EFSA Epidemiology (Epi) Working Group (WG) for Bluetongue (BT) Virus Serotype 8 Epidemic

Hubert Deluyker
SCA Department
EFSA
Background

- **8 September 2006**
  - local epidemiology network (B, D, NL)

- **22 September 2006**
  - European Commission (EC) Chief Veterinary Officer (CVO) meeting recommends for EFSA to create BT Epi WG with
    - experts from Commission, Member States (MS), CRL, OIE Ref Lab
    - chaired by Prof. D. Pfeiffer (Member EFSA AHAW Sci. Panel)

- **5 October 2006**
  - EC requests Scientific Assistance from EFSA (under article 31 of Regulation (EC) No. 178/2002)
Mandate from the European Commission

- **objectives and timelines**
  - regular epidemiological reports: weekly reports
  - global epidemiological analysis: draft report on 31 January 2007

- **final steps after 6 and 7 February meetings**
  - considered comments from 6 and 7 February meetings and put report through 31 January on the EFSA web
  - finalised global epidemiological analysis by 31 March 2007
    - conducted further in-depth analyses, as needed
    - updated reports under review
Global Epidemiological Analysis - Aims

- detailed description and exploration of all relevant outbreak data
- hypotheses: what factors affect
  - introduction,
  - establishment, and
  - spread
Global Epidemiological Analysis - Inputs

- ADNS notification data
- more detailed outbreak information
  - clinical and
  - serological
- animal density data
- international (TRACES) and national movement data
- meteorological and environmental data
Detailed Description of Epidemic: Onset, Establishment and Spread

- Time-space distribution of the outbreak between herds & Identification of the area of first infection – G. Gerbier, CIRAD
- Description of the clinical aspects of the outbreak and Pattern of the disease within herds – A. Elbers, CIDC
- Vector studies – R. Meiswinkel, CIDC
- Environmental factors affecting spread – C. Staubach, FLI
- Human interventions affecting introduction and spread – K. Mintiens, VAR
Identification of the area first affected

G. Gerbier
1CIRAD, France
Area of first infection

- Potential earliest case:
  - farm in Belgium 5km from B,NL,D borders
  - earliest clinical signs: possibly 17/07/2006

- Model-based estimation:
  - probable origin: centered in The Netherlands close to Maastricht
Conclusions

- Not possible to pinpoint precisely farm(s) of first infection statistically (Iceberg effect)
- Instead, 20 km area of first infection (AFI) covering:
  - border area between NL,B,D
  - first reported infections in each country
  - farm with potentially earliest symptoms
Possible routes of introduction

E. Meroc\textsuperscript{1}, K. Mintiens\textsuperscript{1}, M. Aerts\textsuperscript{2}, J. Cortinas\textsuperscript{2}, C. Faes\textsuperscript{2}, E. Ducheyne\textsuperscript{3}, G. Hendrickx\textsuperscript{3}

\textsuperscript{1}CODA-CERVA, Belgium, \textsuperscript{2}Centre for Statistics, Hasselt University, Belgium, \textsuperscript{3}AVIA-GIS, Belgium
Possible routes of Introduction

- not an import risk assessment
- at first all imports considered: no reliable data on BTV8 occurrence outside the EU
- only considered inward movements into AFI
- potential imports in the AFI that were explored
  - import live ruminant: potential to carry BTV infection
  - import non-susceptible mammals: potential to carry BTV-infected vector
  - introduction ruminant-live products (semen, ova, embryos): potential to carry BTV
Conclusions

- Potential scenarios that were not formally explored - *doesn’t mean not potentially important*
  - animals: transit, illegal, travelling animals e.g. circus, zoos
  - vector introduction via plant imports
  - contaminated biologicals

- Results on imports for explored routes
  - domestic or wild ruminants: no imports
  - horses: imports took place, but a risk assessment would need to consider mitigating measures and other factors affecting likelihood of vector introduction with horses
  - ruminant-live products: only indirect imports took place
The molecular epidemiology of Bluetongue in Europe since 1998: routes of introduction of different serotypes and individual virus strains

(Ph. Mellor and P. Mertens, IAH-Pirbright, U.K.)
Nature and Severity of Disease in Cattle and Sheep

A.R.W. Elbers¹, K. Mintiens², C. Staubach³, G. Gerbier⁴, A.N. van der Spek⁵, E. Meroc², F.J. Conraths³, H.M. Ekker⁵, A. Backx¹

¹ CIDC-Lelystad, The Netherlands; ² CODA-CERVA, Belgium; ³ FLI, Germany; ⁴ CIRAD, France; ⁵ VWA, The Netherlands
Results

- **Herds without clinical signs in** 10% of infected cattle and less than 2% of infected sheep flocks.

- In majority of cases, **only 1 or 2 animals showed clinical signs** in a cattle herd or sheep flock at time of clinical inspection.

- One or more BTV-associated **dead animal(s)** at clinical inspection in 9% of infected cattle herds and 34% of sheep flocks.

- No follow-up data from these herds.
Conclusions

- Clinical signs in infected cattle herds were expressed differently to those in sheep flocks.
- BTV-8 associated clinical signs were seen relatively more in sheep flocks than in cattle herds.
- Contrary to historical data that BTV produces only transient and mild - if any - clinical signs in cattle, we found BTV-8 to be associated with distinct clinical signs in some cattle in infected herds.
PCR- and Seroprevalence within Herds

A.R.W. Elbers\textsuperscript{1}, K. Mintiens\textsuperscript{2}, G. Gerbier\textsuperscript{3}, A.N. van der Spek\textsuperscript{4}, E. Meroc\textsuperscript{2}, S. Zientara\textsuperscript{5}, P.A. van Rijn\textsuperscript{1}

\textsuperscript{1} CIDC-Lelystad, The Netherlands; \textsuperscript{2} CODA-CERVA, Belgium; \textsuperscript{3} CIRAD, France; \textsuperscript{4} VWA, The Netherlands; \textsuperscript{5} AFSSA, France
Conclusions

- Only clinically sick animals (1–3 animals within each herd) were sampled at clinical inspection, almost all were found to be positive using PCR and/or serology.

- Although based on sparse data “whole-herd-sampling” revealed two tendencies:
  - a high proportion of the cattle within herds were positive using PCR and/or serology, while
  - only a small proportion of the sheep within flocks were positive using PCR and/or serology.

These observations are supported by initial results obtained from a longitudinal field study being conducted in The Netherlands.
Conclusions

- In **cattle herds** a large proportion of the animals can be PCR and serologically positive but little distinct clinical signs of disease. Hence, a monitoring system based on serological screening may be a good option for cattle herds.

- In **sheep flocks** show clear signs of disease but generally few animals within a flock were PCR and/or serology positive. Thus, for sheep a monitoring system based on clinical signs seems to be the better option.
Results: local rate of spread in area of first infection

- assuming 100 days elapsed since the beginning
- whole dataset used
- average BTV dispersal rate of 2 km/day ~ 15 km / week
- compatible with
  - knowledge about active *Culicoides* flight
  - spread observed in other contexts (Sardinia)
- probably mixture of midge and local animal movements
Temporal distribution within the clusters

- Maastricht
- Köln
- Gent

Mid-September
End of 1st phase

Number of cases

Weeks

33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Conclusions

- two clusters (Maastricht and Gent) separated by a gap: *clue to long distance spread*
- circular shape of the two clusters: *clue to local isotropic spread*
- no merging of the two clusters into one large cluster at the end of 2006
- on the fringe of the epidemic: virus circulation was very limited
Epidemiological characterisation of the control measures

E. Meroc¹, K. Mintiens¹, M. Aerts², J. Cortinas², C. Faes², E. Ducheyne³, G. Hendrickx³

¹CODA-CERVA, Belgium, ²Centre for Statistics, Hasselt University, Belgium, ³AVIA-GIS, Belgium
Description of the measures taken

- **Review based on**
  - procedures and legislation published by affected MSs
- All measures taken in accordance with **directives 2000/75/EC and 2005/393/EC**
  - interpreted slightly differently by NL,D,B
  - more significant differences between NL,D,B and F
- **France**
  - elaborate legislation already in place due to BTV epidemics in the south
  - measures implemented early because of the threat in neighbouring MSs (150km zone)
    - culling of infected animals imported from affected MS
    - epidemiological and entomological surveillance
Description of the measures taken

- Most restrictive at the start of the epidemic
- Amendments throughout the course of the epidemic:
  - Always to lower restriction level
  - Mostly based mutual agreements between affected MSs
  - Concerned ‘Low-risk amendments’ (e.g. animals to slaughterhouse)
- There was no statistically significant association between the measures taken and the intercept and slope of the BT incidence curve
Studies on Culicoides in the affected countries

1R. Meiswinkel, 2T. Baldet, 3R. De Deken, 1M. Goffredo, 4J.-C. Delécolle, 5A. Conte, 1P. Leijs

1CIDC, The Netherlands, 2CIRAD, France, 3ITM, Belgium, 4Université Louis Pasteur Musée Zoologique, Strasburg, Belgium, 5IZS Terramo, Italy
**Conclusions**

- *Culicoides imicola*, that is involved in BTV transmission on southern Europe, was not found in central Europe.
- *Culicoides* endemic to central Europe include multiple vectors of BTV.
- Hence orbiviruses affecting livestock stand a good chance of being transmitted once they are adventitiously introduced in this part of Europe.
- Significant numbers of *Culicoides* were found to enter buildings to bite animals indoors.
Daily Culicoides abundances and altitude-adjusted mean temperature (12 and 27 September 2006)
Main Recommendation: take Culicoides seriously

- they transmit at least 60 viruses
- they have been around for 90 million years, so
  - have experienced climate change and
  - are experienced in ‘survival’ and ‘bloodsucking’
Environmental and Climatic Factors affecting the Vector and the Disease

1C. Staubach, 2A. Conte, 3R. Meiswinkel, 1F.J. Conraths, 1J. Gethmann, 1F. Unger, 1A. Fröhlich, J. 4Gloster, 5B. Purse
1FLI, Germany, 2IZS, Teramo, Italy, 3CIDC The Netherlands, 4CRL-IAH, UK, 5Oxford University, UK
BTV-8 and mean temperature (altitude-adjusted)
Weekly BTV-8 cases (shifted back by 4 weeks) and altitude-adjusted mean temperature
BTV-8 and cattle density (km²)
BTV-8 and elevation
Conclusions

- Daily variations in *Culicoides* numbers were strongly correlated with prevailing temperatures.
- Lag time between temperature and outbreaks is estimated at ~4 weeks.
- Lower average temperatures in cooler, hilly areas may have slowed down the spread of the disease.
- Lower cattle and sheep densities interrupted the spatial continuity of outbreaks of BTV-8.
Possible Vector Spread through Wind

G. Hendrickx¹, E. Ducheyne¹

¹AVIA-GIS, Belgium
BTV-8: Wind density model

- two types of flight behaviour of *Culicoides*:
  - Short distance flights to and from feeding and breeding habitats
  - Long distance wind-assisted dispersal

- can wind events explain the epidemic pattern?
BTV8 2006 outbreak area: 4 week time lag wind / outbreaks

Cumulated Wind density – Week 43
Outbreaks – Week 47
Conclusions

- Observed density of wind events in an east-west direction may partly explain this ‘horizontal’ spread of the epidemic.

- The relatively low number of cross-channel wind density events, especially after the outbreaks had reached the Belgian coastal zone, may explain why BTV did not arrive in the UK.

- Terrain roughness may be an important factor preventing the spread of infected midges on the wind.

- Preventing the establishment of dense primary foci of infected *Culicoides* on farms should probably inhibit subsequent long-range spread of BTV, assuming infected animal movement is controlled.
Overall Conclusions: epidemic results from interactions

- **Biology**: both virus and vector
- **Environment**: may be influenced by climate change
- **Human intervention**: can affect movement of infected animals and vectors
Overall Conclusions: Success Factors for Epidemiological Transboundary Animal Disease Outbreak Investigations

- the good cooperation between institutions involved
  - Member States
  - Commission
  - EFSA

- data access
  - confidentiality issues
  - consistency of data from different Member States
  - quality small ruminant data

- preparedness through training and standardisation