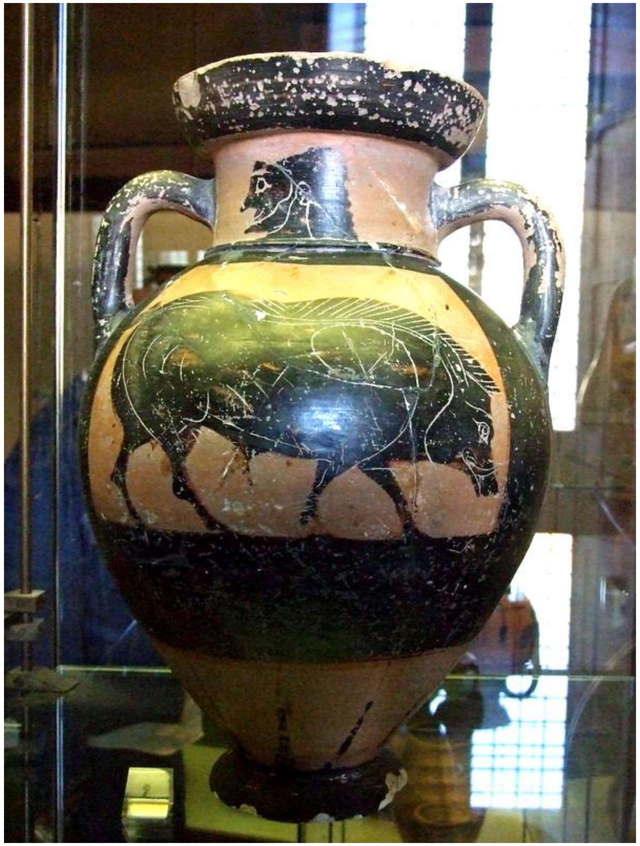
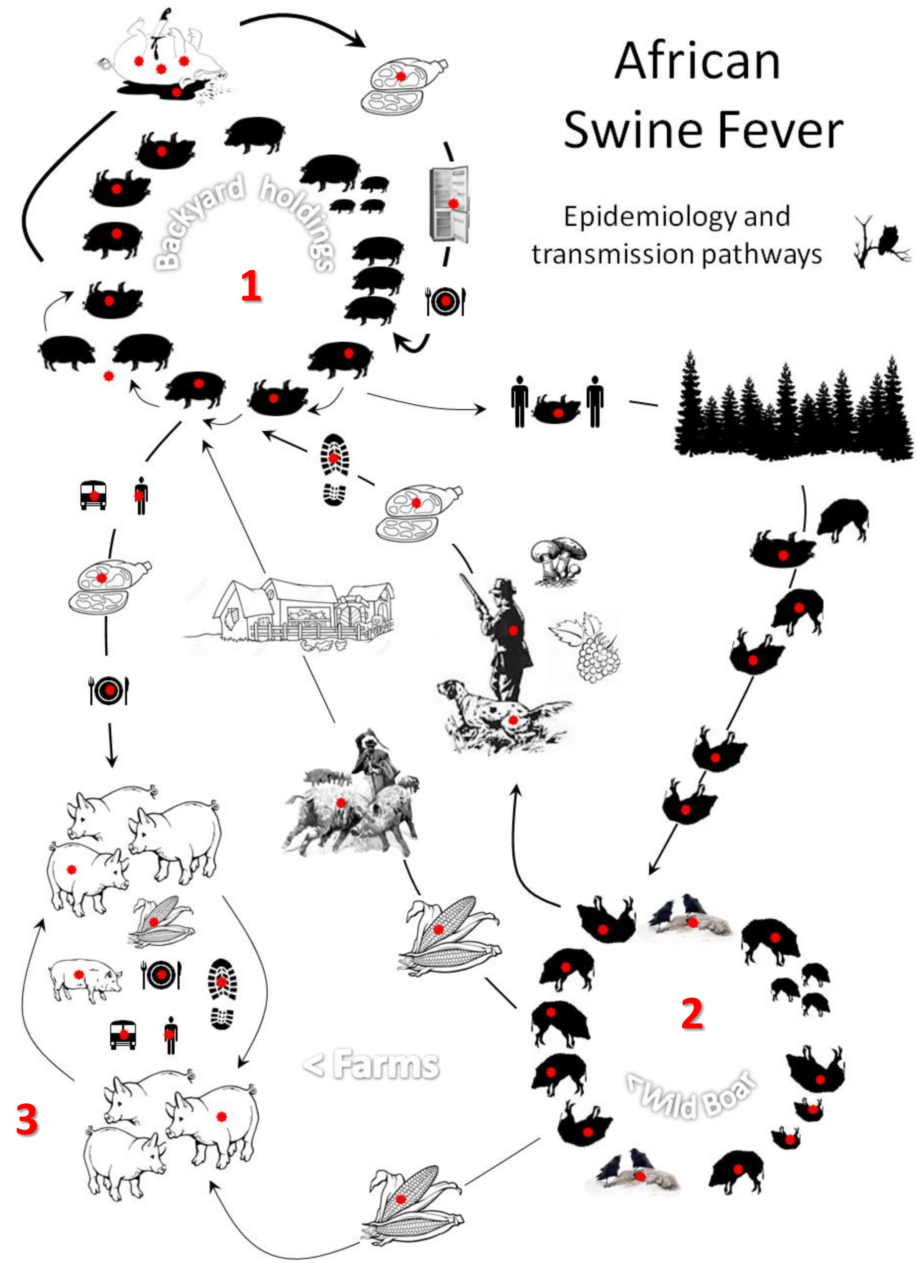
ASF & wild boar

Epidemiological questions and respective data needs

Points to address



- Transmission cycles of ASF in Eastern Europe in 2007-2015
- How ASF survives and gets spread in wild boar populations?
- What are the data gaps and difficulties in analysis ?
- What data is needed and how it needs to be arranged?

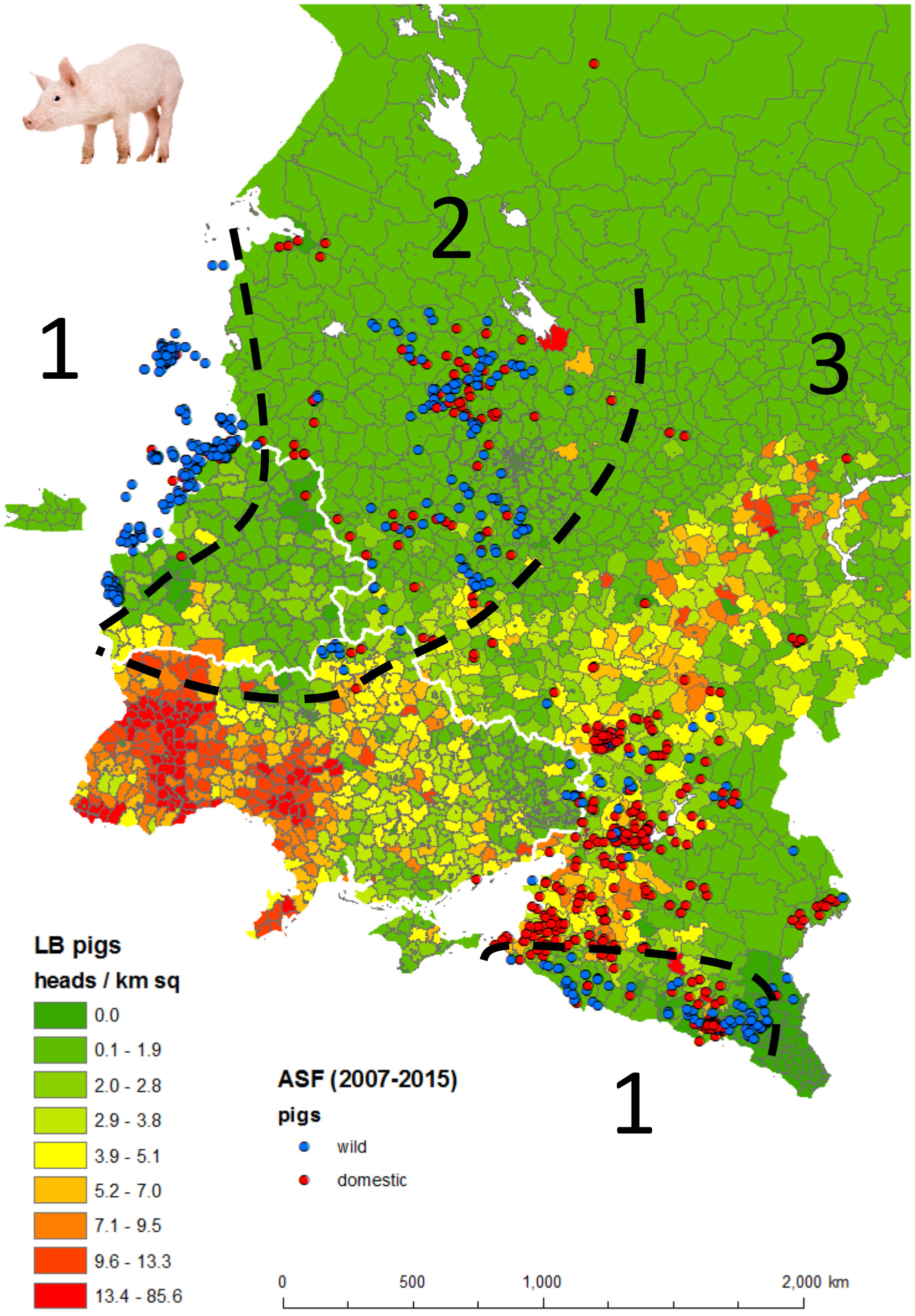


1. **Persistence in backyard sector**
2. **Persistence in wild boar**
3. Seasonal spill-over to farms (*usually dead-end with some contribution to geographic spread*).

Transmission pathways

- Backyard sector -> pig farms
- Backyard sector < - > wild boar
- Wild boar -> pig farms
- Pig farms < - > pig farms

Types of ASF transmission cycles

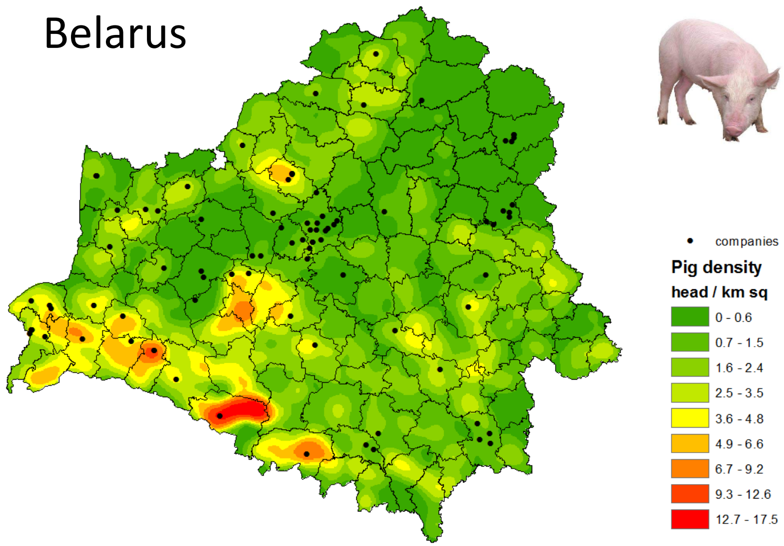


More likely to be a gradient

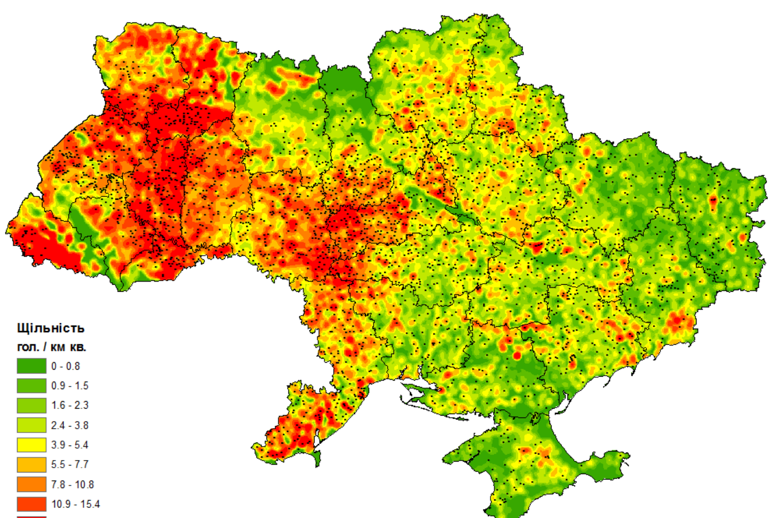
1. Dominated by wild boar;
2. Mixed: wild boar / domestic pigs;
3. Dominated by domestic pigs.

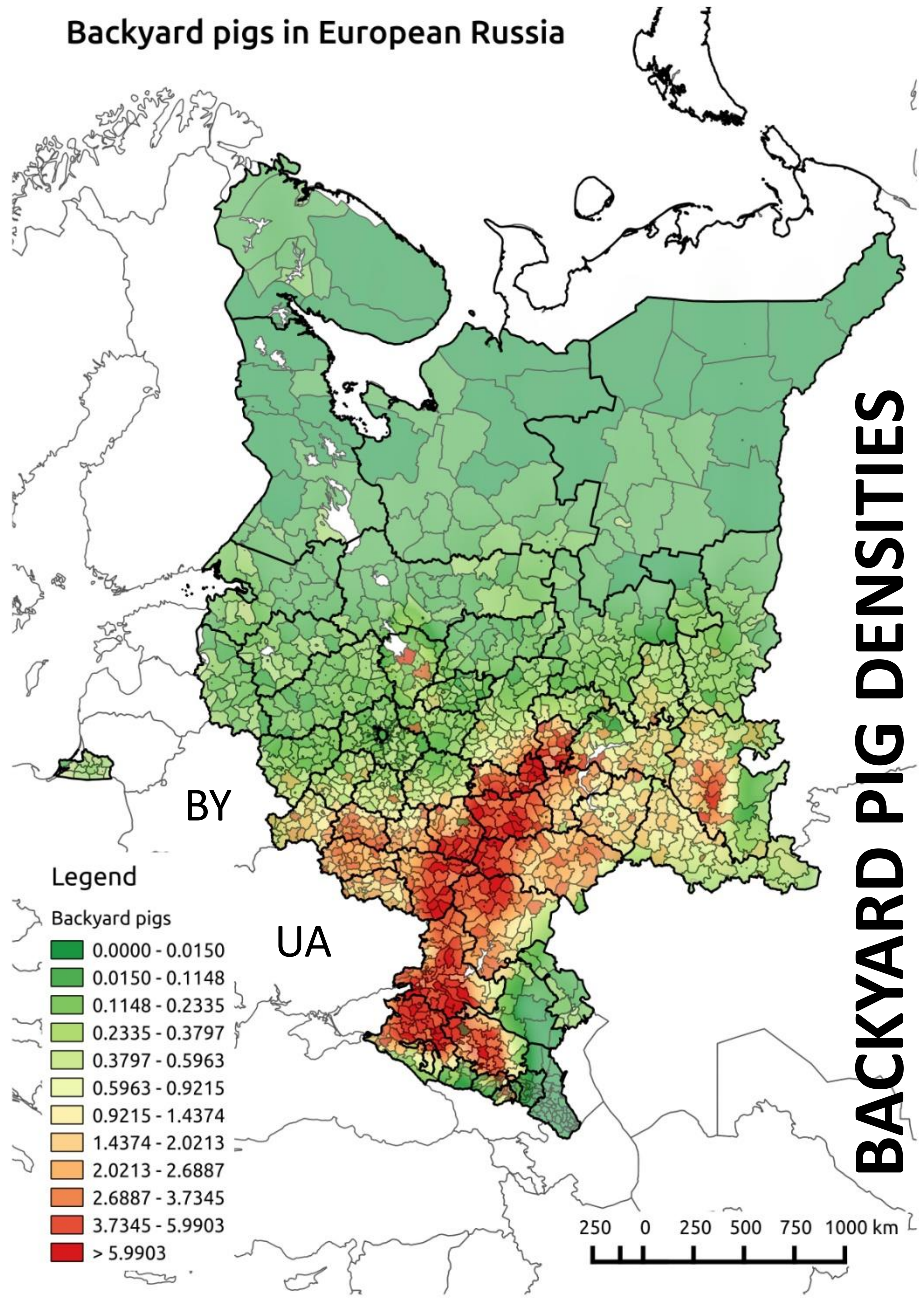
BACKYARD PIG DENSITIES

Belarus

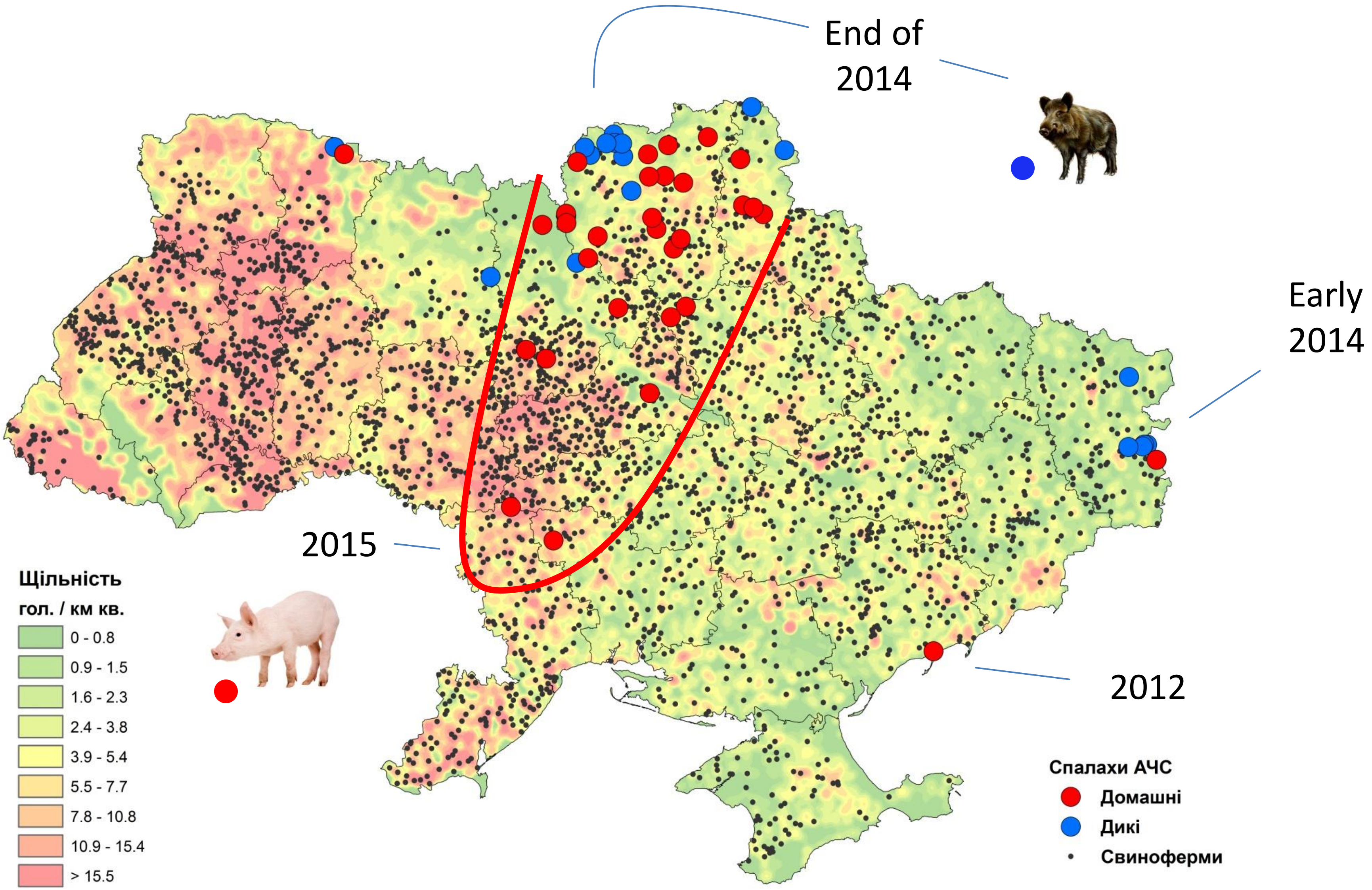


Ukraine

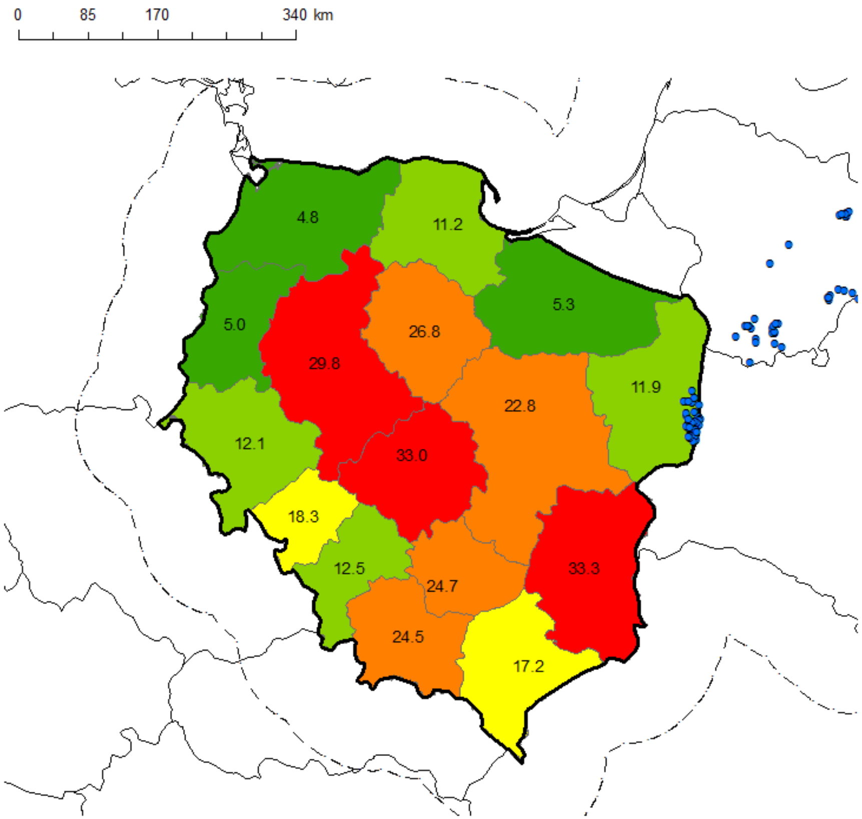




ASF in UA: WB -> domestic pigs

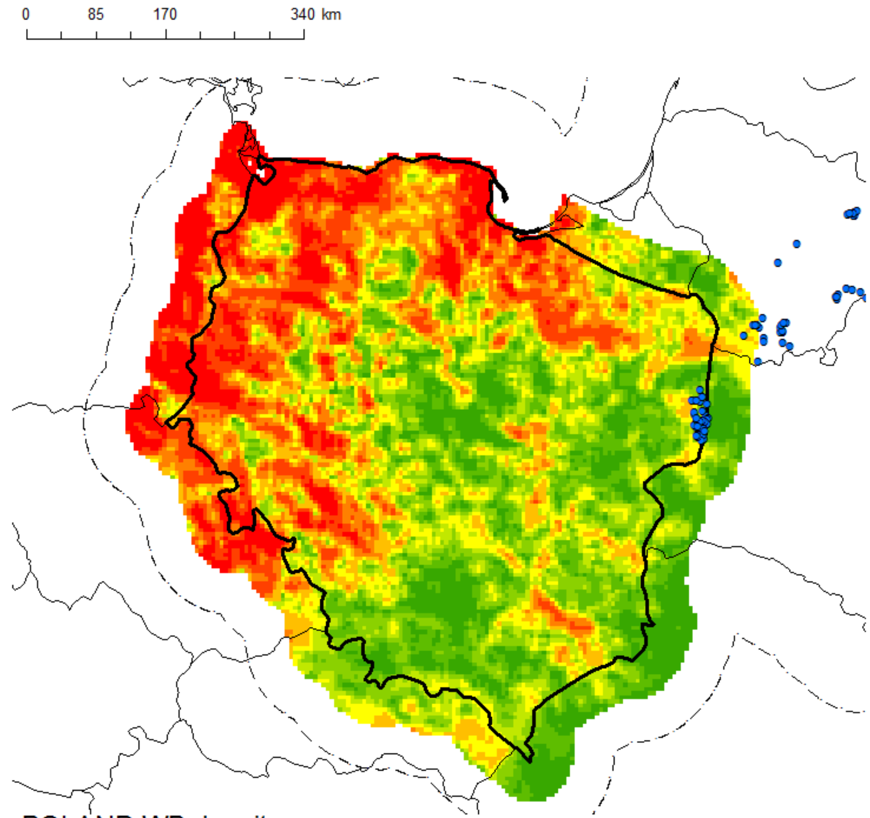


Khomenko & Pittiglio, in prep.



Backyard pigs
heads / km sq
4.840 - 5.339
5.340 - 12.47
12.48 - 18.30
18.31 - 26.82
26.83 - 33.37

• ASF in wild boar (2014-15)



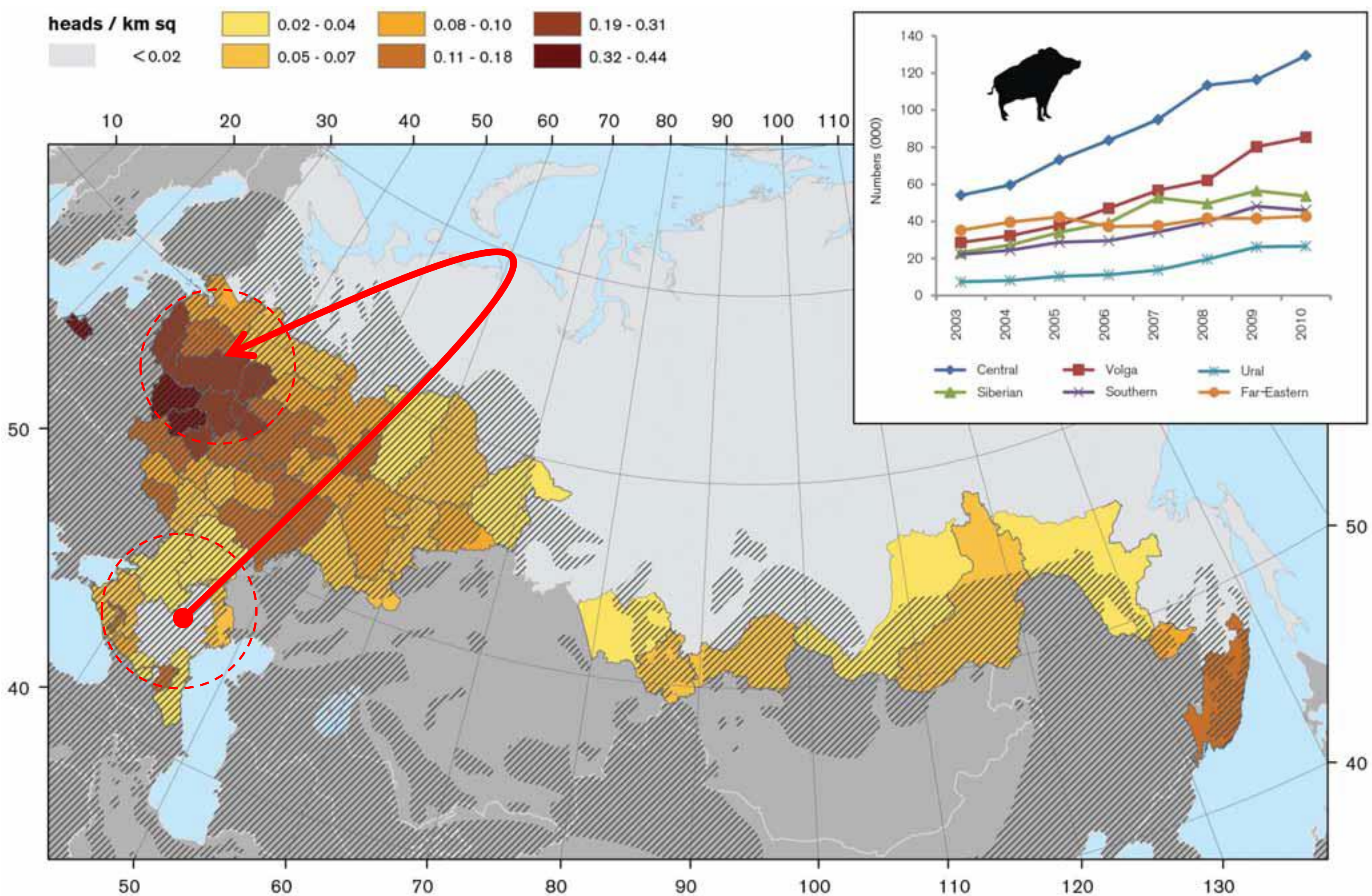
POLAND WB density
heads / km sq
0.01 - 0.19
0.2 - 0.29
0.3 - 0.39
0.4 - 0.5
0.51 - 0.63
0.64 - 0.81
0.82 - 1.05
1.06 - 1.38
1.39 - 4.29

• ASF in wild boar (2014-15)

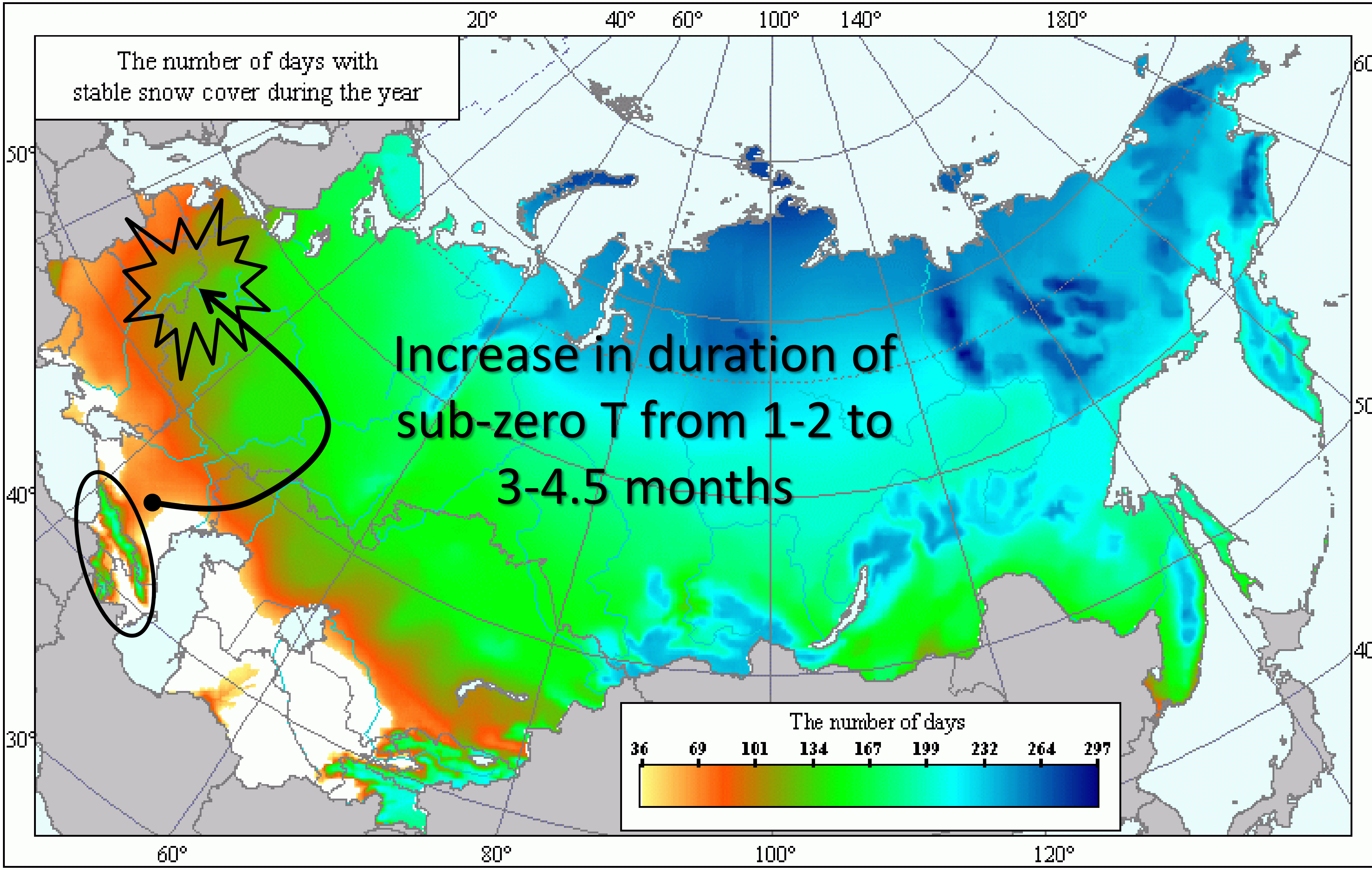
ASF transmission cycle in wild boar

- What is the role of infected carcasses in winter time ?
- What does variation in seasonal incidence / prevalence suggest ?
- Does population density play a role in disease transmission patterns ?
- Other factors: changing social structure, behavior, demography, hunting pressure, heamatophagous insects…

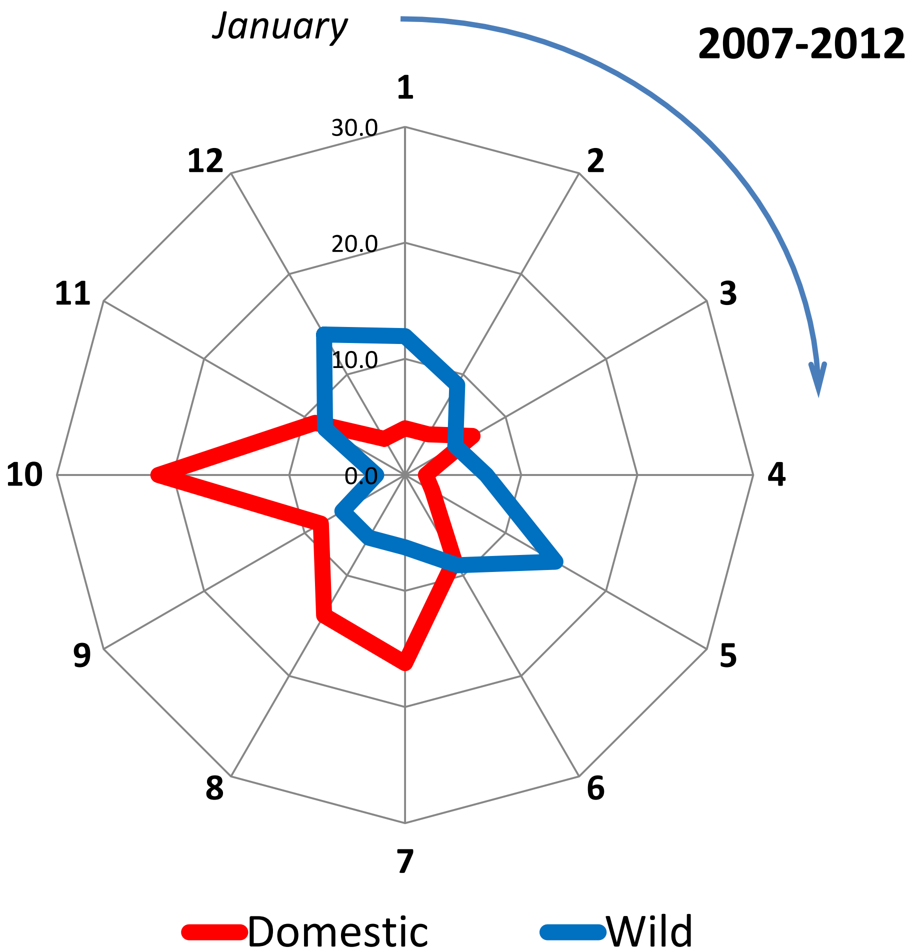
In 2012-2014 ASF has shifted to a much higher density area in the RF and 45 N to 55-60 N

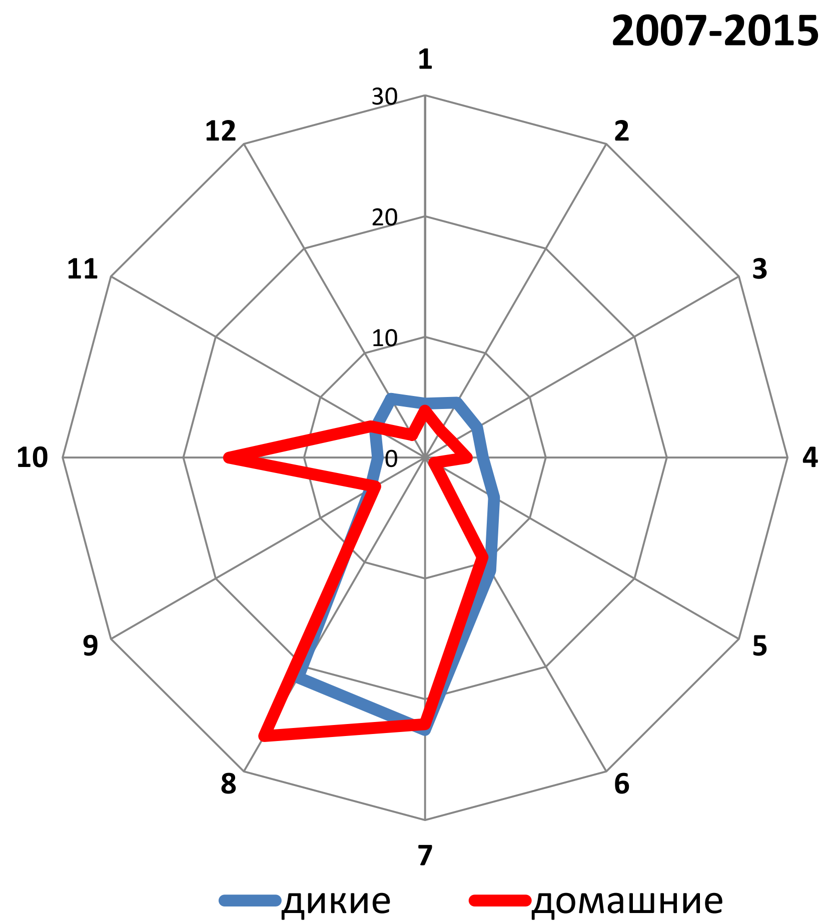


Survival of carcasses in winter



Monthly detections of ASF in domestic pigs and wild boar



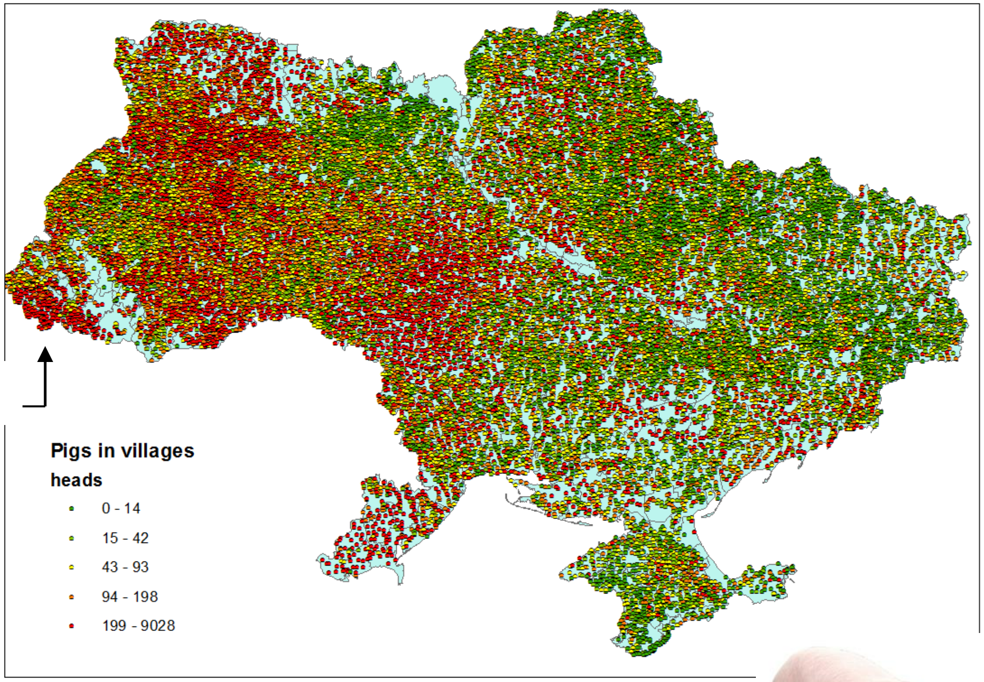


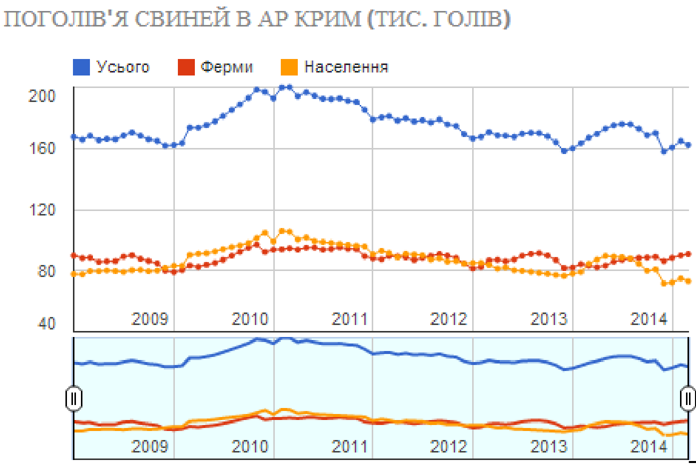
DOMESTIC PIG Seasonality patterns may strongly differ from area to area

W Ukraine

40%

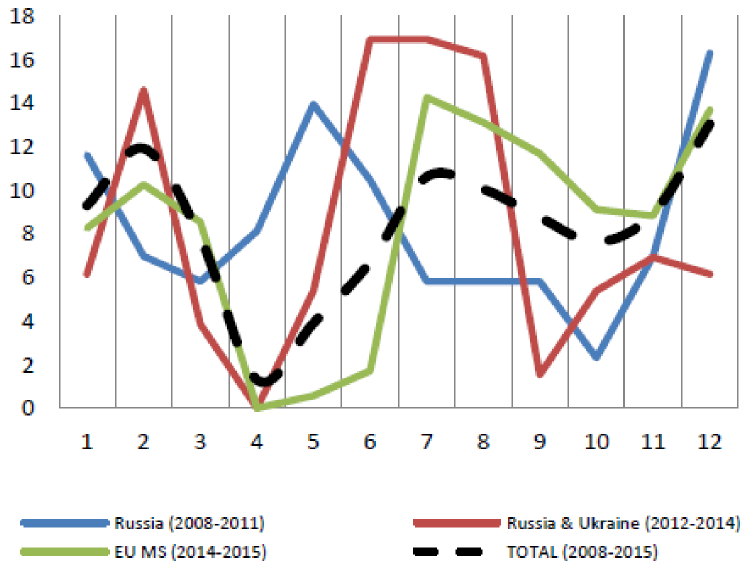
NUMBER OF PIGS IN VILLAGES (n=29000)



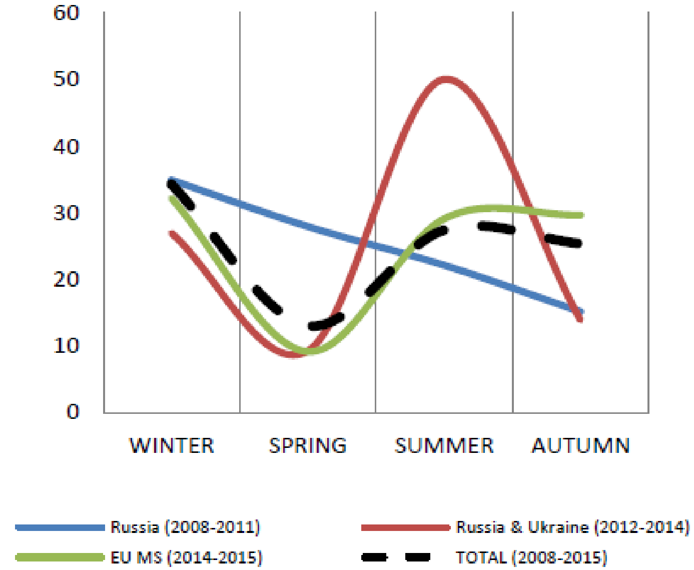


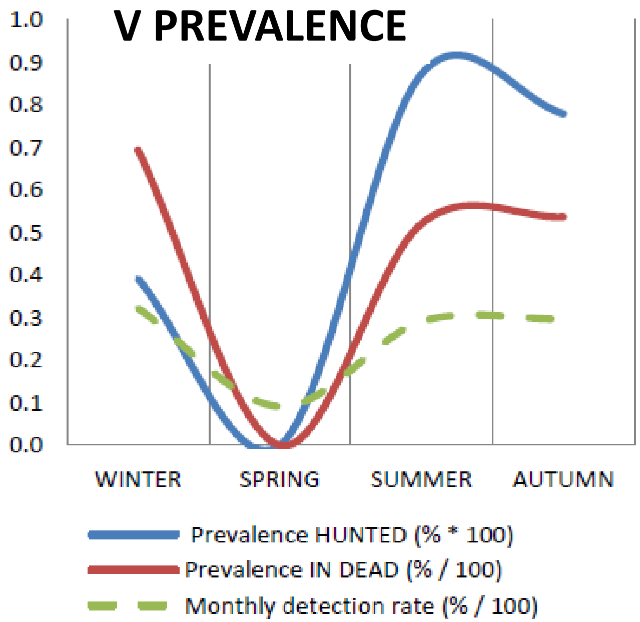
AR Crimea (no seasonality)

DETECTION MONTHLY



DETECTION SEASONALLY

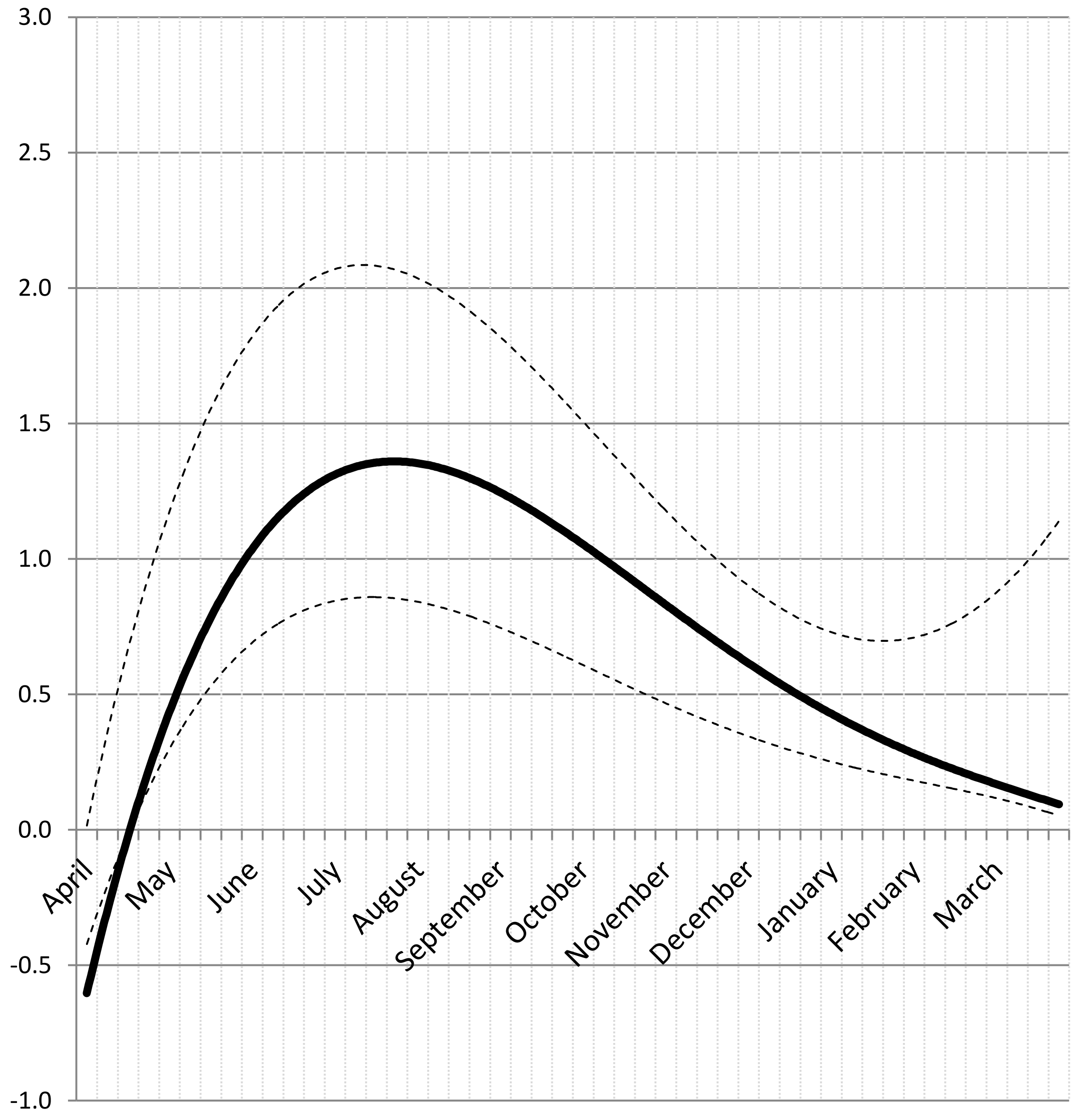




Whichever we consider there is a summer increase in ASF activity

EFSA, 2015

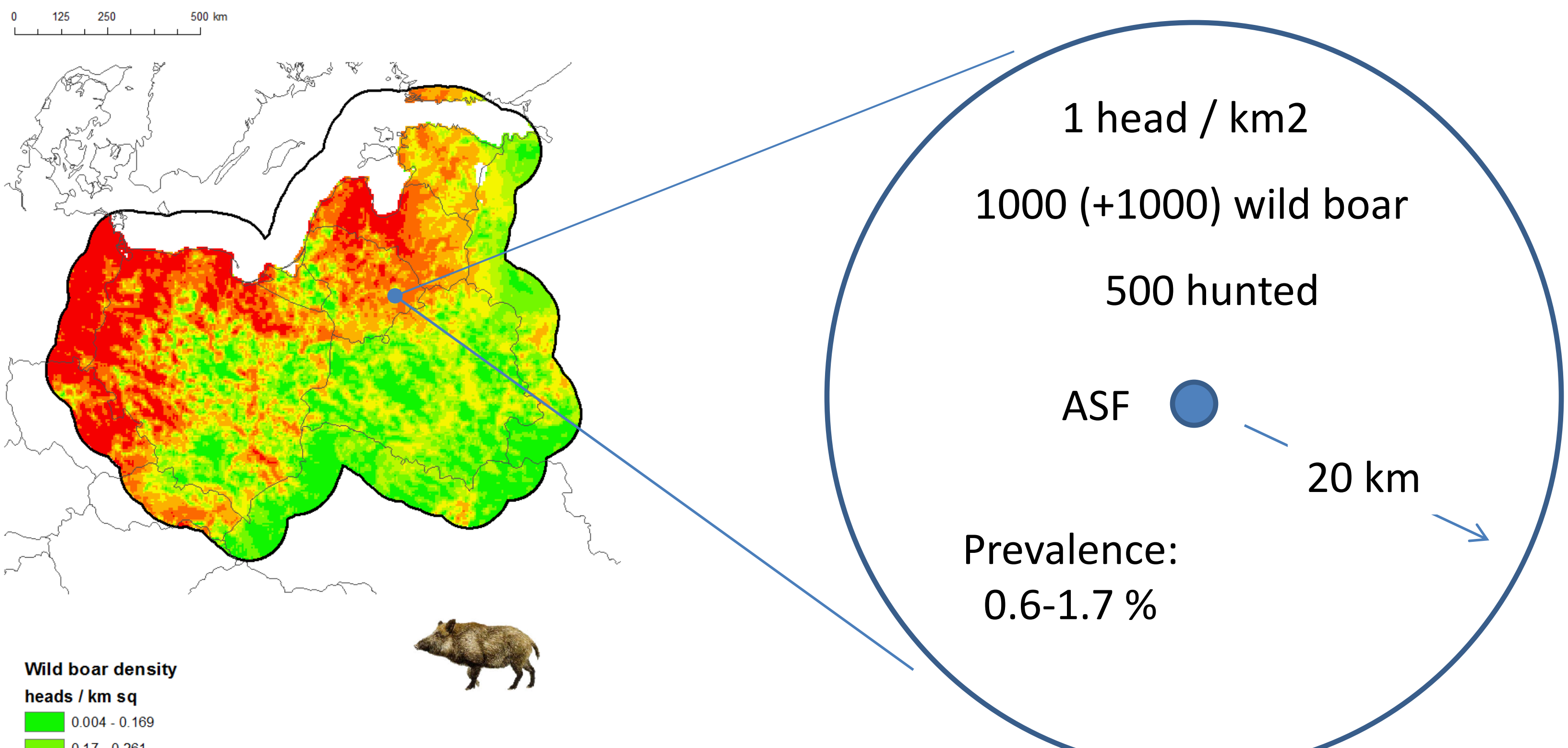
Weekly simulated n of carcasses

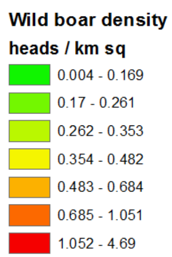


- 1000 head in spring;
- 20 km radius with spring density around 1 head per km sq;
- 50 % (500) hunting bag;
- 100 % (1000) seasonal surplus of juveniles;
- Seasonal ASFV prevalence 0.6-1.7 % as reported by EFSA (2015)

Why summer, not winter?

- Counter intuitively wild boar seem to attend carrion more frequently (2 times) in summer (mainly feeding on invertebrate larvae, Ray et al 2014);
- Cannibalism does not seem to be so frequent. Contrary to expectations wild boar seem to avoid carcasses of conspecifics in winter, though still sometimes attend them (Jedrzejewska & Jedrzejewski, 1998; Selva et al, 2005);
- Condition and origin of carcasses seems to play a role (if they are open, phase of decomposition, killed / hunted / dead);
- Interplay : higher WB density & more frequent encounter with carcasses / easier carcass detection / carcasses more attractive, but last shorter?





First carcass detection may imply that there are at least 9 carcasses around

During 1 year ASF will kill

30 (21-63) animals
of which 10% will be found

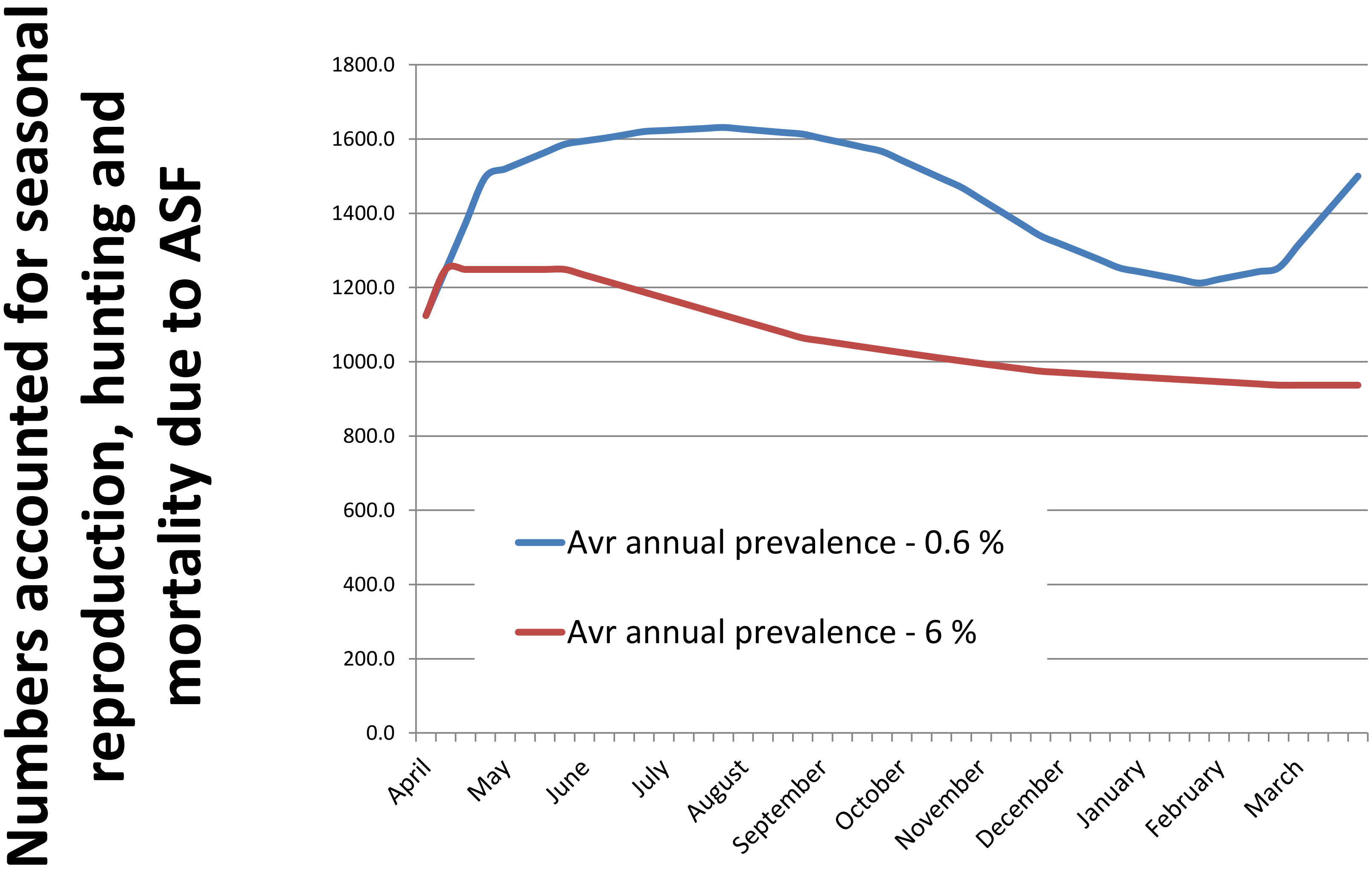
and that introduction happened:

If in MARCH-APRIL: 15 (10-18) weeks before

If in JULY-AUGUST: 7 (5-12) weeks before

Active surveillance will give
2 (1-3) virus positive animals

Population dynamics at 0.6 % (0-1.1) versus 6 % (0-11) virus prevalence

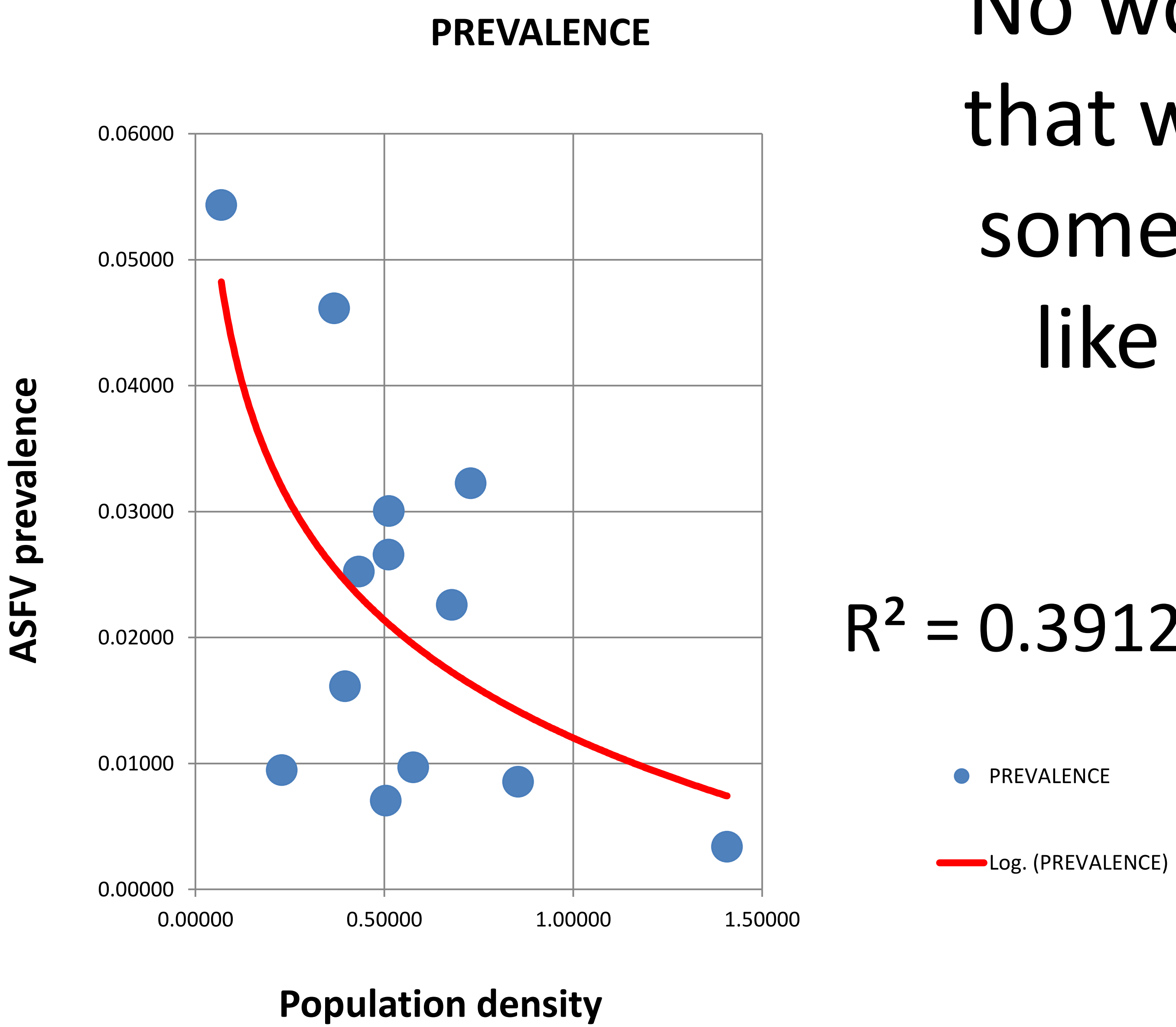


Latvia: virus prevalence across space

	Ciblas novads	Dagdas novads	Daugavpils novads	Ludzas novads	Krāslavas novads	Rēzeknes novads	Alūksnes novads	Burtnieku novads	Naukšēnu novads	Strenču novads	Valkas novads	Krustpils novads
Ciblas novads		0,356	0,360	0,540	0,117	1,000	1,000	0,578	1,000	0,073	0,326	1,000
Dagdas novads			0,794	0,725	0,448	**0,001**	**0,004**	0,764	0,277	0,331	1,000	0,354
Daugavpils novads				0,732	0,213	**0,002**	**0,008**	1,000	0,455	0,178	0,766	0,609
Ludzas novads					0,213	**0,058**	0,091	1,000	1,000	0,139	0,468	1,000
Krāslavas novads						**0,000**	**0,0003**	0,266	0,0967	0,774	0,591	0,212
Rēzeknes novads							1,000	**0,009**	0,231	**0,000**	**0,002**	1,000
Alūksnes novads								0,021	0,290	**0,001**	**0,005**	1,000
Burtnieku novads									0,651	0,282	0,739	0,576
Naukšēnu novads										0,089	0,241	1,000
Strenču novads											0,507	0,158
Valkas novads												0,331
Krustpils novads												

Sample sizes are simply too small to capture variation at given low prevalence

red not a sigle +WB was found (e.g. differences are significant only if 0 prevalence is compared to non-zero :-))))



No wonder that we get something like this

$R^2 = 0.3912$

Effect of density versus socio-demographic structure of WB population

- Higher numbers of disease detections in higher density areas do not imply higher virus prevalence;
- Sub-optimal habitats -> larger home ranges, less stable territories, more emigration / immigration occurs;
- Less feeding resources -> carcasses attended more often, possibly actively searched for;
- Targeted hunting -> destruction of social structure, increased dispersion, redistribution;
- ASF itself can affect socio-demographic structure and behavior of individual animals;
- Higher population density might not necessarily imply higher carcass-to-animal contact rates (as well as animal-to-animal contacts).

Miscellaneous: biology, ecology, management

- Carcass and virus survival in different ecological settings and season and their attendance by WB ?
- Nutritional needs of lactating females / piglets?
- Behavior of piglets (sub-adult females) that lost their leading saw?
- Stable flies *Stomoxys* and local mechanical transmission of ASFV (Baldacchino et al 2013)
- Effect of population management and ASF control interventions: feeding / no feeding (= control of reproduction and survival rates), baiting, various types of hunting, carcass removal, etc ?

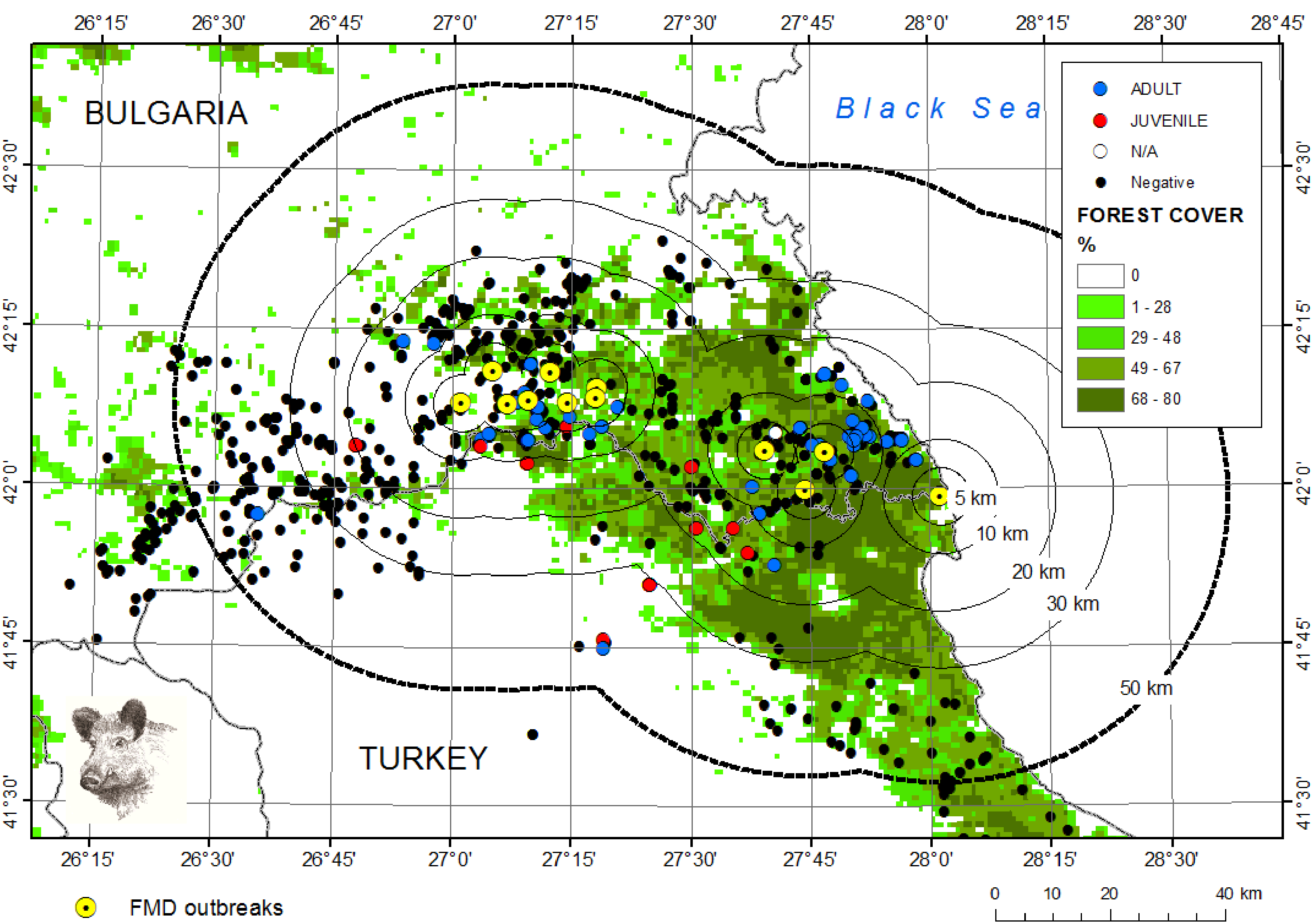
Surveillance & epidemiology

- We are dealing with poorly understood host-parasite system complicated by involvement of domestic pigs & human actions;
- Practical & research needs have to be addressed at the same time;
- We learn as we do (thanks to many people in the field who participate in this work !)
- Surveillance alone is not enough and it needs (apart from reliability and cost efficiency) to be well supplemented with epidemiological data and observations.

Geographical (location) data

- Ideally X,Y of **all** hunted, **all** found dead and **all** tested animals with all the rest of attribute information;
- Alternatively (and more realistically) data can be aggregated (admin, forestry, hunting districts etc.), but need to be standardized, related to geospatial data sets and include population / hunting / testing stats (see further)

Seropositivity to FMDV in Wild Boar in Thrace



Aggregated surveillance data need to be spatially and temporally consistent:

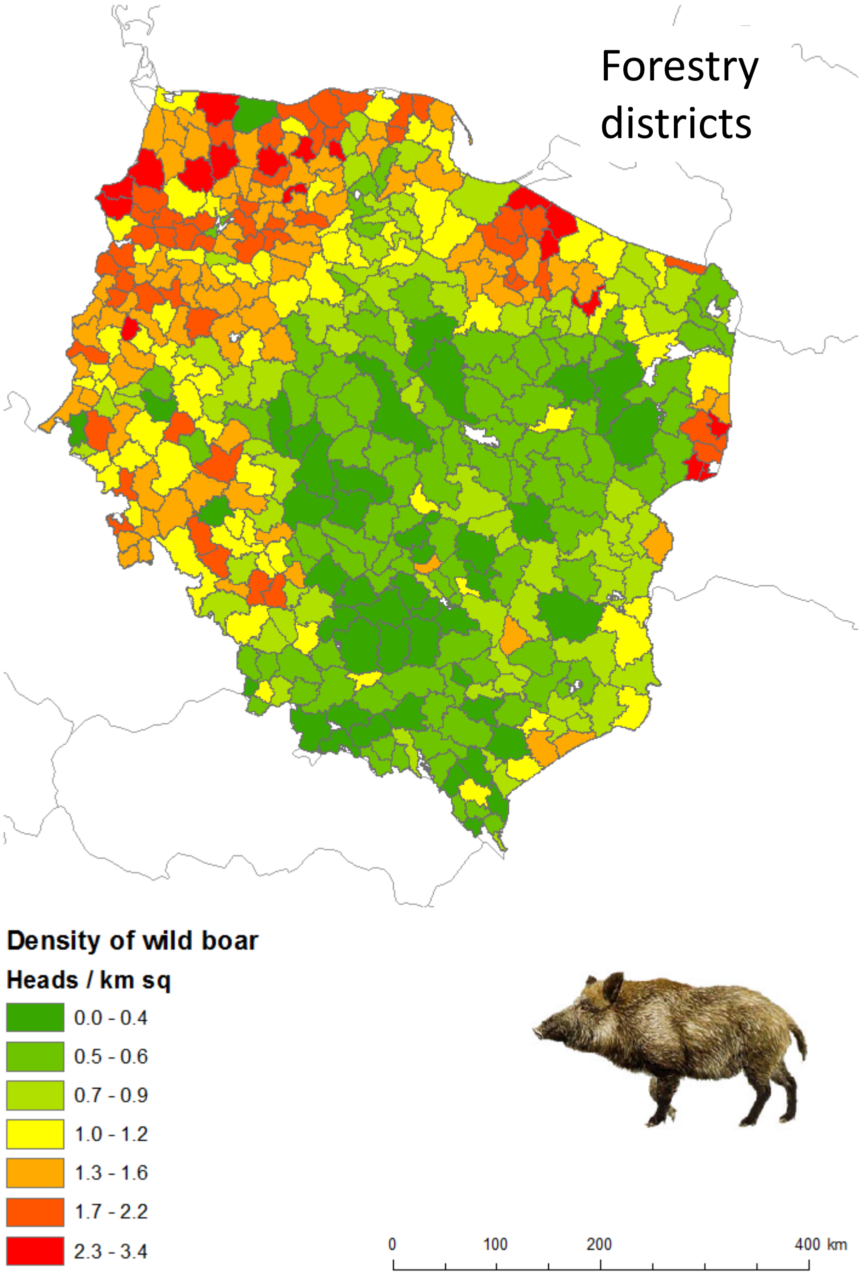
Annually:

1. WB population estimates (spring census data)
2. Pig population (n holdings, % low biosecurity)

Monthly / seasonally or annually ???:

1. Hunting bags (number of animals killed)
2. n of all **found dead animals** (incl. road kills)
3. n of all tested **dead animals** (test wise)
4. n of all “+” and all “-” **dead animals** (test wise)
5. n of all tested **hunted animals** (test wise)
6. n of all “+” and all “-” **hunted animals** (test wise)

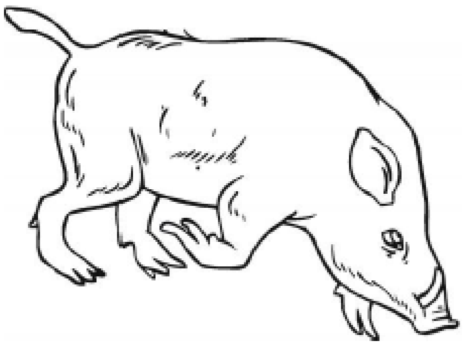
Mismatches in spatial units !



- Admin division schemes used by veterinary services often differ from those used by forestry / wildlife authorities.

WB demographic data

- For all animals: **sex & age** (can be simplified and standardized).
- For carcasses: + **age of the carcass** (how long since the animal has actually died).
- Collection of demographic data makes sense only if it is individual animal resolution database;
- Perhaps a some area (areas) should be identified for such a HR epidemiological studies.



Sero-positivity to FMDV:
Thrace (epidemic O) *versus* Anatolia (endemic O, A, Asia)

AGE GROUP	THRACE		ANATOLIA		P
	n	NSP+ (95 % CI), %	n	NSP+ (95 % CI), %	
ADULT	628	9.1 (6.9 – 11.6)	185	24.9 (18.3 - 32.4)	<0.05
JUVENILE	358	5.6 (3.4 – 8.5)	67	7.5 (2.5 - 16.6)	ns
ALL	1004	7.8 (6.2-9.6)	252	20.2 (15.5 - 25.7)	<0.05

NOTE: NO DIFFERENCE BETWEEN SEXES FOUND

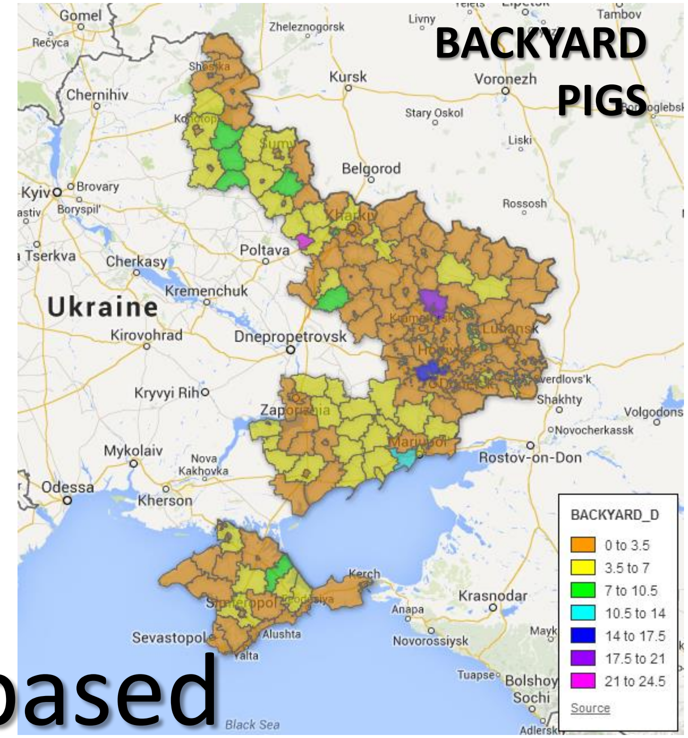
Other data of epi relevance

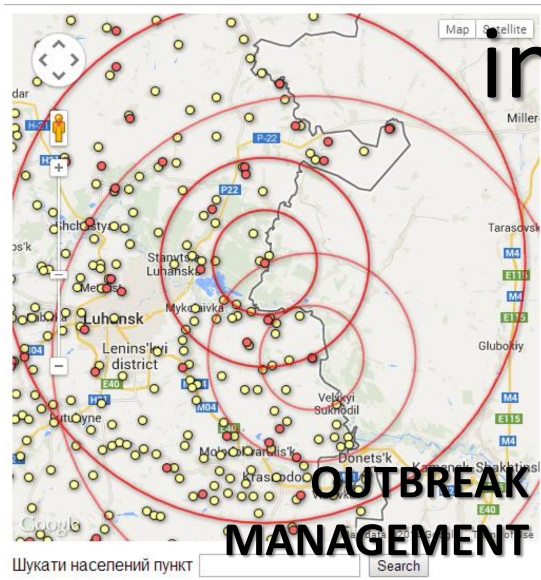
- Human population data (rural, numbers of hunters, etc)
- Accessibility (road networks, travel time to cities, etc.)
- Land cover / land use data / habitat / agriculture / fragmentation and other spatial variables.
- Disease control / wildlife management interventions (hunting pressure, feeding, carcass removal) – all this needs to be properly documented and accounted for in the analysis

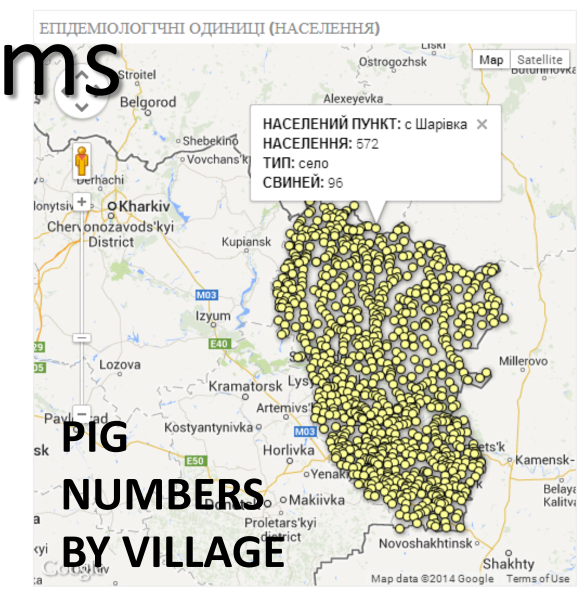
Data collection, analysis, modeling and provision of feedback to countries

- A minimum harmonized data collection scheme for the whole affected area (national veterinary authorities & EFSA);
- Targeted pilot projects in selected countries or areas to address some specific questions in more detail (academic research);
- Modeling (but we need to know exactly what…);
- How do we provide feedback (results, models, recommendations, advice to the MS)?

Fusion Table based information systems







FAO's experience with online decision support GIS for ASF prevention and control in Ukraine and Belarus

- https://sites.google.com/site/uastopasf/
- https://sites.google.com/site/bystopasf/episituation