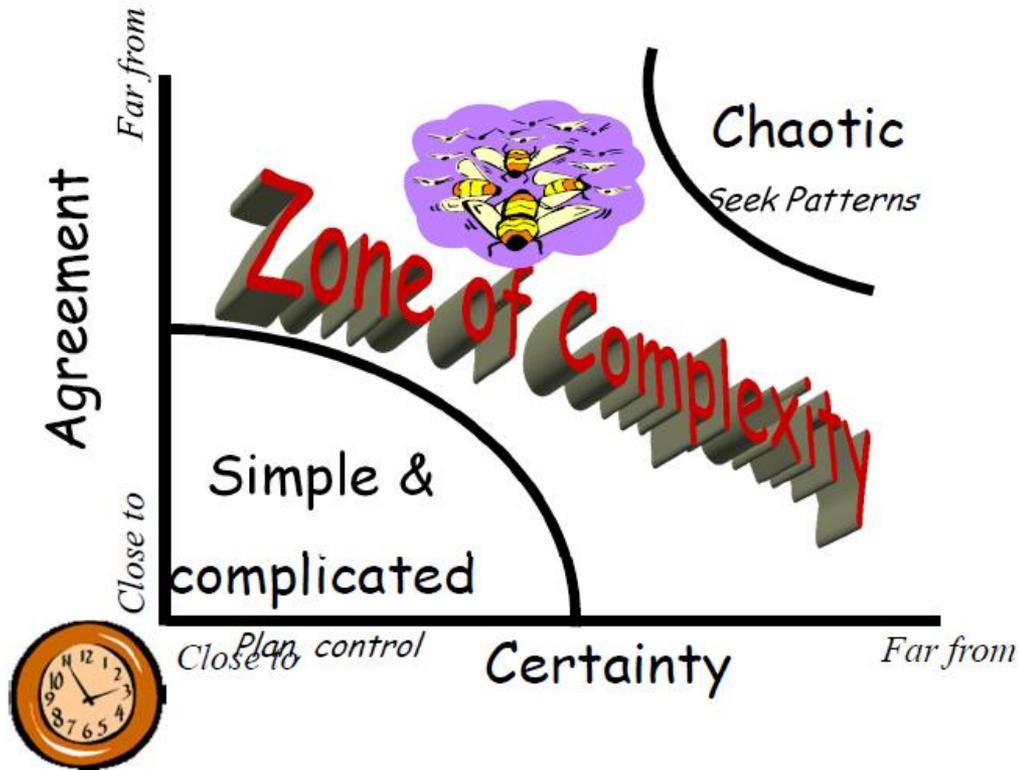# Simple

Making Soup

Right "rec[...]

Gives same r[...]

Complicated

Sending a Rocket to the

Complex

Raising a Child

recipes or protocols
ors influence Experience
t doesn't guarantees
success

Far from

Agreement

Close to

Zone of Complexity

Chaotic

Seek Patterns

Simple &
complicated

Close to

Plan control

Certainty

Close to

Far from

Integrated veterinary WNV monitoring program in Serbia

МИНИСТАРСТВО ПОЉОПРИВРЕДЕ И
ЗАШТИТЕ ЖИВОТНЕ СРЕДИНЕ
УПРАВА ЗА ВЕТЕРИНУ

ПРОГРАМ НАДЗОРА
ВИРУСА ЗАПАДНОГ
НИЛА
У СРБИЈИ

➢ **The integrated WNV monitoring program established by the Veterinary Directorate** MoA was active from spring - May 2014, June 2015, 2017, 2018, 2019, 2021, 2022, 2023, 2024 and 2025.

➢ The main aim of the program – **early detection of WNV presence in the environment** due to the application of timely control measures - the control of vectors (mosquitoes) and prevention of disease outbreaks (epidemics) in humans and animals

➢ Surveillance program **is based on monitoring of antibodies in sentinel animals** (WNV IgG in horses and poultry in 2014; only WNV IgM antibodies in horses from 2015 to 2021; from 2022 IgM Ab in horses and IgG Ab in calves) **as well as on monitoring the presence of the virus in natural hosts and vectors** (wild birds and mosquitoes)
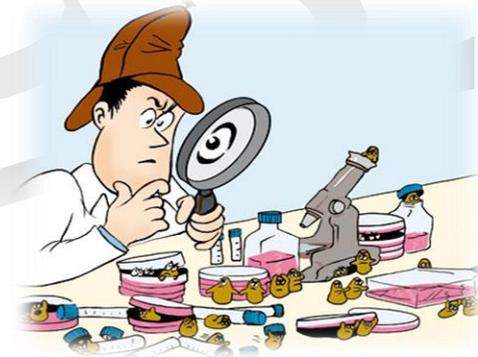
Integrated veterinary WNV monitoring program in Serbia

➢ **Active surveillance was conducted**:

❖ **serological testing of sentinel horses** (ELISA IgM Ab), **chickens** (IgG) or **cattle** (IgG Ab)

❖ testing on **virus presence in mosquito** vectors (RT-PCR)

❖ testing on **virus presence in** samples of found dead / alive captured susceptible **wild birds** (RT-PCR)

➢ **Passive surveillance** – serological testing (pared sera samples) and testing of virus presence in samples of horses with clinical signs of neurological disorders.

➢ By active and passive surveillance **all municipalities in Serbia were covered**, distribution of sampling points is determined based on risk assessment of exposure to WNV.

Integrated veterinary WNV monitoring program in Serbia

> Based on the existing knowledge on presence and circulation of WNV, regions / Districts in Serbia were, regarding the risk of WNV infection divided into Districts of higher and Districts of lower risk for WNV infection (for program 2014):
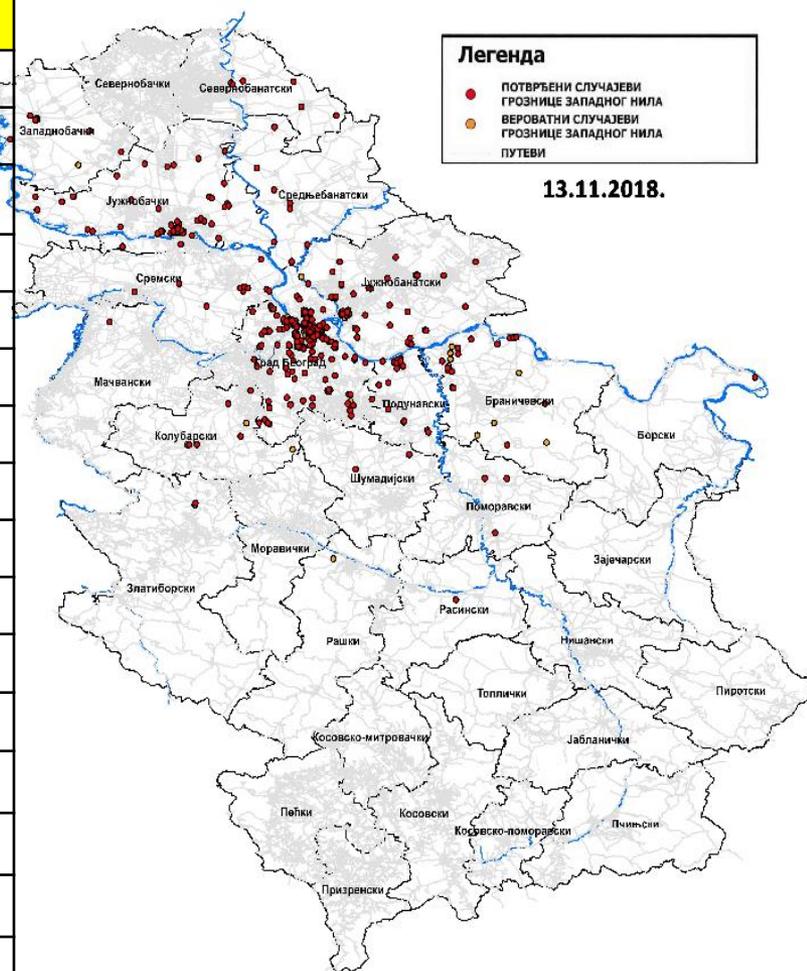
Higher risk areas - Districts	Lower risk areas - Districts
Severno-bački okrug	Severno-banatski okrug
Zapadno-bački okrug	Mačvanski okrug
Južno-bački okrug	Braničevski okrug
Srednje-banatski okrug	Pomoravski okrug
Južno-banatski okrug	Borski okrug
Sremski okrug	Zaječarski okrug
Grad Beograd	Zlatiborski okrug
Kolubarski okrug	Moravički okrug
Podunavski okrug	Rasinski okrug
Šumadijski okrug	Nišavski okrug
Raški okrug	Toplički okrug
	Pirotski okrug
	Jablanički okrug
	Pčinjski okrug
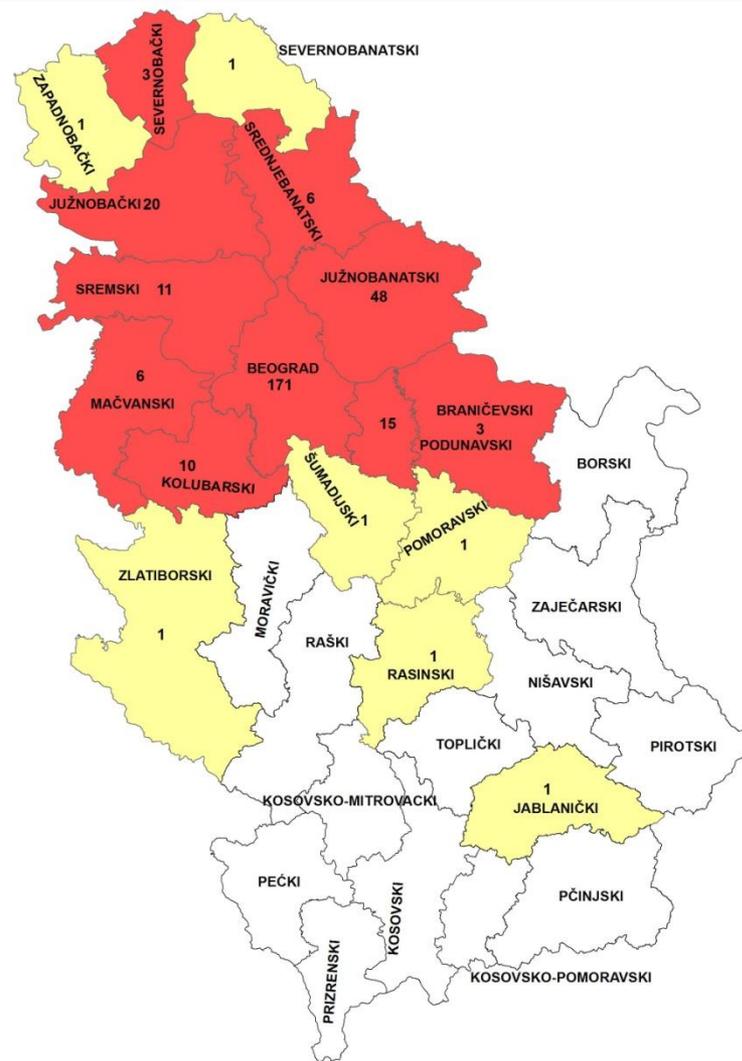
Integrated veterinary WNV monitoring program in Serbia

➢ Based on the existing knowledge on presence and circulation of WNV, regions / Districts in Serbia were, regarding the risk of WNV infection divided into Districts of higher and Districts of lower risk for WNV infection (for program 2023):

Higher risk areas - Districts	Lower risk areas - Districts
North Bačka District	Bor District
West Bačka District	Zaječar District
South Bačka District	Zlatibor District
North Banat District	Rasina District
Central Banat District	Nišava District
South Banat District	Toplica District
Srem District	Pirot District
City of Belgrade	Jablanica District
Podunavlje District	Pčinjski District
Braničevo District	
Mačva District	
Kolubara District	
Šumadija District	
Pomoravlje District	
Raška District	
Moravica District	

Легенда

● ПОТВРЂЕНИ СЛУЧАЈЕВИ ГРОЗНИЦЕ ЗАПАДНОГ НИЛА
● ВЕРОВАТНИ СЛУЧАЈЕВИ ГРОЗНИЦЕ ЗАПАДНОГ НИЛА
ПУТЕВИ

13.11.2018.

National veterinary WNV monitoring program in Serbia

Active surveillance:

Serological testing of sentinel poultry (only in 2014) – Surveillance of sentinel poultry in villages – backyards – **poultry hatched during 2014**
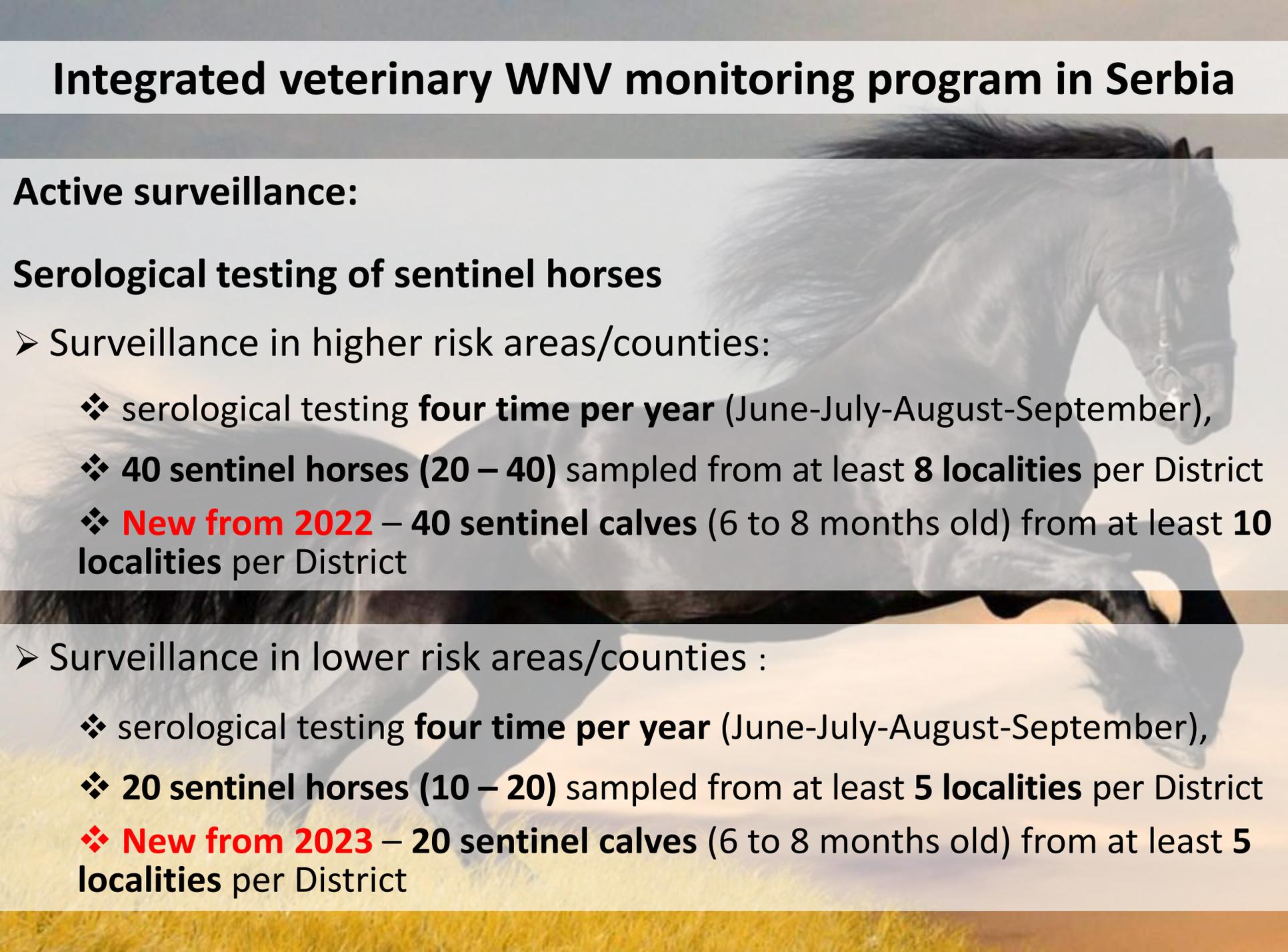
Surveillance in higher risk areas/counties:

- ❖ serological testing **in period May - September**
- ❖ **in 10 settlements / County**, 5 samples per settlement from at least 1 backyard
- ❖ **6 samplings** (1 in May; 1 in June; 2 in July; 1 in August and 1 in September (until 15th)

Surveillance in lower risk areas/counties :

- ❖ serological testing **in period June - September**
- ❖ **in 6 settlements / County**, 5 samples per settlement from at least 1 backyard
- ❖ **4 samplings** (1 in June; 2 in July; 1 in August and 1 in September (until 15th)

Integrated veterinary WNV monitoring program in Serbia

Active surveillance:

Serological testing of sentinel horses

➤ Surveillance in higher risk areas/counties:

❖ serological testing **four time per year** (June-July-August-September),

❖ **40 sentinel horses (20 – 40)** sampled from at least **8 localities** per District

❖ **New from 2022** – **40 sentinel calves** (6 to 8 months old) from at least **10 localities** per District

➤ Surveillance in lower risk areas/counties :

❖ serological testing **four time per year** (June-July-August-September),

❖ **20 sentinel horses (10 – 20)** sampled from at least **5 localities** per District

❖ **New from 2023** – **20 sentinel calves** (6 to 8 months old) from at least **5 localities** per District

Integrated veterinary WNV monitoring program in Serbia

Active surveillance:

 Surveillance of WNV presence in wild birds - testing by RT-PCR or real time RT-PCR methodology

➢ **Surveillance in higher risk areas/counties**:

  ❖ **in tissue samples of 30 found dead** suspect wild birds during the whole year, **or**

 ❖ in samples of **up to 30 planned hunted or live captured susceptible wild birds during June – October**

➢ **Surveillance in lower risk areas/counties**:

  ❖ **in tissue samples of up to 20 found dead susceptible wild birds during period June – October**

National veterinary WNV monitoring program in Serbia

Active surveillance:

Surveillance of **WNV presence in vector Mosquitoes** (*Culex pipiens*) - **testing by RT-PCR or real time RT-PCR methodology**
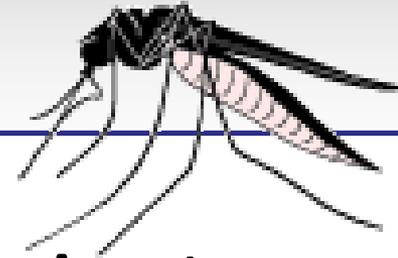
➢ **Surveillance in higher risk areas/Districts**:

   ❖ sampling of mosquitoes **every 2 weeks in period June (May) – August (September)**

   ❖ at **10 localities** distributed throughout the whole territory of the District

   ❖ **4 – 5 samplings** (**2 pools** per sample tested if > 300 mosquitoes)

➢ **Surveillance in lower risk areas/Districts**:

   ❖ sampling of mosquitoes **every 2 weeks in period June – August (September)**

   ❖ at **5 localities** distributed throughout the whole territory of the District

   ❖ **4 – 5 samplings** (**2 pools** per sample tested if > 300 mosquitoes)
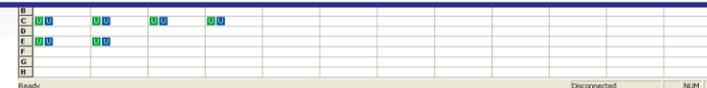
Comparison of WNV positive samples in surveillance and human WNND cases in 2014
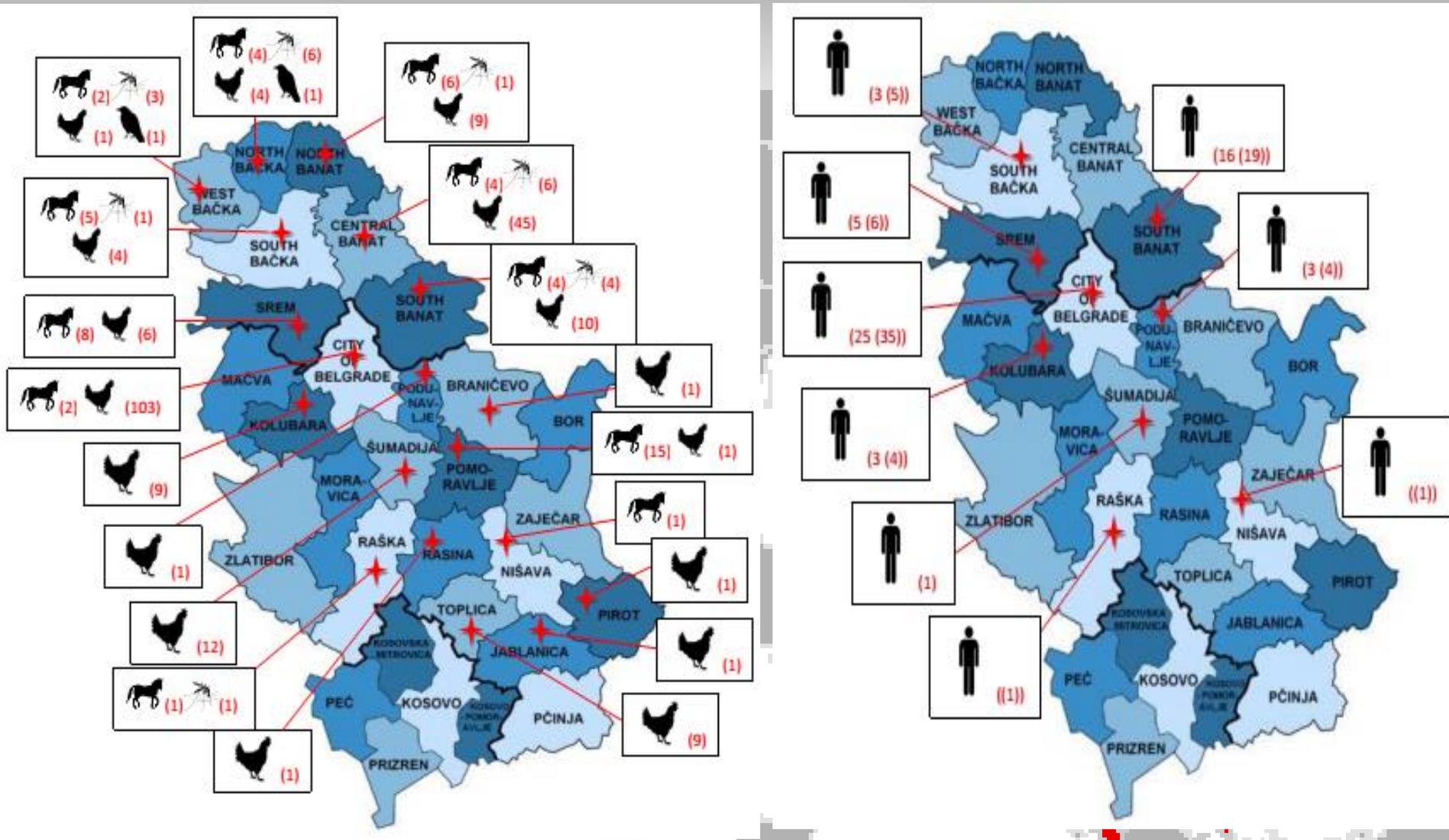
First positive findings in WNV surveillance and first positive human WNND cases in 2014

Region - District	Sentinel horses-blood sera for anti-WNV IgG Ab			Sentinel chicken-blood sera for anti-WNV IgG Ab			Mosquitoes (Culex pipiens)			Wild birds (tissues and tracheal swabs)			Human cases*	
	Tested	Positive	First pos. reported	Tested	Positive	First pos. reported	Tested pools	Positive pools	First pos. reported	Tested	Positive	First pos. reported	First case reported	Total No cases
Bor	66	0		120	0		15	0		0	-	-	-	-
Zaječar	125	0		120	0		20	0		0	-	-	-	-
Podunavlje	45	0		250	1	11/06	70	0		80	0	-	29/08	3 (4)
Braničevo	60	0		250	1	15/06	70	0		65	0	-	-	-
Šumadija	39	0		90	12	25/08	20	0		0	-	-	02/10	1
Pomoravlje	66	15	26/08	90	1	25/08	30	0		98	0	-	-	-
South Banat	122	4	29/07	220	10	04/07	75	4	30/07	6	0	-	29/08	16 (19)
Kolubara	12	0		100	9	21/08	27	0		71	0	-	22/08	3 (4)
Mačva	83	0		95	0		42	0		55	0	-	-	-
Central Banat	100	4	17/07	255	46	15/06	70	6	16/07	23	0	-	-	-
Nišava	72	1	28/07	120	0		25	0		0	-	-	17/07	(1)
Pčinja	87	0		120	0		25	0		0	-	-	-	-
Pirot	90	0		120	1	24/07	25	0		0	-	-	-	-
Jablanica	88	0		115	1	24/07	25	0		0	-	-	-	-
Toplica	72	0		110	9	12/07	25	0		0	-	-	-	-
West Bačka	110	2	23/08	140	1	23/08	23	3	04/09	21	1	21/09	-	-
North Banat	71	6	21/08	88	9	26/08	25	1	04/09	9	0	-	-	-
North Bačka	118	4	30/08	194	4	28/08	82	6	16/07	20	1	29/07	-	-
South Bačka	130	5	21/07	262	4	08/08	64	1	30/07	22	0	-	17/07	3 (5)
Srem	95	8	15/07	201	6	29/07	68	0	16/07	13	0	-	22/08	5 (6)
Rasina	81	0		104	1	05/07	30	0		100	0	-	-	-
Raška	87	1	20/07	89	0		30	1	30/08	70	0	-	10/09	(1)
Moravica	86	0		112	0		25	0		127	0	-	-	-
Zlatibor	68	0		70	0		25	0		0	-	-	-	-
City of Belgrade	47	2	NN**/07	270	103	NN**/06	59	0		88	0	-	17/07	25 (35)
25	2020	52		3705	225		995	22		868	2			55 (76)
%		2.57			6.07			2.21			0.23			

First positive findings in WNV surveillance and first positive human WNND cases in 2014
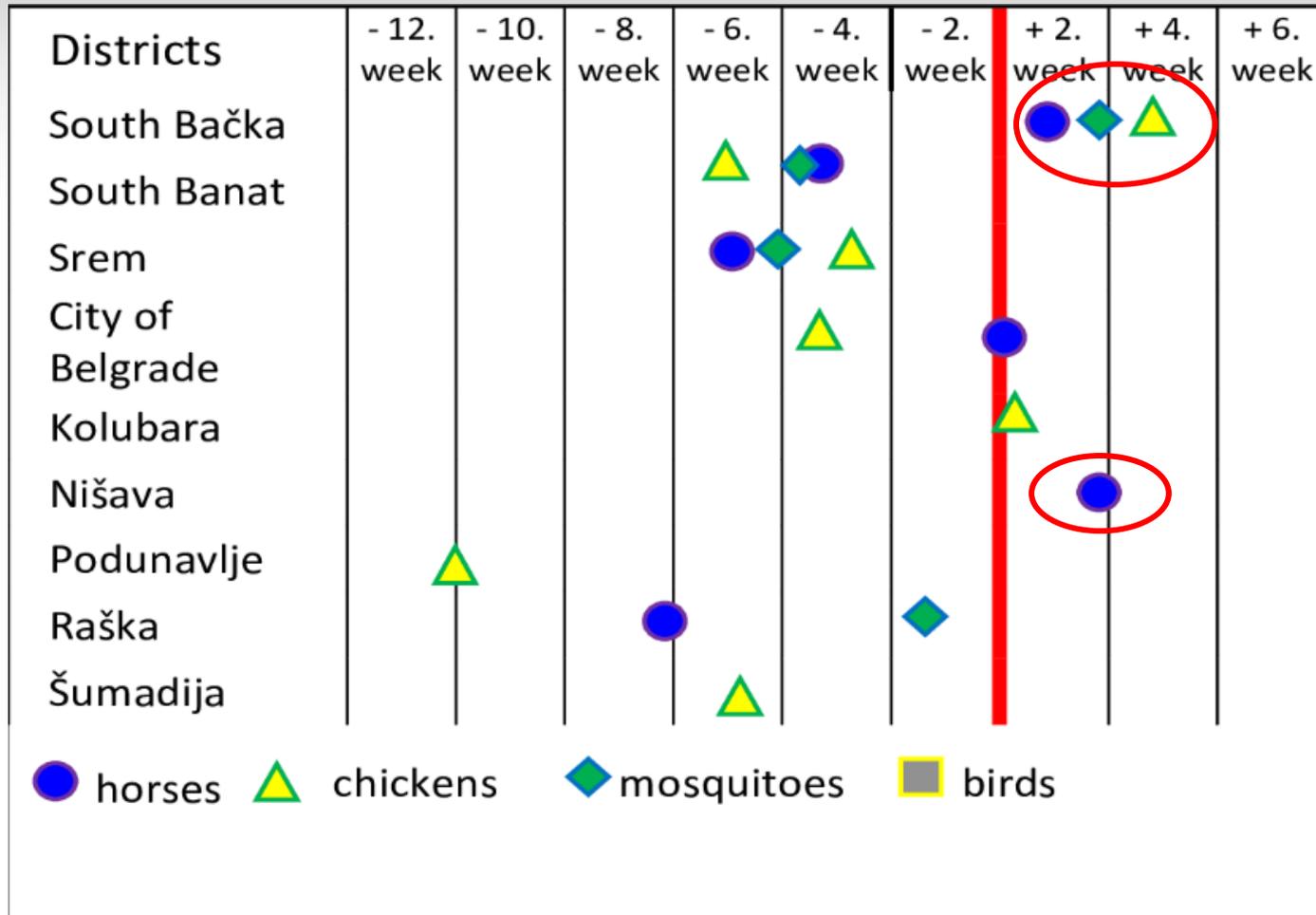
Problems with sentinel animals in WNV surveillance

➤ **Poultry (backyard chickens)**:

❖ **the best possible sentinel species for WNV surveillance** (highly susceptible (birds); ornithophilic mosquitoes (*Cx. pipiens*) are virus vectors; very well distributed in the field)

❖ only poultry hacked after the previous vector season could be used as sentinels (mostly the young ones hatched in the early spring of the year of surveillance.

❖ **at summer and autumn, the young animals can not be recognized from the older poultry in the backyards** (if were not marked);

❖ **vets are not interested in sampling** (do not like to run after the poultry in backyards during sampling & the price for sampling is low)

❖ **animals are usually not marked (read never)**, and it is almost impossible to follow them; backyard poultry

❖ **blood samples** are rarely or never collecting for any of state monitoring programs, so **could not be used from sampling done for other purposes**.

❖ the consequence – **samples collection is problematic** and **high number of false positive results exists due to the sampling of older birds**
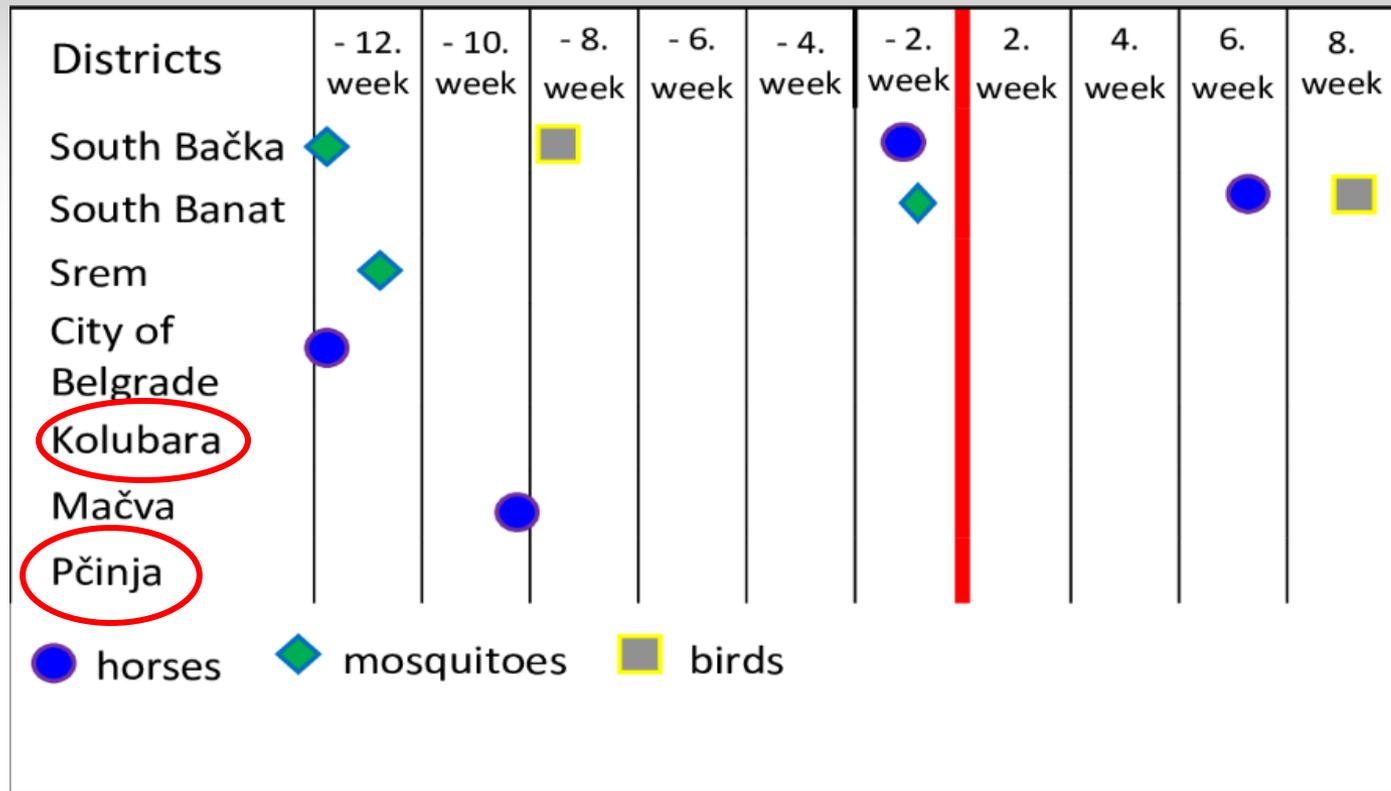
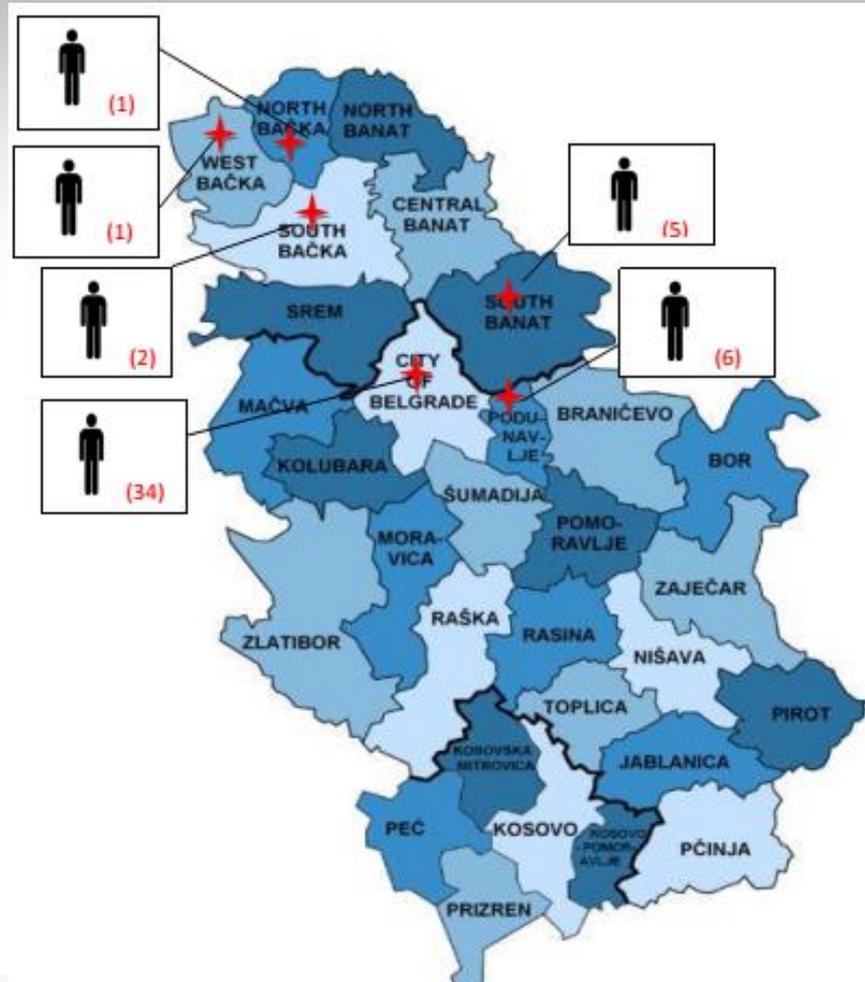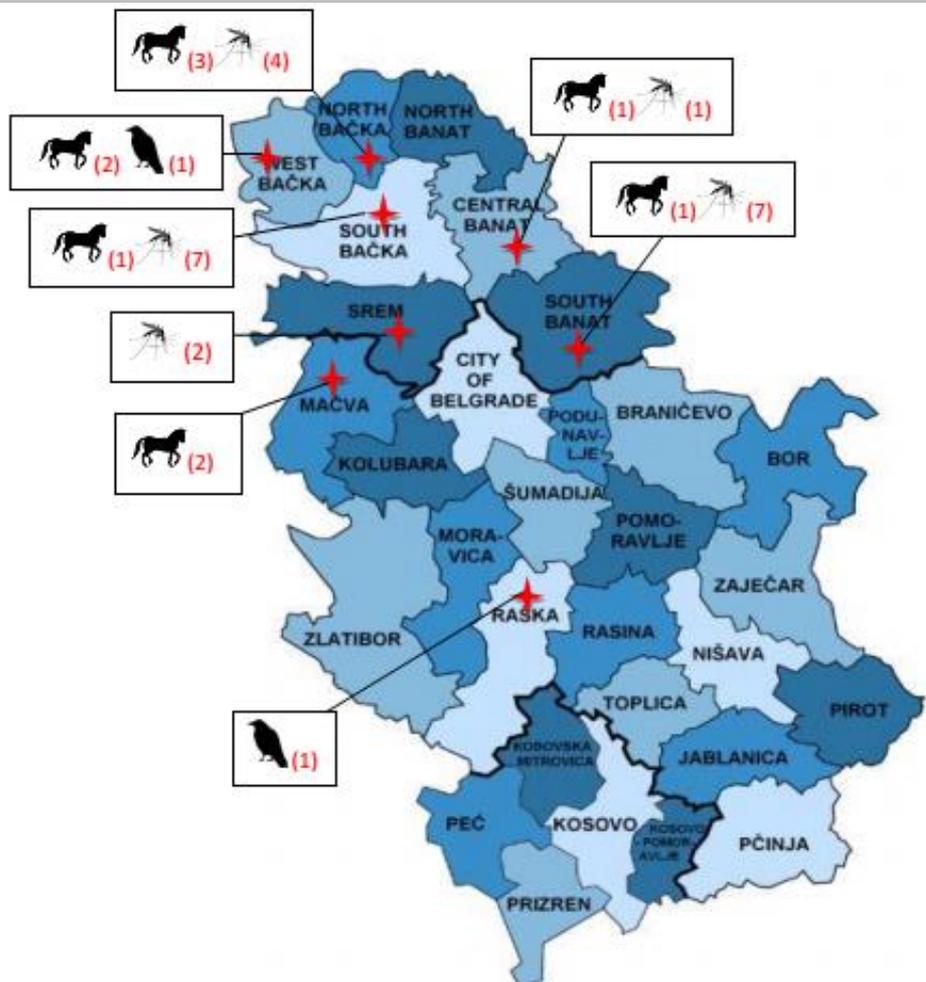# Comparison of WNV positive samples in surveillance and human cases of WNND in 2015
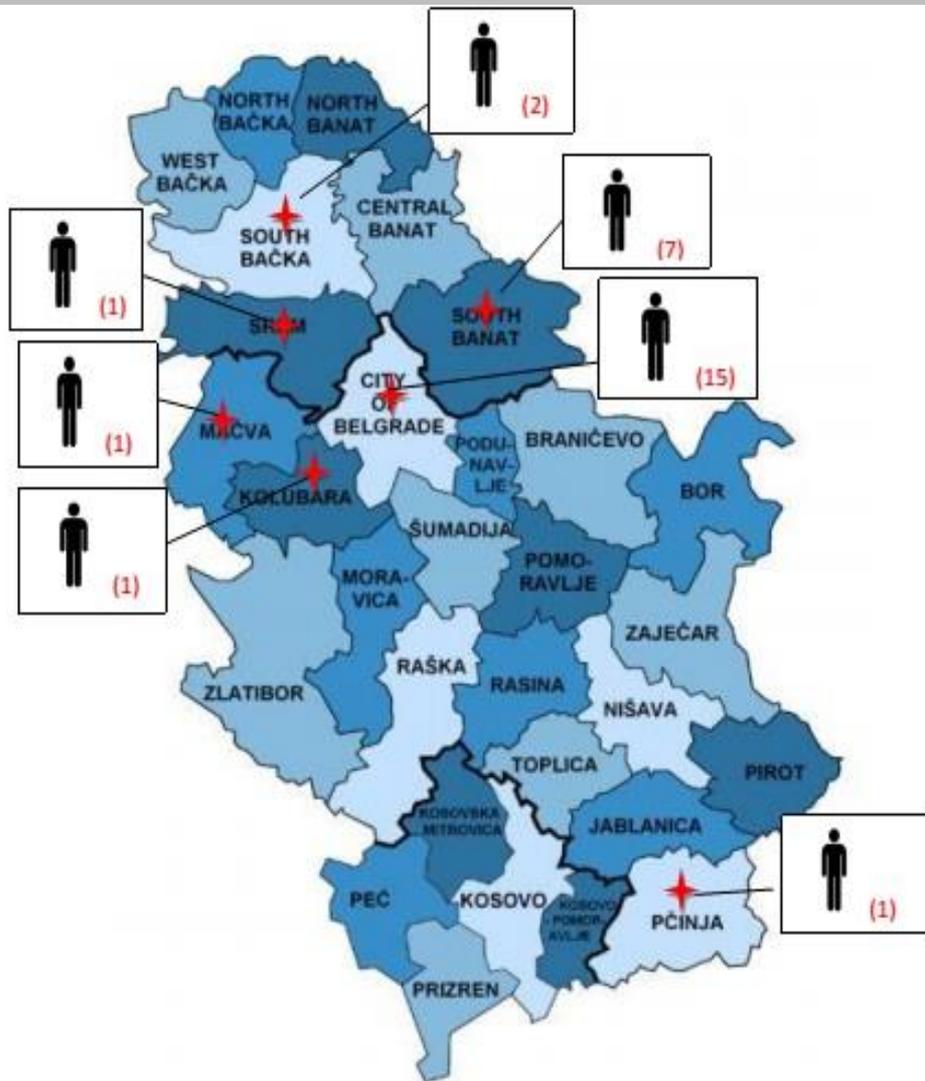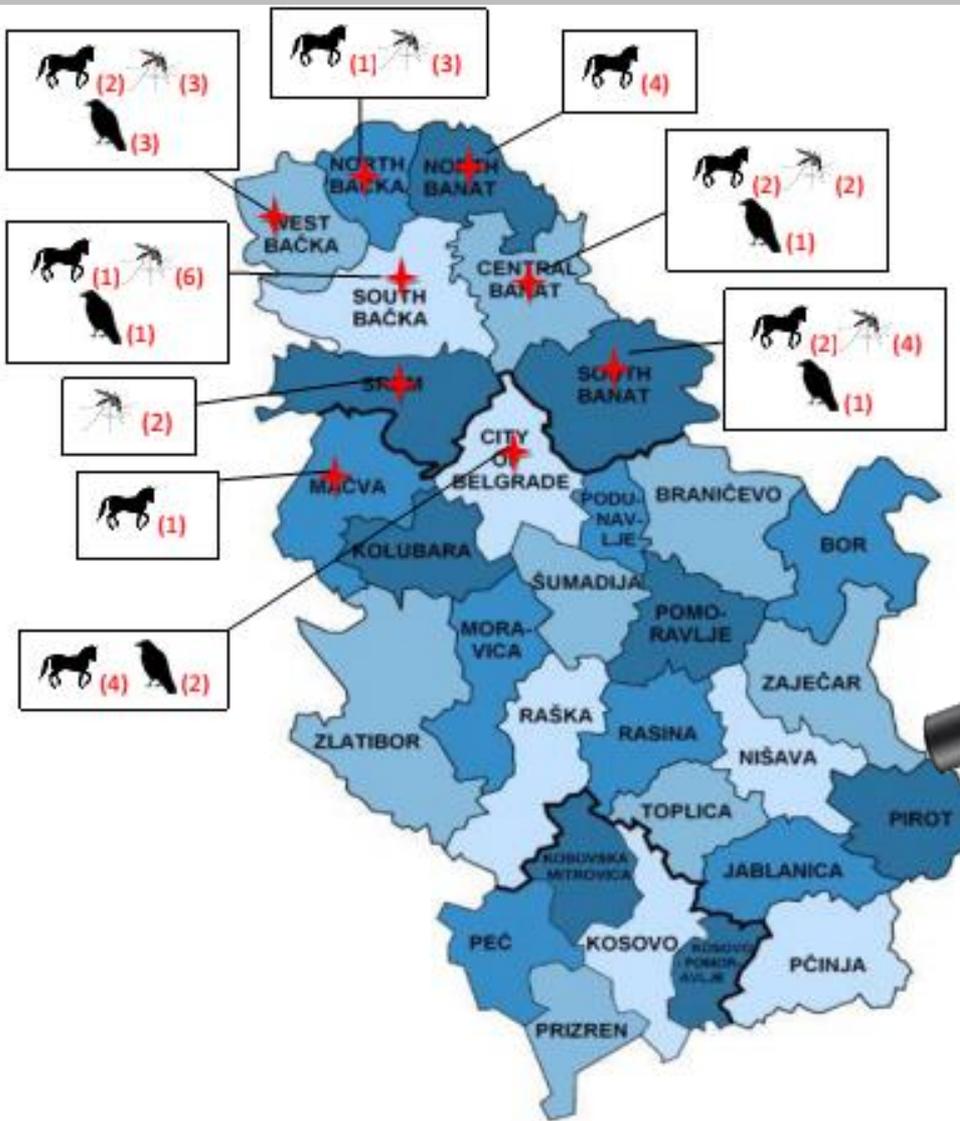
First positive findings in WNV surveillance and first positive human WNND cases in 2015

Region - District	Horses-blood sera for anti-WNV IgM Ab			Mosquitoes (Culex pipiens)			Wild birds (tissues and tracheal swabs)			Human cases*	
	Tested	Positive	First pos. reported	Tested pools	Positive pools	First pos. pool rep.	Tested	Positive	First pos. reported	First case reported	Total No cases
Bor	108	0		20	0		0	0			
Zaječar	102	0		20	0		1	0			
Podunavlje	97	0		70	0		82	0			
Braničevo	84	0		25	0		0	0			
Šumadija	135	0		70	0		107	0			
Pomoravlje	118	0		20	0		3	0			
South Banat	198	2	28/09	71	4	04/08	17	1	08/10	10/08	7
Kolubara	148	0		15	0		200	0		02/11	1
Mačva	87	1	09/09	9	0		53	0		02/11	1
Central Banat	189	2	28/07	70	2	10/08	1	1	20/09		
Nišava	120	0		20	0		0	0			
Pčinja	120	0		19	0		0	0		05/10	1
Pirot	120	0		20	0		0	0			
Jablanica	120	0		20	0		0	0			
Toplica	120	0		20	0		0	0			
West Bačka	234	2	28/08	68	3	30/08	18	3	23/08		
North Banat	120	4	25/08	22	0		5	0			
North Bačka	160	1	27/08	71	3	10/08	11	0			
South Bačka	186	1	28/09	69	6	13/06	8	1	14/08	05/10	2
Srem	140	0		67	2	21/07	11	0		05/10	1
Rasina	75	0		20	0		0	0			
Raška	91	0		70	0		110	0			
Moravica	123	0		20	0		0	0			
Zlatibor	102	0		20	0		0	0			
City of Belgrade	141	4	NN**/06	40	0		93	2	NN**/10	14/09	15
25	3238	17		956	20		720	8			28
%		0.53			2.09			1.11			

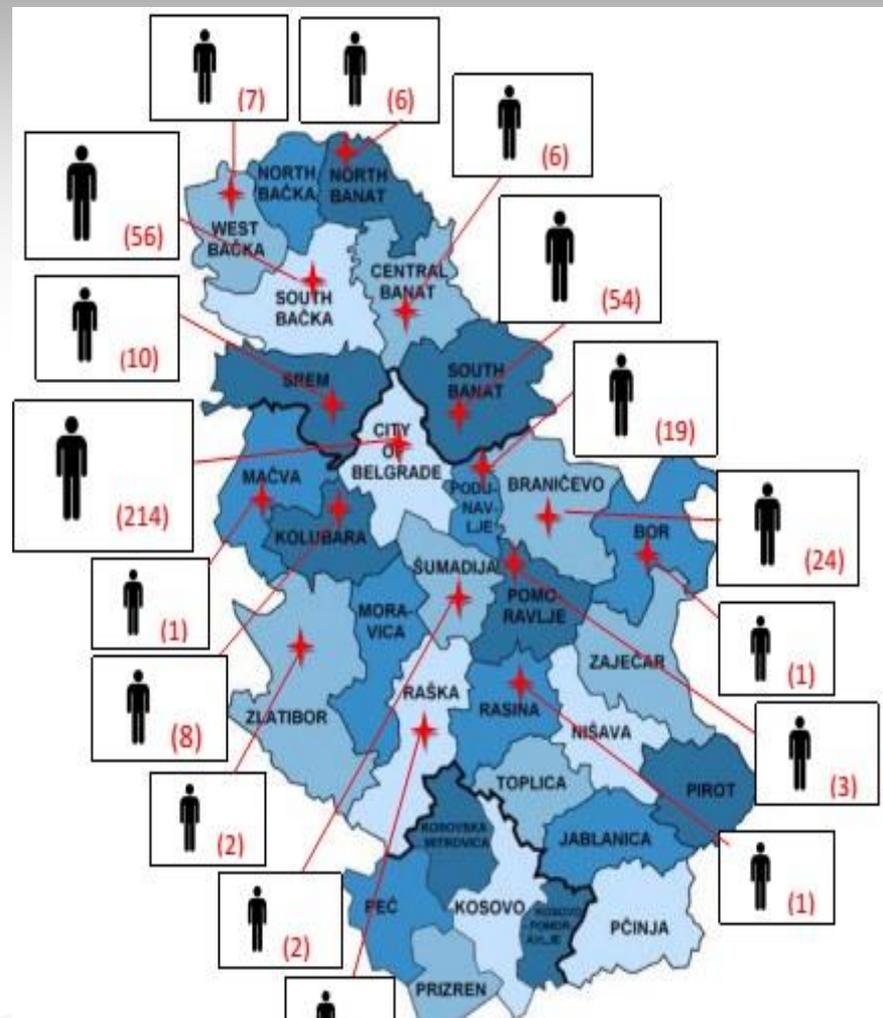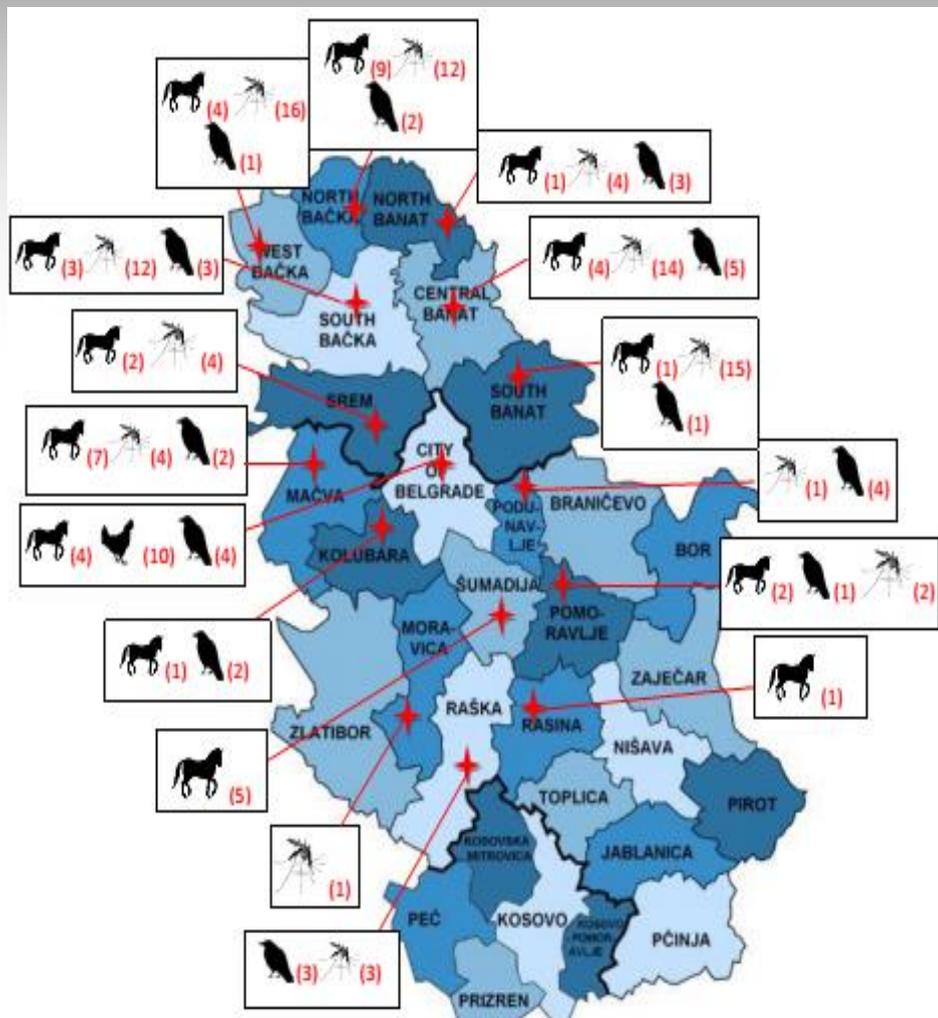# First positive findings in WNV surveillance and first positive human WNND cases in 2015

Comparison of WNV positive samples in surveillance and human WNND cases in 2017

Horses **6 (0.24%)+**/2495; wild birds **2 (0.52%)+**/388 and mosquitoes **22 (2.63%)+**/837 tested

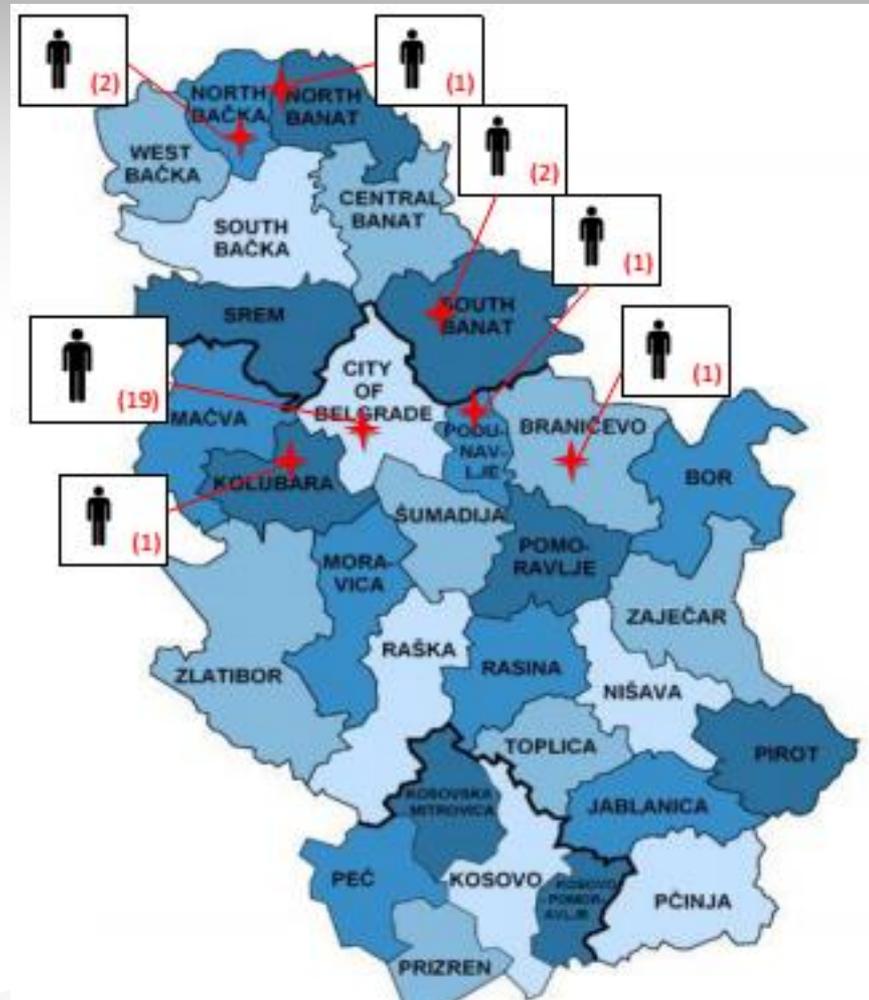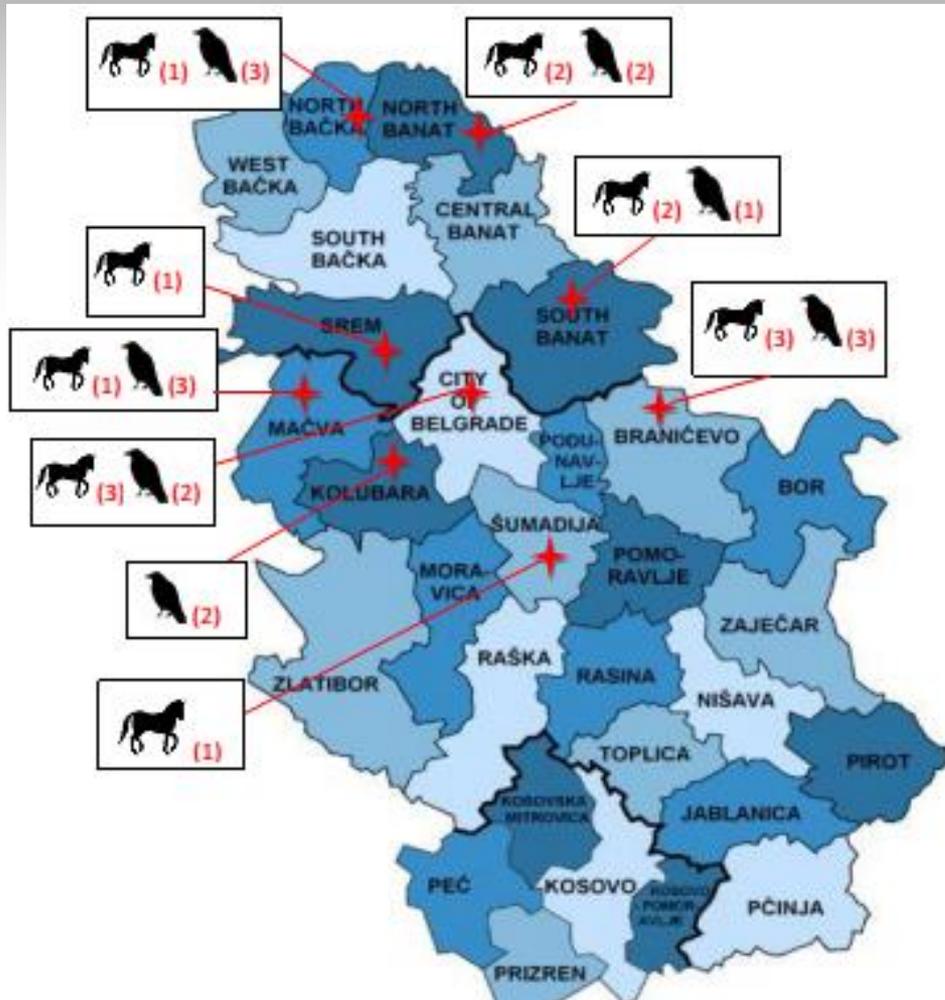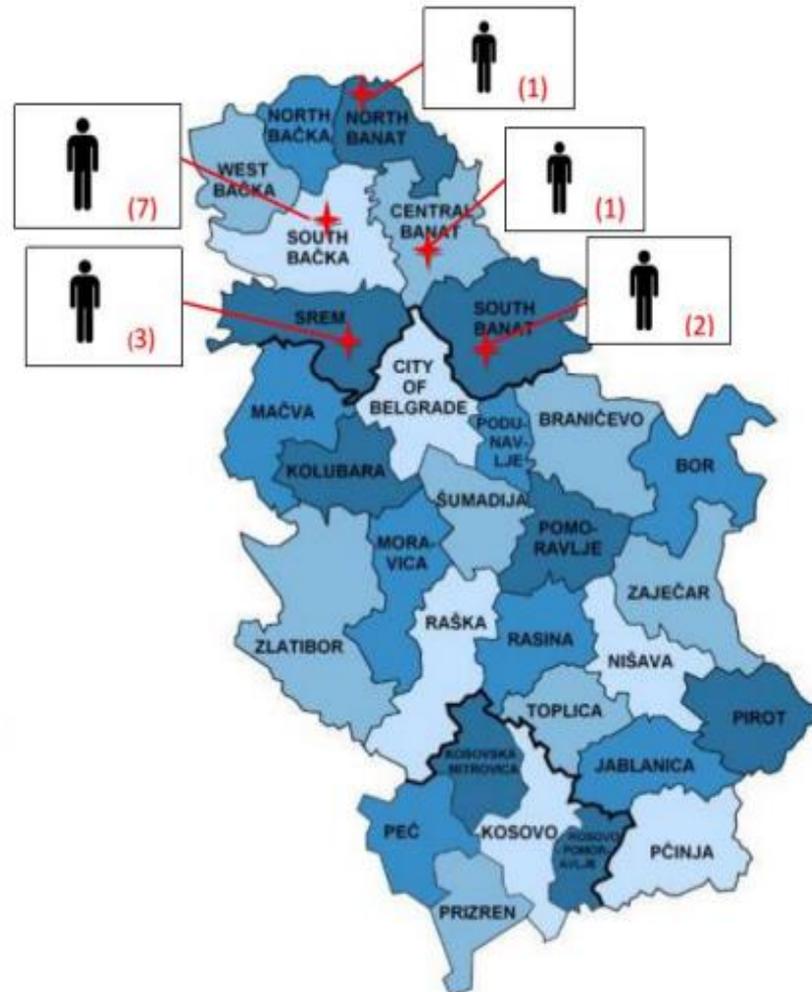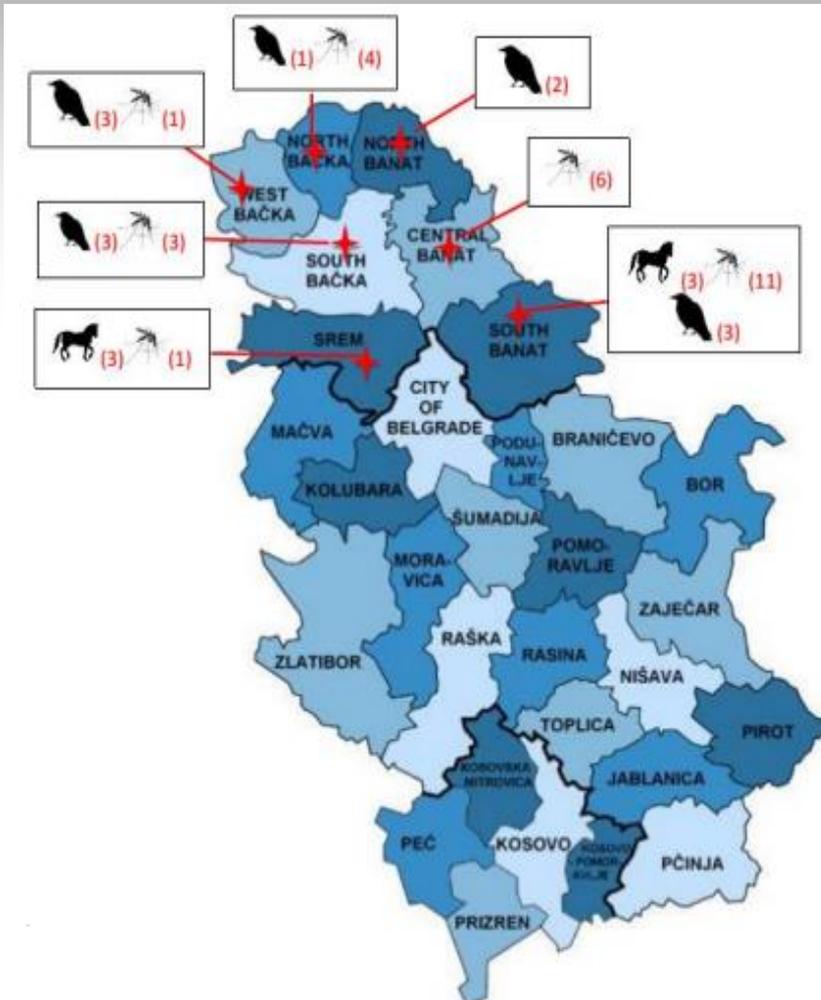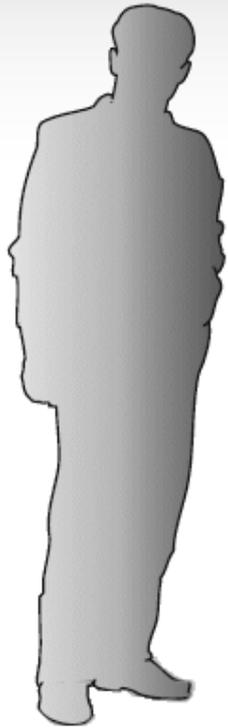**49 human WNND cases reported**, from 6 districts; **2 lethal cases**

Comparison of WNV positive samples in surveillance and human WNND cases in 2018

Horses **44 (1.75%)+**/2511; wild birds **31 (8.49%)+**/365 and mosquitoes **98 (12.21%)+**/802 tested

415 human WNND cases reported, from 17 districts; **36 lethal cases**

Comparison of WNV positive samples in surveillance and human WNND cases in 2019

Horses **10 (0.4%)+**/2464; wild birds **16 (2.87%)+**/557
Mosquitoes were not tested

27 human WNND cases reported, from 7 districts; **1 lethal case**

Comparison of WNV positive samples in surveillance and human cases of WND in 2021

Horses 7 (0.51%)+/1375; wild birds 44 (12.68%)+/347 and mosquitoes 54 (8.7%)+/618 tested

18 human WNND cases reported, from 6 districts; 3 lethal cases

Problems with sentinel animals in WNV surveillance

➢ **Horses**

❖ **excellent sentinel species for WNV surveillance** (highly susceptible (rare mammal species that show clinical disease); responds to infection with synthesis of IgM antibodies – sensitive and specific diagnostic test exists (ELISA); already proven as a good sentinels for WNV surveillance in many countries)

❖ only seronegative animals could be used as sentinels for surveillance (previous contact with the virus and presence of IgG antibodies in blood masks the acute infection and synthesis of IgM antibodies).

❖ **small number of horses and not well distributed in the field**

❖ **most of the horses are pets or expensive sport animals for racing – owners doesn't wish to allow sampling,** especially periodic ones during 4 to 6 months...

❖ **in the endemic areas most of the horses have already been in contact with the virus (already seropositive)** and can not be used as sentinels in the program

❖ the consequence – **not enough available / usable animals for the establishment of sensitive surveillance**

Problems with sentinel animals in WNV surveillance

➤ **What is the possible solution** – what animal species could be used as sentinels in WNV surveillance program if the backyard poultry and horses are not available / usable for different reasons?

➤ **Possibilities: pigs, wild boars, sheep, dogs, cattle, other animal species...?**

❖ **the animals have to be suspectable and to develop specific antibodies** after contact (infection) with the WNV;

❖ **blood sampling need to be easy, and the animals have to be widely distributed in the area**;

❖ If possible, **the chosen animals should be of those used for commercial purposes** (not pets and expensive animals), **so the animals are easily assessable for sampling and the animal owners not opposed from sampling**;

❖ If possible, **the chosen animals has to be marked – in the vet monitoring system;**

❖ if possible, **blood samples from the chosen animal species are usually collected for other state monitoring programs**, so could be used as already existing samples in the vet labs....

Problems with sentinel animals in WNV surveillance

➢ **Young cattle (calves 6 – 8 month of age):**

❖ **good (acceptable) sentinel species for WNV surveillance**

 ✓ **susceptible for WNV infection;**

 ✓ **responds to infection with synthesis of specific antibodies – sensitive and specific diagnostic test exists (ELISA);**

 ✓ **animals marked (in vet monitoring system) and very well distributed in the field;**

 ✓ **often already sampled for other state monitoring programs (available in the labs)**

❖ **detection of specific antibodies for WNV** **was confirmed by literature data**

❖ **one PhD study and one pilot experiment, dedicated to testing cattle** (the cows + pregnant cows (≈ 150) + their newborn calves + monthly testing of those calves up to 6 month of age), on at least 20 farms of different capacity and locations, **were conducted in 2020 and 2021 seasons at the area of 2 districts** (one of high and another of lower risk for WNV infection;

❖ **cattle develop detectable level of specific anti-WNV antibodies after natural WNV infection** (often in high titer). Those **antibodies persists a longer period of time** (more than a year, depending on initial level – titer).

Problems with sentinel animals in WNV surveillance

➢ **Young cattle (calves 6 – 8 month of age):**

    ❖ **good (acceptable) sentinel species for WNV surveillance**

        ✓ **susceptible for WNV infection;**

        ✓ **responds to infection with synthesis of specific antibodies – sensitive and specific diagnostic test exists (ELISA);**

        ✓ **animals marked (in vet monitoring system) and very well distributed in the field;**

        ✓ **often already sampled for other state monitoring programs (available in the labs)**

    ❖ **cows transfer WNV antibodies by colostrum to newborn calves**.

    ❖ **WNV maternal antibodies in calves persists** depending on the initial level in colostrum / in the blood of mother cow), but maximum **up to 100 days of life** (confirmed in more than 25 calves)

    ❖ **the conclusion – presence (detection) of IgG antibodies** (since commercial diagnostic tests (ELISA) for detection of those antibodies are present on the market) **in young animals of 6 to 8 month of age, that were borne after the previous vector season, directly points on acute WNV infection and present the evidence for WNV circulation in environment at that specific time and location/area;**

Problems with sentinel animals in WNV surveillance

➢ **Young cattle (calves 6 – 8 month of age):**

  ❖ **good (acceptable) sentinel species for WNV surveillance**

  ✓ **susceptible for WNV infection;**

  ✓ **responds to infection with synthesis of specific antibodies – sensitive and specific diagnostic test exists (ELISA);**

  ✓ **animals marked (in vet monitoring system) and very well distributed in the field;**

  ✓ **often already sampled for other state monitoring programs (available in the labs)**

  ❖ **the conclusion – cattle as animal species can be used as sentinels in WNV surveillance programs**

  ❖ **the conclusion – only young cattle borne after the previous vector season could be used as sentinels** (mostly the young calves born after November of the previous year)

  ❖ **the problems –** since the nature of infection and available diagnostic tests that are sensitive, but less specific (detect IgG antibodies to all other related flaviviruses), **the detected IgG antibodies in calves has to be confirmed by VNT or PRNT that are WNV specific** (and not for example USUTU or TBE virus specific)

Reported human WNND cases in Serbia during 2022 (Batut and ECDC)

➢ **226 human cases of West Nile disease**, **in 16 out of 25 Districts**.

➢ City of Belgrade **98** cases, Šumadija District **30,** South Banat **21**, South Bačka **16**, Srem **13**, Braničevo **13**, Podunavski **8**, Central Banat **7**, Kolubara **4**, Western Bačka **4,** Pomoravlje **4**, Mačva **3**, North Banat **2**, Zlatibor **1**, Moravica **1** and Rasina District **1** case.

➢ **12 cases** **resulted in lethal outcome**
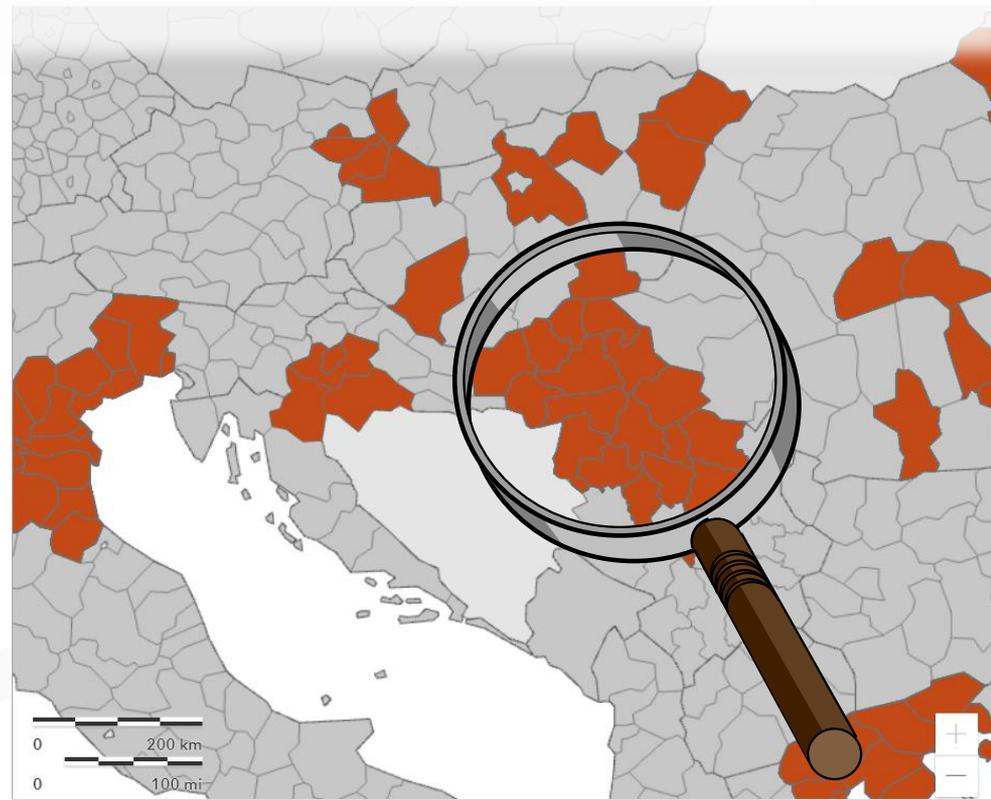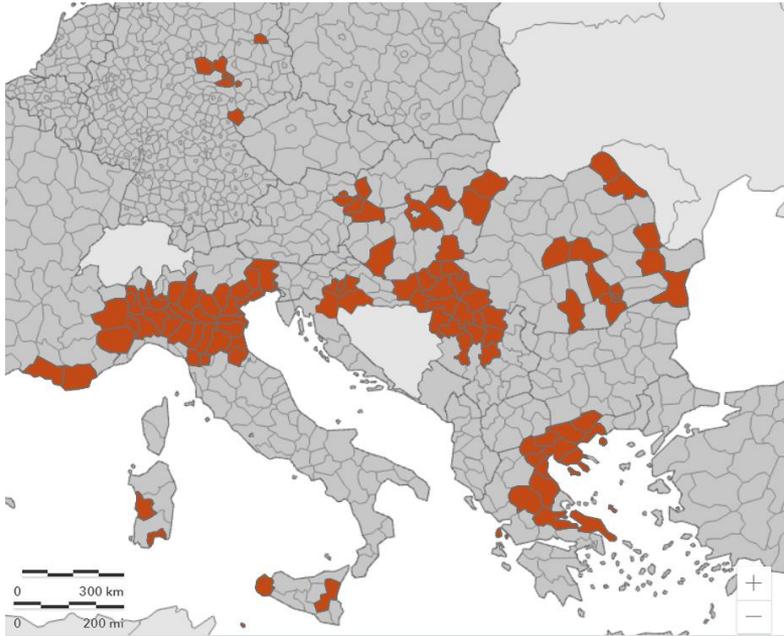
Comparison of WNV positive samples in surveillance and human cases of WNND in 2022
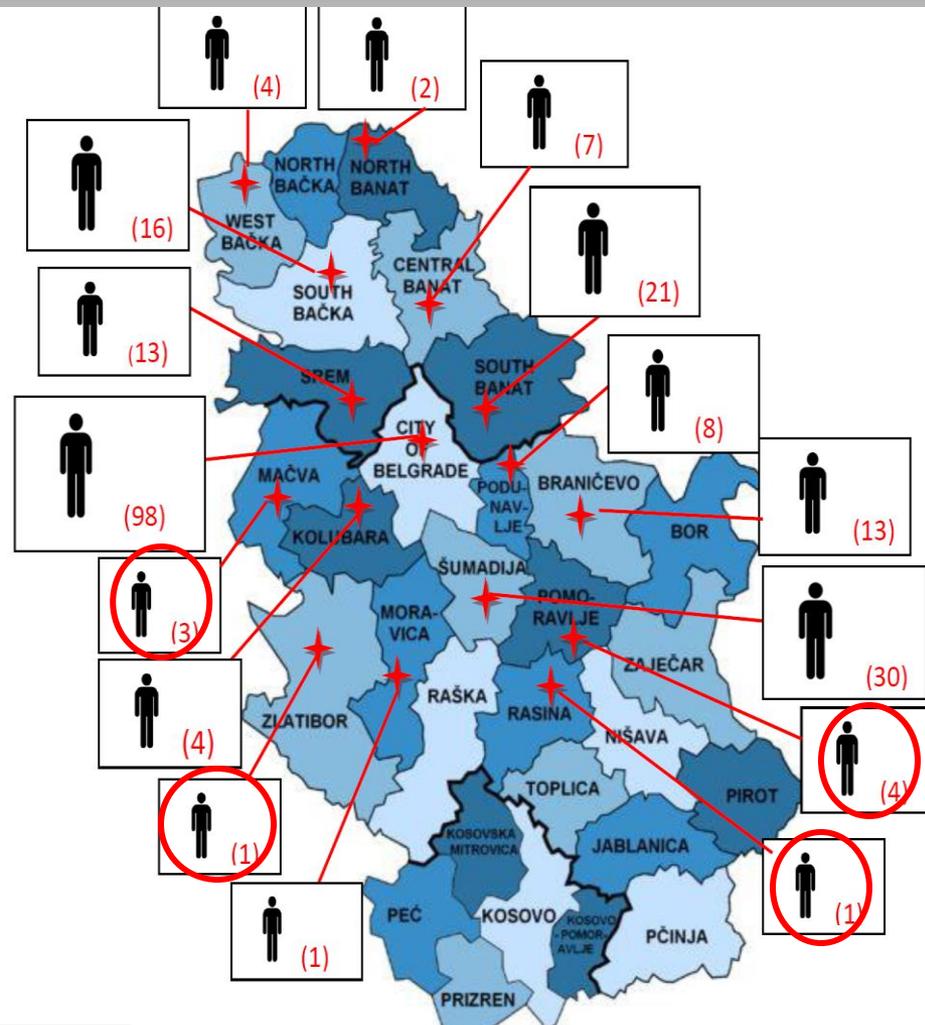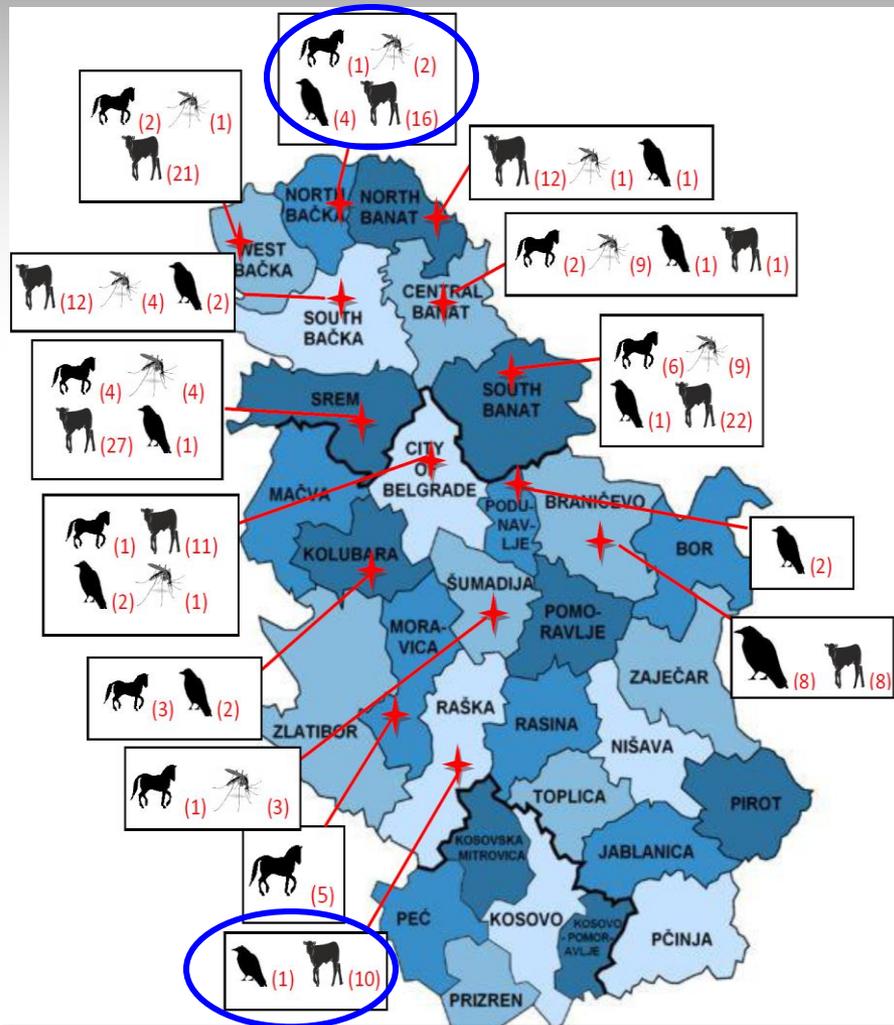
Horses **25 (1.3%)+**/1853; calves **140 (8.0%)+**/1740;
wild birds **25 (5.8%)+**/431 & mosquitoes **34 (4.3%)+**/792 tested

Detected WNV circul. in 14 (in 2, no H.C. det.) and failed in 4 districts

Comparison of WNV-Ab positive samples in surveillance and human cases of WNND in 2022
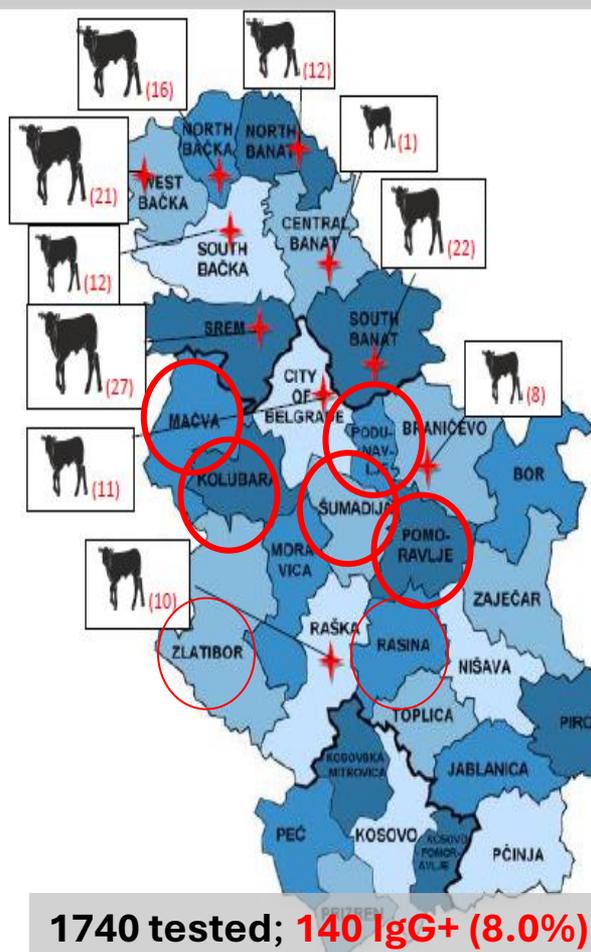
1740 tested; **140 IgG+ (8.0%)**
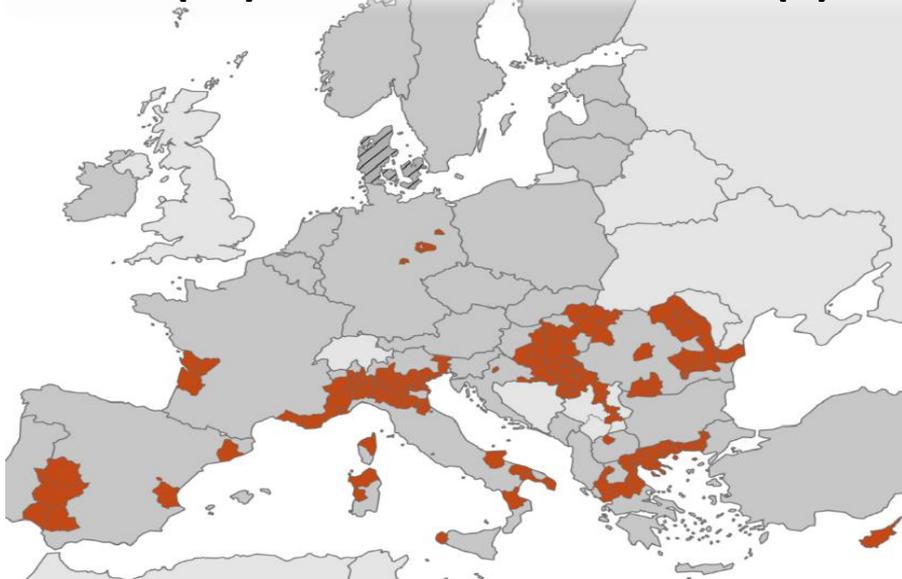
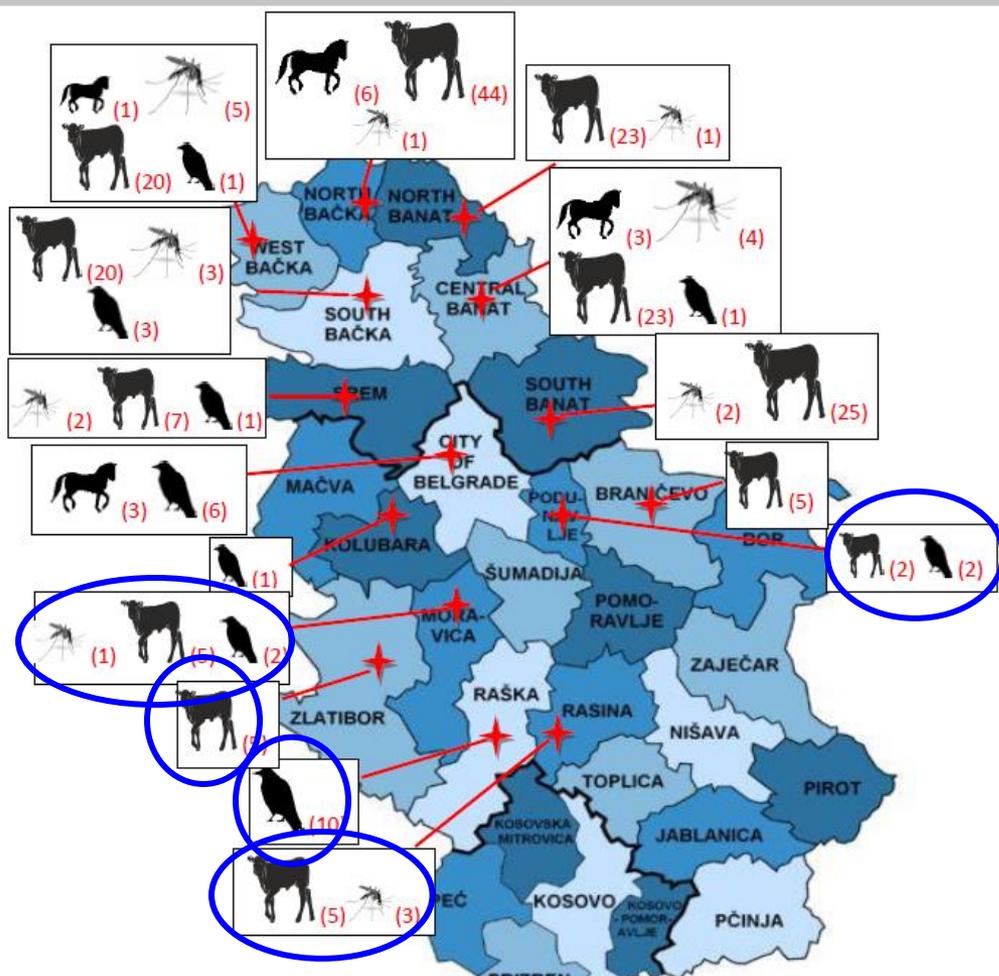**Detected WNV circul. in 10, and failed in 5 + 2 districts**
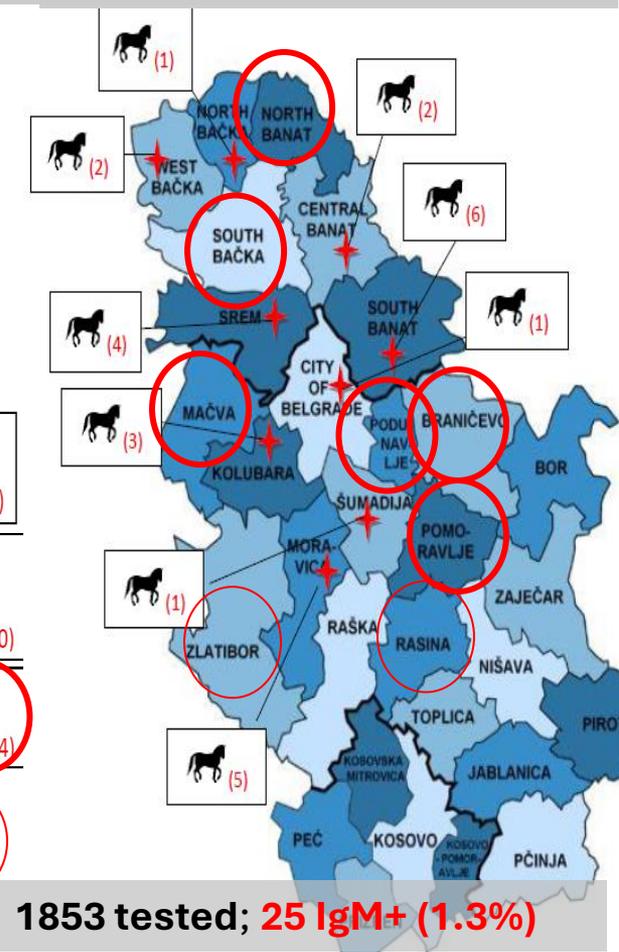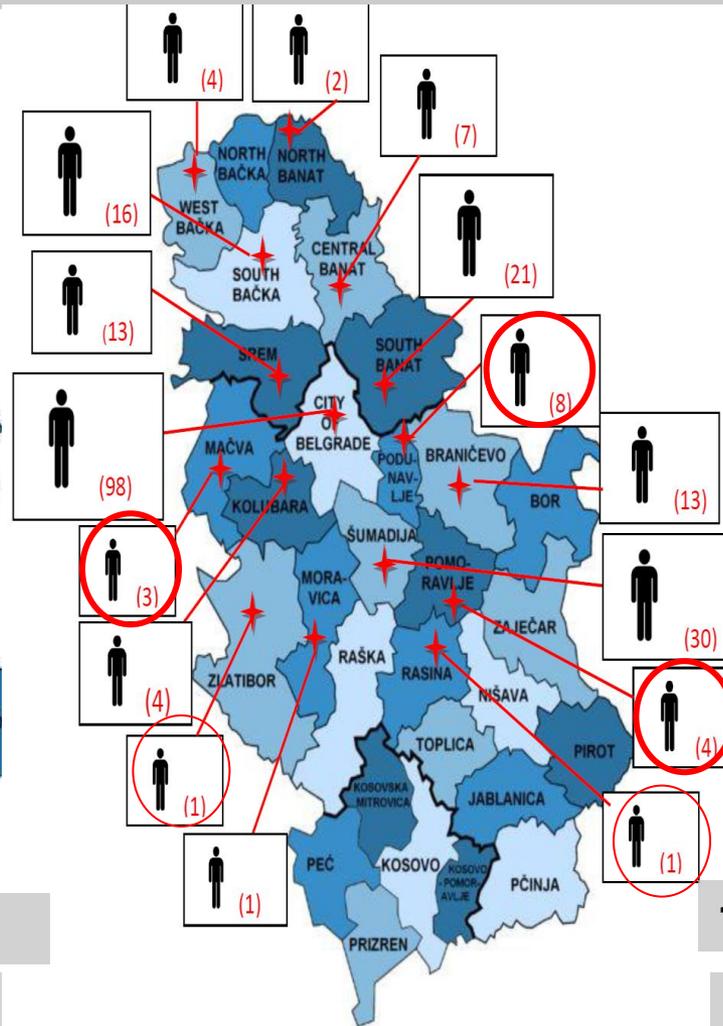
1853 tested; **25 IgM+ (1.3%)**

Detected WNV circulation in 9 and failed in 6 + 2 districts

Reported human WNND cases in Serbia during 2023 (Batut and ECDC)

➤ **90 human cases** of **West Nile neuroinvasive disease**, in **13** out of 25 Districts.

➤ City of Belgrade **23** cases, South Bačka District **24**, Srem **10**, West Bačka **9,** South Banat **6**, Central Banat **4**, Braničevo **3**, North Bačka **2**, North Banat **2,** Kolubara **2**, Mačva **2**, Pomoravlje **2** and Nišava District **1** case. **2 cases with lethal outcome**.

➤ Until January 4, 2024, EU/EEA countries have reported **728 human cases** of WNV infection in **Italy (336), Greece (162), Romania (103), France (43), Hungary (29), Spain (19), Croatia (6), Germany (4) and Cyprus (1).** **In total 47 deaths**

➤ EU-neighbouring countries have reported 91 human cases of WNV infection **in Serbia (90) and North Macedonia (1).**
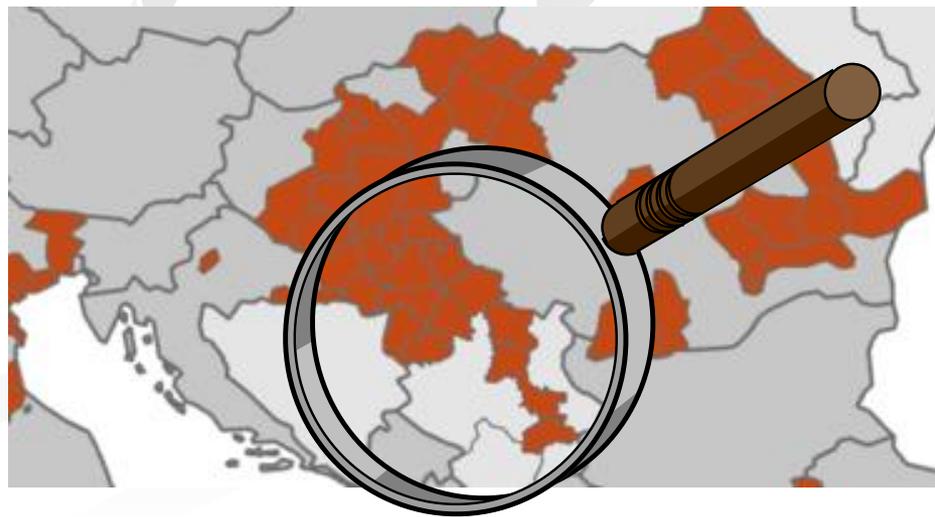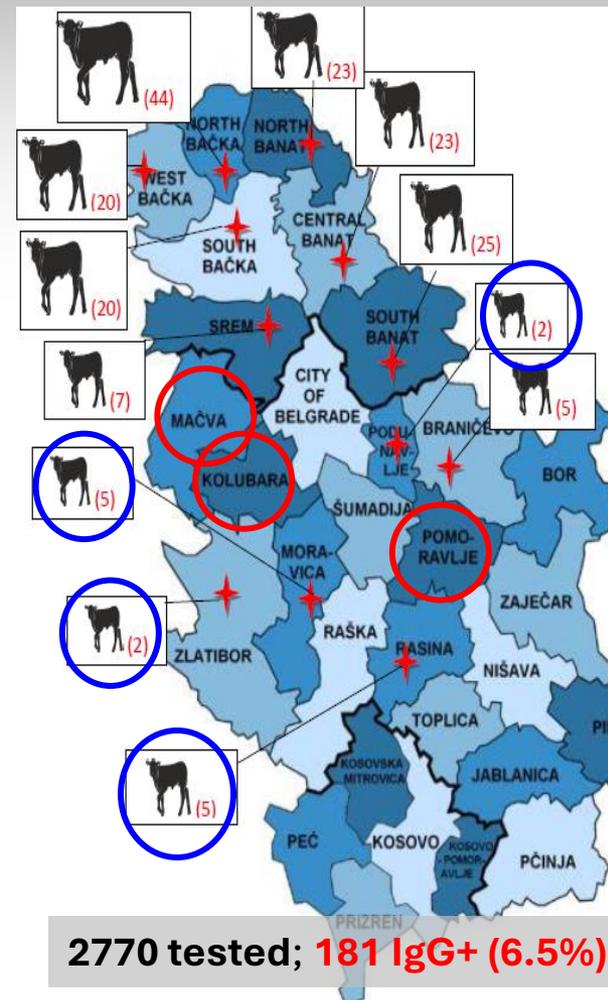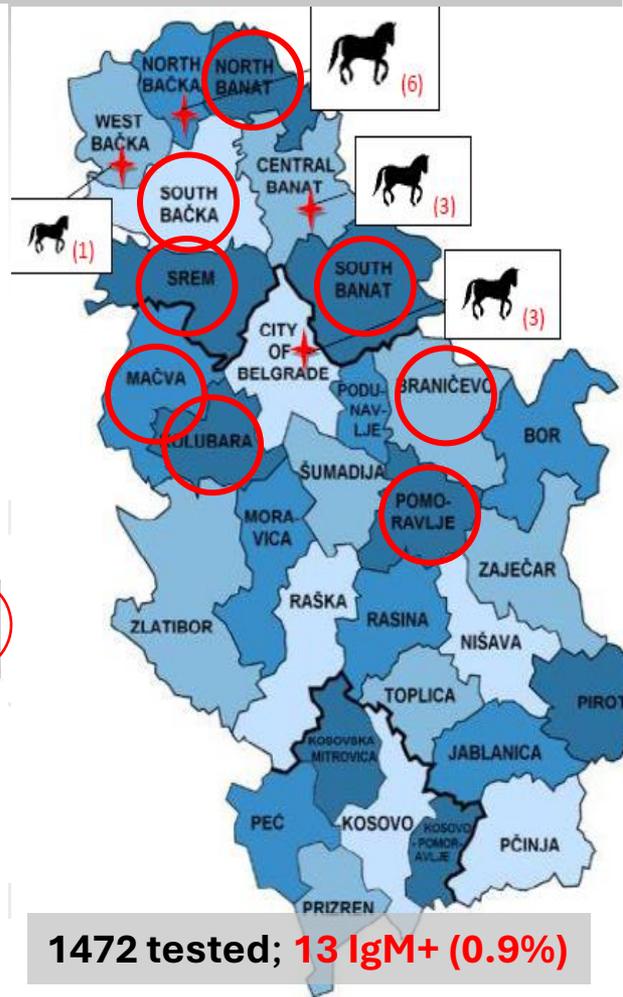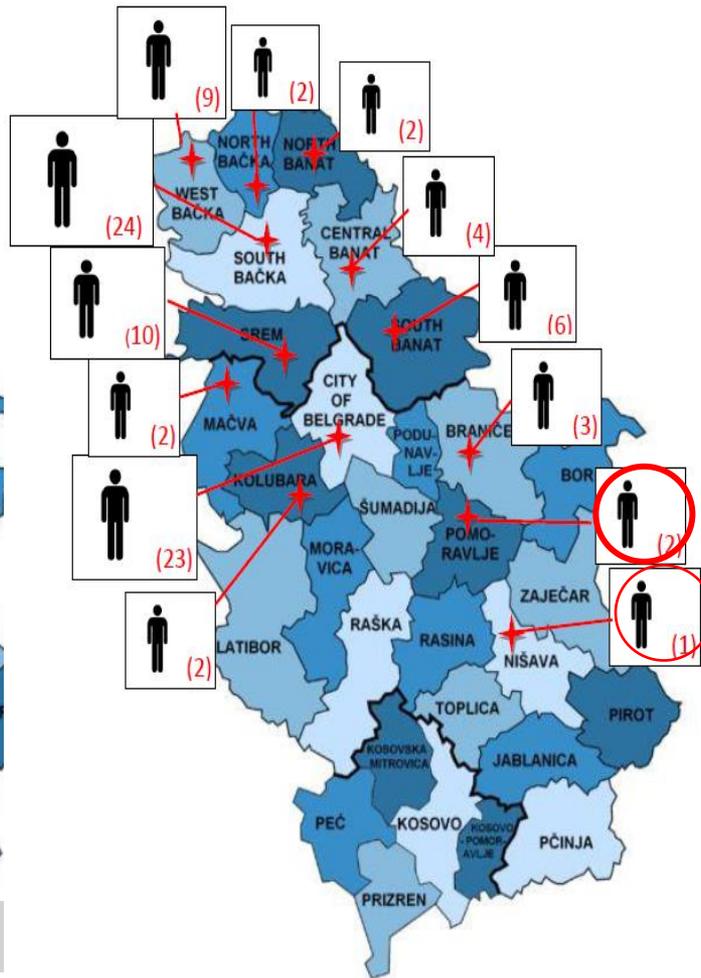
Comparison of WNV positive samples in surveillance and human cases of WNND in 2023
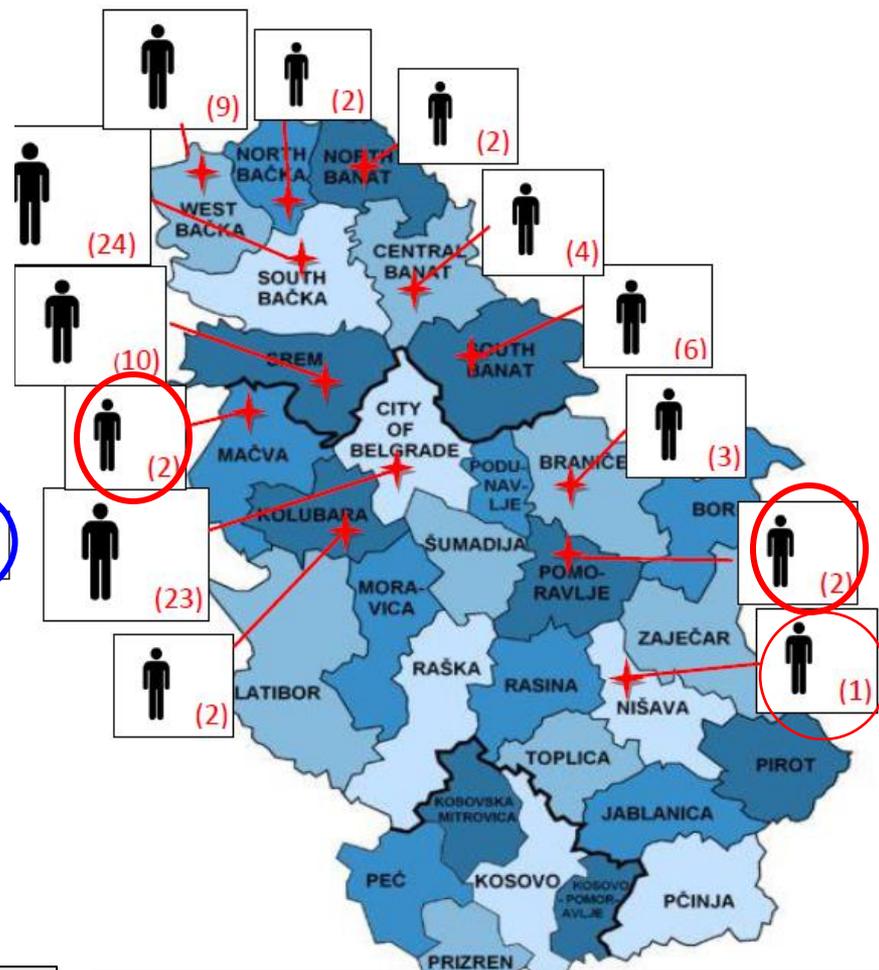
Horses **13+**/1472; calves **181+**/2770;
wild birds **26+**/523 & mosquitoes **22+**/827 tested

Detected WNV circul. in 15 (in 5, no H.C. det.)
and failed in 3 districts

2770 tested; 181 IgG+ (6.5%)

Detected WNV circul. in 12 (in 4, no H.C. det.) and failed in 3 districts

**1472 tested; 13 IgM+ (0.9%)**

Detected WNV circulation in 4 and failed in 8 districts

# Reported human cases of WNV infection in Serbia during 2024 (Batut and ECDC)

➢ **63 human cases** of **West Nile neuroinvasive disease**, **in 14 out of 25 Districts**.

➢ City of Belgrade **21** cases, South Bačka **9**, South Banat **5**, Podunavski **5**, Šumadija District **4,** Mačva **4**, Central Banat **3**, Srem **3**, Western Bačka **2,** North Backa **2**, North Banat **2**, Braničevo **1**, Pomoravlje **1**, and Raška District **1** case.

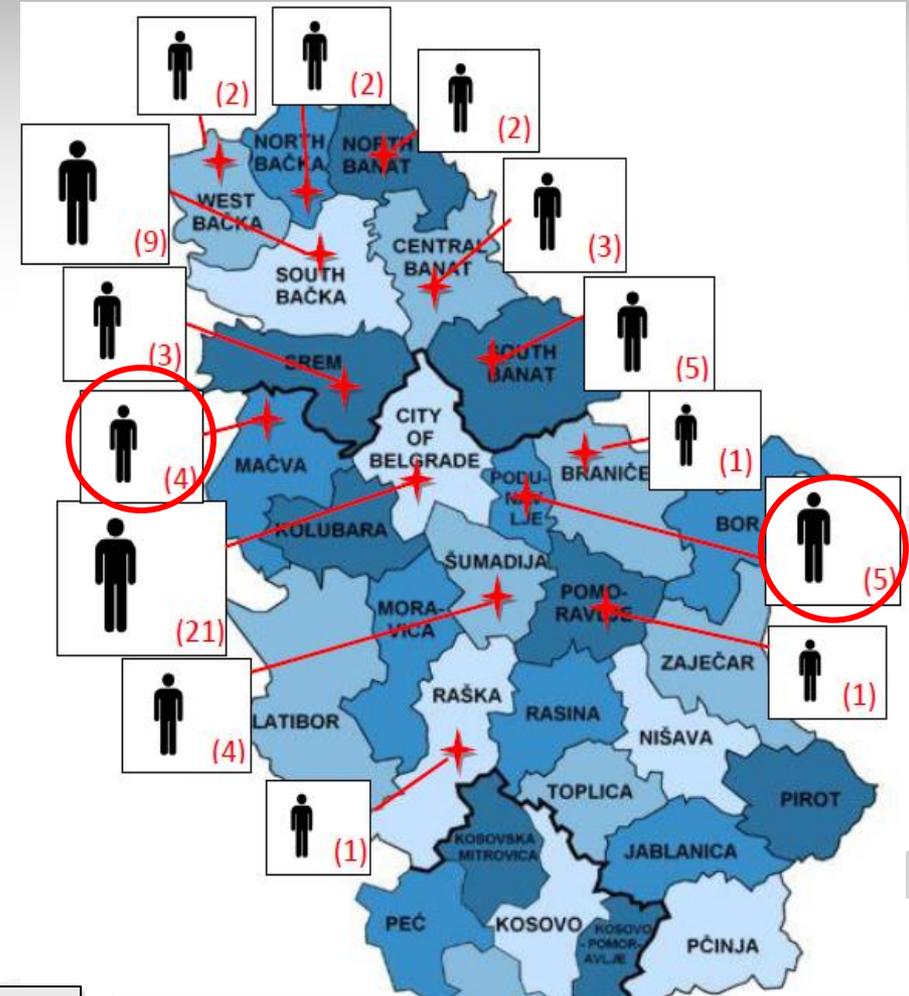➢ **5 cases** resulted in lethal outcome

Legend (as of 04 December 2024)

Total number of human cases

- 1 - 10
- 11 - 20
- >20
- No infections reported
- Not included
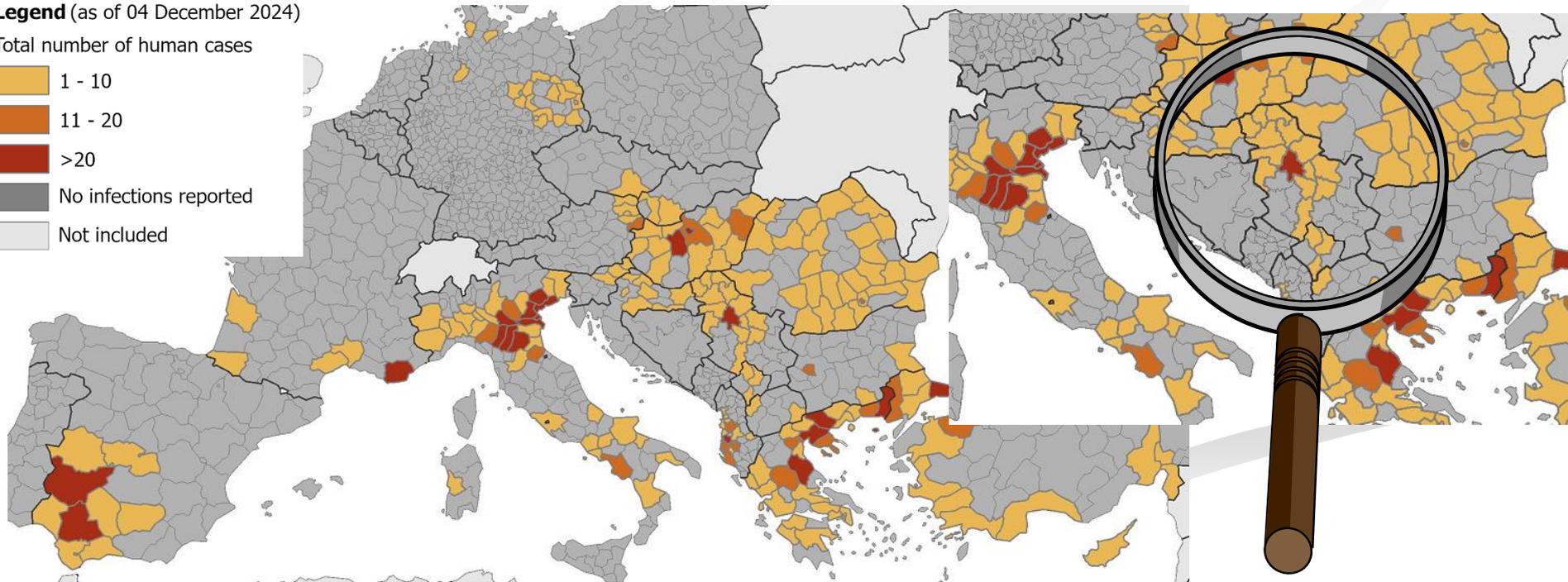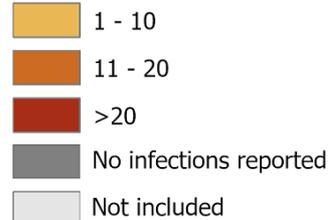
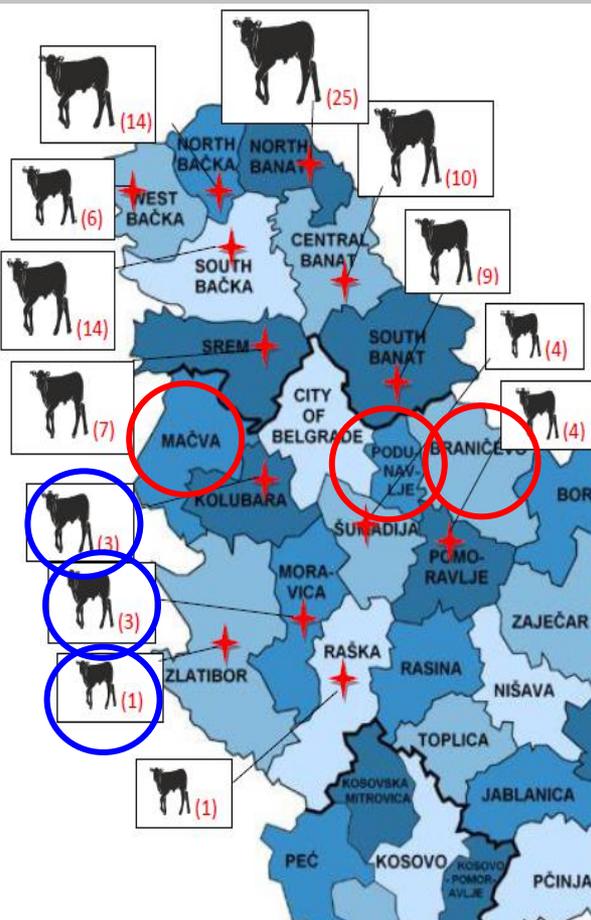# Comparison of WNV positive samples in surveillance and human cases of WNND in 2024
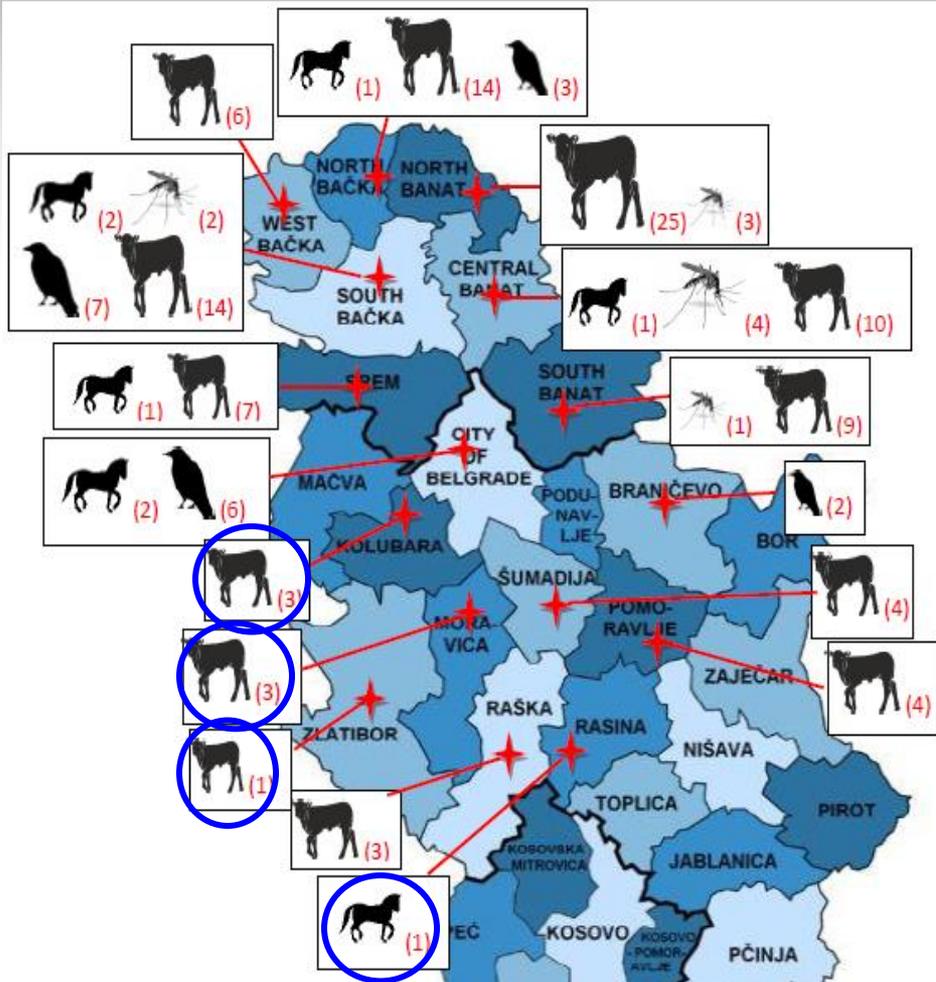
Horses 9+/1113; calves 103+/2288;
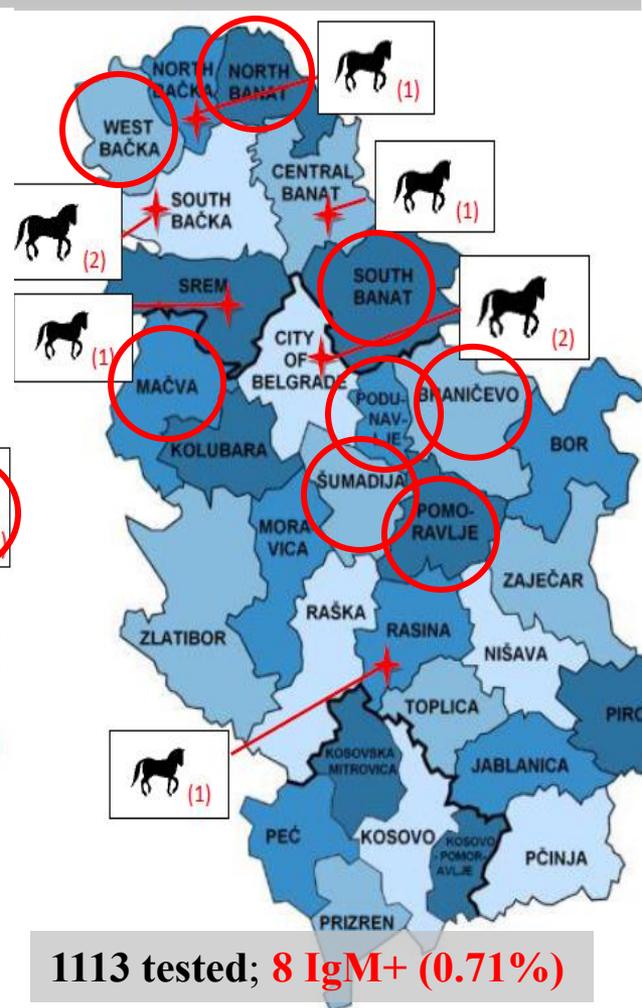**wild birds 10+/444 & mosquitoes 12+/684 tested**
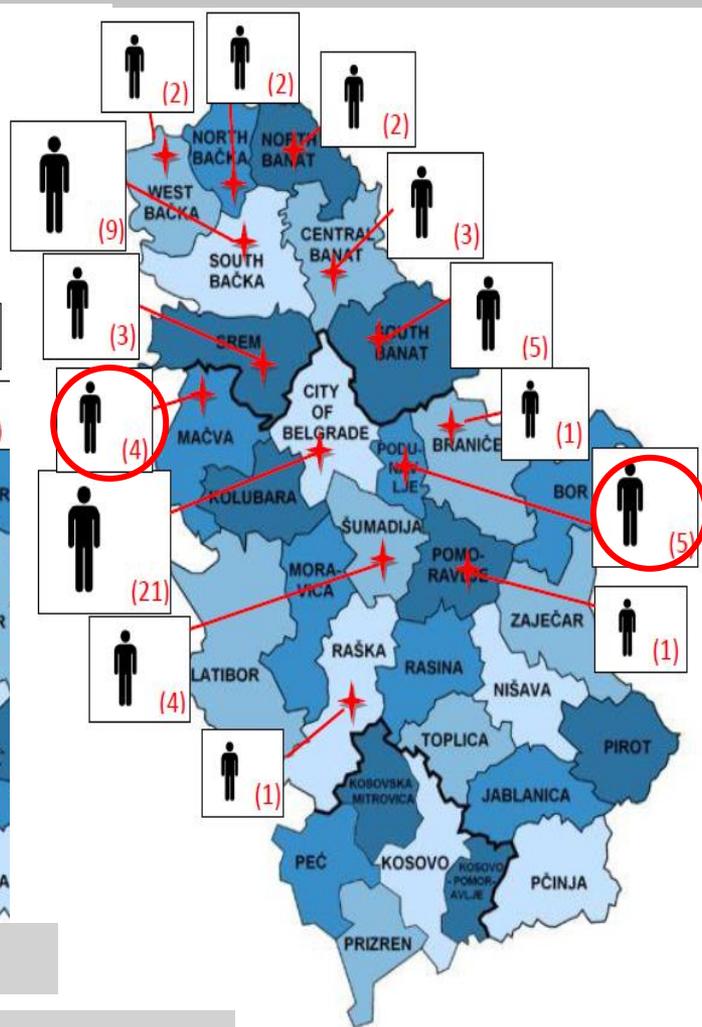
Detected WNV circul. in 16 (in 4, no H.C. det.)
and failed in 2 districts

Comparison of WNV-Ab positive samples in surveillance and human cases of WNND in 2024

2288 tested; 103 IgG+ (4.5%)

Detected WNV circul. in 13 (in 3, no H.C. det.) and failed in 3 districts

1113 tested; 8 IgM+ (0.71%)

Detected WNV circulation in 6 and failed in 8 districts

Project EYWA (Horizon2020)
Winner of the EIC Horizon Prize (early warning for epidemics) on the subject of vector borne diseases surveillance in 2021

Figure 1. Culex mosquito abundance at each trap for June 2021.

Project EYWA (Horizon2020)
Winner of the EIC Horizon Prize (early warning for epidemics) on the subject of vector borne diseases surveillance in 2021
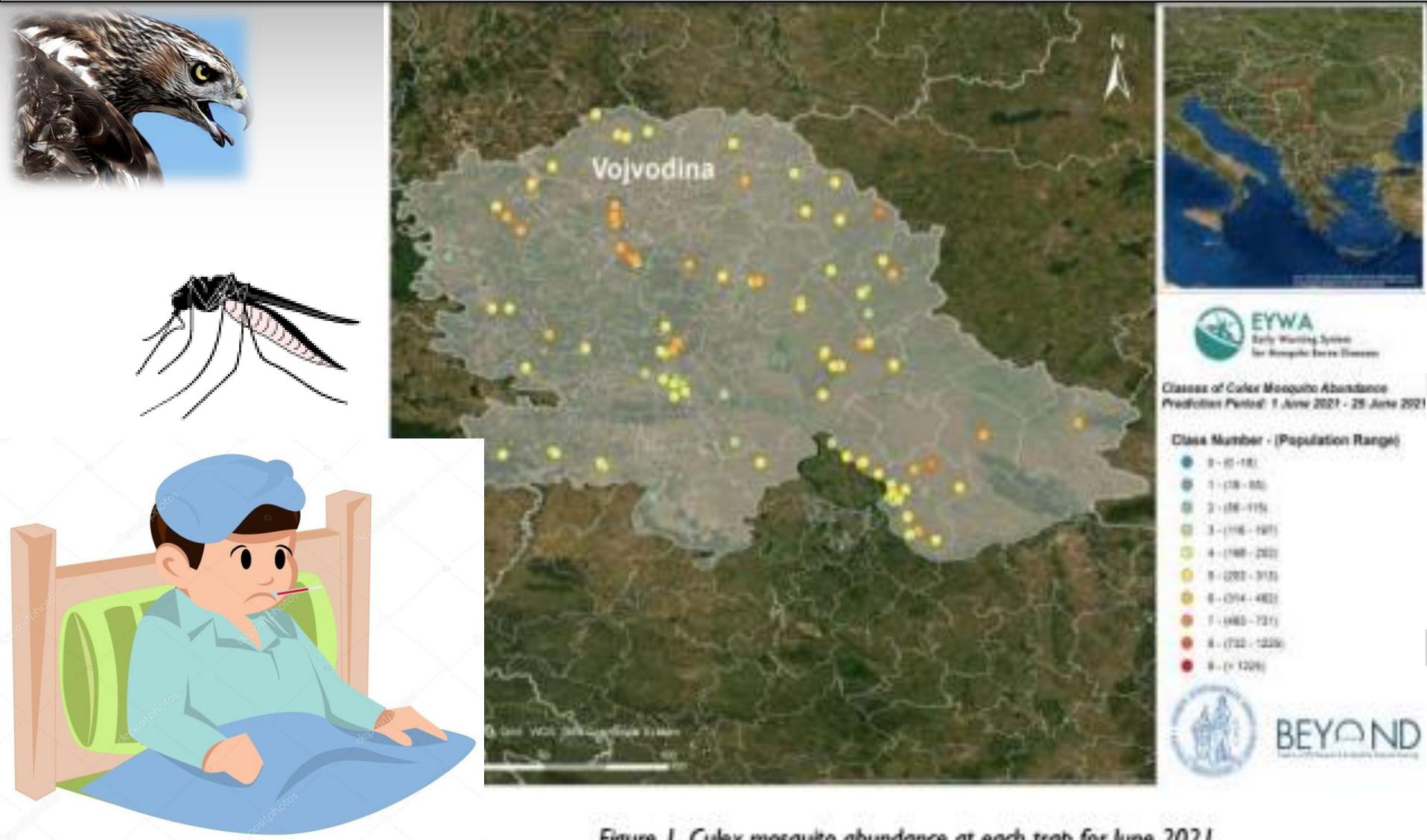

Culex mosquito abundance at 2x2 km grid for June2024
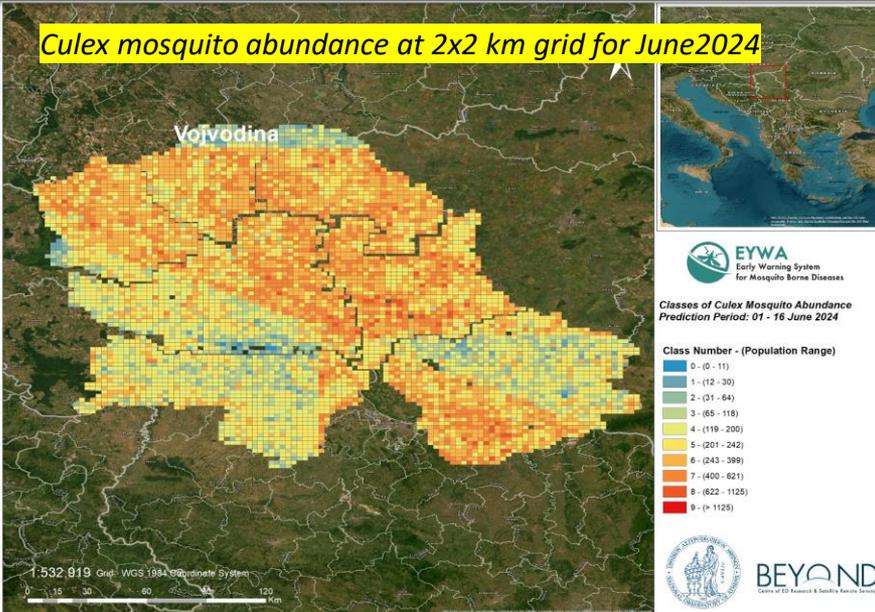
Culex mosquito abundance at 2x2 km grid for August 2024
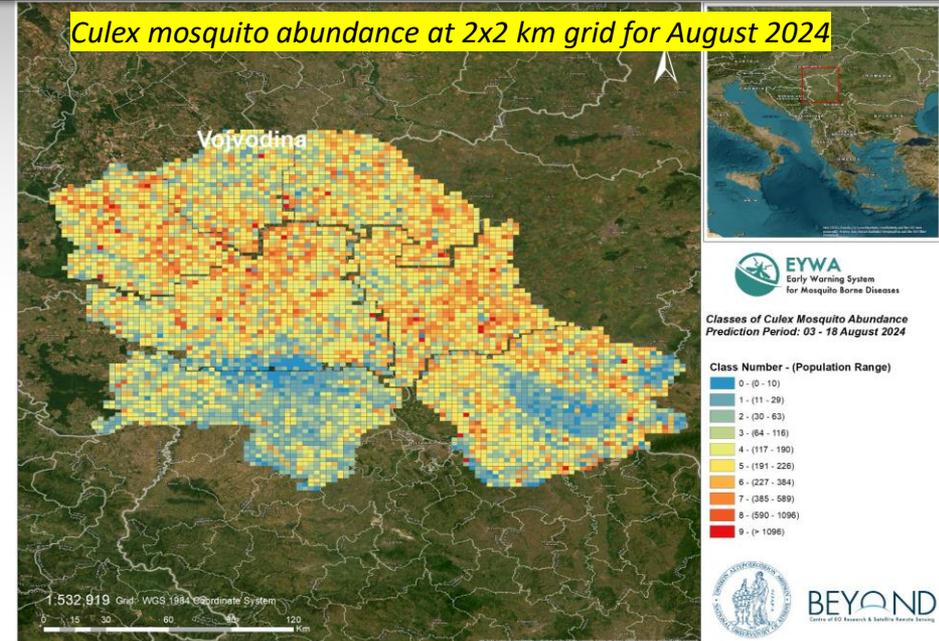
Culex mosquito abundance at 2x2 km grid for September 2024

Culex mosquito abundance at *2x2 km grid* for June 2025

Risk levels- May forecast

Month of 1st incidence for WNV Human Cases in 2025- May forecast
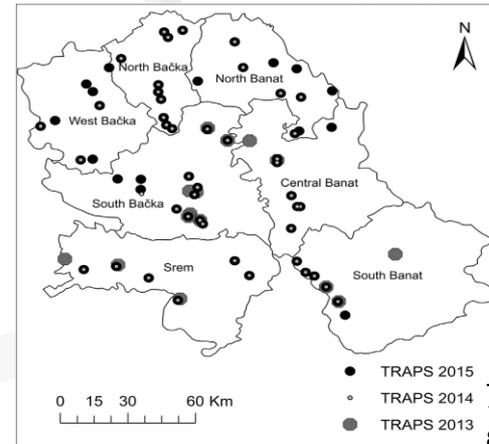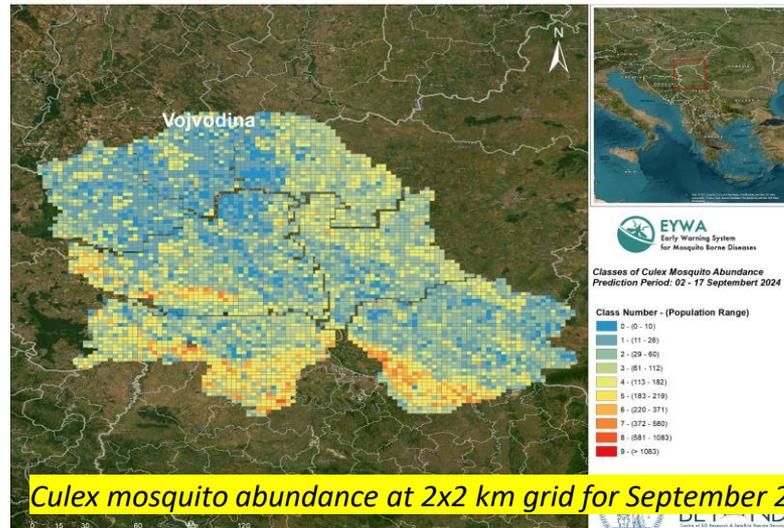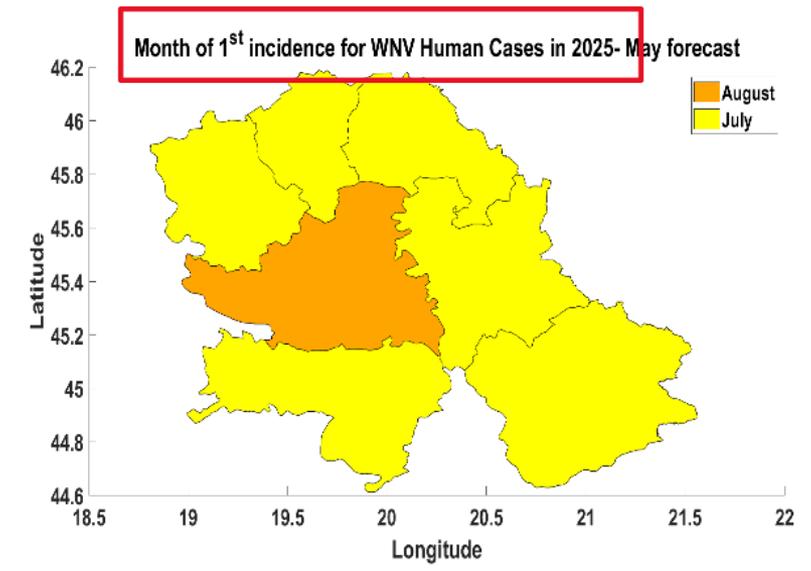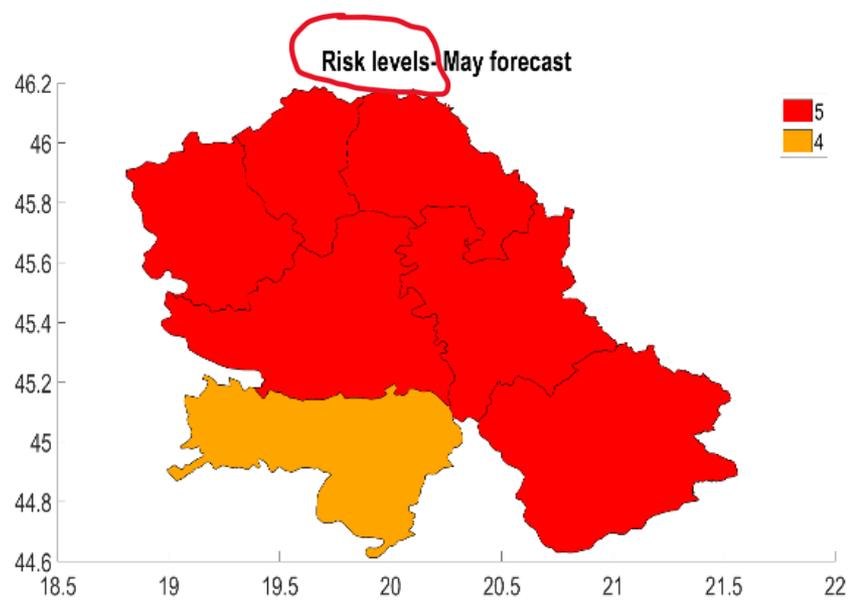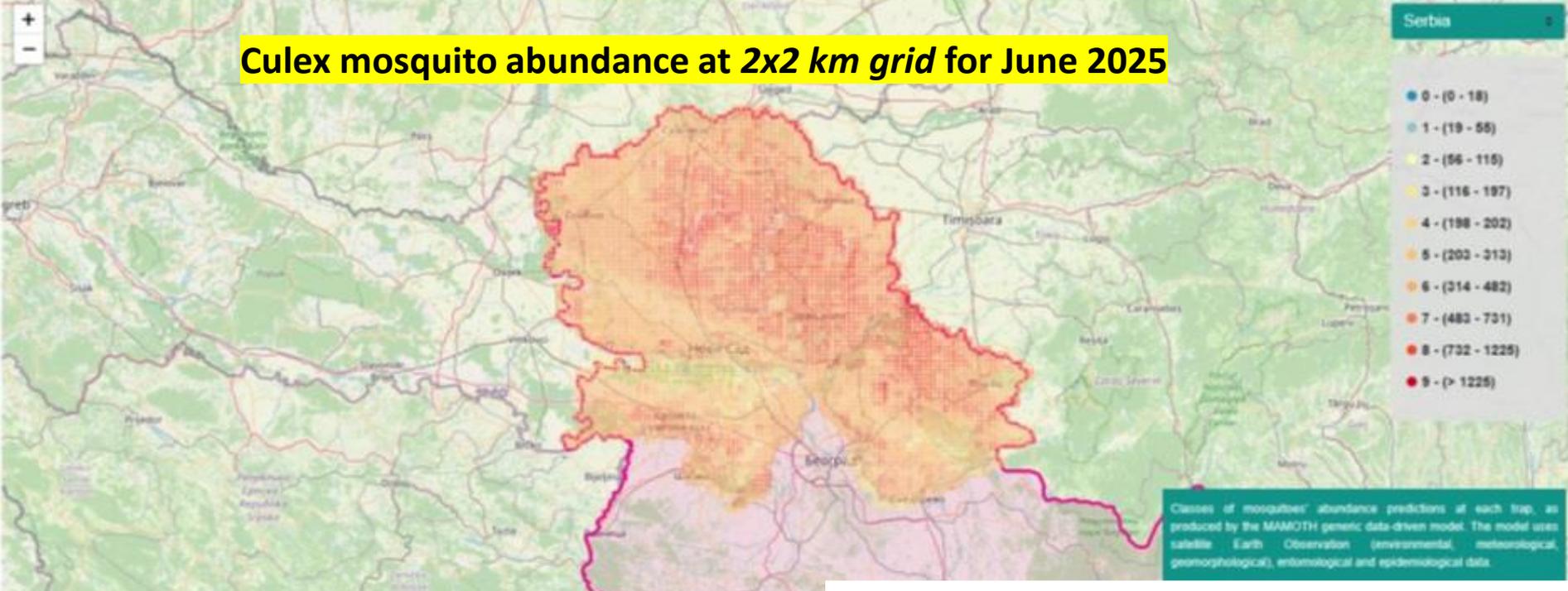
Project EYWA (Horizon2020)
Background and Motivation

- Vector-Borne Diseases account for 17% of global infectious diseases and cause 700.000 deaths annually

- Climate change, unplanned urbanization, and increased mobility are reshaping disease vector distributions.

- Amongst vectors, **mosquitoes** transmit the **deadliest** diseases → West Nile virus, Malaria, Zika, Dengue, Chikungunya

Accurate and **interpretable** disease prediction maps are essential for mitigating the effect of Mosquito-Borne diseases.

EYWA in Europe

Greece

- **1830 cases** from 2010 to 2023.
- EYWA supports **4 regions** with a total of **2500 settlements** and **3.8M people**.
- **Entomological** risk predictions powered by the BAd (Ecodev) and MAMOTH (BEYOND/NOA) models.
- **Epidemiological** risk predictions powered by the NOA risk model BAr (Ecodev) and MIMESIS (Uni of Patras).

Italy

- EYWA supports **2 regions** with a total of **757 municipalities** and **540K people.**
- **Entomological** risk predictions powered by the MAMOTH (BEYOND/NOA) model.
- **Epidemiological** risk predictions powered by the BAr (Ecodev) and MIMESIS (Uni of Patras) models.

France

- EYWA supports **3 regions** with a total of **9935 municipalities** and **12M people.**
- **Entomological** risk predictions powered by the MAMOTH (BEYOND/NOA) model.
- **Epidemiological** risk predictions powered by the BAr (Ecodev) and MIMESIS (Uni of Patras) models.

Serbia

- EYWA supports **Vojvodina regions** with a total of **37 municipalities** and **1.9M people.**
- **Entomological** risk predictions powered by the MAMOTH (BEYOND/NOA) model.

Germany

- EYWA supports **Baden-Württemberg regions** with a total of **47 municipalities** and **11.1M people.**
- **Entomological** risk predictions powered by the MAMOTH (BEYOND/NOA) model.

News

EYWA in the Rest of the World

Ivory Coast

EYWA is **operational** in Ivory Coast

Malaria in 2022:
- 28.1M at risk
- 7.3M suspected cases,
- 11.000 estimated deaths
- 1.500 reported deaths

Dengue fever in 2023:
- 3500 suspected cases,
- 27 deaths

Thailand

- Transferable MAMOTH EYWA model enabled cooperation with Thailand stakeholders
- Thailand experienced **Chikungunya** outbreaks in 2008-2009 (49.069 cases), and 2018-2019 (approximately 15.000 cases
- **Dengue** is hyper-endemic and all 4 serotypes are in active circulation in Thailand.

Latin America

- Submission of a plan to implement an EYWA proof of concept to a competition organized by **TAKEDA** Pharmaceuticals.

- 500M at risk of **Dengue**

EYWA in Africa

Cameroon

Contract **signed to transfer NOA's models,**
Historical Epidemiological data on Malaria cases acquired.
Operational Capacity Expected - Q1 2026

Malaria in Cameroon from 2015 – 2022 according to our data:

- o 7.5M total confirmed cases ~40% (3M) in **Kids Under 5 Years**
- o 3M Severe Cases
- o 2.5M Hospitalizations
- o 16.890 Reported deaths **~75% (12.000) in Kids Under 5 Years**

Cameroon: Total Malaria Cases per Year

Year	Cases
2024	873766
2023	878445
2022	1035107
2021	1101194
2020	939435
2019	778129
2018	604982
2017	468328
2016	379674
2015	513054
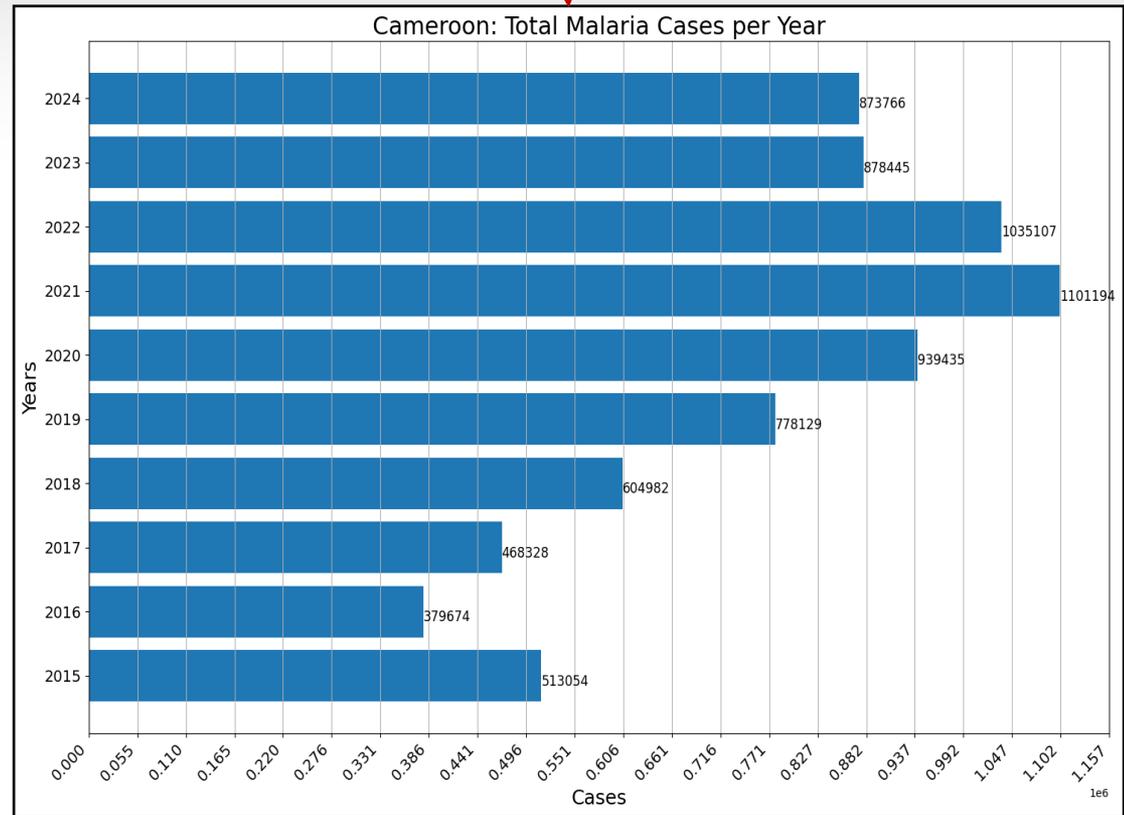
EYWA as an Advanced Application Service in DestinE platform
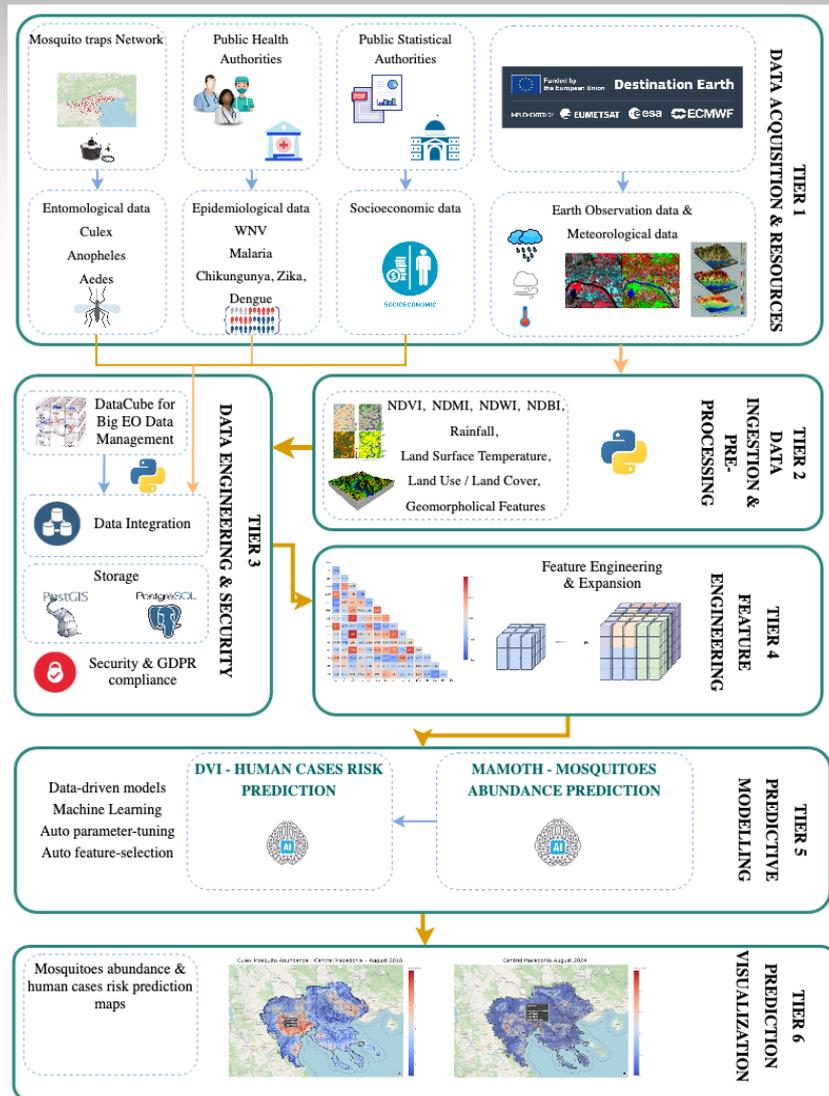
- EYWA continues to be **operational**

- **Proposal for CONOPS** - Early Warning System for Mosquito Borne Diseases Advanced Application: **Accepted**

- **CONOPS will be the continuation of EYWA** and will predict <u>mosquito populations</u> and the associated <u>risk of mosquito-borne diseases</u>.

The EYWA journey up to date…in a nutshell

2020

EYWA started its operations with 5 regions in 2 European Countries (Greece/Italy)
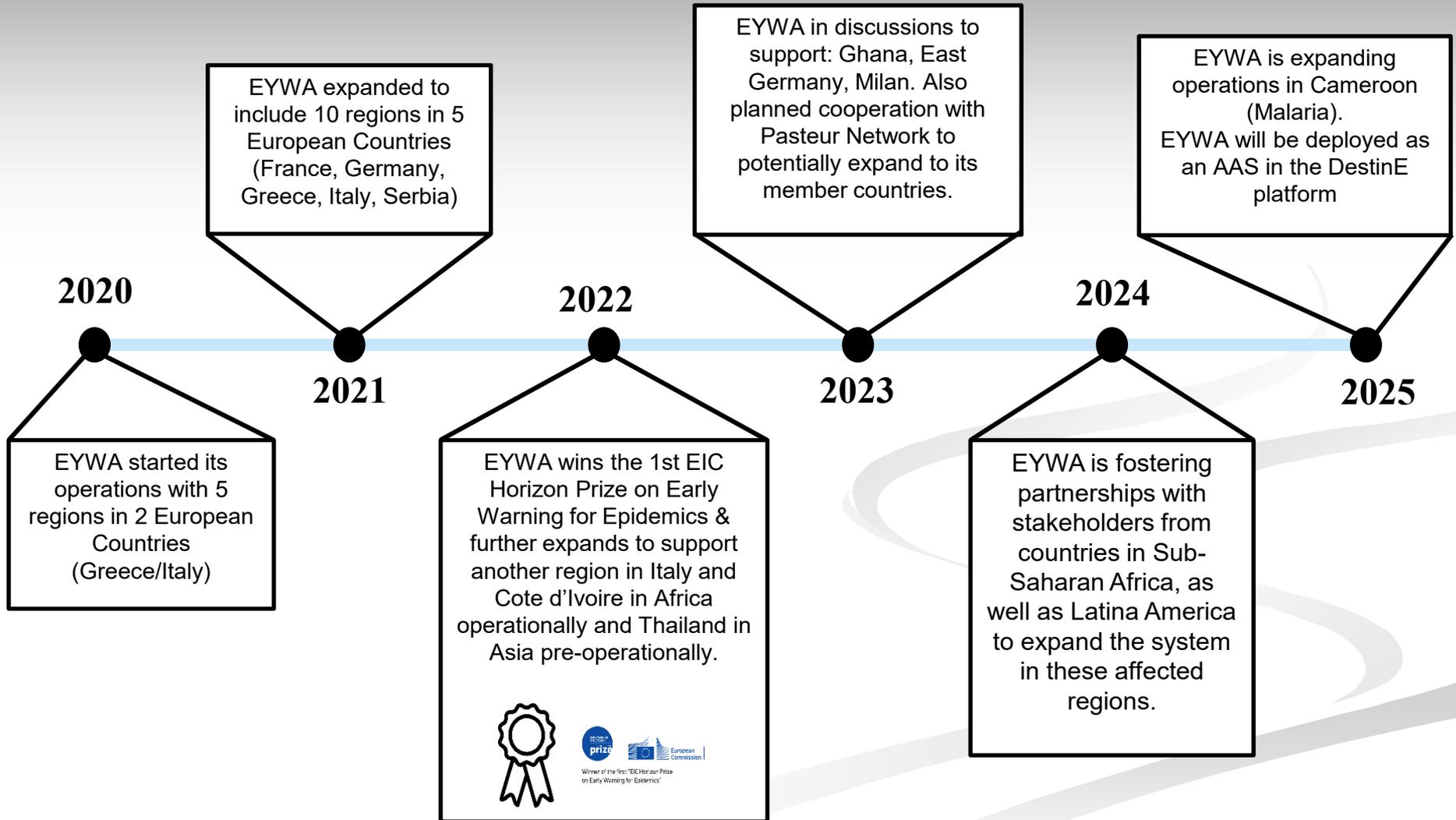
2021

EYWA expanded to include 10 regions in 5 European Countries (France, Germany, Greece, Italy, Serbia)

2022

EYWA wins the 1st EIC Horizon Prize on Early Warning for Epidemics & further expands to support another region in Italy and Cote d'Ivoire in Africa operationally and Thailand in Asia pre-operationally.

2023

EYWA in discussions to support: Ghana, East Germany, Milan. Also planned cooperation with Pasteur Network to potentially expand to its member countries.

2024

EYWA is fostering partnerships with stakeholders from countries in Sub-Saharan Africa, as well as Latina America to expand the system in these affected regions.

2025

EYWA is expanding operations in Cameroon (Malaria). EYWA will be deployed as an AAS in the DestinE platform

CONCLUSIONS

➢ It can be reasonably assumed that WNV, now endemic infection, will continually present **a significant problem for the veterinary and public health**

➢ **It is necessary to establish an effective surveillance system for WNV as well as other flavivirus vector-borne infections (TBEV and USUV)** that threaten or may threaten public health in Serbia in the future.

➢ **A fully integrated surveillance system** (veterinary, human and entomological) as a unique **system based on the principle of "One Health" is the best solution**.

➢ **the establishment of the sensitive and effective surveillance system is not easy job, and it is never finished** - often established system has to be changed accordingly due to the **new situations, changing environment and influences**, **data** collected **from previous season/s, new needs and expectations** etc..

➢ **Even a perfect surveillance system, without an adequate subsequent reaction - a measure of prevention and control is not purposeful** and is not of greater importance in the protection of public health.

WOAH Regional Seminar
"Vector-Borne Diseases in the European Region"

WNV SURVEILLANCE PROGRAM IN SERBIA: CHANGES IN THE METHODOLOGY OVERTIME

THANK YOU FOR YOUR ATTENTION !

Tamaš Petrović
Scientific Veterinary Institute „Novi Sad", Serbia

Teramo, June 25 - 27, 2025