

Role of wild boar in ASF transmission and spread

野猪在非洲猪瘟（ASF）传播扩散过程中的作用

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March 26th, 2019

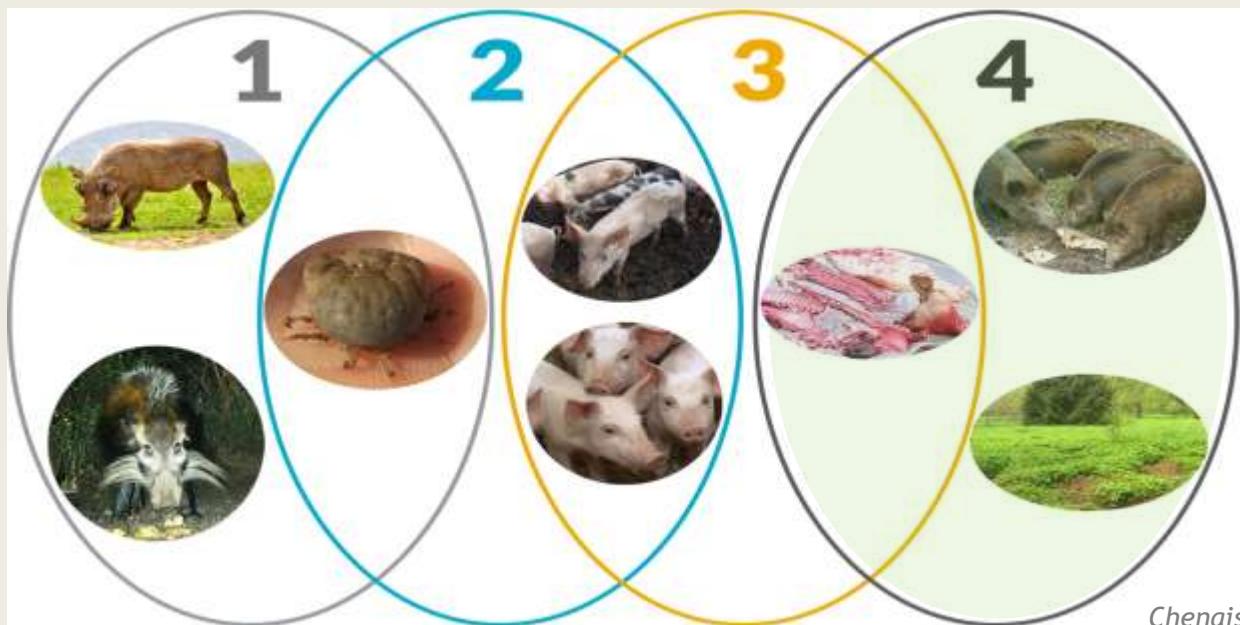
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2019-03-26

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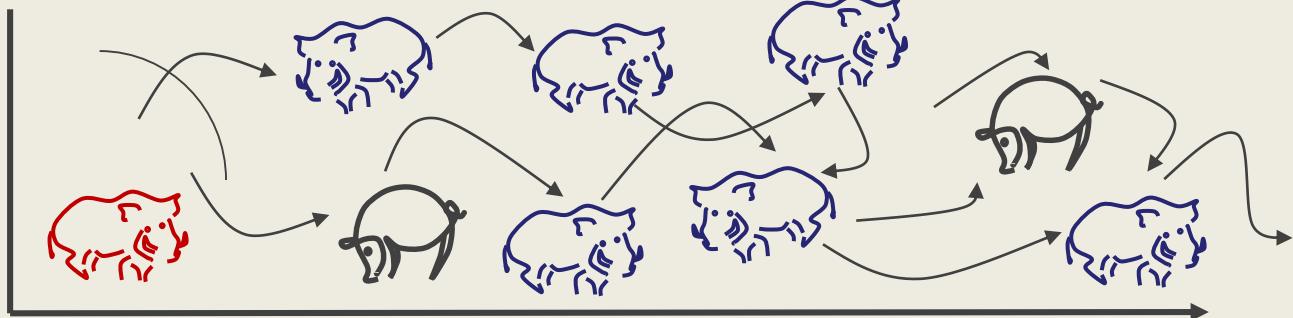
ASF cycles/ASF循环感染



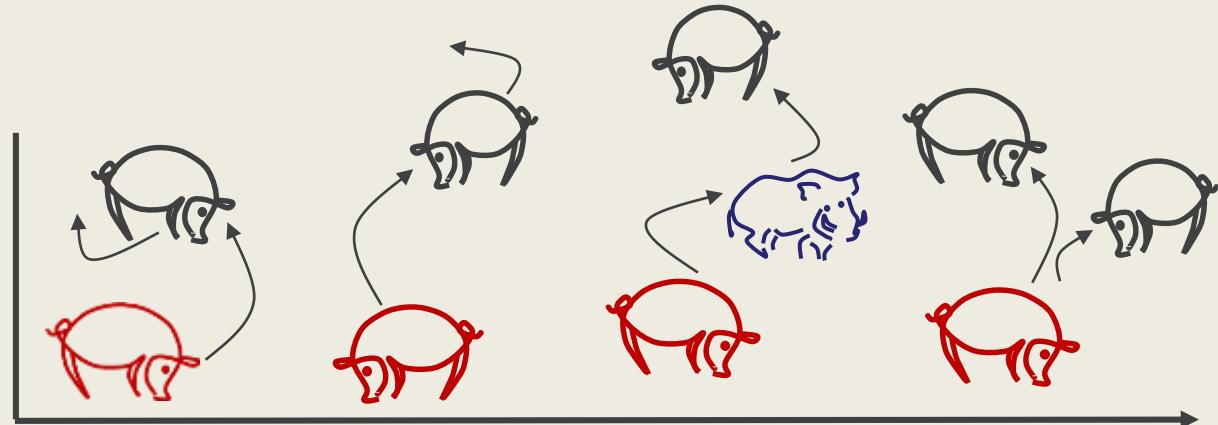
Chenais et al., 2018

- 1) Sylvatic cycle: the common warthogs; bushpigs and soft ticks. 1) 丛林循环：常见的疣猪、灌丛野猪和软蜱。
- 2) Tick-pig cycle: soft ticks; domestic pigs. 2) 蟑-猪循环：软蜱、家猪。
- 3) Domestic cycle: domestic pigs and pig products. 3) 家猪循环：家猪和猪产物
- 4) **Wild boar-habitat cycle:** wild boar; pig- and wild boar products and carcasses; the habitat. 4) 野猪-栖息地循环：野猪、猪和野猪产物和尸体、栖息地。

A



B



Characteristics of epidemics in wildlife populations

野生动物种群的疫情流行特征

Complex situation: interaction of many factors

(*infected animals, animal density, hunting activities, agriculture, etc.*)

情况复杂: 诸多因素交互作用

(被感染动物、动物密度、狩猎活动、农业生产等)

Obscure situation: not all important parameters are known (e.g.

animal density, animal movements, etc...)

情况不明: 不是所有重要的参量都已明了

(例如动物密度、动物流转等)

Dynamic situation: permanent change of parameters (e.g. seasonal

influences, fluctuation in animal number)

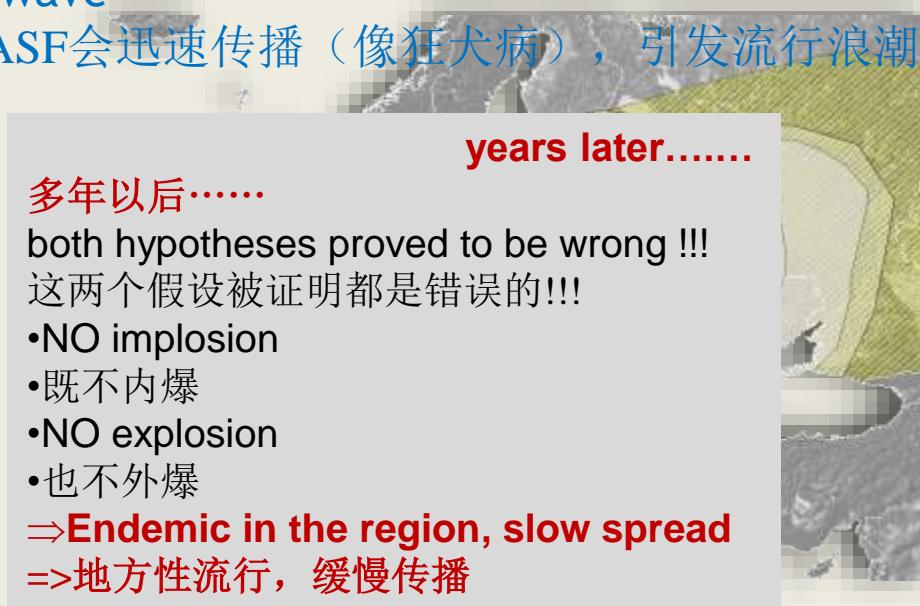
动态特征: 参量的恒久变化

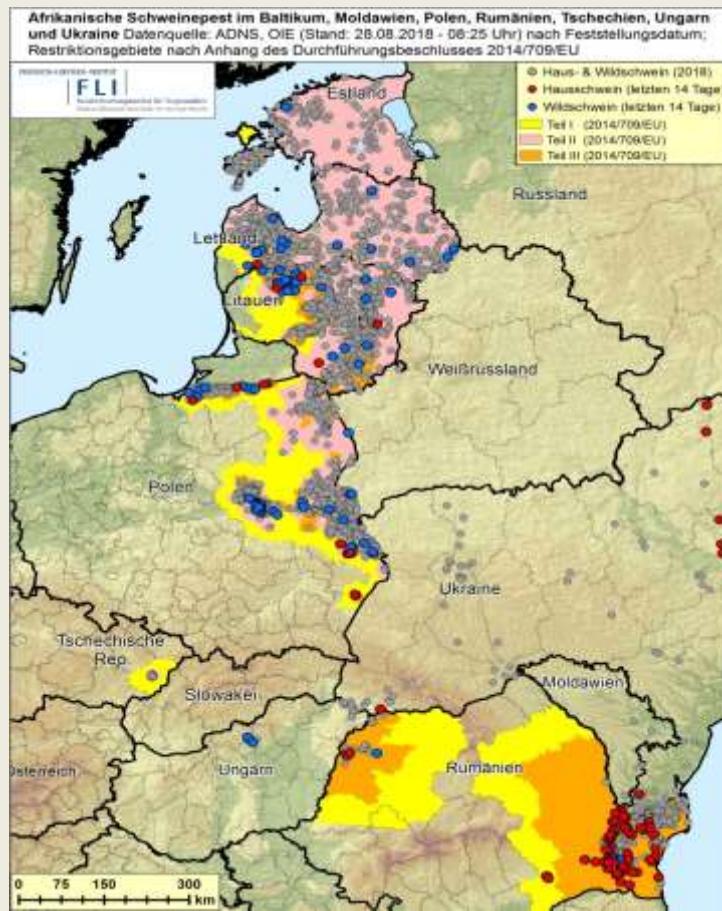
(例如季节影响、动物数量波动 等)

Influencing one factor can cause unpredicted side-effects

Working hypotheses/工作假说

1. **IMPLOSION:** ASF will fade out rapidly due to *high mortality*
1. 内爆: 受高死亡率影响, ASF将迅速消失
2. **EXPLOSION:** ASF will spread rapidly (Rabies like) initiating an epidemic wave
2. 外爆: ASF会迅速传播 (像狂犬病), 引发流行浪潮





Three epidemiological traits/3个流行病学特征

	ASF	CSF	FMD
Contagionist	low	medium	high
Case fatality	high	medium	low
Tenacity	high	low	low
	Persistence	<i>Fade out after vaccination</i>	<i>Fade out spontaneously</i>

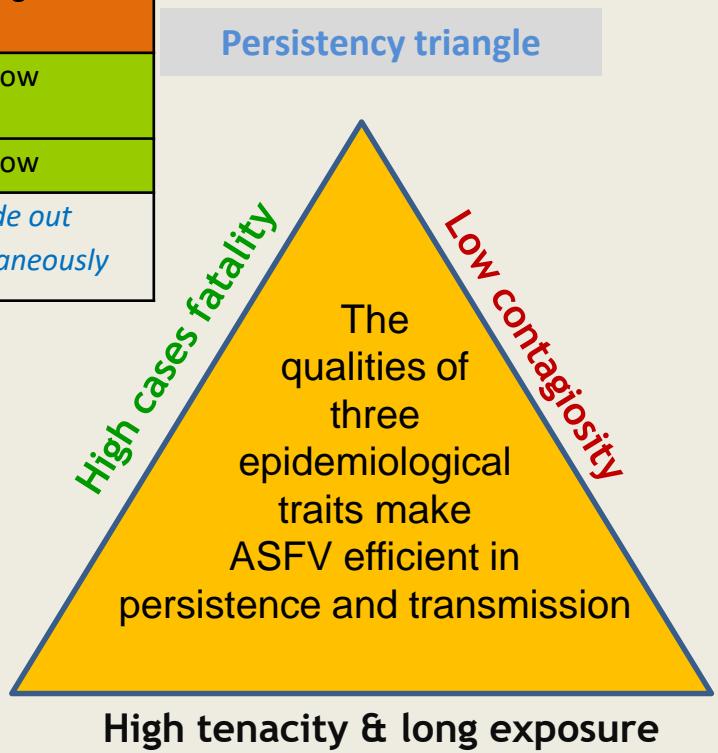
Low contagiousness: prevents fast and complete depletion of the host population

High case fatality: makes the virus largely available in the form of carcasses

High tenacity: ensures long term virus persistence in the environment

The interaction of these three parameters maximize local persistence and limits fast geographical spread

Chenais et al. 2019
(about 20 km/year)



3个流行病学特征

	非洲猪瘟	经典猪瘟	口蹄疫
传染性	低	中	高
致死率	高	中	低
韧性	高	低	低
	持续存在	免疫接种后消失	自然消失

低传染性: 以防宿主种群被快速扑杀和全部灭绝

高致死率: 使病毒大量存在于动物尸体中

高韧度: 使病毒在环境中长期存留

这3个特征交互作用，使病毒在地方长期存留，限制了其在地域间快速传播

(
大约20 km/年)

使病毒长期存留的三角关系



Probability of infection/感染概率

within a group (within stable)
high virus dose (>1000 HAU)
parenteral transmission

群体内（畜舍内）
高病毒剂量 (> 1000血凝单位)
非胃肠道传播

HIGH 高
↑

Contagiousity
传染性

↓
LOW 低



between groups (open system...e.g. forest)

low virus dose (<100 HAU)
oral transmission

群体间（开放式系统，例如森林）
低病毒剂量 (< 100血凝单位)
经口传播



Pārtikas un veterinārais
dienests

K. Lamberga

克里斯汀·兰伯格



ASF virus is relatively stable/ASF病毒较为稳定

- frozen meat: indefinitely
• 冻肉: 无限期
- dry meat and fat: almost one year
• 干肉和脂肪: 大约1年
- blood, salted meat and offal: more than 3 months
• 血液、腌肉和内脏: 3个月以上
- faeces: over one week
• 粪便: 超过1周

Temperature plays an important role in decreasing the survival duration of ASF virus in any material.

在任何材料中，温度对缩短ASF病毒的存活时间都具有重要作用。



ASFV survives the process of putrefaction and carcasses may remain infectious for weeks

ASF病毒能在腐烂过程中存活，尸体可在数周内保持传染性。

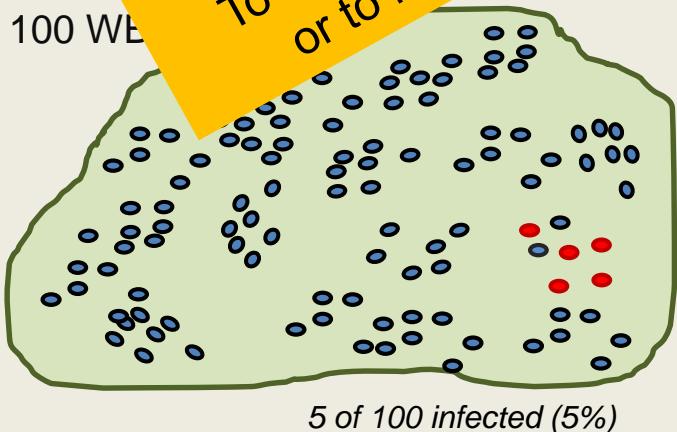
Passive surveillance for WB 野猪被动监测

5/95 surveillance concept is not purposeful
按5/95置信度监测缺乏针对性

Active surveillance gives a false sense of security

主动监测带来虚假的安全感

Period during which a WB can be hunted

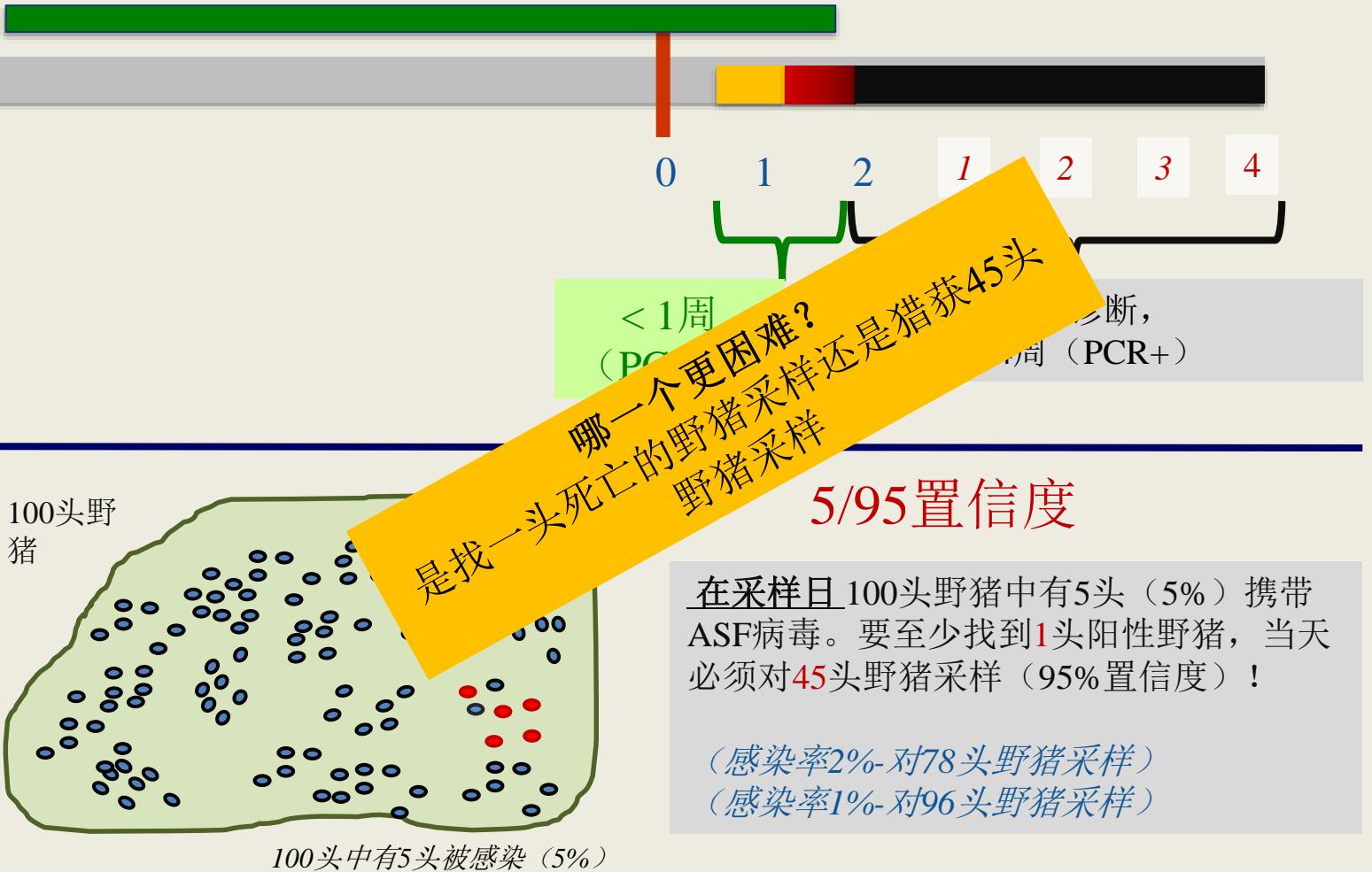


5/95-Concept

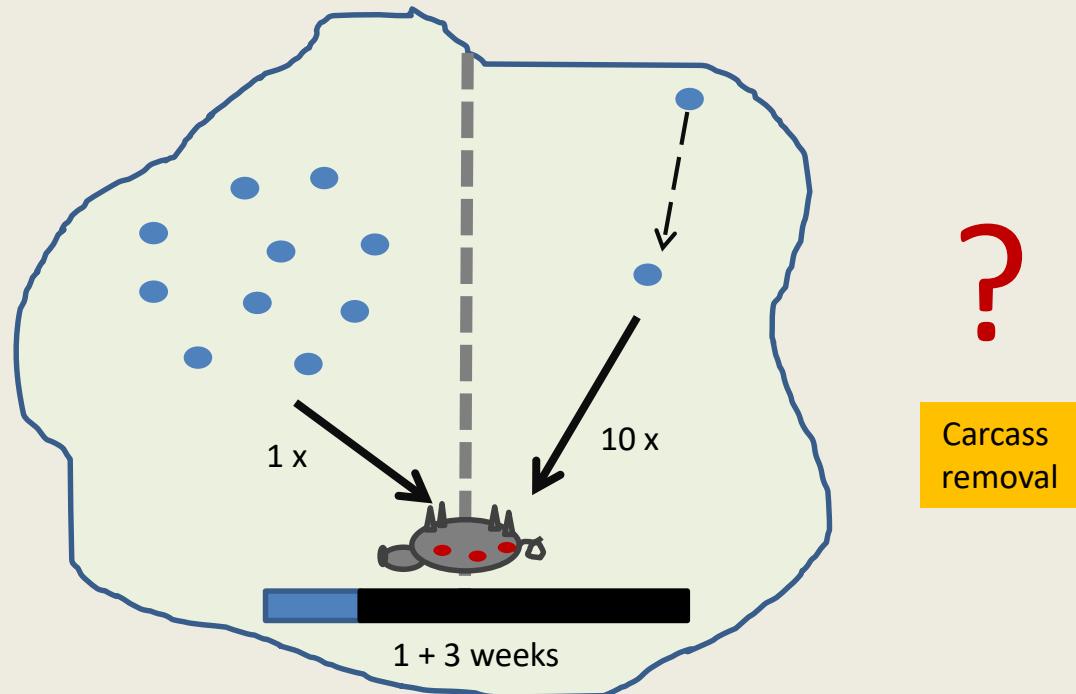
On the day of sampling 5 out of 100 WB (5%) are incubating ASFV. To find at least 1 positive WB **45** have to be sampled same day (95% confidence)!

(Prevalence of 2% -> 78 WB have to be sampled (1% ... 96 WB...))

野猪狩猎期



Exposure opportunity/触染几率



- If carcasses will be removed, exposure opportunity will decrease -> less contacts
- 如果清理尸体, 触染几率将降低-减少接触
- If carcasses will NOT be removed, exposure opportunity will increase -> more contacts
- 如果不清理尸体, 触染几率将提高-增加接触

Passive vs. active surveillance/被动与主动监测

*The probability to detect ASF is many times higher
in sick or dead animals than in (healthy) randomly sampled animals*

从患病或死亡动物体内检出ASF病毒的几率比从随机抽取的健康动物身上高许多倍

(~80 out of 100 cases are detected in wild boar found dead)

(在找到的100头死亡野猪中，有80头被检出)

EFSA Journal 2018,16(11)

欧洲食品安全局期刊, 2018, 16 (11)
)



	n	pos.	% pos.
Passive (found dead)	245	177	72.24
Active (hunted)	2765	40	1.45

Active surveillance in wild boar is particularly cost inefficient as a tool for early detection in free countries/areas, whereas it is useful for understanding the epidemiology in endemic areas

在未发病的国家或地区，如果把野猪主动监测用作早期检测工具，成本效益就特别低下。不过，在流行地区，它有助于了解流行病学特征。

What's all about?/究竟怎么回事?

A: Early detection >>>

Passive surveillance

A: 早期检测 >>>

被动监测

B: Disease control and eradication

Hunting strategy, biosecurity,
feeding strategy, etc...

B: 疾病控制与根除

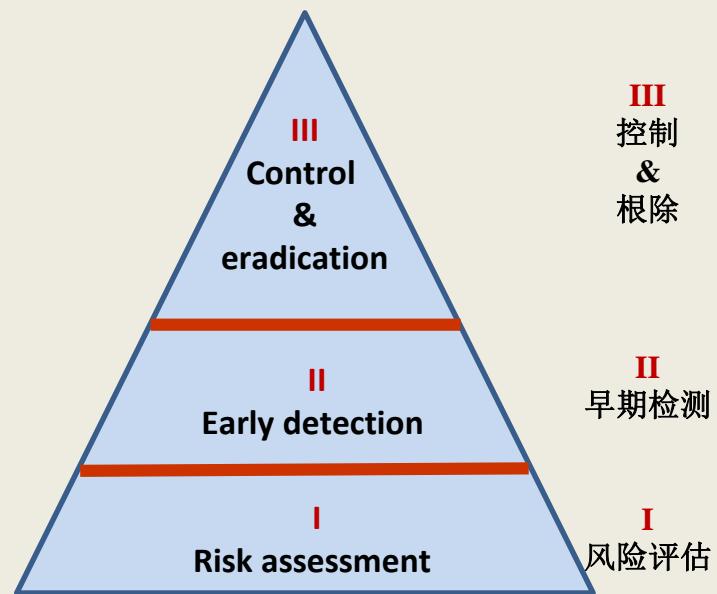
猎杀策略、生物安全、饲喂策略等

• **B works only when A works**

• 只有当A起效时，B才起效

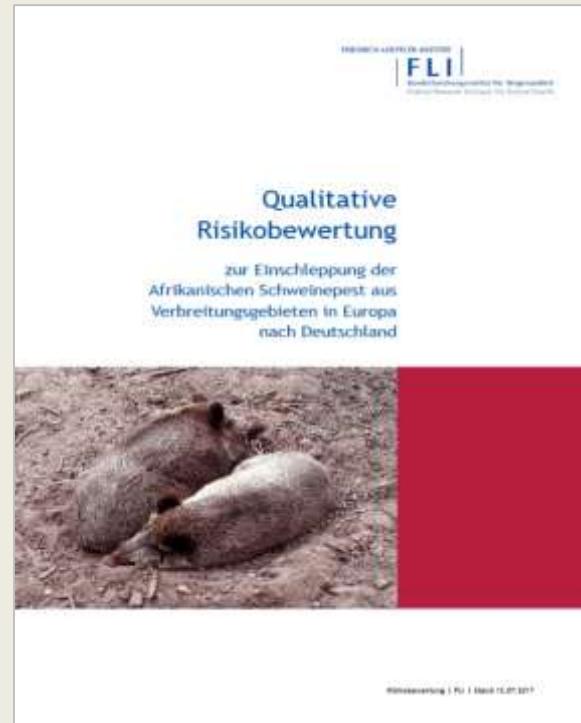
• **A successful when good passive surveillance**

• 良好的被动监测系统是A成功的条件



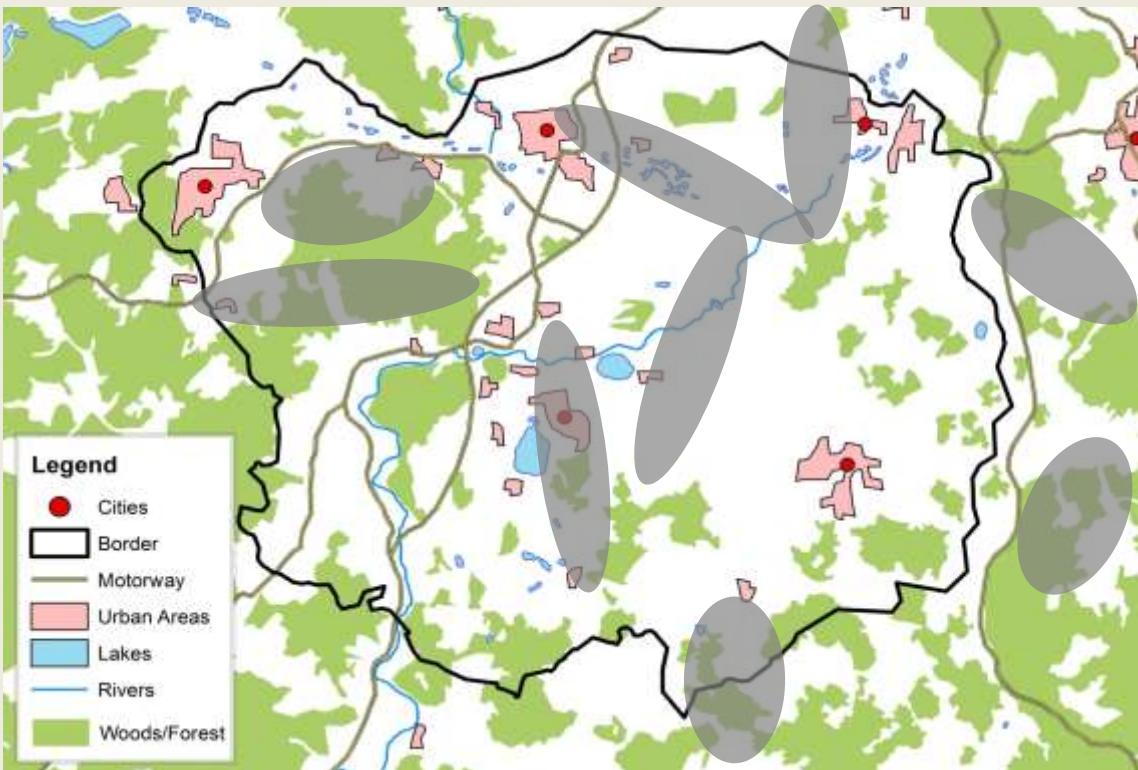
Risk Assessment Germany德国的风险评估

- Assessment for import risk through
- 通过以下方面评估进口风险:
 - Legal import of pigs and products
 - 猪及相关产品的合法进口
 - Contaminated vehicles and clothes
 - 被污染的车辆和衣物
 - Wild boar
 - 野猪
- Qualitative not quantitative
- 定性不定量
 - Negligible / low / medium / likely / high
 - 微乎其微/低/中/很可能/高
- With confidence level
- 置信水平
 - Low, medium, high
 - 低、中、高



Carola Sauter-Louis

Local Risk Assessment/局部风险评估



Risk areas: „urban“ WB; high WB density; resting areas on highways, etc...

危险区域: 城市野猪、高野猪密度、高速路休息区等

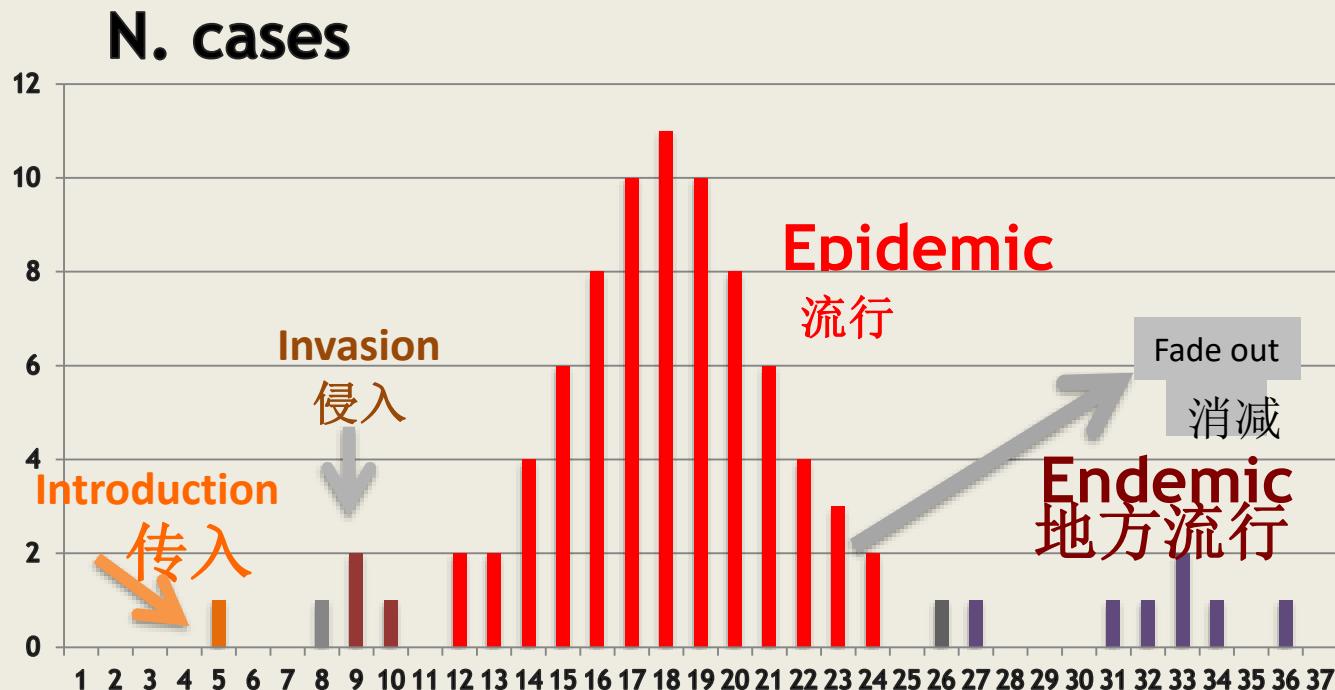


Biosecurity in the forest/森林生物安全



The 4 phases of a transmissible disease

疾病传播的4个阶段



Can we define the threshold density?

我们能够界定密度阈值吗？

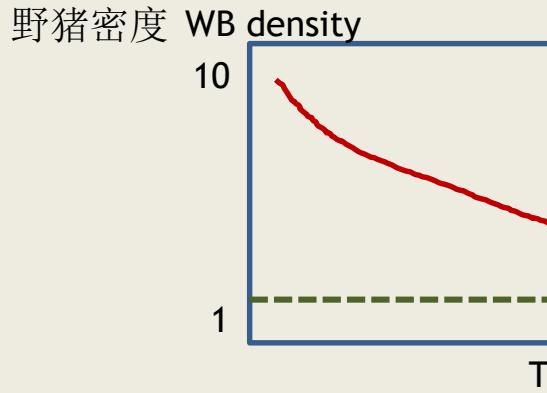
The critical density at which an infection stops (an infectious wild boar does not encounter any susceptible wild boar in due time to spread the infection)

传染停止时的临界密度（具有传染性的野猪在适当的时候没有遇到任何易感野猪以传播疾病）

If the number of susceptible individuals is decreased till a certain density, the infection fades out through a density dependent mechanism

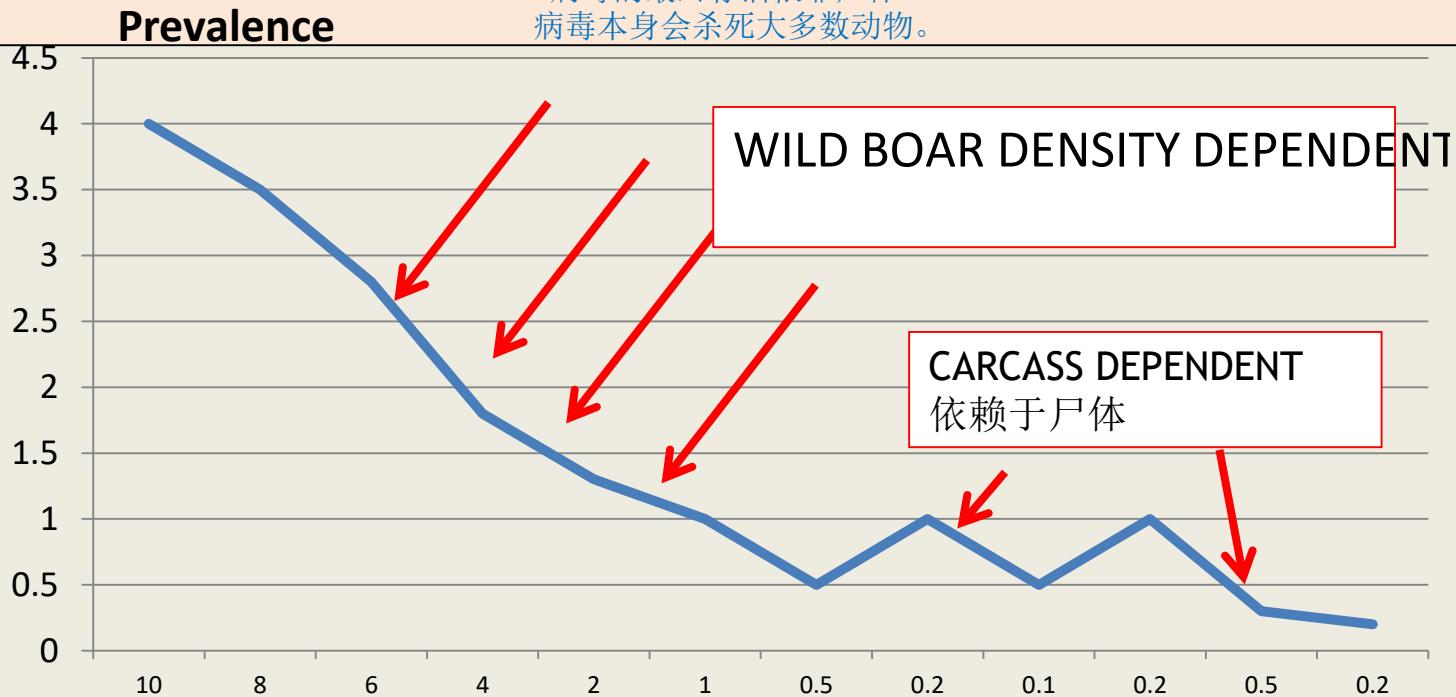
如果易感个体的数量减至特定密度，传染病就会通过某一密度依赖机制消退。

NO WILD BOAR = NO DISEASE 没有野猪 = 没有疾病

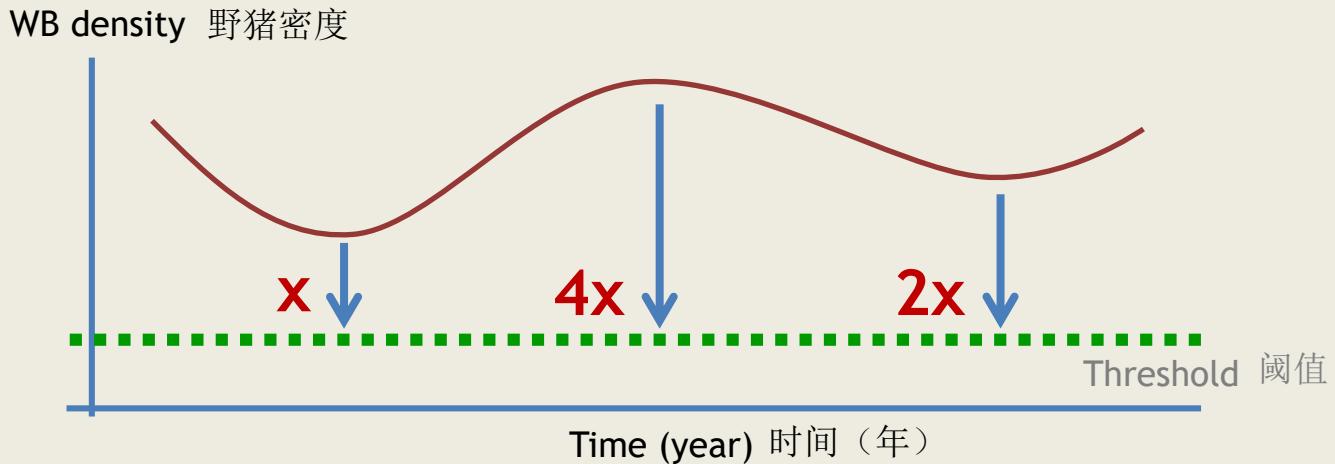


Threshold density
密度阈值

ASF is not a simple density dependent infection.
The ultimate persistence of the virus is guaranteed by carcasses
The virus itself kills most of the animals
ASF并不是一种单纯依赖于野猪密度的传染病。
病毒的最终存活依靠尸体。
病毒本身会杀死大多数动物。



Threshold elasticity/阈值的弹性



- Estimating the threshold: *easy to come up with a theoretical figure*
- 估测阈值: 很容易得出理论值
- Reaching the desired threshold: *difficult (impossible???)*
- 达到理想阈值: 很难 (不可能? ? ?)

• *The total number of wild boar is unknown and all estimates are wrong*

• 野猪的总数未知, 所有的估算都是错误的。

• *Best is, do not disturb the animals and remove carcasses as effectively as possible...*

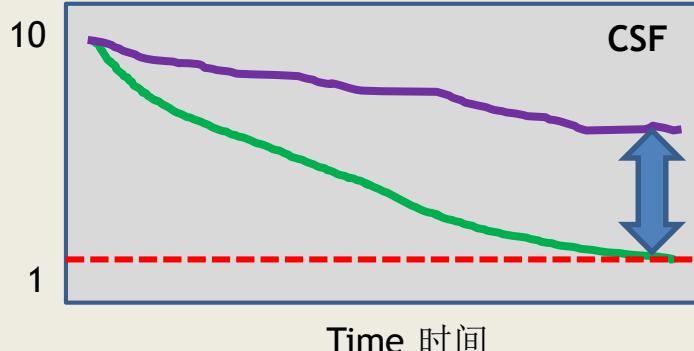
• 最好不要干扰动物, 尽可能有效地清理尸体。

Susceptible population & threshold

易感群体 & 阈值

WB density

野猪密度



WB density

ASF

10

1

Time 时间



Oral vaccination
经口免疫

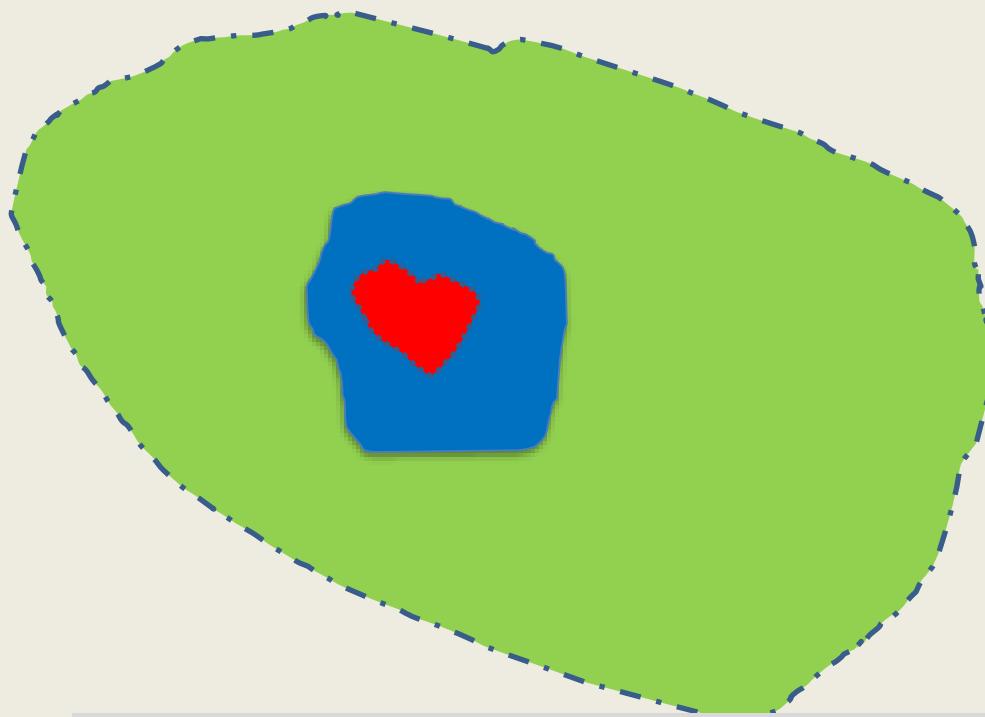
Total population
Susceptible population
Extinction
总群体
易感群体
疾病消亡

No vaccination
(*high case fatality,
few survivors*)

不免疫接种
(高病死率, 少数存活)

Measures in new infected areas

新疫区应对措施



Slow disease => be very patient in CA + BA!!!

Avoid any activity which disturb WB

慢性疾病 => 在CA和BA，要非常有耐心！！！
避免任何打扰野猪的行动

“Czech-Model” “捷克模式”

CA: defined by carcasses found within 1-2 months (no hunting)

疫源区 (CA) : 界定依据为在1-2个月内发现尸体（不狩猎）

BA: defined by home range,
~ 6 km (no hunting)

阻滞区 (BA) : 根据动物活动范围界定
~ 6 km (不狩猎)

IA: “legal area” >200km²

400 - 1000 WB (intensive hunting area)

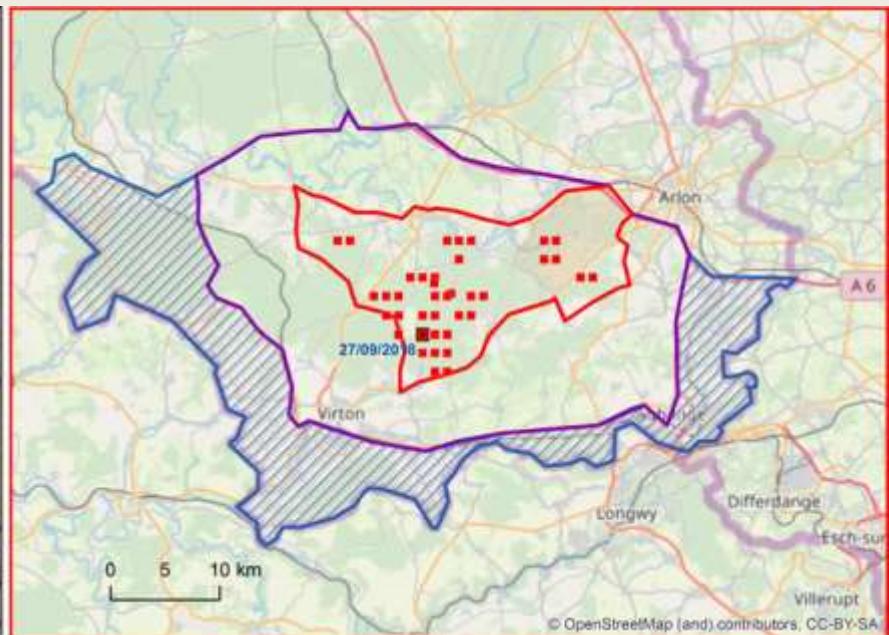
隔离区 (IA) : “法定区” > 200 km²

400-1000头野猪（集中狩猎区）

EFSA, 2018

欧洲食品安全局 (EFSA) ,
2018

Belgium/比利时



EFSA Journal 2018;16(11):5494

欧洲食品安全局期刊, 2018, 16 (11) : 5494

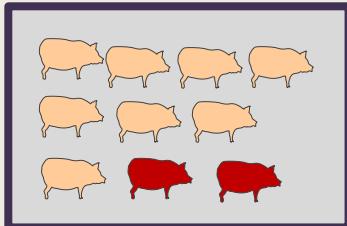
ASF control and eradication/ASF控制与根除

Key characteristics of ASF:

- low contagiousness, slow spread, few secondary infect
- no transmission by wind or insects,
- site fidelity (stable disease / habitat disease),

DP: stable disease

家猪：畜舍内疾病



Measures:

1. Standstill
2. Culling
3. C&D

措施:

1. 以静制动
2. 淘汰
3. 清洗&消毒

Successful approach!!

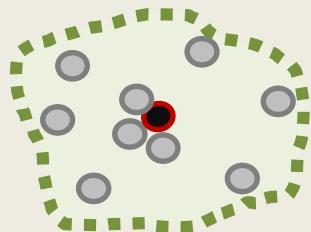
成功的方法!!

ASF的重要特征:

- 传染性低、传播慢、很少继发感染
- 不通过风或昆虫传播
- 原地保真性（畜舍内疾病/栖息地疾病）

WB: habitat disease

野猪：栖息地疾病



措施:

1. 以静制动
(不打扰野猪、不狩猎、电围栏、(饲喂))
2. (诱捕)
3. 尸体处理

Measures:

1. Standstill (no disturbance of WB, no hunting, electrical fence, (feeding))
2. (Trapping)
3. Disposal of carcasses

"Virtual stable" in forest

“病毒库”在森林

Freedom of disease 未发病

Wild boar management measures 野猪管理措施

e.g. population reduction to avoid
agricultural damage

例如减少种群数量，防止损害农业

e.g. Intensive hunting
例如集中狩猎

Presence of disease 发病

Disease control measures

疾病控制措施

not wild boar management
measures!!!

不是野猪管理措施！！！

Movement restriction

限制活动

Ban of feeding
禁止饲喂

Prohibition of hunting
禁止猎杀

Intensive hunting
集中狩猎

Hunting/Slaughtering
狩猎/宰杀



Culling
淘汰

Facts and lesson learned from the ASF epidemic in Europe

欧洲地区非洲猪瘟（ASF）疫情纪实与 经验教训

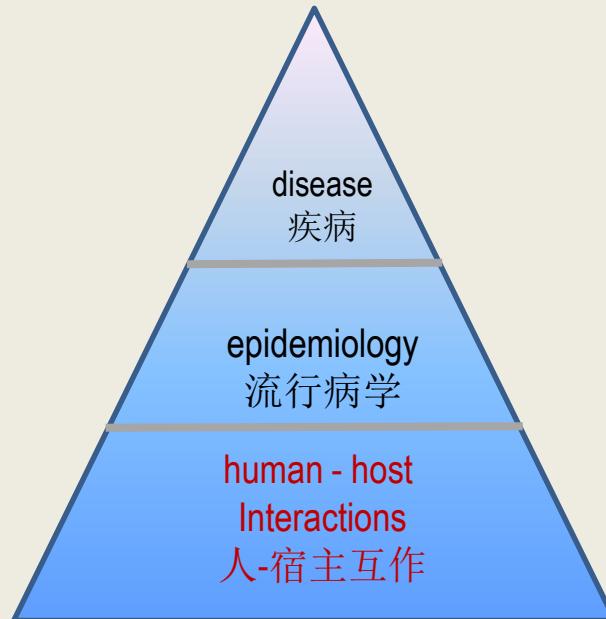
*Klaus Depner, Erika Chenais, Vittorio Guberti,
Klaas Dietze, Anja Globig, Arvo Viltrop, Laura Zani, Karl Ståhl*
克劳斯·德普纳，埃里卡·沉奈斯，维托里奥·古贝蒂，
克拉斯·迪亚兹，安雅·格洛比格，阿尔沃·维尔特罗普，
劳拉·扎尼，卡尔·斯特尔



March 26th, 2019 2019-03-26
Beijing 北京

Understanding ASF 了解ASF

How much do we need to know about ASF
to be able to prevent, control and eradicate?
我们需要对ASF了解多少才能预防、控制和根除？



Described by Eustace Montgomery in East Africa (Kenya), 1921

1921年，由来自东非（肯尼亚）的尤斯塔斯·蒙哥马利首次报道

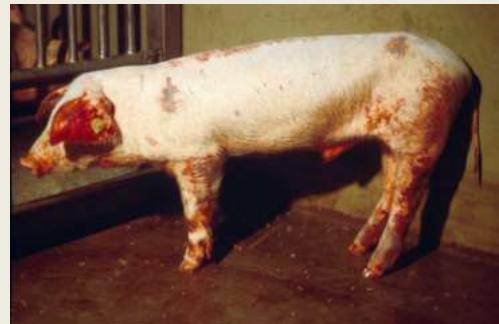
- A domestic pig infected with ASFV will in most cases develop a severe haemorrhagic disease ending with death within a couple of days (**Plowright, 1994**)
大多数情况下，家猪感染ASF病毒后，表现为严重的出血症，数天内死亡
- If the diseased pig or its secretions come into contact with other pigs, most of these will become infected, and meet the same destiny (**Taylor, 2006**)
如果其它猪与病猪或其分泌物接触，多数会被感染，遭遇同样的命运



■ V. Shedding
排毒

■ Viraemia
病毒血症

■ C. Signs
临床症状 ■ Infectious
传染性



Sylvatic (ancient) cycle 丛林循环感染（古老方式）

Warthog = natural (adapted) host 疣猪 = 天然（适应性）宿主



Parenteral infection 非胃肠道传染

(tick bite) (蜱叮咬)

efficient virus transmission 病毒高效传播

no clinic

无临床症状

Non-contagious form: Indirect transmission from infected to susceptible (natural) host via ticks.

非接触性传染方式: 通过蜱从染病动物向易感（天然）宿主间接传播
The asymptomatic wild suids and the transmission among ticks allow a cycle which can be maintained indefinitely in Africa (Parker et al., 1969)

野生猪科动物的无症状性和蜱虫间的传播使ASF病毒感染在非洲呈无限循环状态 (Parker等, 1969)

ASF is a disease „designed“ to be transmitted by tick bites and not by contact between animals (no shedding...)

ASF是一种“经蜱虫叮咬而非动物间接触（不排毒……）传播”的疾病

* Role of bushpig in the sylvatic cycle unknown 非洲灌丛野猪在丛林循环感染中的作用未知

Tick-pig cycle 蟑-猪循环感染

Pig = non-adapted (acquired) host 猪 = 非适应性 (获得性) 宿主



**Parenteral infection 非胃肠道传染
(tick bite) (蜱叮咬)**
efficient virus transmission 病毒高效传播



Non-contagious form: Indirect transmission from infected to susceptible (non-adapted) host via ticks.

非接触性传染方式: 通过蜱从染病动物向易感（非适应性）宿主间接传播

The balance between the natural hosts and the ASFV was altered by the introduction of domestic pigs by colonists from Europe into Africa (Pini and Hurter 1975)

欧洲殖民者把家猪带到非洲，改变了天然宿主与ASF病毒之间的平衡 (Pini 和 Hurter, 1975)

- Historically, domestic pigs are “accidental” hosts
从历史观点上说，家猪是“偶然”宿主

Domestic cycle 家猪循环感染

Pig <-> pig/contaminated products
猪 <-> 猪/被污染的产品



Oral infection 经口感染
less efficient
virus transmission
病毒传播效率较低



Contagious form: Direct (oral) transmission between domestic pigs in the absence of ticks “**atypical transmission**”

接触性传染方式：在没有蜱虫的情况下，在家猪间直接传播（经口）“**非典型传播**”

Depends on: virus dose, infectious material, animal behaviour, management ...

决定因素：病毒剂量、传染性物质、动物行为、管理.....

Wild boar-habitat cycle 野猪-栖息地循环感染

WB <-> WB/contaminated habitat
野猪 <-> 野猪/受到污染的栖息地



Oral infection 经口感染
less efficient
virus transmission
病毒传播效率较低



Contagious form: Direct (oral) transmission between wild boar in the absence of ticks

“atypical transmission”

接触性传染方式：在没有蜱虫的情况下，在野猪猪间直接传播（经口） “非典型传播”

Depends on: virus dose, infectious material, contamination of environment, animal behaviour,...
决定因素：病毒剂量、传染性物质、环境污染、动物行为.....

Non-contagious ASF / Contagious ASF 非接触传染性ASF/接触传染性ASF

parenteral transmission (tick bite)

非胃肠道传播 (蜱叮咬)



- Natural (adapted) host: 天然（适应性）宿主:
 - subclinical infection - 亚临床感染
- Non-adapted host: 非适应性宿主:
 - high case fatality (virulent strains)
- 高致死率（强毒株）
 - low case fatality (mild/vaccine strains)
- 低致死率（弱毒株/疫苗株）

ticks are “overbridging” time 蜱为其架起天桥



oral infection

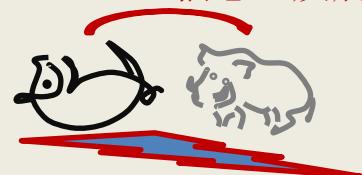
经口传染



- Non-adapted hosts (*sus scrofa*):
非适应性宿主（野猪）
 - high case fatality (virulent strains)
- 高致死率（强毒株）

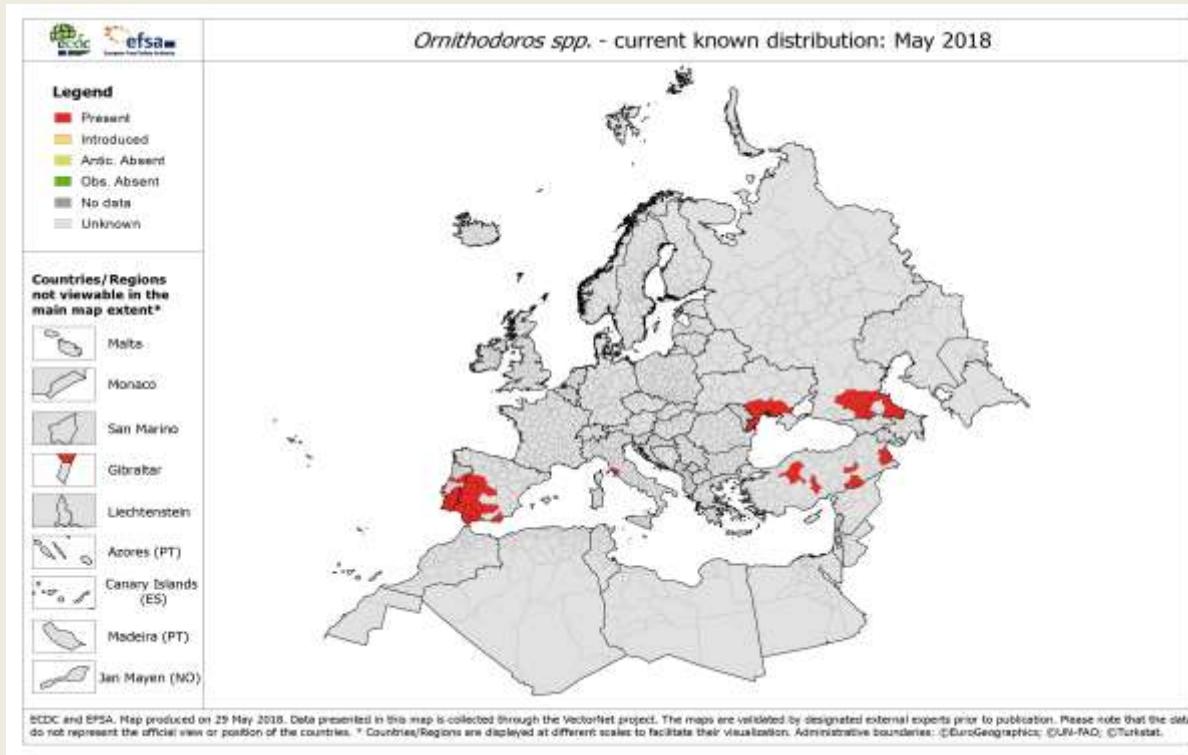
habitat is “overbridging” time
栖息地为其架起天桥

Habitat disease 栖息地疾病



Ornithodoros as competent vector

蜱是有效传播媒介



AFRICA 非洲

O. Moubata complex
毛白钝缘蜱

EUROPE 欧洲

O. Erraticus
游走鸟壁虱
(Vector competency is lower)
(媒介效能较低)

<https://ecdc.europa.eu/en/disease-vectors/surveillance-and-disease-data/tick-maps>

ASF virus is relatively stable ASF病毒较为稳定

- frozen meat: indefinitely 冻肉: 无限期
- dry meat and fat: almost one year 干肉和脂肪: 大约1年
- blood, salted meat and offal: more than 3 months 血液、腌肉和内脏: 3个月以上
- faeces: over one week 粪便: 超过1周

Temperature plays an important role in decreasing the survival duration of ASF virus in any material.

在任何物质中，温度对缩短ASF病毒的存活时间都具有重要作用。



ASFV survives the process of putrefaction and carcasses may remain infectious for weeks
ASF病毒能在腐烂过程中存活，尸体可在数周内保持传染性。

Working hypotheses 工作假说

1. **IMPLOSION**: ASF will fade out rapidly due to *high mortality*

内爆: 受高死亡率影响, ASF将迅速消失

2. **EXPLOSION**: ASF will spread rapidly (Rabies like) initiating an epidemic wave

外爆: ASF会迅速传播 (像狂犬病), 引发流行浪潮

years later.....

多年以后.....

both hypotheses proved to be wrong !!!

这两个假设被证明都是错误的!!!

•NO implosion 既不内爆

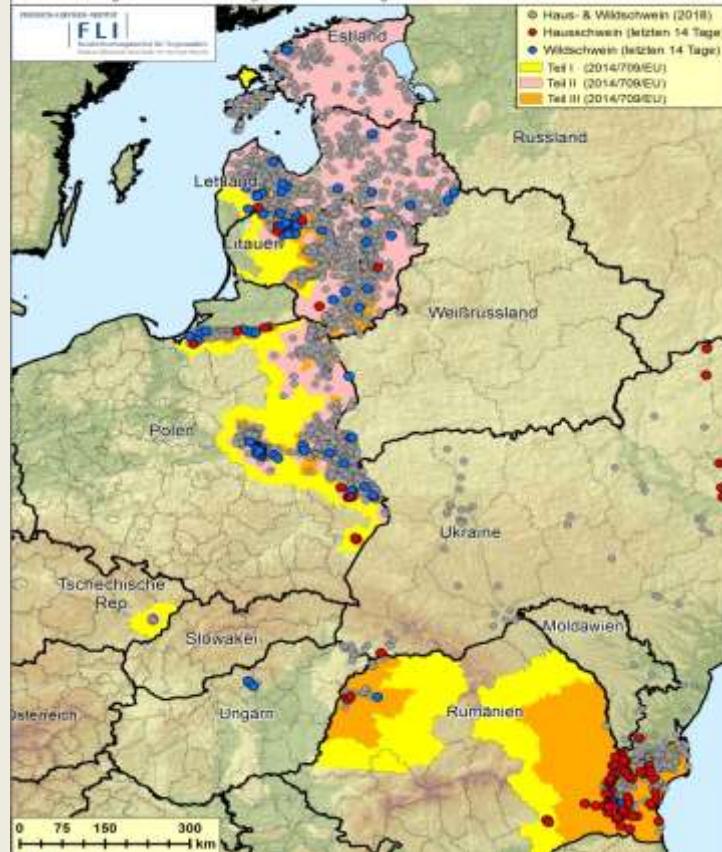
•NO explosion 也不外爆

⇒ **Endemic in the region, slow spread**

⇒ 地方性流行, 缓慢传播



Afrikanische Schweinepest im Baltikum, Moldawien, Polen, Rumänien, Tschechien, Ungarn und Ukraine
Datenquelle: ADNS, OIE (Stand: 28.08.2018 - 06:25 Uhr) nach Feststellungsdatum;
Restriktionsgebiete nach Anhang des Durchführungsbeschlusses 2014/709/EU



ASF is a human driven disease

ASF是一种人为性疾病

“*Anthropogenic factor*”

“人为因素”



Photo: M. Kramer 照片来源: M. 克雷默

Along the road and tradition

沿路传播与传统习俗

GEORGIA 格鲁吉亚



ARMENIA (2007) 亚美尼亚 (2007)



Three basic biosecurity rules

3条基本的生物安全准则

1. No swill feeding

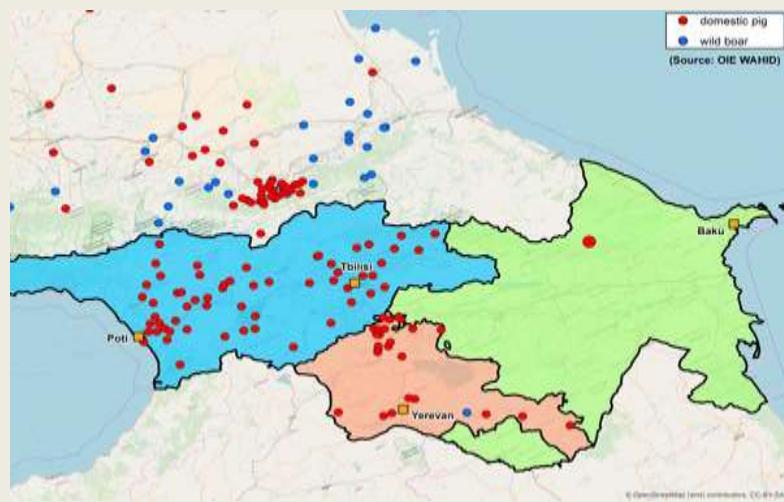
不饲喂泔水

2. No contact with strangers

不与陌生人接触

3. Change boots before entering the stable

进入猪舍前换鞋



(Source: OIE WAHID)

Textbooks are misleading...

教科书正在误导大家.....

copy/paste ...

复制/粘贴.....

“ASF is a highly contagious disease... causing high mortality up to 100%...”

“ASF是一种高度接触性传染病.....死亡率高，可达100%.....”

• *Mortality: Dead animals / epidemiological unit*

死亡率 = 死亡的动物 / 流行区内的动物

• *Case fatality (lethality): Dead animals / infected animals*

致死率（致命性） = 死亡的动物 / 被感染的动物

Contagiosity/Contagiousness 接触传染率/接触传染性

Percentage of animals which get infected after contact with an infectious agent
与致病因子接触后被感染的动物所占的百分率

Probability of infection after contact with a pathogen
与病原体接触后的**感染概率**

It is NOT an indicator for disease severity and impact!!!

它不是一个反映疾病严重度及其影响的指标！！！

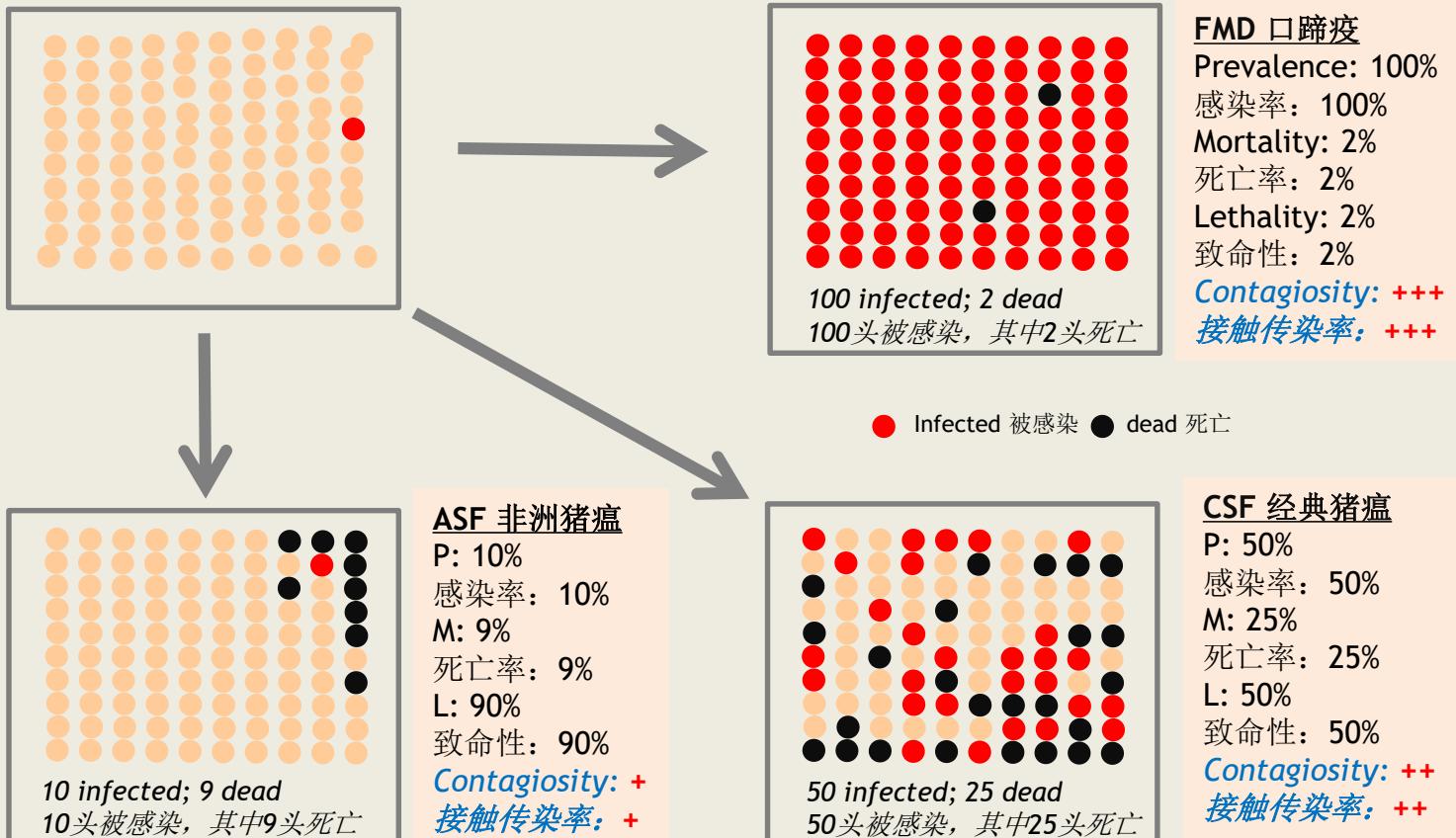
• **Low contagious diseases with severe course and high impact**
既有病程长、影响大的低接触性传染病

• **Highly contagious diseases with mild course and low impact**
也有病程短、影响小的高度接触性传染病

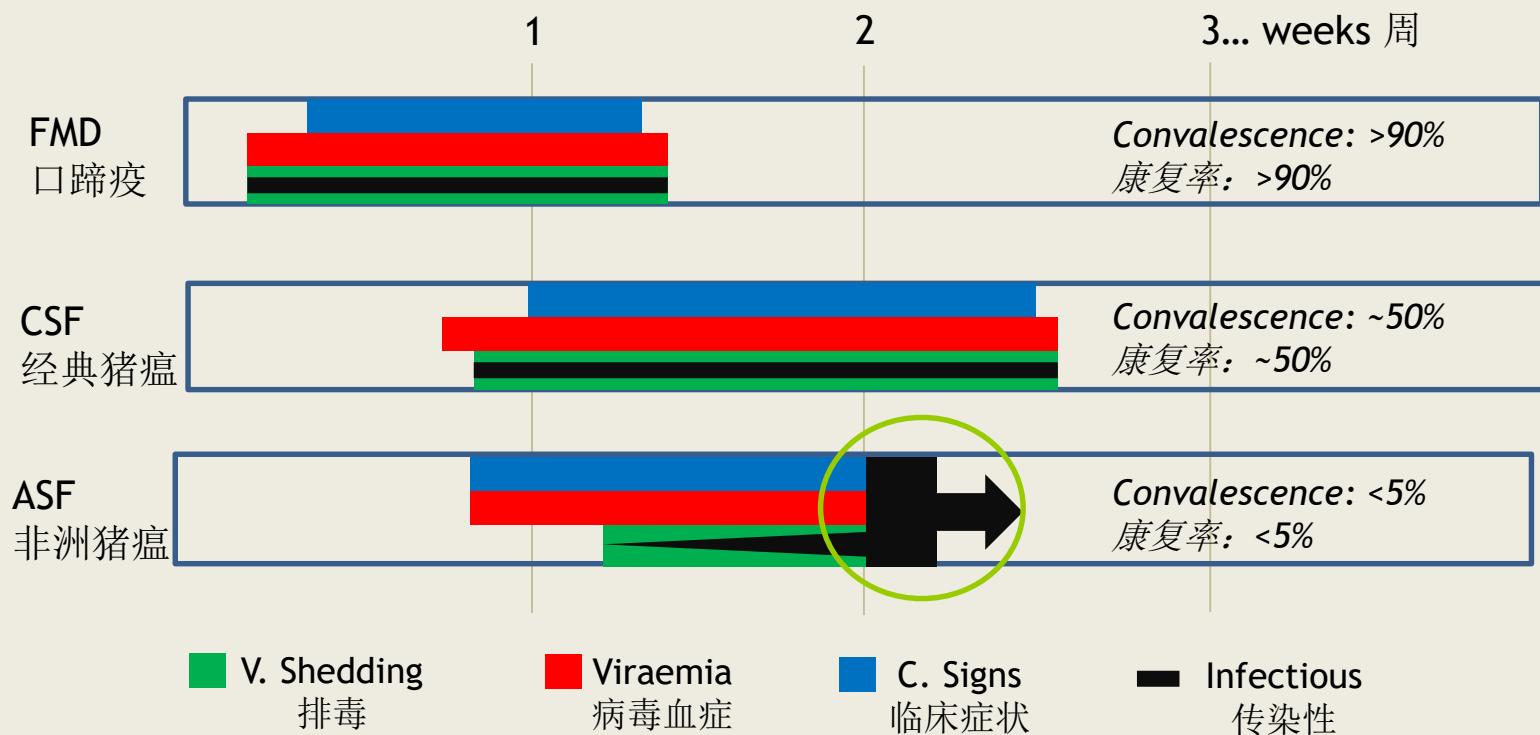
Contagiousness 接触传染性
Probability of infection 感染概率



ASF - CSF - FMD 非洲猪瘟-经典猪瘟-口蹄疫



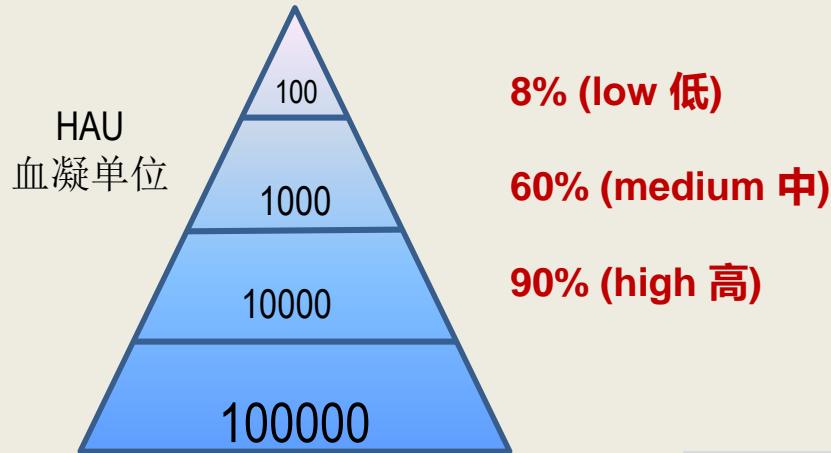
ASF - CSF - FMD 非洲猪瘟-经典猪瘟-口蹄疫



Probability of infection 感染概率

Virus dose & contagiosity

病毒剂量 & 接触传染性



- *Pietschmann et al.* (等) 2015
- *Gabriel et al.* (等) 2011
- *Petrov et al.* (等) 2018
- *Nurmoja et al.* (等) 2017
- *Zani et al.* (等) 2018

Liquid or Feed

通过饮水或采食途径感染

1 vs. 10000 TCID₅₀ (半数组织培养感染剂量)

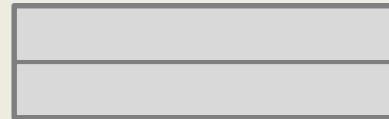


Foto: M. Masiulis 照片来源: M. 马休利斯
Vet. Service Lithuania 立陶宛农业部兽医服务处

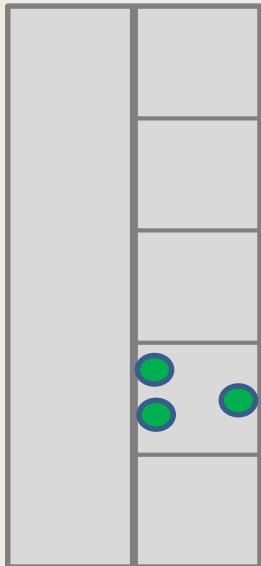
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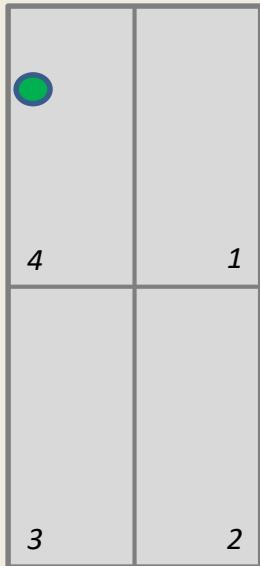
2 (BS)



6 (A,B)



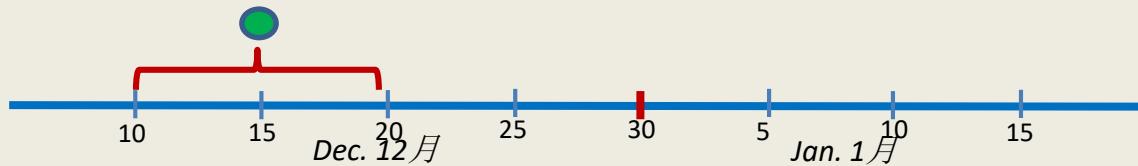
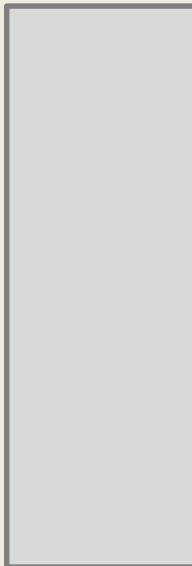
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4



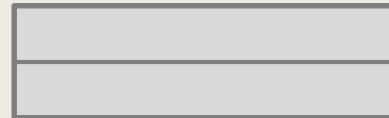
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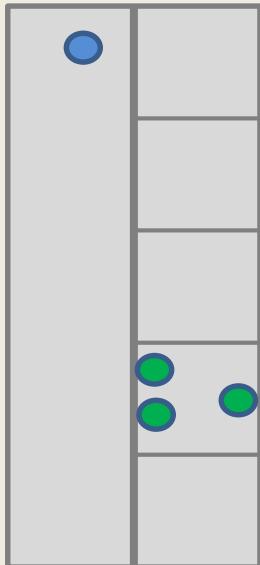
1



2 (BS)



6 (A,B)



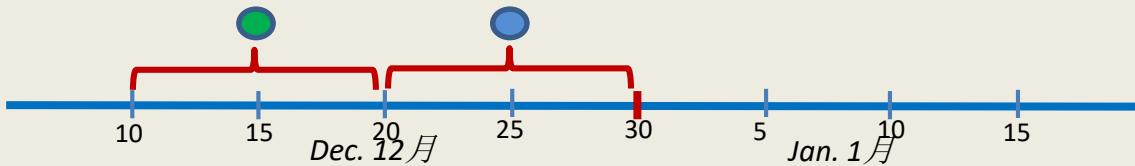
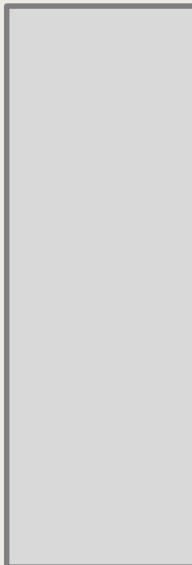
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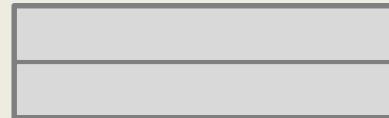
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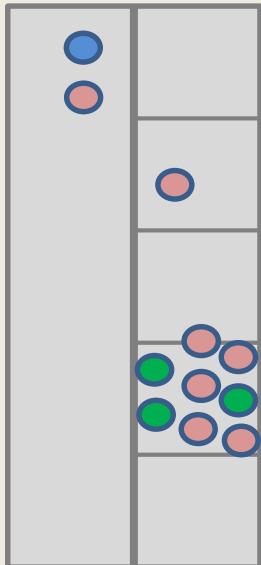
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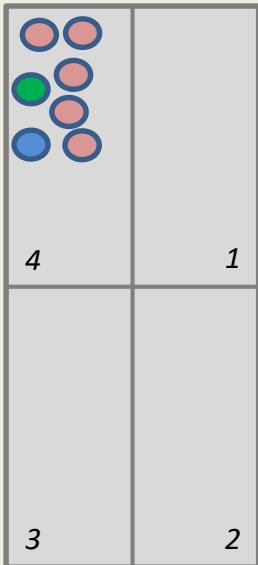
2 (BS)



6 (A,B)



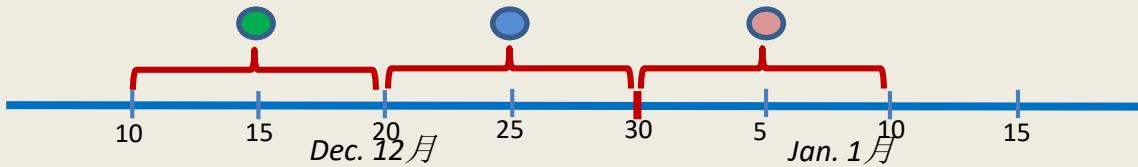
5



4



3



1

2 (BS)

6 (A,B)

5

4

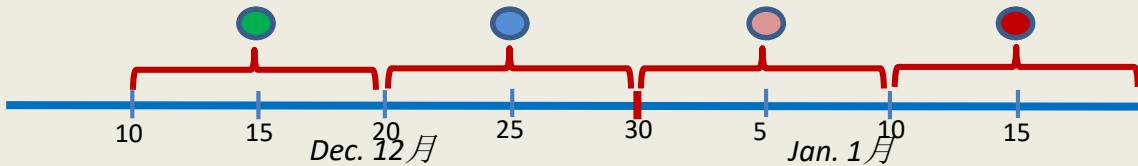
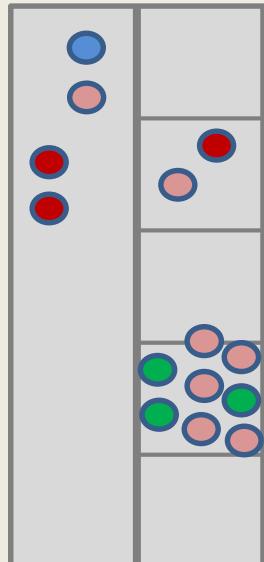
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1

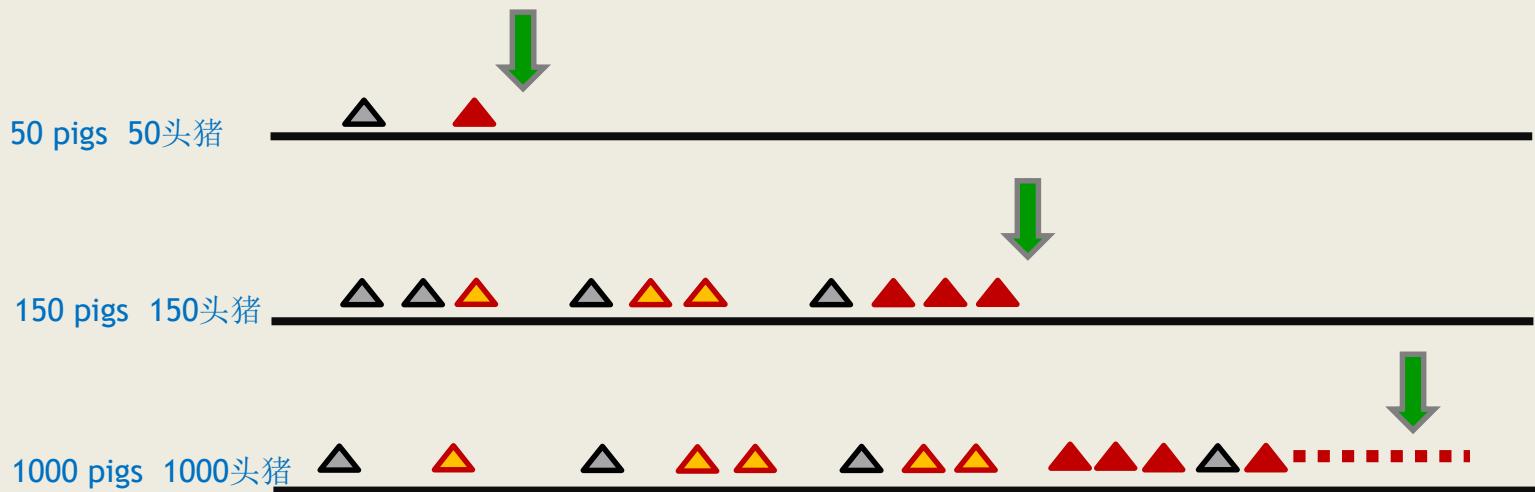
4

2

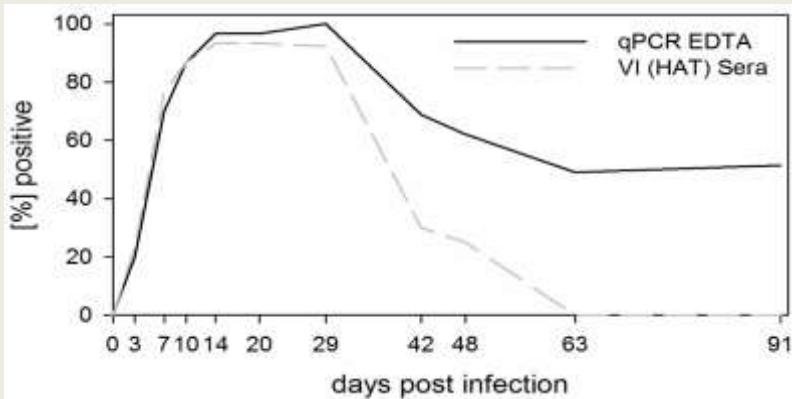
3



High risk period & farm size 高风险期 & 猪场规模



Long-term carrier status? 长期带毒状态?

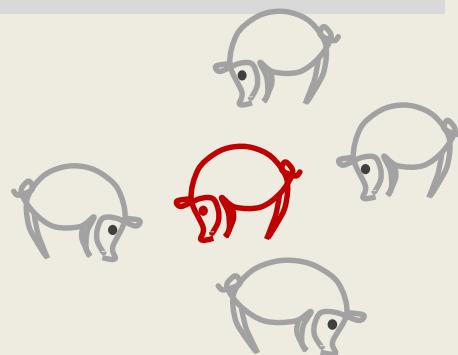


Petrov et al. (等) 2018
(Genotype I - Netherlands)
(基因型 I - 荷兰)

- no ASF transmission to sentinels commingled with survivors 99 dpi
感染后第99天, 未见幸存猪把ASF传播给与己混养的哨兵猪

Nurmoja et al. (等) 2017 (Genotype II - Estonia) (基因型 II - 爱沙尼亚)

- no ASF transmission to sentinels commingled with survivors 50 dpi
感染后第50天, 未见幸存猪把ASF传播给与己混养的哨兵猪



Long-term carrier status? 长期带毒状态?

Review from Sanchez-Botija (1982) 桑切斯-博蒂哈评论 (1982)

At the present time, great importance has been placed on carrier animals in the persistence and spread of A.S.F. However, there is insufficient knowledge on certain aspects necessary to assess the true participation of carrier animals in the spread of A.S.F. These factors include the incidence, distribution and duration of the « carrier » state, their ability to transmit the disease either directly or through feed, the persistence of antibodies, the clinical activation of inapparent infection due to stress factors and transplacental transmission in different conditions (viraemia, clinical activation, highly virulent strains, reinfection, immuno-pathological disorders).

In practice, it is usually difficult to prove that carriers are the source of outbreaks and often some outbreaks of unknown origin are attributed to carriers without sufficient evidence.

实际上，通常很难证明，带毒者是传染源。在没有足够证据的前提下，往往把一些来历不明的疫情归因于带毒者。

- **Hamdy et al. (等) 1984:** (ASF Brazil/Dominican Republic): (ASF, 巴西/多米尼加共和国)
 - no ASF transmission by direct contact to sentinel pigs 5.5 months post infection
感染后第5.5个月，未见ASF直接传播给哨兵猪
 - inoculation of sentinels with blood taken from pigs 100 dpi was successful
感染后第100天，采血，给哨兵猪接种，感染成功
- **Gallardo et al. (等) 2015:** 72 days post infection recovered pigs transmitted low-virulent ASF by direct contact to sentinels (Genotype I, Portugal)
 - 感染后第72天，康复的猪通过直接接触把ASF弱毒株传染给哨兵猪（基因型I，葡萄牙）
- **Gallardo et al. (等) 2018:** no ASF transmission to sentinel pigs 137 dpi (59 days post challenge)(Genotype II, Estonia)
 - 感染后第137天（接触或混养第59天），未见ASF传染给哨兵猪（基因型II，爱沙尼亚）

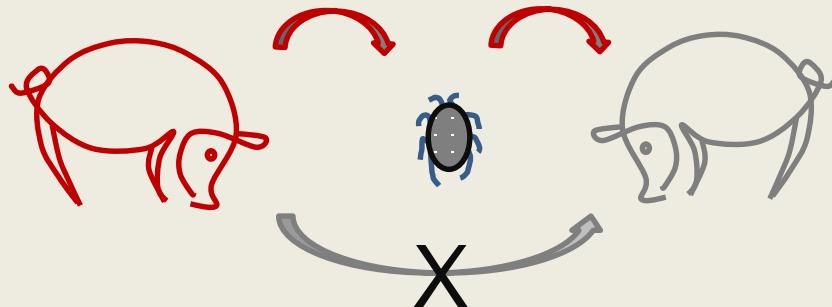
Carriers & Mild strains 携带者 & 弱毒株

A survivor is not automatically a carrier 疫情幸存者不一定是病毒携带者

If carriers may occur, they do not shed virus, no relevance for direct transmission
即使存活者带毒，它们也不排毒，与直接传播无关

Carriers might be of epidemiological importance in combination with ticks (indirect transmission) 在有蜱虫参与的情况下（间接传播），带毒者可能具有流行病学意义

- *Sylvatic cycle in Africa (natural, adapted hosts)* 非洲丛林循环感染（天然、适应性宿主）
- *When mild ASFV strains or vaccine strains are involved (non-adapted, acquired hosts)* 对于弱毒株或疫苗株（非适应性、获得性宿主）



Lessons learned in recent years 近年来的经验教训

- **ASF in the field is not highly contagious** 在现实条件下，ASF不是高度传染性疾病
 - *High case fatality (>90%)* 高致死率 (>90%)
 - *Low (initial) mortality (<5%)* 低死亡率 (<5%)
 - *Low prevalence (<5%)* 低感染率 (<5%)
 - *Not necessarily a density dependent process* 传播过程未必依赖于猪群密度
- **Slow spreading with site fidelity (*habitat disease*)**, easy to control in domestic pigs, difficult in wild boar
传播慢，具有保真性（栖息地疾病），家猪易控制，野猪难控制
- **Survivors are not necessarily carriers and carriers are not shedders:** no epidemiological relevance in an epidemic without tick involvement
存活者未必是病毒携带者，带毒者不排毒：在没有蜱虫介入的疫区，不具有流行病学意义
- **Mild strains are disadvantaged due to the low case fatality:** only indirect transmission via ticks would facilitate virus survival
因为致死率低，所以弱毒株存活力差：只有通过蜱虫间接传播才有利于病毒存活
- **Early detection only by passive surveillance** 早期发现只能依靠被动监测
 - **Biosecurity the only potent tool to control ASF**
生物安全是控制ASF的唯一有效工具
 - **ASF is a human driven disease** ASF是一种人为疾病

Thank you for your attention!!! 感谢您的关注！！！

Humans are the main cause of long distance transmission and virus introduction into pig farms. Thus, it is crucial to include social science when planning prevention, control or eradication measures.

人是导致病毒长距离传播和进入猪场的主要因素，所以，在制定预防、控制和根除措施时，涵盖社会科学非常重要。

By considering only the biological particularities of the disease

- contagiousity,
- tenacity,
- case fatality

but ignoring the human aspects, the epidemic will not be controlled.

如果只考虑疾病的生物学特性

- 接触传染率
- 韧度
- 致死率

而忽视人为因素，流行病就得不到控制

Tsvyatko Alexandrov, Felix Ardelean, Paulius Busauskas, Kristīne Lamberga, Marius Masiulis, Imbi Nurmoja, Edvīns Oļševskis, Mārtiņš Seržants

Sandra Blome, Franz Conraths, Nicolai Denzin, Conrad Freuling, Thomas Müller, Carolina Probst, Carola Sauter-Louis, Katja Schulz, Christoph Staubach

