



# Better Training for Safer Food *Initiative*

## Surveillance of ASF in wild boar

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# BTSEF

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# Overview

- Aim of surveillance
  - Definitions
  - High risk periods during an epidemic
  - Wildlife
- Surveillance in practice
  - Critical points
  - ASF example
  - A final message

## Aim of surveillance

Early detection and control of animal diseases  
Has the infection been introduced?

Determine trends over time  
Is the prevalence of the infection decreasing or increasing?

Assess whether animal health goals and targets are being reached  
Is the applied control/eradication strategy working?

## Broad “official” definitions

Disease **surveillance** in animal health is the on-going systematic collection, analysis and interpretation of data and the dissemination of information to those who need to know *in order to take action*

**Monitoring** may share common features with surveillance programs with the main difference being that monitoring activities do not require a pre-specified action to be taken *although significant changes are likely to lead action*

**Surveys** usually directed to identify a specific problem (for instance a preliminary survey carried out to have an estimate of prevalence before implementing a surveillance system for a specific disease) and surveys are usually limited in time. Surveys may be one component of a surveillance system as a whole

## Passive (reactive)

Stakeholders report to Veterinary Service some "problem"

Individual animals belonging to the "**Suspect case definition**" are reported and - eventually - tested

## Active (proactive)

Veterinarians collect animal health data using a defined protocol to perform actions that are scheduled in advance (sampling, tests etc.)

A population or a part of it (risk based) is actively investigated to detect an infection

# Passive or active: which is better?

## Passive is better when

An official “suspect case”  
definition is available and well  
known among stakeholders

Evident Clinical Symptoms

High lethality rate

High animal owners awareness

High Veterinary Service  
awareness

## Active is better when

Clinical symptoms are not  
evident, episodic or short lasting

Low/null lethality rate

Low animal owners awareness

# High Risk Periods

## FIRST

The period between the introduction of an infection into a Country and the first detection of the infection

**How much time we need to detect the infection?**

The length of the 1<sup>st</sup> HRP depends on: the efficacy and efficiency of the surveillance scheme in place

**Surveillance strategy**

## SECOND

The period between the first animal has been detected as infected and the establishment of measures to prevent virus spreading

**How much time we need to put in place control measures ?**

Outbreak management

## HRPs duration

The success of a disease control policy is related to the capacity to limit the spread of the infection during the two High Risk Periods of an epidemic:

Rapid identification of the virus (agent): early detection  
Increased bio-security and hygienic standards  
Prompt enforcement of appropriate control measures  
(reduction of the wild boar population)



# Which animals have to be tested ?

## The suspect case definition

1. Does not define the clinical signs of the infection we are interested on;
2. Does not define the population at risk;
3. It defines which are the characteristics of the animals that will be actively selected by the surveillance program (investigated, inspected, tested etc.)

# Detection of ASF using two suspect case definitions

- A) All individuals shot, found dead => broad suspect case definition
- B) All individuals shot showing clinical sign of the diseases => narrow suspect case definition

*Expected number of cases?*

*Do we expect the same number of investigated cases?*

*Do we expect the same number of positive cases?*

A) **A BROAD SUSPECT CASE DEFINITION:** high sensitivity of the surveillance system, but too many laboratory investigations, material for field sampling, travels to the lab etc.

C) **A NARROW SUSPECT CASE DEFINITION:** low surveillance sensitivity since wild boars that could show clinical signs are unlikely to be sighted

# Efficiency of a surveillance system

**The efficiency a surveillance system is modulated according to the characteristics of:**

**Disease:** lethality, spread, clinical signs

**Susceptible host population:** species, geographical distribution, size, breeding system; biosecurity etc.

**and**

**Risk of introduction:** risk assessment

# Surveillance in wildlife

**Role played by wildlife in the epidemiology of infection:** reservoir, spill over...*the wild boar population if epidemiological reservoir of ASF virus;*

**Epidemiological unit:** the wildlife metapopulation that lives in a continuous geographic distribution delimited by natural or artificial barriers

**Suspect case definition:** rarely clinical signs are seen, death is the obvious symptom (low lethal diseases)

**Efficacy of the passive surveillance:** difficult to assess: how many dead individuals are retrieved in peace time?

**Sampling unit:** which is correct sampling unit in order to avoid sampling dilution (low detection probability) or oversampling?

**Sample collection:** how to collect sample? Hunters, zoologists

**Timing:** seasonal hunting, catching, virology vs. serology

# Surveillance in practice

**Surveillance:** to develop a strategy that maximize the cost benefit ratio

Highest probability **to detect** the introduction of emergent or -re-emergent infection in a free area (early detection);

Highest precision in measuring epidemiological parameters (i.e. prevalence, n. of seropositive animals etc.);

Sustainable from both implementation and economical terms;

Have a practical approach (actions are foreseen)

# Passive surveillance: critical points I

## **Suspect case definition:**

broad definition will increase the sensibility of the surveillance (many false positive cases) whereas narrow definition will reduce the number of false positive cases but might enhance the number false negative cases and thus leaving undetected for some time the infection in the area.

The suspect case definition could be adjusted according to the (perceived or assessed) risk of the area.

Low risk => narrow case definition (undetected positive cases)

High risk => broader case definition (many negative cases investigated)

# Passive surveillance: critical points II

**Communication chain:** passive surveillance is based on reporting, hence a person willing to report must know to whom to report and how (green lines, mobile of a responsible person, avoid reporting to “Veterinary Service”)

**To whom it should be reported the finding of a dead wild boar in the forest?**

**Awareness and acceptance:** is the most important step of any passive surveillance. I.e. nobody will report what is unknown, or a disease for which a stamp out policy without compensation will be applied.

**The detection of ASF in wild boars poses several restriction when hunting: are hunters willing to participate?**

# Passive surveillance: critical points III

**Evaluation of the passive surveillance efficiency:** no reports does not mean no cases; the number of suspected cases to be investigated has to be estimated in advance, same figures should be used to evaluate the efficacy of the surveillance in place;

**In peace time, how many dead wild boars should be found in at risk areas?**

**Duration:** it is always difficult to maintain an high level of passive surveillance for any disease absents for a long period in an area or totally unexpected.

**When France, Hungary, UK should put in place a efficient surveillance system for the early detection of ASF in wild boars and how long it should run?**



# Active surveillance: critical points

**Epidemiological unit:** the area of interest for which surveillance is addressed and for which homogeneous actions are foreseen (geographically or risk defined). For the purposes of ASF in wild boar, this is equivalent to the Infected Area, as referred to in Article 16(3)b of Council Directive 2002/60/EC

**Sampling unit:** the basic unit from which sampling intensity is calculated and samples collected (forest, administrative units etc.). SANCO working document 7138/2013 on ASF surveillance in wild boar recommends areas of 200km<sup>2</sup> with a wild boar population of 400-1000 head

**Sample size:** expected prevalence adjusted according to literature data and feasibility/sustainability. Antigen vs. antibodies detection

**Sampling rate:** does the length of time that I need to collect the expected n. of samples affect the surveillance results?

# Active surveillance in infected areas

The virus is present;

Quantification of the spread of the virus (prevalence/incidence)

Virological and or serological tests

Sample collection: hunters/veterinarians

**Risk of further spread of infection:** appropriate management of hunting grounds, handling of shot wild boars when transported in private cars; hygienic standard of the dressing areas, of the to the dressing areas inside hunting clubs, storage of carcasses while waiting for the results of the tests; positive carcasses disposal, etc.



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# ASF surveillance in wild boar

## Field example

Aim:

- a) Early detection
- b) evolution of the infection

## The 5%/95% strategy

### What does it means?

1. At least one (1) wild boar will be detected positive if at least 5% of the animals in the sampled population are positive.
2. If “only” 3-4% of the animals are infected NO POSITIVE WILD BOAR will be detected; Currently: *ASF prevalence in endemic areas is 3-4%*
3. In a population of 1000 wild boar, the detection of 1 positive wild boar out of 50 positive animals, could be considered EARLY DETECTION?;

TABLE 1(b)

- (i) SAMPLE SIZE REQUIRED FOR DETECTING DISEASE
- (ii) CONFIDENCE LIMITS FOR NUMBER OF POSITIVES

95%

| Animals<br>population size (N) | Prevalence |     |     |     |     |     |     |    |     |     |      |      |
|--------------------------------|------------|-----|-----|-----|-----|-----|-----|----|-----|-----|------|------|
|                                | 50%        | 40% | 30% | 25% | 20% | 15% | 10% | 5% | 2%  | 1%  | 0.5% | 0.1% |
| 10                             | 4          | 5   | 6   | 7   | 8   | 10  | 10  | 10 | 10  | 10  | 10   | 10   |
| 20                             | 4          | 6   | 7   | 9   | 10  | 12  | 16  | 19 | 20  | 20  | 20   | 20   |
| 30                             | 4          | 6   | 8   | 9   | 11  | 14  | 19  | 26 | 30  | 30  | 30   | 30   |
| 40                             | 5          | 6   | 8   | 10  | 12  | 15  | 21  | 31 | 40  | 40  | 40   | 40   |
| 50                             | 5          | 6   | 8   | 10  | 12  | 16  | 22  | 35 | 48  | 50  | 50   | 50   |
| 60                             | 5          | 6   | 8   | 10  | 12  | 16  | 23  | 38 | 55  | 60  | 60   | 60   |
| 70                             | 5          | 6   | 8   | 10  | 13  | 17  | 24  | 40 | 62  | 70  | 70   | 70   |
| 80                             | 5          | 6   | 8   | 10  | 13  | 17  | 24  | 42 | 68  | 79  | 80   | 80   |
| 90                             | 5          | 6   | 8   | 10  | 13  | 17  | 25  | 43 | 73  | 87  | 90   | 90   |
| 100                            | 5          | 6   | 9   | 10  | 13  | 17  | 25  | 45 | 78  | 96  | 100  | 100  |
| 120                            | 5          | 6   | 9   | 10  | 13  | 18  | 26  | 47 | 86  | 111 | 120  | 120  |
| 140                            | 5          | 6   | 9   | 11  | 13  | 18  | 26  | 48 | 92  | 124 | 139  | 140  |
| 160                            | 5          | 6   | 9   | 11  | 13  | 18  | 27  | 49 | 97  | 136 | 157  | 160  |
| 180                            | 5          | 6   | 9   | 11  | 13  | 18  | 27  | 50 | 101 | 146 | 174  | 180  |
| 200                            | 5          | 6   | 9   | 11  | 13  | 18  | 27  | 51 | 105 | 155 | 190  | 200  |
| 250                            | 5          | 6   | 9   | 11  | 14  | 18  | 27  | 53 | 112 | 175 | 228  | 250  |
| 300                            | 5          | 6   | 9   | 11  | 14  | 18  | 28  | 54 | 117 | 189 | 260  | 300  |
| 350                            | 5          | 6   | 9   | 11  | 14  | 18  | 28  | 54 | 121 | 201 | 287  | 350  |
| 400                            | 5          | 6   | 9   | 11  | 14  | 19  | 28  | 55 | 124 | 211 | 311  | 400  |
| 450                            | 5          | 6   | 9   | 11  | 14  | 19  | 28  | 55 | 127 | 218 | 331  | 450  |
| 500                            | 5          | 6   | 9   | 11  | 14  | 19  | 28  | 56 | 129 | 225 | 349  | 500  |
| 600                            | 5          | 6   | 9   | 11  | 14  | 19  | 28  | 56 | 132 | 235 | 379  | 597  |
| 700                            | 5          | 6   | 9   | 11  | 14  | 19  | 28  | 57 | 134 | 243 | 402  | 691  |
| 800                            | 5          | 6   | 9   | 11  | 14  | 19  | 28  | 57 | 136 | 249 | 421  | 782  |
| 900                            | 5          | 6   | 9   | 11  | 14  | 19  | 28  | 57 | 137 | 254 | 437  | 868  |
| 1000                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 57 | 138 | 258 | 450  | 950  |
| 1200                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 57 | 140 | 264 | 471  | 1102 |
| 1400                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 58 | 141 | 269 | 487  | 1236 |
| 1600                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 58 | 142 | 272 | 499  | 1354 |
| 1800                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 58 | 143 | 275 | 509  | 1459 |
| 2000                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 58 | 143 | 277 | 517  | 1553 |
| 3000                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 58 | 145 | 284 | 542  | 1895 |
| 4000                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 58 | 146 | 288 | 556  | 2108 |
| 5000                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 147 | 290 | 564  | 2253 |
| 6000                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 147 | 291 | 569  | 2358 |
| 7000                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 147 | 292 | 573  | 2437 |
| 8000                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 147 | 293 | 576  | 2498 |
| 9000                           | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 148 | 294 | 579  | 2548 |
| 10000                          | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 148 | 294 | 581  | 2588 |
| a                              | 5          | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 149 | 299 | 598  | 2595 |



TABLE 1(b)

- (i) SAMPLE SIZE REQUIRED FOR DETECTING DISEASE
- (ii) CONFIDENCE LIMITS FOR NUMBER OF POSITIVES

95%

| Animals<br>population size (N) | Prevalence<br>percentage of population (d/N) |     |     |     |     |     |     |    |     |     |      |      |
|--------------------------------|--|-----|-----|-----|-----|-----|-----|----|-----|-----|------|------|
|                                | 50%  | 40% | 30% | 25% | 20% | 15% | 10% | 5% | 2%  | 1%  | 0.5% | 0.1% |
| 10                             | 4  | 5   | 6   | 7   | 8   | 10  | 10  | 10 | 10  | 10  | 10   | 10   |
| 20                             | 4  | 6   | 7   | 9   | 10  | 12  | 16  | 19 | 20  | 20  | 20   | 20   |
| 30                             | 4  | 6   | 8   | 9   | 11  | 14  | 19  | 26 | 30  | 30  | 30   | 30   |
| 40                             | 5  | 6   | 8   | 10  | 12  | 15  | 21  | 31 | 40  | 40  | 40   | 40   |
| 50                             | 5  | 6   | 8   | 10  | 12  | 16  | 22  | 35 | 48  | 50  | 50   | 50   |
| 60                             | 5  | 6   | 8   | 10  | 12  | 16  | 23  | 38 | 55  | 60  | 60   | 60   |
| 70                             | 5  | 6   | 8   | 10  | 13  | 17  | 24  | 40 | 62  | 70  | 70   | 70   |
| 80                             | 5  | 6   | 8   | 10  | 13  | 17  | 24  | 42 | 68  | 79  | 80   | 80   |
| 90                             | 5  | 6   | 8   | 10  | 13  | 17  | 25  | 43 | 73  | 87  | 90   | 90   |
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| 200                            | 5  | 6   | 9   | 11  | 13  | 18  | 27  | 51 | 105 | 155 | 190  | 200  |
| 250                            | 5  | 6   | 9   | 11  | 14  | 18  | 27  | 53 | 112 | 175 | 228  | 250  |
| 300                            | 5  | 6   | 9   | 11  | 14  | 18  | 28  | 54 | 117 | 189 | 260  | 300  |
| 350                            | 5  | 6   | 9   | 11  | 14  | 18  | 28  | 54 | 121 | 201 | 287  | 350  |
| 400                            | 5  | 6   | 9   | 11  | 14  | 19  | 28  | 55 | 124 | 211 | 311  | 400  |
| 450                            | 5  | 6   | 9   | 11  | 14  | 19  | 28  | 55 | 127 | 218 | 331  | 450  |
| 500                            | 5  | 6   | 9   | 11  | 14  | 19  | 28  | 56 | 129 | 225 | 349  | 500  |
| 600                            | 5  | 6   | 9   | 11  | 14  | 19  | 28  | 56 | 132 | 235 | 379  | 597  |
| 700                            | 5  | 6   | 9   | 11  | 14  | 19  | 28  | 57 | 134 | 243 | 402  | 691  |
| 800                            | 5  | 6   | 9   | 11  | 14  | 19  | 28  | 57 | 136 | 249 | 421  | 782  |
| 900                            | 5  | 6   | 9   | 11  | 14  | 19  | 28  | 57 | 137 | 254 | 437  | 870  |
| 1000                           | 5  | 6   | 9   | 11  | 14  | 19  | 28  | 57 | 138 | 259 | 452  | 950  |
| 1200                           | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 57 | 140 | 264 | 471  | 1020 |
| 1400                           | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 58 | 141 | 269 | 487  | 1236 |
| 1600                           | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 58 | 142 | 272 | 499  | 1354 |
| 1800                           | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 58 | 143 | 275 | 509  | 1459 |
| 2000                           | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 58 | 143 | 277 | 517  | 1540 |
| 3000                           | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 58 | 145 | 284 | 542  | 1895 |
| 4000                           | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 58 | 146 | 288 | 556  | 2100 |
| 5000                           | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 147 | 290 | 564  | 2253 |
| 6000                           | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 147 | 291 | 569  | 2358 |
| 7000                           | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 147 | 292 | 573  | 2437 |
| 8000                           | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 147 | 293 | 576  | 2498 |
| 9000                           | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 148 | 294 | 579  | 2548 |
| 10000                          | 5  | 6   | 9   | 11  | 14  | 19  | 29  | 59 | 148 | 294 | 581  | 2595 |

B

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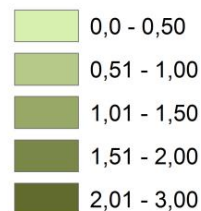
Poland: 264.000 wild boars

Wild boar population assumed as INFINITE: 2900 samples for the entire Country

If 100 sampling areas having  
With an average of 2600 animals:  
 $1600 \times 100 = 160.000$

OK, you completed the sampling on January the 1<sup>st</sup>  
..and if the virus will be introduced on January 2<sup>nd</sup> ?

Wild boar density in 2016 (no/km<sup>2</sup>)



## The 5%/95% strategy

sampling has to follow precise assumptions:

1. Set an expected prevalence according to the goal of sampling: EARLY DETECTION (0,1 – 0,2.....10%)
2. Animals have to belong to the same risk group (same probability to be positive; i.e. same hunting ground, same forest)
3. All the animals have the same probability to be sampled; (adult animals are shot?)

Sampling should be performed in a shorter time in respect to a single cycle of the infection; (i.e. sampling during hunting season: 3 months)



# Suspect case definition and ASF detection

Broader case definition: all shot animals: N. 2733

39 detected cases (1,4%)

2733 negative investigations

First case detected 25/07/2014

Narrow case definition: animals shot while showing clinical signs: N. 1

1 detected case (100%)

Lost 226 cases

No negative investigations

Case detected 20/08/2014

## Early detection of ASF in wild boars Passive surveillance vs. active surveillance

### **LATVIA: Summary of wild boar data (June-December, 2014) within the infected areas (Part II and Part III)**

|               | Number of tested animals | Number of positive results |
|---------------|--------------------------|----------------------------|
| WB found dead | 227                      | 178                        |
| WB hunted     | 2733                     | 39                         |

# Efficiency of passive vs active surveillance

Virus detection in dead animals:  $178/227 = 0,78$

Virus detection in shot animals:  $39/2733 = 0,014$

detection in dead/detection in shot

$0,78/0,014 = 55,7$

The probability to detected a virus in dead animals is 55 times higher than in shot animals

$(55/(55+1))*100 = 98\%$

98 out of 100 are likely to be detected in **dead** wild boars

## Detection probabilities of ASF Virus in a wild boar population

### Ratio and probability between rates

|                                  |    |                       | ratio | detection probability<br>$\% = \text{ratio} / (\text{ratio} + 1)$ |
|----------------------------------|----|-----------------------|-------|---|
| Lethality rate                   | vs | Hunting rate          | 8675  | 99.99   |
| Virus positive Found dead (100%) | vs | Virus positive hunted | 174   | 99.4  |
| Virus positive found dead (10%)  | vs | Virus positive hunted | 17,4  | 94.6  |
| Virus positive found dead (10%)  | vs | Sero-positive hunted  | 348   | 99.7  |

# ASF prevalence estimation

Found dead animals = 78%  
Shot animals = 1,4%

Which is the true period prevalence?

Is prevalence revealed by active or passive surveillance?  
What can be compared among different countries?

# Take at home message

*Surveillance is a strategy shaped by appropriate techniques*

## **Passive surveillance:**

Irreplaceable in the early detection of almost all infectious diseases and in particular for ASF in wild boars;

The minimum number of expected warnings must be planned and reached

**Active surveillance:** useless for early detection in free and at risk areas;

**Active surveillance:** in already infected areas areas

Estimate epidemiological parameters (prevalence, incidence,  $\beta$ , etc.)

Prevalence in hunted animals in infected areas is the sole epidemiological parameters that can be compared among different counties.

Assess the efficacy of passive surveillance



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