



Better Training for Safer Food *Initiative*

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Principles of Active Surveillance

BTSEF

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Passive (reactive)

Active (proactive)

Stakeholders report to
Veterinary Service some
"problem"

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

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

We have a protocol, we go in the farm, collect samples, search for clinical signs etc.

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



Passive is better when

Active is better for infections/diseases
in which:

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

**Clinical symptoms are not evident, episodic or
short lasting**

Evident Clinical Symptoms

Low/null lethality rate

High lethality rate

High animal owners
awareness

Low animal owners awareness

High Veterinary Service
awareness

Active surveillance is based on sampling/investigating animals

The **number** of samples/investigations taken/carried out will determine the successfulness of the planned activity;

To define **sample size** is a crucial step in any active surveillance;

How to define the **sampling intensity** in active surveillance

N. of sample will depend:

Aim of sampling: detect a case; estimate prevalence

Basic principles: expected prevalence; population size etc.

Field implementation: feasibility; sustainability

Aim of active surveillance

- 1) To detect a at least one positive animal
- 2) To estimate disease prevalence(% of positive/examined/population)

The 5%/95% strategy What is for? What does it means?

1. It means that that the number of tested samples will detect **AT LEAST 1 positive** animals if the infection affects at least **5% of the population**
2. We have 95% probability to detect at least one (1) wild boar positive if 5% of the animals in the population are positive.
3. If "only" 3-4% of the animals are infected **NO POSITIVE SAMPLE** will be detected;

Prevalence of ASF virus in wild boar populations

1 positives out of 3 tested animals = 33,3%

5 positives out of 15 tested animals = 33,3%

60 positives out of 180 tested animals = 33,3%

180 positives out of 540 tested animals = 33,3%

On which of the above prevalences you are more confident?

DATA needed to estimate the correct sample size

Expected prevalence
Population size
Level of confidence
(Precision of the estimate)

Cannon RM and Roe RT. 1982 Livestock disease surveys: A field manual for veterinarians. Bureau of Rural Science, Department of Primary Industry; Australian Government Publishing Service, Canberra, Australia. 33 pp.

Expected prevalence

Expected prevalence: the % of infected animals that you expected in the infected population (you do know yet how many animals are positive...but you have to forecast to design the sampling intensity)

Expected prevalence: literature, local epidemiological situation; aim of surveillance

Expected prevalence in Early detection: the very first case **FIRST CASE** has to be detected; a very low prevalence (**0,1-0,5%**) should be chosen;

The expected prevalence (% of positive animals in the population) is of paramount importance

Population size

Population size is the second very important needed data
What does it mean POPULATION?

Population is a group of animals that live in a homogeneous mixing:

Each animal in the population has the **same probability of being infected**

Each animal has the same probability to be **sampled**

Each animal will be sampled in the **SAME MOMENT**

Confidence level

It describes the PRECISION of the obtained estimate

95% Confidence Level means that: if you take the same number of samples in the same population 100 times

95 times you will obtain the same results

Sample size

ONCE you have:

Defined the **AIM** of the active surveillance (case detection or prevalence estimate)

Defined your **EXPECTED PREVALENCE**

Identified your **TARGET POPULATION**

Decided the **Confidence level** (and the **error of the estimation**)

You can estimate the sample size from tables

Free software

(<http://www.winepi.net/uk/index.htm>)

How to detect the initial cases

The example of the
5%-95% strategy

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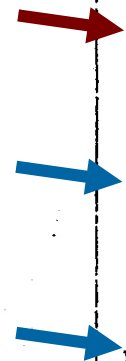


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Sampling has to follow precise assumptions:

Set an expected prevalence according to the goal of sampling:
EARLY DETECTION (0,1 – 0,2.....10%)

Define the population: sampled animals have to belong to the same risk group (same probability to be positive; i.e. same hunting ground, same forest)

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)

Estimate a prevalence

How many shot wild boar should I sample to have a good estimate of the prevalence (% of infected wild boar in the population)

Expected prevalence

Population of interest (sampling unit)

Confidence level

Accepted error of the estimate

Expected prevalence = 5%

Population of interest (Sampling unit)
= 1000

Confidence level = 95%

Accepted error of the estimate = 5%
The true prevalence will lie between 0-
10% (5%+/-5%)



European Commission

Table 4: Sample Size for Estimation of Disease Prevalence

The table gives the approximate sample size required to estimate a prevalence in a large population with the desired fixed width confidence limits.

expected prevalence	level of confidence (100%)								
	90%			95%			99%		
	desired accuracy			desired accuracy			desired accuracy		
	10	5	1	10	5	1	10	5	1
10%	24	97	2435	35	138	3457	60	239	5971
20%	43	173	4329	61	246	6147	106	425	10616
30%	57	227	5682	81	323	8067	139	557	13933
40%	65	260	6494	92	369	9220	159	637	15923
50%	68	271	6764	96	384	9604	166	663	16587
60%	65	260	6494	92	369	9220	159	637	15923
70%	57	227	5682	81	323	8067	139	557	13933
80%	43	173	4329	61	246	6147	106	425	10616
90%	24	97	2435	35	138	3457	60	239	5971

The table assumes a knowledge of the approximate result. If in doubt, either use the 0.5 figure, or use the 0.2 figure, but take additional samples if necessary.

When sampling from a finite population of size N, an adjustment to account for this effect is made by using the size n_{adj} above and calculating

$$\frac{1}{n} = \frac{1}{n_{adj}} + \frac{1}{N}$$

<http://edepot.wur.nl/188646>

10% with 5% error means that the obtained prevalence estimation will lie between 10% (+- 5%) = **5%-15%**

Ожидаемая распространенность	Доверительный уровень								
	90%			96%			99%		
	Требуемая точность			Требуемая точность			Требуемая точность		
	10	5	1	10	5	1	10	5	1
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General

Passive surveillance: suspect case definition dependent

Active surveillance= expected prevalence and population size dependent

In passive surveillance the N. of samples is dependent from the SUSPECT CASE DEFINITION

In Active surveillance the N. of samples is dependent from EXPECTED PREVALENCE and POPULATION SIZE (Sampling Unit)

Active 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

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



European
Commission

Poland: 264.000 wild boars

If we consider that each wild boar living in Poland has the same risk to be ASF infected, we can consider the whole Polish Wild boar population as a **UNIQUE SAMPLING UNIT**

95% Confidence level; 0,1% is the prevalence that we want detect.

Wild boar density in 2016 (no/km²)

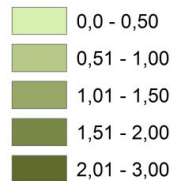


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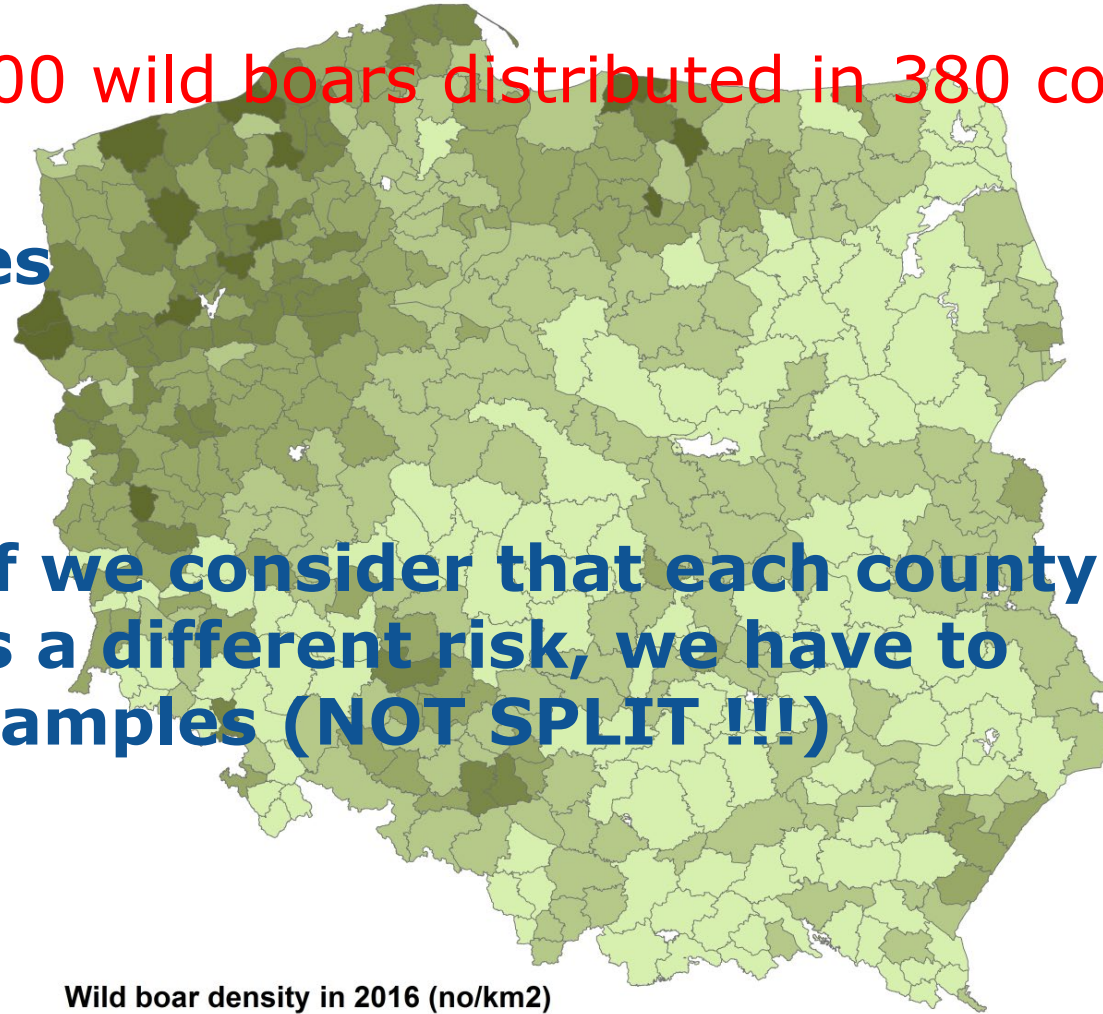
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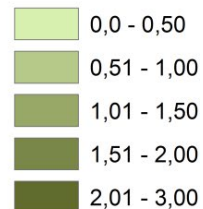
Poland: 264.000 wild boars distributed in 380 counties

**2600 samples
are enough**

**OPPOSITE: if we consider that each county
(powiat) has a different risk, we have to
CUMULATE samples (NOT SPLIT !!!)**



Wild boar density in 2016 (no/km²)





Poland: 264.000 wild boars distributed in 380 counties

2600 samples for each County => 988.000

OPPOSITE: if we consider that each county (powiat) has a different risk, we have to **CUMULATE** samples (NOT SPLIT !!!)

ABSOLUTELY NOT $2600/380 \Rightarrow 7$

NEVER, NEVER DIVIDE THE SAMPLING INTENSITY

Wild boar density in 2016 (no/km²)

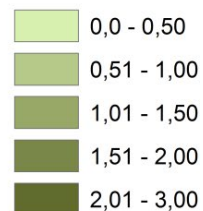


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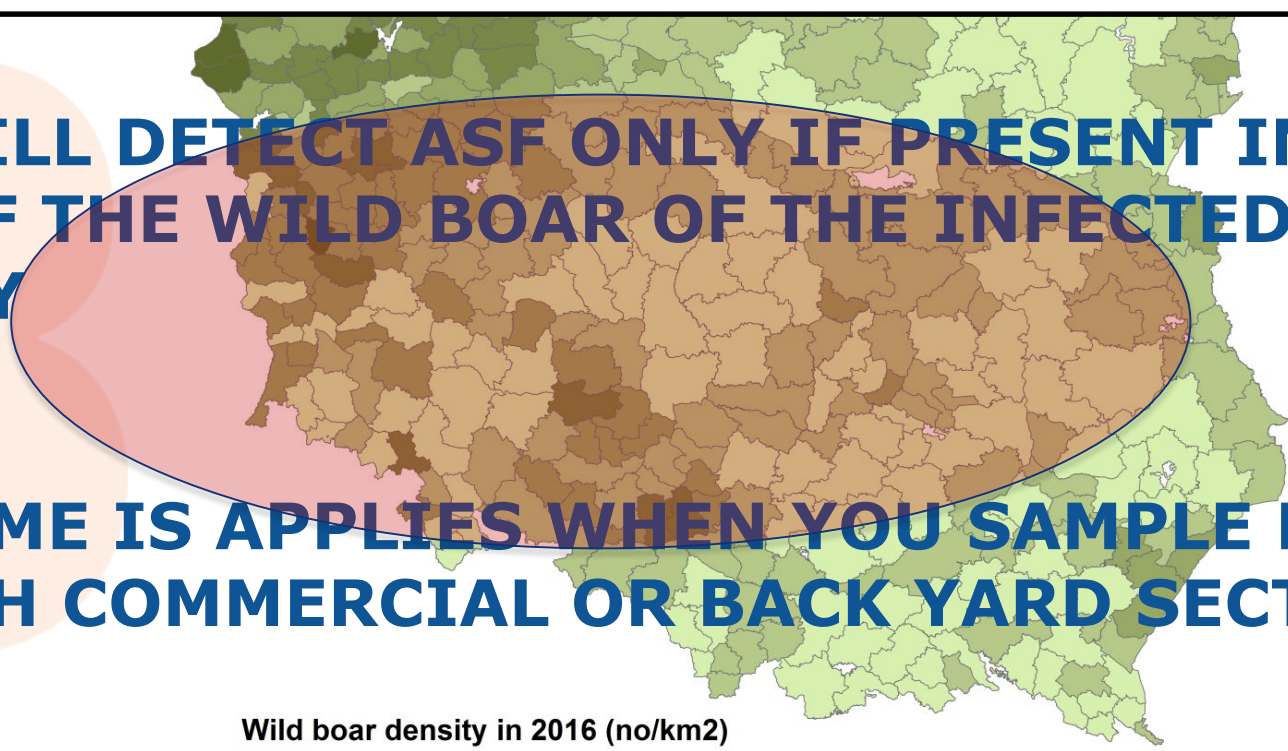
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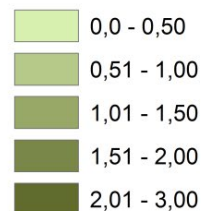
COLLECTING 7 SAMPLES FOR EACH COUNTY

YOU WILL DETECT ASF ONLY IF PRESENT IN 35% OF THE WILD BOAR OF THE INFECTED COUNTY

THE SAME IS APPLIES WHEN YOU SAMPLE PIGS IN BOTH COMMERCIAL OR BACK YARD SECTORS



Wild boar density in 2016 (no/km²)



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 200km² with a wild boar population of 400-1000 head

Sample size: based on the expected prevalence modulated by literature data and feasibility/sustainability.

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

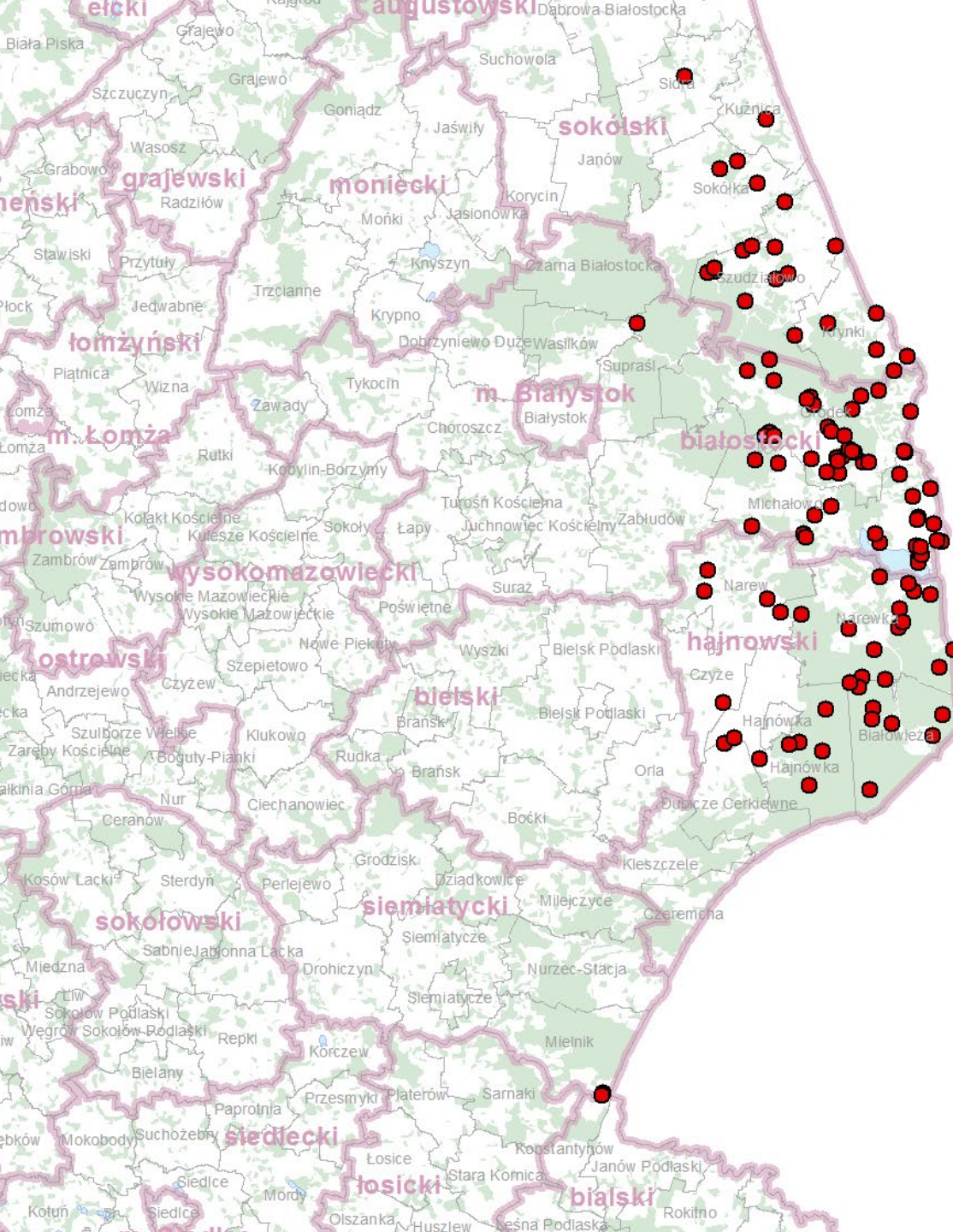
The virus is ALREADY present;
Quantification of the spread of the virus (prevalence/incidence)
Virological and or serological tests
Sample collection: hunters/veterinarians

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, storage of carcasses while waiting for the results of the tests; positive carcasses disposal, etc.

ASF PREVALENCE in wild boar

Field example

B T S F



2014-2016

50 km



Which prevalence?

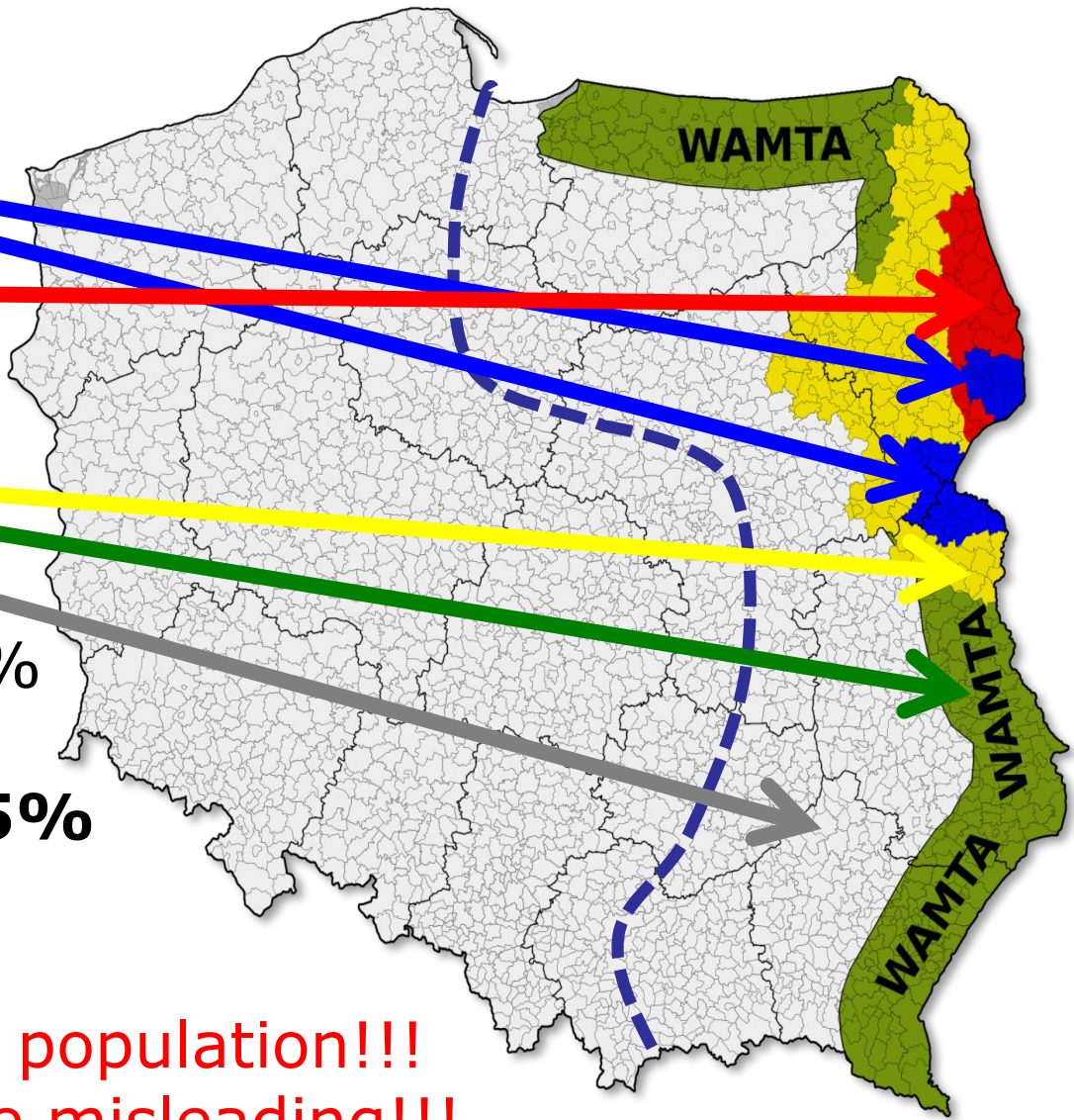
2%

0,5 %

0%

$$2\% + 0,5\% + 0\% + 0\% = 0,005\%$$

Define the infected population!!!
Prevalence could be misleading!!!



ASF prevalence estimation

Latvia data at the onset of the infection

Passive Surveillance =>
Found dead animals = **78%**

Active Surveillance =>
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?

Active surveillance and early detection:

The virus should be detected as soon as possible, hence the expected prevalence has to be set at **0,5-1%**; it means a huge number of samples

Once you have completed your sampling, the area could be free from the virus, but nobody can ensure that the **virus** will not be **introduced the day after** you completed sampling

Active surveillance **cannot be carried out 365 days/year** whereas PASSIVE can be

Take at home message

Surveillance is a strategy shaped by appropriate techniques

Active surveillance: not useful for early detection in free and at risk areas;

Active surveillance: relevant in already infected areas

Estimate epidemiological parameters (prevalence, incidence, β , etc.)

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

Assess the efficacy of passive surveillance



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