Control and Elimination of Rabies in the Baltic States

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The Baltics and their Rabie’s History

Sylvatic rabies emerged in 1950s-1960s
(European epidemic started in 1940s)

Topography relatively flat max ≈300m
≈40% of temperate forest

Two principally infected species:
Nyctereutes procyonoides
Vulpes vulpes
Before 2005: Various manual ORV field experimentations (area, frequency, bait, etc.) in Lithuania and Latvia

Following accession to the European Union in 2004:

Regular harmonised ORV plan in the three countries

- Biannual campaigns (Spring and Autumn)
- On the whole territory since 2006
- Aerial distribution

2006

Estonia and Latvia ≈ half territory

Some variations remain, including:
- Bait density
- Bait type
- Use of automatic device

Rabigen (Virbac)  Fuchsoral (IDT)  Lysvulpen (Bioveta)
Rabies surveillance

Sampling scheme: In the whole country – during all the year

Assessment of rabies incidence

Indicator animals
Animals suspected of having rabies
Animals having contaminated human beings

Rabies diagnosis
High chances to detect positive cases

Rabies diagnosis (FAT, RTCIT, PCR)

No sample size
Evaluation of control strategy efficiency

Hunted foxes and raccoon dogs ("Healthy" animals)

- Seroconversion (ELISA test)
- Bait-uptake (Biomarker detection)

Analysis of rabies antibodies
Analysis of biomarker occurrence

Sample size recommended: 4 animals per 100 km² annually (WHO, 2013; EFSA, 2010)
**TEN YEARS OF SURVEILLANCE AND CONTROL**

- Estonia
- Latvia
- Lithuania

**33% of foxes**

**38% of raccoon dogs**

Time needed to reduce by 90% the number of positive detected cases (based from the maximum semi-annual incidence):

- 2 ORV campaigns in Estonia,
- 4 in Lithuania,
- and 8 in Latvia.
SURVEILLANCE OF RABIES

Taking into account the total number of animals tested

24,919 animals tested in 10 years

Decrease of the proportion of positive samples, as soon as the whole territory of each country was vaccinated.
SURVEILLANCE OF RABIES

Last detected case:
2011 in Estonia
2012 in Latvia
2013 in Lithuania

Maps provided by the Rabies Bulletin Europe website

Surveillance of Rabies

2005

2014

Self-declaration by Estonia on the recovery of its rabies

Self-declaration by Lithuania of freedom from rabies

News from C

Maps provided by the Rabies Bulletin Europe website

Self-declaration by Latvia of freedom from rabies

Self-declaration

OIE Free status
### BAIT UPTAKE RATE

**Influence of the**
- country (Latvia vs Lithuania vs Estonia) on the TTC rate?
- species (fox VS raccoon dog)
- season (autumn vs spring)
- year
- age (juvenile vs adult) for Estonian and Lithuanian data only

#### GLM formulae: glm.nb(npos~species+year+country+offset(log(ntest)))

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Estimate</th>
<th>CI (95%)</th>
<th>P-value (Wald test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a) Baltic states</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPECIES</td>
<td>Raccoon dog</td>
<td>-0.12</td>
<td>-0.190 ; -0.045</td>
<td>0.00149</td>
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<td>YEAR</td>
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<td>&lt;0.0001</td>
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<td>COUNTRY</td>
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<td>-0.175 ; 0.000</td>
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<td>COUNTRY</td>
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<td>-0.21</td>
<td>-0.294 ; -0.116</td>
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<td>b) Estonia and Lithuania</td>
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<tr>
<td>AGE</td>
<td>Juvenile</td>
<td>-0.11</td>
<td>-0.182 ; -0.033</td>
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<tr>
<td>YEAR</td>
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<td>0.03</td>
<td>0.019 ; 0.050</td>
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<td>0.274 ; 0.121</td>
<td>&lt;0.0001</td>
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</table>

Models comparison performed using Akaike criterion (AICc)
BAIT UPTAKE RATE

Evolution of the bait uptake per country

Maximum infected area:
- Estonia: 42,922 km²
- Latvia: 64,000 km²
- Lithuania: 63,000 km²

Year and semester

N dropped baits

N positive cases

SAG 2

SAD B19

SAD Bern

Season and Year

Bait Uptake Rate

Evolution of the bait uptake per species

As suggested by GLM analysis:
TTC level increase over time,
TTC level higher in Red foxes than in Raccoon dogs.
Influence of the

- country (Latvia vs Lithuania vs Estonia) on the Seroconversion rate?
- species (red foxes vs raccoon dogs)
- season (autumn vs spring)
- year
- age class (juvenile vs adult) for Lithuanian data only

GLM formulae: glm.nb(npos~season+offset(log(n.test)))

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<td>Baltic states</td>
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<tr>
<td>SEASON</td>
<td>Spring</td>
<td>0.07</td>
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<tr>
<td>AGE</td>
<td>Juvenile</td>
<td>-0.15</td>
<td>-0.324 ; 0.017</td>
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</table>

No significant factors detected
SEROCONVERSION RATE

Evolution of the seroconversion rate per country

No specific pattern: Reliability of the ELISA tests used?

Suggested by Knoop, 2010; De Benedictis 2012; Wasniewski; 2014, etc..
Central Europe (CE) and Serbian Fox phylogroup

Bourrhy et al., 1999
PHYLOGENETIC STUDY

Weastern Europe (WE) phylogroup

Bourry et al., 1999; Lojkic at al., 2010; Mc Elihnney et al., 2011
PHYLOGENETIC STUDY

Eastern Europe (EE) phylogroup

Bourrhy et al., 1999; Mc Elhinney et al., 2006; Lojkic et al., 2010; Turcitu et al., 2010; Mc Elhinney et al., 2011; Picard et al., 2012;
PHYLOGENETIC STUDY

North Eastern Europe (NEE) phylogroup

Bourrhy et al., 1999; Vanaga et al, 2003; Turcitu et al., 2010; Picard et al., 2012
PHYLOGENETIC STUDY

East of Russia (C) phylogroup

Kuzmin et al., 2004; Picard et al., 2012
PHYLOGENETIC STUDY

158 field rabies virus collected

North Eastern Europe (NEE) phylogroup
PHYLOGENETIC STUDY

5 field rabies virus collected

Western Russia (C) phylogroup
**PHYLOGENETIC STUDY**

2 vaccine associated cases

**1st case:**
- *Marten marten*
- 2008 in Lithuania
- SAD B19 strain identified (N gene)
- but...ORV using Lysvulpen

**2nd case:**
- *Badger badger*
- 2013 in Latvia
- SAD B19 strain identified (N and G genes)
- but...ORV using Lysvulpen

First identification in two non target species
CONCLUSION

☐ ORV effective to eliminate the disease in the three countries.

☐ Possibility to improve the ORV effectiveness by adapting the method more on the raccoon dog biology?

☐ Concern on the reliability of the serological tests, but promising new ELISA kit recently evaluated.

☐ Risk of reintroduction highlighted by sporadic cases of the C lineage: need to continue vaccination belt on border areas.

☐ Vaccine induced rabies cases reported for the first time in two non target species.
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