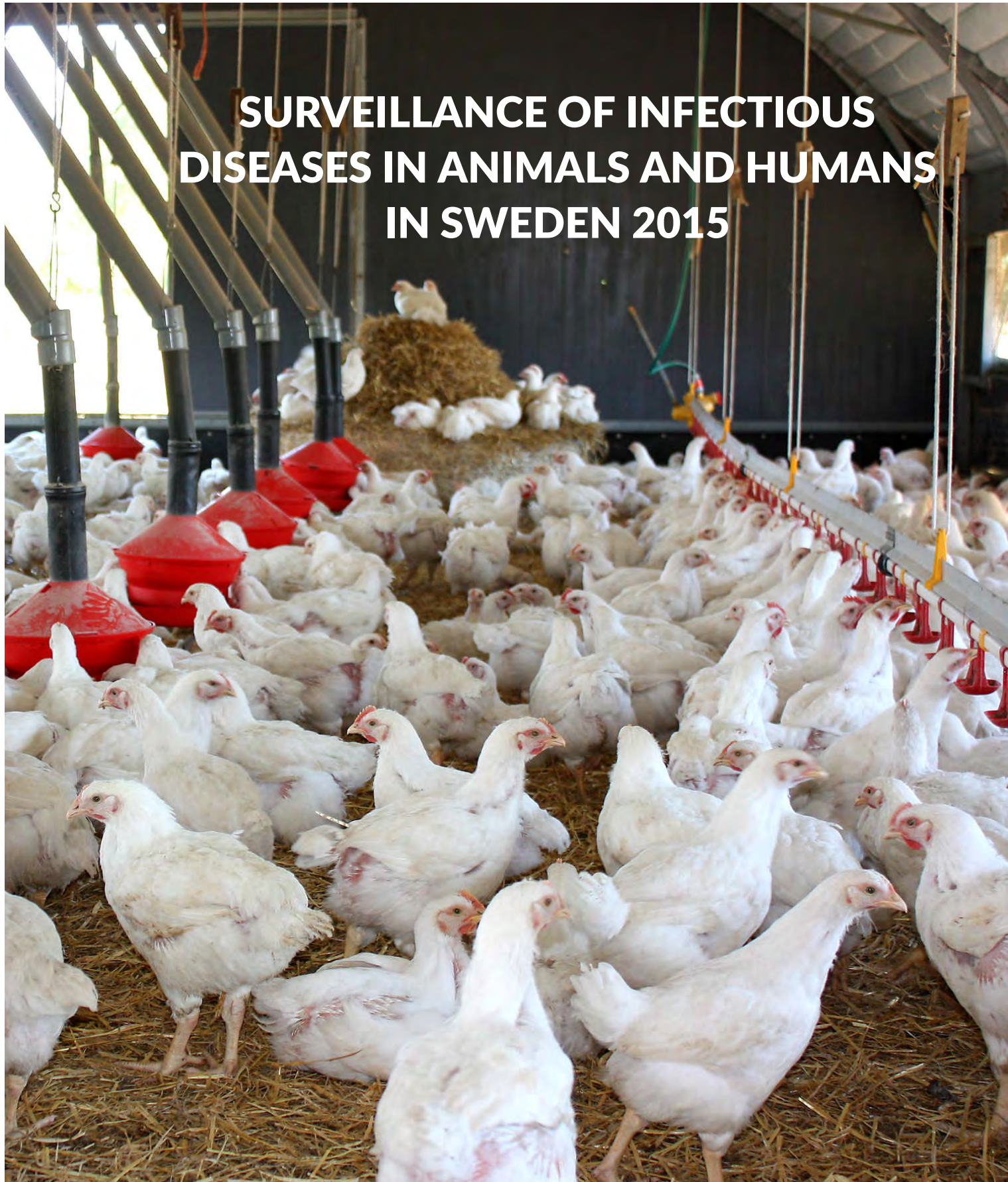


SURVEILLANCE OF INFECTIOUS DISEASES IN ANIMALS AND HUMANS IN SWEDEN 2015



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Photo: Gunilla Hallgren

Introduction

Surveillance of infectious diseases in animals and humans 2015, is the annual update on the surveillance activities carried out in Sweden during the year, for animal diseases and zoonotic agents in humans, food, feed and animals.

Comprehensive animal disease surveillance is an important step in declaring the good health and animal welfare status of Sweden. As stated in the previous report 2014, the maintenance of these surveillance initiatives for serious infectious diseases, within the One Health perspective is not without cost. Resources are required to organise, select and sample diagnostic data from different groups in a representative way, and sustain the use of accurate modern diagnostics. In order to improve the collaboration between the different actors in the system, a working group including authorities and stakeholders was formed. The purpose is to, in a smart and economically feasible way, gather information on the health status of food producing animals. This, in order to follow, prevent and cure health problems in animals and humans as well as establish freedom from certain diseases. In order to improve existing animal surveillance, a national surveillance plan with well-defined quality goals has been developed. The plan is a tool for prioritising both hazards for surveillance and activities related to maintenance and development of surveillance components and programmes and it will continue to be implemented during 2016.

Both human and veterinary epidemiologists struggle with the 'good health status paradox' which means that it can be difficult to motivate the allocation of funding for surveillance efforts when the disease burden is low. However, the declaration of an official health status of Sweden is an important prerequisite for safe trade and movement of animals.

The selection of samples and methods used has to be done in a scientific and transparent way, and the results must be presented.

Surveillance initiatives must be regularly evaluated and allowed to evolve to incorporate new diagnostic methods and new knowledge of the disease. During 2015, a number of interesting projects within this field have been running at SVA. The results will hopefully contribute to more efficient surveillance in the future. The prevalence of *Salmonella* in food producing animals is, like in Finland and Norway, very low. This is illustrated by the low numbers of human cases of salmonellosis caused by domestic food. In order to improve the surveillance of *Salmonella* in dairy herds, the Swedish Board of Agriculture (SBA) is looking into the possibility to launch a bulk milk screening programme. The proposed new strategy would augment existing surveillance with regular national bulk milk surveillance of dairy herds and serological surveillance in beef herds, combined with bacteriological examination.

The evolving situation of African Swine Fever (ASF), avian influenza and Lumpy skin disease in the European region, and just recently Chronic Wasting Disease (CWD) in Norway, is a continuous challenge since it is impossible to anticipate which of the many potential routes will result in disease introduction to Sweden. Good knowledge and awareness in the field, good collaboration with representatives of different sectors along with a well-structured passive surveillance system are vital to prevent the introduction and establishment of serious infectious transboundary diseases from outside of Sweden, and in the case of introduction have means for early detection.

Livestock population and trade in live animals

Demographic data show that most farms are located in the southern and central parts of Sweden and meat and milk are the major lines of production. In the northern part, farms are mainly small. During recent decades the number of holdings with livestock has decreased, but the average size of those remaining have increased.

Figures 1, 2, 3 and 4 give an overview of the livestock population in Sweden in 2015. The data for aquaculture covers 2014.

CATTLE

There are 17,466 holdings with a total number of 1,475,525 cattle (dairy cows, cows for calf production, heifers, bulls, steers and calves younger than one year) in Sweden (Figure 2).

The number of dairy cows has decreased over a long period of time, since the beginning of the 80th the population has almost halved. In 2015, there were 338,397 cows in 4,161 dairy herds with an average of 81 cows per herd. The number of cows for calf production was 184,094 in June 2015 with an average herd size of 18 cows.

In total, approximately 406,000 adult cattle and 22,000 calves were slaughtered during 2015.

PIGS

The total number of pigs was 1,356,027 (Figure 3) in June 2015, which is a slight decrease since 2014. Since 1995 the number of pigs has reduced by 40% and during the past 12 years two out of three holdings have closed down.

About 2,560,000 pigs were slaughtered during 2015.

SHEEP

In 2015, there were 9,110 sheep holdings with a total of 288,675 ewes and rams (Figure 4). Sheep holdings in Sweden are usually small-scale enterprises with an average herd size of 32 adult sheep. During 2015, approximately 256,000 sheep were slaughtered of which 223,000 were lambs.

GOATS

The reported number of goats in December 2015 were 15,001. They were kept on 2,483 different holdings.

POULTRY

The number of fowl has increased continuously the last two decades. In 2015 there were 7.6 million hens (chicken not included) in 2,927 holdings, which means that the population increased but the number of holdings decreased compared to 2014.

Eggs delivered to wholesalers amounted to 105.8 million kilos during 2015.

The number of holdings in June 2015 with broiler production was 263 and about 96 million chickens were sent for slaughter during the year. During 2015, 475,000 turkeys were slaughtered.

The production of geese, ducks and guineafowl is very small. In 2015, 20,092 geese, 1,702 ducks and 301 guineafowl were slaughtered.

FISH AND SHELLFISH

Rainbow trout are the most frequently farmed fish followed by char, salmon and brown trout; salmon and brown trout are mainly for restocking of feral populations. The shell fish production is dominated by cultivated blue mussels.

In 2014, there were 179 holdings with production in aquaculture. The production was 9,454 metric tonnes of food fish, which when converted to round fresh weight is the equivalent of 11,152 tonnes. Rainbow trout dominated, with 85% of the total production of fish for consumption. The total production of fish for restocking was estimated at 1,130 tonnes, mostly rainbow trouts.

To compensate for natural reproduction, that has been lost due to hydroelectric power plants, 2.9 million fry of salmon and sea trout were released, mainly in rivers running into the Baltic sea.

TRADE IN LIVE ANIMALS (LIVESTOCK)

The trade with livestock into and from Sweden is very small.

In 2015, 191 live pigs were brought into Sweden from Norway, two came from UK, one mini-pig

from Denmark and 3,500 pigs were sent from Finland for slaughter. Ten cattle came from Denmark, one from Germany and 1 goat (pet) from Italy.

Approximately 5.6 million day-old chicks (*gallus gallus*) were brought to Sweden from other European countries: Germany, Great Britain, the Netherlands, France and Norway as well as 562,000 hatching eggs from Denmark, France, Poland, Norway and Hungary. 6,748 live poultry came from Denmark.

In addition, 8,000 turkeys (*Melegris gallopova*) were brought from Great Britain and 4,300 ducks (*Aix spp.* and *Anas spp.*) from Denmark as day-old chicks.

Only seven live poultry (silkie) were imported, from USA.

The number of animals that left Sweden for intra-Union trade during 2015 were 269 cattle and 2,472 pigs of which 2,286 were sent for slaughter in Germany. 159 cattle were exported to Russia.

Altogether 5.1 million day-old chicks were sent to Bulgaria, Denmark, Estonia, Lithuania, Poland, Germany, Latvia, the Netherlands and Finland. About 556,000 live poultry (*gallus gallus*) were sent to Germany, Denmark, Norway, the Netherlands and Finland and about 33 million hatching eggs were sent to Belgium, Germany, Finland, Great Britain, Lithuania, the Netherlands, Poland, Romania, Estonia, Norway, USA and Italy.

In addition, there were a few movements of laboratory animals of livestock species into Sweden. In 2015, 10,000 poultry were imported from Norway and 65 pigs from Denmark.

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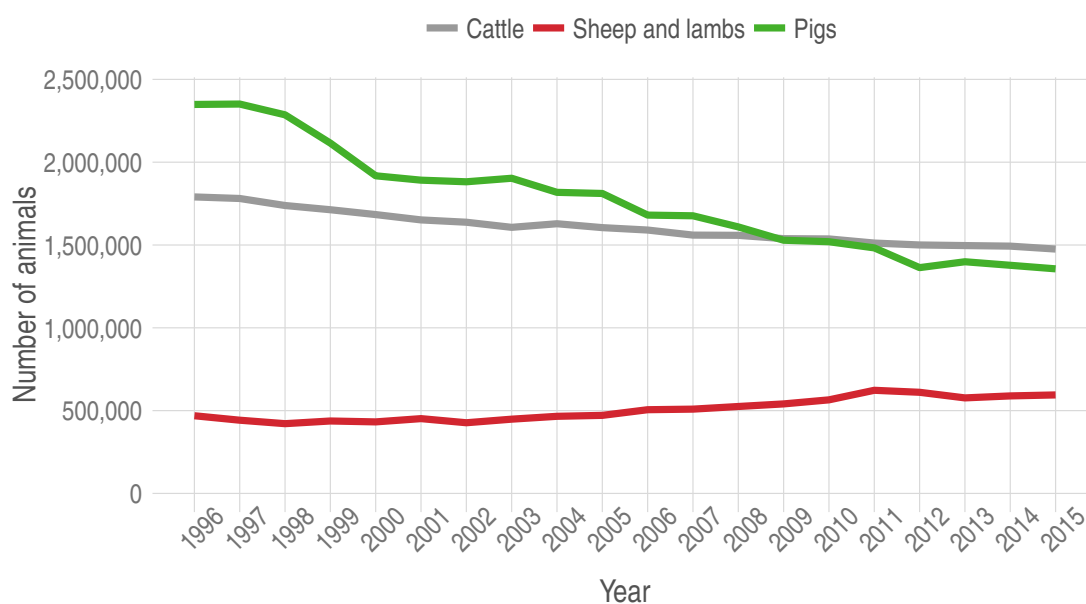


Figure 1: Number of Swedish livestock 1995-2014.

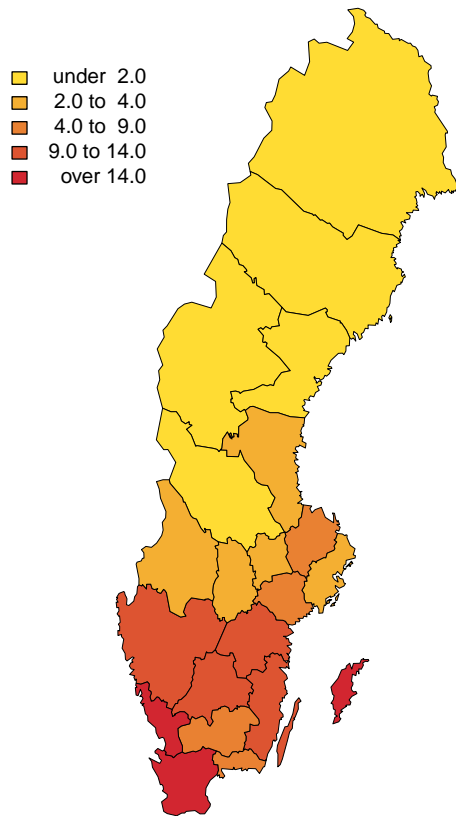


Figure 2: Number of cattle per km² in 21 Swedish counties as of June 2015.

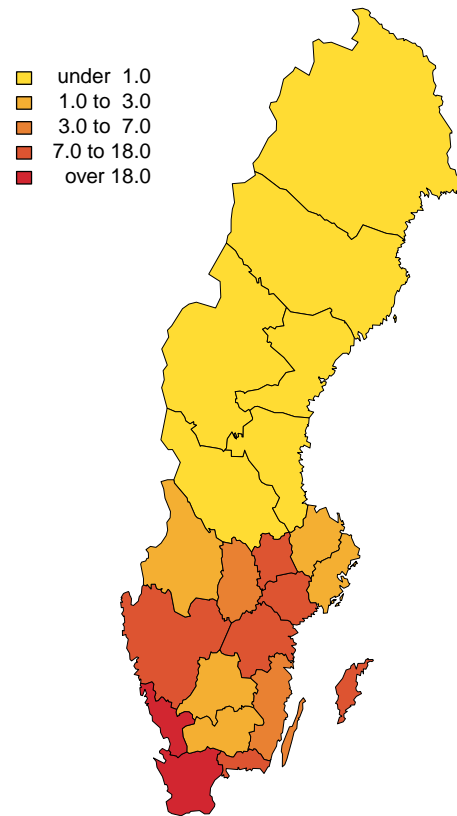


Figure 3: Number of pigs per km² in 21 Swedish counties as of June 2015.

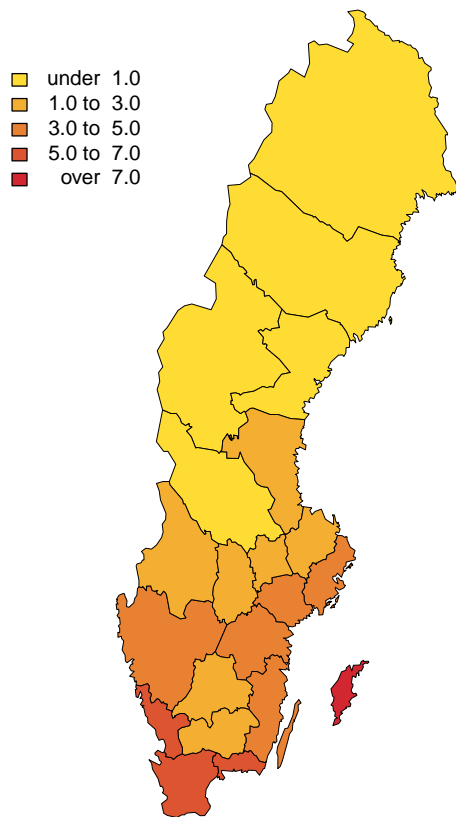


Figure 4: Number of sheep per km² in 21 Swedish counties as of June 2015.

Animal databases



Photo: Erik Ågren

THE CENTRAL REGISTER OF HOLDINGS

The Swedish Board of Agriculture is responsible for the Central Register of Holdings (PLATS). Each holding is allocated a unique identification number (holding number). The register contains information on holdings with bovine animals, pigs, sheep, goats, laying hens and other poultry. Details on holding number, address, type of production, capacity and the geographical coordinates of the holding are included, as well as the name, address and telephone number of the keeper. All egg producers with a capacity of at least 350 laying hens and all those selling eggs for consumption must be registered. The register contains specific information about production method, capacity and the number of houses and sections on the holding.

THE CENTRAL DATABASE OF ANIMAL MOVEMENTS

The Swedish Board of Agriculture is responsible for the Central Database of movements. It contains data on all holdings with pigs, sheep and goats and their movements between holdings. The data encompasses address and holding number as well as name and telephone number of the keeper. The database contains information from the keepers and the abattoirs. Managers may register movements in the database via the internet, or in paper form. Animals are registered in groups in the database when moved. For sheep and goats both the keeper who dispatches the animals, and the keeper who receives the animals, are responsible for reporting to the database, within seven days of the movement.

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 must be reported. The keeper is responsible for reporting of 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 SLAUGHTER REGISTER

The Slaughter Register (SLAKT) is administrated by the Swedish Board of Agriculture. The abattoirs are responsible for reporting all slaughtered animals including wild game. The producer's organisation 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 must be made every week.

THE DATABASE FOR DAIRY HERDS

The national coordinating organisation for dairy and beef production is Växa Sverige. The organisation is responsible for the database for dairy herds (Kodatabas). The database includes milk recordings, fertility results and disease recordings for all animals at the dairy farm. It forms the basis for the development of different management tools used by the farmers, advisors and veterinarians. It is also a valuable tool for research on topics such as: feeding, animal health and genetics. Approximately 90% of all dairy cows in Sweden are included in this recording program. Växa Sverige is further organising the surveillance programmes for bovine leucosis and infectious bovine rhinotracheitis. It is also organising the eradication programme for bovine viral diarrhoea virus and a voluntary control programme for

salmonellosis in bovines. Since the autumn of 2015 the programme for salmonellosis gradually is replaced with a more general biosecurity programme for bovines (Smittsäkrad besättning).

THE ANIMAL HEALTH DATABASE

The Swedish board of Agriculture is responsible for the animal health database (vet@) which 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 continuously report activities of their veterinary practice on production animals. The purpose is to monitor the animal health situation in Sweden and use it as a base for preventive measures.

CENTRAL AQUACULTURE REGISTER

All Aquaculture premises authorised by the county administrative board are registered in the Central Aquaculture Register. The register is administrated by the Swedish Board of Agriculture. The data encompasses name and coordinates of the premise as well as type of production and species kept. It also contains results from official controls, information on the farm's water supply and discharge as well as date information on health status.

THE POULTRY REGISTER

The Swedish board of Agriculture is responsible for the poultry register, which includes data on commercial holdings with ducks, pigeons, pheasants, geese, mallard ducks, chickens, turkeys, guinea fowl, partridges, ratites or quails. The purpose of the register is to allow swift and efficient tracing of contagious diseases (i.e. avian influenza and Newcastle disease). The register encompasses information about the location of the holding, contact information, type of production, species, maximum capacity, number of units on the site etc.

Institutions, organisations and laboratories involved in monitoring



Photo: Magnus Aronson

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, aquaculture and horticulture, including Animal and plant health. This includes monitoring, analysing and reporting to the Government on developments in these areas, and implementing policy decisions within its designated field of activities. The work aim is to fulfil the overall goals of the aggro-food policy and promote food production that is competitive, adapted to environmental and animal welfare concerns, and that benefits consumers.

The SBA promotes animal health by control and prevention of contagious animal diseases. This includes feed, animal by-products and animal health personnel. SBA is also the central authority for animal welfare issues. The SBA district veterinarians

represent a substantial part of the organisation, and constitute the principal body for performing official veterinary controls and for emergency measures to combat contagious diseases. In addition to their official tasks, the district veterinarians also do clinical work and are involved in preventive health care.

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 under the Swedish Ministry of Enterprise and Innovation, and is the nation's leading knowledge centre for infectious diseases in veterinary medicine with expertise within pathology, microbiology, diagnostics, risk assessment, prevention and control of contagious animal diseases and other serious infectious

diseases including zoonotic agents and antimicrobial resistance.

SVA works in four areas: Disease monitoring and contingency planning, diagnostics and analysis, research and development and knowledge communication.

Several control- and monitoring programmes are conducted in cooperation with stakeholder organisations and relevant authorities. SVA outlines the national surveillance plan that is confirmed and enacted by the SBA.

THE PUBLIC HEALTH AGENCY OF SWEDEN

The Public Health Agency of Sweden is a government agency accountable to the Government. This authority operates across the public health spectrum and integrates communicable disease control with other public health work. It works to identify and highlight public health issues where effective interventions can be made. The authority collaborates with other authorities, county councils and municipalities to develop a national knowledge support and to follow up interventions. The Public Health Agency of Sweden promotes health and prevents diseases by supporting communicable disease control with epidemiological and microbiological analyses. The authority also focuses on preparedness for outbreaks of severe infectious diseases, both within the country and outside the borders. Diagnostic analyses of different bacteria, viruses and parasites, as well as water and environmental analyses are carried out by the authority.

NATIONAL FOOD AGENCY

The Swedish National Food Agency (NFA) is a federal agency under the Ministry for Enterprise and Innovation. The NFA works in the interest of the consumer to ensure food safety, to promote fair practices in food trade and to promote healthy eating habits. To accomplish this mission, the agency develops and issues regulations, advice and information as well as coordinates and carries out control. As a basis for these activities the agency performs risk and benefits analyses, collects data on food consumption and composition, and carries out microbiological, chemical and nutritional analyses on food and water. The NFA is also responsible for environmental issues, emergency preparedness, and coordination of drinking water control.

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 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 for prevention, surveillance and eradication of contagious diseases.

DAIRY SWEDEN

Dairy Sweden is the national industry organisation for Swedish dairy farmers and the Swedish dairy industry. Dairy Sweden works on behalf of its owners, who are the six largest dairy companies in Sweden. These companies represent more than 98% of Swedish milk production, including three livestock cooperatives (one of them is Växa Sverige). Dairy Sweden gathers, develops and communicates knowledge relating to the entire chain from cow to consumer, including animal health.

FARM & ANIMAL HEALTH

Farm & Animal Health, is a veterinary consulting company owned by the main meat producing companies in Sweden. The company's business idea originates from the 1960's and is to promote healthy animals for profitable farming. Focus is to prevent animal health problems for pigs, cattle (for meat production) and sheep as well as to improve animal welfare.

The activities are performed with a clear national focus and the consulting services are open to all farmers. A large part of the activities and services are based on officially approved animal health programmes for pigs, cattle and sheep. In addition, Farm & Animal Health is assigned by the Swedish Board of Agriculture to perform specific disease control and surveillance programmes. Examples of such programmes are surveillance of porcine reproductive and respiratory syndrome virus in pigs, the control of Maedi-visna in sheep and Johne's disease in cattle, monitoring of antimicrobial resistance in disease causing bacteria and the national necropsy programme of livestock animals.

Applied research and development are important parts of the business and projects are often performed in collaboration with the National Veterinary Institute and the Swedish University of Agricultural Sciences.

LUNDEN ANIMAL HEALTH ORGANISATION

Lunden Animal Health Organisation is a veterinary consulting company working with pig health and welfare. The objective is to gather, develop and communicate knowledge associated with pig issues. The organisation is part of the national surveillance programme for pig diseases and has permission to perform health control as well as administering a voluntary Salmonella control programme.

SWEDISH POULTRY MEAT ASSOCIATION

Swedish Poultry Meat Association (SPMA) represents 99.5 % of the poultry meat production of chicken, turkey, goose and duck in Sweden, with members from the entire production chain. The members are obligated to participate in the animal welfare and health programmes, administered by SPMA such as control for Salmonella, Campylobacter, coccidiosis and clostridiosis, to meet high standards for food hygiene and safety.

The SPMA is multifunctional; the major task is the work associated with economic and political industry related matters important to its members. SPMA receives legislative referrals from the Swedish public authorities and the EU's institutions. The organisation also initiates and economically supports research.

THE SWEDISH EGG AND POULTRY ASSOCIATION

The Swedish Egg and Poultry Association is the national organisation for Swedish egg producers, hatcheries, rearing companies, egg packing stations

and feeding companies.

The Swedish Egg and Poultry Association is responsible for the organisation of surveillance programmes for animal health and welfare and the voluntary Salmonella control programme. The objective is to support profitable egg production, with a high standard of animal welfare, food hygiene and safety.

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Disease Surveillance 2015

Atrophic rhinitis

BACKGROUND

Atrophic rhinitis (AR) is caused by toxin-producing strains of *Pasteurella multocida*. Since *P. multocida* is a secondary invader and not capable of penetrating an intact mucosa, it is dependent on other infections. Traditionally, *Bordetella bronchiseptica* has been considered the most important precursor, but other bacteria and viruses may also precede *P. multocida* infection. Atrophic rhinitis was a common disease in pig production but improvements in rearing and disease prevention have caused the disease to gradually fade away. Farm & Animal Health administers a control programme which has been in place since 1995.

DISEASE

When *P. multocida* penetrates the nasal mucosa, its toxins can affect the bone building process and the snout may progressively become twisted. Affected pigs will also show retarded growth. *P. multocida* can also damage the nasal epithelium and cilia causing inhaled air to reach the respiratory organs without being filtered or warmed, which in turn increases the risk for other respiratory infections.

LEGISLATION

Atrophic rhinitis is a notifiable disease according to SJVFS 2013:23.

SURVEILLANCE

The purpose of the control programme is to declare herds selling breeding stock free from infection with

toxigenic *P. multocida*, and thereby decrease the incidence of AR in all herds. Nucleus and multiplying herds are actively controlled for the presence of toxigenic *P. multocida* at least once a year and every time there is clinical suspicion of AR. Eradication of *P. multocida* is not realistic since it is an ubiquitous bacterium that can affect all mammals. However, anytime AR is suspected in a herd, tests should be performed for the presence of toxigenic *P. multocida*. If toxigenic *P. multocida* is detected, the health declaration is withdrawn and restrictions on the sale of pigs are put in place 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 1980s and early 1990s offered the possibility to combat AR in an effective way. Nasal swabs are cultured on a special media overnight. The entire microbial growth is harvested and diluted in water and the presence of the *P. multocida* toxin is assessed by an ELISA system.

RESULTS AND DISCUSSION

Atrophic rhinitis used to be a common disease but, due to efforts made in the early 1990s and the control programme initiated in 1995, the disease is now very rare. The last Swedish herd was diagnosed with AR in 2005 (Table 1). In 2009, *P. multocida* was detected in 10 out of 34 imported Norwegian boars in quarantine. These boars were isolated and found negative for *P. multocida* at re-sampling and moved to a boar station as intended.

Table 1: The total number of samples and the outcome of nasal swabs analysed for *P. multocida* 2005-2015. 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
2005	2,413	29	2
2006	1,836	2	0
2007	1,878	1	0
2008	462	0	0
2009	1,724	10	1
2010	1,523	0	0
2011	1,323	0	0
2012	1,431	0	0
2013	1,027	0	0
2014	1,050	0	0
2015	844	0	0

Aujeszky's disease

BACKGROUND

Aujeszky's disease (AD) is caused by a herpes virus with the capacity to infect several species but pigs are the natural host. The disease is of importance for pig production worldwide although it is controlled in many countries, at least in the domestic pig population. AD is widespread in the wild boar populations in Europe and wild boars are reported to develop clinical signs of disease and could act as reservoirs but their role in transmitting the disease is not well known. Other species that are infected, including cattle, sheep, goats, dogs and cats, develop clinical signs but are not of importance for the transmission of the disease, but rather considered as dead-end hosts. A few cases of human infection have been reported but AD is not considered a zoonotic disease.

Sweden has been officially free from AD since 1996 (Commission Decision 96/725/EU with amendments). This status was achieved following a national, government-supported control programme, that was introduced in 1991 and operated by the Farm & Animal Health. Farm & Animal Health is also responsible for the ongoing active surveillance programme and reports to the Swedish Board of Agriculture.

DISEASE

The clinical presentation 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. Species other than pigs develop neurological signs including severe itch ('mad itch') and die within 1-2 days.

LEGISLATION

The disease is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments) and is thereby notifiable on clinical suspicion for all veterinarians and farmers. Sweden has been granted certain additional guarantees by the European Commission regarding AD, in order to protect the Swedish pig health status (Decision 2008/185/EC).

SURVEILLANCE

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

Passive surveillance

As AD is notifiable on clinical suspicion for both veterinarians and farmers, cases with clinical signs consistent with AD will be investigated following the notification to the Swedish Board of Agriculture. The investigation includes sampling of sick or dead animals and examination of the herd for presence of clinical signs and production results. The investigated farm is also placed under restrictions during the investigation.

Active surveillance

In 2015, all samples collected in the abattoir sampling part of the surveillance carried out by the Farm & Animal Health for porcine respiratory and reproductive syndrome virus (PRRSV) were used for the active surveillance for AD. See chapter on PRRS for details on sampling and population. Ongoing testing of animals for export and at breeding centres adds to the active disease surveillance.

In addition to the surveillance of AD in domestic pigs there is also an active surveillance of AD in wild boar, see chapter Infectious diseases in wild boars.

RESULTS

Passive surveillance

During 2015, one clinical suspicion of AD was investigated. In this herd, birth of weak piglets that died within hours was the main clinical manifestation. Adult animals showed no clinical signs consistent with AD. Organ samples from dead piglets and blood samples from sows were analysed for virus genome and for antibodies to AD, classical swine fever and PRRS. Following sampling and testing, the herd was declared negative for AD.

Active surveillance

In 2015, 2,383 samples corresponding to 3 samples per sampling occasion from 521 herds sampled at slaughter were analysed within the active surveillance programme. Each herd was sampled 1-2 times (max 6 times) during the year. All samples were negative for antibodies to the AD virus.

Approximately 1,400 samples from animals for export and from breeding centres were tested during 2015 and all were negative for antibodies to 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 design of the active surveillance has been changed several times since 2007 and since 2011 the AD surveillance is based solely on abattoir sampling in the PRRS surveillance programme. The effects on probability of freedom and sensitivity of the surveillance of these changes have not been evaluated (Table 2).

Table 2: Number of samples and sampling population included in the active surveillance of Aujeszky's disease 2007-2015.

Year	Sampling population	Number of samples
2007	Boars and sows at slaughter	4,529
2008	Boars and sows at slaughter	3,612
2009	Boars and sows at slaughter	776
2009	Fatteners at slaughter	2,712
2010	Field sampling of nucleus herds, multiplying herds and sow pools	1,070
2010	Abattoir sampling	4,371
2011	Abattoir sampling	2,308
2012	Abattoir sampling	2,152
2013	Abattoir sampling	1,548
2014	Abattoir sampling	2,028
2015	Abattoir sampling	2,383

Bluetongue

BACKGROUND

Bluetongue is a vector borne disease of ruminants and camelids caused by any of 27 serotypes of bluetongue virus (BTV). The virus is transmitted by haematophagous midges (*Culicoides* spp).

Until 1998, bluetongue had not been detected in any European country but since then, outbreaks have been detected in several Mediterranean countries. In August 2006, 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 2008, further cases were reported and vaccination campaigns were launched in most of EU as soon as inactivated vaccines became available. In September 2008, the first case of BTV-8 infection in Sweden was confirmed. A vaccination campaign and intensive surveillance activities were initiated nationally, with focus on the southern part of the country. Following the detection of infected animals in new areas, the zones were adjusted accordingly. Vaccination and surveillance activities continued in 2009. In the first quarter of 2009 transplacental infection was detected in three newborn calves, all three cases originating from infections of their dams in autumn 2008.

In December 2010, after extensive surveillance, Sweden was declared free from BTV-8. After that a yearly surveillance according to Commission Regulation (EC) No 1266/2007, with amendments, has been carried out.

DISEASE

BTV causes clinical disease 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 restriction of movements of certain animals of susceptible species are governed by Regulation 1266/2007 with amendments. Bluetongue is a notifiable disease and 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. 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). Organs and blood were analysed with real-time pan-PCR detecting 24 serotypes.

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

Suspicious based on clinical signs must be reported to the Swedish Board of Agriculture and will be subsequently investigated.

Active surveillance

Vector surveillance

The vector surveillance was initiated in 2007 in order to document the activity of relevant *Culicoides* spp. throughout the different seasons of the year. The programme was continued until 2010 but not performed thereafter as Sweden was declared free from BTV-8.

Targeted risk based monitoring

For the 2015 Bluetongue surveillance, approximately 1,360 animals from 136 herds geographically spread over the country were selected for testing. The holdings were not randomly selected, since the number of holdings tested was distributed among the state district veterinarians in accordance with the cattle density in each county. Ten animals from each holding were selected for testing by the sampling veterinarian according to certain fixed inclusion criteria; lactating, unvaccinated, having grazed (been exposed to the vector) during the last season. The sampling took place after the vector season, from December 2015 until February 2016 and samples were analysed with the milk ELISA routinely used. The number of tested herds was sufficient to detect 2 % prevalence with 95% confidence.

In addition to the surveillance programme, serological testing for bluetongue prior to import and export, and at breeding centres was performed.

RESULTS

Two clinically suspect cases were investigated and tested during 2015, and found negative. All other testing performed in 2015 was also negative.

DISCUSSION

In summary, no clinical suspicions of bluetongue were confirmed nor was there any indication of viral circulation during 2015.

Competent vectors are present in Sweden and may spread the infection. Reintroduction of the virus to Sweden may occur by infected animals, infected vectors or other yet unidentified means.

At present, there are no indications of BTV-8 circulation in neighbouring countries. However, as new serotypes emerge in the Mediterranean region or start circulating worldwide, this situation could rapidly change. Moreover, as national vaccination campaigns in northern Europe are ceasing and the prevalence of seropositive animals decline, the population will again become susceptible to BTV-8. Therefore, new introductions of this serotype, or any remaining foci in previously infected countries, could pose a threat.

During 2012 BTV-14, was detected in cattle in Estonia, Latvia, Lithuania, Poland and Russia. Sequencing was performed and indicated that the positive cases were derived from a common source and

suggested significant spread of the virus in the field. The strain was identified as a BTV-14 reference or vaccine strain, possibly indicating the use of a live BTV-14 vaccine.

In 2014 and 2015 BTV-4 spread through Eastern Europe and reached Austria before the end of the vector season, and in late 2015 France reported that BTV-8, of the Northern European strain from 2007, had re-emerged in the central parts of the country. Again demonstrating that BTV may spread and take hold in livestock populations in Europe.

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Bovine spongiform encephalopathy



Photo: SVA

BACKGROUND

Classical bovine spongiform encephalopathy (BSE) belongs to the group of diseases called transmissible spongiform encephalopathies (TSE). It was first described in cattle in the UK in 1986 and from there the disease spread to a large number of European countries as well as countries outside Europe. The current theory about the causative agent is the protein-only hypothesis. This theory assumes that misfolded prions (small proteins) induce the same misfolded structure in normal proteins in the body of the host, resulting in accumulation of prions and cellular damage without involvement of any microorganism. Classical BSE has primarily spread through contaminated meat and bone meal (MBM), i.e. MBM containing parts of animals infected with BSE. However, the primary source of the epidemic has not been established.

In 1996, the disease became a public health concern, after the detection of a new variant of Creutzfeldt-Jacob Disease in humans (vCJD), likely

to be linked to classical 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, restrictions related to feed to avoid recycling of infectious material to ruminants through infected MBM and when a rapid test became available also an intensified surveillance.

In recent years, atypical strains of BSE which show diagnostic dissimilarities with classical BSE have been described. These cases probably occur spontaneously and possible links to classical BSE and potential zoonotic aspects are being discussed.

Sweden has historically had a low risk of introduction of classical BSE and a low risk of recirculation of the disease if it had been introduced. This has been assessed through the Geographical Bovine spongiform encephalopathy Risk (GBR) by the Scientific Steering Committee and by the European Food Safety Authority (EFSA), and later by the OIE Scientific Commission. Sweden is currently,

recognised as having negligible BSE risk, as a result of a resolution adopted by the OIE International Committee.

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 atypical BSE of H-type, i.e. not classical BSE.

DISEASE

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

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, on national level the sampling is regulated by SJVFS 2010:9 saknr K19, last amended through SJVFS 2013:3. BSE is a notifiable disease under the Swedish Act of Epizootic diseases (SFS 1999:657, with amendments) and there is a scheme to compensate farmers for losses due to eradication measures.

SURVEILLANCE

Feed

In order to survey compliance with the feed bans, samples are collected at feed mills and at farm level, of imported raw material for feed production and analysed for the presence of MBM using microscopy, Regulation (EC) 152/2009. The Swedish Board of Agriculture and the County Boards are responsible for this surveillance.

Animals

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

Passive surveillance

All suspicions of BSE (bovine animals not responding to treatment, with clinical signs that are compatible with a BSE diagnosis) must be reported to the

authorities. The obligation to report applies for animal owners, veterinarians and everyone else who is responsible for the animals. Samples are analysed with Bio-Rad TeSeE short assay protocol (SAP) in combination with Bio-Rad TeSeE Western Blot.

Active surveillance

The surveillance design is in accordance with Regulation (EC) No 999/2001 Annex III and Sweden applies derogation for remote areas with low density of cattle in accordance with Commission Decision 2008/908.

The following categories were sampled in the active surveillance:

- Cattle of Swedish¹ origin above 48 months of age that have remarks at antemortem inspection before slaughter or are emergency slaughtered.
- Cattle of other than Swedish¹ origin above 24 months of age that have remarks at antemortem inspection before slaughter or are emergency slaughtered.
- All slaughtered cattle above 30 months of age that originate in a country other than Sweden¹.
- All fallen stock (animals dead or killed on farm but not slaughtered for human consumption) above 48 months of age that originate in Sweden. For cattle that originate in a country other than Sweden, the age limit for sampling is 24 months. The animals are sampled at the rendering plants or at necropsy. Sweden applies derogation (Regulation (EC) 999/2001) for remote areas with a low cattle density, where no collection of dead animals is organised. The cattle population in these areas does not exceed 10% of the total bovine population in Sweden.

All samples were examined with Bio-Rad TeSeE SAP. In case of positive or inconclusive results the material was prepared and examined with Bio-Rad TeSeE Western Blot.

RESULTS

Feed

In 2015, 64 feed samples were taken at feed mills, 41 of these were from feed (29 were cattle feed) and 23

¹Cattle that originates in Sweden or in a country included in the list in SJVFS 2013:3, based on Commission Decision 2009/719.

from raw materials for feed production. All of these samples were negative. No samples were collected at primary production at farm level during 2015.

Animals

Passive surveillance

In 2015, one cattle was examined due to clinical suspicion, with negative results.

Active surveillance

In 2015, 10,042 samples were examined for BSE. All samples were negative. Of these samples 9,789 were from fallen stock, 38 samples were from animals with remarks at antemortem inspection before slaughter, 215 samples were from emergency slaughtered animals.

DISCUSSION

No positive BSE cases were detected. Preventive measures have been in place for many years and the fact that no cases were detected supports 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 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 source of the large epidemic of classical BSE has not been determined and atypical cases cannot be excluded as the source. Thus, the atypical cases may be a potential source of a new epidemic. As the number of cases of classical BSE

is decreasing within the European Union, surveillance is decreasing and suggestions have been made to allow the use of MBM in feed within the EU. Strict separation and bans of these feeding practices must be kept in place to avoid any possibility of recirculation of BSE if it were to enter the system again. Recent international reports of a few cases of classical BSE in young animals born long after implementation of the strict feed ban indicates either problems with the ban or that there are other causes of classical BSE which we yet do not have knowledge of. The last chapter in the BSE history has not yet been written.

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Bovine viral diarrhoea



Photo: Gunilla Hallgren

BACKGROUND

Bovine viral diarrhoea (BVD) is caused by bovine viral diarrhoea virus (BVDV), which is classified in the genus Pestivirus and 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 spread between animals via direct or indirect routes. A voluntary surveillance and control programme with the objective to eradicate BVD without vaccination was launched by the Swedish Dairy Association in 1993. The government and the farmers share the costs for sampling and testing. Since June 2001, there is also a compulsory control programme requiring all cattle herds to be tested for BVDV on a regular basis. Since 2014, Sweden is considered free from BVD.

DISEASE

BVDV may induce disease of varying severity, duration and clinical signs after an incubation period of

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

LEGISLATION

BVD is a notifiable disease (SJVFS 2013:23). The voluntary control is regulated in SJVFS 1993:42 and the compulsory in SJVFS 2002:31.

SURVEILLANCE

Herds are individually risk categorised based on the number of herds they have purchased from and sold to during the preceding 12-month period.

Surveillance of dairy herds is performed by sampling bulk milk in conjunction with milk quality testing. The laboratory gets an order of which herds

to sample from Växa Sverige. All samples are marked using bar code labels. Surveillance of beef herds is performed by blood sampling at slaughter. Field testing can also be carried out as a backup component if case herds cannot be accessed through the abattoir or through sampling of bulk milk. The scheme is designed to detect the presence of infection at a herd design prevalence of 0.02%, with 99% confidence. The within-herd design prevalence is set to 30%. In case of re-appearance of BVD, herds that are infected will be screened, and persistently infected virus carriers identified and removed. Details on numbers of samples and herds tested 2015 are given in tables 3 and 4.

Diagnostic testing is performed at the National Veterinary Institute. For screening, an indirect antibody ELISA (Svanovir® BVDV-Ab ELISA) on serum, milk and bulk milk samples is used. Presence of virus is analysed by an in-house IPX (immunoperoxidase) or PCR tests.

RESULTS

Numbers of antibody positive bulk milk, slaughter, and field samples tested in 2015 are given in table 3. As shown in table 4, a total of 7 herds (all beef herds) were antibody positive during the year. All those herds were investigated and considered to be non-infected. In 2015, no newly infected herds were identified and no virus positive animals were born.

DISCUSSION

All herds in Sweden were affiliated to the voluntary or compulsory programmes during 2015. At the end of the year, no herd was diagnosed to have an ongoing BVD-infection. A newly infected herd has not been detected since 2011, and the last virus positive animal was born in an infected dairy herd in 2012. Since 2014, Sweden is considered free from BVD. Continued surveillance is necessary to confirm freedom from the disease.

REFERENCES

Växa Sverige, Statistics for 2015.

Table 3: Total numbers of samples with different contents of BVDV antibodies tested in 2015.

Sample type	Class/Finding	Herds	Animals
Bulk milk	0-1 ^A	3,790	-
Bulk milk	2-3 ^A	0	-
Blood sample at slaughter	Negative	-	11,093
Blood sample at slaughter	Positive	-	7
Field sample	Negative	-	7
Field sample	Positive	-	0

^A Class 0-1 = no or very low levels of antibodies; Class 2-3 = moderate or high levels of antibodies.

Table 4: Dairy and beef herd results from testing of BVDV antibodies in bulk milk or blood samples in 2015 divided by herd level risk

Herd level risk ^A	Herd numbers (N)	Surveillance area	
		Dairy	Beef
<i>Low risk</i>	N of herds	2,465	7,027
	N of herds tested	1,044	1,726
	N positive	0	3
<i>Medium risk</i>	N of herds	1,655	2,749
	N of herds tested	1,571	1,695
	N positive	0	1
<i>High risk</i>	N of herds	315	342
	N of herds tested	299	283
	N positive	0	3

^A Based on the number of herds they have purchased from and sold to during the preceding 12 month period

Brucellosis

BACKGROUND

Brucellosis is caused by a zoonotic, gram-negative bacterium 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, *Brucella suis* in pigs, *Brucella abortus* in cattle and *Brucella canis* in dogs. The infection is transmitted by contact with placenta, foetus, foetal fluids and vaginal discharges from infected animals and may also be found in milk, urine, semen and faeces. In utero infections occur, however, venereal transmission seems to be uncommon. Humans are usually infected through contact with infected animals or contaminated animal products such as cheese made of unpasteurised milk.

Brucellosis was eradicated from the Swedish cattle population during the first half of the last century. The last Swedish bovine case was recorded in 1957. Brucellosis in humans has been a notifiable disease in Sweden since 2004. Between 4 and 16 human cases have been reported annually. Most of these patients have acquired the infection outside Sweden or via consuming products from endemic countries.

DISEASE

Animals

In animals, brucellosis causes mainly reproductive disorders such as abortions, orchitis and epididymitis. Arthritis is occasionally seen in both sexes. Systemic signs and deaths are rare, except in the foetus or newborn. 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

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 generalised aches. Some patients

recover spontaneously, while others develop persistent symptoms that typically wax and wane. Genitourinary involvement occurs in 2-20% of the human cases. The mortality rate is low, around 2%.

LEGISLATION

Animals

Brucellosis in food-producing animals is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments). Vaccination is prohibited and notification of suspect cases is mandatory. Sweden's bovine brucellosis free status has been officially stated in EU legislation since 1994, Decision 2003/467/EC. Ovine brucellosis is encompassed by Directive 91/68/EEC. Sweden was declared officially free from brucellosis in sheep and goats in 1995, decision 94/972/EC.

Current surveillance standards for bovine and ovine brucellosis are given in the EU legislation, Directive 64/432/EEC and Directive 91/68/EEC, respectively.

Brucellosis in non-food-producing animals is not included in the Swedish Act of Epizootic diseases but is yet a notifiable disease.

Humans

Brucellosis has been a notifiable disease since 2004 according to the Communicable Disease Act (SFS 2004:168 with the amendments of SFS 2013:634).

SURVEILLANCE

Animals

The purpose of the surveillance activities 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. Since the start of the screenings, no samples have been confirmed positive. All diagnostic testing as outlined below is performed at the National Veterinary Institute. Bovine samples (serum and milk) are tested with an ELISA, and porcine, ovine or caprine samples (serum) are tested with Rose Bengal Test (RBT). In case of positive reactions in the ELISA or RBT, serum samples are confirmed with Complement Fixation Test (CFT). For

positive bovine milk samples, serum samples are requested for re-testing with the ELISA.

Diagnostic tests for animals with clinical signs suggesting brucellosis, animals included in the passive postmortem surveillance programme or animals that are to be exported/imported will often be tested with the same diagnostic tests as used in the Swedish surveillance programme. For rare species, CFT is most commonly used and Rapid Slide Agglutination Test (RSAT) is the most common test for dogs. A positive case is defined as an animal from which *Brucella* spp. has been isolated, or an animal with a confirmed positive serological reaction.

Passive surveillance

Animals

Suspicious based on clinical signs in food producing animals must be reported to the Swedish Board of Agriculture and will be subsequently investigated. In addition, culture for *Brucella* spp. is included in the enhanced passive surveillance of aborted foetuses of ruminants and pigs.

Brucellosis in dogs is not included in the Swedish Act of Epizootic diseases and the zoonotic potential of *B. canis* is considered to be significantly smaller than that of *B. abortus* or *B. melitensis*. Nevertheless, confirmed cases of infection with *B. canis* are notifiable and cases have also been investigated and put under restrictions by the Swedish Board of Agriculture. Imported dogs or dogs mated abroad are seen as a risk factor for introduction of *B. canis* into Sweden.

Humans

Surveillance in humans is passive. Diagnosis of human cases is made by detection of *Brucella* species in blood, bone marrow, bronchoalveolar lavage, biopsy, pleural effusion or urine or by detection of antibodies in blood. The bacteria are isolated by culture of clinical samples, and identified by direct real-time PCR on the samples or of colonies.

Active surveillance

Animals

Screening for *B. abortus* has been conducted regularly in Sweden since 1988, for *B. melitensis* since 1995 and for *B. suis* since 1996.

Ongoing serological testing of all susceptible species prior to export, and in bulls and boars at semen collection centres, adds to the active disease

surveillance of *Brucella* spp.

Surveillance for brucellosis in cattle

From 1997 and onwards, approximately 3,000 samples (bulk milk and/or serum samples) have been tested each year for antibodies against *B. abortus*. Samples have been collected within the surveillance programmes for bovine virus diarrhoea and enzootic bovine leucosis and obtained from those samples by convenience sampling (in other words not strictly random), evenly distributed throughout the sampling period. This sampling is, since 2010, conducted every third year and will be performed next time in 2016.

The bovine surveillance of 2013 was designed with a between-herd design prevalence of 0.2%, a within-herd design prevalence of 40% and a risk of introduction of 1 in 50 years. Sample size is calculated on a yearly basis to reach a probability of freedom of 99% at the end of the year. To reach this level of probability of freedom, 4,300 samples over the year (1 sample per herd from 4,300 herds per year) is needed.

Surveillance for brucellosis in sheep and goats

Serum samples were tested for antibodies against *B. melitensis*. The sheep serum samples were collected within the surveillance programme for Maedi/Visna and the goat serum samples were collected within the Caprine Arthritis Encephalitis programme. The samples were obtained from those samples by convenience sampling (in other words not strictly random).

The ovine and caprine surveillance of 2015 was designed with a between-herd design prevalence of 0.2%, a within-herd prevalence of 40% and a risk of introduction of 1 in 25 years. Sample size is calculated on a yearly basis to reach a probability of freedom of 95% at the end of the year. To reach this level of probability of freedom, 2,000 samples over the year (3 samples per herd from 667 herds per year) is needed.

Surveillance for brucellosis in pigs

From 1996 until 2008 approximately 3,000 serum samples from pigs have been tested for antibodies against *B. suis* each year. Beginning in 2009, serum samples will be tested every second year, and accordingly, this sampling was performed in 2015.

The pig surveillance of 2015 was designed with

a between-herd design prevalence of 0.5%, a within-herd prevalence of 40% and a risk of introduction of 1 in 25 years. Sample size is calculated on a monthly basis to reach a probability of freedom of 99% at the end of the year. To reach this level of probability of freedom, 750 samples over the year (1 sample per herd from 750 herds per year) is needed.

In addition to the surveillance of *B. suis* in domestic pigs, there is also an active surveillance of *B. suis* in wild boar (see chapter Infectious diseases in wild boars).

RESULTS

Passive surveillance

Animals

During 2015, a suspect ram at slaughter was reported from one sheep herd. There were no clinical signs of brucellosis in this herd. Serological sample and samples from testicle and epididymis were taken for serological analysis and bacteriological culture. All samples were negative. No clinical suspicion was seen in any other animal species.

Within the surveillance of aborted fetuses, 29 bovine, 31 ovine and 17 pig fetuses were examined for *Brucella* spp. All samples were negative.

Humans

For years, no domestic cases were reported and Sweden is therefore considered free from brucellosis. However, since 2010 there has been approximately one domestic case reported annually. Two of the cases were believed to have been infected while consuming contaminated products from Afghanistan, 2010 (milk powder) and Iraq, 2012 (green cheese). Also during 2011, a domestic case was reported which was not actually infected in Sweden. This case was a child born in Sweden to a mother infected in Syria while she was pregnant. *Brucella* was isolated in blood from both mother and child. The child was healthy but was sampled since *Brucella* was detected in her mother. In 2013, one of the cases was reported as domestic and was a laboratory acquired infection where a student was infected

in an educational setting while handling samples of *Brucella*.

In 2015, 13 cases were reported, countries of infection were: Iraq (9), Syria (3 cases) and Eritrea (1 case). There were five female cases and 8 male cases.

Active surveillance

Animals

During 2015, 2,000 ovine and caprine serum samples from 591 individual holdings (3-4 samples per holding) were analysed for *B. melitensis* and 750 samples corresponding to 1 sample per sampling occasion from 521 herds sampled at slaughter 1-5 times during the year were analysed for *B. suis* within the active surveillance programme. All samples were negative. All samples from serological testing prior to export and from bulls at semen collection centres were negative as well.

DISCUSSION

In summary, *Brucella* infection was not detected in cattle, sheep, goats or pigs during 2015. The long standing and extensive serological screenings performed without finding any infection and the very low number of human cases, only occasionally domestically acquired, confirms that *Brucella* is not present in Swedish food-producing animals. The enhanced passive surveillance in aborted fetuses from food-producing animals is an important part of the surveillance system.

An unknown number of stray dogs from countries where *B. canis* is endemic are brought into Sweden every year. It is important to be aware of the risk this group of dogs represents, for *Brucella* infection as well as for other diseases. Imported non-stray dogs, or dogs mated abroad are seen as a risk factor for introduction of *B. canis* into Sweden as well. During the past five years five dogs have tested positive for *B. canis* using bacterial culture and/or serology. All these dogs were imported or had close contact with imported dogs.

Campylobacteriosis

BACKGROUND

Thermophilic *Campylobacter* spp. are gram negative curved rods, and are the most common causes of human bacterial gastroenteritis in many countries. *Campylobacter* was first isolated from human diarrhoea in 1972, although spiral bacteria had earlier been seen microscopically in human stool samples. Most human infections are caused by *C. jejuni*, followed by *C. coli* and a few by other *Campylobacter* 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* spp. are fragile organisms but are able to survive in water for longer periods. The infectious dose for humans is low. A seasonal peak in the summer months is observed in most European countries. Most human infections are sporadic, which makes identification of the source of infection difficult. Risk factors for infection include consumption or handling of undercooked contaminated meat products (especially poultry), consuming contaminated unpasteurised milk and other dairy products, drinking from contaminated water supplies, travelling abroad and contact with farm animals and pets.

The incidence of human campylobacteriosis has varied between 66.6 and 96.4 cases per 100,000 inhabitants (Figure 5). Of these, approximately 20-40% have been reported as domestic.

DISEASE

Animals

Asymptomatic carriage of thermophilic *Campylobacter* is common in several animal species.

Humans

Campylobacteriosis is an acute usually self-limiting enteric disease that resolves 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, irritable bowel syndrome as well as the neurological disorder, Guillain-Barré syndrome.

LEGISLATION

Animals

Thermophilic *Campylobacter* spp. are notifiable in broilers. In addition, *Campylobacter fetus* subsp. *venerealis*, which causes bovine genital campylobacteriosis, is notifiable in Sweden, according to SJVFS 2013:23.

Food

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

Humans

Infection with *Campylobacter* is notifiable according to the Communicable Disease Act (SFS 2004:168 with the amendments of SFS 2013:634).

SURVEILLANCE

Animals

A surveillance programme for broilers has been operated by the industry (Swedish Poultry Meat Association) since 1991. The programme covers 99% of broilers slaughtered in Sweden. Since 2006, sampling is performed by collecting intact caeca from 10 birds of every slaughter flock at the major abattoirs. The caeca are pooled into one composite sample per batch. All samples were analysed according to ISO 10272: 2014 part 1 and 2.

Food

No official surveillance programme exists. Sampling is performed by national and local authorities.

Humans

Surveillance in humans is passive.

RESULTS

Animals

In 2015, thermophilic *Campylobacter* spp. were detected in 437 (11.6%) of the 3,759 broiler flocks at slaughter in the national *Campylobacter* programme (Figure 6). A seasonal variation of *Campylobacter* in broilers was observed with the least findings in winter and most in the summertime. In November 2015, *Campylobacter* was detected in a larger proportion of flocks compared with the same period in previous years.

Food

The samples collected by local authorities were mostly taken as part of investigations of a complaint or a suspected food poisoning (74 of 97). None of these samples were positive for *Campylobacter*.

Humans

9,180 cases of campylobacteriosis were reported in 2015, which is more than ever previously reported. Of the reported cases, 51% (4,709 cases) were domestic. The incidence in domestic cases increased by 20% from the year before to 47.8/100,000 inhabitants, which is the highest incidence, and highest increase of incidence, since the infection was made notifiable in 1989.

The number of notified cases of campylobacteriosis usually increases during the summer, and this also happened in 2015. However, in 2014 there was an unusual peak in December and this increase during the winter months was repeated in 2015. During the same periods, both in 2014 and in 2015, *Campylobacter* was detected in a larger proportion of poultry flocks than usually during this time of the year. Whole genome sequencing has shown that the same genotypes of *Campylobacter* circulated in both humans and in poultry at the same time during the winter peaks in 2014 and in 2015, respectively. This supports the hypothesis that chicken was the cause of the large increase during these two years.

Among the cases who acquired their infections in Sweden in 2015, the incidence was highest and rather evenly distributed among adults aged 20-69, but somewhat lower in the age group of 30-39 years. As usual, there were more men (53%) than women reported with campylobacteriosis.

Apart from the new seasonal winter peaks no other known outbreak of campylobacteriosis occurred in 2015.

An investigation was conducted during 2015 to understand the cause of the increase in number of invasive cases of campylobacteriosis starting during the second half of 2013. A national laboratory survey was sent out in 2015 and the conclusion of the survey was that the significant increase in Sweden especially during 2014 coinciding with a change in blood cultivation material supplied by a commercial company. At the same time, the incidence of non-invasive *Campylobacter* infections and the overall testing numbers of stool and blood samples remained steady (Figure 7).

DISCUSSION

During the last fifteen years, the number of reported human cases of campylobacteriosis has increased. The increase has been particularly noticeable for the domestic cases. Although most campylobacteriosis cases are considered sporadic, outbreaks do occur. This was noticed in 2012, when stored human isolates could be subtyped together with strains from suspected sources. The subtyping showed to be a useful tool in the outbreak identifications. Moreover, the large increase in human cases in the winter months during the last two years and its link to poultry shows that also national outbreaks of campylobacteriosis occur.

From 2000 to 2005, the prevalence of *Campylobacter* in broiler flocks decreased from approximately 20% to 12-13%. In 2013, the percentage of *Campylobacter* positive broiler flocks was 8.8% which is the lowest reported (Figure 6). Reasons for this decrease are not clear but might be related to improved hygienic barriers and/or unusually dry weather conditions in the summer 2013. In 2014-2015, however, the prevalence in broiler flocks was 11.5% and 11.6%, respectively, which is an increase compared to the previous two years. In 2014 and 2015, thinning was more commonly practised which might have increased the prevalence of *Campylobacter* in broilers.

Reducing *Campylobacter* prevalence at the farm level decreases the risk of human infection. Applying strict biosecurity measures has decreased the number of *Campylobacter* positive broiler slaughter batches in Sweden. Still, more effective measures to control colonisation of broiler flocks are needed. Since flies have been associated with the spread of the infection, a fly control programme has been introduced in some broiler houses. Also, several other control measures to reduce flock prevalence are under investigation.

Carcasses are easily contaminated at slaughter and at secondary processing which necessitates the application of good hygiene practices. Also, freezing *Campylobacter* positive carcasses or scheduling them for heat-treatment would reduce the risk to consumers.

Strict hygiene in the kitchen is essential to avoid cross-contamination between contaminated food and food that will not be heated such as raw vegetables. Likewise good hygiene is important when preparing food for social gatherings.

In order to decrease human incidence of campylobacteriosis a national strategy plan for *Campylobacter* has been prepared and published 2013 as a co-operation between the Swedish Board of Agriculture, National Food Agency, Public Health Agency of Sweden, the National Board of Health and Welfare and the National Veterinary Institute. Several measures to control the infection were proposed in the strategy document.

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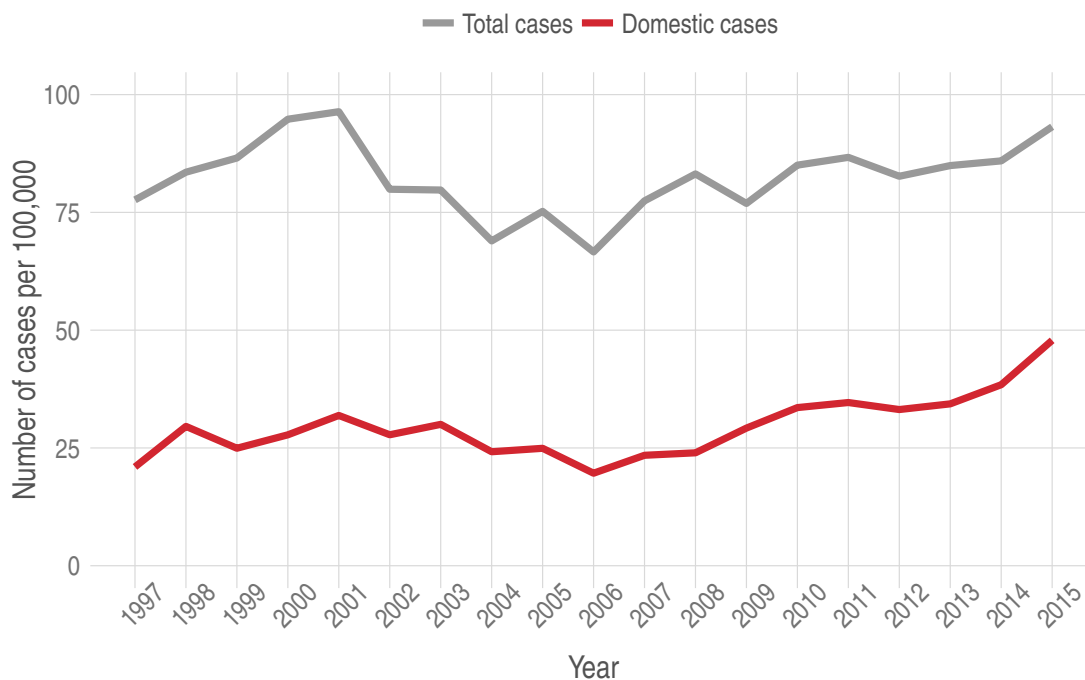


Figure 5: Notified incidence (per 100,000 inhabitants) of human cases of campylobacteriosis in Sweden, 1997-2015

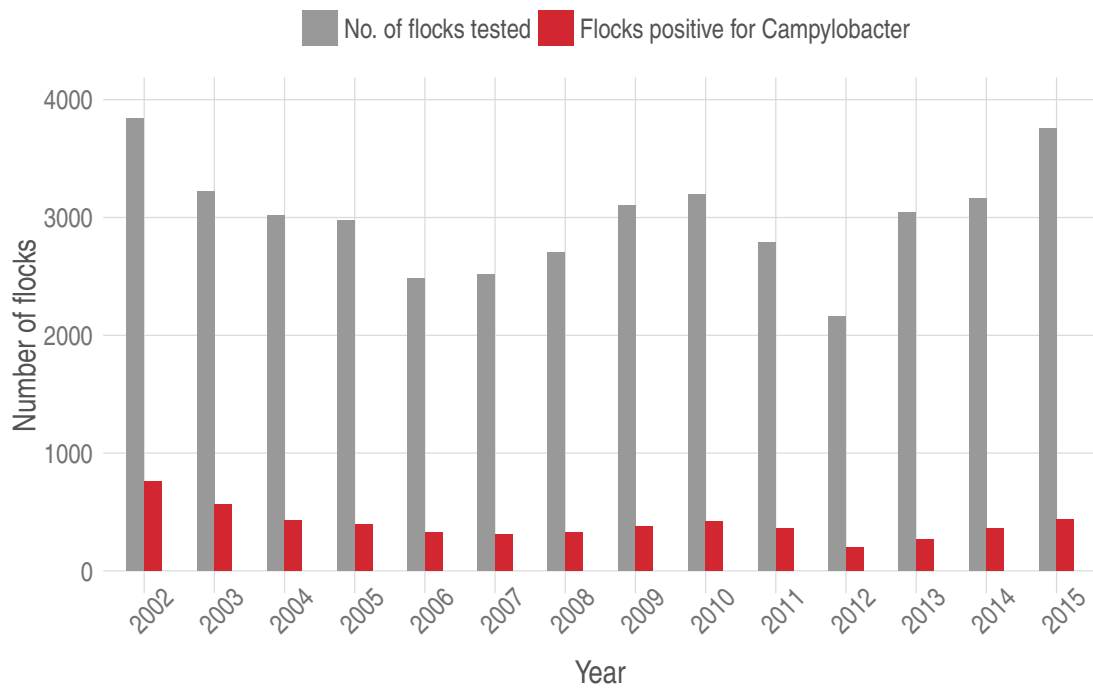


Figure 6: Prevalence of *Campylobacter* in broiler flocks in 2002-2015.

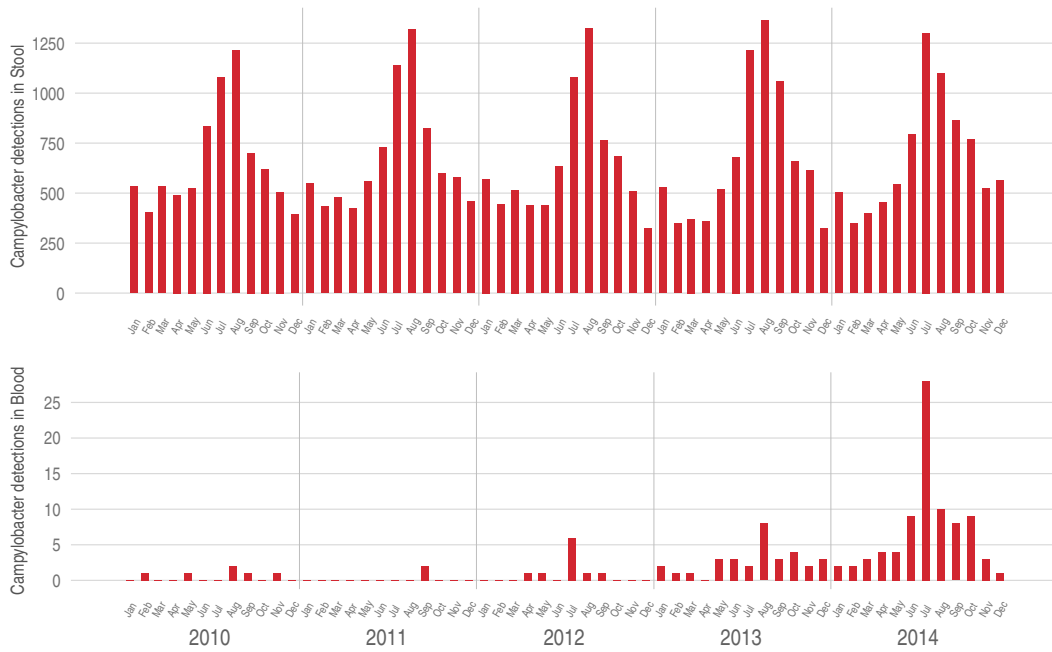


Figure 7: Detection of *Campylobacter* in humans between January 2010 and December 2014 by stool culture and blood culture.

Classical swine fever



Photo: Magnus Aronson

BACKGROUND

Classical swine fever (CSF) is a disease of pigs caused by a pestivirus closely related to bovine virus diarrhoea virus and border disease virus. The acute clinical form of CSF cannot be distinguished from the clinical manifestation of African swine fever (ASF), although these two viruses are not related. CSF is considered one of the most important and devastating pig diseases worldwide. During 1997-98 an extensive outbreak occurred in the Netherlands, Germany, Belgium and Spain. Since then, outbreaks in Europe have been confined to more limited geographic regions although the outbreaks in Lithuania 2009 and 2011 involved very large farms and are thus considered extensive. In 2012 and 2014 CSF was reported in domestic pigs in Latvia and was still present in the wild boar population there during 2015. Ukraine recently reported CSF in wild boar and CSFV is also present in Russia as well as in Asia and South America. CSF has not been diagnosed in Sweden since 1944 and Sweden got official status as a historically CSF free country

in February 2015.

Classical swine fever is a highly contagious disease that is transmitted by direct and indirect contact between animals. Feeding pigs swill contaminated with CSFV is considered the main route of spreading the disease to new areas. Because of this, swill feeding of pigs is prohibited in the European Union.

DISEASE

CSF appears in different clinical forms; acute, chronic and a mild form with reproductive disorders as the main clinical manifestation. The incubation period is 2-14 days and the acute form of the disease includes high fever ($<42^{\circ}\text{C}$), shivering, weak hind legs, purple discolouring of the skin and diarrhoea. Chronically infected animals exhibit a more diffuse clinical picture with intermittent fever, anorexia and stunted growth. In the mild form, abortion is the main clinical sign.

LEGISLATION

CSF is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments) and the control of the disease is regulated in detail through EU-directives.

SURVEILLANCE

The purpose of the surveillance programme is to document freedom from CSF in the Swedish pig population and to contribute to the maintenance of this situation by early detection of an introduction. The National Veterinary Institute is responsible for selection of samples, sample analysis and reporting to the Swedish Board of Agriculture. The serological analyses for CSF, PCR-analyses for the presence of CSF viral genome and CSFV culturing are performed at the National Veterinary Institute. CSF serology is done using a commercial kit (IDEXX® HerdChek CSFV Antibody Test Kit) and in case of positive ELISA results a confirming serum neutralisation (SN) test for detection of antibodies against CSFV is performed.

Passive surveillance

Because CSF is notifiable on clinical suspicion for both veterinarians and farmers, cases with clinical signs consistent with CSF will be investigated following a notification to the Swedish Board of Agriculture. The investigation includes restrictions on the farm during investigation, sampling of sick or dead animals and examination of the herd for presence of clinical signs and production results. Due to the similarity of clinical signs, samples are analysed for both CSF and ASF. This strategy is strongly recommended by the EU.

In addition, analyses for the CSFV genome with PCR are included in the enhanced passive surveillance of aborted foetuses.

Active surveillance

Samples collected for the abattoir sampling part of the surveillance carried out by the Farm & Animal Health for porcine reproductive and respiratory syndrome (PRRS) were used for the active surveillance. See chapter on PRRS for details on sampling and population. The surveillance was designed using a design prevalence of 0.5% between herd, 40% within herd, and a risk of introduction of 1 in 25 years.

Ongoing testing of animals bound for export and at breeding centres adds to the active disease

surveillance of CSF.

In addition to the surveillance of CSF in domestic pigs there is also an active surveillance of CSF in wild boar (see chapter Infectious diseases in wild boars)

RESULTS

Passive surveillance

Three investigations following clinical suspicion of CSF were carried out during 2015. The clinical manifestations included reproductive failure, high piglet mortality and circulatory disorders in sows. Following further investigations, including sampling, the herds could be declared negative for CSF (the investigations also included testing for either or all of PRRS, Aujeszky's disease and African swine fever).

Within the surveillance of aborted foetuses, 17 foetuses from 11 herds were examined for the CSF viral genome and all samples were negative.

Active surveillance

Serum samples from 2000 pigs were analysed and in none of them antibodies to CSFV could be found. Taking the surveillance outcome from 2014 into account, the probability of freedom based on the summarised surveillance during 2015, was >99%.

The approximately 900 samples originating from sampling for export and at breeding centres were all negative for CSFV antibodies.

DISCUSSION

The results from the passive and active surveillance for CSF in Sweden during 2015 add to the documentation of freedom from this infection in the Swedish commercial pig population. During recent years the Swedish pig industry has undergone heavy structural changes leading to a rapidly declining number of herds and extensive changes in the market and in the habits of farmers. The active surveillance in terms of planning design and number of samples is therefore evaluated yearly and adjusted accordingly if needed.

The present situation regarding CSF in the EU, with occasional outbreaks in domestic pigs close to Sweden, presence of the disease in Europe and the extensive movement of products and people, including labour in the animal production sector, emphasises the need for both passive and active surveillance for CSF.

Coccidiosis and clostridiosis

BACKGROUND

Coccidiosis and clostridiosis are intestinal diseases that commonly affect broiler chickens worldwide. Both diseases are major causes of economic losses and reduced welfare.

DISEASE

Coccidiosis is caused by microscopic parasites (genus *Eimeria*) that invade the intestinal epithelium. *Eimeria spp.* are ubiquitous, resilient and host specific parasites that are easily transmitted between birds by the faecal-oral route, especially when birds are kept on litter at a high stocking density. The severity of the intestinal lesions is influenced by parasite and host factors, such as parasite species, infectious dose, host age and level of immunity. Generally, young broiler chickens are highly susceptible.

Clostridiosis is a multifactorial disease and the pathogenesis is not well understood. Clostridiosis is associated with proliferation of the bacterium *Clostridium perfringens* type A, which together with management factors and loss of mucosal integrity cause lesions in the intestines (necrotic enteritis) and liver (cholangiohepatitis).

Clinical signs of coccidiosis and clostridiosis range from clinical disease with significantly increased mortality rates to mild or subclinical forms, which are associated with reduced weight gain and impaired feed conversion. Clostridiosis is also a cause of condemnation at slaughter due to liver lesions. Both diseases may be prevented by in-feed ionophorous anticoccidials.

LEGISLATION

The health control programme for coccidiosis and clostridiosis in broilers is regulated in Swedish legislation (SJVFS 1998:131) and is administered by the Swedish Poultry Meat Association.

SURVEILLANCE

The purposes of the surveillance are to document that the anticoccidials efficiently protect broilers from disease and to monitor the amount anticoccidials used. The longterm goal is to replace anticoccidials by other preventive measures.

Field control of anticoccidial efficacy is performed by a lesion scoring method in broiler chickens from selected farms. If the lesion score of an individual flock exceeds a certain level (2.5) an analysis of the feed for the concentration of anticoccidial is performed and an on-farm investigation of management and general health status is carried out. The occurrence of hepatic and intestinal lesions is monitored at the abattoir, and if more than 0.5% of the birds in a flock are affected samples are sent for histological examination to the National Veterinary Institute. Further, data are compiled on a quarterly basis from all abattoirs on the overall level of condemnations due to liver lesions.

RESULTS AND DISCUSSION

In 2015, a lesion score (MTLS/Mean Total Lesion Score) of > 2.5 was not found in any of 22 investigated broiler flocks.

Samples for histological examination of the liver were submitted from abattoirs from 13 broiler flocks with > 0.5% condemnation due to liver lesions. Lesions consistent with clostridiosis (i.e. cholangiohepatitis) were observed in 11 out of the 13 flocks.

In 2 samples, lesions were found suggestive of IBH (Inclusion Body Hepatitis) in broilers caused by adenovirus (FADV - Fowl adenovirus).

It was concluded that there are currently no indications of reduced efficacy of anticoccidials in Sweden. No longterm trends towards reduced anticoccidial efficacy or increased prevalence of coccidiosis and/or clostridiosis were observed.

Under this year (2016), the Animal Health Board who is responsible for this program will review and make an assessment of the control program and perhaps there will be changes.

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Echinococcosis

BACKGROUND

Echinococcosis is a common name for different diseases in humans caused by tapeworms belonging to the genus *Echinococcus*. Although the genus contains several species, only the species of *E. granulosus* and *multilocularis* exist in Europe. The life cycles of these parasites are completely different but both require 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.

Alveolar echinococcosis

BACKGROUND

Echinococcus multilocularis is endemic in large parts of Europe and has a reported increasing geographical range. Although a rare disease in humans, alveolar echinococcosis is of considerable public health concern due to its high mortality if untreated as well as high treatment costs. The definitive hosts of this parasite are mainly foxes, but raccoon dogs, dogs, coyotes and wolves can also act as definitive hosts. Rodents, mainly voles, serve as intermediate hosts. Foxes contract *E. multilocularis* by eating infected rodents.

HISTORY

Prior to 2010, *E. multilocularis* had not been detected, and no case of alveolar echinococcosis had been reported in Sweden. As a response to finding *E. multilocularis* in foxes in Denmark, an active monitoring programme of the red fox (*Vulpes vulpes*) was implemented in Sweden in 2000. From 2000 to 2009, a total of 2,962 red foxes, 68 raccoon dogs (*Nyctereutes procyonoides*) and 35 wolves (*Canis lupus*) were examined for *E. multilocularis*, all with negative results. Samples from the majority of foxes ($n=2,675$) were examined by ELISA (CoproAntigen ELISA) at the Institute for Parasitology, Zurich University, for the presence of the *E. multilocularis* coproantigen. The remaining samples and those that were ELISA-positive, were examined using the sedimentation and counting technique (SCT) ($n=726$). All samples from raccoon dogs and wolves were examined by SCT.

During 2010, 304 foxes were examined for *E. multilocularis*. A total of 103 were tested by SCT and 201 by egg-PCR. One fox, shot in south-west Sweden (Västra Götaland) and analysed in 2011 was



Photo: Karin Bernodt

found to be positive.

During the spring of 2011, a national surveillance programme was implemented where 2,985 hunter-shot foxes were analysed with segmental sedimentation and counting technique (SSCT). Three foxes were found positive: one in Västra Götaland, one in Södermanland and one in Dalarna County. In addition, 119 faecal samples from hunting dogs collected in the region of the first positive finding were analysed with egg-PCR and all were negative. In the same area 236 rodents were necropsied and all potential lesions examined by an in-house PCR without any positive finding.

To obtain a better prevalence estimate in a known infected area, fox scats were collected, by a

systematic sampling procedure, from an area of 25 km surrounding a positive finding in Södermanland County during 2011 and analysed in 2012 using a newly developed semiautomated magnetic capture probe DNA extraction method and a real time hydrolysis probe PCR assay (MC-PCR). Six out of 790 (0.8%) faecal samples were positive.

A second national screening was initiated in 2012 and continued in 2013 and 2014. In all, a total of 2,779 fox scat samples were analysed and three positive fox scats were identified, one from Gnesta, one from Katrineholm (both in the county of Södermanland) and one from the county of Västra Götaland.

From the five known infected areas, hunters were asked to submit 30 foxes from each circular area with a diameter of 40 km. The aim was to follow up the findings from 2011 (for three areas), and to collect parasites from any positive cases, for further subtyping. Sampling was initiated in 2012 and continued until April 2015 as another two positive areas were identified in this period. In four of five of the areas this sampling was finalised, whereas in one area (Gnesta) only 15 foxes were submitted in time for testing. In Västra Götaland two foxes were positive, in Södermanland two foxes from Katrineholm and one from Gnesta were positive, whereas no foxes from Dalarna were positive.

Within an ongoing Emiro research project (<http://www.emiro.org/>) and FoMA Zoonosis monitoring programme (<http://www.slu.se/en/environment>) at the Swedish University of Agricultural Sciences (SLU) initiated in 2012, intensive sampling of rodents and fox scats are performed to increase the knowledge of the epidemiology of this parasite in Sweden. In this project, the parasite was found for the first time in an intermediate host, voles caught in Södermanlands county in 2013 (Gnesta/Nyköping). One out of 187 *Microtus agrestis* and eight out of 439 *Arvicola amphibius* were positive. Presence of protoscoleces were confirmed in the infected *Microtus agrestis* and in three out of eight *Arvicola amphibius*. No lesions were found in *Myodes glareolus* ($n=655$) and *Apodemus* spp. ($n=285$). In the analysis of fox scat samples, this project also identified a new infected area, Väckjö region in Kronoberg County in 2014.

In 2012, alveolar echinococcosis was diagnosed in humans in Sweden for the first time. There were two human cases with clinical symptoms and both were considered to have been infected abroad. No human cases were diagnosed in 2013 and 2014.

DISEASE

Animals

In the definitive animal host, the infection is asymptomatic. The main intermediate hosts, rodents, will usually die from the infection if not captured by a predator.

Humans

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

LEGISLATION

Animals

Detection of the parasite is notifiable according to Swedish legislation (SJVFS 2013:23). Until December 31, 2011, all imported dogs and cats (except from certain countries) were required to be dewormed with praziquantel before entering Sweden as a preventive measure. Because *E. multilocularis* has been detected in Sweden, there is presently no legal requirement to deworm pets entering the country. However, as the prevalence of the parasite in foxes is very low in Sweden compared to many European countries, dog owners are encouraged to deworm their dogs prior to entry to Sweden.

Humans

Infection with *Echinococcus* spp. has been notifiable since 2004 according to the Communicable Disease Act (SFS 2004:168) with the amendments of SFS 2013:634. However, notification on the species level is not required. If cases of *E. multilocularis* occur in humans the data will be presented in the annual report at the website of the Public Health Agency of Sweden (<http://www.folkhalsomyndigheten.se>). Before 2004, *Echinococcus* spp. was reported on a voluntary basis by the laboratories.

SURVEILLANCE

Animals

As *E. multilocularis* does not cause clinical signs in the definitive host, effective monitoring in these species must be active.

From the five known infected areas, sampling continued during the fox hunting season in the first quarter of 2015, where hunters had been asked to submit 30 foxes from each area. The foxes were tested with MC-PCR and positive foxes were further investigated with SSCT.

All free-living wolves submitted to necropsy at the National Veterinary Institute were analysed with the segmental sedimentation and counting technique (SSCT).

Within the ongoing Emiro research project and FoMA Zoonosis monitoring programme at the Swedish University of Agricultural Sciences (SLU) initiated in 2012, intensive sampling of rodents and fox scats were performed in 4 restricted areas (20 X 20 km), in two areas where *E. multilocularis* had previously been identified: Södermanland (Katrineholm) and Västra Götaland County and in two areas where no cases of *E. multilocularis* has been found: Södermanlands (Gnesta/Nyköping) and Kronobergs County (Växjö). The aim of the project is to increase the knowledge of the epidemiology of this parasite in Sweden. Rodents considered to be potential intermediate hosts (eg. *Arvicola amphibius*, *Microtus agrestis* and *Myodes glareolus*) were trapped biannually (spring and autumn) and submitted to necropsy. Any suspect liver lesions were further investigated by PCR and sometimes further confirmed by histology. Fox scat faeces were collected and analysed with sieving followed by an egg-PCR according to Trachsel (2007) and/or Dinkel et al. (1998), whereas liver lesions were confirmed with PCR according to Trachsel (2007). All positive samples were further confirmed by DNA sequencing.

Humans

Surveillance in humans is passive.

RESULTS

Animals

In the sampling of foxes from the five known infected areas to obtain material for further subtyping, 52 foxes were analysed during 2015 (16 from Katrineholm, five from Gnesta and 31 from Växjö). None of the examined foxes were positive for *E. multilocularis*.

Within the Emiro project and FoMA Zoonosis monitoring program, no positive samples were reported to SJV during 2015.

During 2015, faecal samples were collected at

necropsy from 11 raccoon dogs (*Nyctereutes procyonoides*) for MC-PCR (results are pending). Intestines from 70 wolves (*Canis lupus lupus*) were submitted to the National Veterinary Institute to be examined by SSCT, 67 have been analysed and all were negative and for three wolves results are pending. In addition, four dogs and three foxes were tested with the MC-PCR and all were negative.

Humans

In 2015, there were no cases of alveolar echinococcosis reported.

DISCUSSION

E. multilocularis is considered to be endemic at a very low prevalence in Sweden. It is not known if, and in that case, when the parasite was introduced into the country. The national screening finalised in 2014 has described the present national prevalence and can be used as a baseline. If national screenings are repeated with, for example, 5 or 10 years intervals this will clarify if the prevalence changes over time. It is well known that the prevalence of this parasite varies geographically. Regional screenings have earlier shown a prevalence of more than 1% in a part of Södermanlands County. Based on earlier findings it has been concluded that the parasite is endemic in the country, however the true geographical distribution is unknown. At present a total of five areas have been found infected within the surveillance programs and the Emiro research project. If monitoring continues it is probable that new infected areas will continue to be detected.

E. multilocularis was found for the first time in an intermediate host in 2014. This finding increases our knowledge about in which biotypes the life cycle of the parasite can be completed. However, more research is needed to clarify which intermediate host(s) are most important.

Based on the studies that exist today, the risk that humans will become infected in Sweden is considered negligible.

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Cystic echinococcosis

BACKGROUND

Cystic echinococcosis is caused by *Echinococcus granulosus*. Domestic dogs and wolves are the most frequent main hosts. Eggs of the parasite are excreted in faeces into 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 quite common in reindeer in the northern parts of Scandinavia in the first half of the 20th century. In the 1990's single cases of *E. granulosus* were detected in moose and reindeer in Sweden.

DISEASE

Animals

In animals, the infection is usually asymptomatic.

Humans

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

LEGISLATION

Animals

Detection of the parasite is notifiable in all animals according to (SJVFS 2013:23).

Humans

Echinococcosis has been notifiable according to the Communicable Disease Act since 2004 (SFS 2004:168) with the amendments of SFS 2013:634. However, notification on species level is not required. If cases of *E. multilocularis* occur in humans the data will be presented in the annual report at the website of the Public Health Agency of Sweden (<http://www.folkhalsomyndigheten.se>). Before 2004 *Echinococcus* spp. was voluntarily reported by the laboratories.

SURVEILLANCE

Animals

All animals are inspected for cysts during routine meat inspection. All free-living wolves submitted to necropsy at SVA will be analysed with SSCT.

Humans

Surveillance in humans is passive.

RESULTS

Animals

During 2015 one suspect lesion from reindeer was found at meat inspection and submitted to the National Veterinary Institute for further examination. A total of 70 wolves submitted for necropsy were tested with the SSCT; 67 have been analysed and all

were negative and for three wolves, results are pending. *E. granulosus* was not detected in any animals in 2015.

Humans

In 2015, 26 cases of cystic echinococcosis were reported. Annually around 15-30 cases are reported in Sweden. In 2015, the reported cases ranged in age from 7 to 82 years (median 33.5 years). Five cases were women, 20 were men and for one person the sex was not recorded. They were all considered to have been infected abroad in areas where the parasite is endemic and the most frequently specified countries of infection were Iraq (5 cases) and Afghanistan (4 cases).

DISCUSSION

E. granulosus has not been detected in Sweden in animals since the late 1990s, when it was reported

in two reindeer in the northernmost regions of Sweden, bordering Norway and Finland. The parasite is prevalent in several European countries. In Finland it has occurred in wildlife (wolves, moose and reindeer). In other European countries it is identified mainly in a cycle between dogs and farm animals.

In humans, cystic echinococcosis is a rare disease seen in immigrants or other people who have resided in endemic countries. In Sweden, no domestically acquired human cases have been reported since the infection became notifiable. In Finland, on the other hand, pulmonary cystic echinococcosis (*Echinococcus canadensis*) was confirmed in 2015 in an eight year old child from the eastern parts of the country with no history of travelling abroad. The infection was presumably transmitted by hunting dogs.

Enzootic bovine leucosis

BACKGROUND

Enzootic bovine leucosis (EBL) is caused by bovine leukaemia virus, which is an oncovirus in the family Retroviridae. The viral infection is transmitted by infected lymphocytes via contact with contaminated biological material from an infected animal. Sweden was declared officially free from 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 characterised by multiple cases of multicentric lymphosarcoma in adult cattle within a herd. The incubation period is 4-5 years. The tumours can develop rapidly in many sites, which may cause variable clinical signs depending on the site. Persistent lymphocytosis, without clinical signs, develops earlier but rarely before 2 years of age.

LEGISLATION

EBL is included in the Swedish legislation for notifiable diseases (SJVFS 2013:23). 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. Växa Sverige (former Swedish Dairy Association) is responsible for this surveillance, which is approved and financed by the Swedish Board of

Agriculture.

From 2010 onward, surveillance in dairy herds has been performed by random sampling of at least 1,700 herds every year. Bulk milk samples are collected within the quality control programmes of the dairies. The surveillance in beef herds is performed with an aim to random sample 1-3 animals per herd in at least 2,900 herds every year. Serum is collected from slaughtered cattle above 2 years of age originating from sampled herds. The between-herd design prevalence is 0.2% and the within-herd design prevalence 15%, with a 99% confidence. Details on numbers of herds and animals tested in 2015 are given in table 5.

Diagnostic testing is performed at the National Veterinary Institute. Both milk and sera are analysed using an antibody ELISA (Svanovir® BLV GP-51 ELISA).

RESULTS

No positive samples were found in 2015.

DISCUSSION

Sweden was declared free from EBL in 2001 (Commission Decision 2001/28 EC), and has had a very stable disease-free situation since then. In 2012 one slaughtered animal above 2 years of age was positive for EBL. All animals over 6 months in the herd from which the positive animal originated were tested for EBL in spring 2013 and all samples were negative. The herd was thereafter cleared from suspicions of EBL infection.

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Table 5: Total numbers of herds and animals tested for EBL antibodies in 2015.

Herd type (sample type)	Herds	Animals
Dairy herds (1 bulk milk sample per herd)	1,768	-
Beef herds (blood from 1-3 animals per herd)	2,587	5,042
Beef herds with three animals tested	902	-
Beef herds with two tested animals	651	-
Beef herds with one tested animal	1,034	-

Footrot

BACKGROUND

Footrot is a globally distributed contagious disease in sheep and goats. The causative agent is *Dichelobacter nodosus* (*D. nodosus*). The disease is characterised by inter-digital dermatitis, and predisposing factors are humid and warm weather conditions. The severity of footrot can vary by the strain of *D. nodosus* and the environmental conditions.

The first case of footrot in Swedish sheep was identified in 2004. Data from all affected flocks have been recorded since 2004. A prevalence investigation of slaughter lambs was performed in 2009 and a voluntary control programme for footrot ('Klövkontrollen') was established by Farm & Animal Health in 2009.

DISEASE

The clinical signs of the disease are typically foot lesions, and lameness due to the painful lesions. However, lameness is not a consistent clinical sign in all affected sheep. Footrot varies greatly in severity from inflammation of the interdigital skin to complete underrunning of hoof horn.

LEGISLATION

Footrot is a notifiable disease (SJVFS 2013:23).

SURVEILLANCE

The aim of the control programme is to eliminate footrot from affected sheep flocks and to provide certification of freedom from footrot for the sheep trade. Another important part of the programme is training of veterinarians and non-veterinary staff to perform clinical inspection and footrot scoring. The feet of sheep are inspected by veterinarians and farmers on an annual basis. The inspections are performed during August 15 to October 15, when the risk of footrot is highest due to the weather conditions. If no signs of footrot are detected, the flock is certified free from footrot (F-status). However, if signs of footrot are documented the following measures are taken: foot baths, moving of animals to clean pasture and culling of chronically infected sheep. Flocks with a history of footrot can be certified as free, ten months after the last signs of infection.

Diagnostic testing of samples from interdigital

skin is performed at the National Veterinary Institute. The development of additional diagnostic tools is also linked to the control programme. Recent improvements to the programme include, testing of strains for virulence and pooling of samples. A total of 336 sheep flocks are affiliated with the control programme.

For all newly affiliated flocks and for all flocks where footrot is suspected at the first contact, a new PCR (Frosth et al 2015) is used for detecting *D. nodosus* and determining strain virulence.

RESULTS

During 2015, 13 flocks were detected with footrot, compared to 47 flocks during 2007 (Figure 8). In the programme, 327 flocks were certified free from footrot (F-status).

DISCUSSION

The awareness of disease control has been enhanced in the sheep farming community, and their agreement on a trade ban between certified and non-certified flocks has been essential to the programme's success. Good collaboration between authorities, the sheep farming community and individual sheep farmers has resulted in a cost-effective control programme.

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DISEASE SURVEILLANCE 2015

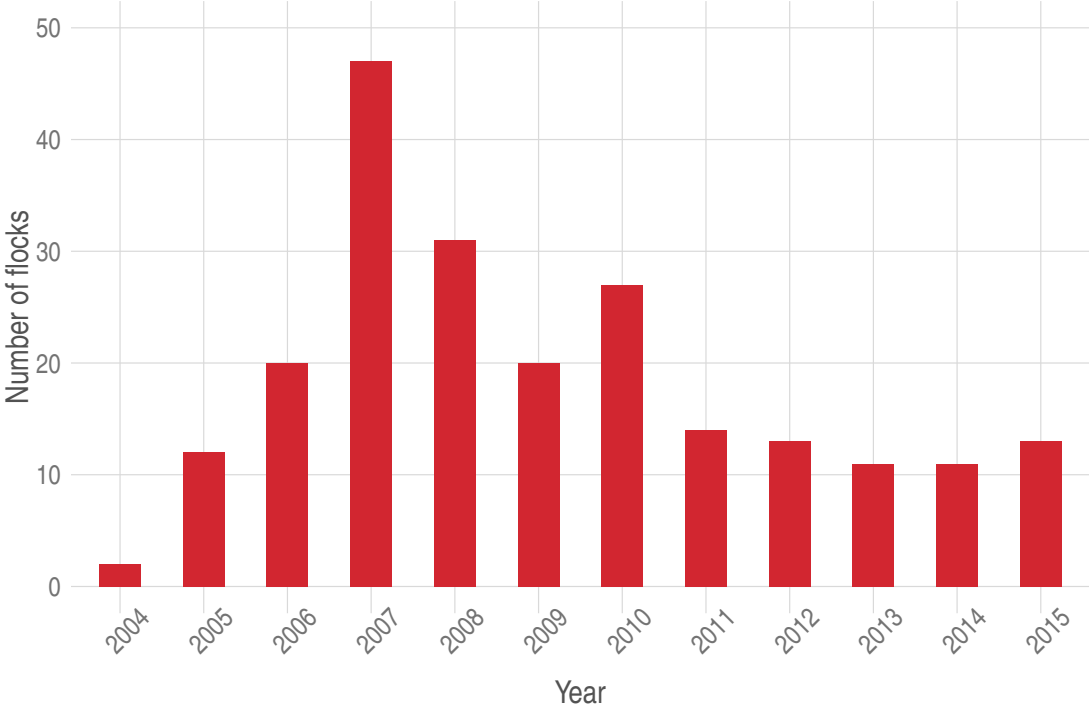


Figure 8: Number of sheep flocks detected with footrot 2004-2015

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.

Examination of Swedish 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 programme was initiated in 1994 and the last seropositive animal was found in 1995.

DISEASE

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

LEGISLATION

The Swedish IBR eradication programme was approved in 1994 (Decision 73/94/ COL and Decision 95/71/EC). Sweden was allowed additional guarantees by the EU to reduce the chance of IBR introduction 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 neighbouring Nordic countries have additional guarantees from the EU 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 prohibited and notification of clinical suspicion is mandatory.

SURVEILLANCE

All diagnostic testing as outlined below was performed at the National Veterinary Institute. Milk and sera were analysed for the presence of antibodies using an indirect ELISA (SVANOVIR™ IBRab, Svanova®). A blocking-ELISA IBR/BHV-1 gB Ab

ELISA kit (IDEXX) was used for confirmatory testing. Semen and organ samples were tested with a real time PCR. A positive case is defined as an animal with a positive PCR result or a confirmed positive serological reaction for IBR.

Passive surveillance

Suspicious based on clinical signs must be reported to the Swedish Board of Agriculture and will be subsequently investigated.

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 Växa Sverige (the former Swedish Dairy Association). Within the surveillance programme, dairy herds are tested by bulk milk samples, in farms with more than 60 cows, pooled milk samples from individual cows are used. The sampling is conducted twice a year within the Dairy association's quality control programme and synchronised with the programmes for bovine viral diarrhoea and enzootic bovine leucosis and thus not strictly random. The surveillance also includes serum samples from beef cattle. Sample size for dairy herds is calculated based on a herd design prevalence of 0.2% and a confidence level of 99%, and for beef cattle on a herd design prevalence of 0.2%, an animal design prevalence of 10% (beef cattle) and a confidence level of 99%.

In addition to the official active surveillance programme, bulls are tested at semen collection centres and all cattle (and other potentially susceptible ruminants) are tested before export and import.

RESULTS

Within the active surveillance, 3,386 bulk milk samples and 5,792 serum samples from beef cattle were examined. 244 cattle were tested at semen collection centres, and 165 heifers, 5 moose, 5 reindeer, 6 mouflon, 7 alpacas and 3 lama were tested prior to export. All samples were tested negative. No herds were investigated due to clinical suspicions of IBR.

DISCUSSION

In summary no herd or individual animal was diagnosed with IBR infection during 2015. This supports Sweden's IBR free status.

Influenza



Photo: Gunilla Hallgren

BACKGROUND

Influenza type A is a viral disease affecting both birds and mammals, including humans. The causative agent is an RNA-virus of the family *Orthomyxoviridae* with the ability to change over time. New strains are created through both accumulation of point mutations ('antigenic drift') and through genetic reassortment (antigenic shift). Influenza type A viruses are classified into different subtypes based on the surface glycoproteins: hemagglutinin (H) and neuraminidase (N).

The main mode of transmission of influenza type A virus is by aerosols containing virus from the airways of infected individuals of the same species. Occasionally influenza type A virus can be transmitted from one species to another, like in the case of avian influenza infecting humans, but typically each host species has its own influenza type A viruses.

Avian Influenza

BACKGROUND

Avian influenza (AI) is caused by Influenza type A viruses. They are divided into different antigenic subtypes based on the combination of two surface glycoproteins; hemagglutinin (H1-H16) and neuraminidase (N1-N9). The disease is highly contagious and is spread both directly and indirectly. Wild birds are reservoirs for low pathogenic viruses

(LPAIV) of subtype H5 and H7, which upon transmission and further adaptation to poultry may mutate and become highly pathogenic (HPAIV).

Since 2005, highly pathogenic H5N1 virus has caused disease in wild birds and been spread by wild birds through Asia, Europe and Africa. In early spring of 2006, HPAIV subtype H5N1 was first detected in wild birds in Sweden. One infected farmed mallard was also detected in a game bird holding during the outbreak in 2006.

During 2015, there were no outbreaks of HPAI or LPAI in poultry or game bird holdings in Sweden. Two mute swans were found positive for HPAI H5N8 within the passive surveillance of wild birds.

In the European Union 70 outbreaks of HPAI were reported in poultry; France (65) Germany (2), Hungary (1), Bulgaria (1) and UK (1). For LPAI, 29 outbreaks in poultry were reported; France (14), Italy (8), Germany (3), Netherlands (3) and UK (1). When subtyping was available, H5N1, H5N2 and H5N9 were the types of HPAI most frequently identified. For LPAI, it was H5N2 and H5N3. H7 was only found in 7 cases, 2 HPAI and 5 LPAI.

Animals

Morbidity in birds infected with HPAIV may be as high as 100%, but depends on the species affected, co-infections, virulence of the virus and other factors. In general, gallinaceous birds, including turkeys and chickens, suffer a more severe disease than waterfowl such as ducks and geese, which may only exhibit minor or no clinical disease. LPAIV infections most often cause asymptomatic infections or mild respiratory disease. HPAIV infections cause variable clinical signs such as cyanosis, respiratory distress, diarrhoea, nervous signs, depression, decreased food and water intake and decreased egg production with altered egg quality. Sometimes the only clinical sign is the sudden death of a large numbers of birds.

Humans

Since 2003, more than 800 human cases of H5N1 infection have been identified worldwide with a death rate of 53%. According to the WHO, most of the positive cases have been diagnosed in Egypt, Indonesia and Vietnam. The majority of human cases of H5N1 infection have been associated with direct or indirect contact with infected live or dead poultry. In addition, a total of 10 laboratory-confirmed cases of human infection with avian influenza A(H5N6) virus, including 6 deaths, have been detected in China since 2013. More than 700 laboratory-confirmed cases of human infection with avian influenza A(H7N9) viruses, including 40% deaths, have been reported since 2013. Controlling the disease in animals is the first step in decreasing the risk to humans.

LEGISLATION

Animals

Highly pathogenic avian influenza of all subtypes as well as LPAI of H5 and H7 subtypes are included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments) and are notifiable upon 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.

Humans

H5N1 infection is notifiable according to the Communicable Disease Act (SFS 2004:168).

SURVEILLANCE

The Avian Influenza surveillance programme in Sweden in poultry and wild birds 2015 was based on Council directive 2005/94/EC and Commission decision 2010/367/EU.

Surveillance programmes have been carried out annually in all member states since 2002 to determine the prevalence of avian influenza, in particular the subtypes H5 and H7. The aim of the surveillance in poultry is to detect infections of avian influenza virus subtype H5 and H7 in different species of poultry. Surveillance of wild birds contributes to the knowledge of the threats from wildlife to domestic animal health and serves as an early warning system for avian influenza threat to domestic poultry flocks.

Poultry

In 2015, sampling was performed in kept game birds (mallard ducks and pheasants), layers, breeders, small-scale broiler production, turkeys, geese, ducks, ratites, and guinea fowl. Ten blood samples from each holding were collected except for holdings with geese, ducks or mallards where 20 samples from each flock were collected. In flocks with fewer individuals than the above mentioned sample size, all individuals were sampled. In total, 2,156 blood samples were taken. Table 6 gives an overview of all poultry flocks sampled in 2007 to 2015. In addition to the surveillance programme, samples were taken on clinical suspicion of avian influenza. On clinical suspicion of AI or Newcastle disease, laboratory analyses for both diseases are generally performed.

The surveillance programme for 2015 was based on representative sampling and the serological analyses were performed at the National Veterinary

Institute. All poultry samples were collected at slaughter, except breeders and game birds. Blood samples from these categories of birds were collected at their holdings. Breeders were sampled late in their production period. Samples were analysed using an ELISA (IDEXX Influenza A Ab Test). Positive results were confirmed with haemagglutination inhibition tests (for subtypes H5 and H7) in accordance to the OIE guidelines.

Wild birds

The surveillance in wild birds is passive and based on birds found dead or diseased and submitted for postmortem examination. The distribution of wild birds examined for avian influenza is shown in figure 9. Swab samples (both cloacal and tracheal) taken from these birds were analysed for the detection of avian influenza viral genome by using an M-gene qRT-PCR. Positive samples are further analysed for detection and identification of H5 and H7 viruses, including virus pathotyping by amplicon sequencing.

From 2006-2010 there was active surveillance of 2,000-4,500 wild birds annually. Since 2011, the surveillance has been conducted on dead birds submitted for necropsy only.

Humans

Every year during the influenza surveillance season 1,500-2,000 samples are collected from sentinel (a surveillance system for influenza) patients with influenza like illness. These samples are analysed for influenza A and B. If influenza A is detected, further subtyping is performed into A(H1N1)pdm09 and A/H3N2. If influenza A positive samples could not be subtyped further characterisation is performed to rule out zoonotic influenza A. A further 200-300 of the influenza positive samples from the diagnostics laboratory are subtyped/characterised. The Public Health Agency of Sweden, also performs a specific PCR for A/H5N1, A/H5N6 and A/H7N9 if requested.

RESULTS

Poultry

Antibodies against influenza virus subtype H5 and H7 was detected in one holding of mallards. The mallards were further investigated by cloacal and tracheal swabs and no influenza A virus genome was detected. All other holdings of any category tested within the surveillance were negative.

In 2015 AI was suspected in poultry or captive

birds 16 times, once due to seropositivity in a mallard flock within the surveillance program and 15 clinical suspicions based on clinical signs; increased mortality, production losses and/or eggshell abnormalities. Three of the suspicions were in hobby flocks, one in a flock of partridge and eleven in commercial layer holdings. All suspicions were investigated by swab and/or organ samples and found PCR-negative for influenza.

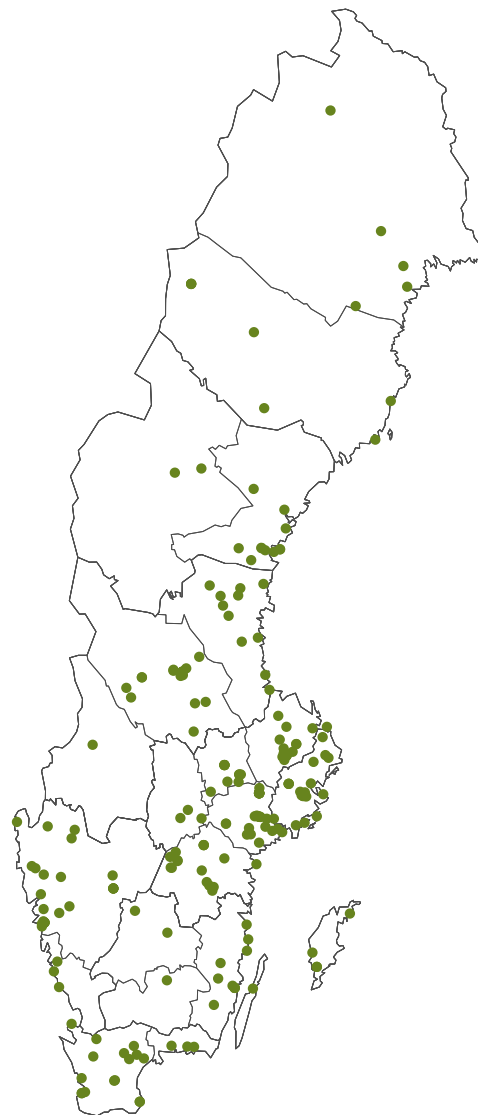


Figure 9: Geographical location of the 221 wild birds analysed for avian influenza in 2015. ©EuroGeographics for the administrative boundaries

Wild birds

Within the passive surveillance programme for 2015, 221 wild birds of 48 different species were sampled of which 47 individual birds were waterfowl or shorebirds. Two mute swans found dead were PCR- positive for HPAI H5N8. One black-headed gull was positive for avian influenza but not of the notifiable H5 or H7 type. All other birds were negative for Influenza A virus.

During February and early March 2015, several dead mute swans were found in the waters around of the area Djurgården, close to central Stockholm. Ten of the birds (two batches of 5 swans each) were postmortem examined and tested for AIV as part of routine surveillance at the National Veterinary Institute in Uppsala. The first 5 examined were all negative for AIV, and postmortem followed by chemical analysis confirmed lead poisoning.

The last five were all positive with recommended RT-qPCR methods targeting the M gene of influenza A viruses. Two of the birds were positive for H5 and were subsequently typed as HPAI H5N8 by molecular means.

Phylogenetic analysis of complete HA and NA segment showed closest relation to H5N8 viruses that circulated in Europe during November- December 2014 causing outbreaks in Germany, the Netherlands, UK and Italy. The cleavage site revealed the same polybasic properties as reported during these outbreaks.

Humans

Influenza A subtype H5N1, H5N6 or H7N9 have not been identified in any human sample in Sweden.

DISCUSSION

The first large outbreak of HPAI in wild birds was reported from China in May 2005. Thereafter wild birds infected with HPAI have been detected in Europe. HPAI may cause disease and death in wild birds, though there seem to be a host-species dependent susceptibility. Wild birds, especially waterfowl, may be infected with LPAI without the presence of clinical symptoms. Considering the capacity of the virus to mutate and become highly pathogenic (HPAI), wild birds may pose a potential risk to poultry since they may host and introduce LPAI into poultry flocks, where the virus may circulate, mutate and become HPAI.

Since the beginning of 2014, HPAI H5N8 has been reported from several countries in the Far East; in the Republic of Korea, Japan and China.

In late autumn of 2014, outbreaks of HPAI H5N8 were reported in four European Union member states. On 6th of November 2014, Germany became the first European country to report an outbreak of highly pathogenic avian influenza caused by an A (H5N8) virus genetically similar to one spreading in the Republic of Korea. Genetically similar viruses were found in outbreaks in poultry holdings in the Netherlands, the UK and Italy. It remains unclear how a highly pathogenic avian influenza virus A (H5N8) was simultaneously introduced into closed indoor holdings in different European countries and different poultry production sectors. The virus from the two HPAI H5N8 positive swans found in Stockholm early spring 2015 show close phylogenetic relation to this virus.

A recent development in the evolution of HPAI H5N1 virus is the emergence of HPAI H5N8 virus. A HPAI H5N8 virus with genes from viruses of the influenza A(H5N1) A/Goose/Guangdong/1/1996 lineage was first detected in birds on live bird markets in China in 2010. This HPAI H5N8 virus is a reassortant virus with the HA gene segment of HPAI H5N1 virus and other gene segments of multiple other AI viruses circulating in eastern China, and is now categorised in the new HPAI H5 virus clade 2.3.4.4 (WHO 2015). This virus caused a large AI outbreak in poultry in South Korea in the winter of 2013/2014, and subsequently spread to Japan, North America, and Europe, causing AI outbreaks there between autumn 2014 and spring 2015.

From late 2014 until July 2015 more than 200 poultry farms in the United States was infected with avian influenza resulting in the death and culling of close to 50 million birds of mainly turkeys and layers. In late autumn 2015 a big outbreak of avian influenza in France was detected. The outbreak is localised to an area known for rearing of geese. At the end of 2015, 65 holdings were found positive and the outbreak is still ongoing.

In Sweden, and the rest of the EU, preventive measures have been focused on increased biosecurity in poultry holdings to prevent the introduction of the virus from wild birds. These measures are still very important. Once introduced to poultry, the virus is more likely to spread further between poultry flocks by routes such as: infected live animals, contaminated vehicles and products. Therefore, continuous biosecurity measures are important to prevent the spread of virus that, if introduced,

could be transmitted to other flocks prior to diagnosis. To combat avian influenza, focus should be on preventive measures that reduce the probability of introduction of the virus into the flock and transmission of virus between poultry flocks.

At the European level, highly pathogenic avian influenza in wild birds has most commonly been found by the passive surveillance programmes. In contrast, the low pathogenic strains have been detected by active surveillance programmes. Therefore, since 2011, the European Commission is no longer economically supporting active surveillance in wild birds. The Swedish surveillance programme in wild birds has been changed accordingly since this decision.

Influenza viruses are unpredictable and changes

by mutation or reassortment occur. This might enable the virus to become more transmissible among humans. Monitoring of human infections with these viruses is also critically important to assess their pandemic potential.

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Table 6: Number of flocks of different poultry categories sampled in 2006-2015.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Laying hens ^A	60	0	65	61	62	61	52	44	58	68
Free range laying hens ^A	-	-	-	-	-	30	27	16	23	23
Turkeys	26	3	23	17	21	22	19	26	16	18
Ducks	2	3	8	3	4	6	3	1	3	3
Geese	28	6	30	13	11	20	20	13	9	9
Broilers ^B	7	7	28	27	24	39	34	26	12	22
Ratites	15	0	10	6	4	5	3	2	3	3
Breeding hens (parents)	40	0	42	33	34	36	36	36	32	31
Breeding turkeys (parents)	4	4	2	4	3	3	3	3	2	3
Game birds (mallards)	0	7	6	6	7	9	7	7	5	6
Game birds (pheasants)	0	3	23	20	17	15	16	16	12	13
Backyard flocks (geese, ducks)	0	0	0	6	0	0	0	0	0	0

^A Between 2006 and 2010 sampling of all laying hens were reported under the same category regardless of housing system. From 2,011 free-range (organic) laying hens are reported separately while the category 'laying hens' includes hens in furnished cages and indoor litter-based housing systems.

^B Small-scale production.

Swine influenza

BACKGROUND

Swine influenza (SI) has a worldwide distribution and causes an acute upper respiratory disease characterised by fever, lethargy, anorexia, weight loss and laboured breathing in pigs. The most commonly occurring subtypes of swine influenza virus (SIV) worldwide are H1N1, H1N2 and H3N2. Of these, the H1N1 SIV was reported to infect pigs in North

America already in 1918. In 2009, a new triple reassortant type of influenza H1N1, partly of porcine origin, began circulating among people. In a number of countries including Sweden, this virus has occasionally infected pigs by transmission from humans. This reassortant H1N1 virus became known as influenza A(H1N1)pdm09.

Animals

Influenza H1N1 was isolated from Swedish pigs for the first time in 1982. The clinical signs were severe in the previously naïve pig population, but waned over time. Since 1982, H1N1 virus has been considered endemic in Sweden. Influenza H3N2 is also present in the Swedish pig population. Antibodies to H3N2 were first detected in 1999, but the clinical signs were not as evident as when H1N1 was introduced. Actually, antibodies to H3N2 were first detected in a screening of apparently healthy animals, and it is therefore less clear when this subtype was introduced. However, H3N2 has since 1999 occasionally been correlated with severe respiratory disease in pigs.

Another swine influenza A type (H1N2) that spread through Europe, was diagnosed for the first time in Sweden in a large multisite unit with respiratory disease in growers during the winter of 2009. Since the first report of the detection of pandemic influenza A(H1N1)pdm09 in early May 2009 in pigs in Canada, H1N1pdm09 has been isolated from pigs throughout the world including several European countries including Germany, Italy, Denmark, Norway, Iceland and Finland. This virus is well adapted to humans and clinical signs of disease in pigs were sparse. In 2013, a new variant of this influenza virus was identified in Swedish pigs where the HA gene revealed high nucleotide identity with contemporary human pH1 strains, suggesting that a recent human to pig transmission was the most likely route of infection in the pigs. The isolate expressed a human pandemic H1N1-pdm09 like HA and a H3N2 SIV-like NA that was closely related to Avian like H1N2 SIV NA from isolates collected in Sweden since 2009. The internal genes were entirely of pandemic H1N1-pdm09 origin which is well adapted to humans. Although the pH1N2 subtype influenza A virus was exclusively prevalent in the Swedish pig population in 2014, the clinical signs of the disease were minor, as later also seen in other countries.

There has not been a regular monitoring of influenza in pigs in Sweden, but serological screenings were performed in 1999, 2002, 2006 and 2010. At each occasion, 1,000 porcine sera were analysed for H1N1, H3N2 and H1N2. The screening in 2006 also included analyses for antibodies to H5 and H7. During the past five years, 10-15 herds have been sampled annually with special focus on influenza, in these herds influenza virus has been demonstrated in 3-5 herds per year (Table 7).

Infection with influenza virus can produce clinical respiratory disease including dyspnoea, sometimes with nasal discharge and coughing, accompanied by fever, inappetence and lethargy. The disease can affect pigs of varying ages and the severity of clinical signs varies from severe respiratory disease to subclinical infection. The morbidity of affected herds is generally high but mortality is low.

Humans

Globally, 5-10 human cases of influenza virus infections with domains associated to pigs are reported every year. However, human-to-human transmissions of such reassortant virus types are rarely reported. In 2014, three cases of human infection with the pig-origin A(H3N2)v virus were detected in USA. Human infection with A(H3N2)v has been associated with agricultural fairs where people are in close contact with potentially infected pig populations.

LEGISLATION

Only Influenza A (H1N1) pdm09 is notifiable according to SJVFS2013:23. However, sustained transmission of influenza among humans with a virus originating from another host is also notifiable.

SURVEILLANCE

Animals

Passive surveillance

During the period from 2009 to 2015, samples from pig herds with respiratory signs consistent with influenza were collected and analysed for presence of the pandemic influenza A (H1N1)pdm09 virus using a polymerase chain reaction (PCR) method. From each affected herd, 5-10 nasal swab samples were collected and analysed first for swine influenza A and if positive, samples were further analysed for pandemic influenza A(H1N1)pdm09. These samples were also investigated for other influenza A types.

Active surveillance

The surveillance in 2010 included 1,008 pig sera collected at slaughter. These sera were randomly selected from the porcine reproductive and respiratory syndrome control programme and included a maximum of 4 sera per herd and sampling occasion. These sera were tested for antibodies to

swine influenza types H1N1, H1N2 and H3N2 using haemagglutination inhibition tests (HI). Titres of $\geq 1:64$ were interpreted as significant levels of serum antibodies. For the recently demonstrated influenza H1N2-virus, two HI-tests were carried out, one using a traditional strain and one based on the strain isolated in Sweden (the 9706-strain).

In 2015, the National Veterinary Institute (SVA) and the Public Health Agency of Sweden (FoHM) initiated a study on the transmission of human and swine influenza among farmers, veterinaries and pigs. In collaboration with the farmer's association, ten field veterinarians were asked to select pig farms that were representative of the pig production systems in Sweden and that were owned by producers interested in participating in the study. All workers on the pig farms with a daily contact with pigs, pig farmers and their families were asked to collect nasal swabs from themselves every third week and whenever they had influenza-like symptoms. Concurrently, samples were collected from the pigs at these farms. Participants were asked to complete a health questionnaire about the type of symptoms, duration of illness, and possible exposures to infected pigs. The participants were also asked if they had been vaccinated against seasonal influenza A viruses.

Starting from the last week of January 2015, participating farms were visited every third week for 6 consecutive visits by the field veterinarian. A total of 15 nasal swab samples from pigs were collected at each farm during each visit. During the visit, the age of the pigs and any respiratory clinical signs (absence or presence of sneezing, coughing and nasal secretion) among the sampled individuals was recorded.

The nasal swabs and submission sheets from animals and humans were shipped overnight to SVA or FoHM, respectively.

Nasal swab samples were initially screened for influenza A virus by real-time reverse transcription PCR (rRT-PCR) selective for the matrix gene. Samples positive by rRT-PCR were further analysed for determination of subtype, including the influenza A(H1N1)pdm09 virus using rRT-PCR specific for hemagglutinin gene of influenza A(H1N1)pdm09 virus. The hemagglutinin and neuraminidase fragments from all positive pig and human isolates were sequenced by the Sanger sequencing method.

Humans

In Sweden, 1,500-2,000 samples are annually collected from patients with influenza like illness during the influenza season in a sentinel surveillance system for influenza. These samples are analysed at FoHM for influenza A and B. If influenza A is detected, further subtyping is performed into A/H1N1pdm09 and A/H3N2. If Influenza A positive samples cannot be subtyped, further characterisation is performed to rule out zoonotic influenza A. A further 200-300 influenza positive samples from the diagnostic laboratory are subtyped/characterised.

Influenza A/H3N2v originates from pigs and has caused outbreaks among humans in USA. During the period from January 2012 to March 2016, 354 human cases of A/H3N2v have been reported, mainly in children. Any Influenza A/H3N2 positive samples in the Swedish sentinel system since 2013 from patients below 15 years of age are therefore further analysed for A/H3N2v. No cases of Influenza A/H3N2v have been diagnosed in Sweden.

RESULTS

Animals

Passive surveillance

Samples from 8 herds with respiratory signs were analysed for swine influenza virus in 2015 (Jan 1st to Dec 31st 2015). In two of these herds, influenza A virus was detected. Influenza A avian like H1N2 was demonstrated in one of these herds and the pandemic A(H1N1)pdm09 virus was demonstrated in the second herd.

Active surveillance

The surveillance in 2010 revealed low frequencies of pigs with significant levels of antibodies to swine influenza types H1N1, H1N2 and H3N2 using HI tests (Table 7). It is, however, notable that the prevalence of pigs with significant levels of antibodies to H1N2 increased somewhat when the analysis was based on the recent Swedish isolate of the strain.

No pigs with clinical disease were observed during the 6 visits to 10 farms as part of the study on the transmission of human and swine influenza among farmers, veterinaries and pigs. Out of ten participating farms, four farms had at least one positive result during this period and two farms were tested positive on at least two occasions. In total, 825 swabs collected from pigs and 330 swabs collected from humans were analysed for the presence of influenza

A viruses. Of these, 19 samples (2%) were positive for influenza A viruses with rRT-PCR.

Humans

The season 2013/2014 was mild and the dominating virus was A(H1N1)pdm09 followed by A/H3N2 and B-Yamagata lineage. The 2014/2015 season was intense and the dominating virus was A/H3N2 followed by B-Yamagata lineage.

A reassortant influenza A(H1N2) virus was identified in the pig population in Sweden in 2013. As part of the study on the transmission of human and swine influenza among farmers, veterinarians and pigs, 77 samples from veterinarians and 253 samples from farmers were analysed. A/H1N2v was detected in nasal swabs from two pig farmers at farms where the virus also was detected in pigs. Both human cases were asymptomatic, and no further human infections have been detected among other farmers or family members.

Influenza A subtype H3N2v has not been identified in any sample from humans in Sweden.

DISCUSSION

The results indicate presence of, but no large impact of swine influenza in the Swedish pig population. In the serological screening carried out in 2010, the incidence of influenza H1N1 and H3N2 was low. The prevalence of pigs with significant levels of serum antibodies was lower during 2010 than 2006. Also the prevalence of pigs with significant levels of serum antibodies to H1N2 was low, regardless of the origin of viral strain used for the analysis.

The reactions defined as low, indicate unspecific reactions rather than true antibodies to the influenza strains analysed for. Still, the difference in results depending on H1N2-viral strain used for analysing, illustrates the necessity to include relevant influenza strains (Table 7) in the testing protocol.

In last five years two new influenza A viruses were detected in the Swedish pig population. Both of these viruses were the result of multiple reassortments between avian or/and human and swine influenza A viruses. Influenza A viruses are unpredictable and changes (mutations or reassortment) might be induced. This could enable the virus to be more transmissible among humans. The veterinary medical importance and the public health significance of influenza A virus in pigs should not be underestimated. Monitoring of human infections caused by these viruses is critically important to assess their pandemic potential.

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Table 7: Reactors from the serological surveys performed in 2006 and 2010. The table shows the prevalence of significant seroreactors to the three porcine adapted strains of influenza present in the country. The table also shows the prevalences with low reaction in the HI tests. Note the difference in prevalences depending on strain used for antibody detection for H1N2 in 2010.

Seropositive samples	H1N1	H3N2	H1N2-standard	H1N2 new (9706strain)
Significant levels of antibodies ($\geq 1:64$)				
2006 (n=999)	33.0%	6.7%	0.6%	-
2010 (n=1,008)	0.6%	3.7%	0.1%	0.9%
Low levels of antibodies ($\leq 1:32$)				
2006 (n=999)	15.1%	18.8%	7.0%	-
2010 (n=1,008)	2.3%	9.6%	1.3%	5.1%

Leptospirosis

BACKGROUND

Several species of the spirochetal bacterium *Leptospira* can cause leptospirosis. All mammals including humans, are susceptible to one or several *Leptospira* serovars. Leptospirosis occurs worldwide but the dominant serovars vary by region. Cattle are considered the reservoir for *L. Hardjo* and pigs for *L. Pomona*. Between 1994 and 2006 sampling and testing for antibodies to *L. Hardjo* and *L. Pomona* in cattle and pigs, respectively, was performed each year and after 2006 every third year.

Leptospira may be transmitted directly between animals or indirectly in the environment. The bacteria do not multiply outside the host, but may survive for long periods in the environment.

DISEASE

Animals

L. Hardjo is one of several pathogenic serovars and is associated with disease in cattle, sheep, goats and horses. Infections may be acute or chronic; asymptomatic, mild or severe. Acute disease is more often seen in calves. Disease in adults may go unnoticed, because the early clinical signs of fever and depression are often transient and mild. Infected herds may have problems with abortions, decreased fertility and decreased milk yield as well as increased mortality in calves. The clinical signs in sheep and goats are similar to those in cattle. Sheep and cattle can act as reservoir hosts because the disease may be asymptomatic. *Leptospira* infections in pigs may also be asymptomatic or may give rise to reproductive failure. In piglets, fever, gastrointestinal disorders and jaundice may be present. The clinical presentations in dogs infected with *Leptospira* range from subclinical to severe clinical illness affecting the kidneys and liver.

Humans

Leptospirosis in humans ranges from asymptomatic or mild influenza-like illness to a severe infection with renal and hepatic failure, pulmonary distress and death.

LEGISLATION

Animals

Since 2004, leptospirosis is a notifiable disease in Sweden (SJVFS 2013:23).

Humans

Leptospirosis in humans is notifiable according to the Communicable Disease Act (SFS 2004:168 with the amendments of SFS 2013:634).

SURVEILLANCE

Animals

Passive surveillance in animals is based on mandatory case reporting of laboratory confirmed cases. Animals sampled for export and in breeding centres adds to the passive surveillance.

The active surveillance in cattle is focused on *L. Hardjo* and is based on serum and bulk milk samples randomly selected from the surveillance programme for bovine viral diarrhoea virus (BVDV) and evenly distributed throughout the sampling period. See chapter on BVDV for details on sampling and population. The surveillance was designed using a between-herd design prevalence of 0.2%, a within-herd design prevalence of 40% and a risk of introduction of 1 in 50 years.

In domestic pigs, the active surveillance is based on samples collected for the abattoir sampling part of the surveillance carried out by Farm & Animal Health for porcine reproductive and respiratory syndrome (PRRS). See chapter on PRRS for details on sampling and population. The surveillance is focused on *L. Pomona* and the surveillance was designed using a between-herd design prevalence of 0.5%, a within-herd design prevalence of 40% and a risk of introduction of 1 in 25 years.

Active surveillance in cattle and pigs is at present performed every third year and no active surveillance was performed during 2015.

The serological analyses were performed at the National Veterinary Institute. The diagnostic test used for *L. Hardjo* was an indirect ELISA (Prio-CHECK *L. Hardjo*, Antibody detection ELISA, Lelystad, Holland) for both blood and bulk milk samples. Positive blood samples were further tested with MAT (Microscopic agglutination test) with results reported as positive at 1:100 or above. For positive or doubtful ELISA results on bulk milk samples, an investigation was carried out in the herd and additional individual samples were taken. *L. Pomona*-antibodies were analysed using the microscopic agglutination test (MAT) with results reported as positive at 1:100 or above.

Humans

The surveillance in humans is passive.

RESULTS

Animals

In 2015, 21 cases of *Leptospira* infection were reported in dogs and one in a horse. All cattle tested for export and in breeding centres, were negative for *L. Hardjo*.

All animals sampled for export or at breeding centres were negative for the *Leptospira* serovars tested.

No active surveillance was performed in cattle and pigs during 2015. See previous reports for surveillance results from 2013 and earlier.

Humans

In 2015, three cases of leptospirosis were reported. All the cases had acquired their infections abroad, one in Bosnia and Herzegovina, one in India and one in Peru. Cases infected outside Sweden have often acquired their infections during leisure activities in contact with water. In 2015, all the cases were adults from 30 to 53 years of age and two of the three cases were male.

DISCUSSION

Leptospirosis occurs worldwide, but the predominant serovars vary by geographic region. The disease is associated with reproductive losses in cattle and significant economic costs worldwide. Certain

Leptospira serovars are present in Sweden. Occasional cases of pigs serologically positive to *Leptospira* spp (other than *L. Pomona*) are diagnosed in Sweden, mostly to an indigenous serovar of *L. Sejroe* (Mouse 2A), *L. Bratislava* and *L. Ichterohaemorrhagiae*. An even lower prevalence to the indigenous strain *L. Sejroe* (Mouse 2A) in cattle has been recorded.

Swedish cattle and the commercial pig population are considered to be free from *L. Hardjo* and *L. Pomona* based on only negative results from the surveillance system since 1994. Since 2006, the surveillance programme in cattle and pigs is no longer performed on a yearly basis as the serological screening of *Leptospira* is considered of less importance compared to screening programmes of other contagious animal diseases. Also, human infections are mainly travel-associated. The Swedish Board of Agriculture can decide to initiate an epidemiological investigation in case of clinical disease consistent with leptospirosis in animals.

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Listeriosis

BACKGROUND

The genus *Listeria* contains several species but *Listeria monocytogenes* is the only zoonotic species and was first described in 1926. Previously, sporadic cases of listeriosis were reported, often in employees in contact with diseased animals but since the 1980s outbreaks of listeriosis have been traced to food products.

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 gravad vacuum-packaged fish products, meat products and soft cheeses or other ready-to-eat foods with a 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 (pasteurisation and cooking). The bacterium is able to grow in vacuum-packed food, at refrigeration temperatures and in modified atmospheres. *L. monocytogenes* is often found as an environmental contaminant in food premises.

In Sweden, during the last ten years approximately 40-120 human cases have been reported annually. Outbreaks have been associated with vacuum-packaged fish (1995-1996, 2013-15), with cheese made of unpasteurised goat's milk (2001) and with cold cuts (2013-2014). Following an increasing trend in the number of cases of listeriosis in Sweden in recent years, the number of cases decreased in 2015.

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 but especially sheep may develop clinical disease, such as neurological symptoms, abortions, mastitis or septicæmia.

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. The severe form most often occurs in immunocompromised persons, newborns, pregnant women and elderly people. Symptoms of invasive listeriosis are septicaemia, meningitis and meningoencephalitis. For those with severe infection, the mortality 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, with an average incubation of 21 days.

LEGISLATION

Animals

Listeriosis is a notifiable disease in animals according to SJVFS 2013:23.

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. Different criteria apply to ready-to-eat (RTE) foods in which growth of *L. monocytogenes* can occur and in RTE foods in which growth of *L. monocytogenes* will not occur during their shelf-life.

Humans

The invasive form of listeriosis has been a notifiable disease in Sweden since 1960. It is notifiable in humans for both clinicians and laboratories according to the Communicable Disease Act (SFS 2004:168 with the amendments of SFS 2014:1549).

SURVEILLANCE

Animals

There is no active surveillance system. Notifications are based on clinical cases and laboratory analyses. The diagnosis can be based on histological findings at necropsy or by detection of the organism by cultivation methods using enrichment in selective broth followed by culture on selective and non-selective agar. Identification is made by biochemical methods. 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. Analysis is based on cultivation methods according to EN/ISO 11290-1 and 11290-2 or NMKL 136 or other methods available at accredited laboratories. The ISO-standard is being revised and is expected to be published by the end of 2016.

Humans

The surveillance in humans is passive. Isolates from human cases are sent to the Public Health Agency of Sweden for typing using whole genome sequencing (WGS) to verify molecular serotype and for cluster detection. During 2015, the Agency started using WGS as the typing method to replace molecular serotyping and PFGE. This technique is much more sensitive and can divide PFGE clusters into finer sub-clusters. As a conventional nomenclature tool, not only the serotype but also the Multi Locus Sequence Typing (MLST) type, ie. ST-type, is extracted from the WGS data. Why *Listeria monocytogenes* is the first food borne agent where the transition into using WGS has been done is because of the relatively small genome, few number of cases in relation to EHEC and *Salmonella* for example, in addition to the severity of the invasive disease.

RESULTS

Animals

In 2015, listeriosis was reported in 26 sheep, six cattle, two wild deer and in one cat.

Food

Available results from official sampling by local authorities at food enterprises showed that 734 samples from various food products were analysed and *L. monocytogenes* was detected in 35 of these samples.

Humans

In 2015, 88 cases of listeriosis were reported (incidence 0.9 cases per 100,000 inhabitants). (Figure 10). This was a decrease in number of cases compared to the year before when 125 cases were notified. Of the reported cases, 52 % were men, and the majority of the cases (80 %) were elderly people over 60 years. Two pregnant women and two infants were also reported with listeriosis. The counties Gotland (incidence 3.5), Jämtland (3.1), Norrbotten

(2.4) and Uppsala (2.0) had the highest incidences in 2015. On a ten years average (2006- 2015), the highest incidences have been reported by the counties of Jämtland and Västernorrland in the north of Sweden.

Listeriosis is most often a domestic infection. During 2015, 73 cases (83%) were reported with Sweden as country of infection. Three cases were reported as infected abroad (Europe) and twelve cases had missing information about country of infection.

In 2015, all but two (98%) of the human isolates were sent in to the Public Health Agency of Sweden for typing. The most common molecular serotypes were IIa (59%), IVb (25%), IIc (8%) and IIb (6%).

During 2015 three cases were identified with a serotype IIa strain identical to the strain causing one of the two national outbreaks in 2013-2014. The source of the outbreak was never identified but epidemiological investigations pointed towards vacuum-packaged smoked and/or marinated salmon. With new analytical methods, and characterisation of isolates, it was possible in 2015 to identify a total of 27 cases connected to the outbreak (the majority of the cases were people over 70 years of age and 67% were men). In May 2015 the outbreak strain could also be identified in several fish products from one producer confirming the epidemiological association with smoked and/or marinated salmon being the suspected source of infection.

In August 2015 four cases were identified with an identical serotype IVb strain. The cases belonged to two different groups that had bought cooked crayfish at the same local producer. A third family who fell ill after eating the same crayfish tested negative for *L. monocytogenes*. The incubation period of 2 days was shorter than normally seen in listeriosis.

DISCUSSION

Despite a decrease in human cases of listeriosis during 2015, the total number of reported cases in Sweden has increased during the latest years, partly due to several national outbreaks. (Figure 10). Also in other European countries an increasing number of reported cases has been observed. The reasons for the overall increase remain unclear but are most likely related to a combination of factors such as an ageing population, a widespread use of immunosuppression medications and consumer preference changes to more ready-to-eat foods.

The case-fatality rate of listeriosis is high. Approximately one third of the patients die within three

months. Since most of the patients suffer from severe underlying diseases the impact of listeriosis is difficult to estimate. The microbiological criteria for *L. monocytogenes*, set in 2005, determine the standard the industry has to achieve for their products to be considered safe for consumers. The results from the 2010 survey, described in the surveillance report from 2012, showed that the fish industry still has problems with *L.monocytogenes*. The results indicate that this is a problem primarily in packaged cold-smoked and gravad fish.

Surveillance of *L. monocytogenes* in humans and in food and food processing environments will be essential for understanding the sources for human infection and giving tools to prevent infections. For detection of outbreak clusters of *L. monocytogenes* and for identifying possible links between humans and food products, subtyping of isolates is essential.

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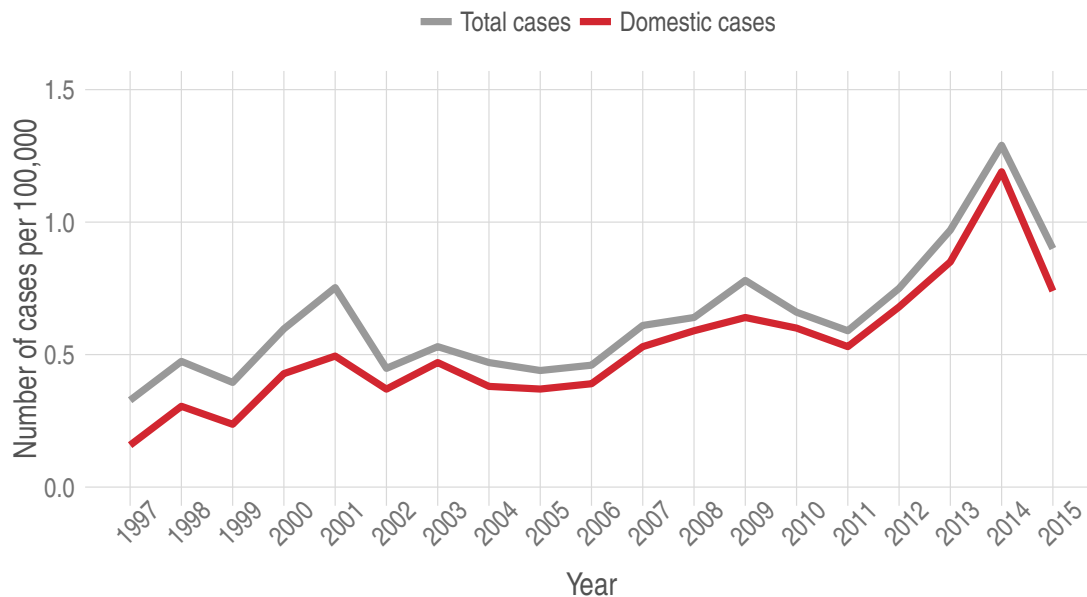


Figure 10: Notified incidence (per 100,000 inhabitants) of human cases of listeriosis in Sweden 1997-2015.

Maedi-visna



Photo: Bengt Ekberg

BACKGROUND

Maedi-visna (MV) is a globally distributed contagious disease in sheep, first described in Iceland in 1939. The causative agent is a lentivirus in the Retrovirus family. Transmission between animals occurs most commonly via the oral route (mainly via milk), but may also occur via inhalation of infected aerosol droplets. The incubation period is long. The first case of MV in Swedish sheep was officially reported in 1974. Fifteen years later the among-flock seroprevalence was 8.2% as demonstrated by sampling of randomly selected sheep at abattoirs. A voluntary control programme for MV was launched by Farm & Animal Health in 1993 and an additional simplified version with single sampling of sheep and goats to identify and enrol flocks into the control programme started in 2005. The simplified version is not regulated within the Swedish legislation and does not require the same obligations from the farmers. The control programme and the simplified version are running in parallel.

Data from all affected flocks have been recorded since 1993.

DISEASE

Only the maedi form of MV is occurring in Swedish sheep flocks; a progressive viral pneumonia. The disease typically remains latent in the flock for several years before appearing with clinical manifestations. In an advanced stage of the disease the typical clinical signs are severe emaciation and respiratory distress in older ewes. In highly infected flocks clinical signs can also appear in younger sheep. After the appearance of clinical signs the outcome is always fatal within weeks to months.

LEGISLATION

MV is a notifiable disease (SJVFS 2013:23).

SURVEILLANCE

The purpose of the control programme is to eradicate MV from Swedish sheep flocks. Documentation of the MV status in the flocks is essential. By

identifying infected flocks for disease control and taking measures, the spread of MV stops and eradication is possible. Prevention of introduction of MV into flocks is crucial.

The programme is based on serological testing of sheep at farm level. A flock specific Maedi status is gained by repeated blood sampling and testing. A contract on an agreement that all sheep in the flock are individually identified and kept in record is signed by the farmer. Purchase of sheep is only allowed from flocks with a similar or higher MV status.

Serological testing is performed on all sheep older than one year. Negative serology grants the flock a M1-status. A second sampling performed 12-16 months later grants a M2-status if all samples are negative for MV antibodies. This procedure is repeated 12-16 months later and a negative result grants a M3-status, which means that the flock is declared free from MV. The MV free status is maintained by an assurance of the animal keeper. An indirect control of the M3 status holdings is performed by testing of sheep from holdings entering the programme as these new animals are mainly bought from M3 status flocks. If antibodies are detected in a flock, depending on the prevalence of positive sheep, either the whole herd is culled or other eradication measures including selective slaughter is performed.

Goats and goat herds can also be included in the MV programme.

The programme is based on serological examination of blood samples for antibodies against MV virus with an AGID-test (agar gel immunodiffusion) for which the antigen was purchased from the Animal and Plant Health Agency. Samples with inconclusive or seropositive results are retested with ELISA (Synbiotic's Elitest MVV/ CAEV), which also is used for flocks under partial eradication and very small flocks with less than five sheep.

Post mortem examinations and histopathology are still important tools to detect MV. Diagnostic testing is performed at the National Veterinary

Institute. Serum samples collected in the MV-programme are also used for other surveys (Brucellosis and Tuberculosis).

RESULTS

During 2015, 18,164 samples from 557 sheep (and some goat) flocks were analysed in the MV control programme for antibodies against MV virus.

At the end of 2015, 3,410 flocks with 131,381 sheep were declared free from MV corresponding to about 50% of the Swedish sheep population. Approximately 1,060 samples were analysed within the simplified programme.

In total during 2015, seven flocks were considered positive of which six were previously untested goat flocks, and one was a sheep flock with previous M3-status.

DISCUSSION

The MV control programme has been running for many years. A huge number of samples have been collected and analysed, and extensive knowledge has been gathered about introduction and appearance of MV in sheep flocks, and diagnostic tests pro's and con's. Thus the programme is very solid. A revision of the programme was made during 2013 by Farm & Animal Health and the National Veterinary Institute. Since July 2014, the programme was refined to reduce sampling in long term MV free and well documented flocks and increase sampling in risk areas and higher risk flocks.

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Nephropathia epidemica



Photo: Torsten Mörner

BACKGROUND

Nephropathia epidemica (NE) is caused by Puumala virus, a member of the Hantavirus genus in the *Bunyaviridae* family. Hantaviruses are the cause of rodent-borne haemorrhagic fevers with renal syndrome (HFRS) and hantavirus pulmonary syndrome (HPS). Puumala virus is likely the most prevalent hantavirus in Europe. The virus is excreted in saliva, urine and faeces from its natural reservoir, the bank vole. Puumala virus can remain infectious in bank vole cage bedding for two weeks. Transmission to humans often occurs in an aerosolised 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.

Nephropathia epidemica was first described by two Swedish physicians independently in 1934. The linkage to the bank vole, was suggested many years later. The virus was first isolated in 1982 in Puumala, a municipality in south-eastern Finland.

In Sweden, between 100 and 600 cases are reported each season with a considerable interannual

variation coupled to the 3-4 year population cycle of the bank vole. During the winter seasons 2006-2007 and 2007-2008 the number of notified cases rose to 1400, where most of the cases occurred in the 2007 calendar year (Figure 11). It is hypothesised that a parallel occurrence of a peak in the bank vole population and lack of snow cover in December, 2006 caused bank voles to seek refuge in buildings and barns, hence increasing their contact with humans.

DISEASE

Animals

In the bank vole, the infection is understood to be subclinical.

Humans

The clinical picture is characterised by a sudden onset of high fever, headache, backache and abdominal pain. 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 has been notifiable since 1989 according to the Communicable Disease Act (SFS 2004:168 with the amendments of SFS 2013:634).

SURVEILLANCE

Animals

There is no surveillance in animals.

Humans

The surveillance in humans is passive.

RESULTS

Humans

In 2015, 285 cases of NE were reported, which was a 32 % decline compared to the numbers reported in 2014. (Figure 11). Most reported cases were in the age category between 40 and 69 years and the median age was 54 years. Just one child below the age of 5 was reported. Consistent with previous years, more cases were reported in men (61%) than in women. The reason for this difference in incidence between age groups and sexes is not completely understood, but behaviour is most likely an

important factor.

In most years, almost all cases were determined to have acquired their infection in Sweden. In 2015, there were no cases known to be infected abroad.

A majority of the cases (83%) were reported from the four northernmost counties in Sweden. In Västerbotten the incidence was highest (38 cases per 100,000 inhabitants) and in Jämtland, Norrbotten and Västernorrland there were 21-23 cases per 100,000 inhabitants. This regional pattern is consistent with previous years. There was a peak in the number of cases during the beginning, whereas the incidence decreased at the end of the year.

DISCUSSION

During recent years, fluctuations in the bank vole population have coincided with increases and decreases in the number of human cases of Puumala virus infections. The 3-4 year natural population cycle and variations in the climatic conditions impact the rodent populations.

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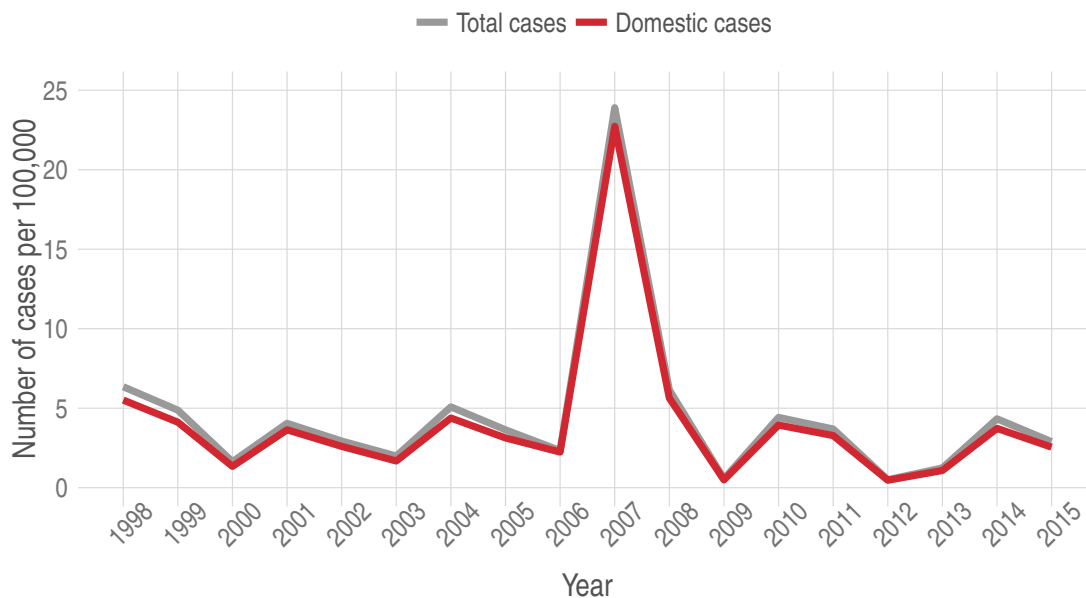


Figure 11: Notified incidence (per 100,000 inhabitants) of human Nephropathia epidemica in Sweden 1998-2015.

Paratuberculosis



Photo: Bengt Ekberg

BACKGROUND

Paratuberculosis is a common disease of ruminants in most parts of the world. Sweden has a unique situation, where the prevalence of the disease is extremely low, or not present at all. However, sporadic cases have previously occurred in beef cattle, all of them connected directly or indirectly to imported animals. The latest case was detected in 2005. Paratuberculosis has never been detected in dairy cattle, other ruminant species or wildlife in Sweden. The overall purpose of the surveillance and the voluntary control programme in beef herds is to document freedom from bovine paratuberculosis and to prevent possible spread by early detection of the infection.

Previous active surveillance

Tracings and several screenings in cattle initiated after detection of a positive beef cow in 1993:

- Screening of 200 dairy herds in the years of 2000, 2003 and 2005.
- Since 2004 all ruminants, above one year of age, submitted for necropsy are sampled for *Mycobacterium avium* subsp. *paratuberculosis* (MAP) and assessed by culture. Sampled

animals includes exotic ruminants like buffalo and camelids.

- Screening of sheep herds during the years 1993- 2011, first with serology, then with faecal culture. The screening of sheep was discontinued in 2012.
- In 2007-2009 screening of beef herds with imported animals during 1990-2005 with faecal culture. In 2012 another screening of beef herds with imported animals during 2005-2011 was done. Herds were investigated by faecal culture.
- Screening of older cows at abattoirs in 2009-2010, aimed at a risk group including cows older than six years with signs of weight loss, resulted in 1,211 sampled cows.

In 2012-2013, a campaign to raise the awareness of the disease among owners and veterinarians was initiated to improve the passive surveillance. Bovine practitioners were encouraged to look for and sample cows with low bodyweight, with or without diarrhoea. The 258 samples were analysed by faecal PCR.

DISEASE

Paratuberculosis, also known as Johne's disease, is an intestinal infection in ruminants caused by *Mycobacterium avium* subsp. *paratuberculosis* (MAP). The bacteria is excreted in the faeces of an infected animal and the normal transmission route is faecal to oral. It causes chronic diarrhoea and emaciation resulting in suffering and death. The disease causes great economic losses due to reduced milk production, reproductive losses and increased replacements of affected animals.

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 in the individual animal during the incubation period.

The zoonotic potential of MAP cannot be ignored and there are ongoing discussions about MAP as a possible contributing factor to the development of Crohn's disease in humans.

LEGISLATION

Paratuberculosis (Johne's disease) has been included in the Swedish Act of Epizootic diseases since 1952 (SFS 1999:657 with amendments). Vaccination is prohibited by law and notification of the infection is mandatory on clinical suspicion. Whole-herd slaughter with subsequent sanitation and tracing of animal trade is performed if MAP is detected in a herd.

SURVEILLANCE

Diagnostic tests

Cultures were pre-treated with HPC and double incubation. Samples were subsequently cultured on modified Löwenstein-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 on a new preparation from the stored samples was performed on samples that had mould overgrowth in the culture.

Samples collected because of clinical suspicion and individual faecal samples from the beef herd control programme during 2015 were analysed with direct PCR.

All tests for MAP were performed at the National Veterinary Institute.

Passive surveillance

Notification, sampling and diagnostic testing are mandatory in animals of any ruminant species exhibiting clinical signs that lead to suspicion of paratuberculosis. Sampling includes faecal samples from live animals and post mortem samples from dead or culled animals. The latter consists of samples from the ileal wall, ileal contents and ileocaecal lymph nodes as well as any macroscopic lesions in the intestines. Wildlife is sampled when MAP is suspected at necropsy.

Active surveillance

Control programme for surveillance in beef cattle

In the control programme, the target population is beef herds that sell animals for breeding. The programme is managed by Farm & Animal Health and financed by the Swedish Board of Agriculture. In total, the control programme for bovine paratuberculosis encompassed 438 herds, of which 417 are of the highest status, at the end of 2015. The control programme includes all main breeding beef herds and a smaller number of dairy herds selling calves to beef herds within the program.

The programme underwent some changes in 2011. In affiliated herds, individual faecal samples are collected annually for three consecutive years, from all cattle over two years of age and all purchased animals from one year of age. Affiliated herds are only allowed to trade with herds of the same status or higher to keep their level within the programme. After three years of negative test results, the faecal sampling is replaced by necropsy of all deceased or euthanized cattle on the premises where paratuberculosis cannot be excluded as a cause of culling.

Post mortem examinations

Sampling was performed on all ruminants above one year of age submitted for post mortem examinations. Samples are taken from the ileal wall, ileal contents and ileocaecal lymph nodes and submitted to the National Veterinary Institute.

Health controls for export reasons

218 cattle were sampled for export reasons, 180 by PCR and 38 by serology. Choice of analysis depends on the recipient country.

RESULTS

In 2015 three animals were investigated due to clinical suspicion of MAP (all cattle). All were analysed by faecal PCR with negative results. In 2015, 36 beef herds were also sampled within the control programme for surveillance in beef herds, resulting in 840 individual samples (797 cattle, 35 sheep and 8 water buffalo). Three hundred and seventy-nine animals were sampled at post mortem examination; 209 cattle, 155 sheep, 9 goats and 6 exotic ruminants (4 alpacas, one camel and one moose). Two positive serological results was initially obtained from bulls sampled for export reasons. Both underwent epidemiological investigation and testing with faecal and semen PCR and were found negative. No cases of MAP were detected in any of the examinations completed in 2015 (Tables 8 and 9).

DISCUSSION

The prevalence of MAP in Swedish ruminants remains at a very low level, if present at all.

The screenings of beef herds with cattle imported from 1990-2011 was aiming for the highest risk group of animals for MAP in Sweden; MAP has been detected in no other breeds or species than beef cattle and all cases have been traced back to imported animals with the latest case back in 2005.

Fallen stock is considered a risk category for MAP and therefore all ruminants older than one year of age, submitted for post mortem examination, are sampled for MAP and examined by culture. All herds affiliated with the control programme must send fallen stock for post mortem examination if paratuberculosis cannot be ruled out as a cause for death or culling. The post mortem sampling also

includes other susceptible species, like sheep, goats and exotic ruminants. The exotic ruminants are sometimes imported, or kept in herds with other exotic ruminants imported from countries where MAP is prevalent.

In a recent study (Frössling, 2013), the probability of freedom and sensitivity of the surveillance system for MAP was estimated. Results show that, at the end of 2008, there was a high probability that the Swedish cattle population was free from or had a very low prevalence of MAP. This supports the need for continued investigations of animals being imported, as imports of susceptible species pose the greatest risk to introduction of MAP to the Swedish cattle population.

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Table 8: Screening of sheep and goats.

Surveillance in sheep	No. of sampled sheep	No. of herds
Sheep sampled in cattle herds within the beef herd surveillance programme	35	4
Sampled at post mortem examinations	164 ^A	120

^A Including 9 goats from 7 herds

Table 9: Screening of cattle and exotic ruminants.

Surveillance in cattle and exotics	No. of samples	No. of herds
Beef herd surveillance programme	805 ^A	36
Sampled cattle at post mortem examinations	209	175
Sampled exotic ruminants at post mortem examinations	6	5
Sampled cattle for export	218	-

^A Including 8 water buffalo from one herd

Porcine reproductive and respiratory syndrome

BACKGROUND

Porcine reproductive and respiratory syndrome (PRRS) is caused by an enveloped RNA-virus belonging to the family Arteriviridae and the disease affects domestic pigs. PRRS is a highly contagious disease transmitted between pigs through both direct and indirect contact.

Seropositive feral pigs and wild boars have been described but there is no evidence of wild boar being a reservoir for PRRSV in Sweden. The disease was first described in USA in 1987 and the virus was subsequently identified in 1991. Since then, PRRSV has spread and is endemic in most of the pig populations of the world. It is considered to be one of the most economically important viral diseases in swine production. In 2006, an atypical variant of PRRSV was reported from Asia. This variant causes more severe clinical signs and higher mortality than previously described genotypes of the virus.

In 1998, Farm & Animal Health launched a surveillance programme for PRRSV in which the Farm & Animal Health is responsible for 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 few countries that had declared themselves free of PRRSV. The outbreak was detected through the active surveillance programme. 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 during the fall of 2007, Sweden was declared free from the disease with a 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 programme was revised in order to enable even earlier detection of an introduction of PRRSV. Another revision of the programme was done in 2012 following extensive changes in the pig production in Sweden.

DISEASE

Infection with PRRSV causes varying clinical signs depending on the 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 fever and inappetence for a few days. The devastating effect of PRRSV infection in this category of animals is that it causes reproductive failure including abortions, mummified foetuses, small litters and increased incidence of non pregnant sows. In fattening pigs the infection mainly causes respiratory signs.

The atypical variant of PRRSV may cause high fever, discolouration of the skin and high mortality rates in all age groups.

LEGISLATION

The disease was included in the Swedish Act of Epizootic diseases in 1999 (SFS 1999:657 with amendments) is notifiable on suspicion and notification will lead to investigation.

SURVEILLANCE

The purpose of the surveillance is to document freedom from PRRSV and to detect introduction of the virus before it is widespread in the population. Both sampling for detection of viral genome and antibodies against PRRSV are used in the surveillance. To detect antibodies against PRRSV a commercial ELISA-method (IDEXX PRRS X3 Ab Test, Idexx Laboratories) is used and presence of the viral genome is analysed using a PCR-method. Samples positive for PRRSV antibodies in the ELISA-test are analysed by an immunoperoxidase monolayer assay (IPMA) for confirmation.

Passive surveillance

Because 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 sampling of sick or dead animals and examination of the herd for presence of clinical signs and analyses of production results. During the investigation the farm is placed under restrictions.

In addition, analyses for the PRRSV genome with PCR are included in the enhanced passive surveillance of aborted fetuses.

Active surveillance

The active surveillance programme revised 2012 and put into effect 2013, comprises a field sampling in all Swedish nucleus herds, multiplying herds and sow pools twice a year and randomly selected production herds are sampled continuously at slaughter. In nucleus herds, multiplying herds and sow pools eight samples per herd are analysed at each sampling occasion and at slaughter three samples per herd are analysed.

The revised programme was designed to take into consideration an increased risk of introduction, the changes in the structure of the pig production and to keep the probability of freedom of PRRS on the same level as after demonstration of freedom after the outbreak in 2007. To achieve this, the programme is designed using a between-herd design prevalence of 0.5%, a within-herd design prevalence of 40% and a risk of introduction of 1 in 5 years.

Ongoing testing of animals for export and at breeding centres adds to the active disease surveillance.

In addition to the surveillance of PRRS in domestic pigs there is also an active surveillance for PRRS in wild boar (see chapter Infectious diseases in wild boars)

RESULTS

Passive surveillance

Five investigations following clinical suspicion of PRRS were completed during 2015. Reproductive failure, weak piglets, high piglet mortality and circulatory disorder in sows were the main clinical manifestations. Other epizootic diseases (African and classical swine fever, Aujeszky's disease) were investigated in parallel to PRRS. The number of animals sampled and the methods chosen varied depending on the nature of the suspicion in terms of clinical manifestation and how widespread the clinical signs were in the herd. Following sampling and testing, the herds were all declared negative for PRRSV.

Within the surveillance of aborted fetuses, 17 fetuses from 11 herds were examined for the PRRSV genome and all samples were negative.

Active surveillance

In 2015, 824 samples, from 52 nucleus herds, multiplying herds and sow pools and 2,382 samples from the abattoir sampling were analysed. The samples from the abattoir sampling originated from 521 herds and each herd was sampled 1-2 times (max 6 times) during the year.

All samples were negative for antibodies against PRRSV. For comparison, the number of samples for the years since the PRRSV outbreak are given in table 10.

Taking the surveillance outcome from 2014 into account, the probability of freedom based on the summarised surveillance during 2015, was >99%.

Approximately 1,300 samples from animals for export and from breeding centres were tested during 2015. One of these samples were positive for PRRS antibodies following confirmation and an investigation including sampling was performed in the herd. All additional samples that were analysed in the investigation were negative and it was concluded that the positive sample was a "singleton reactor".

DISCUSSION

Before the outbreak of PRRS in 2007, the active surveillance programme was based on field sampling in all nucleus herds, multiplying herds, sow pools and 50 production herds once a year, usually clustered in time. This surveillance design had the drawback of being expensive despite having a low sensitivity. After the outbreak, the surveillance was further developed employing continuous abattoir sampling and a more effective field sampling in nucleus herds, multiplying herds and sow pools to improve early detection of a PRRSV introduction and to increase the sensitivity of the surveillance. The evaluation of the programme in 2012 indicated that the probability of freedom and the sensitivity of surveillance were declining over time and the changes that were suggested aimed at breaking this trend. The main reasons for the declining probability of freedom were the decreasing number of samples and an irregular sampling frequency. During recent years, the Swedish pig industry has undergone substantial structural changes leading to a rapidly declining number of herds and extensive changes in the market and in the habits of farmers. These changes emphasise the need for continuous monitoring of surveillance performance over the year and a yearly evaluation of performance and design. The present design with continuous sampling and testing over the year in combination with

the clinical surveillance increase the probability of early detection compared to the strategy used before the outbreak.

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Table 10: Number of samples and herds tested in the active PRRS surveillance 2008-2015 in relation to the number of registered swine herds

Year	Field sampling		Abattoir sampling		Total number of samples	Number of registered swine herds in Sweden ^A
	Number of samples	Corresponding number of sampled herds	Number of samples	Corresponding number of sampled herds		
2008	2,052	128	3,724	1,241	5,776	2,380
2009	1,106	69	2,712	904	3,818	2,027
2010	2,012	126	4,424	1,475	6,436	1,695
2011	1,240	78	2,308	770	3,548	1,515
2012	1,055	66	2,145	717	3,200	1,318
2013	1,024	64	1,548	516	2,572	1,281
2014	912	57	2,028	676	2,940	1,300
2015	824	52	2,382	521	3,206	1,228

^A Sources: Yearbook of agricultural statistics 2009-2013; Sveriges Officiella Statistik - Statistiska Meddelanden JO 20 SM 1403

Psittacosis



Photo: © Staffan Renlund

BACKGROUND

Psittacosis is caused by *Chlamydia psittaci*, an intracellular bacterium. 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 1930s. Since then, outbreaks have been described worldwide.

The main reservoir is birds and the organism is excreted in faeces and nasal discharges. Birds may become carriers of the organism and shed it intermittently for years without any clinical signs. People acquire the infection mainly via inhalation of contaminated dust or through contact with infected birds. In birds, the infection is transmitted via contact, by ectoparasites or contaminated equipment. *C. psittaci* may persist in dry faecal material for months.

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

DISEASE

Animals

Birds commonly develop clinical signs when stressed or when their immune system is suppressed. Clinical signs in birds range from an asymptomatic infection to conjunctivitis, sneezing, pneumonia and generalised infection. Adult birds recover from the infection but 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 infection. The disease is usually mild or moderate, but can be severe especially in untreated elderly persons. Most human cases are sporadic, many infections are probably not diagnosed. The incubation period is usually around 10 days but can vary from 1 to 4 weeks.

LEGISLATION

Animals

C. psittaci is notifiable in animals according to (SJVFS 2013:23).

Humans

Psittacosis has been a notifiable disease since 1969 according to the Communicable Disease Act (SFS 2004:168) with the amendments of SFS 2013:634.

SURVEILLANCE

Animals

No active surveillance exists. Notification is based on detection of the organism by PCR targeting all members of the *Chlamydiaceae* family, including both genera of *Chlamydia* and *Chlamydophila*. Species identification can be performed by sequencing the PCR fragment.

Humans

The surveillance in humans is passive. For laboratory verification of the infection serology and PCR are the methods used.

RESULTS

Animals

In 2015, seven captive birds and three wild birds were tested for *C. psittaci*. All of them tested negative.

Humans

Psittacosis is mainly a domestic infection. Of the 19 cases reported during 2015 only 1 was infected abroad (in Japan). Only 2 of the cases were women aged 51 and 60 respectively. The men were between 31 and 80 years old with a median age of 67.

A majority of the cases, 90% (n=17), reported

that they had been in contact with birds or bird droppings. For the remaining two cases there were no obvious route of transmission. All except for one of the cases were reported from the south of Sweden.

DISCUSSION

At present, *C. psittaci* does not occur in Swedish poultry. The organism is occasionally reported in captive birds but psittacosis is considered common in both captive birds and wild birds. However, *C. psittaci* was detected in only 1% of the Swedish wetland and prey birds.

In the 1980s around 100 human cases were reported each year. During the last decade, between 2 and 24 cases were reported annually. There is no obvious explanation to the decrease in number of cases, but one possible cause could be that people with a clinical presentation consistent with psittacosis are less likely to be sampled than they were in the 1980s which leads to an underestimation of the number of human cases of psittacosis.

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Q fever

BACKGROUND

Q fever is a zoonotic disease caused by the bacterium *Coxiella burnetii*. Because of its tolerance to heat, dryness 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, foetal and vaginal fluids, faeces, urine and semen. *C. burnetii* has also been isolated from ticks.

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 unpasteurised milk may be a risk to susceptible individuals. In humans, immunosuppression, predisposing valvular heart disease and pregnancy may increase susceptibility to Q fever.

Larger outbreaks of Q fever, when reported, are principally associated with small ruminants, whereas cattle appear to be the source of sporadic cases. 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.

The presence of *C. burnetii* in domestic animal populations in Sweden has been known since the early 1990s. The bacterium was first isolated from a sheep placenta in a herd on the isle of Gotland. In 2008/2009, a national survey of dairy cattle herds showed that 8% of the herds were antibody positive in bulk milk. There were large regional differences with the highest prevalence on the isles of Gotland and Öland (59% and 35%, respectively). In 2010, national surveys of sheep and dairy goat herds showed a very low prevalence of antibodies; 0.6% (n=518 herds) and 1.7% (n=58 herds), respectively. In addition, goat bulk milk was also analysed for detection of the agent and *C. burnetii* was not detected. In 2011, 80 sheep farms were investigated for the presence of the agent by analysing vaginal swab samples from sheep taken in conjunction with lambing without detecting the agent in any of the samples. The results supports that *C. burnetii* is a

rare pathogen in the Swedish sheep and goat populations. In a survey of 99 Swedish moose during 2008-2010 no positive samples were found, indicating that *C. burnetii* is rare also in this wild species.

In humans, only two domestic cases were reported in the 1980s and 1990s. During the same period, a serological survey 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 was observed. Only one case was classified as domestic during the period from 2004-2009. In 2010, the situation changed as eight of the totally 11 reported cases claimed to have been infected in Sweden. All these domestic cases were linked to a farm in southern Sweden, which was included in a national survey on dairy herds and where the bulk milk from the cows was shown to be antibody positive for *C. burnetii*.

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 should be determined whether any reproductive problems are due to Q fever or if there are other causes.

Humans

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

LEGISLATION

Animals

Q fever is a notifiable disease (SJVFS 2013:23). Notification of a primary case of Q fever in animals is

based on detection of the agent *C. burnetii* or increased antibody levels in paired samples.

Humans

Q fever has been notifiable according to the Communicable Disease Act since 2004 (SFS 2004:168) with the amendments of SFS 2013:634.

SURVEILLANCE

Animals

There was no active surveillance for *C. burnetii* in 2015. Limited testing was done on cattle for export reasons. Blood samples from 46 cattle were analysed for the presence of antibodies by complement fixation test or ELISA.

Humans

The surveillance in humans is passive. For laboratory verification of the infection, serology and PCR are used.

RESULTS

Animals

All samples from cattle that were submitted for testing were negative.

Humans

Since the 1980s, few domestically acquired cases of Q fever have been reported apart from the cluster in 2010. Most reported cases have been infected in Mediterranean countries. In 2015, four cases of Q

fever, all male and three of them infected in Spain, were reported.

During the period when Q fever has been a notifiable disease, only about 20% of the reported cases have been women. A similar difference in gender distribution has been described from other countries, but the cause of it is not clear.

DISCUSSION

After four years (2008-2011) of active surveillance for Q fever, as well as other related studies, the present surveillance in animals is passive. It is notable that awareness and concern with Q fever as a differential diagnosis has decreased. Due to the nature of the infection, this situation is not likely to change as long as the surveillance remains passive, i.e. dependent on the health or veterinary care seeking behaviour of individuals.

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Rabies



Photo: Linda Ernholm

BACKGROUND

Rabies is caused by a lyssavirus in the family *Rhabdoviridae*, and can infect all warm-blooded animals. The disease occurs worldwide with some exceptions. Rabies is transmitted through contact with saliva, typically via animal bites. Most human cases are caused by bites from infected dogs. The reservoir animal species for rabies in endemic countries are most notably among carnivores of the family *Canidae*. In Europe, the reservoir species are red foxes and raccoon dogs. Bats in Europe may carry another type of lyssavirus called European Bat Lyssavirus (EBLV), but not classical rabies. Since 1886 Sweden has been free from animal rabies. EBLV has never been isolated from bats in Sweden, but antibodies to EBLV have been detected in specimens from live bats suggesting that EBLV is present among in Sweden.

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, severe anxiety, confusion, slight or partial paralysis, excitation, hallucinations, agitation, hypersalivation and difficulty swallowing. The incubation period of rabies is usually 3-6 weeks, but may vary from five days to one year.

Not much is known about clinical signs of EBLV in infected bats. They may express weight loss, disorientation, lack of coordination, muscle spasms and aggression, but some infected bats may be normal in behaviour.

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 must be rabies vaccinated before entering Sweden. In addition, depending on the country of origin, some must have their antibody titre tested. The rules are set in SJVFS 2014:47 and in the EU Regulation 576/2013.

Humans

Rabies in humans is notifiable according to the Communicable Disease Act (SFS 2004:168 with the amendments of SFS 2013:634).

SURVEILLANCE

Animals

Passive surveillance

Animals with clinical signs where rabies cannot be excluded, are tested on suspicion. Diagnostic methods used were FAT or PCR (three cases). No enhanced passive surveillance for EBLV in bats was performed during the year.

Active surveillance

Illegally imported pets, from countries with endemic rabies, that are detected and euthanized are examined for rabies to exclude the possible spread of rabies in Sweden.

Humans

The surveillance in humans is passive.

RESULTS

Animals

Three cats, five dogs, one red fox and one bat (*Myotis daubentonii*) were examined for rabies due to clinical suspicion. During 2015, 20 dogs and three cats were examined after decision by the Swedish Board of Agriculture. The diagnostic method used was PCR. None of the animals had presented clinical signs associated with rabies. All animals tested negative for rabies.

Humans

No human cases were reported during the year.

DISCUSSION

During the recent decades, two people have been hospitalised for rabies in Sweden. In 1974, a Swedish man fell ill after having been infected in India. In 2000 a woman fell ill after a visit to Thailand. Both patients had most probably been infected by rabid dogs. Since Sweden is free from classical rabies, the risk of acquiring the disease from Swedish animals is negligible. However, since 2004, there has been an increasing problem with illegal importation of pets, mostly dogs. Illegally imported dogs from endemic countries are probably the greatest threat to the rabies free status of Sweden. During 2014, SVA made a risk assessment on rabies. The results suggest that the probability of introducing rabies with illegally imported pets is very low, but not negligible. The results are similar to the results from 2005. The Board of Agriculture changed the risk management of illegally imported pets during 2015 which resulted in less euthanized dogs. Instead the dogs are kept under the owner's control. How this changes the overall risk of rabies in Sweden is not known.

Between 1998 and 2012, an enhanced passive surveillance programme where dead bats were examined for the presence of EBLV was in place. In addition, from 2008 to 2013 an active surveillance programme for EBLV was performed in different regions in Sweden.

Antibodies to EBLV have been detected in specimens from live Daubenton's bats as part of the active surveillance programme, suggesting that EBLV is present in Sweden. Daubenton's bats (*Myotis daubentonii*) are 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 bat in Sweden, and may be found all over the country. There are 19 different species of bats in Sweden, all insectivorous belonging to the family of *Vespertilionidae*.

Salmonellosis



Photo: Marianne Elvander

BACKGROUND

Salmonellosis is one of the most important bacterial zoonoses. The genus is divided into two species: *S. enterica* and *S. bongori*. 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. Humans are infected by contaminated food products of various types, through contact with infected animals, via person-to-person transmission or via a contaminated environment.

A severe domestic outbreak of *S. Typhimurium* in 1953 that involved more than 9,000 people prompted the need for a control programme for *Salmonella*. Since then, the strategy for control has been to prevent *Salmonella* in all parts of the production chain, from feed to food of animal origin. When Sweden joined the European Union in 1995,

the Swedish *Salmonella* control programme was accepted.

Around 2,800-3,500 human cases of salmonellosis are reported every year to the Public Health Agency of Sweden. A majority of these (around 75-80%) are infected abroad. The low proportion of domestic infections is unique to Sweden compared to many other countries. A few larger outbreaks have been reported, and the source is often imported food.

DISEASE

Animals

Infected animals are often asymptomatic. However, *Salmonella* can cause clinical illness with diarrhoea, abortions and fever, and lead to death. In Sweden, clinical signs are frequently seen in cattle and horses, but only rarely in pigs and poultry.

Humans

Salmonella infects the gastrointestinal tract and causes an acute gastrointestinal illness. The symptoms can range from asymptomatic and mild to severe. The incubation period is typically between 1 and 3 days but can vary from 6 hours to 10 days. Most patients recover from the illness spontaneously but sequelae such as reactive arthritis occur 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 programme for *Salmonella* at farm level. The feed business operator is responsible for producing *Salmonella*-free feed. Poultry feed must be heat treated according to the legislation. The majority of cattle and pig feed is also heat-treated. The control of feed is supervised by the Swedish Board of Agriculture which carries out announced and unannounced inspections at feed mills. *Salmonella* in feed is regulated in national legislation (SJVFS 2006:81) as well as in an EU regulation (Commission Regulation (EU) No142/2011).

Animals

Investigation is required upon clinical suspicion of *Salmonella* and any finding of *Salmonella*, regardless of serovar, is notifiable and action is taken to eliminate the infection or contamination. Vaccination is not used in Sweden. The *Salmonella* control programme is governed by the Swedish Act on Zoonosis (SFS 1999:658) and its regulations. The aim of the programme is that animals sent for slaughter and animal products should be free from *Salmonella*.

Food

Any finding of *Salmonella* in food is notifiable and a contaminated food product is considered unfit for human consumption. However with one exception, which is *Salmonella diarizonae* serovar 61:(k):1,5(7) in sheep meat which is not considered unfit for human consumption, (LIVFS 2005:20 with amendments).

Humans

Salmonellosis in humans is notifiable according to the Communicable Disease Act (SFS 2004:168 with amendments, SFS 2013:634).

SURVEILLANCE

Feed

In the control programme for feed, the emphasis is on control of feed raw materials, the heat treatment process and preventive measures for preventing re-contamination of heat-treated feed. Suspected feed-borne infections are also investigated.

Surveillance of feed raw materials

Raw materials are the most important risk factor in feed production. In the domestic legislation, feed materials are classified according to the empirical risk of being contaminated, and high-risk feed materials have to be tested negative for *Salmonella* contamination before being used for feed production. All consignments of intra-community traded or imported feed materials classified as a risk, have to be sampled for *Salmonella*. The sampling plan is designed to detect a *Salmonella* contamination in 5% of the batch with 95% probability.

Surveillance of feed mills

The purpose of the surveillance is to ensure the absence of *Salmonella* in the production lines as well as in the feed mill environment. A safety management system is applied in the processing line according to HACCP (Hazard Analysis and Critical Control Points). The management system covers a number of specific GMP (Good Manufacturing Practice) requirements, according to Swedish legislation. A minimum of five samples from feed mills manufacturing compound feeding stuffs for poultry and a minimum of two samples from those manufacturing compound feeding stuffs for other food-producing animals must be collected in the processing line on a weekly basis. These samples are analysed at National Veterinary Institute (using MSRV, amendment to ISO 6579:2002 Draft 251004) and any finding of *Salmonella* is reported to the Swedish Board of Agriculture. The manufacturers also take additional 'own control' samples from the processing line and the feed mill environment.

Food

Control of *Salmonella* is an important part of in-house control programmes in most food enterprises in Sweden. All findings must be reported to the competent authority.

Official sampling by local authorities at food enterprises, other than abattoirs and cutting plants, is at a level of approximately 1,000 samples per year

and samples are analysed using mainly NMKL (nr 71:1999) and Vidas-SLM methods.

Surveillance at abattoirs and cutting plants

According to the Swedish *Salmonella* control programme, samples from intestinal lymph nodes and swabs from carcasses are taken from cattle and swine and neck skin samples from slaughtered poultry. Sampling is proportional to slaughtering capacity. Altogether, approximately 20,000 samples from cattle, adult swine, fattening pigs and poultry are collected annually at abattoirs.

At red meat cutting plants, approximately 5,000 samples are taken annually from crushed meat and meat scrapings and approximately 900 samples are taken in poultry meat cutting plants. The samples are analysed by regional laboratories using the current edition of the NMKL (nr 71:1999) method, with the exception of approximately 700 samples analysed by Vidas-SLM.

Control in food-producing animals

Control in poultry

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

Compulsory programme - poultry

All breeding flocks with more than 250 birds are tested (Table 11). Grandparents of *Gallus gallus* broilers are imported as day-old chicks. Laying hens, turkeys, geese and ducks are imported as parents. Samples consist of sock samples 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 of breeders.

All holdings selling eggs for consumption are sampled (Table 11). All poultry flocks having more than 500 birds, irrespective of species, are tested 1-2 weeks before slaughter. In practice, all poultry flocks are tested prior to slaughter. The results must be available before slaughter.

The producers pay the costs for laboratory analyses and the visits to the farms. 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 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.

Voluntary programme - poultry

A preventive voluntary programme includes all-in all-out production, hygienic measures and a high standard for poultry houses, such as hygienic barriers between the clean and unclean part. Purchases of animals may only occur from holdings affiliated to the voluntary programme and 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 into the voluntary programme. An official veterinarian inspects the housing regularly. The producers affiliated to the voluntary programme receive higher compensation in case of *Salmonella*. All broiler producers belonging to the Swedish Poultry Association are affiliated to the voluntary programme (approximately 99% of the slaughtered broilers). The voluntary programme has been in place for more than 40 years.

Control in cattle and pig herds

The programme includes a compulsory and a voluntary part.

The compulsory part consists of annual faecal sampling from breeding pig herds and gilt-producing herds and twice-a-year sampling from sow pools. *Salmonella* is tested at other post-mortem investigations if an infection is suspected by macroscopic findings. All imported animals are sampled. On clinical suspicion, herds or single animals should be tested for *Salmonella*.

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

Control in other animals

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

All samples from animals (poultry, cattle and

pigs and other animals) are analysed using the MSRV (EN-ISO 6579:2002/A1: 2007: Amendment 1: Annex D) method.

Humans

Salmonella infection is notifiable in humans. A trace back investigation is completed for all domestic cases of *Salmonella*. All isolates sent to the Public Health Agency of Sweden are analysed according to the guidelines of the WHO Collaborating Centre for Reference and Research on *Salmonella*. Institute Pasteur, Paris, France Grimont, P. A. D. and Weill, F-X, 2007.

MEASURES IN CASE OF POSITIVE FINDINGS Isolates

All suspected index isolates of *Salmonella* from non-human sources are sent to the National Veterinary Institute for confirmation, serotyping, resistance testing, and further typing. Index isolates of *Salmonella* from domestic human cases are sent to the Public Health Agency of Sweden for serotyping, phage typing and further molecular typing. A subset of isolates from travel-associated cases are also typed.

Feed

Findings of *Salmonella* in intra-community traded or imported feed materials and compound feeds are reported in 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. After acid treatment the feed material has to be re-tested negative before use in feed production. Finished feed containing *Salmonella* has to be withdrawn from the market. Extended sampling and cleaning are done in the production line if *Salmonella* is detected in the weekly surveillance. 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 obligated to take samples and implement measures to 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.

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

All *Salmonella* positive poultry flocks are destroyed irrespective of serovar. The poultry house 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 partial herd depopulation and hygienic measures controlled by repeated sampling is usually practised. Cattle herds that are under restrictions for *Salmonella* are monitored by a combination of serological and bacteriological testing. 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 by culture from whole-herd sampling at two occasions 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 follow up investigations are performed on the positive horse(s).

Food

Food products contaminated with *Salmonella* are considered unfit for human consumption. Products released on the market will be withdrawn and contaminated products will be destroyed or sent for special treatment to eliminate the *Salmonella* bacteria. However with one exception which is *Salmonella* *disarizonae* serovar 61:(k):1,5(7) in sheep meat, which is not considered unfit for human consumption, (§§

30a-30b, LIVFS 2005:20 with amendments).

Findings in imported consignments are reported in the RASFF-system and the consignments will be returned to the country of origin, destroyed or sent for special treatment as applicable. RASFF is also used for informing about contaminated Swedish food products released on the EU-market.

In food businesses where *Salmonella* has been detected, appropriate follow-up measures will be applied, such as careful cleaning and disinfection and environmental sampling.

RESULTS

Feed

Eleven major feed mills produce approximately 95% of the feed for food producing animals. In the weekly surveillance of feed mills, 8,960 samples were analysed for *Salmonella* with 17 samples (0.19 %) positive. Six serovars were detected; *S. Typhimurium* was the most common (n=9) (Table 14).

In addition, *Salmonella* was detected in 18 out of 1,594 analysed batches from feed materials of vegetable origin. The most common serovar was *S. Senftenberg* (n=10). *Salmonella* was detected in two environmental samples (0.25 %) from domestic rapeseed processing plants. *Salmonella* was detected in 4 out of 1,325 batches from feed materials of animal origin and from pet food.

Animals

Poultry

Salmonella was detected in 13 flocks (0.38%) of 3,390 broilers in routine sampling before slaughter (Table 13). In addition, *S. Typhimurium* was detected in one parent flock (Table 13 and Figure 17). Also, *Salmonella* was detected in two (0.30%) of 661 flocks of layers. *Salmonella* was also detected in one flock of ducks. *Salmonella* was not detected in flocks of turkeys or geese.

Cattle

In summary, *Salmonella* was detected in six new herds in 2015 (Table 15);

- 4 herds were detected by post mortem examination or a faecal sample of a diseased calf
- 1 herd were detected by trace-back investigations from a *Salmonella* positive herd.
- 1 herd was detected by trace-back investigation of a human case.

In addition, *Salmonella* was isolated from six farms put under restrictions before 2015.

Salmonella was isolated from three (0.08%) of 3,756 mesenteric lymph nodes from cattle at slaughter (Table 12 and Figures 13 and 14).

Pigs

In 2015, *Salmonella* was detected in one pig herd after a finding of *Salmonella* in a lymph node sample at slaughter (Figure 15).

Salmonella was detected from two (0.12%) of 1,659 lymph node samples taken from adult pigs from one (0.04%) of 2,540 lymph node samples from fattening pigs (Table 12, Figures 13 and 14).

Other animals

In 2015, *Salmonella* was detected in 83 cats (Table 16). Most (87.7%) of these were reported from March to May. Of the 31 serotyped cat isolates, 30 belonged to *Typhimurium* and one to *Kottbus*.

Also, *Salmonella* was detected in two horses, two dogs and one wild bird (Table 16).

Food

In the Swedish *Salmonella* control programme, *Salmonella* was not detected in any of the 3,786 cattle carcass samples and not in any of the 4,176 pig carcass samples (Table 12). *Salmonella* was neither isolated from any of the 4,594 poultry neck skin samples. However, *Salmonella* was isolated from two (0.04%) of 5,285 samples of red meat taken at cutting plants (Table 12 and Figures 13 and 14).

Available results from official sampling by local authorities at food enterprises showed that 1,284 samples for *Salmonella* were taken for reasons other than the *Salmonella* control programme. Nine of these 1,284 samples were positive. Seven of these nine were spices, one was a pastry bag used for piping mashed potatoes and one was granulated onion.

Humans

In 2015, a total of 2,298 cases of salmonellosis were reported, compared to 2,213 cases in 2014 (Figure 12). Domestic cases increased by 22%, from 547 cases in 2014 to 698 cases in 2015, giving an incidence of 6.99 cases per 100,000 inhabitants.

A majority of the cases (69%) were infected abroad. However, travel-associated cases decreased to 1,582 (1,634 in 2014). Since 2009, a steep decrease in the number of travel-associated cases has been noted, despite an increase in international

travel. Travel-associated cases have decreased since the early 2000s. The fewest travel-associated cases were recorded during the years 2011-2013. The observed decrease has been most apparent among those travelling in Europe. As in previous years, *Salmonella* infection was most commonly acquired in Thailand (356 cases) followed by Turkey (238), Spain (114), Egypt (58), Greece (47) and Indonesia (44).

Among the domestic cases, the median age was 37 years (0-103 years). Children aged 0-10 years accounted for 158 of all reported cases (both the domestic and the travel-related cases). The gender distribution was even among the domestic cases but slightly more women than men (52%) were reported among the travel-related cases.

Of the isolates from domestic cases, 85% were serotyped compared to 17% of the travel-associated cases. Normally in Sweden, *S. Typhimurium* is the most common serovar in domestic isolates followed by *S. Enteritidis* and monophasic *S. Typhimurium* (*S. enterica* sp. *enterica* 1,4,[5],12:i:-). In other countries in the European Union, Enteritidis is normally more common than Typhimurium and due to a large outbreak of *S. Enteritidis* phage type 13a, this was also the most reported serovar in 2015 in Sweden (35% in 2015, 19% in 2014). Serovar *S. Typhimurium* constituted 23 % of all typed isolates in 2015, same percentage as in 2014 and monophasic *S. Typhimurium* 10 % 2015 instead of 14% in 2014.

In the outbreak already mentioned, 132 cases of *S. Enteritidis* phage type 13a were recorded, making this the most common phage type reported in 2015. Other common phage types among domestic cases of *S. Enteritidis* were PT8 (24 cases) and PT21 (6 cases).

During 2013, phage typing of *S. Typhimurium* was completely replaced by MLVA (multi-locus variable number tandem repeat analysis). Of the domestic isolates of *S. Typhimurium*, MLVA profile 4-12-17-9-211 (13 isolates) was the most common, followed by 3-16-N-N-311 and 3-15-N-N-311 (both 7 isolates). MLVA profile 3-11-9-N-211 (10 cases) and 3-12-9-N-211 (9 cases) were most common among domestic isolates of monophasic *S. Typhimurium*.

A clear seasonal variation of domestic salmonellosis is normally observed with most cases during the summer months. In 2015, however, there was an unusual high increase during June and July, with twice as many cases as normally reported. The explanation for this is the large outbreak of *Salmonella*

Enteritidis phage type 13a, which peaked during these months. Most travel-associated cases of salmonellosis are normally reported from January to March when travelling to warmer destinations is common. Also, a clear peak travel-associated cases is usually observed during the summer months when many people have vacation. These two seasonal peaks were also observed in 2015, but the number of travel-related cases continues to decrease with time.

The outbreak described above was one of the largest domestic outbreaks of salmonellosis ever reported in Sweden. From 24 December to 24 July 2015, 174 cases were reported in a nationwide outbreak. Of the reported outbreak cases, 108 were connected to a single restaurant. A spice mix, containing dried vegetables from the restaurant tested positive for the outbreak strain, *Salmonella* Enteritidis PT 13a. Additional spice mixes with similar content from different suppliers also tested positive.

In addition to the large outbreak, 7 other smaller ones also occurred in 2015.

DISCUSSION

The low proportion of domestic human infections is unique to Sweden, Norway and Finland when compared to most European countries. In order to trace and further control the sources of infection it is important that both the total incidence and domestic incidence in humans continue to be reported. The total notified incidence in 2014, 22.8 cases per 100,000 inhabitants, is considerably higher than the domestic incidence of 5.6 cases per 100,000 inhabitants. The Swedish situation with few domestic human cases reflects the low *Salmonella* burden in domestic animals and food.

In the feed sector, data from 2015 showed that *S. Typhimurium* was the most frequently isolated serovar in the weekly surveillance of feed mills (n=9), attributed to several different feed mills. One was a medium sized feed mill that was contaminated by *Salmonella* from locally grown barley. The production line was stopped before contaminated feed was delivered to customers.

Salmonella was detected in 13 broiler flocks, in two flocks of layers and in one parent flock of broilers. These flocks originated from 11 holdings. Four of these holdings had problems with infections of *Salmonella* in consecutive flocks. This might indicate a need for more stringent routines in cleaning and longer empty periods between rounds of flocks. In addition, in December 2015, *S. Typhimurium* was detected in six flocks in four broiler holdings. The

infection was traced to a hatchery.

Since 2012, an outbreak of *Salmonella* Dublin has been ongoing in cattle herds in the county of Skåne. In the beginning of 2015 one new herd was detected and for three of the 12 herds detected in 2012-2014 the restrictions were lifted. All but one of the 13 infected herds are located within a radius of 10 km, in a cattle dense area of Skåne. The only infected herd outside this region had purchased cattle from one of these herds. No more infected herds were detected during 2015, thus the outbreak may reasonably be considered to be in decline. Except this declining outbreak there were five newly detected infected herds, three with *S. Typhimurium*, one with *S. Dublin* and one with *S. Aarhus*. The last serovar has not been detected in cattle in the country at least during the last decades and the source of infection has not yet been identified.

In 2015, *Salmonella* was detected in one pig herd. This is consistent with the low incidence of *Salmonella* in pigs in previous years. However, the dramatic decrease in the number of pig herds in Sweden during the last few years may also play a role in the low incidence.

In 2014, a new laboratory was chosen to perform *Salmonella* analyses within the control programme. This laboratory was accredited for *Salmonella*, but had only a limited experience with *Salmonella*. In 2014, *Salmonella* was not detected in any of the samples taken at the abattoirs or cutting plants. The National Reference Laboratory (NRL) for *Salmonella* and the National Food Agency of Sweden inspected the laboratory and found that the analytical methods and laboratory routines needed improvement. Unfortunately, problems with this laboratory has continued in 2015, now with laboratory contamination and decreased performance. Thus, the results from the control programme from 2014 and 2015 are not fully reliable.

Reported domestic human cases of *Salmonella* vary from year to year depending on the number of outbreaks. In 2015, the total number of notified human cases decreased, but the number of domestic cases increased by 22%. The largest decrease was seen for the travel-associated cases, especially from European countries. This decrease in *Salmonella* cases has been seen in countries throughout the EU and is considered to be the result of the implementation of the harmonised *Salmonella* control programmes in poultry.

Thailand is the most common country for travel-associated salmonellosis as measured by infections

per travel events, although the number of cases has decreased. However, it is still necessary to inform travellers about the risks of contracting *Salmonella* and other infectious diseases in order to further decrease the incidence. Also, information on how to prevent secondary transmission to other persons, to the environment and to animals when returning back to Sweden is crucial.

A large domestic outbreak of *S. Enteritidis* PT13a was detected. The source was traced to a spice mix originating from Serbia. *S. Enteritidis* isolated from the spice mix was of a similar phagetype and MLVA type as found from the cases. The outbreak investigation highlighted the complexity of a food vehicle with a long shelf life and which people may eat but are unlikely to remember.

Routine MLVA typing and comparison of *S. Typhimurium* isolates from humans, animals, food, feed and the environment has proved to be a useful tool to detect clusters and outbreaks.

The Swedish *Salmonella* control programme has been in place for decades and resulted in a very low *Salmonella* burden in domestic animals (Figures 16, 15 and 18). However, the programme is costly and could be modernised. The Swedish Board of Agriculture, the National Food Agency, Public Health Agency of Sweden, the National Board of Health and Welfare and the National Veterinary Institute have jointly published a common national strategy for the control and monitoring of *Salmonella* for the entire chain from animal feed to humans. The strategy includes goals and proposals for important actions to achieve goals, including how the control programme should be made more cost effective.

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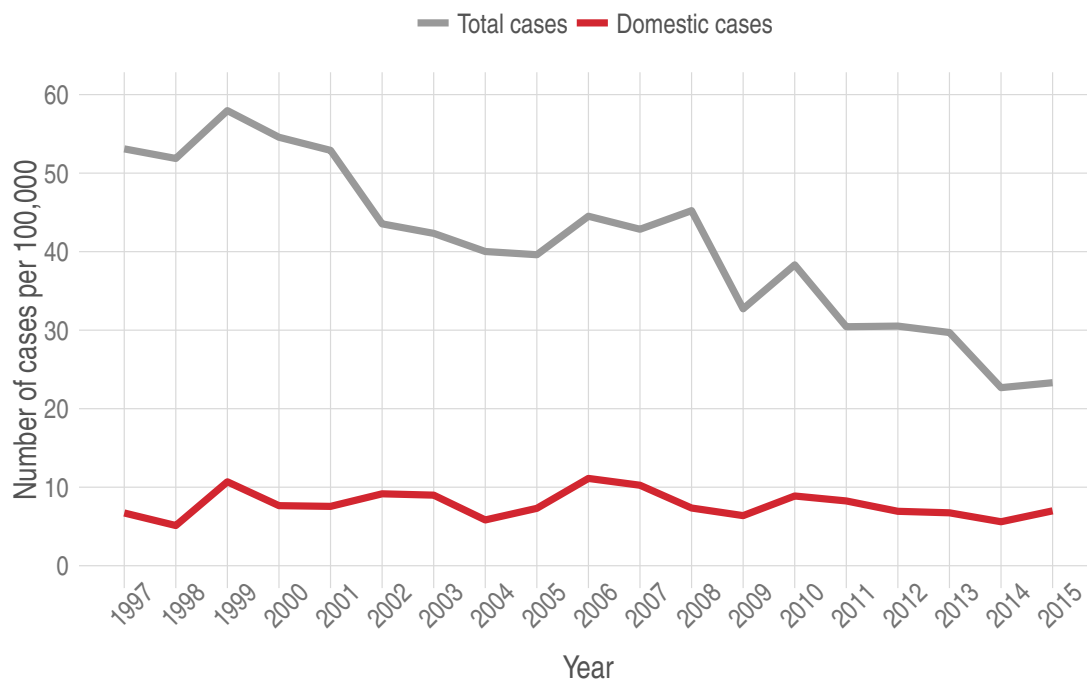


Figure 12: Notified incidence (per 100,000) of human salmonellosis in Sweden, 1997-2015.

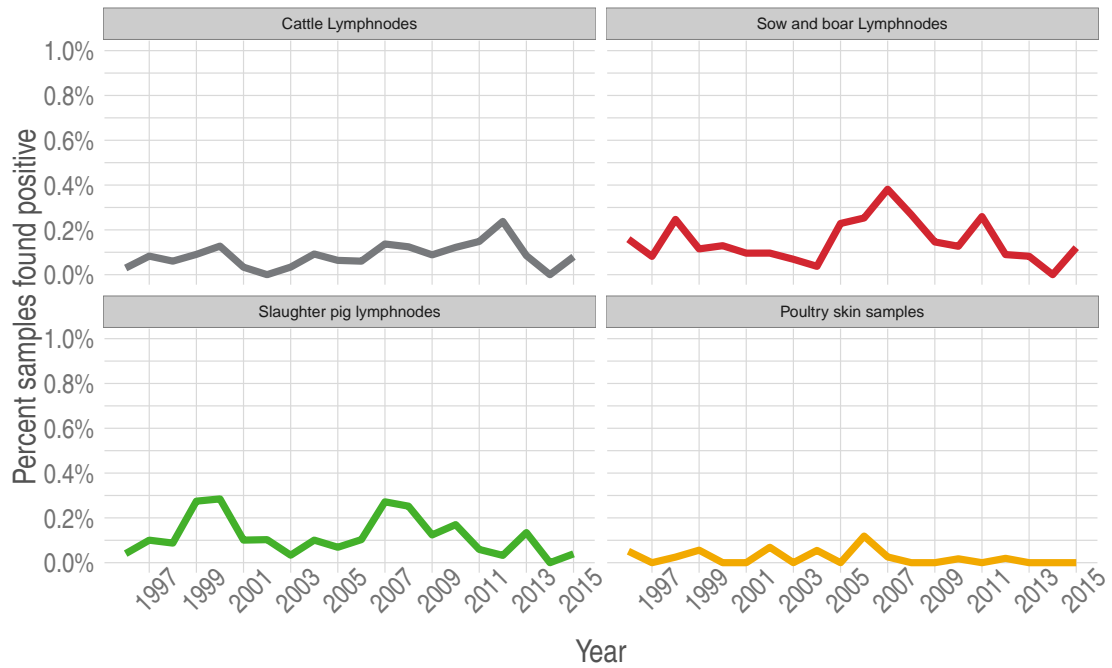


Figure 13: *Salmonella* found in lymph node samples from cattle, sows and boars and fattening pigs sampled at major slaughterhouses as well as neck skin samples from poultry at all slaughterhouses. The laboratory results from 2014 and 2015 are considered to be unreliable and likely an underestimate of the true prevalence of *Salmonella* in the samples tested.

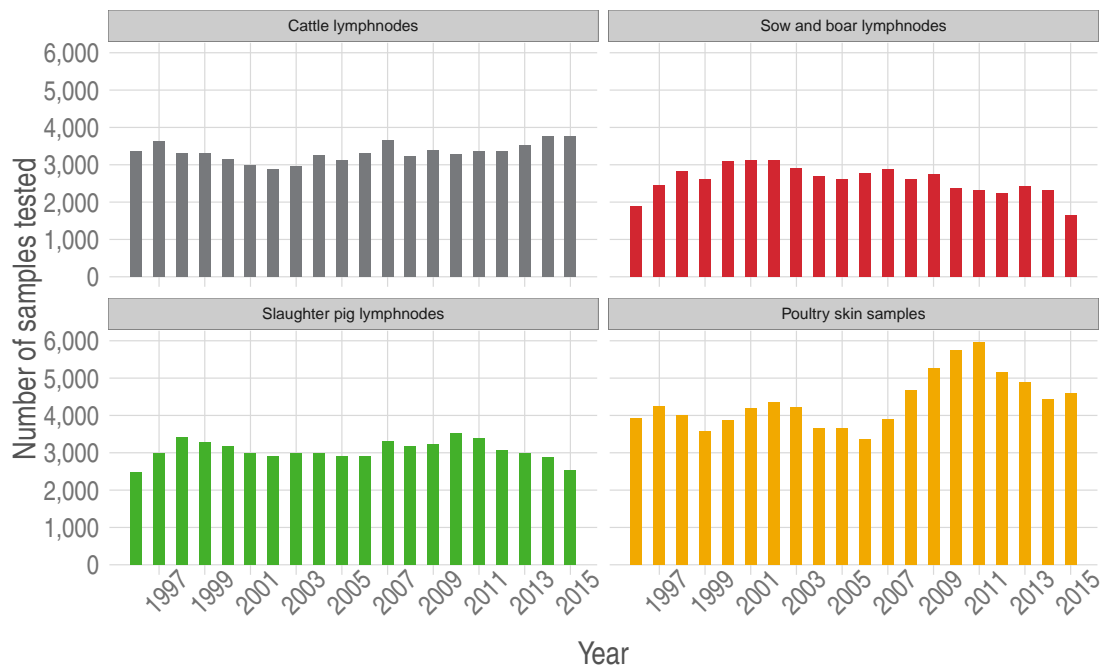


Figure 14: The number of lymph node samples from cattle, sows and boars and fattening pigs sampled at major abattoirs as well as the number of neck skin samples from poultry sampled at all abattoirs. In 2015, 3,756 samples from cattle, 1,659 from sows and boars, 2,540 from fattening pigs, and 4,594 poultry neck skin samples were tested for *Salmonella*.

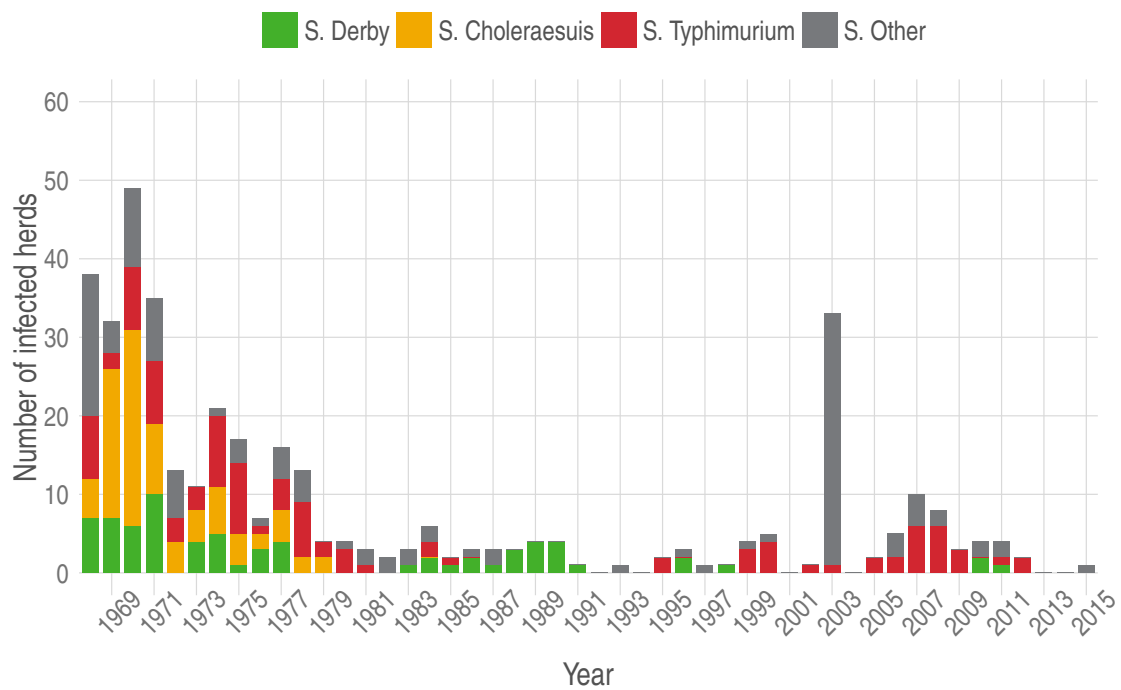


Figure 15: Incidence of *Salmonella* in swine herds during 1968-2015. In 2015, a single herd was identified with *S. Reading*.

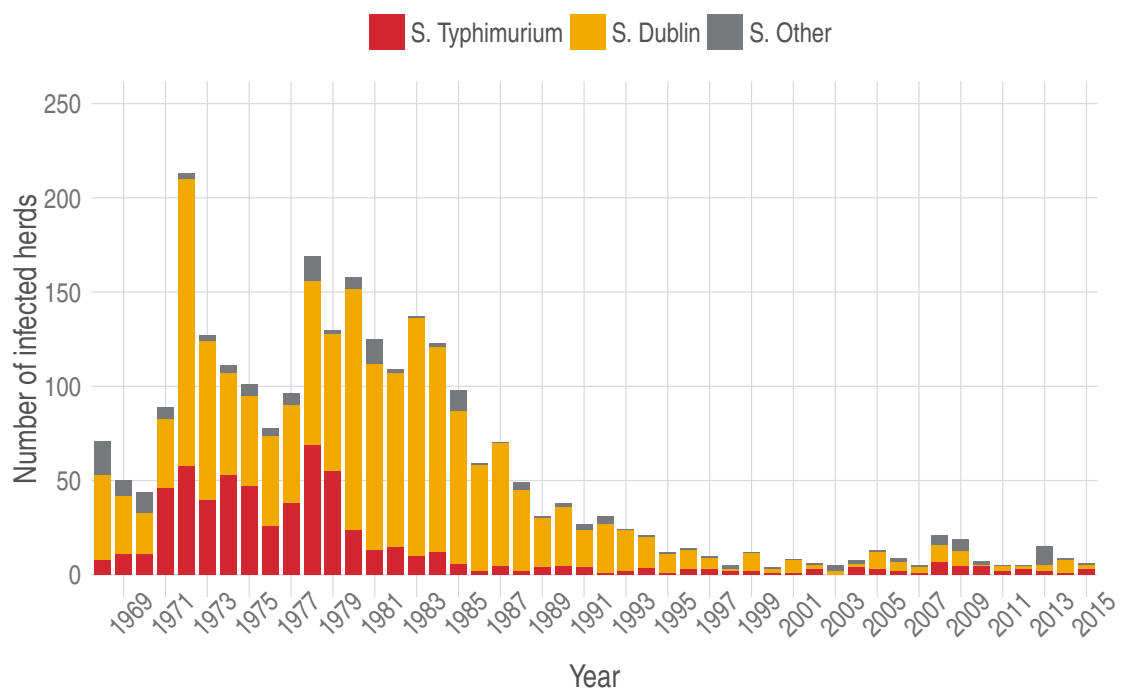


Figure 16: Notified incidence of *Salmonella* in Swedish cattle herds during 1968-2015.

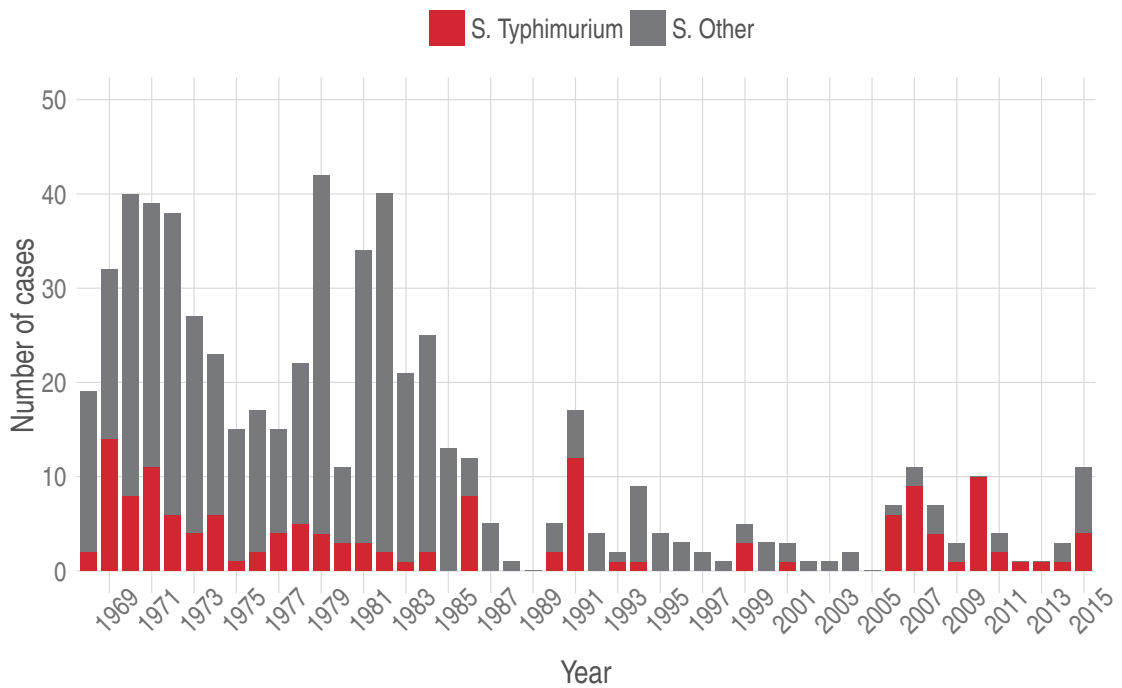


Figure 17: Notified incidence of *Salmonella* in broiler holdings during 1968-2015, breeding flocks included.

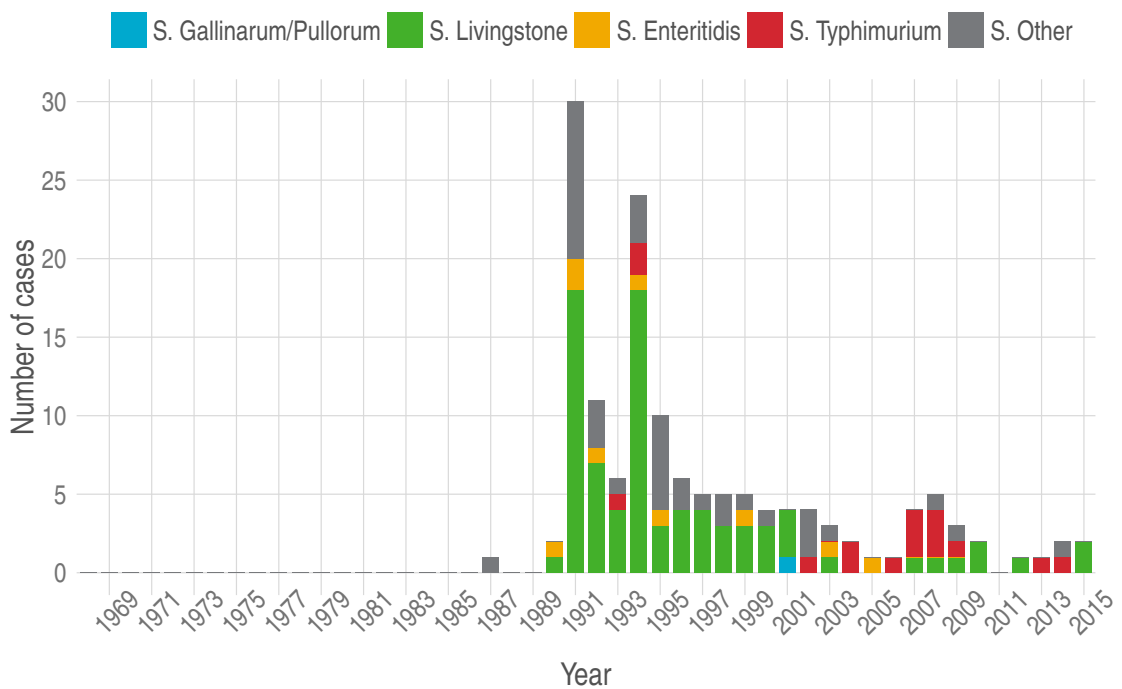


Figure 18: Notified incidence of *Salmonella* in layer holdings during 1968-2015.

DISEASE SURVEILLANCE 2015

Table 11: Sampling scheme of 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 15 th 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

Table 12: Results from the *Salmonella* control programme at slaughterhouses and cutting plants in 2015

Animal species	Sample type	No. samples	Positive	Percent Positive	Serotypes
Cattle	Lymph node	3,756	3	0.08%	<i>S. Agona</i> , <i>S. Duesseldorf</i> , <i>S. Typhimurium</i>
	Carcass swab	3,786	0	0.00%	
Breeding swine	Lymph node	1,659	2	0.12%	<i>S. Agona</i> , <i>S. Reading</i>
	Carcass swab	1,659	0	0.00%	
Slaughter swine	Lymph node	2,540	1	0.04%	<i>S. Typhimurium</i>
	Carcass swab	2,517	0	0.00%	
Cattle and swine	Meat scrapings	5,285	2	0.04%	<i>S. Typhimurium</i>
Poultry	Neck skin	4,594	0	0.00%	
	Meat scrapings	951	0	0.00%	

The laboratory results from 2014 and 2015 are considered to be unreliable and likely an underestimate of the true prevalence of *Salmonella* in the samples tested.

Table 13: Results from *Salmonella* control programme in poultry flocks

Animal species	Production type	Production stage	No. flocks tested	No. positives	Percentage	Serotype
<i>Gallus gallus</i>	Meat production	Adult Grand Parent	20	0	0.00%	
<i>Gallus gallus</i>	Meat production	Adult Parent	115	1	0.87%	<i>S. Typhimurium</i>
<i>Gallus gallus</i>	Meat production	Production	3,390	13	0.38%	See footnote ^A
Turkeys	Meat production	Adult Parent	4	0	0.00%	
Turkeys	Meat production	Production	144	0	0.00%	
<i>Gallus gallus</i>	Egg production	Adult Parent	15	0	0.00%	
<i>Gallus gallus</i>	Egg production	Production	661	2	0.30%	<i>S. Livingstone</i>
Geese	Meat production	Production	37	0	0.00%	
Ducks	Meat production	Production	23	1	4.35%	<i>S. Hessarek</i>

^A *S. Epinay* (n=2), *S. Mbandaka* (n=1), *S. Meleagridis* (n=2), *S. Reading* (n=2), *S. Typhimurium* (n=6)

Table 14: Serotypes of *Salmonella* isolated in feed control in 2015.

Serotype	Feed material of animal origin ^A	Pet food	Feed material of oil seed origin ^B	Feed material of cereal grain origin	Process control feed mills	Process control rapeseed crushing plant
<i>S. Brandenburg</i>	-	-	-	-	2	-
<i>S. Bredeney</i>	-	1	-	-	-	-
<i>S. Cubana</i>	-	-	-	-	-	2
<i>S. Emek</i>	-	-	1	-	-	-
<i>S. Infantis</i>	1	-	-	-	-	-
<i>S. Kentucky</i>	-	-	1	-	-	-
<i>S. Mbandaka</i>	-	1	6	-	2	-
<i>S. Schleissheim</i>	-	-	-	-	1	-
<i>S. Senftenberg</i>	-	1	10	-	2	-
<i>S. Soerenga</i>	-	-	-	-	1	-
<i>S. Typhimurium</i>	-	-	-	-	9	-
Total Positive	1	3	18	0	17	2
Total number of samples	1,157	167	1,187	314	8,960	808

^A Meat and bone meal, fish meal, greaves, bone meal, protein meal, meat meal, blood products, milk products, and poultry offal meal.

^B Derived from palm kernel, rape seed, soya bean and sunflower seed.

DISEASE SURVEILLANCE 2015

Table 15: Cattle herds under restrictions for *Salmonella* infection in 2015

Primary serotype	Restricted since	Restrictions lifted	Reason for sampling
S. Aarhus	2015	-	Necropsy
S. Dublin, S. Duesseldorf	2008	2015	Necropsy
S. Dublin	2012	-	Trace-back
S. Dublin	2012	-	Necropsy
S. Dublin	2013	2015	Trace-back
S. Dublin	2013	2015	Trace-back
S. Dublin	2013	-	Necropsy
S. Dublin	2014	-	Necropsy
S. Dublin	2014	2015	Trace-back
S. Dublin	2014	-	Trace-back
S. Dublin	2014	-	Trace-back
S. Dublin	2014	-	Trace-back
S. Dublin, Livingstone	2014	2015	Trace-back
S. Dublin	2015	-	Necropsy
S. Dublin	2015	-	Faecal sample of a diseased calf
S. Mbandaka	2013	2015	Tracing contaminated feed
S. Typhimurium	2012	2015	Control programme at slaughter
S. Typhimurium	2014	2015	Necropsy
S. Typhimurium	2015	-	Trace-back after a human case
S. Typhimurium	2015	-	Trace-back
S. Typhimurium	2015	-	Necropsy

Table 16: Reported cases of *Salmonella* in cats, dogs, horses, sheep and wild birds in 2015

Serotype	Cats	Dogs	Horses	Sheep	Wild birds
S. Derby	-	1	-	-	-
S. Kottbus	1	-	-	-	-
S. Newport	-	1	-	-	-
S. Typhimurium	30	-	2	-	-
<i>Salmonella enterica</i> sp enterica =61:-1,5	-	-	-	3	-
<i>Salmonella enterica</i> sp enterica (I)=4,5:-1,5	-	-	-	-	1
<i>Salmonella</i> , not serotyped	52	-	-	-	-
Total	83	2	2	3	1

Swine vesicular disease

BACKGROUND

Swine vesicular disease (SVD) is caused by a porcine enterovirus closely related to human Coxsackie B5 virus but is a disease that only affects pigs. The first report of SVD in pigs was from Italy in 1966 and the disease has since then been reported in several European countries as well as Japan and China. Today, SVD is present in Italy and sporadic outbreaks have been reported from Portugal. The route of transmission is mainly by direct contact between infected and non-infected animals and by feed contaminated with SVD virus.

DISEASE

Infection with SVD virus can lead to fever and blisters on the snout, tongue, teats and coronary bands. The similarity of these clinical signs with foot and mouth disease (FMD) is the reason this disease is monitored and controlled in countries free from FMD. Most infections with SVD virus are very mild or subclinical.

LEGISLATION

SVD is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments) and the control of the disease is regulated in detail through EU-directives.

SURVEILLANCE

The purpose of the surveillance activities is to document freedom from SVD in the Swedish pig population and to contribute to the maintenance of disease freedom. The National Veterinary Institute has been responsible for sample selection, sample analysis and reporting to the Swedish Board of Agriculture.

The serological analyses of SVD antibodies on surveillance samples are performed using ELISA and positive results were confirmed with a serum neutralisation (SN) test.

Passive surveillance

Because SVD 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 restrictions on the farm during the investigation, sampling of sick or dead animals and examination of the herd for prevalence of clinical signs and production results.

Active surveillance

Samples collected for the abattoir sampling part of the surveillance carried out by Farm & Animal Health for porcine reproductive and respiratory syndrome (PRRS) are used for the active surveillance. See chapter on PRRS for details on sampling and population. The surveillance was designed using a between-herd design prevalence of 1%, a within-herd design prevalence of 20% and a risk of introduction of 1 in 50 years.

At present, SVD active surveillance is performed every third year and most recently in 2013.

RESULTS

Passive surveillance

No clinical suspicions of SVD were investigated during 2015.

Active surveillance

No active surveillance for SVD was performed during 2015. See previous reports for surveillance results from 2013 and earlier.

DISCUSSION

The result from the surveillance of SVD in Sweden gives additional documentation of freedom from this infection in the Swedish commercial pig population. During recent years, the Swedish pig industry has undergone substantial structural changes leading to a rapidly declining number of herds and extensive changes in the market and in the habits of farmers. The active surveillance in terms of planning design and number of samples is therefore evaluated yearly and adjusted accordingly if needed. Discussions are ongoing within EU and OIE concerning the status of this disease.

Scrapie

BACKGROUND

Scrapie belongs to a group of diseases called Transmissible Spongiform Encephalopathies (TSE) and was first described more than 250 years ago. The current theory about the causative agent is the protein-only hypothesis. This theory assumes that misfolded prions (small proteins) induce the same misfolded and 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 transmission of classical scrapie occurs within a flock at lambing and that pastures can be contaminated for long periods of time. Scrapie is based on epidemiological data not considered a zoonotic disease, but the question was raised again in 2014 after experimental infection studies in transgenic mice.

After classical BSE became a disease of public health concern (see earlier chapter on BSE), and the 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.

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.

In 1998, an atypical variant of scrapie was detected in Norway (Nor98), and it was also detected in Sweden in 2003. Since then, a number of cases have been detected in Sweden. Although atypical scrapie is experimentally transmissible, epidemiological studies on the European level indicate that atypical scrapie probably is a spontaneously occurring disease. When transmitted experimentally, atypical scrapie can cause disease indistinguishable from classical scrapie.

DISEASE

The incubation period is long, up to several years. Clinical signs of classical scrapie 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 the national level, surveillance and control is also regulated by the national scrapie control programme and Sweden has since 2003 had additional guarantees related to trade within the union approved through (Commission Regulation (EC) 546/2006). Moreover, sampling at the national level is regulated by SJVFS 2010:9, saknr K19, last amended through SJVFS 2013:3. Scrapie is a notifiable disease under the Swedish Act of Epizootic diseases (SFS 1999:657, with amendments) and there is a scheme to compensate farmers for losses due to eradication measures.

SURVEILLANCE

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

Passive surveillance

All suspicions of scrapie must be reported to the authorities. The obligation to report applies to animal owners, veterinarians and everyone else who is responsible for the animals. Samples from animals with clinical suspicion of scrapie are examined with Bio-Rad TeSeE short assay protocol (SAP) in combination with Bio-Rad TeSeE Western Blot.

Active surveillance

The design of the surveillance programme is in accordance with Regulation (EC) 999/2001 Annex III and the Swedish national control programme. Within the programme, 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 necropsy. In remote areas where there is no collection of carcasses, the farmers must send the whole head to the National Veterinary Institute for testing. Farms with confirmed cases of atypical scrapie are obligated to have increased surveillance in the herd for two years. In addition to fallen stock, healthy

slaughtered animals above 18 months of age are examined from these flocks.

The samples from active surveillance were examined with Bio-Rad TeSeE short assay protocol (SAP) at the National Veterinary Institute in accordance with Regulation (EC) 999/2001. In case of positive or inconclusive results the material was examined by Bio-Rad TeSeE Western Blot.

RESULTS

Passive surveillance

In 2015, no sheep or goats were examined due to clinical suspicion of scrapie.

Active surveillance

Sheep

In 2015 the National Veterinary Institute examined 6,623 sheep from fallen stock for scrapie. Out of these, all samples were negative for classical scrapie and three were positive for atypical scrapie Nor98.

Goats

In 2015, the National Veterinary Institute examined 149 goats from fallen stock for scrapie. All were negative both for classical scrapie and for atypical scrapie.

DISCUSSION

Classical scrapie

Since the start of the active surveillance in 2002, more than 75,000 sheep have been tested without any positive cases detected. In 2014, Sweden sent an application to the European Commission to obtain status as country with negligible risk for classical scrapie. The dossier contained detailed information about the population, imports (which were limited), education about the disease, the national control programme as well as results of estimates of the probability that Sweden is free from classical scrapie. The Commission evaluated the dossier and also asked the European Food Safety Authority (EFSA) for an opinion. The opinion was published in November 2015 (doi:10.2903/j.efsa.2015.4292) and it was concluded that:

'Sweden has tested annually a sufficient number of ovine and caprine animals over 18 months of age, sourced from the NSHC and SHC, to provide a 95% level of confidence of detecting CS if it is present in that population at a prevalence rate exceeding 0.1%'

which is the requirement set in Regulation 999/2001. At the time of writing, there is a proposal from the Commission to grant Sweden status Negligible risk, but the proposal has not yet been voted.

Sweden has additional guarantees from the EU related to scrapie when farmers import sheep or goats. However, illegal imports which are not detected could pose a potential 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, more than 40 cases have been detected up to the end of 2015. Out of these, two were detected through passive surveillance and the rest through active surveillance. 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 flocks. At the 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. Although within flock transmission between animals seems to be very low (if it exists) other routes of spread and the potential zoonotic aspect are being discussed.

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Tick-borne encephalitis

BACKGROUND

Tick-borne encephalitis virus (TBEV) belongs to the genus flavivirus in the family *Flaviviridae*. TBE virus is endemic in an area ranging from northern China and Japan, through far-eastern Russia to Europe. The virus may cause a neurological infection which may lead to long-term sequelae in the affected patients. The virus is spread by ticks (*Ixodes ricinus* and *I. persulcatus*), which are infected when they suck blood from infected rodents. Rodents are suggested as a possible virus reservoir. The virus also circulates in the tick population through transovarial transmission without involvement of vertebrate hosts. Large mammals, predominantly ungulates, are important to the maintenance of large tick populations. Humans typically become infected via ticks, although unpasteurised cow's and goat's milk and milk products have also been reported as sources. Vaccination of persons living, visiting or working in endemic areas is recommended.

Three sub-types of TBEV are described: 'the Western', 'Siberian' and 'Far eastern' subtypes. In Sweden, only 'the Western' has been found.

The first case of TBE infection in Sweden was reported in 1954. During the following three decades, 10-40 annual cases were reported. From the mid-1980s a clearly increasing trend has been observed. In recent years about 150-300 cases have been reported annually. With a few exceptions, the cases have been domestic. Most have been infected on the eastern coast and archipelago close to Stockholm but in recent decades cases have been noted regularly on the West Coast. The age distribution is wide but most of the cases are between 30 and 70 years. There is a slight over-representation of men. A majority of the patients are diagnosed in July to October.

DISEASE

Animals

A few confirmed cases of disease in dogs have been reported. Seroconversion has been demonstrated in grazing goats and cows. Most authors consider these animals to be a dead-end hosts for the viral infection. Wild rodents are the natural reservoir for TBEV but are not reported to contract the disease. Roe deer also seroconvert but there are no reports of disease in this species.

Humans

In humans, a biphasic course of the disease is common. The first, viraemic phase lasts for about four days. After an interval of about a week, a meningoencephalitic phase appears in about one third of the patients. The symptoms may include fever, headache, nausea, cognitive dysfunctions or spinal paresis. The mortality is low, about 0.5%. The incubation period of TBE is usually between 7 and 14 days.

LEGISLATION

Animals

Demonstration of TBE virus in animals is not notifiable.

Humans

TBE in humans is notifiable as a viral meningoencephalitis since 2004 according to the Communicable Disease Act (SFS 2004:168 with the amendments of SFS 2013:634).

SURVEILLANCE

Animals

There is no continuous surveillance in animals. During 2015, a total of 1,176 samples of bulk tank milk were analysed for TBE. The samples were collected in May (n = 616) and November (n = 560) the previous year as a part of another screening. A total of 554 samples originated from herds that were sampled at both occasions.

Humans

The surveillance is passive in humans.

RESULTS

Animals

The results of the bulk tank milk screening are not yet available.

Humans

In 2015, 268 cases of TBE were reported, which is an about 50 % increase in comparison to 2014 (178 cases) and the same magnitude as during the peak years 2011 and 2012 (Figure 19). More men (62%) than women were identified with TBE. The incidence was highest among people in the age group 40-79 years, but there were cases reported from the

age of 9 months to 89 years of age. All but ten cases had acquired their infections in Sweden. The imported cases had been infected in Finland (seven cases), Estonia (two cases) and Denmark (one case).

The first TBE cases became ill in the beginning of April and the last in mid-November, but the peak occurred in July.

The geographic distribution of the disease was mainly, as in previous years, concentrated in the coastal areas of Stockholm, Södermanland and Uppsala counties, both along the lake of Mälaren and the Baltic Sea (Figure 20). The incidence was highest in the counties of Södermanland (14.5 cases per 100,000 inhabitants) and Uppsala (14.4 cases per 100,000 inhabitants). However, the infection also occurs in many other parts of the country

from Skåne in the south to southern Gävleborg and Dalarna in the north.

DISCUSSION

Since the year 2000, there have been a significant increase in the TBE incidence in basically all the endemic counties in Sweden.

This increase is probably due to several interacting factors. The most important cause is presumably the very dense population of ticks, a consequence of a large roe deer population from the 1980s up until the recent snowy winters. This situation in combination with a high population of small host animals such as bank voles, and optimal weather for both virus spread and humans spending time outdoors, could explain the large number of cases reported.

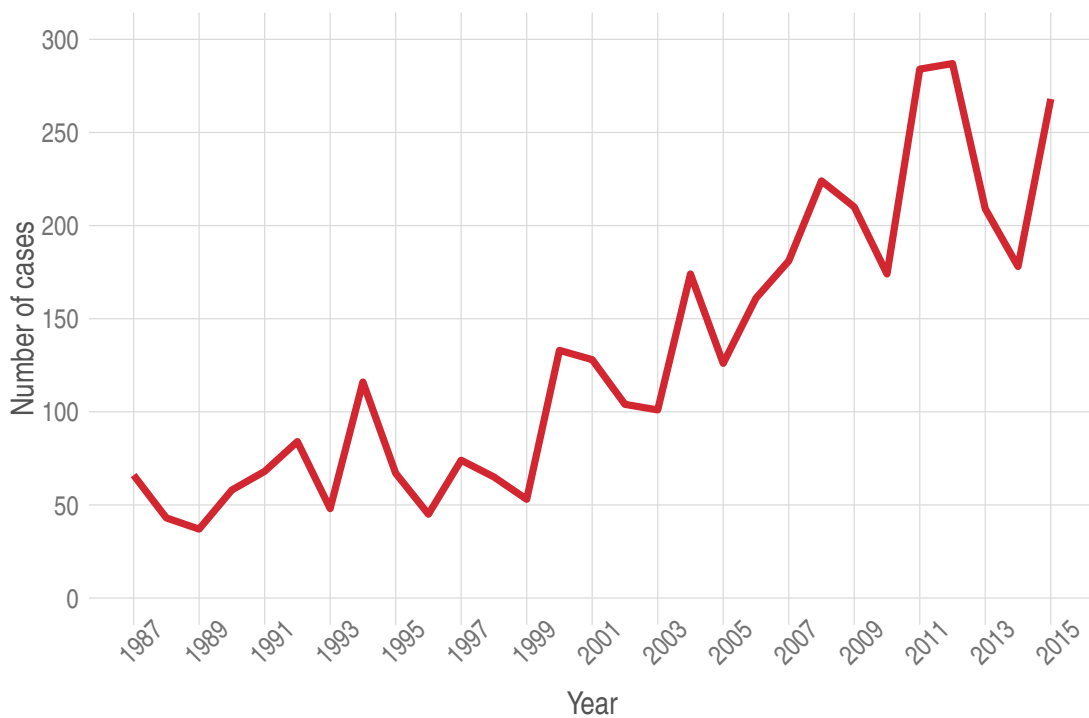


Figure 19: Number of notified cases of TBE in humans 1987-2015.

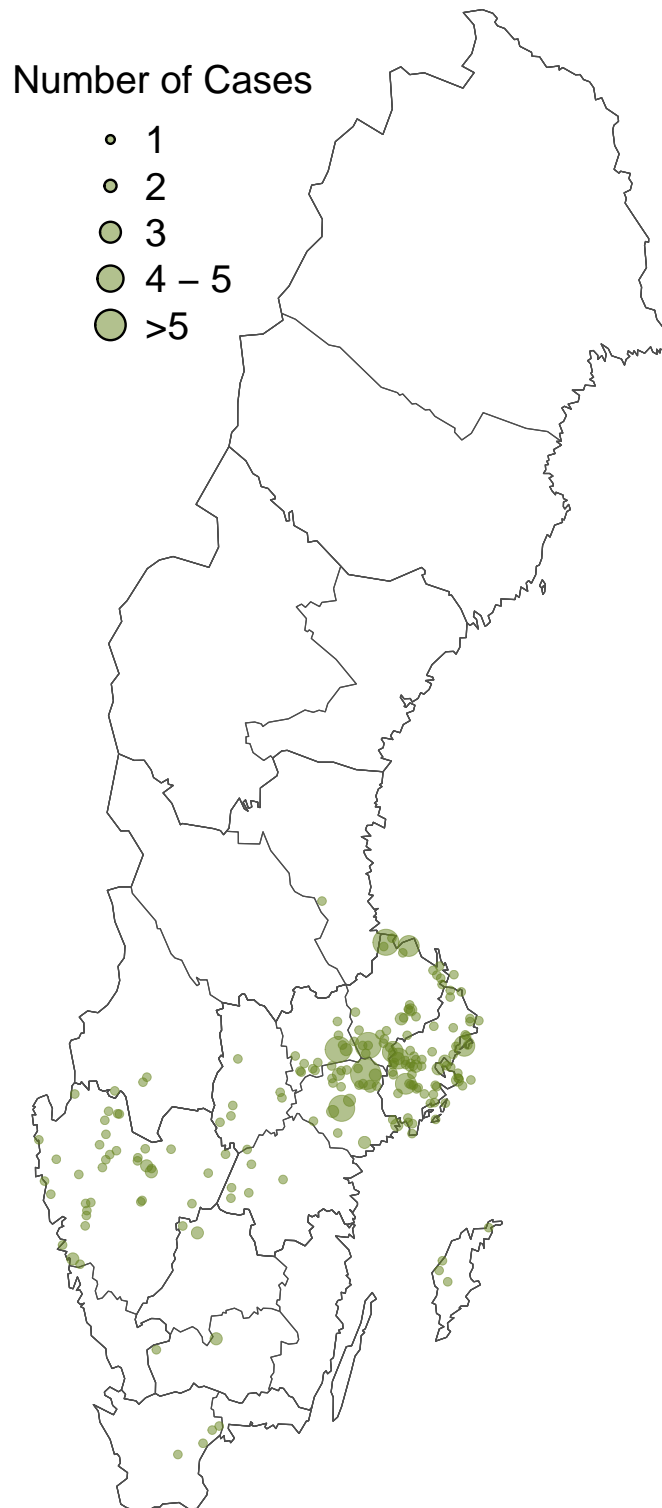


Figure 20: The geographic distribution of the place of infection of cases of TBE in 2015.
©EuroGeographics for the administrative boundaries.

Transmissible gastroenteritis

BACKGROUND

Transmissible gastroenteritis (TGE) is a disease of pigs caused by a coronavirus that can result in severe losses mainly due to very high piglet mortality caused by severe diarrhoea in seronegative herds. The disease is widespread in pig producing areas of the world. In the 1980s a mutant of TGE virus was detected; porcine respiratory corona virus (PRCV). PRCV replicates in the respiratory tract instead of in the intestines and only causes subclinical infection. The mutant spread rapidly and has limited the impact of TGE by giving rise to neutralising antibodies to TGE virus.

TGE is highly contagious and the main means of transmission is through direct contact between pigs and indirectly through fomites and equipment contaminated with manure. There is a seasonality in the epidemiology of the disease with more frequent outbreaks during the winter. This seasonality has been attributed to the high UV- and temperature sensitivity of the TGE virus.

The disease has never been reported in Sweden.

DISEASE

Introduction of TGE virus to a susceptible seronegative herd leads to a rapid spread of the infection with clinical manifestation in all age groups but piglets are the most severely affected. Clinical signs include vomiting, severe watery diarrhoea and dehydration and in piglets under 2 weeks of age. Mortality can approach 100%. Previous infection with PRCV protects against the severe forms of TGEV infection.

LEGISLATION

TGE is a notifiable disease (SJVFS 2013:23) based on detection of the virus or increased antibody levels in paired samples.

SURVEILLANCE

The purpose of the active surveillance programme is to document freedom from TGE in the Swedish pig population. The National Veterinary Institute is responsible for selection of samples, sample analysis and reporting to the Swedish Board of Agriculture.

The serological analyses for TGE antibodies are

performed with an ELISA that can distinguish between antibodies to TGEV and PRCV (Svanovir TGEV/PRCV-Ab).

Passive surveillance

Since TGE has never been reported in Sweden and herds are expected to be seronegative, it is expected that an introduction of the disease would lead to severe clinical signs in the infected herd.

Active surveillance

Samples collected for the abattoir sampling part of the surveillance programme carried out by the Farm & Animal Health for porcine reproductive and respiratory syndrome (PRRS) were used for the active surveillance. See chapter on PRRS for details on sampling and population. The surveillance was designed using a between-herd design prevalence of 1%, a within-herd design prevalence of 40%, and a risk of introduction of 1 in 25 years.

Active surveillance for TGE is at present performed every third year and most recently in 2013.

RESULTS

Passive surveillance

No clinical cases of TGE were reported during 2015.

Active surveillance

There was no active surveillance for TGE during 2015. See previous reports for surveillance results from 2013 and earlier.

DISCUSSION

The spread of PRCV in Europe has led to a diminished importance of TGE. However, if introduced into a seronegative population of pigs, TGE could be devastating. The effects of introduction of another coronavirus in pigs, porcine epidemic diarrhoea virus (PEDV), into a seronegative population has been demonstrated recently in the USA and Canada where the effects of the introduction has been devastating. It is considered possible to maintain freedom from both TGEV and PEDV in the Swedish pig population as long as the restrictive regime concerning import of live animals is maintained.

Trichinellosis

BACKGROUND

Trichinellosis is caused by parasitic nematodes of the genus of *Trichinella*. The parasites can be hosted by different mammals including domestic pigs and horses but the main reservoirs are wild carnivores and omnivores. Humans typically acquire the infection by eating raw or inadequately heated contaminated meat and meat products, often cold-smoked, fermented sausages. In Western Europe, the wild boar appears to be the main source of human infection.

In Europe, *T. spiralis* and *T. britovi* are the dominant causes of human infections. In Sweden, these species are also detected as well as *T. nativa* and *T. pseudospiralis*. *T. pseudospiralis* is mainly isolated from wild boars. In the gut, *Trichinella* larvae, 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 striated muscles the larvae may survive in an encapsulated form for years.

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

The disease is extremely rare in Sweden and detected human cases are usually infected abroad. However during 2013 a domestic case was reported where the clinical symptom indicated infection with *Trichinella* although the diagnosis could not be laboratory confirmed. During 2013 and 2014 single cases were reported with country of infection Poland and Eritrea respectively.

DISEASE

Animals

Animals rarely develop a clinical infection, although both pigs and rodents can exhibit clinical signs.

Humans

The disease in humans 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. Intestinal stages of the disease respond well to treatment. Cardiac and neurological complications

may occur 3-6 weeks post infection. *Trichinella* is not transmitted between humans.

LEGISLATION

Animals

Trichinella is notifiable in animals according to SJVFS 2013:23.

Humans

Trichinellosis is notifiable according to the Communicable Disease Act (SFS 2004:168 with the amendments of SFS 2013:634).

SURVEILLANCE

Animals

All slaughtered wild boars, horses, privately hunted wild boars and bears are tested for *Trichinella*. The digestion method is the only method applied in testing for *Trichinella*. Pig production sites that are officially applying controlled housing conditions are obligated to test all carcasses of breeding sows and boars sent for slaughter each year according to the regulation (EU) No. 2015/1375. Production sites without controlled housing conditions should test all their slaughtered domestic pigs. In conclusion, fattening pigs originating from holdings officially recognised as applying controlled housing conditions are not obligated to test for *Trichinella*.

In addition, several species of wild animals are tested for *Trichinella*, including: foxes, lynxes, wolves, badgers, birds and wolverines. However, during 2015 there was only a limited testing done of wild animals due to lack of allocated resources. The testing of *Trichinella* in animals was performed by six laboratories during 2015.

Humans

Surveillance in humans is passive.

RESULTS

Animals

In 2015, all slaughtered horses (2,934) were tested. The number of tested pigs from controlled housing conditions were 26,042 breeding sows, 468 boars and 1,039,058 slaughter pigs. In addition, 400,773 slaughtered pigs (all categories) from uncontrolled housing conditions were tested. *Trichinella* was not detected in domestic pigs or horses.

Wildboars (12,634) and bears (74) slaughtered at wild game establishments all tested negative. In addition to the slaughtered wild animals, samples taken by private hunters were also sent in for analysis of *Trichinella*.

Trichinella spp. was detected from one out of a total of 89,497 (0.0011%) wild boar samples and also from one bear out of 180 tested bears (0.56%) see Table 17. These figures are based on results from six laboratories testing *Trichinella* and include slaughtered animals at wild game establishments and samples taken by private hunters.

Humans

During 2015 one case was reported with trichinellosis. Probable country of infection was Eritrea. The clinical symptoms were not consistent with a recent *Trichinella* infection. The diagnostic tests were positive but with low titres and a sample was sent to Swiss Tropical and Public Health Institute (Basel) for confirmation and was reported positive.

During 2014, one person was infected with *T. spiralis* after consumption of infected pork in

Poland. Six persons had eaten a dish prepared from pork. Another two of the six persons who reside in Poland were infected. The meat was analysed in Poland and found positive.

During 2013, one possible domestic case of *Trichinella* was reported in Sweden. The diagnostic tests were inconclusive. Further diagnostic tests performed at the European Union Reference Laboratory for Parasites (Italy) did not confirm the diagnosis. However, the clinical symptoms indicated that it was a case of trichinellosis. The person had consumed or handled meat from Swedish wild boar which was not tested for *Trichinella*.

DISCUSSION

Trichinellosis is extremely rare in Swedish food-producing animals and the few 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.

Table 17: Findings of *Trichinella* in wild animals 2015

Animal species	No. samples	No. positives	Percentage (%)	<i>T. britovi</i>	<i>T. nativa</i>
Badger	5	0	0.00%	-	-
Bear	180	1	0.56%	-	1
Beaver	2	0	0.00%	-	-
Red fox	2	0	0.00%	-	-
Seal	1	0	0.00%	-	-
Wild boar	89,497	1	0.001%	1	-
Wolf	46	0	0.00%	-	-
Total		2		1	1

Tuberculosis



Photo: Bengt Ekberg

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 as well as in humans. Historically, the reservoir has been cattle but many other wild and domestic species can also maintain the infection. Wildlife reservoirs including badgers, deer and wild boar cause persistent problems in some countries. Humans usually acquire *M. bovis* infection via unpasteurised 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.

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 now based on meat inspection and passive clinical surveillance.

When Sweden joined the European Union in 1995, the status of OTF (officially tuberculosis free) was obtained.

In 1987, *M. bovis* infection was introduced into the farmed deer population. A control programme for tuberculosis in farmed deer was introduced in 1994 and made compulsory in 2003. The last case of tuberculosis in farmed deer was identified in 1997.

The yearly incidence among humans in Sweden in the early 1940's was above 300/100,000 inhabitants. This was followed by a rapid decline, beginning before effective treatment was available in the early 1950's. Currently, the yearly incidence is 8.5/100,000 inhabitants, which is among the lowest in the world. The vast majority (>90%) of the cases occur in immigrants originating from countries that still have a high incidence of tuberculosis. The yearly incidence among people born in Sweden is 1/100,000 inhabitants.

DISEASE

The symptoms caused by tuberculosis in both humans and animals depend largely on the localisation of the infection. The disease progresses slowly and clinical signs 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, are notifiable in all animal species according to the Swedish Act of Epizootic diseases (SFS 1999:657, with amendments).

Humans

Tuberculosis in humans is a notifiable disease according to the Communicable Disease Act (SFS 2004:168 with the amendments of SFS 2013:634). Contact tracing is compulsory and the treatment is free of charge. Refusing treatment if the patient is contagious can lead to detention.

SURVEILLANCE

Animals

From suspect cases in animals, lymph nodes from five different areas (retropharyngeal, submandibular, mediastinal, mesenteric 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 and Stonebrink's) according to the method at the National Veterinary Institute and cultured for up to twelve weeks. Suspected colonies are tested with MALDI-TOF (Matrix-Assisted Laser Desorption/Ionisation Time Of Flight) and if necessary with sequencing of a specific gene. Isolates suspected to belong to the *M. tuberculosis*-complex or where the *M. tuberculosis*-complex cannot be ruled out are sent for confirmation to the Norwegian Veterinary Institute or the Public Health Agency of Sweden. 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. In case of a positive tuberculin test, the animal is culled and sampled as stated above. Culture is performed on all samples.

Humans

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

Passive surveillance

Animals

As TB is notifiable on clinical suspicion, clinical signs 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, an investigation is performed if there is a reason to suspect exposure of animals to bacteria of the *M. tuberculosis*-complex.

Humans

The surveillance in humans is mainly passive but contact tracing around diagnosed cases is compulsory and asylum seekers from high incidence countries are offered health examination where screening for TB is included.

Active surveillance

Animals

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

The control programme in farmed deer was, until October 2012, based on regular whole-herd tuberculin testing, or whole-herd slaughter and meat inspection. Since October 2012, tuberculin tests are no longer performed in TB-free herds, but inspections at slaughter and necropsy of animals found dead or euthanized are still required.

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

RESULTS

Animals

Due to lesions detected at slaughter, 30 pigs, four cattle and two sheep were investigated by histology and, if relevant, by culture. From these samples NTM (Nontuberculous mycobacteria), from the *Mycobacterium avium/intracellulare*-complex were isolated in 18 pigs. No other samples yielded any mycobacteria. Due to clinical suspicions or lesions found at necropsy, samples from one deer, four dogs and three cats were investigated. A dog with close contact to a person with tuberculosis were sampled as well. From these samples NTM, mainly belonging to the *Mycobacterium avium/intracellulare*-complex were isolated in three cats. No other samples yielded any mycobacteria.

The number of holdings of farmed deer that were considered active, kept deer and had obtained TB free status, was 367. Nine herds were not tested. These herds are exempted from regular testing and instead practice slaughtering of 20% of the herd yearly with meat inspections and necropsies for 15 years to obtain a free status. No TB was detected in any farmed deer in Sweden during 2015.

Since 2012, testing of alpacas for tuberculosis has been done using a serological test instead of an intradermal test as the intradermal test has a demonstrated low sensitivity in alpacas. During 2015, 14 alpacas were tested before export with negative final results.

Humans

Six cases of *M. bovis* were reported in humans in 2015, five in recent arrivals from Syria, Somalia, Egypt and Eritrea and one in an elderly Swede. Three had lymphadenitis, one had gastrointestinal disease and one had pulmonary involvement. The Swedish case was an 84-year-old man with a pleural effusion, most likely due to reactivation of a latent infection acquired in his youth.

DISCUSSION

Animals

The officially free status for bovine tuberculosis has been maintained during 2015. The overall TB situation in animals and humans remains favourable. No cases of TB were detected in Swedish animals during 2015. Although the surveillance is mainly dependent on inspections of slaughtered animals, this

is considered 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 have a 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. The aim is to be able to declare the remaining deer herds 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 human population lived in close contact with domestic animals. This change in contact between humans and animals likely played a role in the changing TB incidence in humans. Today, Sweden has one of the lowest incidences of human tuberculosis in the world.

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Tularaemia



Photo: Anders Lindström

BACKGROUND

The bacterium *Francisella tularensis* is the causative agent of tularaemia, a disease affecting humans and several animal species. There are several subtypes of *F. tularensis* which have variable virulence. *F. tularensis* subsp. *holarctica* (type B) is the main subspecies responsible for human and animal infection in Europe.

F. tularensis is capable of surviving for weeks at low temperatures in water, moist soil, or decaying plant and animal matter. Although many different animal species can be infected, tularaemia is typically found in hares and rodents.

Humans become infected through a variety of mechanisms such as handling infected or dead animals, bites of infected insects or other arthropods, ingesting contaminated food or water, and inhaling aerosols of bacteria. Clinical disease is variable and dependent on the route of transmission. The infection is more often reported in men than in women, which might be attributed to their leisure and professional activities. The age group of 45-70 years is

the most affected in both sexes. Tularaemia might spread during the whole year, but it is most frequent during the late summer.

Sweden has reported cases of tularaemia since 1931. Ever since the first Swedish tularaemia case was reported, an endemic area has been identified in northern and central Sweden.

The mountain hare is the animal species in which tularaemia has most frequently been identified in the endemic areas. However, during the last decade tularaemia has also commonly been diagnosed in the European brown hare and in regions south of the endemic areas.

The annual numbers of reported human cases range from a few cases to more than 2,700 cases in 1967.

DISEASE

F. tularensis is highly infectious, as few as 10-50 colony forming units may cause infection. The incubation period is usually 3-5 days. Tularaemia can be manifested in different forms depending on the

route of transmission and on the virulence of the organism. These forms are: ulceroglandular, oculoglandular, pneumonic, oropharyngeal, gastrointestinal and typhoidal.

Animals

In Swedish hares and in many rodent species that die of tularaemia, the pathological presentation of the disease is a disseminated multi-organ septicaemic form.

Humans

The ulceroglandular form is the most common form; the 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.

LEGISLATION

Animals

Tularaemia is notifiable in animals (SJVFS 2013:23).

Humans

Tularaemia has been a notifiable disease since 1970 according to the Communicable Disease Act (SFS 2004:168) with the amendments of SFS 2013:634.

SURVEILLANCE

Animals

No active surveillance is performed in animals. Surveillance is based on voluntary submission of animals found dead or euthanized by hunters and the general public. The detection is based on PCR or immunohistochemistry of the animal sample.

Humans

The surveillance is passive. For laboratory verification of the infection serology, PCR and isolation of the bacteria could be used.

RESULTS

Animals

In 2015, *F. tularensis* was detected in 24 mountain hares and seven European brown hares, which is significantly more than in previous years (two cases in 2014 and eleven in 2013). The higher number of cases was because of a tularaemia outbreak in the north of Sweden from July to September. Reports of approximately 150 dead mountain hares

were received during this period, most from the coastal region of Norrbotten and northern Västerbotten. Thirty-one mountain hares from the outbreak area were examined, and 24 had died of tularaemia.

The seven positive European brown hares were found dead in counties outside and south of the outbreak area (Dalarna, Örebro, Södermanland, Värmland and Västra Götaland), and they died throughout the year.

All 31 hares that died of tularaemia had a disseminated, multi-organ, septicaemic form of the disease.

Humans

In 2015, 859 human cases of tularaemia were reported, which is the highest number since the 1960s. (Figure 21). There are large natural fluctuations in the number of tularaemia cases observed between years and in different regions, which is probably due to several factors like the number of reservoirs and mosquitoes as well as weather conditions.

More men (59%) than women were reported to be infected in 2015, which is in line with how it has been previous years. The incidence of tularaemia was highest in the age group 40-69 years, similar to previous years. The uneven distribution among age groups and sexes might partially be attributed to their somewhat different leisure and professional activities.

As in previous years, except for a few sporadic cases, tularaemia was only reported from the northern, western and central parts of Sweden. During 2015, the incidence was incomparably highest in the counties of Norrbotten (162 cases/100,000 population) and Västerbotten (68 cases/100,000 population). The majority of people acquired their infections in areas close to the coast of the Bothnian Bay. This was the same area where many dead mountain hares were found. In 2015, only one case was reported as imported, from Finland.

About half of the cases were stated to have been infected via an insect bite but the true number of cases was likely much larger, since the route of transmission is not always specified in the notification. There are estimates that about 90% of the Swedish tularaemia cases are caused by mosquito bites. In 2015, 35 cases were assumed to have been infected through direct contact with animals and nine persons had according to the notifications been infected through their work.

During the first half of the year, just a few cases

were reported each month. The vast majority of people fell ill in August, which is the usual seasonal distribution with a peak of notifications often seen in September. During the last three months of the year the number of cases quickly subsided.

DISCUSSION

Tularaemia has been endemic in northern and central Sweden at least since the early 20th century with a marked annual variation. Years with high numbers of cases are often followed by periods when the disease is virtually absent. There is no obvious explanation for these fluctuations. The reservoir for the

bacterium between outbreaks has not been clearly identified. During the last decade, the epidemiology of tularaemia has changed and the number of reported cases in humans and animals, mainly European brown hares, infected south of the previous endemic region has increased. In animals, outbreaks of tularaemia have in some countries been associated with rises in rodent and hare populations, but this has not been confirmed in Sweden. It is possible that the European brown hare has become an important carrier of *F. tularensis* in many areas, but its epidemiological role remains unclear.

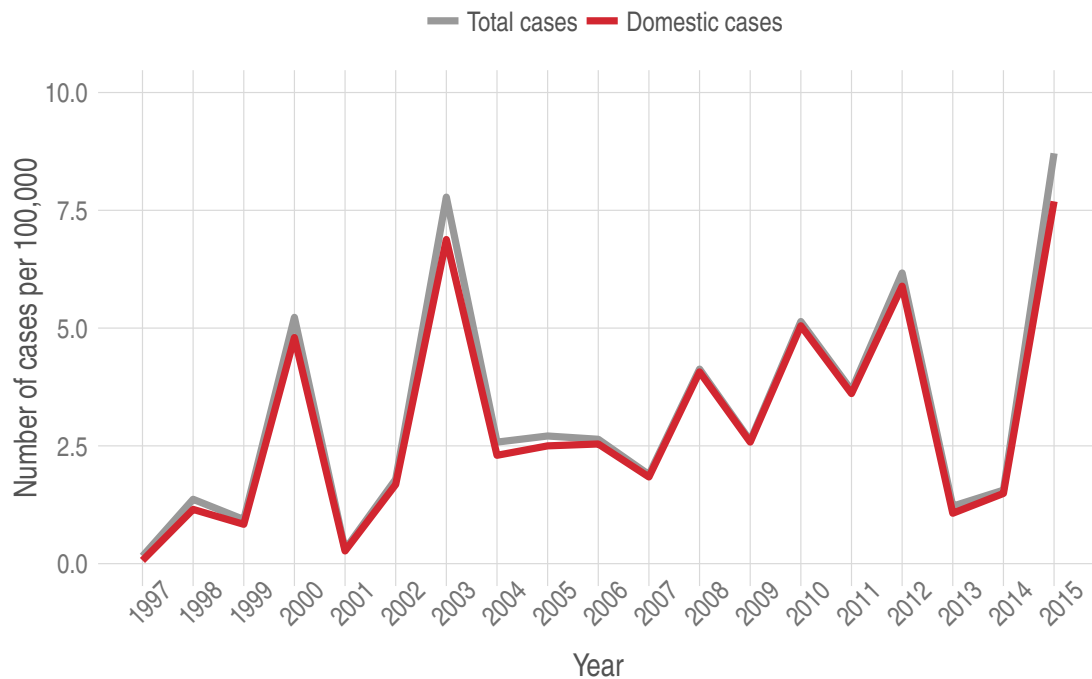


Figure 21: Notified incidence of human cases of tularaemia in Sweden 1997-2014

Verotoxinogenic *Escherichia coli*

BACKGROUND

Verotoxinogenic *Escherichia coli* (VTEC) may cause serious intestinal infections in humans. When these bacteria cause hemorrhagic diarrhoea they are called EHEC (enterohaemorrhagic *E. coli*). More than 380 different VTEC serotypes have been associated with human illness. Previously, many outbreaks and severe disease were caused by serotype O157:H7, but in recent years other serotypes have been associated with severe disease. Often these strains associated with severe disease, carry the verocytotoxin 2 gene. Other common serotypes causing gastrointestinal illness are O26, O103, O111, O121 and O145. Cattle are the main reservoir of VTEC associated with human disease although other animal species also may acquire the organisms. The infectious dose is low, probably less than 100 bacterial cells. Not only foods of bovine origin but also vegetable food items and drinking water have been implicated in outbreaks. The infection can also be transmitted through direct or indirect animal contact, via environment or person-to person transmission.

VTEC was only sporadically detected in Sweden until 1995 when 114 human cases of EHEC O157:H7 were notified. In 1996, VTEC O157 was isolated in Swedish cattle for the first time and human EHEC O157 infection was traced to a cattle herd. In 2002, an outbreak of EHEC O157:H7 in the county of Skåne affecting 30 persons was caused by consumption of cold smoked fermented sausage. The largest Swedish outbreak so far occurred in the summer of 2005 when 135 reported cases, including 11 (8%) HUS (haemolytic uraemic syndrome) cases were infected with O157:H7 after eating contaminated fresh lettuce irrigated with water from a local stream positive for verocytotoxin 2 at the time of harvest. Indistinguishable isolates 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. In 2011, one of the largest known VTEC outbreaks occurred in Germany with 3,816 reported cases of which 845 (22%) developed HUS. Sweden reported the highest number of cases outside Germany (n=53) during this outbreak. The epidemiological characteristics of the cases and the massive

media impact and public awareness make this outbreak unique. The need for a continuous prioritisation of EHEC was highlighted by the large outbreak in Germany with serious consequences not only for the affected individuals but also for politics, the economy, trade and food production in the countries directly or indirectly affected.

Between 250-550 cases (3-6 cases per 100,000 inhabitants) of EHEC infections are reported in Sweden annually, of which 50%-60% are domestically acquired. Most of the domestic cases are reported during the period July to September.

DISEASE

Animals

Animals usually do not develop a clinical disease.

Humans

The clinical picture may vary from asymptomatic infection to non-haemorrhagic or haemorrhagic diarrhoea associated with abdominal cramps. Most patients fully recover. Approximately 7-10% develop HUS, which is characterised by acute renal failure, thrombocytopenia, and microangiopathic haemolytic anaemia and the condition may lead to death. A large proportion of the patients are young children and severe complications are most common in this age group as well as, among elderly people.

LEGISLATION

Animals

Since 1999, VTEC O157 findings in animals are only notifiable when associated with human VTEC infection (SJVFS 2013:23).

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 have been notifiable since 1 July 2004 (SFS 2004:168 with the addition of SFS 2013:634). A laboratory confirmed case could also include those cases that are only positive by PCR i.e. where no isolate could be obtained.

SURVEILLANCE

Active surveillance

Animals

If a County Medical Officer suspects an association with a human EHEC infection to animals or to a farm with animals, the County Veterinary Officer will be informed. A request to the Swedish Board of Agriculture will be made for a trace back investigation and sampling of suspected animals and/or the environment of the animals.

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, faecal samples are randomly selected from abattoirs representing about 90% of slaughtered cattle. In the studies conducted during 2011-2012 and 2014-2015, all positive VTEC O157:H7 were also analysed for a variant of VTEC O157:H7, called clade 8. This variant is often isolated from cattle farms associated with human cases. A baseline study on cattle carcasses was done in 2006-2007 and a prevalence study in sheep was done at nine abattoirs in 2007-2008. Results from a slaughter prevalence study from 1998 showed that 0.1% of the pigs were positive for VTEC O157:H7.

Humans

Surveillance in humans is passive. Isolates from human cases are sent to the Public Health Agency of Sweden for typing.

RESULTS

Animals

Active surveillance

During 2015, four cattle and two sheep farms were investigated as suspected sources for human infection. An epidemiological association was established for one sheep farm with VTEC O121.

Monitoring

VTEC O157 was detected in nine (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 1993 faecal and 8.2% of 500 ear samples in cattle. In the study conducted during 2011-2012, VTEC O157 was detected in 73 of 2,376 faecal samples (3.1%) from cattle. Clade 8 was detected in 15 of the 73 positive samples. In the study conducted during 2014-2015, VTEC O157 was detected in 33 of 1,492 faecal samples (2.2%) from cattle. Clade 8 was detected in 5 of the 33 positive samples. In these studies, VTEC O157:H7 has predominantly been isolated from cattle in southern Sweden but rarely from the northern two thirds of the country. The collected samples during 2011-2012 were also analysed for VTEC O26 and VTEC O103. VTEC O26 was detected in 8 of 1,308 faecal samples (0.6%) and in 15 of 336 cattle ear samples (4.5%). VTEC O103 was detected in three of 1,000 faecal samples (0.3%) and in three of 500 ear samples (0.6%).

Food

Available results from official sampling by local authorities showed that analysis for *E. coli* O157 was done for 38 samples. Out of these, 31 were taken as a part of a project or for verification of a food business operator's microbiological control programme and 7 samples were taken as part of the investigation of food poisoning/complain. All 38 samples were negative. There were also 9 samples analysed with gene detection methods. One of these nine samples were positive. At the border inspection posts, 14 of 29 samples were positive for one or more genes associated with virulence (*eae*, *stx1*, *stx2*) after isolation.

Humans

In 2015, 551 human cases were reported, corresponding to an overall incidence of 5.6 cases per 100,000 inhabitants. 58 percent of the cases were domestic (320 cases) which is the highest number of reported domestic cases. The domestic incidence 2015 was 3.3 cases per 100,000 inhabitants and the increasing trend since 2010 in domestic incidence is continued in 2015. (Figure 22).

As in previous years, most domestic cases (25%) were in the age group of 1-4 years. EHEC normally has a seasonal variation with the most cases reported

during summer months. In 2015, 44% of the domestic cases were reported from June to October.

The domestic incidence was highest in the county of Halland (11.4 cases per 100,000 inhabitants) followed by Gävleborg (9.9), Östergötland (7.8), Kalmar 5.9), Västragötaland (5.8), Jönköping (5.7) and Kronoberg (5.5). The counties in the southern part of Sweden usually have higher incidences which can partly be due to higher screening frequencies for EHEC of faecal samples from children with diarrhoea.

Of the total number of human cases, 40% were infected abroad and Turkey was the most common country of infection (55 cases) followed by Egypt (19) and Spain (11). Turkey and Egypt are usually the countries outside Sweden where most Swedes become infected with EHEC.

A total of 10 cases of EHEC-associated HUS were reported; all but two were domestically acquired infections. Seven of the HUS cases were children under the age of 10.

All of the HUS cases were positive for the *eae* gene. Four of the domestic HUS cases belonged to the serogroup O26. One was *vtx1* positive, two were *vtx2* positive and one was positive for both *vtx1* and *vtx2*. The remaining typeable HUS cases belonged to O153 *vtx2* and O156 *vtx1*.

The two non-domestic cases with HUS belonged to the serogroups O103 carrying *vtx1*, and O145, carrying *vtx2*.

In 2015, 66% of the domestic EHEC cases were serotyped. The most common serogroup was O26 (26%), followed by O103 (15%), O157 (14%), O-Non-Typeable (7%), O145 (5%) and O121 (5%). During the late autumn two outbreaks with O26 and O103 were detected. The outbreaks contributed with 40% of the serotyped O26 cases and with 50% of the O103 cases.

Most of the reported outbreaks in 2015 were within families and included between 2-5 cases.

During the autumn, a cluster of cases that were spread over the country was found. The cases belong to serogroup O26, carrying the *vtx1* and the *eae* genes. During the investigation, another cluster was discovered but with another serogroup, O103 also carrying the *vtx1* gene. These outbreaks are still ongoing in 2016 and no sources of infection have been found.

Some outbreaks were associated with farms or recreational activities near farms. In March, three cases were infected with O121, *vtx2*. The index case was living in the countryside with both sheep and

milking cows in the near environment. Animals and the environment were tested. However, the test results were negative for VTEC.

At the end of July one child was infected with O121, *vtx2*, and also one sibling was tested positive. Both food items, such as sausages and hamburgers, and sheep that were held by the family were suspected to be sources of infection. The animals were confirmed to be positive for the same serotype.

In late July, one child was infected with O26, *vtx2* positive. The child had visited a farm and had consumed unpasteurised milk. The child later developed HUS. The milk and the animals were tested for VTEC four weeks after the date of symptom onset, but were found to be negative.

In November, one case was infected with O157, *vtx1* and *vtx2* positive. The person has a sheep holding and therefore the animals were tested for VTEC, but test results from the sheep were negative.

DISCUSSION

The incidence of EHEC in 2015 was the highest seen since EHEC became notifiable in 1996 and the overall increasing trend since 2005 continued. Increased sampling of patients due to an increasing awareness as well as more sensitive laboratory methods are potential causes for this trend. To better understand the fluctuations in data over time, an analysis on how sampling, screening strategies and methods have changed regionally in recent years must be done.

Several investigations were performed on suspected connections to farms and food items. Most reported cases from humans are in counties with high cattle-density, for example in the southern parts of Sweden. The highest screening frequency of EHEC in faecal samples of children with diarrhoea has, in a previous investigation, been shown to also be the highest in the southern parts. The higher numbers of cases infected abroad, which can also be found in these parts of Sweden, could partly be explained by these differences in screening routines. The cause of this has not been fully investigated.

The prevalence among cattle, based on samples taken at slaughter, has since 2005 been in the range of 2.2-3.4%. In these studies, VTEC O157:H7 has predominantly been isolated from cattle in southern Sweden and rarely from the northern two thirds of the country. In the latest survey, positive VTEC O157 samples were also analysed for the subgroup clade 8. There is a tendency for geographical clustering of clade 8.

A joint study between the National Veterinary Institute and the Public Health Agency of Sweden, was initiated in 2012, with the aim to better understand the epidemiology and the underlying mechanisms of different sources of infection and the importance of different serotypes.

Management of zoonotic agents requires collaboration between several authorities within the veterinary and public health sector. A national strategy document containing a plan to reduce the risk of domestic EHEC cases was recently published by the Swedish Board of Agriculture, the National Food Agency, the Public Health Agency of Sweden, the National Board of Health and Welfare and the National Veterinary Institute. The document is based on a synthesis of current knowledge and identifies what actions the authorities consider as important that should be prioritised in order to reduce the risk of domestic infection with VTEC in humans.

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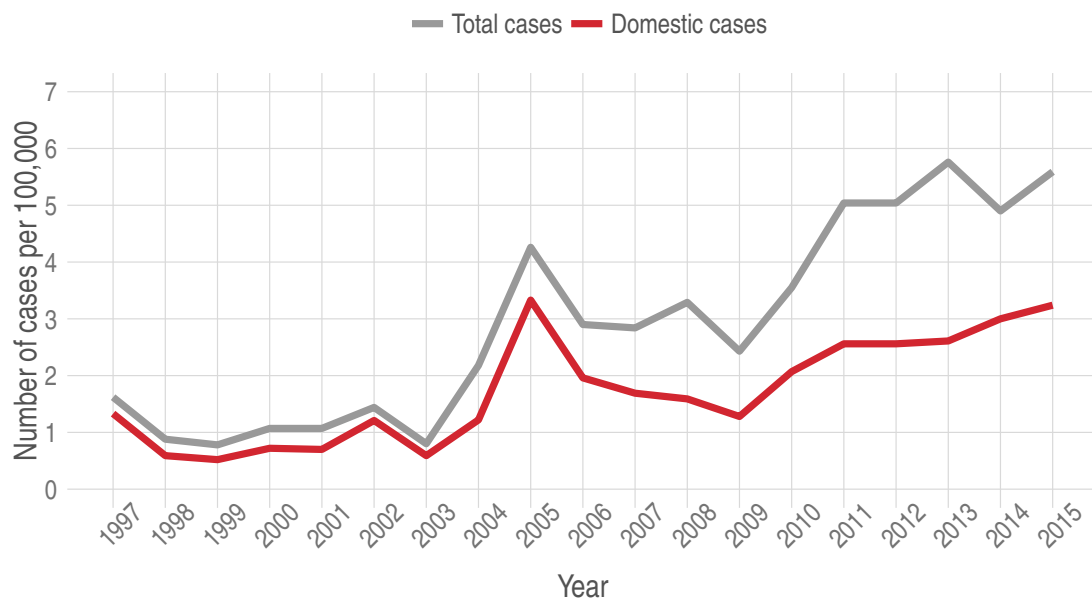


Figure 22: Notified incidence per 100,000 inhabitants of human EHEC cases in Sweden, 1997-2015

Yersiniosis



Photo: Bengt Ekberg

BACKGROUND

The genus *Yersinia* has been associated with human and animal diseases for centuries. Two enteropathogenic species of the genus are zoonotic: *Yersinia enterocolitica* and *Yersinia pseudotuberculosis*. Pigs are considered the main reservoir of *Y. enterocolitica*. *Yersinia* bacteria are widespread in nature, among which, nonpathogenic strains are most frequent. The most common human pathogenic bioserotype 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 porcine intestinal contents. Infections caused by *Y. enterocolitica* are thought to be foodborne and pigs are considered the main source of infection. The sources and vehicles of *Y. pseudotuberculosis* infections in humans remain unclear but infections caused by consumption of contaminated carrots and iceberg lettuce have been described in Finland. *Yersinia* bacteria are killed by heating (pasteurisation and cooking) however are able to grow

at refrigerator temperature and can therefore grow in food that is kept cool. In addition they can grow in vacuum and modified atmosphere packages.

Y. pseudotuberculosis was isolated from diseased guinea pigs in the 1880s. 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 1980s.

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 diarrhoea to acute mesenteric lymphadenitis, which might be difficult to differentiate from appendicitis. Longterm sequelae including reactive arthritis, uveitis and glomerulonephritis occur occasionally. 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 with the amendments of SFS 2013:634).

SURVEILLANCE

Animals

In the fall of 2014 a survey of the presence of *Y. enterocolitica* on Swedish pig farms was completed. Four pen-level faecal samples were collected from each of 105 farms with pigs ready for slaughter. Faecal samples were cultured for *Y. enterocolitica* on on CHROMagar Yersinia (CAY) media. During 2015, all isolates identified in the survey were bityped and serotyped. Isolates were then characterised by Multiple Locus Variable-number of tandem repeat Analysis (MLVA) and for the presence of the *ail*-gene by PCR.

Food

There is no active surveillance in food.

Humans

The surveillance in humans is passive.

RESULTS

Animals

A total of 92 isolates of *Y. enterocolitica* were identified from 32 of the 105 sampled farms. There were 2 bio/serotypes identified: 4/O:3 from 31 farms, and 2/O:9 from a single farm. All isolates were determined to be *ail*-gene positive. The MLVA typing indicated that types were clustered within farms and

that only one pair of farms shared an identical type. No investigation of links between the farms with the same MLVA type was completed.

Food

In 2015 no sample, taken in official food control, was analysed for presence of pathogenic *Y. enterocolitica*.

Humans

Yersiniosis is mainly a domestic infection. Of the 245 cases reported in 2015, 73% (n=179) were domestic. Of the 53 imported cases, 21 % (n=11) were infected in Spain. From other countries only a few cases each were reported. During the years 2000-2004, the number of domestic cases of yersiniosis increased until 2004 when 594 domestic cases were reported (Figure 23). Since 2004, the total number of cases has decreased.

Approximately two-thirds of *Y. enterocolitica* cases occur among infants and children. In 2015, 23% (n=41) of the domestic cases were reported among children younger than 4 years of age.

There is usually a peak in the number of reported cases during the summer, especially during July-August, but in the last three years there has also been a notable increase in the number of reported cases during January. The reason for this is not clear.

DISCUSSION

Yersiniosis has been one of the zoonoses with the highest number of reported domestic human cases in Sweden. However since 2004, the number of reported cases has decreased not only in Sweden but also in EU as a whole. This decrease has occurred without any active interventions in the food chain.

Yersiniosis in humans is considered foodborne. Outbreaks are rare and most infections seem to be sporadic but under-reporting may be considerable. Approximately 75% of the infected cases are domestic. Case-control studies suggest that consumption of pork products is a risk factor. Thus good slaughter hygiene and good manufacturing practices in food processing are essential for control of *Yersinia*.

The survey of Swedish pig herds in 2014 showed that the prevalence of *Y. enterocolitica* among Swedish pig farms (30.5 %) is similar to other pig producing regions where *Y. enterocolitica* has been studied. The dominance of bioserotype 4/O:3 in the survey also agrees with published studies in pigs from other regions and is a common type identified

from human yersiniosis cases. However, the lack of diversity of bioserotypes compared to other studies, may be due to the use of CAY media, which selects for human pathogenic types of *Y. enterocolitica*. All identified isolates carried the *ail*-gene, which is a marker for human pathogenicity. Studies from other regions using the less selective (Cefsulodin-Irgasan-Novobiosin) CIN culture method for *Y. enterocolitica* from pigs have identified a lower prevalence of the *ail*-gene in their isolate collections. This difference may again be related to the selective microbiological method used in the current study. The results of the survey indicate that human pathogenic types of *Y. enterocolitica* are found in approximately 1/3 of Swedish pig farms with slaughter aged pigs.

A national 5-year strategy plan for human pathogenic *Y. enterocolitica* has been published in order to identify measures that should be prioritised to decrease human incidence of yersiniosis. The strategy was developed in co-operation between the Swedish Board of Agriculture, National Food Agency, the Public Health Agency of Sweden, the National Board of Health and Welfare and the National Veterinary Institute.

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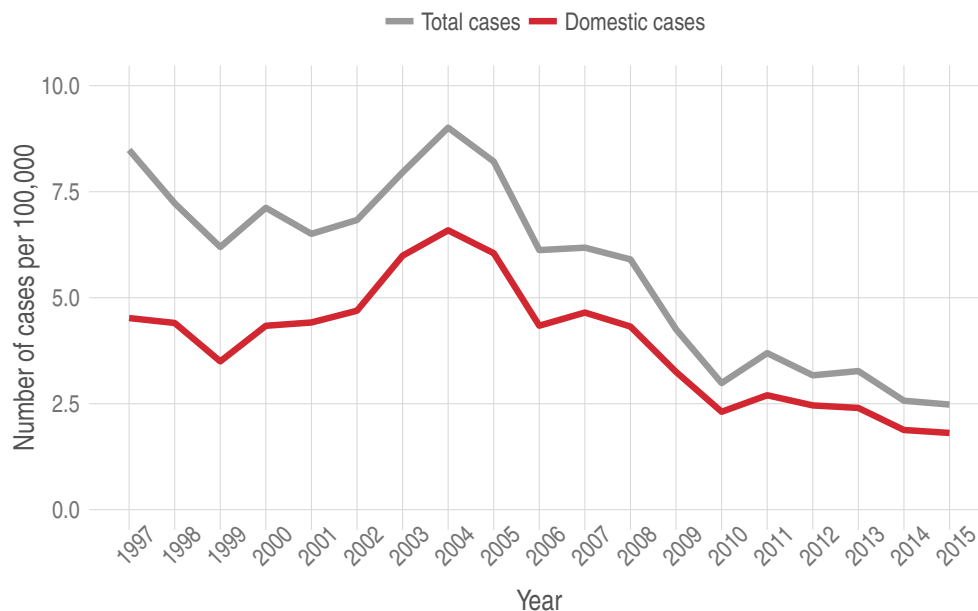


Figure 23: Notified incidence (per 100,000 inhabitants) of human cases of yersiniosis in Sweden, 1997-2015

Additional Surveillance 2015

Clinical passive surveillance

BACKGROUND

Clinical passive surveillance is a fundamental component of disease surveillance for both endemic and epizootic diseases. Especially in the case of epizootic and emerging diseases, early detection is of utmost importance in order to prevent spread and reduce the impact. For diseases with severe and obvious clinical signs, such as foot-and-mouth disease, African swine fever and anthrax, early detection is most efficiently achieved through clinical passive surveillance. For other diseases the clinical passive surveillance is complementary to active surveillance activities. In this chapter clinical passive surveillance of epizootic diseases is described. Specifically, passive surveillance initiatives for foot-and-mouth disease, African swine fever and anthrax are described in more detail. Diseases with both clinical passive and active surveillance are presented in specific chapters.

African swine fever

African swine fever (ASF) is a contagious disease of domestic and wild pigs, in its acute form characterised by haemorrhagic fever and high mortality rates. The disease is endemic in large parts of sub-Saharan Africa and on the Island of Sardinia, Italy, and since 2007 also in Caucasus and the Russian Federation. The geographical distribution of the disease is expanding, and during 2015 ASF was reported in wild boar as well as domestic pigs from Estonia, Latvia, Lithuania and Poland. The risk for further spread within EU is considered high. Because of the typically acute clinical course with high mortality rates associated with the strains of ASF virus currently circulating in Eastern Europe, early detection is most efficiently achieved through clinical passive surveillance.

Anthrax

Anthrax is a serious zoonotic disease that may affect most mammals, especially herbivores, as well as several species of birds. It is caused by *Bacillus anthracis*, a spore forming bacterium. The spores are highly resistant and may survive in the soil for decades. The disease was common in Swedish livestock in the beginning of the 20th century, with a trend of significant reduction in frequency of outbreaks during the latter part of the century. The

last reported outbreaks in Sweden occurred in 1981, 2008, 2011 and linked to that an outbreak in 2013. The disease is endemic in most countries of the world.

Foot-and-mouth disease

Foot-and-mouth disease (FMD) is a highly contagious disease of cloven-hoofed animals such as pigs, cattle, sheep and goats. The mortality rate in FMD is low, but morbidity very high and convalescence is extended, which makes this disease especially important in countries previously free from the disease. FMD is endemic in many parts of the world, but since 2011 the disease is absent in Europe. However, the major FMD epidemics that affected several European countries during the last decade demonstrated that the continent is continuously at risk for FMD virus introduction, and that early detection is crucial.

LEGISLATION

Clinical suspicions of epizootic diseases must be reported to the Swedish Board of Agriculture in accordance with the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments). This obligation applies to animal owners, veterinarians, private veterinary laboratories, and other relevant stakeholders. Suspicions are investigated after consultation with disease experts at the National Veterinary Institute and following notification to the Swedish Board of Agriculture.

SURVEILLANCE

Every year, hundreds of suspicions of serious infectious diseases are reported by field veterinarians, animal owners or private veterinary pathologists to the experts at the National Veterinary Institute. Many of these suspicions can be ruled out already based on anamnesis and initial clinical investigation, whereas others require notification to the Swedish Board of Agriculture and further investigation including sampling of sick or dead animals, with movement restriction measures imposed on the farms during the investigation. Also in cases in which an epizootic disease is not primarily suspected, but in which it cannot be excluded based on clinical investigation, samples can be submitted for laboratory investigation to exclude a diagnosis. This

can only be done after discussions with experts at the National Veterinary Institute and in consultation with the Swedish Board of Agriculture. The system is considered a component of targeted surveillance aimed at increasing the number of samples submitted for analysis of notifiable diseases. The Swedish Board of Agriculture covers all costs for veterinary visits, transports, and diagnostic analyses related to the investigation.

African swine fever

Reported cases of increased mortality or serious morbidity, with clinical signs such as haemorrhagic disorders or reproductive failures in pigs are considered suspicions of ASF until ruled out through further clinical investigation, with or without sampling of affected animals. Due to clinical similarity, samples from domestic pigs collected for ASF are also analysed for CSF. This strategy is strongly recommended by the EU.

Given the current situation in Eastern Europe as regards ASF in wild boar, Swedish hunters are encouraged to report findings of dead wild boar. If possible, samples are taken in to rule out ASF as the cause of death (see also specific chapter on infectious diseases in wild boar).

Anthrax

Reported cases with a history of sudden death in one or more animals on the premise are considered suspicions of anthrax. Clinical signs such as fever, bloody discharges from the nose, mouth, anus or vagina, uncoagulated blood, subcutaneous oedematous swellings and lack of rigor mortis, as well as recent site disturbances (dredging or digging) strengthens the suspicion.

Foot-and-mouth disease

Reported cases of disease in cattle, pigs, sheep or goats which presents with vesicular lesions of the feet, buccal mucosa or mammary glands, are considered suspicions of FMD until ruled out through further clinical investigation, with or without sampling of affected animals.

RESULTS

The suspicions of epizootic diseases that were reported and further investigated based on sampling of sick or dead animals in 2015 can be seen in Table 18. In none of the cases, the suspicions of epizootic disease could be confirmed.

Two clinical suspicions of ASF in domestic pigs were investigated. Samples were collected and sent to the National Veterinary Institute for PCR detection with negative result. Samples were also analysed for CSF and PRRS with negative results. Fifteen samples from wild boar found dead were also analysed for ASF with negative results.

Five clinical suspicions of anthrax in cattle, three in sheep, one wild boar, one roe deer and one moose were investigated. Suspected cases were bled and samples sent to the National Veterinary Institute for examination using direct microscopy and multiplex RT-PCR. Carcasses were left on the premises, covered to prevent any direct contact with the carcass and possibly contaminated surfaces. In none of the cases, anthrax could be confirmed.

One clinical suspicion of FMD in a sheep herd, in which several animals suffered from fever and lesions on the feet, was investigated. Although the case was considered a low-grade suspicion, FMD could not be excluded based on clinical investigation. Samples were sent to the National Veterinary Institute for PCR and serology. All samples were negative and FMD could be excluded.

ADDITIONAL SURVEILLANCE 2015

Table 18: Number of suspicions of epizootic diseases reported through the clinical passive surveillance system during 2015 and investigated by experts at the National Veterinary Institute after notification to the Swedish Board of Agriculture.

Disease	Investigated ^A	Confirmed
African swine fever	17 ^B	0
Anthrax	11	0
Aujeszky's disease	1	0
Avian influenza	15 ^C	0
Bluetongue	2	0
Brucellosis	1	0
BSE	1	0
Classical swine fever	3	0
FMD	1	0
Lumpy skin disease	1	0
Newcastle disease	15 ^C	0
Paratuberculosis	3	0
PRRS	5	0
Rabies	10	0
Tuberculosis	8	0
West Nile fever	2	0

^A In many cases, clinical suspicions were investigated for several diseases with similar clinical picture (e.g. ASF/CSF/PRRS, AI/ND)

^B Includes 15 samples from wild boar found dead, also described in the specific chapter on infectious diseases in wild boar

^C Does not include wild birds found dead

Poultry Health Control Programme

BACKGROUND

The Poultry Health Control Programme is based on provisions (SJVFS 2010:58) issued by the Swedish Board of Agriculture. The programme is mandatory for all hatcheries producing more than 50,000 day-old chicks 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 programme consists of rules on biosecurity, standards for poultry houses, management and clinical surveillance.

LEGISLATION AND DISEASE

All diseases in the programme, except for *Mycoplasma synoviae*, are notifiable according to provisions issued by the Swedish Board of Agriculture (SJVFS 2013:23). The diseases included in the programme during 2015 are briefly described below.

- Fowl typhoid and pullorum disease are two poultry diseases caused by *Salmonella enterica* subspecies *enterica* serovar Gallinarum biovar Gallinarum (*Salmonella* Gallinarum, fowl typhoid) and biovar Pullorum (*Salmonella* Pullorum, pullorum disease) respectively. These two biovars of the same serovar are specially adapted to poultry and vertical transmission is an important feature in addition to the common horizontal spread. Pullorum disease mainly affects foetuses and chickens up to 3 weeks of age while *Salmonella* Gallinarum commonly infects and causes disease (diarrhoea, inappetence, production losses and mortality) in older birds. Both biovars are included in the Swedish zoonosis legislation as well as in the European legislation on trade in poultry and hatching eggs (Council Directive 2009/158/EC). The diseases were eradicated from the Swedish commercial poultry population in the beginning of the 1960's. Since then, a single case of fowl typhoid (*Salmonella* Gallinarum) was detected in a backyard flock in 1984 and pullorum disease (*Salmonella* Pullorum) were detected in two backyard flocks in 2001 and four backyard flocks in 2012.
- *Mycoplasma gallisepticum*, *Mycoplasma synoviae* and *Mycoplasma meleagridis* are important poultry pathogens. However, *M. meleagridis* is only pathogenic for turkeys. These three mycoplasma types are able to spread both horizontally and vertically. They mainly cause respiratory disease and egg production losses. *M. gallisepticum* and *M. synoviae* may also cause arthritis and are present in the backyard poultry population in Sweden. Testing of breeding flocks for *M. gallisepticum* and *M. meleagridis* (only turkey flocks) is included in the European legislation on trade in poultry and hatching eggs (Council Directive 2009/158/EC). Due to its potential to cause disease and production losses testing for *M. synoviae* was included in the programme between 1995 and 2010. During a revision of the programme the agent was excluded but is since the 1st June 2015 included again.
- Paramyxovirus type 1 may cause outbreaks of Newcastle disease, with egg production losses, increased mortality, nervous signs and respiratory disease, 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, twelve outbreaks of Newcastle Disease have occurred in Sweden. The disease is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments). Since all outbreaks have been successfully eradicated, Sweden has a status of Newcastle free country without vaccination according to Commission Decision 95/98/EEC.
- Egg drop syndrome - the virus is a naturally occurring adenovirus in waterfowl (including the wild population) in which it does not cause any clinical disease. In chicken, the clinical signs 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.

ADDITIONAL SURVEILLANCE 2015

SURVEILLANCE

Serological screening within the programme is administered by the National Veterinary Institute and financed by the Swedish Board of Agriculture and the participating companies. In 2015, seven different breeding companies participated in the programme; four broiler-, two laying hen- and one turkey breeding company. In accordance with the provisions of the programme, sixty blood samples were taken from the breeding flocks included in the programme, once during the rearing period and several times during the production period. The blood samples were sent by mail to the National Veterinary Institute where serological tests were performed. The sampling and testing schemes are presented in tables 19 and 20.

RESULTS

Table 21 gives an overview of all samples taken in breeding flocks of chickens and turkeys, and the laboratory methods used, during 2015. All analysed samples tested negative for *Mycoplasma gallisepticum*, *Mycoplasma synoviae*, *Mycoplasma meleagridis* and paramyxovirus type 1.

During 2015, 13 chicken flocks (two grandparent and 11 parent flocks) were further investigated due to a few positive samples for egg drop syndrome. In addition, three chicken flocks (two grandparent and one parent flock) were investigated due to a few positive samples for *Salmonella Gallinarum/Salmonella Pullorum*. No clinical signs were seen in these flocks and after testing new samples from these flocks, the previous positive samples were considered as unspecific serological reactions.

DISCUSSION

The aim of the Poultry Health Control Programme is to document freedom from the included diseases, to stop the introduction and possible further spread of diseases and to allow trade from the participating companies.

In conclusion, the results from the serological screening in the Poultry Health Control Programme in 2015 support the status of freedom from the infections included in the Swedish breeding poultry population. However, the clinical surveillance of the poultry breeding population is also of utmost importance.

Table 19: Sampling schedule for chicken grandparent and parent flocks. Number of blood samples tested at different weeks of age.

Agent	Age in weeks				
	16	24	36	48	60
<i>S. Pullorum/ S. Gallinarum</i>	-	60	-	-	-
<i>Mycoplasma gallisepticum</i>	60	60	60	60	60
<i>Mycoplasma synoviae</i>	60 ^A	60 ^{A,B}	60 ^A	60 ^A	60 ^A
Paramyxovirus type 1	-	-	-	60	-
Egg drop syndrome-virus	-	30	-	-	-

^A Grandparent flocks

^B Parent flocks from June 1, 2015

Table 20: Sampling schedule for turkey parent flocks. Number of blood samples tested at different weeks of age.

Agent	Age in weeks			
	20	32	44	56
<i>S. Pullorum/ S. Gallinarum</i>	-	60	-	-
<i>Mycoplasma gallisepticum</i>	60	60	60	60
<i>Mycoplasma meleagridis</i>	60	60	60	60
<i>Mycoplasma synoviae</i> ^A	-	60	-	-
Paramyxovirus type 1	-	-	-	60

^A From June 1, 2015

Table 21: Number of sampling occasions for grandparent (GP) and parent (P) flocks of chickens and turkeys and total number of samples tested during 2015.

Agent	No. of sampling occasions			No. of samples			Method
	Chickens		Turkeys	Chickens		Turkeys	
	GP	P	P	GP	P	P	
<i>S. Pullorum /S. Gallinarum</i>	12	68	4	720	4,080	240	Serum plate agglutination test, antigen, BioVac
<i>Mycoplasma gallisepticum</i>	0	303	14	0	18,180	840	ELISA MG antibody test, SVANOVA
<i>Mycoplasma gallisepticum / Mycoplasma synoviae</i>	59	34	2	3,540	2,040	120	<i>Mycoplasma gallisepticum/synoviae</i> Antibody Test Kit, ID.Vet
<i>Mycoplasma meleagridis</i>	0	0	16	0	0	960	Serum plate agglutination test, antigen, BioVac
Paramyxovirus type 1	12	63	4	720	3,780	240	NDV screen competition ELISA, ID.Vet
Egg drop Syndrome-virus	12	68	0	360	2,040	0	Antibody haemagglutination inhibition test, antigen, In House test

Infectious diseases in wild boars

BACKGROUND

Wild boars are susceptible to contagious diseases that affect domestic pigs and therefore they have a potential role in spreading diseases to and from domestic pigs. This is particularly the case for classical swine fever which has been spread between wild boars and domestic pigs in several European countries. The ongoing spread of African swine fever (ASF) from Russia and other countries in Eastern Europe into the EU involves wild boar and the direct and indirect contacts between domestic pigs and wild boar in these areas hamper the control and management of the disease. The Swedish wild boar population is increasing rapidly and is presently estimated at 200,000 animals before the reproductive season of 2016. The northern border of the wild boar habitat is extending north and has at present passed the level of the river Dalälven. Since the year 2000, hunted wild boars from different parts of the country have been blood sampled yearly for surveillance purposes. The samples have been sent to National Veterinary Institute for analysis for antibodies to infectious agents that are of importance for the domestic pig production. Due to the worrying situation regarding ASF in Eastern Europe and within EU a passive surveillance for the disease in wild boars found dead was added to the surveillance programme during 2013 and is ongoing.

LEGISLATION

The infections investigated in the wild boar surveillance programme of 2015 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 control the disease and to prevent further spread.

SURVEILLANCE

Passive surveillance

Organ samples from, or whole carcasses of wild boar found dead were brought in for post mortem examination at the National Veterinary Institute. All submitted wild boars or samples thereof were subjected to African swine fever virus genome analysis irrespective of pathological lesions.

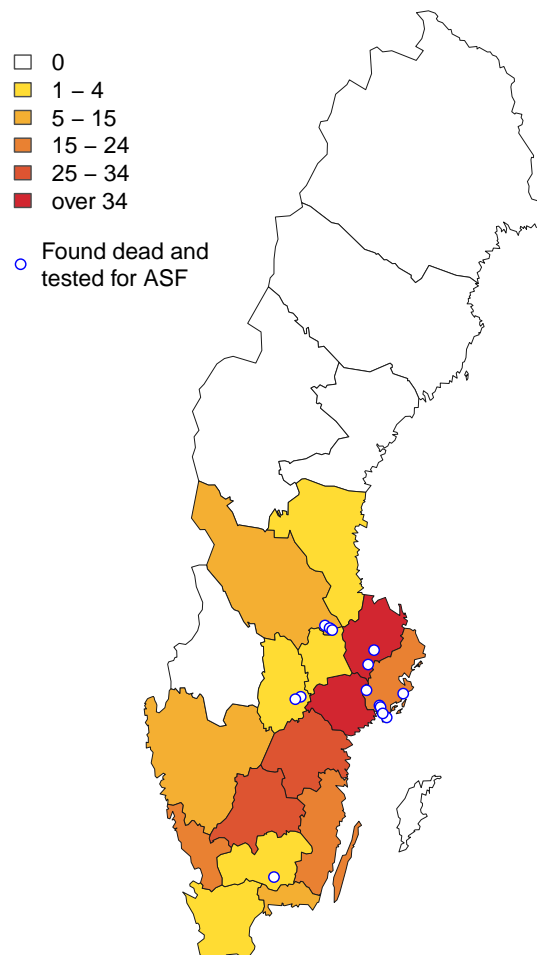


Figure 24: Geographical distribution of the number of hunted wild boar per county sampled in 2015. The white points indicate locations of 15 wild boar that were found dead and then tested negative for African swine fever (ASF). ©EuroGeographics for the administrative boundaries.

Active surveillance

Blood samples from shot wild boars were used for active surveillance of antibodies to Aujeszky's disease virus, porcine reproductive and respiratory syndrome virus and classical swine fever virus. The samples were collected voluntarily by hunters recruited through information on the webpage of the National Veterinary Institute, in hunter's magazines and through using informal networks including information meetings. The surveillance was designed to detect the investigated diseases at 1% prevalence with 99% confidence level. To reach this level of

confidence 500 samples were needed. The samples were analysed using the serological methods described under the respective disease headings in this report.

RESULTS

Passive surveillance

Fifteen wild boars found dead were examined for African swine fever virus genome and all analyses were negative. They were found in the east and northeast part of the wild boar distribution area (Figure 24). Additional post mortem findings in these wild boars are reported under the heading 'Post mortem examinations in wildlife' in this report.

Active surveillance

In 2015, 300 samples were collected from shot wild boars. The geographical distribution of sampled wild boars was roughly correlated to the distribution and density of the Swedish wild boar population (Figure 24). All analyses for Aujeszky's disease and classical swine fever were negative. One sample was positive for antibodies to porcine reproductive and respiratory syndrome virus after confirmation and rendered further investigation of wild boars in the close proximity and of possible contacts with domestic pigs in the area. The investigation led to the conclusion that the sample was a 'singleton reactor' and not caused by true infection with porcine reproductive and respiratory syndrome virus.

The confidence level for freedom of disease from the active surveillance was 95% due to the fact that the goal of 500 samples was not met.

DISCUSSION

The Swedish wild boar population is growing and the boundary of the population is moving north. In areas where wild boars already are present, the population is also becoming denser, which increases the risk of direct and indirect contact between wild boars and domestic pigs. The area in Sweden populated by wild boars is surrounded by sea border. Therefore, there is no risk of wild boars migrating into Sweden with disease. Instead the role of the wild boar in disease spread might be to pick up infectious agents introduced into Sweden by other routes. It is possible that wild boars could gain access to infected meat or other infected animal products for example in garbage or following indirect spread by other means from people, vehicles or equipment. All diseases monitored in 2015 are or have recently been present in neighbouring countries or in close proximity to Sweden. The unfavourable development of the African swine fever situation in Russia, Eastern Europe and within EU is of special concern and calls for reliable methods for early detection of disease in the wild boar population.

Infectious diseases in fish, crustaceans and molluscs



Photo: Charlotte Axén

BACKGROUND

All registered aquaculture farming sites are obligated to participate in the Official Health Control Programme, regulated in accordance with SJVFS 2014:4, issued by the Swedish Board of Agriculture, and by Council Directive 2006/88/EG. Sweden has a very healthy aquaculture as well as wild populations of fish and shellfish. None of the serious diseases that occur through Europe are prevalent in Sweden. A restrictive approach to import of live fish for restocking/farming, an early introduction of health-control in farms and the presence of hydro-electric dams in most Swedish rivers (acting as migration barriers for feral fish from the coastal zone) are parts of this health status. The presence of dams also results in a different health status at the coast compared to the more disease free continental zone. To maintain this situation, all transport of live fish from the coast to the continental zone is forbidden and Sweden has a national conservation programme for salmonids to compensate for the lack of natural migration

DISEASES AND LEGISLATION

All Swedish fish farms have participated in surveillance for the diseases mentioned below since the late 1980's in accordance with EU Directives 2001/183 and 2006/88. Sweden has an approved disease free

zone status (2002/308/EC) for Viral haemorrhagic septicaemia (VHS) and Infectious haematopoietic necrosis (IHN) (2008/427/EG). Additional guarantees are in place for the whole country for Spring Viraemia of Carp (SVC) and for the continental zone for Infectious Pancreatic Disease (IPN) (2010/221/EC). The continental zone of Sweden has an eradication programme for Renibacteriosis/bacterial kidney disease (BKD) and the coastal zone for IPN (2010/221/EU). These diseases are included in the Swedish legislation of notifiable diseases (SJVFS 2013:23). Further, IHN, VHS, IPN (other than serotype ab) and SVC are included in the Swedish Act of epizootic diseases (SFS 1999:657 with amendments). In addition, sampling and diagnostics are routinely done for Koi herpes virus (KHV) in imported, quarantined koi, Crayfish plague in Crayfish and Bonamiosis and Marteiliiosis in shellfish. These diseases are also regulated by the Swedish legislation for notifiable diseases (SJVFS 2013:23). Other notifiable diseases such as furunculosis (*Aeromonas salmonicida salmonicida*/ASS) and yersiniosis/Enteric redmouth disease (ERM) are not tested within the surveillance programs.

Infectious haematopoietic necrosis (IHN) and viral haemorrhagic septicaemia (VHS)

Both diseases are caused by rhabdoviruses and occur frequently in Europe. They are transferred horizontally, but vertical transmission cannot be completely ruled out for IHN. Both diseases have greatest impact in aquaculture of rainbow trout (*Oncorhynchus mykiss*) in freshwater, but have also been detected in several other species. Infected fish exhibit behavioural changes, lethargy and abnormal swimming (whirling). The fish are anaemic with varying degrees of bleeding in multiple organs. VHS is found in a marine form, and a low frequency in wild populations of sensitive species cannot be excluded in the Swedish coastal zone.

Infectious pancreatic necrosis (IPN)

IPN is caused by a Birnavirus that is highly infectious to juvenile salmonids. Susceptibility declines with increasing age. Fish that survive infection become subclinical carriers. In addition to salmonids, virus has been detected in several other species. The virus is transmitted both horizontally and vertically.

The disease has large consequences, with high mortality in young fish, and is considered as one of the most costly in several European countries. Symptoms include darkening, abdominal distension and corkscrew swimming. Bleedings in abdominal fat and internal organs are the most dominant internal findings. Mortality rates can vary between 10-90%.

Renibacteriosis (BKD)

BKD is caused by a gram positive bacterium, *Renibacterium salmoninarum*. The infection can be transmitted both horizontally and vertically. The disease favours low water temperatures, and outbreaks occur mainly at temperatures between 7-15 degrees.

Salmon and arctic char are most susceptible to BKD and mortality can reach 80%. In rainbow trout, the disease is chronic with a continuous low mortality of about 5-10%, however outbreaks of up to 40% mortality can occur. Infected fish may have reduced growth and disease can result in a deterioration of quality of the meat.

Spring viraemia of carp (SVC)

SVC is caused by a rhabdovirus. The disease occurs in Asia and several European countries. The virus has been detected in several fish species in the

cyprinid family. The virus is transmitted horizontally. The clinical signs are usually general, such as darkening, exophthalmia and a slow breathing. The fish swim lazily with sporadic periods of hyperactivity. Other common findings are pale gills, ascites and haemorrhages in the skin and gills. Internally, bleedings are found in various organs including muscle, swim bladder and the brain.

Koi Herpes virus (KHV)

KHV is caused by a DNA virus and affects common carp (*Cyprinus carpio*) and variants thereof, including koi. The virus was first detected in 1998 and has since then been reported from all continents except Australia. The virus is transmitted horizontally. KHV can cause severe problems and is associated with high mortalities. Infected fish usually swim at the surface and have an increased breathing frequency. Symptoms include enophthalmia, spotted gills and secondary bacterial or parasitic infections on gills and skin. Surviving carps can become subclinical carriers.

Crayfish plague

Crayfish plague is caused by an aquatic fungus (*Aphanomyces astaci*), which spread to Europe in the late 1800's from the U.S. with live crayfish. The disease occurs throughout Europe and North America. The fungus reproduces by spores spread in the water. When the spores infect crayfish they grow through the skin and attack the underlying tissues.

The signal crayfish becomes subclinically infected but may exhibit black (melaninated) areas in the shell adjacent to the presence of the fungus in the skin. The spots will disappear when the shell is shed, but may gradually reappear.

When noble crayfish is infected the first sign is high mortality in affected populations. Disease in the individual is characterized by behaviour changes such as moving during daytime, reduced coordination and balance difficulties.

White spot disease (WSD)

WSD is caused by a Whispovirus (WSSv) that can infect a wide range of aquatic crustaceans including marine, brackish and freshwater prawns, crabs, crayfish and lobsters. Outbreaks occur at water temperatures of 18-30°C. The most common clinical sign is white spots in the exoskeleton, but the disease can occur without obvious external signs.

The virus is transmitted both horizontally and vertically and has a long survival time outside the

ADDITIONAL SURVEILLANCE 2015

host animal. The virus is present in imported frozen raw giant shrimps. There is a non-negligible risk that the virus will be introduced to the aquatic environment by anglers using these shrimps for bait. The consequences are difficult to predict but may have a negative impact on Swedish crustacean populations.

Marteiliosis

Marteiliosis, a disease in oysters and blue mussels, is caused by a unicellular parasite (*Marteilia refringens*). The parasite needs a crustacean (*Paracartia grani*) as an intermediate host. The disease causes reduced fitness, impaired growth and resorption of the gonads and hence reduced reproductive capacity. When the animals weaken, they cannot keep the shell halves closed. The parasite is considered to exist in two forms; the 'o' form, which occurs in oysters, and the 'm' form, which occurs in blue mussels.

Bonamiosis

Bonamiosis is a disease in oysters caused by the protistan parasite *Bonamia ostreae*. The parasite invades and destroys the haemocytes. Usually the only sign of disease is increased mortality in the infected oyster population. *B. ostreae* is found along the European Atlantic coast as far up as Denmark, where it has now been found in Limfjorden.

SURVEILLANCE

Within the Official Control Programme, there is active surveillance for the viruses IHN, VHS, IPN and SVC, and also for renibacteriosis/BKD. All farms are tested for presence of the aforementioned diseases. The aim is to document freedom from disease and to contribute to the maintenance of this state. Sampling frequency is based on classification of each farm into one of three categories (high, medium or low risk) after a risk analysis based on the risk for the farm becoming infected; the risk that the farm will further spread the pathogen and the impact of the pathogen.

There is also active surveillance in imported quarantined fish (eel - IPN and koi/carp - KHV) and both farmed and wild shellfish are sampled for marteiliosis and bonamiosis since 2011. Active surveillance is also done when potential invasive alien species - like the marble crayfish - are discovered.

For fish, there is also a voluntary health programme, where samplings are performed at disease

outbreaks, thus passive surveillance. The combination of the Official Control Programme and the voluntary health programme provides a good foundation for early detection of new, exotic diseases, thereby improving the possibility to control emerging diseases.

Crayfish plague is monitored by passive surveillance - analysis is done based on suspicion of disease outbreaks.

DIAGNOSTICS

All diagnostic analyses are performed according to recommendation by EU or OIE at the Swedish reference laboratory, the National Veterinary Institute. VHS, IHN, IPN and SVC are tested on pooled organ material (spleen, kidney, heart/brain) by a cell culturing method. A pool consists of organs from up to ten fish. A cell culture is defined as virus positive if a cytopathogenic effect is detected within two weeks, after which the virus is identified by serum neutralisation (SN-test), ELISA or in some cases PCR. KHV is tested on individual fish by PCR. Thirty fish are sampled in regular fish farms, and in compensatory breeding farms up to 60 fish are sampled after stripping of roe. In the case of carp/koi, only a few fish may be sampled and in eel quarantine as many as 120 fish are sampled.

BKD is tested on kidney tissue from individual fish and demonstrated by an ELISA method and verification is done by PCR. Thirty fish are sampled in regular farms and in compensatory breeding farms up to 60 fish are sampled after stripping of roe.

A. astaci is demonstrated by light microscopy and cultivation and verified by realtime PCR, and WSSv is detected by rt-PCR. The number of sampled animals varies from case to case.

B. ostreae and *M. refringens* is demonstrated by PCR in individual animals, 30 from each production site. Confirmation is done by histology.

RESULTS

Official health programme for fish farmers, crustacean and mollusc surveillance

The number of samples analysed and results are shown in table 22. In summary, the active surveillance detected (one case=one outbreak):

- 1 case of IPNab in rainbow trout, coastal zone
- 1 case of IPNab in rainbow trout, continental zone. However, there is uncertainty whether this farm is actually in the inland zone since

there is a brook connecting with the river Kalixälven (coastal zone)

- 3 cases of BKD, one in rainbow trout and two in arctic char
- 3 cases of Crayfish plague
- 2 cases of Marteilirosis, both in wild blue mussel populations, all on the west coast.

Voluntary health programme for fish farmers

There were two recorded outbreak of other notifiable diseases in fish during 2015; furunculosis (ASS) on a coastal farm and yersiniosis (ERM) on an inland farm. Re-sampling five month after diagnosis showed that yersiniosis was again or still present on the inland farm. Two cases of *Gyrodactylus salaris* were identified in rainbow trout. The second farm had bought fish from the first farm, however the second farm is also situated in the river system where this parasite was first identified in the 1950s.

Outbreaks in wild fish, crustaceans and molluscs

BKD was identified in one wild arctic char and BKD was suspected (positive ELISA, negative PCR) in nine other wild salmonids from the same water system in a project to investigate transmission of BKD between farmed and wild fish. The fish came from one of the two river systems where there are current outbreaks of BKD in farmed fish. One suspicion of BKD was also raised in control of ovary fluid in the obligatory brood stock control program. The fish of origin was a brown trout that had already been released into the wild, and the water system that has not suffered from BKD in over 10 years.

One case of VHS genotype 1b was identified in a wild cod included in an project on causes of wounds in cod and flounder.

DISCUSSION

The number of farms that were sampled for the viruses listed in table 22. Swedish aquaculture has

a good health status, where all severe diseases of importance are absent. The most problematic disease to control is renibacteriosis/BKD, due to its vertical transmission and variable clinical presentation. Control of BKD is expected to be improved by modified sampling and improved methodology, from today's post mortem sampling to an in vivo method. Additional resources must be invested in risk based analysis of individual aquaculture farms to get a more reliable assessment for health surveillance. The number of Crayfish plague outbreaks have decreased by 50% since 2014. However, it is hard to interpret if this is a true decrease since fever sites were sampled in 2015. Marteilirosis has previously been identified in Sweden. This year's sampling identified positive mussels at a new sampling site within the containment zone, as well is in an area that has been positive for the parasite in previous samplings. The crustacean intermediate host of *Marteilia refringens* is not supposed to be present in Swedish waters, it is typically an inhabitant of warmer waters. Because of this, it is not clear how the disease was introduced to Sweden. Some possibilities include: streams, ballast water or illegal import of alien mollusc species. Import of alien species (illegal or legal) always poses a risk for introduction of exotic pathogens. For example, the pacific oyster (*Crassostrea gigas*) can carry *Bonamia ostrea* without showing any clinical signs. *C. gigas* is considered an invasive alien species but is present at the west coast, and there is interest in farming this species. Fish farms importing roe or live fish also pose a risk to introduce new pathogens into Sweden. In addition, the importance of marine VHS genotypes in wild fish is difficult to interpret, and VHS genotypes, such as the identified 1b pathogenic to rainbow trout are present in the Baltic Sea. Thus, there is risk that Sweden imports serious diseases not present in the country today. The official and voluntary programmes are keys to a quick identification and eradication in case such an introduction takes place.

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Table 22: Samples taken in the Swedish surveillance programmes for notifiable diseases in fish, crustaceans and molluscs

Disease	No. of sampled production sites	No. of infected production sites	No. of tested individuals	No. of tested pools	No. of infected individuals/pools
Fish					
VHS	51	0	-	420	-/0
IHN	51	0	-	420	-/0
IPN	51	2	-	420	-/3 ^E
SVC	2	0	-	6	-/0
KHV	2	0	33	-	0/0
BKD	50	3 ^C	3,382	-	35 ^F /-
Crustaceans					
<i>Aphanomyces astaci</i>	7	3	19	0	7/0
WSSv	2	-	-	22	-/0
Molluscs					
<i>Bonamia ostreae</i>	5 ^A	0	150	-	0/-
<i>Marteilia refringens</i>	10 ^B	2 ^D	298	-	2/-

^A 1 farm, 4 wild populations

^B 1 farm, 4 wild populations

^C Two farms in the same river system, the second farm infected through purchase of fish from the first farm. The third farm was identified by source tracing.

^D Wild populations

^E Virus isolation in cell culture, virus identified by ELISA and confirmed by RT-PCR, conventional PCR and sequencing

^F By ELISA. Infection was verified in 8 of 8 fish that were further tested by PCR. 28 of 35 positives were from one farm.

Examination of abortions in food producing animals

BACKGROUND

Postmortem examinations are considered an important part in the early detection and national surveillance for infectious and emerging disease. As mentioned in the part 'Postmortem examinations in food producing animals', the Swedish Board of Agriculture has for the past 20 years financed a programme for encouraging such examinations. Many infections, however, show no macroscopic lesions or cause nonspecific changes not detected at necropsy. Brucellosis, porcine reproductive and respiratory syndrome (PRRS) and classical swine fever (CSF) are examples of infections that may be present without specific macroscopic findings. Moreover, the clinical picture in the herd may be non-specific, which may cause a delay before the suspicion of these diseases occurs in clinical monitoring activities in the herds.

SURVEILLANCE

The surveillance started in 2008. It includes targeted examinations for brucellosis of all ruminant foetuses and for brucellosis, PRRS and CSF of all pig foetuses submitted to necropsy as part of the postmortem examination programme. During the last parts of 2012 and 2013, Schmallenberg virus (SBV) was analysed as well. These infections often cause abortion, therefore sampling of aborted foetuses means sampling within a risk group and increases the chance of detecting the infectious agent

if present in the country. The Swedish Board of Agriculture finances sampling and testing of foetuses for *Brucella*, PRRS and CSF. All diagnostic testing was performed at the National Veterinary Institute. The foetuses were analysed for the CSFV and PRRS genome with PCR and *Brucella* by bacterial culture.

RESULTS

Since the start in 2008, various numbers of foetuses of different species have been examined each year (Table 23). The numbers for 2012 and 2013 were extraordinary high, most likely because of increased attention due to the newly identified infection with Schmallenberg virus (SBV).

All analysed samples were negative for both *Brucella*, PRRS and CSF.

DISCUSSION

The postmortem examinations and sampling of foetuses are an important part of the national surveillance for infectious and emerging diseases, as illustrated by the detection of infections with Schmallenberg virus in 2012 and 2013. Testing for SBV ended in 2013 because the disease, at that time, had become established in Sweden and therefore was considered endemic. During 2014 and 2015 the number of examinations has been declining and therefore future actions are taken to get the anticipated, approximately 140 foetal examinations per year.

Table 23: Number of examined foetuses in the surveillance since start 2008

Species	2009	2010	2011	2012	2013	2014	2015
Cattle	15	62	21	63	114	32	29
Goat	0	9	3	5	4	2	0
Sheep	29	70	45	79	89	28	31
Alpaca	2	5	0	0	4	0	2
Bison	0	0	0	1	1	0	0
Gnu	0	0	0	0	1	0	0
Visent	1	0	2	1	0	0	0
Pig	79	61	51	54	46	31	17
Total	126	207	122	203	259	93	79

Post mortem examinations in food producing animals

BACKGROUND

Early detection of infectious diseases is of utmost importance in order to prevent negative effects. For diseases with severe clinical signs the first line of defence is the detection of disease by animal owners, field veterinarians and pathologists. International and national experience, show that post mortem examinations remain a vital part in disease control and detection of emerging diseases.

As post mortem examinations are considered an important part in the early detection and national disease surveillance, a specific programme for encouraging such examinations by financial means started in the early nineties. The Swedish Board of Agriculture finances the programme, with support of fees from the animal owners. Farm and Animal Health is responsible for the organisation of the post-mortem examination programme.

PROGRAMME

The programme finances post mortem examinations in all food producing animals, including poultry, which were included in the programme in 2007. Since 2008, domesticated exotic ungulates are also included. Approximately 3,000 animals have been examined yearly within the programme since 1999. In conjunction with post mortem examinations, samples are routinely collected from defined categories of animals for surveillance of salmonellosis, paratuberculosis, PRRS, CSF, brucellosis, TSE and antimicrobial resistance.

The programme also includes further education of veterinarians and the veterinary employees at the post mortem facilities. Yearly courses are held and quarterly newsletters are produced.

Transportation of the carcasses to the laboratories is arranged and financed by the owner. This can be a problem for large animals, particularly when the distance between the farm and post mortem facility is long.

RESULTS

During 2015 post mortem examinations were performed at five different sites, all located in the southern half of Sweden: Skara (Eurofins Food & Agro),

Kristianstad (Eurofins Food & Agro), Uppsala (the National Veterinary Institute and the University of Agriculture), Visby (Farm and Animal Health Service) and Karlskoga (Farm and Animal Health). Large animals, such as adult cattle, were examined at four of these sites, Uppsala, Kristianstad, Karlskoga and Visby. A total of 2,640 post mortem examinations were performed within the programme during 2015.

The distribution of species examined over the last 10 years are shown in table 24. The change in the number of animals within the largest livestock producing sectors (swine, cattle, sheep and poultry) is illustrated in figure 25.

In 2015, 75 cases were diagnosed as a notifiable disease at post-mortem examination. Table 25 shows the reported index cases of notifiable diseases.

DISCUSSION

The post-mortem examinations are a vital part of the national surveillance for infectious and emerging diseases, as illustrated by the detection of 75 index cases of notifiable disease in 2015. Post mortem examination is also an important tool for the veterinarians to solve animal health problems at the individual farm. In the last decade the number of post mortem examinations has been around 3,000 per year, with a steady decline in swine and an increase in poultry.

A regional imbalance can be seen in that more examinations are performed in the relatively few regions with local post mortem examination facilities. The highest numbers of examinations are performed in regions with high animal density and access to a regional laboratory performing post mortem examinations.

Distance and transportation method to facilities where post mortem examinations can be performed is important for quality reasons. A long delay before cold storage and examination will result in a higher degree of cadaverous changes and will influence the quality of the post-mortem examination negatively. A project financed by the Swedish Contingency Agency on improving transportation and

logistics for transportation of dead animals submitted for post mortem, to improve quality of the examinations, was initiated in 2014 and was continued through 2015. The project has been successful, meaning less cadaverous changes of carcasses and better logistics. Both laboratories, veterinarians and farmers have expressed a wish to make the transportation pilot project a permanent solution.

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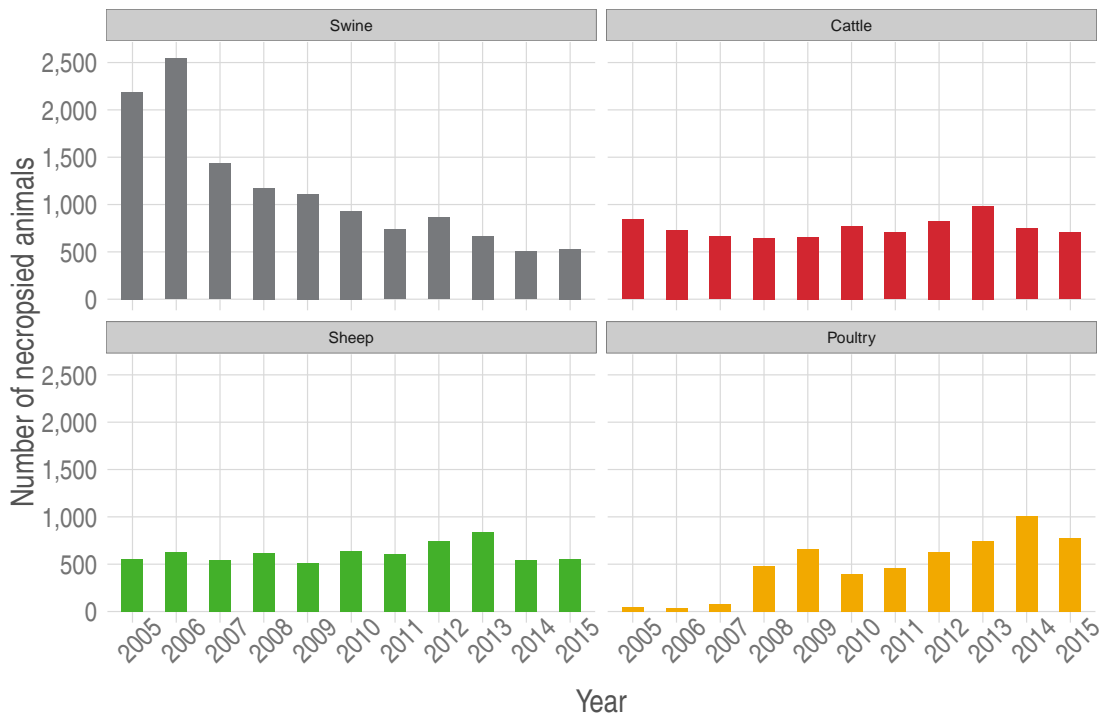


Figure 25: Number of necropsies by selected animal species over a 10 year period

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Table 24: Distribution of food producing species submitted to postmortem examination, 2005-2014.

Year	Pigs	Cattle	Sheep	Goat	Farmed deer	Poultry	Exotic ungulates	Other	Total
2005	2,190	839	550	13	26	49	1	-	3,668
2006	2,543	733	630	7	38	39	-	-	3,990
2007	1,434	660	545	17	39	80	7	-	2,782
2008	1,173	646	613	15	43	480	10	1	2,982
2009	1,112	655	510	11	10	656	18	5	2,982
2010	932	773	637	24	13	391	25	2	2,799
2011	737	707	611	23	11	460	28	1	2,579
2012	862	826	749	35	11	630	37	1	3,152
2013	667	983	840	34	18	749	43	2	3,338
2014	502	747	548	14	11	1,006	40	0	2,868
2015	529	707	557	21	3	778	42	3	2,040

Table 25: Number of index cases of a notifiable disease 2011-2014, diagnosed from samples taken at post mortem examination.

Disease	2011	2012	2013	2014	2015
Anthrax	1	0	0	0	-
Avian rhinotracheitis	-	-	1	0	-
Avian tuberculosis (poultry) ^A	2	1	-	-	-
Blackleg	7	8	7	4	19
Bovine Malignant Catarrhal fever	0	1	3	1	1
Duck Viral Enteritis ^B	-	-	-	1	-
Fowl Cholera (pasteurellosis)	2	0	0	0	-
Fowl typhoid (<i>S. Gallinarum</i>)	0	1	0	0	-
Infectious Bronchitis	2	4	0	0	-
Infectious laryngotracheitis	16	17	36	35	26
Influenza, pigs	0	3	1	1	-
Influenza A typ (H1N1) 2009	-	-	3	0	-
Listeriosis	35	38	49	31	22
Lymphoma (not EBL)	7	11	-	-	-
<i>Mycoplasma gallisepticum</i>	0	3	0	4	4
<i>Mycoplasma</i> , poultry (not gallisepticum)	2	3	-	-	-
Necrotic haemorrhagic enteritis (<i>Clostridium perfringens</i> type C)	0	1	0	-	-
Salmonellosis	4	3	2	3	3
Total	78	94	102	80	75

Statistics from Farm & Animal Health.

^A this disease is no longer notifiable since November 2012, thus one case previously reported was removed from 2012.

^B This disease was not previously diagnosed in Sweden.

Post mortem examinations in wildlife



Photo: Torsten Mörner

BACKGROUND

A passive surveillance programme for diseases of wildlife based on pathology and ancillary testing was established in Sweden in the 1940s. The surveillance programme is financed partly by annual hunting permit fees, and partly by governmental funding. The aim of the general and targeted wildlife disease surveillance programmes is to monitor the health status of wildlife in Sweden, as well as presence or absence of diseases. The mission is to diagnose, define, or acquire knowledge on present and emerging diseases in Swedish wildlife. The disease surveillance and diagnostics provide key information for wildlife management. It is also part of zoonotic and epizootic disease control efforts and can serve as an indicator of environmental and ecosystem health. The National Veterinary Institute is the only laboratory in Sweden where post mortem examination of fallen wildlife is performed, and is

also the national wildlife focal point for OIE and submits biannual reports of OIE-listed wildlife diseases, and an OIE-specific selection of non-listed wildlife diseases.

SURVEILLANCE

The general public, local authorities, and especially hunters submit wildlife that is found dead, or found sick and then euthanized, to the National Veterinary Institute for examination. This includes fallen wildlife and standard samples collected from hunted large carnivores or other game species within research projects and bio-bank sampling. Hunter-harvested wild boar and brown bear (*Ursus arctos*) samples for *Trichinella* analysis are not included in these numbers. All large carnivores: brown bear, lynx (*Lynx lynx*), wolf (*Canis lupus*) and wolverine (*Gulo gulo*), found dead, euthanized or shot in licensed hunting are submitted to SVA for necropsy

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as skinned carcasses or tissue samples. Whenever possible, disease causing agents are identified and cause of death established.

RESULTS

In 2015, over 1,600 wild animals, parts or whole carcasses were submitted and examined at the Department of Pathology and Wildlife Diseases.

In 2015, the most notable larger wildlife disease outbreaks were tularaemia in mountain hares (*Lepus timidus*) mainly along the northeastern coast in the counties of Norrbotten and Västerbotten; myxomatosis in wild rabbits in the southernmost county, Skåne; and an outbreak of severe dorsal dermatitis of unclear aetiology in mainly male moose (*Alces alces*). Another wildlife disease diagnosis of interest during 2015 was the finding of a new strain of rabbit viral hemorrhagic disease virus, RVHDV type 2, in wild and domestic rabbits in Sweden. Also the first definitive diagnosis of nasal bots (*Cephenemyia stimulator*) in roe deer (*Capreolus capreolus*) was recorded in Skåne, which is close to Denmark where this bot fly has been present for a long time. Another new parasite found in Sweden in 2015, was lice infestation in brown bear, where the louse *Trichodectus pinguis* was identified. Sarcoptic mange is a regular finding in both red fox and lynx, but few cases are usually noted in wolves. In 2015, nine cases of mange in wolves were recorded,

which is a higher number of cases compared to earlier years. An unusual mortality event in 2015, was the death of over 20 mute swans (*Cygnus olor*) in central Stockholm in February and March, where 5 of the 10 necropsied swans were affected by lead poisoning, and five swans carried avian influenza virus.

A follow-up surveillance of the fox dwarf tapeworm *Echinococcus multilocularis* around the five known infected foci within four counties was finalised in 2015 (see Alveolar echinococcosis). In hunted red deer (*Cervus elaphus*), hunters often note numerous subcutaneous nodules over the hind quarters when skinning an animal. In a study 2015, the nodules were identified to be caused by the filaroid parasite *Onchocerca flexuosa*.

DISCUSSION

The general disease monitoring is based on citizen science, with the interested public reporting and submitting samples, and a high public interest in wildlife health and conservation continues to make this work possible. Among the health care community and relevant authorities, it is well recognised that wildlife disease surveillance is an integral part of the One Health concept. The wildlife disease surveillance results (Table 26) show that Sweden has few serious infectious disease threats, but new diseases or parasites in wildlife are discovered in most years.

Table 26: OIE non-listed wildlife diseases and number of outbreaks/cases reported to the OIE for 2015.

Disease	Species	Number of cases
Anaplasmosis	Moose	1
Avian influenza	Mute swan	5
Lead poisoning	Golden eagle, White-tailed eagle, Mute swan, Common goldeneye	19
European brown hare syndrome	European brown hare	1
Rabbit Hemorrhagic Disease	Rabbit	1
Myxomatosis	Rabbit	25
Pseudotuberculosis	European brown hare, Rabbit	7
Salmonellosis ^A	Great spotted woodpecker	1
Sarcoptic mange	Lynx, Red fox, Wolf	22
Toxoplasmosis	European brown hare, Capercaille	3
Trichomoniasis	Green finch, Eurasian collared dove	2
Trichinellosis	Brown bear, Wild boar	2
Tularemia	Mountain hare, European brown hare	31
Total		120

^A Salmonellosis screening of wildlife cases was put on hold for economic reasons during 2015.

Antibiotic resistance in bacteria from animals and food

BACKGROUND

The National Veterinary Institute (SVA) has the assignment from the Ministry of Agriculture to monitor and analyse the development of antimicrobial resistance in bacteria from animals and from food of animal origin. Also, the European Commission has decided on mandatory harmonised monitoring of antibiotic resistance in bacteria from food-producing animals and food thereof. The monitoring activities are carried out in the Swedish Veterinary Antibiotic Resistance Monitoring Programme (Svarm) which has been running since 2000.

The objectives of Svarm are to detect trends in resistance and to provide a basis for recommendations on use of antibiotics in animals. Details on methodology are available in the yearly Swedres-Svarm report. Briefly, three types of bacteria are monitored: zoonotic bacteria, specific animal pathogens and indicator bacteria from healthy animals and meat. The rationale for monitoring indicator bacteria, i.e. commensal *Escherichia coli* and *Enterococcus* spp. from the normal intestinal flora of healthy animals, is that resistance among these bacteria reflects the selection pressure from the use of antibiotics in an animal population. These commensal bacteria can also be a reservoir of mobile resistance genes that can reach humans through the food chain. Thus, prevalence of resistance in bacteria that contaminate meat indicates the magnitude of the potential human exposure to such reservoirs in food producing-animals.

The Svarm programme adheres to the instructions for the mandatory monitoring of resistance in EU according to directive (2003/99/EG) and subsequent decisions (2013/653/EU). According to the directive, resistance in *Salmonella*, *Campylobacter jejuni* and in indicator bacteria shall be regularly monitored in broilers, pigs and cattle using harmonised methodology. Briefly, in Sweden this implies that each year, isolates of *Salmonella* from all notified incidents and 100-200 isolates of *Campylobacter* from either broilers or from pigs and calves are tested for antibiotic susceptibility. Also, each year 170 isolates of *E. coli* from intestinal content of healthy broilers or from pigs and cattle are tested.

In addition, each year 300 samples of intestinal content and 300 samples of fresh retail meat from either broilers or from pigs and cattle are screened for ESBL- and carbapenemase producing *E. coli*.

In addition to this mandatory monitoring Svarm is complemented with data on resistance for clinical isolates of bacteria from the routine testing of clinical submissions at SVA. Svarm is also complemented with data from research projects and specifically from the SvarmPat project focusing on resistance in animal pathogens from farm animals. SvarmPat is run in cooperation with Farm and Animal Health and is financed by the Board of Agriculture.

Results of Svarm, i.e. data on antibiotic resistance in bacteria from animals and food are presented in a yearly report together with data on sales of antibiotics for use in animals. Results from Svarm are published together with the corresponding data for human medicine from the Swedres programme at the Public Health Agency of Sweden (FoHM). Results from Swedres and Svarm are reported in a fully integrated report - Swedres-Svarm - available at (www.folkhalsomyndigheten.se) or at (www.sva.se).

SUMMARY SVARM 2015

The situation in Sweden regarding antibiotic resistance in bacteria from humans and animals is still favourable from an international perspective. This confirms that our strategies to promote rational use of antibiotics and to limit the spread of antibiotic resistance are effective. Despite this, antibiotic resistance increases for most parameters monitored. This trend has been going on since national surveillance began in the late 90s.

Antibiotic sales in veterinary medicine

Until 2009, statistics on sales of antibiotics for animals was assumed to be complete. Since, the Swedish pharmacy market has been reregulated and there have been indications that the data on sales from Swedish pharmacies are less complete. This problem probably mainly affects the sales of antibiotics for parenteral use but as such drugs are at least

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70% of the overall consumption the magnitude of overall trends from 2010 cannot be assessed with full certainty.

In 2015, the total reported sales of antibiotics for animals were 10 468 kg. In 2010, the corresponding figure was 14,117 kg. The overall consumption of antibiotics has decreased gradually since the mid-nineties, and there is most likely a true decrease also since 2010. About 55% of the total sales in 2015 were benzylpenicillin.

Products for oral medication of individual animals and oral medication of groups of animals via feed or water are less likely to be affected by the lack of completeness. Major downward trends are noted 2010 to 2015 for both these categories, (35% and 41%, respectively) and for most substance classes.

In 2015, a total of 61.2 and 10.2 tonnes of antibiotics were consumed in human and veterinary medicine, respectively. When measured as mg active substance per kg estimated biomass, the corresponding figures were 94.4 and 12.7 mg per kg. Consumption in human medicine by far outweighs consumption in veterinary medicine for most classes, except for trimethoprim-sulphonamides and aminoglycosides.

Extended spectrum beta-lactamase (ESBL) producing Enterobacteriaceae

ESBL-producing Enterobacteriaceae are, with the exception of broilers, rare among animals in Sweden. In 2015, the occurrence of ESBL-producing *E. coli* in intestinal and meat samples from pigs and cattle and from intestinal samples from broilers was investigated with screening methods. Such bacteria were isolated from 1% of the intestinal samples from both pigs and cattle but not from any meat samples. The occurrence among broilers is higher and ESBL-producing *E. coli* was isolated from 39% of the intestinal samples. Changes in the screening methodology hinder any direct comparisons with the figures from previous years.

Methicillin resistant *Staphylococcus aureus* (MRSA)

The occurrence of MRSA in animals in Sweden is still low which limits spread from animals to humans. MRSA was found sporadically in the animal species horse, dog, cat and cattle in 2014. In a major part of hedgehogs sampled in a screening study, was MRSA with *mecC* detected. In companion animals, the same types of MRSA as in humans dominate,

indicating a human source of MRSA in these animals. In horses, livestock-associated MRSA CC398 is most common.

Methicillin resistant *Staphylococcus pseudintermedius* (MRSP)

In 2014 an increase of methicillin resistant *Staphylococcus pseudintermedius* (MRSP) cases was noticed for the first time since 2009. The increase of cases continued in 2015 with 60 cases notified all, except one case from a cat, where connected to dogs. It is also possible that a clonal shift of MRSP has occurred in Sweden. In 2015, 33% of all cases belonged to ST258, which only have occurred sporadically in the years before, while the previous dominant clone belonging to ST71 continued to decrease in occurrence. MRSP in humans is not notifiable.

Vancomycin resistant enterococci (VRE)

Occurrence of VRE in broilers has decreased significantly since 2010 when the last investigation was done. In 2015, VRE could be isolated from 11% of the samples, and all were *E. faecium* with *vanA*.

Resistance in zoonotic pathogens

Salmonella is rare in animals in Sweden and few incidents involve antibiotic resistant strains. Strains with ESBL-resistance has never been found and resistance to fluoroquinolones is rare. The favourable situation makes animals in Sweden an unlikely source of antibiotic resistant *Salmonella* infecting humans.

Campylobacter from animals in Sweden are mostly susceptible and for example resistance to erythromycin is most uncommon.

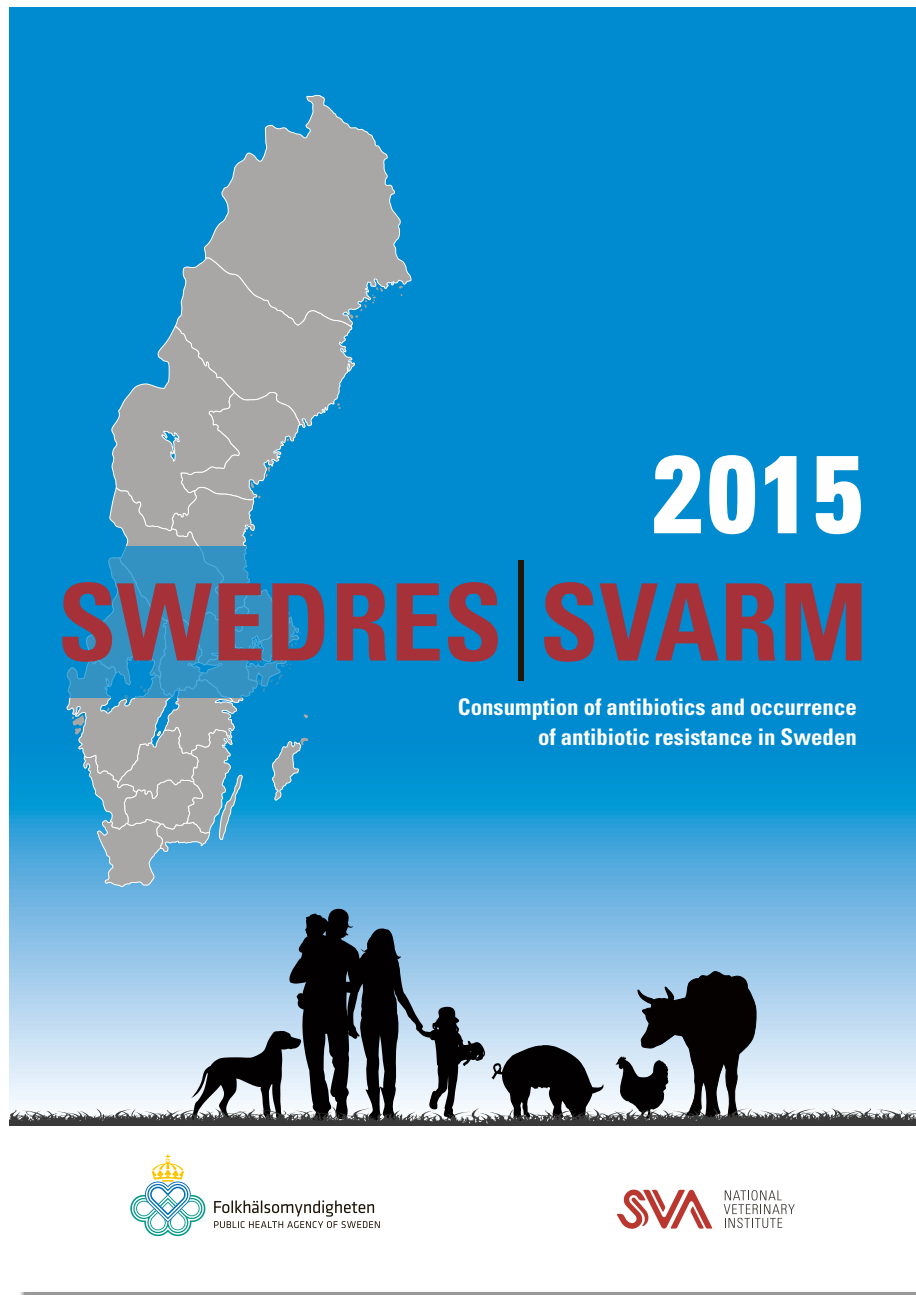
Resistance in animal clinical isolates

Bacteria causing clinical disease in animals are mostly susceptible to antibiotics relevant for treatment. Respiratory pathogens from farm animals and horses are generally susceptible to benzylpenicillin, but penicillin resistance is common in *Staphylococcus pseudintermedius* from dogs and occurs in *Staphylococcus aureus* from horses and *Staphylococcus felis* from cats. Resistance in *E. coli* occurs in all animals but is most prominent in enteric isolates from young calves. Susceptibility testing for guidance in antibiotic therapy is warranted, especially for staphylococci and *E. coli*.

Resistance in indicator bacteria from healthy animals

Antibiotic resistance in *E. coli* from the intestinal flora of healthy animals serve as indicator for presence of resistance in an animal population. Also, the prevalence of acquired resistance in such commensal bacteria indirectly indicates the magnitude of the

selective pressure from use of antibiotics in an animal population. Prevalence of resistance in indicator bacteria from animals in Sweden is low and the situation is favourable in an international perspective. In the latest years there has however been an increasing trend regarding resistance against certain antibiotics among *E. coli* from healthy pigs.



Download the report at www.folkhalsomyndigheten.se or at www.sva.se

