ASF is spreading trough Europe
I'm thinking about
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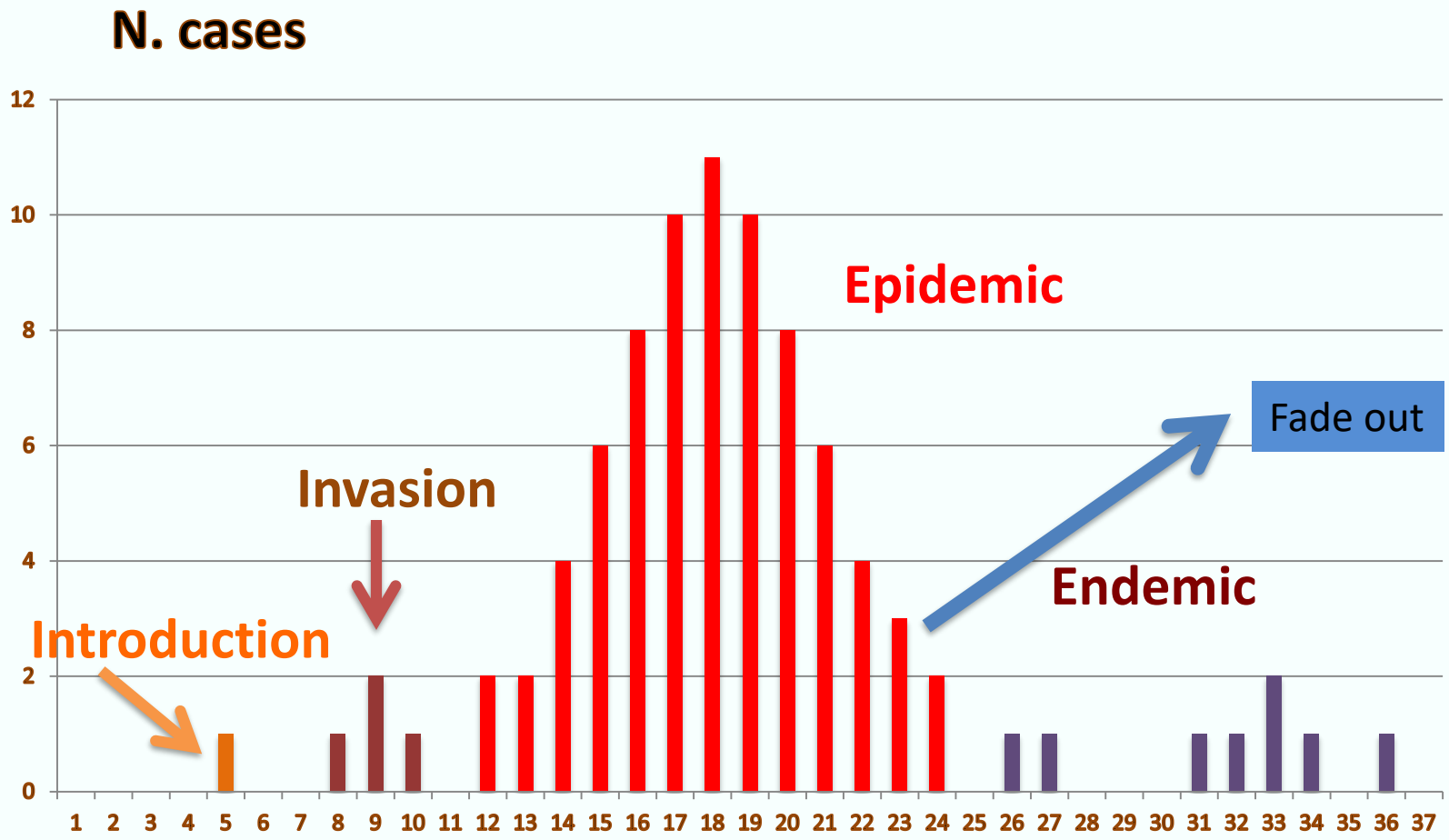
Europe
©MAPS.COM
1. LITHUANIA
2. LUXEMBOURG
3. LIECHTENSTEIN
4. CZECH REPUBLIC
5. BOSNIA & HERZEGOVINA
6. SERBIA
7. MONTENEGRO
8. KOSOVO
JAN MAYAN
SVALBARD
ICELAND
FAROE ISLANDS
Atlantic Ocean
North Sea
NORWAY
SWEDEN
FINLAND
RUSSIA
ESTONIA
LATVIA
BELARUS
ISLE OF MAN
UNITED KINGDOM
IRELAND
DENMARK
NETHERLANDS
GERMANY
POLAND
UKRAINE
GUERNSEY
JERSEY
BELGIUM
SLOVAKIA
MOLDOVA
SWITZERLAND
AUSTRIA
HUNGARY
ROMANIA
SLOVENIA
CROATIA
FRANCE
BULGARIA
AZERBAIJAN
GEORGIA
ARMENIA
AZER.
Caspian Sea
Black Sea
ANDORRA
PORTUGAL
SPAIN
ITALY
SAN MARINO
MONACO
VATICAN CITY
MACEDONIA
GREECE
TURKEY
ALBANIA
Mediterranean Sea
GIBRALTAR
MALTA
70°
60°
50°
40°
5°
0°
5°
15°
25°
35°
45°

Aim of the presentation:

- Highlights the different phases of **any** infectious wildlife disease;
- Based on wildlife disease epidemiology underline **which** interventions are appropriate and **when** in an ASF infected wild boar population

The 4 phases of a transmissible disease



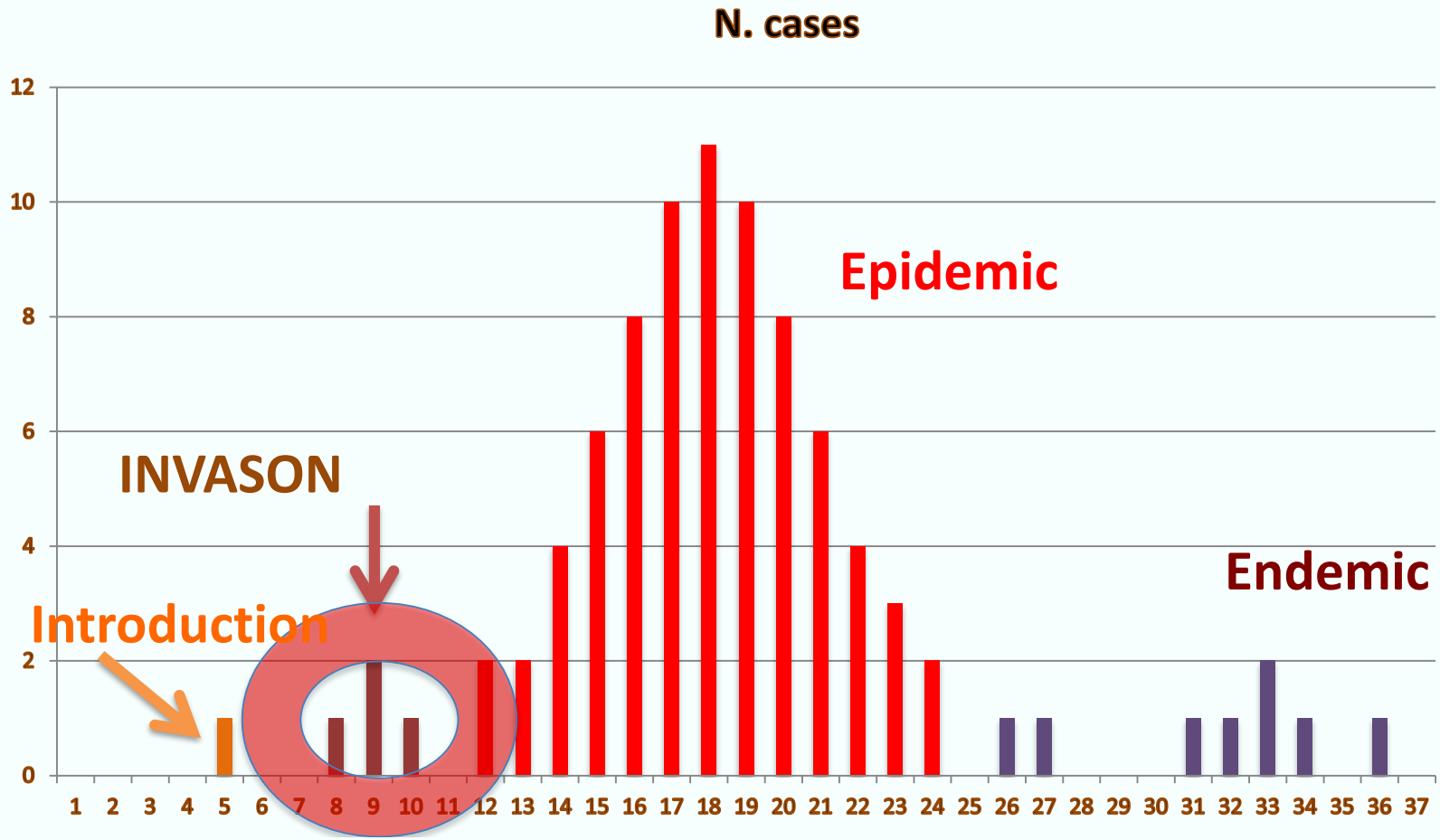
Introduction phase

- An infectious animal (sandwich, infected blood etc.) arrives in a free area;
- Difficult to be prevented;
- Fence the border?
- Hunt every wild boar crossing the border?
- What else?
- FEASEABILITY? SUSTAINABILITY?

REALITY: the virus arrives

Saint Severino, protector of borders (410-482)

INVASION


N. cases
12
10
8
6
4
2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37
Epidemic
Endemic
INVASON
Introduction

The invasion phase initiates when

- A minimum number of susceptible wild boar is available for the virus
- This specific minimum number is defined as: Host **threshold** density for infection invasion (Nt);
- The infection of this minimum number of susceptible – available - hosts is the starting point of any epidemic

What about this Threshold?

- Nt exists when the infection spreads in a density dependent pattern;
- Nt is a deterministic threshold (a precise N. of individuals…that could be espressed also by density i.e. 0,5/1000ha);
- It is simply the number of WB, no gender and age classes have to be considered/known;
- Nt addresses preventive measures aimed in reducing the wild boar population size **BEFORE** the arrival of the infection; **FREE AREAS**

Is it possible to prevent the invasion phase?

In **free areas** it is COULD be possible to prevent the invasion phase (and thus avoiding the epidemic) managing the wild boar below the THRESHOLD DENSITY (Nt)

EFSA, 2017 through a stochastic model

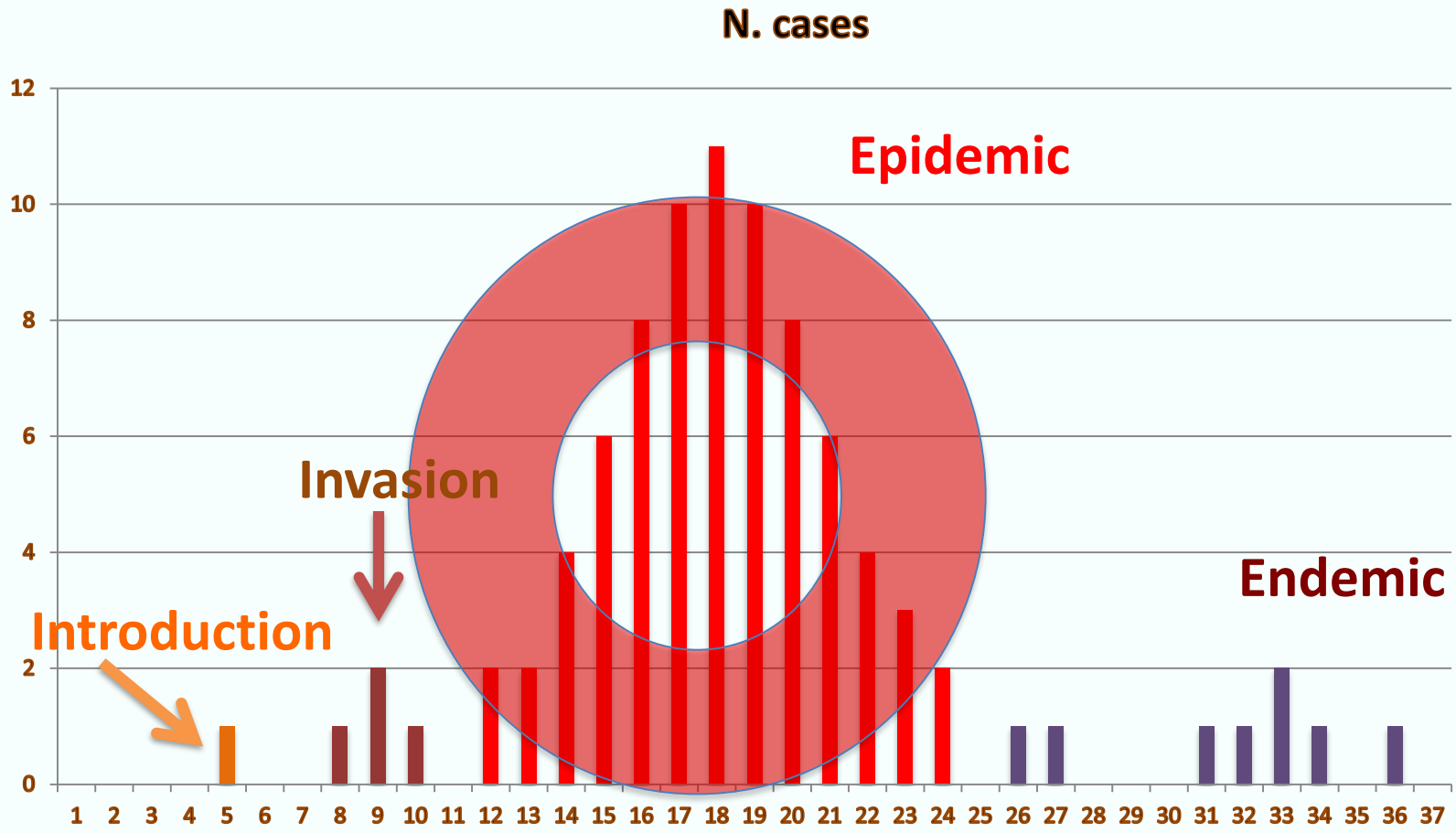
Nt and percentages

- The most widespread mistake is to set a “average” percentage of animals that has to be eliminated;
- 70% (rabies derived) is considered a magic number;
- 70% of 10WB/Kmsq = **3** left in the forest
- 70% of 4WB/kmsq = **1** left
- 70% of wild boar estimated in March = **35%** in winter (usual hunting bag!!!)

Can we prevent ASF managing the wild boar population at the threshold?

- Deterministic (exact) Nt estimation;
- Alternative approach: EFSA (stochastic)
- Precise host population size estimates:
- Zlin=>2/kmsq then 9/kmsq
- Feasibility
- BY NOW ALL ACTIONS IMPLEMENTED WHEN THE VIRUS ARRIVES: NO PREVENTION….BUT …REACTION

Epidemic


N. cases
12
10
8
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4
2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37
Epidemic
Invasion
Introduction
Endemic

The epidemic phase

- The infection spreads in the wild boar population: the chain of infection is fully activated;
- The intensity and the duration of the epidemic results from the interaction between the two populations (host and infection agent) driven by wild boar population size and density;

Epidemic phase: considerations

- Wildlife diseases are detected during the epidemic phase and rarely (if ever) during the invasion phase; **1 detected positive = 3-6 in the forest**
- Countries ask for a threshold to be reached during the epidemic:
- BUT during the epidemic TECHNICALLY THERE IS NOT A THRESHOLD

Is the epidemic phase manageable?

NO!!!

- The infection rate is always higher than any hunting rate
- Hunting will favour an artificial endemic evolution of the infection with **VIRUS PREVALENCE HIGHER THAN NATURAL**
- Hunting will increase the probability to geographically spread the disease (100 year of wildlife diseases management) field studies, ;

EPIDEMIC PAHSE

- Do nothing
- PASSIVE surveillance
- Do not get tired of surveillance;
- Be accurate when collecting data;
- Be patient and wait the end of the epidemic revealed by surveillance;

Probability to eradicate

$p=(1/R_0)^{N.infectious}$

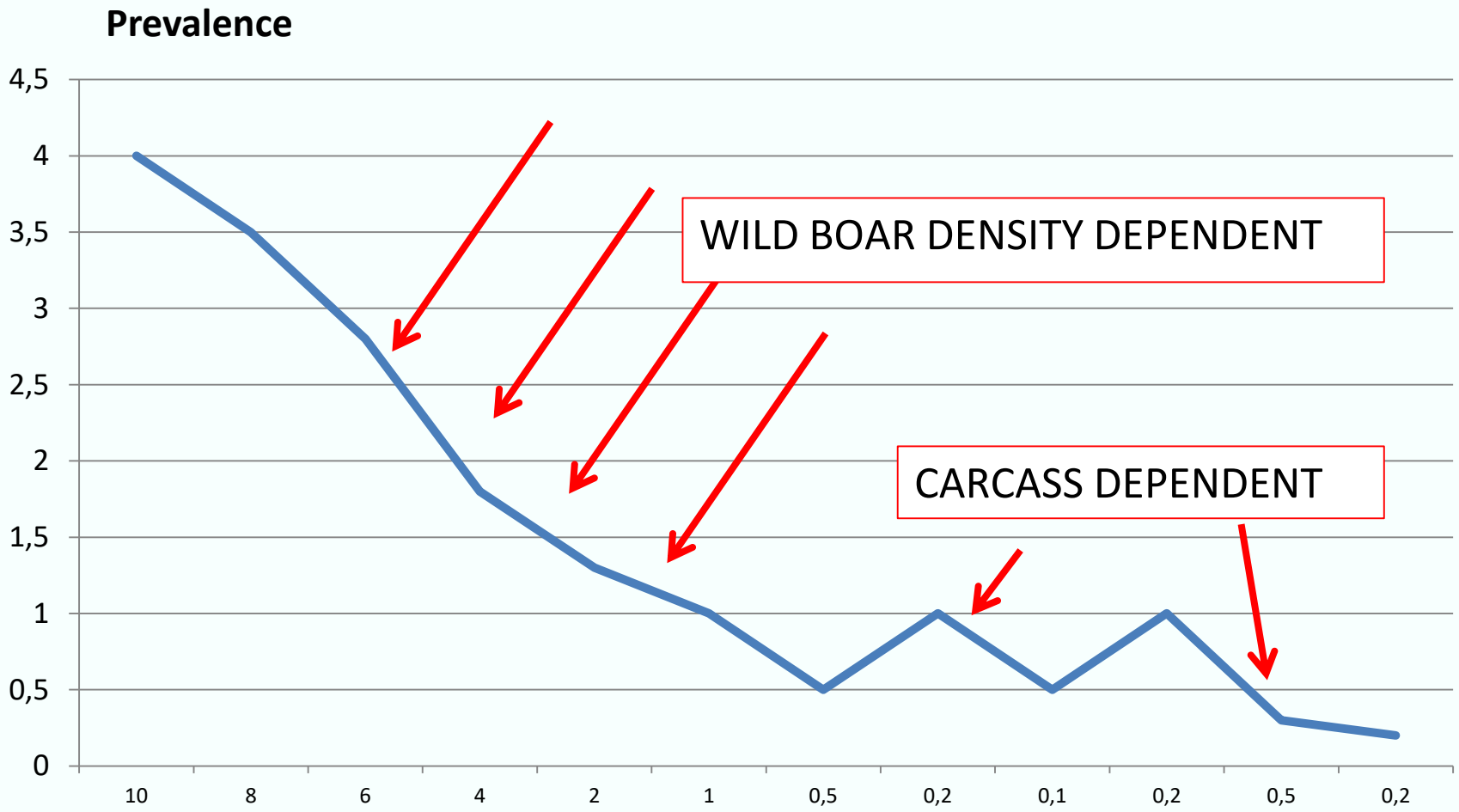
Zlin, R_0 ~1,5

$p =(1/1,5)^1$ = **67%** (**1** infected wild boar)

$p =(1/1,5)^5$ = 13%

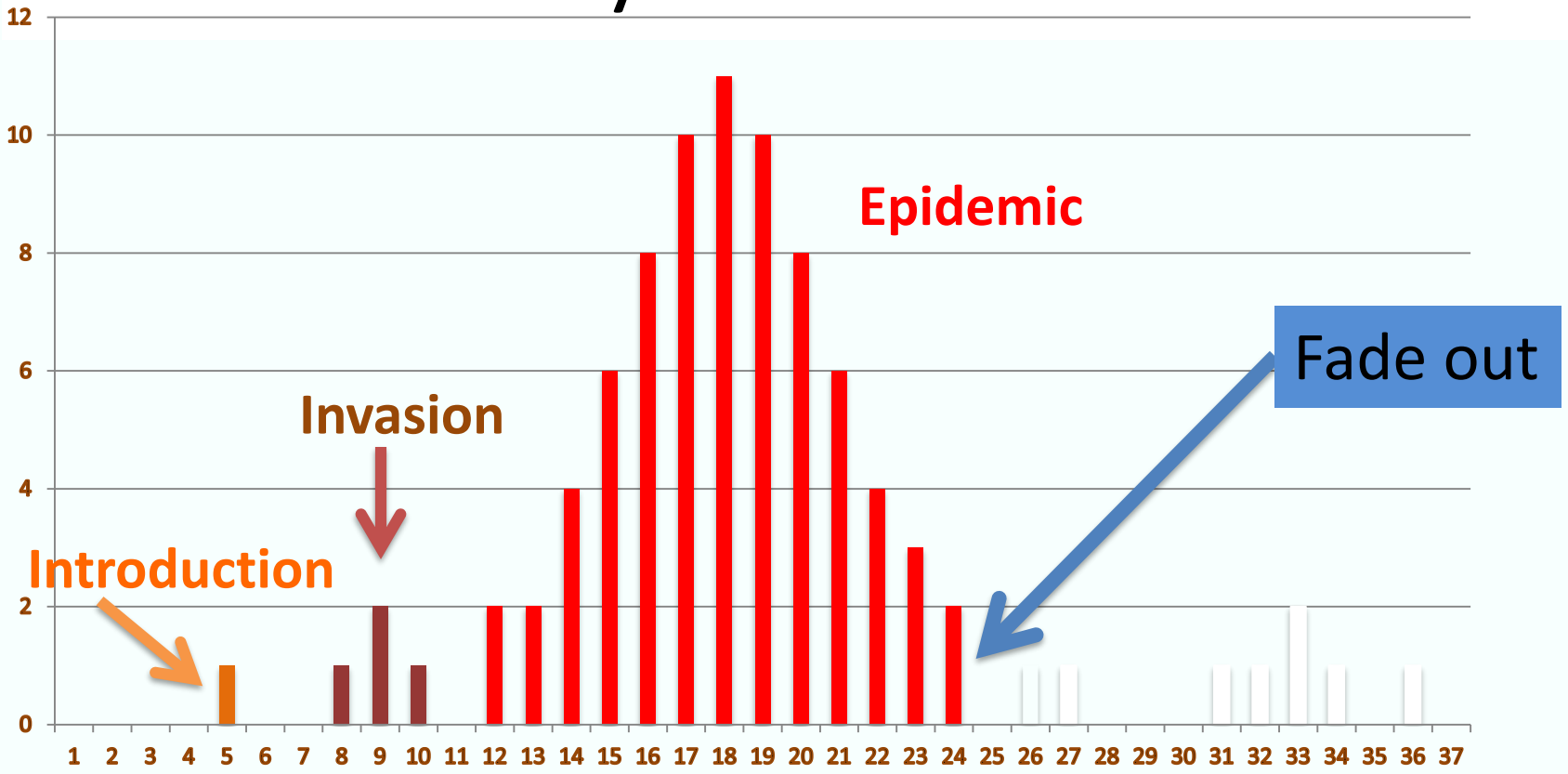
$p =(1/1,5)^{10}$ = **2%** (**10** inf. wild boars)

ASF in not a simple density dependent infection.
The ultimate persistence of the virus is guaranteed by carcasses
The virus itself kills most of the animals

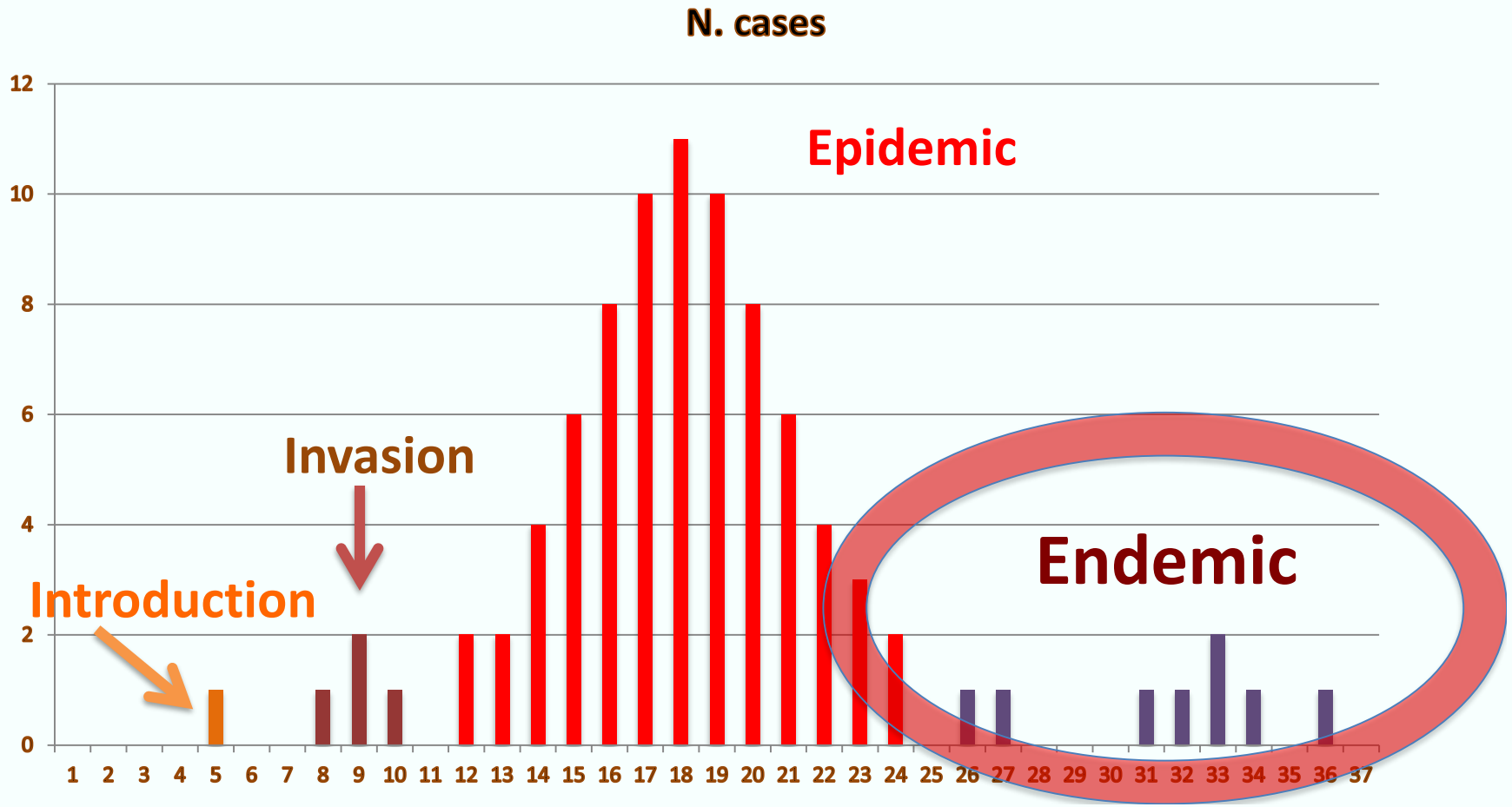


TO QUOTE
HAMLET
ACT III, SCENE III
LINE 87,
NO
HUNTING

Rarely the infection fades out spontaneously
a lucky but rare event



Epidemic evolved endemic



Why an epidemic evolves endemic?

A WILD BOAR CRITICAL COMMUNITY SIZE (CCS) is still present;

- It is the minimum size of a population with its specific demographic parameters that allows virus persistence;
- IT IS NOT a NUMBER of individuals…is a SUB-POPULATION

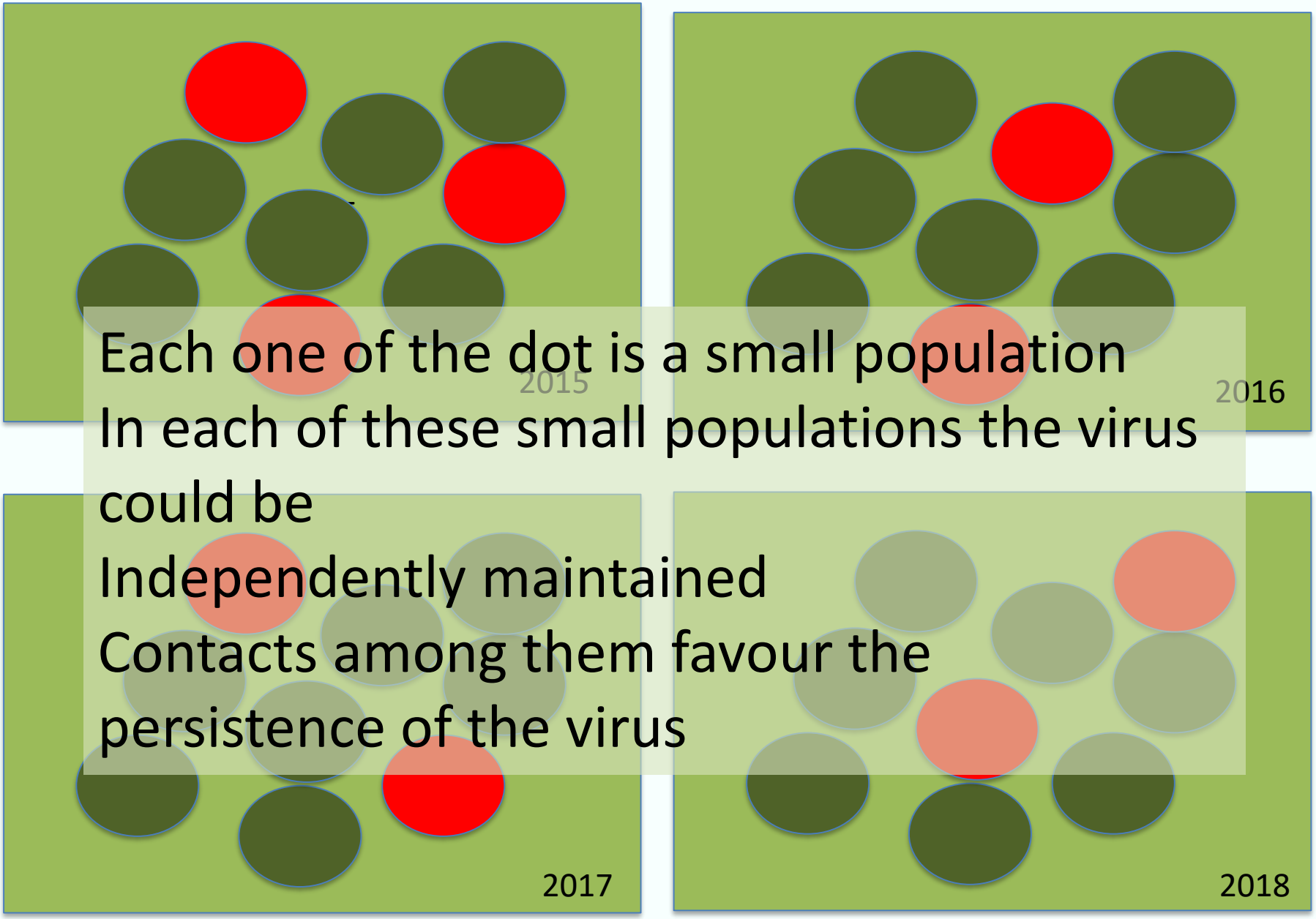
CCS: depends on:

- **Virus** transmissibility, lethality and recovery
- **Host** population density, fertility, turn over, age and gender classes, management (including feeding, hunting quotas and seasons etc. etc.)

Mathematically the CCS is the population size at which the infection has **50% probability** to fade out spontaneously;

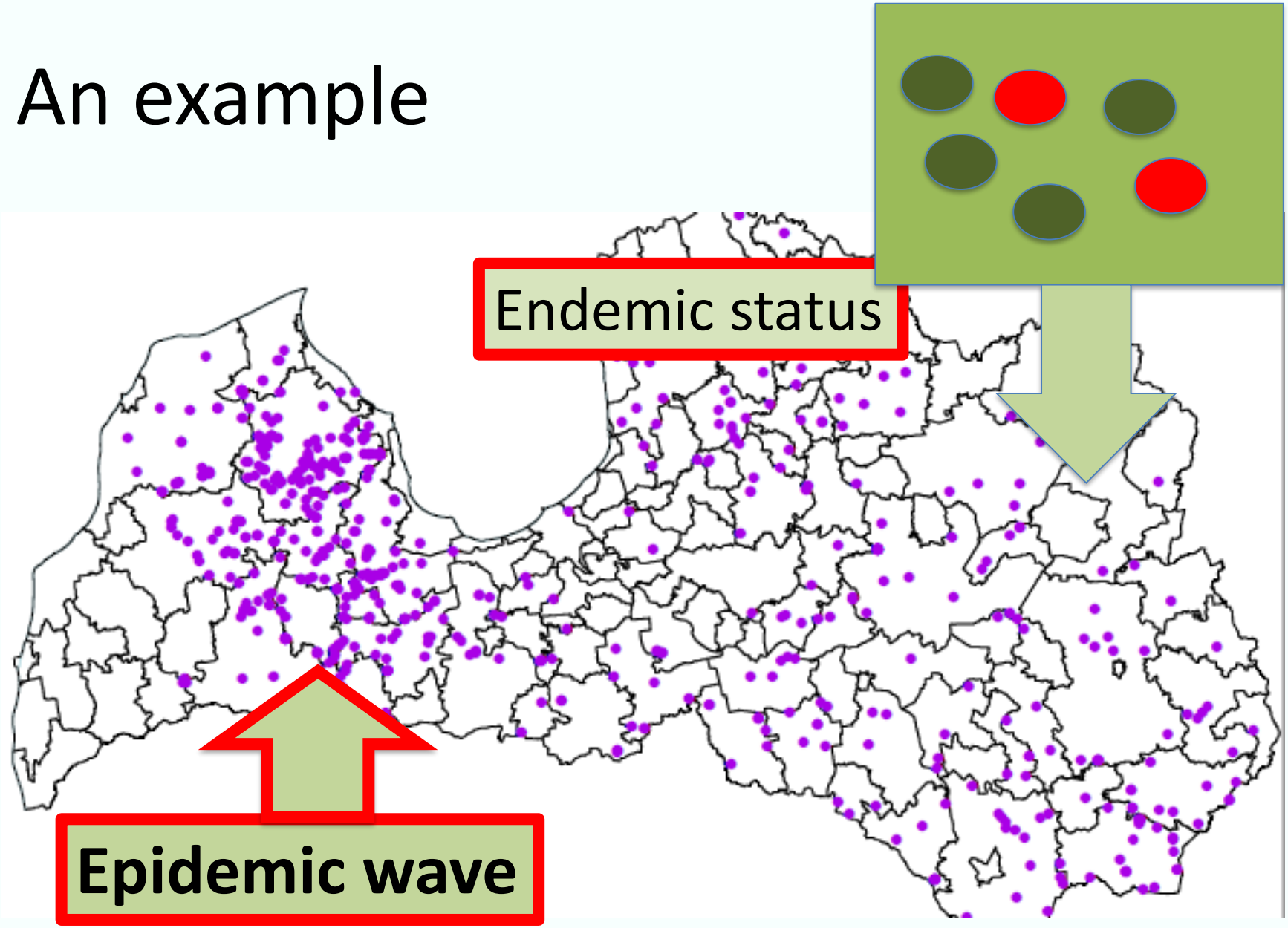
Critical community size

- It cannot be calculated but estimated through simulations that consider all the necessary parameter values (when available);
- It is a probabilistic estimate with some mathematical instability;
- Can work in one area and not in the neighbouring one;
- 100% eradication probabilities coincides with host eradication;



Each one of the dot is a small population
In each of these small populations the virus could be
Independently maintained
Contacts among them favour the persistence of the virus

An example

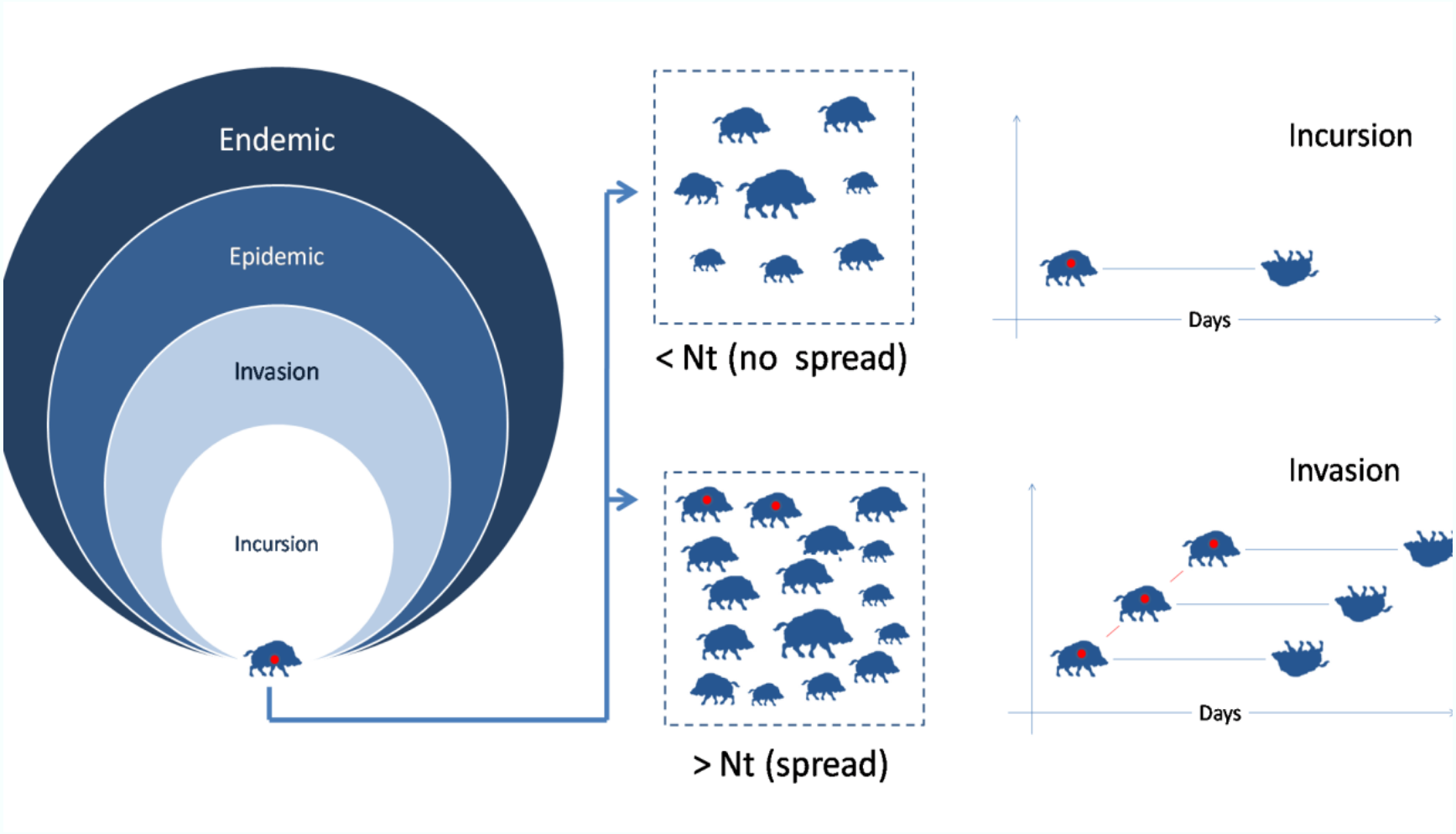


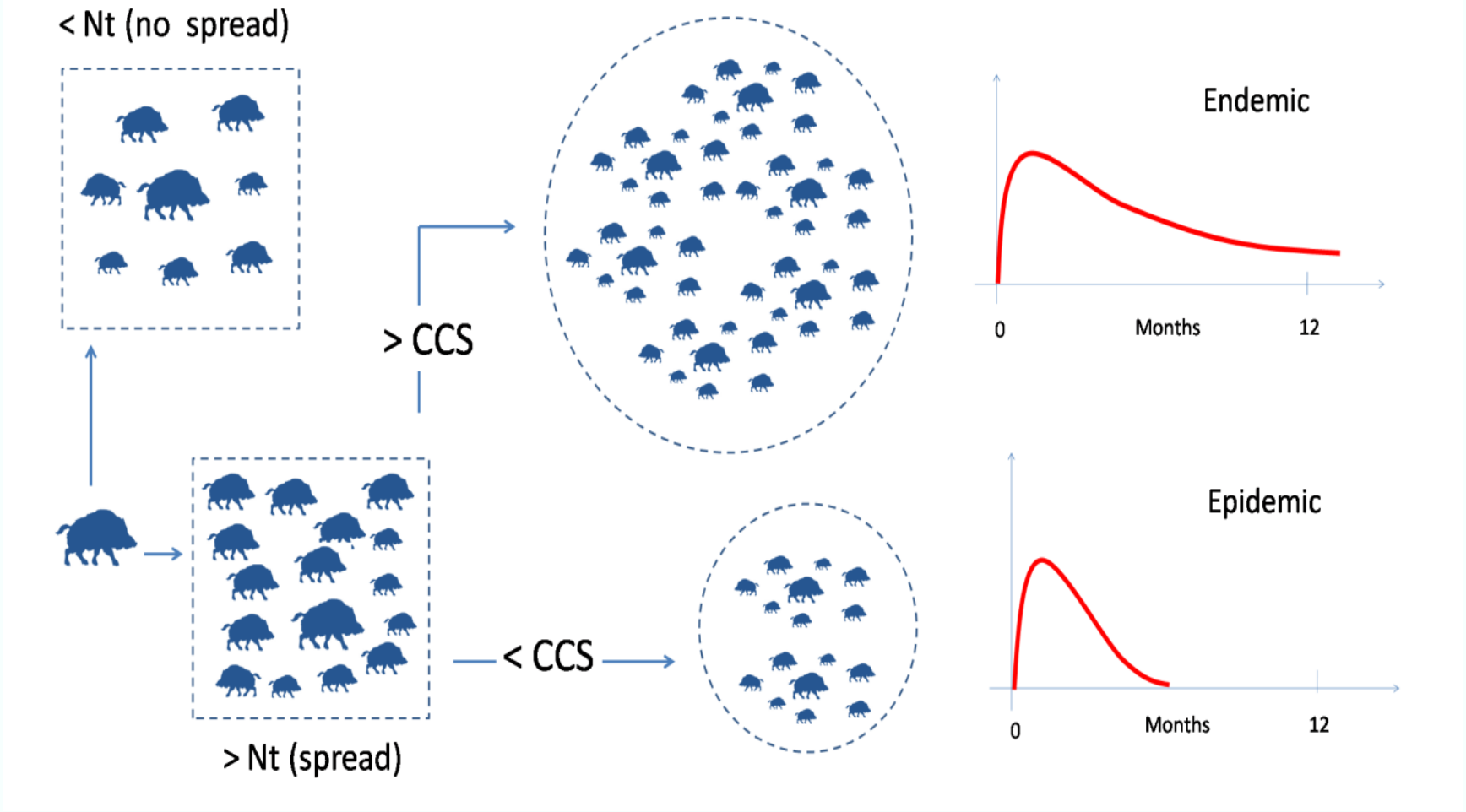
CCS size

ASF survives in small population when :

- Population fertility rate is high;
- Carcasses left in the forest;
- Population turn-over is high

Summarizing (OIE handbook)




< Nt (no spread)
> CCS
< CCS
> Nt (spread)
Endemic
0
Months
12
Epidemic
0
Months
12

ASF: why time has been needed

- Unexpected African disease in North of Europe;
- Spontaneous fade out in wild boar was expected
- Technical difficulties
- New infections = (direct contact) + (contact with carcasses)
- No available scientific literature covers such complex disease….it is new transmission model!!!!

Wild boar management and epidemiology: working together

- Define aims (Nt, CCS, hobby, economic…….)
- Methodologies
- Improving knowledge and technical capacity
- Feasibility and sustainability
- Coherent actions
- Transparency

Take at home message

- Threshold is **a preventive** measure
- During the Epidemic/endemic eradication is aimed in removing the **last infectious** animal
- The probability to remove the last infectious animal is LOW during the **epidemic** (when the virus is detected)
- During the endemic phase, the probability to eliminate the last infectious animal is higher but has to be achieved in each maintenance Critical Community
- The virus **naturally reaches its minimum prevalence** but carcasses make specific the epidemiological landscape of ASF
- During the endemic phase, the **removal of carcasses** is probably more important than any WB density reduction

VISION WITHOUT ACTION IS
DAYDREAM.
ACTION WITHOUT VISION IS
NIGHTMARE.
JAPANESE PROVERB