Scientific Opinion on sheep pox and goat pox

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OUTLINE

- Background and mandate
- Approach
- Outputs
- Conclusions and recommendations

BACKGROUND

- Sheep pox and goat pox (SPP/GTP) are endemic in Africa north of the Equator, the Middle East, Turkey, and some parts of Asia.
- exotic to the EU, but outbreaks occurred in the past in Greece and Bulgaria, and lastly in 2013 (August 2013- current)
- Included in the OIE list - compulsory notification to OIE
- EC need: assessment of the risk of introduction and spread of SPP/GTP and to determine if further measures are justified

EFSA APPROACH

Three mandates with same ToRs on SPP/GTP, peste des petits ruminants (PPR), lumpy skin disease

- Specific recruitment of experts according to expertise on the three diseases for the different meetings
- Similar approach for answering the ToRs, depending on data availability

MANDATE – TERMS OF REFERENCES

1. [redacted]

2. Provide a mapping of the regions of concern and other countries of the Mediterranean Basin and Black sea, displaying identified or likely major live animal trade routes.

3. [redacted]

4. [redacted]

5. Assess the risk of sheep pox and goat pox becoming endemic in animal population in the EU and neighbouring countries.

6. Assess the impact and consequences of sheep pox and goat pox when entering the EU considering different scenarios as regard the effectiveness of surveillance and control measures.

7. [redacted]

DEADLINES AND DELIVERABLES

May 2014

- Disease characterisation and distribution (ToR 1).
- Identification of pathways of introduction of SPP/GTP into the EU (ToR 3).
- Assess the speed of propagation of SPP/GTP (ToR 4).
- Review prevention and control measures (ToR 7).

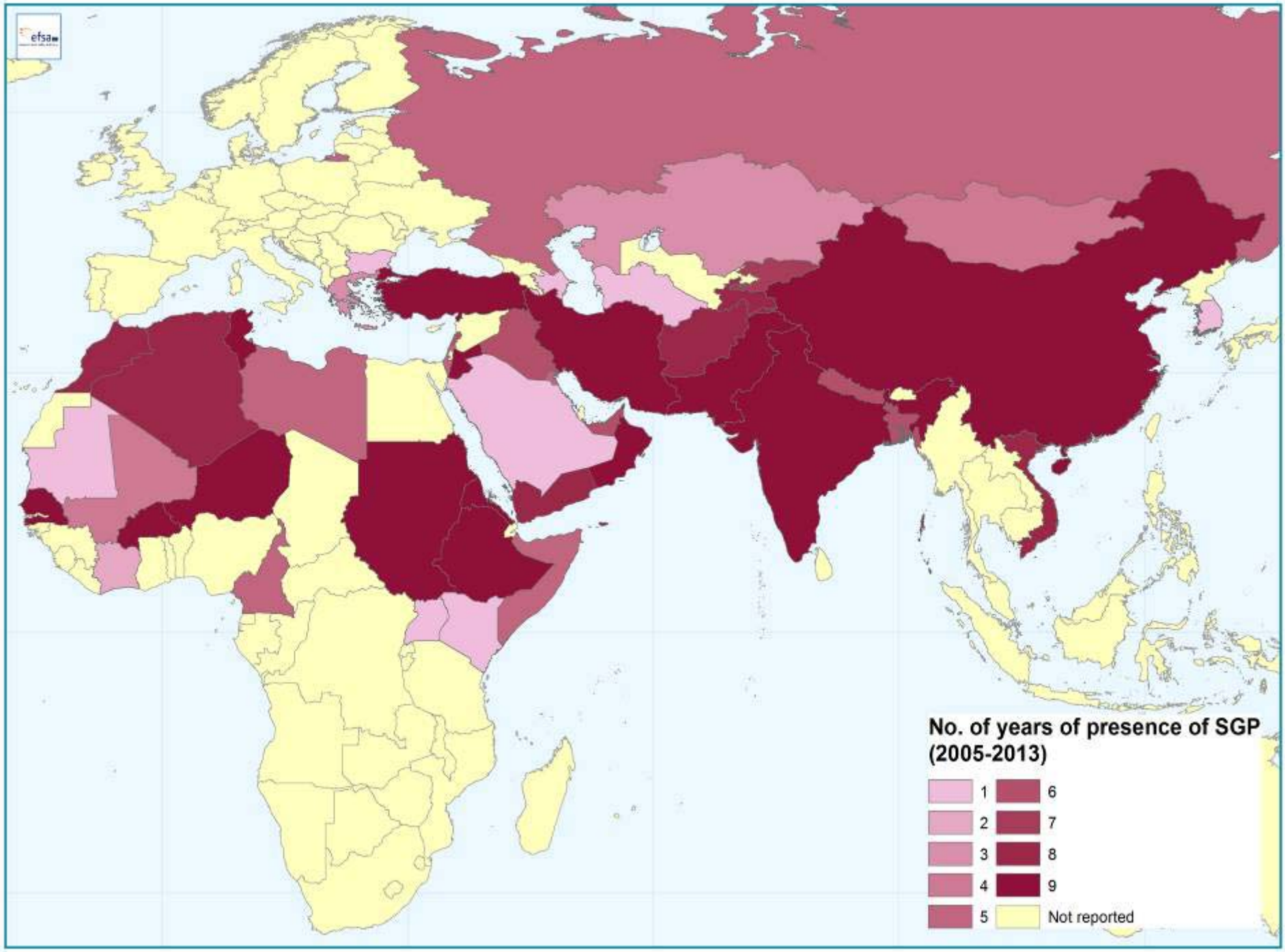
October 2014

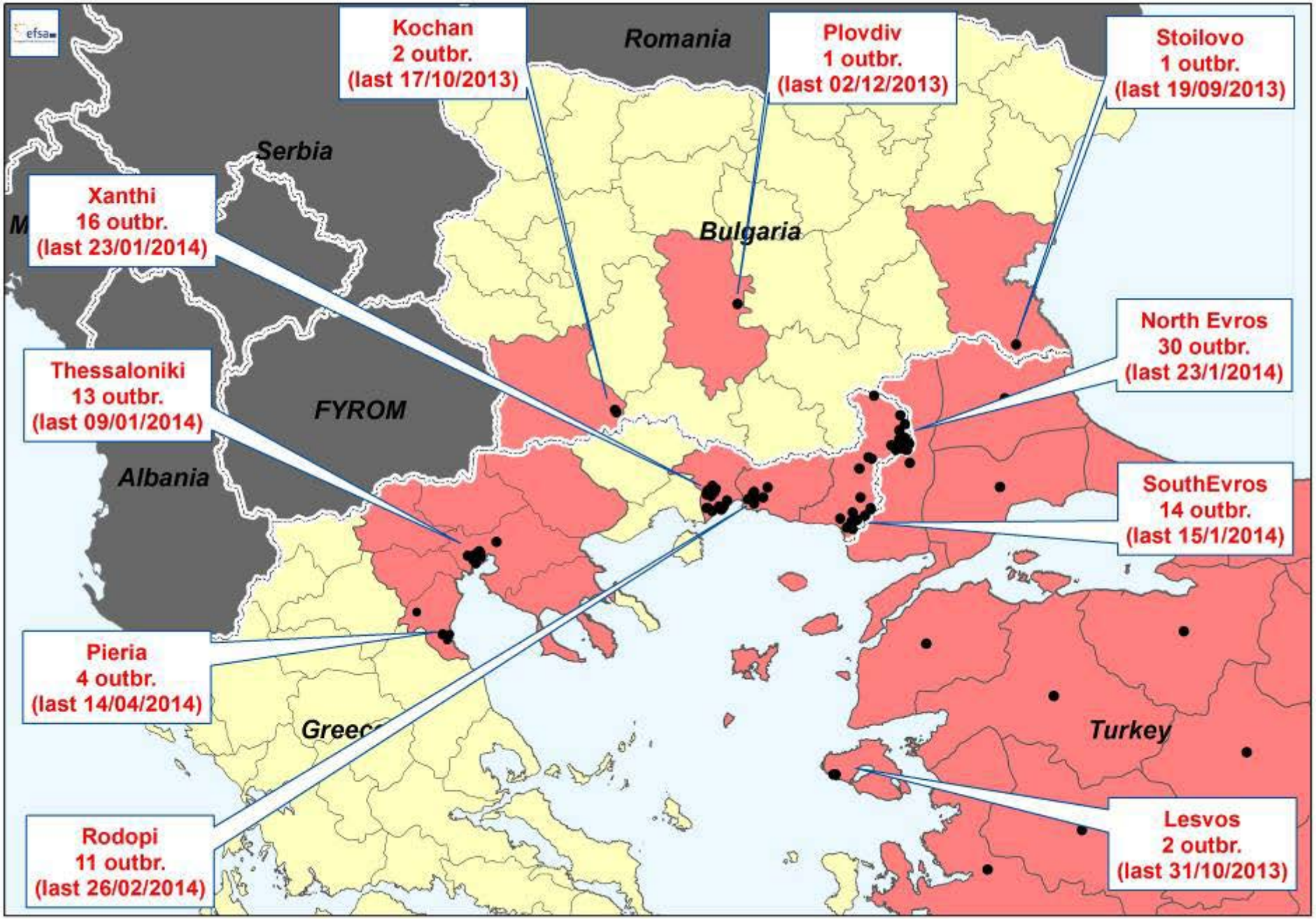
- mapping of identified or likely live animal trade routes (ToR 2).
- ranking pathways of introduction of SPP/GTP into the EU (ToR 3).
- Assess the risk of endemicity of SPP/GTP (ToR 5).
- Assess the impact and consequences of SPP/GTP (ToR 6).

TOR 1: DISEASE CHARACTERISATION AND DISTRIBUTION

Data and methodology

- Literature review
- OIE/ADNS data
- Mapping, GIS


No. of years of presence of SGP (2005-2013)
1
2
3
4
5
6
7
8
9
Not reported


Kochan
2 outbr.
(last 17/10/2013)
Romania
Plovdiv
1 outbr.
(last 02/12/2013)
Stoilovo
1 outbr.
(last 19/09/2013)
Serbia
Xanthi
16 outbr.
(last 23/01/2014)
Bulgaria
North Evros
30 outbr.
(last 23/1/2014)
Thessaloniki
13 outbr.
(last 09/01/2014)
FYROM
Albania
SouthEvros
14 outbr.
(last 15/1/2014)
Pieria
4 outbr.
(last 14/04/2014)
Turkey
Rodopi
11 outbr.
(last 26/02/2014)
Lesvos
2 outbr.
(last 31/10/2013)

CONCLUSIONS– TOR 1

- SPP/GTP are diseases of domestic small ruminants caused by viruses of the genus *Capripoxvirus*
- severe clinical signs and losses especially in naive and young animals
- morbidity up to 90% and case fatality up to 100%
- no evidence to date that these viruses can infect wildlife
- Capripoxviruses are not considered to be zoonotic agents
- recurrent incursions of sheep pox into Greece and Bulgaria, the most recent ones causing 91 outbreaks in Greece and 4 in Bulgaria from August 2013 until April 2014
- Virus can be detected in animal secretions up to two months after infection

CONCLUSIONS– TOR 1

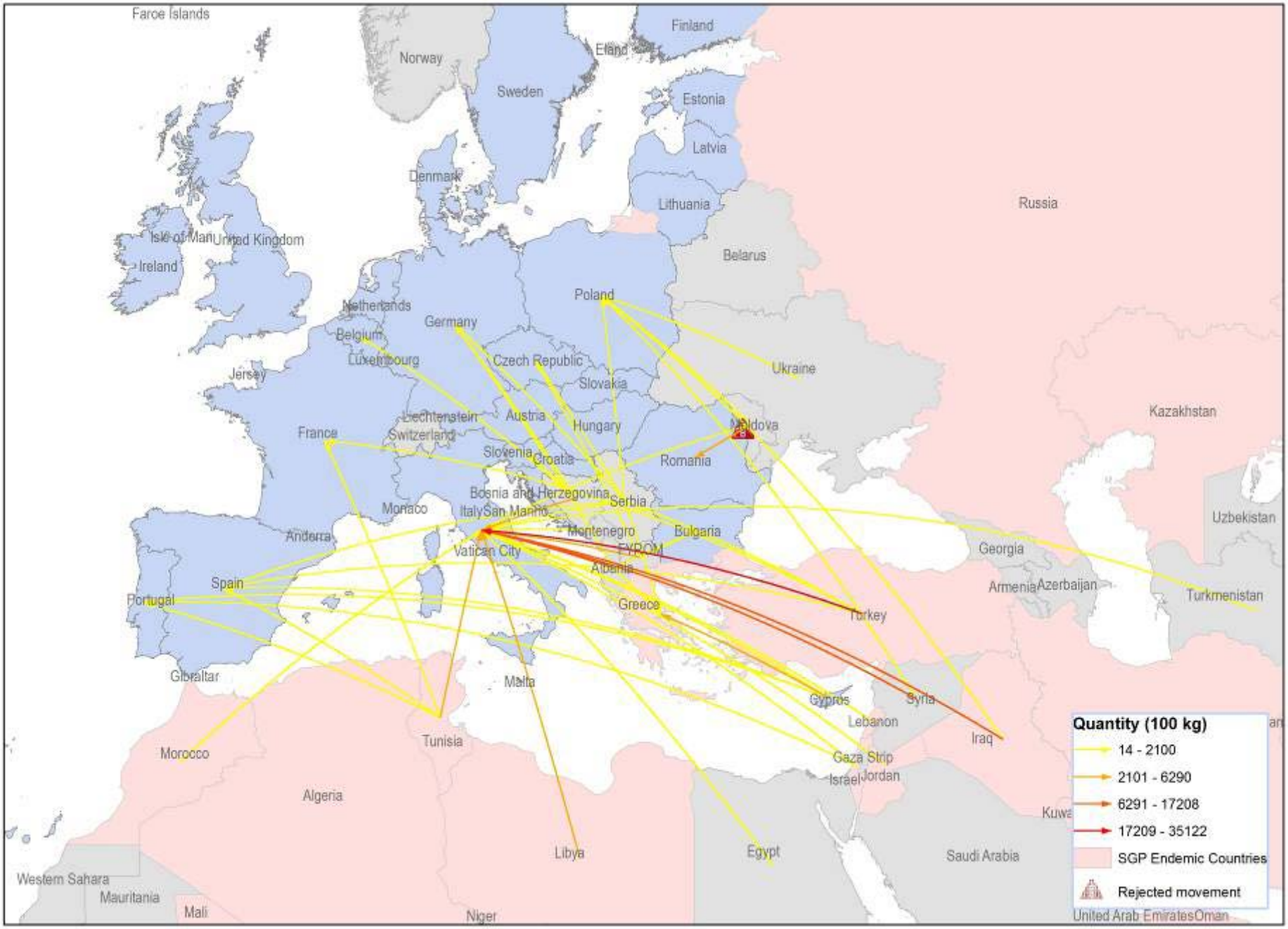
- the virus can survive in scabs if protected from sunlight, and in the environment for up to 6 months, and in wool, hairs or skin of infected animal for up to 3 months
- The virus is susceptible to high temperatures and common disinfectants
- The main mode of transmission of SPP/GTP is direct contact between infectious and susceptible animals
- Indirect transmission : dissemination from animal secretions and products from infected animals or human movements and/or fomites acting as mechanical carriers of virus through

TOR 2: MAPPING OF ANIMAL MOVEMENTS IN THE THE MEDITERRANEAN BASIN AND BLACK SEA

Data and methodology

- Topics considered:
  - trade of animals and products relevant for trasmission
  - animal migration,
  - socio-political drivers
- Screening different database (Eurostat, TRACES, FAO, national authorities)
- Outputs: Flow maps


Romania
Serbia
Montenegro
Bulgaria
FYROM
Albania
Italy
Greece
Turkey
Number of sheep and goats (N. heads)
1 - 500
500 - 1 000
1 000 - 2 500
2 500 - 6 000
Affected region


Faroe Islands
Norway
Finland
Eland
Sweden
Estonia
Latvia
Denmark
Lithuania
Russia
Isle of Man
United Kingdom
Ireland
Belarus
Poland
Netherlands
Germany
Belgium
Luxembourg
Czech Republic
Ukraine
Jersey
Slovakia
Kazakhstan
Liechtenstein
Austria
Hungary
France
Switzerland
Moldova
Slovenia
Croatia
Romania
Bosnia and Herzegovina
Serbia
Monaco
Italy
San Marino
Uzbekistan
Montenegro
Bulgaria
Andorra
Vatican City
FYROM
Georgia
Albania
Spain
Armenia
Azerbaijan
Turkmenistan
Portugal
Greece
Turkey
Gibraltar
Malta
Cyprus
Syria
Lebanon
Iraq
Tunisia
Morocco
Gaza Strip
Israel
Jordan
Algeria
Kuwa
Libya
Egypt
Saudi Arabia
Western Sahara
Mauritania
Mali
Niger
United Arab Emirates
Oman
Quantity (100 kg)
14 - 2100
2101 - 6290
6291 - 17208
17209 - 35122
SGP Endemic Countries
Rejected movement

CONCLUSIONS TOR 2

- Movement of live animals from third countries into the EU is currently forbidden. However, illegal movements of animals cannot be quantified.
- In Greece, Bulgaria and Turkey, there are a large number of within-country movements of live small ruminants from SPP/GTP-affected provinces to other areas.
- There is a substantial trade in skin, wool and hides into the EU from countries where SPP/GTP is present. In order to complete an import risk assessment, detailed information is needed to clarify whether each commodity has undergone appropriate treatment to inactivate SPPV/GTPV.
- Skins and hides processed only by drying or salting treatments may pose a risk for introduction of SPPV/GTPV into the EU if imported from affected areas

TOR 3: IDENTIFICATION AND RANKING OF PATHWAYS

Methodology

Pathways of introduction

- Literature review
- Field evidence from outbreak investigation
- information on sources of outbreaks from OIE + ADNS
- Expert knowledge elicitation (questionnaire +analysis)

OUTPUTS - TOR 3

Pathways identified

- ANIMAL MOVEMENTS
  - legal or illegal trade of live animals
  - legal or illegal trade of animal products
  - movement or proximity of animals to contaminated areas/pastures shared by flocks from infected countries.
- HUMAN MOVEMENTS
  - visitors, tourists
  - animal workers
  - immigrants
- FOMITES OR MECHANICAL CARRIERS
  - movement of vehicles
  - Birds, wildlife and insects

RANKING OF PATHWAY OF INTRODUCTION ACCORDING TO EKE

1. Persons having contact with animals (visitors, immigrants, animal workers)
2. Insects (to be verified)
3. Vehicles
4. Illegal animal imports
5. Wildlife (mammals)
6. Wildlife (birds)
7. Feed or fodder

TOR 4: RISK AND SPEED OF SPREAD OF SPP

Methodology

- A model to evaluate the spread of SPPV over space (data 2013/14 outbreaks in EU and European Turkey)
- The continental-scale spread resolution : NUTS3
- different models and assumptions tested
- Three scenarios for the spread of SPP in the EU after 1, 6, 12 months and after 5 years:
  - incursion in the regions of Bulgaria and Greece
  - incursion in Croatia and Hungary, over Balkans
  - incursion in southern Spain, from northern Africa.

RISK AND SPEED OF SPREAD OF SGP

DATA

- Demographic livestock data (NUTS3) in Europe and Turkey for 2010 (Eurostat, Turkstat).
- Epidemiological data from ADNS - cases in BG, GR, TR 1 January 2013 and 31 January 2014.
- Infected NUTS3 : at least one infectious holding in the region

RISK AND SPEED OF SPREAD OF SGP

three components of the model:

- transmission between NUTS3 regions
- duration for which SPPV circulates within a region
- the number of infected holdings within a region

Transmission between regions was modelled using a kernel-based approach

RISK AND SPEED OF SPREAD OF SGP

kernel-based model

- Force of infection λ : Nr new infections /Nr susceptible exposed*average exposure time
- $\lambda_i(t)$, for region *i* on day *t:*

$$\lambda_i(t) = hD_i \sum_{j \neq i} K(d_{ij}) D_j I_j(t),$$

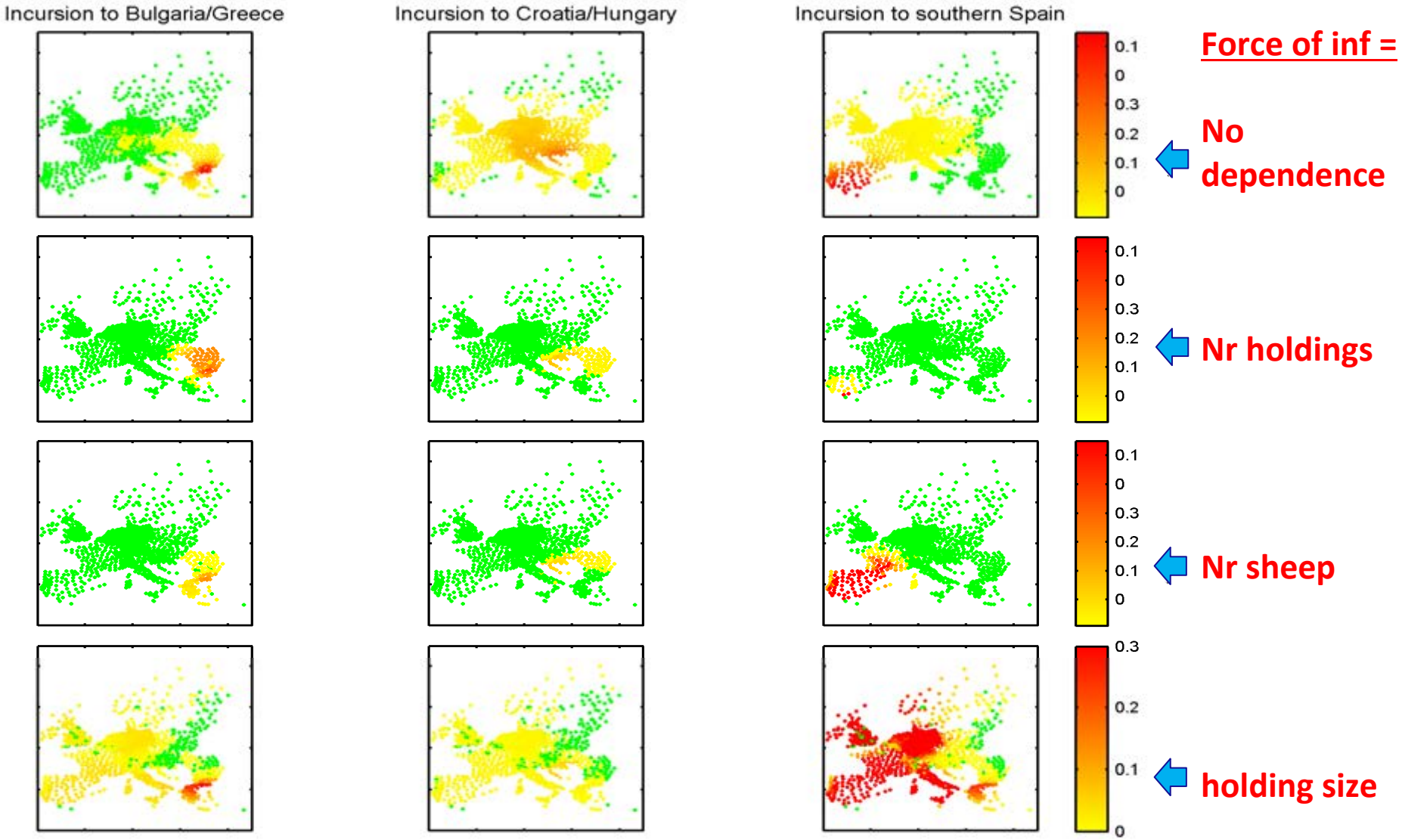
- *h* is the transmission parameter,
- D_i dependence of the λ on host demography in region *i*
- $K(d_{ij})$: distance kernel
- d_{ij} : distance between the centroids of regions *i* and *j*
- $I_j(t)$ variable whether region *j* is uninfected (0) or infected (1) on day *t*.

RISK AND SPEED OF SPREAD OF SPP

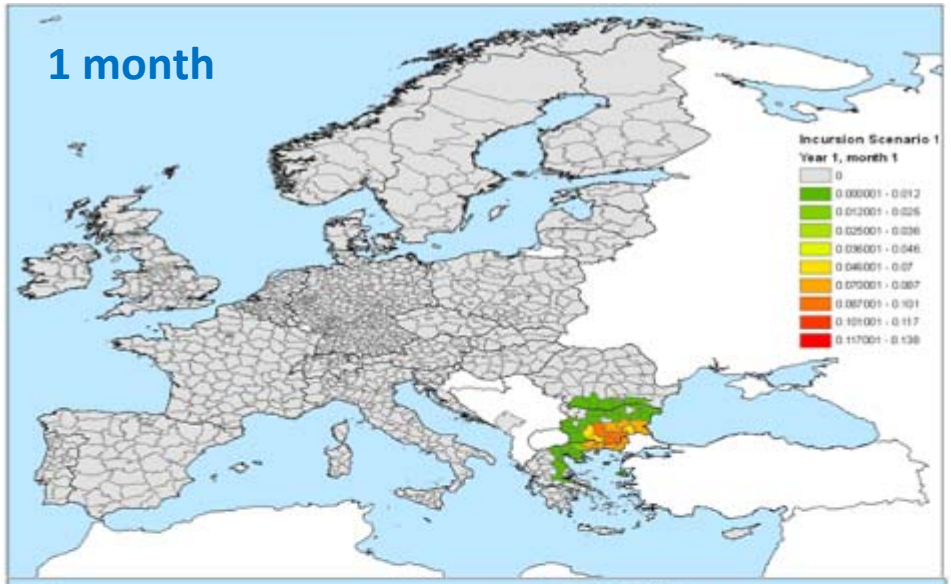
4 models for dependence of the force of infection on host demography:

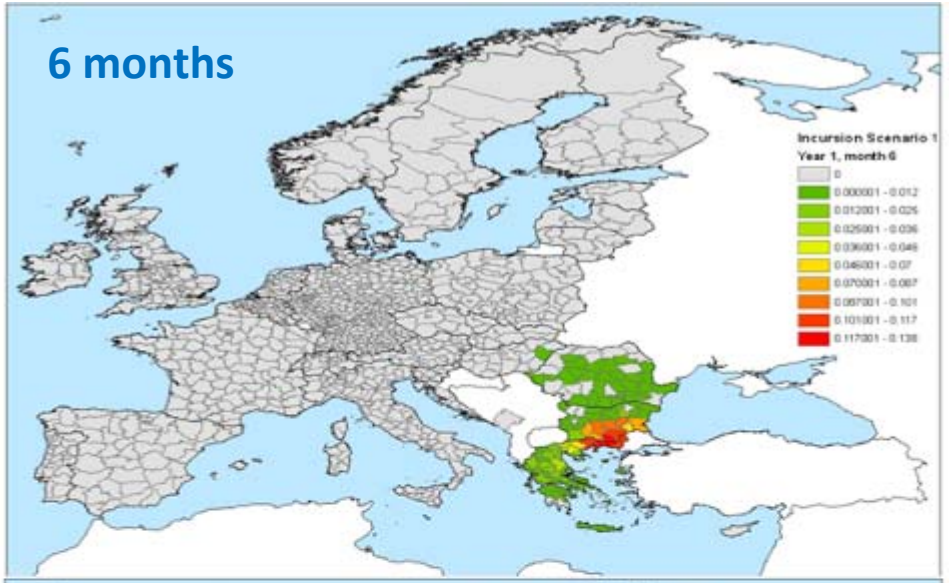
- (i) no dependence (i.e. $D_i=1$)
- (ii) proportional to the number of holdings with sheep, N_i (i.e. $D_i= N_i$)
- (iii) proportional to the number of sheep, S_i (i.e. $D_i=S_i$)
- (iv) proportional to mean holding size (i.e. $D_i=S_i/N_i$)

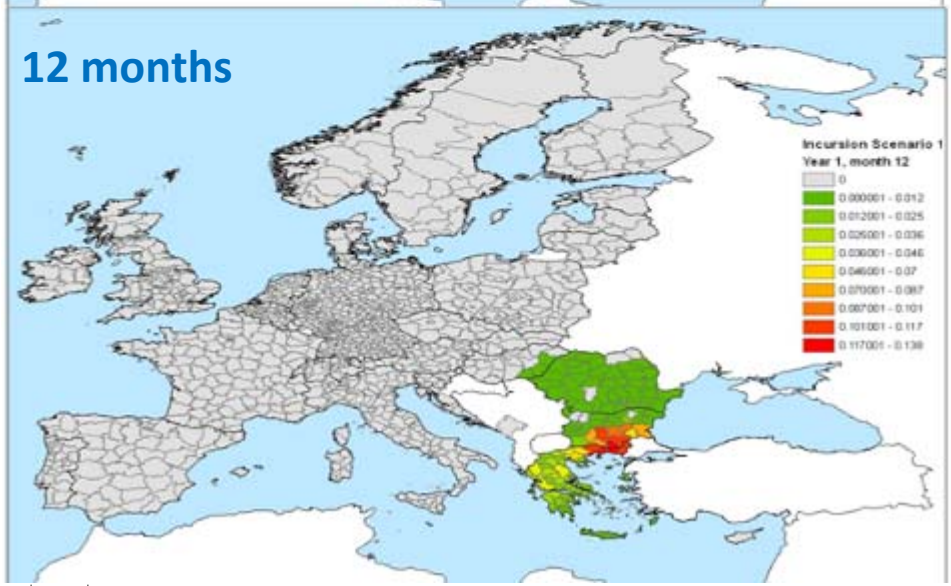
The best fitting model: transmission between regions proportional to the number of sheep per NUTS3

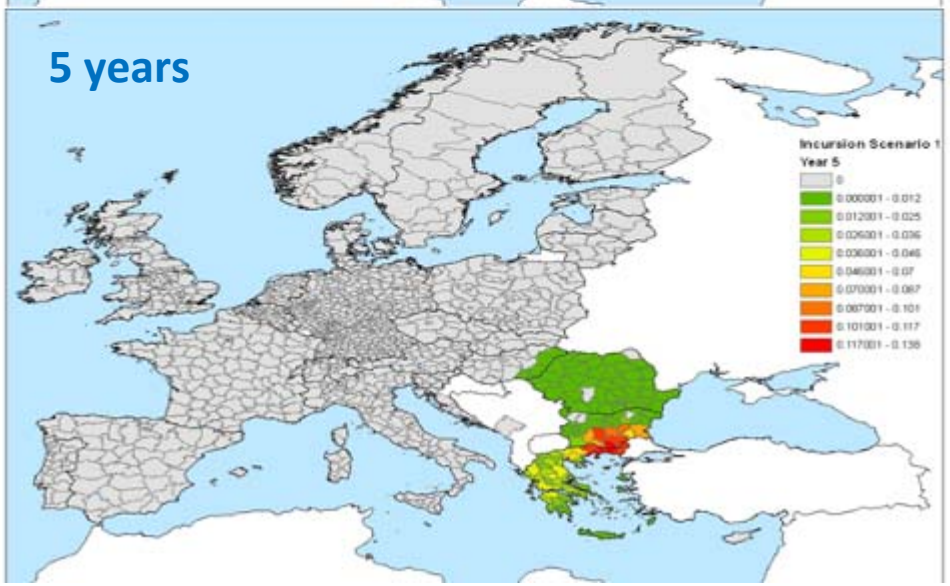


Predicted spatial spread of sheep pox virus in Europe under different incursion scenarios.



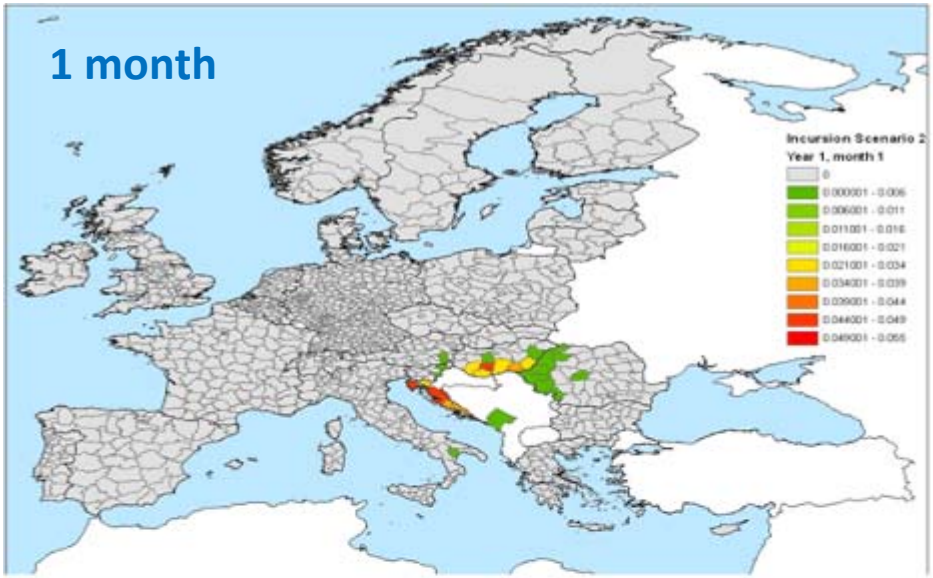


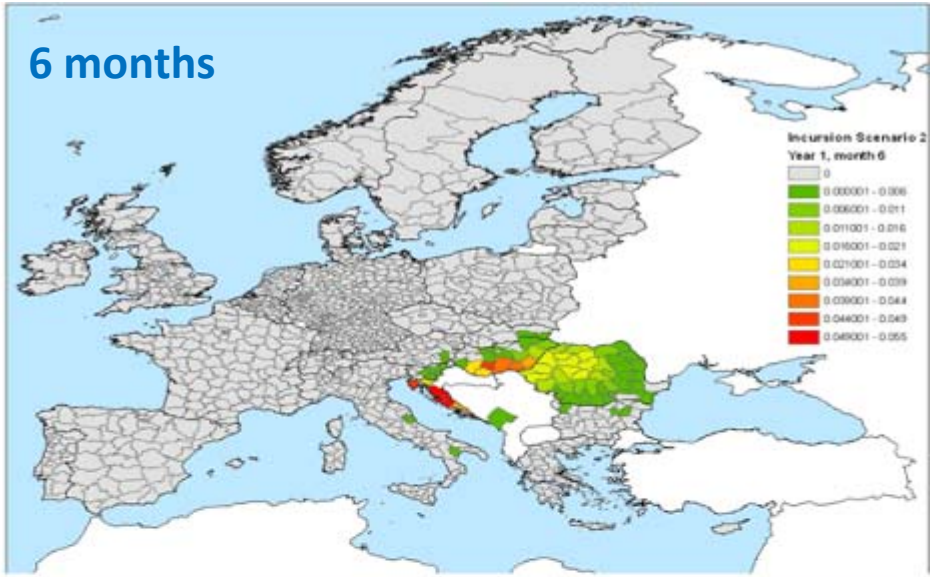


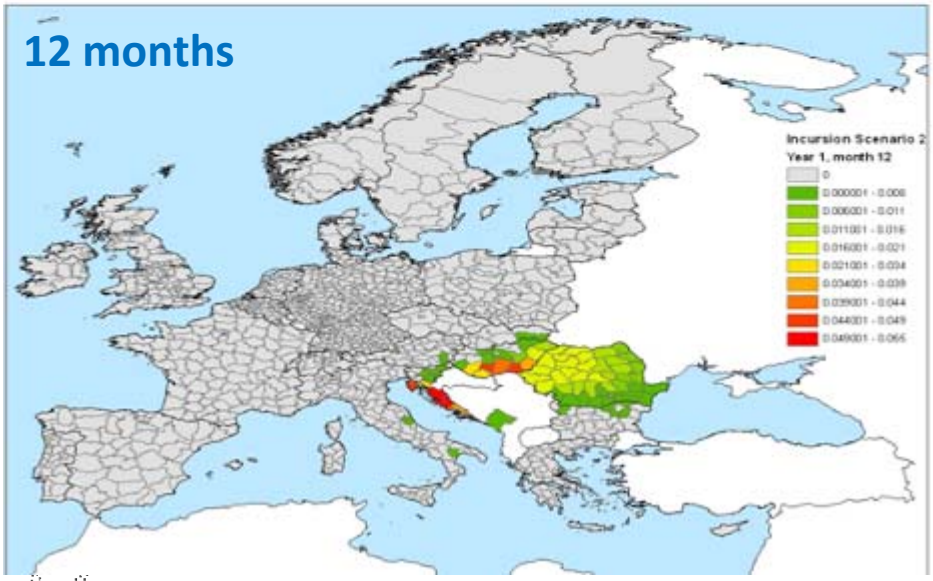


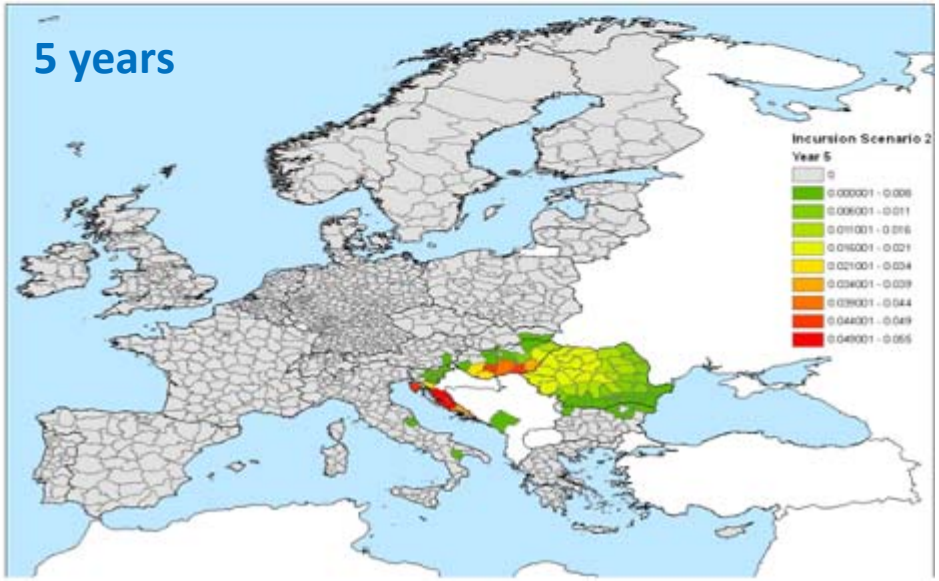
Simulation of SPP/GTP spread over EU after incursion in Greece and Bulgaria

- probability of an area becoming infected, the force of infection between regions is proportional to the number of sheep /NUTS3 and given the control measures as applied in Greece and Bulgaria.



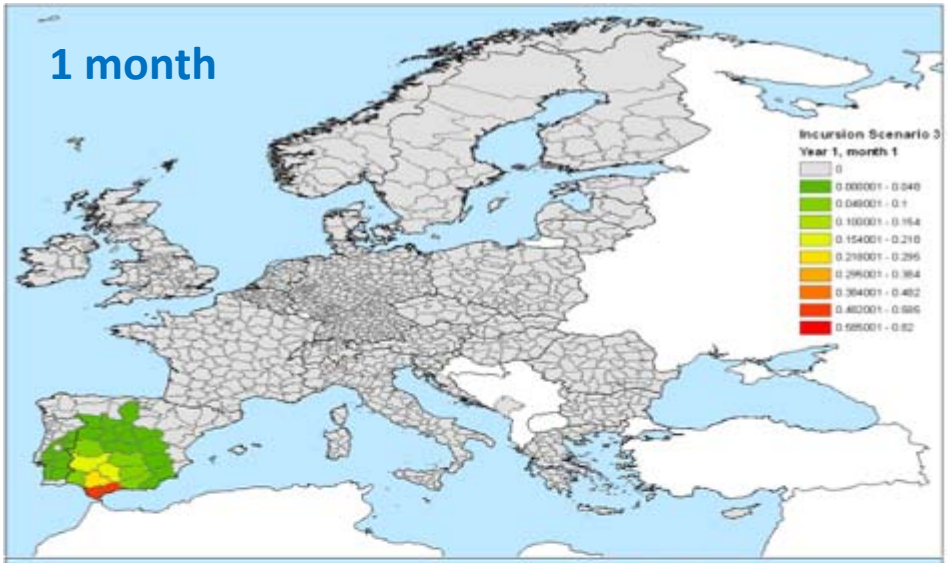


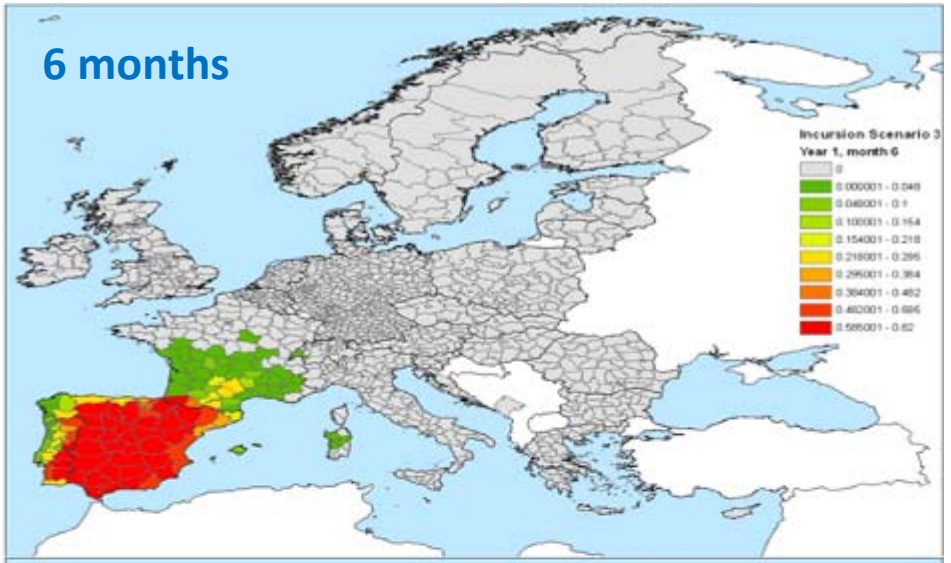


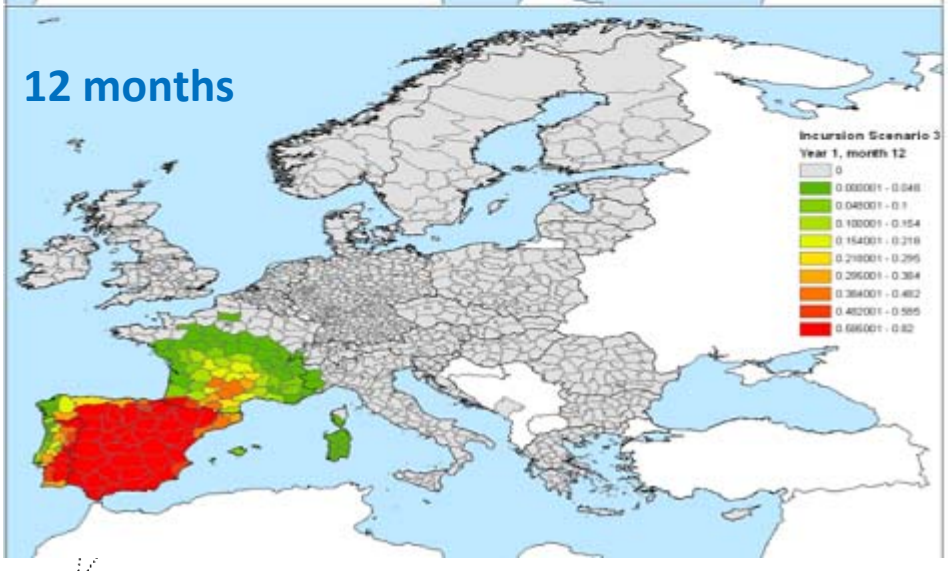


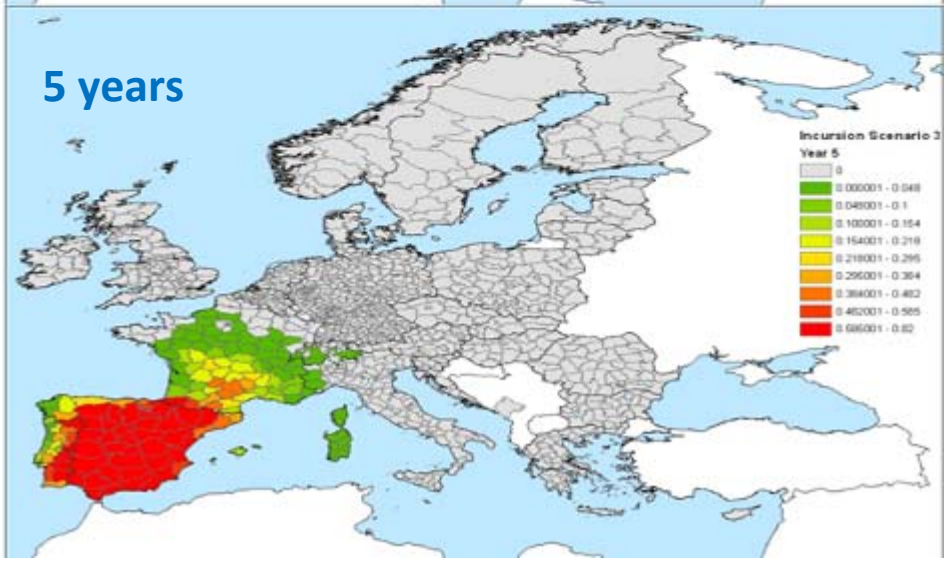
Simulation of SPP/GTP spread over EU after incursion in Croatia and Hungary, over Balkans

probability of an area becoming infected, the force of infection between regions is proportional to the number of sheep /NUTS3 and given the control measures as applied in Greece and Bulgaria.









Simulation of SPP/GTP spread over EU after incursion in southern Spain

- probability of an area becoming infected, the force of infection between regions is proportional to the number of sheep /NUTS3 and given the control measures as applied in Greece and Bulgaria.

ASSUMPTIONS & LIMITATIONS

- the contact patterns within Europe are similar to those in Bulgaria and Greece.
- limited availability of data
  - analysis restricted to an evaluation of the probability of SPPV transmission over a given distance; *f*(Nr number of herds or sheep in a region)
  - This model does not distinguish between possible transmission routes
  - Large uncertainty in quantifying the level of transmission.
- the model predictions to be considered as an example of the options when assessing risk of SPP epidemics in EU

TOR 5: RISK OF ENDEMICITY

Data and methodology: literature + epidemiological information from outbreak investigation in Greece and Bulgaria

Conclusions

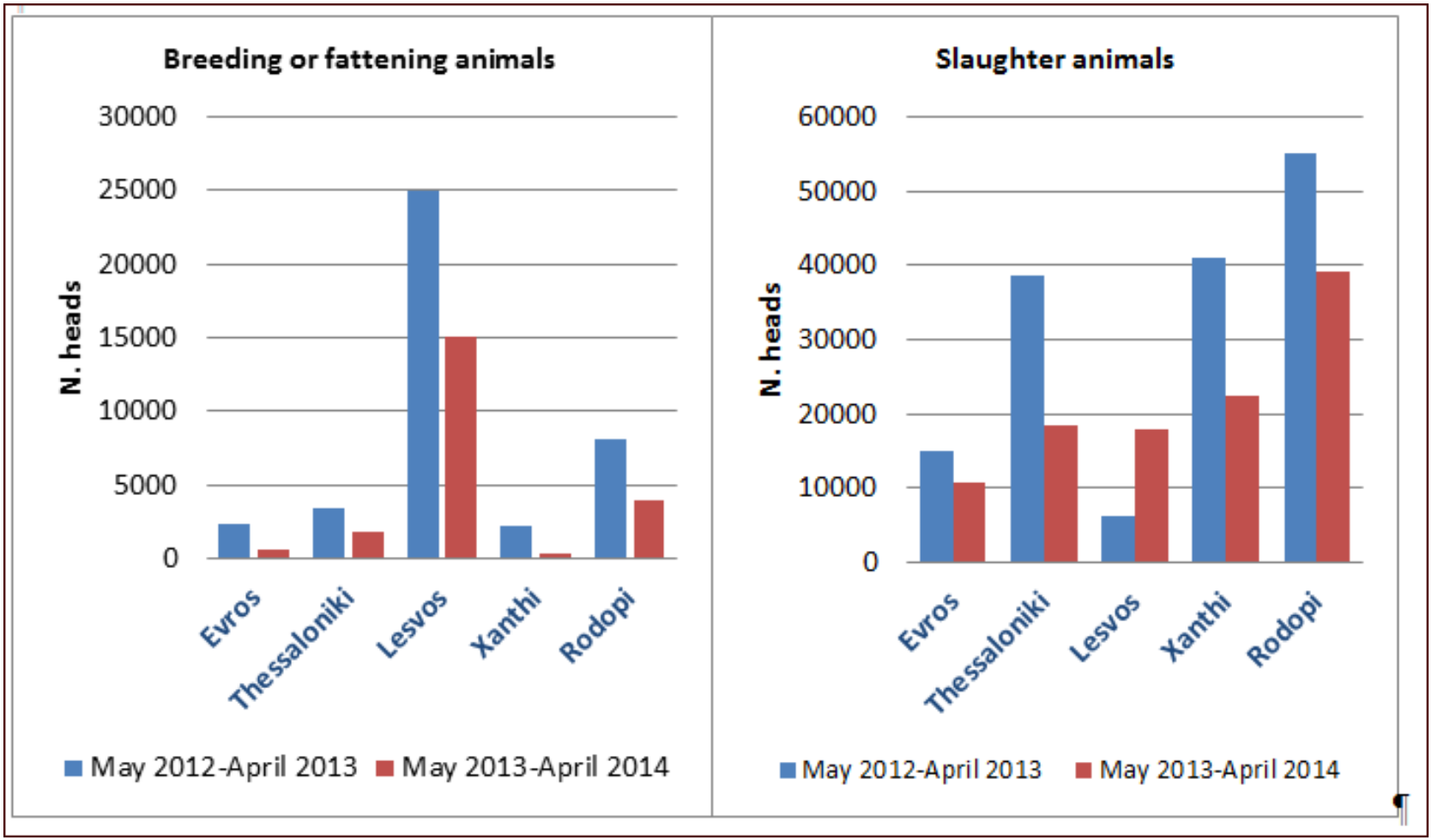
- The long-term survival of the SPPV in the environment enhances the likelihood of SPP endemicity.
- The likelihood of SPP endemicity can be reduced by extensive cleaning and disinfection measures of premises and risk materials, combined with a waiting period before re-stocking of culled herds is allowed.
- Under the control measures applied in affected MSs, SPP has not become endemic

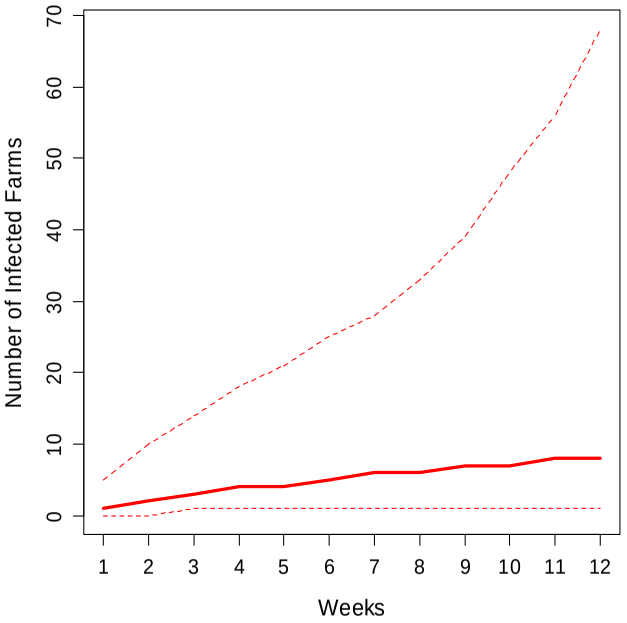
TOR 6: ASSESS THE IMPACT OF SPP AND GTP ENTERING THE EU

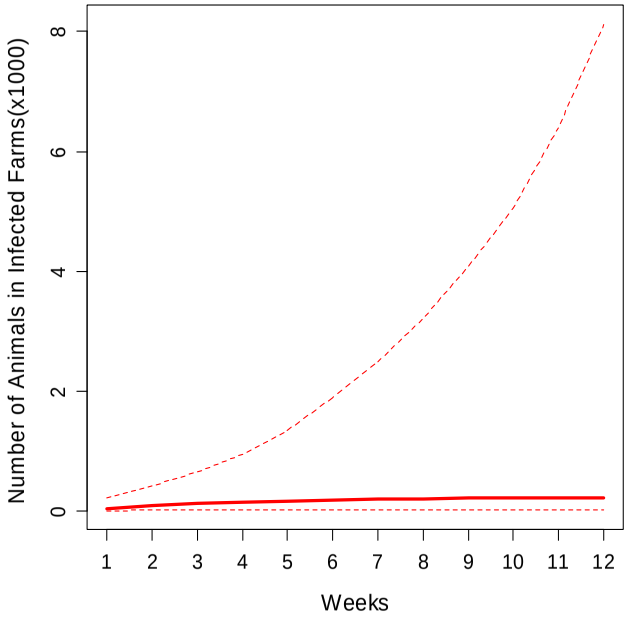
Data and methodology

- information on direct losses from outbreaks in Greece and Bulgaria
- Simulations of impact scenarios with the spread model

ANIMAL MOVEMENT IN GREECE IN 2012–2013 COMPARED WITH 2013–2014

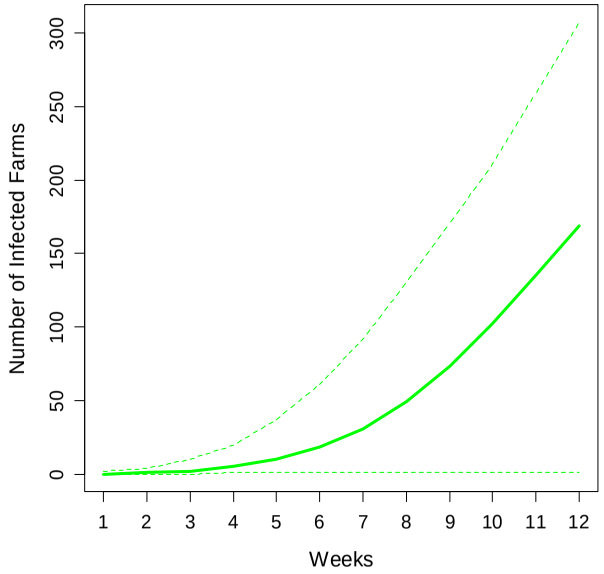


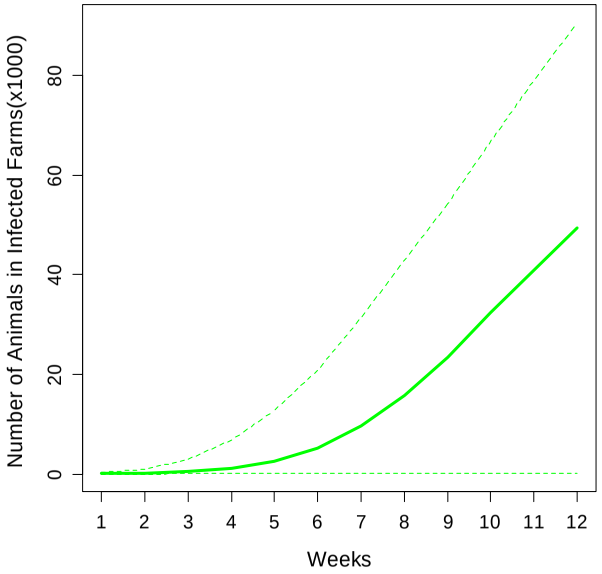




A - Scenario in Greece and Bulgaria

B - Scenario in Iberian peninsula





OUTPUTS – TOR 6

- The major impact of SPP in Greece and Bulgaria was the culling of animals, around 19 300 animals in Greece and 687 in Bulgaria up until April 2014, and the decrease in animal movements from the affected provinces because of the restriction policy (34 % decrease in Greece and 80 % decrease in Bulgaria).
- Based on the output from a spread modelling study and assuming that control measures, such as those implemented by Greece and Bulgaria, are in place, it is predicted that the disease will have limited impacts on the greater region after its emergence in Greece and Bulgaria, even 12 weeks after the initial outbreak.
- In contrast, it is predicted that, by simulating the introduction of SPP/GTP infection in the Iberian Peninsula, the impact of the disease will be much higher, based on the output from a spread modelling study and assuming that the control measures currently applied in Greece and Bulgaria are used. This is attributed to the higher concentration of farms per NUTS3 in this region.
- Each of the modelling outputs has underlying uncertainty and all need to be interpreted with care.

TOR 7: REVIEW OF CONTROL MEASURES

feasibility, availability and effectiveness

Methodology

- **literature review >> knowledge map**
- **expert knowledge**

Framework
Population: sheep and goats
Intervention: Direct and indirect diagnostic tests
Target: SGP virus
Outcome: Se and Sp

OUTPUTS – TOR 7

Diagnostic test

- Under field conditions the **clinical diagnosis** performed by trained veterinary staff is effective for the early detection of outbreaks and the consequent prompt implementation of measures.
- The high variability of reported studies on diagnostic test and vaccine performance makes their comparison difficult, and conclusions on test and vaccine performance should be made with caution.
- Among the test for detection of virus and its nucleic acid PCR assays (including different **real time PCR and gel-based PCR** assays) are considered the most sensitive and specific.

  Sequencing of virus nucleic acid can be used to determine the virus strain for molecular epidemiology purposes.

  Virus isolation is not suitable for primary diagnostics but is needed to confirm the infectivity of the virus.

OUTPUTS – TOR 7

Serological tests

- the performance of **ELISA** assays for SPP/GTP ranges from 70% to 100% for the sensitivity and from 84 to 100% for the specificity. Novel recombinant ELISAs are at experimental stage.
  - **Serum/virus neutralization test** : very specific but not sufficiently sensitive and not suitable as a primary assay or for testing large numbers of samples.
  - **Agar gel immune diffusion test** : a very simple test, requires minimum laboratory facilities, but it lacks sensitivity and specificity.
  - **Western blotting** cannot be used as primary assay but it can be used if an inconclusive or positive SNT/ELISA results need to be confirmed.

OUTPUTS – TOR 7

vaccines

- commercially available vaccines for sheep and goat pox
  - live attenuated vaccines
  - prepared with a limited number of strains.
  - None of these are licensed within the EU
  - the use of these vaccines would inflict immediate restrictions for the international trade of live sheep and goats.
- None of the available vaccines support the DIVA concept.
- Where applied, live attenuated SPP/GTP vaccines provide good protection if a minimal coverage of 75% is created and maintained.

OUTPUTS – TOR 7

vaccines

- Although capripoxviruses are considered to be cross-protective, the use of homologous vaccine is more effective.
- Sufficiently attenuated and tested vaccines are safe and effective, also for use in pregnant animals providing three months of immunity to lambs.
- However some vaccines may have unacceptably high levels of residual pathogenicity.
- Inactivated vaccines are not commercially available, the immunity provided by those is not long-lasting (up to 6 months).
- The use of inactivated vaccines could be considered only in case of an immediate threat of an outbreak, as an emergency vaccine and as a safer option than the use live attenuated vaccine in non-endemic countries.

OUTPUTS – TOR 7

Movement restrictions, biosecurity

- movement restriction of animals appears to be an effective measure to prevent direct contact between animals
- Culling of the affected herds on the basis of the clinical signs and lesions is an effective and time-saving measure to reduce the risk of spread.

RECOMMENDATIONS

Preparedness

- A quantitative import risk assessment of skin and hides coming from affected regions should be performed. This will allow specific measures to be identified to reduce the risk posed by this commodity.
- Enforced biosecurity measures should be applied in risk areas, i.e. (i) introduction of new animals into the herds (quarantine), (ii) farm workers, visitors and veterinarians (e.g. cleaning and disinfection of hands, use of clean protective clothing and footwear) and (iii) cleaning and disinfection of the wheels of vehicles entering/exiting farms.
- Adequate veterinary care and improved surveillance should be in place for transhumant flocks along the migratory routes in risk areas, in particular for long-distance migration.

RECOMMENDATIONS

Preparedness

- Awareness-raising campaigns and training for farmers and veterinary staff in recognising the disease under field conditions should be considered, especially for regions at higher risk of introduction of SPP (i.e. those bordering affected regions).
- In order to reduce the uncertainty regarding SPP epidemiology, harmonised data collection of outbreaks from MSs and neighbouring countries is recommended.
- If non-biological drivers of transmission of transboundary animal diseases change (e.g. breakdown of veterinary infrastructures, human migration, political unrest), the risk of SPP/GTP introduction should be accordingly reassessed. Under this perspective, the cooperation of the EU with neighbouring countries should be encouraged for prevention of TADs and enhance preparedness.

RECOMMENDATIONS

Control

- After culling and disinfection, fully susceptible young sheep could be used as sentinel animals prior to re-stocking. The health of animal sentinels should be monitored for three months (clinical inspection).
- active surveillance to be in place for the first months after repopulating previously infected premises, to enable early detection of recurring epidemics.
- Extending the duration of setting the surveillance and protection zone beyond 21 and 42 days, as prescribed by the EC, could be considered in order to reduce the risk of secondary outbreaks.
- Owing to a large amount of animal movement from affected provinces, it is recommended that restriction of animal movements is promptly and efficiently set when SPP cases are detected, in order to limit the spread of the disease.
- More stringent control measures, including prompt culling after clinical diagnosis and/or extension of the duration and/or size of the surveillance and protection zone, should be considered for SPP/GTP control after introduction into areas with greater numbers of sheep.

RECOMMENDATIONS

Supporting research – The following should be investigated:

- Molecular typing of SPPV/GTPV strains isolated during an outbreak.
- The potential transmission of SPP/GTP through arthropods and wildlife.
- The survival and infectivity of SPPV and GTPV in grazing sites, as well as in animal feed (e.g. fodder or silage), and the need or effectiveness of any inactivation treatments on these matrices.
- real-scale trials on SPPV/GTPV inactivation treatments on sheep and goat hides, skins and wool.
- Diagnostic test validation studies in accordance OIE guidelines in order to properly assess test performance.
- the development of inactivated vaccines, preferably along with application of the DIVA principle.
- Safety of live attenuated vaccines, especially with regard to, for example, the reversion to virulence, the residual virulence, the spread of the vaccine strain and recombination in the field

Thank you for your attention!

Acknowledgements to the team!

- AHAW Panel
- Experts of WGs
- Contractors
- EFSA staff (AHAW and AMU)