Foot & Mouth Disease epidemics in Bulgaria in 2011 and the silence of wild boar
Welcome to Strandzha

4th Jan 2011, 22:00 p.m.
Wild boar positive for FMD type O;
5th Jan - Start of the measures for control and eradication of FMD according to Dir. 2003/85/EC. Clinical and epidemiological examinations as well as blood sampling of susceptible animals in all villages located in the risk area.

Decision 2011/44/EC

Annex I
Annex II

Black sea

Turkey
1. Kosti, (9th Jan) in the vicinity of the place were the wild boar was shot;
2. Rezovo, (15th January) located at the border with Turkey;
3. Gramatikovo, (31st Jan) situated about 7 km west of Kosti,
Kosti – the village of the bones
No Man’s land beyond the barn wire
Disinfection at the only exit from Rezovo
Gramatikovo, Jan 31st

Common grazing areas
FMD or not FMD?
46 days later
Outbreaks:

4. Cattle farm near Kirovo (19th March)
5. Granichar (24th March)
6. G. Bukovo (25th March)
7. Fakia (25th March)
8. Momina Tsarkva (25th March)
9. Bliznak (3rd April)
10. Farm near Bliznak (3rd April)
11. Dolno Yabalkovo (7th April)
Positive wild boar (4th Jan 2011)

FMD outbreak (first wave Jan 2011)

11 FMD outbreaks in Bulgaria in 2011

FMD outbreak (second wave March - April 2011)
Total livestock per village

Map produced by Sergei Khomenko
TCS analysis of complete genome sequences:

- Putative common ancestor
  - Bulgarian (wild boar included) outbreaks
  - First phase of Bulgarian outbreaks in livestock
  - Second phase of Bulgarian outbreaks in livestock

- Closest Turkish virus (Bursa)
- 40 nt changes
- BUL/1/2010 Wild boar
- 30/12/2010
- 26/07/2010

- Kostis
  - 14/01/2011
  - 12LPN1

- Rezovo
  - 16/01/2011
  - 12LPN3

- Kirovo
  - 19/03/2011
  - BUL/11/11

- Momin Tsakva
  - 01/04/2011
  - BUL/32/2011

- Fakia
  - 01/04/2011
  - BUL/30/2011

- Granichar
  - 28/03/2011
  - BUL/26/2011

- Goliamo Bukovo
  - 28/03/2011
  - BUL/20/2011
Control in the protection and surveillance zones

- Last outbreak - 7th April
- Clinical examinations on daily basis negative for FMD clinical signs
- Blood sampling on 18-19 April
- Blood sampling on 28 - 29 April
- Blood sampling on 18-19 May

Note: animals sampled within village to allow detection of 5% sero-prevalence with 95% confidence

Control outside the protection and surveillance zones

Serological surveillance (18-19 April) outside surveillance and protection zones
6942 blood samples of susceptible animals tested FMD negative (type O ELISA):

<table>
<thead>
<tr>
<th>Region</th>
<th>Municipalities sampled</th>
<th>Villages sampled</th>
<th>Domestic susceptible animals sampled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burgas</td>
<td>10</td>
<td>33</td>
<td>4809</td>
</tr>
<tr>
<td>Varna</td>
<td>2</td>
<td>2</td>
<td>307</td>
</tr>
<tr>
<td>Shumen</td>
<td>2</td>
<td>4</td>
<td>824</td>
</tr>
<tr>
<td>Silven</td>
<td>1</td>
<td>4</td>
<td>491</td>
</tr>
<tr>
<td>Yambol</td>
<td>4</td>
<td>9</td>
<td>811</td>
</tr>
<tr>
<td>Haskovo</td>
<td>2</td>
<td>3</td>
<td>297</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>66</td>
<td>6842</td>
</tr>
</tbody>
</table>

Serological surveillance (18-19 May) outside surveillance and protection zones
1172 blood samples of susceptible animals tested with negative results for FMD;

Note: animals sampled within village to allow detection of 5% sero-prevalence with 95% confidence.
## Surveillance in East-Balkan pigs, 2011 - 2012

### Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of blood samples tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burgas</td>
<td>553</td>
</tr>
<tr>
<td>Shumen</td>
<td>582</td>
</tr>
<tr>
<td>Varna</td>
<td>80</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1215</strong></td>
</tr>
</tbody>
</table>
Plan for the control of FMD in susceptible wildlife in South-East Bulgaria

- **clinical examinations** and monitoring of all herds **every 21 days**;
- **blood sampling** for serological surveillance to detect 5% sero-prevalence with 95% confidence within epidemiological unit **every third month**
- FMD susceptible animals can leave “Cordon sanitaire” only for slaughter under special authorisation by veterinary service
- Products thereof can leave “Cordon sanitaire” only after special treatment and under special authorisation by veterinary service
- **Surveillance in wildlife**

<table>
<thead>
<tr>
<th>Number of villages</th>
<th>Animal holdings at Village</th>
<th>Number of animals per Village</th>
<th>Wild Life at the area of village</th>
<th>Hunting fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>106</td>
<td>3,696</td>
<td>10,837 45,258 17,216 176 3,346</td>
<td>4,507 5,424</td>
<td>141</td>
</tr>
</tbody>
</table>
Sero-surveillance in susceptible livestock in the “Cordon Sanitaire”, Aug 2011 – Feb 2012

<table>
<thead>
<tr>
<th>Sampling period</th>
<th>Villages, n</th>
<th>animal holdings, n</th>
<th>Animals, n</th>
<th>blood samples taken to detect 5% prevalence with 95% confidence within village, n</th>
<th>Lab results Type O ELISA</th>
</tr>
</thead>
</table>
Sampling area | wild boar | wild ruminants
--- | --- | ---
A | 59 | 35
B | 59 | 35
C | 59 | 35
Total | 177 | 105

Surveillance goals

Blood samples for serological testing and tissue samples (tonsils) for PCR have to be taken from every animal
Hunting and trapping for surveillance purposes
(7 traps for wild boar established along the border)
Movie: 11 piglets in 1 trap, Kosti, 21.06.2011
Numbers of wild animals tested monthly in the course of surveillance campaign in Bulgaria during the period from February 2011 to January 2012 by species and age groups.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>Age group</th>
<th>Months, 2011:</th>
<th>2011 Total</th>
<th>2012:</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3 4 5 6 7 8 9 10 11 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wild boar</td>
<td>Adult</td>
<td>5 11 22 7 142 162 160</td>
<td>509</td>
<td>29</td>
<td>538</td>
</tr>
<tr>
<td></td>
<td>Juveniles</td>
<td>1 2 30 11 63 93 50</td>
<td>250</td>
<td>7</td>
<td>257</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>17</td>
<td>17</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>5 12 2 0 52 18 222 255 210</td>
<td>776</td>
<td>36</td>
<td>812</td>
</tr>
<tr>
<td>Roe deer</td>
<td>Adult</td>
<td>1 5 17 13 4 17 9 66</td>
<td>66</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Juveniles</td>
<td>1 1</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1 5 0 17 13 5 18 9 68</td>
<td>68</td>
<td></td>
<td>68</td>
</tr>
<tr>
<td>Red deer</td>
<td>Adult</td>
<td>2 3 1 1 7</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mouflon</td>
<td>Adult</td>
<td>2</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>All 4 species</td>
<td>Total</td>
<td>6 17 2 0 71 31 3 230 273 220</td>
<td>853</td>
<td>36</td>
<td>889</td>
</tr>
</tbody>
</table>

No virus detected!
All sero-positive roe deer (n = 3) were adults shot in June near the FMD outbreaks in livestock (~ 5-12 km).
## Surveillance in wild boar (*Sus scrofa*), Feb 2011 – Jan 2012

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Total sampled, n</th>
<th>Ab positive, n</th>
<th>Prevalence (95 % CI), %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td>538</td>
<td>51</td>
<td>9.5 (7.1 – 12.3)</td>
</tr>
<tr>
<td>Juveniles</td>
<td>257</td>
<td>4</td>
<td>1.6 (0.4 - 3.9)</td>
</tr>
<tr>
<td>Age unknown</td>
<td>17</td>
<td>1</td>
<td>5.9 (0.1 – 28.7)</td>
</tr>
<tr>
<td>Total</td>
<td>812</td>
<td>56</td>
<td>6.9 (5.2-8.9)</td>
</tr>
</tbody>
</table>

**Results of serological surveillance for FMD in wild boar in by age groups**

![MONTHS Diagram](image_url)

**LEGEND**
- **B**: Born
- **Mat. Ab, protection**
- **FMD susceptible**
- **Killed**

**Estimated life spans of 4 sero-positive piglets.**
<table>
<thead>
<tr>
<th>ZONE</th>
<th>Negative, n</th>
<th>Positive, n</th>
<th>Total, n</th>
<th>Prevalence, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 5 km</td>
<td>149</td>
<td>16</td>
<td>165</td>
<td>9.7</td>
</tr>
<tr>
<td>6 – 10 km</td>
<td>134</td>
<td>27</td>
<td>161</td>
<td>16.8</td>
</tr>
<tr>
<td>11 – 20 km</td>
<td>195</td>
<td>12</td>
<td>208</td>
<td>5.8</td>
</tr>
<tr>
<td>21 – 30 km</td>
<td>96</td>
<td>-</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>31 – 50 km</td>
<td>127</td>
<td>1</td>
<td>128</td>
<td>0.8</td>
</tr>
<tr>
<td>&gt; 50 km</td>
<td>54</td>
<td>-</td>
<td>54</td>
<td></td>
</tr>
</tbody>
</table>

**Map Note:**
- **Wild boar in Turkey (ND)**
- **FMD outbreaks**
- **ELISA by age group**
  - Negative, JUVENILE
  - Positive, ADULT
  - Negative, ADULT
  - Positive, JUVENILE
During hunting season 2011 – 2012 (Oct – Jan) 4709 wild boar carcasses from the whole territory of Bulgaria were investigated for lesions and signs suggesting FMD.
FMD or not FMD?
Hypothesis outline: ???

- FMD easily spills over to WB from SR (around Kurban?) and develops into epidemics in Nov – March;
- Livestock (summer) and WB (winter) epidemics are in a seasonal in antiphase ("old serotypes" detected);
- Mostly adult animals are involved (rut?);
- Many piglets born thereafter have maternal Ab protection (low prevalence in juveniles);
- This + low population density in early spring + higher temperatures bring $R_0$ below 1.
**THRACE:** virus O +

Dec 2010

**BG:**

Livestock: KURBAN

Farrowing Rut Farrowing Rut

Dec 2010

(a–e) Lesions after FMDV type O infection of wild boar. Vesicles on the dorsum of the snout (a) and the interdigital space (b), 4 DPI. Ruptured vesicles on the heel 8 DPI (c) and 28 DPI (d). Serofibrinous infilling in the interdigital space, 8 DPI (e). Claw deformation after coronary band lesions, 28 DPI (f).

❖ Clinical signs on the 4 DPI (domestic 2 DPI) – e.g. incubation 4 days;
❖ Most severe and evident lesions – 7 DPI;
❖ Viraemia: 1 DPI through at least 9 DPI;
❖ NSP antibodies detected 7-8 DPI;
❖ RNA in saliva normally found up to 14 DPI and up to DPI 24 DPI intermittently.
❖ Wild boar do not play an important role as virus carriers.
• Most likely the disease died out in mid-summer 2011, and the areas subject to intensive surveillance both in Bulgaria and Turkey are now free from FMD in wildlife (and domestic animals). This is based on the observations with epidemiological considerations (hot summer in 2011, which was detrimental for environmental survival of FMDV, a relatively low density of wild boar of ~2-3 heads km, absence of clinical signs or virus detections in a considerably large proportion of animals inspected and tested in Bulgaria in October-December 2011 exactly in the former area of the infection, as well as further away in Turkey).

• The epidemiological model indicates that the presence of deer in the populated area does not alter the spatio-temporal dynamics of the infection in the model and that deer alone are not able to facilitate spread of the infection through the whole landscape.

• The epidemiological model indicates that the strong temperature dependence of FMDV survival in the environment explains the seasonal increased chance of virus fade-out.

• The epidemiological model indicates that continued maintenance (e.g. with moderately virulent CSFV in wild boar) cannot be expected from a wild boar + deer host system alone for FMDV. There is need for cross-transmission between wildlife sub-populations due to human movement or cross-transmission to the domestic sector for virus circulation to be maintained.
Conclusions on FMD epidemic in Southeast Bulgaria

- Spread was spatially and temporary limited;
- Transmission between livestock and wildlife was both ways (facilitated by humans?);
- Disease event in wildlife developed in winter and died away end of spring
- However, serology fails to DATE different stages of this particular disease event ...

EFSA, 2012; Alexandrov et al, 2013, Dhollander et al (in prep.)
• Wild Boar – 4,500,000 (Putman, 2011; EMPRES data);
• Roe Deer – 9,500,000 (Burbaitė & Csanyi, 2009);
• Red Deer – 1,700,000 (Burbaitė & Csanyi, 2010).

20 – 22 million FMD susceptible wild ungulates after reproduction
Reinstatement of the FMD free status

- 1\textsuperscript{st} application dossier submitted in Nov 2011
- 2\textsuperscript{nd} application dossier submitted end of May 2012
- Additional information for surveillance on the whole territory of Bulgaria submitted in July 2012
- 31\textsuperscript{st} Aug 2012 - Reinstatement of the free status of Bulgaria – one year and five months after the last outbreak
Acknowledgements

- Kamenov, Boykovski, Naidenska, Miteva and the whole team of the Animal Health and welfare Directorate at the BFSA
- Prof. Georgiev, Polihronova and the whole team of the Bulgarian NRL for FMD
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- Sergei Khomenko – FAO
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