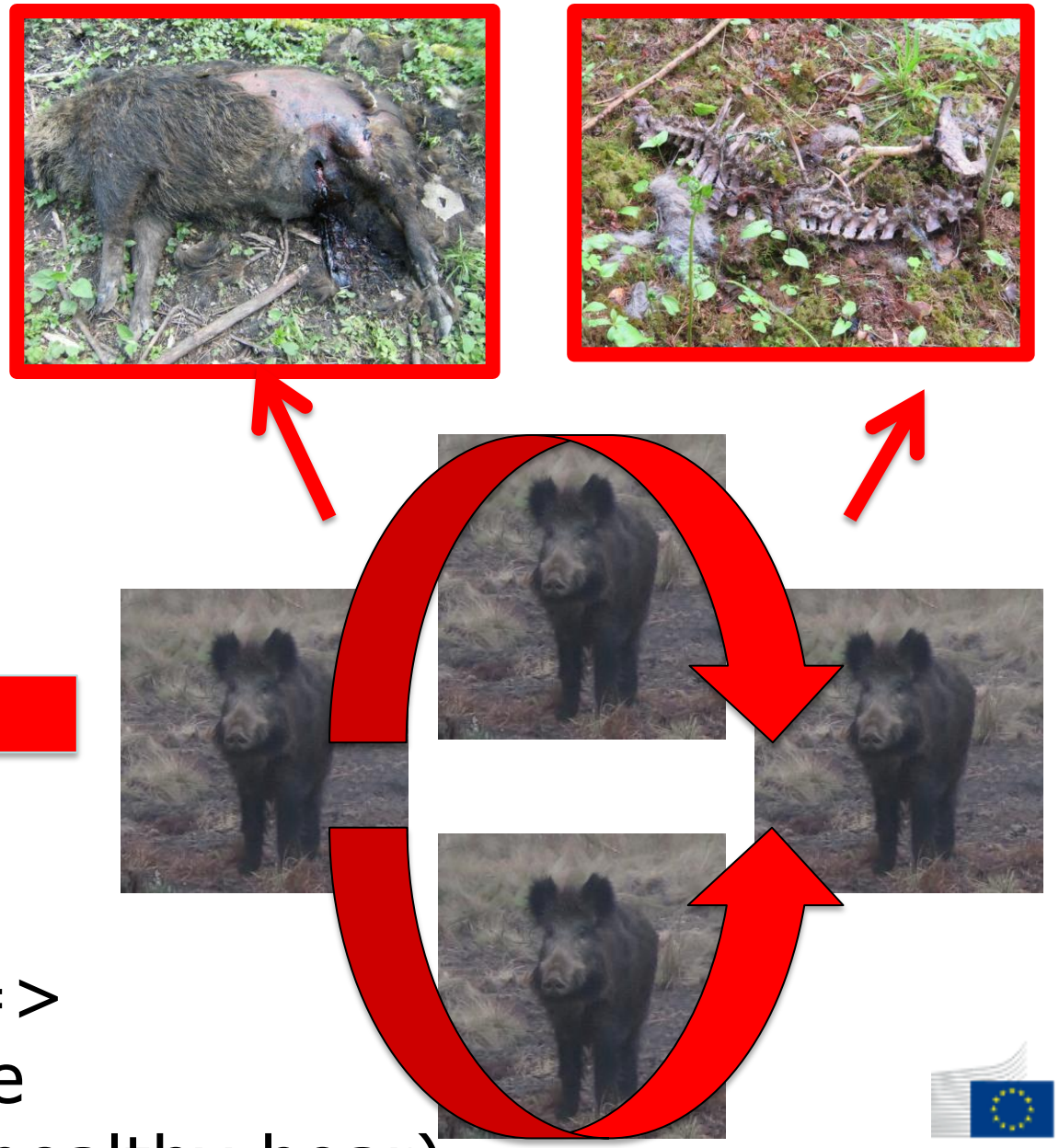
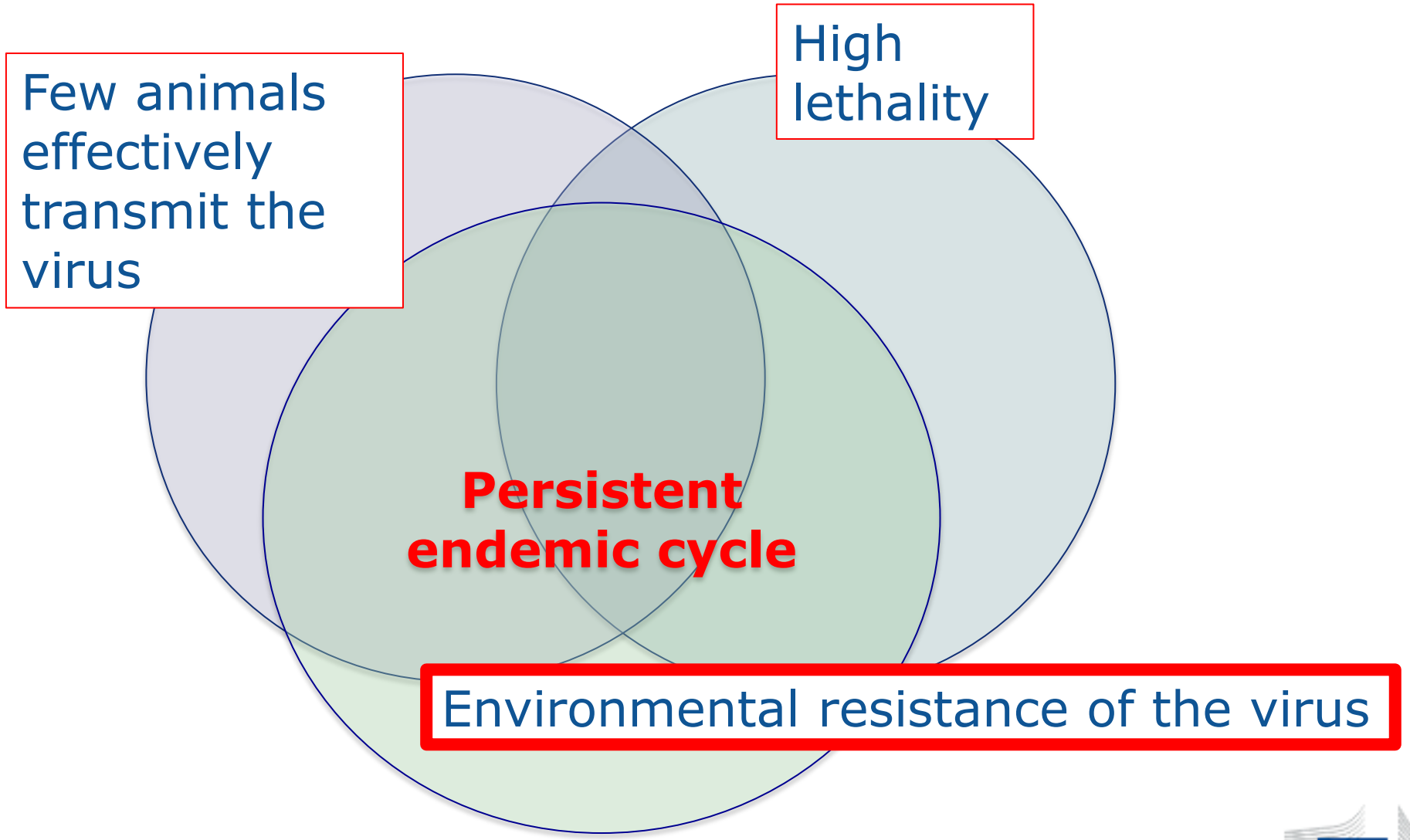
Epidemiological cycle
in the boar



Spring-summer =>
Mainly direct cycle
(infected boar - healthy boar)

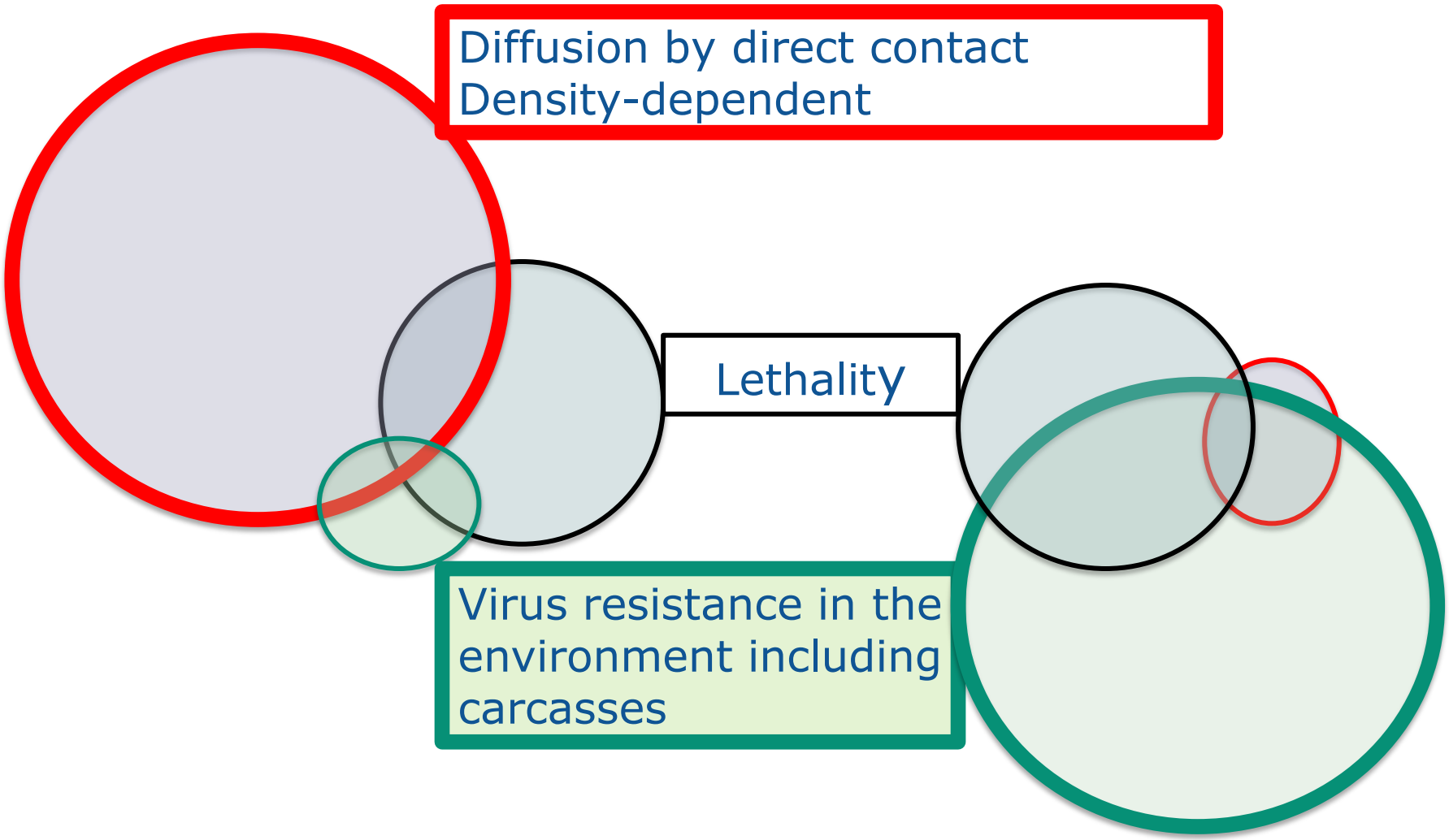
European Commission

3 factors contribute to the persistence of the virus

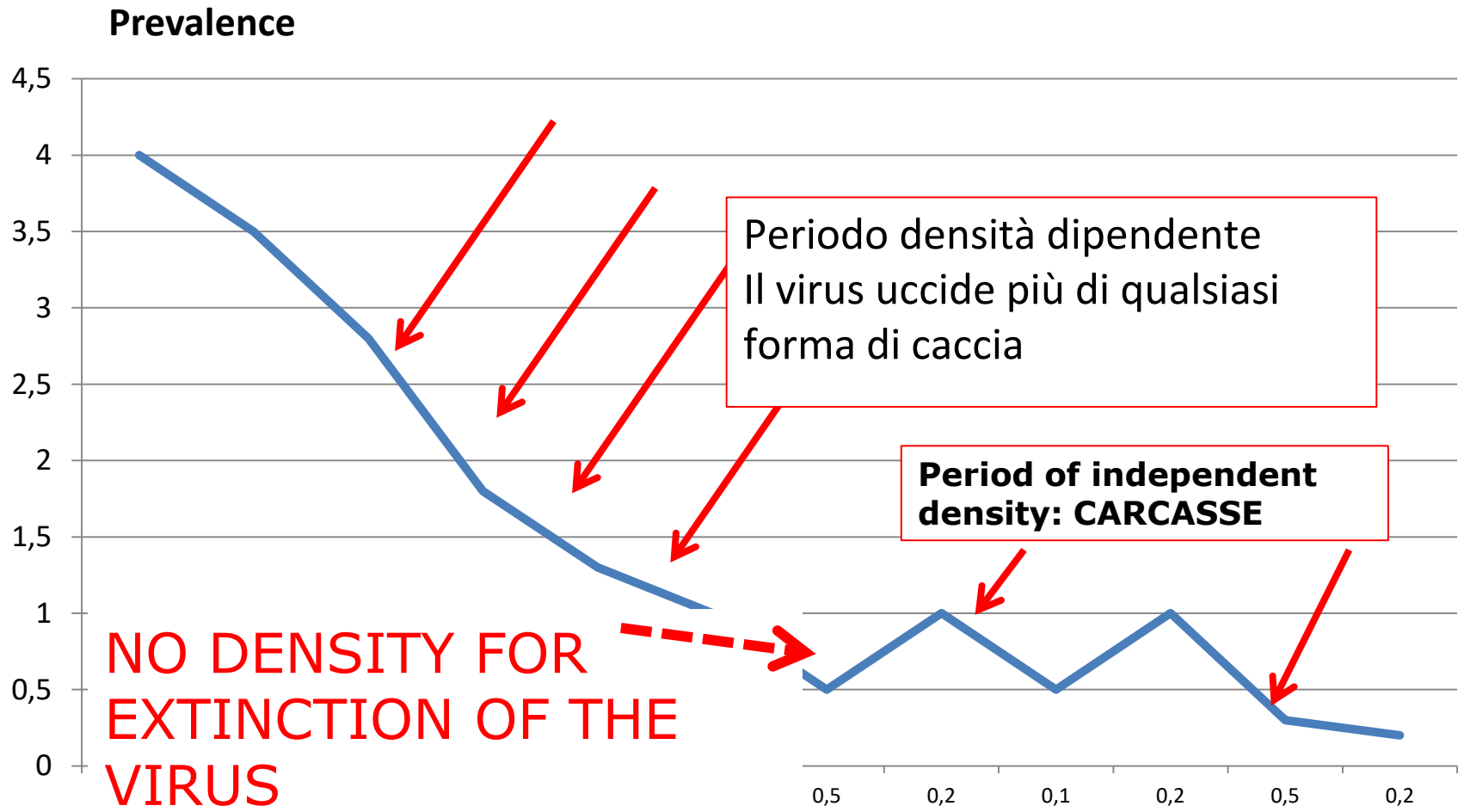


Epidemic and post-reproductive phase
Wild boar density is the main cause of infection transmission
Infection spreads spatially

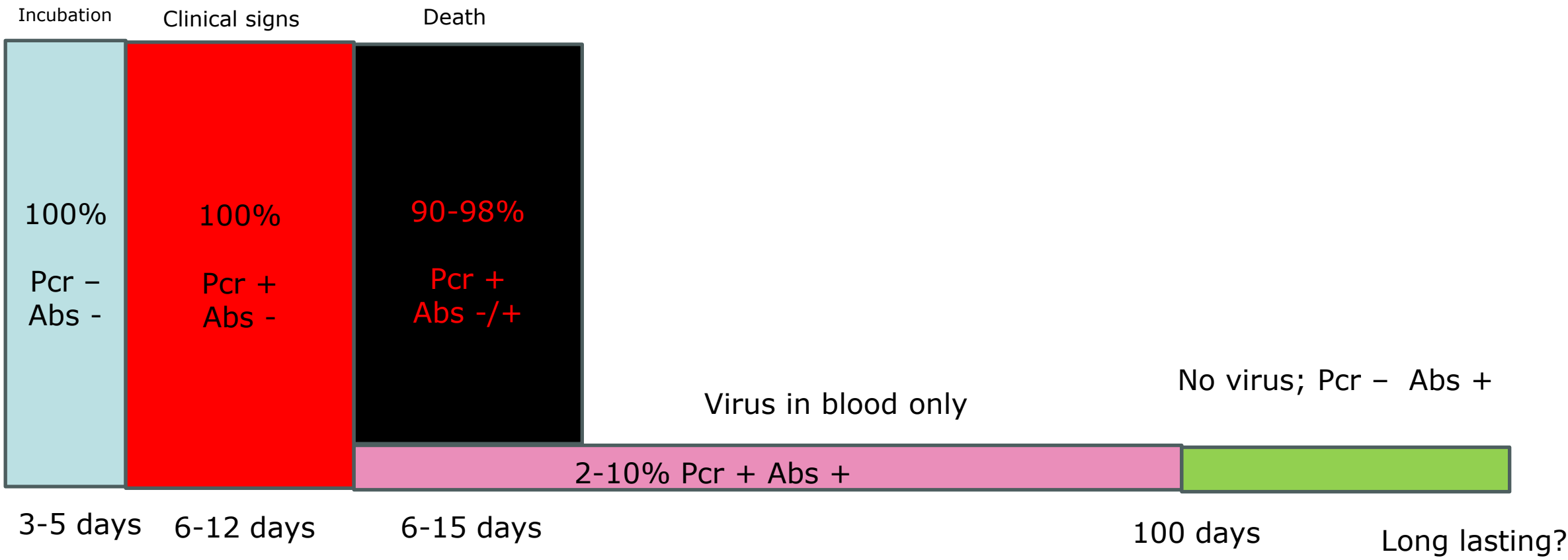
Endemic and pre-reproductive phase
Environmental resistance of the virus is the main cause of the persistence of the infection
The infection tends not to spread spatially



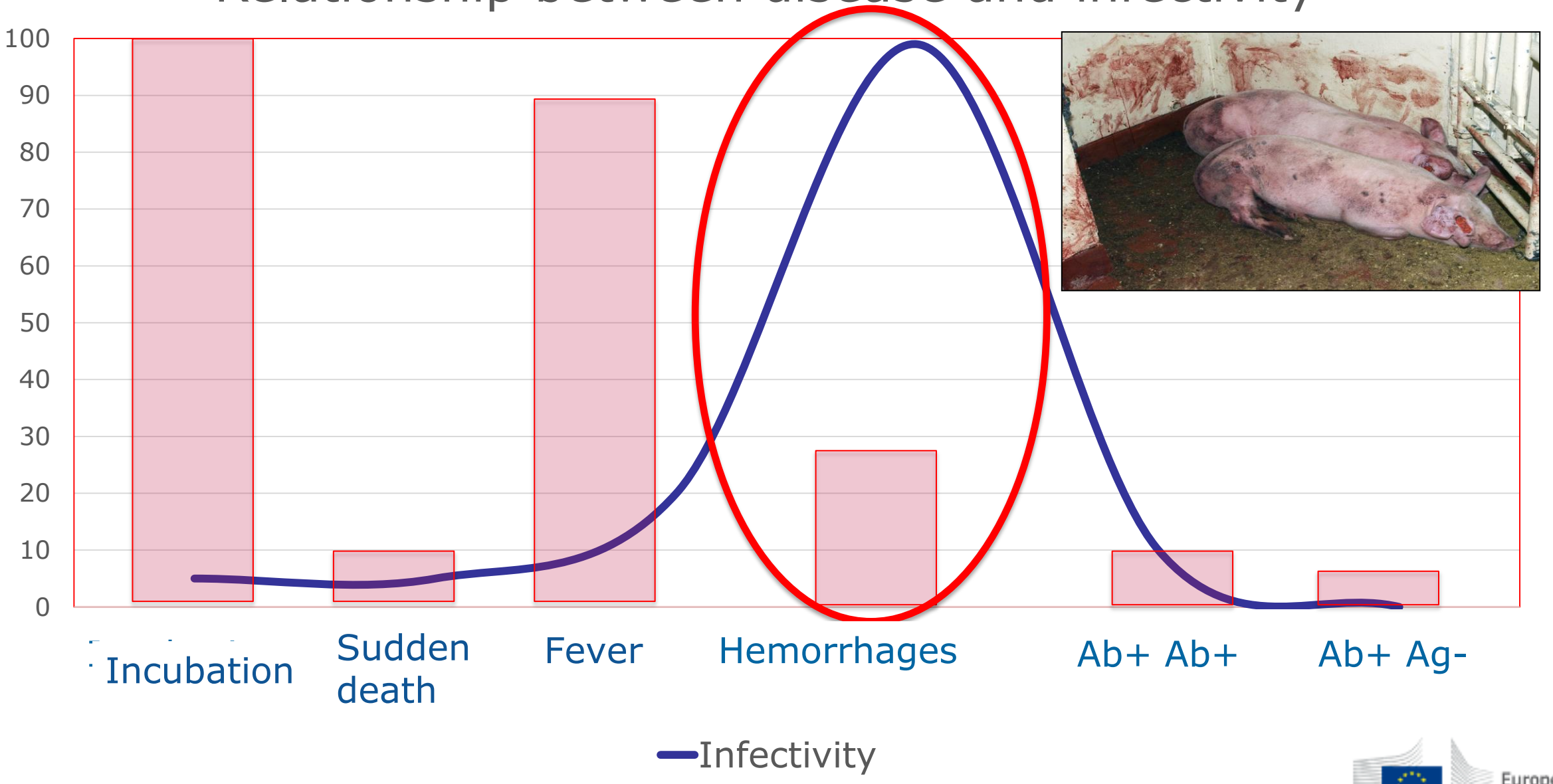
Mixed transmission:
"boar density dependent" during summer
INDEPENDENT density during winter



Clinical and immunological evolution of ASF in the wild boar



Relationship between disease and infectivity



Virus simulation models tell us that

100 *infected animals*

60-70 *die practically before transmitting the virus*

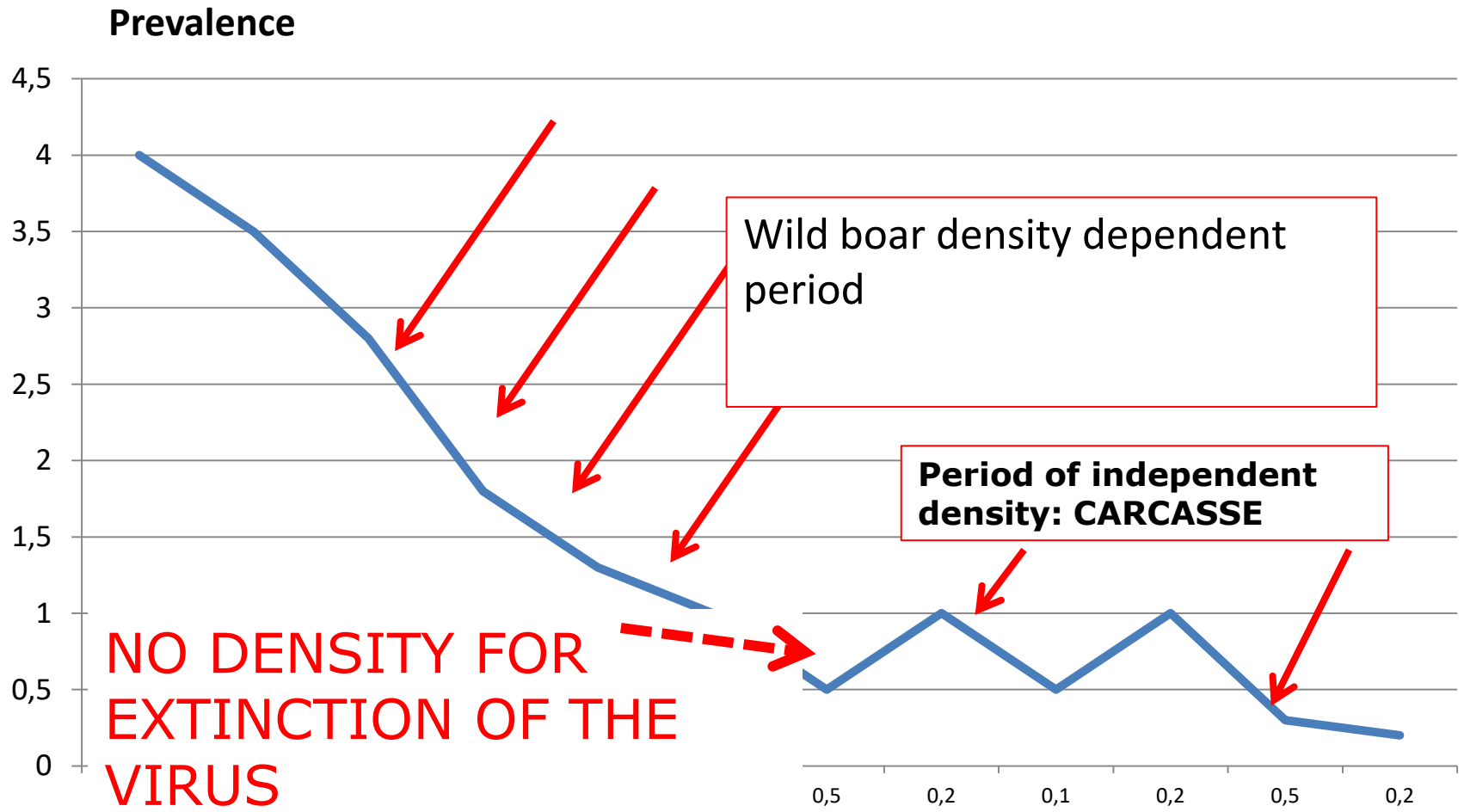
40-30 *transmit it efficiently (super spreaders)*

35-30/25-20 *die after passing it on*

5-10 *survive*

This is obviously an average from a simulation, but it explains why the infection is not transmitted so quickly

Mixed transmission:
"boar density dependent" during summer
INDEPENDENT density during winter



The lower the density of wild boar the greater the importance of transmission indirect via carcasses and viruses in micro-habitats

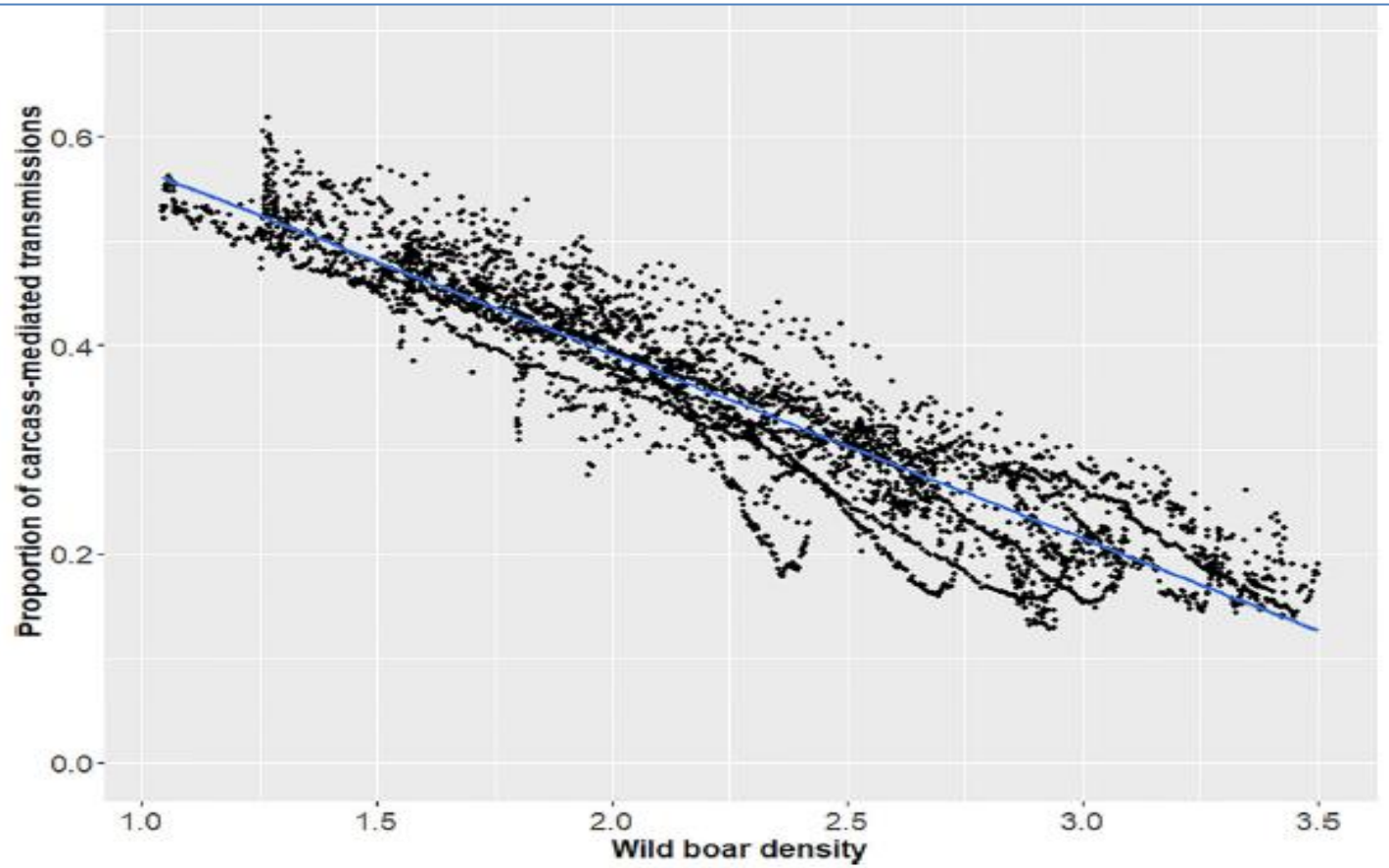
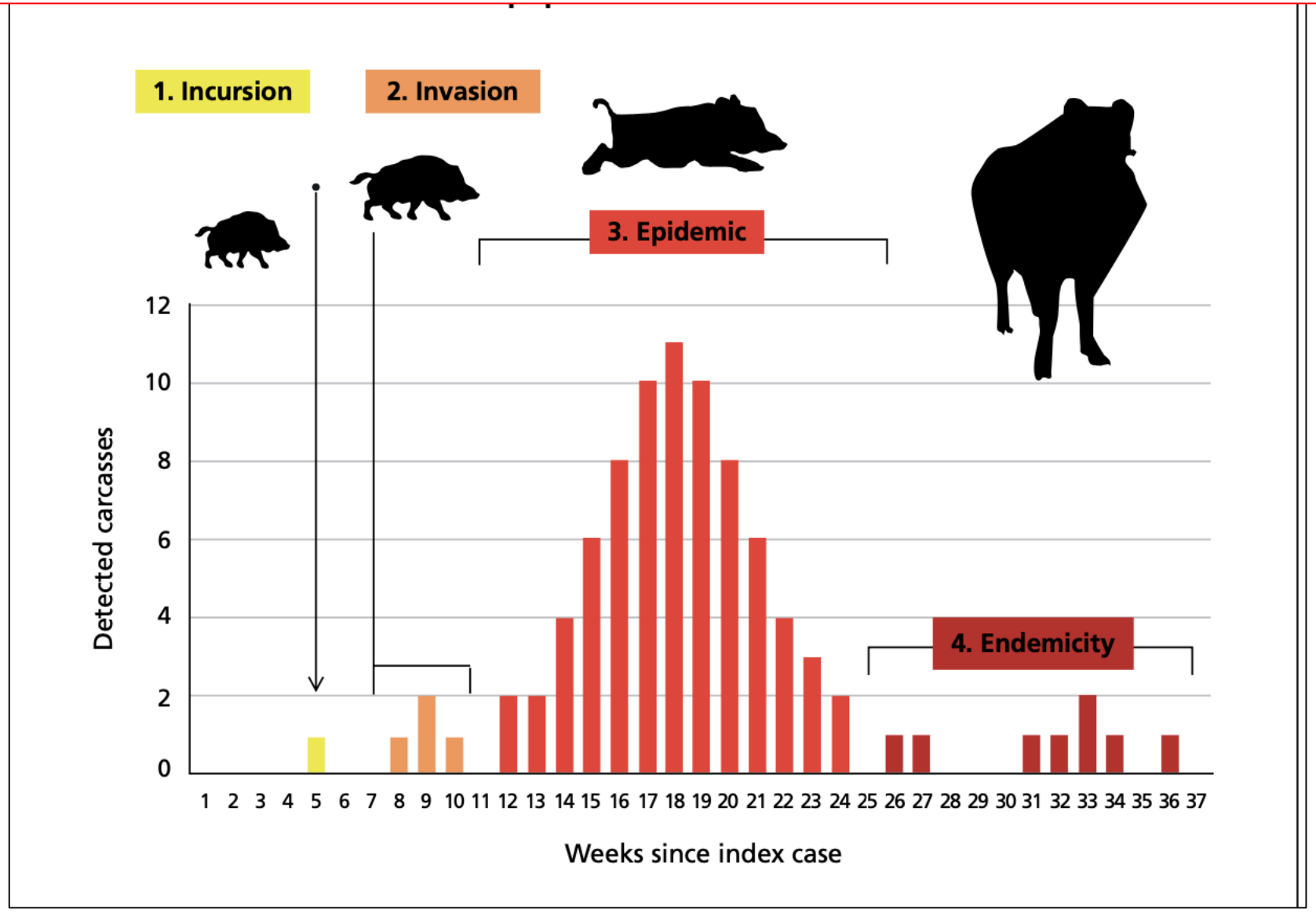


FIGURE 5 Functional relationship between wild boar population density and the proportion of ASF infections occurring through infected carcasses

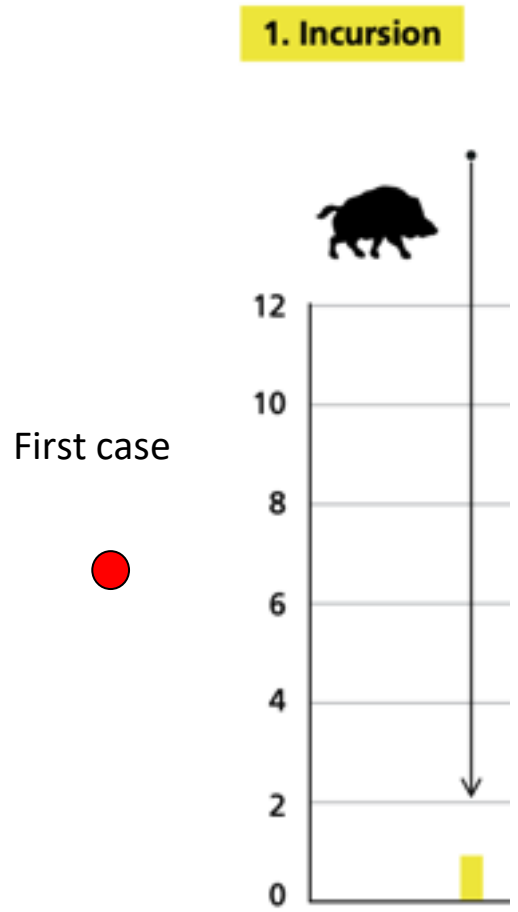
Introduction
2 main risks

Anthropogenic Introduction	Introduction for continuity with infected wild boar populations
Risk of introduction **by humans: Unpredictable**; Areas of increased potential risk NON-PREVENTABLE risk	Risk of introduction due to **geographical continuity** with infected wild boar populations. The location of infected areas is known and indicators that raise the risk can be easily identified (i.e neighbouring countries)
Always present risk	High risk if infected populations are inappropriately managed

Evolution of African Swine Fever in a Boar Population (static representation)



Dynamic representation of ASF in wild boar



1. INCURSION

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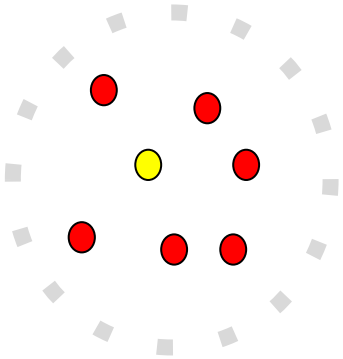
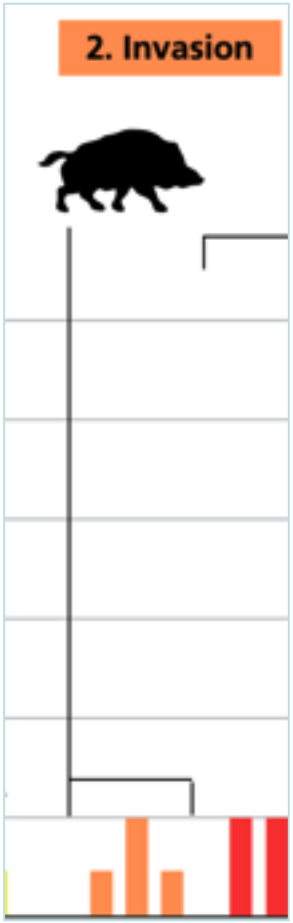
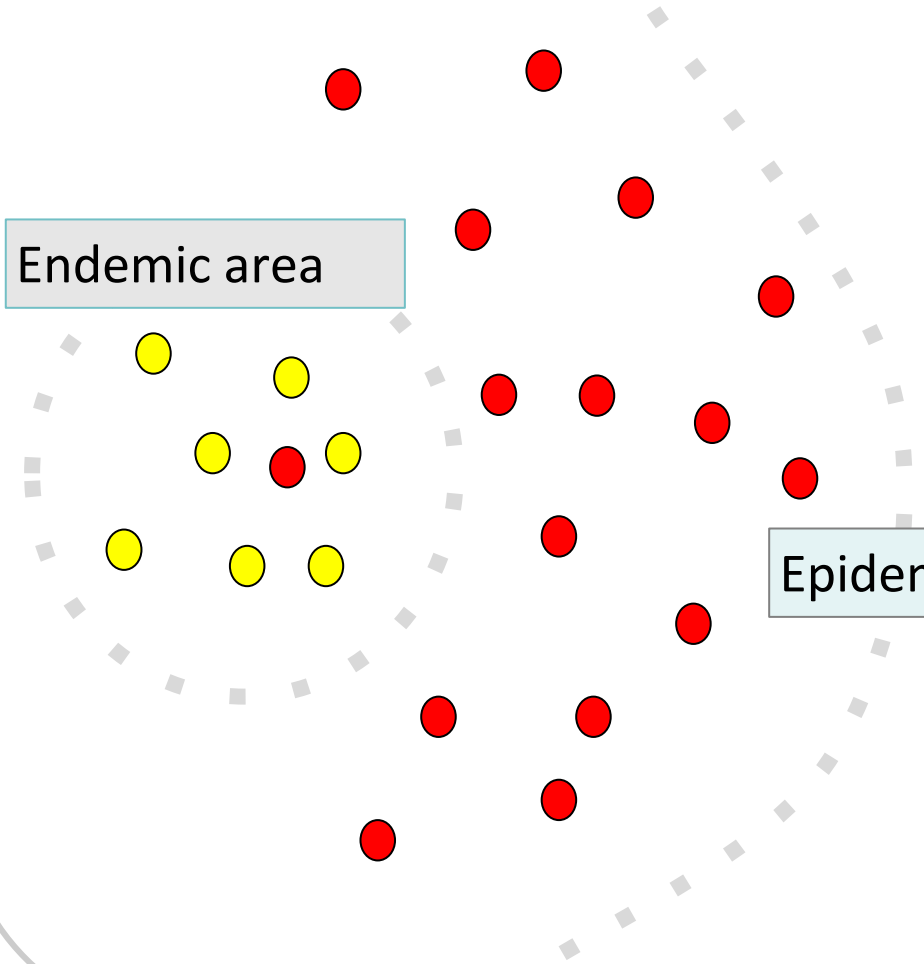
Secondary cases

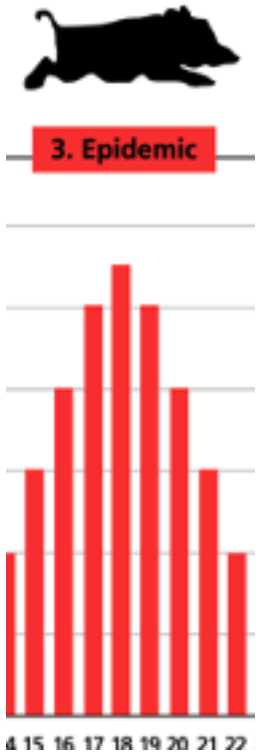




2. INVASION

European Commission





3. EPIDEMIC

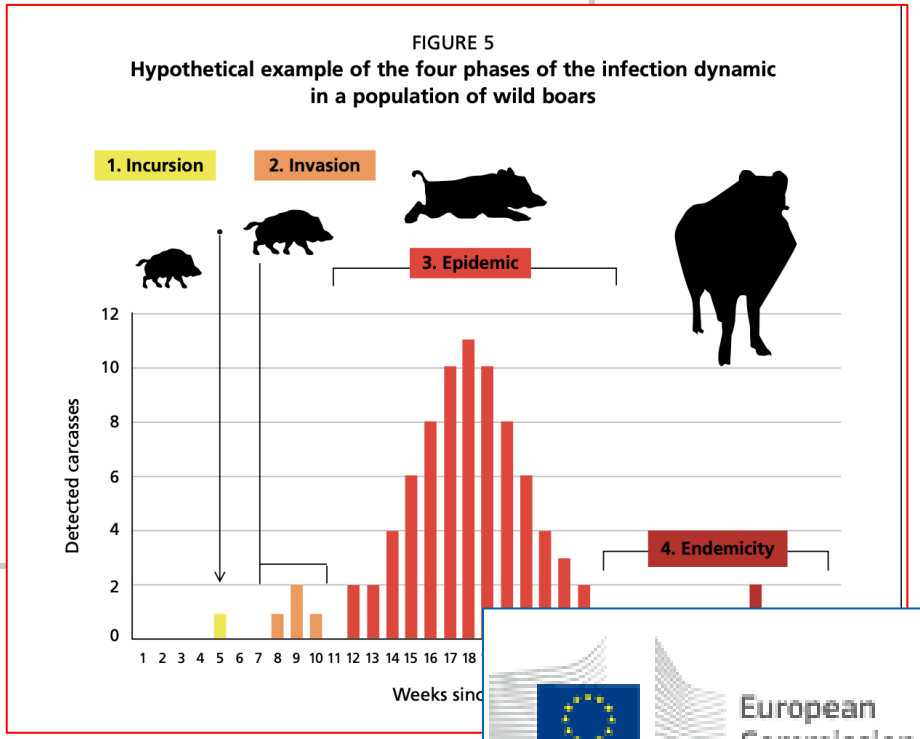
New first case

New Introduction

Endemic area

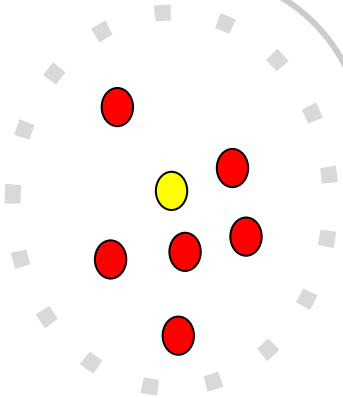
Epidemic wave

4. Human-determined virus incursion

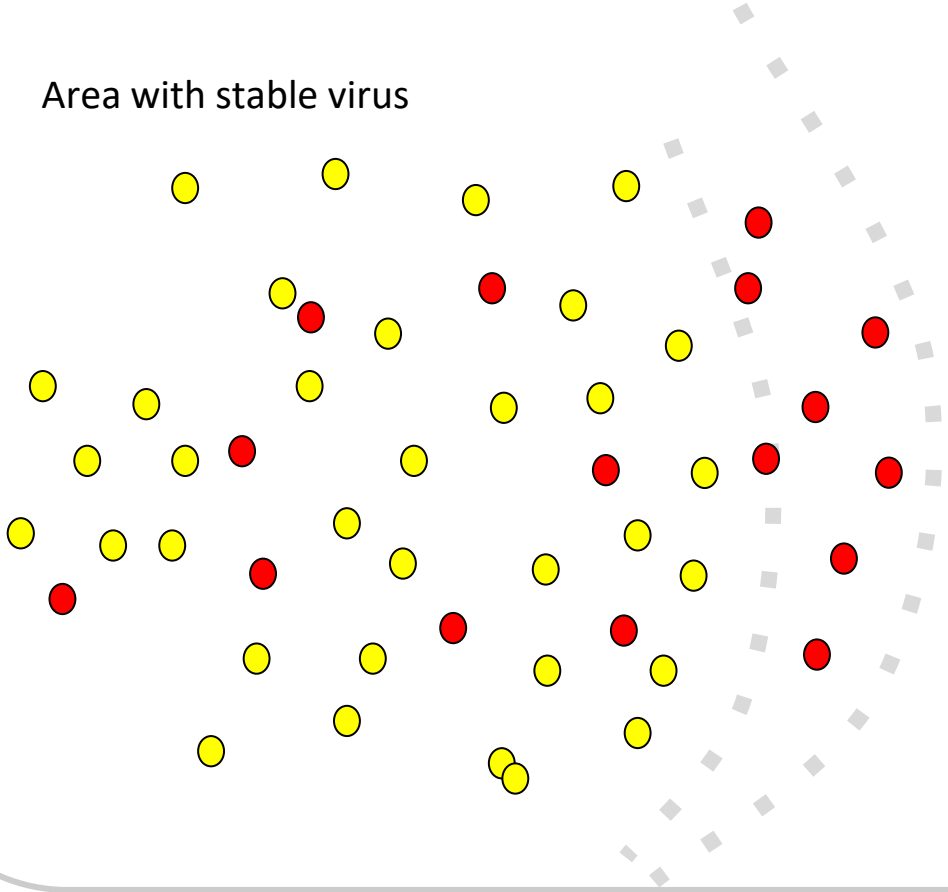


European Commission

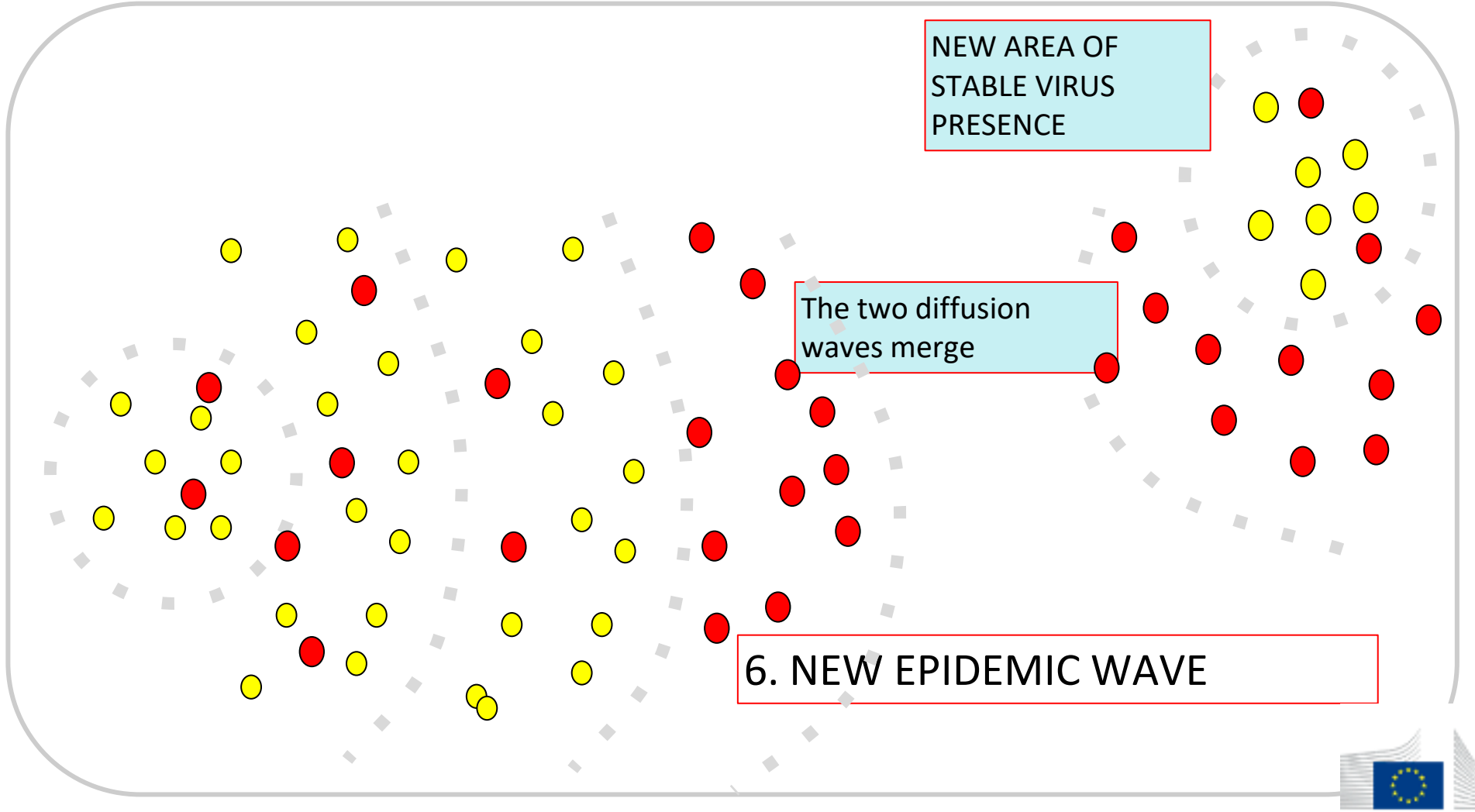
Secondary cases



Area with stable virus



5. New Invasion



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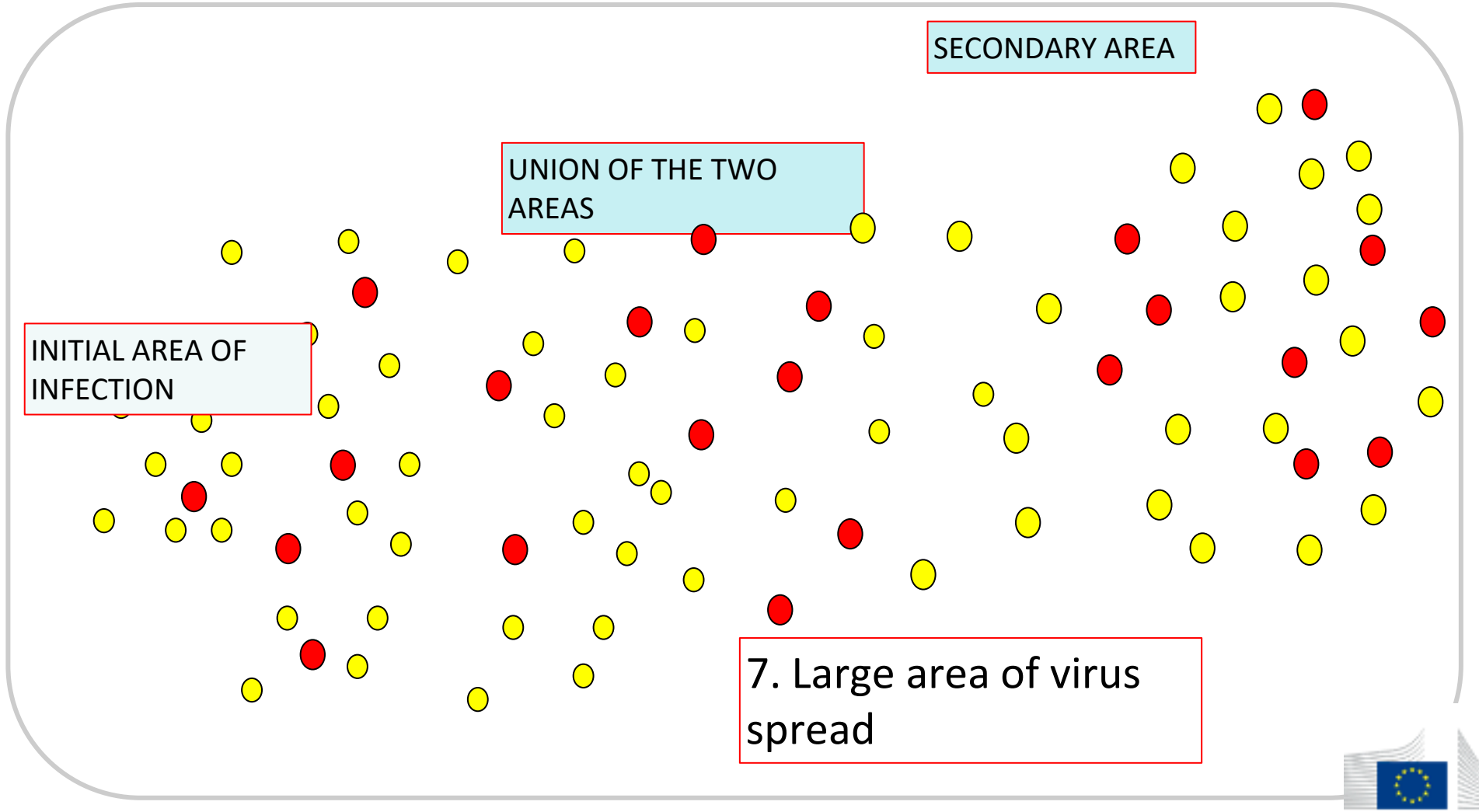

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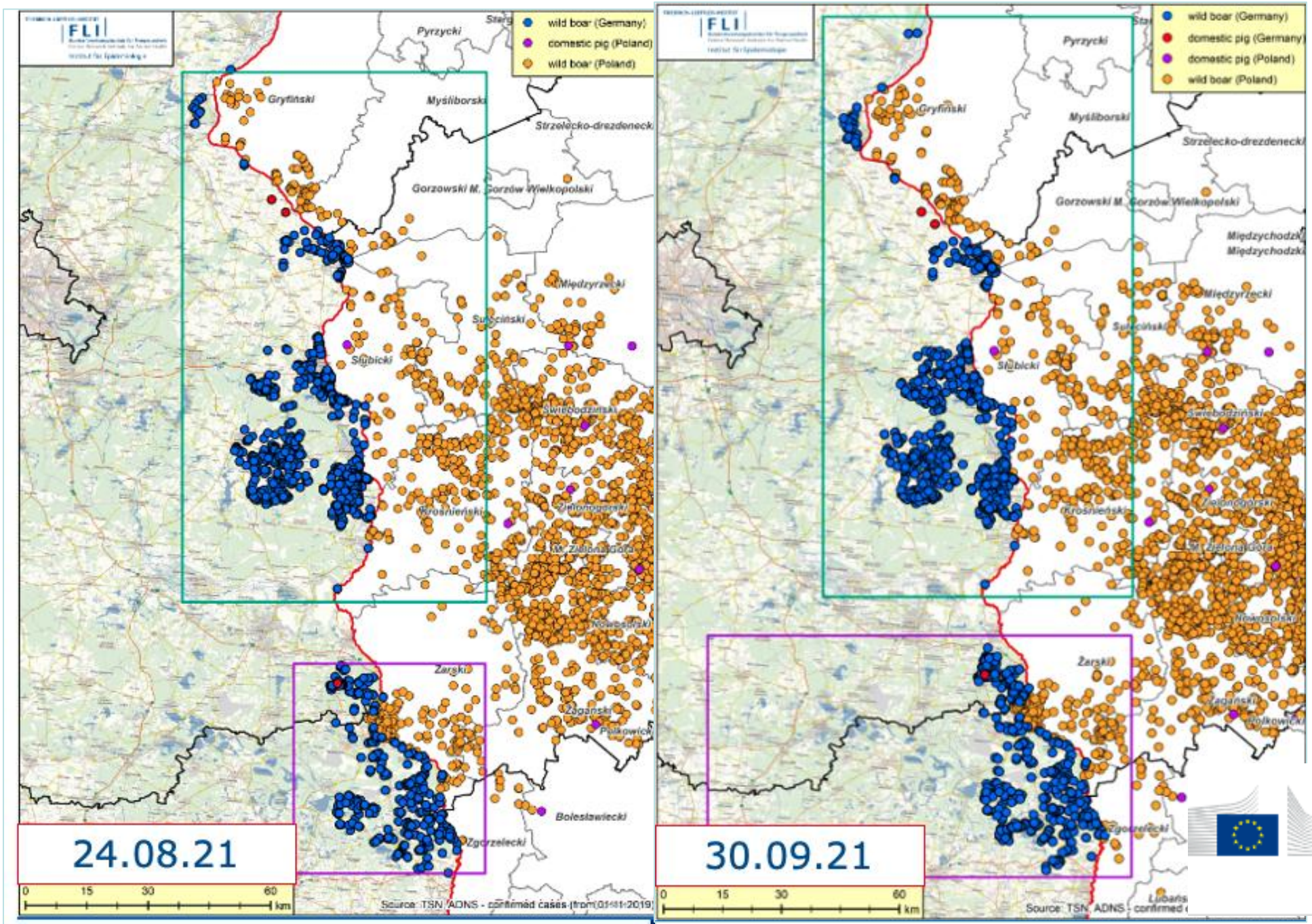

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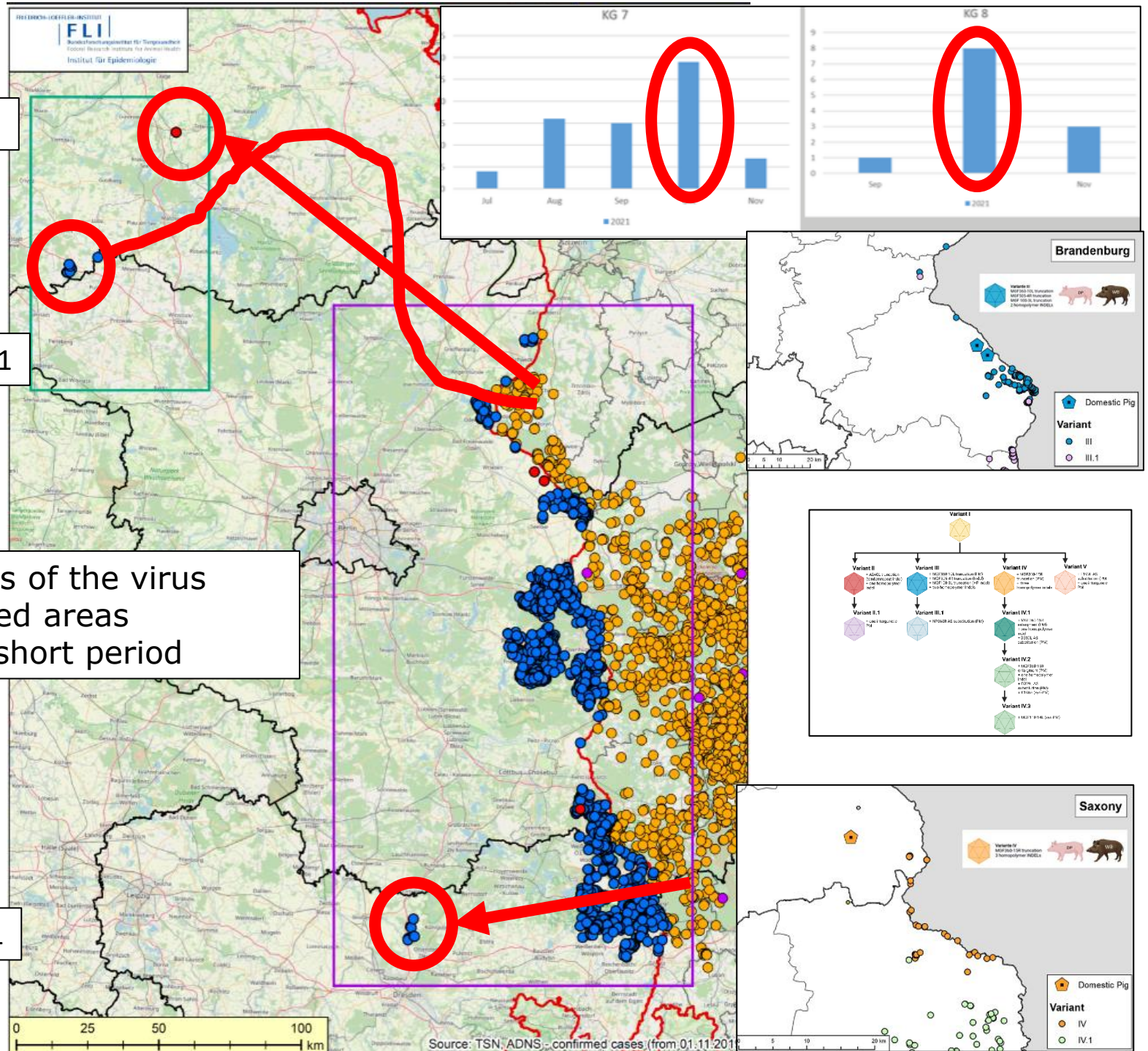
16 November 2021

25 November 2021

Three incursions of the virus outside restricted areas in a relatively short period

20 October 2021



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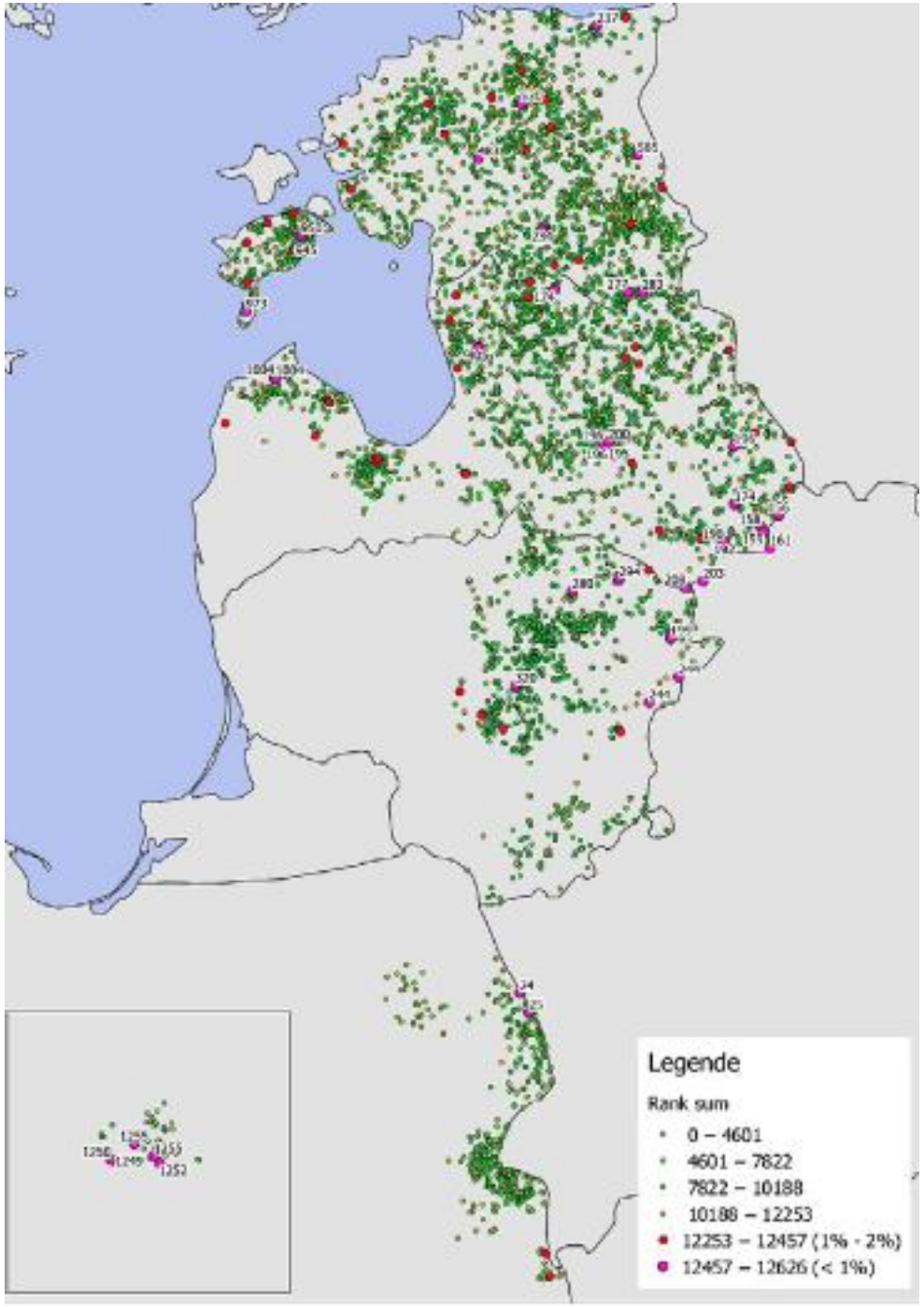


EFSA
in the first 4 years of
presence of the virus
in the EU the virus was
found
more than 100 times
beyond the radius of
possible spread by the
nearest infected wild boar

These short-to-medium
virus jumps
rays are imputed to the
man

European Commission

ASF and geography

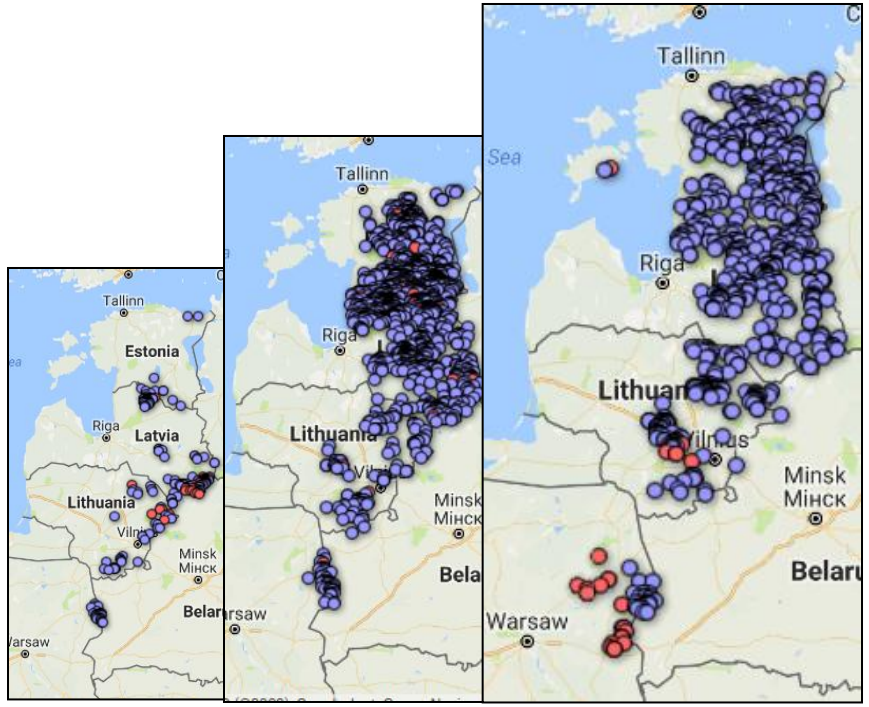
ASF in wild boar

The virus arrives in a new area and starts to spread;

Invariably there is an epidemic wave that spreads mainly through the habitats most suitable for wild boar (i.e. woods, forests, rivers, wetlands, etc.).

During the epidemic wave, most boars die of ASF (>60%) and therefore the virus -by itself- causes a major reduction in the boar population;

Despite the low density of wild boar, the virus does not die out, but tends to persist endemically;



The epidemic wave

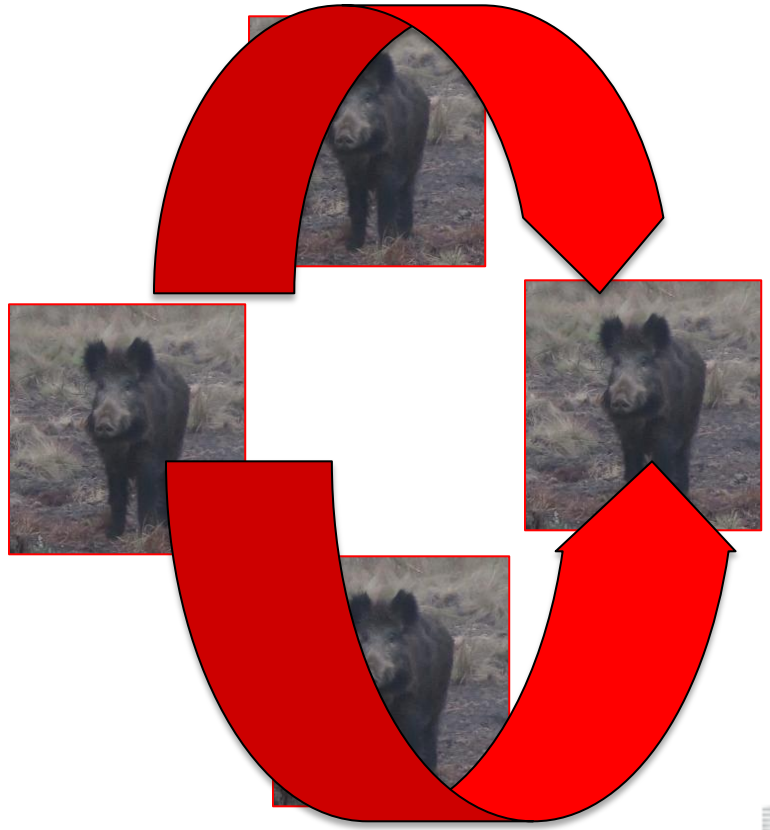
The speed and amplitude of the epidemic wave depend on:

Wild boar population density;

Continuity of habitats suitable for the species (absence of natural or artificial barriers)

Inappropriate management of infected wild boar populations (i.e. poaching; drastic reduction in numbers in infected areas)

ASF in wild boar



Geographical spread of the virus

Area	Country	Average distance	Min Max	Source
Etalle	Belgium	2km/month		Licoppe et al., 2022
Europe		1-5km/month		Schultz et al., 2019
Piedmont Liguria	Italy	-	1km/month 2,7km/month	Gervasi et al., in press

The endemic persistence

More likely when:

the virus was discovered late

Good connectivity and large extent of habitats suitable for wild boar

Highly virus-contaminated forests

Anthropic factors

- Inappropriate hunting techniques (poaching, artificial feeding, etc.);
- Lack of minimum biosecurity criteria during hunting, carcass removal, etc;
- Poaching;
- Use of the forest:

Environmental Persistence

Stable at pH 4-13…

Survives at least:

- 11 days in feces (room temp)

- 1 month in soiled pig pens

- 70 days in blood on wooden boards

- 15 weeks in putrefied blood

- 18 months in blood at 4°C

Wild boar independent spread/maintenance of the virus

The role of ASF virus contaminated habitat

A set of micro-habitats, each with its own characteristics and in which the virus lives for a certain period of time, even a long time;

In any infected forest/forest, there will always be a micro-habitat suitable for the virus in which a wild boar will roam and pick up the infection;

Or a person will put his foot in the 'wrong' place and carry the virus in his car and from there ... who knows where

It is a probability... the larger the infected area, the larger the boar population involved, the larger the number of people circulating... the greater the PROBABILITY of having a persistent/endemic infection;

Which parameters influence the probability of endemic persistence of infection and which of them can be managed

TABLE 3 Sensitivity of ASF persistence to changes in the main epidemiological and demographic parameters

Parameter				
Symbol	Description	Sensitivity	SE	*p* value
P_d	Transmission probability from infected wild boars	**−0.067**	**0.010**	**<0.001**
P_c	Transmission probability from infected carcasses	**−0.107**	**0.012**	**<0.001**
P_s	Transmission probability from ASF survivors	−0.001	0.011	0.88
χ	Duration of ASF survivors' infectivity period	0.016	0.017	0.11
I	Duration of carcasses infectivity period	**0.088**	**0.010**	**<0.001**
γ	Disease lethality	**−0.042**	**0.011**	**<0.001**
h	Hunting rate (wild boar density > 0.75/km^2)	**−0.385**	**0.088**	**0.001**
h	Hunting rate (wild boar density < 0.75/km^2)	0.006	0.059	0.21
R	Proportion of females reproducing in the population	**0.171**	**0.086**	**0.04**

The values result from a global regression-based sensitivity analysis based on standardized input values. Sensitivity values significantly different from zero are highlighted in bold font.

Received: 4 May 2021 | Revised: 17 June 2021 | Accepted: 17 June 2021
DOI: 10.1111/tbed.14194
SPECIAL ISSUE ARTICLE
Transboundary and Emerging Diseases
WILEY

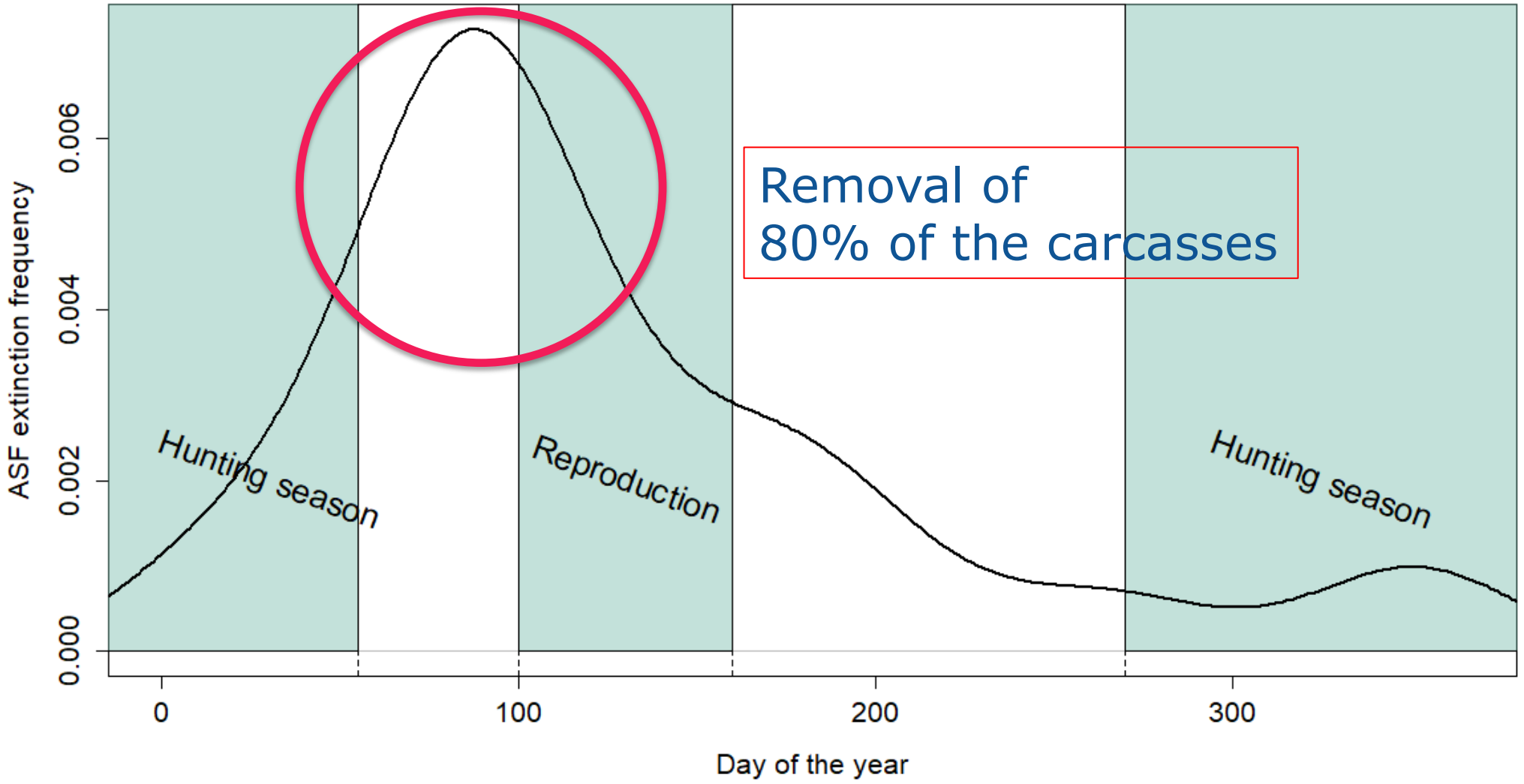
African swine fever endemic persistence in wild boar populations: Key mechanisms explored through modelling

Vincenzo Gervasi | Vittorio Guberti

European Commission

The ASF virus is characterised by high environmental resistance

Hihest probability to drive ASFV to the extinction/eradication



Reduction of the wild boar population before the arrival of the virus

Advantages	Disadvantages
Non-sanitary advantages: reduced damage to agriculture, game birds; reduced environmental damage (orchids) reduced competition for forest fruits and mushrooms	Hardly feasible and sustainable even in the short term (2-3 years)
Fewer animals to manage in infected area, therefore - at least theoretically - more likely to be eradicated	Not particularly accepted by the hunter society, which is - in fact - also called upon to carry out depopulation;
Reduced speed of geographical spread of the virus (epidemic wave)	in the event of PSA introduction, fewer dead wild boars = less likelihood of early detection
	The virus immediately becomes endemic

Food and Agriculture Organization of the United Nations

World Organisation for Animal Health
Founded as OIE

ISSN 1810-1119

African swine fever in wild boar
Ecology and biosecurity

Second edition

FAO ANIMAL PRODUCTION AND HEALTH / **MANUAL 28**

FIGURE 23
Example wild boar data-collection template

WILD BOAR N. _____

MUNICIPALITY _____

LOCALITY _____

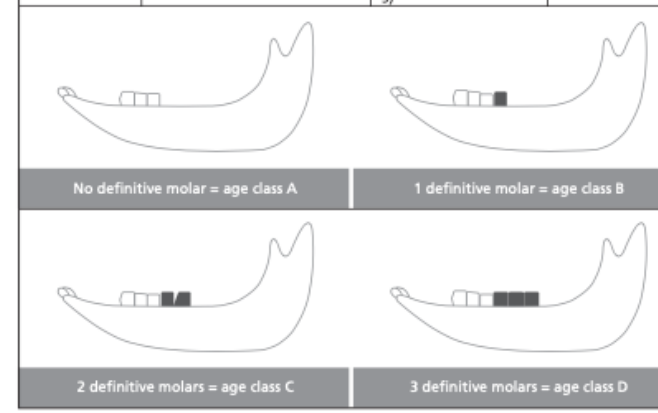
HUNTING GROUND _____

PERSON COLLECTING SAMPLES: _____

LATITUDE AND LONGITUDE _____

DATE: _____

	Wild boar data	Gender	Sampled organs
N. laboratory _____	Wild boar data ☐ Single hunt from tower ☐ Single hunt by searching ☐	Male ☐	
N. hunted wild boar _____	Found dead ☐ Shot healthy ☐ Shot abnormal behavior ☐	Female ☐ Pregnant ☐ N. fetus _____	
	Decomposition stage	1) 2) 3) 4) 5)	



Source: **Guberti, V., Khomenko, S., Masiulis, M. & Kerba S.** 2019. *African swine fever in wild boar ecology and biosecurity.* FAO Animal Production and Health Manual No. 22. Rome, FAO, WOAH and EC. https://doi.org/10.4060/CA5987EN.

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