Exploring BPHS lesions time trends:
July 2005 - March 2015

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1 EXECUTIVE SUMMARY

The purpose of this report is to explore the temporal trends of the conditions assessed under the BPEX Pig Health Scheme from the middle of 2005 to March 2015.

The prevalence of enzootic pneumonia-like (EP-like) lesions (mild and severe) is on the increase in the last quarter. The prevalence of pleuropneumonia lesions showed the same increase in the last quarter, while the prevalence of the other respiratory lesions (pleurisy, abscesses in the lung and viral-like pneumonia) showed a decrease.

The proportion of animals affected by peritonitis, pericarditis papular dermatitis, hepatic scarring and pyaemia seems to be stable since the beginning of 2014 although some lesions show seasonal variation.

An increase in prevalence of milk spots lesions and tail damage was observed in the last quarter.

2 OBJECTIVE

The purpose of this report is to explore the temporal trend of the conditions assessed under the BPEX Pig Health Scheme (BPHS): enzootic pneumonia-like lesions (EP-like), pleurisy, milk spot, hepatic scarring, papular dermatitis, pleuropneumonia lesions, pericarditis, peritonitis, viral-like lesions, abscess, pyaemia and tail damage.

3 BACKGROUND

The BPHS is one of the main projects implemented by BPEX with the aim of supporting the pig industry. The main objective is to increase the awareness of pig producers and veterinarians about the occurrence of subclinical disease.

The BPHS, with eight years of consistent monitoring in English abattoirs, offers a unique opportunity to explore the trends in the occurrence of different abattoir lesions, in order to identify any improvements in pig health.

4 MATERIAL AND METHODS

4.1 Data source

We used the records available for the BPHS from July 2005 (when the scheme started) to March 2015. No distinction between members is made in this report because, since previous reports, the definition of being a member has changed and therefore any comparison between members and non-members across time is not valid. A total of 52,043 batches from producers have been assessed during that time period, consisting of 2,221,205 individual pigs assessed. In January 2013 no assessment was carried out. The trend in the number of batches assessed per month can be observed in Figure 1.

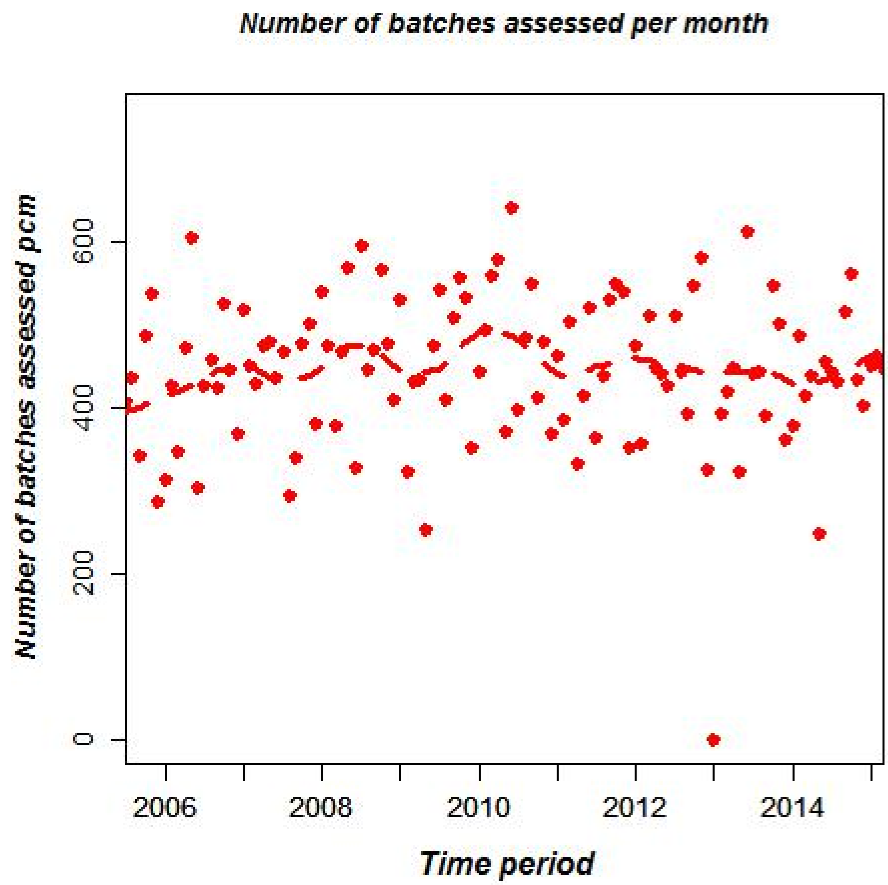

Figure 1. Evolution of the number of batches assessed. The dots represent the data and the lines the fitted trend.

4.2 Exploratory analyses.

4.2.1 Prevalence data - time series.

The pig level time-series was composed of the sequence of monthly prevalence, computed as the number of pigs affected with the lesions divided by the number of pigs assessed. The seasonal cycle was studied yearly (12 month).

Batch-level prevalence was studied in four ways: “at least 1 pig affected” where the batch was considered positive when any pig is affected with the condition; “over 5%” where the batch was considered positive when more than 5% of the pigs inspected in the batch are affected with the condition; “over 10%” where the batch was considered positive when more than 10% of the pigs inspected in the batch are affected with the condition; and “over 15%” where the batch was considered positive when more than

15% of the pigs inspected in the batch are affected with the condition. Since, in the majority of cases, BPHS assessed 50 pigs per batch, the lowest batch-level prevalence "at least 1 pig affected" corresponds to a batch-level prevalence of 2%. The batch level time-series was composed of the sequence of batch monthly prevalence, computed as the number of positive batches divided by the number of batches assessed.

4.2.2 Trend analyses.

Trend was investigated using STL, a nonparametric and non-inferential filtering procedure for decomposing time-series into additive components of variation (trend, seasonal and the remainder) by application of a locally-weighted regression smoothing modelling. The STL decomposition method has been recommended above other methods due to its good visualization capabilities and good performance on the data fitting. For January 2013, as no data was collected, the average of all the months of January from previous years was used to input a value which could be used for the trend analysis. In this way the seasonal trend is taken into consideration.

4.2.3 Program.

All the above mentioned analyses were performed with R version 3.0.2 from the R Foundation for Statistical Computing. http://www.r-project.org.

5 RESULTS AT PIG LEVEL

5.1 Results for EP-like lesions.

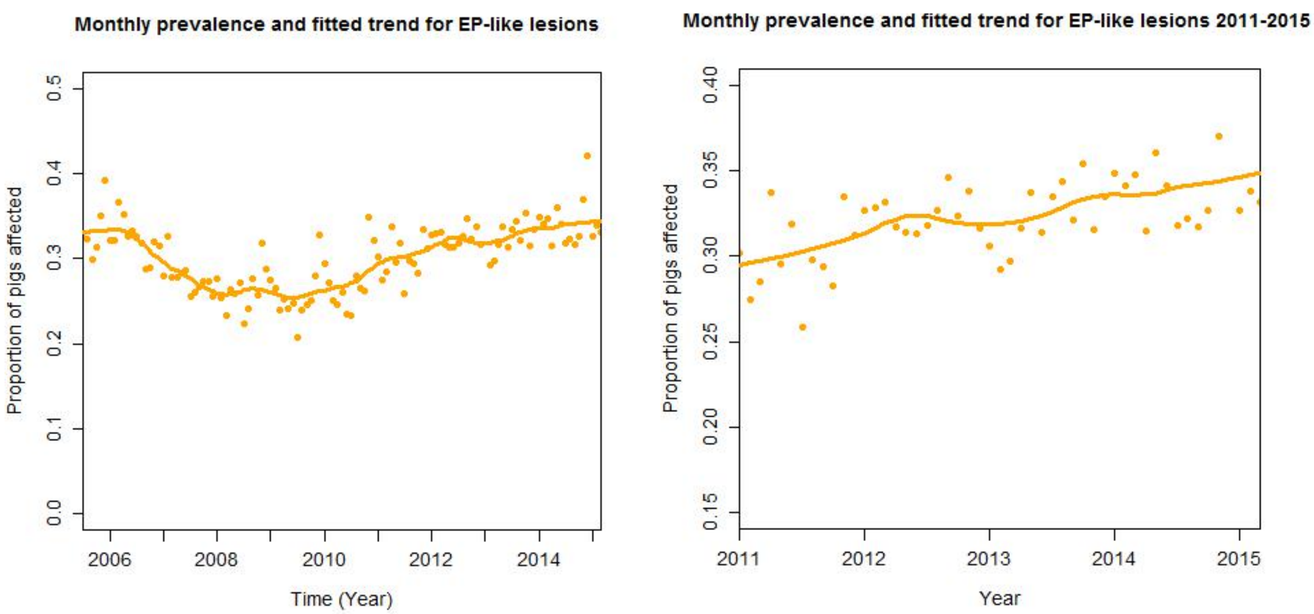

Figure 2a. Animal level trend for EP-like lesions. The dots represent the data and the lines the fitted trend. The left plot shows the trend over all the years of the scheme. The right plot is an extract of the left plot showing the trend from 2011 to 2015 in greater detail.

Enzootic pneumonia is a contagious pulmonary disease of pigs caused by *Mycoplasma hyopneumoniae.* It is characterised clinically by coughing, illthrift and, although associated with very low mortality, is a cause of economic loss. The spread of infection within a unit depends upon the husbandry system. Infection is transmitted most rapidly within common airspaces in continuous stocking systems with open pen divisions, and least rapidly in all-in-all-out systems and outdoor systems. Swine influenza, PRRS, *Haemophilus* infection and other mycoplasma infections also can cause EP-like lesions.

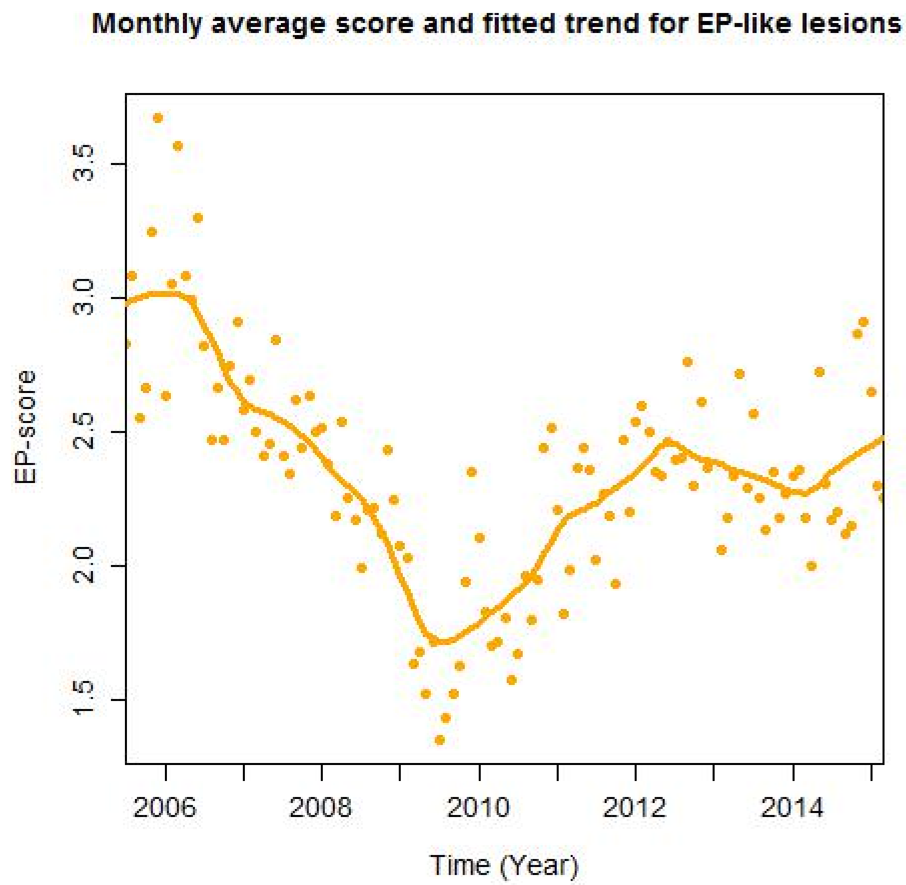

Figure 2b. Animal level average score trend for EP-like lesions. The dots represent the data and the lines the fitted trend.

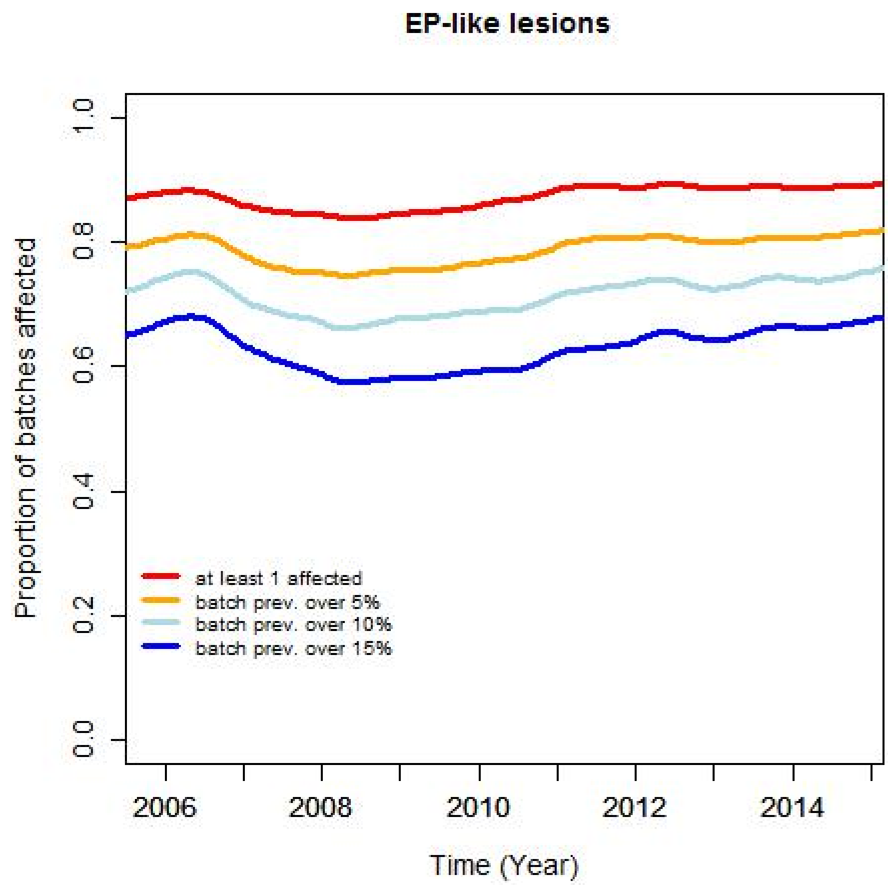

Figure 3. Batch level trend for EP-like lesions.

The analysis of the trend shows that there was an increase in the proportion of individual pigs affected (Figure 2a, left plot) from the middle of 2009, until the middle of 2012, followed by a slight decrease (more evident on Figure 2b). From the middle of 2013 the prevalence appears to increase (Figure 2a, right plot). In contrast the EP-like lesions scores show a decrease from the middle of 2012, although with seasonal variation, resulting in an increase by the end of 2014 to levels seen in 2012 (Figure 2b).

At batch level most of the batches (around 90%) had at least one positive animal (red line in Figure 3), and seven of every ten batches had at least 15% of animals affected (blue line in Figure 3).

5.2 Results for EP-like severe lesions.

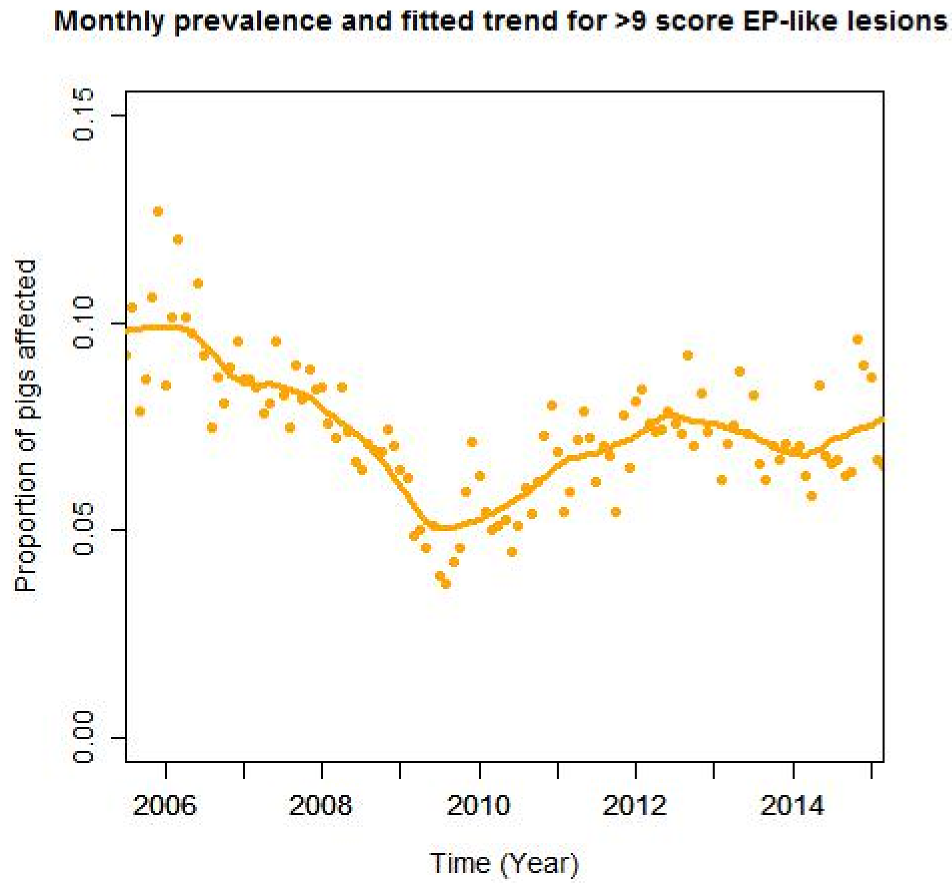

Figure 4. Animal level trend for EP-like severe lesions for those with pig individual score over 9. The dots represent the data and the lines the fitted trend.

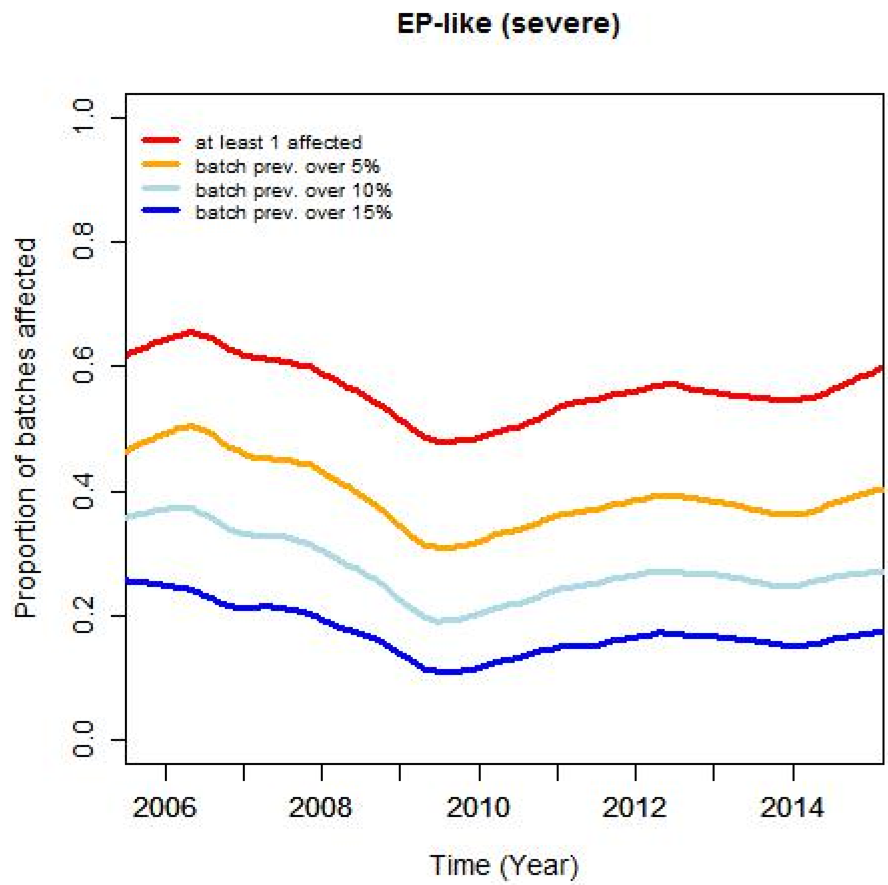

Figure 5. Batch level trend for EP-like severe lesions for those pigs with an individual score over 9.

The EP-like severe lesions (with score higher than 9) are the ones that cause more economic loss as they influence the growth of pigs. The trend of EP-like severe lesions (Figure 4) is similar to the trend for the average EP-like score (Figure 2). Within more recent years, a decrease in the proportion of animals affected from the middle of 2013 until the beginning of 2014 has been followed by an increase since then (Figure 4). Figure 5 shows a similar trend at batch level.

5.3 *Results for pleurisy.*

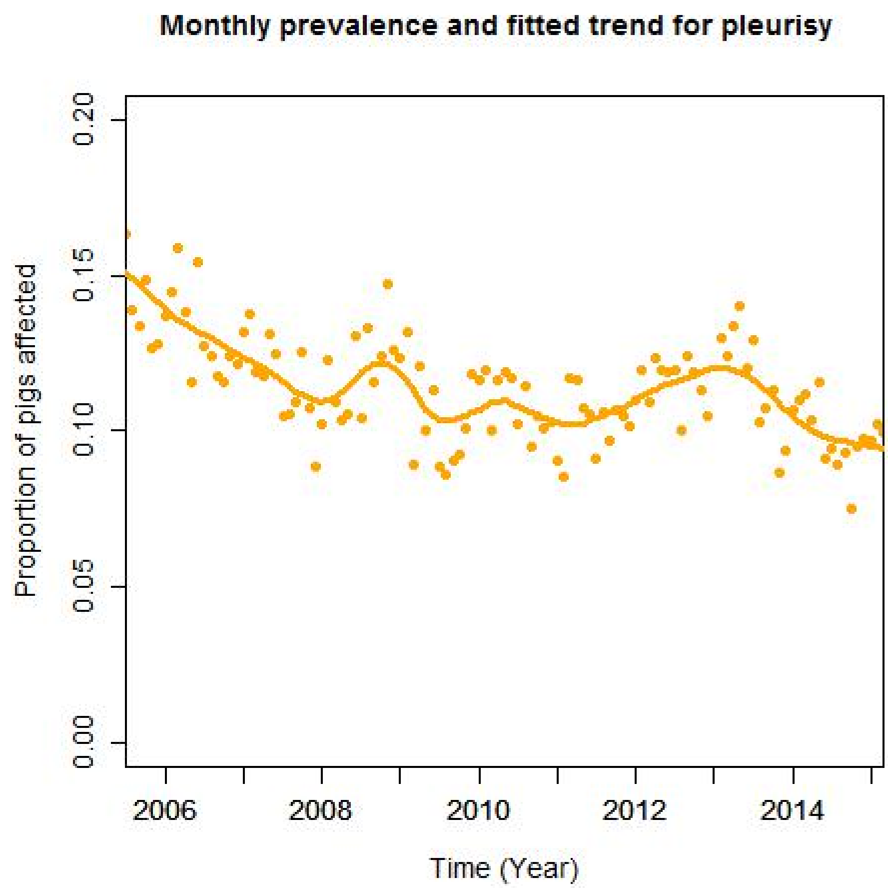

Figure 6. Animal-level trend for pleurisy. The dots represent the data and the lines the fitted trend.

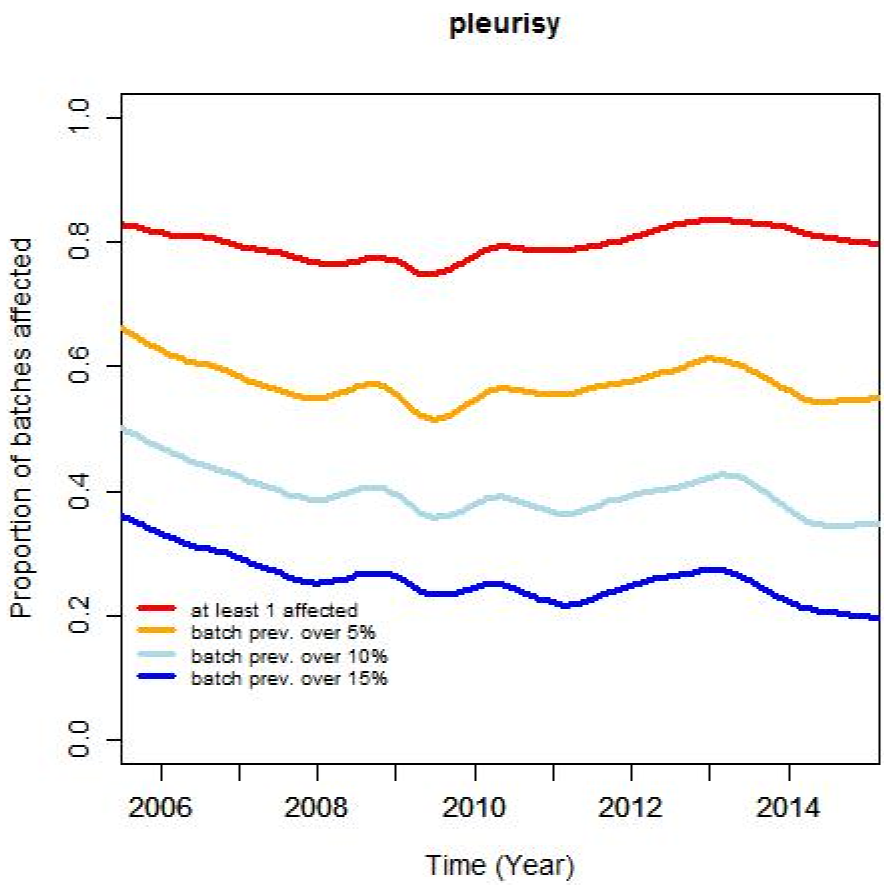

Figure 7. Batch-level trend for pleurisy.

Pleurisy describes adhesions between lung lobes (mild) or between the lungs and the thoracic wall (severe). This, together with pericarditis, is very common in pigs and accounts for considerable loss through condemnation at slaughter. Viruses such as flu, PRRS, swine fever and the bacteria *Actinobacillus pleuropneumoniae*, *Haemophilus parasuis* and *Pasteurella multocida* can cause pleurisy. Figures 6 and 7 show that the prevalence of pleurisy has fluctuated over the years. Since the first quarter of 2013 the prevalence shows a decreasing trend (Figure 6 and 7) and this decreasing trend seems to be due to the decrease in the prevalence of batches with more than 5% of pigs affected (Figure 7 – yellow, light blue and dark blue lines).

5.4 Results for milk spots.

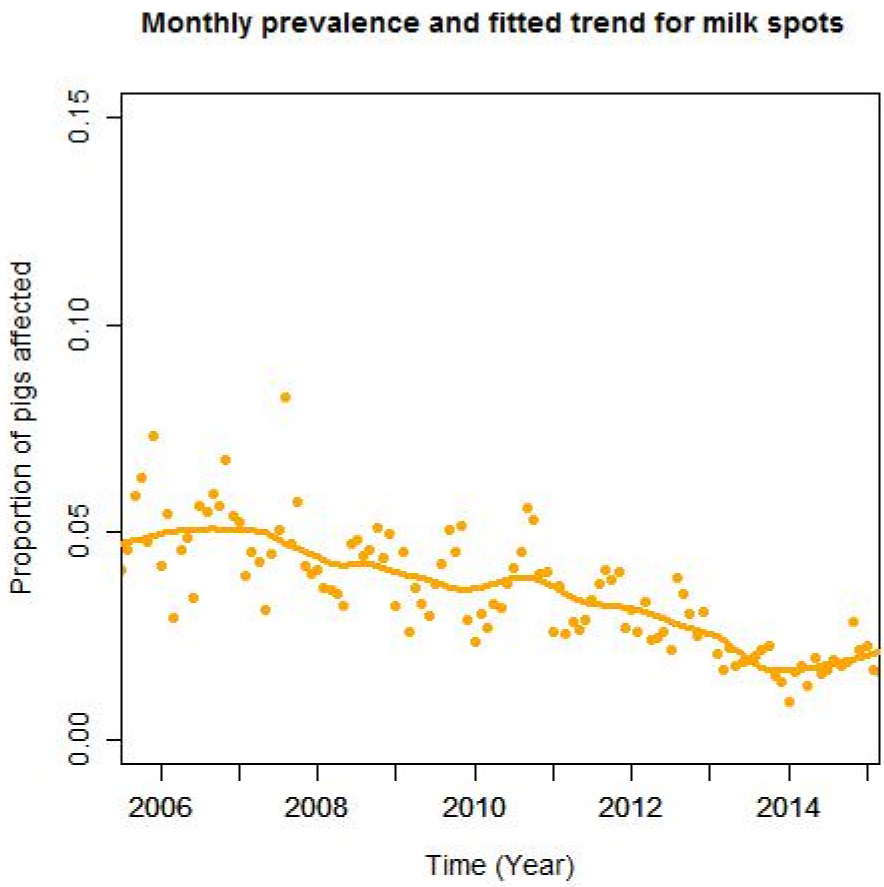

Figure 8. Animal-level trend for milk spot liver. The dots represent the data and the lines the fitted trend.

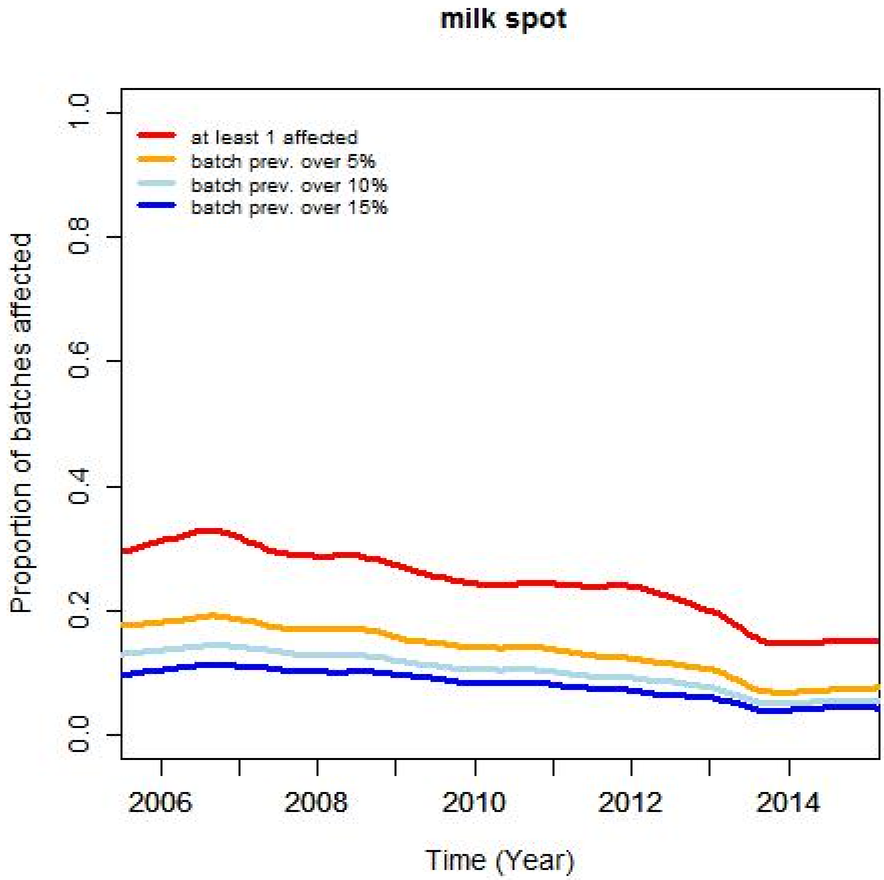

Figure 9. Batch-level trend for milk spots in liver.

Milk spots in the liver are evidence of recent migration of *Ascaris* nematode worms, a cause of condemnation of livers. *Ascaris* nematode worms also affect the growth rate and food conversion. There has been a slow decline in the proportion of pigs and batches affected over the years (Figure 8 and 9). It is noticeable that the proportion of batches affected severely (more than 15% affected pigs in the batch) is below 10% (Figure 9). Since the beginning of 2014 the animal prevalence appears to have stabilized or slightly increased (Figure 8).

5.5 Results for hepatic scarring.

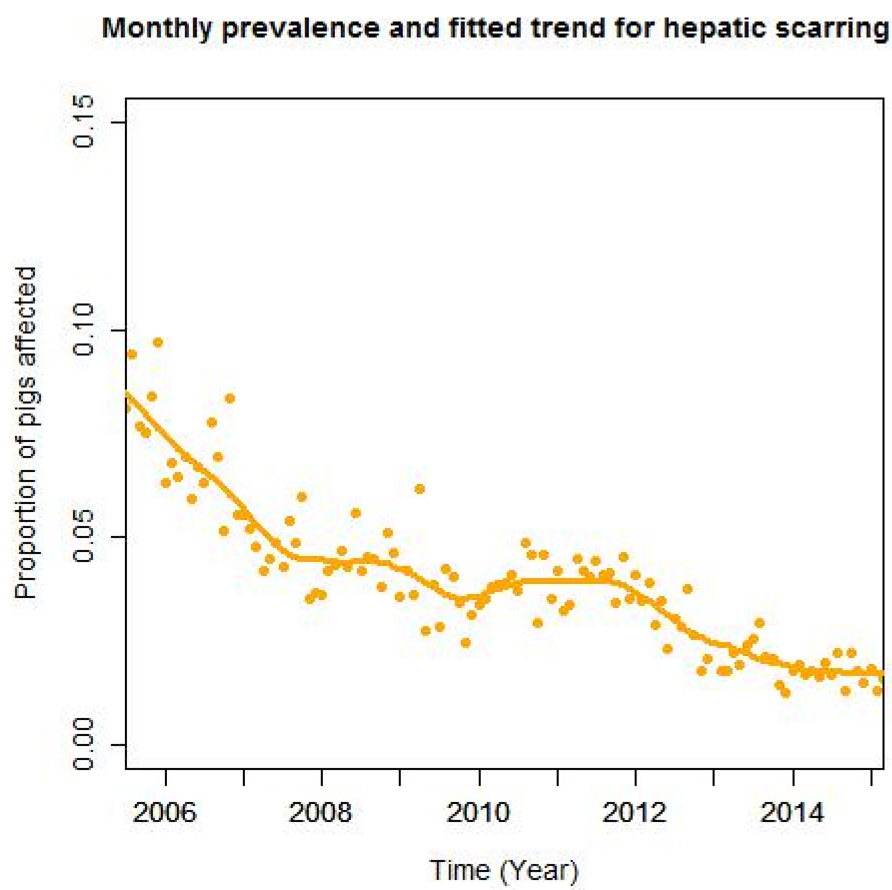

Figure 10. Animal-level trend for hepatic scarring. The dots represent the data and the lines the fitted trend.

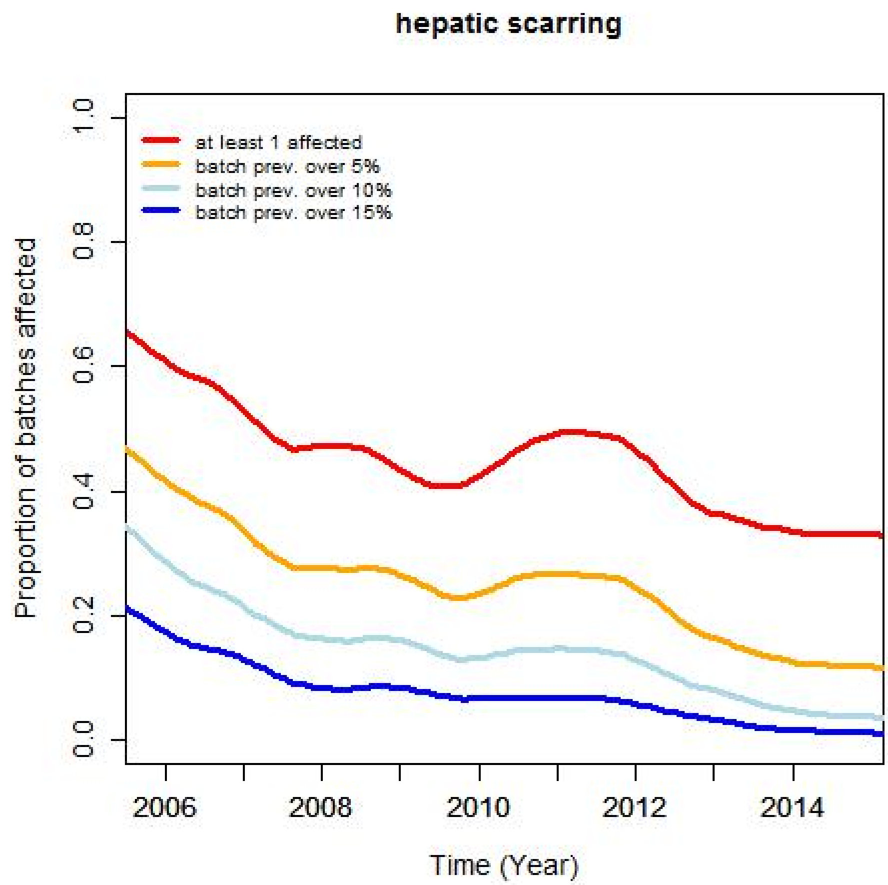

Figure 11. Batch-level trend for hepatic scarring.

Hepatic scarring is likely to represent the old healed lesion of a milk spot. There was a sharp decrease in the proportion affected until 2008. Thereafter, although the proportion of animals affected fluctuated, there continued to be an overall slow decline (Figure 10 and 11). The proportion of severely affected batches (dark blue line on Figure 11) is lower than 5%. At animal level (Figure 10) the proportion of animals affected is lower than 2.5%.

5.6 Results for papular dermatitis.

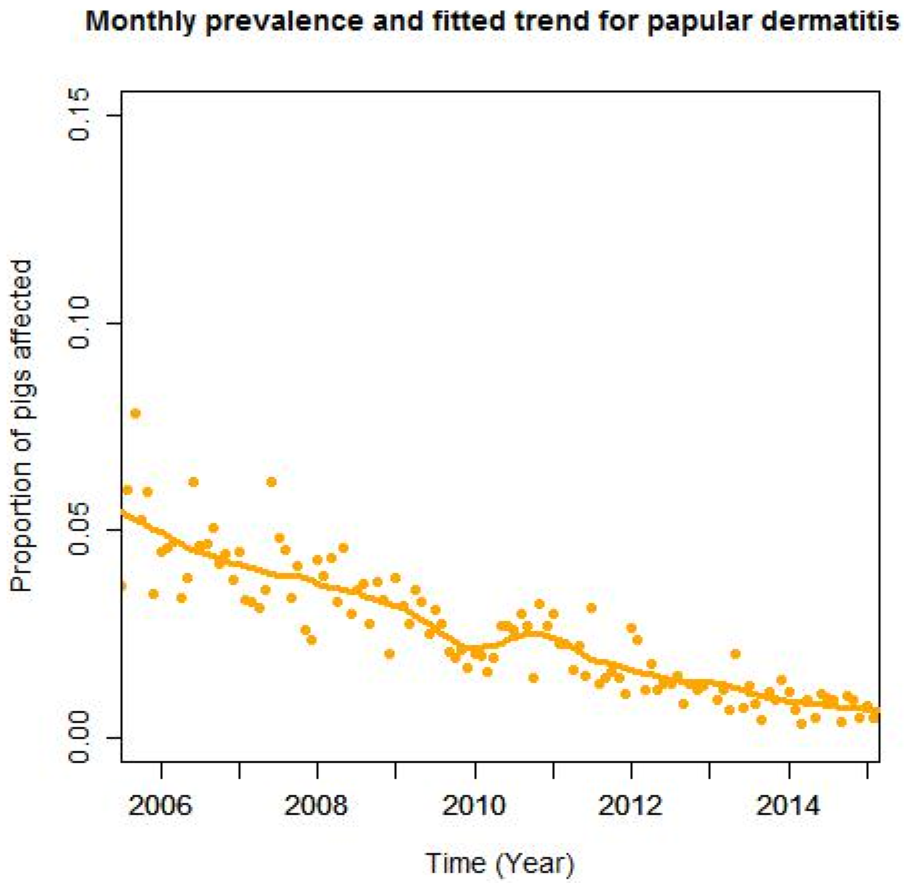

Figure 12. Animal-level trend for papular dermatitis. The dots represent the data and the lines the fitted trend.

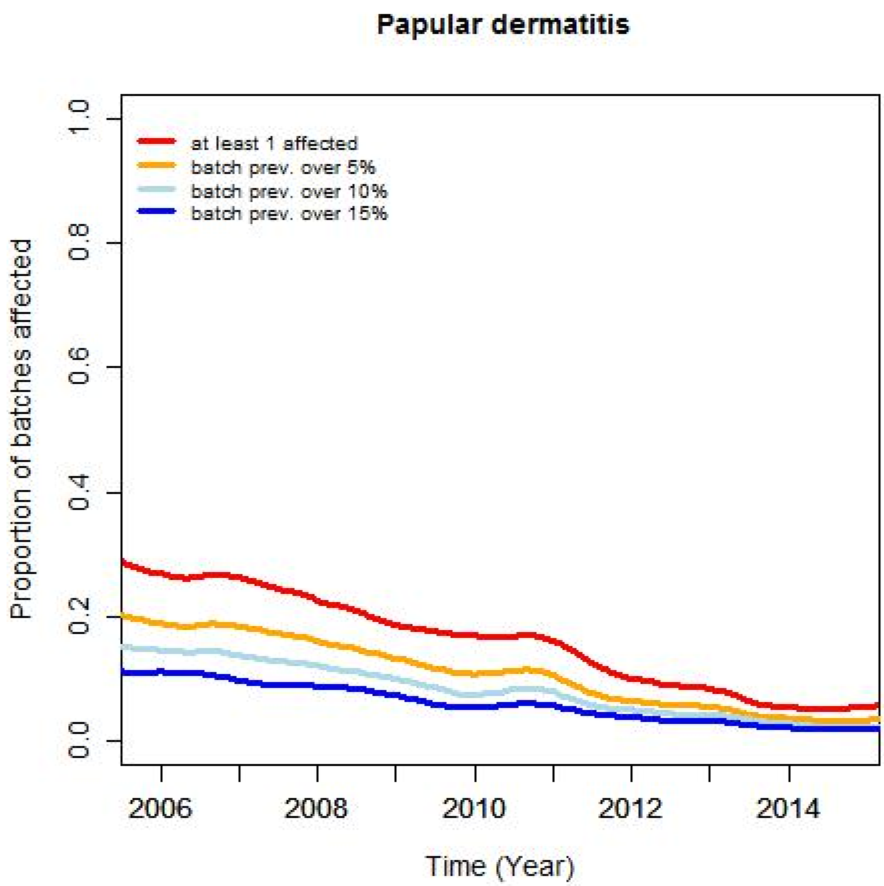

Figure 13. Batch-level trend for papular dermatitis.

The most common cause of papular dermatitis is mange, and a marked increase of papular dermatitis highlights the possibility of an increase in mange. There are also financial losses associated with papular dermatitis. There has been a decrease in the proportion of affected animals both at individual and batch level over the time period studied (Figure 12 and 13).

5.7 *Results for pericarditis.*

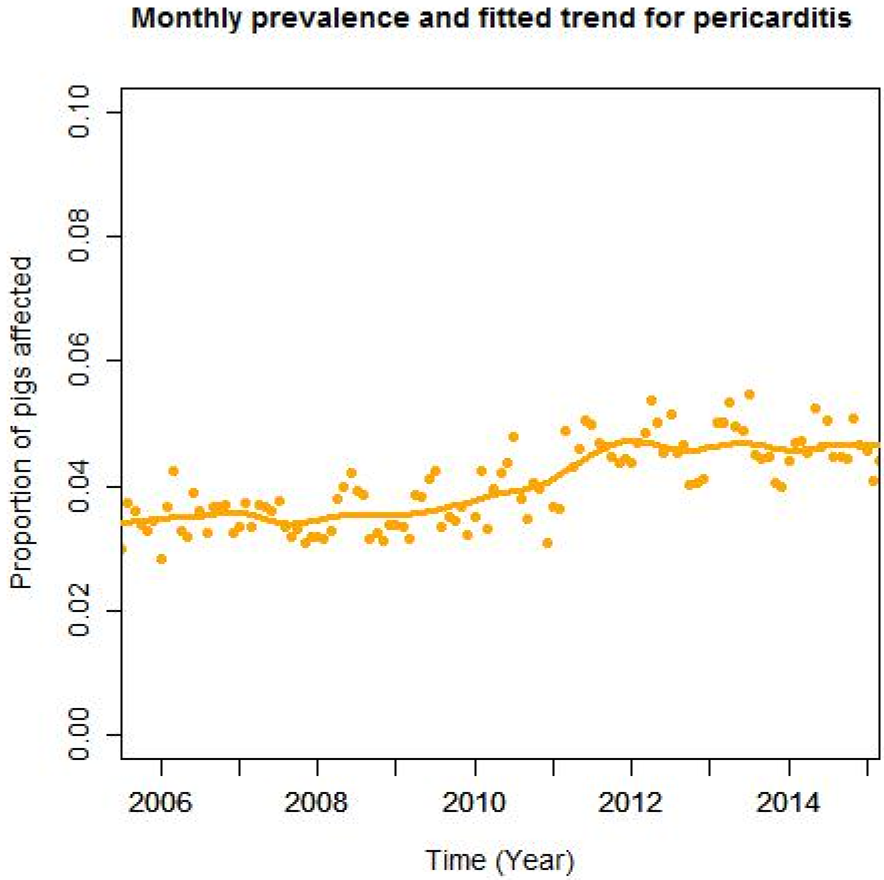

Figure 14. Animal-level trend for pericarditis. The dots represent the data and the lines the fitted trend.

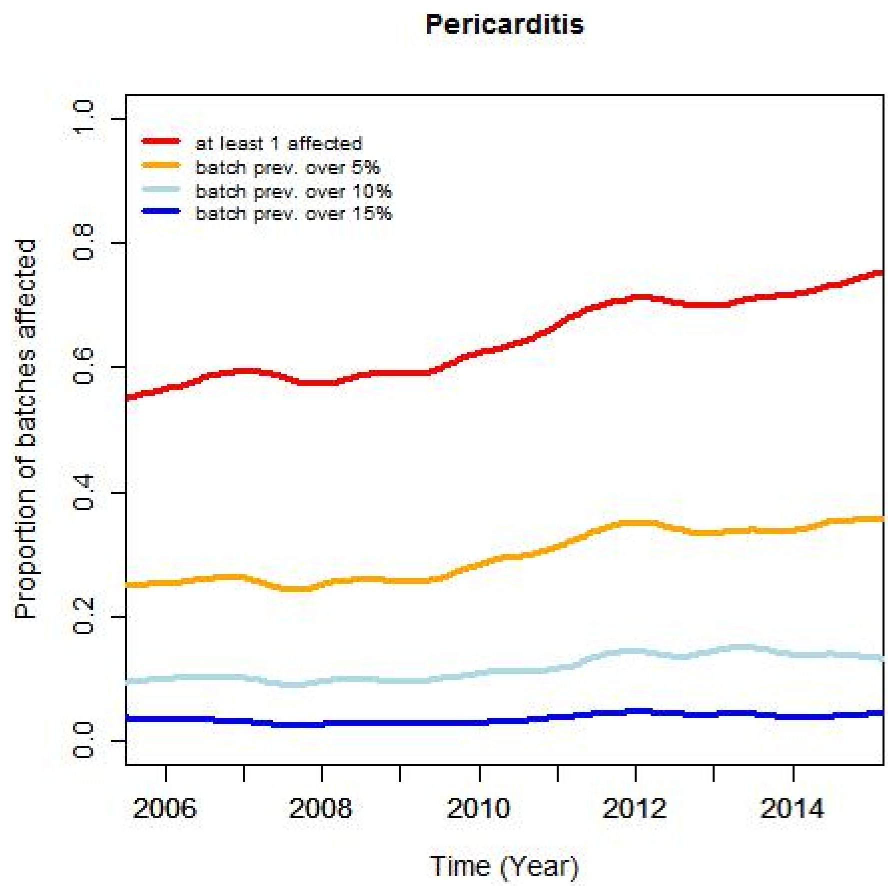

Figure 15. Batch-level trend for pericarditis.

Pericarditis describes adhesions between the heart and the pericardial sac surrounding it. It is very common in pigs and accounts for considerable loss through condemnation at slaughter. Figures 14 and 15 show an increase in the proportion of individuals and batches affected until the middle of 2012, although the values of the proportions are low at pig level. If we refer to Figure 14, the dots suggest that there is also a seasonal pattern with peaks in summer and troughs in late autumn. At batch level however (Figure 15), it was the increase in the batches where a low proportion of pigs are affected per batch (red and yellow line in Figure 15) that was responsible for the increase in the overall proportion. The proportion of severely affected batches (blue lines in Figure 15) does not show any change over time. Since the middle of 2012 the proportion of individual pigs affected appears to have stabilized.

5.8 Results for peritonitis

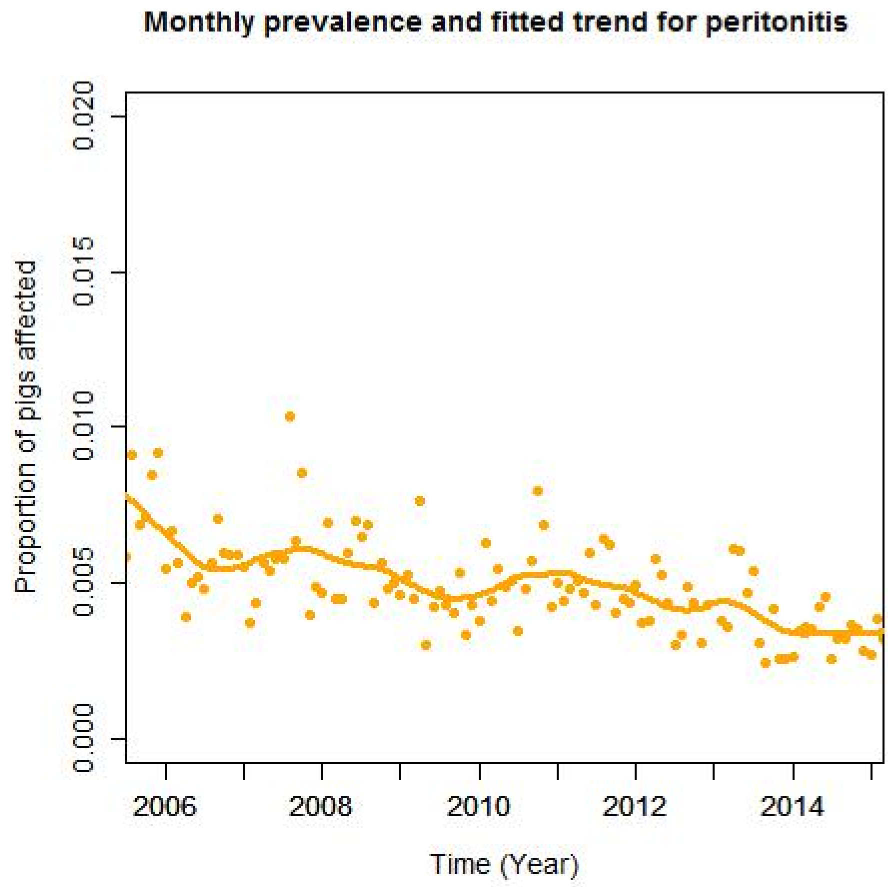

Figure 16. Animal-level trend for peritonitis. The dots represent the data and the lines the fitted trend.

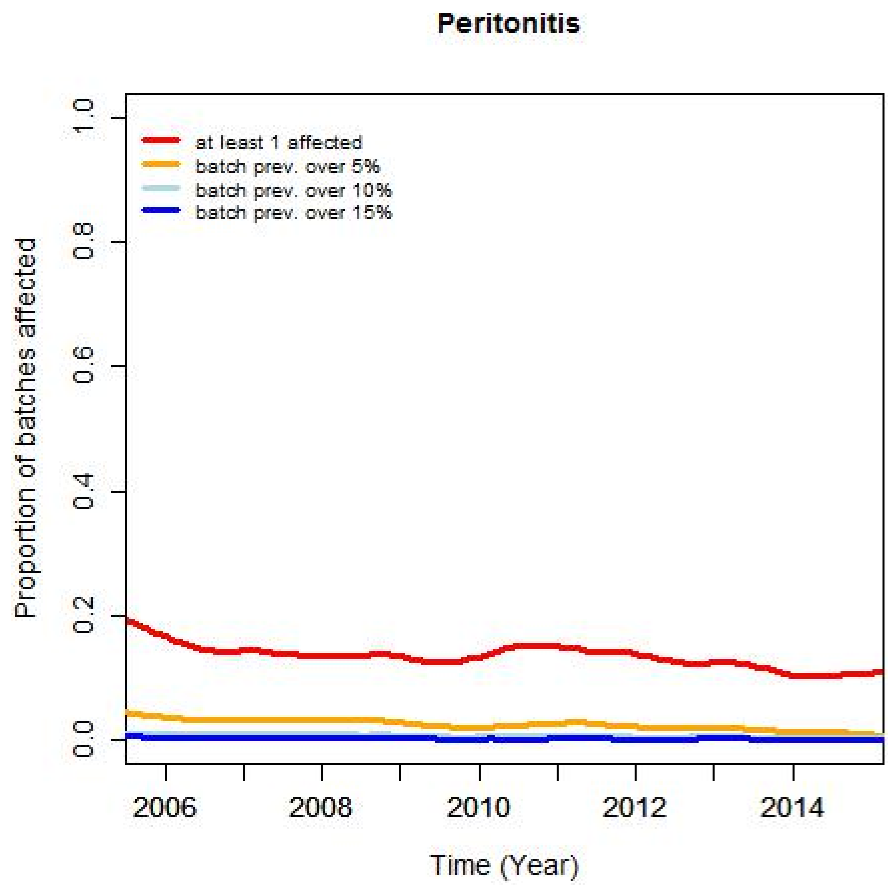

Figure 17. Batch-level trend for peritonitis.

Peritonitis describes adhesion between the viscera in the abdomen but can also refer to adhesion between viscera and the body wall. It may be coincident with pleurisy and pericarditis. Ruptured gastric ulcer, perforated bowel, penetration of the abdomen via mating, external trauma to the abdomen and ruptured bowel or liver, and conditions such as *Actinobacillus pleuropneumonia*, migrating ascarid worms and miscellaneous generalised infections may also result in peritonitis. The proportion of animals with peritonitis is quite low (lower than 0.5%, Figure 16) and the batches are not severely affected (Figure 17). Since the beginning of 2014 the prevalence appears to have stabilized.

5.9 Results for pigs with both peritonitis and pericarditis.

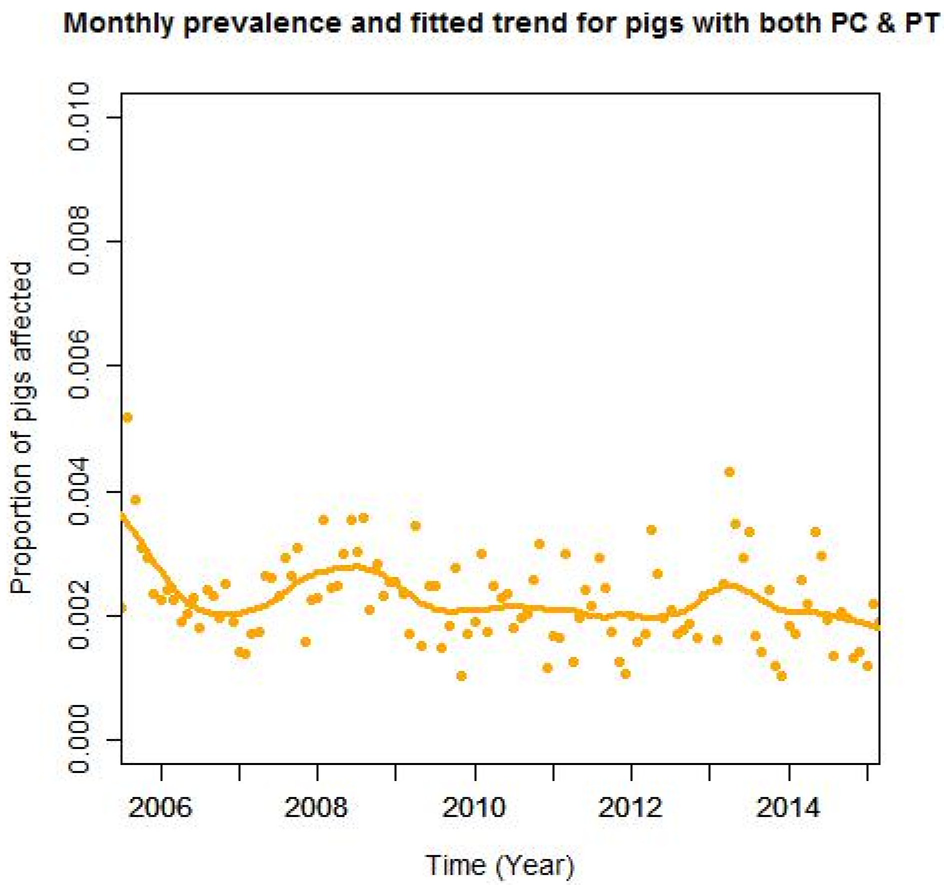

Figure 18. Animal-level trend for pigs affected with peritonitis (PT) and pericarditis (PC). The dots represent the data and the lines the fitted trend.

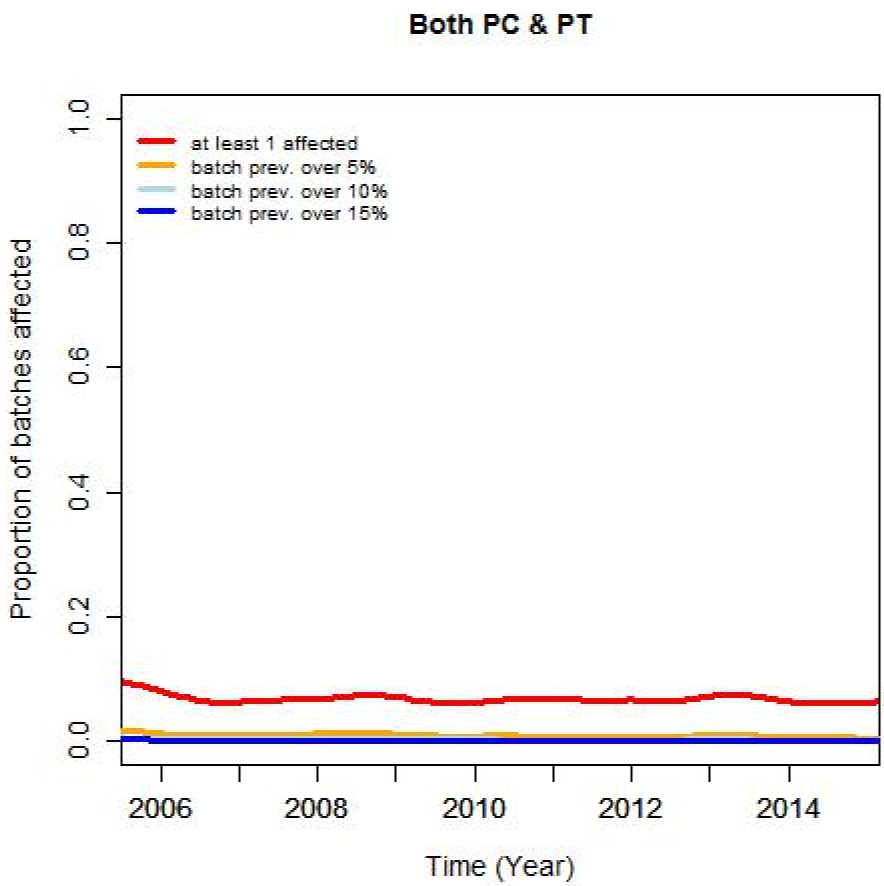

Figure 19. Batch-level trend for pigs affected with peritonitis (PT) and pericarditis (PC).

The proportion of pigs affected with both peritonitis and pericarditis (indicating a disseminated disease) is quite low (ca. 0.2%) (Figure 18) and once again the proportion at batch level indicates that the majority of the batches affected have just one animal affected per batch (Figure 19).

5.10 Results for abscesses in the lungs.

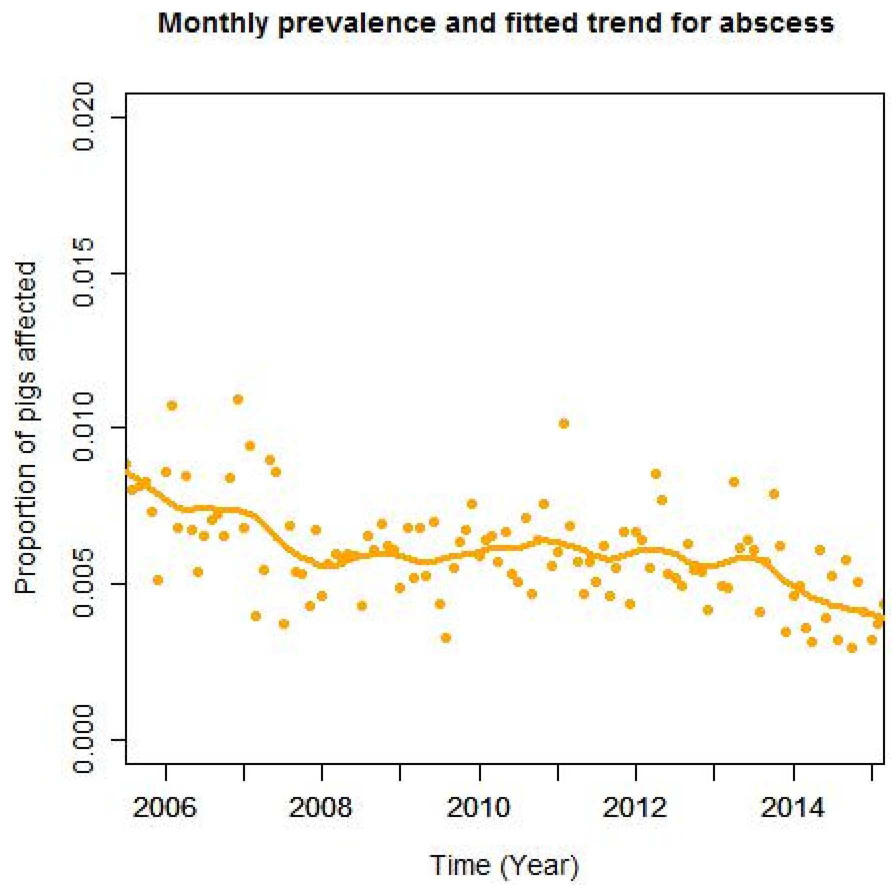

Figure 20. Trend for abscesses in the lungs. The dots represent the data and the lines the fitted trend.

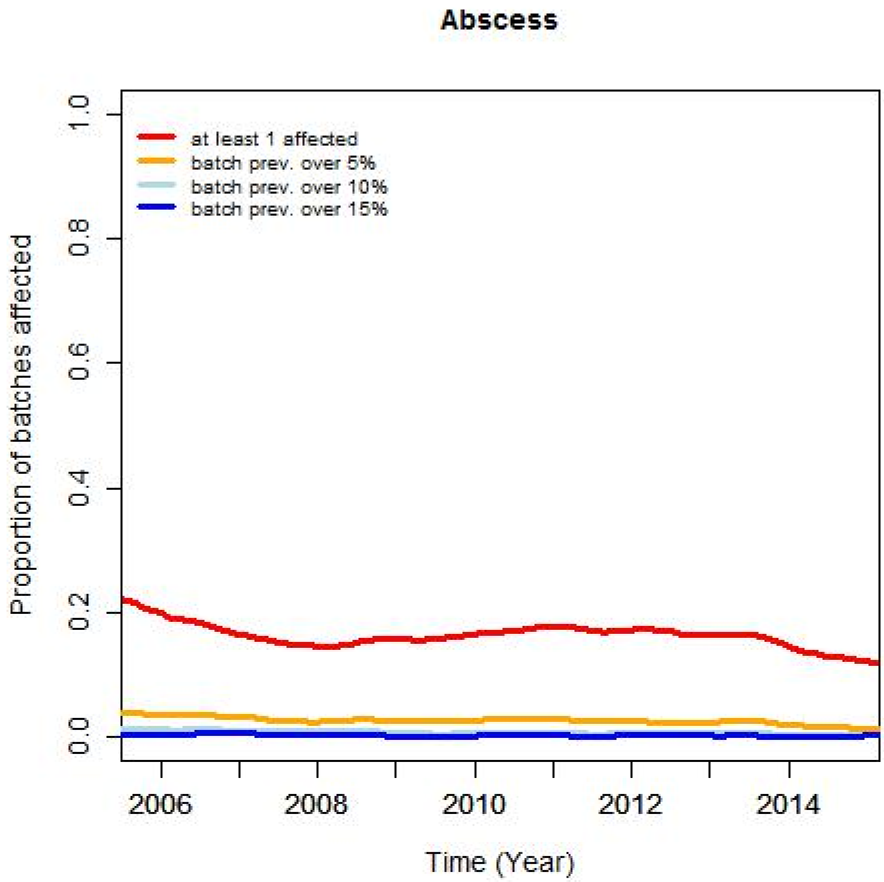

Figure 21. Batch-level trend for abscesses in the lungs.

The proportion of pigs and batches with an abscess in the lung has been relatively constant over the last five years (Figures 20 and 21), showing a decreasing trend over the last year (Figure 20). Less than 20% of the batches had at least one animal affected (red line in Figure 21).

5.11 Results for pyaemia.

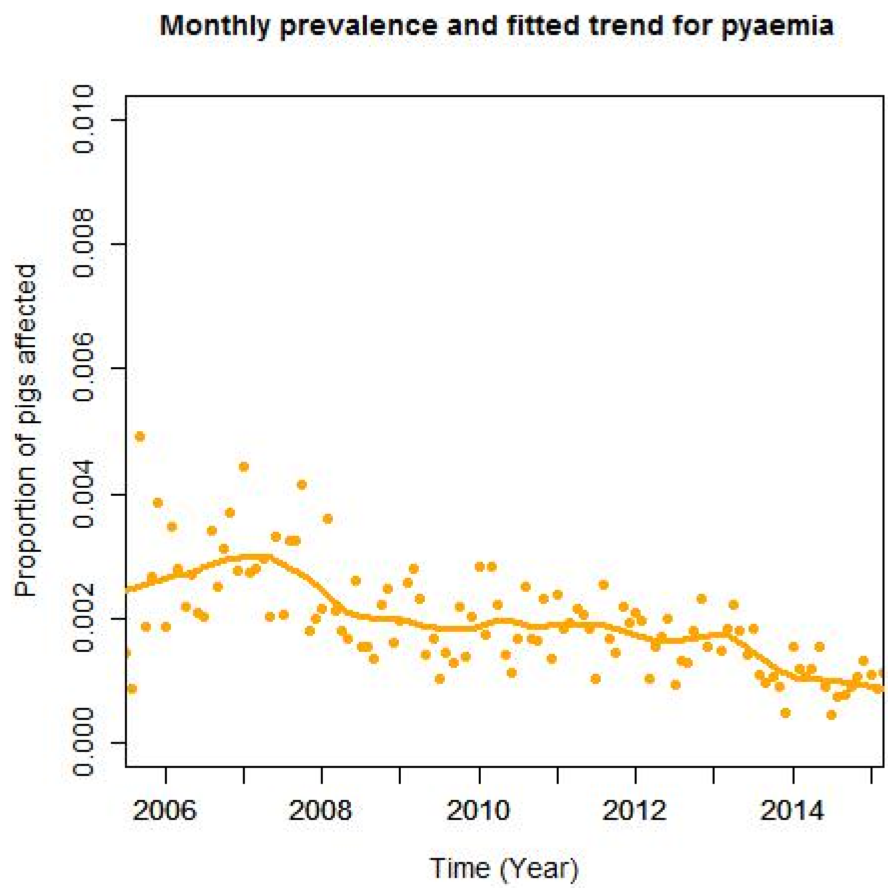

Figure 22. Animal-level trend for pyaemia. The dots represent the data and the lines the fitted trend.

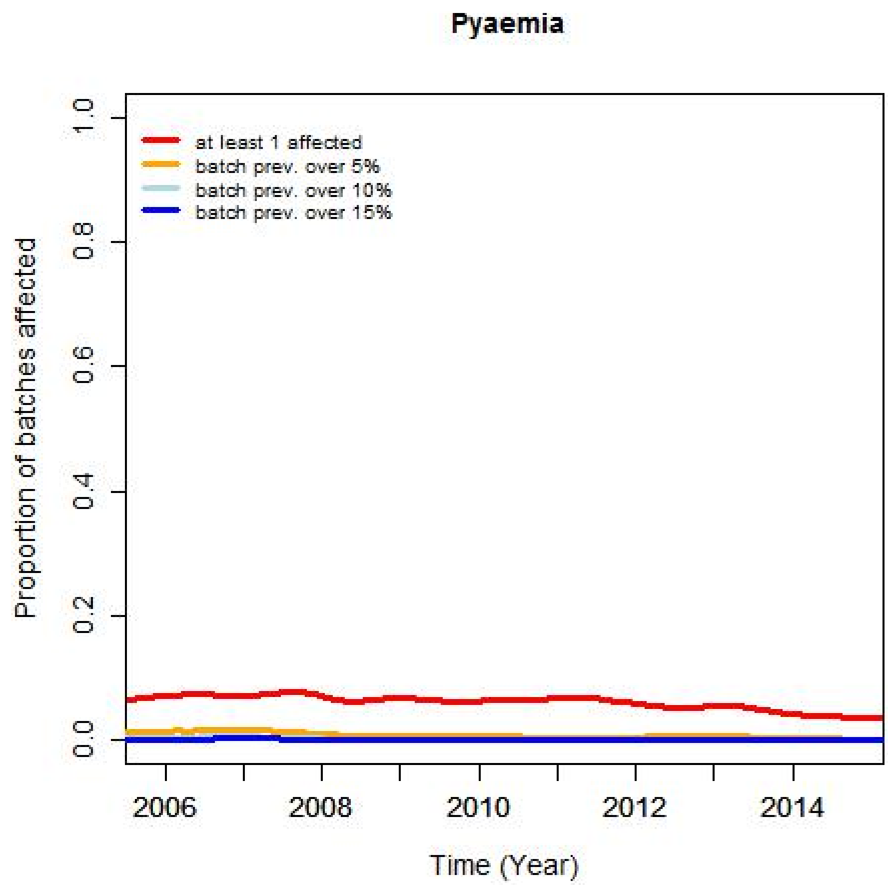

Figure 23. Batch-level trend for pyaemia.

Pyaemia defines a bacterial infection disseminated via the bloodstream causing multiple small abscesses. It may be a result of tail-biting, endocarditis or abscessation in another part of the body. The proportion of pyaemia at animal level did not show any particular trend between 2008 and the end of 2012. Since the beginning of 2013 there has been a decreasing trend (Figure 22). The majority of the batches affected had a low prevalence at batch level (red line on Figure 23).

5.12 Results for tail damage.

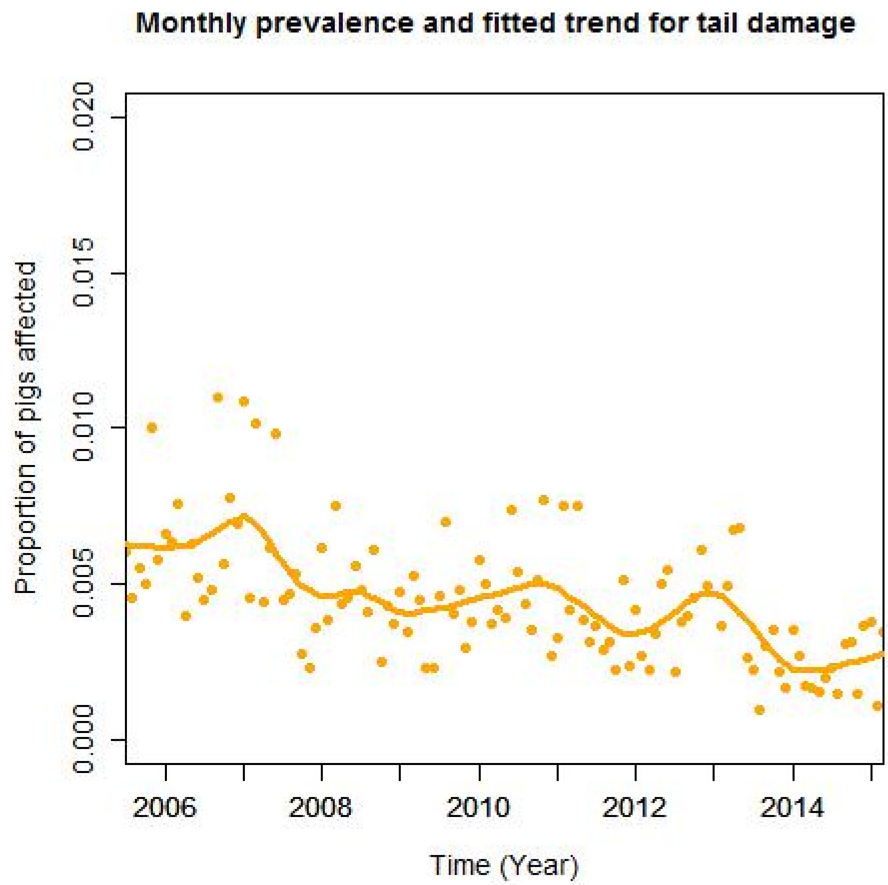

Figure 24. Animal-level trend for tail damage. The dots represent the data and the lines the fitted trend.

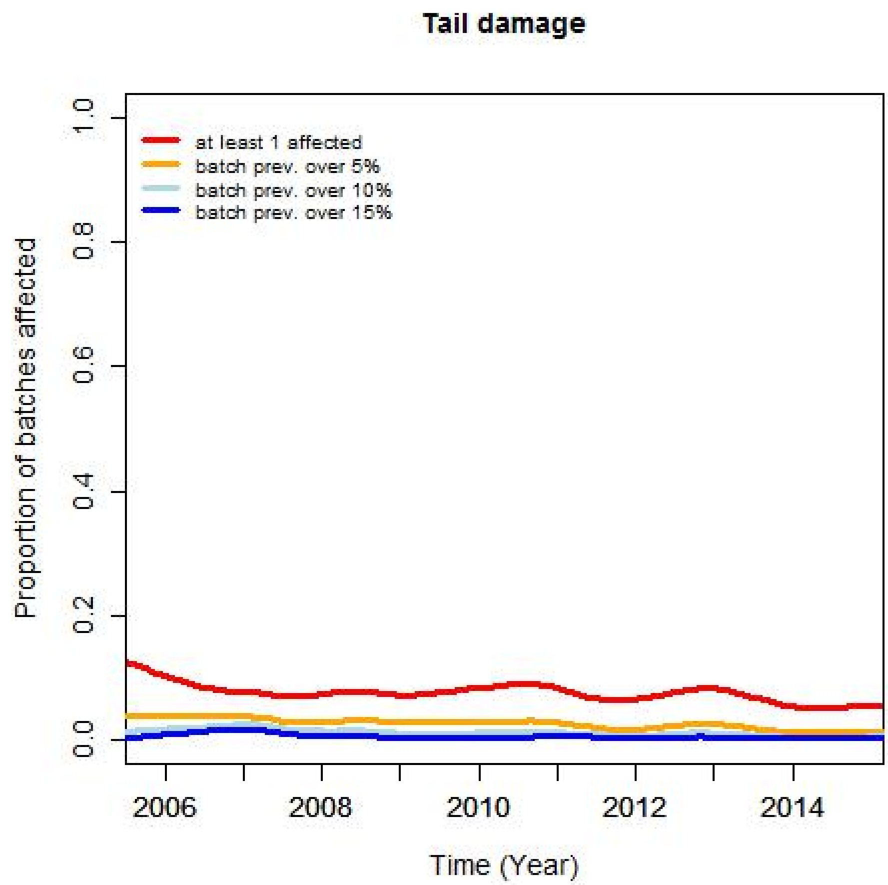

Figure 25. Batch-level trend for tail damage.

Tail biting lesions indicate stress, adverse environmental conditions and probably intercurrent disease. They may result in blood-borne spread of bacteria from the wounds and cause pyaemia, resulting in total carcass condemnation. The proportion of pigs affected by tail damage has fluctuated over the years but with a general decreasing tendency. This decrease has been more pronounced since the beginning of 2013 (Figure 24).

5.13 Results for pleuropneumonia lesions.

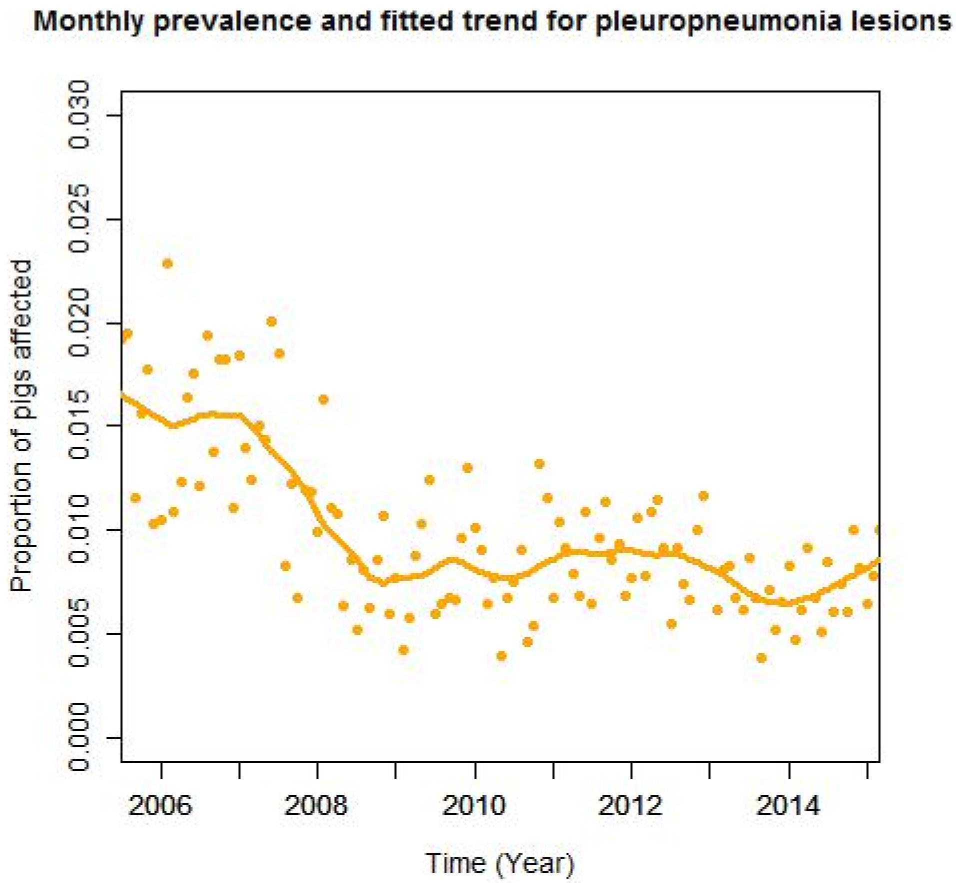

Figure 26. Trend for pleuropneumonia lesions. The dots represent the data and the lines the fitted trend.

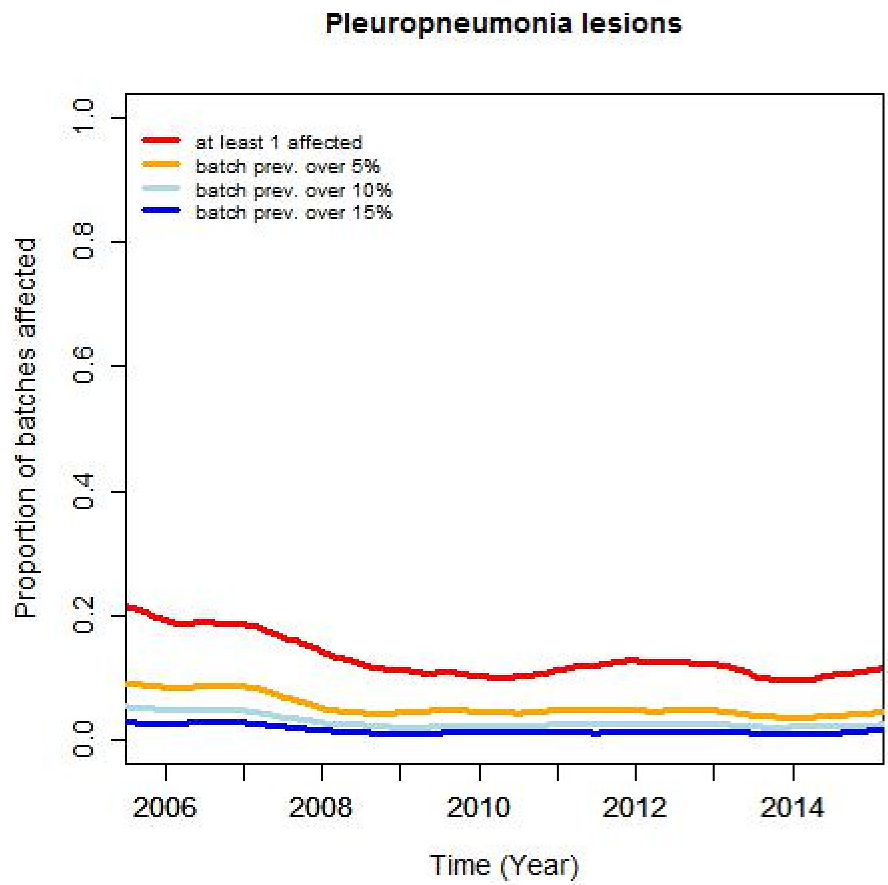

Figure 27. Batch-level trend for pleuropneumonia lesions.

Pleuropneumonia lesions can be caused by *Actinobacillus pleuropneumoniae* (APP) infection and other organisms. The spread between farms is mainly by the movement of carrier pigs and by fomite transmission. There was a decrease in the proportion of pigs affected (Figure 26) until 2009, a decrease which is also seen in the proportion of batches affected for the batches with at least one animal affected (Figure 27). After 2009 the proportion of animals affected has fluctuated, although the overall prevalence is low. These last two quarters have shown a slight increase in both pig-level and batch-level prevalence, which seems mostly due to a slight increase in those batches with at least one pig affected (Figure 27). This is likely to represent normal seasonal variation.

5.14 Results for viral-like pneumonia.

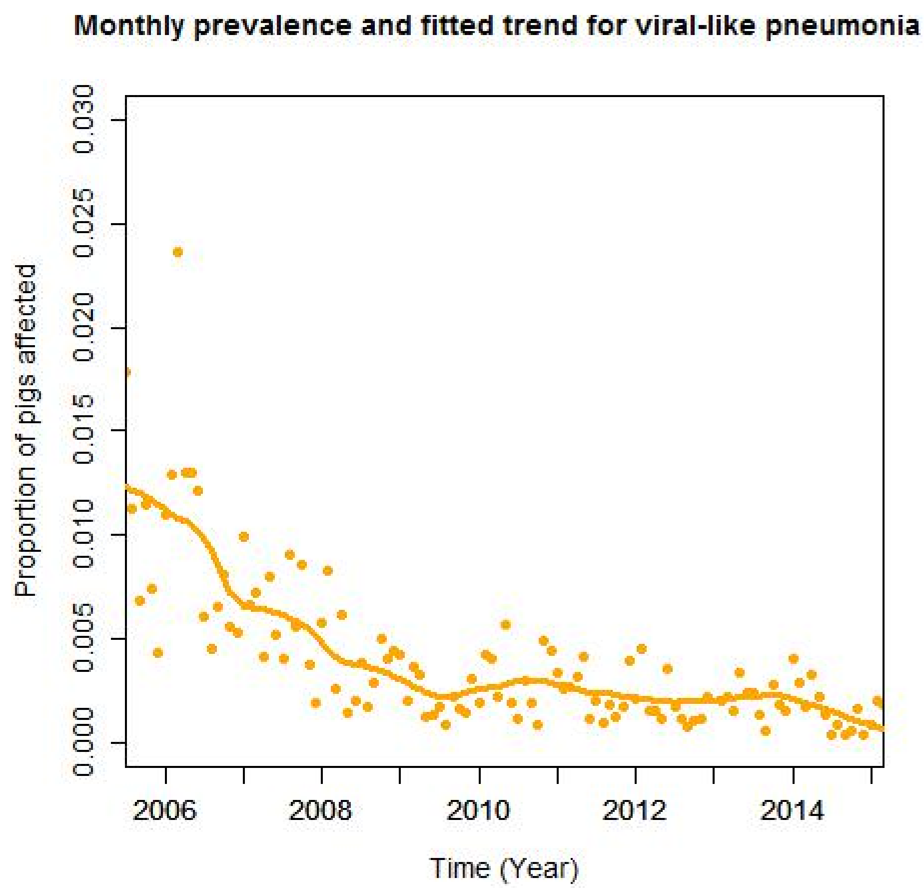

Figure 28. Animal-level trend for viral-like pneumonia. The dots represent the data and the lines the fitted trend.

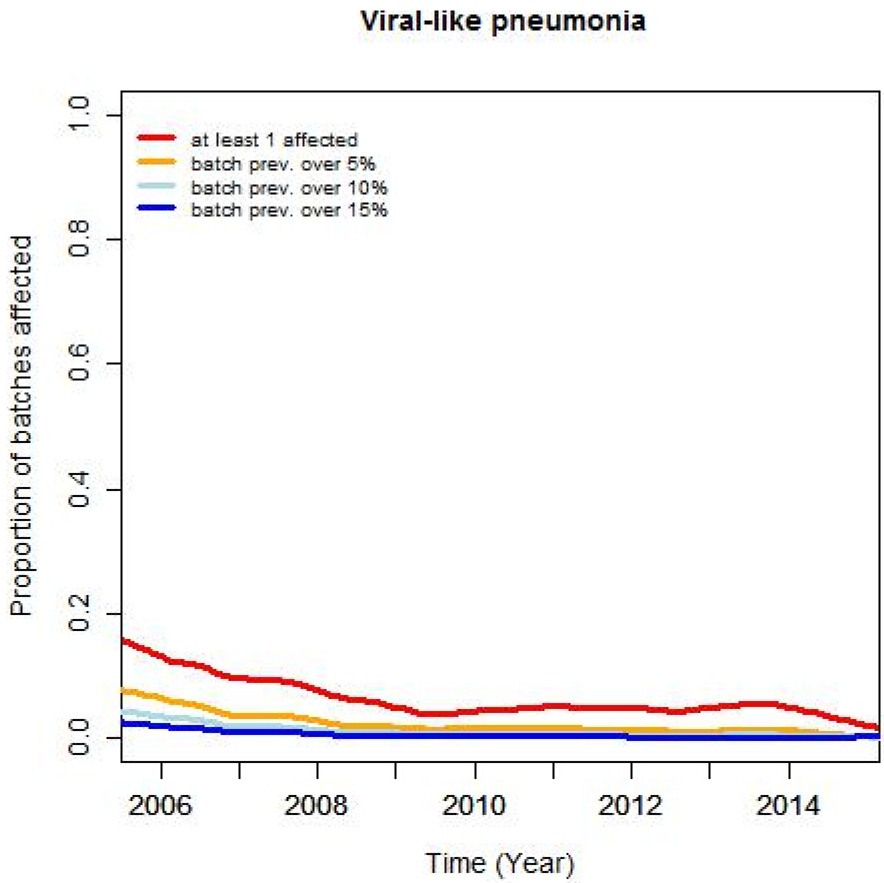

Figure 29. Batch-level trend for viral-like pneumonia.

Viral-like pneumonia lesions describe a certain distribution and appearance of lung consolidation that is suggestive of viral pneumonia. Some of the viruses that could cause pneumonia are the Porcine Reproductive and Respiratory Syndrome virus, Swine influenza virus, porcine respiratory coronavirus and Aujeszky's disease virus (not present in UK). There was a decrease in the proportion of individual pigs and batches affected until the middle of 2009 (Figure 28 and 29), after which the proportion seems to have remained constant or with a slight decrease, albeit the normal seasonal variation.