



# SURVEILLANCE OF ZOO NOTIC AND OTHER ANIMAL DISEASE AGENTS IN SWEDEN 2009

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# Introduction

The report describes active and passive surveillance on zoonotic and other animal disease agents in Sweden 2009. It replaces the previous reports on Zoonoses respective Surveillance and Control Programs in Sweden. Practically all diseases covered by this report are notifiable according to Swedish legislation either to Swedish Board of Agriculture, National Food Administration or Swedish Institute for Infectious Disease Control.

In Sweden, control of Salmonella covers the whole food production chain from feed to food. This work was initiated in the 1950's which has led to a low Salmonella prevalence in food-producing animals. Accordingly, efforts to keep this good situation are prioritized.

An increasing trend of reported human cases of listeriosis is seen in several European countries, Sweden included. This in spite of efforts made by the EU to set microbiological criteria to ensure safe products on the market. A majority of these infections are domestic. The reasons for the increase remain unclear and should be elucidated because of the severity of the infection.

Sweden has rarely experienced serious outbreaks of epizootic or other contagious diseases, and disease freedom has been demonstrated for several of them;

Sweden is officially free from bovine brucellosis, enzootic bovine leucosis and bovine tuberculosis and has an approved disease free zone status for viral hemorrhagic septicemia and infectious haematopoietic necrosis in fish. Furthermore, Sweden has been granted additional guarantees for infectious bovine rhinotracheitis in cattle, Aujeszky's disease in pigs and infectious pancreatic necrosis and renibacteriosis in fish, and spring viraemia of carp. An application has been submitted to the European Commission where freedom from infection with Mycobacterium bovis in Swedish herded deer is demonstrated and freedom from porcine reproductive and respiratory syndrome was documented in 2008 after a smaller outbreak in 2007.

After bluetongue (BT) was introduced to Sweden in 2008 a vaccination campaign was initiated in restricted areas. Excessive sampling and investigations were carried out in 2009 and no further infected animals could be found. In addition, Sweden has a very favourable situation concerning paratuberculosis. Work is under way to demonstrate the level of certainty that freedom from paratuberculosis can be regarded by. And finally, of all bovine herds 99,8 % were certified free from bovine virus diarrhoea virus at the end of 2009 and the eradication program is expected to be fulfilled during 2011.

The favourable situation from an international perspective regarding antimicrobial resistance in bacteria of animal origin may change. For instance, methicillin-resistant Staphylococcus pseudointermedius as well as methicillin-resistant Staphylococcus aureus and vancomycin-resistant enterococci are now present in the Swedish animal population.

The importance of thorough and reliable surveillance systems is emphasized in order to meet rapid changes in the disease situation.

# The livestock population

Demographic data show that most farms are located in the southern and central parts of Sweden and animal husbandry is the major line of production. In the northern Sweden there are mostly small farms. The number of holdings with livestock has decreased during the last decades, whereas those remaining have increased in size. Since 1995 the average pig herd size has more than tripled. Most data relates to the situation in June 2009. Maps 1-3 give an overview of the livestock population and the number of holdings with animals in Sweden.

## CATTLE

There are 21,733 herds with a total number of 1,538,280 cattle (including dairy and suckler cows, heifers, bulls, steers and calves younger than one year) in Sweden (Map 1).

The dairy sector is important to Swedish agriculture. The number of dairy cows has, however, decreased over a long time period. In June 2009 there were roughly 357,000 cows in 6,020 dairy herds with an average of 55 cows per herd. The number of suckler cows has increased somewhat since 2007 and was 191,500 in 2009. The average herd size was 16 cows.

In total, approximately 430,000 adult cattle and 29,400 calves were slaughtered during 2009, which is an increase compared to 2008.

## PIGS

The number of boars and sows was 160,000 in 2009, compared to 245,000 in 1995. The total number of pigs was 1,529,000 (Map 2). The number of holdings with sows decreased during 2009, whereas the average herd size increased to 140 sows per herd. The farrowing interval is 2.2 times per year and artificial insemination is used in over 90% of the matings.

About 2.9 million pigs were slaughtered at an age of six to seven months during 2009.

## SHEEP

In 2009, there were 8,169 sheep holdings in Sweden with a total of approximately 254,000 ewes and rams, and 286,600 lambs, (Map 3). The number of ewes and rams has increased with about 30% since 1995. Sheep farms in Sweden are usually small-scale enterprises but the herd size has been increasing in later years. The average number of adult sheep was 31 per herd.

Approximately 221,000 lambs were slaughtered in 2009, which is an increase from the years before.

## GOATS

In 2009 the number of goats and goat holders in Sweden were 10,300 and 1,541, respectively. Most holders only have a few goats per farm and the number of farms with  $\geq 10$  goats were 221.

## POULTRY

The number of holdings with broiler production is slowly decreasing. In 2009 there were 183 holdings. About 73.5 million chicken were sent for slaughter during the year.

There were approximately 5.3 million hens ( $\geq 20$  wks) in 3,306 holdings. The egg production was 79.8 million kilos during 2009 which is an increase of about 2% compared to 2008.

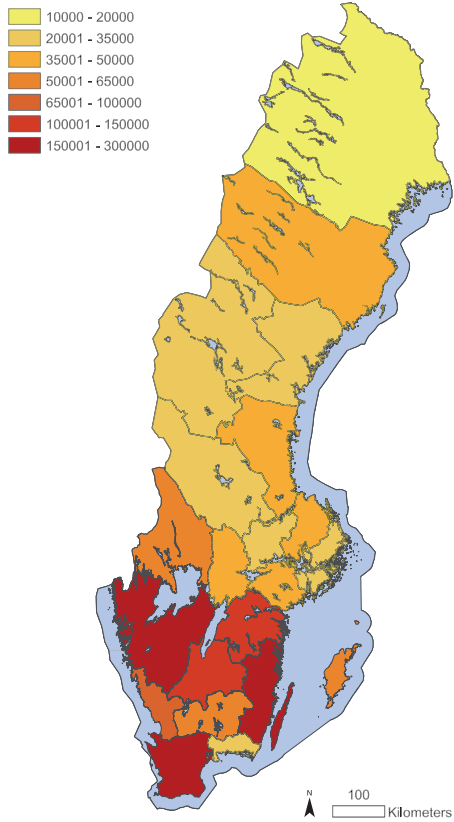
About 477,000 turkeys were slaughtered in 2009. The production of geese and ducks is very small. Less than 10,000 geese and ducks were slaughtered during 2009.

## FISH AND MOLLUSKS

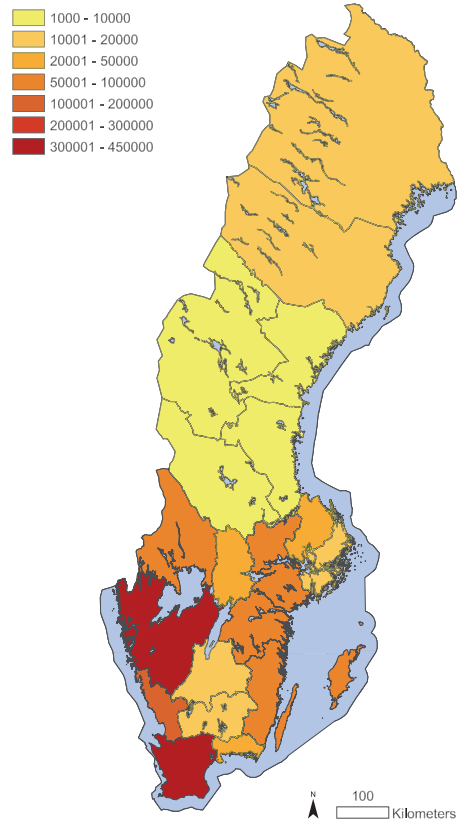
Sweden is a very small producer when it comes to aqua culture. The farms are evenly distributed over the country with a slight predominance to the middle and south parts, (Map 4). Rainbow trout is the most frequently farmed fish followed by salmon, brown trout and char. Salmon and brown

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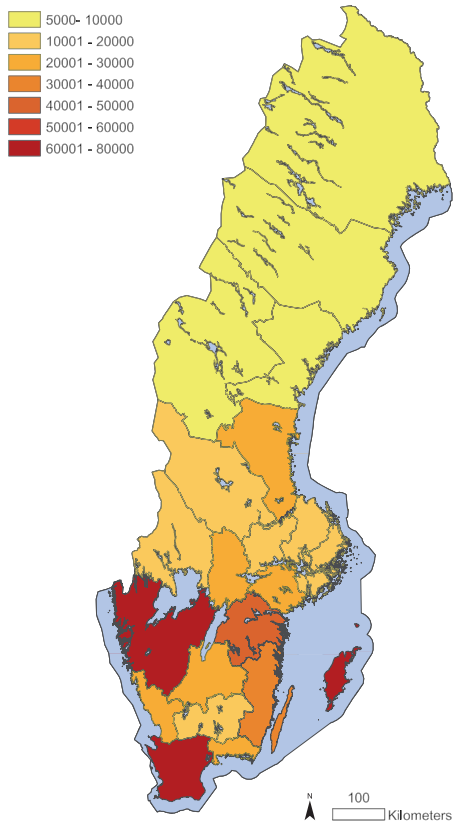
Map 1. Number of cattle per county (21 in total) in Sweden as of June 2009.



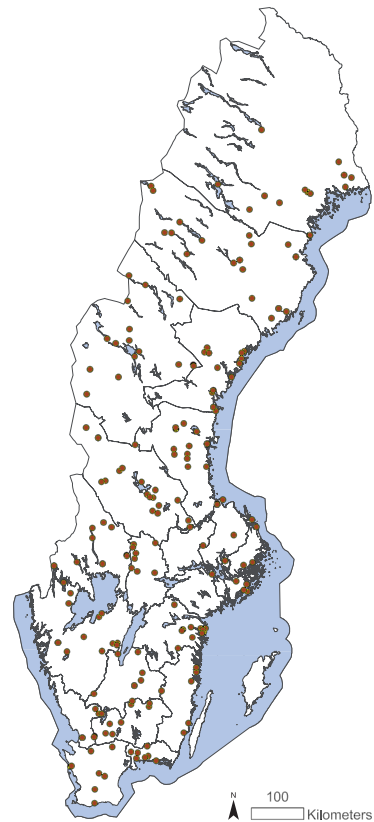
Map 2. Number of pigs per county (21 in total) in Sweden as of June 2009.



Map 3. Number of sheep per county (21 in total) in Sweden as of June 2009.



Map 4. Geographical distribution of fish farms, including places for caught of feral broodfish, in Sweden 2009.



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trout mainly for restocking feral populations. Eels are imported from Severn in the UK through quarantine procedures for the restocking of feral populations. A minor part is farming of pike-perch and perch. The main tonnage is produced in the continental zone. Many of the farms are quite small compared to European standard, but there is a trend towards bigger units. During the last five to ten years there has been an increased foreign ownership, mainly Finnish.

During 2009 there has been an increasing interest for aquaculture of mollusks. The dominating species, blue mussel, is farmed for consumption and for improving environmental conditions. Swedish oysters have been discovered in Europe as a high quality product and consequentially farming and harvesting of natural banks have grown in interest.

### TRADE IN LIVE ANIMALS

In 2009, 2,809 pigs were brought into Sweden (from Norway and Finland only), 2 cattle (from Denmark), 13 sheep (from Denmark), 15 sheep from Finland (for slaughter) and 1 goat (from Finland).

The number of animals leaving the country during 2009 consisted of 1,310 cattle of which 208 were sent for slaughter, 14,718 pigs of which 14,608 were sent for slaughter to Germany, 11 sheep were sent to Germany, 1 sheep to Finland and 45 sheep and goats were sent for slaughter to Denmark. Regarding the trade in poultry no figures are available

### ANIMAL DATABASES

The Central Register of Holdings

The Swedish Board of Agriculture is responsible for the Central Register of Holdings. Each holding is allocated a unique identification number (holding number). The register contains information on all activities concerning bovine animals, pigs, ovine and caprine animals with details on holding number, visiting address, species. Any change in the present situation shall be reported within a month after the change. The register provides the specific animal databases with information.

The Central Database for Porcine animals

The Swedish Board of Agriculture is responsible for the Central Database for Porcine animals (GRIS). It contains data on all holdings with pigs

and movements of pigs between holdings. The data encompasses address and registration number of the holding as well as name and telephone number of the keeper, type of production, capacity and the geographical coordinates of the holding. Regarding movements, the receiving holding is responsible for reporting the movements of the animals within seven days. The register's purpose is to allow swift and efficient tracing of contagious diseases.

The Central Database for Bovine animals

The Swedish Board of Agriculture is responsible for the Central Database for Bovine animals (CDB), to which all bovine births, deaths and movements shall be reported. The keeper is responsible to report any changes within seven days of the occurrence. The purpose of the register is to allow swift and efficient tracing of a contagious disease, verification of the country of origin of a meat product, as well as control and administration of cross compliance. The system enables the scanning of animal disease forms into the data system.

The Central Database for Sheep and Goats

The Swedish Board of Agriculture is responsible for the Central Database for Sheep and Goats. It has been in operation since 1 January 2008. Keepers may register movements in the database via the Internet, or in paper form. Animals are registered in groups in the database when moved. Both the keeper who dispatches the animals, and the keeper who receives the animals, are responsible for reporting to the database, not later than seven days after the movement.

The Slaughter Register

The Slaughter Register (SLAKT) is administrated by the Swedish Board of Agriculture. The slaughterhouses are responsible for reporting all slaughtered animals including wild game. The producer's organization number or personal code number must be reported for all species except wild game. The holding number of the supplier is compulsory information for all species except horses and wild game. Reports shall be made every week.

The Register of Laying Hens

The Register of Laying hens is administrated by the Swedish Board of Agriculture. All egg producers with a capacity of at least 350 laying hens and all those selling eggs for consumption shall be

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registered. The register contains information about address, production method, capacity, geographic coordinates and the number of houses and sections on the holding. The purpose of the register is to allow efficient tracing of the eggs in case of a contagious disease and to ensure good food safety.

### The Poultry Register

The Poultry Register is administrated by the Swedish Board of Agriculture and includes all holdings with commercial poultry production. An exception is holdings with at least 350 laying hens, which are registered separately. The purpose of the register is to allow efficient tracing and eradication of contagious diseases. The name and address of the holding, name of animal keeper, information on all houses and sections, production method, maximum capacity, species and geographic coordinates shall be registered.

### The database for dairy herds

The Swedish Dairy Association is responsible for the database for dairy herds (Ko-databas). The database include milk recordings, fertility results and disease recordings for all animals at the dairy farm. It forms the bases for the development of different management tools used by the farmers, advisors and veterinarians. It is also a valuable tool for research concerning feeding, animal health, genetics etc. Approximately 90% of all dairy cows in Sweden are included in this recording program.

### Register at the Swedish Animal Health Service

The Swedish Animal Health Service is responsible for different control and monitoring programmes. Relevant information about holdings with cattle, sheep, pigs and farmed deer that are affiliated to these programmes is kept in computerised registers.

### The animal health database

The animal health database (vet@) is used by the veterinary services for the documentation of the health situation on farms, including details about health status, treatment and vaccinations of individual animals. It is based on reports from practitioners to the Swedish Board of Agriculture. All veterinarians are obliged to report their various practice activities. It is mandatory for all veterinarians to report continuously as concerns production animals. The purpose is to monitor the animal health situation in Sweden and use it as a base for preventive measures.

## REFERENCES

Traces (TRAdE Control and Expert System), Database developed by EU COM.

Yearbook of agriculture statistics, JO 20 SM 0901, Livestock in June 2009, Swedish Board of Agriculture.





# Institutions, organisations and laboratories involved in monitoring

## Swedish Board of Agriculture

The Swedish Board of Agriculture, SBA, is the Government's expert authority in the field of agricultural and food policy, and is responsible for agriculture and horticulture. This includes monitoring, analyzing and reporting to the Government on developments in these areas, and implementing policy decisions within its designated field of activities.

The SBA promotes animal health by strict animal welfare requirements and by combating and preventing the spread of contagious animal diseases and is also the chief authority for the Swedish district veterinarians.

## National Veterinary Institute

The National Veterinary Institute, SVA, is a Swedish national authority that strives for good animal and human health, a good environment and sustainable food production.

SVA is an expert authority within the field of risk assessments, prevention, diagnosis and the control of contagious and other serious infectious diseases of animals that imply a threat to supplies of animal foodstuffs, that lead to losses for the production of animals, that concern pets, or involve zoonotic diseases.

Diagnostic capacity for the most feared contagious animal diseases is available at SVA. Several control- and monitoring programs are being conducted in cooperation with animal owner organisations and relevant authorities. Research and development is further one of SVA's main tasks.

## Swedish Institute for Infectious Disease Control

The Swedish Institute for Infectious Disease Control (SMI) is a governmental expert agency with the mission to monitor the epidemiological situation for infectious diseases in humans. Central to SMI operations is to, with the help of reports received, efficiently trace, analyze and combat infectious diseases. Preparedness is at a high level at SMI as concerns outbreaks of severe infectious diseases, both inside and outside the country's borders. SMI carries out diagnostic analyses of different bacteria, viruses, parasites and fungi, as well as water and environmental analyses. SMI's research and development is closely connected to its other preventative measures, as well as to the current public health situation.

## National Food Administration

The National Food Administration, NFA, is the central supervisory authority for matters relating



to food, including drinking-water and has a direct responsibility to the Government.

The NFA has the task of protecting the interests of the consumer by working for safe food of good quality, fair practices in the food trade, and healthy eating habits. Fair practices in the food trade imply that the consumer can rely on the labelling as regards, for example, the composition, weight, keeping qualities and origin of the food.

### County Administrative Board

Sweden is divided into 21 counties, each of which has its own County Administration and County Governor. The County Administrative Board is a government authority that exists in close proximity to the people in each county. The County Administrative Board is an important link between the people and the municipal authorities on the one hand and the government, parliament and central authorities on the other. The County administrations have important coordinating functions regarding prevention, surveillance and eradication of contagious diseases.

### The Swedish Dairy Association

The Swedish Dairy Association is the national industry organization for Swedish dairy farmers and the Swedish dairy industry. The Swedish Dairy Association works on behalf of its owners, who are the seven largest dairy companies (jointly representing more than 99% of Swedish milk production), seven livestock cooperatives, two semen-producing companies, and nine breeder societies. The Swedish Dairy Association gathers, develops and communicates knowledge relating to the entire chain from cow to consumer, including issues concerning animal health. The Swedish Dairy Association is further organizing the surveillance programs regarding bovine leucosis and infectious bovine rhinotracheitis. It is also organizing the eradication program for bovine virus diarrhoea virus and a control program for salmonellosis in bovines.

### Swedish Animal Health Service

The Swedish Animal Health Service AB (SvDhv) is a veterinary company which business ideas originate from the 1960's. SvDhv is mainly engaged in animal health issues concerning the rearing of pigs, cattle (for meat production) and sheep. The goal is healthy animals for profitable farming and the customers are farmers, the industry and the government. The services provided by SvDhv

are open to all farmers. SvDhv is owned by the main meat producing companies in Sweden and is officially responsible for general animal health programs for pigs, cattle and sheep. In addition, SvDhv is officially responsible for specific disease control programs, monitoring of resistance in pathogenic bacteria and the routine autopsy activity in farm animals. Research and development are also performed.

### Swedish Poultry Meat Association

Swedish Poultry Meat Association (SPMA) represents 98% of the poultry meat production of chicken, turkey, goose and duck in Sweden, with members from the entire production-chain. The members are obliged to participate in the animal health programmes, administered by SPMA such as control for *Salmonella*, *Campylobacter*, coccidiosis and clostridiosis.

Out of 73.5 million approved chickens produced during 2009, the members of SPMA produced 71.8 million. SPMA is multi functional; the major task is the work associated with economic and political industry related matters important to its members. SPMA is receiving legislative referrals from the Swedish public authority and the EU's institutions. The organization also initiates and economically supports research.

### The Swedish Egg and Poultry Association

The Swedish Egg and Poultry Association is the national organization for Swedish egg producers, hatcheries, rearing pullet companies, egg packing stations and pullet feeding companies.

The Swedish Egg and Poultry Association is responsible for the organization of surveillance programs regarding animal health and welfare and the voluntary salmonella control program. The objective is to further support a sound egg production, with a high standard of animal welfare and food hygiene /safety on an economically competitive basis.

## REFERENCES

[www.sva.se](http://www.sva.se)  
[www.smi.se](http://www.smi.se)  
[www.lst.se](http://www.lst.se)  
[www.jordbruksverket.se](http://www.jordbruksverket.se)  
[www.slv.se](http://www.slv.se)  
[www.svdhv.se](http://www.svdhv.se)  
[www.svenskmjolk.se](http://www.svenskmjolk.se)  
[www.svenskfagel.se](http://www.svenskfagel.se)  
[www.svenskaagg.se](http://www.svenskaagg.se)

# Atrophic rhinitis

## BACKGROUND

Atrophic rhinitis (AR) is caused by toxin producing strains of *Pasteurella multocida* (PMT). Since PMT is a secondary invader not capable of penetrating an intact mucosa it is dependant on other infections. Traditionally *Bordetella bronchiseptica* has been considered the most important precursor for PMT, but also other bacteria and virus may precede PMT.

AR used to be a common disease in pig enterprises, but as improvements in rearing and disease preventing measures have been made the disease have gradually faded away. The Swedish Animal Health Service effectuates a control program since 1995.

## Disease

When PMT penetrate the nasal mucosa the nose mussels are destroyed and inhaled air will reach the respiratory organs without being sealed or warmed, which in turn increases the risk for other infections. Further, the bone building process is affected and the snout may become obliquely in young pigs. Affected pigs will also show a retarded growth.

## Legislation

Atrophic rhinitis is a notifiable disease according to SJVFS 2002:16 (with amendments).

## SURVEILLANCE

The purpose of the control program is to declare herds selling breeding stock free from infections with PMT, and thereby decrease the incidence of AR in all herd categories. Eradication of PMT is not realistic since it is an ubiquitous bacterium that can affect all mammals.

Nucleus and multiplying herds are controlled for presence of PMT at an annual basis. Anytime AR is suspected in a herd, it should be controlled for presence of PMT. If PMT is demonstrated the health declaration is withdrawn and restrictions on sale of pigs are effectuated until the herd is sanitised and declared free from the disease. Diagnostic tools developed by DAKO (Copenhagen, Denmark) and evaluated at SVA during the late 80ies and early 90ies offered a possibility to combat AR in an effective way. Nasal swabs are cultivated on special media overnight. The entire microbial growth is harvested and diluted into water and the toxin of PMT is demonstrated by an ELISA system.

## RESULTS AND DISCUSSION

AR used to be a rather common disease, but due to efforts made in the early 90ies and to the control program initiated in 1995 the disease is now very rare (Table 1).

## REFERENCES

- Wallgren, P., S. Mattsson, J. Rabe, M. Lindblad, B. Molander and M. Wierup (1994) Age distribution of pigs carrying toxin-producing *Pasteurella multocida* in herds affected with atrophic rhinitis. Proc. IPVS 13: 122.
- Wallgren, P., S. Mattsson, M. Stampe, B. Molander, M. Lindblad and M. Wierup, (1994) Control of infections with toxin-producing *Pasteurella multocida* in herds affected with atrophic rhinitis. Proc IPVS 13: 123.
- Wierup, M. and P. Wallgren (2000) Results of an intensive control of atrophic rhinitis in elite breeding and multiplier herds in Sweden. Proc. IPVS16:158.



Table 1. The total number of samples and the outcome of nasal swabs analysed for PMT. The samples have been collected in all nucleus and multiplying herds, as well as in production herds suspected for AR.

Year	Samples	Positive samples	Diagnosed herds
2002	2,472	0	0
2003	3,020	167	2
2004	2,413	29	2
2005	1,975	13	3
2006	1,836	2	0
2007	1,878	1	0
2008	462	0	0
2009	1,724	9	1

# Aujeszky's disease

## BACKGROUND

*Aujeszky's disease* (AD) virus is a herpesvirus with capacity to infect several species but the pig is the natural host of the virus. AD is an important disease in the swine production worldwide although many countries have controlled the disease, at least in the domestic swine population. Wild boars are reported to develop clinical signs of disease but their role as reservoirs or transmitting the disease is debated. Other species that are infected, including cattle, sheep, goat, dog and cat, develop clinical signs but are not considered important for the transmission of the disease. A few cases of human infection have been reported but AD is not considered a zoonotic disease.

## History

*Aujeszky's disease* (AD) was described for the first time in Hungary 1902 and was diagnosed in Sweden in 1965. Since then the disease has been notifiable. Until the 1980s the number of outbreaks in Sweden was limited to a few every year but during the 1980s the incidence was increasing. A national control program supported by the government and operated by the Swedish Animal Health Service was introduced in 1991. The control program was open to all pig-producing herds and participation in the program was voluntary. However there were strong motives to participate because towards the end of the program pigs from non-member herds were not accepted for slaughter and insurance companies did not pay compensation to non-member herds. In 1995 all herds were declared officially AD-free. In 1996 the European Commission officially recognized the swine population in Sweden as free from AD (Commission Decision 96/725/EU with amendments).

Swedish Animal Health Service is responsible for the ongoing active surveillance program and reports to the Swedish Board of Agriculture.

## Disease

The clinical manifestation of AD is different depending on the age of the infected animal. The most severe clinical signs develop in newborn or very young piglets in which infection leads to neurological signs and nearly 100% mortality, whereas adult pigs show only mild respiratory signs and inappetence. In addition to the mild clinical signs, pregnant sows can abort as a consequence of the infection.

## Legislation

The disease is included in the Swedish Act of Epizootic Diseases (SFS 1999:657 with amendments) and thereby notifiable on clinical suspicion for all clinicians and farmers. Sweden has been granted certain additional guarantees by the European Commission regarding AD (Commission Decision 92/244/EEC, with amendments), to protect the Swedish swine health status.

## SURVEILLANCE

The purpose of the surveillance is to document continued freedom from the disease. Samples are analyzed for antibodies against AD virus using a blocking ELISA (Svanovir™, PRV-gB-Ab ELISA, Svanova) and in the case of clinical suspicions also for virus or virus genome. All analyses are performed at the National Veterinary Institute (SVA).

## Passive surveillance

As AD is notifiable on clinical suspicion for both veterinarians and farmers, cases with suspect clinical signs will be investigated following notification to the Swedish Board of Agriculture. The following investigation includes, in addition to restrictions on the farm during investigation, sampling of sick or dead animals and examination of the herd for prevalence of clinical signs and production results. Ongoing testing of animals for import and export and at breeding centers adds to the passive disease surveillance.

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### Active surveillance

The active surveillance program comprises sampling of sows, boars and fatteners at slaughter. The fattener samples used for the surveillance originate from the PRRS surveillance, in which three pigs from each selected herd are sampled.

### RESULTS

#### Passive surveillance

During 2009 there were no clinical suspicions of AD to be investigated.

#### Active surveillance

In 2009, 776 boars and sows and 2,712 slaughter pigs were sampled within the active surveillance program. All these samples were negative regarding antibodies against AD virus.

### DISCUSSION

The purpose of the surveillance is to document freedom from the disease and to contribute to the

maintenance of this situation by detection of an introduction of the disease before it is widely spread in the swine population. The fact that no clinical suspicions of AD has been investigated during 2009 might indicate that the awareness concerning this disease has decreased over time. The effect of changing from sampling solely boars and sows at slaughter to sampling of fewer sows and boars in favor of slaughter pigs has not been evaluated.

### REFERENCES

Engel M, 1999. Eradication of Aujeszky's Disease (Pseudorabies) Virus from Pig Herds: Alternatives to Depopulation. Acta Universitatis Agriculturae Sueciae, Veterinaria 58. Swedish University of Agricultural Sciences, Uppsala, Sweden.

Estola T, Obel AL, Rutqvist L, 1965. "An outbreak of Aujeszky's disease in Sweden" Ett utbrott av Aujeszky's sjukdom i Sverige (in Swedish). Nord. Vet. Med. 17, 649-656.



# Avian Influenza surveillance programmes in poultry and wild birds

## BACKGROUND

Avian influenza (AI) is caused by Influenza A viruses. The viruses belong to different antigenic subtypes based on hemagglutinin (H1-H16) and neuraminidase (N1-N9) surface structures. The disease is highly contagious and is spread both directly and indirectly. Wild birds are reservoir for low pathogenic viruses (LPAIV), which may mutate and become highly pathogenic (HPAIV) if introduced in large poultry flocks. Since 2005 highly pathogenic H5N1 virus has affected and been spread by wild birds in Asia, Europe and Africa. In early spring 2006 highly pathogenic avian influenza (HPAI) of subtype H5N1 was detected in wild birds for the first time in Sweden. One infected farmed mallard was also detected in a game bird holding.

In 2009 in the European Union there was one outbreak of HPAI H7N7 in a farm with layers (Spain) and 50 outbreaks of LPAI of different subtypes in Germany (n=6), Spain (1), Romania (1), France (3), Czech republic (2) and Italy (37). One HPAI H5N1 infected mallard was detected within the active surveillance in wild birds in Germany.

## Animals

Morbidity may be as high as 100%, but depends on species affected, co-infections, virulence in the virus and other factors. In general gallinaceous birds including turkeys and chicken suffer a more severe disease than waterfowl as ducks and geese, which may only express minor clinical signs, if any. LPAIV infections most often cause asymptomatic infections or mild respiratory disease. HPAIV infections cause variable clinical signs like cyanosis, respiratory distress, diarrhea, nervous signs,

depression, decreased food and water intake, decreased egg production with altered egg quality. In some cases the only sign is sudden death of large numbers of birds.

## Legislation

Avian influenza is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments) and is notifiable on suspicion. If AI is suspected or confirmed on a farm, measures will be taken to combat the disease and to prevent further spread according to Council Directive 2005/94/EC.

## SURVEILLANCE

The Avian Influenza surveillance programmes in Sweden in poultry and wild birds are based on Council directive 2005/94/EC and Commission decision 2007/268/EC. The latter determines the general and specific requirements and criteria about sampling, target populations, survey design, laboratory testing, reporting etc. for both poultry and wild birds.

The survey in wild birds shall contribute to the knowledge of avian influenza ecology and the threats from wildlife to animal health as well as to serve as an early warning system of avian influenza strains that may be introduced into poultry flocks from wild birds. The aim of the survey in poultry is to detect infections of avian influenza virus subtype H5 and H7 in different species of poultry. The survey programmes have been carried out on a yearly basis in all member states since 2002 to determine the prevalence of avian influenza, in particular avian influenza virus subtypes H5 and H7.

## SURVEILLANCE 2009

### Animals

#### Poultry

The serological analyses were performed at the National Veterinary Institute (SVA). All poultry were sampled at slaughter except for breeders, game birds and backyard flocks. The breeders were bled late in their production period within the Poultry Health Control Programme. The game birds and the backyard flocks were bled at the holding. The samples were analysed using a haemagglutination-inhibition test described in the diagnostic manual for avian influenza as provided for in Council Directive 2005/94/EC.

Within the programme sampling has been performed in game birds (mallard ducks and pheasants), layers, turkeys, breeders, geese, ducks, ratites, small-scale broiler production and some backyard flocks with geese and ducks. Ten blood samples from each holding were collected except for holdings with geese, ducks and mallard ducks where 40 samples from each flock were collected. In flocks with less than 10 and 40 birds respectively, all birds were sampled. In total 2,613 samples were taken. Table 2 gives an overview of all poultry flocks sampled in 2004 to 2009.

In addition to the surveillance programme, samples taken on suspicions, including clinical suspicions for Newcastle disease, are analyzed for AIV.

#### Wild birds

The survey in wild birds consists of both active surveillance on living birds and passive surveillance on birds found dead or diseased. The surveillance was primarily targeting high risk species in accordance with Commission decision 2007/268/EC, Annex II. In total 3,889 birds were sampled; 374 of them were sampled within the passive surveillance which was carried out by SVA.

The active surveillance was performed from April until December by SVA in cooperation with the Swedish University of Agricultural Sciences in Umeå and by Kalmar Bioscience at three different wild bird habitats in Sweden. Most of the live birds were sampled with cloacal and oropharyngeal swabs. In some cases fresh faeces from the ground were collected.

From dead birds that were autopsied, swab samples (mostly both cloacal and tracheal) were used for PCR analyses. The samples were analysed for the detection of avian influenza virus genome by using an M-gene realtime PCR. Positive samples were further analysed for detection and identification of H5 and H7 viruses, including virus pathotyping by amplicon sequencing.

From the birds sampled within the surveillance performed by Kalmar Bioscience two swabs were always taken. One swab was analysed for the detection of avian influenza virus genome by using

Table 2. Number of flocks of different poultry categories sampled in 2004-2009.

	2004	2005	2006	2007	2008	2009
Laying hens	60	60	60	60	65	61
Turkeys	26	35	26	23	23	17
Ducks	21	16	2	3	8	3
Geese	25	22	28	16	30	13
Broilers <sup>1</sup>	0	0	7	17	28	27
Ratite	11	7	15	10	10	6
Breeding hens (parents)	40	40	40	40	42	33
Breeding turkeys (parents)	0	5	4	4	2	4
Game birds (mallards)	0	0	0	7	6	6
Game birds (pheasants)	0	0	0	23	23	20
Backyard flocks	-	-	-	-	-	6

<sup>1</sup> Small-scale production.





an M-gene real-time PCR at the Kalmar Bioscience. If the sample was positive the other swab from the same bird was sent to the Virological department at SVA for further testing.

### RESULTS

#### *Poultry*

All samples analysed were negative regarding antibodies to avian influenza virus subtype H5 and H7 except for in total eight samples from two holdings which were positive for H5. The holdings, one backyard flock with geese and ducks and one game farm with mallards, were further investigated but no influenza A virus genome was detected.

#### *Wild birds*

Within the passive surveillance one mallard (*Anas platyrhynchos*) was positive regarding low pathogenic H5 influenza virus. No other samples from dead wild birds were positive for influenza A viruses.

Within the active surveillance 3,515 birds were sampled and no HPAIV positive birds were detected. One common teal (*Anas crecca*) and 60 mallards were positive for low pathogenic avian influenza virus subtype H5. Five mallards were positive for low pathogenic avian influenza virus subtype H7. The absolute majority of the positive birds were sampled in the autumn (Oct-Nov) and all of them in the south of Sweden. In addition samples from 298 birds (mostly mallards) were positive for avian influenza virus, but none for avian influenza subtypes H5 or H7. The actual subtypes were not determined in these cases.

### DISCUSSION

In May 2005 the first big outbreak of HPAI among wild birds was reported from China. Ever since, infected wild birds have been detected in Europe. Although there has not been any great mortality in wild birds, they pose a risk for domestic birds since the virus is directly pathogenic in poultry. Preventive measures in Sweden and the rest of Europe have been focused on increasing biosecurity in poultry holdings to prevent the introduction of the virus from wild birds. These measures are still very important but once introduced to poultry the virus is more likely to be spread in between poultry flocks via infected live animals, contaminated vehicles and products etc. When combating the disease focus should thus be on preventive measures in order to reduce transmission of virus between poultry flocks.

### REFERENCES

- Slomka MJ, Coward VJ, Banks J, Löndt BZ, Brown IH, Voermans J, Koch G, Handberg KJ, Jørgensen PH, Cherbannel-Pansart M, Jestin V, Cattoli G, Capua I, Ejdersund A, Thorén P, Czifra G. (2007) Identification of sensitive and specific avian influenza polymerase chain reaction methods through blind ring trials organized in the European Union. *Avian Dis.* Mar;51(1 Suppl):227-34.
- Spackman, E., Senne, D.A., Myers, T.J., Bulaga, L.L., Garber, L.P.,
- Perdue, M.L., Lohman, K., Daum, L.T., Suarez, D.L., 2002.
- Development of a real time reverse transcriptase PCR assay for type A influenza virus and the avian H5 and H7 haemagglutination subtypes. *J. Clin. Microbiol.* 40, 3256-3260.

# Bluetongue

## BACKGROUND

Bluetongue is a vector borne disease of ruminants and camelids caused by any of 24 serotypes of Bluetonguevirus (BTV), which is a member of the orbivirus genus of the family reoviridae. The virus is transmitted by haematophagous midges (*Culicoides spp*).

### History

Until 1998 Bluetongue was considered to be restricted to areas with a tropical and temperate climate as far as 40°N and had not been detected in any of the European countries. Since then, outbreaks of different serotypes have been detected in several Mediterranean countries. In August 2006 a new serotype for Europe (BTV-8) appeared in the Netherlands. During 2006 and 2007 this outbreak spread to a large number of countries in northern and Western Europe. In October 2007 one case was reported in Denmark and the restriction zone around the Danish case encompassed the south-west part of the county of Skåne in the most southern parts of Sweden. In 2008, further cases were reported in all BTV-8 infected EU countries and large vaccination campaigns were executed in most of EU as soon as inactivated vaccines became available. On the 6th of September 2008 the first case of BTV-8 infection in Sweden was confirmed. A vaccination campaign and intensive surveillance activities were promptly initiated nationally, with focus on the southern part of the country. Surveillance included both passive and active surveillance by serology and PCR in ruminants, as well as vector surveillance. The investigations revealed that the infection occurred over a large area in southern Sweden during September and October 2008, despite comparatively low vector activity, an apparently low viral load and only one case of clinical disease. Restrictions comprising a standstill, a vaccination and a restriction zone was applied in accordance with EU legislation. Following the detection of more infected animals over a larger area, the zones were adjusted accordingly.

The zones indicated in the map (Map 5) are applicable since November 13th 2008. Vaccination and surveillance activities continued in 2009. In the first quarter of 2009 three newborn calves tested positive for presence of the BTV-8 viral genome, infections in all three cases being transmitted transplacentally and originating from autumn 2008. Further to this no sign of viral circulation has been recorded since the beginning of the vector free period autumn 2008. During 2009 several serotypes in addition to BTV-8 were circulating in Europe, most epidemiologically noteworthy being the northbound spread of BTV-1 that by the end of 2009 reached northern France.

### Disease

Bluetongue virus cause clinical disease to various extents in ruminants, mainly in sheep. The different serotypes appear to vary in their ability to cause clinical signs in different animal species and also in the severity of clinical signs in the same species. The signs include fever, lesions in the mucous membranes of the mouth and nostrils, inflammation of the coronary band, swollen head and oedema in various body tissues.

### Legislation

The control, monitoring, surveillance and restrictions on movements of certain animals of susceptible species are governed by Directive 2000/75/EC with amendments. Bluetongue is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments).

## SURVEILLANCE

All diagnostic testing as outlined below was performed at the National Veterinary Institute (SVA). Serum samples were analysed with a competitive ELISA (ID Screen® Bluetongue Competition ELISA) and milk samples were analysed with an indirect ELISA (ID Screen® Bluetongue Milk). These ELISAs test for presence of antibodies directed against the VP7 protein.

## SURVEILLANCE 2009

The VP7 is a major core protein possessing antigens common to the 24 serotypes. Organs and blood were initially analysed with real time PCR for BTV-8 and in May 2009 a real time pan-PCR was implemented detecting all 24 serotypes. (FLI, Germany).

A positive case is defined as an animal giving rise to a positive PCR-product or an unvaccinated animal without remaining maternal antibodies giving a significant antibody titre.

### Passive surveillance

Bluetongue is notifiable according to the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments), requiring suspicions based on clinical signs to be reported to the Swedish Board of Agriculture and subsequently investigated. In addition to the passive surveillance clinicians and official veterinarians, in accordance with the law as outlined above, carries out serological testing for Bluetongue prior to import and export, before movements of animals out of the standstill- or restriction zones and at breeding centers.

### Active surveillance

#### *Vector surveillance*

The vector surveillance, initiated in 2007 in order to document the activity of relevant *Culicoides* spp. throughout the different seasons of the year, was continued in 2009. 16 light traps were placed on 16 different farms geographically spread over the country (Map 5) and checked once a week. The vector monitoring program was designed according to EU guidelines. During the seasonally vector free period the traps were placed indoors, upon the first capture of *Culicoides* spp they were moved outside, and at the onset of the vector free period in the autumn 2009 again moved inside.

#### *Surveillance in Cattle*

A national surveillance program with various components was initiated in 2008 upon the introduction of the disease. This program was adopted as outlined below for 2009. The National Veterinary Institute (SVA) was responsible for the screenings, which were financed by the Swedish Board of Agriculture.

#### *Serological surveillance outside the restriction zone*

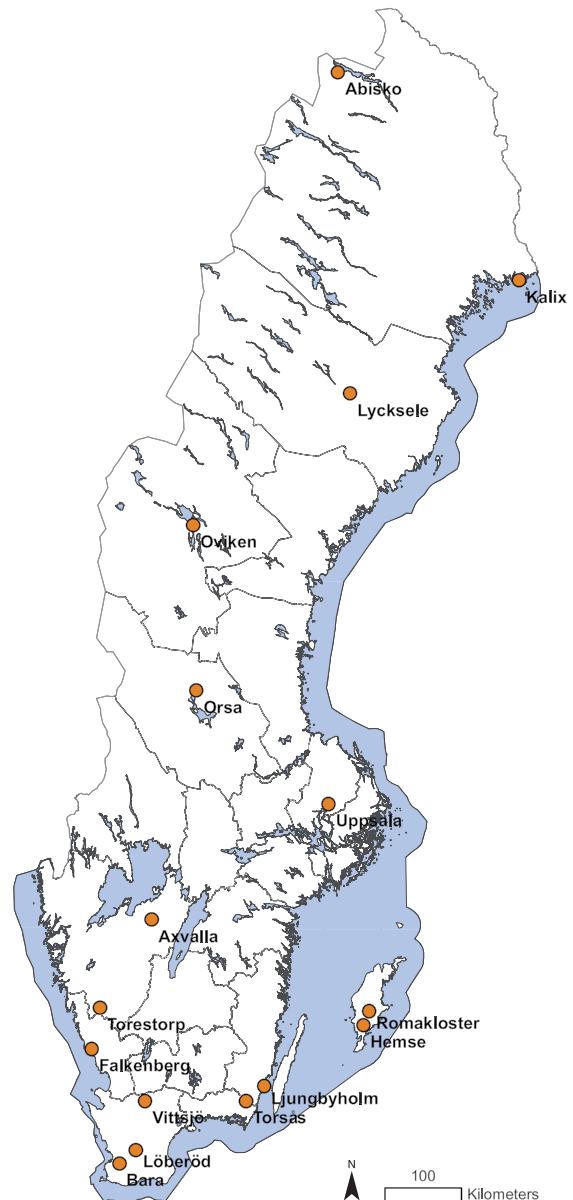
During the vector active period surveillance was performed in the form of analysis of serum samples from beef cattle outside the restriction zone.

Samples were obtained by convenience sampling from the surveillance program for Bovine virus diarrhea (BVD) and enzootic bovine leucosis (EBL), taken at slaughter and thus not strictly random. The number of samples analyzed from each herd was based on herd size, with a maximum of three samples taken from the largest herds. In total 763 serum samples were analyzed for the presence of antibodies against BTV.

#### *Risk-based monitoring of sentinel animals with bulk milk samples*

Bulk milk samples have proved to be a sensitive method for detecting antibodies against Blueton-

Map 5. Locations of the 16 vector traps operated in 2009.





unge disregarding herd-size and the method was used in several different screenings during 2009;

- Upon introduction of BTV-8 infection in Norway in February 2009 bulk milk samples were taken from 450 dairy farms in the areas close to the Norwegian border.
- During the vector active period a limited number of bulk milk samples were taken from randomly selected dairy farms in the entire country outside the restriction zone
- During the part of the vector active period with highest risk for disease outbreaks (July-November) monthly bulk milk samples were taken from all dairy herds in a buffer zone outside the vaccination area but inside the restriction zone (Map 6). In total 996 farms were sampled every month. This area was chosen for intensive surveillance as it was considered a high risk area for remaining infection.

Altogether 7,689 bulk milk samples were analyzed for the presence of antibodies against Bluetongue in 2009.

*Targeted risk based monitoring in the vaccination area*  
In accordance with the EU-legislation a risk based monitoring for the detection of antibodies against Bluetongue in a target population of susceptible animals at high risk, based on location and epidemiology of the virus, was performed in the vaccination area. Unvaccinated calves of beef breed, born in 2009 but older than four months, that had been exposed to the vector during the summer were chosen as sentinel animals. 603 randomly chosen calves representing 0,5 % of the sentinel population in the vaccination zone were sampled in connection with the vaccination campaign during autumn 2009 and tested for the presence of antibodies against BTV.

*Monitoring of transplacental infections*  
All calves born between 1 November 2008 and 30 April 2009 (i.e in the vector free period) in herds that had tested positive to Bluetongue in autumn 2008 were tested for presence of viral genome with PCR. In total 215 calves were tested.

## RESULTS

### Vector surveillance

Large quantities of potential BTV vectors were found in all monitoring areas, in total during the vector active season 35,258 midges, whereof 29,419, or 91 %, were potential vectors. (i.e. *Culicoides obsoletus*, *C. scoticus*, *C. chiopterus*, *C. dewulfi* and *C. pulicaris*). The species distribution was similar from the various capture sites and also from former years. In 2009, vector activity started in mid-April and had ceased by the end of October in most areas. Based on the results from the monitoring and on temperature data, the seasonally vector active period was declared on the 22 April 2009 and the seasonally vector free period on 1 November 2009.

### Surveillance in Cattle

During 2009, 28 herds were investigated due to suspicions based either on clinical symptoms or on positive samples from any of the screenings. For the clinical suspicions affected animals were tested either for the presence of antibodies or viral genome or both. In the cases where suspicions were

raised after positive samples from any of the screenings all epidemiologically important animals in the affected herds were tested with the same methods. No suspicions were confirmed positive.

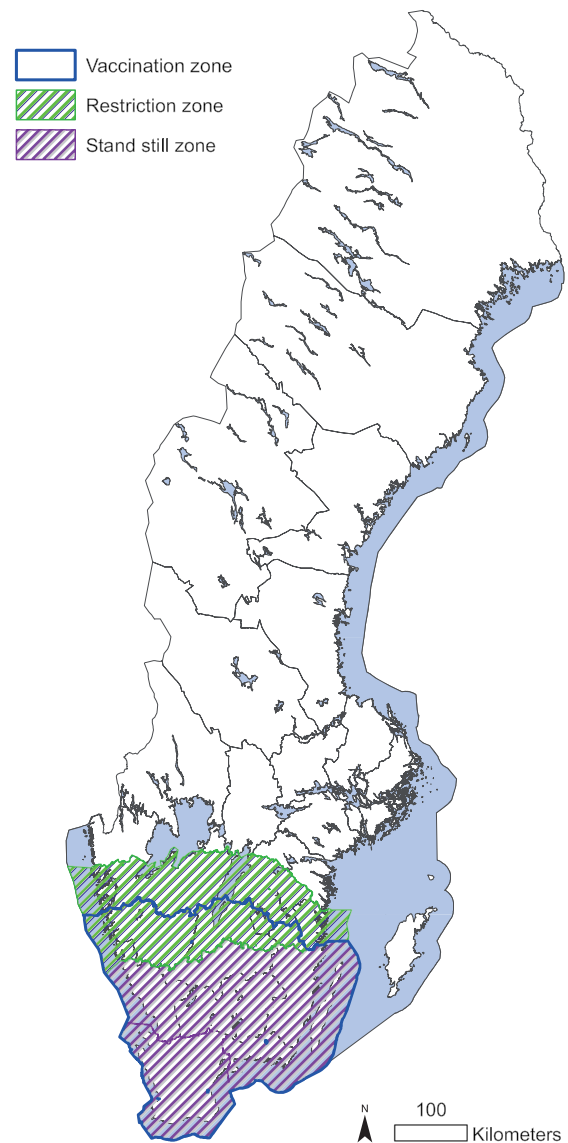
### *Results in summary:*

- Two animals from the serological surveillance outside the restriction zone tested positive, both animals turned out to be vaccinated.
- In total 83 bulk milk samples tested positive. All herds were investigated and for most cases it was found that vaccinated animals had been purchased and introduced into the herd. Those herds were subsequently not recorded as suspicions. If no such events were recorded the herd was regarded as a suspicion and all animals having contributed to the positive bulk-milk sample were individually tested with serum samples. No positive results were found from this complementary sampling. These positive bulk milk samples were thus concluded to be false positive.
- In the targeted risk based monitoring in the vaccination area one calf tested positive for antibodies but negative for presence of viral genome. The calf had not showed any clinical signs, nor had any other animals in the herd. The positive test result was most probably a false positive as the test used had a specificity of 99 %.
- During 2009 three calves born very early in, or before the onset of, the vector season from mothers having been PCR positive the previous year, tested positive for presence of Bluetongue viral genome. These calves could not have required the infection in 2009 and were thus trans-placentally infected in 2008.

### DISCUSSION

In summary no clinical suspicions of Bluetongue were confirmed nor could any proof of viral circulation be established during 2009. This suggests that the BTV-8 infection introduced in autumn 2008 has been contained via the mass vaccination program, aided by the Nordic climate hindering over wintering by other means than trans-placentally, and in addition that no other serotypes have been introduced.

Map 6. Stand-still-, vaccination- and restriction zones as applied from 13th November 2008 and all through 2009.



### REFERENCES

- BTnet (2009) <http://eubtnet.izs.it/btnet/reports/EpidemiologicalSituation.html>
- Hendrickx, G. 2009. The spread of Bluetongue in Europe. *Small Ruminant Research*. 86: 34-39.
- Nielsen S. A., Nielsen B. O., Chirico J. 2010. Monitoring of biting midges (Diptera: Ceratopogonidae: Culicoides Latreille) on farms in Sweden during the emergence of the 2008 epidemic of bluetongue. Accepted in *Parasitology Research*.
- Sternberg Lewerin, S., Hallgren, G., Miezewska, K., Treiberg Berndtsson, L., Chirico, J. & Elvander, M., 2009. Infection with BTV8 in Sweden 2008. Accepted in *Veterinary Record*.

# Bovine spongiform encephalopathy

## BACKGROUND

Bovine Spongiform Encephalopathy (BSE) belongs to the group of diseases called Transmissible Spongiform Encephalopathies (TSE) and was first described in cattle in the UK in 1986. The current theory about causative agent is the prion-only hypothesis. This theory assumes that misfolded prions (small proteins) induce the same pathological structure in normal proteins in the body of the host resulting in accumulation of prions and cellular damage without involvement of any microorganism. BSE has primarily spread through contaminated meat and bone meal (MBM), i.e. MBM containing parts of animals infected with BSE. Through export of MBM and export of cattle already infected and which later ended up as MBM, the disease was spread outside the UK. However, the primary source of the prions involved in the large BSE-epidemic has not been established, although scrapie in sheep or spontaneous occurrences in cattle have been discussed.

In 1996 the disease became a public health concern, after the detection of a new variant of Creutzfeldt Jacobs Disease in humans (vCJD), likely to be linked to BSE in cattle. This resulted in actions taken to prevent transmission to humans through removal of Specified Risk Material (such as brain and spinal cord) at slaughter and restrictions related to feed to avoid recycling of infectious material to ruminants through ban on the use of meat and bone meal. The possible occurrence of BSE in sheep and a confirmed case of BSE in a French goat induced increased surveillance of TSEs in small ruminants. This is described further under the chapter related to scrapie.

In recent years strains of BSE which show diagnostic dissimilarities with "classical BSE" have

been described, the possible spontaneous occurrence of these cases is being discussed as well as possible links to classical BSE and potential zoonotic aspects.

Sweden has had a low risk of introduction and a low risk of recirculation of the disease if it had been introduced. This was due to national decisions taken; in 1986 the inclusion of MBM produced from fallen stock was prohibited in animal feed due to ethical reasons, the industry voluntarily decided on a ban on MBM in feedstuff intended for dairy cows in 1987, in June 1988 all imports of livestock and MBM from the United Kingdom were banned and in 1991 MBM was legally banned from feedstuff for all cattle. The low risk has been confirmed through repeated external assessments of the Swedish situation first through the Geographical Bovine spongiform encephalopathy Risk (GBR) by the Scientific Steering Committee and reassessed by the European Food Safety Authority (EFSA), and later by the OIE Scientific Commission for Animal Diseases (Scientific Commission). Sweden is currently through a Resolution adopted by the International Committee recognized as having negligible BSE risk in accordance with the OIE Terrestrial Code.

One case of BSE has been detected in cattle in Sweden. This was in 2006 in a beef cow born in 1994. This case was confirmed to be of H-type.

## Disease

The incubation period is long, from a couple up to several years. Symptoms are related to the neurological system and include altered behaviour and sensation as well as affected movement and posture. Clinical symptoms can last for weeks. The disease is progressive and always fatal.

## SURVEILLANCE 2009

### Legislation

Surveillance and control is regulated through the Regulation (EC) No 999/2001 of the European Parliament and of the Council of 22 May 2001. BSE is a notifiable disease under the Swedish Act of Epizootic diseases (SFS 1999:657, with amendments) and there is a compensation scheme for farmers to compensate losses due to eradication measures.

### SURVEILLANCE

#### Feed

In order to survey compliance with the feed bans, samples are collected at feed-mills, of imported raw material for feed production and at farm level and analyzed for the presence of MBM. The Swedish Board of Agriculture and the County Boards are responsible for this surveillance. In addition feed-mills take samples as part of their own-control. Samples are analysed at the National Veterinary Institute (SVA).

#### Animals

The Swedish Board of Agriculture is responsible for the surveillance programme, which is carried out in cooperation with the National Veterinary Institute (SVA). SVA is appointed National Reference Laboratory, NRL (Regulation (EC) 999/2001. Samples from animals in passive surveillance and risk categories are analysed at the SVA, and healthy slaughtered animals are examined at private laboratories in Sweden.

#### *Passive surveillance*

All suspicions of BSE (bovine animals not responding to treatment, with clinical signs that are compatible with BSE symptoms) must be reported to the authorities. The obligation to report applies for animal owners, veterinarians and everyone else who is responsible for the animals.

Previously the method required for analysis of samples from animals with clinical suspicion of BSE was histopathology and immunohistochemistry in accordance with Regulation (EC) No 999/2001, as amended. However, the regulation was changed during 2009 and the protocol was replaced by use of Bio-Rad TeSeE rapid assay in combination with Bio-Rad TeSeE Western Blot.

#### *Active surveillance*

The design of the surveillance programme is in

accordance with Regulation (EC) No 999/2001 Annex III. In accordance with Commission Decision 2008/908 Sweden applies derogation and in 2009 the age limits of animals sampled were changed from 24 months for fallen stock and 30 months for normal slaughter, to 48 months for both of these categories.

The following categories are sampled in the active surveillance:

- All healthy slaughtered cattle over 48 months of age
- All healthy slaughtered cattle over 30 months of age if they origin in a country not included in the list in Commission Decision 2008/908
- All emergency slaughtered cattle above 48 months of age, including slaughter used for feed to large carnivores.
- All fallen stock (animals dead or killed on farm but not slaughtered for human consumption) above 48 months of age. The animals are sampled at the rendering plants or at autopsy. EU Member States may decide to derogate from the requirement of monitoring in animals not slaughtered for human consumption in remote areas with a low animal density, where no collection of dead animals is organised. This has been applied in Sweden in remote areas and the bovine population in these areas does not exceed 10% of the total bovine population in Sweden.

The samples from fallen stock, emergency slaughter, clinical suspects and some samples from normal slaughter at small slaughterhouses were examined with rapid tests at SVA. In case of positive or inconclusive results the material was prepared and examined by Biod-rad Western Blot.

The large majority of the samples from healthy slaughtered animals were examined with rapid tests at two regional laboratories, which was during the year changed to only one private laboratory. The samples were tested with rapid test (Bio-Rad TeSeE or Idexx HerdChek BSE-Scrapie Antigen Test Kit, Idexx Laboratories) as described by the manufacturers. In case of positive or inconclusive results the material was prepared and examined by Biod-rad Western Blot at the SVA.

### RESULTS

#### Feed

In 2009, 264 feed samples were taken at feed-mills, 89 samples of imported raw material, and 209

## SURVEILLANCE 2009

samples in the primary production at farm level. Out of these samples two samples at farm level included traces of mammalian protein, most likely due to contamination at farm level (rodents had access to the storage of raw material). All samples at feed-mills were negative. Six samples from imported raw material are under investigation due to possible contamination with fish meal.

### Animals

#### *Passive surveillance*

In 2009 two cattle were examined due to clinical suspicion, both with negative results.

Animals with diseases related to the central nervous system are also likely to have been examined as fallen stock and are thus included in that category.

#### *Active surveillance*

In 2009, in total 124,567 samples were examined for BSE and all samples were negative. Of these, 12,064 were from fallen stock and 157 from emergency slaughter.

### DISCUSSION

No positive BSE cases were detected and although the age limit for sampling was altered, the number of animals sampled is still very high and the results are valid. Preventive measures have been in place for many years and the fact that no cases were detected support that these measures have been

effective. The low number of clinical suspicions may be an indication of a lower degree of awareness among farmers and veterinarians compared to 5-10 years ago.

Reports of prion transmission studies including several passages in different species have shown that prion strains do not always remain stable through these passages. The atypical cases cannot be excluded as the source of the large BSE-epidemic. What happened in the UK can happen again if the measures implemented to avoid recirculation are not kept. Although the prevalence is constantly decreasing on European level it is of uttermost importance to keep bans related to feed to avoid any possibility of recirculation of BSE if it would enter the system again.

### REFERENCES

Gavier-Widén D, Nöremark M, Langeveld JP, Stack M, Biacabe AG, Vulin J, Chaplin M, Richt JA, Jacobs J, Acín C, Monleón E, Renström L, Klingeborn B, Baron TG. Bovine spongiform encephalopathy in Sweden: an H-type variant., *J Vet Diagn Invest.* 2008 Jan;20(1):2-10.

EFSA Scientific Report on the Assessment of the Geographical BSE-Risk (GBR) of Sweden. Adopted July 2004 (Question No EFSAQ-2003-083). Last updated 8 September 2004. Publication Date 20 August 2004

Personal communication, Anna-Karin Båvius, The Swedish Board of Agriculture (results of feed-control).

[http://www.efsa.europa.eu/en/science/tse\\_assessments/gbr\\_assessments/572.html](http://www.efsa.europa.eu/en/science/tse_assessments/gbr_assessments/572.html)





# Bovine viral diarrhoea

## BACKGROUND

Bovine viral diarrhoea (BVD) is caused by bovine viral diarrhoea virus (BVDV), which is classified in the genus Pestivirus in the family Flaviviridae. Cattle are the primary host of BVDV, but most even-toed ungulates are probably susceptible to the disease. Cattle that are persistently infected serve as a natural reservoir for virus. The virus may be spread between animals via direct or indirect routes.

### History

A voluntary surveillance and control program with the objective to eradicate BVD without vaccination was launched by the Swedish Dairy Association in 1993 and has been running since then. The National Veterinary Institute (SVA) performs the laboratory analyses and the government together with the farmers bear the costs for sampling and testing. Since June 1, 2001, there is also a compulsory control program requiring all cattle herds to be tested for BVDV on a regular basis.

### Disease

BVDV may induce disease of varying severity, duration and symptoms after an incubation period of 6-12 days. Fever, depression, respiratory symptoms and diarrhoea are typical signs of acute BVD. In pregnant cattle, infection may result in reproductive failure such as abortion and stillbirth or the birth of calves that may be persistently infected with the virus. A more uncommon form of BVD is mucosal disease that may occur in acute or chronic form in persistently infected animals.

### Legislation

BVD is a notifiable disease (SJVFS 2002:16 with amendments). The voluntary control is regulated in SJVFS 1993:42 and the compulsory in SJVFS 2002:31.

## SURVEILLANCE

The purpose of the control program is to eradicate the disease from the Swedish cattle population without vaccination. Sampling depends on type of production and status of the herd. The program relies upon the ability to distinguish infected herds

from non infected herds. Herds that are free from infection are monitored to demonstrate continuous freedom and certified as being free from infection. Herds that are infected are screened and persistently infected virus carriers are identified and removed. Another important part of the program is creating a positive attitude to biosecurity in the farming community and to protect the free herds from introducing the BVDV.

All dairy herds are tested with a yearly bulk milk sample. Milk samples are collected within the quality control programs of the dairy organisations. In beef herds serum samples are taken from slaughtered cattle and/or from live animals in the herd. In herds not declared free from the disease, individual blood samples are taken from live animals in the herds.

For screening, an indirect antibody ELISA (Svanovir® BVDV-Ab ELISA) for serum, milk and bulk milk samples is being used.

## RESULTS

In 2009, the total number of herds affiliated to the voluntary program was 17,686 and at the end of the year 17,658 herds were certified as free from the disease. Of the remaining herds, 11 are considered to still be infected. The other herds only have to be tested further before becoming certified free from the disease. Nine herds were discovered to be newly infected by the virus during 2009.

## DISCUSSION

All herds in Sweden were affiliated to the voluntary or compulsory programs during 2009. At the end of 2009, 99.8% of the herds were certified BVD-free and 0.1% or less was infected by BVD-virus. The control program has been successful, and the goal is to eradicate the disease during 2011.

## REFERENCES

Merck Veterinary Manual, [www.merckvetmanual.com](http://www.merckvetmanual.com), 2010.

Personal communication, Sofie Andersson, Swedish Dairy Association, Statistics for 2009.

# Brucellosis

## BACKGROUND

Brucellosis is caused by zoonotic, gram-negative bacteria belonging to the genus *Brucella*. Most human cases are caused by four species, each having a preferred animal host. *Brucella melitensis* occurs mainly in sheep and goats, *B. suis* in pigs, *B. abortus* in cattle and *B. canis* in dogs. The infection is transmitted by contact with the placenta, fetus, fetal fluids and vaginal discharges from infected animals and may also be found in milk, urine, semen and feces. In animals infection usually occurs by ingestion and through mucous membranes, *B. abortus* can in addition be transmitted through broken skin. In utero infections occur, however venereal transmission seems to be uncommon. Humans are normally infected through contact with infected animals or contaminated animal products such as cheese made of unpasteurized milk.

### History

#### *Animals*

Brucellosis in Swedish cattle was eradicated during the first half of the last century, the last Swedish bovine case was recorded in 1957 (OIE).

#### *Humans*

Brucellosis has been a notifiable disease in Sweden since 2004 according to the Communicable Disease Act. Since then not more than 10 annual cases have been reported. All of them have acquired the infection outside Sweden.

### Disease

#### *Animals*

In animals brucellosis mainly affects the reproductive system causing abortions, stillbirths and the birth of weak offspring. The placenta may be retained, secondary metritis can occur and lactation may be decreased. Acute orchitis and epididymitis, which may result in infertility, can occur in males and arthritis is occasionally seen in both

sexes. Systemic signs do not usually occur in uncomplicated infections, deaths are rare except in the fetus or newborn. In pregnant, previously unexposed and unvaccinated animals abortion storms are common after exposure, with abortion rates varying from 30% to 80%. The period between infection and abortion or other reproductive signs is variable. Infected asymptomatic females may shed the organism in milk and uterine discharges.

#### *Humans*

Occupational exposure of brucellosis is seen worldwide in laboratory workers, farmers, veterinarians and others who are in contact with infected animals or tissues, for people without occupational exposure unpasteurized dairy products are the most common routes of infection. *B. melitensis* is considered to be the most severe human pathogen in the genus. Brucellosis in humans can be asymptomatic, but the course of the illness is extremely variable and the clinical signs may appear insidiously or abruptly. Typically, brucellosis begins as an acute febrile illness with nonspecific flu-like signs such as fever, headache, malaise, back pain, myalgia and generalized aches. Some patients recover spontaneously, while others develop persistent symptoms that typically wax and wane. Genitourinary involvement is noticed in 2-20% of the human cases. The mortality rate is low, around 2% and the disease can be treated with antimicrobial drugs.

## LEGISLATION

### *Animals*

Brucellosis in food-producing animals is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments). Vaccination is according to this act prohibited and notification of suspect cases is mandatory. Sweden's bovine brucellosis free status is officially stated in EU legislation since 1994, Decision 2003/467/EC last amended by Decision 2005/764/EC (originally in



## SURVEILLANCE 2009

Act of Accession of Austria, Finland and Sweden and in former Decisions 94/972/EC and 95/74/EC). Ovine brucellosis is encompassed by Directive 91/68/EEC, Sweden was declared officially free of brucellosis in sheep and goats in 1995 (Decision 94/972/EC). *B. melitensis*, *B. suis* and *B. abortus* are all included on the OIE list of infectious diseases and current surveillance standards for bovine and ovine brucellosis are given in the EU legislation, Directive 64/432/EEC and Directive 91/68/EEC, respectively.

### Humans

Brucellosis has been a notifiable disease since 2004 according to the Communicable Disease Act (SFS 2004:168).

## SURVEILLANCE

### Animals

All diagnostic testing as outlined below is performed at the National Veterinary Institute (SVA). A positive case is defined as an animal from which *Brucella* spp. has been isolated, or an animal giving a significant antibody titre.

### Passive surveillance

Suspicion based on clinical signs in food producing animals must be reported to the Swedish Board of Agriculture and subsequently investigated. During 2009 four clinical suspicions in bovines were investigated.

In addition to the passive surveillance, serological testing for brucellosis is performed prior to import and export of all susceptible species, and at cattle and pig breeding centres.

### Active surveillance

Screening for brucellosis has been conducted regularly in Sweden since 1988 for *B. abortus*, since 1995 for *B. melitensis* and since 1996 for *B. suis*. The purpose of the surveillance is to document freedom from bovine and ovine brucellosis in Sweden in accordance with the EU legislation and to further document freedom from the disease in the Swedish pig population. The Swedish Board of Agriculture finances the surveillance, which is planned and executed by the National Veterinary Institute (SVA). Since the start of the screenings no samples have been confirmed positive. In addition to the screenings described per species below active surveillance is performed via post mortem exami-

nation and culture of aborted fetuses. In 2009 17 bovine, 29 ovine and 62 porcine fetuses were examined by culture of stomach contents.

### Surveillance for brucellosis in bovines

From 1997 and onwards, approximately 3,000 samples (bulk milk and/or serum samples) have been tested each year. During 2009, serum samples from 1,092 beef cattle and bulk tank milk samples from 756 dairy herds were analysed for antibodies against *B. abortus*. The samples were collected within the surveillance programs for Bovine virus diarrhoea and Enzootic bovine leucosis and were obtained from those samples by convenience sampling (in other words not strictly random), evenly distributed throughout the sampling period. The diagnostic tests used were an indirect ELISA (SVANOVIR® Brucella-Ab I-ELISA, Svanova, Biotech, Uppsala, Sweden). For confirmation, the complement fixation test was used.

### Surveillance for brucellosis in sheep and goats

Since 1995 approximately 10,000 samples have been tested each year, representing approximately 5% of the sheep population. During 2009, 7,000 serum samples were analysed for *B. melitensis*. The serum samples were collected within the surveillance program for Maedi/Visna. The samples were obtained from those samples by convenience sampling (in other words not strictly random) collecting 5 samples from each flock sampled for Maedi/Visna. An additional 261 serum samples from goats were analysed for *B. melitensis*. Those samples were collected within the Caprine Arthritis Encephalitis program. The diagnostic test used was the Rose Bengal Test; serum agglutination test with buffered antigen (RBT), with the complement fixation test for confirmation.

### Surveillance for brucellosis in pigs

From 1996 and onwards, approximately 3,000 serum samples have been tested each year. In 2009 serum samples from 1,806 pigs were tested for antibodies against *B. suis*. The serum samples were collected within the surveillance program for Porcine reproductive and respiratory syndrome and were obtained from those samples by convenience sampling (in other words not strictly random), evenly distributed throughout the sampling period. The diagnostic test used was the RBT.

## SURVEILLANCE 2009

### Surveillance for brucellosis in wild boar

Blood samples from hunted wild boars were as in previous years taken in connection with slaughter and analyzed for a number of diseases that could be spread by the wild boar population, including *B. suis*. In 2009 serum samples from 500 wild boars were tested for antibodies against *B. suis*. The diagnostic test used was the RBT.

### Humans

Brucellosis has been a notifiable disease since 2004 according to the Communicable Disease Act and cases must be reported to the Swedish Institute for Infectious Disease Control as well as to the County Medical Office. No domestic cases have been reported and Sweden is declared free from brucellosis.

## RESULTS

### Animals

During 2009 clinical signs causing brucellosis to be suspected were reported from four bovine herds. Serum samples were taken from affected individuals, all samples analyzed were negative.

### Humans

In 2009 seven cases were reported, five men and two women. For six of the cases the country of infection was stated and three out of those six patients had acquired their infection in Iraq.

## DISCUSSION

In summary no domestic human cases, no herd or any individual animal was diagnosed with *Brucella* infection during 2009. The long standing and rather extensive serological screenings performed without finding any confirmed positive animals and the very low number of human cases confirms the stable and positive situation with no brucellosis in food-producing animals being present in Sweden. Imported dogs might harbor *Brucella canis*. As infected dogs only shed the agent in semen and placental fluids the risk of getting brucellosis from infected castrated dogs is considered small.

## REFERENCES

Report on trends and sources of zoonoses, Sweden 2008.

Radostits, O. M., et al 2000. Veterinary Medicine, 9th edition. W.B. Saunders Company Ltd, Harcourt Publishers Limited, London, UK.

[http://www.cfsph.iastate.edu/Factsheets/pdfs/brucellosis\\_abortus.pdf](http://www.cfsph.iastate.edu/Factsheets/pdfs/brucellosis_abortus.pdf)

[http://www.cfsph.iastate.edu/Factsheets/pdfs/brucellosis\\_melitensis.pdf](http://www.cfsph.iastate.edu/Factsheets/pdfs/brucellosis_melitensis.pdf)

[http://www.cfsph.iastate.edu/Factsheets/pdfs/brucellosis\\_ovis.pdf](http://www.cfsph.iastate.edu/Factsheets/pdfs/brucellosis_ovis.pdf)

# Campylobacteriosis

## BACKGROUND

Thermophilic *Campylobacter* spp., curved gram negative rods, are the most common causes of human bacterial gastroenteritis in many countries. A number of *Campylobacter* species have been implicated in human illness. Most human infections are caused by *C. jejuni*, followed by *C. coli* and a few by other species. Birds are considered the principal reservoir although *Campylobacter* can colonise the intestinal tract of many other animal species. The bacteria are excreted in faeces. *Campylobacter* are fragile organisms but are able to survive in water for longer periods. The infectious dose is low. A seasonal peak in the summer months is observed in most European countries. Most human infections are sporadic, which makes tracing of source of infection difficult. Risk factors for infection include ingesting of or handling undercooked contaminated meat products (especially poultry), consuming contaminated unpasteurized milk and other dairy products, drinking water from contaminated supplies, travelling abroad and contact with farm animals and pets. routes.

### History

#### Animals

Because broilers are an important source of human campylobacteriosis, a surveillance program for these birds was initiated in Sweden in 1991. The program was operated by the industry (Swedish Poultry Meat Association) and involved sampling of flocks at slaughter. The program was extended in 2001 to be part of a poultry health control programme. During 2001–2005 cloacal swabs or caecal samples and neck skin samples were collected at slaughter. Since 2006, sampling is performed by collecting intact caeca from 10 birds from every slaughter batch at the major slaughterhouses and pooling these samples to one. The program covers 99% of broilers slaughtered in Sweden.

In 2008 a European baseline survey on the prevalence of *Campylobacter* spp. in broiler flocks and *Campylobacter* spp. and *Salmonella* spp. in broiler carcasses was performed.

#### Humans

*Campylobacter* were for the first time isolated from human diarrhoea in 1972 although spiral bacteria had been seen microscopically in human stool samples in earlier decades.

The number of reported cases during the last decade has varied between approximately 6,000 and 8,600 (Figure 1). Of these, approximately 1,800–2,800 (30–45%) were reported as domestic cases. There is a pronounced seasonal variation with most domestic cases reported by the end of the summer. Food borne outbreaks seldom occur; the majority of the cases are sporadic.

#### Disease

#### Animals

Asymptomatic carriers of thermophilic *Campylobacter* are common in several animal species.

#### Humans

Campylobacteriosis is an acute enteric disease that is usually self-limiting, resolving within a week. In some individuals the symptoms may last longer. The symptoms are mild to severe: diarrhoea, fever, abdominal pain, nausea and malaise. The infection can be complicated by reactive arthritis and a neurological disorder, Guillain-Barré syndrome.

#### Legislation

#### Animals

Thermophilic *Campylobacter* are not notifiable in animals. Only *Campylobacter fetus* sp. venerealis, which causes bovine genital venerealis is notifiable in Sweden.

#### Food

Detection of *Campylobacter* spp. in food is not notifiable.

## SURVEILLANCE 2009

### Humans

Infection with *Campylobacter* is notifiable according to the Communicable Disease Act (SFS 2004:168).

### SURVEILLANCE

#### Animals

A surveillance program for broilers has been operated by the industry (Swedish Poultry Meat Association) since 1991. Since 2006, sampling is performed by collecting intact caeca from 10 birds from every slaughter batch at the major slaughterhouses and pooling these samples to one. The program covers 99% of broilers slaughtered in Sweden.

#### Food

Monitoring is based on in-house control in the companies and sampling by the authorities. Official sampling has been very limited during the year.

#### Humans

Infection with *Campylobacter* is notifiable according to the Communicable Disease Act and cases must be reported to the Swedish Institute for Infectious Disease Control and the County Medical Office in the affected county.

### RESULTS

#### Animals

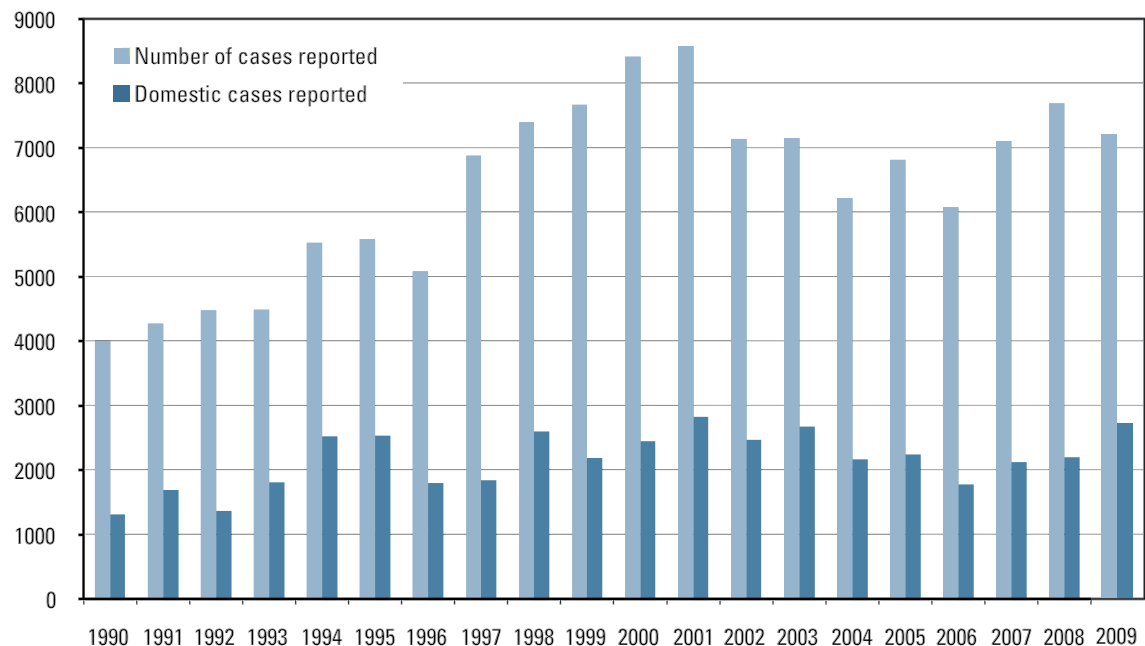
In 2009, thermophilic *Campylobacter* were detected in 386 (12.0%) of the 3,219 slaughter batches in the national *Campylobacter* program (Figure 2). As in previous years, the prevalence of *Campylobacter* in broilers was very low (2-5%) in winter but high (21-28%) in late summer (Figure 3).

#### Humans

During 2009, 7,179 cases were notified, which was a decrease by 7% from the previous year. However, domestic cases increased by 20% to 2,714 (Figure 1). The majority of the domestic cases were reported in July and August. Domestic infection was most common in the age group of 40-49 years. Men were dominating in all age groups infected in Sweden. Of the 4,149 persons infected abroad, 1,147 were reported from Thailand, mostly during December-April. Among persons infected abroad women were dominating in the age groups between 15-24 years.

A trend analysis demonstrated a slight but significant downward trend at a 10% level among domestic cases during the last 12-year period with an average annual decrease of the incidence of 0.5 cases per 100,000 inhabitants. The incidence of the total number of cases demonstrated no significant trend.

Figure 1. Number of notified cases of campylobacteriosis in humans in Sweden 1990-2009.



# SURVEILLANCE 2009

Figure 2. Incidence of *Campylobacter* in Swedish broiler batches. Broilers delivered from members of Swedish Poultry Meat Association.

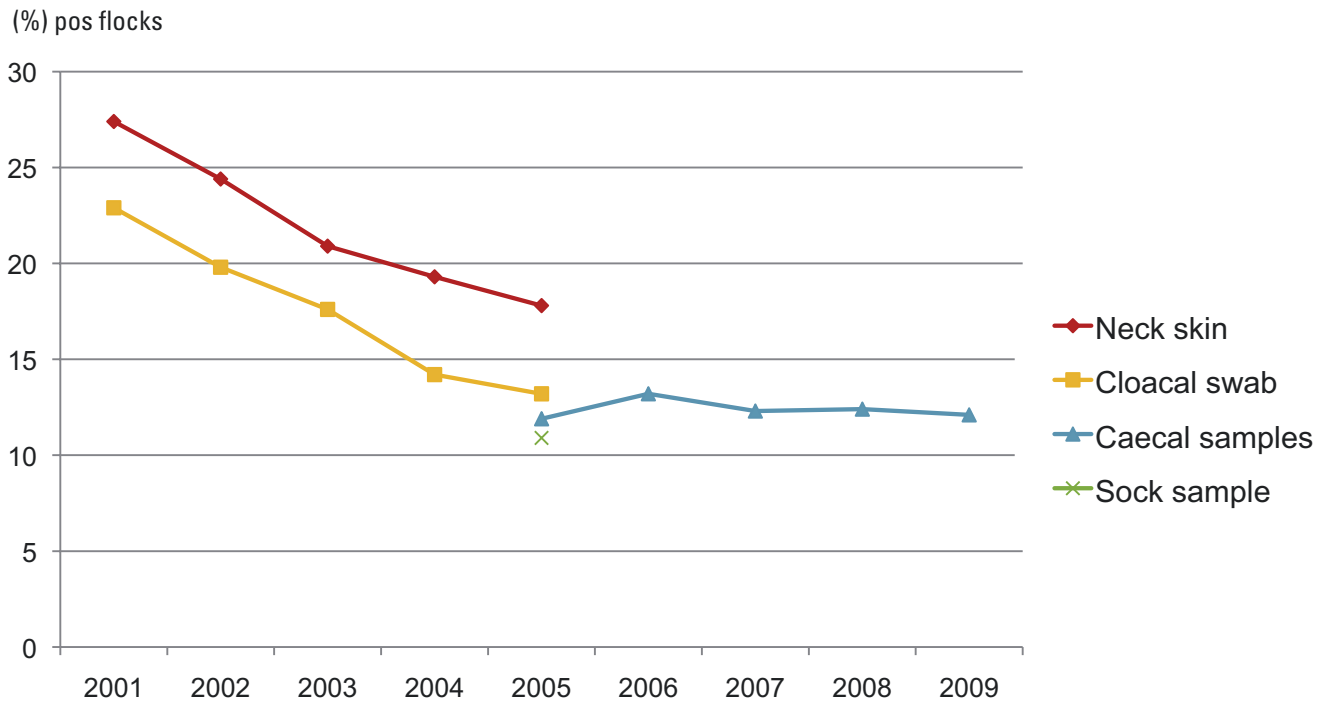
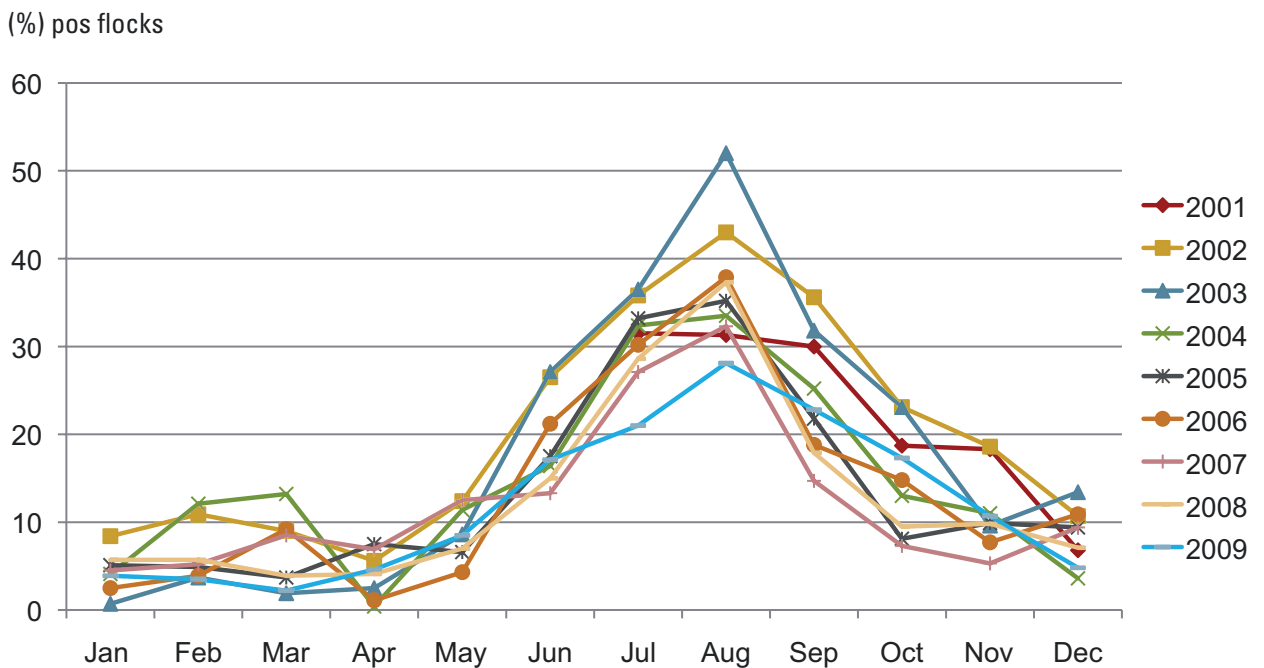


Figure 3. Seasonal incidence of *Campylobacter* in Swedish broiler batches\*. Cloacal samples 2002-2005, Caecum samples 2006-2009.



\* Delivered by members in Swedish Poultry Meat Association



### Food

Reported samples are too few to be commented upon.

### DISCUSSION

*Campylobacter* is the main bacterial cause of human diarrhoea in Sweden. The number of reported cases has varied between 6,000 and 8,600 during the last decade. Of these, approximately 1,800-2,800 (30-45 %) have been infected in Sweden. An increase in domestic infections was noted in 2009. However, a slight but significant downward trend has been seen among domestic cases during the last 12-year period. A decrease in the prevalence of *Campylobacter* positive slaughter batches of broiler has been seen during the same time period. Import of chicken meat has increased, which might partly explain the increase in domestic infections. There are other sources that also should be considered.

Reducing *Campylobacter* prevalence at farm level decreases the risk of human infection. Applying strict biosecurity measures has decreased the number of *Campylobacter* positive broiler slaughter batches in Sweden. Several other control measures to reduce flock prevalence are under investigation.

The broiler producers can be divided into three groups on the basis of the prevalence of *Campylobacter* positive slaughter batches. Approximately 50% of the Swedish producers seldom or only sporadically deliver *Campylobacter* positive slaughter batches whereas 38% of the producers have seasonal problems with the pathogen. A group of 12-13% producers often deliver *Campylobacter* positive slaughter batches. This group accounts for 40% of the *Campylobacter* load of domestic poultry.

Since domestic flies have been associated with spread of the infection a fly control program has been introduced in some broiler houses.

Carcasses are easily contaminated at slaughter and at secondary processing which necessitates application of good hygienic practises. Furthermore *Campylobacter* negative birds can be contaminated at slaughter. This can be prevented by slaughtering flocks tested positive or flocks from operators often delivering positive birds separately from *Campylobacter* free flocks. *Campylobacter* are sensitive to heat and infection is reduced by freezing. Thus, freezing *Campylobacter* positive carcasses or scheduling them to heat-treatment reduces the risk for consumers.

Strict hygiene in the kitchen to avoid cross-contamination between possible contaminated food and food that will not be heated i.e. raw vegetables is essential.

### REFERENCES

- Hansson I, Forshell LP, Gustafsson P, Boqvist S, Lindblad J, Engvall EO, Andersson Y, Vågsholm I. Summary of the Swedish *Campylobacter* program in broilers, 2001 through 2005. J Food Prot. 2007; 70:2008-14.
- Hansson I, Vågsholm I, Svensson L, Olsson Engvall E. Correlations between *Campylobacter* spp. prevalence in the environment and broiler flocks. J Appl Microbiol. 2007; 103:640-9.
- Lindblad M, Lindmark H, Lambertz ST, Lindqvist R. Microbiological baseline study of broiler chickens at Swedish slaughterhouses. J Food Prot. 2006; 69:2875-82.
- Lindqvist R, Lindblad M. Quantitative risk assessment of thermophilic *Campylobacter* spp. and cross-contamination during handling of raw broiler chickens evaluating strategies at the producer level to reduce human campylobacteriosis in Sweden. Int J Food Microbiol. 2008; 121:41-52.

# Coccidiosis and clostridiosis in broilers

## BACKGROUND

Coccidiosis is one of the most important diseases of poultry and may lead to heavy economic losses. The disease is caused by microscopic parasites belonging to the genus *Eimeria*.

Clostridiosis in broilers caused by *Clostridium perfringens* (type A) is a constant threat to the broiler industry. Since 1990 ionophores have been used as anticoccidials in Sweden as these drugs even have a preventive effect on clostridiosis.

## Disease

In chicken coccidiosis is characterized by severe enteritis which may cause high mortality. Infections with *Eimeria* species are ubiquitous but the disease is primarily a problem in flocks with high stocking density on litter, a common feature in intensive broiler production.

Clostridiosis may appear as a necrotic enteritis or a hepatitis.

The necrotic enteritis mostly leads to increased mortality rates during rearing whereas the hepatitis predominantly has a chronic character and leads to increased number of condemnations at slaughter.

## Legislation

Organised health control regarding clostridiosis and coccidiosis in broilers is regulated in Swedish legislation (SJVFS 1993:42).

## SURVEILLANCE

The Swedish program for control of coccidiosis and clostridiosis within the broiler industry started 1999. The organization responsible for the control program is the Swedish Poultry Meat Association (SPMA).

The purposes of the program is to control the efficacy of the anticoccidials used for preventing coccidiosis and clostridiosis in broilers on an ongoing basis, continuously supervise the use of

anticoccidials in the broiler industry and finally, in the long perspective, to replace the preventive medication with anticoccidial drugs by other methods.

Field control of coccidiosis is performed by means of lesion scoring of birds in 20 farms twice a year by specially trained persons (agronomists or veterinarians). The farms that are tested are selected on the basis of production results. Farms with average results are included in the control program. Five birds from each flock are examined for intestinal lesions and the results from each scoring is sent to the National Veterinary Institute (SVA). If the lesion score exceeds a certain level an analysis of the feed regarding the concentration of anticoccidial shall be performed and a farm investigation concerning management and general health status of the flock shall be carried out.

The occurrence of hepatic and intestinal disease in slaughtered broilers is reported from the slaughterhouses four times a year.

When hepatic or intestinal disease observed at the slaughterhouses is exceeding a certain level (0,5%) in a single flock, histological samples are taken and submitted to SVA for examination.

Results from all parts of the control program are sent to the Department of Animal Health and Antimicrobial Strategies at SVA for analysis and compilation. Results indicating a significant increase of coccidiosis or clostridiosis are immediately reported to the chief veterinarian of SPMA. At the end of each year all results from the different parts of the control is compiled by SVA and sent to SPMA. On the basis of results from the field control and the slaughterhouses SPMA decides, after consultation with a reference group, whether special measures have to be taken. SPMA reports to the Swedish Board of Agriculture on a yearly basis.



### RESULTS AND DISCUSSION

An increase of about 100% regarding the number of flocks affected with clostridiosis (more than 0.5% infected birds in a single flock) were reported from the slaughterhouses during 2009 compared to the year before. A similar increase regarding coccidiosis was not seen. As the incidence of infectious diseases in general was higher in the broiler population during 2009 efforts have mainly

been concentrated on finding factors which could lead to immunosuppression or increased exposure to infectious agents. So far there are no indications that the increased number of cases with clostridiosis were due to a reduced effect of the anticoccidials used.

### REFERENCES

Poultry Diseases (2008) Sixth edition.

# Echinococcosis

## BACKGROUND

Echinococcosis is caused by tapeworms belonging to the genus of *Echinococcus*. Although the genus contains several species, only the species of *E. granulosus* and *multilocularis* exist in some European countries. The life cycle of these parasites requires two hosts: a definitive and an intermediate host. Humans are dead-end hosts of these parasites and may become infected by accidental ingestion of the eggs.



Photo: Pekka Nikander

# Alveolar echinococcosis

## BACKGROUND

Human alveolar echinococcosis is a serious zoonosis caused by *Echinococcus multilocularis*. The definitive hosts of this parasite are mainly foxes but also raccoon dogs, dogs, cats, coyotes and wolves. Small rodents and voles serve as intermediate hosts. The main host, the fox, contracts *E. multilocularis* from eating rodents.

### History

*Echinococcus multilocularis* has never been detected in Sweden and no domestic cases of alveolar echinococcosis have been reported in Sweden. As a response to the finding of *E. multilocularis* in Denmark in foxes and intermediate hosts, an active monitoring program of the red fox (*Vulpes vulpes*) was implemented in Sweden in 2000.

### Disease

#### Animals

In the definitive animal host, the infection is asymptomatic.

### Humans

In humans, alveolar echinococcosis may develop into a serious, potentially fatal disease characterized by tumour-like lesions in the affected organ. Because of the long incubation period the disease is most frequently seen in adults. The most common site of localization is the liver but other organs can also be affected. Symptoms depend on the site and size of the lesion. The incubation period for developing alveolar echinococcosis in humans is between 5 and 15 years.

### Legislation

#### Animals

Detection of the parasite is notifiable in all animals according to SJVFS 2002:16. Since 2004, all dogs and cats entering Sweden from other countries (except for certain countries) have to be treated with praziquantel before entering Sweden as a preventive measure. The EU Regulation 998/2003 gives a transitional period for Sweden to maintain these rules until 31 December 2011.

### Humans

Alveolar echinococcosis has been a notifiable disease since 2004 according to the Communicable Disease Act (SFS 2004:168).

## SURVEILLANCE 2009

### SURVEILLANCE

#### Animals

Since year 2000, 11 - 405 foxes per annum (median= 305), in total approximately 2,440 foxes, have been examined for *E. multilocularis*. As a rule, all animals are controlled for cysts at meat inspection.

In 2009, 305 hunted red foxes from different parts of Sweden were sent to the SVA (Map 7). The hunters were compensated economically. The foxes were examined at necropsy and the bowel from each fox was frozen (-80°C) for at least seven days to destroy all possible viable eggs. Faecal samples from all foxes were sent to the Institute for Parasitology, Zurich University for antigen detection by ELISA (CoproAntigen ELISA). In addition, the bowels from 100 foxes were examined with sedimentation for detection of the parasite as well as the bowels of 15 foxes with antigen positive results in ELISA,

#### Humans

Echinococcosis has been a notifiable disease since 2004 according to the Communicable Disease Act (SFS 2004:168) and cases must be reported the Swedish Institute for Infectious Disease Control as well as to the County Medical Office.

### RESULTS

#### Animals

*E. multilocularis* was not detected in any animals.

#### Humans

No cases of alveolar echinococcosis were reported in Sweden in 2009.

### DISCUSSION

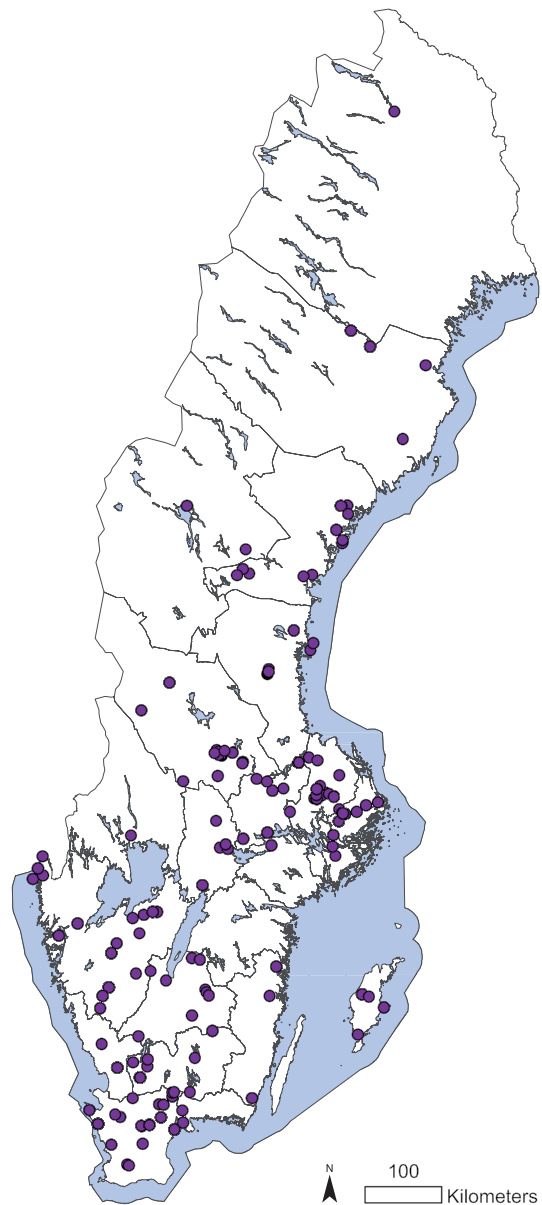
So far, *Echinococcus multilocularis* has not been detected in Sweden. The parasite is endemic in several other European countries and seems to be emerging. The increasing prevalence may be due to growing red fox and raccoon dog populations and in particular to an increasing number of urban foxes. There is a risk of introducing the parasite with pets infected with *E. multilocularis* from endemic regions. The likelihood of introduction depends on the compliance and efficiency of the anthelmintic treatment of dogs and cats. If the transitional derogation is allowed to expire or no other similar rules are accepted, the introduction of the parasite is likely to occur. It has been

estimated that in a 10-year period the number of infected dogs entering Sweden would be 166. The consequences of introduction of the parasite in Sweden would be serious especially as the parasite would probably remain undetected for several years.

### REFERENCES

Vågsholm Ivar et al 2006, An assessment of the risk that EM is introduced with dogs entering Sweden from other EU countries without and with anthelmintic treatments.

Map 7. Distribution of foxes tested for *E. multilocularis* in 2009.



# Cystic echinococcosis

## BACKGROUND

Cystic echinococcosis is caused by *E. granulosus*. Domestic dog and wolves are the most frequent main hosts. Eggs of the parasite are excreted in faeces and thus to the environment where they can infect intermediate hosts such as cattle, horses and wild ruminants. The eggs develop into the larval stage (hydatid cyst) mainly in the liver and occasionally in other organs of the intermediate host. The main hosts get the infection when consuming organs containing larval cysts.

### History

Echinococcosis was earlier quite common in the northern parts of Scandinavia, where it had a connection to the possession of reindeers. In the 1990's *E. granulosus* was sporadically detected in moose and reindeer in Sweden.

### Disease

#### *Animals*

In animals, the infection is usually asymptomatic.

#### *Humans*

In humans, the main site of localization of cystic echinococcosis is the liver. However, other organs might also be involved, such as the lungs, heart or brain tissue. Infected patients may remain asymptomatic for years or permanently. Clinical signs of disease depend on the number of cysts, their localization and pressure exerted on surrounding organs or tissues. The incubation period for developing cystic echinococcosis ranges between several months to years.

### Legislation

#### *Animals*

Detection of the parasite is notifiable in all animals according to SJVFS 2002:16

#### *Humans*

Echinococcosis has been notifiable according to the Communicable Disease Act since 2004 (SFS 2004:168).

## SURVEILLANCE

### Animals

All animals are inspected for cysts during routine meat inspection.

### Humans

Echinococcosis has been notifiable according to the Communicable Disease Act since 2004.

## RESULTS

### Animals

*E. granulosus* was not detected in any animals in 2008.

### Humans

In 2009, 15 cases of cystic echinococcosis were notified, which is about the same number as for previous years. Of these, 5 infected persons were women and 8 were men (for two persons the sex was unknown), aged between 17 and 62 years old. They were reported to have been infected in areas where the parasite is endemic, for example in Iraq, Iran and parts of the former Yugoslavia.

## DISCUSSION

*E. granulosus* has not been detected in Sweden in animals since the late 1990's, when it was reported in reindeer in the northernmost regions of Sweden, bordering on Norway and Finland. The parasite is prevalent in several European countries. In Finland it has occurred in wildlife (wolves, elk and reindeer); in other European countries mainly in a cycle of dogs-farm animals.



# Enzootic Bovine Leucosis

## BACKGROUND

Enzootic bovine leucosis (EBL) is caused by bovine leukemia virus, which is an oncovirus in the family Retroviridae. Infection occurs by transfer of infected lymphocytes for example via contact with contaminated biological material from an infected animal.

### History

Sweden was declared officially free from enzootic bovine leucosis (EBL) by the European Union (EU) in January 2001 (former Decision 2001/28/EC, currently Decision 2003/467/EC last amended by Decision 2005/764/EC). Before this, a voluntary control programme had started in 1990 and a mandatory eradication programme had been running since the autumn of 1995.

### Disease

EBL is characterized by multiple cases of multicentric lymphosarcoma in adult cattle within a herd after an incubation period of 4-5 years. The tumors can develop rapidly in many sites, which may cause variable clinical signs depending on the site. Persistent lymphocytosis without clinical signs occurs earlier but rarely before 2 years of age.

### Legislation

EBL is included in the Swedish legislation regarding notifiable diseases (SJVFS 2002:16) and the control is specifically regulated in SJVFS 2003:64. According to these regulations vaccination is prohibited and all animals that are found EBL positive shall be slaughtered within six months. EBL is also on the OIE list of infectious diseases and current surveillance standards are given in EU legislation, Directive 64/432/EEC.

## SURVEILLANCE

The purpose of the surveillance is to document freedom from EBL in accordance to Directive 64/432/EEC. The Swedish Dairy Association is

responsible for this surveillance, which is approved and financed by the Swedish Board of Agriculture.

All dairy herds are tested with a yearly bulk milk sample. Milk samples are collected within the quality control programmes of the dairies. The surveillance programme in beef herds is performed by sampling at least 2,300 herds every year. Serum is collected from slaughtered cattle above 2 years of age in sampled herds. At the end of 2009, 6,911 dairy herds and 10,904 beef herds were affiliated to the programme, but some of those were no longer active as producers.

In addition to above mentioned milk and blood samplings, individual blood samples are also taken in new herds joining the program to assure that they are free of EBL, and in herds having a positive sample in the surveillance program.

Diagnostic testing is performed at the National Veterinary Institute (SVA), Uppsala, Sweden. Both milk and sera are analyzed using an antibody ELISA (Svanovir BLV GP-51 ELISA).

## RESULTS

During 2009, no herd was diagnosed with EBL, and at the end of the year a total of 6,907 dairy herds and 10,891 beef herds were declared free of disease.

## DISCUSSION

As no herd was diagnosed with EBL 2009 Sweden has now been declared free from EBL for 9 years. It has therefore been decided that the disease surveillance from 2010 will be performed by analysing random samples taken from bulk milk and at slaughter.

## REFERENCES

Merck Veterinary Manual,  
[www.merckvetmanual.com](http://www.merckvetmanual.com), 2010.

Personal communication, Sofie Andersson, Swedish Dairy Association, Statistics for 2009.

# Infectious Bovine Rhinotracheitis

## BACKGROUND

Infectious bovine rhinotracheitis (IBR) is caused by Bovine herpes virus 1. The same virus can affect different organ systems causing respiratory-, abortive-, genital- or conjunctival disease. Transmission is mainly by aerosol for the respiratory form and by venereal transmission for the genital form.

### History

IBR was for a long period of time considered to be absent in Swedish cattle. However, examination of bulk milk samples during the early nineties showed the presence of a small number of seropositive herds. No signs of clinical disease were present in these herds. An eradication program was initiated in 1994 and the last seropositive animal was found in 1995.

### Disease

The incubation period for IBR is 3-21 days, but virus can be silently present in the host animal and be reactivated by stress or immunosuppression. The clinical picture varies with the subtype of the virus but also with the environmental and surrounding factors. Several manifestations of the disease can be present in the same outbreak in the same herd, the symptoms being concentrated either to the respiratory tracts, reproductive organs or the eyes.

### Legislation

The EFTA Surveillance Authority and EU approved the Swedish IBR eradication program in 1994 (Decision 73/94/ COL and Decision 95/71/ EC). Sweden had additional guarantees relating to IBR in 1995 (Decision 95/109/EC) and was officially declared free from IBR in 1998 (former Decision 98/362/ EC, current Decision 2004/558/ EC). Since 2004, all neighboring Nordic countries

have additional guarantees relating to this disease (Decision 74/94/ COL and Decision 95/71/EC). IBR is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments). Vaccination is according to this law prohibited and notification on clinical suspicion is mandatory. IBR is on the OIE list of infectious diseases.

## SURVEILLANCE

All diagnostic testing as outlined below was performed at the National Veterinary Institute (SVA). Milk and sera were analysed for presence of antibodies using an indirect ELISA (SVANO-VIRTM IBR-ab, SvanovaR). In case of positive or intermediate reactions a blocking-ELISA IBR/ BHV-1 gB Ab ELISA kit (IDEXX) was used for confirmatory testing. If necessary a serum neutralisation test could be performed. Semen and organ samples were tested for detection of nucleic acids from the viral genome with a real time PCR. A positive case is defined as an animal giving rise to a positive PCR-product or a significant antibody titre.

### Passive surveillance

Suspicions based on clinical signs are reported to the Swedish Board of Agriculture and subsequently investigated. In 2009 four herds or individuals were investigated due to clinical suspicion.

In addition to the passive surveillance testing is performed within an auxiliary health control program at breeding centers for cattle and before export or import of all bovines, including the more exotic species such as buffalo, visent and yak.

### Active surveillance

The purpose of the surveillance is to document freedom from IBR. The Swedish Board of Agriculture is responsible for the surveillance, which is coordinated by the Swedish Dairy Association.





Within the surveillance program dairy herds are tested with bulk milk samples, in farms with more than 50 cows pooled milk samples are used. These samples are collected twice yearly within the Dairy association's quality control program and synchronized with sampling for the Bovine virus diarrhea and enzootic bovine leucosis programs and thus not strictly random. The surveillance program also includes serum sampling of beef cattle. In 2009 3,806 samples from bulk tank milk and 2,325 serum samples from beef cattle were examined.

### RESULTS

In 2009 four herds or animals were investigated due to clinical suspicion of IBR. Two of these suspicions arose in herds with reproductive problems; affected cows were investigated for presence of antibodies against IBR. The two other cases were cows with symptoms from the respiratory tract; both individuals were investigated for presence of viral genome as well as antibodies against IBR. The diagnostic testing ruled out the suspicions. All other samples tested in 2009 were also negative. In summary 6,638 tests were performed for IBR in 2009 with no positive results.

### DISCUSSION

In summary no herd or individual animal were diagnosed with IBR infection during 2009. This confirms that IBR is not present in Sweden.

### REFERENCES

Radostits, O. M., et al 2000. *Veterinary Medicine*, 9th edition. W.B. Saunders Company Ltd, Harcourt Publishers Limited, London, UK.

# Influenza (pig)

## BACKGROUND

Influenza is a viral disease affecting both birds and mammals, including humans. The cause is a RNA-virus of the family Orthomyxoviridae that is highly inclined to change over time and new strains are created both through mutations (“antigenic drift”) and through mixing of existing strains (“reassortment”). Influenza viruses are classified into subtypes based on their surface antigens, hemagglutinin (H) and neuraminidase (N). The main mode of transmission of influenza virus is by aerosols containing virus from the airways of infected individuals of the same species. Occasionally influenza virus can be transmitted from one species to another (like in the case with avian influenza infecting humans), but the main rule is that each species has their own influenza viruses. The most common swine influenza virus subtypes internationally are H1N1, H1N2 and H3N2. Of these, the H1N1 swine influenza virus was reported to infect pigs in North America already in 1918.

During 2009 a new pandemic type of H1N1, possibly of partly porcine origin, began circulating in people and this virus has occasionally infected swine by transmission from humans in a number of countries including Norway, Denmark and Finland.

### History

Influenza H1N1 was isolated from Swedish pigs for the first time in 1982. The clinical signs were severe in the previously naive pig population but got milder over time. The H1N1 virus is since 1982 established in the country and has become endemic. Influenza H3N2 is also present in the Swedish pig population. Antibodies against H3N2 was first detected in a serologic screening performed in 1999. Since the clinical signs were not as evident as when H1N1 was introduced and the H3N2 was detected in screening of apparently healthy animals it is less clear when this subtype was introduced. However, H3N2 has since 1999

occasionally been correlated to severe respiratory illness.

Another porcine influenza A type (H1N2) that has been spread through Europe was diagnosed for the first time in Sweden in a large multisite unit with respiratory disease in growers during the winter 2009. The spread of this virus within the Swedish pig population will be monitored in a serological screening in 2010.

There has been no regular monitoring for influenza in pigs in Sweden, but SVA has managed to run serological screenings during 1999, 2002 and 2006 for the presence of serum antibodies in 1000 porcine sera. The screening in 2006 also included analyses for antibodies to H5 and H7 (avian influenza) (Table 3).

### Disease

Infection with influenza virus can produce clinical respiratory disease manifested as dyspnoea, sometimes with nasal discharge and cough, accompanied by fever, inappetence and inactivity. The disease can affect pigs of varying age and the severity of clinical sign varies from severe respiratory disease to subclinical infection. The morbidity of affected herds is generally high whereas mortality is low.

### Legislation

Influenza in pigs is not regulated in the Swedish legislation.

## SURVEILLANCE

### Passive surveillance

During autumn and winter 2009, samples from pig herds with respiratory signs that could be associated with influenza were collected with the aim to analyze the samples for presence of the pandemic influenza A (H1N1) virus using a polymerase chain reaction (PCR)-method. From each affected herd 5-10 nasal swab samples were collected and analyzed in a stepwise mode; samples positive for swine influenza A were further analysed for

## SURVEILLANCE 2009

Table 3. Results from the serosurvey performed 2006. The table shows the overall prevalence of seroreactors to five strains of influenza. The table also divides these reactors into low and significant reactors.

Seropositive samples	H1N1 n=999	H1N2 n=999	H3N2 n=999	H5N1 n=200	H7N1 n=200
Overall	48,1 %	7,6 %	25,5 %	5,5 %	4,5 %
Level of antibodies					
Low <sup>1</sup>	15,1 %	7,0 %	18,8 %	5,5 %	4,5 %
Significant <sup>2</sup>	33,0 %	0,6 %	6,7 %	0	0

<sup>1</sup> Reacting in a serum dilution of 1:32 or less. <sup>2</sup> Reacting in a serum dilution of 1:64 or higher.

pandemic influenza A (H1N1). Collection of samples and investigation of the herds have been performed by the Swedish Animal Health Service and in connection with this surveillance further investigations of these samples regarding other influenza A types and presence of antibodies against influenza A has been and will be performed in cooperation between SVA and the Swedish Animal Health Service.

### Active surveillance

No active surveillance for swine influenza has been performed during 2009.

## RESULTS

### Passive surveillance

Samples from ten herds with respiratory signs were analyzed for swine influenza virus and, if positive, for pandemic influenza A (H1N1). In two herds influenza A virus was detected, but in no case was pandemic influenza A (H1N1) virus found.

## DISCUSSION

In the serological screening carried out in 2006, the incidence of influenza was low with respect to H1N1 and H3N2 and all antibody reactors against the avian strains of influenza (H5N1, H7N1) were of low magnitude. This was true also for H1N2 at this time. These low reactions rather indicated unspecific reactions than presence of these influenza strains (Table 3). In view of the development of the influenza situation with detection of the new subtype H1N2 among Swedish pigs and the new pandemic form of H1N1 affecting pigs internationally the need for the renewed surveillance of swine influenza in Sweden during 2010 is apparent.

## REFERENCES

Wallgren, P. (2004) Evidence of both virus and bacteria during an acute outbreak of respiratory disease in a fattening pig herd. Proc. IPVS 18: (1) 201.



# Listeriosis

## BACKGROUND

The genus *Listeria* contains several species but only one zoonotic species, *Listeria monocytogenes*. *Listeria* bacteria are widely distributed in the environment, such as in soil, silage and water. They can survive for long periods in the environment and tolerate disinfection and also grow at refrigeration temperatures. These properties make elimination of *L. monocytogenes* difficult. The main sources of human listeriosis are contaminated food products, such as smoked or marinated vacuum-packaged fishery products, meat products and soft cheeses or other ready-to-eat foods with long shelf-life. The infection can also be transmitted from infected animals to humans or via person-to-person contact. The environment and animals serve as important reservoirs of the pathogen.

*L. monocytogenes* is destroyed by heating (pasteurization and cooking). The bacterium is able to grow at refrigeration temperatures, in vacuum-packages and at modified atmosphere. *L. monocytogenes* is also capable of adhering onto different surface materials. Food products may become contaminated during processing. If established in a food processing plant, *L. monocytogenes* is difficult to eliminate.

Risk groups, which include pregnant women and immune-compromised persons, are given advice not to consume the above-mentioned food products.

## History

*L. monocytogenes* was first described in 1926. Sporadic cases of listeriosis were reported, often in workers in contact with diseased animals. In the 1980's outbreaks of listeriosis were reported in different countries. The sources of these outbreaks were traced to dairy products and ready-to-eat foods.

Listeriosis has been a notifiable disease in Sweden since 1960. During the last ten years approximately 40-60 cases have been reported every year to the Swedish Institute for Infectious

Disease Control. In Sweden, outbreaks have been associated with vacuum-packaged fish (1995-1996) and with cheese made of raw goat milk (2001).

## Disease

### Animals

*L. monocytogenes* can infect a wide range of animal species, both domestic and wild. Animals may be asymptomatic carriers and shed the organism. Animals, especially sheep may develop clinical disease, such as neurological symptoms, abortions, mastitis or septicemia.

### Humans

Listeriosis can be manifested either as a milder non-invasive form or as a severe invasive disease. The non-invasive form is mainly febrile gastroenteritis. A severe form mostly occurs in immune-compromised persons, the newborn, pregnant women and elderly people. Symptoms for the invasive listeriosis are septicaemia, meningitis and meningoencephalitis. For those with severe infection, the fatality rate is high (20-40%). The infection can lead to miscarriage, premature delivery or neonatal death. The incubation period of listeriosis varies from 3-70 days, the average being about 21 days.

## Legislation

### Animals

Listeriosis is notifiable in animals according to (SJVFS 2002:16 with amendments).

### Food

Criteria for *L. monocytogenes* in foods are specified in EU-regulation on microbiological criteria (EC 2073/2005). Food business operators shall ensure that foodstuffs are in compliance with the regulation. The food business operators have to classify their products into ready-to-eat foods in which growth of *L. monocytogenes* can occur or in RTE foods in which growth of *L. monocytogenes* will not occur during their shelf-life. Different criteria

apply for these two categories. Although these criteria are mainly intended to be used by the food business operators in the good hygiene practice and HACCP procedures, the criteria apply also to samples taken for official controls to verify that the criteria laid down are met.

### Humans

Listeriosis is notifiable in humans for both clinicians and laboratories according to the Communicable Disease Act (SFS 2004:168).

## SURVEILLANCE

### Animals

There is no active surveillance system. Notifications are based on clinical cases and laboratory analyses. The Swedish Board of Agriculture can decide on epidemiological investigations if needed.

### Food

No official control programme exists. Sampling is performed by national and local authorities, mainly at retail level but also at production units. Sampling performed by the industry is not normally reported to the authorities.

### Humans

Listeriosis is notifiable according to the Communicable Disease Act and cases must be reported to the Swedish Institute for Infectious Disease Control and to the County Medical Office.

## RESULTS

### Animals

In 2009, *Listeria monocytogenes* was notified in 31 sheep and in 6 cattle.

### Food

Altogether 792 samples were reported from 29 local authorities. Of these, 13 samples were considered unsatisfactory due to presence of *Listeria*. Most notably, more than 10% of samples of fish and fish products were considered unsatisfactory due to the bacteria.

### Humans

In 2009, 73 human cases of listeriosis were reported, which is the highest number ever reported in Sweden and an increase with 22 % compared to 2008. The increasing trend in the Swedish incidence during 1997-2009 is statistically significant (Figure 4).

Older persons dominated among the cases, 85 % were above 60 years. The increase in cases was mainly in the older age groups and not among the younger people or among pregnant women. The gender distribution was even.

Information about underlying disease or other reason for a compromised immune system was available for around half of the cases. Among these, cancer diseases were the most common. Two newborn babies were infected during birth but survived.

Around one fifth of the cases died within a month after the onset of disease and as many as one third had died within three months. The three largest counties reported most cases, but the northern counties, Västernorrland and Jämtland had the highest notified incidence. Other northern counties also have a slightly higher incidence than many other counties in Sweden.

Listeriosis is most often a domestic infection. During 2009, 60 cases were reported with Sweden as country of infection. Two cases were infected abroad and 11 cases had missing information about country of infection.

Forty-six isolates (63 %) were serotyped. Of these, 83% belonged to serogroup 1 and the rest to serogroup 4. The observed increase was for serogroup 1.

No outbreaks were reported during the year, however many investigations were made to explain the increase of cases. A certain cluster was observed during 2009 with seven isolates with identical subtype. This particular strain was not identified in the previous year. The source of infection for these cases has yet not been found but investigation is continuing in 2010.

## DISCUSSION

An increasing trend of reported human cases of listeriosis is seen in several European countries, Sweden included. The reasons for this increase remain unclear and should be elucidated because of the severity of the infection. The increase in the notified incidence may be attributed to changes in consumer habits, in the food chain or in legislative changes.

The case-fatality rate of listeriosis is high. One third of the patients died within three months but it is however difficult to estimate the impact of the infection, as a majority of the cases suffered from severe underlying diseases. Usually, one to two



pregnant women are diagnosed with listeriosis each year.

The microbiological criteria on *L. monocytogenes*, set in 2005 decide the standard the industry has to achieve for their products to be safe for consumers. The EU-Commission has initiated a baseline study of *L. monocytogenes* in ready-to-eat foods in 2010 and a national baseline study is also undertaken this year. As a compliment, all human isolates will be sent to the Swedish Institute for Infectious Disease Control for subtyping to compare with the food isolates.

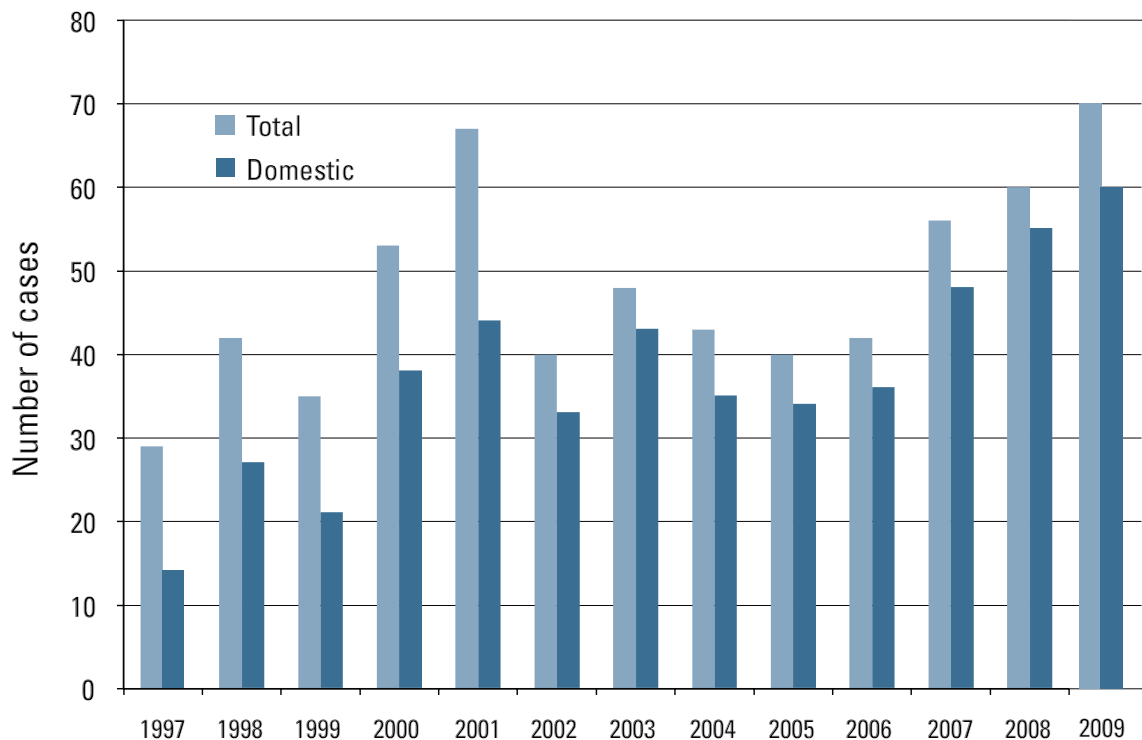
Parihar VS, Lopez-Valladares G, Danielsson-Tham ML, Peiris I, Helmersson S, Unemo M, Andersson B, Arneborn M, Bannerman E, Barbuddhe S, Bille J, Hajdu L, Jacquet C, Johansson C, Löfdahl M, Möllerberg G, Ringberg H, Rocourt J, Tjernberg I, Ursing J, Henriques-Normark B, Tham W. Characterization of human invasive isolates of *Listeria monocytogenes* in Sweden 1986–2007. *Foodborne Pathogens and Dis.*, 2008; 5; 6.

Tham W, Ericsson H, Loncarevic S, Unnerstad H, Danielsson-Tham ML. Lessons from an outbreak of listeriosis related to vacuum-packed gravad and cold-smoked fish. *Int J Food Microbiol.* 2000; 62(3):173-5.

**REFERENCES**

Carrique-Mas J, Hökeberg I, Andersson Y, Arneborn M, Tham W, Danielsson-Tham ML, Osterman B, Leffler M, Steen M, Eriksson E, Hedin G, Giesecke J. Febrile gastroenteritis after eating on-farm manufactured fresh cheese – an outbreak of listeriosis? *Epidemiol Infect.* 2003;130(1):79-86.

Figure 4. Number of notified human cases of listeriosis in Sweden, 1997-2009.





## Maedi/Visna

### BACKGROUND

The causative agent of maedi/visna (M/V) is a lentivirus in the Retrovirus family. Transmission between animals occurs most commonly via the oral route (e.g. via milk), but may also occur via inhalation of infected aerosol droplets. The incubation period is long indicated by the name lenti meaning slow.

### History

In Sweden M/V was diagnosed in 1974 by post mortem examination at slaughter. A serological screening performed at seven Swedish abattoirs in 1989 demonstrated 8.2 % seropositive herds. A voluntary control program for M/V was launched by the Swedish Animal Health Service in 1993. The conditions applying to this program are stated in the Swedish legislation (SJVFS 1999:25). A second M/V program for sheep and goats that is not regulated within the Swedish legislation and does not require the same obligations from the farmers, started by the Swedish Animal Health Service at the end of 2005. The two M/V programs are running in parallel.

Since 1993 more than 600 herds have been diagnosed with M/V of which 270 herds with close to 15,000 sheep have been culled and in a majority of the herds some sort of eradication measures have been performed.

### Disease

In most cases clinical signs such as wasting, respiratory distress, arthritis and staggering, do not occur until the sheep are 3-4 years old or more. However, it can be an underpinning cause of other infection manifestations.



## SURVEILLANCE 2009

### Legislation

Decision 1991/0068/EEC encompasses M/V. It is a disease from which a Member State can be declared free after appropriate supporting documentation has been presented to the Commission. M/V is included in the Swedish legislation regarding notifiable diseases (SJVFS 2002:16) stating that the disease shall be reported when it has been diagnosed.

### SURVEILLANCE

The initial goal of the control program was to create a pool of M/V free breeding stock. This goal was reached some years ago, and in the second phase the aim is to eradicate M/V from the Swedish sheep population.

Farmers joining the initial program sign a contract where they agree that all animals have to be individually identified and the farmers have to keep a record of the flock. Blood samples are collected from all sheep older than 12 months of age. If the serology is negative, the flock gets an M1-status. 12-16 months later, a second sampling of all individuals older than 24 months is performed and if all samples are negative for M/V antibodies M2-status is granted. This procedure is repeated 12-16 months later and a negative result grants M3-status, which means that the flock is declared free of M/V. Farmers within the program are only allowed to bring in animals from flocks with the same or higher M/V status. In flocks where antibodies are detected, depending on the prevalence of positive animals, either a whole herd cull or eradication measures including selective slaughter is performed.

At the end of 2009, 3,067 herds with a total of 134,233 sheep were enrolled in the initial program. Approximately 39,000 samples were analyzed within the programs during the year.

Diagnostic testing was performed at the National Veterinary Institute (SVA). Sera were analyzed using an AGID-test (agar gel immune diffusion) for which the antigen was purchased from VLA or with an ELISA-test (Synbiotic's Elitest MVV/CAEV).

### RESULTS

A total of 268 herds reached M3-status during the year, making the number of herds with M3-status (i.e. declared M/V free) 2,413 at the end of the year, with a total of 105,082 sheep.

### DISCUSSION

It is estimated that more than 190,000 sheep are controlled in the programs, which is approximately 75% of the Swedish sheep population. There is still, however, a significant number of small herds that is not included in the control programs. Therefore, efforts to contact and enroll new herds will continue.

### REFEREMCES

Lindqvist A. Maedi-visna – en lentivirusorsakad sjukdom hos får. SVT nr 8-9 1993, vol 45.

Merck Veterinary Manual,  
[www.merckvetmanual.com](http://www.merckvetmanual.com), 2010.

Swedish Animal Health Service, Verksamhetsrapport för år 2009 över kontrollprogrammen avseende Maedi-Visna hos får.

# Nephropathia epidemica

## BACKGROUND

Nephropathia epidemica (NE) is caused by Puumala virus, a member of Hantavirus genus in the family of Bunyaviridae. Hantaviruses are the cause of rodent-borne haemorrhagic fevers. Puumala virus is likely the most prevalent Hantavirus in Europe. The virus is excreted from its natural reservoir, the bank vole by saliva and faeces. Puumala virus can remain infectious in bank vole cage beddings for two weeks. Transmission to humans often occurs in an aerosolized form. Humans may be exposed to virus aerosols during occupational or recreational activities, such as working with hay, cleaning barns or summer cottages, cutting wood and entering buildings contaminated with rodent excretions.

### History

Nephropathia epidemica was first described by two Swedish physicians independently in 1934. The linkage to its natural reservoir, the bank vole, was suggested years later. The virus was isolated in 1982 in Puumala, a place in eastern Finland. Since 1989, the disease has been notifiable according to the Communicable Disease Act (SFS 2004:168).

In Sweden, between 100 and 600 cases are reported each season with a considerable inter-annual variation coupled to the 3-4 year population cycles of the bank vole. During the seasons 2006-2007 and 2007-2008 the annual number of notified cases rose to 1,400 (Figure 5).

### Disease

#### *Animals*

In bank vole, the infection is subclinical.

#### *Humans*

The clinical picture is characterized by a sudden onset with high fever, headache, backache and abdominal pain. In the acute phase, the kidneys are affected and internal hemorrhaging may occur. The symptoms range from sub-clinical to renal

failure requiring intensive care and dialysis, but fatal cases are rare. The incubation period varies from 2 to 6 weeks.

### Legislation

#### *Animals*

Hantaviruses are not notifiable in animals.

#### *Humans*

Nephropathia epidemica is a notifiable disease and cases must be reported the Swedish Institute for Infectious Disease Control as well as to the County Medical Office.

## SURVEILLANCE

### Animals

There is no surveillance in animals.

### Humans

Nephropathia epidemica is a notifiable disease and cases must be reported the Swedish Institute for Infectious Disease Control as well as to the County Medical Office.

## RESULTS

### Humans

In 2009, 53 infections of Puumala virus were notified (Figure 5). Even though the incidence in 2009 was low in all ages, it was highest between 60 and 69 years. No children below the age of 15 years were reported. A majority (66 %) of the cases were men. Almost all cases (81 %) had acquired their infection in Sweden. The four northernmost counties reported 74% of the cases, but a few persons were also infected outside the endemic area. In contrast to earlier years, when most persons have fallen ill during the winter, in 2009 the cases were spread throughout the whole year.

# SURVEILLANCE 2009

## DISCUSSION

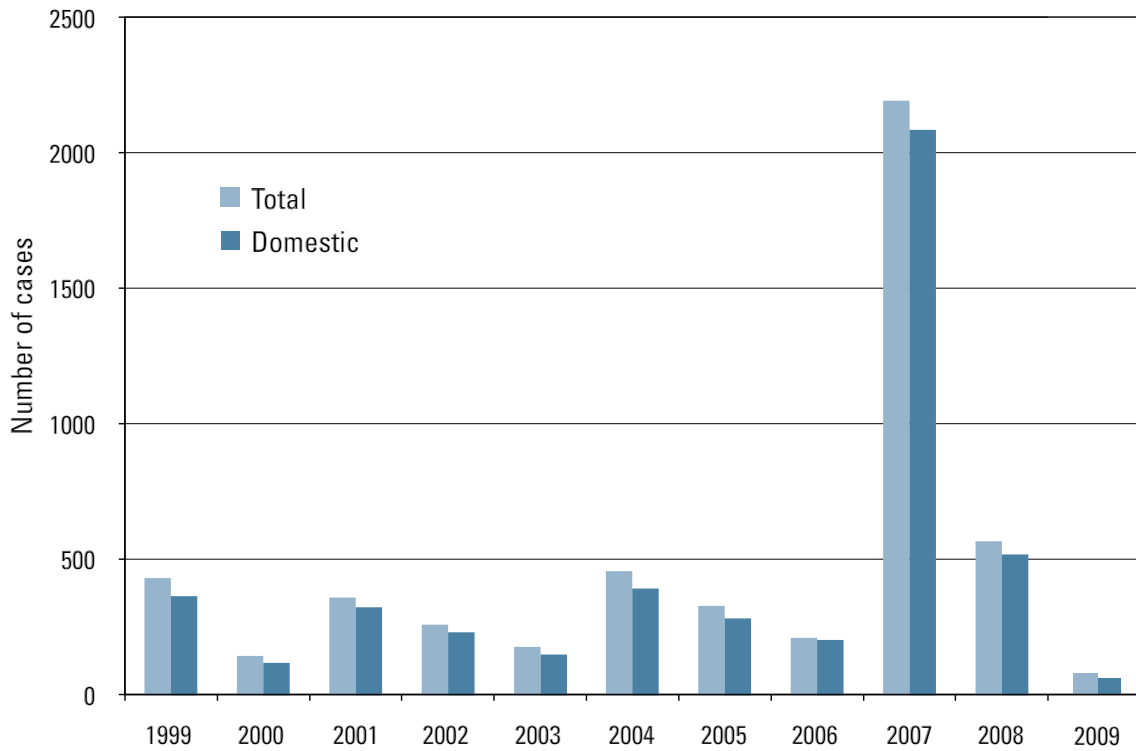
Variations in the climatic conditions have an impact on rodent populations. Peaks in the bank vole population coincide with increased number of human cases Puumala infections which was clearly seen last years. In 2009, a dramatic reduction in the number of notified cases was noted in comparison with the two years before, which can be explained by the crash of the bank vole population in 2008. The bank vole population remained very small also during 2009.

## REFERENCES

Evander, M and Ahlm, C. Milder winters in northern Scandinavia may contribute to larger outbreaks of haemorrhagic fever virus. Global Health Action 2009.

Report on trends and sources of zoonoses, Sweden 2008.

Figure 5. Notified human cases of Nephropatia epidemica in Sweden in 1999-2009.



# Paratuberculosis

## BACKGROUND

Paratuberculosis, also called Johne's disease, is an intestinal infection in ruminants caused by *Mycobacterium avium* subsp. *Paratuberculosis* (MAP). MAP can be excreted in the faeces from infected animals and the transmission route is faecal to oral. Most commonly infection occurs by animal to animal contact or by ingestion of contaminated feed or water. The zoonotic potential of MAP cannot be ignored, there are ongoing discussions about MAP as one possible cause for Crohn's disease in humans. In countries with high prevalence of the disease, MAP has been demonstrated to occur in animal products such as milk and meat by which humans can be exposed to the bacteria.

### History

Paratuberculosis is a common disease in most countries in the world, the Swedish situation with an extremely low prevalence is unique. However, sporadic cases in beef cattle, all of them connected directly or indirectly to imported animals have occurred, most recently in 2005. Paratuberculosis has never been detected in dairy cattle, other ruminants or wildlife in Sweden. The overall purpose of the surveillances and the control program in beef herds is to document freedom from bovine paratuberculosis and to prevent possible spread by early detection of the infection.

### Previous active surveillances

Since 2004, all ruminants above one year of age, submitted for necropsy are sampled for MAP culture. One positive beef cattle, imported from Germany, was detected within this sampling, in 2005. All other samples have been negative on culture, (in 2007 this was 88 cattle and 36 sheep and in 2008 it was 102 cattle and 43 sheep).

### Beef cattle

After detection of paratuberculosis in 1993, in an animal imported to Sweden, an investigation was made to trace the infection. 52 herds and 500

contact herds were sampled. Infection was found mainly in beef herds of the Blonde d'Aquitaine and Limousin breeds.

In an extended investigation in 1995-1996, all herds that had imported cattle between 1980 and 1994 were included. In the same period, a screening of sanitary slaughtered cattle that involved culture from internal organs was made. These two investigations resulted in three confirmed cases with consecutive eradication measures taken in the herds. A control programme focusing on pedigree beef herds was initiated in 1998.

Recently, the screening of herds that had imported cattle was extended to include all herds that had imported animals 1995-2005. This added up to a total of 64 herds of which 38 herds had been sampled until the end of 2009.

### Dairy cattle

Screenings in dairy herds have been performed in 2000, 2003 and 2005 without detection of MAP. Faecal samples were collected from 20 older cows in 200 dairy herds. The herds were selected as a stratified random sample, to achieve a representative geographical distribution. The herds selected for sampling 2005 were different from the herds sampled in 2001 and 2003.

### Sheep

In sheep, since 1993, yearly screenings have been undertaken. For 10 years serology (AGID) was used with serum samples collected from the Maedi-Visna programme. The number varied between the years with an average of 2000 samples per year being analysed. An average of one seropositive sample was found every year.

Further investigations into these herds, including slaughtering of the positive animal and testing of all other animals in the herd, revealed no paratuberculosis. In 2004 serology was replaced by faecal culture in the screenings of sheep with sampling of the 10 oldest animals performed in 60-70 sheep herds every year.



## SURVEILLANCE 2009

### Disease

Paratuberculosis is an intestinal infection in ruminants caused by MAP. It causes chronic diarrhoea and emaciation resulting in animal suffering. To the farmer it means great economic losses due to reduced milk production and reduced lifetime of affected animals. Calves are most susceptible, but infection can occur at any age. The incubation period is several years, in areas with endemic infection clinical disease is most commonly seen at the age of 2-5 years. There is no reliable method to detect the infection during the incubation period.

### Legislation

Paratuberculosis (Johne's disease) is included in the Swedish Law of Epizootic diseases since 1952 (SFS 1999:657 with amendments). Vaccination is according to this law prohibited and notification of the infection is mandatory based on clinical suspicion. Whole-herd slaughter is performed if MAP is detected in a herd.

## SURVEILLANCE

### Diagnostic tests

In 2009 culture was used for all surveillances. In cases of mouldy overgrowth on samples within the beef control program, direct PCR for MAP was used on a new preparation from the stored sample. After pre-treatment with NaOH and oxalic acid, samples were cultured on modified Lowenstein-Jensen medium supplemented with mycobactin and on Herrolds Egg Yolk medium for up to 4 months. Faecal samples from sheep were cultured for up to 6 months, on both modified L-J with mycobactin and modified

Middlebrook 7H10 with mycobactin. Direct PCR (Herthnek 2009) was performed on samples within the control programme that had moldy overgrowth in the culture. All tests for MAP were performed at the National Veterinary Institute, SVA.

### Passive surveillance

Sampling and diagnostic work up is mandatory in animals of any ruminant species showing symptoms that lead to clinical suspicion of paratuberculosis. Sampling includes faecal samples from live animals and post-mortem samples from dead or culled animals. The latter include samples from the ileal wall, ileal content and ileocaecal lymph nodes

as well as any macroscopic lesions in the intestines. Wildlife is sampled when MAP is suspected at necropsy.

In 2009, nine clinical suspicions were raised (one sheep, five cattle, two bison and one pudu antelope).

### Active surveillance

#### Control program in beef cattle

In the control program, the target population is beef herds that sell animals for breeding. The control program is managed by the Swedish Animal Health Service and financed by the Swedish Board of Agriculture. In total, the control program for bovine paratuberculosis encompassed 563 herds during 2009 including all main breeding beef herds and a smaller number of dairy herds. In affiliated herds, yearly faecal samples are collected from all cattle from two years of age and all purchased animals from one year of age. After five years of negative results, sampling is reduced to faecal sampling of 20 % of the animals in the herd, or a minimum of ten animals, every second year. The samples are pooled five and five, except for imported animals that are cultured individually. In 2009 the number of sampled herds within the control program were 269 encompassing samples from 3,787 individuals.

#### Screening of beef herds with imported cattle

This screening encompasses herds that have imported animals during 1990-2005, in total 64 herds. The screening is managed by the Swedish Animal Health Service and financed by the Swedish Board of Agriculture. Until 2009 38 of these herds had been sampled and in 2009 another 20 were sampled. Four herds are scheduled for sampling early 2010 and the two last herds will be handled by the Swedish Board of Agriculture.

#### Screening of older cows at slaughterhouses

The active surveillance in slaughterhouses, starting in 2008, is managed by the Swedish Animal Health Service and financed by the Swedish Board of Agriculture.

Samples from the ileal wall, ileal content and ileocaecal lymph nodes were collected from cows older than six years with signs of weight loss at eight different slaughterhouses (Scan Linköping, Scan Skara, Skövde slakteri, KLS, Karlgrens, Siljands Chark AB, Scan Visby, Hälsinge Shcark AB). Approximately 50,000 cows older than six

## SURVEILLANCE 2009

years are appreciated to be slaughtered in a year, and roughly 20 % of these might show signs of weight loss. The sampling started in October 2008 and is planned to continue for two years with collection of 1,800 individuals. 577 cows were sampled in 2009, with the total number of sampled cows adding up to 1,022 since the start of this screening.

### Post mortem examinations

Sampling was performed on ruminants above one year of age submitted to post mortem examinations. Samples are taken as above and submitted for culture. In 2009, 188 animals were sampled (113 cattle, 73 sheep, 1 bison one 1 vicent).

### Sheep

Ten of the older animals within 72 sheep herds where selected for sampling, in total collection of 720 samples during 2009. These were herds sampled within the Maedi-Visna program and they were selected to achieve a geographical scattered distribution throughout the country.

## RESULTS

No MAP was detected within the control program. One of the samples from the control program was initially positive on a PCR examination. Several more PCR examinations were performed on the saved faecal sample from this individual, and none of these examinations were positive. The animal was culled and samples taken at necropsy were negative on PCR and culture. In conclusion MAP infection could not be confirmed.

Within the control program, at the end of 2009, 498 affiliated herds had the so called A-status (herds that have undergone 5 annual whole herd samplings with negative results).

All other examinations performed on clinical suspicions and the different screenings reported above were negative on examination for MAP.

## DISCUSSION

The investigations undertaken show that the prevalence of paratuberculosis in Swedish ruminants remains at a very low level. Work is in progress aiming at demonstrating freedom of paratuberculosis in Swedish cattle using multiple complex datasources described by Martin et al.

## REFERENCES

- Herthnek, D., 2009. Molecular diagnostic methods for *Mycobacterium avium* subsp. paratuberculosis. PhD thesis. Swedish University of Agricultural Sciences, Uppsala <http://diss-epsilon.slu.se/archive/00001954/>.
- Sternberg, S. and D. Viske, 2003. Control strategies for paratuberculosis in Sweden. *Acta Veterinaria Scandinavica* 44:247-249.
- Martin, P.A.J., Cameron, A.R., Greiner, M., 2007. Demonstrating freedom from disease using multiple complex data sources 1: A new methodology based on scenario trees. *Prev. Vet. Med.* 79, 71-97.
- Sternberg, S., A. Holmstrom, D. Viske, J-A Robertsson, G. Bolske and B. Larsson. Control programme for paratuberculosis in Swedish beef herds. In the proceedings of: 7th ICP, Bilbao, June 2002. Pp 438-440.
- Sternberg Lewerin, S., E Agren, J Frossling, G Bolske, A Holmstrom, A Lindberg, E Szanto, D Viske. Control of paratuberculosis in Sweden. In the proceedings of: 9th ICP, Japan, Nov 2007.



# Porcine Respiratory and Reproductive Syndrome

## BACKGROUND

Porcine Respiratory and Reproductive Syndrome (PRRS) is caused by an enveloped RNA-virus belonging to the family *Arteriviridae* and the disease affect domestic swine. Seropositive feral pigs and wild boars have been described but there is no evidence of wild boar being a reservoir for PRRS. The disease was first described in USA in 1987 and the virus was subsequently identified in 1991. Since then PRRS has spread to be endemic in most of the swine populations of the world and is now considered to be one of the most economically important viral diseases in swine production. PRRS is a highly contagious disease transmitted between swine both through direct and indirect contact.

## History

During the 1990s, PRRS spread throughout Europe and in 1998 the Swedish Animal Health Service launched a surveillance program in which the Animal Health Service does the sampling and the National Veterinary Institute performs the analyses. The first case of PRRS in Sweden was confirmed in July 2007. Until then Sweden was one of the few countries (together with Norway, Finland, New Zealand and Australia) that declared themselves free of PRRS. The outbreak was detected through routine sampling within the surveillance program. Since the disease was not widespread at the time of detection a decision was made to control the outbreak through a modified stamping out procedure. The actions taken to eradicate the disease proved to be effective and

following extensive surveillance sampling during the fall of 2007 it was possible to declare Sweden free from the disease with high probability in the beginning of 2008. Despite extensive investigation the source of the outbreak could not be established. After the outbreak in 2007 the surveillance program has been revised in order to enable an even earlier detection of a new introduction of the disease.

## Disease

As indicated by the name, infection with PRRS virus causes varying clinical signs depending on age of the infected animals. The incubation period is 2-7 days (usually 2-3 days) and in adult swine the clinical signs are usually mild, consisting of increased body temperature and inappetence for a few days. The devastating effect of PRRS infection in this category of animals is that it might lead to reproductive failure including late abortions, mummified fetuses, small litters and increased frequency of non pregnant sows. In fattening pigs the infection mainly causes respiratory signs.

## Legislation

The disease was included in the Swedish Act of Epizootic Diseases in 1999 (SFS 1999:657 with amendments) meaning that any suspicion of PRRS is compulsory notifiable and notification will lead to investigation.

## SURVEILLANCE

The purpose of the surveillance is to document freedom from PRRS and to detect introduction of



the disease before it has been widely spread in the population. Both sampling for detection of virus genome and antibodies against PRRS virus are used in the surveillance. To detect antibodies against PRRS virus a commercial ELISA-method (HerdChek® PRRS X3 Antibody ELISA, Idexx Laboratories) is used and presence of virus genome is analyzed using a polymerase chain reaction (PCR)-method. Samples positive for PRRSV antibodies in the ELISA-test are analyzed in an immunoperoxidase monolayer assay (IPMA) for confirmation.

### Passive surveillance

As PRRS is notifiable on clinical suspicion for both veterinarians and farmers, cases with suspect clinical signs will be investigated following notification to the Swedish Board of Agriculture. The investigation includes, in addition to restrictions on the farm during investigation, sampling of sick or dead animals and examination of the herd for prevalence of clinical signs and analyses of production results.

Ongoing testing of animals for import and export and at breeding centers adds to the passive disease surveillance.

### Active surveillance

The revised active surveillance program implemented in 2007 comprises sampling in all Swedish nucleus herds, multiplying herds and sow pools twice a year and randomly selected production herds at slaughter once a year. In nucleus herds, multiplying herds and sow pools eight samples per herd are analyzed at each sampling occasion and at slaughter three samples per herd are analyzed. In addition, analyses for PRRS virus genome with PCR is included in the active surveillance of aborted fetuses from sows.

## RESULTS

### Passive surveillance

Ten investigations following clinical suspicion of PRRS was undertaken during 2009. In six of these, reproductive failure was the main clinical manifestation. Following sampling the herds could be declared negative for PRRS.

Samples originating from pre-testing for import and export and at breeding centers were all negative regarding PRRS.

### Active surveillance

In 2009, 1,106 samples from nucleus herds, multiplying herds and sow pools and 2,712 samples originating from approximately 900 herds taken at slaughter were analyzed. All samples were tested for the presence of antibodies to PRRS. In three samples antibodies against PRRS virus were detected and confirmed whereupon investigations were initiated. These investigations concluded the positive samples to be single reactors not due to infection with PRRS in the herds.

Within the surveillance of aborted fetuses, 77 fetuses were examined for PRRS virus genome and all samples were negative regarding PRRS.

## DISCUSSION

Following the outbreak of PRRS in 2007, the active surveillance program was further developed for even earlier detection of PRRS introduction into the country. The results of the surveillance program 2009 provides a basis for documentation of freedom of disease.

## REFERENCES

- Carlsson U, Wallgren P, Renström LH, Lindberg A, Eriksson H, Thorén P, Eliasson-Selling L, Lundeheim N, Nörregård E, Thörn C, Elvander M, 2009. Emergence of porcine reproductive and respiratory syndrome in Sweden: detection, response and eradication. *Transbound Emerg Dis* 56(4), 121-131.
- Frössling J, Ågren ECC, Eliasson-Selling L, Sternberg Lewerin S, 2009. Probability of freedom from disease after the first detection and eradication of PRRS in Sweden: Scenario-tree modeling of the surveillance system. *Preventive Veterinary Medicine* 91(2-4),137-45.
- Keffaber KK, 1989. Reproductive failure of unknown etiology. *American Association of Swine Practitioners Newsletter* 1, 1-10.
- Wensvoort G, Terpstra C, Pol JMA, Ter Laak EA, Boemrad M, DeKluyver EP, Kragtan C, Van Buiten L, Den Bensten A, Wagenaar F, Boekhuijsen JM, Moonen PL, Zetstra T, De Boer EA, Tibben HJ, De Jong MF, Van't Veld P, Groenland GJR, Ven Gennep JA, Voets MT.h, Verheijden JHM, Braamskamp J, 1991. Mystery swine disease in The Netherlands: the isolation of Lelystad virus. *Vet Q* 13, 121-130.



Photo: Karin Bernodt

# Psittacosis

## BACKGROUND

Psittacosis is caused by *Chlamydophila psittaci*, an intracellular bacterium. The infection occurs worldwide. The main reservoir is in birds. The organism is excreted in faeces and nasal discharges. Birds may become carriers of the organism and shed it for years without any symptoms. People acquire the infection mainly via inhalation of contaminated dust or through contact with infected birds. In birds, the infection is transmitted via contact or via ectoparasites or via contaminated equipment. *C. psittaci* may persist in dry faecal secrete for months.

Control of psittacosis is very difficult. As the organism exists in both domestic and wild birds, eradication is impossible.

## History

In 1879, psittacosis was described for the first time when an outbreak of pneumonia associated with exposure to tropical pet birds was detected among Swiss patients. The organism was identified in the 1930's. Since then, outbreaks have been described world-wide.

## Disease

### Animals

Birds commonly develop symptoms when stressed or immune system is depressed. Symptoms in birds range from an asymptomatic infection to conjunctivitis, sneezing, pneumonia and generalized infection. Adult birds recover from the infection whereas mortality can be up to 90% among young birds.

### Humans

In humans the symptoms often include fever, headache, rash, myalgia, chills and upper or lower respiratory tract disease. Respiratory symptoms are often mild. The disease is usually mild or moderate, but can be severe especially in untreated elderly persons. The incubation period is usually between 5 and 14 days.

## Legislation

### Animals

*C. psittaci* is notifiable in animals according to (SJVFS 2002:16 with amendments).

### Humans

Psittacosis has been a notifiable disease since 1969 according to the Communicable Disease Act (SFS 2004:168).

## SURVEILLANCE

### Animals

No active surveillance exists. Notifications are based on clinical findings or other investigations.

### Humans

The surveillance is passive. Psittacosis has been a notifiable disease since 1969.

## RESULTS

### Animals

No cases were reported in animals in 2009.

### Humans

In 2009, psittacosis was notified in 10 persons and all of them were infected in Sweden. All cases were between 40 and 80 years old and included three women and seven men. Probably, several of them became infected while feeding wild birds or cleaning birdfeeders. During late winter 2009 a man in southern Sweden fell ill in psittacosis after having cleared up pine trees containing several birds' nests in his garden. The man later died in his infection. Environmental samples were taken from the place in the garden where the pine trees had been standing, but no bacteria were found.

## DISCUSSION

In the 1980'ies around 100 cases were reported each year. During the last decade, between 2 and 24 cases have been notified yearly. There is no obvious explanation to this decrease in number of cases, but one possible cause could be that there is less sampling of ill persons. Surveys performed in other countries suggest that psittacosis in humans is underestimated. Detection methods are not sensitive enough.

At present *C. psittaci* does not occur in Swedish poultry. Occasional cases have been reported in cage birds but the agent is common in wild birds.

# Q fever

## BACKGROUND

Q fever is a zoonotic disease caused by the bacterium *Coxiella burnetii*. Although strictly intracellular, and difficult to culture, *C. burnetii* also has a metabolic form which is very resistant in the environment, and the infectious dose is very low. Because of its tolerance to heat, drying and many disinfectants, the organism is difficult to eradicate.

Cattle, sheep and goats are considered to be the main reservoirs of the organism, but pets such as dogs and cats may also become infected. The agent is shed through several routes, such as milk, fetal and vaginal fluids, feces, urine and semen.

*C. burnetii* has also been isolated from ticks, which may play a role in maintaining the infection in animal populations.

Transmission to humans is mainly considered to be through inhalation of contaminated aerosols and dust. Therefore, contact with dusty animal products and -environments, such as wool, hay and bedding material may pose a risk. Also, consumption of unpasteurized dairy products, in particular raw milk, may constitute a risk to susceptible individuals. In humans, immunosuppression, predisposing valvular disease and pregnancy may increase susceptibility to Q fever.

Since 2007, there has been a large outbreak of Q fever in humans in the Netherlands, with more than 3,500 cases reported. The source is considered to be large dairy goat- and sheep herds with abortions due to *C. burnetii*. Apart from the Netherlands, larger outbreaks of Q fever have recently been reported from e.g. Germany, United Kingdom and Slovakia, all associated with small ruminants. In Denmark, the disease has gained a lot of attention within the dairy industry after reports on cases of Q fever in dairy farmers. In many countries, Q fever is seen as an occupational hazard for professionals in contact with domestic ruminants and their environments, such as farmers, veterinarians and abattoir workers.

## History

### Animals

The presence of *C. burnetii* in domestic animal populations in Sweden is known since the early 1990's, when the bacterium was first isolated from a sheep placenta in a herd on the isle of Gotland. In 1993, a survey on Swedish sheep and cattle showed a low seroprevalence (0.3% in sheep (n=1001) and 1.3% in cattle (n=784).

After these investigations, Q fever was not subject to further studies in animal populations until 2008, when a survey on dairy herds was performed. Overall, 8% of the herds were antibody positive in bulk milk, but there were large regional differences, with highest prevalence on the isles of Gotland and Öland (59 and 35%, respectively).

### Humans

In the 1980's and the 1990's, only a single sporadic domestic case was reported every decade. During the same period, a serosurvey in humans identified 28% of sheep farmers and 13% of veterinarians to be antibody positive, indicating a larger extent of the exposure. However, a prospective study on cases of endocarditis showed that only one of 329 patients had antibodies to *C. burnetii* indicating that the chronic Q fever endocarditis is rare. Since Q-fever became notifiable in humans in 2004, one to three cases have been reported annually until 2008, when an increase could be observed. Only one case was classified as domestic during that period. As for several other diseases, the incidence of the disease in humans seems to be underestimated.

## Disease

### Animals

Q fever in animals is usually asymptomatic but can also lead to reproductive failures such as abortions or still-/weakborn calves. In herds where the agent has been proven to be present it has to be ascertained whether any reproductive problems are due to Q fever or if there are other causes.

## SURVEILLANCE 2009

### *Humans*

In humans the infection can vary from asymptomatic or flu-like illness to acute pneumonia. Liver complications and abortions occur. Most patients recover but some may develop a chronic illness. Incubation period varies depending on the number of organisms inhaled but is usually 2-3 weeks.

### Legislation

#### *Animals*

Q fever is a notifiable disease according to (SJVFS 2002:16 with amendments). Notification of a primary case of Q fever in animals is based on detection of the agent or increased antibody levels in paired samples.

### *Humans*

Q-fever has been notifiable according to the Communicable Disease Act since 2004 (SFS 2004:168).

## SURVEILLANCE

### Animals

In 2009, samples were submitted from six cattle herds and one goat herd as part of investigations on reproductive disorders. Materials submitted were blood (n=7 (cattle); n=3 (goat)), serum (n=9) and

bulk milk samples (n=2) for antibody detection by an indirect ELISA (CHEKIT Q-fever, Idexx) and aborted material (n=3) and bulk milk (n=1) for detection of the agent by RT-PCR (Adiavet Cox PCR detection kit, Adiagene).

Active surveillance activities during 2009 consisted of a bulk milk survey in June, on a systematic random sample of 537 dairy herds. The survey was a continuation of a survey initiated in November 2008. Samples were collected from materials submitted for testing within the national control scheme on Bovine Viral Diarrhoea Virus, where an absolute majority (>95%) of all herds are tested on bulk milk. The test used for antibody detection was the same as above.

Also, a research project was carried out as a follow-up on herds that were positive for antibodies in the 2008 part of the bulk milk survey. Of 85 herds, 41 submitted a new bulk milk sample which was retested for antibodies, and also tested for presence of the agent by RT-PCR.

Finally, a limited number of samples were submitted for testing prior to export (n=23, representing 16 animals), either by indirect ELISA (n=9) or by complement fixation (CFT) (n=14).



## SURVEILLANCE 2009

### RESULTS

#### Animals

One cow tested antibody positive as a result of the clinical submissions during 2009. All other samples were negative for *Coxiella* antibodies and/or DNA.

Forty-one dairy herds were antibody positive in the 2009 part of the bulk milk survey (7.6% (5.5-10.2; 95% confidence interval). Together with the results from 2008, the overall estimate of prevalence of dairy herds with antibodies to *C. burnetii* in bulk milk is 8.2% (6.9-9.7). The prevalence (2008/2009) at the county level is given in table 4. The spatial distribution of antibody positive herds is shown in map 8.

In the research project, 35 of 41 herds (85%) were still antibody positive at the retest, which was conducted 7-11 months after the initial test. Twenty-nine of the 35 antibody positive herds (83%) were also positive for bacterial DNA by PCR (Table 4). One herd tested positive on PCR although it was negative for antibodies in bulk milk. The 30 PCR-positive herds were notified to the Board of Agriculture as new cases of Q fever.

None of the samples submitted for export testing were positive for *C. burnetii*.

#### Humans

During 2009, five cases of Q-fever were notified. The infected persons were all infected abroad. All the cases were men between 45 and 75 years of age.

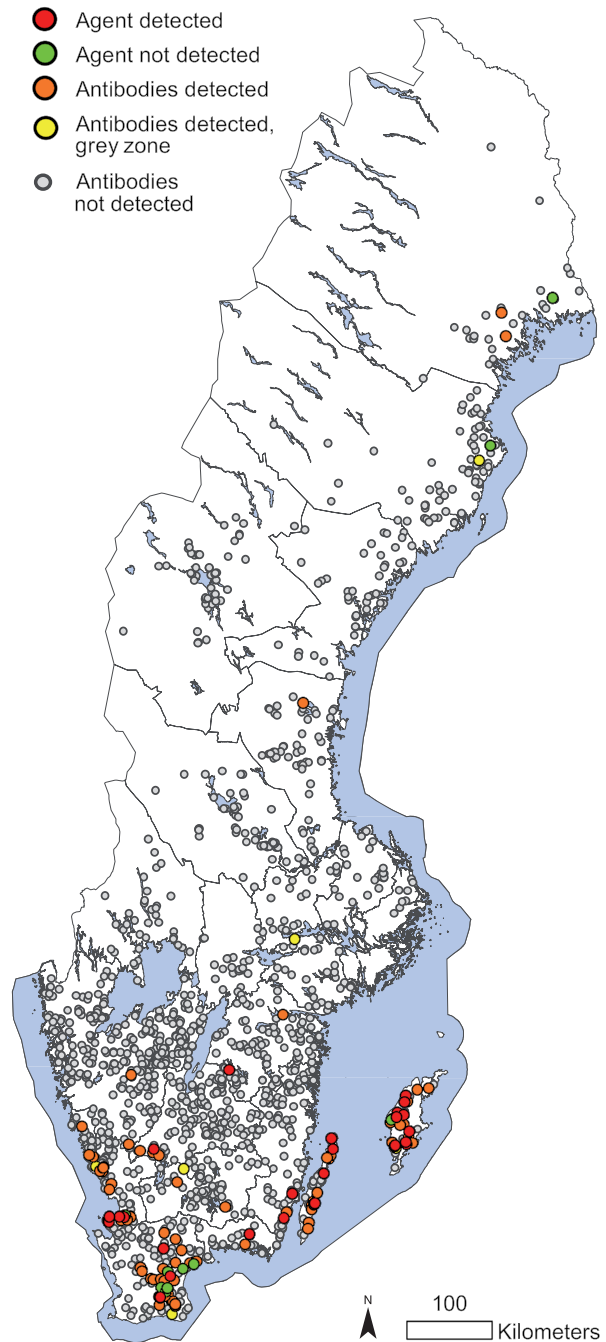
### DISCUSSION

Because Q fever in both humans and animals is mostly asymptomatic, it is likely to be underreported. Also, up to 2010, the awareness of Q fever as a potential cause of clinical illness in animals was, most likely, very low. However, recent findings that indicate that Q fever may be underestimated as a cause of reproductive disorders in ruminants has resulted in an increased number of clinical submissions.

The research project carried out in 2009 confirmed the presence of *C. burnetii* in Swedish dairy herds and indicated that if antibodies can be detected in bulk milk, there is a high likelihood that the bacterium can also be detected. The high prevalence of antibody positive herds on the isles of Gotland and Öland is intriguing and further investigations into risk factors are warranted.

Up until 2010, the studies conducted have all been in dairy cattle. Within this sector of the cattle

Map 8. Spatial distribution and status of Swedish dairy herds tested for antibodies to *Coxiella burnetii* in bulk milk, and for presence of the agent. In all 1,537 herds were tested for antibodies in a national random survey in 2008/2009. Forty-one of 126 antibody positive herds were also tested for bacterial DNA within a research project. Antibodies were detected by an indirect ELISA (CHEKIT Q-fever, IDEXX), and bacterial DNA was detected by RT-PCR (Adiavet Cox PCR detection kit (Adiagene, Saint Brieuc, France)).



## SURVEILLANCE 2009

Table 4. Swedish dairy herds positive to antibodies against *Coxiella burnetii* in bulk milk. County and overall prevalence with 95% confidence interval (CI). Sample collection was based on systematic random sampling and was performed in November 2008 and June 2009.

County	No tested	No positive	%	95% CI
Stockholm	12	0	0	0- 26.5
Uppland	26	0	0	0- 13.2
Södermanland	33	0	0	0- 10.6
Östergötland	87	2	2.3	0.3- 8.1
Jönköping	151	5	3.3	1.1- 7.6
Kronoberg	61	2	3.3	0.4- 11.3
Kalmar	151	22	14.6	9.4- 21.2
Gotland	40	24	60	43.3- 75.1
Blekinge	25	2	8	1.0- 26
Skåne	162	44	27.2	20.5- 34.7
Halland	102	18	17.6	10.8- 26.4
Västra Götaland	310	2	0.6	0.1- 2.3
Värmland	39	0	0	0- 9
Örebro	25	0	0	0- 13.7
Västmanland	21	0	0	0- 16.1
Dalarna	50	0	0	0- 7.1
Gävleborg	54	1	1.9	0- 9.9
Västernorrland	42	0	0	0 - 8.4
Jämtland	47	0	0	0- 7.5
Västerbotten	70	1	1.4	0- 7.7
Norrbottn	28	3	10.7	2.3- 28.2
County unknown	1	0	0	
<b>OVERALL</b>	<b>1537</b>	<b>126</b>	<b>8.2</b>	<b>6.9- 9.7</b>

industry, the extent of the infection is considered to be fairly well understood, although many questions about the implications still remain. However, there is still very limited knowledge about the situation in Swedish sheep and goats as well as in beef cattle. Surveys in sheep and dairy goats are being performed during 2010.

### REFERENCES

Angelakis, E., Raoult, D. Q Fever. *Veterinary Microbiology* (2010) 140:297-309.

Macellaro A, Åkesson A, Norlander L. A survey of Q-fever in Sweden. *European Journal of Epidemiology* (1993) 9:213-216.

Office Internationales des Epizooties, *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* 2009. Available online: [http://www.oie.int/eng/normes/mmanual/2008/pdf/2.01.12\\_Q-FEVER.pdf](http://www.oie.int/eng/normes/mmanual/2008/pdf/2.01.12_Q-FEVER.pdf)

Schimmer, B., Dijkstra, F., Vellema, P., Schneeberger, P.M., Hackert, V., ter Schegget, R., Wijkman, C., van Duynhoven, Y., van der Hoek, W. Sustained intensive transmission of Q fever in the south of the Netherlands, 2009. *Euro Surveillance*. (2009) 14:19.



Photo: Anders Lindström

# Rabies

## BACKGROUND

Rabies is caused by a rhabdovirus belonging to a family of Lyssaviruses. Rabies can infect all warm-blooded animals. Rabies occurs worldwide with some free areas. Rabies is transmitted through contact with saliva, typically via animal bites. Most human cases are caused by infected dog bites. The reservoir animal species of rabies in endemic countries are wild carnivores or stray dogs. In Europe the reservoir species are red fox and raccoon dogs. Bats in Europe may carry another type of rabies virus called European Bat Lyssa virus (EBLV), but never classical rabies. Since 1886 Sweden has been free from animal rabies. EBLV has never been isolated from bats in Sweden.

## Disease

### *Humans and animals*

Rabies virus infects the central nervous system of humans and mammals. Early symptoms of rabies are nonspecific, consisting of fever, headache, and general malaise. As the disease progresses, neurological symptoms appear and may include insomnia, anxiety, confusion, slight or partial paralysis, excitation, hallucinations, agitation, hypersalivation and difficulty swallowing. Without post-exposure treatment the disease leads to death within days of the onset of symptoms. The incubation period of rabies is usually 3–6 weeks, but may vary from five days to one year.

Not much is known about symptoms in EBLV infected bats. They may express weight loss,

disorientation, lack of coordination and muscle spasms and aggression, but some infected bats may be normal in behavior.

## Legislation

### *Animals*

Rabies is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments) and is notifiable on suspicion. If rabies is suspected or confirmed measures will be taken to combat the disease and to prevent further spread.

To prevent the introduction of rabies, dogs and cats have to fulfill certain provisions before entering Sweden. Depending on the country of origin they either have to be placed in quarantine or have to be rabies vaccinated and have their antibody titer tested. The rules are set in the EU Regulation 998/2003 and Sweden may keep these rules until 31 December 2011.

### *Humans*

Rabies in humans is notifiable according to the Communicable Disease Act (SFS 2004:168).

## SURVEILLANCE

### *Animals*

Since 1998, a passive surveillance program has been in place where dead bats have been examined for the presence of rabies virus. Annual information about the survey has been sent to different interested parties with an appeal to send in bats and with instructions how to handle the dead bats to reduce the risk of rabies infection.

In addition, in 2008 an active surveillance program was performed for the first time in Sweden. The program was run as a cooperation project with The Swedish Institute for Infectious Disease Control and The Swedish Environmental Protection Agency.

During 2009, three dogs and three cats were examined for rabies due to clinical suspicion. The diagnostic method used was based on the detection of antigens in brain tissue by use of a fluorescent antibody test, FAT.

### *Passive surveillance*

72 dead or wounded and euthanized bats were sent



## SURVEILLANCE 2009

to the National Veterinary Institute (SVA) for rabies examination (Map 9). The contributors were mostly private persons. The diagnostic method used was FAT. 32 bats were in no condition to be examined for rabies, mostly due to missing brain. The bats were sent to The Swedish Museum of Natural History, Stockholm, to determine the species.

### Active surveillance

77 Daubenton's bats (*Myotis daubentonii*) and 47 Northern bats (*Eptesicus Nilssonii*) were caught in the County of Skåne and Uppsala respectively by using mist nets. Blood samples and oral swabs were taken and the species and age were determined. After sampling the bats were released.

For serology the FAVN-method with EBLV-1 virus was used. The swabs were analysed by real-time PCR for the detection of EBLV by The Swedish Institute for Infectious Disease Control.

## RESULTS

### Animals

Eight Daubenton's bats (*Myotis daubentonii*) caught in Skåne were serologically positive for EBLV, but no virus was detected by PCR. All other animals tested were negative for rabies.

### Humans

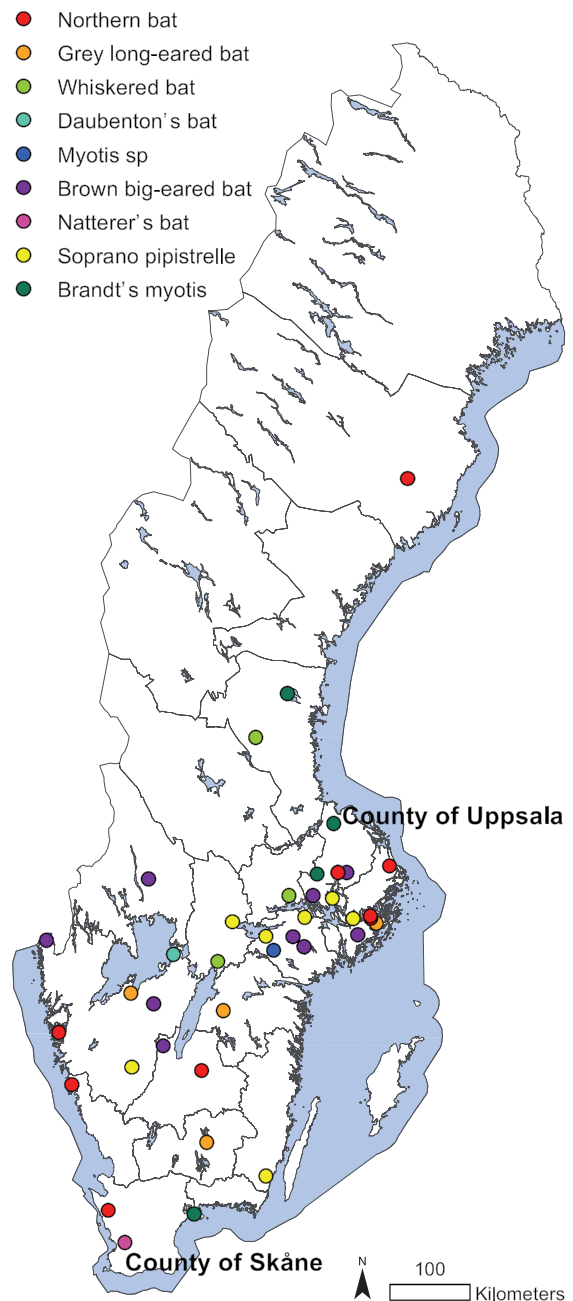
No human cases were reported during the year.

## DISCUSSION

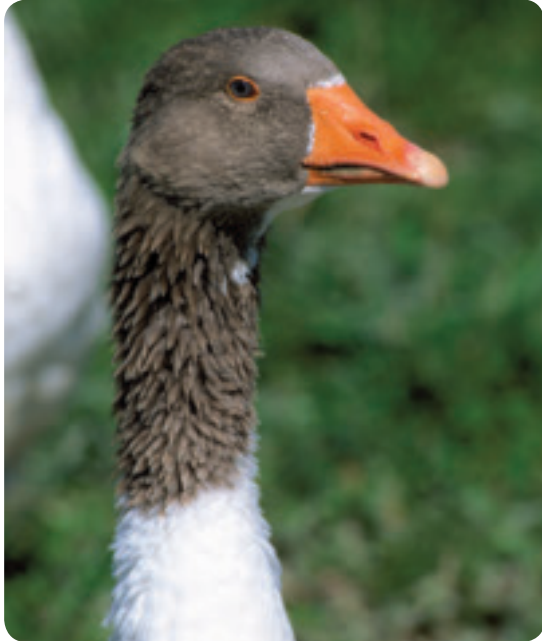
During the last decades, two persons have been hospitalized for rabies in Sweden. In 1974, a Swedish man fell ill after having been infected in India and in 2000 a woman fell ill after a visit in Thailand. Both patients had most probably been infected by rabid dogs. Since Sweden has been free from classical rabies, the risk of acquiring the disease from Swedish animals is negligible. There has been an increasing problem with illegal importation of pets since 2004, mostly dogs. Illegally imported dogs are probably the greatest threat to the rabies free status of Sweden even though the risk of introducing rabies is rather low. During 2009 both Northern Bats and Daubenton's bats have been especially investigated for EBLV and the results suggest that EBLV is present in Sweden. There are 18 different species of bats in Sweden, all insectivorous belonging to the family of Vespertilionidae. Daubenton's bat (*Myotis*

*daubentonii*), associated with EBLV-2 infections, is common and may be found from the south up to the county of Ångermanland in the north. Six other *Myotis* species may also be found in Sweden. The Serotine Bat (*Eptesicus serotinus*), associated with findings of EBLV-1 in Europe, is found in certain habitats in the south of Sweden. The Northern Bat (*Eptesicus Nilssonii*), which is related to the Serotine Bat, is the most common in Sweden, and may be found all over the country.

Map 9. Distribution of bats tested for rabies in passive surveillance.



# Salmonellosis



## BACKGROUND

*Salmonella* infection is one of the most important bacterial zoonoses. The genus is divided into two species: *S. enterica* and *S. bongori*. *S. enterica* is further divided into six subspecies. Most *Salmonella* belong to *S. enterica* subspecies enterica. More than 2,500 different serovars belonging to this subspecies have been described. *Salmonella* can infect reptiles, all warm-blooded animals as well as humans. The reservoir is in the animal population. *Salmonella* are able to survive in the environment for a considerable time. Humans are infected by contaminated food products of various ranges, through contact with infected animals or via person-to-person transmission or via a contaminated environment.

## History

### Animals

A severe domestic outbreak of *S. Typhimurium* in 1953, that involved more than 9,000 people prompted the need for a control program for

*Salmonella*. When Sweden joined the European Union in 1995, the Swedish *Salmonella* control program was accepted.

### Feed

A control program for feed was initiated in the late 1950's, as an agreement between the National Veterinary Institute (SVA) and the feed industry. Studies carried out in the 1950's showed that imported feed materials including animal proteins contained *Salmonella* and heat treatment of pellets was shown to be an effective procedure to remove the contamination. In 1991 a new control program for *Salmonella* in feed was launched based on HACCP (Hazard Analysis Critical Control Points) principles. This program became mandatory in 1993 when it was implemented by the Swedish Board of Agriculture.

### Humans

Sweden has statistical data for *Salmonella* infection dating back to 1875. Earlier, the statistics were based on clinical diagnostics and later also voluntary laboratory reporting. Since 1996 laboratory reporting is mandatory. According to the Swedish legislation, the source of the *Salmonella* infection has to be investigated to prevent further spread. Around 3,000-4,000 cases are reported every year to the Swedish Institute for Infectious Disease Control. A majority of these (around 80-85 %) are infected abroad. The low proportion of domestic infections is unique for Sweden compared to many other European countries. Few larger outbreaks are reported and the source is more often imported food than domestic.

### Disease

*Salmonella* can infect humans, all other warm-blooded animals and reptiles. The incubation period is normally between 1 and 3 days but can vary from 6 hours to 10 days.

### *Animals*

Infection in animals is often asymptomatic. However, *Salmonella* can cause clinical illness with symptoms of diarrhoea, abortions, fever and lead to death. In Sweden clinical signs are frequently seen in cattle herds, but only rarely in swine herds and poultry flocks.

### *Humans*

*Salmonella* infects the gastrointestinal tract and causes an acute gastrointestinal illness. The symptoms can range from asymptomatic and mild to severe.

Most patients recover from the illness spontaneously but sequelae such as reactive arthritis occurs in approximately 1-15% of the patients. Moreover, prolonged symptomless excretion of the pathogen is common.

### Legislation

#### *Feed*

Control of animal feed is an integrated and essential part of the control program for *Salmonella* at farm level. The manufacturer is responsible for producing *Salmonella*-free feed. Poultry feed has to be heat treated according to the legislation. The major part of cattle and swine feed is also heat treated. The control of feed is supervised by the Swedish Board of Agriculture which also carries out unannounced inspections at feed mills.

*Salmonella* in feed is regulated in national legislation (SJVFS 2006:81; SJVFS 2009:53) as well as in EU regulation (EC) 1774/2002.

### *Animals*

Investigation is required on clinical suspicion of *Salmonella* and any finding of *Salmonella*, irrespective of serovar, is notifiable and action is taken to eliminate the infection or contamination. Vaccination is not used in Sweden. The *Salmonella* Control Program is governed by the Swedish Act on Zoonosis (SFS 1999:658) and its regulations. The aim of the program is that animals sent for slaughter and animal products should be free from *Salmonella*. The strategy is to prevent *Salmonella* in any part of the production chain, from feed to food of animal origin.

### *Food*

Any finding of *Salmonella* in food is notifiable and a contaminated food product is considered unfit for human consumption.

### *Humans*

Salmonellosis in humans is notifiable according to the Communicable Disease Act (SFS 2004:168).

## SURVEILLANCE

### *Feed*

In the control program for feed the emphasis is on control of feed raw materials, the heat treatment process and preventive measures regarding recontamination of heat treated feed. Also, suspected feed-borne infections are carefully investigated.

### Monitoring of feed raw materials

Raw materials are the most important risk factor in feed production. The sampling plan for feed raw materials is designed to detect *Salmonella* with a 99% probability. Previous experience has shown that feed materials of both animal as well as of vegetable origin have caused problems. However, due to restrictions on the use of feed materials of animal origin, certain feed materials of vegetable origin are presently the most important risk factors.

According to domestic legislation feed materials are classified according to the empirical risk they present. The highest risk is feed materials of animal origin (S1) and some feed materials of vegetable origin (S2, e.g. soy bean meal).

All consignments of feed materials classified as S1, S2 or S3 have to be sampled for salmonella according to a sampling plan. Feed raw materials where salmonella was not detected or acid treated raw materials are allowed to be used in feed production.

### Monitoring feed mills

The purpose of the monitoring is to ensure the absence of *Salmonella* in the production lines or the feed mill environment.

A safety management system shall be applied i.e. the critical steps have to be identified in the processing line. The management system covers a number of specific GMP (Good Manufacturing Practises) requirements, according to Swedish legislation.

A minimum of five samples from feed mills manufacturing compound feeding stuff for poultry and a minimum of two samples from those manufacturing compound feeding stuff for other food-producing animals must be collected at specified places in the processing line on a weekly basis. These samples are analysed at the SVA and

## SURVEILLANCE 2009

any finding of *Salmonella* is reported to the Swedish Board of Agriculture. The manufacturers take additional samples from the processing line and the feed mill environment. Adequate measures shall be performed in case of positive findings of *Salmonella*.

### Food

Control of *Salmonella* is an important part of in-house control programs in most food enterprises in Sweden. All findings shall be reported to the competent authority. Sampling at retail level is also frequent even if the number of samples has decreased from previous very high numbers.

### Surveillance at slaughterhouses

According to the Swedish *Salmonella* control program samples from intestinal lymph nodes and swabs from carcass are taken from cattle and swine and neck skin samples from slaughtered poultry. Sampling is proportional to slaughtering capacity. Altogether 28,000 samples from cattle, adult swine, fattening pigs and poultry are collected annually.

At red meat cutting plants, approximately 3,000 samples are taken annually from crushed meat and meat scrapings and approximately 1,200 samples are taken in white meat cutting plants.

### Control in Food-producing Animals

#### Control in poultry

The program comprises a compulsory part and a voluntary part. All poultry species are included in the compulsory part, which gives the rules for obligatory sampling.

A preventive voluntary program includes all-in all-out production, hygienic measures and certain standard of poultry houses, such as hygienic barriers between the clean and unclean part. Purchase of animals is only allowed from holdings affiliated to the voluntary program. Only heat-treated feed is allowed. The poultry houses must be cleaned and disinfected before introduction of a new flock. The broiler producer has to make an application to be accepted in the voluntary program. An official veterinarian controls the housing regularly. The producers affiliated to the voluntary program are allowed higher compensation in case of *Salmonella*. All broiler producers belonging to the Swedish Poultry Association are affiliated to the voluntary program (approximately 99% of the slaughtered broilers). The voluntary program has been in place for more than 40 years. All broiler flocks are analyzed for *Salmonella* before slaughter. Positive flocks are destroyed.

All breeding flocks having more than 250 birds are tested (Table 5). Grandparents of *Gallus gallus* broilers are imported in Sweden as day-old chicken. Laying hens, turkeys, geese and ducks are imported as parents. Samples consist of boot swabs taken from all parts of the house where the birds are kept. From rearing flocks two pairs of sock samples are taken and pooled into one, five pairs pooled to two are taken from production flocks.

All holdings selling eggs for consumption are sampled (Table 5). All poultry flocks having more than 500 birds, irrespective of species, are tested 1-2 weeks before slaughter. The results must be available before slaughter.

Table 5. Sampling scheme for *Salmonella* in poultry.

Category of poultry	Sampling frequency	Sample type	Sampling before slaughter	Official veterinarian
Breeders in rearing	1 d, 4 weeks, 2 weeks prior to rearing or moving	2 pairs sock samples	14 d before slaughter	Once a year
Breeders in production	every 2nd week	5 pairs sock samples	14 d before slaughter	3 times under production
Layers in rearing	2 weeks prior to moving	2 pairs sock samples or 2 faecal samples of 75 g	14 d before slaughter	Once a year
Layers in production	every 15th week (start at 22-26 weeks)	2 pairs sock samples or 2 faecal samples of 75 g	14 d before slaughter	Once a year
Poultry for meat production (all species)		2 pairs sock samples or 2 faecal samples of 75 g	14 d before slaughter	Once a year

The producers pay the costs for laboratory analyses and the visits to the holdings. Only accredited laboratories are allowed to perform the analyses. The laboratory sends the test results to the County Veterinary Officer on a quarterly basis. According to the regulations the County Veterinary Officer has to send a report on the test results of all poultry holdings to the Swedish Board of Agriculture once a year.

### *Control in cattle and pig herds*

The program comprises a voluntary and compulsory part. The voluntary program is a preventive hygienic program aiming at decreasing the risk of *Salmonella*. Holdings affiliated to the program get higher compensation in case of positive findings. The majority of all breeding holdings and many of the large dairy herds are affiliated to the program. In addition, affiliated holdings can apply for a commercial *Salmonella* insurance.

The compulsory part consists of faecal sampling annually from breeding pig herds and gilt-producing herds and twice a year from sow pools. At necropsy, all calves younger than six months are tested for *Salmonella*. *Salmonella* is tested at other post-mortem investigations if an infection of *Salmonella* is suspected on the basis of the macroscopic findings. All imported animals are sampled. On clinical suspicion, herds or single animals should be tested for *Salmonella*.

In addition, in 2009, a bulk-milk screening with analysis for *S. Dublin* antibodies was performed in a region historically known to have a higher incidence of *S. Dublin* compared to other parts of the country. This screening included all dairy herds on the island of Öland (n=204).

### *Control in other animals*

Animals are tested for *Salmonella* at suspicion or trace-back. Wild animals necropsied at the SVA are tested for *Salmonella*.

### *Measures in case of positive findings*

All suspected primary isolates of *Salmonella* are sent to the SVA for confirmation, resistance testing, serotyping and further typing.

### Feed

Findings of *Salmonella* in imported feed materials and compound feeds are reported within the Rapid Alert System for Food and Feed (RASFF).

Measures are always taken when *Salmonella* is

detected in feed samples. *Salmonella* positive feed materials are usually treated with organic acids, such as formic acid. After acid treatment the feed material has to be re-tested with negative result before using it in feed production. Manufactured feed containing *Salmonella* has to be withdrawn from the market.

A larger sampling is made in the production line if *Salmonella* is detected in the weekly monitoring and different measures are then undertaken. If *Salmonella* is found before heat treatment the contaminated part of the production line is thoroughly cleaned and disinfected, usually by dry cleaning, followed by disinfection. If *Salmonella* is found after heat treatment, the feed mill has to be thoroughly cleaned and disinfected. Environmental sampling must show negative results before production is resumed.

### Animals

If *Salmonella* is suspected in an animal, a veterinarian is always obliged to take samples and prevent further transmission. When *Salmonella* is isolated at a laboratory the laboratory has to notify the Swedish Board of Agriculture and the County Veterinary Officer. The County Veterinary Officer informs the official veterinarian at the abattoir and others needing the information before confirmation. The isolate is sent to SVA for confirmation and further typing.

When *Salmonella* is confirmed on a farm, the holding is put under restrictive measures and an epidemiological investigation is always performed and a plan to eradicate *Salmonella* from the holding is designed. Animal movements to and from the holding are forbidden.

All *Salmonella* positive poultry flocks are euthanized irrespective of serotype. The poultry stable and all possible contaminated areas are thoroughly cleaned and disinfected. Before introduction of new birds, all environmental samples must be negative for *Salmonella*.

In pigs and cattle, a combination of stamping out of groups of animals and hygienic measures controlled by repeated sampling is usually practiced. Hygienic measures can include reducing the number of animals, control of animal, feed and manure movements on the farm and reduction of *Salmonella* in the environment by cleaning and disinfection. No *Salmonella* positive animals should enter the cleaned and disinfected parts of the stable. Negatively tested animals, when

considered at low risk of being infected, may be slaughtered under certain conditions with extra hygienic measures and sampling of each carcass. The restrictions are lifted when the cleaning and disinfection have been completed and *Salmonella* cannot be detected from two whole-herd samplings for culture performed four weeks apart.

If *Salmonella* is detected in companion animals advice is given to the owners. If *Salmonella* is detected in horses, the stables and or the paddocks at risk are put under restrictions and the horse is followed up.

### Humans

*Salmonella* infection is notifiable in humans. All reported domestic cases are traced for the source of infection.

## RESULTS

### Feed

Fifteen major feed mills produce approximately 95% of all feed consumed. In the monitoring of feed mills, 9,629 samples were taken. *Salmonella* was detected in 42 samples (0.4%). Fifteen serotypes were detected; *S. Typhimurium* was the most common (n=21) (Table 6, Figure 6).

In addition, *Salmonella* was detected in 18 (0.4%) of 4,684 samples from material of vegetable origin. The most common serotype was *S. Livingstone* (n=4). *Salmonella* was detected in 4 of 788 (0.5%) environmental samples from domestic rapeseed processing plants. *Salmonella* was detected in 31 of 2,339 samples from processing plants for animal by-products and feed materials of animal origin.

Studies were also performed to compare the ability of the standard method used for isolation of *Salmonella* in feed in the Nordic countries, the NMKL71 method (Nordic Committee on Food Analysis) with the Modified Semisolid Rappaport Vassiliadis method (MSRV) and the international standard method (EN ISO 6579:2002).

Five different feed materials were investigated, wheat grain, soybean meal, rape seed meal, palm kernel meal, pellets of pig feed and also scrapings from a feed mill elevator. Four different levels of the *Salmonella* serotypes *S. Typhimurium*, *S. Cubana* and *S. Yoruba* were added to each feed material, respectively. The results obtained with all three methods showed no differences in detection levels, with an accuracy and sensitivity of 65% and 56%, respectively. However, Müller-Kauffmann tetrathionate-novobiocin broth (MKTn),

performed less well due to many false-negative results on Brilliant Green agar (BGA) plates. Compared to other feed materials palm kernel meal showed a higher detection level with all serotypes and methods tested.

### Animals

#### Poultry

In total, *Salmonella* was detected in 18 poultry flocks (Table 7).

*Typhimurium* RDNC was isolated from ten flocks of different species. A trace back investigation identified goslings purchased from one holding with geese breeders as the source. This holding also had fattening geese and turkeys and a history of *Salmonella* infection in recent years with clinical salmonellosis in children. With the exception of the breeding holding, most of the infected flocks were small.

*Salmonella* was detected in four broiler flocks (Table 7). *S. Goldcoast* was isolated from two flocks of one holding. *S. Agona* was isolated from one flock of one holding with consecutive isolations of the same serotype in subsequent flocks although the infected birds were killed and the holding was cleaned and disinfected between the rounds.

Three flocks of laying hens were infected: one with *Livingstone*, one with *S. enterica* sp. *diarizonae* and one with *S. Typhimurium* RDNC. *Salmonella* was also detected in four turkey flocks (Table 7). Serotype *Sandiego* was isolated from three flocks of one holding.

#### Cattle

In 2009, *Salmonella* was detected in 19 new cattle herds (Figure 20, Table 8, Map 10). *S. Dublin* was detected in eight herds, *S. Reading* in five, *S. Typhimurium* in five, and a monophasic *Salmonella* 4,5,12:i:- in one herd. An additional serotype was detected on five farms: *S. Düsseldorf* on two farms, a monophasic *Salmonella* on two farms and *Typhimurium* NT on one. In total, 35 farms were under restrictive measures in 2009 due to an infection detected in 2007-2009. By the end of 2009, 18 farms were under restriction.

Seven herds were detected in a bulk milk screening survey and seven herds were detected in trace-back investigations. Two herds were detected after a finding in the control program performed at slaughterhouses and one after a finding at necropsy. In 2009, all herds with *S. Dublin* were detected in a bulk-milk screening for antibodies against *S. Dub-*

Table 6. *Salmonella* serotypes isolated in feed control in 2009.

Serotype	Meat and bone meal	Meat and bone meal (environment)	Fish meal*	Greaves (environment)	Maize derived*	Meat meal*	Palm kernel derived*	Pet food*	Poultry of-fal meal*	Process control feed mills	Rape seed*	Rape seed (environment)	Soya bean*	Sunflower seed*
<i>S. Aairhus</i>										1				
<i>S. Adelaide</i>										1				
<i>S. Agona</i>	9	2								1				
<i>S. enterica</i> sp. <i>enterica</i> (I)									4					
<i>S. Havana</i>										1				
<i>S. infantis</i>								1						
<i>S. Isangi</i>							13							
<i>S. Kedougou</i>						1								
<i>S. Kentucky</i>							1							
<i>S. Lexington</i>													1	
<i>S. Livingstone</i>				2	1						3			
<i>S. London</i>										3				
<i>S. Mbandaka</i>		4								1	1			
<i>S. Meleagridis</i>										1				1
<i>S. Montevideo</i>				2						1				
<i>S. Ohio</i>			1								1			
<i>S. Rissen</i>										1				
<i>S. Ruiru</i>										1				
<i>S. Schwartzengrund</i>										1				
<i>S. Senftenberg</i>										1	1	4	1	1
<i>S. Sorenga</i>													1	
<i>S. Tennessee</i>										1			1	
<i>S. Typhimurium</i>					1									
<i>S. Typhimurium</i> DT120										19				
<i>S. Typhimurium</i> U302										2				
<i>S. Worthington</i>										2			1	
<i>S. Yoruba</i>										2			1	
Untyped				5							1			
<b>TOTAL</b>	<b>9</b>	<b>6</b>	<b>1</b>	<b>9</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>13</b>	<b>42</b>	<b>7</b>	<b>4</b>	<b>6</b>	<b>2</b>

\* Imported

## SURVEILLANCE 2009

Figure 6. Number of samples in the weekly monitoring analysed at SVA, taken in the HACCP control of feed mills and percentage of positive findings.

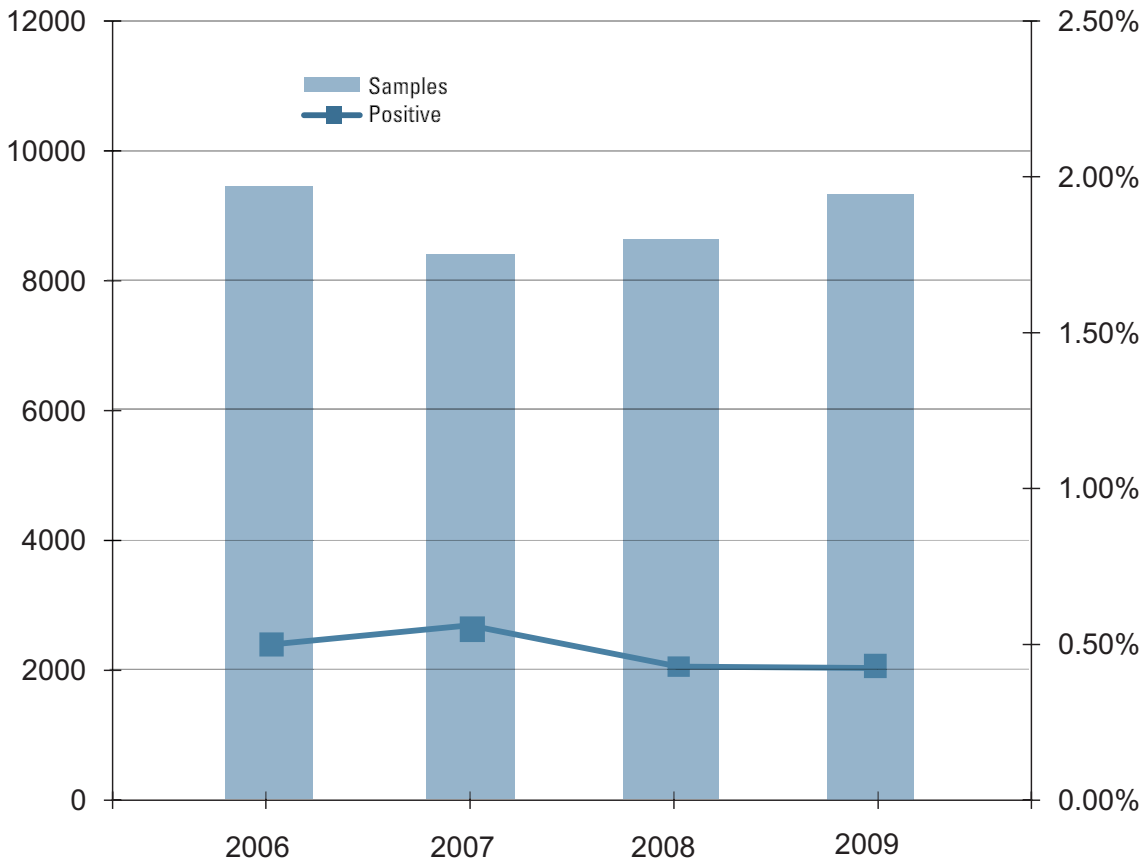


Figure 7. *Salmonella* in carcass swab samples of fattening pigs, sampled at major slaughterhouses.

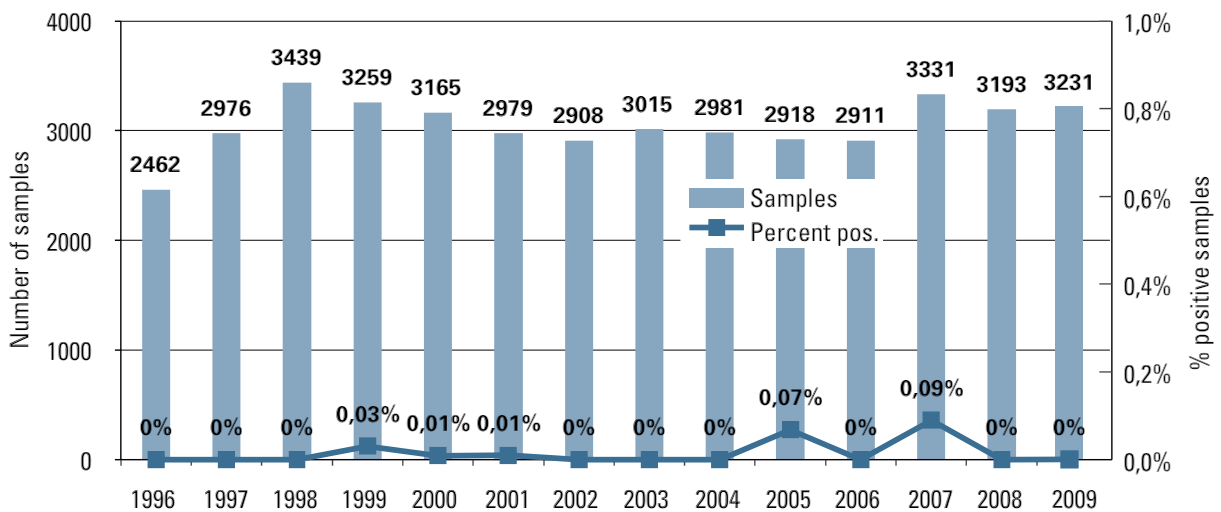




Table 7. Poultry flocks infected with *Salmonella* in 2009.

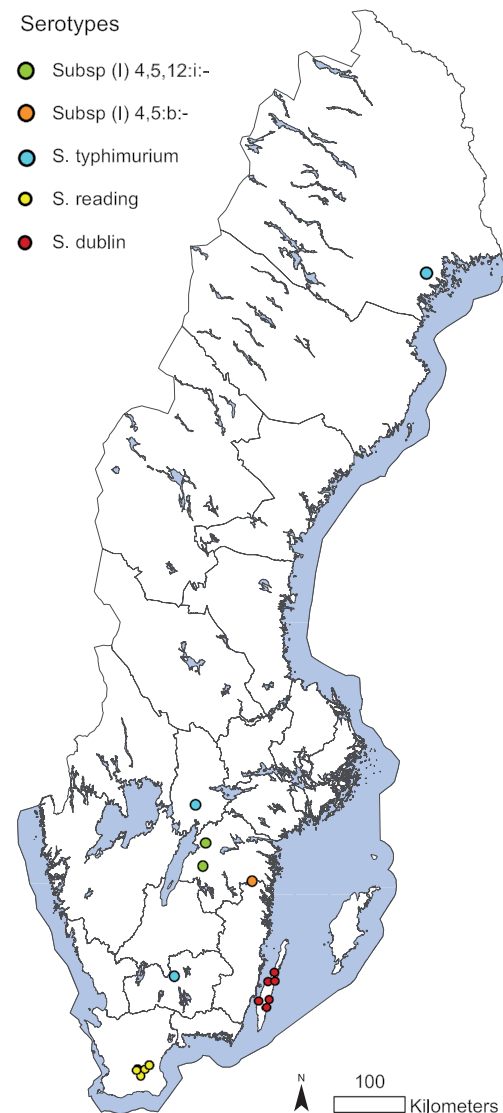
Serotype	Phagetype	Species	Production stage	Production type	No. infected flocks
<i>S. Agona</i>	not relevant	<i>Gallus gallus</i>	Production	Meat production	1
<i>S. Typhimurium</i>	RDNC	<i>Gallus gallus</i>	Production	Meat production	1
<i>S. Goldcoast</i>	not relevant	<i>Gallus gallus</i>	Production	Meat production	2
<i>S. Sandiego</i>	not relevant	Turkeys	Production	Meat production	3
<i>S. Typhimurium</i>	RDNC	Turkeys	Production	Meat production	1
<i>S. Typhimurium</i>	RDNC	<i>Gallus gallus</i>	Production	Egg production	1
<i>S. Livingstone</i>	not relevant	<i>Gallus gallus</i>	Production	Egg production	1
<i>S. diarizonae</i>	not relevant	<i>Gallus gallus</i>	Production	Egg production	1
<i>S. Typhimurium</i>	RDNC	Ducks	Production	Meat production	1
<i>S. Typhimurium</i>	RDNC	Geese	Production	Meat production	5
<i>S. Typhimurium</i>	RDNC	Geese	Breeding	Meat production	1

lin including all herds on the island of Öland or in trace-back investigations from these herds. In the screening 33 (16.2%) of 204 herds were positive for antibodies against *S. Dublin*, one of these herds was already, since 2008, under restrictions and seven of the herds were positive on culture after whole-herd samplings. One herd was detected at trace-back investigations.

*S. Reading* was detected in five new cattle herds in 2009. The farms were situated in close proximity to each other, but at some distance from the previously infected region in the county of Skåne. Also in this new area *S. Reading* was isolated from water streams and wild birds. An investigation of herds along water streams in the new region as well as trace-back investigation from the first detected herd in the new region was performed. The same subtype was isolated from one cattle herd in June, from pasture of one beef herd in July and from two dairy herds in August. The first detected herd in the new region was sampled due to detection of *S. Reading* in one employee.

A monophasic *Salmonella* was isolated from three herds. Two of these herds were neighbours and located along a river and the third herd had bought calves from one of the other two herds. One herd was already under restrictions due to *S. Dublin*. Three persons with exposure to the same river or farm were diagnosed with the same subtype of *S. subspecies I*.

Map 10. *Salmonella* serotypes in Swedish cattle herds in 2009.



## SURVEILLANCE 2009

Table 8. Cattle farms infected with *Salmonella* in 2009.

Primary sero-type	Phagetype	Other serotypes in 2009	Production type	Restricted since	Restrictions lifted	Reason for sampling
S. Dublin	not relevant	<i>S. enterica</i> sp. <i>enterica</i> O 4,5,12:i;-	dairy	2007	no	Slaughter line
S. Dublin	not relevant		meat	2008	2009	Trace-back
S. Dublin	not relevant		dairy	2008	2009	Trace-back
S. Dublin	not relevant		meat	2008	no	Trace-back
S. Dublin	not relevant		dairy	2008	no	Necropsy
S. Dublin	not relevant		dairy	2008	2009	Clinical symptoms
S. Dublin	not relevant		meat	2008	2009	Control program
S. Dublin	not relevant		dairy	2009	no	Serological screening
S. Dublin	not relevant		dairy	2009	no	Serological screening
S. Dublin	not relevant		dairy	2009	2009	Serological screening
S. Dublin	not relevant	<i>S. Duesseldorf</i>	dairy	2009	no	Serological screening
S. Dublin	not relevant		dairy	2009	no	Serological screening
S. Dublin	not relevant		dairy	2009	2009	Serological screening
S. Dublin	not relevant		dairy	2009	no	Serological screening
S. Dublin	not relevant		meat	2009	no	Trace-back
S. Enteritidis	PT1		meat	2008	2009	Necropsy
S. Enteritidis	PT1		dairy	2008	2009	Trace-back
S. Reading	not relevant		multiple	2007	no	Control program
S. Reading	not relevant		meat	2008	no	Necropsy
S. Reading	not relevant		dairy	2008	no	Clinical symptoms
S. Reading	not relevant		meat	2008	2009	Trace-back
S. Reading	not relevant		dairy	2009	2009	Human infection
S. Reading	not relevant		meat	2009	no	Trace-back
S. Reading	not relevant		meat	2009	2009	Trace-back
S. Reading	not relevant	<i>S. Typhimurium</i> RDNC	dairy	2009	2009	Trace-back
S. Reading	not relevant		dairy	2009	2009	Trace-back
<i>S. enterica</i> sp. <i>enterica</i> O 4:b:-			dairy	2009	2009	Trace-back
<i>S. Typhimurium</i>	DT104		meat	2008	2009	Trace-back
<i>S. Typhimurium</i>	NT	PT 41	dairy	2008	2009	Necropsy
<i>S. Typhimurium</i>	PT1		dairy	2008	2009	Necropsy
<i>S. Typhimurium</i>	DT120	<i>S. Duesseldorf</i>	dairy	2009	2009	Necropsy
<i>S. Typhimurium</i>	DT120		meat	2009	no	Control program
<i>S. Typhimurium</i>	RDNC		dairy	2009	no	Control program
<i>S. Typhimurium</i>	NT	<i>S. enterica</i> sp. <i>enterica</i> O4,5,12:i;-	dairy	2009	no	Trace-back
<i>S. Typhimurium</i>	U277		meat	2009	no	Trace-back

\* NT= non typable. RDNC=reacts but does not conform to established phage types.

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*Salmonella* was isolated from 6 of 3,652 lymph nodes analyzed (Table 9, Figure 8). Three of these animals were slaughtered at high-capacity and three at smaller abattoirs. On the following whole-herd sampling in the originating herds, *Salmonella* was detected in two of these six cases.

*Salmonella* was also isolated from four individual cases at necropsy and detected in one of the herds of origin.

### Pigs

In 2009, *Salmonella* was detected in three new pig herds: two after an isolation of in the control program and one after trace-back (Table 10,

Figure 19). Six additional herds were under restrictive measures due to an infection detected in 2007 or 2008. Serotype Typhimurium was detected on seven of these herds, Infantis and Reading on one herd, respectively. At the end of 2009, five pig herds were under restrictive measures.

*Salmonella* was detected from 4 of 2,739 lymph node samples taken from adult pigs (Figure 10) and from 4 of 3,250 lymph nodes of fattening pigs (Figure 11). All findings were from high-capacity abattoirs. In all except for one case, *Salmonella* could be isolated both from the pooled sample and from the individual lymph node sample.

Figure 8. *Salmonella* in cattle lymph nodes sampled at major slaughterhouses.

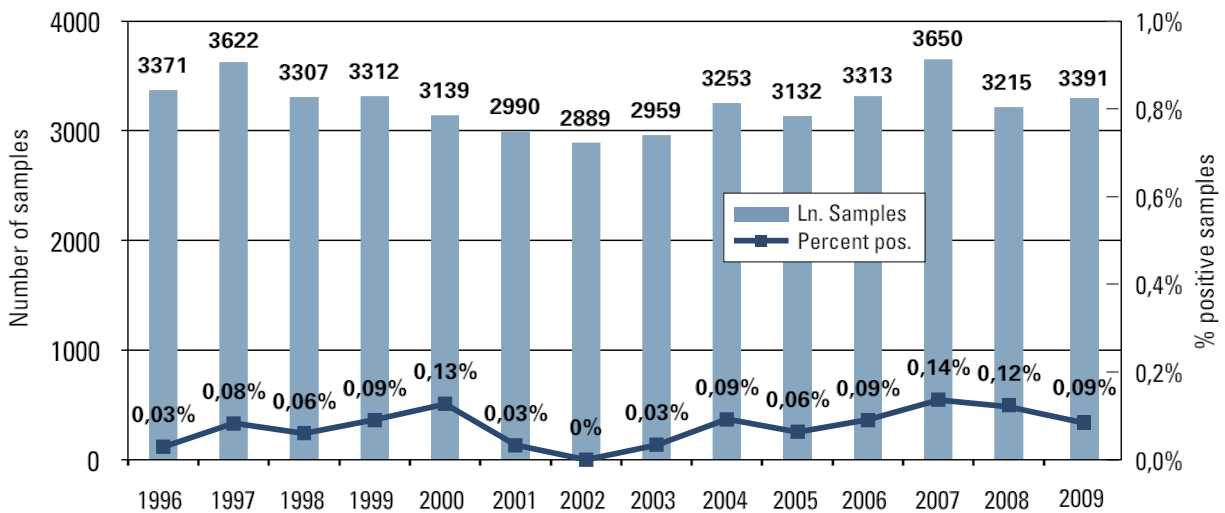
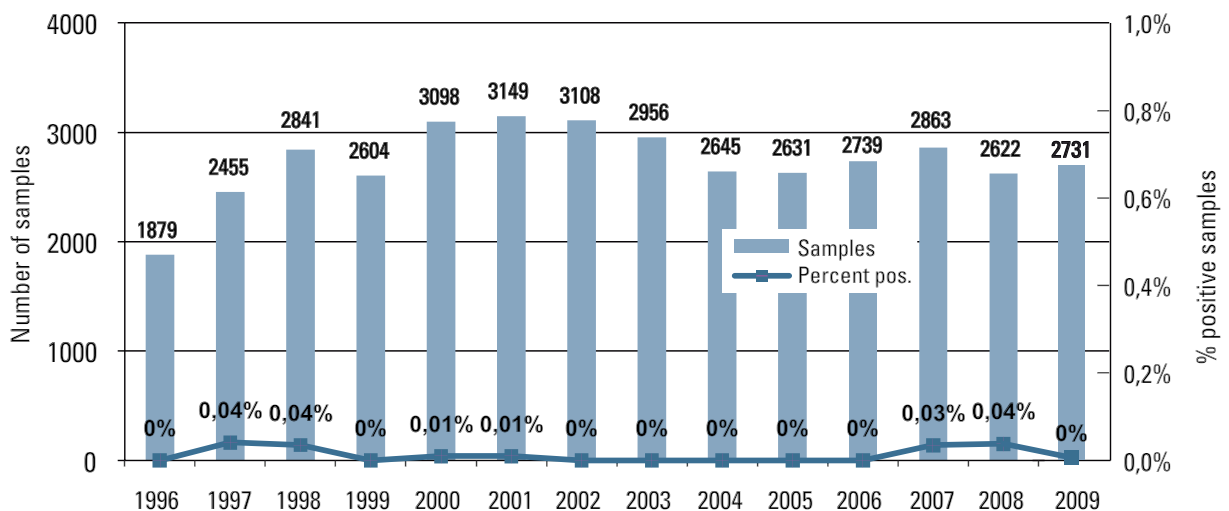


Figure 9. *Salmonella* in carcass swab samples of adult pigs, sampled at major slaughter-houses.



## SURVEILLANCE 2009

Figure 10. *Salmonella* in lymph nodes of adult pigs, sampled at major slaughterhouses.

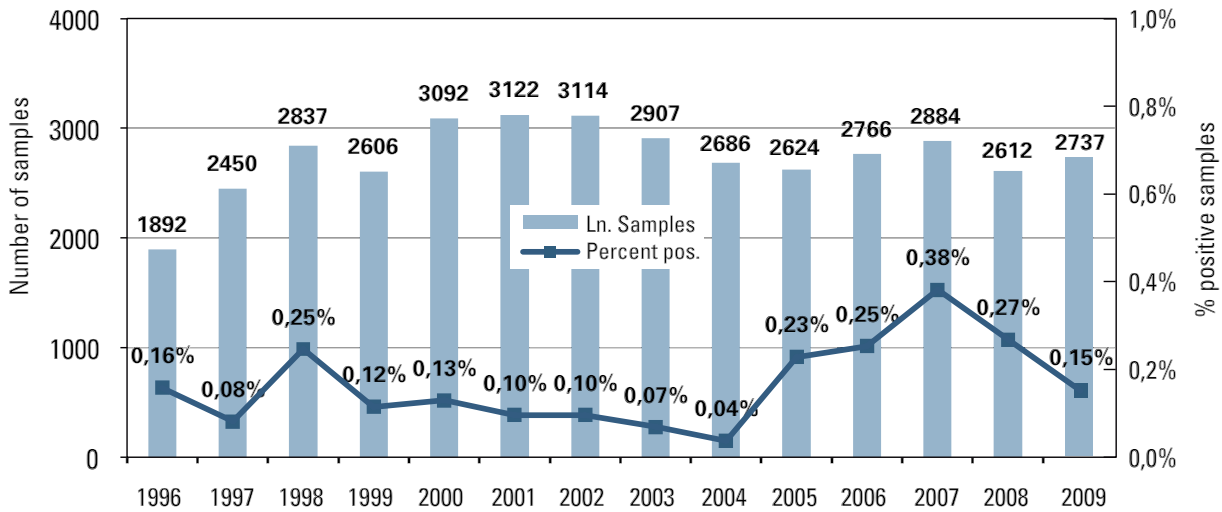
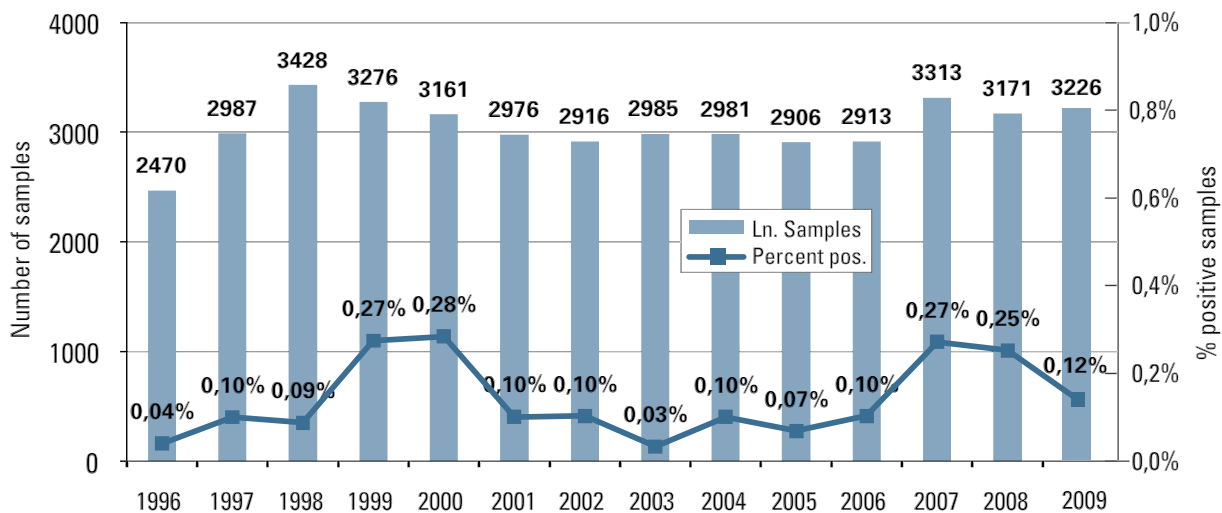


Figure 11. *Salmonella* in lymph nodes of fattening pigs, sampled at major slaughterhouses.



### Horses

In 2009, eight establishments including parts of an animal hospital were under restrictive measures due to an infection with serotype Typhimurium in horses. Phagetype (PT) 146 infected horses at two animal hospitals and one stud farm, and phagetype RDNC at another stud farm. A veterinarian at one animal hospital was positive for PT 146. PT 41 was isolated from one sporadic case in a horse.

### Other animals

*Salmonella* was reported in 117 cats (Table 11). Of these, 33 were serotyped to Typhimurium. Furthermore, *Salmonella* was detected in 9 dogs, one sheep and 8 reptile pets. *Salmonella* Typhimu-

rium was detected in 20 wild birds and a monophasic *Salmonella* in three wild birds. *Salmonella* was also isolated from seven hedgehogs and from one seal.

### FOOD

*Salmonella* was not detected from any of the 5,260 poultry neck skin samples (Figure 12), 3,621 cattle or 5,962 pigs carcasses sampled (Figures 7, 9, 13). *Salmonella* was not isolated from meat scrapings either (Figures 14 and 15).

### Humans

During 2009 a total of 3,054 cases were reported with *Salmonella* infection (Figure 16). This is a

Table 9. Results from the *Salmonella* control programme at slaughterhouses and cutting places in 2009.

Animal species	Abattoir	Sample type	No. samples	Positive	Percentage (%)	Serotype
Cattle	Major	Lymph node	3391	3	0.09%	S. Typhimurium DT120, RDNC (n=2)
	Small	Lymph node	261	3	1.15%	S. Derby, S. Typhimurium DT40, RDNC
	Major	Carcass swab	3366	0	0.00%	
	Small	Carcass swab	255	0	0.00%	
Breeding pigs	Major	Lymph node	2737	4	0.15%	S. Reading, S. Typhimurium DT120 (n=2), RDNC
	Small	Lymph node	2	0	0.00%	
	Major	Carcass swab	2731	0	0.00%	
	Small	Carcass swab	1	0	0.00%	
Slaughter pigs	Major	Lymph node	3226	4	0.12%	S. Typhimurium DT40 (n=2), DT41, RDNC
	Small	Lymph node	24	0	0.00%	
	Major	Carcass swab	3231	0	0.00%	
	Small	Carcass swab	26	0	0.00%	
Cattle and pigs		Meat scrapings	3888	0	0.00%	
Poultry	Major	Neck skin	5226	0	0.00%	
	Small	Neck skin	34	0	0.00%	
		Meat scrapings	1432	0	0.00%	

decrease with more than 1,000 cases compared to 2008. A total of 593 cases were infected in Sweden with an incidence of 6.3 cases per 100,000 inhabitants. Travel-associated infections decreased by 31% and domestic by 13 % compared to 2008.

Young children (0-4 years) and adults (30 years and above) were dominating among the domestic cases. The gender distribution was even. The decrease in domestic cases was most evident in the age groups 50 years and above.

As for previous years, most cases were reported from the three largest counties in Sweden. However, the counties Blekinge (11.8 cases/100,000 inhabitants), Kalmar (10.7) and Skåne (9.9) had the highest incidences.

The majority of the *Salmonella* cases are infected abroad (80 % in 2009). As in previous years, the infection was most commonly acquired in Thailand (809 cases) followed by Turkey (258), Egypt

(162) and Spain (122) in 2009.

*S. Typhimurium* dominated (32 % of the typed isolates) among domestic cases, as in previous years. PT 104 was the most common (21 %). *S. Typhimurium* was followed by *S. Enteritidis* (17 %) and *S. subspecies I* (12 %). The most common phage type for *S. Enteritidis* was phage type 8 (28 %).

During 2009, domestic isolates of *S. Typhimurium* and *S. subspecies I* (monophasic *Typhimurium*) from humans, animals, feed, food and environment were subtyped by MLVA at the Swedish Institute for Infectious Disease Control in order to detect clusters and outbreaks at an early stage.

Fewer outbreaks were reported compared to previous years: 13 smaller outbreaks with 94 reported cases.

# SURVEILLANCE 2009

Figure 12. *Salmonella* in neck skin samples of poultry at major slaughterhouses.

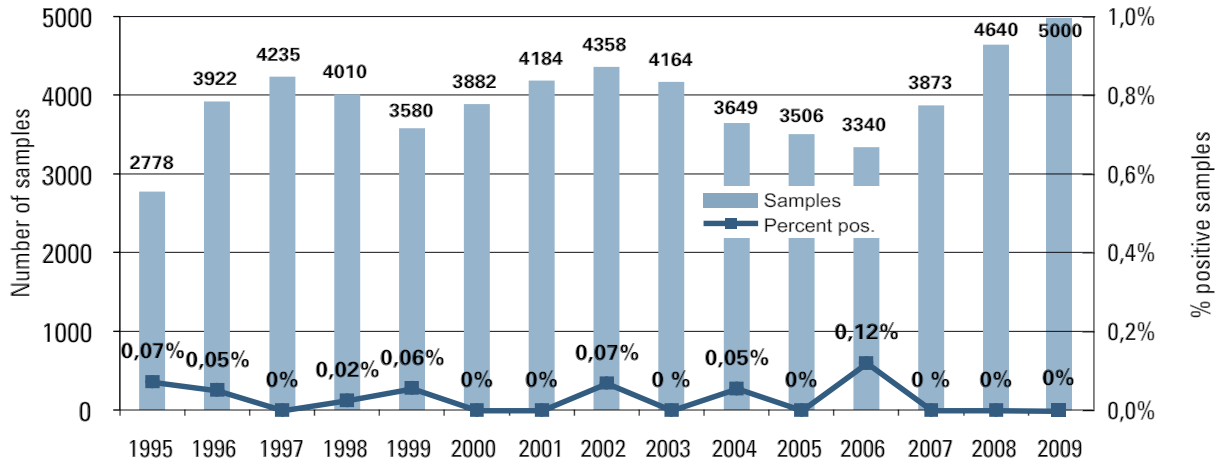


Figure 13. *Salmonella* in carcass swab samples of cattle, sampled at major slaughterhouses.

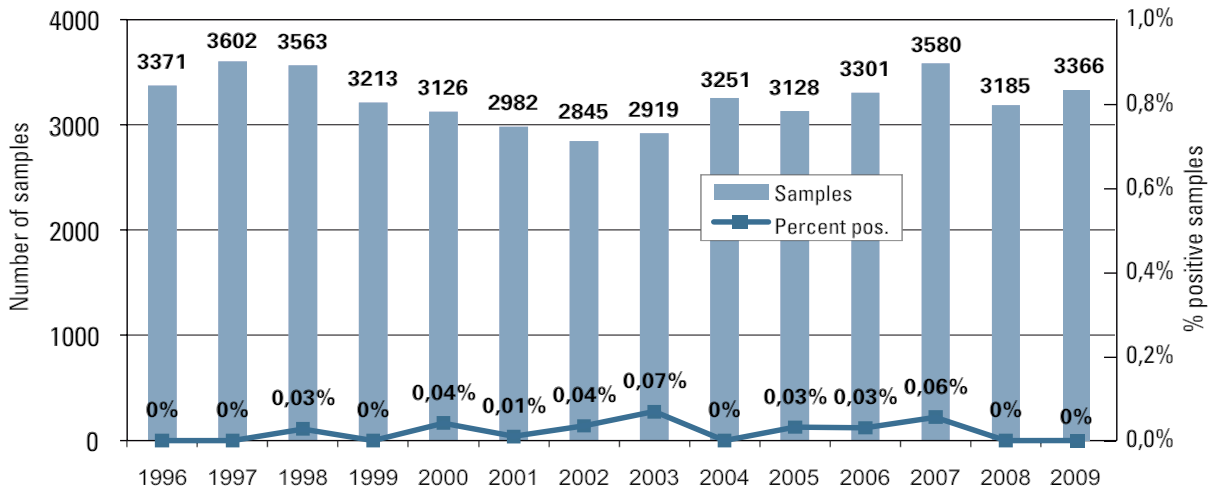


Figure 14. *Salmonella* crushed meat/scraping (beef, pork).

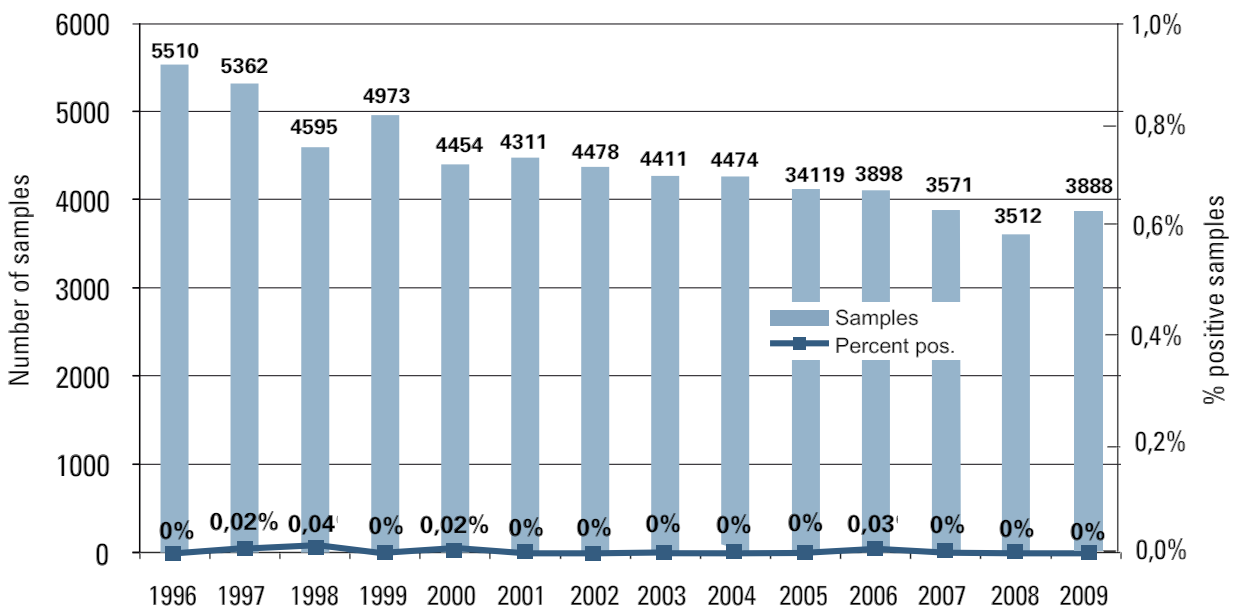


Figure 15. *Salmonella* in samples of crushed meat/meat scrapings (poultry) at cutting plants.

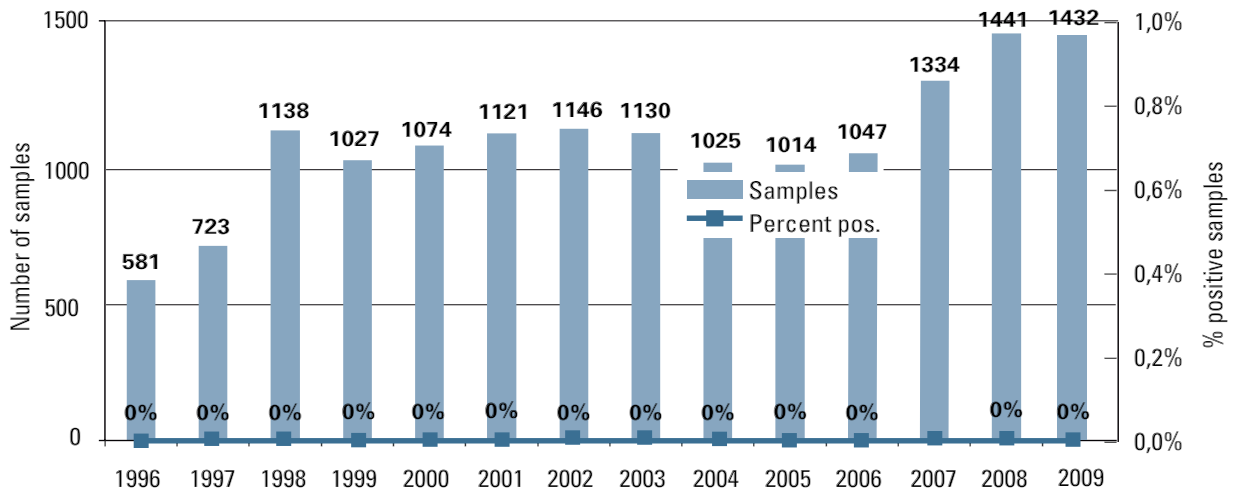
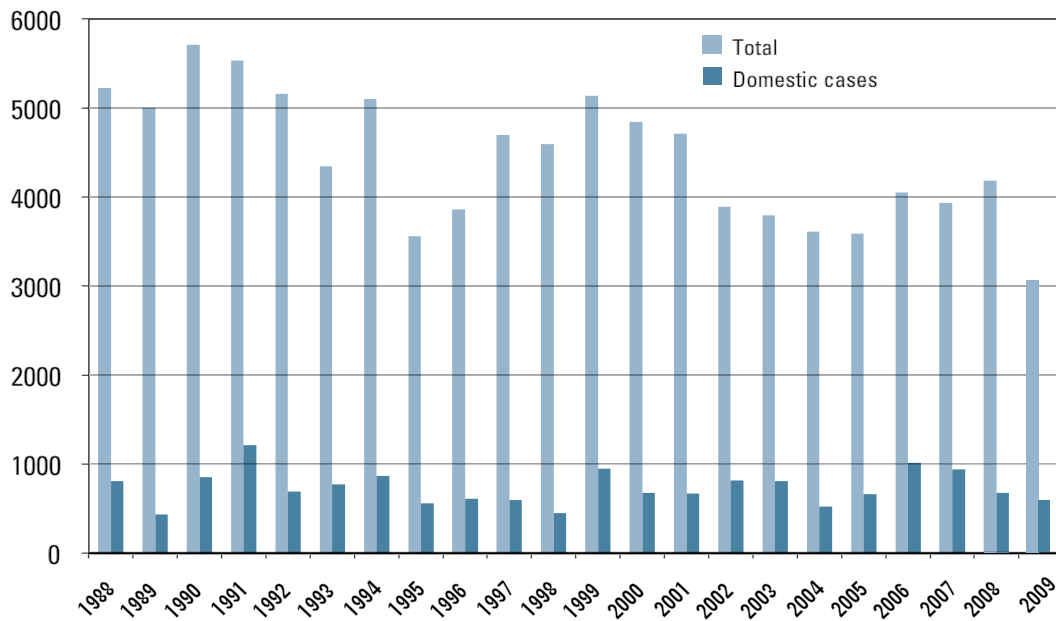


Figure 16. Notified human cases of salmonellosis in Sweden in 1988 -2009.



*S. sub*species I is the third most commonly reported *Salmonella* in Sweden. One specific type is dominating, monophasic Typhimurium-like with antigen formula 4,5,12:i:-. These together with 4,12,i:- can be distinguished by MLVA. Several clusters were detected in 2009 but the source could only be found in one outbreak associated with cattle herds.

A prolonged outbreak of *S. Reading* has since 2007 affected humans and animals in the county of Skåne. *S. Reading* has been found in humans, animals, feed and environment in a certain region in Skåne. Eight human cases were reported in 2009,

which is approximately the same number as in previous years.

During the summer, four cases were notified with *S. Typhimurium* phage type U292, the same MLVA subtype as in the large Danish outbreak affecting more than 1,200 persons since 2008. The Swedish cases of 2009 were thoroughly investigated by Swedish and Danish authorities, but the common source could never be found and no further Swedish cases were reported.

Eight persons were infected with *S. Typhimurium* phage type 104 after eating a buffet at a wedding. A thorough investigation was performed

Table 10. Pig herds infected with *Salmonella* in 2009.

Primary serotype	Phagetype	Other phage types	Restricted since	Restrictions lifted	Detection site	Primary sample type
<i>S. Infantis</i>	not relevant		2007	no	Baseline study of slaughter pigs	Lymph node
<i>S. Reading</i>	not relevant		2007	no	Control programme in cattle 2007	Lymph node in cattle
<i>S. Typhimurium</i>	40		2008	2009	Control programme in 2009	Lymph node
<i>S. Typhimurium</i>	40		2009	2009	Control programme in 2009	Lymph node
<i>S. Typhimurium</i>	DT104		2007	no	Control programme in 2007 & trace-back	Lymph node & faeces
<i>S. Typhimurium</i>	DT120		2007	2009	Control programme in 2007	Lymph node
<i>S. Typhimurium</i>	DT120	PT7	2009	no	Control programme in 2009	Lymph node
<i>S. Typhimurium</i>	DT120		2009	no	Trace-back	Faeces
<i>S. Typhimurium</i>	RDNC		2007	2009	Control programme in 2007	Lymph node

RDNC=reacts but does not conform to a specific phagetype.

but the source was not found. Moreover, several outbreaks with phage type 104 of different MLVA subtypes were reported during the year but the sources were not found.

The largest outbreak took place in the counties Kalmar and Blekinge during the summer and affected 19 cases. Most cases were infected with an indistinguishable MLVA subtype of *S. Typhimurium* phage type 41 but other phage types were also detected. Case interviews showed that approximately half had eaten langos in the same festival and the other half had eaten in the same pizzeria. In spite of intense investigations, the exact connection between the festival and the pizzeria could not be fully verified.

An outbreak of *S. Java* among children in a primary school was caused by contaminated aquarium water. *S. Java* was isolated in both patients and water.

Also in 2009, *S. Napoli* was isolated in imported rucola salad. At least two cases shared the same PFGE subtype as the salad.

### DISCUSSION

The low proportion of domestic human infections is unique for Sweden, Norway and Finland

compared to most European countries. This reflects the good *Salmonella* situation in domestic animals and food. The *Salmonella* situation in domestic animals has been very favourable for many decades. The number of infected poultry flocks, pig and cattle herds decreased in the late 1980's (Figures 17-20).

In feed sector, data from 2009 showed a different picture compared to other periods because *S. Typhimurium* was the most frequently isolated serotype in feed mills, a situation which could be attributed to a lengthy contamination in one major feed mill. The results showed that this serotype could become established in feed mill environments and present a risk for feed-borne infections in livestock.

The number of cattle herds (n=19) detected with *Salmonella* in 2009 was two less than in 2008, but higher than in previous years. However, this higher number might be a consequence of increased sampling with a bulk-milk screening of dairy herds in a region with historically known higher incidence of *S. Dublin* infected herds compared to other regions in Sweden. This resulted in detection of seven new herds with *S. Dublin*. In the regional bulk-milk screening the prevalence of herds



Table 11. Reported cases of *Salmonella* in cats, dogs, hedgehogs, pet reptiles, wild birds and zoo and other animals.

Serotype	Phagetype	Cat	Dog	Hedgehogs	Reptiles	Wild birds	Zoo animals	Other wild animals
<i>S. Dublin</i>	not relevant							1
<i>S. Dusseldorf</i>	not relevant							
<i>S. Enteritidis</i>	RDNC			2				
<i>S. Enteritidis</i>	not phagetyped		1	1				
<i>S. Potsdam</i>					1			
<i>S. Waycross</i>					1			
<i>S. Tennessee</i>					1			
<i>S. Cubana</i>					1			
<i>S. Montevideo</i>	not relevant		1					
<i>S. Newport</i>							1	
<i>S. diarizonae</i>	not relevant				1			1
<i>S. arizonae</i>	not relevant				1			
<i>S. houtenae</i>					2			
Subspecies I			1			3		
<i>S. Typhimurium</i>	PT 1			3				
<i>S. Typhimurium</i>	PT 2					1		
<i>S. Typhimurium</i>	PT 9			1				
<i>S. Typhimurium</i>	PT 41					1		
<i>S. Typhimurium</i>	DT 104		1					
<i>S. Typhimurium</i>	DT 146		1					
<i>S. Typhimurium</i>	U 277		1					
<i>S. Typhimurium</i>	RDNC	1	1					
<i>S. Typhimurium</i>	not phagetyped	32	1			18		
Untyped	not relevant	84	1					
<b>Total</b>		<b>117</b>	<b>9</b>	<b>7</b>	<b>8</b>	<b>23</b>	<b>1</b>	<b>2</b>

RDNC=reacts but does not conform to a specific phagetype.

serologically positive for *S. Dublin* was 16 % (33/204). This can be compared with another investigation of bulk-milk samples from 1,068 randomly selected herds throughout the country showing a prevalence of 0.6 % (6/1068). The bulk-milk screening highlights large regional differences in occurrence of *S. Dublin* in Sweden. In two regions, the county of Skåne with *S. Reading* and the county of Östergötland. *S. subspecies I* was suspected to have been spread via water streams. Further investigations are being planned.

Reported human cases of *Salmonella* vary from year to year depending on the number of outbreaks. According to a trend analysis the total number of notified human cases has significantly decreased between 1997-2009 but a trend could not be identified for the domestic cases. The low percentage of domestic infections is unique for Sweden compared to most other European countries.

The number of Swedes travelling abroad during 2009 was lower than previous years which might partly explain the decrease in the number of

## SURVEILLANCE 2009

Figure 17. Incidence of *Salmonella* in layer holdings during 1968-2009.

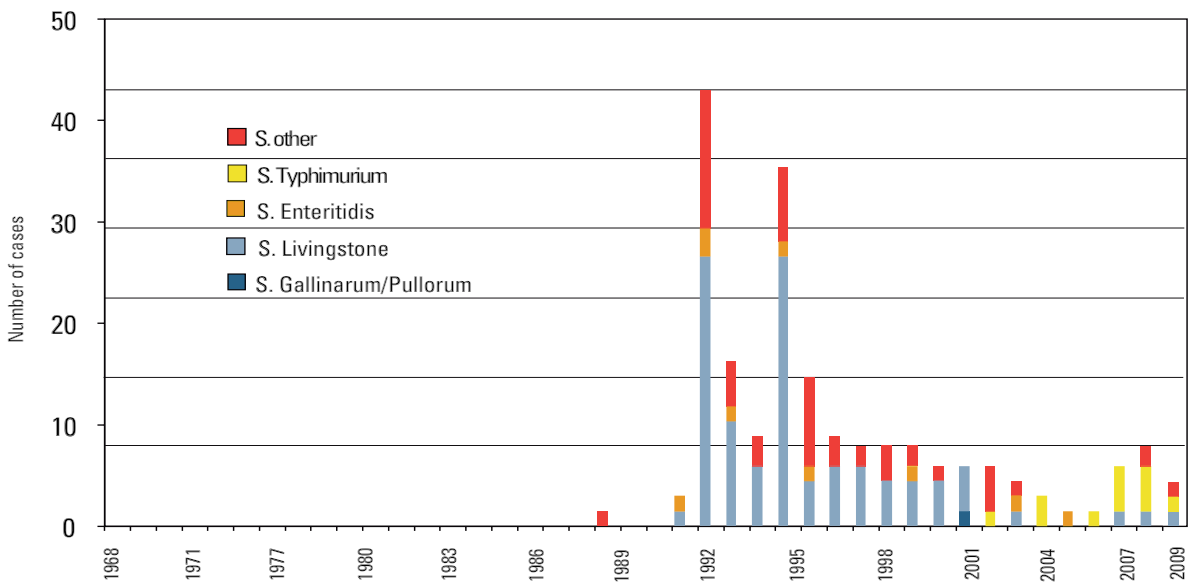
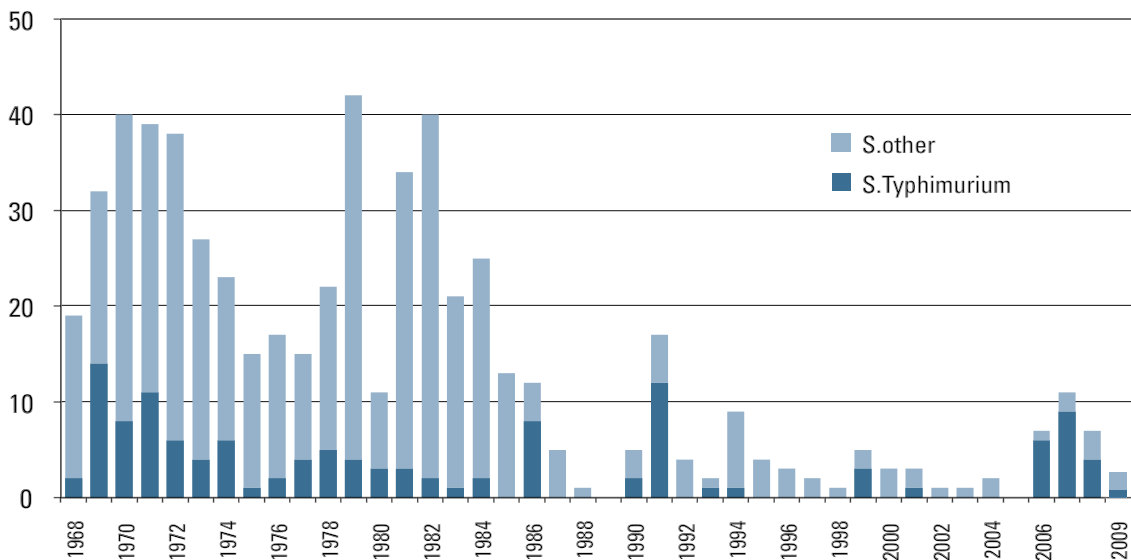


Figure 18. Incidence of *Salmonella* in broiler holdings during 1968-2009, breeding flocks included.



notified cases. A similar decrease was also seen for other food and waterborne diseases during 2009. Also, no large domestic outbreaks were reported, which explains the decrease for the domestic cases.

For outbreaks the trend has been changing from large meat outbreaks towards smaller outbreaks with vegetable sources. An observation that makes Sweden unique compared to many other European countries where meat and egg sources still are the main problem.

An increased awareness regarding the risk of *Salmonella* in untraditional sources such as leafy green vegetables is needed as these products are

commonly not cooked or heated prior to eating as compared to meat products and they are quite frequently found to be contaminated with *Salmonella*.

Subtyping of isolates from humans, animals, food, feed and environment by MLVA proved to be a useful tool to detect clusters and outbreaks.

*Salmonella enterica* sp. *enterica* serovar 4,5,12:i:- is a monophasic variant of serovar Typhimurium. An increase of this type has been observed in recent years in Sweden and in other European countries which has led to ongoing investigations.

Figure 19. Incidence of *Salmonella* in pig herds during 1968-2009.

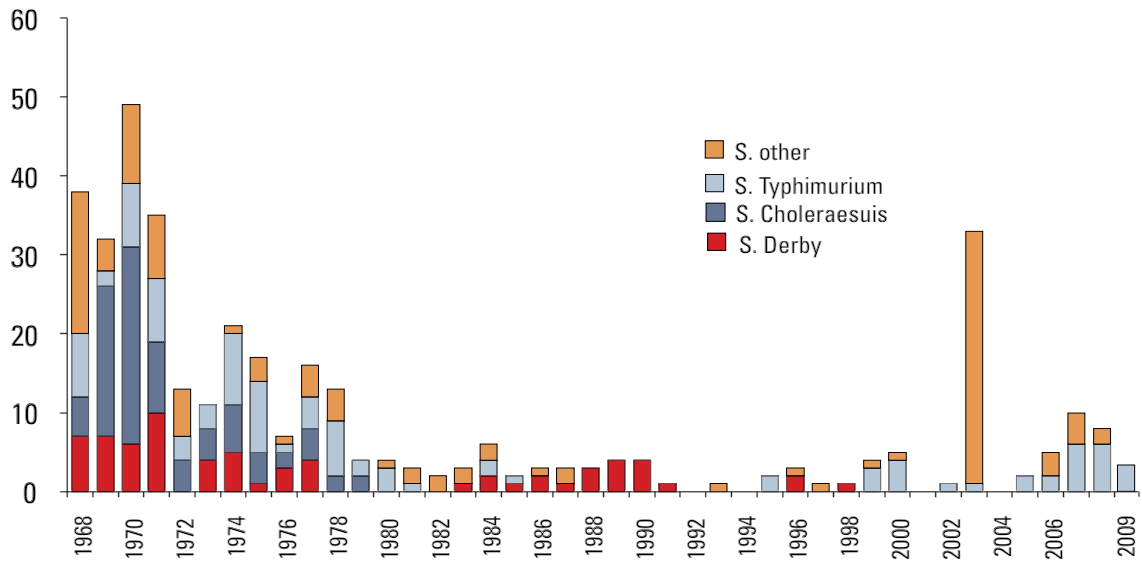
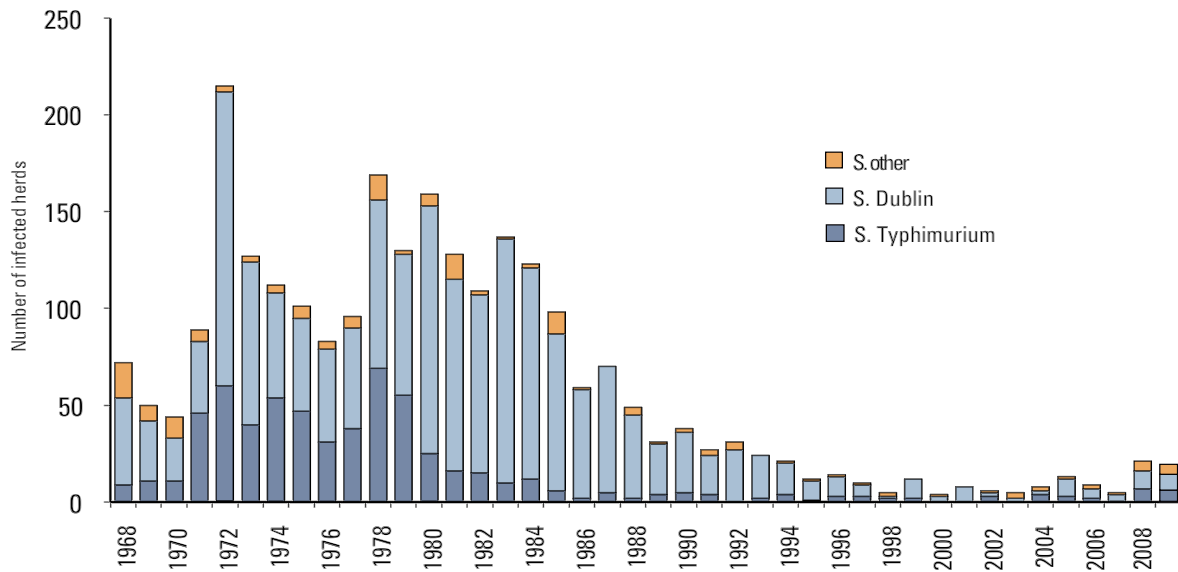


Figure 20. Notified incidence of *Salmonella* in Swedish cattle herds during 1968-2009.



**REFERENCES**

Koyuncu, S and P. Häggblom. 2009. A comparative study of cultural methods for the detection of *Salmonella* in feed and feed ingredients. BMC Veterinary Research 5:6.

Sternberg Lewerin, S., S. Boqvist, P. Häggblom and B. Engström, 2005. Chapter 8. The effective control of salmonella i Swedish poultry. In: Food safety control in the poultry industry. Ed.: G. Mead. Woodhead Publishing Ltd, Cambridge, UK. 195-215 Österberg J, Vågsholm I, Boqvist S, Sternberg Lewerin S. Feed-borne outbreak of *Salmonella cubana* in Swedish pig farms: risk factors and factors affecting the restriction period in infected farms. Acta Vet. Scand. 2006; 47:13-21.

Sternberg Lewerin, S., Wahlström, H, Häggblom, P., Szanto, E., Plym Forshell, L., 2006. The Swedish national salmonella control programme –future challenges. In the proceedings of I3S, International Symposium on *Salmonella* and Salmonellosis, St Malo, France, May 2006. Pp 531-534.

Wierup M, Häggblom P. An assessment of soybeans and other vegetable proteins as source of *Salmonella* contamination in pig production. Acta Vet Scand. 2010 Feb 17;52:15.

# Scrapie

## BACKGROUND

Scrapie belongs to the group of diseases called Transmissible Spongiform Encephalopathies (TSE) and was first described more than 250 years ago. The current theory about causative agent is the prion-only hypothesis. This theory assumes that misfolded prions (small proteins) induce the same pathological structure in normal proteins of the host resulting in accumulation of prions and cellular damage without involvement of any microorganism. Susceptibility to scrapie is genetically related. All routes of transmission have not been established, however, it is clear that spread can occur related to lambing.

Since BSE (see further chapter on BSE) became a disease of public health concern, and existence of BSE in small ruminants was suspected, both surveillance and control of TSE in small ruminants was increased within the European Union in 2002.

In 1998 an atypical variant of scrapie was detected in Norway. Although this strain is experimentally transmissible, epidemiological studies on European level indicate that atypical scrapie may be a spontaneously occurring disease.

Classical scrapie has been detected in Sweden once, in a single flock in 1986. The whole flock was culled and the origin of the disease was never established.

## Disease

The incubation period is long, up to several years. Symptoms are related to the neurological system and include altered behaviour and sensation, affected movement and posture, as well as pruritus and skin lesions. The disease is progressive and always fatal.

## Legislation

Surveillance and control is regulated through the Regulation (EC) 999/2001 of the European Parliament and of the Council of 22 May 2001. On national level surveillance and control is also regulated by the National control program and

Sweden has since 2003 additional guarantees related to trade within the union (Commission Regulation (EC) 546/2006). Scrapie is a notifiable disease under the Swedish Act of Epizootic diseases (SFS 1999:657, with amendments) and there is a compensation scheme for farmers to compensate losses due to eradication measures.

## SURVEILLANCE

The Swedish Board of Agriculture is responsible for the surveillance program, which is carried out in cooperation with the National Veterinary Institute (SVA). SVA is appointed National Reference Laboratory, NRL (Regulation (EC) 999/2001). Samples are analysed at the SVA.

### Passive surveillance

All suspicions of scrapie must be reported to the authorities. The obligation to report applies for animal owners, veterinarians and everyone else who is responsible for the animals.

Previously the method required for analysis of samples from animals with clinical suspicion of scrapie was histopathology and immunohistochemistry in accordance with Regulation (EC) 999/2001, as amended. However, the regulation was changed during 2009 and the protocol was replaced by use of Bio-Rad TeSeE rapid assay in combination with Bio-Rad TeSeE Western Blot.

### Active surveillance

The design of the surveillance program is in accordance with Regulation (EC) 999/2001 Annex III and the Swedish national control program.

Within the program, all dead sheep and goats over 18 months of age which are not slaughtered for human consumption should be sampled. The carcasses are sampled at rendering plants and at autopsy. Trace-back to the herd is ensured through a system where the carcasses are tagged by the carcass collectors. In remote areas where there is no collection of carcasses, the farmers send the whole skull to the SVA. This is also the routine

which is applied by farmers with increased surveillance in the herd due to detected cases of atypical scrapie. In addition, healthy slaughtered animals above 18 months of age should be examined from these flocks.

The samples were examined with rapid tests at SVA in accordance with Regulation (EC) 999/2001. In case of positive or inconclusive results the material was prepared and examined by Biod-rad Western Blot.

### RESULTS

#### Passive surveillance

In 2009 one sheep was examined due to clinical suspicion and this sheep was positive for atypical scrapie Nor98.

#### Active surveillance

##### *Sheep*

In 2009 SVA examined 4806 sheep from fallen stock for Scrapie and out of these all samples were negative for classical scrapie and one was positive for atypical scrapie Nor98. From herds under restrictions due to cases of atypical scrapie, one sheep was examined at normal slaughter, with negative result.

##### *Goats*

In 2009 SVA examined 60 goats from fallen stock for scrapie and all were negative both for classical scrapie and for atypical scrapie Nor98.

### DISCUSSION

#### Classical scrapie

Since the start of the active surveillance in 2002, more than 45,000 sheep have been tested without any positive cases detected. According to the design of the surveillance all dead sheep which are not slaughtered for human consumption should be examined. The Swedish Board of Agriculture pays the cost for carcass collection on the farm since the start of the national program, and when this was introduced there was a remarkable increase in the number of sheep at rendering. There is no central register for individual sheep and thus the number of dead animals cannot be compared to the number of sampled animals, although not all sheep are collected and although some of them are too autolysed to be sampled during the warmest summer months, the animals tested in 2009 still constitute approximately 1,9 % of the population of

adult sheep. Thus, the results support the freedom of the disease or very low prevalence in the country.

Sporadic cases of illegal imports of sheep and goats not fulfilling the requirements in the TSE-regulation or the Swedish additional guarantees have been detected. When this is the case, farms and animals are put under restrictions. However, illegal imports which are not detected can pose a threat to the current scrapie status in the Swedish sheep and goat population.

#### Atypical scrapie

Since the first case of atypical scrapie was detected in Sweden in 2003, in total 19 cases have been detected until the end of 2009. Initially the positive flocks were culled and examined for scrapie, currently the flocks are put under intensified monitoring in accordance with the regulation (EC) 999/2001. No additional cases of atypical scrapie have been found in the positive flock. On European level, two epidemiological studies have concluded that the prevalence is similar in different countries and that the prevalence in positive flocks does not differ from the prevalence in the rest of the sampled population. This pattern differs from the way contagious disease are normally distributed in the population and support the hypothesis that atypical scrapie is spontaneously occurring. However, transmission studies have shown that atypical scrapie can be transmitted to sheep and other species under experimental conditions. Although potential within flock transmission directly between animals seem to be very low (if it all exists) other routes of spread and the potential zoonotic aspect are being discussed.

### REFERENCES

- Fediaevsky A, Tongue SC, Nöremark M, Calavas D, Ru G, Hopp P. BMC Vet Res. 2008 Jun 10;4:19.
- Fediaevsky A, Maurella C, Nöremark M, Ingravalle F, Thorgeirsdottir S, Orge L, Poizat R, Hautaniemi M, Liam B, Calavas D, Ru G, Hopp P. BMC Vet Res. 2010 Feb 7;6:9.
- The prevalence of atypical scrapie in sheep from positive flocks is not higher than in the general sheep population in 11 European countries.
- A descriptive study of the prevalence of atypical and classical scrapie in sheep in 20 European countries.

# Tick-borne encephalitis (TBE)

## BACKGROUND

Tick-borne encephalitis virus belongs to the genus of Flaviviruses. TBE virus is endemic in an area ranging from northern China and Japan, through far-eastern Russia to Europe. The virus causes a neurological infection which may lead to long-term sequelae in the affected patients. The virus is spread by ticks (*Ixodes ricinus*), which are infected when they take their blood meals at infected rodents. Larger mammals, predominantly ungulates, are important to feed the adult ticks, thereby leading to a larger tick population. Humans mainly get the infection via infected ticks although unpasteurized milk and milk products have also been reported as a source. Vaccination of persons living, visiting or working in endemic areas is recommended.

Three virus sub-types are described: Western, Siberian and Far eastern tick-borne encephalitis virus. In Sweden, only the first one has been found.

### History

#### *Humans*

The first TBE case in Sweden was reported in 1954 and during the following three decades, there were 10-40 annual cases reported annually. From the mid-1980's a clearly increasing trend has been observed. The last years about 200 cases have been reported annually. With a few exceptions all the cases are infected in Sweden. Most of them have acquired their infection in the counties of Stockholm, Södermanland and Uppsala close to the Baltic Sea or at the eastern and middle parts of Lake Mälaren. The age distribution is wide but most of the cases are between 30 and 70 years. There is a slight overrepresentation of men. About 80 % of the patients are diagnosed in July to October.

### Disease

#### *Animals*

Animals do not develop a disease.

#### *Humans*

In humans, a biphasic course of the disease is common. The first, viremic phase appears with fever, muscle pain, fatigue and headache and lasts for about four days. After a free interval of about a week, a meningoencephalitic phase appears in about one third of the patients. The symptoms may then include fever, headache, nausea, cognitive

dysfunctions, spinal paresis, etc. The mortality is low, about 0.5%. The incubation period of TBE is usually between 7 and 14 days.

### Legislation

#### *Animals*

TBE virus is not notifiable in animals.

#### *Humans*

TBE in humans is notifiable as a viral meningoencephalitis since 2004 according to the Communicable Disease Act (SFS 2004:168).

## SURVEILLANCE

### Animals

There is no surveillance in animals.

### Humans

TBE in humans as a viral meningoencephalitis is a notifiable disease and cases must be reported the Swedish Institute for Infectious Disease Control as well as to the County Medical Office.

## RESULTS

### Humans

During 2009, a marginal decrease (6 %) in the number of TBE cases was noted. In total, 210 infections were reported, 56 % in men. Men were in majority in almost all age groups, but especially in the younger ones. The average age was 46 years and two thirds of the ill persons were between 30 and 69 years.

A majority of the TBE cases (199 persons) had acquired the infection in Sweden. Other sites of infection were Åland (in Finland), Switzerland, Italy and Serbia-Montenegro.

In 2009, the first TBE cases fell ill in the beginning of May and the last in the beginning of November, but the great majority in July and August.

## DISCUSSION

An increase in the number of human TBE cases has been noted during the last decades in Sweden as well as in other European countries. Most Swedish cases were infected in the coastal areas of Stockholm, Södermanland and Uppsala counties, both along the lake of Mälaren and the Baltic Sea. Unexpectedly, one case was reported in the county of Västernorrland, where the disease had never been seen before.

# Trichinellosis

## BACKGROUND

Trichinellosis is caused by parasitic nematodes of the genus of *Trichinella*. Several species are included in the genus. In Europe, *T. spiralis*, *T. britovi* and *T. nativa* are the dominant causes of human infections. The parasites can be hosted by different mammals, such as domestic pigs and horses but the main reservoirs are wild carnivores and omnivores. Humans mainly acquire the infection by eating raw or inadequately heated meat, typically cold-smoked sausage. In Sweden, the species detected include the aforementioned three as well as *T. pseudospiralis*. The infection is acquired by ingestion of raw or undercooked meat containing *Trichinella* larvae. In the gut the larvae are released, develop into adults and mate. After mating, the female releases larvae which penetrate the intestinal mucosa and travel via the bloodstream to various organs and muscles. In the striated muscles the larvae may survive for years.

## History

### Animals

In Sweden, *Trichinella* has been inspected at slaughter in domestic pig since the 20th century. During 1970-1990 sporadic cases were detected in domestic pig, but since 1994 there have been no cases. The parasite is endemic in Swedish wildlife.

### Humans

The disease is extremely rare in Sweden and detected human cases are infected abroad. The most recent reported case (in 2007) had consumed wild boar sausage brought in privately from Spain. The preceding case occurred in 2003 after consumption of cold-smoked ham in the Balkans. Before that there had not been a case since 1997, which also was travel-associated.

## Disease

### Animals

Animals rarely develop a clinical infection.



Photo: Pekka Nikander

### Humans

The disease can range from subclinical infection to fatal disease. The incubation period varies from 5-15 days. Symptoms initially involve diarrhoea and abdominal pain and later muscle pain, fever, oedema of the upper eyelids and photosensitivity. Early stages of the disease respond well to treatment. Cardiac and neurological complications may occur 3-6 weeks post infection. Trichinellosis is not transmitted between humans.

## Legislation

### Animals

*Trichinella* is notifiable in animals according to (SJVFS 2002:16 with amendments).

### Humans

Trichinellosis is notifiable according to the Communicable Disease Act (SFS 2004:168).

## SURVEILLANCE 2009

### SURVEILLANCE

#### Animals

All slaughtered domestic pigs and wild boar as well as horses and hunted wild boars and bears are tested for *Trichinella* by digestion method. In addition, several species of wild animals are tested for *Trichinella*, including e.g. fox, lynx, wolves, badgers, birds and wolverines. *Trichinella*-free regions have not been created in Sweden.

#### Humans

Trichinellosis is a notifiable disease according to the Communicable Disease Act and cases must be reported the Swedish Institute for Infectious Disease Control as well as to the County Medical Office.

### RESULTS

#### Animals

In 2009, all slaughtered domestic swine (2,969,690)

and horses (3,810) were tested for *Trichinella*. *Trichinella* was not detected in domestic pigs or horses. *Trichinella* spp. was detected from two of 47,900 (0.0042 %) wild boar samples. *Trichinella* was detected from 14 lynxes, two wolves, two foxes, one wolverine and one bear (Table 12).

#### Humans

No human cases of *Trichinella* were reported in 2009.

### DISCUSSION

Trichinellosis is extremely rare in Swedish food-producing animals and detected human cases in the last decades were infected abroad. The *Trichinella* situation in Swedish animal population seems to be stable. *Trichinella* occurs in wild carnivores but the risk of getting *Trichinella* from domestic pigs and horses is negligible. Creation of *Trichinella*-free regions may be considered.

Table 12. Findings of *Trichinella* in wild animals 2009.

Animal species	No. samples	No. positives	Percentage (%)	<i>T. britovi</i>	<i>T. nativa</i>	<i>T. spiralis</i>	<i>T. spp.</i>
Badgers	33	0	0.00%				
Bears	201	1	0.50%		1		
Grey seals	1	0	0.00%				
Lions (zoo)	2	0	0.00%				
Lynxes	200	14	7.00%		11		3
Otters	10	0	0.00%				
Raccoon dogs	51	0	0.00%				
Red foxes	269	2	0.74%	1	1		
Wild birds	10	0	0.00%				
Wild boars	47902	2	0.004%	1		1	
Wolverines	5	1	20.00%		1		
Wolves	15	2	13.33%		2		
<b>Total</b>	<b>48699</b>	<b>22</b>		<b>2</b>	<b>16</b>	<b>1</b>	<b>3</b>



# Tuberculosis

## BACKGROUND

Tuberculosis (TB) is a serious disease in humans and animals caused by bacteria included in the *Mycobacterium tuberculosis* complex. *Mycobacterium bovis* causes bovine tuberculosis in several animal species and humans. Historically, the reservoir of this bacterium has been cattle but many other wild and domestic species can also maintain the infection. Wildlife reservoirs in e.g. badgers, deer and wild boar cause persistent problems in some countries. Humans usually acquire *M. bovis* infection via unpasteurized milk or via inhalation. The predominant cause of human tuberculosis is however *Mycobacterium tuberculosis*. In countries where human tuberculosis caused by *M. tuberculosis* is common, this bacterium is also frequently isolated from various species of animals.

### History

Sweden was declared officially free from bovine tuberculosis in 1958. Since then, sporadic cases have occurred in cattle, the most recent in 1978. Compulsory tuberculin testing of all cattle was abolished in 1970 and the national tuberculosis control in cattle is based on meat inspection and passive clinical surveillance.

In 1987, *M. bovis* infection was introduced into the farmed deer population via imported fallow deer. After further investigation and eradication measures, a voluntary control program for tuberculosis in farmed deer was introduced in 1994. In 2003, the control program was made compulsory for all deer farms. The program is based on regular whole-herd tuberculin testing, or whole-herd slaughter and meat inspection. The most recent case was detected in 1997.

When Sweden joined the European Union in 1995, the status of OTF (officially tuberculosis free) was obtained (former Decision 95/63/EC, Commission Decision 03/046/EG). Sweden fulfils the requirements for control measures in OTF member states (Council Directive 64/432/EEC,

Annex A). A scenario tree model (see references) showed that a claim for freedom from tuberculosis in farmed deer is also valid.

The yearly incidence among humans in Sweden in the early 1940's was above 300/100,000 inhabitants. Followed by a rapid decline, beginning even before effective treatment was available in the early 1950's. The yearly incidence in modern time is about 6/100,000 inhabitants, which is among the lowest in the world. The vast majority of the cases occur in immigrants originating from countries that still have a high incidence of tuberculosis.

### Disease

The symptoms caused by tuberculosis in both humans and animals depend largely on the localisation of the infection. The disease progresses slowly and symptoms may take a long time to develop, even in cases with substantial lesions. Weight loss and sometimes coughing (in cases with respiratory tract infection), ascites (due to infection in intestinal lymph nodes or liver) or mastitis (mainly in cattle with udder infection) can be seen. The incubation period varies from weeks to years.

## LEGISLATION

### Animals

Suspect cases of infection with *Mycobacterium bovis*, *M. tuberculosis*, or other mycobacteria in the *M. tuberculosis*-complex, is compulsory notifiable in all animal species (SJVFS 1999:102 and 2002:16, with amendments). If tuberculosis is confirmed in a food producing animal, eradication measures are implemented, including depopulation of the whole herd, in accordance with the Swedish Act of Epizootic diseases (SFS 1999:657, with amendments). TB vaccination of animals is not allowed in Sweden.

### Humans

Tuberculosis in humans is a notifiable disease according to the Communicable Disease Act (SFS 2004:168). Contact tracing is compulsory and the

## SURVEILLANCE 2009

treatment is free of charge. Refusing treatment if the patient is contagious can lead to detention.

### SURVEILLANCE

#### Animals

The aim of the surveillance in animals is to document freedom from bovine tuberculosis, according to Council Directive 64/432/EEC and to contribute to the maintenance of this favourable situation.

From suspect cases in animals, lymph nodes from five different areas (retropharyngeal, submandibular, mediastinal, mesenterial and inguinal) and organs with macroscopic lesions are collected. Histology and direct smears are performed on all materials. If TB cannot be ruled out by histology or if direct smears are positive, culture is performed. Cultures are performed on solid media (Löwenstein-Jensen, Stonebrink's, Modified Middlebrook) according to the accredited method at SVA and checked once a week for eight weeks. Microscopy of all suspect colonies is performed and bacteria in the *M. tuberculosis*-complex are identified with a specific genetic probe. Positive isolates are further subtyped.

Skin fold tuberculin tests are performed according to EC 1226/2002 (amending annex B of EC 64/432) and SJVFS 2003:33, K62. The comparative intradermal test is used, mostly at the neck site except for camelids where the auxiliary site is used. In case of a positive tuberculin test, the animal is culled and sampled as stated above. In the case of tuberculin reactors, the animals are culled and culture is performed on all samples.

#### Humans

In humans sputum smear is the standard test when pulmonary tuberculosis is suspected. Otherwise culture from urine, feces, blood or liquor is also a possibility or biopsies from suspected site of infection.

### ACTIVE SURVEILLANCE

#### Animals

Monitoring is performed by meat inspections at slaughter of food producing animals. Veterinary officers of the National Food Administration perform the inspections. Suspect lesions are sent to the SVA for histology and bacteriology.

After the detection of *M. bovis* in farmed deer (introduced via imported fallow deer), a voluntary

control program in farmed deer was introduced in 1994. In 2003, the control program was made compulsory for all deer farms. The program is based on regular whole-herd tuberculin testing, or whole-herd slaughter and meat inspection. Deer may only be sold for direct slaughter unless they originate from a herd that have undergone three consecutive herd tests and continue to test regularly.

### PASSIVE SURVEILLANCE

#### Animals

As TB is notifiable on clinical suspicion, clinical symptoms in animals or lesions detected at necropsy of an animal, prompt official investigations including sampling for bacteriology, tuberculin testing of contact animals and epidemiological investigation, are carried out. In addition, sampling is performed if any other reason to suspect exposure of animals to bacteria of the *M. tuberculosis*-complex.

Furthermore, tuberculin tests are performed at artificial insemination centres and at export/import of animals as required according to EU-legislation (Council Directive 64/432/EEC).

#### Humans

According to the Communicable Disease Act all patients with newly diagnosed active TB are to be reported by the consulting physician to the Swedish Institute for Infectious Disease Control and the county medical officer

## RESULTS

### ACTIVE SURVEILLANCE

#### Animals

The number of animals investigated by histology and, if relevant, bacteriology, due to lesions detected at slaughter were 74 pigs, 5 deer, 31 cows and one sheep. From these samples, bacteria from the *Mycobacterium avium/intracellulare*-complex were isolated in 16 cases (15 pigs, one deer). No other samples yielded any mycobacteria.

The total number of registered holdings for farmed deer was close to 600. However, a large proportion of these do not keep deer after obtaining TB free status. The number of herds that were considered active, i.e. kept deer and had obtained TB free status were 336. A total of 19 herds were still exempted from testing and allowed

## SURVEILLANCE 2009

to perform meat inspections and necropsies for 15 years to obtain free status. Out of these, three will be depopulated in the near future. Another three herds will be depopulated due to their application of exemption from testing being rejected. No TB was detected in any tested deer herds.

### PASSIVE SURVEILLANCE

#### Animals

Two cats were investigated due to clinical suspicion. None of these samples yielded any mycobacteria.

#### Humans

Five cases of *M. bovis* were reported in humans in 2009. Two of the cases were elderly Swedes most likely infected in their youth, and the remaining cases were patients originating from TB endemic countries most likely infected before arrival in Sweden.

### DISCUSSION

#### Animals

No cases of TB were detected in Swedish animals during 2009. Although the surveillance is mainly dependent on inspections of slaughtered animals, this is regarded as sufficient for monitoring. However, the submission rates of lesions from slaughtered ruminants should be improved. Passive surveillance based on clinical suspicions and necropsy findings will always be of low sensitivity as clinical symptoms and massive lesions are mainly seen in late stages of the infection.

The eradication efforts in farmed deer have been successful and the probability that Swedish farmed deer are TB free is high. It is important that the remaining herds are dealt with so that all registered herds can be declared officially free.

#### Humans

The rapid decline of tuberculosis in humans in the 1940's coincided with the eradication of tuberculosis in cattle and started before the introduction of effective treatment in the 1950's. A much larger part of the population lived in close contact with domestic animals then and it's likely to be more than a coincidence. Today Sweden has one of the lowest incidences of human tuberculosis in the world.

The officially free status as regards bovine tuberculosis has been maintained during 2009.

The overall TB situation in animals and humans remains favourable.

### REFERENCES

Wahlström, H., Frössling, J., Sternberg Lewerin, S., Ljung, A., Cedersmyg, M. and Cameron, A., 2010. Demonstrating freedom from infection with *Mycobacterium bovis* in Swedish farmed deer using non-survey data sources. *Preventive Veterinary Medicine* 94:108-118.



# Tularaemia

## BACKGROUND

Bacterium *Francisella tularensis* is a causative agent of tularaemia, a disease affecting both humans and several animal species. *F. tularensis* comprises at least four subspecies which show differences in virulence. *F. tularensis* subsp. *holarctica* (type B) is the main subspecies responsible for human and animal infection in Europe. In Sweden, *F. tularensis* *holarctica* is endemic whereas the subspecies *F. tularensis tularensis* has not been identified.

*F. tularensis* is found in a wide range of animal hosts and is capable of surviving for weeks at low temperatures in water, moist soil, or decaying plant and animal matter. Although different animals can be infected tularaemia is typically found in small mammals such as hares and rodents.

Humans become infected through a variety of mechanisms such as handling infected or dead animals, bites of infected insects or arthropods, ingesting contaminated food or water, and inhaling aerosols of bacteria. Tularaemia can in some areas occur in some areas in a mammal host – tick cycle, and in other areas in a water – mammal cycle, which is the type of cycle occurring in Scandinavia. Clinical disease is variable and dependent on the route of transmission.

## History

Sweden has reported cases of endemic tularaemia since 1931. Ever since the first Swedish tularaemia case was reported a discrete endemic centre has been identified in the northern parts of central Sweden. The infection in Sweden is most often domestic.

## Animals

Although tularaemia can infect a wide range of animals the mountain hare has been the animal species mostly affected. However, in recent years, tularaemia has been detected in the European brown hare in new geographic areas.

## Humans

The yearly numbers of notified cases range from a few cases to more than 2,700 cases in 1967. During the last decade the epidemiology of tularaemia has changed and the number of reported human cases infected south of the identified endemic region has increased. In animals, outbreaks of tularaemia have elsewhere been considered to be associated with rises in rodent and hare populations, but this has not been observed in Sweden.

## Disease

*F. tularensis* is highly infectious, with possible infection in humans produced after exposure to as few as 10–50 colony forming units. The incubation period is usually 3–5 days. Tularaemia can be manifested in different forms depending on the route of transmission, the virulence of the organism and animal species. These forms are: ulceroglandular, oculoglandular, pneumonic, oropharyngeal, gastrointestinal, and typhoidal. The ulceroglandular form is the most common form in humans: respiratory, oculoglandular and oropharyngeal forms being less common. In the ulceroglandular form, a local ulcer usually appears at the site of infection and the adjacent lymph nodes are enlarged. The general symptoms of tularaemia are high fever, headache and nausea. In the Swedish hares and in many rodent species that die of tularaemia the pathological presentation of the disease is a disseminated multi-organ septicemic form.

## Legislation

### Animals

Tularaemia is notifiable in animals (SJVFS 2002:16 with amendments).

### Humans

Tularaemia has been a notifiable disease since 1970 according to the Communicable Disease Act (SFS 2004:168).

## SURVEILLANCE 2009

### SURVEILLANCE

#### Animals

No active surveillance is performed in animals. Surveillance is based on voluntary submission of animals found dead or euthanized diseased hares by hunters and the general public. The detection is based on direct immunofluorescence of the sample spread.

#### Humans

The surveillance is passive.

### RESULTS

#### Animals

*F. tularensis* was not detected from animals in 2009 with immunofluorescence.

#### Humans

During 2009, 244 cases of tularaemia were reported, which is a decrease by 36 % since 2008 (Figure 21). Most cases were between 30 and 70 years old and 58% were men. Almost all (99 %) of the reported persons had acquired their infection in Sweden. Some acquired the infection in Finland, Norway and Canada. The patients were mainly living in the counties of Värmland, Dalarna and Gävleborg. The county of Värmland had the

highest incidence (24 cases/100 000). Most cases (80 %) fell ill in August and September.

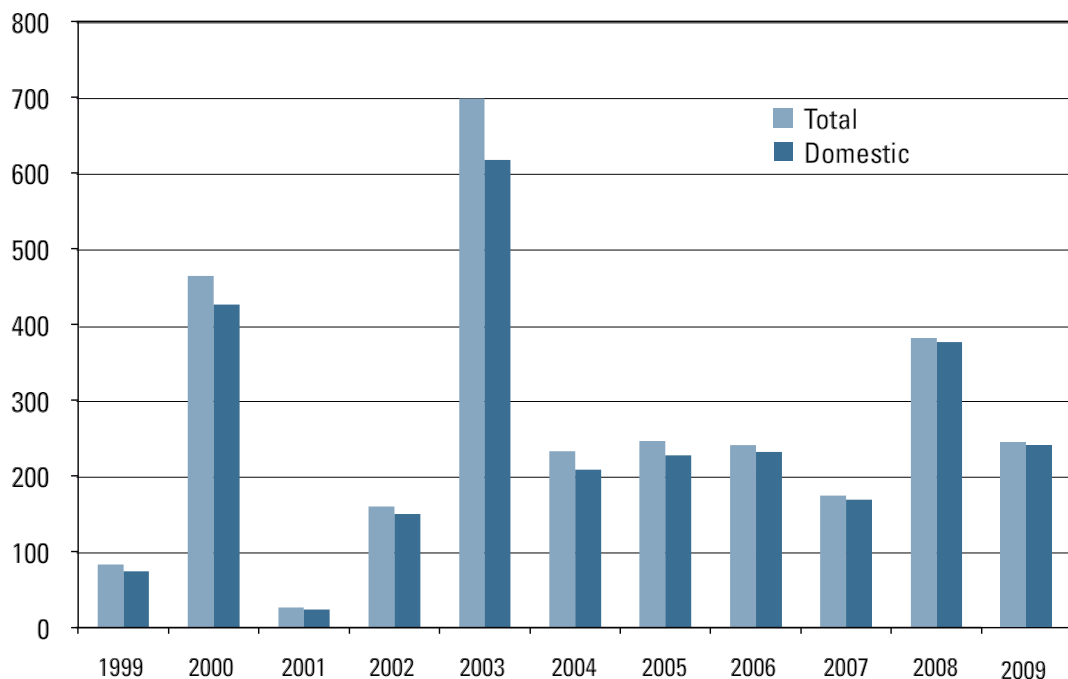
### DISCUSSION

Tularaemia has been endemic in northern Sweden at least since the early 20<sup>th</sup> century with a marked variation in the number cases between different years. Years with high numbers of cases are often followed by periods when the disease is virtually absent. There is no obvious explanation to this decrease, but substantial fluctuations in the number of cases between years are not unusual. It is still unclear why the infection emerges in some places and years and where the bacterium hides in between these occasions.

The infection is more often reported in men, which might be attributed to their leisure and professional activities. The age group of 30-65 years is the most affected in both genders. Tularaemia might spread during the whole year, but it is most frequent during late summers.

The reservoir for *F. tularensis* is not yet clearly elucidated. In Sweden, surveys in dead animals are used for monitoring tularaemia. It is possible that the European brown hare has become an important carrier of *F. tularensis* and might act as a reservoir in many areas.

Figure 21. Notified human cases of tularaemia in Sweden during 1999-2009.



# Vero-Toxin producing Escherichia coli (VTEC)

## BACKGROUND

Verocytotoxin producing *Escherichia coli* (VTEC), also known as shiga-toxin producing *E. coli* (STEC), are causative agents of serious intestinal infections in humans. These bacteria often cause hemorrhagic diarrhoea; they are then called EHEC (enterohaemorrhagic *E. coli*). More than 380 different VTEC serotypes have been associated with human illness but most outbreaks and severe illnesses are caused by serotype O157:H7. Other common serotypes causing gastrointestinal illness are O26, O103, O111 and O145. Cattle are the main reservoir of VTEC associated with human disease although other animal species also may acquire the organism. The infectious dose is low, probably just a few bacterial cells. Not only foods of bovine origin but also vegetable food items have been implicated in outbreaks. The infection can also be transmitted through direct or indirect animal contact, via environment or person-to-person transmission.

## History

Only sporadic cases of VTEC infections were reported in Sweden until 1995 when 114 human cases of infection caused by VTEC O157:H7 were notified. In 1996, VTEC O157 was isolated in Swedish cattle for the first time and human *E. coli* O157 infection was traced back to presence of VTEC O157 in a cattle herd. In the autumn 2002 an outbreak of VTEC O157:H7 in the county of Skåne affecting 30 patients was caused by consumption of cold smoked fermented sausage. The biggest Swedish outbreak so far occurred in the summer of 2005 when 135 cases, including 11 (8%) HUS (haemorrhagic uraemic syndrome) cases, were infected with O157:H7 after eating contaminated fresh lettuce irrigated with water positive for verocytotoxin 2. Identical strains from humans and cattle faeces from a farm upstream confirmed the implicated source and control

measures that lead to the termination of the outbreak were implemented.

Around 200-300 cases of EHEC are reported annually, of which 50 -65% are domestically acquired. Most of the cases are reported during the period July to August.

National guidelines were established in 1997 and were revised in 2008. The aim is to minimize the spread of VTEC to humans and animals. The guidelines give for instance general recommendations to all farms and special recommendations to farms associated with human infections. Sampling is mainly targeted on young cattle because they more often shed the bacterium. Washing of hands after contact with animals is recommended as well as avoiding drinking unpasteurised milk. A risk profile was produced by the responsible authorities in 2007.

## Disease

### *Animals*

Animals usually do not develop a clinical disease.

### *Humans*

VTEC infection is associated with asymptomatic infection, non-specific diarrhoea, and bloody diarrhoea. The illness often starts with severe abdominal cramps, followed by watery diarrhoea, which may become bloody. Most patients recover fully. Approximately 7-10% develop haemolytic-uraemic syndrome (HUS), which is characterised by acute renal failure, thrombocytopenia, and microangiopathic haemolytic anaemia. Severe complications are most common in children less than five years and elderly people. HUS may lead to renal transplantations, permanent renal failure or death.

## Legislation

### *Animals*

Since 1999 VTEC O157 findings in animals are

## SURVEILLANCE 2009

only notifiable when associated with human VTEC infection (SJVFS 2002:16 with amendments).

### Humans

EHEC O157 has been notifiable for both clinicians and laboratories under the Swedish Communicable Disease Act since 1996. All EHEC serotypes pathogenic to humans are notifiable since 1 July 2004 (SFS 2004:168).

## SURVEILLANCE

### Active surveillance

#### Animals

Trace back investigations of farms that are suspected as sources of human infections. When a human case is suspected to have connection with a farm, such as drinking unpasteurised milk or environmental contamination, the farm will be investigated and sampled. However, if the human serotype is rare and analytical methods are lacking the connection can never be proven.

### Surveys

#### Animals

Between 1997 and 2002 annual prevalence studies of VTEC in slaughter cattle were conducted. Since 2002, prevalence studies have been performed every third year. The aim is to detect a prevalence of 0.1% with a 90% confidence level. In each study, about 2000 cattle faecal samples were randomly selected from abattoirs responsible for about 90% of cattle slaughtered. A baseline study on cattle carcasses was done in 2006-2007 and a prevalence study in sheep was done at nine slaughterhouses in 2007-2008.

### Humans

All serotypes of human pathogenic EHEC infections have been notifiable since 1 July 2004. If a County Medical Officer suspects an association with a human VTEC infection to a farm, the county veterinary officer will be informed. A request to the Swedish Board of Agriculture will be made for sampling suspected animals.

## RESULTS

### Animals

#### Active surveillance

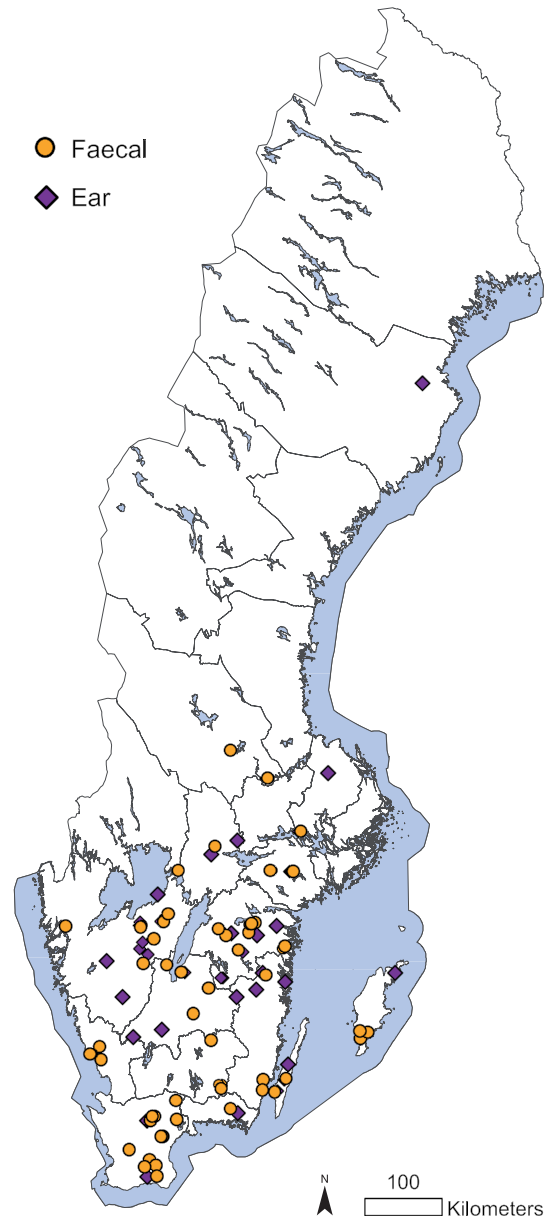
During 2009 14 farms were epidemiologically investigated as suspected sources for human infection. VTEC O157 was isolated from an environ-

mental sample of one sheep farm but not from the animals.

### Monitoring

VTEC O157 was detected in 9 (1.8%) of 492 faecal and 2 (1.9%) of 105 ear samples from sheep in a survey performed in 2007-2008. In cattle, surveys during 1997-2002 showed a prevalence of approximately 1%. In the study done in 2005-2006, VTEC O157 was detected in 3.4% of faecal samples. In the abattoir survey conducted in 2008-2009 VTEC O157 was detected in 3.3% of faecal and 8.2% of 500 ear samples (Map 11).

Map 11. Geographical distribution of VTEC O157 positive faecal and ear samples collected at slaughter at the major slaughterhouses in a survey conducted during 2008/2009 in Sweden.



In these studies, VTEC O157:H7 has predominantly been isolated from cattle in the south of Sweden whereas very seldom from the northern two thirds of the country. However, in the latest survey, VTEC O157:H7 was isolated from one ear sample from Luleå in the northern part of Sweden. This is the most northern isolate in the Swedish slaughterhouse surveys performed.

**Humans**

In 2009, 228 human cases were reported, a decrease by 25% from the year before (304 cases) (Figure 22). Around half (54 %) of the cases were domestically infected which follows the last years decrease in domestic cases (15 % decrease from 2008). The incidence of notified domestic VTEC infections was 1.34 cases per 100,000 population in 2009 which was the lowest incidence compared to previous years.

Children and adolescents below 20 years accounted for almost half of the domestic cases in 2009. The largest age group was very young children between 1-4 years with almost one fourth of the domestic cases.

Most domestic cases were reported from the counties Västra Götaland, Skåne, Stockholm and

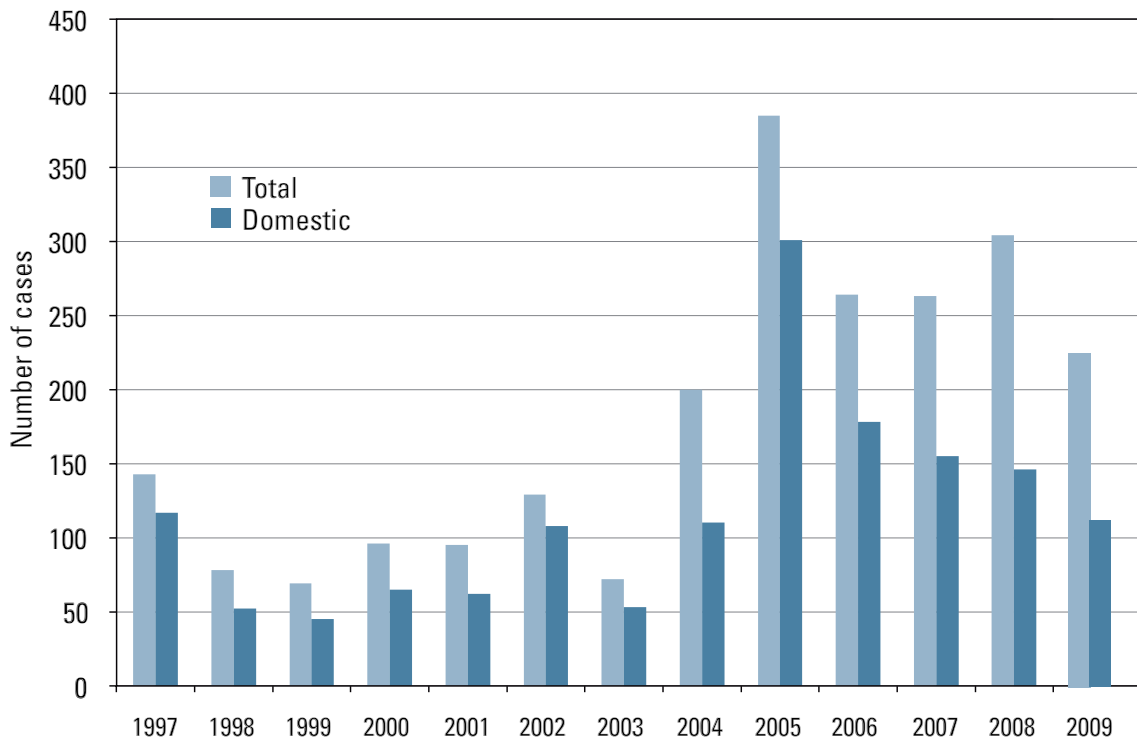
Jönköping. Jönköping in the south of Sweden had the highest incidence (3.0 cases/ 100,000 population). Previously, the incidence has been highest in the county Halland. It is too early to say if it is a change in trends or just an observation of a single year.

Around half of the cases were infected abroad (42%). This number decreased during 2009 with 38% compared to 2008. A similar decrease was also seen for several other food and waterborne infections and can be explained by a decrease in international travel during 2009. Egypt and Turkey were the main countries of infection acquired abroad.

O157:H7 was the most common serotype with 45 cases of which half were domestic infections. The number of O157 has not been so low since 2001. The most common subtypes of O157:H7 (the Halland types) were dominating during 2009, however the common variant (smi-H) decreased considerably which can partly explain the total decrease in domestic cases. It is still too early to say if the decrease in O157 is a significant trend.

The second most common serotype was O26, followed by O121, O103 and O145. A majority of the human cases were sporadic and the few clusters reported during 2009 were family

Figure 22. Notified VTEC cases in humans in Sweden during 1997-2009.





members or epidemiologically connected to farms. In the summer of 2009, a family was infected with EHEC O145 after drinking water from a contaminated well in a small community. An indistinguishable subtype of VTEC O145 was isolated from the untreated well water and the human cases. The samples from drinking water were positive by PCR but the bacterium could not be isolated. The serotype O145 could not be identified from any other sources such as water, farms and environment despite sampling efforts. Control measures for the well and water quality were successfully implemented.

### DISCUSSION

A decreasing trend in domestic EHEC infections has been observed, and in 2009, especially, the number of O157 was lower than in many earlier years. The highest notification rates in humans are in counties with higher cattle-density, i.e. in southern Sweden but for 2009 also these numbers were lower than in previous years. It is still too early to predict if the observed decreasing trend is stable. The established recommendations and increased awareness may, at least partly, explain the decreasing trend of notified human cases.

Because of modifications of the detection methods, the results of the different prevalence surveys cannot be directly compared. Therefore it is difficult to determine whether the observed increase in animal prevalence from one to three

percent is true or merely an effect of improved detection methods. Measures to decrease the animal prevalence are being investigated.

### REFERENCES

- Albihn A, Eriksson E, Wallen C, Aspán A. Verotoxinogenic *Escherichia coli* (VTEC) O157:H7--a nationwide Swedish survey of bovine faeces. *Acta Vet Scand.* 2003;44(1-2):43-52.
- Boqvist S, Aspan A, Eriksson E. Prevalence of verotoxinogenic *Escherichia coli* O157:H7 in fecal and ear samples from slaughtered cattle in Sweden. *J Food Prot.* 2009 Aug;72(8):1709-12.
- Sartz L, De Jong B, Hjertqvist M, Plym Forshell L, Alsterlund R, Löfdahl S, Osterman B, Ståhl A, Eriksson E, Hansson H-B, Karpman D. An outbreak of *Escherichia coli* O157:H7 infection in southern Sweden associated with consumption of fermented sausage; aspects of sausage production that increase the risk of contamination, *Epidemiol. Infect.* (2008) 136, 370-380.
- Söderström A, Österberg P, Lindqvist A, Jönsson B, Lindberg A, Blide Ulander S, Welinder-Olsson C, Löfdahl S, Kaijser B, De Jong B, Kühlmann-Berenzon S, Boqvist S, Eriksson E, Szanto E, Andersson S, Allestam G, Hedenström I, Ledet Muller L, Andersson Y. A large *Escherichia coli* O157 outbreak in Sweden associated with locally produced lettuce, *Foodborne Pathog. Dis.*, Vol 5, Nr 3 2008.
- National guidelines: Handlingspolicy avseende kontroll av verotoxinbildande *Escherichia coli*. Available from: [http://www.smi.se/upload/Publikationer/VTEC\\_5GD\\_080520.pdf](http://www.smi.se/upload/Publikationer/VTEC_5GD_080520.pdf)
- [www.sva.se](http://www.sva.se)



# Yersiniosis

## BACKGROUND

Two enteropathogenic species of the bacterial genus of *Yersinia* are zoonotic, namely *Yersinia enterocolitica* and *Yersinia pseudotuberculosis*. Pigs are considered the main reservoir of *Y. enterocolitica*. The most common human pathogenic variant is *Y. enterocolitica* 4/O: 3.

Wild animals, especially rodents and birds are considered the principal reservoir of *Y. pseudotuberculosis*. Both *Y. enterocolitica* and *Y. pseudotuberculosis* are frequently found in pig tonsils and intestinal contents. Infections caused by *Y. enterocolitica* are thought to be food-borne. The sources and vehicles of *Y. pseudotuberculosis* infections in humans remain obscure but infections caused by consumption of contaminated carrots and iceberg lettuce have been described. *Yersinia* bacteria are destroyed by heating (pasteurization and cooking) but are able to grow at low temperatures and can therefore grow in food that is kept cool. Thus, long storage times of ready-to-eat food items should be avoided. *Yersinia* bacteria are widespread in nature but nonpathogenic strains are common. Good slaughtering hygiene is essential in controlling *Yersinia*.

## History

The genus *Yersinia* has been associated with human and animal diseases for centuries. *Y. pestis* is a well-known cause of plague. *Y. pseudotuberculosis* was isolated from diseased guinea pigs in the 1880's. Mainly sporadic cases of yersiniosis were reported in humans until a large outbreak of *Y. enterocolitica* associated with chocolate milk occurred in the USA in 1976. The first food- and waterborne outbreaks of *Y. pseudotuberculosis* were reported in 1980's.

## Disease

### Animals

Pigs are asymptomatic intestinal carriers of pathogenic *Y. enterocolitica* and *Y. pseudotuberculosis*. Infection with *Y. pseudotuberculosis* in other animals

may vary from asymptomatic to severe mesenteric lymphadenitis and lead to septicaemia and death.

*Y. enterocolitica* has occasionally been isolated from cats and dogs with diarrhoea.

### Humans

*Y. enterocolitica* causes gastrointestinal symptoms in humans ranging from mild self-limiting diarrhea to acute mesenteric lymphadenitis, which might be difficult to differentiate from appendicitis. Long-time sequelae including reactive arthritis, uveitis and glomerulonephritis occur sometimes. Prolonged carriage has been reported in children as well as in adults.

## Legislation

### Animals

*Y. enterocolitica* and *pseudotuberculosis* are not notifiable in animals.

### Food

*Y. enterocolitica* and *pseudotuberculosis* are not notifiable in food.

### Humans

Yersiniosis is notifiable according to the Communicable Disease Act (SFS 2004:168).

## SURVEILLANCE

### Animals

There is no active surveillance in animals.

### Food

There is no active surveillance in food.

### Humans

Yersiniosis is notifiable and cases must be reported to the Swedish Institute for Infectious Disease Control and to the County Medical Office in the affected county.

**RESULTS**

**Animals**

*Y. pseudotuberculosis* was isolated from two hares, two deer and one antelope (zoo animal) and *Y. enterocolitica* from one dog tested at the SVA.

**Food**

Hardly any samples were reported from official sampling.

**Humans**

In 2009, 398 cases were reported and 303 (76%) of them were domestic (Figure 23). As in previous years children between 0 and 4 years was the most affected group (31%). The number of notified domestic cases has decreased since 2004. Of the 64 cases infected abroad, 17 were infected in Spain, which was the most common country of infection.

Yersiniosis in humans is considered foodborne.

Outbreaks are rare and most infections seem to be sporadic. Approximately 70% of the infected cases are domestic. Case-control studies suggest consumption of pork products as a risk factor. Pathogenic *Y. enterocolitica* are common in pigs. A baseline survey performed in Swedish slaughterhouses in 2006 showed pathogenic *Y. enterocolitica* on 16% of 541 pig carcasses.

**REFERENCES**

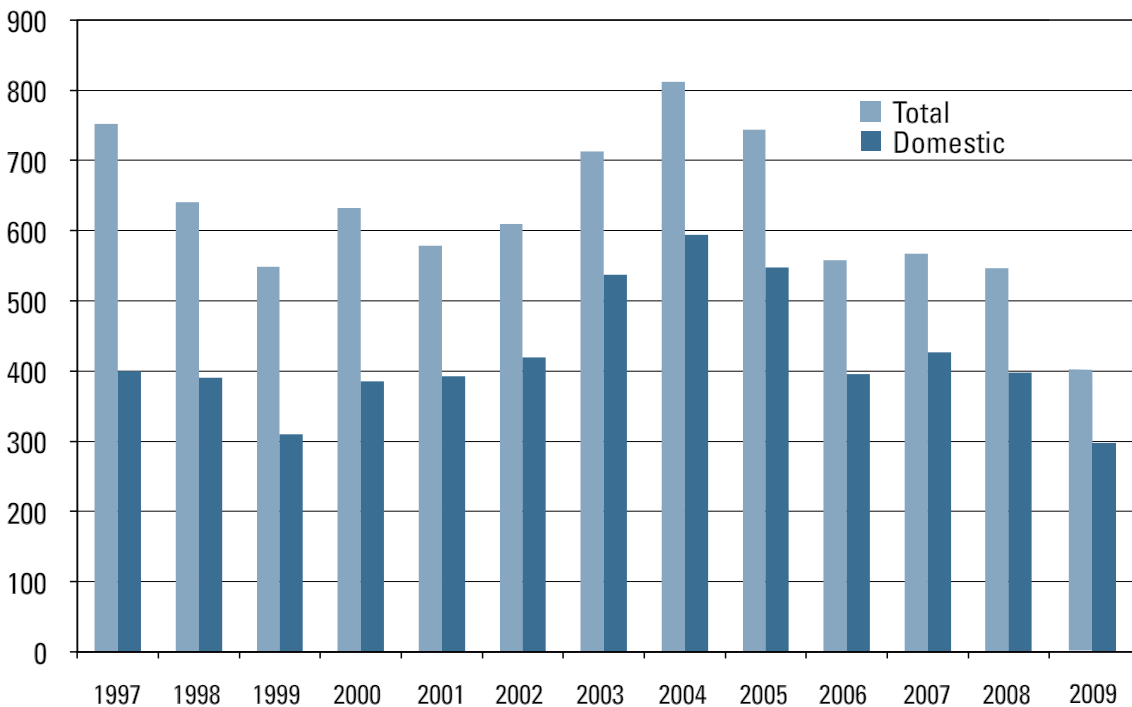
Boqvist S, Pettersson H, Svensson A, Andersson Y Sources of sporadic *Yersinia enterocolitica* infection in children in Sweden, 2004: a case-control study. *Epidemiol Infect.* 2009;137(6):897-905

Lindblad M, Lindmark H, Thisted Lambertz S, Lindqvist R. Microbiological baseline study of swine carcasses at Swedish slaughterhouses. *J Food Prot.* 2007;70(8):1790-7.

**DISCUSSION**

Yersiniosis is one of the most notified zoonoses in Sweden. However, since 2004, the number of notified yersiniosis cases in humans has decreased with 49%. This decrease has occurred without any active measures in the food chain.

Figure 23. Notified cases of yersiniosis in humans in Sweden during 1997-2009.



# Poultry Health Control Program

## BACKGROUND

The Poultry Health Control Program is based on provisions issued by the Swedish Board of Agriculture (SJVFS 1995:123) and is mandatory for all hatcheries producing more than 50,000 day-old chickens per year and all breeding establishments (grandparent and parent flocks of layers, broilers and turkeys) delivering hatching eggs to these hatcheries. In addition to serological sampling for several infectious diseases the program consists of rules on biosecurity, standard of the houses, management, clinical surveillance etc.

All diseases within the program are notifiable according to provisions issued by the Swedish Board of Agriculture (SJVFS 2002:16 with amendments). The diseases are briefly described below.

- *Salmonella* Gallinarum (causing Fowl typhoid) and *Salmonella* Pullorum (causing Pullorum disease) are salmonella serotypes specially adapted to poultry. Both serotypes are important vertical infections in addition to the common horizontal spread. Both serotypes are included in the Swedish zoonosis legislation as well as in European legislation on trade in poultry and hatching eggs (Council Directive 2009/158/EC). These two salmonella serotypes were eradicated from the Swedish commercial poultry population in the beginning of the 1960's. *S. Gallinarum* has not been detected in Swedish poultry since 1984 when a backyard flock was found to be infected. *S. Pullorum* was last detected in two backyard flocks in 2001. *S. Gallinarum* commonly infects and cause disease (diarrhoea, inappetence, production losses and mortality) in older birds. Pullorum disease mainly affects fetuses and chickens up to 3 weeks of age.

- *Mycoplasma gallisepticum* (MG), *Mycoplasma synoviae* (MS) and *Mycoplasma meleagridis* (MM) are important poultry pathogens mainly causing respiratory disease. MG and MM infections also leads to egg production losses, MM is however only

pathogenic for turkeys. MG and MS may also cause arthritis. The mycoplasmas are able to spread both horizontally and vertically. They are today present among backyard poultry in Sweden and MS also to some extent in the laying hen population. According to European legislation (Council Directive 2009/158/EC) breeding flocks have to be tested for MG and MM (only turkey flocks) several times during their lifetime, and found free, to allow trade. MS has been included in the Swedish poultry health control program due to its potential to cause disease and production losses.

- Paramyxovirus type 1 may cause outbreaks of Newcastle Disease, with egg production losses, increased mortality, nervous signs and respiratory symptoms, the severity of the disease may however vary. The virus is transmitted through direct and indirect contacts with infected birds and for shorter distances also with the wind. Wild birds are an important reservoir. Since 1995, ten outbreaks of Newcastle Disease have occurred in Sweden, the last one in 2009 on a holding with broiler parents in southern Sweden. The disease is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments). Sweden is a Newcastle free country and has the status as a non-vaccinating country for this disease according to Commission Decision 95/98/EEC.

- Egg drop syndrome - virus (an adenovirus) is naturally occurring in water fowl (including the wild population) without causing any symptoms. In chickens symptoms are only seen during the production period as decreased egg production in an otherwise clinically healthy flock. The virus is able to spread both vertically and horizontally. The Swedish breeding population is free from the disease.

- Avian pneumovirus is the causal agent of avian rhinotracheitis, a disease causing respiratory symptoms and decreased egg production, in both

## OTHER SURVEILLANCES 2009

turkeys and chickens. Transmission of the virus occurs through contacts (direct and indirect). Following an outbreak in 1998 some of the broiler breeding flocks are still vaccinated against the disease. Positive serological reactions against avian pneumovirus have previously been seen among fattening turkeys in a limited area in the south of Sweden. Clinical signs, typical for this disease, have however not been observed in these flocks and during the last serological surveillance in 2007 all fattening turkey flocks tested were negative.

- Infectious laryngotracheitis, a respiratory disease caused by a herpesvirus, is present among backyard poultry in Sweden. In 2007 a commercial layer farm was also affected by the disease, but no further spread has been detected. Vaccination has been performed in this affected layer farm as well as in the backyard population. The virus spreads between flocks through direct and indirect contacts, healthy latent carriers are especially important.

### SURVEILLANCE

In 2009 nine different breeding companies participated in the program; four broiler-, four laying hen- and one turkey breeding company. In accordance with the provisions, sixty blood samples were

taken from the breeding flocks included in the program, once during the rearing period and several times during the production period. The blood samples were sent by mail to the National Veterinary Institute (SVA) where serological tests were performed according to the same sampling schedule as previous years. Both chicken and turkey flocks were tested for *Salmonella Gallinarum*, *Salmonella Pullorum*, *Mycoplasma gallisepticum*, *Mycoplasma synoviae*, paramyxovirus type 1 and avian pneumovirus. Breeding flocks vaccinated against avian pneumovirus were however not tested for this disease. In 2009 breeding flocks from three companies were exempted from this analysis. Furthermore only turkeys were investigated for *Mycoplasma meleagridis* and investigations regarding egg drop syndrome and infectious laryngotracheitis were only performed in chicken. The sampling and testing schemes are presented in Table 13 and 14.

The serological screening within the program is administered by the National Veterinary Institute and financed by the Swedish Board of Agriculture and the participating companies.

Table 15-17 give an overview of all samples taken in breeding flocks of chickens and turkeys and methods used during 2009.

Table 13. Chickens. Number of sampling occasions for grandparent (GP) and parent (P) flocks and total number of samples tested.

Agent	No of sampling occasions		No of samples		Method
	GP	P	GP	P	
S. Pullorum/S. Gallinarum	9	76	540	4 620	Rapid plate agglutination
<i>Mycoplasma gallisepticum</i>	55	410	3 300	24 660	ELISA Svanovir MG antibody test, SVANOVA
<i>Mycoplasma synoviae</i>	36	160	2 160	9 600	ELISA Svanovir MS antibody test, SVANOVA
Paramyxovirus type 1	10	76	600	4 620	ELISA Svanovir NDV antibody test, SVANOVA
Egg Drop Syndrome-virus	19	76	570	2 340	Haemagglutination inhibition test
Avian Pneumovirus	0	51	0	3 120	ELISA Svanovir APV antibody test, SVANOVA
Infectious laryngotracheitis-virus	9	79	180	1 640	ELISA ILT antibody test kit, Biochek

Ref: OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals.

Ref: A laboratory manual for the isolation and identification of avian pathogens published by AAAP, 1998.

## OTHER SURVEILLANCES 2009

Table 14. Turkeys. Number of sampling occasions for breeding flocks (only parents) and total number of samples tested.

Agent	No of sampling occasions	No of samples	Method
<i>S. Pullorum/S. Gallinarum</i>	4	240	Rapid plate agglutination
<i>Mycoplasma gallisepticum</i>	17	1 020	ELISA Svanovir MG antibody test, SVANOVA
<i>Mycoplasma synoviae</i>	9	540	ELISA Svanovir MS antibody test, SVANOVA
<i>Mycoplasma meleagridis</i>	17	1 020	Rapid plate agglutination
Paramyxovirus type 1	4	240	ELISA Svanovir NDV antibody test, SVANOVA
Avian Pneumovirus	4	240	ELISA Svanovir APV antibody test, SVANOVA

Ref: OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals.

### RESULTS

All analysed samples tested negative for *Salmonella Gallinarum*, *Salmonella Pullorum*, *Mycoplasma synoviae*, *Mycoplasma meleagridis*, Paramyxovirus type 1, Avian pneumovirus and Infectious laryngotracheitis.

During 2009 two flocks (chicken grandparents) and eleven flocks (chicken grandparents and parents) were further investigated due to a few positive samples for *Mycoplasma gallisepticum* and Egg drop syndrome, respectively. No clinical signs were seen in these flocks and after testing new samples taken in the flocks the positive samples were considered as unspecific serological reactions.

### DISCUSSION

The aims of the Poultry Health Control program are to document freedom from the diseases included, to stop the introduction of diseases to the holdings and to facilitate trade from the participating companies.

The results from the serological screening in the Poultry Health Control Program in 2009 supports the status of freedom from these infections of the Swedish breeding poultry population. However, the outbreak of Newcastle Disease on a broiler parent holding this year illustrates, and supports previous experiences, the importance of clinical surveillance in the poultry population when it comes to detecting infections in poultry.

## OTHER SURVEILLANCES 2009

Table 15. Sampling schedule in chicken parent flocks. Number of blood samples tested at different weeks of age.

Agent	Age in weeks	16	24	36	48	before slaughter
S. Pullorum/ S. Gallinarum			60			
<i>Mycoplasma gallisepticum</i>		60	60	60	60	60
<i>Mycoplasma synoviae</i>			60			60
Paramyxovirus type 1			60			
Egg drop syndrome-virus			30			
Avian pneumovirus				60		
Infectious laryngotracheitis-virus				20		

Table 16. Sampling schedule in chicken grandparent flocks. Number of blood samples tested at different weeks of age.

Agent	Age in weeks	16	24	36	48	54	before slaughter
S. Pullorum/ S. Gallinarum			60				
<i>Mycoplasma gallisepticum</i>		60	60	60	60	60	60
<i>Mycoplasma synoviae</i>			60	60	60		60
Paramyxovirus type 1							60
Egg drop syndrome-virus			30				30
Avian pneumovirus							60
Infectious laryngotracheitis-virus				20			

Table 17. Sampling schedule in turkey parent flocks. Number of blood samples tested at different weeks of age.

Agent	Age in weeks	20	32	44	before slaughter
S. Pullorum/ S. Gallinarum			60		
<i>Mycoplasma gallisepticum</i>		60	60	60	60
<i>Mycoplasma synoviae</i>			60		60
<i>Mycoplasma meleagridis</i>		60	60	60	60
Paramyxovirus type 1			60		
Avian pneumovirus				60	

# Surveillance for a selection of infectious diseases in pig herds

## BACKGROUND

The surveillances included under this heading are performed either yearly, every second or third year or on an irregular basis depending on the disease. At present, the surveillances for classical swine fever (CSF), swine vesicular disease (SVD) and brucellosis are performed yearly, whereas transmissible gastroenteritis (TGE) is investigated every second year (latest surveillance 2008) and leptospirosis (*Leptospira Pomona*) every third year (latest surveillance 2007). Influenza in pigs is investigated on an irregular basis, the latest surveillance was carried out in 2006.

During 2009 active surveillances were performed regarding swine vesicular disease (SVD), classical swine fever (CSF) and brucellosis. The results of the brucellosis surveillance and the situation regarding influenza in pigs are presented elsewhere in this report.

## SVD

SVD is a disease solely affecting pigs and it is caused by a porcine enterovirus of the family Picornaviridae. The virus is closely related to human coxsackie B5 virus. The first report of SVD affected pigs was from Italy 1966 and the disease has since then been reported from several European countries and also from Japan and China. Today most EU countries are free from the disease but SVD is still present in Italy.

Route of transmission is mainly by direct contact between infected and non-infected animals and by oral intake of feed contaminated with SVD virus.

## CSF

CSF is a dreaded disease of pigs caused by a pestivirus closely related to bovine virus diarrhoea virus and border disease virus. It is considered one of the most important and devastating pig diseases worldwide. During 1997-98 there was an extensive outbreak in Holland, Germany, Belgium and Spain. Since then outbreaks have been confined to more limited geographic regions. CSF is present in the European wild boar population and some countries in Eastern Europe have difficulty in

controlling CSF in back yard and feral pigs. The disease is also present in Asia and South America. CSF is a highly contagious disease that is transmitted by direct and indirect contact between animals. Feeding pigs infected swill is considered the main means of spreading the disease to new areas. Due to this, swill feeding of pigs is prohibited in the European Union.

## History

SVD has never been diagnosed in Sweden and CSF has not been diagnosed since 1944. Sweden is therefore considered free of these diseases

## Disease

### SVD

Infection with SVD virus can lead to high fever and blisters in coronary bands, snout, tongue and teats within 2-7 days. In practice, the disease is often discovered due to several animals in the herd being lame. In countries free of foot- and mouth disease (FMD) one of the important features of SVD is that it cannot be distinguished from FMD clinically. In endemic areas the clinical manifestation of the disease can be very mild or the infection can be subclinical.

### CSF

CSF appears in different clinical forms; acute, chronic and a mild form with reproductive disturbances as the main clinical manifestation. The incubation period is 2-14 days and in the acute form of the disease high fever (42°C), shivering, weak hind legs, purple discoloring of the skin and diarrhea is seen. Chronically infected animals exhibit a more diffuse clinical picture with intermittent fever, anorexia and stunted growth. In the mild form abortions is the main clinical sign.

## Legislation

Both SVD and CSF are included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments) and the control of these diseases are also regulated in detail through EU-directives.



## OTHER SURVEILLANCES 2009

### SURVEILLANCE

The purpose of the surveillance activities is to document freedom from these diseases in the Swedish pig population and to contribute to the maintenance of this situation. The National Veterinary Institute (SVA) has been responsible for collection, sample analysis and reporting to the Swedish Board of Agriculture.

The serological analyses of SVD and CSF samples, analyses for CSF virus genome and CSF virus culturing were performed at the National Veterinary Institute (SVA). CSF serology was done using a commercial kit (IDEXX® HerdChek CSFV Antibody Test Kit) and in case of positive ELISA results a confirming neutralization peroxidase-linked assay (NPLA) for detection of antibodies against CSFV was performed. SVD serology was done using an ELISA and positive samples were rerun and confirmed using a serum neutralization test (SN-test).

#### Passive surveillance

As both SVD and CSF are notifiable on clinical suspicion for both veterinarians and farmers, cases with suspect clinical signs will be investigated following notification to the Swedish Board of Agriculture. The following investigation includes, in addition to restrictions on the farm during investigation, sampling of sick or dead animals and examination of the herd for prevalence of clinical signs and production results.

Ongoing testing of animals for import and export and at breeding centers adds to the passive disease surveillance.

#### Active surveillance

In 2009, sera for the active surveillance were collected by convenience sampling from the slaughter house surveillance carried out by the Swedish Animal Health Service for porcine respiratory and reproductive syndrome (PRRS). In addition, analyzes for CSF virus genome with PCR is included in the active surveillance of aborted fetuses from sows.

### RESULTS

#### Passive surveillance

##### *SVD*

No investigations following clinical suspicion of SVD was carried out during 2009.

##### *CSF*

Ten investigations following clinical suspicion of CSF were carried out during 2009. In three of these, reproductive failure was the main clinical manifestation. Following investigation including further sampling the herds could be declared negative for CSF.

Samples originating from sampling for import and export and at breeding centers were all negative regarding CSF.

#### Active surveillance

##### *SVD*

Serum samples from 2,519 pigs were analyzed regarding antibodies to SVD. In three of these animals, positive reaction for SVDV antibodies was detected. Following investigation, the herds from which the samples originated could be declared free from SVD.

##### *CSF*

Serum samples from 2,521 pigs were analyzed regarding antibodies to CSF. None of these were positive for antibodies to CSF.

Within the surveillance of aborted fetuses, 75 fetuses were examined for CSF virus genome and all samples were negative regarding CSF.

### DISCUSSION

The results from the surveillance in Sweden regarding SVD and CSF during 2009 give additional documentation of freedom from the mentioned infections in the Swedish commercial pig population.

The present CSF situation in EU member countries in Eastern Europe and the diverse clinical picture of CSF with a spectrum of clinical signs from very severe to very mild or subclinical emphasizes the need for both passive and active surveillance for CSF.

Ongoing discussions of changing the regulations concerning SVD could lead to higher demands on Member States to be able to prove freedom of disease and this would, if put into practice, probably mean more extensive sampling in countries free of SVD.

# Wild boars, surveillance for certain infections

## BACKGROUND

Contagious pig diseases in general and classical swine fever in particular can affect and be spread by the wild boar population. This is the situation in several European countries. The wild boar population is increasing in Sweden and is estimated by the Swedish environmental protection agency to be more than 100,000 heads.

### History

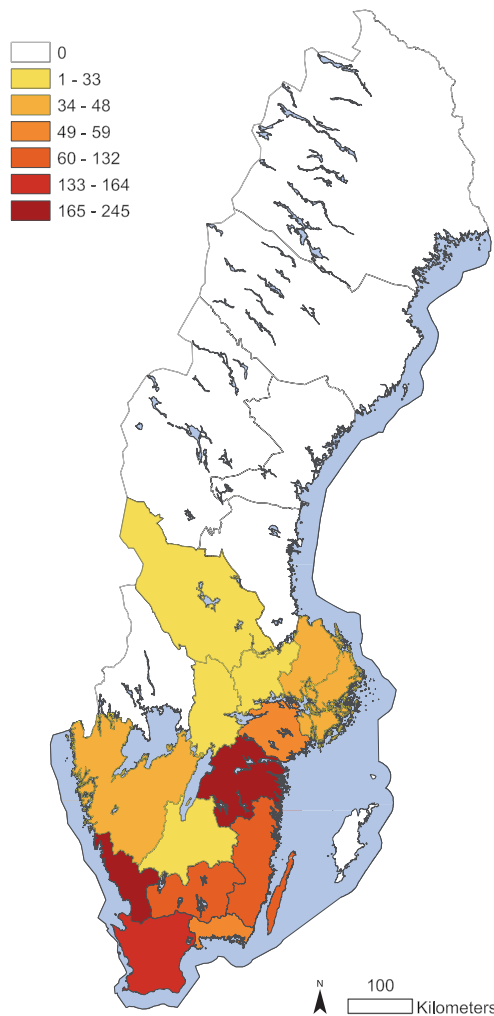
Since year 2000 more than 2,000 dead hunted wild boars from different parts of the country have been bled in connection with slaughter. The samples were sent to National Veterinary Institute (SVA) for analysis for antibodies to certain infections. The hunters were economically compensated.

### Legislation

The infections included in the wild boar surveillance 2009 except for Leptospirosis are all included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments) and are notifiable on suspicion. If any of them are suspected or confirmed, measures will be taken to combat the disease and to prevent further spread. Leptospirosis is notifiable on confirmation.

## SURVEILLANCE

In 2009 five hundred blood samples from wild boars from different parts of Sweden were analysed for antibodies to Aujeszky's disease, Porcine Reproductive and Respiratory Syndrome, *Leptospira pomona* and *Brucella suis*. In addition, 716 samples (n=1,216) were analysed for antibodies for classical swine fever (Map 12). Methods used are described under the respective disease headings. A microscopic agglutination test (Faine



Map 12. Number of wild boar tested per county.

et al 1999) was used for the leptospirosis analysis. Some samples (n=186) could not be used for the diagnostic test for *Brucella suis* due to too heavy haemolysis, and were replaced with samples from other wild boars.

## RESULTS

All samples tested were serologically negative.

## DISCUSSION

The material is too small for statistical evaluation. However, together with the negative testing during the last decade and the absence of reports of clinical signs typical for the chosen diseases, the results indicate that these diseases are not present in the Swedish wild boar population.

## REFERENCES

- Faine S. et al 1999. *Leptospira* and leptospirosis, second ed. MediSci, Melbourne. Sid 126-128  
<http://www.naturvardsverket.se>

# Fish and shellfish, surveillance for a selection of infectious diseases



Photo: Anders Alfjorden

Infectious hematopoietic necrosis (IHN) and viral haemorrhagic septicaemia (VHS)

Both diseases are caused by rhabdovirus and occur frequently in Europe. They are both transferred horizontally, and a vertically transmission can not be completely ruled out for IHN. VHS is found in a marine form, why a spread through wild populations can not be excluded.

Infectious pancreatic necrosis (IPN)

IPN is caused by a virus associated to the group Birnaviridae. The virus is highly infectious to juvenil salmonids and the sensitivity declines with increasing age. Fish that survived the virus infection is asymptomatic virus carriers. In addition to the salmonids virus has been detected in several species. Infection can be transmitted both horizontally and vertically.

Renibacterioses (BKD/*Renibacterium salmoninarum*)

BKD is caused by a gram positive, small rod bacterium *Renibacterium salmoninarum*.

The infection can be transmitted both horizontally and vertically. The disease is favored by low

water temperatures, which is why outbreaks occur mainly during spring and fall at temperatures between 7-15 degrees.

Spring viremia of carp (SVC)

SVD is caused by a rhabdovirus. The disease occurs in Asia and several European countries. The virus has been detected in several fish species. The disease is transmitted only horizontally.

Marteiliosis

is caused by a unicellular parasitic animal (*Marteilia refringens*). The parasite need a crustacean (*Paracartia Grani*) as an intermediate host, a parasite considered not to exist in Sweden due to the climate.

Crayfish plague

is caused by an aquatic fungus parasite, (*Aphanomyces astaci*), which in late 1800 spread to Europe from the U.S. with live crayfish. The disease occurs throughout Europe and North America. The parasitic fungus reproduces by spores spread by water. When the spores finds a crayfish they grow through the skin and attack the underlying tissues.

History

Several Swedish rivers have dams in their reaches due to hydropower stations. These are very effective migrations barrier for feral fish and are of a great help to protect the continental zone from existing and emerging coastal diseases. This gives a different health situation at the coast compared to the continental zone. All transport of live fish from the coastal to the continental zone is forbidden. Due to the migration barriers Sweden has a national conservatory program for salmonids. Migrating brood fish are caught at the first barrier and kept until ready to spawn. In connection with

## OTHER SURVEILLANCES 2009

stripping, the fish are sampled for virus and BKD. After fertilization and disinfection the eggs are placed in quarantine and kept there until the results from the tests are available. The quarantines are supplied with water from the continental zone and outlets are made to the coastal. All eggs from positively tested parents are destroyed. After hatching and rearing, in freshwater emanating from the continental zone, the offspring's are released to the coastal zone.

Sweden has approved disease free zone status (2002/308/EC) for Viral hemorrhagic septicemia (VHS) and Infectious haematopoietic necrosis (IHN) and received additional guaranties (2004/453/EC) for Infectious pancreatic necrosis (IPN), Spring viraemia of carp (SVC) and Renibacterios (BKD). Sampling and diagnostics for these diseases have encompassed all Swedish fish farms since the late 80ies, and since 1994 according to EU directive 92/532 (2001/183).

### DISEASE

Infectious hematopoietic necrosis (IHN) and viral haemorrhagic septicemia (VHS)

Both diseases have greatest impact in aqua culture of rainbow trout (*Oncorhynchus mykiss*) in freshwater, but has been detected in several other species. For both diseases the fish exhibit behavioral changes, lethargy and abnormal swimming (whirling). The fish are anemic with varying degrees of bleeding in multiple organs. Therapy and vaccins are lacking.

Infectious pancreatic necrosis (IPN)

The disease mostly get notice in the form of sudden high mortality in young fish. The fish exhibit external symptoms such as darkening and abdominal distension. Corkscrew- swimmingis characteristic. Internally bleeding in the abdominal fat and internal organs are the most dominant finding. Mortality rates can vary between 10-90%.

Renibacterioses (BKD/*Renibacterium salmoninarum*)

In rainbow trout the disease can be characterized as chronic and provide a continuous low mortality of about 50-10 percent. Infected fish may have an impaired growth and disease can result in a deterioration of quality of fish for human consumption. Salmon and arctic char, however, are more susceptible to BKD, especially in terms of stress, and mortality can reach up to 80 percent.

Spring viremia of carp (SVC)

The symptoms of the disease is usually general, such as darkening, exophthalmia and a slow breathing. The fish swim lazily by sporadic periods of hyperactivity. Common findings are also pale gills, a distended abdomen with ascites and small haemorrhages in the skin and gills. Internally bleeding is found in organs including muscle, swim bladder and brain.

Marteiliosis

The disease casuse reduced fitness, an impaired growth and resorption of the gonads and hence reduced reproductive capacity. When the animals' weaken it will have difficulties to keep the shell halves closed.

The crayfish plague

The signal crayfish - exhibit black (melaniniserade) areas adjacent to fungal contaminated areas of the skin. The spots will disappear in the shedding of the shell, but may gradually come back.

The noble crayfish - The first sign is a high mortality in the crayfish populations. Crayfish exhibit mainly behavioral symthoms such as: Avoid non-lighting (moving during the day), -reduced coordination, balance difficulties.

### LEGISLATION

All the diseases except crayfish plague are included in the Swedish legislation regarding notifiable diseases (SJVFS 2007:090) and the control is specifically regulated in SJVFS 2006:015. Further, IHN, VHS, IPN, BKD and SVC are included in the Swedish Act of epizootic diseases (SFS 1999:657, with amendments). Crayfish plaugue is regulated by the Board of Fishery (FIFS 2001:3).

### SURVEILLANCE

Sweden has two control programs, the national compulsory and the voluntary.

The aim of the programs is to document freedom from IHN, VHS, IPN, BKD and SVD in the Swedish fish population and to contribute to the maintenance of this situation. The programs also provides an opportunity for early detection of new, exotic diseases, thereby improving the conditions of control.

The national compulsory program is regulated by EU directive 2006/88 and the Swedish Board of

## OTHER SURVEILLANCES 2009

Agriculture. Practically it is performed by the Swedish Fish Health Control. It prescribes inspections and sampling for virus and renibacterios (BKD/*Renibacterium salmoninarum*) based on the risk for a farm to obtain infection, its dissemination and impact of infection. For each farm a risk analysis is done, forming the basis for classification and hence the number of visits and samples to be performed in the farm. The inspections are to be performed at a water temperature that is optimum for searched agent.

The voluntary program prescribes an additional inspection at a water temperature of over 14°C, and a yearly sampling for BKD in farms with breeding program.

The National Board of Fisheries implements the control of crayfish for cray fish plague (*Aphanomyces astaci*). White spot syndrome (WSS) has been considerable debated during 2009, above all due to the risks of transmission to wild populations of Crustacea primarily through angling. The disease is not included as an active target in the Swedish control program

During 2009, Sweden also has conducted a screening of (*Marteilia refringens*) in blue mussels. The study was conducted at the Swedish west coast in both farms and wild populations.

All analyses were performed at the Swedish reference laboratory, the National Veterinary Institute (SVA) and testing for virus are performed by cell culture techniques and for BKD by ELISA.

Viral haemorrhagic septicemia (VHS), Infectious hematopoietic necrosis (IHN), Infectious pancreatic necrosis (IPN)

In 2009, 614 pools of samples (spleen, kidney, heart/brain) were tested by a cell culturing method. A pool consists of samples from up to ten fishes. Approximately 6,000 individuals from both continental and coastal zone were tested.

Spring Viremia of Carp (SVC)

In 2009, 5 pools, 10 fish in each (spleen, kidney, heart/brain) were tested for virus by a cell culturing method.

Bacterial Kidney Disease (BKD)

Kidneys from 2,750 fish were tested.

*Marteilia refringens*

150 samples of blue mussel (*Mytilus edulis*) from three farms and two wild populations on the Swedish west coast were tested.

Crayfish plague

The disease was investigated in 20 cases from eight different locations.

### RESULTS AND DISCUSSION

All samples were found to be negative for VHS, IHN, SVC, IPN.

Four cases of BKD were found, of which one in wild brood fish.

Regarding *Martelia refringens* the parasite was found in one farm, and as a consequence models of sampling and methods to control the disease are now valuated. Fourteen cases of crayfish plague were found positive and these were from seven different wild populations.



# Post mortem examinations in food producing animals

## BACKGROUND

Early detection of infectious diseases is of utmost importance in order to mitigate negative effects. The Department for Environment, Food and Rural Affairs (Defra), United Kingdom, has made calculations on number of days from the start of an outbreak until its confirmation and found it to be on average 2,5 days for Highly Pathogenic Avian Influenza in the EU and further that in the last outbreak of Foot and Mouth Disease in the United Kingdom it took 10 days from introduction to detection. During this delay the diseases spreads further, infects more animals and thus increases the size and cost of any control or eradication campaign. For some diseases with mild or no clinical signs the introduction into immunologically naïve populations can most reliably be detected by active surveillance, for example in the form of serological surveys. For diseases with severe clinical signs the first line of defence is the detection of disease by animal owners, field veterinarians or pathologists. International experiences as well as practical examples from Sweden shows that post mortem examinations remains a vital part in disease control and that emerging diseases have many times been detected at the autopsy table. This was for example the case when of PMWS was introduced to Sweden in 2003, and again in 2008 when anthrax was diagnosed for the first time since 1981.

## History

During the last three decades the number of post mortem examinations has decreased with more than 50% compared to earlier figures. The main reason for the decline is that most sanitary slaughterhouses have been closed down. Other contributing factors are the reduction in the number of premises where post mortem examinations can be performed, the decrease in the number of food-producing herds and increased costs for transport of carcasses to the laboratories. As post mortem examinations are considered an important part in the early detection and national surveillance for infectious and emerging disease a specific program for encouraging such examinations by financial means started in the early nineties. Since 1992 almost all post mortem examinations performed on cattle, pigs, sheep, goats and farmed deer have been financed by these funds. Approximately 3,000 animals have been examined yearly, and since 2003 the numbers are increasing. The quantitative aim of the program is to perform 4,000 post mortem examinations every year and by doing so register the health situation among Swedish food-producing animals and, if present, detect infectious diseases. The Swedish Board of Agriculture finances the program and the Swedish Animal Health Services (SvDHSV) is responsible for the organization. The program also includes further education of the veterinary employees at the post

## OTHER SURVEILLANCES 2009

mortem facilities. Yearly courses are held and quarterly newsletters are produced. The program has been of crucial importance to keep the laboratories in southern Sweden in business and thus for maintaining high quality in the surveillance for infectious diseases in Sweden. For farmers affiliated to the SvDHFV the post mortem examinations are performed without costs for the farmers, for others a small cost is charged. Transportation of the carcasses to the laboratories is arranged and financed by the owner, which with large animals can be a problem. Swift arrival to the laboratory, or more specifically its cooling facilities, is of outmost importance for halting the onset of cadaverous change and thus safeguarding the quality of the examination. During 2008 efforts were made in finding more efficient transport systems and in 2009 different options for improving the transport logistics in one identified region were discussed among all stakeholders and regionally adopted information materials were developed. The quality of the carcasses received for post mortem examinations in that region were subsequently improved and the concept will now be implemented in other regions.

During 1998-2001 the number of examinations performed on different species did not correlate to the size of the population in each region. Most cattle, sheep and swine underwent post mortem examination in the Uppsala region whereas the biggest populations are present in the southern parts of the country. A regional imbalance can still be seen in that more examinations are performed in the relatively few regions with close proximity to post mortem examination facilities, but the number of examinations is now definitely highest in regions having high animal density in addition to access to a regional laboratory performing post mortem examinations.

### RESULTS

During 2008 post mortem examinations were performed at five different sites throughout the southern part of the country; Skara (Eurofins), Kristianstad (Eurofins), Uppsala (SVA and SLU), Visby (Swedish Meats) and Karlskoga (DVO in cooperation with SvDHFV and Konvex). Large animals, such as adult cattle, could be examined at four of these sites; Uppsala, Visby, Kristianstad and Karlskoga. A total of, 2,985 post mortem examinations were performed within the program, the

distribution between species is shown in table 18. Out of the 2,985 cases, 118 were diagnosed with a notifiable disease of which 86 were primary cases. In two cases diseases included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments) were detected by the post mortem examinations (Table 18-19).

Table 18. Number of post mortem examinations in food producing animals performed during 2008.

Species	Total in 2008
Swine	1,173
Cattle	646
Sheep	613
Goat	15
Farmed deer	43
Horse	4
Poultry	480
Exotic ungulates	3
Other	8
<b>Total</b>	<b>2,985</b>

### DISCUSSION

The number of post mortem examinations increased from 2,777 in 2007 to a total of 2,985 in 2008. The increase in the total number of examinations was mainly due to a sharp rise (from 80 to 480) in the number of examined poultry, this being related to a program policy change regarding the inclusion criteria for poultry.

As well as being a vital part of the national surveillance for infectious and emerging disease, as illustrated by the detection in 2008 of 86 index cases of notifiable diseases, including two cases of epizootic diseases, post mortem examinations is furthermore an important tool for the individual farmer in solving animal health problems at the farm, and during recent years there has been an increasing interest in the program financing the post mortem examinations of food producing animals. The program continues to be regarded as vital by all stakeholders including the financing Swedish Board of Agriculture, and funds have been secured, and slightly increased, for a continuation in 2010.

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Table 19. Number of diagnosed cases with a notifiable disease 2008.

Disease	Index case	Following cases	Total
Anthrax*	1	2	3
Tuberculosis in birds, <i>Mycobacterium avium</i>	5	0	5
Black leg, <i>Clostridium Chauveoi</i>	10	3	13
Botulism	4	3	7
Foot root, <i>Dichelobacter nodosus</i>	1	0	1
Infectious bronchitis (IB)	1	4	5
Infectious laryngotrachitis (ILT)	9	14	23
Influenza in swine	1	2	3
Listeriosis	32	3	35
Lymphoma	10	0	10
Malignant catarrhal fever	2	0	2
Newcastle disease*	1	0	1
Salmonellosis	9	1	10
<b>Total</b>	<b>86</b>	<b>32</b>	<b>118</b>

\*Diseases included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments) as well as on the OIE list of diseases.

### REFERENCES

- Anonymous, 2009, Jordbruksverket Dnr 33-9456/09, Redovisning av uppdrag om veterinär obduktionsverksamhet.
- Gustafsson, K, Lundstrom J and Robertsson, J-A, 2004. Efter döden upplevelser i Skara. Svensk Veterinartidning; 56 (4), 21-24.
- Gustafsson, K, 2005. Fastingar vid fastning. Svensk Veterinartidning; 57 (3), 23-26.
- Personal communication, Nigel Gibbons, Chief veterinary Officer, Department for Environment, Food and Rural Affairs (defra), United Kingdom.
- Personal communication, Jenny Lundstrom, Swedish Animal Health Service.



# Post mortem examinations in wild birds and mammals

## BACKGROUND

A scanning surveillance program for diseases of wildlife was established in Sweden in the 1940s. The general public, local authorities and hunters all have the opportunity to submit wild animals that have been found dead, or euthanized to the National Veterinary Institute (SVA) for examination.

The surveillance program is funded by hunting fees and governmental funds making the examinations free of charge for the submitters. In addition, an active surveillance program for wildlife diseases was established in 2006 in order to detect and define present and emerging diseases in Swedish wild birds and mammals. Forensic investigations are also performed at the Institute, primarily for large carnivores such as brown bears (*Ursus arctos*), grey wolves (*Canis lupus*), Eurasian lynx (*Lynx lynx*), and wolverines (*Gulo gulo*). An estimated 1,500 to 2,000 animals or animal samples are submitted each year. For every case, a written report is sent to the submitting party and each year, a summary of disease events and results of the disease surveillance programs is compiled for the Environmental Protection Agency, and published on [www.sva.se](http://www.sva.se).

## SURVEILLANCE

The aim of the passive and active wildlife disease surveillance programs is to monitor the health situation in wild birds and mammals in Sweden. Whenever possible, disease-causing agents are identified. The disease surveillance and diagnostics provide key information for wildlife management and often serve as indicators of environmental and ecosystem health, as well as means to help protect human and livestock health.

The National Veterinary Institute is the only laboratory in Sweden where post mortem examinations of fallen wild birds and mammals are performed.

## RESULTS

In 2009, 1,858 samples including 1,423 whole carcasses of wild birds and mammals were examined. Of the 1,423 carcasses, 950 were mammals, primarily carnivores (836) including 408 red foxes (*Vulpes vulpes*), 214 lynxes (*Lynx lynx*), 53 raccoon dogs (*Nyctereutes procyonoides*), 42 badgers (*Meles meles*), 35 brown bears (*Ursus arctos*) and 22 otters (*Lutra lutra*). The 465 birds included birds of prey (148), finches (106), water birds (90), pigeons (27) and corvids (27).

43 cases examined at the Institute were diagnosed with a listed disease according to OIE or National legislation (Table 20). The number of salmonella cases (24) was higher than 2008 (8) and no cases of tularemia were diagnosed 2009 which coincides with lower numbers of human cases compared to 2008. The wildlife disease situation in Sweden remains at a low level with regard to severe infectious diseases. There is a continuous risk of introduction of new diseases from the European continent, but due to the relative isolation of the Scandinavian peninsula, Sweden today hosts healthy wildlife populations.

## REFERENCES

[www.sva.se/vsop](http://www.sva.se/vsop)

Table 20. Findings of *Salmonella* and *Trichinella* in post mortem examinations of wild animals.

Salmonellosis 24 (passerines, woodpeckers, gulls and hedgehogs)

Trichinellosis 19 (14 lynx, 2 grey wolf, 2 red fox, 1 wolverine)



# Antimicrobial resistance in bacteria from animals

## BACKGROUND

SVA has the assignment to monitor and analyze the development of antimicrobial resistance in bacteria from animals and in bacteria from food of animal origin. This is carried out in the Swedish Veterinary Antimicrobial Resistance Monitoring Programme (SVARM) which has been running since 2000. Results of SVARM, i.e. data on antimicrobial resistance in bacteria from animals and data on sales of antimicrobials for use in animals, are published in a yearly report.

The programme is organized and run from the Department of Animal Health and Antimicrobial Strategies at SVA. Integrated with SVARM is the programme SVARMpat focusing on resistance in animal pathogens from farmed animals.

SVARMpat is run in cooperation with Swedish Animal Health Service and is financed by the Board of Agriculture. The reports from SVARM are available at [www.sva.se](http://www.sva.se).

The objectives of SVARM are to detect trends in resistance and to provide a basis for recommendations on use of antimicrobials in animals. Details on methodology used are available in the report ([www.sva.se](http://www.sva.se)). Briefly, three types of bacteria are monitored: zoonotic bacteria, specific animal pathogens and indicator bacteria (*Escherichia coli* and *Enterococcus spp.*) from healthy animals. The rationale for monitoring indicator bacteria, i.e. commensal bacteria from the normal intestinal flora of healthy animals is that resistance among these bacteria reflects the selection pressure of use of antimicrobials in an animal population. Moreover, these bacteria can constitute a reservoir of mobile resistance genes. By using harmonised methodology for studies on indicator bacteria, data can be compared on an international level and over time. Thereby valid conclusions on trends in resistance can be made.

## SUMMARY SVARM 2009

The 2009 report from SVARM shows that the situation regarding antimicrobial resistance in bacteria of animal origin remains favourable from an international perspective. In the ten years since

the program started, the situation has mostly been stable but there are examples of worrying and undesired trends. Methicillin resistant *Staphylococcus pseudintermedius* (MRSP) has emerged as an important pathogen in animal health care and methicillin resistant *Staphylococcus aureus* (MRSA) has found its way into populations of Swedish animals. Also a clone of vancomycin resistant enterococci (VRE) has spread among broilers. These three examples illustrate that the situation can rapidly change in an unfavourable direction and emphasize the need to continuously monitor resistance and use of antimicrobials. But monitoring is only an adjunct to efforts aiming at improving prudent use, infection control and animal health, which are the three cornerstones for mitigating resistance.

The total amount of antimicrobials used for animals was 15,368 kg in 2009, which is the lowest figure in 30 years. The amount of antimicrobials for in-feed or in-water medication has decreased by 8% since 2006 and is today but 13 % of the total sales. The sales of products for administration to individual animals have decreased by 10% since 2006. The sales of cephalosporins, mainly products for dogs, have decreased by 39% since 2006. The sales of antimicrobials for dogs have decreased by 14% since 2006, measured as total number of prescriptions dispensed. The downward trend in prescriptions for dogs is probably explained by ongoing national and local initiatives on hygiene and prescribing policies.

Methicillin resistant *Staphylococcus aureus* (MRSA) were confirmed in two dogs, two cats and two horses in 2009. Since first reported in 2006, there have been 15 cases in dogs, 2 in cats and 12 in horses until the end of April 2010. So far MRSA has not been found in food producing animals in Sweden. Isolates from dogs and cats were of spa-types t032, t127, t002 all of which are common among MRSA from humans in Sweden. In contrast, all isolates from horses are of spa-type t011 which belong to the livestock associated MRSA CC398, commonly found in several animal species in other countries but rare among humans in Sweden. Since there is a zoonotic aspect to MRSA

in animals the situation should be closely monitored. Also, routines and recommendations for prevention of spread, as well as for management of MRSA in animals, should be elaborated.

*Salmonella* is rare in Swedish animals and most incidents involve susceptible strains. In 2009, 91% of the strains were susceptible to all antimicrobials tested and only 4 of 74 strains from food producing animals and 2 of 24 strains from companion animals were multiresistant. Resistance to third generation cephalosporins was not observed. There are no indications of increased occurrence of resistance but in view of the public health consequences vigilance towards resistant *Salmonella* in food-producing animals is warranted. This is emphasised by the three incidents this year of multiresistant monophasic *Salmonella* subspecies I, O 4,5,12;i- in cattle.

Resistance in indicator bacteria, i.e. *Escherichia coli* and *Enterococcus* spp. from the intestinal flora of healthy animals, are believed to reflect the antimicrobial selective pressure in an animal population. In indicator bacteria from fattened calves, studied this year, resistance was most rare. No isolate of *E. coli* was resistant to fluoroquinolones and transferable resistance to third generation cephalosporins was not observed although all samples were screened for this type of resistance. Likewise, resistance to vancomycin, linezolid or streptogramins was not observed in enterococci.

The findings, in agreement with previous studies in dairy cows and calves/yearlings, show that *E. coli* and *Enterococcus* in these categories of cattle is no significant reservoir of resistance genes and indicate a low selection pressure for resistance in Swedish cattle older than six months.

Vancomycin resistant enterococci (VRE) among broilers, screened by culture on vancomycin supplemented media, gradually increased from less than one percent in 2000 to a peak of 41% of 99 samples cultured in 2005. The increase was caused by spread of a single clone of *E. faecium* carrying the vanA gene. This year, VRE were isolated from 23% of 105 samples which is similar to the prevalence in 2006-2008 indicating that the spread has abated.

*Escherichia coli* from clinical submissions were often resistant to ampicillin, tetracycline or trimethoprim-sulphonamides, irrespective of source (pig, cattle, horse, dog or cat). Multiresistance commonly involved these substances, ranging from 4% in isolates from cats to 33% in

isolates from cattle. In addition, resistance to enrofloxacin was common (12%) in *E. coli* from pigs with diarrhoea.

Since 2007, production of extended spectrum beta-lactamases (ESBL) has been confirmed in 14 isolates of *Enterobacteriaceae* from dogs, cats and horses. Beta-lactamases involved were of groups CTX-M-1 and SHV and in addition the isolates were multiresistant.

In *Brachyspira* spp. from pigs, resistance to tiamulin occurred in *B. pilosicoli* but was not observed in *B. hyodysenteriae*. The majority of *B. pilosicoli* and *B. hyodysenteriae* were resistant to tylosin. In *Actinobacillus pleuropneumoniae* and in *Pasteurella* spp. from the respiratory tract of pigs as well as in *Pasteurella* spp. from the respiratory tract of calves resistance was rare. Also in *Fusobacterium necrophorum*, isolated from lame cattle and sheep, resistance was uncommon.

In *Aeromonas salmonicida* subsp. *acchromogenes*, *Flavobacter columnare* and *Flavobacter psychrophilum* from farmed fish, deviating high MICs to nalidixic acid, tetracycline or florfenicol in some isolates indicate acquired resistance to these antimicrobials.

*Streptococcus zooepidemicus* from the respiratory tract of horses were uniformly susceptible to penicillin, but resistance to trimethoprim-sulphonamides was common. Penicillinase production was the most common resistance trait in *Staphylococcus aureus* from skin samples of equine origin (36%). Only 5% were multiresistant.

Most *Staphylococcus pseudintermedius* from dogs with dermatological disorders were resistant to penicillin. Resistance to clindamycin, erythromycin, fusidic acid or tetracycline was also common (between 25 and 31%). One third of *S. pseudintermedius* were multiresistant and 9% were resistant to at least five antimicrobials. The number of methicillin resistant *Staphylococcus pseudintermedius* (MRSP) confirmed has increased since first isolated in 2006. During 2009, 121 MRSP from dogs, 7 from cats and 1 from a horse were verified.

*Pseudomonas aeruginosa* isolated from the external ear canal of dogs were susceptible to polymyxin B, whereas 5% of the isolates were resistant to gentamicin and 25% to enrofloxacin.

### REFERENCES

SVARM 2009, Swedish Veterinary Antimicrobial Resistance Monitoring. The National Veterinary Institute (SVA), Uppsala, Sweden, 2010. www.sva.se, ISSN 1650-6332

# Antibiotic resistance in bacteria from humans

## BACKGROUND

While a few forms of antibiotic resistance are notifiable under the Communicable Disease Act the vast amount of data on antibiotic resistance in Sweden is gathered by the voluntary reporting by Swedish clinical microbiology laboratories. All laboratories take part in the annual resistance surveillance and quality control (RSQC) program, and three fourths of the laboratories also contribute with data on defined invasive isolates to the European Antimicrobial Resistance Surveillance System, EARSS. For some microorganisms data are produced and presented by laboratories with referral functions and/or with special interest in certain species (e.g. *Neisseria* spp.). In the present SWEDRES report the most recent data on antibiotic resistance is presented and analysed together with data from previous years. Some of the most important findings are summarised below.

## SUMMARY SWEDRES 2009

*Staphylococcus aureus*: A total of 1,480 cases of MRSA were notified in 2009, a 13 percent increase compared to 2008. Almost half of the reported cases had acquired MRSA in Sweden, and one-third had acquired the infection abroad. Community-acquired infections dominated among domestic cases but were less frequent among imported cases. Hospital-acquired infections were comparatively more common in imported cases (41 percent) than among domestic cases (12 percent), indicating continued good compliance to basal hygiene principles. Only eighteen invasive isolates of MRSA were found in 2009 and Sweden is still one of the few countries having less than 1 percent of MRSA among invasive *Staphylococcus aureus* (EARSS).

Epidemiological typing of all MRSA isolates is performed primarily by *spa*-typing. The five most commonly encountered *spa*-types in 2009 were

t008, t044, t002, t019 and t015, comprising one third of all isolates. The prevalence of MRSA with PVL toxin was 34 percent and was present in all or a majority of isolates with the common *spa*-types t008, t044, and t019. Multiresistance among MRSA was a rare phenomenon, and most cases could be correlated to six different *spa* types. These strains were often acquired abroad and associated with healthcare. *Staphylococcus aureus* from skin and soft tissue infections (RSQC programme) were susceptible to antibiotics in > 95% of cases.

*Streptococcus pneumoniae*: In 2009 there were 446 notifications of PNSP (*Streptococcus pneumoniae* with MIC of penicillin > 0.5 mg/L) in Sweden, a decrease by 21% compared with 2008. Most cases were identified through nasopharyngeal culture. The majority of PNSP cases, independent of year observed, were found in the age group 0-4 years. Multiresistance (resistance to penicillin and at least two more antibiotics) was common among PNSP. The most commonly found serotypes among all PNSP were types 19F, 23F, 9V, 19A, and 6B. For five antibiotics tested on *Streptococcus pneumoniae* in the yearly RSQC programme 2009 the rates of resistance were slowly increasing, and low rates of quinolone-resistant isolates have been seen since 2005.

*Enterococcus faecalis* and *Enterococcus faecium*: Enterococci, and more specifically vancomycin resistant enterococci (VRE), have been important causes of nosocomial outbreaks in many parts of the world, but have until 2007 been rare in Sweden. In 2007 there were 53 notified cases, in 2008 618 cases, and in 2009 402 cases of VRE. These high notification rates were attributable to the spread of *vanB*-carrying *Enterococcus faecium* in Stockholm, Halland and Västmanland. Intensive infection control efforts, implementation of screening programmes, contact tracing, and also other measures undertaken have contributed to the reduction in new cases in 2009. The strain of

## ANTIMICROBIAL RESISTANCE 2009

*Enterococcus faecium* with the vanB gene, affecting all three counties, was a new strain according to epidemiological typing.

Among invasive isolates of both *Enterococcus faecalis* and *Enterococcus faecium* high-level resistance to aminoglycosides (HLAR) was common with 20% and 25%, respectively.

*Streptococcus pyogenes*: Data was obtained on 134 invasive isolates in 2009 (data derived from eleven laboratories using ADBact laboratory information system). Three isolates were resistant to erythromycin and clindamycin, indicating MLS<sub>B</sub> type of resistance. Thirteen isolates were resistant to tetracycline, a marked decrease compared to 2008.

*Haemophilus influenzae*: Data was obtained in the RSQC programme in 2009 and compared to results from 2008. In 2009 the high frequencies of resistance remained with 23 percent for penicillins and 18 percent for trimethoprim-sulfamethoxazole. Betalactam-resistant strains from all laboratories and from both 2008 and 2009 were selected for further analysis. Co-resistance between trimethoprim-sulfamethoxazole and betalactams was more frequent among betalactamase-negative than among betalactamase-positive strains. Epidemiological typing of these selected strains indicated a wide variety of strains. *Haemophilus influenzae* was rarely found among blood isolates, only 49 cases in 2009 derived from eleven laboratories using ADBact laboratory information system. Ten of these (20 percent) were beta-lactamase producing, and seven were resistant to trimethoprim-sulfamethoxazole.

*Enterobacteriaceae* producing extended spectrum beta-lactamases (ESBL) were made notifiable by the laboratories from February 2007. A total of 3,754 cases were notified during 2009, corresponding to a national incidence of 40 cases per 100,000 inhabitants. When comparing the second halves of 2008 and 2009, respectively, a 27 percent increase of ESBL cases was noted for 2009. The most commonly reported species was *Escherichia coli* (82 percent), followed by *Klebsiella pneumoniae* (7 percent). Most ESBLs were found in urine samples, but 186 cases of invasive infections were noted in 2009. Isolates with ESBLs, most often of CTX-M-type, were often multiresistant, thereby seriously limiting the options for treatment.

*Escherichia coli*, mainly derived from urinary tract infections, are surveyed in the national surveillance program (RSQC) since 1996, and invasive isolates have been included in EARSS since 2001.



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Ampicillin resistance was found in 30 percent of both blood isolates and urine isolates in 2009. Resistance to third generation cephalosporins among blood isolates had increased to 3 % and was often caused by plasmid-mediated ESBLs of CTX-M type. Resistance to fluoroquinolones has increased every year and was similar in urine and blood isolates, 13-15 percent in 2009.

*Klebsiella pneumoniae* is monitored in the RSQC programme and in EARSS since 2005 and with comparable results. Two percent of *K. pneumoniae* were cephalosporin resistant and ESBL-producing. A few isolates of *K. pneumoniae* with KPC-2 or -3 (*K. pneumoniae* carbapenemase) have been detected in Sweden since 2007, and all the cases were healthcare related.

*Pseudomonas aeruginosa* has been monitored in the RSQC programme and through the EARSS network since 2005. The rates of resistance to tested antibiotics were comparable between the two surveillance programmes, but carbapenem resistance was more frequent in invasive isolates (7.5%) than among "all" isolates in the RSQC surveillance (4%). Fluoroquinolone resistance was approximately 10%.

A national surveillance program for *Clostridium difficile* was initiated by SMI in 2009. The program included both a voluntary laboratory reporting system of all new cases and determination of resistance and epidemiological typing of collected

isolates. Among isolates from 25 laboratories, collected during two weeks 2009, the PCR ribotype 014 was most frequent followed by types 020, 001, 023, 078 and 012. One isolate of type 027 was detected; however this isolate was susceptible to moxifloxacin. In summary, there was geographical clustering of certain *C. difficile* types that also were resistant to several antibiotics.

In *Campylobacter jejuni/coli* high levels of resistance were seen for fluoroquinolones (30-60 %), tetracyclines (20-35%) and low but variable for erythromycin (1-7 %) during the last ten years.

*Neisseria gonorrhoeae*. In 2009 611 cases with the disease gonorrhoea were reported. Isolates from 387 of the notified clinical cases were completely characterised at the Swedish Reference Laboratory for Pathogenic Neisseria, Örebro University Hospital, and at Karolinska University Hospital Huddinge, representing 63 percent of the notified cases. In 2009 44 % of these isolates were beta-lactamase producing and ampicillin resistant, and 75 % were resistant to ciprofloxacin.

### REFERENCE

SWEDRES 2009. A Report on Swedish Antimicrobial Utilisation and Resistance in Human Medicine. Swedish Institute for Infectious Disease Control (SMI), Solna, Sweden, 2010.

[www.smittskyddsinstitutet.se](http://www.smittskyddsinstitutet.se), ISSN 1400-3473.





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